ILLINOIS INSTITUTE OF TECHNOLOGY

A World-Class Smart Grid Education and Workforce Training Center

Task 6.0 Report – Identify Specific Job Classifications for Training and Skill Deficiencies

Revision: 0.0

Project Number: DE-OE0000449
Site Name: Chicago, IL
Date: March 31, 2011
Prepared For: Department of Energy

1 Cover & Signature Page

1.1 Revisions Page

Revision Date	Rev #	Author	Description
03-31-2011	0	IIT	Initial submission of Task 6.0 Report

1.2 Signature Page

Project Name:	World Class Smart Grid Education and Workforce Training Center
Project Number:	DE-OE0000449
Site Name:	Chicago, IL
Date:	March 31, 2011
Revision:	0.0
Restrictions or Classification:	None
Approval Authority:	Mohammad Shahidehpour

Illinois Institute of Technology

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DOE Authorized Signature

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Printed Name and Title

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Date

1.3 Acronyms List

Acronym	Acronym Definition
AMI	Advanced Metering Infrastructure
AC	Alternating Current
AFL-CIO	American Federation of Labor-Congress of Industrial Organizations
ARRA	American Recovery and Reinvestment Act
BPL	Better Power Lines (organization)
BPL	Broadband Over Power Lines
CE	Continuing Education
Center	World-Class Smart Grid Education and Workforce Training Center
CPP	Critical Peak Pricing
CPS	Chicago Public Schools
CIS	Customer Information System
CSR	Customer Service Representative
DoE	Department of Energy
DoD	Department of Defense
DSL	Digital Subscriber Line
DA	Distribution Automation
DMS	Distribution Management Systems
EEI	Edison Electric Institute
EPRI	Electric Power Research Institute
EUCI	Electric Utility Consultants, Inc. (organization)
FERC	Federal Energy Regulatory Commission
FTTH	Fiber To The Home
GWA	GridWise Alliance
GWAC	GridWise Architecture Council
HVAC	Heating, Ventilation, & Air Conditioning
HTS	High Temperature Superconductivity
HAN	Home Area Network
IDES	Illinois Department of Employment Security
IIT	Illinois Institute of Technology
ISGI	Illinois Smart Grid Initiative
ITIF	Information Technology and Innovation Foundation
iGEN	Innovative Generation
IGEN	Illinois Green Economy Network
IDES	Illinois Department of Employment Security
IEEE	Institute of Electrical and Electronics Engineers
iDEN	Integrated Digital Enhanced Network
IBEW	International Brotherhood of Electrical Workers (Union)
LEED	Leadership in Energy and Environmental Design
LTC	Load Tap Changer
MDM	Meter Data Management
MOS	Military Occupation Specialties
NARUC	National Association of Regulatory Utility Commissioners

NEMA	National Electric Manufacturers Association
NECA	National Electrical Contractors Association
NOC	Network Operations Center
OMS	Outage Management System
PHEV	Plug-in Hybrid Electric Vehicle
PLC	Power Line Communications or Power Line Carrier
RFID	Radio Frequency Identification
RFP	Request for Proposal
RFQ	Request For Quotation
SEIU	Service Employees International Union
SEA	Smart Energy Alliance
SGIC	Smart Grid Information Clearing House
SGIP	Smart Grid Interoperability Panel
SGJSM	Smart Grid Jobs & Skills Matrix
SGMM	Smart Grid Maturity Model
SEI	Software Engineering Institute
SOC	Standard Occupational Classification
SA	Substation Automation
SCADA	Supervisory Control and Data Acquisition
TMC	Technology Marketing Corporation
TOU	Time of Use (Rate)
UPB	Universal Powerline BUS
USNAP	Utility Smart Network Access Port
VSAT	Very Small Aperture Terminal
VA	Veterans Affairs
VAR	Volt-Ampere Reactive
WiMAX	Worldwide Interoperability for Microwave Access

1.4 Acknowledgements

To create this Task 6.0 Report the Illinois Institute of Technology (IIT) has relied upon significant original input, continuing contributions, and review comments from the following individuals and organizations. IIT also acknowledges the efforts of West Monroe Partners in facilitating the process in assembling and assimilating these contributions that serve as the foundation for this Task 6.0 Report.

Professor Mohammad Shahidehpour, Illinois Institute of Technology
Andrew Barbeau, Illinois Institute of Technology
Melissa Gordon, Illinois Institute of Technology
Tom Hulsebosch, West Monroe Partners
Tom Kerestes, West Monroe Partners
Jack Winter, West Monroe Partners
Scott Southard, West Monroe Partners
AJ Brown, West Monroe Partners

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2 Executive Summary

The smart grid industry has recently experienced a dramatic increase in growth due to $3.4 billion in federal grant funds distributed to utilities as smart grid investment grants. Additional projections from Pike Research Group project that the level of investment in smart grid technology will exceed $200 billion from 2008 to 2015[1]. Further, GE recently reported that the U.S. spent $7.09 billion in 2010 alone. To respond to the need to prepare the existing and future workforce for smart grid implementation, the U.S. Department of Energy (DoE) launched the *Workforce Training for the Electric Power Sector Program*. As part of that program, Illinois Institute of Technology (IIT) is establishing a World-Class Smart Grid Education and Workforce Training Center, using the university's strong smart grid research, demonstration and education infrastructure to lead a nationally-significant effort to educate and train those who will design, implement, operate and perfect the smart grid.

IIT commissioned this report to identify the jobs impacted by the smart grid, the level of impact on these jobs, and smart grid skills deficiencies that exist. The result of this report has been the creation of the "IIT Smart Grid Jobs & Skills Matrix". The IIT Smart Grid Jobs & Skills Matrix (SGJSM) is comprised of 104 standard occupational classifications (SOC) that will be impacted by the smart grid, summarized under seven organizational/department categories and three functional expert categories. 98 specific skills related to smart grid were identified under twelve major skill categories.

The jobs were identified through a review of DoE smart grid classifications, the Occupational Information Network, and the Bureau of Labor Statistics of the U.S. Department of Labor. The preliminary list was further validated through interviews with industry thought-leaders and experts.

The smart grid skill deficiencies were identified from industry-leading trade organization reports and published data, national electric standards, and the Software Engineering Institute's Smart Grid Maturity Model. The complete listing of all resources is included within this report.

The IIT SGJSM was formulated and vetted through: on-line surveys; round table discussions with the military, labor unions, K-12 and community college representatives; and, interviews with industry thought leaders. The IIT SGJSM will be populated as part of the future research in Task 7.0.

Through the investigative process, findings were identified that will be incorporated when developing content for future training and program offerings in the smart grid sector. The findings are as follows:

- Smart grid development requires significantly more communication skill to effectively reach the stakeholders.
- The smart grid will bring new job duties, titles and roles.
- Introduction of smart grid technologies into a utility will result in significant business transformation activities.
- Development of smart grid technology will permit utilities to reach into new markets.
- The smart grid will allow utilities to partner with their customers in energy usage through advanced integrated information technology.
- The smart grid will increase the demand for knowledge of multiple varieties of telecommunication systems.

[1] Pike Research Group

- Currently, smart grid training within organizations is minimal.
- Labor union legacy workforce approaches will be challenged.

3 Introduction

3.1 Project Objectives

Illinois Institute of Technology (IIT) will lead an extensive and collaborative effort in establishing a World-Class Smart Grid Education and Workforce Training Center (Center). The Center will facilitate the development of a well-trained and highly skilled smart grid workforce, which is vital to maintaining our nation's leading edge in smart grid research and implementation. The Center will use IIT's strong and already established smart grid and power engineering infrastructure to engage utilities, corporations, labor unions, Veterans, K-12 students and 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 environment, and sustainable energy.

3.2 Project Scope

The Center will work closely with the IEEE Power and Energy Society, Argonne National Laboratory, power companies and Independent System Operators throughout the country, other institutions of higher education and community colleges in the United States and abroad, Agencies of the State of Illinois, associations for the promotion of green jobs, Boards of high schools and higher education in Illinois, and labor union training organizations to provide a world-class education opportunity on smart grid.

The Center will train power industry employees, union workers and apprentices, energy industry workers, individuals seeking new careers in energy and smart grid technologies, college and high school students, high school teachers, government employees, veterans, lawyers, investors, venture capitalists and employees of other financial institutions, entrepreneurs and general public, IT professionals, telecom professionals, and others.

The Center will offer the most advanced education in program content, format, and organization and will continuously enhance the quality of training programs to respond to the evolving needs of its constituents.

3.3 Task Description: 6.0 - Identify Specific Job Classifications for Training and Skill Deficiencies

The grant recipient shall survey various organizations, stakeholders, and interest groups in the smart grid and energy industries. The Recipient shall interview decision-makers at all levels of government, educational, labor and private sectors, and will review published data for a complete and thorough assessment of deficiencies. The Recipient shall identify specific job classifications to be targeted for training, and skill deficiencies to be addressed through the workforce improvement efforts. The job classifications and the skill deficiencies will reflect needs identified through, but not limited to, organizational assessments, field surveys, and workforce training evaluations.

4 Job Classifications for Training and Skill Deficiencies

4.1 Approach Overview & Description

The objective of the Task 6.0 report is to identify the specific smart grid job classifications and the subsequent smart grid skill deficiencies for training. The overall approach and the methods employed to achieve these objectives are described below.

The approach included initial kick-off roundtables with key stakeholders (industry, military, labor unions, training providers, etc.), the deployment of the initial *IIT Smart Grid Education & Workforce Training Center Survey* (i.e., Survey I), qualitative interviews with a cross section of industry, academic, and union representatives impacted or involved with smart grid technologies, an extensive review of existing secondary research literature on smart grid skills and smart grid jobs, and the vetting and validation of the identified smart grid jobs and skill deficiencies through validation interviews with smart grid technology experts and educators. This overall approach is depicted in the diagram below.

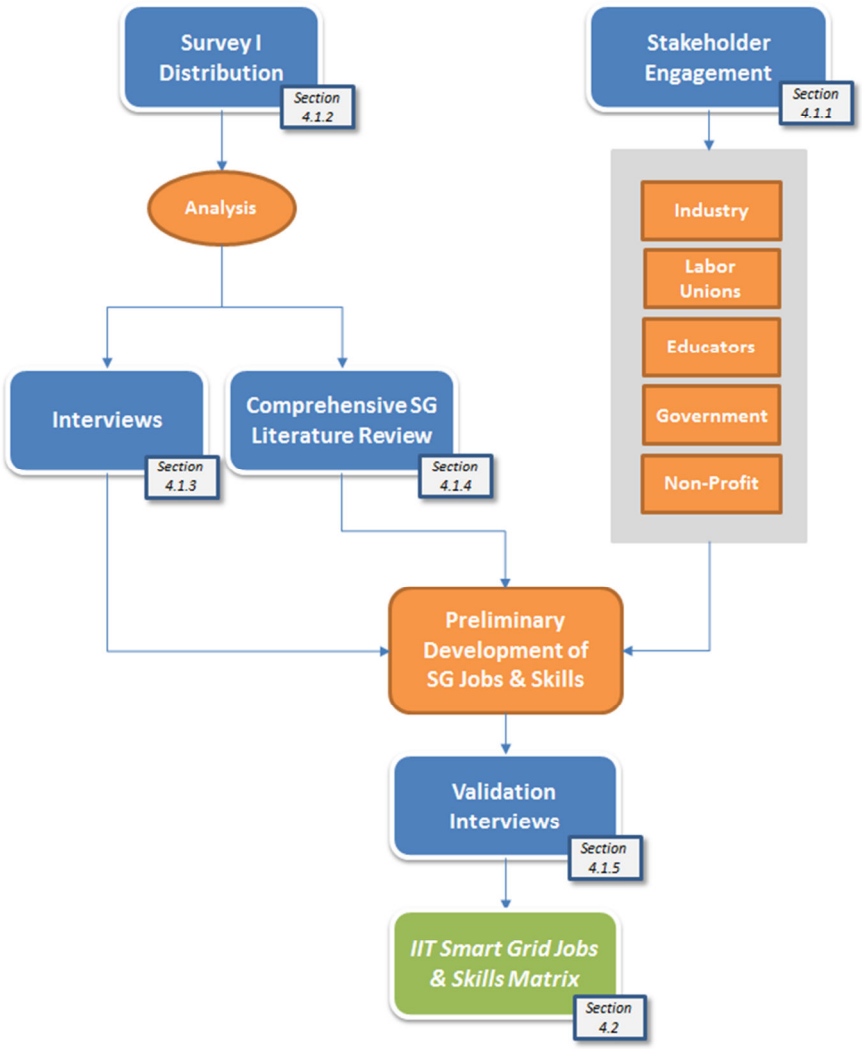

Figure 1: IIT Smart Grid Skill & Jobs Matrix Development Methodology

4.1.1 Stakeholder Engagement

4.1.1.1 Roundtable Discussion: Military and Labor Unions

On December 9, 2010, key stakeholders from IIT, the military, labor unions, and government agencies gathered on IIT's campus to examine best practices for developing and delivering smart grid courses for military and labor unions.

This roundtable served as the first step in many well-orchestrated actions of requests for feedback and validation. The content and exchange of information for the roundtable consisted of two sections: (1) Roundtable Presentation; and, (2) Roundtable Breakout Session Discussion.

Table 1: Roundtable Presentations: See Appendix D for individual presentation summaries

Presentation
Smart Grid Overview
Smart Grid Education and Training Center Overview
Center for Electricity Innovation
Smart Grid Occupational Projections
Returning Veterans and Unemployment
Energy Security for Military
Teamsters International Helmets to Hardhats Coordinator
Remarks on IBEW and Smart Grid

Table 2: Roundtable Breakout Sessions Discussions

Breakout Session	Topic
Session I: Military	Smart grid for military applications and training, education and job opportunities for Veterans
Session II: Labor Unions	Smart grid for Labor Unions

The breakout sessions focused on the following objectives:

- Identify skills needed to be developed for the smart grid workforce
- Identify courses/coursework the Center should develop to meet the gaps in current training
- Identify the best way to integrate returning Veterans into smart grid jobs / industries

Break-out Sessions Summary - Military

Approach

The Military Break-out Session identified the opportunity for IIT to become a leader in connecting military veterans to jobs, and smart grid is the means to fulfilling this opportunity. The method by which IIT is actively engaging key stakeholders in developing its training program; such as government leaders, military leaders, labor union executive management, and corporate thought leaders; can serve as a roadmap on building a business case for other institutions to follow when attempting to achieve the same objectives in their own region. In regards to the initial training content, IIT would be best served

focusing its curriculum on the most immediate job needs, which the roundtable group identified as auditing and LEED related skills. The group agreed that the way in which IIT is gathering requirements and assessing current labor union training should be replicated for military training.

Three steps should be taken to begin this effort and demonstrate to government leaders that programs to prepare military veterans for smart grid jobs can be effective:

1. Find gaps between current jobs and required jobs of the future
2. Identify skills necessary to prepare workers for required jobs of the future
3. Establish a program and curriculum for teaching these skills to military veterans

Job Classifications/Training

The military has several Military Occupation Specialties (MOS) identified for engineering, which indicates that plenty of veterans have skills that align with available engineering jobs, i.e., both current and future jobs. However, an initiative needs to be put into motion to match and track these jobs. Otherwise, we're experiencing military veterans trained within an engineering MOS not knowing which engineering jobs match their skills. This leads to frustration and decreased motivation when attempting to find a job upon returning home after military service.

Additional Considerations

- **Green Fort Transformation** – A potential idea to promote smart grid awareness and application is to encourage commanders to transform their forts into "green" forts beyond existing federal executive order requirements. Commanders could work to incorporate smart grid technologies into the fort to enable their engineers to experience hands-on, real-life concepts, not to mention the awareness and participation in the smart grid environment by all fort occupants. Early adopter commanders who successfully launch and sustain their green fort can share the plan with others. This could even be viewed as a microcosm of a civilian community, which might have real value to be shared as real-life case studies across the United States.

- **GI Bill –** The GI Bill must be leveraged right from the start, as the government is considering amending it to include vocational training.

- **Executive Orders –** Executive orders drive federal agencies. We are already seeing that mandates and deadlines have been assigned to spur progression of our nation's energy infrastructure and capabilities. A reasonable belief exists that 2011 will be the year of hiring veterans. One of the next executive orders might include a mandate of all federal agencies to hire veterans, which should include federal building operations and energy management opportunities.

<u>Break-out Sessions Summary - Labor</u>

Approach

The table below was developed as a matrix for reviewing the various items required for each known labor entity. This matrix proved useful in the development of an online survey that sought further detailed information from relevant stakeholders.

Table 3: Skill Matrix for Various Labor Entities

Entity	What skills	Training Programs/ Curriculum	Strategies to integrate union workers to smart grid jobs
Labor union training centers			
Short courses			
Certificate programs			
Train the trainer strategy			
Identifying channels for access			
Civilian applications vs. military applications			
Delivery options – Partnership With America/Labor Partnership			
Obstacles to roll out			
Opportunities for expansion			
Employment opportunities			
Identifying and training for innovative technologies			

Additional input from the participating members included some key points for consideration. There was a strong message that job availability and job placement potential should be linked to certificate courses. An eye to the migration between military and civilian jobs was recommended. Clearly, the materials, functions and substance of such jobs are similar in substance.

The union representatives expressed an interest and appreciation for additional meetings that would allow IIT to gain more insight into their specific needs and concerns. IBEW has significant training facilities throughout the country, including IBEW local 134 in Chicago area which employees trainers with various train-the-trainer arrangements. The Service Employees International Union (SEIU) provides training to union personnel, and is a group that can be partnered with to enhance smart grid training opportunities. The majority of buildings in Chicago are maintained by members of SEIU. Clearly a broad audience of labor representation is desirable to gain a wide acceptance of training designed and offered to union personnel.

Next Steps

Several next steps were identified in the area of skills and training gaps. Specific areas for investigation include the following entities in the table below.

Table 4: Union Skills and Training Gap Matrix

Entity	Skills and Training Gap Focus
Teamsters	All types
Laborers	All types
SEIU	Potentially meet with the training facility people

IBEW	National Director
IBEW	Local training center
Chicago and Cook County	Building Trades
Military	Training needs

Results/Outcomes

Participants became educated about smart grid in general and IIT's efforts to promote smart grid education. In addition, participants engaged in break-out sessions with their peers to discuss the needs and opportunities to offer smart grid training to organization members.

Next steps included the need to involve key labor union and military stakeholders. These key stakeholders were targeted and engaged in surveys and interviews at later dates.

4.1.1.2 Roundtable Discussion: Smart Grid Education Delivery K-12 Teacher and Community Colleges

On March 24, 2011, key stakeholders from IIT, the K-12 teachers, and community college representatives gathered on IIT's campus to examine best practices for developing and delivering smart grid courses for K-12 and community college use, including development of smart grid certifications, teacher seminars, and short courses.

This roundtable served as the first step in many well-orchestrated actions of requests for feedback and validation.

Approach

The content and exchange of information for the roundtable consisted of two sections: (1) Roundtable Presentation; and, (2) Roundtable Breakout Session Discussion.

Table 5: Roundtable Presentations[2]

Presentation
Welcome & Introductions
Smart Grid Overview
Smart Grid Education & Training Center Overview
Center for Electricity Innovation
Smart Grid Occupational Projections
CPS Sustainability
IGEN Overview

[2] See Appendix F for individual presentation summaries

Table 6: Roundtable Breakout Sessions Discussions

Breakout Session	Topic
Session A: K-12 Teachers	Smart grid and STEP education for K-12 students and teachers including a discussion on how best to create bridge/dual credit programs
Session B: Community Colleges	Smart grid for community college students and faculty, including a discussion of how best to create bridge/dual credit programs from Community College to IIT

The breakout sessions focused on the following objectives:

- Identify skills needed to be developed and at what age/grade
- Identify courses/coursework the Center should develop to meet the gaps in current training
- Identify the certifications needed to be developed and by whom

Breakout Session Summary – K-12 Teachers

Approach

The approach taken for the K-12 roundtable breakout session was to discuss the actions to be taken during the Summer Program 2011 and during the 2011-2012 academic years. Some of the specific questions that were to addressed include determining the length of time for a summer workshop for teachers, determining specific teaching topics (units), and then discussing the details of the specific program delivery and on-going communication/collaboration efforts.

Results

The K-12 Teachers breakout session discussed several topics that resulted in multiple decisions to accommodate incorporating smart grid curriculum into the K-12 academic program.

First, the participants identified several incentives that should be considered to elicit teach participation in a summer workshop to be hosted this summer. The incentives included:

- Compensation and purchasing materials
- Accessing researchers and scientists in the field
- Offer college credit options
- Offer networking with college professors

Next, the roundtable participants identified several ideas to further engage students in the program, these include:

- Offering field trips to the IIT campus
- Establishing student-faculty relationships
- Developing relevant case study / problem solving material
- Offering completive projects in conjunction with IIT
- Offer kits to schools for hands-on demonstrations
- Alternative spring break program

The overall smart grid education program for K-12 was presented to include (1) lesson plans to be developed, (2) summer workshop for teachers, (3) course instruction (testing the lesson plan), and (4) periodic meetings to collaborate and discuss feedback on the program.

The lesson plans will be developed to include general (basic) smart grid topics and the group consented that an additional topic to be covered will be "Alternative Transportation Fuels" – which will include PHEV, bio-fuels, etc.

Lastly, the roundtable participants determined how best to continue collaborating and communicating through the development and execution of the program. A few suggestions include:

- Periodic On-line after-school meetings
- Large in-person meetings at IIT campus (January)
- Establish a centralized on-line team collaboration website (i.e., Wiki)

Breakout Session Summary – Community Colleges

Approach

The approach for the community college roundtable discussion was to facilitate a discussion around how the smart grid will impact community college students and faculty, and determine how best to create bridge/dual credit programs from community college to IIT.

Results

The roundtable discussion participants introduced an initial discussion on the specific skills and abilities that will be required of students and that will need developed, these skill/abilities include:

- Mathematical skills
- Basic electricity and electrical system knowledge
- Energy economics
- Engineering economics
- Telecom skills
- Computer networking
- Energy auditing
- Interpersonal skills (change management, teamwork, public speaking, etc.)

In addition, the roundtable discussion participants discussed several innovative ideas on how training could be offered and how best to offer bridge programs to IIT. Samplings of these ideas include:

- IIT could jointly develop courses with teachers to deliver in community colleges
- A blended learning curriculum should be considered
- An industry recognized certification would be valuable as a recognized pathway to study for smart grid
- Consider assembling a forum for curriculum development by contacting specialists in each school and establish a webinar or discussion to actually get a list of existing basic skills and certifications

Lastly, the roundtable participants consented on the immediate action steps to consider going forward, these include:

- Develop state-wide list of current general/basic and focused courses to see how they might be used for smart grid learning
- Use existing certifications and courses to build smart grid blended certifications
- Build seamless pathways from K-12 – community colleges – universities
- Continue collaborative development with all groups
- Increase outreach and communication, because this new smart grid environment is like the internet

4.1.1.3 Other Stakeholder Engagement Meetings

In addition to the roundtable discussions, IIT has identified and continues to collaborate with key stakeholders involved in the development of the IIT Smart Grid Training and Workforce Education Center. These various stakeholder engagement meetings were conducted with select educational institutions, labor unions, training providers, manufacturers, and service providers, etc.

The table below summarizes additional key stakeholder engagement meetings:

Table 7: Other Stakeholder Engagement Meetings

Stakeholder Meetings	
Academy for Global Citizenship	Illinois Department of Veterans' Affairs
Aileron Communications	Illinois Science and Technology Coalition
Argonne National Labs	IPro
CareerBuilder	Lake County Community College
Chicago Federation of Labor	Lewis & Clark Community College
Chicago Housing Authority	Mikva Challenge
Chicago Public Schools	Moraine Valley Community College
City of Chicago	MWH Global
Clean Energy Trust	National Education Association
Council for Adult and Experiential Learning, The (CAEL)	NECA
Department of Labor	Operation Green Jobs
Eaton	Partnership with America
Electrical Contractors Association of City of Chicago, Inc.	Pipefitters Union
EMB Consultants, Inc.	Project Lead the Way
eMeter	S&C Electric
EnergyNet	SEIU Local 73
First Choice	Siemens
Galvin Electricity Initiative	State Energy Sector Partnership

Governor's Veterans' Task Force	State of Illinois, Office of the Governor
Helmets to Hardhats	Student Veterans of America
Heroes to Healthcare	Teamsters
Hudson Highland Group, Inc.	Tennessee Valley Authority
IBEW	UL
IGEN (Illinois Green Economy Network)	United States Army
Illinois Board of Higher Education	United States Marine Corps
Illinois Department of Commerce and Economic Opportunity	Veteran Affairs Hospital
Illinois Department of Employment Security	Vulcan Materials
Illinois Department of Financial and Professional Regulation	Wounded Warrior Project

4.1.2 Survey I: IIT Smart Grid Education & Workforce Training Center Survey

Following the initial kick-off session conducted with the military and labor unions, IIT developed the initial Smart Grid Education & Workforce Training Center Survey. This survey was intended to obtain applicable cross-industry data for the Task 6.0 report.

Survey Objectives

The primary objectives of the survey were to identify the:

1. Activity level of smart grid products/services with which organizations are currently involved
2. Projected growth in smart grid products/services throughout the next three to five years
3. Projected increase in smart grid workers throughout the next three to five years
4. Preferred methods of developing and delivering training
5. Effectiveness of different training formats
6. Priorities of training format characteristics
7. Preferred training pricing formats
8. Average per employee value placed on smart grid related training

A secondary objective was to engage key stakeholders from various industries that are anticipated to be impacted by smart grid technologies, including organizations such as utilities, manufacturers, vendors, training firms, and educational institutions. This survey served as an instance of a long and well-orchestrated process of requesting feedback and validation.

Data Collection

The data collection procedures for this initial survey involved the use of Constant Contact, a web-based survey tool, to distribute the survey and collect confidential responses. The survey comprised of 20 questions to achieve the objectives described above. Please see Appendix G for a listing of each survey question.

The survey was distributed on January 3, 2011 to 3,337 contacts from the following sources:

1. **West Monroe Partners:** 2,738 contacts primarily from the utilities industry. The list includes executive, managerial, and functional contacts from independently-owned, cooperative, and municipal utilities across North America. The list also includes utility product manufacturers, vendors, and engineering and consulting firms.
2. **Illinois Institute of Technology:** 599 contacts from the education, engineering industry, utilities, labor unions, the military, educational institutions, government officials, manufacturers, and training vendors.

The survey collected 113 responses from January 3, 2011 through January 21, 2011, resulting in a response rate of rate of 3.4%.

Data Analysis

Demographics

The figures below provide a summary of the survey respondent demographics, including the size of organizations, geographic areas of operations, and organization type.

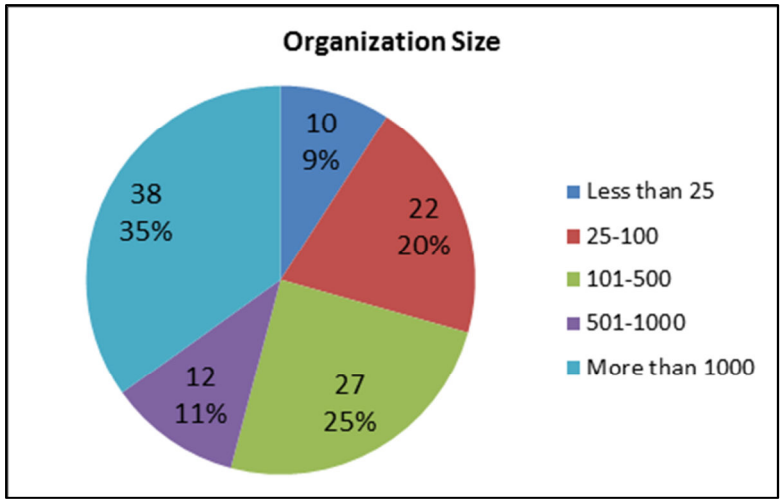

Figure 2: Survey I - Demographics

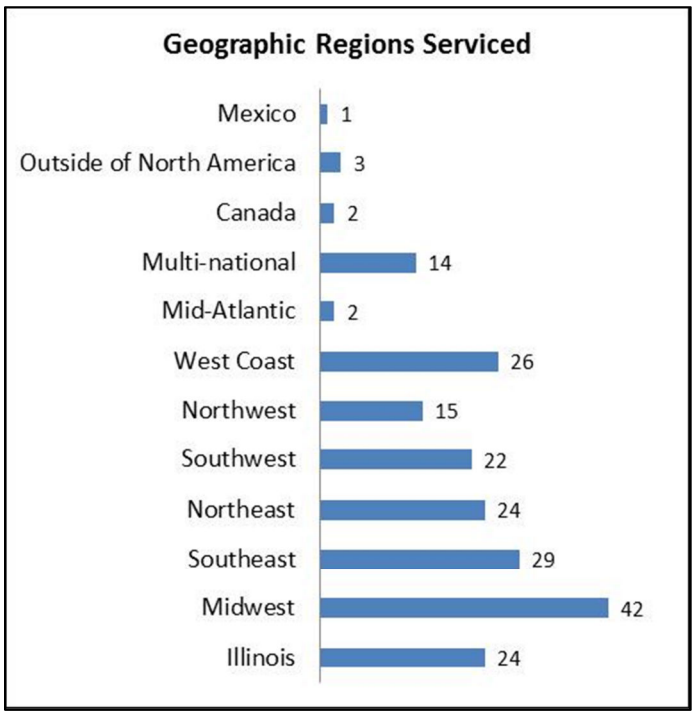

Figure 3: Survey I - Geographic Regions

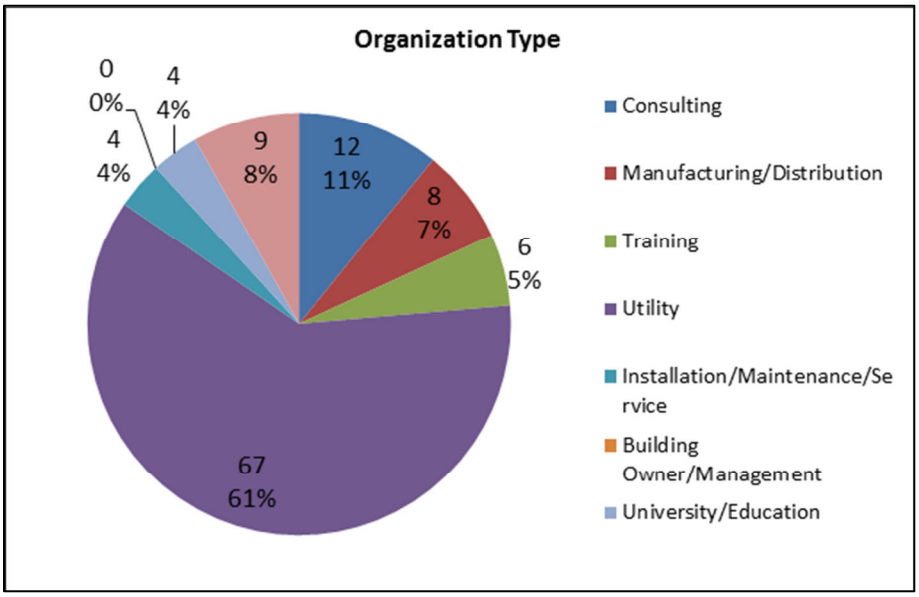

Figure 4: Survey I - Organization Type

Key Findings
Below are key themes from the survey responses:

- **Smart Grid Topics**
  1. Smart grid AMI Communications; Control Systems (SCADA/DMS) were the two subjects that respondents said they were currently the most actively involved with.
  2. According to respondent hiring projections in the next 3 to 5 years, Energy management solutions for Commercial & Industrial customers rated as the second highest need – Replacing existing jobs due to aging workforce was highest need.

- **Growth (in next 3-5 years)**
  1. 97% of respondents project growth in their smart grid products/services.
  2. 44% of respondents anticipate hiring 1-10 new or replacement smart grid employees (16% anticipate hiring 50 or more).

- **Training Preferences**
  1. In planning for growth projections, respondents are likely to re-train existing staff, recruit new employees, train new employees, and provide training to customers.
  2. Executive level short courses and CE credits offered through seminars are two most preferred methods of training formats.

Specifically, below are key themes from a cross tabular analysis of each industry sector that received multiple survey responses:

Table 8: Survey I - Findings Summary by Industry

Industry/Segment	Smart Grid Growth	Training Preferences
Utility	All respondents anticipate growth in smart grid products/services – most expect to see up to 35% growth 83% believe they will hire new or replacement smart grid workers	CE credits and Executive level short courses are most popular training formats
Installation/Maintenance/Service	All believe they will need new or replacement smart grid workers – most anticipate at least 100 more	Most likely to develop and deliver training entirely "in-house"

Industry/Segment	Smart Grid Growth	Training Preferences
Manufacturing/Distribution	All believe they will need new or replacement smart grid workers – most anticipate at least 20 to 50 or more	Most likely to deliver training "in-house," might use outside help to develop
Training	Most agree that they will need new or replacement smart grid workers	CE credits is most popular training preference
Consulting	All anticipate growth in smart grid products/services – most between 20-50%	Graduate level certificate is most popular training preference

Results & Outcomes

The final question of the survey asked if the respondent is interested in volunteers willing to participate in a follow up interview to provide more detailed information.

36 of the 113 respondents (31.9%) provided contact information and volunteered for such an interview. The next section will describe the approach and method for conducting the follow-up interviews.

4.1.3 IIT Smart Grid Education & Workforce Training Center Interviews

Following the completion and analysis of the initial survey, the project team identified survey respondents interested in conducting a follow up interview for more qualitative data collection. Specifically, the purpose of the interview was to gather information to better gauge the smart grid training needs and desired training formats of those interviewed. Described below is the approach to the interviews, including the overview of the interview questions, demographics, and the interview results.

Objectives

A majority of the interview was designed to facilitate qualitative responses to the 19 interview questions conducted over a 30 to 45 minute interview. The interview was divided into 5 sections (see Appendix H for the standardized interview script):

1. Demographics
2. General
3. Job Classification Skills
4. Training
5. Short Courses

Demographics

The *Demographics* section captured the interviewees name, company, total employees, main office location, current interviewee location, and type of organization.

General

The *General* section facilitated a discussion on how the interviewee received their industry and smart grid information – designed to assess how the interviewee collected knowledge and information surrounding smart grid technologies.

Job Classification Skills

The *Job Classification Skills* section identified what current description of jobs working with smart grid in the interviewee's organization and a review the employee's current and future skills needed related to smart grid operations. Additionally, any future jobs or expansion of current jobs were identified and discussed by the interviewee.

Training

The *Training* section defined the current and long-term training needs for the jobs impacted by smart grid that the interviewees previously identified. The section also defined what employers would like employees to know about smart grid when first entering the job market.

Short Courses

The final section of the interview, *Short Courses*, facilitated discussion on the interviewees' interest in participating in several potential short-course topics related to smart grid. Additionally, the interviewees also defined who typically attends and approves short-course attendance for the interviewees' organization.

Data Collection

The result of the initial survey yielded 43 potential respondents indicating an interest to participate in a follow up interview. From the interested respondents, the research team successfully completed 18 interviews, a completion rate of 48%.

The interviewees were comprised of a deliberate cross-section of public and private sectors, including utilities, manufacturers, educational institutions, training providers, labor unions, engineering firms, and consulting organizations.

Data Analysis

The review and analysis of the interview data was tabularized by total and by respondent organization type. The analysis was organized by Training and Short Courses – common themes from interviewees were grouped and summarized in each of the tables below.

Smart Grid Training Needs & Preferences

Table 9: Interview Summary - Training Needs

Org. Type	Current Training Types Used	Advantages	One Thing to Change	Long-Term SG Training Needs	Base Level of SG Knowledge
Electric Utility	In-house classroom, OTJ, outside vendors	Hands-on, location/ convenience, comprehensive	Have all equipment in place, Provide hands-on SG	Provide hands-on SG, CEs	Common understanding of components and vocab
Installer/Vendor	Union	Hands-on,	Briefer/Quantity,	SG benefits,	Common

Org. Type	Current Training Types Used	Advantages	One Thing to Change	Long-Term SG Training Needs	Base Level of SG Knowledge
	apprenticeships, In-house classroom	comprehensive	Introduce new technology sooner	Soft skills	understanding of components and vocab, How power works
Consulting	Outside vendors, Online	No pre-reqs	Holistic/Non-vendor influence	SG benefits	Common understanding of components and vocab, How power works
Academic	CE, Online, In-house classroom	Well organized, Comfort	Briefer/Quantity	Technology, not vendor application specific	Common understanding of components and vocab
Labor Union	CE		Holistic/Non-vendor influence	CEs	
Non-Profit R&D	In-house classroom, Online	Hands-on	Intro to SG, Basic vocab	Technology, not vendor application specific	Common understanding of components and vocab
Product Certification	CE	Freedom/flexibility	Introduce new technology sooner		Common understanding of components and vocab, Trends of SG
ALL	**In-house classroom**	**Hands-on**	**Briefer/Higher quality**	**Technology (not vendor application specific), SG benefits, CEs**	**Common understanding of components and vocab**

Smart Grid Short-Course Preferences

Table 10: Interview Summary - Smart Grid Short-Course Preferences

Org. Type	Attend	Approve	Overview	Utility Business Case	Regulatory	Community Outreach	Cyber Security	Renewable Integration	Consumer Business Case	Others?
Electric Utility	Engineers, Mid-management	Direct manager	3.5	3.3	2.7	3.8	4.7	3.5	3.5	IP Networks, Technology-specific
Installer/ Vendor	Engineers, Facility	Direct manager	3	2.5	3.5	4.5	3	3.5	4	

	managers									
Consulting	VPs – mid-management	CEO, Direct manager	5	4	3.7	4.3	4.7	4.7	4.3	CVR, Data management, PHEV
Academic	Mid-management	Direct manager	3.5	4	3.5	4	4	4.5	3.5	High voltage safety for Telecom
Labor Union	None	N/A	5	4	5	5	5	4	5	Code issues
Non-Profit R&D	Mid-management	VP/Director	4	3	3	4	3	3	5	
Product Certification	Engineers, BD Managers, VPs	Direct manager	5	4	3	4	4	2	3	Micro-grids
ALL	**Mid-management, Engineers**	**Direct manager**	**3.9**	**3.4**	**3.2**	**3.9**	**4.3**	**3.8**	**3.7**	**Data management**

4.1.4 Smart Grid Jobs Classification & Skills Deficiency Literature Review

To appropriately define the industries, jobs, and specific occupation skills that will be impacted by smart grid, an extensive review of existing secondary research and data was conducted.

Objectives

This literature review was conducted under the scope of two objectives, including: (1) identifying the specific job categories and (2) defining the specific smart grid related skills.

Under the first objective, the scope of the research comprised of reviewing the DoE smart grid job classifications, the Occupational Information Network (O*Net), and the Bureau of Labor Statistics of the U.S. Department of Labor.

Similarly, the second objective of defining specific smart grid related skills included the review of several industry leading trade organization reports and published data, national electric standards, and the Software Engineering Institute's Smart Grid Maturity Model.

The following summary of smart grid related research and resources serve as a comprehensive repository of current thought leadership resources. These resources were reviewed and synthesized for the purposes of incorporating all relevant smart grid related research and knowledge into this report.

Research Summary

Smart Grid Websites, Resources, and Industry Trade Associations

Below is a summary of the research resources used as input to identify the smart grid job classifications and related smart grid skills:

- **Department of Energy Smart Grid SOC codes (See Appendix B) –** Within the *Guidebook for ARRA Smart Grid Program Metrics and Benefits* the DoE published the group names for the

specific smart grid related Department of Labor Job Categories. This initial listing of occupational categories was used to define the initial listing of smart grid related occupations.

- **Occupational Information Network (O*Net) –** The Occupational Information Network (O*Net) was used to review the descriptions and further define the listing of the DoE smart grid SOC occupations. Additionally, the listing of DoE smart grid SOC codes was comparatively analyzed against the O*Net Green Occupations database sector from the report "Greening of the World of Work: Implications for O*NET®-SOC and New and Emerging Occupations" The O*Net database helped provide the preliminary input for job description and job related tasks for the occupation.

- **Banner Center for Energy** – A statewide, industry-driven resource for energy workforce education and training. The website and resources were reviewed to incorporate smart grid technologies and processes into this report.

- **Better Power Lines (BPL) Global** – A smart grid technology company dedicated to leading the transformation of energy efficiency and reliability. The website and resources were reviewed to incorporate smart grid technologies and resources into the research findings.

- **Cambridge Energy Research Associates (CERA)** – Leading advisor to international energy companies, governments, financial institutions, and technology providers. The website and resources were reviewed to incorporate smart grid technologies and resources into the research findings.

- **Carnegie-Mellon Software Engineering Institute (SEI)** – The Smart Grid Maturity Model (SGMM) is a management tool that helps utilities plan smart grid implementation, prioritize options, and measure progress. SGMM was used to identify skill categories and training deficiencies.

- **Department of Energy (DoE), Smart Grid** – Established to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions. The list of DoE grants (SGIG awards and SG Workforce Selections) programs, technologies, standards were reviewed and incorporated into the research.

- **Edison Electric Institute (EEI)** – An association of shareholder-owned electric companies. Provides information about EEI products, services, meetings; electric utility industry restructuring. The website and resources were reviewed to incorporate smart grid technologies, policies, standards, activities into the research findings.

- **Edison Foundation** – **Institute for Electric Efficiency** – Promotes advance energy-efficiency practices and demand response among electric utilities, the sharing of information, ideas, and experiences in energy efficiency and demand response in the power sector, and development a resource base of effective business models, practices, and processes. The website and resources were reviewed to for research, developments, and technologies related to the smart grid.

- **Electric Power Research Institute (EPRI)** – An independent, non-profit company performing research, development and demonstration in the electricity sector for the benefit of the public. The website and resources were reviewed for Smart grid technologies, standards, research, papers, activities, etc.

- **Electric Utility Consultants Inc. (EUCI)** – A leading provider of in-person and online conferences, seminars, workshops, and courses designed exclusively for the energy industry. The website and resources were reviewed for industry technologies, issues, conferences, report findings.

- **Federal Energy Regulatory Commission (FERC)** - Provides notices, major orders, and energy information for the electric, gas, oil, and hydro industries. The website and resources were used to review policies, programs, initiatives, technologies, developments, research related to smart grid.

- **Galvin Electricity Initiative** – The organization is leading a campaign to transform the way communities generate, deliver, and use electricity across the nation. Promotes a new smart grid paradigm that is consumer-focused and based on microgrids. The website and resources were reviewed to consider smart grid technologies, services and developments.

- **Global Smart Grid Federation** – Committed to creating smarter, cleaner electricity systems around the world. The federation will share best practices, identify barriers and solutions, foster innovation, and address key technical and policy issues. The website and resources were used to review smart grid technologies, world market developments, and other smart grid activities.

- **Greentech Media (GTM) Research** – Provides critical and timely market analysis in the form of concise and long-form market research reports, monthly newsletters and strategic consulting services. The website and published reports were used to research smart grid developments, links, technologies, and research.

- **GridWise Alliance** – The GridWise Alliance developed into an organization that represents a broad range of the energy supply chain from utilities to large tech companies to academia to venture capitalists to emerging tech companies. The website and resources were used to understand smart grid developments, technologies, and industry activities.

- **GridWise Architecture Council (GWAC)** – A team of industry leaders who are shaping the guiding principles, or architecture, of a highly intelligent and interactive electric system. The website and resources were used to define the underlying smart grid technologies, designs, and systems.

- **IBM** – Develops innovative smart grid technologies for utilities, helping to reduce energy usage, costs and greenhouse gasses. The website and resources were used to define technologies, processes, activities, industry information, Global Intelligent Utility Network Coalition, and the Smart Grid Maturity Model.

- **Illinois Smart Grid Collaborative (ISGC)** – The Illinois Statewide Smart Grid Collaborative was established by the Illinois Commerce Commission (ICC) in September 2008, by its Order in

Docket No. 07-0566. The website and on-line resource documents were referenced and used to understand Illinois smart grid developments, smart grid definitions, smart grid applications, technical components, current strategies, challenges, policies, and consumer engagement models.

- **Illinois Smart Grid Initiative (ISGI)** – The ISGI is a public-private working group formed in 2008 to engage Illinoisans in examining the nature and potential benefits of a modernized electric grid, and to map a policy path for achieving those benefits for consumers and the economy. The website and resources were used to review the Illinois state smart grid strategy, developments, and key stakeholders.

- **Information Technology and Innovation Foundation (ITIF)** – A think tank organization at the cutting edge of designing innovation policies and exploring how advances in information technology will create new economic opportunities to improve the quality of life. The website and resources were used to review smart grid technologies and developments.

- **Institute of Electrical and Electronics Engineers (IEEE)** – The largest professional engineering association for advancing technological innovation and excellence for the benefit of humanity. The website and resources were used to review smart grid technologies, standards, developments, and research.

- **KEMA** – A global, leading authority in energy consulting and testing & certification, active throughout the entire energy value-chain. The website and resources were used to review smart grid technologies, processes, and services.

- **National Association of Regulatory Utility Commissioners (NARUC)** – A non-profit organization dedicated to representing the State public service commissions who regulate the utilities that provide essential services such as energy, telecommunications, water, and transportation. The website and resources were used to understand state regulatory smart grid policies, testimony, developments, reports, and various resource links.

- **National Energy Technology Laboratory (NETL)** – Part of DoE's national laboratory system, is owned and operated by the DoE. NETL supports DoE's mission to advance the national, economic, and energy security of the United States. The website and resources were used to review of smart grid technologies and processes.

- **National Institute of Standards (NIS)** – An agency of the U.S. Department of Commerce was founded in 1901 as the nation's first federal physical science research laboratory. The National Institute of Standard provides resources used for standards for the smart grid, energy efficient lighting, photovoltaic, net-zero-energy buildings, and software for "smart" building. The website and resources were used for standards, guidelines for regulators, general smart grid information.

- **National Electrical Manufacturers Association (NEMA), Smart Grid** – The trade association of choice for the electrical manufacturing industry with 450 member companies manufacturing products used in the generation, transmission and distribution, control, and end-use of

electricity. The website and resources were used to understand emerging smart grid technologies, systems, and applications.

- **North American Electricity Reliability Corporation (NERC)** – Organization of US electrical grid operators with published research papers on grid reliability standards, self-assessments, and research reports. The website and resources were used to define smart grid standards, technologies, security, and risks.

- **PEW Environment Group** – A charitable trust driven by the power of knowledge to solve today's most challenging problems. Pew applies a rigorous, analytical approach to improve public policy, inform the public and stimulate civic life. The website and resources were used to define smart grid solutions, technologies, and benefits.

- **Smartgrid.gov** –A resource for information about the smart grid and government- sponsored smart grid projects. The website and resources were used to understand overall smart grid activities, technologies, standards, reports, developments, and links to DoE, FERC activities, details on ARRA grants and research

- **Smart Energy Alliance (SEA)** – An alliance of organization that combines deep industry strengths of Capgemini, Cisco Systems, GE Energy, Hewlett-Packard, Intel and Oracle to help utilities transform their transmission and distribution operations. The website and resources were used to define smart grid technologies, resources, services, and research.

- **Smart Grid Collaborative** – Primary goal is to accelerate revolutionary change by encouraging smart grid solutions of one country are replicable in others. The website and resources were used to define FERC/NARUC collaborative dialogue on smart grid transition issues, policies, and technologies.

- **Smart Grid Interoperability Panel (SGIP)** – Support NIST in fulfilling its responsibilities under the 2007 Energy Independence and Security Act. The SGIP will identify, prioritize and address new and emerging requirements for smart grid standard. The website and resources were used to review specific smart grid technical developments under NIST sponsorship.

- **Smart Grid Information Clearing House (SGIC)** – The objective of the clearinghouse is to populate, manage, and maintain a public Smart Grid Information Clearinghouse (SGIC) portal. Contents in the SGIC portal will include demonstration projects, use cases, standards, legislation, policy and regulation, lessons learned and best practices, and advanced topics dealing with research and development. The website and resources were used to review the smart grid industry technologies and developments.

- **SmartGridNews.com** – The largest and highest-ranked specialty site. It produces daily news analysis, a weekly email summary, the sector's only hands-on product reviews, and the Web's largest collection of smart grid-specific resources, including research papers, case studies and stimulus tools.

- **Smart Grid Today** – The worldwide daily news journal of the modern electric utility industry. The website and resources were reviewed for smart grid technologies, links, and activities.

- **SmartMeters.com** – Established as a comprehensive online source for news and views surrounding the smart energy industry. The website was used to review smart grid technologies and processes.

- **Technology Marketing Corporation (TMC) Smart Grid** – The world's leading business to business and integrated marketing media company, servicing niche markets within the communications and technology industries. The website and specific smart grid resources were used to understand current developments, technologies, telecommunications and smart grid systems.

- **Transmission and Distribution World** – A magazine targeted for engineers and operations professionals in the electric power transmission and distribution industry. The website and resources were used to review smart grid developments, technologies, and systems.

- **Utility Smart Network Access Port (USNAP) Alliance** –The alliance is established to create a protocol independent serial interface standard that enables any HAN (Home Area Network) standard, present and future, to use any vendor's Smart Meter as a gateway into the home, without adding additional hardware in the Smart Meter. The website and resources were used to define smart grid technologies, Home Area Networks (HAN), portals, gateways, and further industry research.

- **Utilimetrics** – The world's premier utility technology association, providing advocacy for utilities and information about innovative technologies that lead to improved operations, customer service and resource utilization. The website and resources were used to review smart grid technologies and processes.

Occupational Job Sites

The following occupational job sites were reviewed to define specific smart grid related skills and smart grid competence for various smart grid related occupations.

- America's Career Infonet (ACINet.org)
- California.Greenjobs (California.greenjobs.net)
- CareerBuilder (careerbuilder.com)
- Career GPS (careergps.com)
- Center for Energy Workforce Development (cewd.org)
- Electri International (electri.org)
- GreenCareersguide (greencareersguide.com)
- Greenjobs (greenjobs.greenjobsearch.org)
- Helmets To Hard Hats (helmetstohardhats.org)
- HVAC Excellence (hvacexcellence.org)
- IBEW (ibew.org) – Green Job Training Facilities around the country
- IEEE (IEEE.org)
- Illinois Worknet (illinoisworknet.com)

- Indeed (indeed.com)
- JobFox (jobfox.com)
- Jobs (Jobs.smartgridzjobs2.com)
- JuJu Job Search Engine (job-search-engine.com)
- Monster (monster.com)
- National Electrical Contractors Association (necanet.org)
- National Electricity Forum (nationalelectricityforum.org)
- National Joint Apprenticeship and Training Committee (NJATC.org)
- National Training Institute (nti.njatc.org)
- Next 10 (next10.org)
- O-Net (onetonline.org)
- SEIU (SEIU.org)
- Simply Hired (simplyhired.com)
- Smart Grid Careers (smartgridcareers.com)
- Smart Grid News (smartgridnews.com)
- TipTopJob (TipTopJob.com)
- Utility Worker (utility-worker.com)

Results

The extensive review of existing secondary research was a significant contributor to the initial identification of smart grid related occupations and the associated skill deficiencies. Combining the review of the secondary research listed above to all previous primary research yielded the preliminary development of the IIT SGJSM.

The IIT SGJSMcis comprised of 104 standard occupational classifications (SOC) that will be impacted by the smart grid. These job classifications are summarized under seven organizational/department categories and three functional expert categories. Lastly, 98 specific skills related to smart grid were identified under 12 major skill categories. A summary of the IIT SGJSM is provided in the figure below.

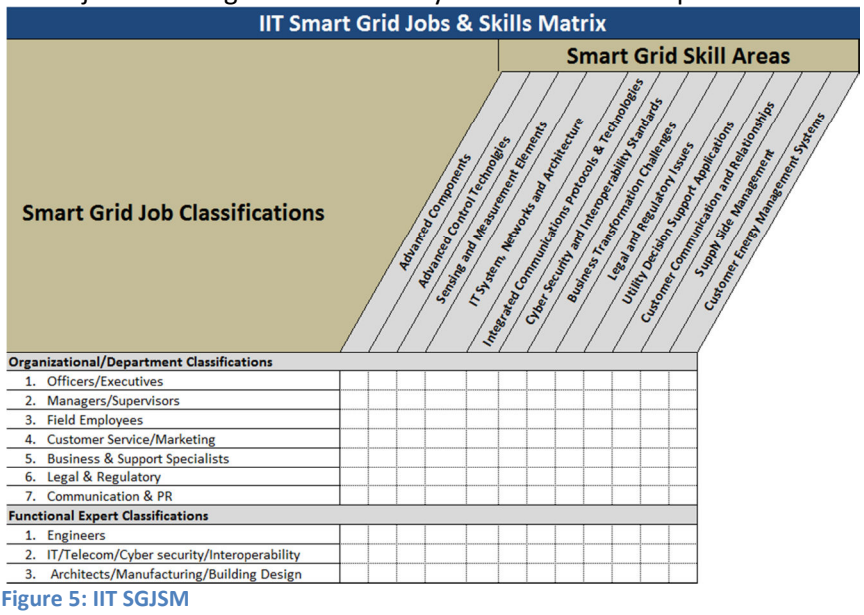

Figure 5: IIT SGJSM

4.1.5 Smart Grid Jobs & Skill Deficiency Validation

The next step toward fully defining and well vetting and accepting the IIT SGJSM required IIT to seek external validation from industry experts on the preliminary draft of the job classifications and skill deficiencies. The purpose of the validation interviews was to review the IIT SGJSM with a number of experts in each industry to seek verification of the data.

Specifically, the external validation was to:

- Confirm the appropriate identification of smart grid Jobs
- The likely impact of smart grid programs on the identified jobs
- The breadth and scope of the Skills Deficiencies catalog.

Methodology

The IIT SGJSM is intended for use across several industry sectors, including: utilities, utility and electrical contractors, smart grid equipment manufacturers, industrial and commercial building design and construction firms, architect and architectural/engineering firms, and building material suppliers, among others.

The selection methodology was prioritized for the industry sectors with the largest workforces and the likely highest impact from smart grid programs. This industry prioritization resulted in the following ranked industries:

- Electric and combination utilities
- Contractors and labor organizations
- Architect and architectural/engineering firms
- Small sampling of other interested expert contacts

Electric Utility Sector

The impact of smart grid technologies and programs will have the highest visibility in the electric utility sector, where over 3,100 companies and 560,000 employees will experience some level of change over the next five to ten years. Therefore, this sector was the first targeted for company identification. The methodology for selecting potential interview candidates was a combination of geographical and organizational diversity and the level of current smart grid activities.

- **Geographical Diversity** – The potential interviewees were selected from a sampling of regional presence: Northeast, Southeast, Midwest, Southwest, and West coast.

- **Organizational Diversity** – Included investor-owned utilities and public power utilities. A summary of the level of smart grid activities was created by combining the following information: Recipients of Smart Grid Investment Grants; recipients of Smart Grid Workforce Training Grants; utilities with membership in the Global IBM Intelligent Utility Network Consortium; utilities with active AMI programs; utilities with strategic alliances with the Illinois Institute of Technology and its partners.

This screening approach resulted in the list of potential interviewees identified in the table below.

Table 11: Electric Utility Sector Interview Candidates

Company	Workforce Training Grants[3]	Strategic Grid Investment Grants ($Mil)[4]	IBM Global Utility Intelligent Network Member[5]	Target AMI/AMR Deployment[6]
Alliant Energy				1,000,000
Ameren Services	Topic B			1,100,000
Baltimore Gas & Electric		200/451.8		2,000,000
CenterPoint Energy		200/639.2	X	2,200,000
Central Maine Power		95.9/195.9		650,000
ComEd/Exelon				131,000
Consolidated Edison	Topic B	136.2/272.3		40,000
Dayton Power & Light				180,000
Detroit Edison		83.8/167.6		4,000,000
Duke Energy	Topic B	200/851.7		2,400,000
Electric Power Board of Chattanooga		111.6/226.7		170,000
First Energy		57.5/114.9		5,000
Florida Power & Light	Topic B	200/578.3		4,400,000
National Grid USA	Topic B			54,000
NV Energy		138/298		1,300,000
Oklahoma Gas & Electric		130/293.2		771,000
Oncor Electric Delivery Company	Topic B		X	3,000,000
Pacific Gas & Electric				5,100,000
PECO Energy/Exelon		200/422.6		600,000
Progress Energy		200/520	X	160,000
Sacramento Municipal Utility District		127.5/307.8		620,000
Salt River Project		56.8/114.0		935,000
San Antonio City Public Service				700,000
Sempra		28.2/60.0	X	1,400,000
Southern California Edison			X	5,300,000
Southern Company	Topic B	164.5/330.1		4,300,000

Non-Utility Sector

In addition to electric utilities, smart grid technologies will impact other industrial sectors including electrical contractors, architect/engineering firms, commercial and industrial building/energy management firms, various construction industries, and manufacturing firms.

[3] Department of Energy
[4] Department of Energy
[5] IBM
[6] Edison Foundation

The following companies and organizations were targeted for interviews based on impacts in their industry sectors, strategic partnerships with IIT, and relevant job market needs:

- International Brotherhood of Electrical Workers (IBEW) – front-line employees
- Burns & McDonald – Engineering and architectural/engineering firms
- Epstein Global - Engineering and architectural/engineering firms
- Federation of Labor – AFL-CIO – front line employees
- J. Patalski – Architectural/engineering firms
- National Electrical Contractors Association (NECA) - front-line employees
- National Electrical Manufacturers Association (NEMA) – equipment manufacturers
- Power Systems Engineering – Engineering and project management firms
- US Green Building Consortium - Architects and building designers
- US Military and Veterans employment programs
- Service Employees International Union (SEIU) – front-line employees
- Teamsters Joint Council – front-line employees

Data Collection Procedures

Potential candidates for validation interviews were drawn from the above list of companies and organizations. Specific organizational positions and contact were identified. Both e-mail and voice-mail outreach tools were utilized to explain the project, establish a level of interest in participation, and schedule an interview time.

A standardized interview template was designed to ensure equal and complete coverage of the topic (see Appendix I). A standardized version of the IIT SGJSM was shared with each participant through the Microsoft Live Meeting application. After collecting standard demographical information, the IIT SGJSM was reviewed with each participant.

The participants were asked to agree or disagree with the ranking of each job as placed on the matrix (i.e., jobs that would be impacted by smart grid developments in a major, moderate, or minor level). Each participant was also asked for significant gaps in the Job Classifications or particular types of jobs that should be included in the matrix. Finally, each participant reviewed the list of Skills Deficiencies for completeness and details of potential skills training. Participants were asked for their agreement, feedback, and suggestions for further training needs.

Closing questions included permission to note the participation of their organization in the interview, but only at an aggregate level as well as their level of interest in receiving the second survey. The results of each survey were individually documented.

Data Analysis Procedures

The results of the 16 completed interviews over a two week period were repeatedly shared, analyzed, and re-combined by the interviewers. Suggested modifications in Job Classification rankings and expansions of Skills Deficiencies were captured in a master IIT SGJSM format. Significant comments and open-ended replies were also captured.

Results

The final product and detailed description of the validated smart grid job categories and skill deficiencies are discussed in the following section. Based on the initial research and this series of validation interviews, this product is considered a significant and thorough analysis of Job Classifications and Skills Deficiencies that are evident in the smart grid industry.

4.2 Findings & Conclusions

The overall objectives to the Task 6.0 report were to (1) identify specific job classifications to be targeted for training and (2) identify skill deficiencies to be addressed through the workforce improvement efforts.

These objectives were to be achieved by employing the following methods:

- Survey various organizations, stakeholders, and interest groups in the smart grid and energy industries.
- Interview decision-makers at all levels of government, educational, labor and private sectors.
- Review published data for a complete and thorough assessment of deficiencies.

The research team conducted an extensive review of existing published data, research, and literature; collected 113 survey responses; and conducted 18 qualitative interviews with diverse sampling of industry professionals. This effort provided IIT with the data necessary to formulate a preliminary draft of the smart grid job classifications and skill deficiencies. The draft of the job classification and skills deficiencies were further validated and reviewed with a sampling of cross industry experts through 16 individual validation interviews. This validation exercise led to the conclusive definition of the specific job classifications to be targeted for training and the skill deficiencies to be addressed through workforce improvement efforts.

The figure below displays the summary version of the IIT SGJSM.

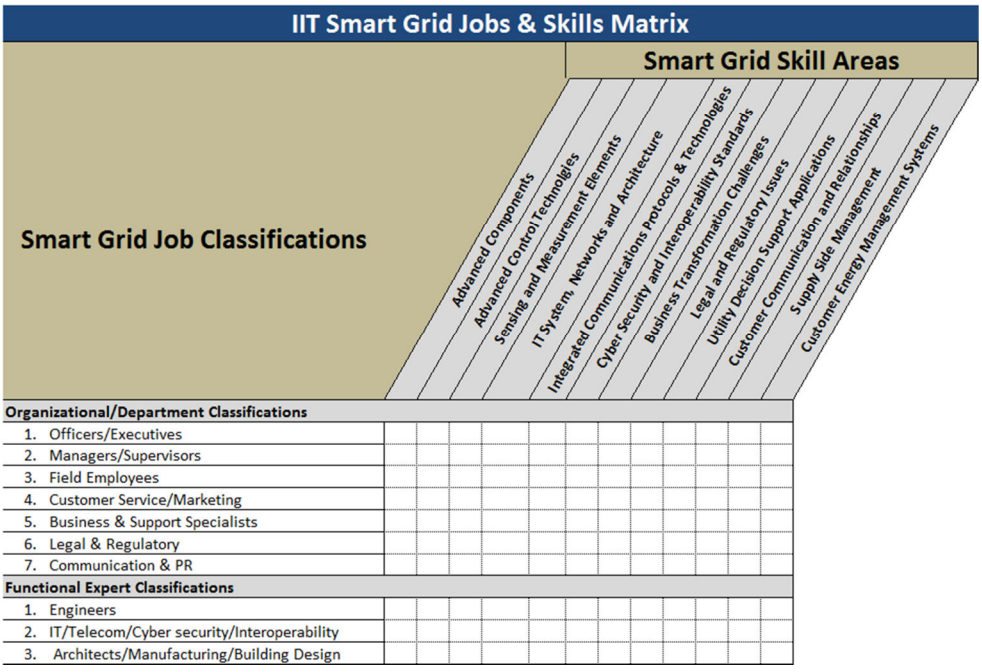

Figure 6: IIT SGJSM

The following sections describe the specific components of job classifications and the skill deficiencies.

4.2.1 Smart Grid Job Classifications

The job classifications were initially defined by the DoE Smart Grid Department of Labor SOC List (Appendix B). The primary and secondary research of IIT, and the validation interviews further refined the initial listing of the job classifications.

First, the job classifications were arranged in seven organizational / department classifications, and three functional / expert classifications. Below is a description of each job classification by category:

Organizational / Department Classifications

Officer/Executive - Determine and formulate policies and provide the overall direction of companies or private and public sector organizations within the guidelines set up by a board of directors or similar governing body. Plan, direct, or coordinate operational activities at the highest level of management with the help of subordinate executives and staff managers.

Manager/Supervisor - Supervise and coordinate the activities of staff employees of a particular functional group. Duties may include management functions, such as purchasing, budgeting, accounting, and personnel work, in addition to supervisory duties.

Field & Line Crew – Install or repair products necessary to the organization's operations. For the utility industry, includes installing and repairing cables or wires used in electrical power or distribution systems.

Customer Service/Marketing - Interact with customers to provide information in response to inquiries about products and services and to handle and resolve complaints. Also could include determining the demand for products and services offered by a firm and its competitors and identify potential customers.

Business & Support Specialists – Perform the day-to-day operational activities necessary to the organization's business (including human resources functions). Duties and responsibilities may include conducting research, preparing statistical reports, collecting and interpreting data, benefits administration, resource management etc.

Legal & Regulatory – Represent or assist representing the organization proactively and reactively in legal or regulatory proceedings – may include researching legal precedent, investigating facts, and preparing legal documents.

Communication & PR - Engage in promoting or creating good will for individuals, groups, or organizations by writing or selecting favorable publicity material and releasing it through various communications media.

Functional Expert Classifications

Engineering – Apply engineering theory and related knowledge to test and modify developmental or operational machinery and control equipment and circuitry in industrial or commercial plants and laboratories.

IT/Telecom/Cyber Security/Interoperability – Plan, direct, or coordinate activities in such fields as electronic data processing, information systems, systems analysis, computer programming, voice and data communications systems, security systems, and systems management and integration.

Architecture/Manufacturing/Building Design – Plan and design structures, such as private residences, office buildings, factories, and other structural property.

Subsequently, each job was classified as either major, moderate, or minor with respect to the severity of impact that smart grid activities will have on the typical daily job functions. A job classified as being impacted in a minor way are those jobs requiring the basic knowledge of what the smart grid is, how it is used, how it relates to their job, and why it is important to making either themselves or their employer successful in the marketplace.

Jobs classified as receiving moderate impact by smart grid implementation will be those that must change some portion of their daily activities due to component devices, methods, or applications that have materially changed and require additional in-depth training on those specific elements or components of the smart grid.

Jobs classified as receiving major impact from smart grid implementation would be decision-makers who determine how capital expenditures will be allocated, job positions that have more than 50% of their job duties or responsibilities redefined, or in the case of meter readers, eliminated.

The table below provides detailed listing of the major, moderate, and minor smart grid impacted job classifications.

Table 12: Job Classifications

SOC	Job Classifications w/Major Impact (35)	SOC	Job Classifications w/Moderate Impact (17)	SOC	Job Classifications w/Minor Impact (52)
	Organizational/Department Classifications		**Organizational/Department Classifications**		**Organizational/Department Classifications**
	1. Officers/Executives		**1. Officers/Executives**		**1. Officers/Executives**
				11-1011	*a. Chief executives*
	2. Managers/Supervisors		**2. Managers/Supervisors**		**2. Managers/Supervisors**
11-1021	*a. General and operations managers (includes facility managers)*	11-3011	*a. Administrative services managers (CSR)*	11-3051	*a. Industrial production managers*
11-2020	*b. Marketing and sales managers*	11-9021	*b. Construction managers*	11-3061	*b. Purchasing managers*
11-3021	*c. Computer and information systems managers*			11-3071	*c. Transportation, storage, and distribution managers*
11-9041	*d. Engineering managers*			11-9141	d. Right-of-Way and Real Estate Managers
11-3031	*e. Financial managers*				
	3. Field Employees		**3. Field Employees**		**3. Field Employees**
47-1011	*a. First-line supervisors/managers of construction trades and extraction workers*	43-2000	*a. Communications equipment operators*	43-1000	*a. Supervisors, office and administrative support workers*
33-1000	*b. First-line supervisors/managers, protective service workers*	49-9040	*b. Industrial machinery installation, repair, and maintenance workers*	47-2061	*b. Construction laborers*
43-5041	*c. Meter readers, utilities*			47-2070	*c. Construction equipment operators*
47-2111	*d. Electricians*			47-2150	*d. Pipelayers, plumbers, pipefitters, and steamfitters*
47-4011	*e. Construction and building inspectors*			47-3010	*e. Helpers, construction trades*
49-2094	*f. Electrical and electronics repairers, commercial and industrial equipment*			49-2092	*f. Electric motor, power tool, and related repairers*
49-2095	*g. Electrical and electronics repairers, powerhouse, substation, and relay*			49-9069	*g. Precision instrument and equipment repairers, all other*
49-9051	*h. Electrical power-line installers and repairers*			51-2020	*h. Electrical, electronics, and electromechanical assemblers*

SOC	Job Classifications w/Major Impact (35)	SOC	Job Classifications w/Moderate Impact (17)	SOC	Job Classifications w/Minor Impact (52)
49-9052	*i. Telecommunications line installers and repairers*			51-2022	*i. Electrical and electronic equipment assemblers*
49-9099	*j. Installation, maintenance, and repair workers, all other*			51-2023	*j. Electromechanical equipment assemblers*
51-8012	*k. Power distributors and dispatchers (include system dispatchers)*				
	4. Customer Service/Marketing		**4. Customer Service/Marketing**		**4. Customer Service/Marketing**
41-4011	*a. Sales representatives, wholesale and manufacturing, technical and scientific products*			41-4012	*a. Sales representatives, wholesale & manufacturing, except technical & scientific products*
43-4051	*b. Customer Sales Representatives*				
	5. Business & Support Specialists		**5. Business & Support Specialists**		**5. Business & Support Specialists**
13-1111	*a. Management analysts*	19-2040	*a. Environmental scientists and geoscientists*	13-1081	*a. Logisticians*
15-2031	*b. Operations research analysts*	19-3011	*b. Economists*	13-1199	*b. Business operation specialists, all other*
		19-3020	*c. Market and survey researchers*	13-2011	*c. Accountants and auditors*
		15-2031	*d. Operations research analysts*	15-2041	*d. Statisticians*
				19-4061	*e. Social science research assistants*
				19-4090	*f. Other life, physical, and social science technicians*
				27-1024	*g. Graphic designers*
				27-3040	*h. Writers and editors*
				43-3000	*i. Financial clerks*
				43-4000	*j. Information and record clerks*
				43-5000	*k. Material recording, scheduling, dispatching, and distributing occupations*
				43-5061	*l. Production, planning, and expediting clerks*
				43-5071	*m. Shipping, receiving, and traffic clerks*
				43-5081	*n. Stock clerks and order fillers*
				43-6011	*o. Executive secretaries and*

SOC	Job Classifications w/Major Impact (35)	SOC	Job Classifications w/Moderate Impact (17)	SOC	Job Classifications w/Minor Impact (52)
					administrative assistants
				43-9061	*p. Office clerks, general*
				43-9071	*q. Office machine operators, except computer*
				43-9081	*r. Proofreaders and copy markers*
				43-9111	*s. Statistical assistants*
				43-9199	*t. Office and administrative support workers, all other*
				Pending	*u. Right-of-Way and Real Estate Managers*
	6. Legal & Regulatory		**6. Legal & Regulatory**		**6. Legal & Regulatory**
11-9199.01	*a. Regulatory Affairs managers*	23-1011	*a. Lawyers*		
13-1041.07	*b. Regulatory Affairs specialists*				
	7. Communication & PR		**7. Communication & PR**		**7. Communication & PR**
27-3031	*a. Public relations specialists*				
	Functional Expert Classifications		**Functional Expert Classifications**		**Functional Expert Classifications**
	1. Engineers		**1. Engineers**		**1. Engineers**
17-2070	*a. Electrical and electronics engineers*	15-1030	*a. Computer software engineers*	17-2051	*a. Civil engineers*
17-2071	*b. Electrical engineers*	17-2061	*b. Computer hardware engineers*	17-2081	*b. Environmental engineers*
17-2072	*c. Electronics engineers, except computer (includes telecommunications engineer)*	17-3023	*c. Electrical and electronic engineering technicians*	17-2112	*c. Industrial engineers*
		17-2141	*d. Mechanical engineers - associate with integrated building systems*	17-2199	*e. Engineers, all other*
				17-3022	*f. Civil engineering technicians*
				17-3024	*g. Electro-mechanical technicians*
				17-3025	*h. Environmental engineering technicians*
				17-3026	*i. Industrial engineering technicians*
				17-3027	*j. Mechanical engineering technicians*
				17-3029	*k. Engineering technicians, except drafters, all other*

SOC	Job Classifications w/Major Impact (35)	SOC	Job Classifications w/Moderate Impact (17)	SOC	Job Classifications w/Minor Impact (52)
				17-3031	*l. Surveying and mapping technicians*
	2. IT/Telecom/Cyber security/Interoperability		**2. IT/Telecom/Cyber security/Interoperability**		**2. IT/Telecom/Cyber security/Interoperability**
15-1061	*a. Database administrators*	15-1021	*a. Computer programmers*	15-1011	*a. Computer and information scientists, research*
15-1071	*b. Network and computer systems administrators*	15-1041	*b. Computer support specialists*	15-2090	*b. Miscellaneous mathematical science occupations*
15-1081	*c. Network systems and data communications analysts*	15-1051	*c. Computer systems analysts*	43-9011	*c. Computer operators*
15-1099.02	*d. IT Systems Architecture (Computer Systems Engineers/Architects)*	15-1099	*d. Computer specialists, all other*		*d. Data entry and information processing workers*
15-1030	*e. Computer software engineers*				
15-1031	*f. Computer software engineers, applications*				
15-1032	*g. Computer software engineers, systems software*				
	3. Architects/Manufacturing/Building Design		**3. Architects/Manufacturing/Building Design**		**3. Architects/Manufacturing/Building Design**
17-1011	*a. Architects*				
17-3011.01	*b. Architectural drafters (include GIS mappers)*				

4.2.2 Skill Deficiencies

Skill deficiencies arising from implementation of the smart grid include opportunities to update and integrate current knowledge and areas where new roles will be required. This research offers broad and diverse opportunities for the future smart grid workforce. Deficiencies are related to the technologies and operations of smart grid elements, as well as the business and management issues triggered by smart grid evolution. Needed skills are strategically aligned into four primary quadrants: Smart Grid Technology, Smart Grid Systems Integration & Communications, Smart Grid Organizational Management, and Smart Grid Customer Management. Each quadrant is further organized into key areas, as shown in the figure below.

Figure 7: IIT Smart Grid Skills Requirements[7]

[7] Developed by West Monroe Partners in conjunction with IIT

Smart Grid Technology includes the skills and knowledge necessary to design, build, operate, and maintain components, controls, and key elements of the electrical system. Information regarding smart grid technology was derived from the following sources:

- Department of Energy National Energy Technology Laboratory (NETL), especially the results from the five-year smart grid Implementation Strategy research;
- Institute of Electrical and Electronics Engineers (IEEE), including the Smart Grid Conceptual Model, Grid Operations and Planning, and IntelliGrid standards, research, and reports;
- Electric Power Research Institute (EPRI) smart grid research, demonstration projects, and resources;
- Illinois Statewide Smart Grid Collaborative (ISSGC) research and reports;
- Private industry research, technologies, and reports.

Skills deficiencies in this quadrant are grouped under the following three areas: Advanced Components; Advanced Control Technologies; and, Sensing and Measuring Elements.

Advanced Components[8] – Skills associated with installing, operating, and maintaining smart grid devices are included in this area. Typically training on devices is provided by vendors of those devices, but when selecting and specifying devices there should be a basic understanding of when and where such devices are utilized on the network. Additionally, economic considerations should be understood with respect to costs and benefits derived from installation of such devices. New smart grid components are designed and tested regularly so the table below should be considered a living compendium.

Table 13: Typical Smart Grid Advanced Components

Advanced Components	
Advanced LTCs	Advanced Protective Relays
Controllable Network Transformers	Convertible Static Compensator
Current Limiting Conductors	Distribution VAR, Static VAR
Flow Control Using HTS Cable	Grid Tie Inverter
Load Control Receiver	Medium Voltage Static Transfer Switch
Short-Circuit Current Limiter	Narrow Band PLCs
Smart Meter	One-Cycle Controller
Smart Wire Class. of Dist. Series Impedance Device	Real-Time Response Control Device
Static Shunt Compensators	Solid State Transfer Switches
Static VAR Compensators	Static Synchronous Series Compensator
Thyristor Controlled Series Compensators	Universal Power Interface
Unified Power Flow Controllers	

Advanced Control Technologies[9] – Control methods associated with smart grid operations are both advances of current technologies and development of new applications as the smart grid grows more intelligent. These systems and technologies allow for remote feedback and control of devices and

[8] Derived from the sources listed above in the Smart Grid Technology Management discussion
[9] Ibid.

deliver decision support information for operator action. The following table lists typical control technologies currently under development or proposed.

Table 14: Typical Smart Grid Advanced Control Technologies

Advanced Control Technologies	
Advanced Feeder Automation	Advanced Substation Gateway
Distributed Intelligent Control System	Distribution Automation
Grid Friendly Appliance Controller	Demand Response
SCADA	Distribution Fault Locators
Substation Automation	Utility Energy Management Systems

Sensing & Measurement Elements[10] – Smart grid intelligent devices provide status information to decision makers and include equipment sensors and monitoring systems. This area also includes applications that notify operators and allow them to properly assess events. An Outage Management System (OMS) would fall into this category. The table below lists some of the sensing and measurement equipment and applications involved.

Table 15: Typical Smart Grid Sensing and Measurement Elements

Sensing and Measurement Elements	
Cable Monitoring System	Battery Monitoring System
Current Sensor	Circuit Breaker Monitoring System
Instrument Transformer	Fiber Optic Sensor
Power Quality Monitoring System	Outage Management System
Temperature Monitoring System	Voltage SAG Profile (VARs)
Wide-Area Measurement System	Transformer Monitoring System
Wireless Condition Monitoring	

Smart Grid System Integration & Communications includes the skills and knowledge necessary to design, integrate, and operate the information systems and telecommunications systems necessary for safe, reliable, and continuous grid functionality. This quadrant embraces a wide range of current and emerging telecommunications platforms and technologies, software and information systems, and the critical standards necessary to protect and integrate new smart grid developments. Information regarding smart grid system integration, communication, and architecture was derived from a number of standards development, software design, and infrastructure pilot programs and initiatives. The following sources were particularly relevant:

- Carnegie-Mellon, Computer Emergency Response Team (CERT) Program on Cyber Security;
- Institute of Electrical and Electronics Engineers (IEEE), interoperability and communications standards and technology committees;

[10] Ibid.

- International Electrotechnical Commission (IEC) Smart Grid Framework, Technical Committees, and SG3 strategic group standards development activities;
- Federal Energy Regulatory Commission (FERC) rulemakings under Section 1305 of the Energy Independence and Security Act of 2007 (EISA);
- National Institute of Standards and Technology (NIST) Framework and Roadmap for Smart Grid Interoperability Standards, and information from the NIST Federal Advisory Committee;
- North American Electric Reliability Corporation (NERC) Smart Grid Task Force, standards, and critical infrastructure protection programs.

Skills deficiencies in this quadrant are grouped under the following three areas: IT System, Networks, and Architecture; Integrated Communications Protocols and Technologies; and, Cyber Security and Interoperability Standards.

IT System, Networks and Architecture[11] – The smart grid requires more extensive data flow and data manipulation than legacy systems. Integrating the data flow from discrete interfaces requires broader and more flexible approaches. For example utilities are installing Enterprise Service Buses rather than create point-to-point interfaces between applications. The output from these new systems and networks will increase database management issues and create new jobs that require new skills. The table below lists typical data flow activities under development or being deployed in smart grid initiatives.

Table 16: Typical Smart Grid IT Systems, Networks and Architecture

IT System, Networks and Architecture	
Advanced Metering Infrastructure	Database Management
Application Design and Support	Meter Data Management Systems
Business Systems Management	Network Operations Center Deployment
Enterprise Service Bus	System Architecture Design
System Integration	

Integrated Communications Protocols and Technologies[12] – Smart grid components and systems will use a wide array of existing and new telecommunications approaches. People working in this sector of the smart grid economy will need to master both the technologies and the standards that allow for interoperability amongst the various devices on the smart grid system. This relates to standards associated both on the utility side and the customer side. The table below lists some of the most commonly used protocols under development or existing today.

Table 17: Typical Smart Grid Integrated Communications Protocols & Technologies

Integrated Communications Protocols & Technologies	
Communication to Meter (PLC, BPL, Cellular, DSL, FTTH, VSAT)	Communication Standards (WiMAX, Internet Protocol)

[11] Derived from the sources listed above in the Smart Grid Integrated Systems Management discussion
[12] Ibid.

Integrated Communications Protocols & Technologies	
HAN Standards (X10, UPB, INSTEON, Z-Wave, ZigBee)	Radio Comm. (RFID, SS Radio, Multiple Address Radio, Paging, iDEN)

Cyber Security & Interoperability Standards[13] – A critical aspect of the smart grid is protecting the information that passes through various and sundry communication systems. Additionally, with the implementation of new applications, moving data effectively between these applications provides significant value to utilities. The table below lists typical items included within this area.

Table 18: Typical Smart Grid Cyber Security and Interoperability Standards

Cyber Security and Interoperability Standards	
Cyber Security Risk Documentation	Smart grid Interfaces Between Utility and Home
IEC Standards 61970, 61968, 61850, 62351, 600870-6	Smart Meters Interfaces to In-Home Displays, PHEV, Smart Appliances

Smart Grid Organizational Management includes the skills and knowledge required to address business and organizational opportunities and risks that develop from smart grid initiatives. The skills required to transform utility industry companies, organizations, and suppliers are critical to successful smart grid implementation and integration. Information regarding organizational management in this new environment was derived from numerous academic, industry, and subject matter expert sources. The following sources were particularly useful:

- Carnegie-Mellon Software Engineering Institute (SEI), Smart Grid Maturity Model (SGMM);
- Edison Electric institute (EEI) smart grid public policy advocacy, studies, and reports;
- KEMA/GridWise Alliance Perspectives for Job Creation research and report;
- National Association of Regulatory Utility Commissioners (NARUC) policies, presentations, and FERC-NARUC Collaborative on Smart Grid Response.

Skills deficiencies in this quadrant are grouped under the following three areas: Business Transformation Challenges; Legal & Regulatory Issues; and, Utility Decision Support Applications.

Business Transformation Challenges[14] – Implementation of smart grid technology within a utility will impact many areas of the organizational structure. Organizational change management techniques and business transformation strategies will need to be developed to manage these cultural and structural challenges. The table below lists typical areas of f Business Transformation Challenges.

Table 19: Typical Smart Grid Business Transformation Challenges

Business Transformation Challenges	
Business Process Optimization	Smart Grid Strategy Design

[13] Ibid.
[14] Derived from the sources listed above in the Smart Grid Organizational Management discussion.

Business Transformation Challenges	
Economic Business Case Creation	Contract Administration
Organizational Design Structure	Organizational Change Management
Performance Metric Development	Smart Grid Training Design and Delivery
Smart Grid Relationship Management	

Legal & Regulatory Issues[15] - Utilities and their regulators face many new challenges as smart grid investments are larges and the systems are complex. New and alternative rate structures require design regulatory approvals. In addition, as new smart grid devices and systems are marketed, there will be patent, manufacturing, and reliability issues that develop new devices also bring with them safety and health concerns. Additionally, data privacy issues continue to surface. The table below offers a glimpse into these new and emerging issues within the legal and regulatory framework.

Table 20: Typical Smart Grid Legal and Regulatory Issues

Legal and Regulatory Issues	
Advanced Rate Design (TOU, CPP, Real Time)	Smart Grid Cost Recovery
Carbon Legislation	Equipment Reliability & Security
Compliance (Regulatory, Standards, Legislative)	Confidentiality & Privacy Issues
Procurement and Contract Management	Fraud - Stealing Energy through SG Devices
Smart Grid Patent Infringement	Demand Side Management

Utility Decision Support Applications[16] - Smart grid information passes between and through various devices and systems. This information is used to control the network and individual devices. The information is also used for maintenance planning, workforce management, outage restoration, and planning future smart grid expansion or upgrades. The table below lists some of the applications that will be used by utilities to improve these types of decisions.

Table 21: Typical Smart Grid Utility Decision Support Applications

Utility Decision Support Applications	
Consumer Gateway & Portal	Distributed Energy Resources Controller
Microgrid Control Software	Power Distribution Analysis Software
Power Transmission Analysis Software	Real-Time Digital Simulator
System Visualization Software	

[15] Ibid.

[16] Ibid.

Smart Grid Customer Management includes the skills and knowledge applicable to a wide range of stakeholder management, customer technologies, and alternative generation resources that occur when the smart grid is fully deployed and operating. These issues are occurring today in many areas across the country and the world as utilities plan for new customer relationships, new customer choices, and new customer control over their energy consumption in the smart grid economy. The skills include application of existing outreach and communications techniques, as well as the management and integration of new technologies beyond the meter and beyond the localized grid. Resources available for this research are expanding daily, and the following sources were relevant to this study:

- Edison Electric institute (EEI) smart grid public policy advocacy, studies, and reports;
- National Association of Regulatory Utility Commissioners (NARUC) policies, presentations, and FERC-NARUC Collaborative on Smart Grid Response.
- California Public Utility Commission (CPUC) smart grid policies, rules, and research;
- Florida Public Service Commission (FPSC) smart grid policies, rules, and research;
- Illinois Commerce Commission (ICC) smart grid policies, rules, and research;
- Maryland Public Service Commission (MPSC) smart grid policies, rules, and research;
- New York Public Service Commission (NYPSC) smart grid policies, rules, and research;
- North Carolina Utility Commission (NCUC) smart grid policies, rules, and research;
- Oregon Public Utility Commission (OPUC) smart grid policies, rules, and research;
- Pennsylvania Public Utility Commission (PPUC) smart grid policies, rules, and research;
- Public Utility Commission of Ohio (PUCO) smart grid policies, rules, and research;
- Texas Public Utility Commission (TPUC) smart grid policies, rules, and research;

Skills deficiencies in this quadrant are grouped under the following three areas: Customer Communications and Relationships; Supply Side Management; and, Customer Energy Management Systems.

Customer Communication & Relationships[17] – The smart grid will create more customer information and choices, requiring additional systems and skills to facilitate and manage new relationships. Strategies and channels must be developed to effectively communicate essential information to the customer regarding program offerings, event occurrences and other energy conservation initiatives. In addition, utilities will also need more skilled customer and marketing resources to maximize the value of the new smart grid. The table below provides some of the activities and programs that are emerging from smart grid initiatives. These options will continue to expand and challenge the industry

Table 22: Typical Smart Grid Customer Communication and Relationships

Customer Communication and Relationships	
Intelligent Call Center	Social Networking for Real-Time Pricing
Marketing Smart Grid Technology, Value, Energy Conservation	Stakeholder Management
Smart Grid Communication Strategy	

[17] Derived from the sources listed above in the Smart Grid Customer Management discussion

Energy Supply Side Management[18] – The smart grid standardizes and enables the integration of alternative and renewable energy resources added beyond the grid by customers. The planning, integration, dispatch, safety, and billing for these resources will require new systems and skills. In fact, there are entire new industries that have developed around these "green energy" opportunities. This research did not try to capture nor distill the dynamic growth in this market sector. Rather, these elements are included to provide a platform for skills development in managing their integration to the smart grid. There are many variations of this type of distributed generation and a few typical alternatives are shown in the table below.

Table 23: Typical Smart Grid Energy Supply Side Management

Energy Supply Side Management	
Energy Storage	Purchased Power
Distributed Generation	Renewable Energy Integration to the Grid

Customer Energy Management Systems[19] – Beyond the utility meter, the customer also seeks control of their energy cost. This includes the ability to effectively install and control renewable energy on the grid as well as controlling their energy consumption, timing of use, and choices of services. This area has attracted numerous entrants including utilities who desire to offer competitive services beyond the meter in regulated and deregulated service territories. The table below provides a few areas of training needs in this growing market sector.

Table 24: Typical Smart Grid Customer Energy Management Systems

Customer Energy Management Systems	
Home Area Networks	Battery Technology
PHEV Charging Devices	Facility HVAC Controls
Programmable Thermostats	Smart Appliance Interface Unit

[18] Ibid.
[19] Ibid.

4.2.3 Key Findings

Interview and secondary research has provided insight to the most likely jobs and skill deficiencies. The following are the most relevant findings from the investigation.

Finding #1: Smart grid development requires significantly more communication skills to effectively reach and impact the stakeholders.

Implementing a smart grid program includes changing the entire utility corporate mindset relative to customer relationships and involvement in the energy business. Integrated knowledge of alternative resources, new sources of data, and new choices for the customers must be blended into a myriad of educational resources (on-line customer education, digital media, community outreach and education). The outreach, marketing, and education activities also need to embrace regulatory and employee stakeholder management.

As AMI is rolled out, the customer will become more involved in the energy procurement process. It's important the customer not push back when introduced to the new technology. This implies more information must be provided to the customer. Information about smart grid can come from different sources, but one source will definitely be the local utility.

Finally, utilities must also learn to use the new social media (Facebook, Twitter, etc.) to reach the users of tomorrow's smart grid. These technologies will allow utilities to create digital communities for both traditional customer relationship management and the new two-way relationship of product to customer.

Finding #2: The smart grid will bring new job duties, titles and roles.

The convergence of telecommunications systems and electrical system operations will demand combined and blended skill sets for frontline employees, technicians, operators, and engineers. In essence, the electrical utility industry will be expanding current network communications systems into full spectrum telecommunications technologies. They will be adding the necessary design, operations, and maintenance skills from the telecom industry to their electrical knowledge base. The integration and blending of these skill sets will create new field and operations roles and responsibilities.

The addition of two-way communications from the customer usage perspective will create new job duties and responsibilities for the front-line customer service representatives. Utilities need to add knowledge and job skills in managing customer options and relationships. This re-training effort requires integrating traditional customer account manager responsibilities, new knowledge of smart grid information flow, HAN integration, and improved customer service skills. Utilities are creating positions such as Customer Energy Advisors and Customer Energy Experts and blending call center responses with knowledge delivery capabilities similar to that of a consultant role.

The current "Energy Auditor" position, while responsible for some of these functions; is now assuming the role of an Advisor or Energy Expert who must advice customers on how to reduce their bill through a myriad of energy conservation offerings and rate structures. Advising customers on PHEV, energy conservation and demand side management programs become responsibilities that comprise similar aspects to that of "energy consultants".

The utility industry is currently experiencing a significant roll-out of AMI systems and components and the majority of these programs are staffed by temporary and contract employees. As the industry continues to expand smart grid technologies and components over the next five to ten years, the presence of contract labor will expand and become an integrated component of ongoing utility operations. The utility industry is familiar with project-based management skills and seasonal or episodic needs for contract labor and has developed techniques and tools to manage these issues. However, the rapid expansion of new technologies, new operations, and new relationships virtually assure the critical need for more contract management and project management skills in the utility of the future. The ability to effectively and efficiently assemble, organize, deploy, and disband groups of specialized employees and skill sets will go far beyond the relatively direct approach for project management and storm restoration. Utilities that master and leverage these skills will be able to better manage the nimble and responsive workforce required to maintain and operate a new customer-focused intelligent grid. The utility must intelligently utilize the system it owns and learn to utilize contract employees who will become ubiquitous in this workspace. This is an essential skill for utilities of the future.

Finding #6: The smart grid will increase the demand for knowledge of multiple varieties of telecommunication systems.

Electric utilities have traditionally hired telecommunication technicians and engineers to manage their SCADA, telecommunication and radio systems. AMI developments will require broad and significant expansion of telecommunication systems, including wireless and cell technologies, not currently held by electrical utility workers. In addition, current telecommunication workers are not familiar, nor trained, in maintenance, installation, and repair of integrated electric/telecommunication networks. They are typically restricted to working in the telecommunication “safe zone” residing below the distribution lines.

Emerging AMI and DA communication systems in the radio and Wi-Fi spectrums will be overlaid on existing SCADA and voice systems. The electric utility will resemble a telecommunication company in every aspect, including the requirements for creating an integrated Network Operations Center (NOC). Customer portals, substation gateways, and DA device intelligence will be linked through multiple media options and technologies, each with their own life-cycles and maintenance cycles. Radio and cell frequencies require constant attention and tuning, different than the “plug and play” maintenance requirements of current electric technicians. Differences in material and equipment hardening and installation will also require a new kind of “wireman” in both emergency response and restoration and in original construction.

The end result is an integrated communication technology. While the internal Home Area Network uses ZigBee from the meter to the house, utilities may use wireless mesh network from the meter to a collection point, then WiMAX technology for communication from the collectors to a cell tower and further, there’s could be a fiber or even a microwave backhaul link to the main office where the data is stored. Multiple communication protocols are being utilized and must be understood and maintained by utility personnel.

Finding #7: Currently, smart grid training within organizations is minimal.

Interviews revealed that while companies and organizations have initiated new smart grid employee training and development, it consists of a basic awareness and exposure to the smart grid. Very few utilities have initiated comprehensive and integrated training platforms for future smart grid skill development. Participants of the survey gleaned their own knowledge from individual internet "surfing" of favored sites. Utilities involved with AMI programs are also receiving vendor education and team familiarization to components and minimal integration (usually at the IT and Technician levels). Some industry seminars are attended, but no one has yet to develop an integrated and sustainable employee development plan. Such and effort will be addressed in Task 7.0 of this overall grant.

The interviews revealed that a useful tiered learning framework could offer initial and ongoing opportunities to create and expand organizational smart grid skills tied to the timing and expansion of a utility's own smart grid plans. For instance a Tier One exposure to AMI, for current and future employees would provide knowledge and skills mastery over the HAN, AMI, and communication systems as well as the required service, support, and education of customers. Tier 2 might include maintenance and operations of the digital system integration, including MDM and cyber security as AMI becomes more widespread and coverage is completed. Tier 3 might address DA and SA applications, skills, and integration into legacy systems, including new grid control and dispatch skills, information management skills, and component and technology mastery. This approach would use internal and external training programs, self-paced instruction, on-site or off-site certification, continuing education, and new learning technologies, and does not yet exist as an integrated, bundled, and delivered product set.

Finding #8: Labor union legacy workforce approaches will be challenged.

Training a new workforce with blended telecommunications and power system electrical skill sets will require new learning methods, incremental expansion of current basic skill sets, and challenges for organized labor legacy approaches to jurisdictional classifications and contract job duties. In addition, front line employees will also be expected to regularly interact with the customer in a new information sharing and partnership relationship requiring major upgrades to their communications and relationship management skills. Real-time decision making, customer communications, and flexibility in work duties will require labor unions to redesign current approaches to building employee/member value and receiving fair and equitable reimbursement in return. Multiple blended job classifications shared among multiple labor unions will be necessary to effectively create a new smart grid workforce. Currently, this sector of the industry is gathering information and designing new classes, but this work is occurring in separated and disparate clusters across the country. Absent national leadership, guidance, and direction, the impact of smart grid systems on this workforce will move forward in an independent and reactive basis and could jeopardize labor/management relationships in the future.

4.3 Future Research Implications

This Task 6.0 report presented the extensive approach that was undertaken by IIT to define the specific job classifications to be targeted for training and deficiencies to be addressed through the workforce improvement efforts. The result of this effort presented the defined IIT Smart Grid Job Classifications and Skills Deficiencies Matrix.

The next Task from IIT's Statement of Project Objectives for the project *A World-Class Smart Grid Education and Workforce Training Center Illinois Institute of Technology* is Task 7.0 - Identify Gaps in Training Needs. Specifically, the scope of Task 7.0 is to identify gaps in training needs, with respect to any combination of curricula, while assessing the capacity and the accessibility of current training opportunities in the United States. IIT is responsible for conducting a comprehensive overview of available training practices in use for the specified job classifications and skill deficiencies identified in Task 6.0.

To achieve the Task 7.0 report objectives, IIT will define the competency level required for each point of intersection on IIT SGJSM – which will provide the specific smart grid skill competency for each job classification. This will be achieved through the administration of a second survey where respondents will identify the level of competence required for each job classification and specific smart gird skill deficiency. Additionally, IIT will conduct a market analysis of the current training opportunities in the United States for the specified job classification and skill deficiencies. This planned primary and secondary research approach for the Task 7.0 will conclude with a comprehensive understanding of the current gaps in smart grid training needs.

5 Appendices

5.1 Appendix A: Contributors

IIT would like to thank our contributors whose efforts helped create this report:

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Jason Hopkins, Underwriters Laboratories
Jason Tyszko, Deputy Chief of Staff, IDCEO
Jay Marhoefer, Intelligent Generation LLC
Jeff Carroll, Siemens
Jeff Chamberlain Argonne, Director of Advanced Energy Storage and Technology Transfer, Argonne National Labs
Jeff Teuscher, Dayton Power & Light
Jens Nedrud, Puget Sound Energy
Jerry Weber, College of Lake County
Jerry Weber, President, Lake County Community College
Jesse Brown VA Hospital
Jill Wine-Banks, Director, Operation Green Jobs
Jillian Watson, Executive Assistant, EMB Consultants, Inc.
Jim Reimer, Government Consulting Services
Joan Paparigian
Joel Graves, West Monroe Partners
John Donahue, IBEW NECA Technical Institute
John Gasal, Connexus Energy
John Loehr, CPS
John Patelski, Independent A/E
John Tucker, First Choice

Johnnie Turner, CPS
Joo Wook Lee
Jordan Cutler, Illinois Science and Technology Coalition
Joyce Kenner, CPS
Julian Hilmara, CPS
Jun Do-Bong, KEPCO KDN
Karen Helland, Education Director, Illinois Board of Higher Education
Karoline Sharp, CPS
Kate Tomford, IDCEO
Katrina Sivels, CPS
Ken Roland, Tennessee Valley Authority
Ken Vaughn
Kevin Lynch, Director, IBEW Sustainability Training and Education, Local 134
Kim Harrell, CPS
Kwok Cheung, AREVA T&D
Larry Fuller, CenterPoint Energy
Lavonna Williams
Lawrence Bass, CPS
Leith Sharpe, IGEN
Lillian Degand, CPS
Linley White, Moraine Valley Community College, Dean of Workforce Development
Lolita Hardiman, CPS
Lonnie Upshaw, East Gate Energy, Inc.
Lynne El-Amin-Muhammad
Mack Wathen, PHI
Mae Jefferson, Chicago Public Schools, Director of External Partnerships
Mae Jefferson, CPS
Marc Rosenow, Corporate Vice President - Operations, Hudson Highland Group, Inc.
Marcia Lochman, Lewis & Clark
Marcia Lochmann, Lewis & Clark
Margo De Ley, CPS
Margo DeLay, CPS
Maria Pfister, CPS
Mark Browning, ComEd
Mark Handy, KenJiva Energy Systems
Marsh Streby, Public Outreach Director, Chicago Housing Authority
Marsha Lochman, IGEN
Marshall Kellow, Hopkinsville Electric System
Marty Price, Viryd Technologies, Inc
Mary Cummane, Perspectives Charter School
Mary Reidy, NationalGrid
Maudie Walls
Melissa Gordon, Illinois Institute of Technology
Melvin Slater, CPS
Michael Abba, Ameren
Michael Gravely, California Energy Commission
Michael Yauger, Teamsters International H2H Coordinator

Michael Yauger, Teamsters International H2H Coordinator
Mike Williams
Mohammad Shaidapour, Illinois Institute of Technology
Musse Ahmed, IIUM
Nichelle Grant, Marketing Director, Siemens
Nick Kaleba, Chicago Federation of Labor
Nick Powers, ABB Inc.
P. Lewis, CPS
Paul Kash, CPS
Perry Buffett, West Monroe Partners
Pete Schoedel, CPS
Pete Zimmerman
Peter Vitale
Phil Martini, SEIU Veterans Caucus, SEIU Local 73, Vice President
Phil Miller, Vulcan Materials
Phyllis Kuziel-Perri,
Ray Prendergast, CPS
Rebecca Towne, Green Mountain Power
Rhonda Patterson, CPS
Richard Moore, CPS
Rick Mills, CPS
Rob Malnik, Student Veterans of America
Robert Burke, EN Engineering
Robert Eidson, MWH
Robert Morphis, City of Aurora
Robert Reynolds, Prairie Power
Robert Sokol, CPS
Robert Wilcox, Rappahannock Electric Cooperative
Roberto Napoli, Politechnico di Torino
Robin Podmore, IncSys
Ryan Neris, CPS
Sakinah Kushmir
Sarah Ippel, CPS
Scott Southard, West Monroe Partners
Sergio Estrada, Assistant Director, Illinois Department of Veterans' Affairs
Shauntel Savage
Sheryl Cheatom, CPS
Simon Wlodarski, Chief of Staff, Illinois Department of Veterans' Affairs
Sonia Leva, Politechnico di Milano
Stephen Dorgan, Director, Operation Green Jobs
Stephen Konya, Chief of Staff, IDCEO
Steve Blume, Applied Professional Training
Suzanne Carlson, CPS
Suzanne Carlson, Director of Sustainability, Chicago Public Schools
Taheria Brown, CPS
Tammy Butler , CPS
Terry Schuster, ENERGYCONNECT, INC.

Thomas Wiedman, WPSCL
Tim Taylor, IPro
Todd Katz, CPS
Tom Hulsebosch, West Monroe Partners
Tom Kerestes, West Monroe Partners
Tom O'brien, CPS
Tom Villanova, President, Chicago and Cook County Building and Trades Council
US Army General Pete Cooke (ret), Partnership with America
USMC Col. Jay Houston
USMC General Ronald Coleman (ret)
USMC Sergeant Edward Schrank
Val Jensen, Exelon Corporation
Valerie Hardy, CPS
Veronica Martinez, CPS
Virgilio Santos, CPS
Wayne Straza, Deputy Director, Illinois Department of Financial and Professional Regulation
William Schmutz, City of Chicago Veterans Affairs
William Sproles, NationalGrid

5.2 Appendix B: DoE Smart Grid Department of Labor SOC List from the Guidebook for ARRA Smart Grid Program Metrics and Benefits

Department of Labor Job Categories

SGP Group	Department of Labor Occupation Category	
Managers		
	11-1011	Chief executives
	11-1021	General and operations managers
	11-2020	Marketing and sales managers
	11-3011	Administrative services managers
	11-3021	Computer and information systems managers
	11-3031	Financial managers
	11-3051	Industrial production managers
	11-3061	Purchasing managers
	11-3071	Transportation, storage, and distribution managers
	11-9021	Construction managers
	11-9041	Engineering managers
Analysts		
	13-1081	Logisticians
	13-1111	Management analysts
	13-1199	Business operation specialists, all other
	13-2011	Accountants and auditors
Computer-Related Occupations		
	15-1011	Computer and information scientists, research
	15-1021	Computer programmers
	15-1030	Computer software engineers
	15-1031	Computer software engineers, applications
	15-1032	Computer software engineers, systems software
	15-1041	Computer support specialists
	15-1051	Computer systems analysts
	15-1061	Database administrators
	15-1071	Network and computer systems administrators
	15-1081	Network systems and data communications analysts
	15-1099	Computer specialists, all other
	15-2031	Operations research analysts
	15-2041	Statisticians
	15-2090	Miscellaneous mathematical science occupations
Engineers		
	17-2051	Civil engineers
	17-2061	Computer hardware engineers
	17-2070	Electrical and electronics engineers
	17-2071	Electrical engineers
	17-2072	Electronics engineers, except computer
	17-2081	Environmental engineers
	17-2112	Industrial engineers
	17-2141	Mechanical engineers
	17-2199	Engineers, all other
	17-3022	Civil engineering technicians
	17-3023	Electrical and electronic engineering technicians
	17-3024	Electro-mechanical technicians
	17-3025	Environmental engineering technicians
	17-3026	Industrial engineering technicians
	17-3027	Mechanical engineering technicians
	17-3029	Engineering technicians, except drafters, all other
	17-3031	Surveying and mapping technicians

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SGP Group	Department of Labor Occupation Category	
Environmental and Social Scientists		
	19-2040	Environmental scientists and geoscientists
	19-3011	Economists
	19-3020	Market and survey researchers
	19-4061	Social science research assistants
	19-4090	Other life, physical, and social science technicians
Business Occupations		
	23-1011	Lawyers
	27-1024	Graphic designers
	27-3031	Public relations specialists
	27-3040	Writers and editors
	33-1000	First-line supervisors/managers, protective service workers
	41-4011	Sales representatives, wholesale and manufacturing, technical and scientific products
	41-4012	Sales representatives, wholesale & manufacturing, except technical & scientific products
	43-1000	Supervisors, office and administrative support workers
	43-2000	Communications equipment operators
	43-3000	Financial clerks
	43-4000	Information and record clerks
Recording, Scheduling, Computer Operator Occupations		
	43-5000	Material recording, scheduling, dispatching, and distributing occupations
	43-5041	Meter readers, utilities
	43-5061	Production, planning, and expediting clerks
	43-5071	Shipping, receiving, and traffic clerks
	43-5081	Stock clerks and order fillers
	43-6011	Executive secretaries and administrative assistants
	43-9011	Computer operators
	43-9020	Data entry and information processing workers
	43-9061	Office clerks, general
	43-9071	Office machine operators, except computer
	43-9081	Proofreaders and copy markers
	43-9111	Statistical assistants
	43-9199	Office and administrative support workers, all other
Construction, Electrical, and Other Trades		
	47-1011	First-line supervisors/managers of construction trades and extraction workers
	47-2061	Construction laborers
	47-2070	Construction equipment operators
	47-2111	Electricians
	47-2150	Pipelayers, plumbers, pipefitters, and steamfitters
	47-3010	Helpers, construction trades
	47-4011	Construction and building inspectors
	49-2092	Electric motor, power tool, and related repairers
	49-2094	Electrical and electronics repairers, commercial and industrial equipment
	49-2095	Electrical and electronics repairers, powerhouse, substation, and relay
	49-9040	Industrial machinery installation, repair, and maintenance workers
	49-9051	Electrical power-line installers and repairers
	49-9052	Telecommunications line installers and repairers
	49-9069	Precision instrument and equipment repairers, all other
	49-9099	Installation, maintenance, and repair workers, all other
	51-2020	Electrical, electronics, and electromechanical assemblers
	51-2022	Electrical and electronic equipment assemblers
	51-2023	Electromechanical equipment assemblers

5.3 Appendix C: Roundtable Discussion – Military & Union Attendees List

US Army General Pete Cooke (ret), Partnership with America
USMC General Ronald Coleman (ret)
Robert Eidson, MWH
Nick Kaleba, Chicago Federation of Labor
David Baker, IIT
Debbie Halvorson, US Congresswoman, 11th District
Jill Wine-Banks, Operation Green Jobs
Tom Kerestes, West Monroe Partners
Scott Southard, West Monroe Partners
Michael Yauger, Teamsters International H2H Coordinator
Phil Martini, SEIU Veterans Caucus, SEIU Local 73, Vice President
Elizabeth Belcaster, Teamsters H2H Consultant, EMB Consultants, Inc.
Bill Mulcrone, Helmets to Hardhats, Midwest Regional Director
Kevin Lynch, Electrical Program coordinator, IBEW
Harold Ohde, IBEW 134
Aderemi Olodun, USAR, Employer Partnership Office, Aderemi Olodun
Derrick Morrison, Department of Veterans' Affairs
Sergio Estrada, Assistant Director, Illinois Department of Veterans' Affairs
Simon Wlodarski, Chief of Staff, Illinois Department of Veterans' Affairs
Stephen Konya, Chief of Staff, IDCEO
Jason Tyszko, Deputy Chief of Staff, IDCEO
Kate Tomford, IDCEO
Jordan Cutler, Illinois Science and Technology Coalition
Dave Bieneman Illinois Department of Employment Security
William Schmutz, City of Chicago Veterans Affairs
Rob Malnick, Student Veterans of America
James Flagg, Student Veterans of America
Don West, PWR
Dave Lundy, Aileron Communications
Phil Miller, Vulcan Materials
USMC Sergeant Edward Schrank
Jeff Carroll, Siemens
Jim Reimer, Government Consulting Services
Caroll Timms, EnergyNet
John Tucker, First Choice

5.4 Appendix D: Roundtable Discussion – Military & Union Meeting Minutes

Meeting Minutes

Meeting: IIT Smart Grid Working Training Meeting for Military and Labor Union *Center for Electricity Innovation*

Date: December 9, 2010

Location: IIT Herman Hall Lounge, 3241 S. Federal, Chicago, IL 60606

Speaker	Content

Smart Grid Overview	**Topics for Today**
	• Elements of smart grid
	• Implementation of DoE smart grid Project at IIT
	• Conclusions
	Additional Commentary
	• This is the First meeting we have (of a number) to discuss issues that are important for training related to smart grid
	• It's very important to identify training courses and tasks to embark on training the next generation of individuals to perform smart grid jobs
	Utility History
	• About 15 years ago, generation, transmission, and distribution got divided into three segments.
	• This created competition. Smaller companies working on renewable energy sources could enter into the market.
	• Smart grid was also added to this system. Smart grid is a response to economic, security, and environmental mandated placed on energy supply and delivery.
	Smart Grid
	• Smart grid is like giving an IP address out to any device like your laptop can access any server in the world.
	• The 2003 blackout impacted 50 million people.
	  ○ Many reports came out as to why we had such a massive blackout.
	  ○ People did not know how to control the system – knew there was a problem but didn't know where it was. More communication was needed.
	• Smart grid came as a means to provide data to control center so system can be controlled much more comprehensively.
	• Consumers can also receive real time rate data. Two-way communication.
	• Smart grid Advantages
	  ○ Users don't use appliances at night (when it's highest), bills are lower.
	  ○ Plus, frees up space on the grid at night – power is more reliable across the network.
	IIT Micro-grid Project
	• Perfect Power – Funded by US DoE. Involves the entire campus.
	• Peak Load Reduction Micro-grid Project – Figuring out how to build micro-grid at different locations with different features. In NV, trying to figure out how to build homes outside of Las Vegas into Smart Homes.
	• Reliability – Switches isolate problem in the loop of energy – more than

	one line to substation. • Energy Efficiency – Building controllers and micro-grid master control allow constant communication for real time pricing. Coordinates what processes can be curtailed to reduce peak load. • Sustainability – Integrates renewable energy sources (such as wind and solar) to disconnect from utility supply for short periods of time. • Ability to Replicate – IIT is like a small town. The micro-grid can be used to design and develop replicas at other locations in any area. • Disconnect from Grid – can isolate university from existing grid if there is a disturbance off of campus that could impact campus. • Reduces base and peak power consumption will reduce university costs about $1 million per year – pays back the cost of the $5 million substation in about five years. **Additional Facts** • Power generation contributes to about 40% of the United States' carbon footprint. • Smart grid can be broken into two topics o New meter technology to communicate two-way o T&D infrastructure with automated devices • Smart grid could slash US carbon footprint by 25%
Smart Grid Education and Training Center Overview	**Today's Objectives** • **G**et your ideas of what is needed for training. • What are the most important areas to address with the most urgency? • What methods are the best, what topics are the best? **Grant Background** • Melissa found grant, called utilities she knew, led her to Mohammed. • She told Mohammed that he had to include veterans, unions, community colleges, k-12 in the consideration of the grant. • Then they worked together to get all partners together. **Training Facts** • There is a critical shortage of engineers and energy workers. • Three levels of training exist o Fundamental (basic and executive level) o Applied (install and maintain) o Advanced (four year or graduate level degree) • Not enough students and engineering faculty in pipeline to support job growth. **Training Process** • Work with stakeholders to identify gaps, then address them. • Initial course was delivered in the fall – *Elements of Smart Grid* • Next course will be taught in the spring – Elements of Renewable Energy
Center for Electricity Innovation	**Smart Grid Training Center** • On the 16th floor of the IIT tower. Hands-on demonstration rooms, smart grid simulators, can look at actual switches and devices of micro-grid. **IIT Wind Energy Consortium** • Look at existing wind generation to get predictive analysis to make it

	more useful/higher performance. • Bought 1.5 MW GE Wind Turbine • Putting two 8 kW wind turbines on campus. **Wind integration and infrastructure planning** • Wind resources are in center of nation, energy demand is on east coast. • Working on planning optimal scenarios using existing transmission infrastructure to optimize how to use it. **Illinois Smart Grid Regional Innovation Cluster** • Bring cluster of companies in smart grid space together to bring new jobs, etc. to this space. • New start-ups in smart grid space – provide resources to help them. Allow opportunity to plug into micro-grid and test out solutions. **Industry R&D Partnerships** • Looking at phasor measurement units, distributed energy resource integration, building energy management systems, demand response. **Community Deployments** • Design and look for opportunities around smart grid perfect power implementation opportunities – help guide development. **DoD Micro-grids Proposal** • Assist with micro-grid technology development and deployments, sustainment training for DoD personnel

Smart Grid Occupational Projections	**Current Grid and Smart Grid**
	• Utility has power grid that they use to deliver energy to homes.
	• Smart grid is laying communications on top of it. Adds some jobs to maintain.
	Components of Smart Grid
	• AMI – get information from meter to utility database.
	• Microwave – IP communications.
	• IT Applications "Hand-Off."
	• Substation & Distribution Comms – can control equipment that utilities have in place right now.
	• Micro-grid – giving more intelligence to systems to isolate the outage.
	• HAN and EMS.
	Smart Grid Federal Grants
	• Total of $3.4 billion.
	  ○ 41% goes to building meters and actual grid.
	  ○ 27% indirect supply chain (components).
	  ○ 17% direct new hires (maintain new meter devices).
	Five trends of adding job potential
	• Energy Efficiency – driven by time-of-use or real time pricing, send different pricing signals to end user.
	• Transforming the Utility Industry – telecomm/IT technical job to read meters.
	• Distributed generation manufacturers – controlling energy coming back from consumers.
	• Telecomm and IT jobs for networking.
	• Higher education and advanced training personnel.
	• **How does smart grid feed into jobs outside of utilities?**

	• Putting in smart grid is the foundation to job creation.
	• Then start training
	  ○ White collar jobs to understand and promote strong business cases.
	  ○ Create business pod software for on-site energy savings calculations.
	  ○ Real time or time of use signal to homes and business, distributed renewable generation, micro-grid development provides benefits.
	  ○ We now have smart grid functionality – home energy management job creation, commercial & industrial load management job creation.
	Where are we today?
	• Development is underway (ARRA grants), we are preparing to train on this.
	What to expect in the utility industry
	• We believe Google will be an energy company in the future because of using mobile devices to power appliances.
	• IBM, Intel, Microsoft as well.

Smart Grid Occupational Projections	**Occupational projections** • Each qtr. every state collects info from employers (employment numbers, wage data, etc.). • From database – have employer contact information and job information. • Can give % of occupation breakdown per number of employees/people (i.e., 4.8% of these people will be accountants) **Uncertainty** • A lot of uncertainty on how fast smart grid industry can develop. • Determined a lot on how was federal government invests in smart grid. • If you're making projections, you're probably going to be conservative in making projections. • 280,000 projected jobs related to smart grid – be careful about finding out source of data and if source is credible (not sure how number was created). **Handout** • Numbers in handout – numbers for these occupations for economy as a whole – not just for smart grid. • Wage data survey – pretty accurate. Sent directly to employers, employers have motivation to accurately fill out (data to find out what competitors are paying). **Job Classifications** • Change to jobs in electric power generation industry – Hydroelectric, Fossil Fuel, Nuclear, Other. Starting next year – Solar, Wind, Geothermal, etc. adding these to classifications. • Occupational coding – additions to SOC code dictionary come slow. Estimations only done for occupations with SOC codes. • Some occupations you may be interested in will likely be grouped into other SOC codes, or all other category.

Returning Veterans and Unemployment	• Left command a year ago – largest geographical command in the reserve (54% of people fighting the fight right now are reserves). It's now an operational reserve. • Smart grid is a national security issue. What happens when most of our veterans come back and don't have a job? • Does America understand that we are running our military at a very high speed? • A lot of federal agencies do not respond quickly enough for the needs of veterans (RFQs, RFPs). • If we don't find ways to generate new jobs, we're in trouble. • We need to tie MOSs to veterans. President might mandate in 2011 that in RFPs and RFQs, going to have to find a way to hire veterans.
Energy Security for Military	• Provides federal consulting mostly for the federal government. • IIT is a great location to organize a community effort to work with fellow Americans. • All federal agencies are under very strict mandates to become more energy efficient and more sustainable to renewable energy. We can't afford for this to just come from federal funding. • We need private sector designing, private sector building, funding. Partnership opportunities are there. • In this room, we all have different interests, but all have same drivers. Training for veterans, equipping veterans. • VA and DoD likes the community approach like what we're doing with the IIT.
Remarks on IBEW and Smart Grid	• The last thing a veteran wants to do is go through a two year education when coming back from duty. • We need continuing education while on duty. • The problem is knowing where jobs are at. Veterans need maps to get to jobs.

5.5 Appendix E: Roundtable Discussion – Smart Grid Education Delivery Strategies for K-12 and Community Colleges Invitee List

Aarti V Dhupelia, CPS
Al Brown, CPS
Allessandra Cair, IGEN
Alonzo Hoskins, CPS
Arabella Perez, CPS
Baxter Gamble, CPS
Carolyn Olsen Smarz , CPS
Chad Solomon, CPS
Chris Banakis, CPS
Chuck Schroeck, CPS
Dace, Jacquelyn, CPS
Dan Schnitzer, Academy for Global Citizenship
Dan Swinney, Center for Labor and Community Research
David Robbins, CPS
Dr. Joenile Albert-Reese, CPS
Edward Kang, CPS
Erica Cahill, CPS
Jan Dudzik, CPS
Janice Coleman-Mathus, CPS
Jerry Weber, College of Lake County
John Loehr, CPS
Johnnie Turner, CPS
Joyce Kenner, CPS
Julian Hilmara, CPS
Karoline Sharp, CPS
Katrina Sivels, CPS
Kim Harrell, CPS
Lawrence Bass, CPS
Leith Sharp, College of Lake County
Lolita Hardiman, CPS
Mae Jefferson, CPS
Marcia Lochman, Lewis & Clark
Margo De Ley, CPS
Maria Pfister, CPS
Mary Cummane, Perspectives Charter School
Maudie Walls, CPS
Melvin Slater, CPS
Mike Williams, CPS
P. Lewis, CPS
Paul Kash, CPS
Pete Schoedel, CPS
Pete Zimmerman, CPS
Peter Vitale, Academy for Global Citizenship

Phyllis Kuziel-Perri, CPS
Ray Prendergast, CPS
Rhonda Patterson, CPS
Richard Moore, CPS
Rick Mills, CPS
Robert Sokol, CPS
Ryan Neris, CPS
Sakinah Kushmir, EnergyNet
Sarah Ippel, CPS
Sheryl Cheatom, CPS
Suzanne Carlson, CPS
Taheria Brown, CPS
Tammy Butler , CPS
Todd Katz, CPS
Tom O'brien, CPS
Valerie Hardy, CPS
Veronica Martinez, CPS
Virgilio Santos, CPS

5.6 Appendix F: Roundtable Discussion – Smart Grid Education Delivery Strategies for K-12 and Community Colleges Meeting Minutes

Topic	Notes

Smart Grid Education & Training	• Found the grant opportunity and referred to professor to assist with center development
	• The need for SG
	  ○ Ability to improve outage management
	  ○ Economic benefits
	  ○ Government mandates
	  ○ Incentives to adjust behavior
	• IIT's DoE Proposal
	  ○ Identified all of the stakeholders -- this is what differentiated the IIT proposal
	• Target Audience (Partners)
	  ○ CC
	  ○ Labor Unions
	  ○ CPS
	  ○ Military
	  ○ End User
	  ○ Corp Employees
	• Proposal Partners
	  ○ State of Illinois
	  ○ Argonne
	  ○ Exelon
	  ○ Corp (Siemens, Johnson Controls, GE, S&C Electric)
	  ○ Helmets to Hardhats
	  ○ Student Vets
	• Future Center Offerings
	  ○ *Fundamental*: SG basics
	  ○ *Applied*: IT, engineering techs
	  ○ *Advanced*: Engineering degree programs
	• Illinois workforce Data
	  ○ 10.4% overall unemployment
	  ○ KEMA/GridWise Alliance investment of 280,000 jobs
	  ○ Concern with not enough engineering students
	• Next steps in the process
	  ○ Issue with identifying the recipients of the other grants -- in process of identifying the principal investigator for each grant

Galvin Center for Electricity Innovation	• The purpose of the presentation is to present how IIT is developing into a living laboratory
	• Smart Grid
	  ○ Brought system wide change in how we generate, distribute, and consume electricity
	• IIT Projects Overview
	  ○ Perfect Power Initiative
	  ▪ Smart switches installed to re-route power
	  ▪ Loss of power was approx $500k / year
	  ▪ On-site renewable generation (wind farm, solar panels)
	  ▪ Energy storage

	○ Electric vehicle charging stations (Level 2 and Level 3 charging stations) ○ Center for demonstration, experiments, classrooms, etc. ○ Wind energy consortium ○ Wind integration and infrastructure planning research ▪ The challenge is how to generate energy from wind in the plain states to the east coast efficiently for distribution) ○ Industry R&D Partnerships ○ Smart grid regional innovation center (smartgridcluster.com)
Smart Grid Occupational Projections	• Overview of the Smart Grid ○ AMI Infrastructure build-out ○ Microwave -- communications (2-way) ○ IT Apps -- Ability to provide information back to the consumer ○ Substation & Distribution Automation ○ Micro-grid development ○ 2-way voice & Data -- dispatch ○ Home -- pre-pay meters, etc. • DoE Funding Careers & Jobs ○ 3.4B investment ○ 280k new jobs and 50% permanent • Projected breakdowns: ○ Utility suppliers ○ Indirect supply chain • Overview of trends in the Industry for Job Potential ○ Time of Use Rates ○ Changing Job Functions in the Utility ○ Distribution Generation Manufacturers for end-use markets ○ Telecom & IT jobs ○ Higher Education & Advanced SG Training • IIT Smart Grid Skills Requirements ○ SG Technology ○ SG System & Communications ○ SG Customer Management ○ SG Organizational Management
CPS Environmental Action Plan	• CPS Environmental Action Plan ○ Transportation / Air – e.g., Anti-idling enforcement ○ Green cleaning act -- Only green products in schools ○ Energy Management -- Energy management system, Siemens energy data review, energy star rating compared to nation-wide, 100k shutdown ○ Energy renewables -- Solar installation and demonstration, top K-12 purchaser in the US (www.illinoissolarschools.org) ○ Recycling ○ Waste composting -- hands on waste composted ○ Engagement: ▪ Green teams ▪ Waste Audit for schools ▪ Earth Hour ▪ Earth Day activities ▪ www.cps.edu/gogreen (school environmental scorecard)
IGEN Overview	• Began with 4, and today have 12 members

	• IGEN is Fully funded through state / federal funding
	• Focused on greening the campus, curriculum, and providing training
	• Waves of innovation
	  ○ Important that Illinois get on board with the waves of innovation
	  ○ We are in the 6th wave -- new wave of information and CC need to provide education and training
	• Green economy
	  ○ Green jobs nationally are growing
	  ○ Understanding the green workforce training needs
	  ○ Retrain existing occupations
	• 39 Illinois CC signed the governor's commitment to green jobs
	• 48 CC --> 1M --> 650k enrolled in certificate programs
	• Illinois CC network is the 3rd largest in the nation
	• Overview of green programs
	  ○ Inventory by curriculum topics
	  ○ Igencc.org

5.7 Appendix G: Survey I Questions

ILLINOIS INSTITUTE OF TECHNOLOGY

IIT SMART GRID EDUCATION & WORKFORCE TRAINING CENTER SURVEY

Required Question(s)

1. How many employees work at your organization? If more than 1,000, please specify in the "other" box:

- Less than 25
- 25-100
- 101-500
- 501-1000
- Other

2. Which category best describes your organization type?

- Consulting
- Manufacturing/ Distribution
- Training
- Utility
- Installation/ Maintenance/ Service
- Building Owner/ Management
- Other

3. In what geographic region does your company operate? (select all that apply)

- Illinois
- Midwest
- South East
- North East
- South West
- North West
- West Coast
- Multi-national
- Other

4. **Rate your organization's level of activity with the following Smart Grid Meters/AMI/MDMS products/services:**

	Not Active	Not Very Active	Somewhat Active	Active	Very Active
Smart Meters	○	○	○	○	○
Communications	○	○	○	○	○
Meter Data Management	○	○	○	○	○

Comment:

500 characters left.

5. **Rate your organization's level of activity with the following Smart Grid Demand/Response products/services:**

	Not Active	Not Very Active	Somewhat Active	Active	Very Active
Curtailment Service Providers	○	○	○	○	○
Technology Enablers	○	○	○	○	○

Comment:

500 characters left.

6. **Rate your organization's level of activity with the following Smart Grid Distribution Grid Management products/services:**

	Not Active	Not Very Active	Somewhat Active	Active	Very Active
Feeder Distribution Automation	○	○	○	○	○
Substation Automation	○	○	○	○	○

Distribution Management System (DMS) Software					

Comment:

500 characters left.

7. Rate your organization's level of activity with the following Smart Grid Equipment Installation/Maintenance products/services:

	Not Active	Not Very Active	Somewhat Active	Active	Very Active
General Contracting					
Subcontracting					

8. Rate your organization's level of activity with the following Smart Grid products/services:

	Not Active	Not Very Active	Somewhat Active	Active	Very Active
Control Systems (SCADA/DMS)					
Grid Interconnect					
Home Energy Management					
Building Energy Management					
Utility					
Other (please specify in comment box below)					

Comment:

500 characters left.

9.

How much growth does your company expect to see in your Smart Grid products/services over the next 3 to 5 years?

- No Growth
- 1 to 10%
- 10 to 20%
- 20 to 35%
- 35 to 50%
- 50 to 75%
- 75 to 100%
- More than 100%
- Other

*** 10.**

How many new or replacement Smart Grid workers does your company expect to need over the next 3 to 5 years? If over 1000, please specify in the "other" box.

- 0
- 1 to 5
- 5 to 10
- 10 to 20
- 20 to 50
- 50 to 100
- 100 to 200
- 200 to 500
- 500 to 1000
- over 1000
- Other

11.

According to your hiring projections, how many of the following positions do you anticipate will be filled/created in the next 3 to 5 years?

	None	1-10	11-50	51-100	More than 100
Replacement of existing jobs due to aging workforce					
Energy management solutions for Commercial & Industrial customers					
Home Area Network (HAN) sales and installations					
Conservation Voltage Reduction (CVR) contracts/services					

Renewable solutions installation (solar, wind, geothermal, etc.)					
Renewable solutions production (solar, wind, geothermal, etc.)					
Other (please specify in the comment box below)					

Comment:

500 characters left.

12. **According to your growth projections, how likely are you to apply the following staff augmentation and training planning activities?**

	Not Very Likely	Not Likely	Neutral	Likely	Very Likely
Re-training existing staff					
Recruiting new employees					
Training new employees					
Providing training for customers					
Providing training for consumers/end users					

13. **In planning for worker, customer and end user training, how likely are you to use the following to develop and roll out training curriculum?**

	Not Likely	Not Very Likely	Somewhat Likely	Likely	Very Likely
Development and delivery entirely through "in-house" training dept.					
Develop training with outside consultants but deliver "in-house"					
Deliver training through outside organizations					
Have outside oranizations deliver training on your premises					
Utilize registered apprenticeship programs					
No formal training other than "on the job"					
Other (please specify in comment box below)					

Comment:

500 characters left.

14.

Rate the effectiveness of the following training formats for your employees, customers or consumers:

	Very Ineffective	Somewhat Ineffective	Neutral	Somewhat Effective	Very Effective
Executive level short courses	○	○	○	○	○
A Smart Grid registered apprenticeship	○	○	○	○	○
Technical Smart Grid certificate courses offered through Community Colleges	○	○	○	○	○
Associate Degrees offered through Community Colleges	○	○	○	○	○
Continuing Education Credits offered through seminars	○	○	○	○	○
Undergraduate degrees offered through a university	○	○	○	○	○
Graduate level certificate programs offered through a university	○	○	○	○	○
Graduate degrees offered through a university	○	○	○	○	○
Other (please specify in the comment box below)	○	○	○	○	○

Comment:

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15.

Rank, in order of importance, the following features of any proposed training program.

(1 = Least Important)

- Online delivery
- State recognized certification
- Combination of on-line and instructor-led
- Hands-on experiential learning
- Quality of materials provided
- Location of training delivery
- Continuing education credits
- Instructor-led delivery (at an off-site location)
- Instructor-led delivery (at your location)

Comment:

500 characters left.

16. If using outside training providers, which of the following pricing formats would be best for your company?

	Much Less Interested	Somewhat Less Interested	Neutral	Somewhat More Interested	Much More Interested
Group/employee discounts from outside provider					
Corporate "membership" plan with unlimited training for 1 price					
Individual price per participant, per course					
No set plan other than recommendation of availability					

Comment:

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17. **What are the most critical features for training programs for your company's Smart Grid workforce, customers or consumers?**

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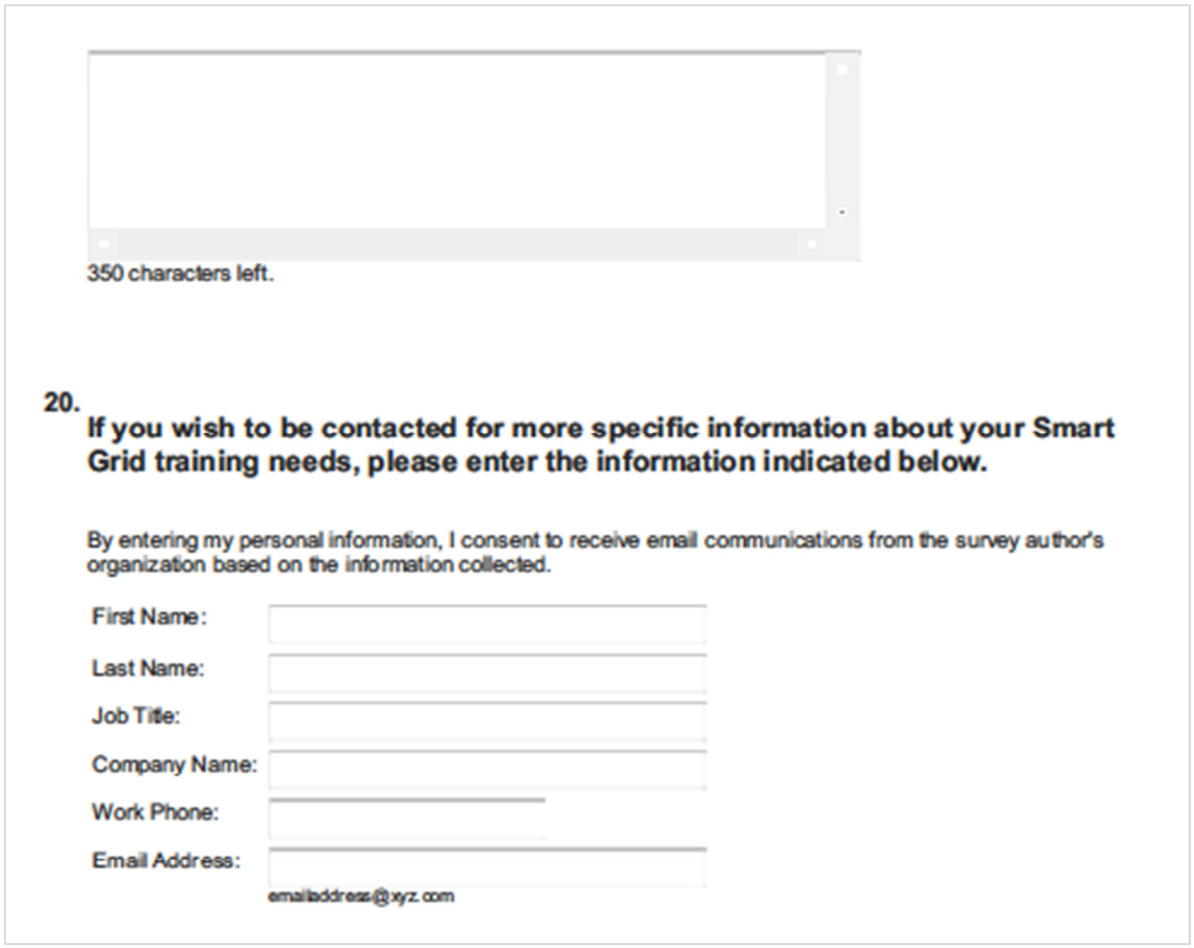
18. **What is the average per employee value you place on Smart Grid related training for your workforce?**

- Less than $500
- $500 to $1000
- $1000 to $1500
- $1500 to $2000
- $2000 to $3000
- More than $3000

19. **Please provide any additional comments you have about your projected training needs.**



350 characters left.

20. If you wish to be contacted for more specific information about your Smart Grid training needs, please enter the information indicated below.

By entering my personal information, I consent to receive email communications from the survey author's organization based on the information collected.

First Name:

Last Name:

Job Title:

Company Name:

Work Phone:

Email Address:

emailaddress@xyz.com

5.8 Appendix H: Standardized Smart Grid Training Needs Interview Guide

IIT Smart Grid Workforce Training Center
Interview Guide
February 8, 2011

Introduction

Hi, my name is _____, and I'm working with the Illinois Institute of Technology to develop a world class Smart Grid Education and Workforce Training Center. Our records indicate that you scheduled a brief 30 minute interview for this time. Does this time still work with your schedule?

Great, thanks so much for meeting with me today. The purpose of this interview is to gather information so that we can better gauge your organization's smart grid training needs. This will ultimately help us develop and train your workforce to meet the global challenges in smart grid, energy independence, clean tech and sustainable energy.

Please answer my questions from the perspective of your organization. Your responses are anonymous, so please feel free to be candid. Only aggregate information will be used in our findings. For example, we might say that 80% of those interviewed predict 10% growth in smart grid services in the next five years.

Do you have any questions before we begin?

Demographics

First, I just have a few questions about your organization.

1. How many employees work at your organization (all locations)?

2. What type of organization is yours (manufacturing, utility, installation, etc.)? What products do you make or services do you provide?

3. Where is your central operations located (main office)?

4. Where are you, yourself, located (if not central operations)?

General

5. *Outreach* – How do you get your industry information? From mangers? Trade publications? Corporate communications?
    a. How do you educate yourself on smart grid?

Job Classifications and Skills

Now I'm going to ask about some current positions you feel will require smart grid training.

6. *Current job classifications* – What are some current jobs that you foresee will work with smart grid technologies in the future? (Which positions will need to receive smart grid training?) And could you please describe at a high level what these jobs do today?

7. *Current employee skills* – What skills do these positions require that will be instrumental in working with smart grid technologies?

8. *Future employee skills* – What additional skills do you foresee these positions needing to work with smart grid technologies?

9. *Future job classifications* – What new jobs do you foresee your organization creating to work with smart grid technologies?

Training

I'd like to get a better feel for the training you receive today and gain some insight that will help shape our training.

10. *Current training needs* – For the current jobs you previously mentioned, how do they receive training today?
    a. Provider
    b. Format
    c. Location
    d. Pricing

11. *Current training needs* – What's the greatest advantage about how these employees currently get trained?

12. *Current training needs* – What is one thing you would change about how these employees currently get trained?

13. *Training program requirements* – What are your long-term training needs that aren't being fulfilled today?

14. *Future training needs/Gaps in training needs* – What additional training is necessary to prepare these employees for smart grid technologies?
    a. What do you want employees to know about smart grid when they walk through your door?
    b. Would a smart grid certificate be helpful for your organization?

15. *Training program requirements* – How can our smart grid workforce training center assist you in the aging workforce challenge?

Short Courses

Are you familiar with short courses? A short course is a two to three day course that focuses on a concentrated subject.

16. *Audience* – Who in your organization typically attends short courses?

17. *Audience* – Who in your organization approves short courses?

18. *Short Course Selection* – I'm going to list some ideas of short courses, and I'd like you to tell me which ones you think would be the most valuable to your organization on a scale of 1 to 5 (1 being completely not valuable and 5 being extremely valuable):
    a. Overview
        i. Tailor to the audience (e.g., SG for attorneys, SG for policymakers, SG for manufacturing executives)
    b. Utility Business Case
    c. Regulatory
    d. Community Outreach
    e. Cyber Security
    f. Renewables Integration
    g. Consumer Business Case
    h. Anything else you can think of?

19. *Audience* – In the next 12 months, how many people from your organization might attend these short courses? (This is just an estimate, we will not hold you to it).

Do you have any questions from me or information that you feel valuable that I did not touch upon?

For first few interviews – Do you have any recommendations for how I might be able to better conduct this interview? Would it have been helpful for you to review the questions prior to our conversation?

Thank you very much for your time and willingness to participate in helping to build a world class Smart Grid Workforce Education and Training Center. If I have any follow-up questions for you, is it OK for me to call you back directly?

From here, we are going to gather the data from all of the interviews and form some conclusions. We'll circle back and share these conclusions with you when they are ready.

Also, we are looking to develop a second survey to get more detailed and quantitative information on skill and training needs. You should receive this second survey in a few weeks. Thank you in advance for your consideration in filling it out. Thanks again, and have a great day.

5.9 Appendix I: Standardized Validation Interview Guide

IIT Smart Grid Workforce Training Center
Interview Guide for Job Classifications and Skill Deficiencies Validation
March 4, 2011

Introduction

Hi, my name is _____, and I'm working with the Illinois Institute of Technology to develop a world class smart grid Education and Workforce Training Center. Our records indicate that you scheduled a brief 30 minute interview for this time. Does this time still work with your schedule?

Great, thanks so much for meeting with me today. The purpose of this interview is to gather information so that we can better gauge the industry's smart grid training needs. This will ultimately help us develop and train your workforce to meet the global challenges in smart grid, energy independence, clean tech and sustainable energy.

We expect to have an interactive dialogue today so please respond candidly from the perspective of your organization and role. We would like to cite your company as a source of information for this survey.

Do you have any questions before we begin?

Demographics

First, I just have a few questions about your organization.

20. Name
21. Title (Level)
22. Department
23. Phone Number (Confirm Correct)
24. Email (for survey)

25. Where is your central operations located (main office)?

26. Where are you, yourself, located (if not central operations)?

27. Total Employees in organization

General

28. *Outreach* – How do you get your industry information? From mangers? Trade publications? Corporate communications?
    a. How do you educate yourself on smart grid?

29. Have you or your organization developed a procedure for training your current and future workforce in smart-grid technologies, impacts, and issues?

Job Classifications

Now we will get into the details of our interview. I would like your feedback on this working draft of **jobs most likely impacted** by smart grid expansion in U.S. Please examine this spreadsheet with me. We have listed current SOC job classifications on the left side of this matrix. The DoE actually generated a list of over 90 job classifications across a number of industries. Our own research has added a few more critical jobs and has also divided the jobs into three categories: those which will see major impact from smart grid applications; those which will see moderate change, and those which will see minor change.

In each of these three categories we have further organized the jobs into a typical business structure as well as including functional expert categories. So, in examining these jobs:

1. **Do we have the right jobs identified?**
2. **Have we prioritized these appropriately?**

(Engage in dialogue, ask questions, explain rationale for major/moderate/minor rankings, get feedback)

1. Orient the interviewee to the overall grouping (most impact, moderate impact, minor impact) and inform them we will be asking them to agree or disagree with our placement of particular jobs and the consequent smart grid impact on that job
- Starting with the Organizational Classifications, get the interviewee to agree or disagree with these jobs being the most impacted.
- Note any suggested additions, deletions, or modifications to the underlying jobs in each Classification;
- Continue with the Functional Expert Classifications, again getting the interviewee to agree or disagree with these jobs being the most impacted.

2. After reviewing the “most impacted” category, move down the matrix and repeat the process for the “moderate” category.
- Starting with the Organizational Classifications, get the interviewee to agree or disagree with these jobs being moderately impacted.
- Note any suggested additions, deletions, or modifications to the underlying jobs in each Classification;
- Continue with the Functional Expert Classifications, again getting the interviewee to agree or disagree with these jobs being moderately impacted.

3. Finally, move to the third category, minor impact, and briefly repeat the process
- Starting with the Organizational Classifications, get the interviewee to agree or disagree with these jobs being the least impacted.
- Note any suggested additions, deletions, or modifications to the underlying jobs in each Classification;

- Continue with the Functional Expert Classifications, again getting the interviewee to agree or disagree with these jobs being the least impacted.

4. Get any final input from the interviewee regarding their own workforce training priorities; this leads into a discussion of the suggested skills deficiencies or training categories

Job Deficiencies

Now I would like to turn to the top row of our matrix, where we have listed potential job skills deficiencies. These skills were derived from a variety of sources and represent our current best approach at capturing smart-grid training requirements. While we feel all employees affected by smart-grid will likely need some level of exposure and awareness, the skills listed are those **most likely required** by people in the major and moderate categories of job impact.

Please examine this list with me and let me quickly review each category. (Engage in explanation and toggle back and forth between detailed and summarized views if needed)

In examining these potential deficiencies/skills needed I would like to get feedback in two areas:

1. **Have we captured the right deficiencies?**
2. **Do you have other suggestions or ideas for further training?**

(Engage in dialogue, ask questions, get feedback)

1. Review each category and get the interviewee to agree or disagree that these are the right set of overall training categories.
2. Ask interviewee for feedback on the importance of each category for their organization (high, medium, low)
3. Note interviewee suggestions, modifications, or clarifications in each category.
4. Note additional categories or suggestions for other skills deficiencies.

Do you have any questions from me or information that you feel valuable that I did not touch upon?

Thank you very much for your time and willingness to participate in helping to build a world class smart grid Workforce Education and Training Center. If I have any follow-up questions for you, is it OK for me to call you back directly?

From here, we are going to gather the data from other research and interviews and form some conclusions. We'll circle back and share these conclusions with you when they are ready.

Also, we are looking to develop a second survey to get more detailed and quantitative information on skill and training needs. You should receive this second survey in a few weeks. Thank you in advance for your consideration in filling it out. Thanks again, and have a great day.