2010

Retrofitting the Workforce: Report #3

Smart Energy Technologies

TEXAS FOUNDATION FOR INNOVATIVE COMMUNITIES

Good Company Associates

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This report is designed to offer useful information to Texas' workforce investment boards and community colleges about the availability and potential of green jobs in the smart energy technology industry in Texas as well as to provide details on the workforce training needs of employees in the industry.

Thanks to all members of the Green Jobs Business Council and the Green Corridor Consortium for their participation and interest in this topic. Particular thanks to all those who gave time and expertise to contribute to the report, including:

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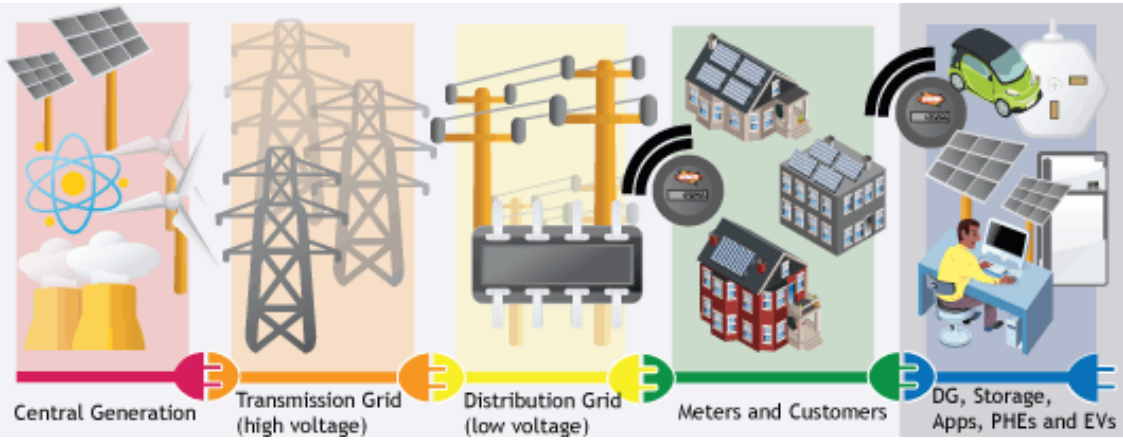
EXECUTIVE SUMMARY

Many definitions of "Smart Grid" and "Smart Energy" are used in the marketplace today. This paper does not presume to resolve the debate over terminology; rather it recognizes that there are unique workforce training requirements for those who will be involved in the design, installation, and service of the "Smart Energy" devices and technologies that can be used by consumers to interact with the grid and effectively manage their energy use once a "Smart Grid" infrastructure has been deployed. Some holistic definitions of Smart Grid encompass these intelligent "behind-the-meter" consumer devices and technologies as well, but we have chosen to address them—and their associated occupational requirements and training needs—separately in this paper as "Smart Energy Technologies."

For those unfamiliar with electric grids and consumer energy devices, the following figure from Austin Energy provides some useful background.[1] In the context of this paper, "Smart Grid" improvements pertain to the modernization of the high-voltage transmission grid and the low-voltage distribution grid depicted in the second and third panels below. "Smart Energy Technologies" include the behind-the-meter consumer devices and technologies shown in the fourth and fifth panels below that help consumers effectively manage their energy use. Examples include building automation systems (BAS), "smart" thermostats, in-home energy management displays, home area networks (HAN) for energy management, grid-friendly appliances, and certain resources that enable demand response.



For those who would like to read more about Smart Grid, please see the "Technology Overview" section of this paper. Additionally, an excellent introductory paper and some supplemental papers have been sponsored and published by the U.S. Department of Energy's Office of Electricity Delivery and Energy Reliability. The documents are available online at www.smartgrid.gov/books.[2]

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[1] From: http://www.austinenergy.com/About%20Us/Company%20Profile/smartGrid/index.htm.

[2] For example, the introductory paper explains that: "In the short term, a smarter grid will function more efficiently, enabling it to deliver the level of service we've come to expect more affordably in an era of rising costs, while also offering considerable societal benefits – such as less impact on our environment…Longer term, expect the Smart Grid to spur the kind of transformation that the internet has already brought to the way we live, work, play and learn."

As of April 2010, more than 1.1 million smart meters have been installed in the Oncor and CenterPoint Energy service areas in the Dallas/Ft. Worth and Houston areas respectively. Over the next few years more than 6.3 million smart meters will be installed in Texas' competitive retail electric markets.[3] Deployments are also active at Austin Energy, CPS Energy, and some of the state's electric cooperatives. In the next 2 years, well over half of the 5+ million customers in Central Texas will have a smart meter.

Once an advanced meter has been installed on a home, building, or facility (or once another form of two-way communication has been established), then a Smart Energy Technology can be installed. According to a report by the Edison Electric Institute, approximately half of the U.S. population will have an advanced meter by 2020,[4] and thereby **be** eligible for a Smart Energy Technology. Therefore, the potential size of this market, as well as the workforce needed to support it, could be massive.

There is very little data that can be used to generate reliable forecasts for Smart Energy industry employment needs. However, according to a study by the consulting firm KEMA, Smart Grid deployment is expected to generate over 280,000 jobs over the next four years.[5] The Apollo Alliance projected that a $2 billion federal investment in Smart Grid over 10 years could create 441,000 jobs[6] (and federal Stimulus spending on Smart Grid now exceeds $4 billion).

There are also several existing Smart Energy projects in Texas which may provide indicators of what is to come in the mass market. For example, our review of three vendors within the residential Smart Energy space that are launching pilot programs this summer in Central Texas found that:

1. The bulk of the training required has been focused on installation and service personnel (two of the three companies are using HVAC professionals while the third will use electricians primarily because this company will be installing technology on high-voltage lines).
2. Customer service personnel have required training on how the technology will affect the consumer.
3. Project management personnel have been trained on the technology and program needs on an ad hoc basis. Consequently, the projects have been run in a relatively inefficient manner due to the steep learning curves that the management teams have faced.
4. The majority of the marketing jobs for these programs were sourced outside the State of Texas.
5. All manufacturing was sourced outside the State of Texas.

In general, most Smart Energy workers and employers will come from existing industries and require enhanced skill training. Key occupations in the Smart Energy industry include engineers, product developers, system integrators, HVAC professionals, electricians, customer service representatives, assemblers, technicians, project managers, facility service managers, other maintenance/repair workers, sales and marketing professionals, as well as associated management and administrative staff.

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[3] From www.puc.state.tx.us/nrelease/2010/043010.pdf. Oncor will be installing approximately 3 million meters, while CenterPoint Energy will be installing approximately 2.2 million meters.
[4] www.eei.org/whatwedo/PublicPolicyAdvocacy/TFB%20Documents/100312OwensOstpSmartGrid.pdf.
[5] www.kema.com/services/consulting/utility-future/job-report.aspx.
[6] apolloalliance.org/downloads/resources_ApolloReport_022404_122748.pdf.

Because the Smart Energy industry is in its infancy, existing certifications and training programs do not yet adhere to broadly accepted best practices. Actually, much of the training for the emerging Smart Energy industry has come from other related industries from which technologies and or services have grown into the energy space, such as digital home technology integration. There are a variety of certifications in the market today pertaining to the installation and service of digital technologies in homes and buildings such as home theatre, automation, and security systems.

In 2006, the Electronic Systems Professional Alliance (ESPA) was formed from prominent consumer electronics associations to develop a universal education and certification program to serve as a gateway for new professionals entering the workforce. The baseline certification, Electronic Systems Technician (EST), is that gateway.[7] In 2006 Texas State Technical College–Waco launched a leading edge training and certification program aimed at the rapidly growing field of "home technology integration." Home technology integration encompasses a variety of analog and digital technologies throughout the home including elements of home control, communications, entertainment, security, health monitoring, and energy management.

A summary of the leading Digital Technology Integration certifications can be found in the table below.

Digital Technology Integration Certifications

Organization	Name of Certification	Offered by Texas Community College?
Texas State Technical College-Waco	Home Technology Integration Certificate or Specialization	Yes
Electronic Systems Professional Alliance (ESPA)	Electronic Systems Technician (EST)	No
Custom Electronic Design & Installation Association (CEDIA)	Numerous certifications pertaining to residential home theater, audio, video, and electronic systems, including an Advanced EST Certification and a Designer Certification	No
Consumer Electronics Association (CEA) and Computing Technology Industry Association (CompTIA)	Digital Home Technology Integrator (DHTI+)	No
National Systems Contractors Association (NSCA)	Electronic Systems Technician-L2 (EST-L2)	No
Electronics Technicians Association (ETA)	Numerous certifications including Residential Electronics Systems Integrator (RESI) and Associate Electronics Technician (CETa)	No

In addition to digital home integration skills, there are also types of Smart Energy products and services that require skills found in the licensed electrician and HVAC professions, such as the handling of high-voltage wires. Both professions are currently licensed by the Texas Department of Licensing and Regulation so some reasonable boundaries will need to be established as the industry grows.

[7] Additional information available at: www.espa.org/Technicians/Certification-Exam-Info.aspx.

To effectively serve consumers in the Smart Energy industry, workers will need to be able to offer comprehensive services. For example, an air conditioning contractor will need to be able to service the electronics in the digital thermostat that controls the air conditioner as well as the air conditioner itself, and the customer service representative at the local utility will need enhanced skills to accurately diagnose problems within a home or building and dispatch the appropriate technician. There are broad workforce needs in this industry, the training and cross-training of which represent both challenges and opportunities.

Other major findings and recommendations in this report include:

- Texas community colleges should incorporate Smart Energy concepts into existing trainings for HVAC professionals, electricians, building trades, digital home integrators, and other relevant occupations. TSTC's existing home integration offerings should be leveraged as appropriate.
- Texas community colleges should work with local employers to pursue Skills Development Funds for enhanced skill trainings in Smart Grid and Smart Energy. Courses could be timed so that they are not held at inconvenient times for industry professionals.
- Texas community colleges should ensure that the latest technologies and devices are available in the classrooms and teaching materials.
- The utilities in the Green Corridor Consortium (i.e., Austin Energy, CPS Energy, Pedernales Electric Cooperative, Oncor) could consider forming a working group to discuss how skills developed under individual Smart Grid and Smart Energy initiatives could be portable throughout the state. Other relevant utilities and entities could obviously be included as well.
- Texas community colleges should develop relationships with entities that are either developing Smart Grid/Smart Energy trainings or have received significant federal funds to do so. This includes the Pecan Street Project, CenterPoint, and community colleges in other states.
- Texas community colleges should develop a relationship with the Electronic Systems Professional Alliance (ESPA). ESPA is working with experts across the country to develop the turnkey materials needed to offer the ESPA Certified Electronic Systems Technician (EST) curriculum and industry recognized credential in 2010.
- Texas community colleges could install Smart Energy Technologies, such as Building Automation Systems and Smart Thermostats, in campus buildings to be used as demonstration sites and teaching aides.
- Texas workforce investment boards and community colleges should work with chambers of commerce and other economic development stakeholders to develop strategies to attract Smart Energy Technology product developers and manufacturers to Texas.
- The Green Corridor Collaborative should work with other relevant stakeholders to aggressively pursue federal funds that will be made available for Smart Grid and Smart Energy.

The complete report follows.

TECHNOLOGY OVERVIEW

DEFINITION OF SMART GRID

The following explanation from www.smartgrid.gov/basics provides a good starting point for our definition of a Smart Grid:

> "An electrical grid is a network of technologies that delivers electricity from power plants to consumers in their homes and offices. A smarter grid is different in a few important ways. First, it uses information technologies to improve how electricity travels from power plants to consumers. Second, it allows those consumers to interact with the grid. Third, it integrates new and improved technologies into the operation of the grid. A smarter grid will enable many benefits, including improved response to power demand, more intelligent management of outages, better integration of renewable forms of energy, and the storage of electricity."[8]

This definition, as well as numerous others (including the one used by Austin Energy[9]), recognizes a difference between: a) the "smart" transmission and distribution infrastructure that delivers electrons more efficiently from power plants to consumers, and b) the "smart" devices that can subsequently be used by consumers to interact with the Grid and effectively manage their energy use (i.e., "Smart Energy Technologies"). Since there are substantive differences in the workforce training requirements for those who design, install, and service the "smart" infrastructure versus those who design, install, and service the "smart" technologies attached to that infrastructure, we will make the same distinction in this paper so that we can focus on the latter.

Therefore, in the context of this paper, the term "Smart Grid" refers to all of the improvements being made to modernize the nation's electric transmission and distribution infrastructure (i.e., the "Grid") —up to, and including, the electrical meter on a customer's home, building or facility. Examples of Smart Grid improvements include advanced meters, transformer monitors, phasor measurement units (PMUs), dynamic line rating technologies, advanced visualization systems, superconducting wire, and other hardware and software improvements that result in improved prevention of outages, identification of impending faults, and effective transmission and distribution of electricity, among other benefits.[10]

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[8] Many other useful resources are also available at: www.smartgrid.gov.

[9] Per www.austinenergy.com/About%20Us/Company%20Profile/smartGrid/index.htm: "A Smart Grid is the seamless integration of many parts: an electric grid; a communications network; and hardware and software to monitor, control, and manage the creation, distribution, storage, and consumption of energy. The Smart Grid of the future will be distributed, interactive, self-healing, and capable of reaching every device."

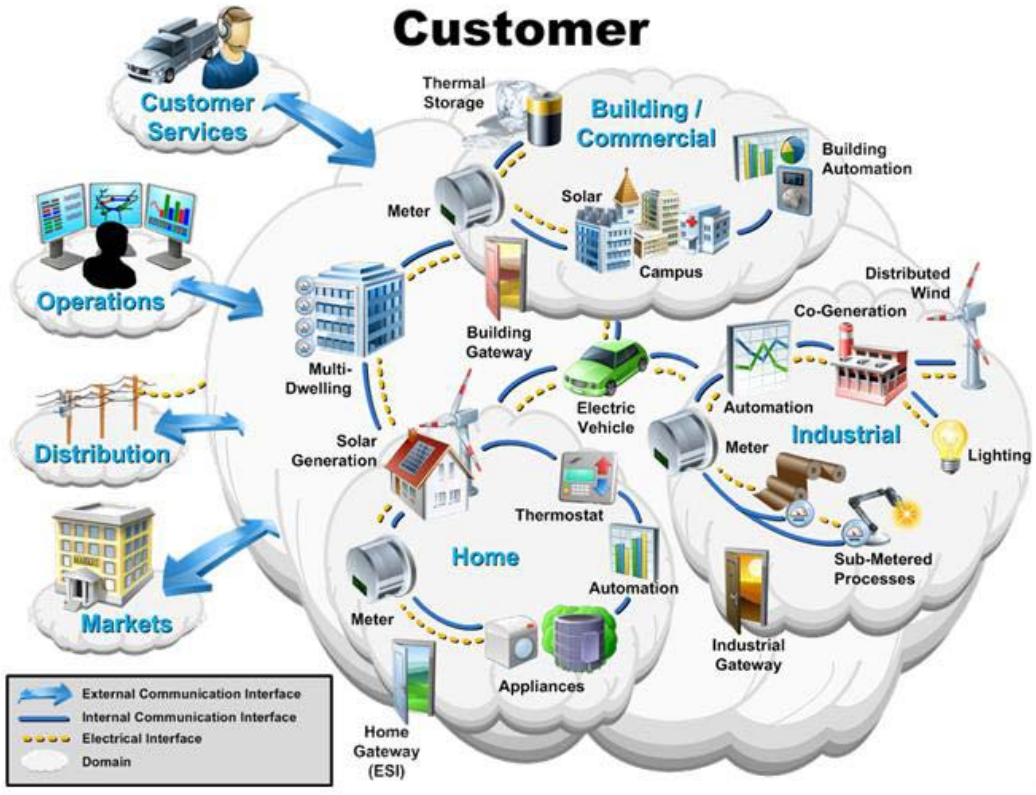
[10] For additional information on these types of projects in Texas, please see the list available at: www.electrictechnologycenter.com/projects.html.

DEFINITION OF SMART ENERGY TECHNOLOGIES

In the context of this paper, the term "Smart Energy Technologies" refers to all of the advanced technologies located behind a customer's meter that add intelligence to energy management, including digital control and communications technologies such as building automation systems (BAS), "smart" thermostats, in-home energy management displays, home area networks (HAN) for energy management, grid-friendly appliances, and certain resources that enable demand response. Some representative companies that produce and service these technologies, along with some specific examples of products, can be found on the following pages of this document.

Other dynamic energy resources such as plug-in hybrid vehicles with interactive energy storage devices and thermal energy storage could also be included within this definition; however the focus of this paper will be on technologies that will help customers better manage their energy usage, rather than on those that generate or store the same amount on-site. Additionally, the workforce implications of distributed renewable resources, such as on-site solar and wind, have been covered in other publications and therefore will not be addressed directly in this paper on "Smart Energy Technologies."

The following graphic from the International Electrotechnical Commission[11] shows the types of Smart Energy Technologies that can be enabled by the Smart Grid:



[11] Available at: www.iec.ch/online_news/etech/arch_2009/etech_0909/pic_tech/smart_grid_lrg.jpg.

EXAMPLES OF SMART ENERGY TECHNOLOGIES

The following companies are actively involved in the Smart Energy industry. A more comprehensive inventory of the smart energy industry has been included as Appendix A.

	Cisco	www.cisco.com/web/strategy/energy/smart_grid_solutions.html#~2
Cisco, with their ecosystem of partners, offers a wide variety of smart grid and smart energy solutions for business and home energy management; transmission and distribution automation; security systems; as well as smart meter communications. Their Building Automation Services (BAS) offerings for commercial buildings, such as the Network Building Mediator, are particularly relevant in the context of this paper.		
	Consert	www.consert.com
Consert, like many of its fellow home energy startups (e.g., Tendril, Control4, EcoFactor, EnergyHub), uses local wireless communications like ZigBee technology to hook up a host of load sensors in the home to a gateway device, such as a smart thermostat or Web-enabled platform. That device then links to a smart meter and links its gateway devices to the Internet. Unlike some of its competitors, Consert can also control the major household loads like air conditioners, water heaters, and pool pumps. Consert's solution is being piloted by multiple utilities in the Central Texas region.		
	Control4	www.control4.com
Control4's home automation software and hardware products enable energy management, home theater control, multi-room music, smart lighting, temperature control, security, and other features through a range of in-home and over-the-web remote control technology, with one universal remote. Some of Control4's products can be found in Best Buy stores.		
	Dell	http://www.dell.com/content/topics/topic.aspx/global/products/optix/topics/en/optix_energy?c=us&l=en
In addition to Dell's numerous Green IT and other environmental initiatives, Dell offers a number of software and hardware products that help consumers manage their energy use more effectively. They are also actively involved in Austin's Pecan Street Project and other smart energy initiatives.		
	Grid Net	www.grid-net.com
Grid Net develops real-time, all-IP Smart Grid and Smart Home software platforms for any device and any broadband technology. Their platform is designed to integrate substation automation, distribution automation, smart meters, demand response, load management, and home automation capabilities. Major investors include Cisco, GE, and Intel. Austin Energy's former CIO, Andres Carvallo, is their Chief Strategy Officer.		
	Honeywell	buildingsolutions.honeywell.com
Honeywell Building Solutions is a global provider of energy and utility services, as well as building automation technology and support services. Honeywell is also the largest implementer of residential demand response in North America, giving utilities combined control of more than 1 GW of peak load, which is equivalent to the capacity of approximately 20 gas-fired peaking plants. Their demand response thermostat, UtilityPRO, is a touchscreen device designed specifically for residential programs.		
	GE	www.ge-energy.com/home/index.htm
GE Energy is a leading provider for utility-specific applications and equipment globally and is an active participant in numerous Smart Energy initiatives, including the Smart Energy Alliance. GE Appliances & Lighting claims to be the first company to		

achieve ZigBee Smart Energy certification for its smart or smart grid-enabled appliances.		
Google	**Google**	www.google.com/powermeter
Google PowerMeter is a free energy monitoring tool that helps save energy and money. Using energy information provided by utility smart meters and energy monitoring devices, Google PowerMeter enables the viewing of a home's energy consumption from anywhere online. It is one of Google many new initiatives in the energy area.		
GRIDPOINT	**GridPoint**	www.gridpoint.com
GridPoint's smart energy solutions combine software, hardware, and services that integrate, aggregate, and manage distributed sources of energy consumption, generation, and storage. An enterprise-class software platform provides a shared foundation for their products, creating a common point of integration, asset provisioning, and real-time management.		
hp	**HP**	h71028.www7.hp.com/enterprise/w1/en/solutions/utilities-overview.html
HP provides a range of Advanced Meter Infrastructure, compliance, and other solutions to the utilities industry, and their computers run 65% of the world's SCADA & EMS systems. HP is an active participant in numerous Smart Energy initiatives, including the Smart Energy Alliance.		
IBM	**IBM**	www.ibm.com/smarterplanet/us/en/smart_grid/ideas
IBM has launched numerous smart energy initiatives, including a particularly notable project with CenterPoint Energy in the Houston area and active involvement in Austin's Pecan Street Project.		
Johnson Controls	**Johnson Controls**	www.johnsoncontrols.com
Johnson Controls brings ingenuity to the places where people live, work and travel. By integrating technologies, products and services, they create smart environments that redefine the relationships between people and their surroundings. Offerings particularly relevant for this report include their Metasys Building Management Solution, Metasys Sustainability Manager, Energy and Emissions Management System, EnNEt middleware, Visual Living Lab, and technology contracting services.		
Microsoft	**Microsoft**	www.microsoft.com/industry/manufacturing/utilities/default.mspx
The Smart Energy Reference Architecture (SERA) is Microsoft's first comprehensive reference architecture that addresses technology integration throughout the full scope of the smart energy ecosystem. Additionally, an alliance with Ford Motors will enable Microsoft Hohm, an Internet-based service, to better manage home energy use and help electric vehicle owners optimize their vehicle recharging needs. Hohm can also help utilities understand and better manage the rise in energy demand expected from the surge in electric vehicle ownership.		
SIEMENS	**Siemens**	www.energy.siemens.com/hq/en/energy-topics
With the new Siemens Smart Grid Applications project and other forward-looking initiatives, the integrated technology company is expanding its expertise to the "last mile" of the value added chain in the area of intelligent power network. The company intends to leverage its experience, for example, in energy automation and its IT expertise to comprehensively advise its customers about setting the right course for the new age of energy.		
SmartSynch	**SmartSynch**	www.smartsynch.com
SmartSynch is a provider of standard, IP communicating end-to-end smart metering solutions that enable utilities to communicate with any device on the grid utilizing public wireless networks. Earlier this year, Texas-New Mexico Power (TNMP) selected SmartSynch's Residential SmartMeter solution for a 231,000 unit point-to-point deployment to residential customers throughout the utility's Texas market.		

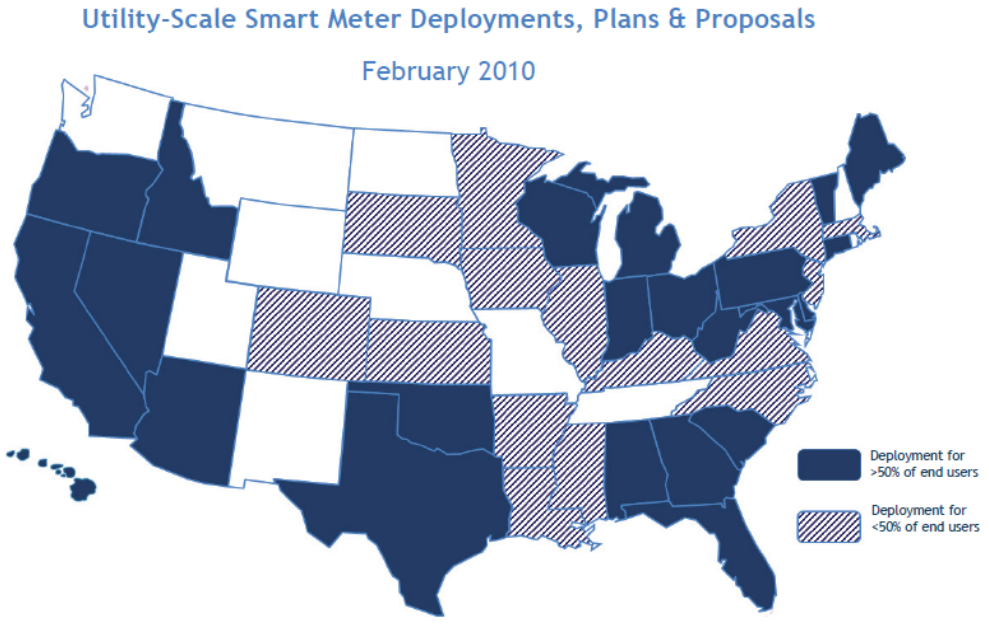
MARKET OVERVIEW

SIZE AND SCOPE OF THE MARKET

In a November 2008 report, the Brattle Group estimated that it may take as much as $2 trillion to modernize the grid by 2030.[12] The federal government has already awarded in excess of $4B toward Smart Grid pilot and deployment projects,[13] and healthy funding is likely to continue since modernization of the nation's electric grid is a vital component of the national energy plan. For reference, a listing of Smart Grid projects in Texas that received federal funding has been included as Appendix B.

The Smart Energy market is enabled by the two-way flow of energy consumption information through Advanced Metering Infrastructure (AMI) or other communication gateways. Therefore by reviewing utility AMI programs, we can get a fairly accurate estimation of a minimum number of consumers who will be able to take advantage of Smart Energy Technologies in the near future.

As of July 2009, approximately 4.7% of all U.S. customers were served by AMI with states in the Mid-Atlantic and Midwest experiencing the highest rates of usage at around 8-11% (Pennsylvania had the highest penetration with 23.9%).[14] The following figure from the Edison Electric Institute shows the planned and proposed deployments of smart meters across the U.S. in the next decade.[15] If full deployment is achieved, a total of 59,859,150 meters will be installed and operable by 2019. According to EIA's forecast of electricity customers in 2020, this represents roughly 47% of U.S. households.[16]



[12] www.eei.org/ourissues/finance/Documents/Transforming_Americas_Power_Industry.pdf.
[13] From: www.smatgrid.gov/projects.
[14] From the DoE's 2009 Smart Grid System Report, available at: www.oe.energy.gov/SGSRMain_090707_lowres.pdf.
[15] From: www.eei.org/whatwedo/PublicPolicyAdvocacy/TFB%20Documents/100312OwensOstpSmartGrid.pdf.
[16] Ibid.

Once an advanced meter has been installed (or another form of two-way communication has been established), then a Smart Energy Technology can be installed. As shown in the previous figure, **approximately half of the U.S. population will be eligible for a Smart Energy Technology by 2020**, and over 50% of the population in Texas will be eligible in a much shorter time-frame as will be discussed below. **Therefore, the potential size of this market, as well as the workforce needed to support it, could be massive.**

According to a report from the American Council for an Energy-Efficiency Economy, the cost of a home energy display device currently ranges from $125 to $400, plus up to three hours of installation by a contractor.[17] According to the report though, most products are simple and easy to install, at $125 to $200 purchase price plus no more than $100 (one hour of fully loaded labor) installation.[18] Sophisticated building automation systems for commercial buildings will likely be significantly more expensive, as will more complex home devices. Many of the companies in this industry are still determining their revenue models, but expect some companies to charge monthly fees in addition to one-time equipment and installation charges.

SMART ENERGY IN TEXAS

Texas is quickly becoming a perfect battleground for emerging Smart Energy products and services. The ERCOT market in Texas brings a unique combination of smart metering, strong competition for retail services, a lack of Federal Energy Regulatory Commission (FERC) jurisdiction, and wholesale settlement of retail accounts – all of which can spur a competitive, nimble, and innovative marketplace for Smart Energy Technologies. The market itself should ultimately choose which technologies, vendors, and service providers will be sustainable, and could become a prototype for other areas of the US to follow.

In 2005 legislation was passed in Texas which required all of the utilities in the competitive space to implement AMI. As a result, over 85% of the competitive space will have smart meters by the end of 2011, with full deployment expected within four years. This legislation had strict requirements about how the utilities should read meter data on a 15-minute interval and use it to create a more robust grid. More importantly for Smart Energy however, the legislation mandated that: a) customers shall have unimpeded, real-time access to their consumption information, and b) this information is the sole property of the customer.

As of April 1, 2010, more than 1.1 million smart meters have been installed in the Oncor and CenterPoint Energy service areas, and eventually more than 6.3 million smart meters will be installed in the Texas competitive retail electric market.[19] Deployments are also active at Austin Energy, CPS Energy, and some of the state's electric cooperatives. In the next two years, well over half of the 5+ million customers in Central Texas will have access to a smart meter.

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[17] See www.aceee.org/emertech/2006_EnergyDisplays.pdf.
[18] Ibid.
[19] From www.puc.state.tx.us/nrelease/2010/043010.pdf. Oncor will be installing approximately 3 million meters, while CenterPoint Energy will be installing approximately 2.2 million meters.

In addition to innovative service offerings in the competitive markets, Central Texas has a large number of municipal utilities and electric cooperative which have Smart Energy Technology initiatives underway. A few large cooperatives within LCRA's service territory as well as CPS Energy in San Antonio will be conducting pilot programs in summer 2010 on Smart Energy Technologies. These particular pilots will test the ability for the utilities to use load control as a resource to reduce energy costs and improve reliability. Through technologies like these that increase awareness in the home, other energy efficiency services can be enabled.

The actions of Austin Energy and Austin's Pecan Street Project[20] are also notable. Initiated in 2008, the Pecan Street Project intends to address the integration of clean energy with the needs of Austin Energy and the community. Part of the Department of Energy's $10M grant funding will go towards a technology development platform to spur innovation and open market enterprise in Smart Energy. If successful, the project could be a model for how Smart Energy can operate in integrated utilities throughout the US. Austin Energy is in a unique position to take advantage of an actively green community, significant peak energy costs, and a relatively flexible regulatory situation when compared to other areas of the country. A final project scope and timeline are still under development.

It should also be noted that on May 1, 2010, the Texas A&M College of Architecture launched a six month research consortium to help electric cooperatives, municipal and other public utilities evaluate the business case for Smart Grid and Smart Energy investments.[21] The business model in particular is challenging for smaller utilities since there are many moving pieces and benefactors which need to be accounted for in order to justify associated costs.

Given the scope of activities currently underway and our favorable regulatory environment for Smart Energy Technologies, Texas is in prime position to be a leader in their implementation. However, just because Texas will be one of the leading consumers of these technologies, that does not mean that our state will necessarily capture all of the jobs and economic benefits associated with this industry. Great care must be given to continue attract and retain industry leaders to maximize the benefits for Texas.

[20] See pecanstreetproject.org for additional information.
[21] See smartgridresearchconsortium.org for additional information.

OCCUPATIONAL OVERVIEW

Most Smart Energy workers and employers will come from existing industries, although there are a number of impressive start-up companies currently in the market. The Smart Energy industry is very broad and encompasses numerous functional areas, including information and communications technologies; digital and analog technology design; residential and commercial energy efficiency services; power integration; high-tech manufacturing; green sales and marketing; as well as a combination of these areas.

Key occupations in the Smart Energy industry are: engineers, product developers, system integrators, HVAC professionals, electricians, customer service representatives, assemblers, technicians, project managers, facility service managers, other maintenance/repair workers, sales and marketing professionals, as well as associated management and administrative staff.

One of the particular challenges for this industry is that, traditionally, separate contractors offer electrical, mechanical, insulation, building shell, fenestration, controls, appliances, home entertainment, and networked products/services. To effectively serve consumers in the Smart Energy industry, workers will need to be able to offer comprehensive services. For example, an air conditioning contractor will need to be able to service the electronics in the digital thermostat that controls the air conditioner as well as the air conditioner itself, and the customer service representative at the local utility will need enhanced skills to accurately diagnose problems within a home or building and dispatch the appropriate technician. There are broad workforce needs in this industry, the training and cross-training of which represent both challenges and opportunities.

An overview of potential industry occupations, organized by area of the Smart Energy industry, follows.

Technology Development and Information Processing

The Smart Energy industry requires near real-time exchange of energy consumption information to create awareness and enable conservation. Technology development and information processing companies and suppliers are therefore key enablers of the Smart Energy industry's success. Due to the versatility that Smart Energy requires, this subsector encompasses contributors up and down the technology supply chain including information technology, telecommunications, electronics design, and software development. Specific technologies used in the Smart Energy industry include load control devices, digital thermostats, advanced switches, internet technology, wireless devices, radio communications, and other computing technology. **Key occupations include hardware and software engineers, programmers, test engineers, product developers, network technicians, system integrators, project managers, and other associated management/administration.**

Related Industry Subsectors: Information and Communications Technology; Telecommunications, Consumer Electronics; Internet Publishing and Broadcasting; Data Processing and Hosting

Representative Companies: Cisco, Dell, HP, IBM, Intel, Microsoft, Google, GE, Siemens, Control4, GridPoint, Grid Net, Tendril, Consert, EcoFactor, Comverge, EnerNOC, Honeywell, Landis+Gyr, Itron, SmartSynch, AT&T, Verizon

Installation / Service

The majority of the jobs in the Smart Energy industry will come from these occupations. The primary role of these occupations is to install Smart Energy equipment; troubleshoot problems; maintain high levels of safety; inform customers on Smart Energy related issues; and maintain equipment. **Key occupations include HVAC professionals, electricians, customer service representatives, project managers, facility service managers, and other maintenance/repair workers.** Cross-training in multiple disciplines (i.e., electrical, mechanical, etc.) will be critical for these workers.

Related Industry Subsectors: Heating, Ventilation, and Air Conditioning (HVAC); Electrical Services; Facility Services; Repair and Maintenance; Customer Service; Utilities

Representative Companies: Honeywell, Johnson Controls, Siemens, Schneider Electric, HVAC companies (e.g., Strand Brothers, Fox, Stan's A/C), electrical service companies (e.g., Hill Electric, Corbo Electric), energy service companies (e.g., Standard Renewable Energy/Gridpoint), Best Buy, Conn's, Lowes, Home Depot, local utilities (e.g., Austin Energy, CPS Energy, Oncor, Pedernales Electric Cooperative)

Building/Facility Operations and Management

Smart Energy in small commercial buildings as well as some industrial facilities is a relatively mature market. Maintenance and management of a small commercial facility generally includes software and controls to automate functions such as preventive maintenance, security, remote monitoring and in many cases energy management. While actively managing a building's energy costs is not a priority for most building operators, improved technology and awareness to energy saving techniques are driving Smart Energy to be more attractive to small commercial owners and facilities managers.

Related Industry Subsectors: Building Operations and Management; Facility Operations and Management; Real Estate

Representative Companies: Honeywell, Johnson Controls, Siemens, Schneider Electric

Manufacturing

Smart Energy vendors and service providers will source goods through traditional companies in both the light and high-tech manufacturing sectors. Manufacturing methodologies are not unlike what these subsectors currently deploy to support today's more established markets, and therefore the workforce need will primarily be driven by increased demand. **Key occupations include engineers, assemblers, supervisors, and technicians.**

Related Industry Subsectors: Computer and Electronic Product Manufacturing; Electrical Equipment, Appliance and Component Manufacturing; and Miscellaneous Manufacturing.

Representative Companies: GE, Siemens, Landis+Gyr, Itron

Green Sales / Marketing

This is an emerging field driven by the lack of consumer awareness and understanding with regards to green technologies and services. Occupations within this group will have a strong educational background in business-to-consumer sales or marketing and an in-depth understanding of the economics of Smart Energy.

Related Industry Subsectors: All of the above
Representative Companies: All of the above

Additional information on specific occupational requirements can be found in a subsequent section of the paper.

For reference, a partial inventory of the industry in Texas has been included as Appendix A.

TRAINING, CERTIFICATION, AND LICENSING OVERVIEW

Because the Smart Energy industry is in its infancy, existing certifications and training programs are still very regional in scope and do not yet adhere to broadly accepted best practices as with other established industries. Actually, much of the training for the emerging Smart Energy industry has come from other related industries from which technologies and or services have grown into the energy space. Therefore this section provides an overview of some potentially applicable occupational trainings and certifications from related industries. For reference, a listing of applicable certifications for Smart Energy equipment and manufacturing has been included as Appendix C.

EXISTING TRAININGS IN TEXAS

In 2006 Texas State Technical College–Waco launched a leading edge training and certification program aimed at the rapidly growing field of "home technology integration." Home technology integration encompasses a variety of analog and digital technologies throughout the home including elements of home control, communications, entertainment, security, health monitoring, and energy management. Home Technology Integration is a specialization of within TSTC's Computer Maintenance Technology program and is also a Certificate of Completion program that a full-time, academically prepared student can complete in about one year.[22]

OTHER DIGITAL TECHNOLOGY INTEGRATION CERTIFICATIONS

There are a variety of certifications in the market today pertaining to the installation and service of digital technologies in homes and buildings such as home theatre, automation, and security systems. In 2006, the Electronic Systems Professional Alliance (ESPA) was formed from prominent consumer electronics associations to develop a universal education and certification program to serve as a gateway for new professionals entering the workforce. The baseline certification, Electronic Systems Technician (EST), is that gateway.[23]

For those wishing to obtain advanced certifications in residential installation, the Custom Electronic Design & Installation Association (CEDIA) offers a few relevant certifications, including an Advanced EST Certification and a Designer Certification.[24] And the Consumer Electronics Association (CEA) and the Computing Technology Industry Association (CompTIA) jointly offer a Digital Home Technology Integrator certification (DHTI+) to help identify knowledgeable and skilled digital home technology professionals.[25] CEDIA, CEA, and CompTIA are all members of the ESPA.

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[22] Additional information available at: www.waco.tstc.edu/cmt/cmt_home/index.php.
[23] Additional information available at: www.espa.org/Technicians/Certification-Exam-Info.aspx.
[24] Additional information available at: www.cedia.net/education/certification.php.
[25] Additional information available at: www.comptia.org/certifications/listed/dhti.aspx.

For those wishing to obtain advanced certifications in installation for small businesses or commercial buildings, the National Systems Contractors Association (NSCA) EST-L2 certification is preferred. It is a certification for technicians with 1-3 years of experience in the commercial electronic systems industry.[26] NSCA is also a member of the ESPA.

The Electronics Technicians Association (ETA) also sponsors a variety of certifications which are applicable to Smart Energy, including a Residential Electronics Systems Integrator certification with an endorsement in Environmental Controls (RESI-EC) and an Associate Electronics Technician (CETa) certification.[27] Generally this career path is similar to that of the ESPA; however there are two primary differences. First, the skill set and knowledge base generated from ETA includes product testing and design fundamentals in addition to in-home services training that ESPA provides, which makes the trainee more easily transferrable to a development or manufacturing environment. Second, ETA-certified technicians tend to have a much more developed understanding of power electronics compared to an ESPA-certified graduate. This is directly applicable to renewable energy and electric vehicle integration, which are closely tied to Smart Energy.

A summary of the leading Digital Technology Integration certifications can be found in the table below.

Digital Technology Integration Certifications

Organization	Name of Certification	Offered by Texas Community College?
Texas State Technical College-Waco	Home Technology Integration Certificate or Specialization	Yes
Electronic Systems Professional Alliance (ESPA)	Electronic Systems Technician (EST)	No
Custom Electronic Design & Installation Association (CEDIA)	Numerous certifications pertaining to residential home theater, audio, video, and electronic systems, including an Advanced EST Certification and a Designer Certification	No
Consumer Electronics Association (CEA) and Computing Technology Industry Association (CompTIA)	Digital Home Technology Integrator (DHTI+)	No
National Systems Contractors Association (NSCA)	Electronic Systems Technician-L2 (EST-L2)	No
Electronics Technicians Association (ETA)	Numerous certifications including Residential Electronics Systems Integrator (RESI) and Associate Electronics Technician (CETa)	No

[26] Additional information available at: www.nsca.org/Home/ESTCertification/ESTL2Certification/tabid/1057/Default.aspx.
[27] Additional information available at: www.eta-i.org/certifications.html.

TEXAS LICENSURE CONSIDERATIONS

The majority of the skills needed to supply the Smart Energy installation and maintenance workforce can be derived from the various digital technology integration certifications that already exist. Knowledge in local area networking, building automation, low voltage electronics, information technology, and wiring practices are paramount; and all of these are part of the aforementioned trainings. However, there are types of Smart Energy products and services which –under current Texas laws— require skills from the electrician and HVAC service industries. In these cases, it is more likely an electrician or HVAC technician would need to be trained in the applicable digital technology integration principles to perform these specialized tasks.

Examples of these tasks are listed below, with their perspective career path noted:

Electrician	Products and services which require handling of high-voltage (+120V) wires or equipment including direct load control, micro-generation, and/or commercial building facilities.
HVAC	Products and services which enhance the optimization of the HVAC system including energy efficiency measures, HVAC diagnostics, and HVAC maintenance.

Both professions are currently licensed by the Texas Department of Licensing and Regulation.

SMART GRID DEGREES AT OTHER COMMUNITY COLLEGES

Cincinnati State Technology and Community College has developed a broad training platform to service Duke Energy's needs. Beginning in the fall of 2010, students can begin working towards an associate's degree in Smart Grid. The curriculum will combine related engineering principles with specialized Smart Grid topics such as control systems, distribution and transmission technologies, and instrumentation. This will train student for short and long term needs in Smart Grid infrastructure. Shorter term needs will include functions such as meter installers, while long term needs will bringing together career paths to specialize in the maintenance of the Smart Grid, including the transmission and distribution of energy.

Other colleges actively developing a Smart Grid degree program include: Metropolitan Community College in Kansas City, KA, The Community College of Rhode Island in Warwick, RI, and Lansing Community College in Lansing, MI.

NOTABLE DEPARTMENT OF ENERGY SMART GRID WORKFORCE TRAINING INITIATIVES

On April 8, 2010, U.S. Secretary of Energy Steven Chu announced that the Department of Energy awarded $100 million for 54 smart grid workforce training programs in the U.S. to help prepare the next generation of workers in the utility and electrical manufacturing industries.[28] While these projects were not limited to Smart Energy Technologies, the trainings developed under these programs could affect trainings available for Smart Energy industry workforce. The projects will leverage more than $95 million in funding from community colleges, universities, utilities, and manufacturers to develop and implement training programs. The selectees estimate that the programs will train approximately 30,000 Americans. The programs will focus on training activities that support electricians, line workers, technicians, system operators, power system engineers, cyber security specialists, and transmission planners. Workers will receive training on the transmission and distribution systems as well as new intelligent grid systems, such as smart meters, phasor measurement sensors, and advanced communication networks. Three programs from Texas received funding. They are described below. Other relevant projects can be found in Appendix D.

University of Houston Coalition - Strategic Training and Education in Power Systems

A coalition led by the University of Houston's College of Technology has received $2.5 million to develop a smart grid workforce training program. The total project value is listed at $3.8M. This coalition includes the University of Houston, CenterPoint Energy, San Jacinto College, the Power Technology Institute, SkillsNET, and the Texas Business and Education Coalition (TBEC). The grant will be used to assess the overall workforce needs of the utility and related industries, and to develop training programs for continuing education of existing employees and the infusion of new employees in order to compensate for employees lost through attrition. The program will include establishing a 'Power Training Campus' within UH's Energy Research Center. Among professions supported are: electricians, line workers, technicians, system operators, power system engineers, cyber security specialists, and transmission planners.

Oncor Electric Delivery Company - Smart Grid Workforce Training

Oncor received $188,748 in grants to fund a $431,937 program called Grid Reliability through Engineer Advancement and Training (GREAT). The intent is to prepare Oncor's system planners and system protection engineers to successfully achieve a Smart Grid that effectively incorporates the growing generation of renewable energy in Texas. The project supports Oncor's workforce development efforts needed to construct, operate, and maintain over 850 miles of new competitive renewable energy zone (CREZ) lines, 4 new wind collection stations, and 4 new 345 kV switching stations throughout Texas.

Austin Community College - Developing and Enhancing Workforce Training Programs

ACC received $87,210 in federal funds to launch a $132,169 program called Preparing Occupations for Lineman Education (The POLE Program). ACC plans to develop a utility line worker Certificate and Associate Degree curriculum to train students to install, maintain, and repair electric power lines and qualify them to work as utility line workers - an occupation key to enabling the Smart Grid functionality.

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[28] For more information, including a list of selected projects, please see www.energy.gov/news/8842.htm.

DETAILED OCCUPATIONAL ANALYSIS

O*NET "GREEN" OCCUPATIONS RELATED TO THE SMART ENERGY INDUSTRY

O*NET is the Occupational Information Network. In 2009, O*NET published a paper entitled *Greening of the World of Work*, in which three occupational categories of green jobs were identified,[29] each with different effects from the "greening" of work.[30] All of these categories apply to the Smart Energy industry and are important for educational institutions and workforce boards as **all could require new capacity and/or trainings be developed.** The three identified categories are:

(1) *Green New and Emerging (N&E) Occupations* - The impact of green economy activities and technologies is sufficient to create the need for unique work and worker requirements, which results in the generation of a new occupation relative to the O*NET taxonomy.

(2) *Green Enhanced Skills Occupations* - The impact of green economy activities and technologies results in a significant change to the work and worker requirements of an existing O*NET-SOC occupation. The essential purposes of the occupation remain the same, but tasks, skills, knowledge, and external elements, such as credentials, have been altered.

(3) *Green Increased Demand Occupations* - The impact of green economy activities and technologies is an increase in the employment demand for an existing occupation. However, this impact does not entail significant changes in the work or requirements of the occupation. The work context may change, but the tasks themselves do not.

A listing of occupations most relevant to the Smart Energy industry in each of the O*Net categories follows.[31] Please note that attempts to categorize occupations are ongoing.

New and Emerging Occupations

- Electrical Engineering Technologists
- Electromechanical Engineering Technologists
- Electronics Engineering Technologists
- Energy Auditors
- Energy Engineers
- Green Marketers
- Manufacturing Engineers
- Mechatronics Engineers
- Sustainability Specialists
- Testing Adjusting and Balancing Technicians
- Weatherization Installers and Technicians

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[29] O*NET points out "the need to shift the level of specificity from 'job' to 'occupation' when discussing the workforce implications of the green economy. The current literature focuses almost exclusively on green jobs –or simply green job titles– rather than taking a perspective more conducive to workforce development efforts: an occupational perspective."

[30] O*NET's definition of green jobs is as follows: "the green economy encompasses the economic activity related to reducing the use of fossil fuels, decreasing pollution and greenhouse gas emissions, increasing the efficiency of energy usage, recycling materials, and developing and adopting renewable sources of energy."

[31] From http://www.onetcenter.org/green/emerging.html. Please note that these are just the occupations most directly related with Smart Energy; there are many other green occupations listed on O*NET.

Enhanced Skills Occupations

- Construction and Building Inspectors
- Electrical Engineering Technicians
- Electrical Engineers
- Electro-Mechanical Technicians
- Electronics Engineers, Except Computer
- Engineering Managers
- General and Operations Managers
- Heating and Air Conditioning Mechanics and Installers
- Industrial Engineering Technicians
- Maintenance and Repair Workers, General
- Marketing Managers
- Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products
- Sheet Metal Workers
- Training and Development Specialists

Increased Demand Occupations

- Commercial and Industrial Designers
- Computer Software Engineers, System Software
- Customer Service Representatives
- Dispatchers, Except Police, Fire, and Ambulance
- Electrical and Electronic Equipment Assemblers
- Electrical and Electronics Repairers, Commercial and Industrial Equipment
- Electricians
- Electronics Engineering Technicians
- First-Line Supervisors/Managers of Mechanics, Installers, and Repairers
- Helpers-Installation, Maintenance, and Repair Workers
- Industrial Engineers
- Insulation Workers, Floor, Ceiling, Wall
- Refrigeration Mechanics and Installers
- Stationary Engineers and Boiler Operators
- Team Assemblers

As you can see, increased demand for Smart Energy Technologies could potentially benefit many "green" occupations.

Detailed occupational skill and knowledge requirements for selected occupations can be found in Appendix E.

CURRENT EMPLOYMENT STATUS IN TEXAS AND FORECASTED NEEDS

There is very little data that can be used to generate reliable forecasts for Smart Energy industry employment needs. According to a study by KEMA, Smart Grid deployment is expected to generate almost 280,000 jobs over the next four years.[32] The Apollo Alliance projects a $2 billion federal investment in Smart Grid over 10 years could create 441,000 jobs.[33] But unfortunately these studies were not focused solely on Smart Energy.

There are, however, several existing Smart Energy projects in Texas which may provide indicators of what is to come. We reviewed three vendors within the residential Smart Energy space that are launching pilot programs this summer in Central Texas. Each of these companies secured at least one project agreement with a participating utility for installations. All three of these companies provide both hardware and software technologies which, once installed in the home, provide control and visibility to the homeowner to help reduce energy costs. Below are the major findings:

1. The bulk of the training required has been focused on the installation and service personnel.
    a. Two of the three companies will use HVAC-based service personnel for installations and maintenance. The third will use electricians primarily because this company will be installing technology on high-voltage lines.
    b. The cross-training required for each group is as follows:
        i. HVAC Personnel: home area networking mechanics; energy efficiency basics
        ii. Electricians: home area networking mechanics; basic HVAC system; thermostat analysis; energy efficiency basics
    c. Training was developed internally for these programs and administered with the assistance of the participating service companies, but they would have been open to working with a community college.
2. Customer service personnel have required training on how the technology will affect the consumer. To serve these needs, the vendors have developed reading materials and Frequently Asked Questions lists to help prepare them for inquiries.
3. Project management personnel have been trained on the technology and program needs on an ad hoc basis. Consequently, the projects have been run in a relatively inefficient manner due to the steep learning curves that the management teams have faced.
4. The majority of the marketing jobs for these programs were sourced outside the State of Texas.
5. All manufacturing was sourced outside the State of Texas.

Additionally, our discussions with industry leaders serving the commercial and industrial sectors (e.g., Cisco, Dell, IBM, Johnson Controls, Honeywell, Siemens) have indicated a significant amount of business development activities for Smart Energy products and services, which will likely result in sustained job creation and industry growth over the next few years.

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[32] www.kema.com/services/consulting/utility-future/job-report.aspx.
[33] apolloalliance.org/downloads/resources_ApolloReport_022404_122748.pdf

MAJOR CONCLUSIONS AND RECOMMENDATIONS

MAJOR CONCLUSIONS

- There are substantive differences in the workforce training requirements for those who design, install, and service the Smart Grid infrastructure versus those who design, install, and service Smart Energy Technologies attached to that infrastructure.

- Key occupations in the Smart Energy industry include: engineers, product developers, system integrators, HVAC professionals, electricians, customer service representatives, assemblers, technicians, facility service managers, project managers, maintenance/repair workers, sales and marketing professionals, as well as associated management and administrative staff.

- Most of the Smart Energy training to date has been enhanced skills training for installation and service personnel, such as HVAC professionals, electricians, utility employees, and customer service representatives. Some of this could be easily provided by community colleges. There are also needs for enhanced skills training for workers in the information and communications technology industries.

- Due to federal spending and other utility investments on advanced meter infrastructure, approximately half of the U.S. population will theoretically be able to take advantage of a Smart Energy Technology by 2020, therefore the potential size of this market, as well as the workforce needed to support it, could be massive.

- Texas is a world-leader in smart meter deployment due to policy and regulatory factors. The rapid pace of smart meter deployment in the State of Texas will be a catalyst for the early development of a market for residential Smart Energy Technologies over the next 24-48 months, as will federal Stimulus spending.

- Our discussions with industry leaders serving the commercial and industrial sectors (e.g., Cisco, Johnson Controls, Honeywell, Siemens) have indicated a significant amount of business development activities for Smart Energy products and services in these sectors as well, which will likely result in sustained job creation and industry growth over the next few years.

- Texas will not necessarily capture the majority of the Smart Energy Technology product development and manufacturing jobs, although the scale of the various demonstration/pilot projects in the state and our market are favorable to attract them. It is far from a given though.

- Existing trainings/certifications for digital home technology integration, such as the program at TSTC-Waco, can be leveraged to develop Smart Energy industry trainings/certifications. A few educational institutions have received federal grants to begin working on this, and some trade associations have begun to focus on it as well.

- To effectively serve consumers in the Smart Energy industry, workers will need to be able to offer comprehensive services. For example, an air conditioning contractor will need to be able to service the electronics in the digital thermostat that controls the air conditioner as well as the air conditioner itself, and the customer service representative at the local utility will need enhanced skills to accurately diagnose problems within a home or building and dispatch the appropriate technician.

- There is very little data that can be used to generate reliable forecasts for Smart Energy industry employment needs. However, there are several Smart Energy projects underway in Texas which may provide indicators of what is to come.

MAJOR RECOMMENDATIONS

- Texas community colleges should incorporate Smart Energy concepts into existing trainings for HVAC professionals, electricians, building trades, digital home integrators, and other relevant occupations. TSTC's existing home integration offerings should be leveraged as appropriate.

- Texas community colleges should work with local employers to pursue Skills Development Funds for enhanced skill trainings in Smart Grid and Smart Energy. Courses could be timed so that they are not held at inconvenient times for industry professionals.

- Texas community colleges should ensure that the latest technologies and devices are available in the classrooms and teaching materials.

- The utilities in the Green Corridor Consortium (i.e., Austin Energy, CPS Energy, Pedernales Electric Cooperative, Oncor) could consider forming a working group to discuss how skills developed under individual Smart Grid and Smart Energy initiatives could be portable throughout the state. Other relevant utilities and entities could obviously be included as well.

- Texas community colleges should develop relationships with entities that are either developing Smart Grid/Smart Energy trainings or have received significant federal funds to do so. This includes the Pecan Street Project, CenterPoint, and community colleges in other states.

- Texas community colleges should develop a relationship with the Electronic Systems Professional Alliance (ESPA). ESPA is working with experts across the country to develop the turnkey materials needed to offer the ESPA Certified Electronic Systems Technician (EST) curriculum and industry recognized credential in 2010.

- Texas community colleges could install Smart Energy Technologies, such as Building Automation Systems and Smart Thermostats, in campus buildings to be used as demonstration sites and teaching aides.

- Texas workforce investment boards and community colleges should work with chambers of commerce and other economic development stakeholders to develop strategies to attract Smart Energy Technology product developers and manufacturers to Texas.
- The Green Corridor Collaborative should work with other relevant stakeholders to aggressively pursue federal funds that will be made available for Smart Grid and Smart Energy.

APPENDIX A: INVENTORY OF THE SMART ENERGY INDUSTRY IN TEXAS

The following is a partial list of companies involved in the industry in Texas.

	NAME	LOCATION	WEB SITE
Smart Energy Vendors with a Significant Presence in Texas			
	Cisco Systems	San Francisco, CA	www.cisco.com
	Consert	Raleigh, NC	www.consert.com
	Cpower	New York, NY	www.cpowered.com
	Dell	Round Rock, TX	www.dell.com
	EnerNOC	Boston, MA	www.enernoc.com
	IBM	Armonk, NY	www.ibm.com
	Johnson Controls	Glendale, WI	www.johnsoncontrols.com
	Microsoft	Seattle, WA	www.microsoft-hohm.com
	Siemens Energy and Automation	Austin, TX	www.siemens.com
	Site Controls	Austin, TX	www.site-controls.com
Other Notable Smart Energy Vendors			
	Aclara	Hazelwood, MO	www.aclara.com
	Climetrics	Boston, MA	www.cimetrics.com
	Comverge	Norcross, GA	www.comverge.com
	Control4	Salt Lake City, UT	www.control4.com
	Corporate Systems Engineering	Indianapolis, IA	www.corporatesystems.com
	Echelon	San Jose, CA	www.echelon.com
	Ecobee	Toronto, CA	www.ecobee.com
	EcoFactor	San Francisco, CA	www.ecofactor.com
	Energate	Toronto, CA	www.energateinc.com
	Energy Hub	San Francisco, CA	www.energyhub.net
	GE Energy	Atlanta, GA	www.gepower.com
	Google	San Francisco, CA	www.google.com/powermeter
	Grid Net	San Francisco, CA	www.grid-net.com
	GridPoint	Arlington, VA	www.gridpoint.com
	Honeywell	Morristown, NJ	www.honeywell.com
	Itron	Raleigh, NC	www.itron.com
	Landis + Gyr	Alpharetta, GA	www.landisgyr.com
	Radio Thermostat Company	San Francisco, CA	www.radiothermostat.com
	Sequentric Energy Systems	Charollette, NC	www.sequentric.com
	SmartSynch	Jackson, MS	www.smartsynch.com
	Tantalus Systems	Angier, NC	www.tantalus.com
	Tendril	Boulder, CO	www.tendril.com
	Trilliant	Redwood City, CA	www.trilliantinc.com
	Verdiem	Seattle, WA	www.verdiem.com
Texas Manufactuers that Could Participate in the Smart Energy Industry			
	ARQ Electronics Manufacturing	College Station, TX	www.arqelectronics.com
	Electronic Manufacturing of Texas	Buda, TX	electronicmanufacturingoftexas.com
	Ember Industries	San Marcos, TX	www.emberindustries.com
	EMCOT Corp	Houston, TX	www.emcotcorp.com
	HL Electronics	Grand Prarie, TX	www.hlelectronics.com
	KoDIAK Assembly Solutions	Austin, TX	www.kodiakassembly.com
	North Texas Manufacturing	Grand Prarie, TX	northtexaselectronics.com
	Spectra Dynamics Corp	Austin, TX	www.spectra-dynamics.com
Central Texas Utilities with Known, Active Smart Energy or Smart Grid Programs			
	Austin Energy	Austin, TX	www.austinenergy.com
	Bluebonnet Electric Cooperative	Bastrop, TX	www.bluebonnetelectric.coop
	Co-Serv Electric	Corinth, TX	www.coserv.com
	CPS Energy	San Antonio, TX	www.cpsenergy.com
	LCRA	Austin, TX	www.lcra.org
	Oncor Energy	Dallas, TX	www.oncor.com
	Pedernales Electric Cooperative	Johnson City, TX	www.pec.coop
	San Marcos Electric	San Marcos, TX	www.ci.san-marcos.tx.us
	United Electric Cooperative	Cleburne, TX	www.united-cs.com
Central Texas Service Providers / Installers with Known, Active Smart Energy Programs			
	Direct Energy	Houston, TX	www.directenergy.com
	Reliant Energy	Houston, TX	www.reliant.com
	Service Experts	Richardson, TX	www.serviceexperts.com
	Standard Renewable Energy	Houston, TX	www.sre3.com
	TXU Energy	Dallas, TX	www.txu.com

APPENDIX B: SMART GRID DEMONSTRATION PROJECTS IN TEXAS

The following Smart Grid demonstration projects in Texas have received federal funding[34]:

Project	Size of Award	Total Project	Advanced Metering	Smart Energy	Central Texas
Co-Serv Electric Smart Grid (dba Denton County Electric)	$17.2M	$41.0M	X	X	X
Center for the Commercialization of Electric Technologies	$13.5M	$27.4M	X	X	X
CenterPoint Energy Smart Grid	$200.0M	$639.2M	X		
El Paso Electric Smart Grid	$1.0M	$2.2M			
Golden Spread Electric Cooperative	$17.3M	$43.2M	X		
Oncor Electric Delivery LLC Demonstration Project	$3.5M	$7.3M			X
Pecan Street Smart Grid Demonstration Project	$10.4M	$24.7M	X	X	X
Reliant Energy Smart Grid Project	$19.8.0M	$63.7M	X	X	

For additional information on these types of projects in Texas, please see the list available at: www.electrictechnologycenter.com/projects.html.

[34] Per http://www.smartgrid.gov/projects.

APPENDIX C: TRAININGS AND CERTIFICATIONS FOR EQUIPMENT AND MANUFACTURING

Equipment

Equipment varies greatly within the Smart Energy industry. Potentially, any device or piece of machinery that uses, stores, or generates electricity on a micro-grid level could ultimately be considered a Smart Energy piece of equipment. Unfortunately, we are not quite to a point where someone can bring home products from retail channels, plug them in, and immediately begin to receive the benefits of Smart Energy. Standards for communication and security are still being developed and implemented.

Manufacturing

The fundamental manufacturing and design principles of Smart Energy hardware originate from low power consumer electronics. This very diverse industry does include very specific standards for specialized devices, but lacks widely accepted standards, or even best practices, for product manufacturing. The standards that are prevalent in the industry are associated with safety and interoperability. Manufacturers of smart energy products do not obtain any certifications specific to quality, but most obtain ISO 9001:2000 quality management certification for their facilities like manufacturers of other products. Most manufacturers also will be taking steps to ensure their products adhere to the US EPA ENERGY STAR equipment standards, as that is now a prerequisite for many of the federal tax credits that have been made available for the industry.

Interoperability

Under the Energy Independence and Security Act (EISA) of 2007, the National Institute of Standards and Technology (NIST) has *"primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems…"*

Interoperability is vitally important to the performance of Smart Energy at every level. It enables integration, effective cooperation, and two-way communication among the many interconnected elements of the electric power grid. This is built on a unifying framework of interfaces, protocols, and the other consensus standards. These standards facilitate useful interactions so that, for example, "smart" appliances and meters will tell consumers how much power they are using and at what cost, providing them with more control over their power consumption and energy bills. Widely adopted standards also will help utilities to mix and manage varying supplies of solar, wind, and other renewable energy sources and better respond to changing demand.[35]

[35] www.nist.gov/smartgrid.

Security

Security is a paramount concern for the electric utility in general. Overseen by the Federal Energy Regulatory Commission, security requirements exist from top to bottom of the electrical delivery system and cover each and every device and interface. Even though Smart Energy does not directly interface with the bulk electric delivery system, Smart Energy does have an impact on how the grid operates and therefore the industry's emphasis on security is shared. Within home area networking, generally accepted security standards are integrated with other accepted communication networks such as ZigBee, 6LoWPANa and TCP/IP. Equipment that interfaces with the smart meter must conform to American National Standards Institute (ANSI) standards.

Summary Table

A summary of the leading certifications and standards for smart energy equipment and manufacturing can be found in the table below.

Organization(s)	**Name of Certification/Standard**	**Description**
American National Standards Institute	C12.19; C12.21; C12.22	Connectivity and data presentation standards for interfacing with a smart meter.
National Institute of Standards and Technology	ZigBee Smart Energy Profile 2.0; HOMEPLUG; IPv6; 6LoWPAN; TCP/IP; ASHRAE 135-2008	Communications standards.
Underwriters Laboratory	Safety Standards (varies based on product / technology)	Widely accepted safety standards organization with extensive guidelines for electronic products.
ISO	ISO 9001:2000	Quality management certification for facilities
US EPA	ENERGY STAR	Designation for energy efficient products

APPENDIX D: OTHER NOTABLE DOE SMART GRID WORKFORCE TRAINING GRANT AWARDS

Also of note within the Department of Energy Smart Grid Workforce Training awards were the following national projects that could have implications for the development of Smart Energy trainings in Texas:

Other Notable DoE Smart Grid Workforce Training Grant Awards		
Organization	**Project Description**	**Project Size**
The Community College of Rhode Island (Warwick, RI)	The Rhode Island Electrical Power Technician Program will develop and implement a new Energy Utility Technology (EUT) Certificate that will be articulated with a redesigned Engineering Systems Technology (EST) Associate Degree to provide a qualified entry level workforce in the greening of the electrical power sector.	$745,841 Grant ($911K Total Budget)
Pratt Community College (Pratt, KS)	The Kansas Community College Energy Consortium's Smart Grid Curriculum Development program will enhance electric power and information network training programs with smart grid technology. Project develops online and hybrid smart grid training modules, provides career pathways toward industry certifications and degrees (e.g. "stackable" credentials in clean energy), and enhances training with simulation software.	$749,375 Grant ($861K Total Budget)
Pacific Center for Advanced Technology Training (University of Hawaii Community Colleges) (Honolulu, HI)	Electric Power Sector Training will develop and enhance a career pathway for technicians that will deploy and maintain electric power transmission and distribution through the application of smart grid technologies. The project will provide a pathway for traditional high school graduates to become technicians to maintain the Smart Grid (two-year certificate program) and offer industry-certified courses for displaced workers, non-traditional students and the incumbent workforce (workforce development /non-credit program).	$750,000 Grant ($833K Total Budget)
Duke Energy Business Services (Charlotte, NC)	The Duke Energy Smart Grid Workforce Training program will train the smart grid workforce that will plan, design, build, operate, and sustain Duke Energy's transformed Midwest electric system and related "beyond the meter" products and services which will increase the consumer's role in managing energy use and reducing carbon emissions. Over 3,100 employees in the states of Indiana, Ohio, and Kentucky will receive smart grid training.	$3.5M Grant ($7M Total Budget)
Florida Power and Light (Juno Beach, FL)	The Gateway to Power (G2P): Development of Innovative Strategic Electric Power, Renewable Energy, and Smart Grid Workforce Training project will transform the traditional approach to electric power workforce training by bringing industry and academia together to design and execute workforce training initiatives that will produce multidisciplinary standards in power systems that holistically address smart grid technologies. Through FPL's Energy Smart Florida project, over 6,000 new jobs are being created for which workforce training may be necessary.	$5.0M Grant ($12.5M Total Budget)

Glendale Community College (Glendale, CA)	The Southern California Utility Initiative will expand training curricula and programs in the Southern California region. The project will raise awareness and interest in careers in utilities, address the predicted number of workers eligible for retirement, and focus on training the workforce from the local community. The project is also intended to provide an electrical engineering pathway from the community college to the university level.	$750,000 Grant ($1.1M Total Budget)
University Enterprises, Inc. (on behalf of CSU Sacramento) (Sacramento, CA)	The California Smart Grid Workforce Development Network will engage electric utilities, California State University campuses, California Community Colleges, labor unions, and smart grid manufacturers to create, execute, and evolve a statewide workforce development strategy. The project's collaborating utilities include PG&E, Southern California Edison, and Sacramento Municipal Utility District.	$750,000 Grant ($833K Total Budget)
Illinois Institute of Technology (Chicago, IL)	IIT will create a world-class "Smart Grid Education and Workforce Training Center" to develop and deploy smart grid technology courses and certificate programs via instructor-led and distance-learning methodologies. The Center is expected to train about 49,000 power industry employees, union workers, teachers, and students in a three year period.	$5M Grant ($12.6M Total Budget)
Pennsylvania State University (University Park, PA)	The GridSTAR Center (Smart Grid Training Application Resource Center) will provide system-based continuing education and train-the-trainer programs in advanced power systems design, energy economics, cyber security, distributed energy generation, and building-vehicle-grid systems. System experts will work closely with manufacturing and technology partners to deliver high quality education and training programs.	$5M Grant ($10M Total Budget)
Ivy Tech Community College (Indianapolis, IN)	The Crossroads Smart Grid Training Program will develop trained operators, technicians, engineers, and research scientists necessary to achieve Indiana's renewable power and energy objectives. 1,500 student-seats for new smart grid training will be offered.	$4.7M Grant ($7.9M Total Budget)
Pepco Holdings, Inc. (Washington, D.C.)	The PHI Smart Grid Workforce Training Project will ensure a well-trained and highly skilled workforce with the requisite knowledge, expertise, and capabilities to: a) implement, operate, and enhance the Smart Grid; and b) provide sound energy advice to customers. 700 new and existing employees will receive training in order to fill new roles and enhance existing ones.	$4.3M Grant ($8.7M Total Budget)
General Electric (Schenectady, NY)	The Smart Grid Center of Excellence (SGCOE) will develop the expertise needed to design and develop smart grid technology. The project supports the training of approximately 260 Engineers and Software Developers.	$650,000 Grant ($1.3M Total Budget)

A complete list of awardees is available at:
http://www.energy.gov/news/documents/04-08-2010_SG_Workforce_Selections.pdf.

APPENDIX E: DETAILED OCCUPATIONAL SKILL & KNOWLEDGE REQUIREMENTS

Based on an analysis of the topics covered in the current industry trainings and certifications, requirements for the following skills and knowledge appear to exist.

For Technology Development and Information Processing Professionals

(e.g., Commercial/Industrial Designers; Software Engineers; Electrical Engineers; Network Administrators)

- Knowledge:
  - Computers and Electronics: circuit boards, chips, electronic equipment, and general hardware/software architecture.
  - Design: knowledge of design techniques, tools, and principles involved in the production and design of Smart Energy technologies and products.
  - Energy Physics: knowledge of physical principles, laws, and applications related to thermal and energy performance of structures and devices.
  - Mathematics: arithmetic, algebra, geometry, statistics, and their applications.
  - Software: architecture, structure, and constructs for application level and low level software designs.
  - Telecommunications: knowledge of transmission, broadcasting, switching, control, and operation of systems.
- Skills:
  - Analyzing Data: identifying underlying principles of information by breaking down data into separate contributions.
  - Complex Problem Solving: analyzing complex information and evaluating different options to choose the best solution.
  - Deductive Reasoning: the ability to apply general rules to specific problems and solve them.
  - Processing Information: compiling, coding, categorizing, calculating or verifying information and data.
  - Technology Design: generating or adapting equipment and technology to serve user needs.

For Installation/Service Professionals

(e.g., Electricians; Heating and Air Conditioning Mechanics and Installers; Maintenance and Repair Workers; Mechatronics Engineers; Refrigeration Mechanics and Installers; Testing Adjusting and Balancing Technicians)

- Knowledge
  - Building and Construction: materials, methods, and tools involved in the construction or repair of energy efficient houses or buildings.
  - Engineering and Technology: applying principles, techniques, and procedures in Smart Energy technology to the design and implementation of Smart Energy equipment.
  - Sales and Marketing: showing, promoting, and selling Smart Energy products or services.
  - Telecommunications: knowledge of transmission, broadcasting, switching, control, and operation of systems.
- Skills:
  - Critical Thinking: using logic and reasoning to weigh the strengths and weaknesses of different solutions.
  - Equipment Maintenance: performing routine maintenance on Smart Energy equipment and being able to diagnose when such maintenance may be needed.
  - Installation: installing equipment, wiring or programs to meet Smart Energy standards.
  - Problem Solving: analyzing information and evaluating results to choose the best solution.
  - Troubleshooting: determining the causes of functional or operational malfunctions and the ability to decide what the appropriate course of action is.

For Facilities/Building Operations Professionals

(e.g., General and Operations Managers; Maintenance and Repair Workers; Stationary Engineers and Boiler Operators)

- Knowledge:
  - Building and Construction: materials, methods, and tools involved in the construction or repair of energy efficient houses or buildings.
  - Engineering and Technology: applying principles, techniques, and procedures in Smart Energy technology to the design and implementation of Smart Energy equipment.
  - Mechanical: knowledge of machines and tools, including their designs, uses, repair and maintenance.
- Skills:
  - Complex Problem Solving: analyzing complex information and evaluating different options to choose the best solution.
  - Critical Thinking: using logic and reasoning to weigh the strengths and weaknesses of different solutions.
  - Deductive Reasoning: the ability to apply general rules to specific problems and solve them.
  - Equipment Maintenance: determining when and what kind of maintenance is needed.
  - Monitoring: Monitoring/Assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.
  - Troubleshooting: determining the causes of functional or operational malfunctions and the ability to decide what the appropriate course of action is.

For Manufacturing Professionals

(e.g., Electrical and Electronic Equipment Assemblers; Electrical Engineers; Manufacturing Engineers)

- Knowledge:
  - Engineering and Technology: applying principles, techniques, and procedures in Smart Energy technology to the design and implementation of Smart Energy equipment.
  - Production and Processing: knowledge of raw materials, production processes, quality control, costs, and other techniques for more effective manufacture and distribution of products.
  - Computers and Electronics: circuit boards, chips, electronic equipment, and general hardware/software architecture.
  - Energy Physics: knowledge of physical principles, laws, and applications related to thermal and energy performance of structures and devices.
- Skills:
  - Deductive Reasoning: the ability to apply general rules to specific problems and solve them.
  - Analyzing Data: identifying underlying principles of information by breaking down data into separate contributions.
  - Monitor Processes and Materials: the ability to detect and assess problems through monitoring and reviewing materials, events or the manufacturing environment.
  - Interacting with Computers: using computers and computer systems to operate machinery, write software, enter data or process information.
  - Problem Solving: analyzing information and evaluating results to choose the best solution.

For Green Sales/Marketing Professionals

(e.g., Marketing Managers; Green Marketers; Customer Service Representatives)

- Knowledge:
  - Sales and Marketing: showing, promoting and selling Smart Energy products or services.
  - Customer Service: understanding of the principles and processes within customer service. Includes customer needs assessment and evaluation of customer satisfaction.
  - Smart Energy Economics: general understanding of the different products and methodologies within the industry and how they can directly save money according to particular customer needs.
- Skills:
  - Active Listening: giving full attention to what other people are saying and taking the time to understand points being made.
  - Critical Thinking: using logic and reasoning to weigh the strengths and weaknesses of different solutions.
  - Presentation: using clear and concise messaging to inform others of the features, advantages and benefits of Smart Energy products and services.
  - Inductive Reasoning: the ability to combine multiple pieces of information to form general rules for conclusions.