Tennessee Advanced Energy Economic Impact Report

Tennessee Advanced Energy Business Council

June 2015

Research conducted by The Howard Baker Jr. Center for Public Policy at the University of Tennessee

Tennessee Advanced Energy Business Council

www.TNAdvancedEnergy.com

Table of Contents

About Us

The Tennessee Advanced Energy Business Council (TAEBC) champions advanced energy as a job creation and economic development strategy. No other entity in the state concentrates specifically on this robust sector.

We educate public officials and business leaders about the value and job creation potential of Tennessee's advanced energy assets, establish strategic partnerships to connect assets with opportunities, and inform policy that expands and strengthens the industry.

TAEBC seeks to understand the advanced energy sector's priorities (manufacturers, installers, researchers, entrepreneurs, professional service providers and companies that are end users of advanced energy technologies), share information about the value of this sector with public and private sector leaders, and develop programs that connect and leverage our state's assets with opportunities to promote Tennessee's advanced energy economy.

The Howard Baker Jr. Center for Public Policy at the University of Tennessee is an education and research center that serves the University of Tennessee, Knoxville, and the public. The Baker Center is a nonpartisan institute devoted to education and public policy scholarship focused on energy and the environment, global security, leadership and governance.

What is Advanced Energy?

Advanced energy is a relatively new term, but already represents a $1.3 trillion global market.

Rather than favoring specific technologies, the term advanced energy is technology neutral. Any technology that makes energy cleaner, safer, more secure and more efficient is considered advanced energy. Examples include electric and plug-in hybrid cars, lightweight composites for the automotive industry, natural gas fueled trucks, pollution control equipment, bio energy, high-performance buildings, more efficient industrial processes, power reliability, smart grids, combined heat and power and the latest wind, solar, and nuclear technologies.

Examples of Tennessee's advanced energy industry are scattered throughout this report to give the reader a better understanding of the breadth and depth of the advanced energy economy.

Foreword

Tom Ballard, President, Tennessee Advanced Energy Business Council

The *Tennessee Advanced Energy Economic Impact Report* is the first document of its kind that defines the scope of Tennessee's advanced energy sector and quantifies its economic impact. This report identifies the number of jobs, contribution to state Gross Domestic Product (GDP), state/local taxes, and the number of companies associated with Tennessee's advanced energy sector.

Compiling this information was an important task to undertake—for our state and for our members.

Here's why: The global energy sector is changing rapidly. These changes are rippling through all sectors of the economy in increasingly visible ways, leading to the emergence of what is now called the advanced energy economy, a $1.3 trillion global market.

Because this is a relatively new and emerging industry, there was no comprehensive inventory of the economic activity that falls under the advanced energy umbrella for Tennessee—until now.

Neighboring states like Arkansas, North Carolina and South Carolina, however, have been benchmarking and touting the strength of their advanced energy economies. Their stories tell us that other states have recognized the economic importance of this emerging sector and are vying for a piece of the $1.3 trillion global market.

Yet, as you will see, Tennessee is well-positioned to gain a significant portion of this trillion dollar pie.

This report, commissioned by the Tennessee Advanced Energy Business Council, is a critically important first step in identifying, benchmarking and quantifying Tennessee's advanced energy economy as it relates to the state's unique research, workforce and entrepreneurial assets for three reasons.

1. To increase the visibility of advanced energy as an economic driver for Tennessee, a significant emerging reality that is fostering the growth of Tennessee companies and technologies.
2. To highlight Tennessee as a national and international leader in this rapidly burgeoning $1.3 trillion global marketplace.
3. To showcase opportunities for our emerging workforce as we drive to get 55 percent of Tennesseans equipped with a college degree or certificate by the year 2025.

In fact, that is why the Tennessee Advanced Energy Business Council formed in 2014, to champion advanced energy as an economic development and job creation strategy.

We are grateful to Dr. Matt Murray and his team at The Howard H. Baker Jr. Center for Public Policy for leading this important research. We are equally appreciative to those who funded this report: The University of Tennessee's TN-SCORE initiative, The Energy Foundation and our members.

The hope is that the *Tennessee Advanced Energy Economic Impact Report* provides a context for decisions by public officials and private sector leaders to make lasting contributions to Tennessee's economic base for the next decade and beyond.

Executive Summary

This report represents the first comprehensive look at the advanced energy sector in Tennessee.

It details the scope of Tennessee's advanced energy economy and defines a standard, measurable state-specific definition of advanced energy that can be used to assess the growth and impact of Tennessee's advanced energy economy over time.

As the advanced energy economy continues to evolve, it's important to note the Tennessee Advanced Energy Business Council took that first step to identify, benchmark and quantify the economy as it relates to our unique research, workforce and entrepreneurial assets.

It is imperative that Tennessee shine as a leader in this $1.3 trillion global market, helping economic development stakeholders attract businesses to the state, creating jobs for residents.

Prepared by The Howard H. Baker Jr. Center for Public Policy, the following extensive research reveals six clear themes:

- **Advanced Energy (AE) is a rapidly expanding and lucrative growth sector in Tennessee.**
  - The presence of a significant AE sector will help attract other firms in the traditional supply chain and foster stronger economic growth through the provision of services to other businesses that can make them more competitive.
- **AE requires skilled labor and thus is a source of quality jobs in Tennessee.**
  - Nearly 325,000 jobs are supported by firms in the state's AE sector paying an annual average wage of $48,764, which is well above the state average.
- **Tennessee manufacturers benefit from a robust AE sector.** Especially automotive manufacturers that are integrating advanced energy technologies into their processes and products as a result of higher fuel economy standards.[1]
- **AE production and service activities contribute significantly to our state and local economies** and tax payments from workers in the AE sector help support the provision of essential public services like education.
  - Tennessee's AE sector contributes $33.4 billion to state gross domestic product while workers in the AE sector pay more than $820 million in sales tax to state and local governments.
- **AE represents an opportunity to promote rural economic development.**
  - Currently, almost 80 percent of AE activity is centered in just 20 counties in Tennessee. Rural Tennessee could benefit from further growth in AE activity.
- **Tennessee is not the only state vying for a piece of the advanced energy economy.** We must continue to highlight our assets and opportunities in order to gain a competitive edge in the recruitment and retention of the advanced energy sector.
  - Additional gains will accrue as the advanced energy sector enables other Tennessee businesses to be more energy efficient in the provision of their goods and services, many of which are sold to external markets.

[2] National Highway Traffic Safety Administration, "Obama Administration Finalizes Historic 54.5 mpg Fuel Efficiency Standards, August 2012. http://www.nhtsa.gov/About+NHTSA/Press+Releases/2012/

Background

Supported by a variety of national and regional economic indicators, there is increasing evidence that Tennessee's advanced energy sector is poised for a period of sustained growth.

The Tennessee Advanced Energy Business Council (TAEBC) was founded to help facilitate this growth by championing the deployment, manufacturing and research of advanced energy as an economic development and job creation strategy.

Rather than favoring specific technologies, advanced energy is technology neutral. Any technology that makes energy cleaner, safer, more secure and more efficient is considered advanced energy. It includes users of advanced energy technologies, manufacturers, professional service providers, researchers and entrepreneurs.

One of the first projects the TAEBC pursued was the Tennessee Advanced Energy Asset Inventory[2], a listing of advanced energy assets, unique to Tennessee. It was the first document of its kind dedicated to promoting the use of advanced energy technologies and assisting Tennessee businesses in deploying or integrating advanced energy products, services or technologies.

[2] Tennessee Advanced Energy Business Council, Tennessee's Advanced Energy Asset Inventory, September 2013: http://www.tnadvancedenergy.com/site/wp-content/uploads/2012/09/TAEBC-Energy-Asset-Inventory.pdf

The inventory took a comprehensive identification and review of Tennessee's assets in each of these categories:

- Research: University of Tennessee, Oak Ridge National Laboratory, Vanderbilt University, Tennessee Technological University, Tennessee Valley Authority, etc.
- Organizations: Association of Energy Engineers, Tennessee Department of Environment & Conservation Office of Energy Programs, Tennessee Advanced Energy Business Council, etc.
- Entrepreneurial: Launch Tennessee, Knoxville Entrepreneur Center, Venture Incite, etc.
- Workforce: Roane State, Columbia State Community College, University of Tennessee Center for Industrial Services, etc.
- Incentives: Tax incentives, grants, bonds, state programs, etc.

After reviewing all of the information, TAEBC found the potential for expansion of advanced energy will be shaped by the myriad of economic assets unique to Tennessee.

Understanding what our unique assets bring to the discussion, as well as their willingness to combine expertise in support of advanced energy technologies, will ultimately help shape the opportunities for the expansion of the industry in Tennessee.

One example - The University of Tennessee, the Tennessee Valley Authority (TVA), Oak Ridge National Laboratory (ORNL) and the state's expanding automobile and logistics sectors - offer Tennessee an unparalleled platform for collaboration, innovation, testing, and implementation of advanced energy technologies, companies and jobs.

Initiatives at the Tennessee Valley Authority, Oak Ridge National Lab and the University of Tennessee have been responsive to efforts by Tennessee's automotive manufacturers to promote clean and advanced technologies, both in their products and in the operation of their manufacturing facilities. Tennessee has been ranked as the number one state for automotive manufacturing strength for four consecutive years.[3] Given the global shift toward fuel-efficient vehicles, the automotive sector represents a major end user and manufacturer of advanced energy technologies.

[3] Tennessee Department of Economic and Community Development. http://www.tnecd.com/industries/automotive/

The scope and scale of Tennessee's economic assets and the collaboration among assets and private sector opportunities are special to Tennessee. In fact, it's an attribute that distinguishes Tennessee from other states when it comes to economic development. The days of low wages and low taxes as the sole economic differentiator are behind us. Global industry demands innovation and Tennessee is poised to deliver.

Our optimism for advanced energy is well-founded.

The *Advanced Energy Now 2015 Market Report*[4], published by Advanced Energy Economy, indicated strong growth nationally and globally in the advanced energy market. At nearly $1.3 trillion in estimated global revenue for 2014, the market for advanced energy products and services is comparable to the apparel and fashion industry and clocks in at almost four times the size of the semi-conductor industry worldwide.

[4] Advanced Energy Economy, Advanced Energy Now 2015 Market Report, February 2015: https://www.aee.net/articles/report-advanced-energy-is-a-nearly-1-3-trillion-global-industry

The study, conducted by Navigant Research, found that advanced energy in the United States represents an estimated $199.5 billion market in 2014, up 14% from 2013 ($169 billion), and five times the rate of growth of the U.S. economy overall.

EXAMPLE: TENNESSEE ADVANCED ENERGY

University of Tennessee/Oak Ridge National Laboratory, Institute for Advanced Composites Manufacturing Innovation

Knoxville/Oak Ridge, TN

Led by the University of Tennessee and headquartered in Knoxville, the Institute for Advanced Composites Manufacturing Innovation (IACMI) will develop new low-cost, high-speed, and efficient manufacturing and recycling process technologies that will promote widespread use of advanced composites. The new Institute will focus on lowering the overall manufacturing costs of advanced composites by 50 percent, reducing the energy used to make composites by 75 percent, and increasing the ability to recycle composites by more than 95 percent within the next decade.

IACMI's analysis has shown that the market for composite materials will nearly double globally by 2020. Decreasing both the amount of materials needed to produce a product and the energy to run it should save money for both consumers and producers. High-speed production of composites at lower cost could enable broader use in high-volume, cost-sensitive markets such as automotive, wind energy and compressed gas storage.

Understandably, traditional businesses want access to these advanced energy technologies.

Power Forward 2.0: How American Companies are Setting Clean Energy Targets and Capturing Greater Business Value[5] shows that Fortune 100 and Fortune 500 companies are increasing the demand for cleaner, more efficient sources of energy. The report found that 53 Fortune 100 companies reporting on climate and energy targets are collectively saving $1.1 billion annually through their emission reduction and renewable energy initiatives. It's clear the trend is moving toward greater adoption of advanced energy technologies and policies.

[5] Ceres, Power Forward 2.0: How American Companies are Setting Clean Energy Targets and Capturing Greater Business Value, June 2014: http://www.ceres.org/resources/reports/power-forward-2.0-how-american-companies-are-setting-clean-energy-targets-and-capturing-greater-business-value

Power Forward 2.0 further indicates that 215 companies in the Fortune 500 have set targets in one of three categories: 1) greenhouse gas reduction commitments, 2) energy efficiency and 3) renewable energy. These companies, many of which have Tennessee ties, including FedEx and General Motors, will be looking for ways to meet their targets. The advanced energy economy in Tennessee stands to benefit from this movement.

Clearly, research demonstrates that states which offer a favorable business climate, possess unique assets and provide a workforce for both companies that use advanced energy. As a part of the advanced energy supply chain, states will gain a competitive advantage in recruiting and retaining those businesses. This means higher paying, quality jobs.

Objectives

Because advanced energy is a new and rapidly growing industry, there was no prior comprehensive inventory for Tennessee of the economic activity that falls under the advanced energy umbrella. That's all rapidly changing.

By commissioning this report, the Tennessee Advanced Energy Business Council took the first step to identify, benchmark and quantify the scope of Tennessee's advanced energy economy as it relates to our unique research, workforce and entrepreneurial assets.

EXAMPLE: TENNESSEE ADVANCED ENERGY

Schneider Electric, Wiser Air Smart Thermostat

LaVergne, TN

Schneider Electric employs approximately 1,500 people at its development, manufacturing, and commercial facilities in middle Tennessee. The company is focused on making energy safe, reliable, efficient, productive and green. One of Schneider's newest advanced energy products is the Wiser Air Smart Thermostat. Developed in Tennessee, the Wiser Air Smart Thermostat is a home energy management tool that makes homes more energy efficient, saving homeowners 30% on their utility bills. By having access to real-time home energy output information via the thermostat's smart phone style touch screen, smart phone app, and a web portal, end users can program, monitor, manage and control what they pay each month on their utility bills.

The report includes the following:

- Standard, measurable state-specific definition of advanced energy that can be used to assess growth and impact of Tennessee's advanced energy economy over time;
- List of each component of Tennessee's advanced energy economy and descriptions of industry groupings based on the North American Industrial Classification System (NAICS);
- Estimate of advanced energy's contribution to state GDP;
- Number of full time jobs in advanced energy sectors;
- Total payroll expenditures in advanced energy sectors;
- State and local sales taxes associated with the advanced energy economy;
- Case studies that provide examples of the state's advanced energy sector.

The Scope and Scale of Tennessee's Advanced Energy Sector

- The state-specific definition of advanced energy yielded 62 four-digit industries that together comprise Tennessee's advanced energy sector. The industries chosen for inclusion generally align with those that have been identified as part of the advanced energy economy in other states.
- Firms in the advanced energy sector employed 324,920 workers in 2013 and provided total payroll of $15.9 million. The average salary of a worker in the advanced energy sector was $48,764 which falls well above the statewide average.
- There are 17,334 business establishments in the state's advanced energy sector. Nearly one-half of these establishments (47.5 percent) are in the utilities and construction grouping of industries.
- Businesses in the advanced energy sector contributed $33.4 billion to state gross domestic product in 2013.
- Workers in the advanced energy sector made sales tax payments to the state and to various local governments amounting to $820 million. These revenues are used by the state and local governments to provide a range of essential services, including education and training that helps foster economic growth.
- Almost 80 percent of employment in the advanced energy sector is concentrated in just 20 of Tennessee's 95 counties, led by Davidson County.

Conclusion

Businesses in Tennessee's advanced energy sector account for a significant share of statewide employment, provide relatively high earnings to their workers and make a substantial contribution to state GDP. These direct impacts on the state economy are captured in this report. Several important indirect effects can also enhance the competitiveness of the state economy. Businesses in Tennessee that compete against producers from other states are under intense competition. By utilizing the products and services of the state's advanced energy sector, and thus being more efficient in energy use, in-state businesses may be better able to compete against their counterparts from elsewhere. Further growth in the advanced energy sector promises to bring forth more benefits for businesses and workers in Tennessee.

Introduction

Keeping America competitive requires affordable energy. And here we have a serious problem: America is addicted to oil, which is often imported from unstable parts of the world. The best way to break this addiction is through technology. Since 2001, we have spent nearly $10 billion to develop cleaner, cheaper, and more reliable alternative energy sources – and we are on the threshold of incredible advances.

—President George W. Bush

Following President Bush's 2006 State of the Union address, he announced the Advanced Energy Initiative and proposed a 22 percent increase in funding for clean energy technology research at the Department of Energy. This Advanced Energy Initiative was one catalyst that helped spark focus on a new sector of the economy – the advanced energy (AE) economy. The AE economy has now received considerable attention and has flourished since its identification as an important part of the overall economy. A series of national and state-level studies have been completed documenting the size and growth of the AE sector. From 2013 to 2014 alone, U.S. firms engaged in AE activities have seen revenue grow 14 percent. That is five times greater than the growth rate of the overall U.S. economy (Navigant Research, 2015). By 2014, the AE market in the U.S. reached just under $200 billion, which makes up 15 percent of the global market. It is clear that the AE industry has experienced extensive growth and this growth is expected to continue.

Other states have seen the growth potential of the AE economy and reports have been commissioned to document its current size. This includes Arkansas, California, Iowa, Illinois, Pennsylvania, Florida, Massachusetts, North Carolina, South Carolina, Vermont, and Washington. These state-specific studies have relied on relatively small surveys and typically have low survey response rates. For example, Arkansas was estimated to employ only 16,000 workers in the advanced energy economy, based on survey responses from only 141 businesses. The state studies show that advanced energy employment is roughly one to four percent of overall statewide employment.

The goal of this report is to document and benchmark the scope of the AE economy in Tennessee using the most comprehensive and recently available data. Of particular interest is the footprint of firms that might potentially be engaged in the provision of AE products and services. Having this information will enable comparisons to other states and allow Tennessee's AE economy to be monitored for progress over time. The analysis relies on the U.S. Census Bureau's County Business Patterns (CBP) database which provides detailed state and sub-state data available for 2013 (and preceding years). These data include information on number of firms, payroll expenditures and employment by industry, based on the North American Industrial Classification System (NAICS). No information on specific firms or companies is included in the CBP data. In principle, data are available at the county, metropolitan statistical area (MSA),

and state levels. In practice, data are missing or subject to nondisclosure for many smaller counties and numerous AE sectors with small levels of economic activity. The CBP data allow determination of the universe of firms potentially engaged in the advanced energy economy.

Sixty-two four-digit industry groups were ultimately identified for inclusion in the benchmarking of the Tennessee AE economy. These industries represent the foundation of current AE activity and the potential for future growth. Together these industries employed 324,920 workers and provided payroll of $15.8 billion in 2013. Over 17,000 business establishments are part of the Tennessee AE economy. The AE manufacturing sector alone accounted for 43.1 percent of all AE employment in the state. The Nashville metropolitan area had the largest AE employment impact in 2013.

EXAMPLE: TENNESSEE ADVANCED ENERGY

FedEx, fuel efficiency

Memphis, TN

FedEx Corporation is an American global courier delivery services company headquartered in Memphis. Beyond moving packages from point A to point B, FedEx also has a commitment to sustainability in its practices.

The company is within half a percentage point of its goal to increase FedEx Express vehicle fuel efficiency by 30% from a 2005 baseline by 2020 – five years ahead of schedule. The company estimates a $62 million cost savings from better fuel efficiency in the 2014 fiscal year.

FedEx's goal is to obtain 30 percent of its aviation fuel from alternative sources by 2030. FedEx is actively engaged with other stakeholders to develop viable sustainable alternatives to petroleum-based jet fuel.

In April 2015, FedEx, in collaboration with the U.S. Department of Energy, rolled out the "world's first zero emissions, hydrogen fuel cell ground support equipment (GSE)." FedEx received a $2.5 million grant from the U.S. Department of Energy to operate 15 hydrogen fuel cell-powered Charlatte GSEs and a Plug Power Inc. hydrogen fueling station.

Defining the Advanced Energy Economy

Defining advanced energy is a valid and valuable exercise, especially at the state level. As state economic stakeholders evaluate their economies and make decisions about sectors and strategies that will increase high-quality employment opportunities and provide the best return for taxpayers, it's important to establish a baseline from which to evaluate year after year.

After a thorough review of previous studies on advanced energy, clean energy, green energy and Tennessee's AE assets, the AE sector in this report is conceptually defined as the following:

> **An advanced energy firm is defined as being directly involved with researching, developing, producing, manufacturing, distributing, selling, or implementing components, goods or services related to advanced energy; energy efficiency; renewable, nuclear, and natural gas electricity generation; distributed generation; advanced manufacturing; lightweight composites for the automotive industry; electric and hybrid vehicles; pollution control technologies; smart grid; and other related technologies. This can include supporting services such as consulting, finance, tax, and legal services related to advanced energy. It includes farm workers involved in growing feedstock (corn, soy, etc.) for advanced fuels.**

Emerging research, including many of the state studies summarized above, recognizes that defining advanced energy and measuring this new industry sector is challenging. AE has been interpreted somewhat differently by various stakeholders and in different research studies. Moreover, measurement is difficult because AE activities span traditional industrial and occupational categories, which serve as the common means of measuring economic activity. Similar challenges arise in defining related "green" or "clean" industries. Unfortunately, no publically-available national or regional database exists on the AE economy and its sub-industries.

Recent studies on Arkansas, California, Iowa, Massachusetts, North Carolina, South Carolina, and Vermont have taken a conceptual approach similar to that followed here where AE activity is classified as being directly involved with researching, developing, producing, manufacturing, distributing, selling, or implementing components, goods or services related to alternative fuels and vehicles, energy efficiency, renewable, nuclear, and natural gas electricity generation; smart grid; and other related technologies. This classification system can include supporting activities such as consulting, finance, tax, and legal services related to AE. This definition characterizes the activities of a firm in the AE industry on being on either the demand or supply side of the market.

An alternative means of conceptualizing the AE economy is to investigate characteristics of production and service processes instead of the nature of products and services themselves.[6] For comparison, consider advanced manufacturing, which has received considerable attention in recent years. One way to define advanced manufacturing is in terms of the final product—a smartphone, for example. What about wood products or bricks? These products may not appear to be very sophisticated, but in practice they may be the output of highly-advanced and sophisticated production processes. This simple example is intended to highlight the importance of thinking about underlying production processes—which may reflect workers' skills, research, development and innovation—as well as the final product when defining the AE economy.

Tennessee has several AE assets that are unique to the state. A review of Tennessee's Advanced Energy Asset Inventory[7] reveals an extensive array of research, entrepreneurial and workforce assets. Economic assets unique to Tennessee will shape the potential for the expansion of the state's advanced energy sector. Therefore, it is important to be mindful of these assets as we define advanced energy for Tennessee.

For example, initiatives at the Tennessee Valley Authority, Oak Ridge National Lab and the University of Tennessee have been responsive to efforts by Tennessee's automotive manufacturers to promote clean and advanced technologies, both in their products and in the operation of their manufacturing facilities. Tennessee has been ranked as the number one state for automotive manufacturing strength for four consecutive years.[8] Given the global shift toward fuel efficient vehicles, the automotive sector represents a major end-user and manufacturer of advanced energy technologies.

Tennessee's definition of advanced energy provides the foundation for classifying industries as elements of the AE economy. The application of this definition is constrained by the standard method of classifying business establishments under the National Amercian Industry Classification System (NAICS), noted above. NAICS is a two- through six-digit hierarchical classification system, offering differing levels of detail, from very high levels of aggregation to highly-detailed levels of granularity. Each digit in the code is part of a series of progressively narrow categories, and more digits in the code signify greater classification detail (North American Industry Classification System, 2014). The data used in this study relies on four-digit NAICS codes, which designate well-defined industry groups.

[6] This is the approach followed by the Brookings Institution. They identify America's advanced industries by using two criteria: (i) an industry's research and development (R&D) spending per worker must fall in the 80th percentile of industries or higher, exceeding $450 per worker, and (ii) the share of workers in an industry whose occupations require a high degree of STEM (science, technology, engineering, and math) knowledge must also be above the national average, or 21 percent of all workers (Muro, Rothwell, Andes, Fikri, & Kulkarni, 2015). Most definitions of advanced industry, including those discussed in the text, focus on products or services, whereas Brookings seeks to focus on innovation and skills that underlay production processes. Detailed data are not available at the sub-state level to allow implementation of the Brookings approach.

[7] Tennessee Advanced Energy Business Council, Tennessee Advanced Energy Asset Inventory, September 2013: http://www.tnadvancedenergy.com/site/wp-content/uploads/2012/09/TAEBC-Energy-Asset-Inventory.pdf

[8] Tennessee Department of Economic and Community Development. http://www.tnecd.com/industries/automotive/

EXAMPLE: TENNESSEE ADVANCED ENERGY

PHG Energy, Waste-To-Energy

Nashville, TN

PHG Energy installs state-of-the-art waste-to-energy technology, which converts industrial and municipal waste, or renewable biomass, to a clean-burning fuel gas through a thermo-chemical process. That synthetic gas can be utilized like natural gas to produce economical electric or thermal power.

The Cities of Covington and Lebanon both deployed downdraft gasification systems from PHG Energy to provide an environmentally sustainable, cost effective method of waste disposal and produce green power. Both systems generate electricity that is used for internal power needs and export electricity to their co-located wastewater treatment plants.

Utilizing Tennessee's definition of advanced energy and previous state reports, candidate industries were evaluated and a list of NAICS codes was ultimately selected as comprising the AE economy in Tennessee. Determining the list of NAICS codes that depict AE involved examining previous studies on advanced energy, clean energy, and green energy by other states and national organizations. Each NAICS code that is included in this study has been identified by either the Center for Community Innovation at the University of California, Berkeley; the Puget Sound Regional Council and the Workforce Development Council of Seattle-King County; the Iowa Workforce Development; the Bookings Institution; or the Washington State Employment Security Department. Further, each NAICS code that is included in this report captures some element of the definition of AE presented above.

In total, 62 NAICS codes were identified for inclusion in this study. These industries capture firms currently engaged in AE activity as well as firms poised to take advantage of future growth opportunities. The selected NAICS naturally fall into five different industry groups:

- Advanced energy utilities and construction;
- Advanced energy manufacturing;
- Advanced energy information;
- Advanced energy professional, scientific, and technical services; and
- Advanced energy other services (includes administrative and support, waste management and remediation services, and health care and social assistance).

A large portion of the NAICS codes fall under the umbrella of AE manufacturing – 36 four-digit NAICS industries in total. The next largest subgroup is AE utilities and construction, containing nine NAICS industries. AE information includes seven four-digit NAICS industries, while AE professional, scientific, and technical services has six NAICS industries. Finally, AE other services includes four NAICS industries. The selected industry groups are shown in Table 1.

Table 1: Advanced Energy NAICS Industry Groups

Industry Group	NAICS	Descriptor
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution
	2212	Natural Gas Distribution
	2361	Residential Building Construction
	2362	Nonresidential Building Construction
	2371	Utility System Construction
	2379	Other Heavy and Civil Engineering Construction
	2381	Foundation, Structure, and Building Exterior Contractors
	2382	Building Equipment Contractors
	2383	Building Finishing Contractors
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation
	3221	Pulp, Paper, and Paperboard Mills
	3241	Petroleum and Coal Products Manufacturing
	3251	Basic Chemical Manufacturing
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing
	3253	Pesticide, Fertilitzer, and Other Agricultural Chemical Manufacturing

Industry Group	NAICS	Descriptor
Advanced Energy Manufacturing	3259	Other Chemical Product and Preparation Manufacturing
	3272	Glass and Glass Product Manufacturing
	3279	Other Nonmetallic Mineral Product Manufacturing
	3311	Iron and Steel Mills and Ferroalloy Manufacturing
	3313	Alumina and Aluminum Production and Processing
	3315	Foundries
	3331	Agriculture, Construction, and Mining Machinery Manufacturing
	3332	Industrial Machinery Manufacturing
	3333	Commercial and Service Industry Machinery Manufacturing
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing
	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing
	3339	Other General Purpose Machinery Manufacturing
	3341	Computer and Peripheral Equipment Manufacturing
	3342	Communication Equipment Manufacturing
	3343	Audio and Video Equipment Manufacturing
	3344	Semiconductor and Other Electronic Component Manufacturing
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
	3346	Manufacturing and Reproducing Magnetic and Optical Media
	3351	Electric Lighting Equipment Manufacturing
	3352	Household Appliance Manufacturing
	3353	Electrical Equipment Manufacturing
	3359	Other Electrical Equipment and Component Manufacturing
	3361	Motor Vehicle Manufacturing
	3362	Motor Vehicle Body and Trailer Manufacturing
	3363	Motor Vehicle Parts Manufacturing
	3364	Aerospace Product and Parts Manufacturing
	3366	Ship and Boat Building
	3369	Other Transportation Equipment Manufacturing
	3391	Medical Equipment and Supplies Manufacturing
	3399	Other Miscellaneous Manufacturing
Advanced Energy Information	5112	Software Publishers
	5152	Cable and Other Subscription Programming
	5172	Wireless Telecommunications Carriers (except Satellite)
	5174	Satellite Telecommunications
	5179	Other Telecommunications
	5182	Data Processing, Hosting, and Related Services
	5191	Other Information Services

Industry Group	NAICS	Descriptor
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services
	5414	Specialized Design Services
	5415	Computer System Design and Related Services
	5416	Management, Scientific, and Technical Consulting Services
	5417	Scientific Research and Development Services
	5419	Other Professional, Scientific, and Technical Services
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal
	6215	Medical and Diagnostic Laboratories
	8112	Electronic and Precision Equipment Repair and Maintenance
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance

The U.S. Census Bureau's County Business Patterns (CBP) database was chosen since it includes the universe of all firms in the state and provides detail (including number of establishments) not otherwise available. Measuring the AE sector relied on information on the number of establishments, payroll expenditures, and employment by NAICS code. These data are available at the county level, Metropolitan Statistical Area (MSA) level, and state level. In practice, disclosure problems increase as the level of detail gets smaller (going from state-level data to county-level data). This is to prevent releasing data on individual companies. Another issue is that the employment data are often reported over a range as opposed to a point estimate. When an employment range is observed, the average of the two endpoints of the range is used in the analysis.

EXAMPLE: TENNESSEE ADVANCED ENERGY

A.O. Smith, High-efficiency water heaters and boilers

Statewide

A.O. Smith Corporation is one of the world's leading manufacturers of residential and commercial water heating equipment. Its Tennessee operations are located in Ashland City, Cookeville, Franklin, Knoxville, Lebanon and Johnson City. The company's North American business continues to expand, paced by double-digit increases in its high-efficiency boiler business and growth in its high-margin commercial water heater business. In September 2014, the company announced a 74,000 square foot addition to its Lebanon plant to accommodate the increasing demand for high-efficiency boilers.

Tennessee's Advanced Energy Economy: Statewide Impacts

Based on the analysis of the CBP data, Tennessee was home to 324,920 jobs in the AE sector in 2013. (See Figure 1 and Table 2.) This is 13.6 percent of total statewide Tennessee employment in 2013. In 2012, the total AE job count in Tennessee was 314,930, indicating 3.2 percent growth in the sector between 2012 and 2013, well above the state's overall rate of job growth. AE manufacturing comprises the largest share of employment in the state at 139,953 employees or 43.1 percent of all AE jobs in Tennessee. Manufacturing employment in the AE sector represented 46.7 percent of overall manufacturing employment in Tennessee in 2013. While this is a very large share of the state's manufacturing sector, it must be recognized that Tennessee's modern industrial sector now makes products that compete with similar products produced around the world, from computers to transportation equipment. Competitive pressures compel businesses to stay on the frontline of productivity and cost containment and necessitate the use of AE goods, services and practices.

The next closest industry group to AE manufacturing in terms of employment is AE utilities and construction, which lays claim to 90,510 employees or 27.9 percent of the total AE employment. Note that while AE manufacturing includes around 49,000 more jobs than AE utilities and construction, the number of NAICS codes for each group is also vastly different. The contrast between the two industry groups is 27 NAICS codes, meaning that AE construction and utilities captures a large share of AE jobs in the state with a significantly lower NAICS code count. AE professional, scientific, and technical services account for 62,182 employees (19.1 percent),

EXAMPLE: TENNESSEE ADVANCED ENERGY

Nissan, LEAF, electric vehicle batteries and advanced building technologies

Smyrna, TN

Nissan has a very large footprint in Tennessee and represents both the end-user of and manufacturer of advanced energy technologies. The electric Nissan LEAF is assembled at the company's manufacturing facility in Smyrna and its Electric Vehicle (EV) Lithium-ion Battery is manufactured next door at the company's battery plant. As a DOE Better Buildings Better Plants Challenge Partner, Nissan has committed to reducing energy use in its three U.S. plants 25% by 2020, affecting 12 million square feet of plant space.

while AE information employs 19,094 individuals (5.9 percent). Lastly, AE other services represents 13,181 jobs or 4.1 percent of AE employment in Tennessee.

Payroll figures are reported in Table 2. Since AE manufacturing represents the largest portion of AE jobs in Tennessee, it follows that it accounts for the most payroll spent in the state in 2013 at nearly $5.8 billion. This same pattern emerges for the other industry groups, including payroll expenditures in the AE utilities and construction industry groups which has the second-highest payroll at just over $4.2 billion. Firms in the AE professional, scientific, and technical services sector spend $4.1 billion on payroll, whereas AE information accounts for $1 billion in payroll expenditures. Rounding out the industry groups is AE other services, which provides $722 million in payroll. This yields total payroll expenditures in the state associated with AE of $15.8 billion. Note that because of disclosure limitations, this is a conservative estimate--there are several data points at the state level that have AE activity, but detailed data are not reported. The exact NAICS codes that do not disclose payroll information can be found in the Appendix tables, which detail all the data (employment, payroll, and number of establishments) at the state level for Tennessee.

Table 2: Advanced Energy in Tennessee by Industry Group, 2013

Industry Group	Employment	Payroll ($1,000)	Number of Establishments
AE Utilities and Construction	90,510	$4,217,074	8,230
AE Manufacturing	139,953	$5,783,446	1,799
AE Information	19,094	$1,007,872	696
AE Professional, Scientific, & Technical Services	62,182	$4,114,066	5,759
AE Other Services	13,181	$721,981	850
Total Advanced Energy Industry	**324,920**	**$15,844,439**	**17,334**

The average wage for an employee of the advanced energy sector in Tennessee is $48,764, which is higher than the state average. Investigating the average wage for each industry group in the advanced energy sector reveals that AE professional, scientific, and technical services earn the highest average wage at $66,162 annually. AE other services earns the second-highest average wage at $54,774. Making slightly less than that are those employed in the AE information industry group who make $52,785 a year. The AE utilities and construction workers earn $46,592, while the AE manufacturing employees earn $41,324 annually.

EXAMPLE: TENNESSEE ADVANCED ENERGY

Volkswagen, solar and advanced building technologies

Chattanooga, TN

In January 2013, Volkswagen dedicated the largest solar installation at an automotive manufacturing facility in the United States and one of the single biggest solar installations in Tennessee. The 9.5 Megawatt solar system, developed by Tennessee-based Silicon Ranch Corporation, provides 12 percent of the power required for Volkswagen's massive Chattanooga assembly plant when in operation. In 2012, the Chattanooga facility was designated as the only LEED Platinum automotive manufacturing plant in the world.

Interestingly, the number of AE establishments in the state does not follow the ranking trend of employment and payroll. Instead, AE utilities and construction accounts for the largest number of establishments in Tennessee at 8,230 or 47.5 percent of the state total AE establishments in 2013. AE professional, scientific, and technical services include 5,759 establishments, which is 33.2 percent of all AE establishments. The largest employer of AE in Tennessee, AE manufacturing, only includes 1,799 establishments (10.4 percent). This indicates that AE manufacturing has fewer establishments larger in employment size, and AE utilities and construction have many establishments with a smaller number of employees. AE other services accounts for 850 establishments or 4.9 percent of the total, and AE information contains 4.0 percent of all Tennessee AE establishments with 696 firms. This makes the total number of AE establishments in Tennessee at 17,334. The shares of establishments for each industry group can be found in Figure 2.

The data sources used to compile this information do not directly reveal the value of output that AE firms contribute to state GDP nor the amount of sales tax revenue that accrues to state and local governments in Tennessee because of AE activity. However, it is possible to estimate GDP impacts based on employment data. It is also possible to estimate sales tax revenue impacts based on statewide payroll figures.

Using data from the U.S. Bureau of Economic Analysis (BEA), a measure of output per worker was calculated for the entire state as well as each of the five industry groups used in this report (U.S. Bureau of Economic Analysis, 2014). The ratio of output per worker was then multiplied by the number of employees in the AE sector (for the state and five industry groups separately), which yields a measure of state GDP for Tennessee in 2013. Table 3 displays the state GDP values for the AE sector in 2013. AE manufacturing dominates state GDP, providing $19.2 billion in output for Tennessee. AE professional, scientific, and technical services along with AE utilities and construction provide similar levels of GDP for the state at $5.2 billion and $5.1 billion, respectively. AE information generates $3 billion in state GDP, while AE other services rounds out the industry groups creating $933.7 million in GDP. The total state GDP generated by the AE sector in Tennessee is $33.4 billion.

EXAMPLE: TENNESSEE ADVANCED ENERGY

Small Modular Reactors

Small modular nuclear reactors (SMRs) offer the advantage of lower initial capital investment, scalability, and citing flexibility at locations unable to accommodate more traditional larger reactors. They also have the potential for enhanced safety and security. The U.S. Department of Energy has signed two agreements that support SMR development. One agreement with Babcock & Wilcox, Tennessee Valley Authority and Bechtel. The other with NuScale Power. To date, none of the SMR concepts have been designed, licensed or constructed.

Table 3 also exhibits both state and local sales tax revenue produced by the AE sector in the state, based on the value of payroll disbursements by AE firms. Again, AE manufacturing generates the most state and local tax revenue with $222.7 million and $76.7 million each. AE utilities and construction provides a slightly larger amount of revenue at the state ($162.4 million) and local ($55.9 million) level than AE professional, scientific, and technical services ($158.4 million for the state and $54.5 million locally). AE information produces $38.8 million in state sales tax revenue and $13.4 million in local sales tax revenue. AE other services completes the industry groups with $27.8 million in state sales tax revenues and $9.6 million local sales tax revenues, making the total amount of state sales tax generated by the AE sector $610 million and the total local amount $210 million.

Table 3: Advanced Energy State GDP and Sales Tax Revenues in Tennessee by Industry Group, 2013

Industry Group	GDP	State Sales Tax Revenue	Local Sales Tax Revenue
AE Utilities and Construction	$5,080,643,108	$162,357,349	$55,897,316
AE Manufacturing	$19,190,334,316	$222,662,671	$76,659,577
AE Information	$3,015,743,420	$38,803,072	$13,359,343
AE Professional, Scientific, & Technical Services	$5,162,248,061	$158,391,541	$54,531,945
AE Other Services	$933,670,961	$27,796,269	$9,569,858
Total Advanced Energy Industry	**$33,382,639,866**	**$610,010,902**	**$210,018,039**

The Advanced Energy Economy in Tennessee's Metropolitan Areas

MSA-level data more accurately pinpoint the geographic location of where AE activity is occurring in Tennessee. Tables 4-13 display employment, payroll, and the number of establishments for the ten MSAs in the state by industry group. The largest MSA in Tennessee is the Nashville-Davidson-Murfreesboro-Franklin MSA (henceforth Nashville MSA) and captures AE activity in Cannon, Cheatham, Davidson, Dickson, Hickman, Macon, Maury, Robertson, Rutherford, Smith, Sumner, Trousdale, Williamson, and Wilson Counties. The Nashville MSA employs 101,384 AE workers. This is 13.7 percent of total employment in the MSA. AE utilities and construction employ the largest set of AE employees in the Nashville MSA at 33,847 jobs, followed closely by AE manufacturing with 27,630 employees. The other three industry groups follow the state trend in their order of size and can be found in Table 3. It is interesting that AE professional, scientific, and technical services provide the largest AE payroll expenditures for the Nashville MSA, with nearly $1.7 billion in payroll. This could be in part due to the disclosure issues that are more prominent in the MSA-level data. (This can be explored in detail in the Appendix tables which indicate if the payroll information was disclosed or not.) A common theme with the data at MSA and county levels is that the AE manufacturing payroll numbers are often not disclosed at a higher rate than the other industry groups. Also note that there are some MSAs that will not have any activity for a given NAICS code. This just means that this MSA does not have any activity in that industry, which shouldn't be confused with data not disclosed for confidentiality reasons. Firms in the Nashville MSA AE sector spend approximately $4.6 billion on payroll expenditures and account for a total of 5,838 establishments.

EXAMPLE: TENNESSEE ADVANCED ENERGY

Renewable Algal Energy, biofuels

Johnson City, TN

Headquartered in Johnson City, Renewable Algal Energy (RAE) is an algal biotechnology firm committed to producing high-quality, refined raw materials. RAE's patented technology provides an economical and sustainable route for algal products to serve the nutraceutical, animal nutrition and renewable fuels markets. In 2014, RAE announced a strategic partnership with Neste Oil Corporation, the world's largest producer of renewable diesel fuel. Under the agreement, Neste can purchase RAE's crude algal oil on a commercial scale for use as a feedstock for producing renewable fuel.

Table 4: Advanced Energy in Nashville-Davidson-Murfreesboro-Franklin, TN MSA by Industry Group, 2013

Industry Group	Employment	Payroll ($1,000)	Number of Establishments
AE Utilities and Construction	33,847	$1,662,116	2,623
AE Manufacturing	27,630	$490,204	460
AE Information	10,615	$473,562	312
AE Professional, Scientific, & Technical Services	23,816	$1,684,510	2,172
AE Other Services	5,476	$288,993	271
Total Advanced Energy Industry	**101,384**	**$4,599,385**	**5,838**

The next largest AE-employing MSA in the state is the Memphis, Tennessee-Mississippi-Arkansas MSA (Memphis MSA). This MSA captures the advanced energy sector in Fayette, Shelby, and Tipton Counties in Tennessee; Crittenden County, Arkansas; and Benton, Desoto, Marshall, Tate, and Tunica Counties in Mississippi. As shown in Table 5, AE employment in the Memphis MSA totals 48,775 which is 9.3 percent of total employment in the MSA. The Memphis MSA mirrors the Nashville MSA in the order of employment size by industry group. AE utilities and construction accounts for 16,818 of the 48,775 total AE employees in the Memphis MSA for 2013. Approximately $2.3 billion is spent on payroll in the advanced energy sector, while there are 3,014 total AE establishments in the Memphis MSA.

Table 5: Advanced Energy in Memphis, TN-MS-AR MSA by Industry Group, 2013

Industry Group	Employment	Payroll ($1,000)	Number of Establishments
AE Utilities and Construction	16,818	$805,812	1,419
AE Manufacturing	16,292	$729,933	261
AE Information	2,592	$49,428	145
AE Professional, Scientific, & Technical Services	10,290	$594,650	1,021
AE Other Services	2,783	$155,147	168
Total Advanced Energy Industry	**48,775**	**$2,334,970**	**3,014**

EXAMPLE: TENNESSEE ADVANCED ENERGY

WACKER POLYSILICON, polysilicon production for solar cells

Charleston, TN

In April 2011, WACKER started construction work for the company's integrated polysilicon production site. The new facility, based in Bradley County, Tennessee, is scheduled to start production in mid-2015. WACKER POLYSILICON represents WACKER's continuation to invest in the growing photovoltaic and solar energy industries. The site will create 650 new jobs.

The MSA with the third-largest amount of AE activity in Tennessee is the Knoxville MSA in 2013, as summarized in Table 6. The Knoxville MSA covers Anderson, Blount, Campbell, Grainger, Knox, Loudon, Morgan, Roane, and Union Counties. There are a total of 47,217 individuals employed by the advanced energy sector in the Knoxville MSA, representing 14.9 percent of total MSA employment.[9] The Knoxville MSA employs more AE professional, scientific, and technical services individuals than any other industry group with 15,714 employees. AE manufacturing represents 14,736 of the total AE employees in the Knoxville MSA, followed by 10,951 employed by the AE utilities and construction industry group. AE information and AE other services account for 3,193 and 2,623 employees, respectively. Total AE payroll expenditures in the Knoxville MSA were $2.4 billion in 2013. There are 2,625 establishments housing the AE sector in this MSA.

[9] As discussed below, Knoxville may be the second-largest AE MSA in the state, because all of the activity is centered within the state's borders. That is not the case for the Memphis MSA, since it includes AE outcomes for counties in Mississippi and Arkansas.

Table 6: Advanced Energy in Knoxville, TN MSA by Industry Group, 2013

Industry Group	Employment	Payroll ($1,000)	Number of Establishments
AE Utilities and Construction	10,951	$496,461	1,194
AE Manufacturing	14,736	$492,201	230
AE Information	3,193	$78,763	77
AE Professional, Scientific, & Technical Services	15,714	$1,159,873	997
AE Other Services	2,623	$144,724	127
Total Advanced Energy Industry	**47,217**	**$2,372,022**	**2,625**

The Kingsport-Bristol-Bristol, Tennessee-Virginia MSA (Kingsport MSA) data in Table 7 summarizes the AE sector in Hawkins and Sullivan Counties in Tennessee and Scott County, Washington County and Bristol City, Virginia. Overall AE employment represents 32.5 percent of total employment in the MSA. This MSA is dominated by AE manufacturing, employing 25,358 of the 34,501 AE total jobs in 2013. AE utilities and construction is the next largest employer for AE jobs in the Kingsport MSA with 5,102 AE employees. AE information and AE professional, scientific, and technical services are very similar in employment size: 1,790 and 1,613 employees, respectively. AE other services employs the last 638 AE jobs in the Kingsport MSA. The AE payroll expenditures for this MSA total $337.9 million; no data are disclosed for the AE information industry group. As mentioned above, the lack of complete disclosure means that these payroll numbers reported in Table 7 are conservative. Even though AE manufacturing employs the vast majority of the AE sector in the Kingsport MSA, it does not have the largest payroll expenditures. Instead, AE utilities and construction spends $125.2 million on payroll, which is about $18 million more than the AE manufacturing industry group spends. There are a total of 743 AE establishments in the Kingsport MSA.

Table 7: Advanced Energy in Kingsport-Bristol-Bristol, TN-VA MSA by Industry Group, 2013

Industry Group	Employment	Payroll ($1,000)	Number of Establishments
AE Utilities and Construction	5,102	$125,152	362
AE Manufacturing	25,358	$107,241	97
AE Information	1,790	$-	20
AE Professional, Scientific, & Technical Services	1,613	$84,843	227
AE Other Services	638	$20,651	37
Total Advanced Energy Industry	**34,501**	**$337,887**	**743**

The Chattanooga, Tennessee-Georgia MSA has significant AE activity in 2013 as shown in Table 8. This MSA represents Hamilton, Marion, and Sequatchie Counties in Tennessee and Catoosa, Dade, and Walker, Counties in Georgia. There are approximately 28,147 employees in the AE sector for the Chattanooga MSA, representing 13.4 percent of total employment in the area. Of those, 12,445 employees are accounted for in AE manufacturing and 8,632 individuals in AE utilities and construction. AE professional, scientific, and technical services employs 5,186 workers, while AE information represents 1,094 AE employees. There are 790 individuals employed in the AE other services sector in the Chattanooga MSA. The 1,478 total establishments spend $976.8 million on payroll in the AE sector in this MSA. AE utilities and construction accounts for $424.7 million of those payroll dollars, while AE professional, scientific, and technical services includes $268.7 million of payroll. AE manufacturing spends around $221.2 million on payroll in the Chattanooga MSA, and AE other services devotes $49.1 million to payroll expenditures. AE information rounds out the payroll expenditures with $13.1 million.

Table 8: Advanced Energy in Chattanooga, TN-GA MSA by Industry Group, 2013

Industry Group	Employment	Payroll ($1,000)	Number of Establishments
AE Utilities and Construction	8,632	$424,709	675
AE Manufacturing	12,445	$221,154	170
AE Information	1,094	$13,086	48
AE Professional, Scientific, & Technical Services	5,186	$268,734	511
AE Other Services	790	$49,077	74
Total Advanced Energy Industry	**28,147**	**$976,760**	**1,478**

EXAMPLE: TENNESSEE ADVANCED ENERGY

City of Knoxville/Ameresco, Energy Savings Performance Contract

Knoxville, TN

The City of Knoxville undertook an ambitious plan to become one of the greenest cities in the nation. With help from Ameresco, a leading energy efficiency and renewable energy services provider, the City utilized renewable energy and energy efficiency solutions to save over a million dollars a year and enhance public spaces and official buildings. According to the City's 2014 Energy & Sustainability Work Plan & Emissions Inventory Update, energy consumption at City facilities has fallen dramatically as a result of energy efficiency investments and programs. In the ten City buildings that use the most energy, energy consumption has fallen 16% since 2007.

The last MSA with at least 10,000 people employed in the AE sector is the Clarksville, Tennessee-Kentucky MSA, as reported in Table 9. This MSA characterizes employment, payroll, and establishments in Montgomery County, Tennessee and Christian and Trigg County, Kentucky. Overall AE employment in the Clarksville MSA is 10,844, or 16.3 percent of total employment in the MSA. AE manufacturing employs the most AE workers in the Clarksville MSA with 6,930 AE employees. AE utilities and construction and AE professional, scientific, and technical services have very similar AE employee counts with 1,968 and 1,626 employees, respectively. AE information (175) and AE other services (145) employ a small share of AE jobs in the Clarksville MSA. Again, there is no payroll data disclosed for AE information since there are only nine establishments in the AE information industry group for the Clarksville MSA. The Clarksville MSA spends about $343.9 million on payroll for the AE sector, which is housed in a total of 516 establishments.

Table 9: Advanced Energy in Clarksville, TN-KY MSA by Industry Group, 2013

Industry Group	Employment	Payroll ($1,000)	Number of Establishments
AE Utilities and Construction	1,968	$66,090	285
AE Manufacturing	6,930	$132,402	56
AE Information	175	$-	9
AE Professional, Scientific, & Technical Services	1,626	$141,191	138
AE Other Services	145	$4,228	28
Total Advanced Energy Industry	**10,844**	**$343,911**	**516**

The Johnson City, Tennessee MSA is home to Carter, Unicoi, and Washington Counties. As shown in Table 10, there are approximately 7,392 AE employees in this MSA, representing 11.7 percent of total employment in the region. Of the total, 3,512 of the jobs are found in the AE manufacturing industry group. For the NAICS code data that are disclosed for the Johnson City MSA, around $119.9 million is spent on payroll in the 468 AE establishments in 2013.

Table 10: Advanced Energy in Johnson City, TN MSA by Industry Group, 2013

Industry Group	Employment	Payroll ($1,000)	Number of Establishments
AE Utilities and Construction	1,773	$57,009	250
AE Manufacturing	3,512	$14,898	41
AE Information	905	$1,081	20
AE Professional, Scientific, & Technical Services	941	$32,756	131
AE Other Services	261	$14,200	26
Total Advanced Energy Industry	**7,392**	**$119,944**	**468**

Chester, Crockett, and Madison Counties constitute the Jackson, Tennessee MSA. This metropolitan area's AE activity is shown in Table 11. AE employment in the Jackson MSA is 12.5 percent of total employment for the area. AE manufacturing and AE utilities and construction account for the majority of AE jobs in the Jackson MSA. There are 4,090 and 2,112 workers, respectively, employed in these two AE industry groups. Approximately 6,889 AE employees overall work in 354 establishments in the Jackson MSA. These establishments spend more than $154.2 million on payroll for the AE energy sector. Note that there are no data disclosed for the AE information industry group.

Table 11: Advanced Energy in Jackson, TN MSA by Industry Group, 2013

Industry Group	Employment	Payroll ($1,000)	Number of Establishments
AE Utilities and Construction	2,112	$94,853	197
AE Manufacturing	4,090	$25,798	44
AE Information	140	$-	10
AE Professional, Scientific, & Technical Services	467	$20,164	89
AE Other Services	80	$13,398	14
Total Advanced Energy Industry	**6,889**	**$154,213**	**354**

The Morristown, Tennessee MSA barely escaped being the MSA with the smallest amount of advanced energy activity in the state. Hamblen and Jefferson Counties make up the Morristown MSA. Information on the area's AE sector is shown in Table 12. Total AE employment is 5,756 or 15.7 percent of the area's total employment. Like many other MSAs, the AE manufacturing and AE utilities and construction industry groups account for almost the entire AE sector in this MSA. AE manufacturing represents 4,119 AE employees of the 5,756 total AE employees while AE utilities and construction employ 1,158 AE jobs. The other 479 AE employees are dispersed amongst the other three industry groups, with the number of employees doubling between the groups. There are two industry groups that have no data disclosed for the payroll spent on AE sector in the Morristown MSA: AE information and AE other services. Based on the reported data, total AE payroll expenditures in this MSA amount to $163.9 million. AE manufacturing represents the bulk of these payroll disbursements, with $136.3 million being spent on payroll for AE employees. There are 192 AE establishments in the Morristown MSA for 2013.

Table 12: Advanced Energy in Morristown, TN MSA by Industry Group, 2013

Industry Group	Employment	Payroll ($1,000)	Number of Establishments
AE Utilities and Construction	1,158	$21,741	96
AE Manufacturing	4,119	$136,349	39
AE Information	70	$-	3
AE Professional, Scientific, & Technical Services	269	$5,854	46
AE Other Services	140	$-	8
Total Advanced Energy Industry	**5,756**	**$163,944**	**192**

As shown in Table 13, the Cleveland, Tennessee MSA holds the least amount of AE activity in the state for 2013. Bradley and Polk Counties are represented by the Cleveland MSA. Total AE employment in the MSA is 13.2 percent of total employment. Again, the majority of AE jobs in this MSA are attributable to AE manufacturing with 3,815 of the 5,157 AE jobs. While AE manufacturing captures a large share of the AE employment in the Cleveland MSA, there are no data disclosed on payroll. The AE information industry group is again plagued with disclosure issues. Nevertheless, there is approximately $39.1 million spent on payroll in the AE sector in the Cleveland MSA. There are 234 establishments housing AE activity in the Cleveland MSA.

Table 13: Advanced Energy in Cleveland, TN MSA by Industry Group, 2013

Industry Group	Employment	Payroll ($1,000)	Number of Establishments
AE Utilities and Construction	741	$23,749	116
AE Manufacturing	3,815	$-	31
AE Information	60	$-	2
AE Professional, Scientific, & Technical Services	411	$13,669	75
AE Other Services	130	$1,651	10
Total Advanced Energy Industry	**5,157**	**$39,069**	**234**

EXAMPLE: TENNESSEE ADVANCED ENERGY

Signal Energy Constructors, utility scale renewable energy design/build contractor

Chattanooga, TN

Signal Energy Constructors is a full-service design/build contractor providing Engineering, Procurement and Construction (EPC) services for utility-scale renewable energy projects across North America. The company is headquartered in Chattanooga and has installed over 8,000 megawatts of utility scale renewable energy. Signal Energy Constructors designed and built the 5-megawatt West Tennessee Solar Farm, one of the largest solar-generating facilities in Tennessee, owned and operated by the University of Tennessee.

County-Level Economic Impacts from the Advanced Energy Economy

A small number of counties account for the lion's share of statewide activity in the AE sector. The top 20 AE counties employ 269,611 individuals in 12,983 establishments, spending $9.3 billion on payroll expenditures. This accounts for close to 80 percent of all AE activity in Tennessee for 2013.

The top 20 counties measured by employment levels in 2013 are reported in Table 14. This table allows for a partial disaggregation of the MSAs – attributing employment, payroll, and number of establishments to the largest employment counties in Tennessee. Davidson County employs 43,424 individuals in the AE sector and pays out around $2.3 billion in payroll expenditures from 2,463 establishments. Shelby County is a close second, with 40,370 AE employees in 2,317 establishments. The AE sector in Shelby County spends approximately $2.0 billion on payroll. Sullivan County is the third largest AE county in Tennessee; however, it would have to employ about 13,600 more individuals to even be close to Shelby County's AE employment size. There are 26,807 employees in the 412 AE establishments in Sullivan County. These establishments spend around $190.7 million on payroll expenditures in the AE sector. Hamilton, Knox, Rutherford, Williamson, and Anderson counties support between 10,000 and 25,000 AE energy jobs. The rest of the top 20 AE sector counties in Tennessee are Sumner, Madison, Robertson, Montgomery, Blount, Washington, Bradley, Hamblen, Maury, Coffee, McMinn, and Putnam counties. There are three counties in this list that are not represented in the MSA level data: Coffee, McMinn, and Putnam counties.

EXAMPLE: TENNESSEE ADVANCED ENERGY

Eastman Chemical, Combined Heat and Power

Kingsport, TN

Eastman Chemical is a global specialty chemical company that produces a broad range of products found in items people use every day. The company is headquartered in Kingsport, TN.

Eastman needs both steam and electricity to make its products, so it uses a highly efficient process called cogeneration at its largest manufacturing sites. Also called Combined Heat and Power (CHP), cogeneration is the concurrent production of electricity and heat from a single energy source – in Eastman's case, coal. CHP systems recover heat that normally would be wasted during electricity generation, therefore saving fuel that would otherwise be used to produce heat or steam. Using CHP enables Eastman to convert more than 70 percent of the energy it obtains from fossil fuel into power and steam for its manufacturing processes.

Table 14: Advanced Energy in Top 20 Tennessee Counties by Employment, 2013

County	Employment	Payroll ($1,000)	Number of Establishments
Davidson	43,424	$2,261,881	2,463
Shelby	40,370	$2,049,476	2,317
Sullivan	26,807	$190,700	412
Hamilton	23,130	$886,942	1,207
Knox	21,872	$973,205	1,604
Rutherford	20,337	$264,821	656
Williamson	16,902	$1,036,618	1,119
Anderson	13,516	$517,718	281
Sumner	7,012	$282,808	465
Madison	6,377	$138,362	293
Robertson	6,082	$28,682	168
Montgomery	5,697	$136,655	313
Blount	5,537	$94,668	357
Washington	5,516	$95,950	353
Bradley	5,046	$37,041	213
Hamblen	4,839	$150,272	116
Maury	4,791	$43,686	194
Coffee	4,577	$24,653	142
McMinn	4,079	$16,522	91
Putnam	3,700	$54,455	219
Total Advanced Energy Top 20 Counties	**269,611**	**$9,285,115**	**12,983**

EXAMPLE: TENNESSEE ADVANCED ENERGY

Memphis Bioworks Foundation, biobased products

Memphis, TN

Memphis Bioworks Foundation is an organization that creates companies, jobs and investments in bioscience. Through its focus on bioscience commercialization, Memphis Bioworks Foundation has been a major catalyst for business-led approaches to commercializing advanced biofuels, biomass feedstocks and biobased products across Tennessee and the Mid-South region.

Conclusion

The advanced energy economy is demonstrating robust growth around the globe and now represents a $1.3 trillion market. This report is the first of its kind to document the scope of the advanced energy sector in Tennessee. Benchmarking this industry is important as businesses seek to tap further into the global growth potential of the advanced energy economy. Policymakers should be keenly interested because of the significant role played by the state's advanced energy sector in promoting job and income gains and tax base growth.

Based on a definition of the advanced energy economy tailored to Tennessee, 62 four-digit NAICs industry groups were identified as constituting the state's advanced energy sector. These detailed industries naturally fall into five mutually exclusive categories: AE utilities and construction, AE manufacturing, AE information, AE professional, scientific and technical services and AE other services. Almost 80 percent of advanced energy employment is concentrated in 20 counties. While the AE economy tends to be more pronounced in the state's larger communities, it has a statewide presence that encompasses all of Tennessee's 95 counties.

Firms in the state's advanced energy sector operate 17,334 business establishments in Tennessee that employ 324,920 workers. With total payroll expenditures of $15.9 million, workers in the advanced sector earn an average wage of $48,764. While the utilities and construction category account for the largest number of establishments (8,230), the advanced energy professional, scientific and technical services category pays the highest wages ($66,162). The Nashville-Davidson-Murfreesboro-Franklin metropolitan area accounts for more advanced energy activity than any other metropolitan area of the state.

EXAMPLE: TENNESSEE ADVANCED ENERGY

Alcoa, lightweight metals

Alcoa, TN

Alcoa Inc., headquartered in Alcoa, TN, is a global leader in lightweight metals engineering and manufacturing. The company's goal is to design sustainable products that use energy and natural resources more efficiently and improve environmental impact. Its products allow engines to run faster and hotter; they enable smart buildings, sustainable food and beverage packaging, high-performance defense vehicles, and more efficient power generation. For example, its high-performance aluminum, titanium, and nickel-based alloy products produce lighter, more fuel-efficient planes with highly efficient engines. Its lightweight solutions for the automotive market, which produce a lighter-weight vehicle, improve energy efficiency of the vehicle.

The state's advanced energy economy contributed $33.4 billion to state GDP in 2013. The advanced energy manufacturing category accounted for the largest contribution--$19.2 billion. While this output is produced in Tennessee, much of it is sold outside of the state. The advanced energy sector directly enhances the state's competitiveness. By providing goods and services to other firms in the state, the advanced energy sector also indirectly boosts the state's competitive position.

The advanced energy economy will undoubtedly grow in the years ahead as consumers and producers alike seek energy efficiency gains and a reduced environmental footprint from the use of energy. Tennessee is poised to capture its share of this growth which will yield additional economic benefits for businesses and workers in the state.

Works Cited

North American Industry Classification System. (2014, November 5). Retrieved May 8, 2015, from United States Census Bureau: http://www.census.gov/eos/www/naics/faqs/faqs.html#q1

Frequently Asked Questions. (2015, February 10). Retrieved May 8, 2015, from U.S. Energy Information Administration: http://www.eia.gov/tools/faqs/faq.cfm?id=87&t=1

Aldina, R., Carey, J., & Urlaub, I. (2014). North Carolina Clean Energy Industry Census. NC Sustainable Energy Association.

Arkansas Advanced Energy Association and Advanced Energy Economy Institute. (2010). Employment in the Arkansas Advanced Energy Industry. Arkansas Advanced Energy Association and Advanced Energy Economy Institute.

BW Research Partnership. (2014). California Advanced Energy Employment Survey. Advanced Energy Economy Institute.

BW Research Partnership. (2014). Clean Jobs Illinois: An In-Depth Look at Clean Energy Employment in Illinois. Clean Energy Trust.

BW Research Partnership. (2014). Iowa Advanced Energy Employment Survey. Advanced Energy Economy Institute.

BW Research Partnership. (2014). Massachusetts Clean Energy Industry Report. Massachusetts Clean Energy Center.

BW Research Partnership. (2014). Vermont Clean Energy Industry Report. Vermont Clean Energy Development Fund.

BW Research Partnership and The Economic Advancement Research Institute. (2014). Clean Jobs Florida: Sizing Up Florida's Clean Energy Jobs Base and its Potential. Environmental Entrepreneurs (E2) and Energy Services Coalition and Florida Alliance for Renewable Energy.

BW Research Partnership and The Economic Advancement Research Institute. (2014). Clean Jobs Pennsylvania: Sizing Up Pennsylvania's Clean Energy Jobs Base and its Potential. Environmental Entrepreneurs (E2) and Keystone Energy Efficiency Alliance.

HISTECON Associates, Inc. (2014). The Economic Impact of Advanced Energy in Arkansas: A Survey of Busness Activity in 2014. Little Rock: Arkansas Advanced Energy Foundation.

Muro, M., Rothwell, J., Andes, S., Fikri, K., & Kulkarni, S. (2015). America's Advanced Industries. The Brookings Institution.

Navigant Research. (2015). Advanced Energy Now 2015 Market Report. Advanced Energy Economy.

The Center for Community Innovation. (2008). Innovating the Green Economy in California Regions. The Center for Community Innovation.

U.S. Bureau of Economic Analysis. (2014, June 11). Regional Economic Accounts. Retrieved May 8, 2015, from U.S. Department of Commerce: http://www.bea.gov/regional/index.htm

U.S. Bureau of Labor Statistics. (2015, March 25). Occupational Employment Statistics. Retrieved May 8, 2015, from United States Department of Labor: http://www.bls.gov/oes/current/oes_tn.htm

Washington State Employment Security Department. (2012). Green-Economy Jobs Report. Washington State Employment Security Department.

Appendix

Appendix Table 1: Advanced Energy by NAICS in Tennessee, 2013

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution	2,333	$153,388	92
	2212	Natural Gas Distribution	750	D	27
	2361	Residential Building Construction	7,550	$350,178	1,877
	2362	Nonresidential Building Construction	16,774	$860,087	681
	2371	Utility System Construction	7,690	$401,456	351
	2379	Other Heavy and Civil Engineering Construction	790	$39,556	78
	2381	Foundation, Structure, and Building Exterior Contractors	13,175	$524,555	1,284
	2382	Building Equipment Contractors	32,956	$1,565,591	2,603
	2383	Building Finishing Contractors	8,492	$322,263	1,237
	Subtotal		**90,510**	**$4,217,074**	**8,230**
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation	2,147	$62,732	148
	3221	Pulp, Paper, and Paperboard Mills	3,155	$209,949	10
	3241	Petroleum and Coal Products Manufacturing	833	$69,513	55
	3251	Basic Chemical Manufacturing	17,500	D	59
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	2,034	$126,350	29
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	375	$17,247	17
	3259	Other Chemical Product and Preparation Manufacturing	3,799	$202,377	58
	3272	Glass and Glass Product Manufacturing	3,647	$171,781	30
	3279	Other Nonmetallic Mineral Product Manufacturing	1,689	$67,018	74
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	1,496	$110,894	15
	3313	Alumina and Aluminum Production and Processing	2,685	$164,041	18
	3315	Foundries	2,907	$153,323	31
	3331	Agriculture, Construction, and Mining Machinery Manufacturing	4,239	$208,662	44
	3332	Industrial Machinery Manufacturing	889	$44,733	52
	3333	Commercial and Service Industry Machinery Manufacturing	1,348	$72,304	25

Appendix Table 1, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Manufacturing	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	8,397	$368,567	44
	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	1,784	$107,335	18
	3339	Other General Purpose Machinery Manufacturing	4,477	$239,480	97
	3341	Computer and Peripheral Equipment Manufacturing	547	$28,881	9
	3342	Communication Equipment Manufacturing	175	$8,144	12
	3343	Audio and Video Equipment Manufacturing	375	D	9
	3344	Semiconductor and Other Electronic Component Manufacturing	1750,	D	30
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	2,583	$167,923	53
	3346	Manufacturing and Reproducing Magnetic and Optical Media	254	$11,846	17
	3351	Electric Lighting Equipment Manufacturing	434	$21,978	17
	3352	Household Appliance Manufacturing	6,881	$293,634	18
	3353	Electrical Equipment Manufacturing	2,257	$139,055	40
	3359	Other Electrical Equipment and Component Manufacturing	2,627	$123,490	32
	3361	Motor Vehicle Manufacturing	7,500	D	5
	3362	Motor Vehicle Body and Trailer Manufacturing	1,750	D	44
	3363	Motor Vehicle Parts Manufacturing	31,117	$1,626,251	181
	3364	Aerospace Product and Parts Manufacturing	1,926	$137,321	24
	3366	Ship and Boat Building	2,429	$103,503	21
	3369	Other Transportation Equipment Manufacturing	215	$7,562	17
	3391	Medical Equipment and Supplies Manufacturing	7,091	$488,237	195
	3399	Other Miscellaneous Manufacturing	6,641	$229,315	251
	Subtotal		**139,953**	**$5,783,446**	**1,799**

Appendix Table 1, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Information	5112	Software Publishers	1,641	$170,214	93
	5152	Cable and Other Subscription Programming	1,750	D	9
	5172	Wireless Telecommunications Carriers (except Satellite)	7,879	$363,965	224
	5174	Satellite Telecommunications	10	$326	3
	5179	Other Telecommunications	269	$11,459	58
	5182	Data Processing, Hosting, and Related Services	6,693	$408,779	201
	5191	Other Information Services	852	$53,129	108
	Subtotal		**19,094**	**$1,007,872**	**696**
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services	16,864	$1,174,906	1,506
	5414	Specialized Design Services	1,021	$48,831	285
	5415	Computer System Design and Related Services	12,337	$965,076	1,142
	5416	Management, Scientific, and Technical Consulting Services	14,486	$970,469	1,538
	5417	Scientific Research and Development Services	6,782	$631,945	166
	5419	Other Professional, Scientific, and Technical Services	10,692	$322,839	1,122
	Subtotal		**62,182**	**$4,114,066**	**5,759**
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal	1,699	$102,868	83
	6215	Medical and Diagnostic Laboratories	6,324	$394,303	249
	8112	Electronic and Precision Equipment Repair and Maintenance	2,503	$107,522	202
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	2,655	$117,288	316
	Subtotal		**13,181**	**$721,981**	**850**
All Advanced Energy Industry	**Total**		**324,920**	**$15,844,439**	**17,334**

Appendix Table 2: Advanced Energy by NAICS in Chattanooga, TN-GA MSA, 2013

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution	162	$9,059	8
	2212	Natural Gas Distribution	60	D	3
	2361	Residential Building Construction	521	$18,000	139
	2362	Nonresidential Building Construction	750	$57,262	54
	2371	Utility System Construction	1,320	$84,109	35
	2379	Other Heavy and Civil Engineering Construction	98	$4,258	7
	2381	Foundation, Structure, and Building Exterior Contractors	976	$29,383	88
	2382	Building Equipment Contractors	4,116	$199,225	250
	2383	Building Finishing Contractors	629	$23,413	91
	Subtotal		**8,632**	**$424,709**	**675**
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation	10	D	1
	3221	Pulp, Paper, and Paperboard Mills	375	D	2
	3241	Petroleum and Coal Products Manufacturing	10	D	3
	3251	Basic Chemical Manufacturing	375	$15,762	10
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	952	$64,316	9
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	10	D	1
	3259	Other Chemical Product and Preparation Manufacturing	60	$4,556	7
	3272	Glass and Glass Product Manufacturing	60	D	3
	3279	Other Nonmetallic Mineral Product Manufacturing	175	D	10
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	60	D	2
	3313	Alumina and Aluminum Production and Processing	NA	NA	NA
	3315	Foundries	375	D	6
	3331	Agriculture, Construction, and Mining Machinery Manufacturing	1,750	D	7
	3332	Industrial Machinery Manufacturing	324	$20,472	7
	3333	Commercial and Service Industry Machinery Manufacturing	NA	NA	NA
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	175	D	2

Appendix Table 2, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Manufacturing	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	750	D	1
	3339	Other General Purpose Machinery Manufacturing	534	$26,643	14
	3341	Computer and Peripheral Equipment Manufacturing	60	D	1
	3342	Communication Equipment Manufacturing	10	D	2
	3343	Audio and Video Equipment Manufacturing	NA	NA	NA
	3344	Semiconductor and Other Electronic Component Manufacturing	10	D	1
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	60	$4,159	5
	3346	Manufacturing and Reproducing Magnetic and Optical Media	NA	NA	NA
	3351	Electric Lighting Equipment Manufacturing	NA	NA	NA
	3352	Household Appliance Manufacturing	1,750	D	1
	3353	Electrical Equipment Manufacturing	15	$618	3
	3359	Other Electrical Equipment and Component Manufacturing	434	$20,745	7
	3361	Motor Vehicle Manufacturing	1,750	D	3
	3362	Motor Vehicle Body and Trailer Manufacturing	375	D	2
	3363	Motor Vehicle Parts Manufacturing	847	$35,011	7
	3364	Aerospace Product and Parts Manufacturing	NA	NA	NA
	3366	Ship and Boat Building	NA	NA	NA
	3369	Other Transportation Equipment Manufacturing	119	$4,103	6
	3391	Medical Equipment and Supplies Manufacturing	375	D	23
	3399	Other Miscellaneous Manufacturing	645	$24,769	24
	Subtotal	**12,445**	**$221,154**	**170**	
Advanced Energy Information	5112	Software Publishers	10	D	1
	5152	Cable and Other Subscription Programming	10	D	1
	5172	Wireless Telecommunications Carriers (except Satellite)	750	D	21
	5174	Satellite Telecommunications	NA	NA	NA

Appendix Table 2, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Information	5179	Other Telecommunications	60	$1,027	6
	5182	Data Processing, Hosting, and Related Services	213	$9,356	11
	5191	Other Information Services	51	$2,703	8
	Subtotal		**1,094**	**$13,086**	**48**
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services	1,809	$134,510	147
	5414	Specialized Design Services	94	$4,521	30
	5415	Computer System Design and Related Services	742	$46,522	102
	5416	Management, Scientific, and Technical Consulting Services	1,029	$52,625	117
	5417	Scientific Research and Development Services	175	D	15
	5419	Other Professional, Scientific, and Technical Services	1,337	$30,556	100
	Subtotal		**5,186**	**$268,734**	**511**
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal	38	$1,949	6
	6215	Medical and Diagnostic Laboratories	360	$28,092	22
	8112	Electronic and Precision Equipment Repair and Maintenance	54	$2,235	18
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	338	$16,801	28
	Subtotal		**790**	**$49,077**	**74**
All Advanced Energy Industry	**Total**		**28,147**	**$976,760**	**1,478**

Appendix Table 3: Advanced Energy by NAICS in Clarksville, TN-KY MSA, 2013

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution	175	D	3
	2212	Natural Gas Distribution	10	D	2
	2361	Residential Building Construction	322	$9,981	71
	2362	Nonresidential Building Construction	172	$6,784	27
	2371	Utility System Construction	250	$11,573	17
	2379	Other Heavy and Civil Engineering Construction	NA	NA	NA
	2381	Foundation, Structure, and Building Exterior Contractors	149	$5,363	29
	2382	Building Equipment Contractors	689	$26,316	94
	2383	Building Finishing Contractors	201	$6,073	42
	Subtotal		**1,968**	**$66,090**	**285**
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation	60	$1,999	6
	3221	Pulp, Paper, and Paperboard Mills	NA	NA	NA
	3241	Petroleum and Coal Products Manufacturing	60	D	4
	3251	Basic Chemical Manufacturing	76	$6,217	4
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	NA	NA	NA
	3253	Pesticide, Fertilitzer, and Other Agricultural Chemical Manufacturing	NA	NA	NA
	3259	Other Chemical Product and Preparation Manufacturing	60	D	2
	3272	Glass and Glass Product Manufacturing	NA	NA	NA
	3279	Other Nonmetallic Mineral Product Manufacturing	375	D	3
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	175	D	1
	3313	Alumina and Aluminum Production and Processing	175	D	1
	3315	Foundries	60	D	1
	3331	Agriculture, Construction, and Mining Machinery Manufacturing	NA	NA	NA
	3332	Industrial Machinery Manufacturing	NA	NA	NA
	3333	Commercial and Service Industry Machinery Manufacturing	NA	NA	NA
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	1,750	D	2

Appendix Table 3, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Manufacturing	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	NA	NA	NA
	3339	Other General Purpose Machinery Manufacturing	375	D	2
	3341	Computer and Peripheral Equipment Manufacturing	NA	NA	NA
	3342	Communication Equipment Manufacturing	NA	NA	NA
	3343	Audio and Video Equipment Manufacturing	NA	NA	NA
	3344	Semiconductor and Other Electronic Component Manufacturing	60	D	2
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	NA	NA	NA
	3346	Manufacturing and Reproducing Magnetic and Optical Media	10	D	1
	3351	Electric Lighting Equipment Manufacturing	10	D	1
	3352	Household Appliance Manufacturing	NA	NA	NA
	3353	Electrical Equipment Manufacturing	NA	NA	NA
	3359	Other Electrical Equipment and Component Manufacturing	10	D	1
	3361	Motor Vehicle Manufacturing	NA	NA	NA
	3362	Motor Vehicle Body and Trailer Manufacturing	750	D	2
	3363	Motor Vehicle Parts Manufacturing	2,739	$123,721	12
	3364	Aerospace Product and Parts Manufacturing	NA	NA	NA
	3366	Ship and Boat Building	NA	NA	NA
	3369	Other Transportation Equipment Manufacturing	NA	NA	NA
	3391	Medical Equipment and Supplies Manufacturing	10	$465	6
	3399	Other Miscellaneous Manufacturing	175	D	5
	Subtotal		**6,930**	**$132,402**	**56**
Advanced Energy Information	5112	Software Publishers	NA	NA	NA
	5152	Cable and Other Subscription Programming	NA	NA	NA
	5172	Wireless Telecommunications Carriers (except Satellite)	175	D	9
	5174	Satellite Telecommunications	NA	NA	NA

Appendix Table 3, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Information	5179	Other Telecommunications	NA	NA	NA
	5182	Data Processing, Hosting, and Related Services	NA	NA	NA
	5191	Other Information Services	NA	NA	NA
	Subtotal		**175**	**$-**	**9**
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services	249	$14,451	30
	5414	Specialized Design Services	13	$313	5
	5415	Computer System Design and Related Services	900	$112,931	45
	5416	Management, Scientific, and Technical Consulting Services	175	$5,090	23
	5417	Scientific Research and Development Services	10	D	2
	5419	Other Professional, Scientific, and Technical Services	279	$8,406	33
	Subtotal		**1,626**	**$141,191**	**138**
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal	NA	NA	NA
	6215	Medical and Diagnostic Laboratories	60	$3,478	8
	8112	Electronic and Precision Equipment Repair and Maintenance	60	D	11
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	25	$750	9
	Subtotal		**145**	**$4,228**	**28**
All Advanced Energy Industry	**Total**		**10,844**	**$343,911**	**516**

Appendix Table 4: Advanced Energy by NAICS in Cleveland, TN MSA, 2013

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution	60	D	2
	2212	Natural Gas Distribution	NA	NA	NA
	2361	Residential Building Construction	53	$1,403	17
	2362	Nonresidential Building Construction	60	$1,651	11
	2371	Utility System Construction	60	D	8
	2379	Other Heavy and Civil Engineering Construction	NA	NA	NA
	2381	Foundation, Structure, and Building Exterior Contractors	145	$5,429	17
	2382	Building Equipment Contractors	303	$13,053	42
	2383	Building Finishing Contractors	60	$2,213	19
	Subtotal		**741**	**$23,749**	**116**
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation	10	D	2
	3221	Pulp, Paper, and Paperboard Mills	NA	NA	NA
	3241	Petroleum and Coal Products Manufacturing	10	D	1
	3251	Basic Chemical Manufacturing	175	D	2
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	375	D	1
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	NA	NA	NA
	3259	Other Chemical Product and Preparation Manufacturing	375	D	3
	3272	Glass and Glass Product Manufacturing	NA	NA	NA
	3279	Other Nonmetallic Mineral Product Manufacturing	60	D	2
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	NA	NA	NA
	3313	Alumina and Aluminum Production and Processing	NA	NA	NA
	3315	Foundries	10	D	1
	3331	Agriculture, Construction, and Mining Machinery Manufacturing	60	D	2
	3332	Industrial Machinery Manufacturing	NA	NA	NA
	3333	Commercial and Service Industry Machinery Manufacturing	NA	NA	NA
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	175	D	1

Appendix Table 4, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Manufacturing	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	NA	NA	NA
	3339	Other General Purpose Machinery Manufacturing	10	D	1
	3341	Computer and Peripheral Equipment Manufacturing	NA	NA	NA
	3342	Communication Equipment Manufacturing	NA	NA	NA
	3343	Audio and Video Equipment Manufacturing	NA	NA	NA
	3344	Semiconductor and Other Electronic Component Manufacturing	NA	NA	NA
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	NA	NA	NA
	3346	Manufacturing and Reproducing Magnetic and Optical Media	10	D	2
	3351	Electric Lighting Equipment Manufacturing	NA	NA	NA
	3352	Household Appliance Manufacturing	1,750	D	2
	3353	Electrical Equipment Manufacturing	175	D	1
	3359	Other Electrical Equipment and Component Manufacturing	375	D	1
	3361	Motor Vehicle Manufacturing	NA	NA	NA
	3362	Motor Vehicle Body and Trailer Manufacturing	NA	NA	NA
	3363	Motor Vehicle Parts Manufacturing	10	D	1
	3364	Aerospace Product and Parts Manufacturing	NA	NA	NA
	3366	Ship and Boat Building	NA	NA	NA
	3369	Other Transportation Equipment Manufacturing	NA	NA	NA
	3391	Medical Equipment and Supplies Manufacturing	60	D	5
	3399	Other Miscellaneous Manufacturing	175	D	3
	Subtotal		**3,815**	**$-**	**31**
Advanced Energy Information	5112	Software Publishers	NA	NA	NA
	5152	Cable and Other Subscription Programming	NA	NA	NA
	5172	Wireless Telecommunications Carriers (except Satellite)	60	D	2
	5174	Satellite Telecommunications	NA	NA	NA

Appendix Table 4, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Information	5179	Other Telecommunications	NA	NA	NA
	5182	Data Processing, Hosting, and Related Services	NA	NA	NA
	5191	Other Information Services	NA	NA	NA
	Subtotal		**60**	**$-**	**2**
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services	62	$2,476	19
	5414	Specialized Design Services	10	D	2
	5415	Computer System Design and Related Services	21	$1,406	10
	5416	Management, Scientific, and Technical Consulting Services	60	$4,555	18
	5417	Scientific Research and Development Services	NA	NA	NA
	5419	Other Professional, Scientific, and Technical Services	258	$5,232	26
	Subtotal		**411**	**$13,669**	**75**
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal	60	D	2
	6215	Medical and Diagnostic Laboratories	10	D	1
	8112	Electronic and Precision Equipment Repair and Maintenance	NA	NA	NA
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	60	$1,651	7
	Subtotal		**130**	**$1,651**	**10**
All Advanced Energy Industry	**Total**		**5,157**	**$39,069**	**234**

Appendix Table 5: Advanced Energy by NAICS in Jackson, TN MSA, 2013

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution	60	D	4
	2212	Natural Gas Distribution	10	D	1
	2361	Residential Building Construction	143	$3,957	33
	2362	Nonresidential Building Construction	260	$14,187	18
	2371	Utility System Construction	328	$15,276	9
	2379	Other Heavy and Civil Engineering Construction	NA	NA	NA
	2381	Foundation, Structure, and Building Exterior Contractors	222	$12,654	34
	2382	Building Equipment Contractors	898	$44,768	63
	2383	Building Finishing Contractors	191	$4,011	35
	Subtotal		**2,112**	**$94,853**	**197**
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation	60	D	2
	3221	Pulp, Paper, and Paperboard Mills	NA	NA	NA
	3241	Petroleum and Coal Products Manufacturing	NA	NA	NA
	3251	Basic Chemical Manufacturing	10	D	1
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	NA	NA	NA
	3253	Pesticide, Fertilitzer, and Other Agricultural Chemical Manufacturing	NA	NA	NA
	3259	Other Chemical Product and Preparation Manufacturing	175	D	2
	3272	Glass and Glass Product Manufacturing	175	D	1
	3279	Other Nonmetallic Mineral Product Manufacturing	60	D	2
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	375	D	1
	3313	Alumina and Aluminum Production and Processing	439	$23,879	5
	3315	Foundries	375	D	2
	3331	Agriculture, Construction, and Mining Machinery Manufacturing	NA	NA	NA
	3332	Industrial Machinery Manufacturing	10	D	1
	3333	Commercial and Service Industry Machinery Manufacturing	NA	NA	NA
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	NA	NA	NA

Appendix Table 5, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Manufacturing	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	NA	NA	NA
	3339	Other General Purpose Machinery Manufacturing	375	D	5
	3341	Computer and Peripheral Equipment Manufacturing	NA	NA	NA
	3342	Communication Equipment Manufacturing	NA	NA	NA
	3343	Audio and Video Equipment Manufacturing	NA	NA	NA
	3344	Semiconductor and Other Electronic Component Manufacturing	NA	NA	NA
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	10	D	1
	3346	Manufacturing and Reproducing Magnetic and Optical Media	NA	NA	NA
	3351	Electric Lighting Equipment Manufacturing	NA	NA	NA
	3352	Household Appliance Manufacturing	NA	NA	NA
	3353	Electrical Equipment Manufacturing	175	D	2
	3359	Other Electrical Equipment and Component Manufacturing	NA	NA	NA
	3361	Motor Vehicle Manufacturing	NA	NA	NA
	3362	Motor Vehicle Body and Trailer Manufacturing	10	D	2
	3363	Motor Vehicle Parts Manufacturing	1,750	D	5
	3364	Aerospace Product and Parts Manufacturing	NA	NA	NA
	3366	Ship and Boat Building	NA	NA	NA
	3369	Other Transportation Equipment Manufacturing	10	D	1
	3391	Medical Equipment and Supplies Manufacturing	60	$1,159	6
	3399	Other Miscellaneous Manufacturing	21	$760	5
	Subtotal		**4,090**	**$25,798**	**44**
Advanced Energy Information	5112	Software Publishers	NA	NA	NA
	5152	Cable and Other Subscription Programming	NA	NA	NA
	5172	Wireless Telecommunications Carriers (except Satellite)	60	D	6
	5174	Satellite Telecommunications	NA	NA	NA

Appendix Table 5, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Information	5179	Other Telecommunications	10	D	2
	5182	Data Processing, Hosting, and Related Services	10	D	1
	5191	Other Information Services	60	D	1
	Subtotal		**140**	**$-**	**10**
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services	191	$11,779	28
	5414	Specialized Design Services	10	D	1
	5415	Computer System Design and Related Services	27	$1,293	12
	5416	Management, Scientific, and Technical Consulting Services	119	$4,058	21
	5417	Scientific Research and Development Services	10	D	2
	5419	Other Professional, Scientific, and Technical Services	110	$3,034	25
	Subtotal		**467**	**$20,164**	**89**
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal	NA	NA	NA
	6215	Medical and Diagnostic Laboratories	60	$13,398	9
	8112	Electronic and Precision Equipment Repair and Maintenance	10	D	3
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	10	D	2
	Subtotal		**80**	**$13,398**	**14**
All Advanced Energy Industry	**Total**		**6,889**	**$154,213**	**354**

Appendix Table 6: Advanced Energy by NAICS in Johnson City, TN MSA, 2013

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution	10	D	2
	2212	Natural Gas Distribution	60	D	3
	2361	Residential Building Construction	217	$6,873	59
	2362	Nonresidential Building Construction	285	$10,157	26
	2371	Utility System Construction	60	D	6
	2379	Other Heavy and Civil Engineering Construction	10	D	1
	2381	Foundation, Structure, and Building Exterior Contractors	211	$7,208	40
	2382	Building Equipment Contractors	706	$25,782	79
	2383	Building Finishing Contractors	214	$6,989	34
	Subtotal		**1,773**	**$57,009**	**250**
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation	60	D	6
	3221	Pulp, Paper, and Paperboard Mills	NA	NA	NA
	3241	Petroleum and Coal Products Manufacturing	NA	NA	NA
	3251	Basic Chemical Manufacturing	750	D	1
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	175	D	2
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	NA	NA	NA
	3259	Other Chemical Product and Preparation Manufacturing	NA	NA	NA
	3272	Glass and Glass Product Manufacturing	NA	NA	NA
	3279	Other Nonmetallic Mineral Product Manufacturing	60	D	3
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	NA	NA	NA
	3313	Alumina and Aluminum Production and Processing	10	D	1
	3315	Foundries	NA	NA	NA
	3331	Agriculture, Construction, and Mining Machinery Manufacturing	60	D	1
	3332	Industrial Machinery Manufacturing	10	D	2
	3333	Commercial and Service Industry Machinery Manufacturing	NA	NA	NA
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	375	D	1

Appendix Table 6, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Manufacturing	3339	Other General Purpose Machinery Manufacturing	175	D	4
	3341	Computer and Peripheral Equipment Manufacturing	NA	NA	NA
	3342	Communication Equipment Manufacturing	NA	NA	NA
	3343	Audio and Video Equipment Manufacturing	NA	NA	NA
	3344	Semiconductor and Other Electronic Component Manufacturing	60	D	2
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	10	D	1
	3346	Manufacturing and Reproducing Magnetic and Optical Media	NA	NA	NA
	3351	Electric Lighting Equipment Manufacturing	NA	NA	NA
	3352	Household Appliance Manufacturing	750	D	2
	3353	Electrical Equipment Manufacturing	375	D	2
	3359	Other Electrical Equipment and Component Manufacturing	NA	NA	NA
	3361	Motor Vehicle Manufacturing	NA	NA	NA
	3362	Motor Vehicle Body and Trailer Manufacturing	NA	NA	NA
	3363	Motor Vehicle Parts Manufacturing	175	D	2
	3364	Aerospace Product and Parts Manufacturing	NA	NA	NA
	3366	Ship and Boat Building	NA	NA	NA
	3369	Other Transportation Equipment Manufacturing	NA	NA	NA
	3391	Medical Equipment and Supplies Manufacturing	375	$11,741	7
	3399	Other Miscellaneous Manufacturing	92	$3,157	4
	Subtotal		**3,512**	**$14,898**	**41**
Advanced Energy Information	5112	Software Publishers	60	D	1
	5152	Cable and Other Subscription Programming	NA	NA	NA
	5172	Wireless Telecommunications Carriers (except Satellite)	750	D	8
	5174	Satellite Telecommunications	NA	NA	NA
	5179	Other Telecommunications	10	D	3
	5182	Data Processing, Hosting, and Related Services	25	$1,081	5
	5191	Other Information Services	60	D	3
	Subtotal		**905**	**$1,081**	**20**

Appendix Table 6, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services	175	$9,350	37
	5414	Specialized Design Services	10	$316	5
	5415	Computer System Design and Related Services	60	$5,427	15
	5416	Management, Scientific, and Technical Consulting Services	260	$9,800	32
	5417	Scientific Research and Development Services	175	D	6
	5419	Other Professional, Scientific, and Technical Services	261	$7,863	36
	Subtotal		**941**	**$32,756**	**131**
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal	60	D	2
	6215	Medical and Diagnostic Laboratories	60	$5,428	7
	8112	Electronic and Precision Equipment Repair and Maintenance	10	D	5
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	131	$8,772	12
	Subtotal		**261**	**$14,200**	**26**
All Advanced Energy Industry	**Total**		**7,392**	**$119,944**	**468**

Appendix Table 7: Advanced Energy by NAICS in Kingsport-Bristol-Bristol, TN-VA MSA, 2013

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution	175	D	9
	2212	Natural Gas Distribution	60	D	2
	2361	Residential Building Construction	321	$10,501	95
	2362	Nonresidential Building Construction	1,750	D	28
	2371	Utility System Construction	205	$8,198	17
	2379	Other Heavy and Civil Engineering Construction	60	$1,894	5
	2381	Foundation, Structure, and Building Exterior Contractors	480	$15,521	63
	2382	Building Equipment Contractors	1,872	$84,029	103
	2383	Building Finishing Contractors	179	$5,009	40
	Subtotal		**5,102**	**$125,152**	**362**
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation	60	D	5
	3221	Pulp, Paper, and Paperboard Mills	375	D	1
	3241	Petroleum and Coal Products Manufacturing	10	D	2
	3251	Basic Chemical Manufacturing	17,500	D	5
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	750	D	1
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	10	D	1
	3259	Other Chemical Product and Preparation Manufacturing	750	D	4
	3272	Glass and Glass Product Manufacturing	532	$27,577	4
	3279	Other Nonmetallic Mineral Product Manufacturing	NA	NA	NA
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	NA	NA	NA
	3313	Alumina and Aluminum Production and Processing	60	D	1
	3315	Foundries	199	$4,894	5
	3331	Agriculture, Construction, and Mining Machinery Manufacturing	319	$17,343	5
	3332	Industrial Machinery Manufacturing	10	D	2
	3333	Commercial and Service Industry Machinery Manufacturing	10	D	2
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	750	D	2

Appendix Table 7, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Manufacturing	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	NA	NA	NA
	3339	Other General Purpose Machinery Manufacturing	375	D	6
	3341	Computer and Peripheral Equipment Manufacturing	NA	NA	NA
	3342	Communication Equipment Manufacturing	60	D	1
	3343	Audio and Video Equipment Manufacturing	NA	NA	NA
	3344	Semiconductor and Other Electronic Component Manufacturing	60	D	2
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	NA	NA	NA
	3346	Manufacturing and Reproducing Magnetic and Optical Media	NA	NA	NA
	3351	Electric Lighting Equipment Manufacturing	175	D	1
	3352	Household Appliance Manufacturing	NA	NA	NA
	3353	Electrical Equipment Manufacturing	375	D	5
	3359	Other Electrical Equipment and Component Manufacturing	375	D	4
	3361	Motor Vehicle Manufacturing	NA	NA	NA
	3362	Motor Vehicle Body and Trailer Manufacturing	750	D	2
	3363	Motor Vehicle Parts Manufacturing	1,244	$51,546	10
	3364	Aerospace Product and Parts Manufacturing	375	D	1
	3366	Ship and Boat Building	NA	NA	NA
	3369	Other Transportation Equipment Manufacturing	NA	NA	NA
	3391	Medical Equipment and Supplies Manufacturing	60	$2,441	13
	3399	Other Miscellaneous Manufacturing	174	$3,440	12
	Subtotal		**25,358**	**$107,241**	**97**
Advanced Energy Information	5112	Software Publishers	10	D	1
	5152	Cable and Other Subscription Programming	NA	NA	NA
	5172	Wireless Telecommunications Carriers (except Satellite)	1,750	D	12
	5174	Satellite Telecommunications	NA	NA	NA

Appendix Table 7, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Information	5179	Other Telecommunications	10	D	1
	5182	Data Processing, Hosting, and Related Services	10	D	3
	5191	Other Information Services	10	D	3
	Subtotal		**1,790**	**$-**	**20**
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services	445	$29,003	66
	5414	Specialized Design Services	10	$519	9
	5415	Computer System Design and Related Services	134	$5,540	21
	5416	Management, Scientific, and Technical Consulting Services	531	$36,872	62
	5417	Scientific Research and Development Services	60	D	8
	5419	Other Professional, Scientific, and Technical Services	433	$12,909	61
	Subtotal		**1,613**	**$84,843**	**227**
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal	10	D	2
	6215	Medical and Diagnostic Laboratories	319	$15,503	14
	8112	Electronic and Precision Equipment Repair and Maintenance	175	D	12
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	134	$5,148	9
	Subtotal	**638**	**$20,651**	**37**	
All Advanced Energy Industry	**Total**		**34,501**	**$337,887**	**743**

Appendix Table 8: Advanced Energy by NAICS in Knoxville, TN MSA, 2013

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution	18	$988	3
	2212	Natural Gas Distribution	10	D	2
	2361	Residential Building Construction	1,247	$63,161	335
	2362	Nonresidential Building Construction	1,461	$84,646	98
	2371	Utility System Construction	538	$26,052	31
	2379	Other Heavy and Civil Engineering Construction	172	$6,829	22
	2381	Foundation, Structure, and Building Exterior Contractors	1,394	$45,278	178
	2382	Building Equipment Contractors	4,556	$206,813	351
	2383	Building Finishing Contractors	1,555	$62,694	174
	Subtotal		**10,951**	**$496,461**	**1,194**
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation	175	D	9
	3221	Pulp, Paper, and Paperboard Mills	750	D	1
	3241	Petroleum and Coal Products Manufacturing	60	$1,253	7
	3251	Basic Chemical Manufacturing	180	$8,699	6
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	60	D	1
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	60	D	2
	3259	Other Chemical Product and Preparation Manufacturing	375	D	4
	3272	Glass and Glass Product Manufacturing	375	$16,181	8
	3279	Other Nonmetallic Mineral Product Manufacturing	60	D	3
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	375	D	4
	3313	Alumina and Aluminum Production and Processing	750	D	4
	3315	Foundries	60	D	2
	3331	Agriculture, Construction, and Mining Machinery Manufacturing	175	D	3
	3332	Industrial Machinery Manufacturing	175	D	6
	3333	Commercial and Service Industry Machinery Manufacturing	301	$20,744	4
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	375	D	5

Appendix Table 8, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Manufacturing	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	10	D	1
	3339	Other General Purpose Machinery Manufacturing	641	$33,955	14
	3341	Computer and Peripheral Equipment Manufacturing	60	D	1
	3342	Communication Equipment Manufacturing	NA	NA	NA
	3343	Audio and Video Equipment Manufacturing	375	D	1
	3344	Semiconductor and Other Electronic Component Manufacturing	10	D	3
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	965	$65,419	22
	3346	Manufacturing and Reproducing Magnetic and Optical Media	60	D	1
	3351	Electric Lighting Equipment Manufacturing	60	D	2
	3352	Household Appliance Manufacturing	175	D	4
	3353	Electrical Equipment Manufacturing	128	$12,789	4
	3359	Other Electrical Equipment and Component Manufacturing	207	$11,187	5
	3361	Motor Vehicle Manufacturing	NA	NA	NA
	3362	Motor Vehicle Body and Trailer Manufacturing	115	$3,203	6
	3363	Motor Vehicle Parts Manufacturing	5,683	$280,592	22
	3364	Aerospace Product and Parts Manufacturing	10	D	3
	3366	Ship and Boat Building	750	D	6
	3369	Other Transportation Equipment Manufacturing	60	D	2
	3391	Medical Equipment and Supplies Manufacturing	830	$26,124	33
	3399	Other Miscellaneous Manufacturing	291	$12,055	31
	Subtotal		**14,736**	**$492,201**	**230**
Advanced Energy Information	5112	Software Publishers	127	$8,022	13
	5152	Cable and Other Subscription Programming	1,750	D	2
	5172	Wireless Telecommunications Carriers (except Satellite)	906	$49,366	23
	5174	Satellite Telecommunications	NA	NA	NA

Appendix Table 8, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Information	5179	Other Telecommunications	60	D	6
	5182	Data Processing, Hosting, and Related Services	216	$12,408	20
	5191	Other Information Services	134	$8,967	13
	Subtotal		**3,193**	**$78,763**	**77**
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services	4,633	$353,140	317
	5414	Specialized Design Services	175	$6,280	38
	5415	Computer System Design and Related Services	1,894	$129,027	170
	5416	Management, Scientific, and Technical Consulting Services	2,960	$181,400	275
	5417	Scientific Research and Development Services	4,627	$451,360	35
	5419	Other Professional, Scientific, and Technical Services	1,425	$38,666	162
	Subtotal		**15,714**	**$1,159,873**	**997**
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal	981	$68,451	24
	6215	Medical and Diagnostic Laboratories	1,087	$52,668	32
	8112	Electronic and Precision Equipment Repair and Maintenance	118	$5,280	26
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	437	$18,325	45
	Subtotal		**2,623**	**$144,724**	**127**
All Advanced Energy Industry	**Total**	**47,217**	**$2,372,022**	**2,625**	

Appendix Table 9: Advanced Energy by NAICS in Memphis, TN-MS-AR MSA, 2013

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution	302	$20,065	12
	2212	Natural Gas Distribution	60	D	2
	2361	Residential Building Construction	1,012	$53,456	231
	2362	Nonresidential Building Construction	1,632	$88,652	135
	2371	Utility System Construction	711	$29,312	43
	2379	Other Heavy and Civil Engineering Construction	497	$26,139	13
	2381	Foundation, Structure, and Building Exterior Contractors	2,910	$128,419	197
	2382	Building Equipment Contractors	7,757	$382,706	557
	2383	Building Finishing Contractors	1,937	$77,063	229
	Subtotal		**16,818**	**$805,812**	**1,419**
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation	60	$1,289	3
	3221	Pulp, Paper, and Paperboard Mills	750	D	2
	3241	Petroleum and Coal Products Manufacturing	750	D	12
	3251	Basic Chemical Manufacturing	1,309	$121,004	17
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	60	D	3
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	375	$8,786	9
	3259	Other Chemical Product and Preparation Manufacturing	375	D	10
	3272	Glass and Glass Product Manufacturing	10	D	2
	3279	Other Nonmetallic Mineral Product Manufacturing	370	$14,013	18
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	375	D	2
	3313	Alumina and Aluminum Production and Processing	175	D	2
	3315	Foundries	10	D	2
	3331	Agriculture, Construction, and Mining Machinery Manufacturing	60	D	3
	3332	Industrial Machinery Manufacturing	97	$4,713	9
	3333	Commercial and Service Industry Machinery Manufacturing	219	$10,409	5
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	2,227	$89,052	12

Appendix Table 9, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Manufacturing	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	375	D	4
	3339	Other General Purpose Machinery Manufacturing	486	$25,329	14
	3341	Computer and Peripheral Equipment Manufacturing	375	D	1
	3342	Communication Equipment Manufacturing	60	D	3
	3343	Audio and Video Equipment Manufacturing	10	D	1
	3344	Semiconductor and Other Electronic Component Manufacturing	375	D	3
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	175	D	8
	3346	Manufacturing and Reproducing Magnetic and Optical Media	NA	NA	NA
	3351	Electric Lighting Equipment Manufacturing	375	D	4
	3352	Household Appliance Manufacturing	NA	NA	NA
	3353	Electrical Equipment Manufacturing	191	$8,217	10
	3359	Other Electrical Equipment and Component Manufacturing	175	D	2
	3361	Motor Vehicle Manufacturing	60	D	1
	3362	Motor Vehicle Body and Trailer Manufacturing	60	D	2
	3363	Motor Vehicle Parts Manufacturing	750	$29,839	14
	3364	Aerospace Product and Parts Manufacturing	224	$9,725	7
	3366	Ship and Boat Building	NA	NA	NA
	3369	Other Transportation Equipment Manufacturing	60	D	2
	3391	Medical Equipment and Supplies Manufacturing	4,742	$387,865	44
	3399	Other Miscellaneous Manufacturing	577	$19,692	30
	Subtotal		**16,292**	**$729,933**	**261**
Advanced Energy Information	5112	Software Publishers	160	$13,085	11
	5152	Cable and Other Subscription Programming	10	D	1
	5172	Wireless Telecommunications Carriers (except Satellite)	1,750	D	70
	5174	Satellite Telecommunications	NA	NA	NA

Appendix Table 9, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Information	5179	Other Telecommunications	50	$1,074	10
	5182	Data Processing, Hosting, and Related Services	602	$34,020	46
	5191	Other Information Services	20	$1,249	7
	Subtotal		**2,592**	**$49,428**	**145**
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services	2,374	$151,972	224
	5414	Specialized Design Services	242	$9,023	58
	5415	Computer System Design and Related Services	2,747	$191,402	226
	5416	Management, Scientific, and Technical Consulting Services	2,369	$128,325	282
	5417	Scientific Research and Development Services	529	$45,957	36
	5419	Other Professional, Scientific, and Technical Services	2,029	$67,971	195
	Subtotal		**10,290**	**$594,650**	**1,021**
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal	265	$13,628	10
	6215	Medical and Diagnostic Laboratories	1,633	$103,026	53
	8112	Electronic and Precision Equipment Repair and Maintenance	293	$12,019	40
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	592	$26,474	65
	Subtotal		**2,783**	**$155,147**	**168**
All Advanced Energy Industry	**Total**		**48,775**	**$2,334,970**	**3,014**

Appendix Table 10: Advanced Energy by NAICS in Morristown, TN MSA, 2013

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution	175	D	2
	2212	Natural Gas Distribution	10	D	1
	2361	Residential Building Construction	78	$2,198	27
	2362	Nonresidential Building Construction	115	$4,039	9
	2371	Utility System Construction	175	D	6
	2379	Other Heavy and Civil Engineering Construction	NA	NA	NA
	2381	Foundation, Structure, and Building Exterior Contractors	257	$9,555	14
	2382	Building Equipment Contractors	173	$5,949	27
	2383	Building Finishing Contractors	175	D	10
	Subtotal		**1,158**	**$21,741**	**96**
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation	60	D	3
	3221	Pulp, Paper, and Paperboard Mills	NA	NA	NA
	3241	Petroleum and Coal Products Manufacturing	NA	NA	NA
	3251	Basic Chemical Manufacturing	NA	NA	NA
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	60	D	1
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	NA	NA	NA
	3259	Other Chemical Product and Preparation Manufacturing	175	D	2
	3272	Glass and Glass Product Manufacturing	NA	NA	NA
	3279	Other Nonmetallic Mineral Product Manufacturing	60	D	1
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	NA	NA	NA
	3313	Alumina and Aluminum Production and Processing	NA	NA	NA
	3315	Foundries	NA	NA	NA
	3331	Agriculture, Construction, and Mining Machinery Manufacturing	175	D	3
	3332	Industrial Machinery Manufacturing	10	D	2
	3333	Commercial and Service Industry Machinery Manufacturing	60	D	1
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	60	D	1

Appendix Table 10, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Manufacturing	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	175	D	1
	3339	Other General Purpose Machinery Manufacturing	60	$1,553	5
	3341	Computer and Peripheral Equipment Manufacturing	NA	NA	NA
	3342	Communication Equipment Manufacturing	NA	NA	NA
	3343	Audio and Video Equipment Manufacturing	NA	NA	NA
	3344	Semiconductor and Other Electronic Component Manufacturing	NA	NA	NA
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	NA	NA	NA
	3346	Manufacturing and Reproducing Magnetic and Optical Media	NA	NA	NA
	3351	Electric Lighting Equipment Manufacturing	10	D	1
	3352	Household Appliance Manufacturing	NA	NA	NA
	3353	Electrical Equipment Manufacturing	175	D	1
	3359	Other Electrical Equipment and Component Manufacturing	NA	NA	NA
	3361	Motor Vehicle Manufacturing	NA	NA	NA
	3362	Motor Vehicle Body and Trailer Manufacturing	NA	NA	NA
	3363	Motor Vehicle Parts Manufacturing	2,654	$134,489	8
	3364	Aerospace Product and Parts Manufacturing	NA	NA	NA
	3366	Ship and Boat Building	NA	NA	NA
	3369	Other Transportation Equipment Manufacturing	NA	NA	NA
	3391	Medical Equipment and Supplies Manufacturing	10	$307	4
	3399	Other Miscellaneous Manufacturing	375	D	5
	Subtotal		**4,119**	**$136,349**	**39**
Advanced Energy Information	5112	Software Publishers	NA	NA	NA
	5152	Cable and Other Subscription Programming	NA	NA	NA
	5172	Wireless Telecommunications Carriers (except Satellite)	60	D	2
	5174	Satellite Telecommunications	NA	NA	NA

Appendix Table 10, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Information	5179	Other Telecommunications	NA	NA	NA
	5182	Data Processing, Hosting, and Related Services	10	D	1
	5191	Other Information Services	NA	NA	NA
	Subtotal		**70**	**$-**	**3**
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services	60	$1,761	13
	5414	Specialized Design Services	NA	NA	NA
	5415	Computer System Design and Related Services	11	$369	6
	5416	Management, Scientific, and Technical Consulting Services	60	D	5
	5417	Scientific Research and Development Services	NA	NA	NA
	5419	Other Professional, Scientific, and Technical Services	138	$3,724	22
	Subtotal		**269**	**$5,854**	**46**
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal	10	D	1
	6215	Medical and Diagnostic Laboratories	10	D	1
	8112	Electronic and Precision Equipment Repair and Maintenance	60	D	3
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	60	D	3
	Subtotal		**140**	**$-**	**8**
All Advanced Energy Industry	**Total**	**5,756**	**$163,944**	**192**	

Appendix Table 11: Advanced Energy by NAICS in Nashville-Davidson-Murfreesboro-Franklin, TN MSA, 2013

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Utilities and Construction	2211	Electric Power Generation, Transmission and Distribution	750	D	24
	2212	Natural Gas Distribution	375	D	10
	2361	Residential Building Construction	2,694	$156,221	608
	2362	Nonresidential Building Construction	7,983	$435,953	203
	2371	Utility System Construction	2,907	$167,140	101
	2379	Other Heavy and Civil Engineering Construction	71	$2,107	22
	2381	Foundation, Structure, and Building Exterior Contractors	5,209	$226,877	437
	2382	Building Equipment Contractors	10,953	$552,499	795
	2383	Building Finishing Contractors	2,905	$121,319	423
	Subtotal		**33,847**	**$1,662,116**	**2,623**
Advanced Energy Manufacturing	3211	Sawmills and Wood Preservation	350	$10,289	25
	3221	Pulp, Paper, and Paperboard Mills	NA	NA	NA
	3241	Petroleum and Coal Products Manufacturing	60	$11,956	15
	3251	Basic Chemical Manufacturing	214	$15,680	6
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	66	$4,374	6
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	60	D	1
	3259	Other Chemical Product and Preparation Manufacturing	607	$35,885	23
	3272	Glass and Glass Product Manufacturing	750	D	6
	3279	Other Nonmetallic Mineral Product Manufacturing	343	$12,965	24
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	237	$12,964	4
	3313	Alumina and Aluminum Production and Processing	669	$34,079	3
	3315	Foundries	561	$29,605	4
	3331	Agriculture, Construction, and Mining Machinery Manufacturing	108	$7,153	7
	3332	Industrial Machinery Manufacturing	126	$5,038	8
	3333	Commercial and Service Industry Machinery Manufacturing	315	$21,428	8
	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	375	$14,081	10

Appendix Table 11, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Manufacturing	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	60	D	3
	3339	Other General Purpose Machinery Manufacturing	826	$45,571	20
	3341	Computer and Peripheral Equipment Manufacturing	15	$832	4
	3342	Communication Equipment Manufacturing	60	D	3
	3343	Audio and Video Equipment Manufacturing	26	$1,545	7
	3344	Semiconductor and Other Electronic Component Manufacturing	259	$8,816	9
	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	454	$18,797	9
	3346	Manufacturing and Reproducing Magnetic and Optical Media	198	$9,237	12
	3351	Electric Lighting Equipment Manufacturing	262	$14,010	8
	3352	Household Appliance Manufacturing	3,750	D	4
	3353	Electrical Equipment Manufacturing	568	$42,934	7
	3359	Other Electrical Equipment and Component Manufacturing	858	$30,942	11
	3361	Motor Vehicle Manufacturing	3,750	D	2
	3362	Motor Vehicle Body and Trailer Manufacturing	261	$9,993	12
	3363	Motor Vehicle Parts Manufacturing	7,500	D	58
	3364	Aerospace Product and Parts Manufacturing	750	D	5
	3366	Ship and Boat Building	750	D	4
	3369	Other Transportation Equipment Manufacturing	60	$1,151	4
	3391	Medical Equipment and Supplies Manufacturing	512	$23,639	45
	3399	Other Miscellaneous Manufacturing	1,870	$67,240	83
	Subtotal		**27,630**	**$490,204**	**460**
Advanced Energy Information	5112	Software Publishers	828	$92,970	54
	5152	Cable and Other Subscription Programming	10	D	4
	5172	Wireless Telecommunications Carriers (except Satellite)	3,750	D	75
	5174	Satellite Telecommunications	10	D	2

Appendix Table 11, continued

Industry Group	NAICS	Descriptor	Employment	Payroll ($1,000)	Number of Establishments
Advanced Energy Information	5179	Other Telecommunications	92	$5,526	20
	5182	Data Processing, Hosting, and Related Services	5,408	$338,858	97
	5191	Other Information Services	517	$36,208	60
	Subtotal		**10,615**	**$473,562**	**312**
Advanced Energy Professional, Scientific, and Technical Services	5413	Architectural, Engineering, and Related Services	6,229	$426,960	506
	5414	Specialized Design Services	483	$27,700	141
	5415	Computer System Design and Related Services	5,342	$454,356	500
	5416	Management, Scientific, and Technical Consulting Services	6,813	$532,906	642
	5417	Scientific Research and Development Services	1,291	$112,264	57
	5419	Other Professional, Scientific, and Technical Services	3,658	$130,324	326
	Subtotal		**23,816**	**$1,684,510**	**2,172**
Advanced Energy Other Services (Includes Administrative and Support, Waste Management and Remediation Services, and Health Care and Social Assistance)	5622	Waste Treatment and Disposal	189	$9,767	25
	6215	Medical and Diagnostic Laboratories	2,845	$173,398	85
	8112	Electronic and Precision Equipment Repair and Maintenance	1,770	$77,319	66
	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	672	$28,509	95
	Subtotal		**5,476**	**$288,993**	**271**
All Advanced Energy Industry	**Total**		**101,384**	**$4,599,385**	**5,838**