Survey Results

CLEAN JOBS TENNESSEE

Sizing Up Tennessee's Clean Energy Jobs Base and its Potential

Presented by

Environmental Entrepreneurs®

JULY 2015

ABOUT ENVIRONMENTAL ENTREPRENEURS

Environmental Entrepreneurs (E2) is a national, nonpartisan group of business leaders, investors and others who promote sound environmental policies that drive economic growth. E2 members, active in nearly every state in the country, have built or financed more than 1,700 companies that have created more than 570,000 jobs, and manage more than $100 billion in venture and private equity capital. E2 is an affiliate of the Natural Resources Defense Council (NRDC).

E2 has been tracking clean energy jobs and clean energy job announcements since 2012 and has produced extensive clean energy jobs research reports in numerous states across the country. For more information see **www.cleanenergyworksforus.org**. To learn more about E2 see **www.e2.org**.

Additional Partners

Southern Alliance for Clean Energy

SRW & Associates

The initial results of this study were presented at a conference entitled "The Clean Power Plan: Health, Energy Demand and Economic Effects," which took place May 18–19, 2015, and was co-hosted by Vanderbilt University Law School and Vanderbilt University School of Medicine. This report was made possible through partial funding from the Energy Foundation.

ABOUT THE RESEARCH AND ANALYSIS PARTNER

BW Research Partnership

BW Research Partnership (www.bwresearch.com) is a full-service research consulting firm with offices in California and Massachusetts. Recognized by the Congressional Research Office as developing the most accurate data to date, BW Research has conducted more clean energy labor market analyses than any other firm. Recent projects include: The Solar Foundation's National Solar Jobs Census[1], wind[2] and solar[3] labor market reports for the National Renewable Energy Laboratory (NREL), and clean energy studies for the Natural Resources Defense Council (NRDC)[4], the Massachusetts Clean Energy Center[5], the Clean Energy Trust (Illinois)[6], the State of Vermont[7], and many others.

STUDY METHODOLOGY OVERVIEW

This report includes the findings of a comprehensive employer survey to determine the size and scope of Tennessee's clean energy economy.[8] The methodology has been replicated in 12 states, and is based on a survey of employers in Tennessee together with state and federal labor market data. For this study, 16,679 businesses were contacted, and responses were gathered from 1,007 companies. This level of sampling provides a margin of error of +/-2.95% at a 95% confidence interval. Surveys averaged 14 minutes in length and were fielded from March 26–April 18, 2015. Survey data was used to extrapolate employment and establishment data to the Tennessee economy using the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW).[9] Clean energy employment includes jobs in renewable energy, energy efficiency, alternative transportation, or greenhouse gas management and accounting.

For a more detailed explanation of the study methodology, and definitions of terms and job categories used in this report, please refer to Appendix A.

INTRODUCTION

Defined as including energy efficiency, renewable energy sources, alternative transportation and greenhouse gas (GHG) management and accounting, the clean energy industry is a source of good jobs for tens of thousands of Tennesseans.

In 2015, clean energy firms in Tennessee supported 44,269 workers at 2,611 businesses. Nearly half (46%) of business respondents derive a majority of their revenue from clean energy activities. This was an increase of 2,600 workers over 2014 (6.3%), and businesses said they expect to create 2,500 more jobs by 2016.

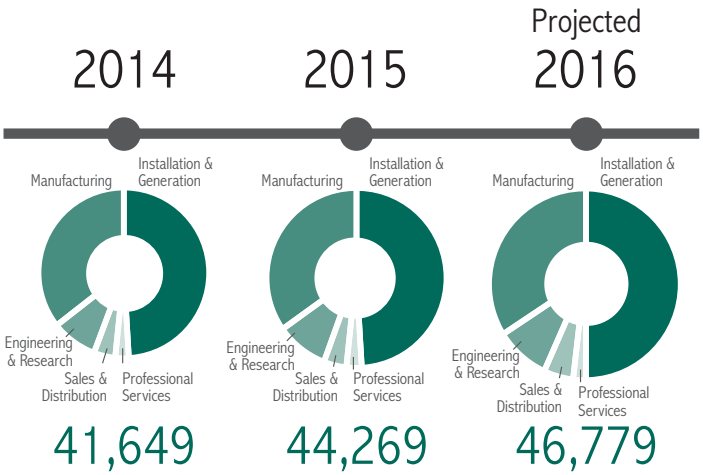
Tennessee is somewhat unique in its concentration of large clean energy employers. In fact, more than 25% of Tennessee's clean energy employment is found in fewer than 10 employers that are focused on renewable energy generation, electric vehicle manufacturing, and production of ENERGY STAR appliances.

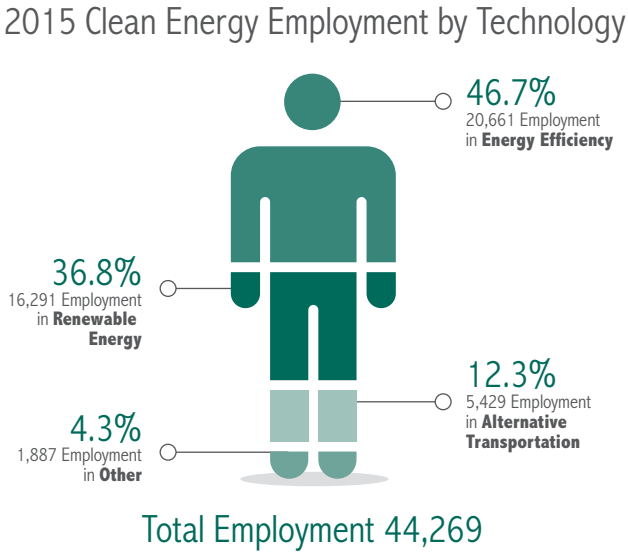
Clean energy workers comprise 1.6% of the Tennessee's labor market. Most workers (21,542) support installation and generation, but the manufacturing sector grew by nearly 10%, adding 1,249 new jobs.

Energy efficiency (47% of workers) and renewable energy (37%) comprise the bulk of Tennessee's clean energy industry, though alternative transportation does account for roughly 5,500 jobs. About 70% of renewable technology firms indicate that solar is the primary technology; bioenergy (27%) and geothermal (25%) also represent a sizeable of chunk of business.

While nearly 80% of clean energy customers are within the state, Tennessee's strong manufacturing sector supports an industry that is more export-driven than other states where similar studies have been conducted. Many clean energy businesses in Tennessee (44%) support in-state suppliers and vendors, while 49% source their equipment from outside the state.

Clean energy businesses demand public support to stimulate consumption. Nearly one-third (32%) of employers indicate that financial incentives would best accelerate the adoption of clean energy goods and services; 26% of employers suggested regulations and standards.





Industry Landscape

Tennesseans' rate of energy consumption per capita is among the highest in the nation, which indicates that there is a particularly significant opportunity to save ratepayers money through energy efficiency while also creating jobs. While there is still plenty of room for improvement, the state has been reducing its reliance on coal-fired generation and increasing utilization of cleaner resources, including energy efficiency and renewable energy.[10]

Solar

Tennessee's solar market consists of 151 companies employing roughly 2,200 workers across the state.[11] Installed solar capacity doubled last year, with current statewide generation at 130 MW. In 2014, Tennessee was one of only four states in the nation to supply 100 percent of new electrical capacity from solar energy. Most projects (52 MW) are utility-scale, but commercial and residential solar account for 4 MW of generation.[12] Tennessee Valley Authority (TVA), the state's main electricity generator, offers a variety of programs including Green Power Providers, Solar Solutions, and its Renewable Standard Offer program. In 2013, TVA approved 120 MW of renewable capacity to be purchased at or above market rates for at least 20 years.[13] To complement these long term pricing contracts, TVA administers the Green Power Switch Program, in which commercial customers can purchase 150 kWh blocks of renewable energy at $4 per month.[14] New generators also receive $1,000 upon installation.[15] With $62.5 million from the American Recovery and Reinvestment Act, the Tennessee Solar Institute established the Volunteer Solar Initiative which offered a series of installation and innovation grants under the Solar Opportunity Fund until its expiration in 2013.[16] The Fund totaled $23.5 million and financed over 17 MW of solar capacity.[17] The state also offers a Green Energy Tax Credit of up to $1.5 million to any company investing more than $250 million dollars in the green energy supply chain, along with sales tax credits for the purchase of clean energy equipment and reduced tax rates for manufacturers that invest $100 million and create 50 full-time jobs.[18]

Solar energy employs 2,200 workers statewide.

Wind

Currently the only state in the Southeast with installed wind capacity, Tennessee is home to the Buffalo Mountain Wind Farm.[19] TVA developed the initial three wind turbines in 2000, and in 2004, Invenergy added another fifteen turbines. The 27 MW Buffalo Mountain Wind Farm produces enough energy to power 3,400 homes every year; TVA owns all the electricity the wind farm generates.[20] The state also hosts at least 10 manufacturing facilities that produce wind turbine components.[21]

Energy Efficiency

In its 2011 Integrated Resource Plan (IRP), TVA aimed to become the energy efficiency leader of the Southeast. The Board of Directors set out to reduce sales by 3.5% through increased energy efficiency by 2015.[22] TVA offers residential and non-residential energy efficiency programs through its EnergyRight Solutions brand, which has achieved highly cost-effective energy savings at an average lifetime cost of 1.8 cents per kWh.[23] However, the programs have fallen short of meeting TVA's 2011 goals, in part due to insufficient funding; as of this writing, funding for industrial incentives has been fully committed for the current fiscal year, and no new applications are being accepted.[24]

While there has been some progress, Tennessee still falls below the national average for overall energy efficiency spending and savings. The state ranked 38th on the 2014 ACEEE National Energy Efficiency Scorecard. A home rule state, Tennessee's building codes are adopted and enforced by each jurisdiction. With no formal targets for public buildings, the only mandatory standard for residential and commercial construction is the 2006 IECC (International Energy Conservation Code).[25] In 2012, the Department of Energy (DOE)

released a study comparing energy cost savings for Tennessee homeowners under both the 2009 and 2012 IECC codes.[26] The following year, the DOE addressed a letter to Gov. Bill Haslam urging the state to update its energy code to federal standards, citing energy cost savings of up to $250 million annually by 2030.[27] The state's Department of Commerce and Insurance replied, requesting additional time to review, develop, and implement the 2006 IECC code and related training programs before updating compliance.[28]

In a promising recent development, the office of Gov. Haslam has announced that its new EmPower TN initiative, which has received initial funding in the state budget for 2015–2016, is expected to reduce utility bills at buildings owned or operated by the state by an estimated 28% over the next eight years through energy efficiency and renewable energy.[29] The EmPower TN initiative calls for a $200 million in funding from 2016–2019, with $57 million in cumulative savings reinvested annually from 2020–2023, which will allow for a self-sustaining program. The $200 million investment is projected to yield $1 billion in savings for Tennessee taxpayers by 2035.

Biomass

Tennessee has an estimated 4.5 million acres of land with suitable soil and climate for farming switchgrass.[30] In 2007, the state invested $70 million in the UT Biofuels Initiative, creating Genera Energy and prompting farmers to plant up to 7,000 acres of switchgrass within a 50-mile radius of a pilot cellulosic ethanol biorefinery. Two years later, the DOE invested $24 million in the UT Biofuels Initiative.[31] The DOE has since continued supporting biofuels research in Tennessee, awarding another $5 million in 2013 to Genera Energy and the University of Tennessee to continue innovating supply chain systems that process switchgrass.[32]

Advanced Energy Manufacturing

In 2013, the DOE announced the Clean Energy Manufacturing Initiative at the Carbon Fiber Technology Facility in Tennessee's Oak Ridge National Laboratory (ORNL).[33] Its objectives are to produce clean and efficient energy products and components. ORNL is currently conducting research into carbon fiber composites, combined heat and power technologies,

More than 16,000 people work in renewable energy in Tennessee.

energy storage, and battery manufacturing. The lab operates the country's largest battery manufacturing research and development facility, open to any U.S. battery manufacturer, supplier, or user.[34]

This past January, the White House selected UT-Knoxville to lead the Institute for Advanced Composites Manufacturing Innovation (IACMI). With $70 million from the DOE and $189 million from IACMI partners, the Institute joins four others to advance wind turbine technology and produce lightweight vehicles with increased fuel economy. In the same year, Tennessee's Department of Economic and Community Development granted an additional $15 million to IACMI.[35]

Advanced Transportation

In May 2015, the Tennessee Department of Environment and Conservation (TDEC) announced the second round of a two-tiered rebate program that became available after June 15, 2015. The program offers $2,500 for the purchase or lease of zero-emission electric vehicles and $1,500 for plug-in hybrid vehicles.[36] There are currently 493 alternative fuel stations in Tennessee, including biodiesel (22), compressed natural gas (10), ethanol (60), electric (304 stations with 697 outlets), liquefied natural gas (2), and propane (95).[37] There are also seven truck stop electrification sites across the state that allow drivers to power necessary systems without idling the engine.[38] In 2013, the Nissan Leaf vehicle assembly and battery manufacturing plant opened in Smyrna, Tennessee. The facility produces 640,000 vehicles annually and employs over 8,000 workers.[39]

EXECUTIVE SUMMARY

Tennessee's clean energy employment sector is substantial and growing.

As this report finds, Tennessee is already home to more than 2,600 clean energy employers and nearly 45,000 workers. Its companies supply the world with electric cars, energy-efficient materials, renewable energy and advanced building controls, and supply Tennesseans with clean, renewable energy. Clean energy employers are adding jobs faster than the overall state economy, and growth is expected to continue in the coming year.

But the state can — and must — do much more if it wants to keep growing and catch up with national leaders in a clean energy economy.

Smart policy options, such as strong implementation of the federal Clean Power Plan and creation of a state Renewable Portfolio Standard (RPS), can help Tennessee continue to build on the clean energy progress it has made so far. Policies that encourage development of a broader in-state ecosystem of vendors and suppliers to big clean energy companies also would help drive growth in clean energy jobs and provide more stability to the state's economy.

Tennessee residents and employers clearly want the state to do more.

Many firms interviewed for this study reported the need for greater consumer incentives, better renewable energy standards and more innovative financing mechanisms to expand the state's clean energy market. Nearly 30 percent of respondents said they thought the Clean Power Plan would result in a moderate or significant increase in their business; about 90 percent said the plan would not affect their business negatively.

Meanwhile, over four-fifths of registered voters support increasing the use of renewable energy in Tennessee, according to a 2014 survey.[40]

The bottom line: To continue to grow and reap the economic development, job creation and cost-saving benefits of renewable energy and energy efficiency, Tennessee must be proactive and implement smart policies that encourage growth in these sectors, including a state plan for the federal Clean Power Plan that emphasizes cost-effective energy efficiency and renewable energy policies.

MAJOR FINDINGS

TENNESSEE'S CLEAN ENERGY ECONOMY IS EXPANDING — PROJECTED GROWTH IS NEARLY 6%.

The state is home to 2,611 clean energy employers,[41] who support 44,269 jobs. The clean energy employment sector represents 1.6% of the state's labor market,[42] with presence across the entire supply chain.[43] Clean energy employment rose by 6.3% in the last 12 months, creating roughly 2,600 new jobs and surpassing the overall statewide employment growth of 2.2%. Firms project additional growth of 5.7% or 2,500 more jobs in the next 12 months (Figure 1, Table 2).

Compared to other states where similar studies have been performed, Tennessee falls roughly in the middle of the pack in terms of the percentage of total jobs in the state that are in the clean energy industry, but the state lags far behind the percentages seen in leading states (Table 1). Looking at recent growth in clean energy employment, Tennessee ranks among the top states studied. However, clean energy employers in Tennessee expect lower future job growth than clean energy employers in other states. These findings suggest that more supportive policies could help to build on the recent progress in expanding Tennessee's clean energy industry.

Table 1. Tennessee's Clean Energy Industry Compared to Other States

State	CE Jobs	Total (Non-farm) Jobs	% of Total Jobs	Past Growth	Future Growth
California	431,800	15,994,300	2.7%	5%	17%
Illinois	104,449	5,784,500	1.8%	7.8%	7.5%
Florida	130,000	7,831,700	1.7%	6%	9.2%
Iowa	22,643	1,563,500	1.4%	-4%	6%
Massachusetts	88,372	3,430,900	2.6%	10.5%	13.3%
Missouri	39,416	2,769,300	1.4%	4.8%	7.1%
Ohio	89,000	5,180,000	1.5%	5.4%	12.4%
Pennsylvania	57,000	5,781,600	1%	4.4%	8.5%
Tennessee	44,269	2,766,813	1.6%	6.3%	5.7%
Vermont	15,286	308,900	4.9%	3.4%	12%

Figure 1: Clean Energy Industry Employment Growth 2014–2016 (Projected)

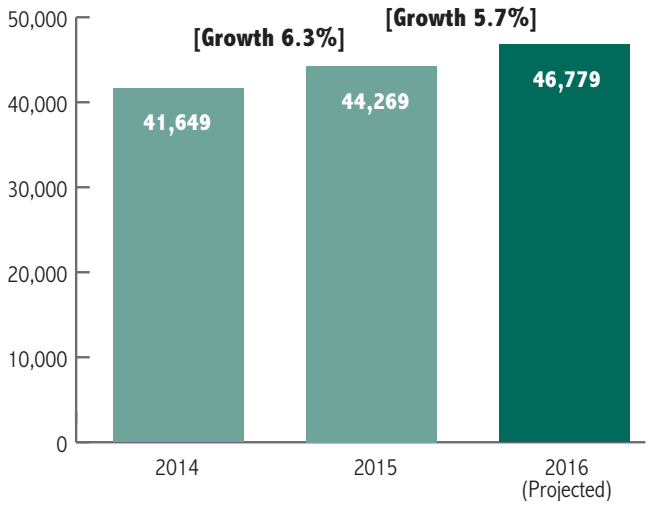
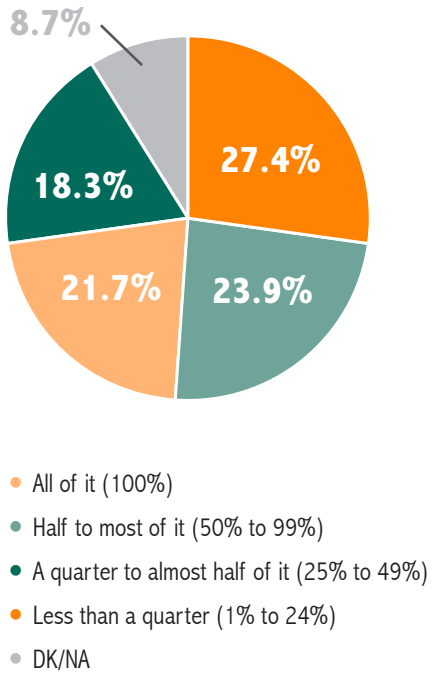


Figure 2. Percentage of Revenue from Clean Energy Goods and Services



CLEAN ENERGY PROVIDES AN IMPORTANT REVENUE STREAM FOR BUSINESSES.

Nearly half (45.6%) of clean energy business establishments derive a majority of their revenue from clean energy activities (Figure 2).

Table 2. Clean Energy Employment and Growth by Value-Chain Activity[44]

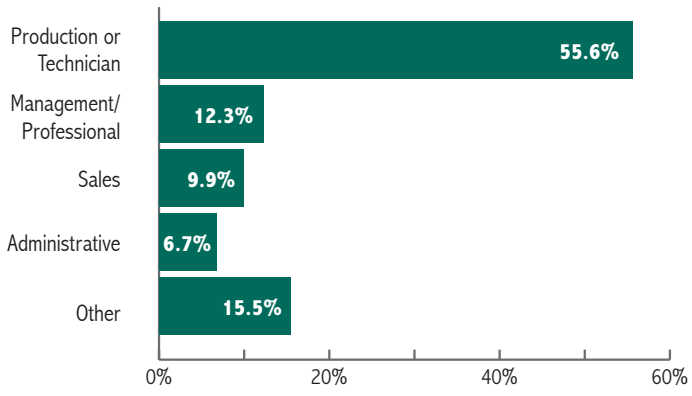
	2014	2014–2015 Growth	2015	2015–2016 Projected Growth	2016 Projected
Installation & Generation	20,302	6.1%	21,542	8.2%	23,300
Manufacturing	12,684	9.8%	13,933	2.3%	14,252
Engineering & Research	6,248	2.0%	6,372	4.2%	6,638
Sales & Distribution	1,689	-1.4%	1,666	5.1%	1,751
Professional Services	667	4.1%	694	11.5%	773
Other	59	4.1%	62	6.3%	65
TOTAL	**41,649**	**6.3%**	**44,269**	**5.7%**	**46,779**

CLEAN ENERGY WORKERS SUPPORT THE ENTIRE VALUE CHAIN OF ACTIVITIES.

Installation and generation employs the most employees (21,542), but the manufacturing sector experienced the highest growth (9.8% or 1,249 new jobs) in the last 12 months. Both professional services and installation and generation are projected to see employment grow in the next year at 11.5% and 8.2%, respectively (Table 2).

As reported by clean energy employers, most new jobs (55.6%) added over the past 12 months were in the production or technician fields (Figure 3).

Figure 3. Recent Hire Occupational Categories



CASE STUDY: *Architect and developer uses energy efficiency, renewables to revitalize Memphis and create local jobs*

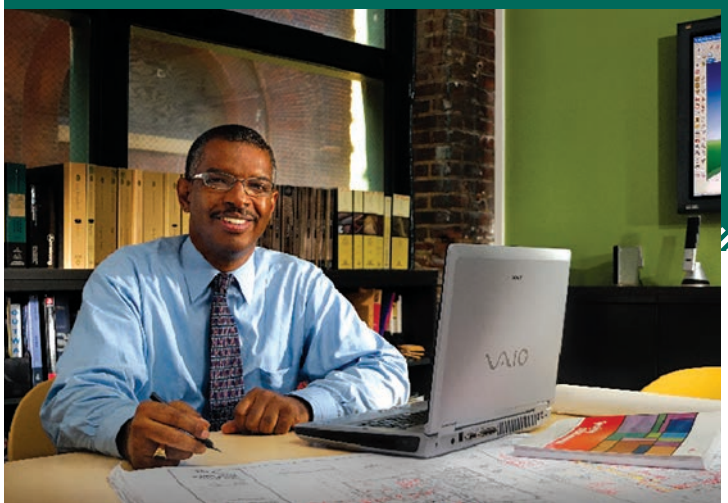
As one of the founding principals of a successful architectural firm in Memphis, Jimmie Tucker has made it his mission to improve the buildings and lives of Memphis residents. Self + Tucker Architects (STA) is celebrating 20 years in business this year, and STA has created many well-designed and energy-efficient buildings — and jobs — throughout the Mid-South since 1995.

After spending his childhood in Memphis, Tucker left the city to pursue his architectural career, receiving architecture degrees from Princeton and Washington University in St. Louis. After working for several years in St. Louis and New York, Tucker returned to his native Memphis to help revitalize the city, which had been abandoning historical buildings and failing to engage in energy efficient building design and planning.

Over the years, however, Tucker's firm has completed numerous projects that have breathed new life into old buildings — while also cutting energy costs and creating good jobs.

Currently, Tucker is working on the revitalization of the historic but long-vacant Universal Life Insurance Building. For this project, he is serving as both architect and developer as he has owned the building since 2005 with his business partner, Juan Self. The new Universal Life Insurance Building will feature a green roof and a large parking lot solar canopy.

The project will include a local workforce training program offering clean energy job training for local residents — training that will pay dividends in the local economy as demand for solar and energy efficiency retrofits increase.



Tucker's firm is also working on the Residences at Green Leaf, an existing 10-unit apartment building in Memphis, which is being designed for energy efficiency and will incorporate an 8-kilowatt solar power system.

—SACE and Environmental Entrepreneurs

Memphis architect Jimmie Tucker designs and develops energy efficient buildings across the Mid-South. (Photo courtesy of STA via cleanenergy.org)

RENEWABLES AND EFFICIENCY COMPRISE THE BULK OF TENNESSEE'S CLEAN ENERGY INDUSTRY.

Most clean energy workers are employed in jobs that support energy efficiency (47%) and renewable energy (37%) (Table 3). However, the energy efficiency subsector is significantly smaller than other states, including Missouri (82.6%), Massachusetts (73.8%), California (70%), Florida (75%), and Illinois (66%).[45]

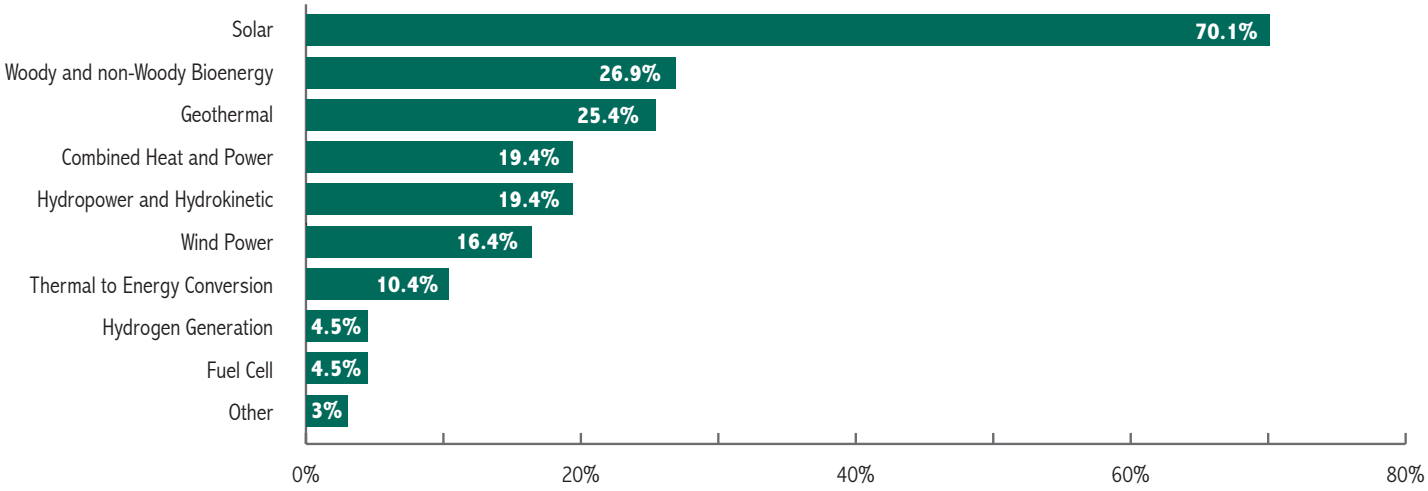
Table 3. Clean Energy Employment by Technology

	Employment	% of Employment
Energy Efficiency	20,661	46.7%
Renewable Energy	16,291	36.8%
Alternative Transportation	5,429	12.3%
Other	1,887	4.3%
TOTAL	**44,268**	**100.0%**

SOLAR TECHNOLOGY IS CENTRAL TO TENNESSEE'S RENEWABLE ENERGY SUBSECTOR.

About 70% of renewable technology firms indicated that solar generates significant business. Bioenergy and geothermal represent a sizeable portion of business at roughly 27% and 25%, respectively. About 19% of firms reported working with hydropower or hydrokinetic technologies (Figure 4).

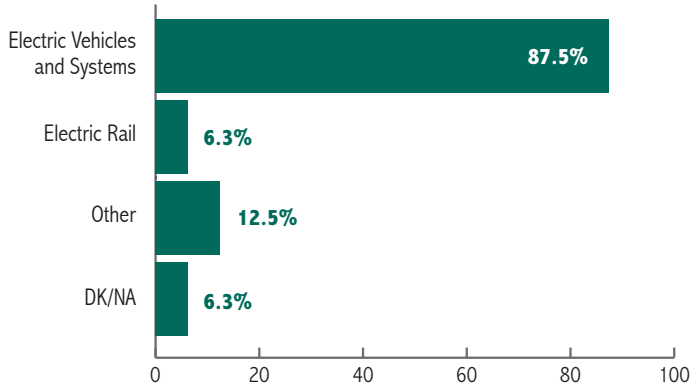
Figure 4. Percentage of Renewable Energy Technologies[46]



ELECTRIC VEHICLES PROPEL TENNESSEE'S ALTERNATIVE TRANSPORTATION SECTOR.

Of those firms that indicated a share of business from alternative transportation, about 88% reported work with electric vehicles and systems (Figure 5).

Figure 5. Percentage of Alternative Transportation Technologies



TENNESSEE'S CLEAN ENERGY MARKET IS MORE EXPORT DRIVEN THAN OTHER STATES.

While nearly 80% of the industry's customer base is located within Tennessee (Figure 6), a significantly high proportion of manufacturing jobs indicates a strong clean energy export market (Figure 7).[47]

Figure 6. Primary Location of Clean Energy Customers

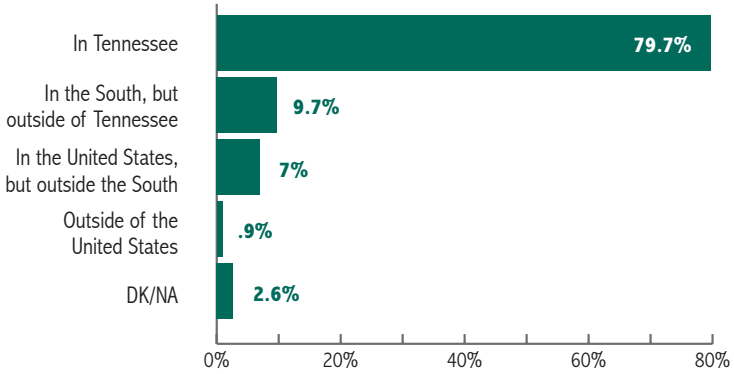
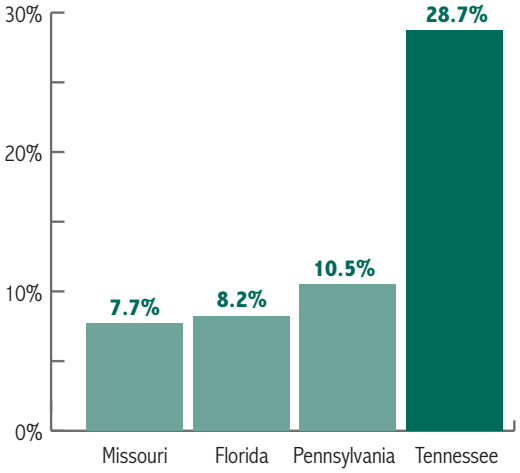


Figure 7. Proportion of Employment in Manufacturing



CASE STUDY: *For businesses with big buildings, using energy smarter boosts bottom line*

Chattanooga-based Energy Efficiency and Sustainability Consulting is creating good jobs and growing Tennessee's economy by helping make businesses like auto dealerships, textile manufacturers, fitness centers, and furniture stores more energy efficient.

With offices in five states, EES employs nine people in Tennessee. These employees design outdoor lighting control systems, tighten building envelopes, improve existing HVAC systems, install money-saving window film, and advise clients on renewable energy technologies like solar and combined heat and power (CHP).

Recently, EES was hired by a vertically integrated manufacturer of zippers. One of the largest employers in the Sequatchie Valley, the company, Dunlap Industries, wanted to continue to focus on its core business while hiring EES to make its three facilities — distribution, sales and manufacturing — more energy efficient.

EES retrofitted the lighting in each facility. When completed, Dunlap realized a one-third drop in energy costs and a combined annual savings of nearly $20,000. The entire investment will pay for itself in less than three years.

"They earned the business by coming in and doing the evaluations and helping us to see what options would work the best for us," Dunlap owner and president Robert Kwasnik said of EES.

Other recent lighting retrofits by EES include an auto dealership ($9,000 in annual savings) and a 400-room hotel ($25,000 in savings).

Daniel LeVan is a managing director at the EES offices in downtown Chattanooga. He said smart policies like the federal Clean Power Plan can help grow his business — and improve Tennessee's economy by creating good jobs and making businesses with large building footprints operate more efficiently.

"Our state can strengthen its own economic climate by taking advantage of the new opportunities created by EPA's Clean Power Plan," he said.

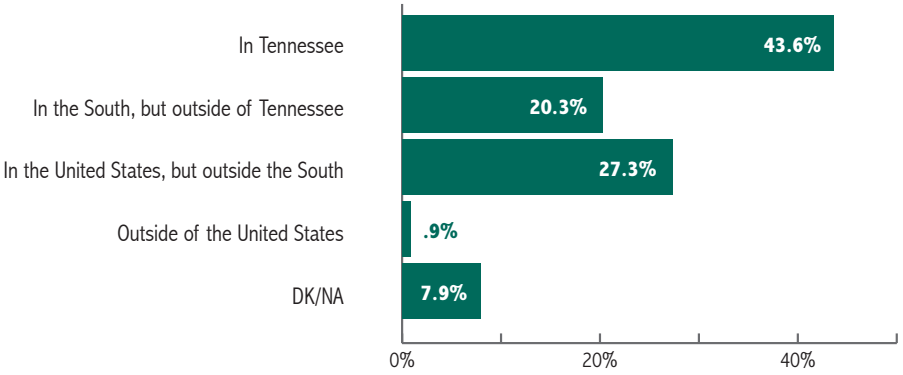
— Environmental Entrepreneurs

Daniel LeVan, managing director of Chattanooga-based EES, said the federal Clean Power Plan will strengthen Tennessee's economic climate. (Photo courtesy of EES)

NEARLY HALF OF THE STATE'S CLEAN ENERGY CLUSTER SUPPORTS LOCAL VENDORS AND SUPPLIERS.

Many firms (43.6%) support in-state suppliers and vendors while the other half (48.5%) source their equipment from outside the state (Figure 8).

Figure 8. Primary Location of Clean Energy Suppliers and Vendors



BUSINESSES WANT PUBLIC SUPPORT TO STIMULATE CLEAN ENERGY CONSUMPTION.

Nearly one-third of employers (32.2%) indicated that consumer financial incentives would have the greatest impact in accelerating the adoption of clean energy goods and services. About one-fourth of firms (26.2%) suggested regulations and standards would best support business growth (Figure 9).

About three in four employers (74.8%) were aware of the Environmental Protection Agency's Clean Power Plan, under which Tennessee is expected to reduce carbon pollution from existing power plants by about 39% in part through more renewable energy and energy efficiency. Of these employers, 60.5% felt that the Clean Power Plan would have no impact on their business, while 7% indicated that the Plan would significantly increase business (Figure 10).

Figure 9. Policies that would Impact Growth of Clean Energy Adoption[48]

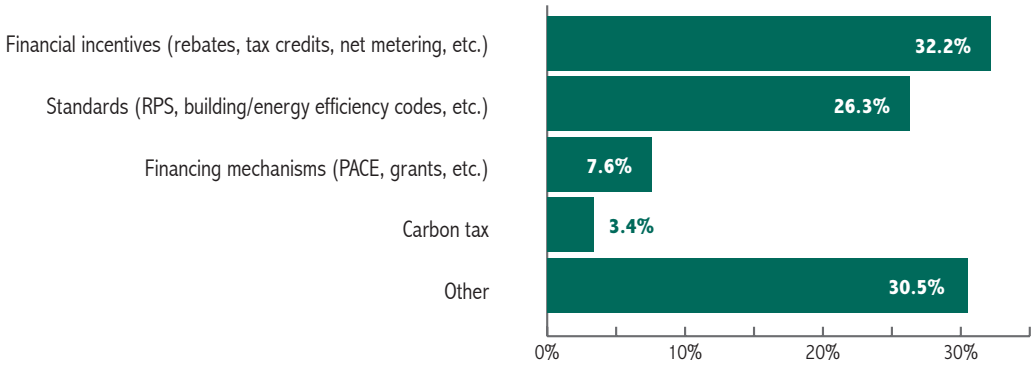
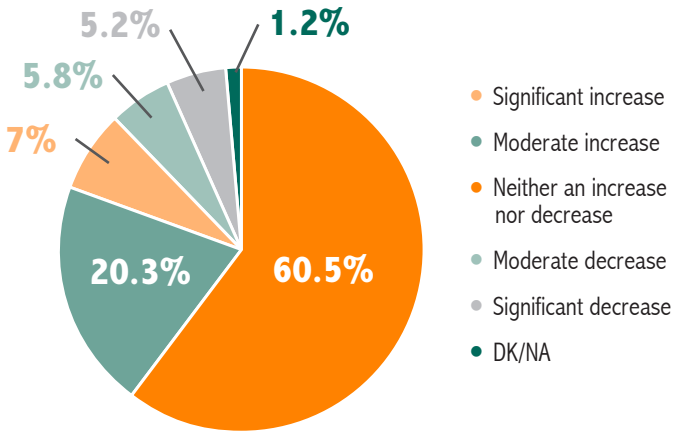


Figure 10. EPA Clean Power Plan, Expected Impact to Business in Tennessee



CLEAN POWER PLAN IS GOOD BUSINESS.

Nearly 90 percent of companies contacted said they expect the federal Clean Power Plan to improve or have no impact on their business. About 30 percent expect business to increase because of the plan.

CASE STUDY: *High-profile projects in solar, energy efficiency keep Knoxville company's workers, contractors busy*

Solar, energy efficiency and other clean energy technologies are helping Knoxville-based ARiES Energy create jobs and grow Tennessee's economy. ARiES' mission: to make clean energy easy, accessible and affordable for its clients.

Since its founding in 2011, ARiES has seen revenues double every year. It now employs 10 workers in production, sales and other roles.

ARiES works on projects across Eastern Tennessee.

For example, in early June 2014, a row of scaffolding went up along one side of the Three Rivers Market in Knoxville. Soon, the market's rooftop was transformed into a busy worksite, as contractors and employees from ARiES began installing a 50-kilowatt solar PV array.

About 10 days after construction began — on the summer solstice, no less — the array was commissioned, delivering via a Made-in-the-U.S.A. inverter enough clean, renewable electricity to offset the burning of nearly 50,000 pounds of coal annually.

The project took advantage of a TVA Green Power Providers program and the federal Investment Tax Credit, an economy-expanding tax incentive that's scheduled to expire at the end of 2016 unless Congress steps in to renew it.

For Jacqueline Arthur, general manager of Three Rivers Market, investing in the array was a no-brainer.

"For any financially conservative, locally-owned, values-based business or organization with a long-term commitment to our region, it is the right thing to do," she said. "The financial, environmental, and social return on the investment is unequivocal."

In addition to the Three Rivers Market, ARiES has done commercial solar installations above a beer garden in Knoxville, atop the elephant house at the Knoxville Zoo and above a pottery studio in Morristown's historic downtown district.

Beyond solar, ARiES has also built a biomass gasification plant and completes lighting retrofits as well. At the restaurant 212 Market in Chattanooga, for instance, ARiES completed a lighting retrofit that replaced existing overhead lighting with energy efficient lighting, reducing the restaurant's lighting energy by 71 percent.

It will take less than three years for the restaurant to earn back its initial investment.

—Environmental Entrepreneurs

In Knoxville, workers install a rooftop solar array at the Bearden Beer Market. (Photo courtesy of ARiES)

CONCLUSION

As Tennessee's clean energy economy expands, the industry will contribute to statewide economic vitality. With a diverse renewable energy portfolio and robust employment across all value-chain activities, employers are optimistic about future growth. Increased support for local suppliers and vendors will encourage successful industry expansion, spur local job creation, and further bolster the state's economy.

Tennessee could capitalize on its market diversity by tapping into the region's renewable potential and committing to energy efficiency as a resource. The National Renewable Energy Laboratory (NREL) found that Tennessee's technical solar potential for utility-scale projects is 1,296 GW and 16 GW for rooftop photovoltaics. With an additional 54 GW potential from geothermal systems and 1 GW from hydropower, the state's clean energy cluster will benefit by developing these resources.[49] Other states provide solid examples of how effective energy efficiency policies focused on consumer incentives, rebates and proactive utility programs can create jobs across traditional industries, especially within the building trades.[50] States that are leaders in energy efficiency have illustrated that supportive clean energy policies are highly correlated to economic impacts, particularly regarding construction-related employment. If Tennessee could emulate these policies, the resulting employment impact could exceed 10,000 new clean energy jobs across the state.

Tennessee is already home to more than 2,600 clean energy employers and nearly 45,000 workers. Its companies supply the market with electric cars, energy efficient materials, renewable energy and advanced building controls. Clean energy employers are adding jobs faster than the overall state economy and project continued growth in the coming year. To sustain this growth, many firms report the need for greater consumer incentives, more supportive policies on renewable energy and more innovative financing mechanisms to expand the state's clean energy market.

The state has several strengths within its clean energy sector, particularly in alternative transportation, manufacturing, and renewable energy generation. A few large clean energy establishments drive the sector, whereas in most states, small businesses dominate the clean energy sector. Larger firms provide an important ecosystem and can be leveraged to build clusters of activity around them, but they do not provide the same employment stability as a broad distribution of companies because their relocation could terminate the employment of thousands of workers. Because of its unique situation, Tennessee could leverage the presence of these large manufacturers to expand the ecosystem of suppliers, vendor and others — and expand the clean energy jobs and the economic stability that would come with that.

Alternative transportation, manufacturing and renewable energy generation are some of the strongest sectors in Tennessee's clean energy industry.

Tennessee should focus on three areas:

1. **Encourage policies that promote and advance renewable energy and energy efficiency.** By creating a state plan for the federal Clean Power Plan that focuses on renewable energy and energy efficiency, the state could send a strong market signal that encourages growth in these sectors — and growth in clean energy jobs. In addition to the Clean Power Plan, the state could take other steps to encourage more energy efficiency and renewable

energy job growth. For example, the state could build off of recent positive developments, like the EmPower TN initiative, and facilitate ways for local government and the private sector to reduce utility bills through investments in cost-effective energy efficiency and renewable energy. A low-cost way to do that is to enable innovative financing arrangements like Property Assessed Clean Energy (PACE). The state should also consider updating its building energy codes, as was recommended by the DOE.

2. **Foster the expansion of clean energy activity in traditional economic sectors, with a particular focus on small businesses in the building trades.** This appears to be best accomplished through expanded consumer incentives, increased marketing and contractor training. With these supports in place, Tennessee could expect greater employment stability for its residents.

3. **Build on existing strengths and strengthen a local ecosystem of vendors and suppliers.** While certain facets of Tennessee's clean energy economy lag behind national leaders, it has oversized employment compared to other states surrounding electric vehicles, manufacturing of energy efficiency products and renewable energy generation (particularly hydroelectric power). Supporting these segments by attracting and retaining business in these areas could lead to a larger and more stable clean energy employment landscape. Electric vehicles represent a key opportunity, as the state could both increase rebates for purchasing electric vehicles to levels closer to those offered by top states in this area, and provide more attractive incentives for in-state manufacturers that are a part of the electric vehicle industry.

Tennessee's clean energy industry lags behind national leaders. However, the state is poised to capture the economic benefits of clean energy technologies, providing sustainable employment growth and economic stability. Increased commitment to deployment policies that foster market expansion and support the existing nucleus of activity will pave the way for Tennessee to become a leader in clean energy generation, manufacturing, and distribution.

Workers install equipment at the Three Rivers Market in Knoxville. (Photo courtesy of ARiES)

APPENDIX A: METHODOLOGY

Industry Survey Methodology

The data in the report were derived from a comprehensive survey of business establishments in Tennessee conducted between March 26 and April 18, 2015. Surveys were administered online and over the phone to a list of known employers as well as a representative, clustered sample of companies from the North American Industry Classification System (NAICS) identified by the Bureau of Labor Statistics (BLS), BW Research Partnership, and the Economic Advancement Research Institute as being potentially related to the clean energy industry. The research methodology employed for this report has been used increasingly as a tool for measuring clean energy industry jobs and businesses, including in Massachusetts, Illinois, Vermont, Missouri, Iowa, and other states, as well as several national analyses.

Employment and establishment totals were derived by extrapolating survey results to the Tennessee economy based on the most recently collected Quarterly Census of Employment and Wages (QCEW) from the Bureau of Labor Statistics. The program originated in the 1930s, and was known as the ES-202 program until 2003 when the current QCEW name was adopted. The primary economic product is the tabulation of employment and wages of establishments that report to the Unemployment Insurance (UI) programs of the United States. Employment covered by these UI programs represents about 97% of all wage and salary civilian employment in the country.

QCEW does not collect or report detailed information on clean energy activities. Therefore, the survey results are used to determine the incidence and further quantify clean energy activity within the QCEW framework.

For this study, the research team placed 16,679 telephone calls to employers. The combined margin of error for the survey effort was approximately +/- 2.95% at a 95% confidence interval. The survey yielded 1,007 responses from employers in Tennessee and averaged 14 minutes in length.

"Known Universe"

The "known universe" includes firms previously identified by researchers as clean energy companies. The combined database was developed from previous work and databases from BW Research Partnership and the Economic Advancement Research Institute. This list was also supplemented with industry lists provided by partners to the research or that were publicly available.

"Unknown Universe"

The "unknown universe" included firms not previously identified by researchers as clean energy companies. This database was drawn from BLS NAICS industries and InfoUSA businesses.[51] More than 1,000 firms provided information as to whether they were involved in clean energy or not. The overall margin of error for the incidence rate analysis is estimated at approximately +/- 2.97% at a confidence level of 95%. Of the firms that provided information, 197 firms from the "unknown universe" identified themselves as clean energy and completed the full survey.

At the Three Rivers Market, workers put the finishing touches on a 50-kilowatt solar array that was commissioned on the summer solstice. "The financial, environmental, and social return on the investment is unequivocal," said the market's general manager. (Photo courtesy of ARiES)

APPENDIX B: DEFINITIONS

Clean Energy Firm

A clean energy firm is defined as any business location with employees that is focused, in whole or in part, on goods or services directly connected to renewable energy, energy efficiency, alternative transportation, or greenhouse gas management and accounting. This definition is closely aligned with studies conducted in other states for comparability.

Clean Energy Worker

A clean energy worker is defined as an employee of a Clean Energy Firm that spends some portion of his or her time supporting the clean energy portions of the business.

Included Technologies

Renewable Energy

- Solar (photovoltaic, thermal, or concentrated)
- Woody and non-Woody bioenergy
- Geothermal
- Hydropower or Hydrokinetic (river, wave, or tidal)
- Combined Heat and Power
- Wind Power
- Thermal to Energy Conversion
- Fuel Cell
- Hydrogen Generation

Energy Efficiency

- HVAC and Building Controls
- Lighting
- Energy Efficient Appliances
- Energy Efficient Building Materials
- Weatherization Services
- Water and Wastewater Technologies (related to conservation)
- Energy Efficient Machinery (and processes)
- Smart Grid (smart computing and software)
- Demand Response Services
- Energy Storage

Alternative Transportation

- Electric Vehicles and Systems
- Electric Rail

Greenhouse Gas Management and Accounting

- Carbon Capture and Storage
- Secondary Carbon Market
- Coal Gasification

Most new jobs added over over the past 12 months in Tennessee's clean energy economy were in the production or technician fields.

ENDNOTES

[1] 2010-2014: http://www.thesolarfoundation.org/solar-jobs-census/national/

[2] http://www.nrel.gov/docs/fy13osti/57512.pdf

[3] http://www.nrel.gov/docs/fy12osti/49339.pdf

[4] http://www.nrdc.org/energy/files/american-wind-farms-ip.pdf

[5] http://www.masscec.com/content/2014-clean-energy-industry-report

[6] http://cleanjobsillinois.com/2015/#top

[7] http://publicservice.vermont.gov/sites/psd/files/Announcements/Vermont%20Clean%20Energy%20Industry%20Report%20FINAL.pdf

[8] Defined as firms that are directly engaged in the research, development, manufacture, sale, distribution, installation, or maintenance of renewable energy, energy efficiency or conservation, smart grid, energy storage, greenhouse gas emissions accounting and management, electric or hybrid vehicles (includes supporting services such as consulting, finance, tax, and legal services related to clean energy)

[9] QCEW 2014 Q3 data from: http://www.bls.gov/cew/apps/table_maker/v4/table_maker.htm#type=10&year=2014&qtr=3&own=5&area=47000&supp=0

[10] http://www.eia.gov/state/?sid=TN&CFID=20259894&CFTOKEN=253cab28f-3c6ef86-7E0611EF-237D-DA68Ffiftee-24ACEC1A28F61F9C&jsessionid=84306d4b77c841f-06bc1177f139453163623; http://www.eia.gov/electricity/monthly/xls/table_6_02_a.xlsx. http://www.eia.gov/electricity/monthly/xls/table_6_02_c.xlsx

[11] http://www.seia.org/state-solar-policy/tennessee

[12] http://www.seia.org/news/tennessee-records-strong-solar-growth-2014

[13] http://www.tva.com/news/releases/julsep13/Fact%20Sheet%20-%20TVA%20Solar%20Programs.pdf

[14] http://www.tva.gov/greenpowerswitch/

[15] http://programs.dsireusa.org/system/program/detail/542

[16] http://www.tennessee.edu/media/releases/071210_solar.html

[17] http://www.tennessee.edu/media/releases/092011_solargrants.html

[18] http://programs.dsireusa.org/system/program?state=TN

[19] http://apps2.eere.energy.gov/wind/windexchange/wind_installed_capacity.asp

[20] http://www.cleanenergy.org/wp-content/uploads/Buffalo-Mtn-Elevated-Opportunities-Wind-Technology-for-the-South.pdf

[21] http://awea.files.cms-plus.com/FileDownloads/pdfs/Tennessee.pdf

[22] http://database.aceee.org/state/tennessee

[23] http://www.energyright.com/pdf/highlights_2014.pdf

[24] http://www.energyright.com/industrial/how_to.html

[25] http://database.aceee.org/state/tennessee

[26] https://www.energycodes.gov/sites/default/files/documents/TennesseeResidentialCostEffectiveness.pdf

[27] http://www.energycodes.gov/sites/default/files/documents/TennesseeDOEDeterminationLetter05312013.pdf

[28] http://www.energycodes.gov/sites/default/files/documents/TN%20Certification%20of%20Commercial%20and%20Residential%20Building%20Energy%20Codes.pdf

[29] http://www.tn.gov/governor/section/empower-tn

[30] http://www.eia.gov/state/analysis.cfm?sid=TN

[31] http://tennessee.edu/media/releases/111809_doegrant.html

[32] **https://ag.tennessee.edu/news/Pages/NR-2013-11-GeneraUTcompleteGrant.aspx**

[33] **http://energy.gov/articles/energy-department-launches-new-clean-energy-manufacturing-initiative**

[34] **http://www.ornl.gov/science-discovery/clean-energy/research-areas/manufacturing**

[35] **http://www.prnewswire.com/news-releases/white-house-picks-university-of-tennessee-to-lead-national-composites-manufacturing-institute-300018433.html**

[36] **https://news.tn.gov/node/13929**

[37] **http://www.afdc.energy.gov/fuels/stations_counts.html**

[38] http://**www.afdc.energy.gov/truckstop**

[39] **http://nissannews.com/en-US/nissan/usa/channels/Plant-Fact-Sheets/releases/vehicle-assembly-plant-smyrna-tennessee**

[40] Survey of Tennessee Registered Voters Regarding Energy Issues. June 2-5, 2014. North Star Opinion Research. **http://www.cleanenergy.org/wp-content/uploads/TN_Energy_Presentation_for_Release.pdf**

[41] For the purpose of this report, "firm," "employer," and "respondent" are used interchangeably and are defined as business establishments using the Bureau of Labor Statistics definition of a business location with employees.

[42] **http://www.bls.gov/oes/current/oes_tn.htm#00-0000**

[43] Defined as manufacturing, engineering and research, sales and distribution, installation and generation, professional services, and other.

[44] Firms were asked to select the primary value-chain activity of their business establishment (location with employees) from the choices in Table 1, below. All employees who work within the clean energy portion of the business are included in the categories in Table 1.

[45] **http://cleanjobsmissouri.org; http://www.masscec.com/content/2014-clean-energy-industry-report; http://cleanjobsflorida.com; http://www.masscec.com/content/2014-clean-energy-industry-report; http://info.aee.net/hs-fs/hub/211732/file-2173902479-pdf/PDF/aeei-california-advanced-energy-employment-survey-fnl.pdf; http://publicservice.vermont.gov/sites/psd/files/Announcements/Vermont%20Clean%20Energy%20Industry%20Report%20FINAL.pdf; http://www.cleanjobsillinois.com; http://cleanjobsmissouri.com**

[46] Non-woody biomass is agriculturally based and includes sugar, starch, lignocellulose, and/or oils and fats. From: **http://www.wgbn.wisc.edu/key-concepts/grassland-biomass-sources/sources-biomass**

[47] See generally, **http://www.masscec.com/content/2014-clean-energy-industry-report; http://info.aee.net/hs-fs/hub/211732/file-2173902479-pdf/PDF/aeei-california-advanced-energy-employment-survey-fnl.pdf; http://publicservice.vermont.gov/sites/psd/files/Announcements/Vermont%20Clean%20Energy%20Industry%20Report%20FINAL.pdf; http://www.cleanjobsillinois.com**

[48] For "other," no individual category over three percent.

[49] **http://www.nrel.gov/docs/fy12osti/51946.pdf**

[50] **http://cleanjobsmissouri.org; http://www.masscec.com/content/2014-clean-energy-industry-report; http://info.aee.net/hs-fs/hub/211732/file-2173902479-pdf/PDF/aeei-california-advanced-energy-employment-survey-fnl.pdf; http://cleanjobsflorida.com; http://www.cleanjobsillinois.com**

[51] **https://www.salesgenie.com/**

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For more information on clean energy jobs in America and more state-specific studies:
www.cleanenergyworksforus.org

For more information on Environmental Entrepreneurs (E2):
www.e2.org