ELECTRICAL EQUIPMENT AND APPLIANCES WHITE PAPER



Department of Economic & Community Development Center for Economic Research in Tennessee (CERT)

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Contents

Introduction	2
Industries	5
Lighting Fixture Manufacturing	5
Electric Lamp Bulb and Part Manufacturing	8
Appliance Manufacturing	10
Electrical Equipment Manufacturing	13
Battery Manufacturing	16
Exports	19
Recent Projects	20



Introduction

The appliances industry cluster is one of Tennessee's strongest traded clusters. Companies in this industry manufacture a wide variety of electrical devices and components, including lamps, lighting, household appliances, motors, transformers, switchboards, and batteries. Currently, appliances companies in Tennessee employ 17,753 workers, the fourth highest level of employment in the nation.¹ Since 2012, employment grew by 11.2%, significantly higher than the regional or national growth rates. This job creation (1,789 net new jobs) was the fourth largest increase in employment in the nation. Major household appliance manufacturing made the largest employment gains in Tennessee during this time, adding 2,216 net new jobs. Power, distribution, and specialty transformer manufacturing achieved a 50.1% increase in employment.

Tennessee's employment concentration for these industries (3.13) is the second highest in the nation behind Wisconsin. Tennessee has the highest employment concentration in the nation for appliance manufacturing. Average employee earnings for this cluster in Tennessee are \$87,297. Average employee earnings in lighting equipment manufacturing (\$114,257) rank first nationally.² Tennessee also ranks second nationally for average employee earnings in lighting fixture manufacturing as well as switchboard manufacturing. In 2017, Tennessee appliance companies earned \$1.4 billion. Household appliance manufacturers accounted for 11.3% of all cluster revenue.

NAICS	Industry	2017 Jobs	Business Locations	Location Quotient	Average Employee Earnings	2017 Earnings
Lighting	Fixture Manufacturing					
335121	Residential Electric Lighting Fixture Manufacturing	63	10	0.33	\$50,057	\$3,783,681
335122	Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing	1,249	12	2.63	\$111,106	\$128,637,976
335129	Other Lighting Equipment Manufacturing	70	3	0.43	\$114,257	\$8,662,714
Electric L	amp Bulb Manufacturing					
335110	Electric Lamp Bulb and Part Manufacturing	37	2	0.24	\$100,811	\$3,791,414
Applianc	es Manufacturing					
335210	Small Electrical Appliance Manufacturing	1,369	10	5.92	\$72,411	\$91,642,416
335220	Major Household Appliance Manufacturing	8,770	23	8.34	\$74,476	\$601,464,089
Electrical Equipment Manufacturing						
335311	Power, Distribution, and Specialty Transformer Manufacturing	2,044	15	3.92	\$86,276	\$162,259,814
335312	Motor and Generator Manufacturing	773	13	1.09	\$77,341	\$55,358,072
335313	Switchgear and Switchboard Apparatus Manufacturing	2,348	32	3.53	\$141,401	\$307,258,818
335314	Relay and Industrial Control Manufacturing	116	9	0.13	\$65,182	\$8,166,054
Battery M	/lanufacturing					
335911	Storage Battery Manufacturing	237	5	0.66	\$74,662	\$16,750,266
335912	Primary Battery Manufacturing	678	7	2.67	\$74,580	\$47,203,932
	Total	17,753	141	3.13	\$87,297	\$1,434,979,247

¹ Industry estimates were obtained from Economic Modeling Specialist's 2018.2 data run.

² Average employee earnings, which include wages as well as supplemental benefits, are adjusted for cost-of-living.

Between 2017 and 2022, Tennessee is predicted to continue growing employment at a rate greater than the regional and national averages. The three states that currently outrank Tennessee in employment – Ohio, Wisconsin, and California – are expected to each lose 600 jobs or more during this time.

Tennessee has 141 companies in this cluster. Switchgear and switchboard apparatus manufacturing accounts for the most significant share of business locations in this cluster (32 total establishments), followed by major household appliance manufacturing (23). Overall, Tennessee's appliances industries have an establishment size of 126 workers on average, which is the fourth highest average of any US state. Establishment size varies substantially between industries.



Employees per Establishment (Industry Averages)

Workforce

Tennessee's appliances cluster encompasses 168 occupations. Some of these occupations are unique to certain industries, but significant overlaps exist between industries. Manufacturers in this cluster employ workers with similar skill sets, creating a large, experienced labor force from which the entire cluster can draw.

NAICS	Industry		Median Hourly Earnings
Managen	nent Occupations		
11-1021	General and Operations Managers	45,541	\$40.97
11-3051	Industrial Production Managers	5,040	\$37.90
Architect	ure and Engineering Occupations		
17-2071	Electrical Engineers	2,490	\$41.41
17-2112	Industrial Engineers	6,522	\$36.93
17-2141	Mechanical Engineers	4,163	\$41.11
17-3023	Electrical and Electronics Engineering Technicians	2,395	\$26.25
17-3026	Industrial Engineering Technicians	4,196	\$20.93
Sales and	l Related Occupations		
41-4012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	21,669	\$25.45



NAICS	Industry	2017 Jobs	Median Hourly Earnings
Office an	d Administrative Support Occupations		
43-4051	Customer Service Representatives	60,264	\$14.21
43-5061	Production, Planning, and Expediting Clerks	8,100	\$22.25
43-5071	Shipping, Receiving, and Traffic Clerks	17,486	\$14.26
Installati	on, Maintenance, and Repair Occupations		
49-9071	Maintenance and Repair Workers, General	32,759	\$17.53
Productio	on Occupations		
51-1011	First-Line Supervisors of Production and Operating Workers	16,342	\$25.22
51-2021	Coil Winders, Tapers, and Finishers	600	\$18.12
51-2022	Electrical and Electronic Equipment Assemblers	3,689	\$14.03
51-2023	Electromechanical Equipment Assemblers	1,027	\$16.87
51-2092	Team Assemblers	63,430	\$14.51
51-2099	Assemblers and Fabricators, All Other	5,482	\$13.75
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	6,457	\$14.50
51-4081	Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	3,862	\$14.92
51-4121	Welders, Cutters, Solderers, and Brazers	6,772	\$17.74
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	13,833	\$15.77
51-9198	HelpersProduction Workers	20,323	\$11.49
Transpor	tation and Material Moving Occupations		
53-7051	Industrial Truck and Tractor Operators	17,863	\$14.28
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	95,411	\$12.41

Demographics of the labor force in these industries differ from the overall Tennessee labor force. The concentration of workers aged 45-64 is higher in appliances industries (50.6%) than the overall workforce (42.9%).

Gender demographics in this cluster also differ from the overall workforce. 66.1% of workers in the appliances industries are male. Only 33.9% are female. Across all industries, male and females account for roughly the same share of the workforce (50.9 and 49.1%, respectively).

	Age	2017 Jobs
•	14-18	18
	19-24	1,139
•	25-34	3,549
•	35-44	4,065
•	45-54	4,770
•	55-64	3,698
•	65+	514

TN Economic & Community Development



Tennessee's post-secondary institutions offer 223 programs related to appliance industry occupations. In 2016, these institutions produced 24,555 graduates with the skills necessary to pursue a career in these industries.

Industries

Lighting Fixture Manufacturing

With 25 total businesses and 1,382 employees, this industry is a key component of Tennessee's appliances cluster. Businesses in this industry manufacture residential lighting fixtures as well as lighting fixtures for commercial, industrial, and institutional settings. This industry also includes establishments that produce similar types of equipment, such as spotlights, stadium lighting, and so on. Products made by this industry, which are electric lamps that provide illumination, are distinct from electric lamp bulbs and parts.



Nearly all of Tennessee's employment in this industry involves manufacturing of commercial, industrial, and institutional lighting fixtures. These manufacturers employ 1,249 Tennesseans, the sixth highest level of employment in the nation and second only to Georgia in the Southeast region. Employment concentration in Tennessee is 268% higher than the national average. This location quotient (1.66) is the fourth highest nationally and the second highest in the region.

Currently, 12 counties in Tennessee have employment in lighting fixture manufacturing. Nearly two-thirds of employment is located in Shelby County. Of the 933 metropolitan statistical areas (MSAs) in the United States, Memphis has the fifth largest employment for this industry. The largest Shelby employer is ABB-subsidiary Thomas & Betts, a publicly-traded manufacturer that relocated its headquarters to Memphis in 1993. The company recently decided to invest \$20.7 million as part of a project with TNECD to create 90 additional jobs and consolidate its research and development to a new Memphis location.³ Other key areas in Tennessee for this industry are Hamblen County (General Electric/ABB) and Davidson County (D&P Custom Lights & Wiring Systems, Inc.). GE's Morristown facility in Hamblen County was recently acquired by Swiss-owned ABB Group in a larger sell-off of GE's lighting division.⁴ Hamblen County's employment concentration for lighting fixture manufacturing ranks in the top 20 across the 3,193 counties in the United States.

In 2017, lighting fixture manufacturers in Tennessee generated \$141.1 million in total earnings. Most of this revenue came from commercial, industrial, and institutional electric lighting products. Tennessee's production of commercial lighting is exceptionally strong. Manufacturers in Tennessee are able to satisfy 45% of in-state demand for these products with only 12% of total annual sales. Average employee earnings for these industries (\$108,462) are the second highest in the nation. For lighting equipment manufacturing, average employee earnings rank first nationally.

NAICS	Industry	Average 2017 Employee Earnings		2017 Sales	% In- Region Sales
335122	Commercial, Industrial, and Institutional	\$111,106	\$128,637,976	\$384,876,044	12%
335121	Residential Electric Lighting	\$50,057	\$3,783,681	\$11,310,688	38%
335129	Other Lighting Equipment	\$114,257	\$8,662,714	\$25,751,788	30%
	Total	\$108,462	\$141,084,371	\$421,938,520	14%

Since 2012, a few key trends have emerged in this industry. Lighting fixture manufacturers have grown in number and have spread into new areas of the state. Moreover, the average establishment size has shrunk due to new market entrants and downsizing at existing manufacturers.

> Net establishment growth

Tennessee currently has 25 manufacturers of this kind, as compared with 17 in 2012. Roughly half of all these establishments are located in Davidson County and Shelby County. Other lighting equipment manufacturing was the only type of lighting fixture manufacturing with a net decrease in establishments.

Industry	2012 Establishments	2017 Establishments
Commercial, Industrial, and Institutional Electric Lighting	9	12
Residential Electric Lighting	4	10
Other Lighting Equipment Manufacturing	4	3
Total	17	25

³ TNECD. (2017). ABB to Expand Thomas & Betts and its Electrification Products Division in Memphis.

http://www.tnecd.com/news/430/abb-to-expand-thomas-betts-and-its-electrification-products-division-in-memphis/ ⁴ Sorah, L. (2017). *Morristown facility included in GE Sale*. <u>http://www.citizentribune.com/news/local/morristown-facility-included-in-ge-sale/article_c62c4752-a39b-11e7-af23-4f1bc819ad6e.html</u>



Establishment growth was unusual for lighting manufacturing during this time period. Across the U.S., consolidation of businesses has been the norm in this industry. Large manufacturers are purchasing smaller competitors with niche products to widen their market share and achieve economies of scale. Since 2012, the total number of lighting manufacturers in the U.S. has decreased at an annualized rate of 0.2%. Analysts predict a reversal of this trend. Revenue growth will catalyze new establishment creation, likely at a rate as high as 0.4% per year.⁵ Tennessee's industry started experiencing this trend sooner than the rest of the nation.

> Geographic concentration

Lighting fixture manufacturers have been setting up shop in new regions of the state since 2012. Cookeville in Putnam County and Union City in Obion County, both micropolitan statistical areas (µSAs) in Tennessee, added their first lighting fixture manufacturer during this time. The other establishments created during this time are located within a Tennessee MSA, including McMinn, Hamilton, Rutherford, Sumner, and Blount Counties. Athens now has the 14th highest employment concentration for commercial and industrial lighting manufacturing of any MSA in the country.

Three counties in Tennessee (Montgomery, Anderson, and White) lost all industry presence during this time. In the case of White County, job losses caused by the closing of Philips Lighting have been mostly offset by an expansion of the local tourism industry. Jackson Kayak, in partnership with TNECD, has reinvigorated the local economy through a boat manufacturing venture.⁶ Philips still retains a medium-sized operation in Memphis.

> Average establishment size

Since 2012, the average establishment size at Tennessee's lighting manufacturers has decreased from roughly 83 employees per establishment to 55. This change is in part due to recent market entrants. Many establishments to open in the last few years are manufacturers of residential electric lighting and other lighting equipment. These operations tend to be small-sized operations, often with 10 or fewer employees. Growth in these kinds of establishments drove down the average establishment size across lighting manufacturing.

Moreover, overall employment in commercial and industrial lighting manufacturing has been declining even as the total number of establishments increased. Shelby County, in which employment declined from 958 in 2012 to 852 today, increased its number of commercial lighting manufacturers from three to five. Davidson County also experienced a slight decline in employment, even while adding increasing its number of manufacturers from four to seven.

Unlike establishment growth, employment patterns in Tennessee mirror the national trend for this industry. Technological innovation has enabled improvements in efficiency. Companies can now produce the same amount of product with less labor. Cost-saving measures, such as identifying redundancies and using technology to scale back labor costs, were more aggressively pursued as imports captured an increasing share of domestic demand.⁷

⁷ IBISWorld. (2017). Bright future: Legislation will boost demand for energy-efficient lights and support fixture sales.



⁵ IBISWorld. (2017). Bright future: Legislation will boost demand for energy-efficient lights and support fixture sales.

⁶ McGee, J. (2016). *How a champion kayaker transformed a Tennessee county's economy, culture.* <u>https://www.tennessean.com/story/news/environment/2016/11/12/how-champion-kayaker-transformed-tennessee-countys-economy-culture/89106256/</u>

> Developing trends

Employment is projected to decline further in coming years due to continued consolidation and greater technological efficiency. By 2022, Tennessee will likely lose 9% of its employment in lighting fixture manufacturing. These job losses will be contained to commercial, industrial, and institutional lighting. Residential lighting and other lighting equipment manufacturers may grow employment slightly in coming years.

Demand is expected to increase substantially. New residential and commercial construction projects will lead to increased sales of lighting fixtures. Tennessee manufacturers stand to benefit greatly from a strong local real estate market and large customer base in the region. Sales to the construction industry are a major source of revenue for lighting fixture manufacturers in Tennessee.

Industry	Key Buying Industries	In-Region Sales	% of Total In-Region Sales
	Plumbing, Heating, and Air-Conditioning Contractors	\$2,471,494	4.1%
Commercial, Industrial, and Institutional Electric Lighting	Electrical Contractors and Other Wiring Installation Contractors	\$1,982,933	3.3%
	Commercial and Institutional Building Construction	\$1,557,732	2.6%
Residential Electric Lighting	Plumbing, Heating, and Air-Conditioning Contractors	\$252,734	4.4%
	Electrical Contractors and Other Wiring Installation Contractors	\$220,335	3.8%
	Commercial and Institutional Building Construction	\$188,424	3.2%
	Plumbing, Heating, and Air-Conditioning Contractors	\$617,004	4.1%
Other Lighting Equipment Manufacturing	Electrical Contractors and Other Wiring Installation Contractors	\$497,177	3.3%
	Other Engine Equipment Manufacturing	\$407,107	2.7%

Manufacturers will continue to struggle to compete with low-cost imports from China and Mexico. Fortunately, increasing consumer demand for premium products like environmentallyfriendly lights and "smart" fixtures that provide automated or sensor-based light adjustment will differentiate American-made products from inexpensive imports. New export opportunities will exist due to recent bans on incandescent lighting in countries like China, Japan, and the Netherlands. The European Union's ban on halogen lighting will also improve export prospects and strengthen the market share for LED products.

Electric Lamp Bulb and Part Manufacturing

One of the cluster's smallest industries, electric lamp bulb and part manufacturing employs only 37 Tennesseans at two establishments. Between 2013 and 2014, employment declined from 124 jobs to a little more than 10. Average employee earnings in this industry (\$100,811) compare well against the regional average. In 2016, Tennessee manufacturers generated \$3,791,414 in earnings and completed \$7,152,907 in sales transactions, 18% of which were in-region.

When viewed from a long-term perspective, the decline of this industry in Tennessee created opportunities for the overall cluster. The electric lamp bulb and part industry is in direct competition



with manufacturers of LED products. The growing popularity of substitutes to electric bulbs has steadily eroded industry revenue. Moreover, electric bulb manufacturers are particularly vulnerable to heightened import competition. The low-cost nature of these products plays to importers' strengths. Since 2012, employment in this industry has declined 7% in the United States. 12 of the 15 states with the most employment experienced a net decrease in jobs. For these states, the five-year growth rate was -17%. Analysts expect LEDs to capture 80% of the global lighting market by 2022.⁸

The story of electric lamp bulb manufacturing in Tennessee reveals important lessons for overall cluster strategy. While cluster industries often work in tandem with one another, sometimes these industries compete for the same customers. (This dynamic is evident in glass and rubber products, which can be substitutes for one another in construction projects.) Tennessee's transition away from electric bulb manufacturing, coupled with strong performance in lighting fixture manufacturing, was a demonstration of the cluster's resiliency, a key vital sign regarding the long-term health of a cluster. In pivoting towards future markets, the regional economy successfully adapted to changing circumstances.

The societal transition away from incandescent lighting has resulted in a few key trends across lighting manufacturing industries.

> High-skilled labor force

The advent of solid-state lighting technology, including LED, has revolutionized the luminaire production process. Companies now rely on a different type of worker. In the past, mechanics with limited skill sets could produce incandescent lights. Workers would pop a socket into a custom-cut piece of metal. LED lights are more sophisticated devices, and the assembly process requires an understanding of electronic components. Today, workers mount circuit boards and use spectrometers and power meters to check the final product. Companies rely on skilled labor with previous experience in electronics and manual dexterity to assemble small components.⁹

> New upstream markets

The transition to solid-state technology coincides with another technological advancement, computer numeric control (CNC). This technology allows manufacturers to design and create the tools they will need for production. Previously, lighting manufacturers bought custom-made tools from tool and dye companies. Each type of incandescent light (sometimes called "legacy lighting" products) had a corresponding tool. Today, LED manufacturers use computers to design their new products then upload these designs into their CNC fabrication machines, which can create the parts automatically. Manufacturers will occasionally use hard-pressed tooling for a particular type of pendant or fixture, but for the most part, CNC has replaced traditional tooling.

In Tennessee, lighting manufacturers rely on different types of materials depending on the type of product they produce. Products made by the power, distribution, and specialty transformer industry are key purchases for manufacturers of electric lighting and lighting fixtures.

⁹ Shapiro, G. (2015). *Light Manufacturing: Then and Now*. Architectural Lighting. http://www.archlighting.com/technology/lightmanufacturing-then-and-now_o



⁸ IBISWorld. (2017). *Lights out: Industry revenue will decline due to the rising popularity of LED-lighting systems.*

Electric Lamp B	Bulb Manufacturing
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Purchase Category	% of Total Purchases
Corporate, Subsidiary, and Regional Managing Offices	7.1%
Glass Product Manufacturing Made of Purchased Glass	6.0%
Wholesale Trade Agents and Brokers	5.2%
Corrugated and Solid Fiber Box Manufacturing	4.2%
Machine Shops	3.4%
Nonferrous Metal Rolling, Drawing, and Extruding	3.3%
Glass Container Manufacturing	2.5%
Other Pressed and Blown Glass and Glassware Manufacturing	2.4%
Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminum)	2.3%
Lessors of Nonfinancial Intangible Assets	2.1%

Electric Lighting Manufacturing

Purchase Category	% of Total Purchases
Power, Distribution, and Specialty Transformer Manufacturing	6.7%
Corporate, Subsidiary, and Regional Managing Offices	5.8%
Iron and Steel Mills and Ferroalloy Manufacturing	3.8%
Wholesale Trade Agents and Brokers	3.3%
Fabricated Pipe and Pipe Fitting Manufacturing	3.0%
Bolt, Nut, Screw, Rivet, and Washer Manufacturing	2.3%
Other Aluminum Rolling, Drawing, and Extruding	2.2%
Machine Shops	2.2%
Precision Turned Product Manufacturing	2.0%
Aluminum Sheet, Plate, and Foil Manufacturing	1.9%

Appliance Manufacturing

Appliance manufacturing is one of Tennessee's strongest industries in this cluster. Tennessee's employment concentration (7.90) is the highest in the nation. This type of manufacturing includes two industries: small electrical appliance manufacturing and large household appliance manufacturing. Typical products made by the small electrical appliance industry are cosmetic items like portable hair dryers and curling irons, portable temperature control devices including humidifiers/dehumidifiers and space heaters, ventilating and exhaust fans such as ceiling fans and bath fans, portable cooking appliances, and vacuum and carpet cleaning devices. Major household appliances are typically non-portable and can be either electrical or non-electrical. Products include dishwashers, garbage disposals, refrigerators, ovens (including microwave), water heaters, and many more.

Tennessee's 33 appliance manufacturers employ 10,139 workers. Major household appliance manufacturers (23 in total) employ 8,770. Tennessee ranks first in the region and second nationally for employment and total establishments in major household appliance manufacturing. Employment concentration in Tennessee for this industry (734% higher than the average state) is second in the nation. Areas with the strongest industry presence are Robertson County (Electrolux Home Products North America, Atwood Mobile Products), Bradley County (Maytag Corporation, Brown Stove Works), Cheatham County (State Industries LLC), Washington County (A.O. Smith Water Products Company), Wilson County (Lochinvar LLC), and Shelby County (Hunter Fan).



Major Household Appliance Manufacturing



Robertson County has the third highest level of employment and second highest employment concentration among all U.S. counties for this industry. The Nashville MSA employs more workers in this industry than every other MSA in the nation besides Louisville (KY-IN). The Chattanooga and Cleveland MSAs have the ninth and tenth highest level of employment of the 933 MSAs in the United States.

Small electrical appliance manufacturing is also an important industry for Tennessee. These 10 manufacturers employ 1,369 workers. Tennessee ranks first in the region and second in the nation for both employment concentration and total employment. In the Southeast region, Tennessee has more businesses in this industry than every state besides Florida. Tennessee accounts for 10.2% of all industry establishments in the United States.¹⁰ Key areas in Tennessee for this industry are Warren County (Sunbeam Products), Williamson County (Lasko Products, The Scott Fetzer Company), and Putnam County (Tutco, Inc.).



Small Electrical Appliance Manufacturing

Warren County has the highest employment concentration and third most industry jobs of any U.S. county for small appliance manufacturing. The city of McMinnville has the highest employment concentration and third highest employment of all MSAs.

In 2017, appliance manufacturers in Tennessee generated \$693.1 million in earnings after completing \$2.9 billion in sales. Manufacturers of small electrical appliances were able to satisfy 80% of in-state demand with only 9% of total sales. Household appliance manufacturers met 50% of local demand, also with 9% of sales being made to other Tennessee businesses. Average employee earnings in household appliance manufacturing (\$74,476) are slightly higher than average employee earnings for small appliance manufacturing (\$72,411).

¹⁰ IBISWorld. (May 2018). *Home grown: An improving housing market has led to industry revenue growth.*



NAICS	Industry	Average Employee Earnings	2017 Earnings	2017 Sales	% In-Region Sales
335220	Major Household Appliance	\$74,476	\$601,464,089	\$2,598,820,477	9%
335210	Small Electrical Appliance	\$72,411	\$91,642,416	\$261,221,230	9%
	Total	\$74,197	\$693,106,505	\$2,860,041,707	9%

A few key trends emerged in these industries since 2012. Tennessee showed a strong competitive edge that bodes well for future growth.

> Competitive effect

A good measure of a region's advantages in an industry is called the competitive effect. This measurement calculates the amount of job creation that occurred in a region because of factors unique to the state.¹¹ A state demonstrate a competitive advantage in an industry if job creation exceeds what could be reasonably expected due to other economic factors (or if net job losses were lower than expected).

In both types of appliance manufacturing, Tennessee has a strong competitive edge. Since 2012, household appliance manufacturers have added a staggering 2,216 net new jobs in Tennessee. This job creation was the strongest in the nation during this time period. More than half of these new jobs were created because of advantages unique to Tennessee. One out of every eight jobs in the current household appliance manufacturing labor force exists because of Tennessee's unique competitive strengths.

Tennessee also has an edge over other states in small electrical appliance manufacturing, even though employment declined slightly (-3%) since 2012. This industry struggled in the Southeast in recent years, but Tennessee's loss of 49 jobs in this industry did not rise to the level that analysts predicted. More than 50 jobs in this industry still exist because Tennessee was well-prepared for recent setbacks in this industry.

NAICS	Industry	Employment Growth Rate (2012-2017)	Net New Jobs (2012-2017)	Competitive Effect	% of Industry Due to Competitive Effect
335220	Major Household Appliance	34%	2,216	1,120	12.6%
335210	Small Electrical Appliance	(3%)	(49)	54	3.9%
	Total	27%	2,167	1,174	11.6%

> Establishment creation

The major household appliance industry did not undergo a major change in establishments in the last few years. Tennessee added one net new manufacturer since 2012. No counties added their first establishment during this time. Manufacturers were appearing (or disappearing) in counties with pre-existing industry presence. Employment growth was a more noticeable trend than establishment creation. Rutherford County led the state in job creation (991 net new jobs) without adding an additional manufacturer.

¹¹ Competitive effect, which is a component of shift-share analysis, is calculated by subtracting the industrial mix effect (job creation that can be explained by regional industry growth) and the national growth effect (job creation attributable to economic growth) from the actual number of jobs created in a region during this time period.



Tennessee had a net increase of two small appliance manufacturers since 2012. No county in Tennessee lost an establishment during this time. Similar to the household appliance industry, most counties were adding new jobs without experiencing an establishment increase. The exceptions were Bradley and Greene Counties, which added their first company during this time.

Establishment creation was common during this time. Rising disposable incomes and a booming housing market led to increased sales of appliances, motivating new entrepreneurs to enter the market.¹²

> Developing trends

By 2022, Tennessee is likely to rank first in the nation for employment concentration in small appliance manufacturing and second for household appliance manufacturing. Tennessee is expected to add 100 or more net new jobs in small appliance manufacturing while retaining roughly the same employment in major household appliance manufacturing.

In most parts of the U.S., these industries will experience a swift decline. American manufacturers are having an increasingly difficult time competing with importers, who have the advantage of lower production costs. The threat of import penetration is even greater for appliance manufacturing than other industries because consumers are very price-sensitive when it comes to appliance products. In 2018, imports are expected to capture 82.3% of domestic appliance demand. The advent of "smart" appliances, which share data with one another to improve the customer experience, provides manufacturers with an opportunity to differentiate their products from those of their competitors.¹³

Electrical Equipment Manufacturing

This industry is composed of four smaller industries: switchgear and switchboard apparatus manufacturing; power, distribution, and specialty transformer manufacturing; motor and generator manufacturing; and relay industrial control manufacturing.

NAICS	Industry	Employment	Business Locations	Location Quotient	Average Employee Earnings
335311	Power, Distribution, and Specialty Transformer	2,044	15	3.92	\$86,276
335312	Motor and Generator	773	13	1.09	\$77,341
335313	Switchgear and Switchboard Apparatus	2,348	32	3.53	\$141,401
335314	Relay and Industrial Control	116	9	0.13	\$65,182
	Total	5,280	69		\$109,014

¹³ IBISWorld. (February 2018). *Clean sweep: Imports will continue to capture the majority of domestic demand, hindering growth.*



¹² IBISWorld. (May 2018). *Home grown: An improving housing market has led to industry revenue growth.*



Switchgear and Switchboard Apparatus Manufacturing

This industry contributes the most significant share of employment to electrical equipment manufacturing in Tennessee (2,348 employees). Companies in this industry manufacture switches for electrical power systems as well as circuit breakers, electric fuses, and control panels. Tennessee's location quotient in this industry (3.53) is the highest in the nation. Tennessee ranks first in the region and fourth nationally for employment. Between 2012 and 2017, employment grew at a per annual rate of 1.2%. Total establishments increased from 11 to 32 during this time, the largest establishment growth of any US state. In 2017, Tennessee switchgear manufacturers earned \$307.3 million and sold \$1.1 billion worth of product. These manufacturers captured 65% of inregion demand with only 11% of total sales. Average employee earnings in Tennessee for this industry (\$141,401) are the second highest in the nation behind Rhode Island.

Other highlights include:

- Crockett County, where ABB Inc.'s Alamo facility is located, ranks first among all US counties for employment concentration
- Rutherford County (Square D) ranks third among all US counties for industry employment



Power, Distribution, and Specialty Transformer Manufacturing

Companies in this industry manufacture power, distribution, and transformers for industrial and commercial use. These companies employ 2,044 Tennesseans. Currently, Tennessee ranks third in the nation behind Mississippi and Georgia for employment. Tennessee's location quotient (3.92) is also the third highest in the nation. Since 2012, employment has increased 50.1% in Tennessee. This job creation (682 new jobs) was the highest in the nation during this time. More than 95% of this job creation can be attributed to Tennessee's unique competitive strength in this industry. One-third of Tennessee's current industry results from this competitive effect.¹⁴ Tennessee now has 15 companies in this industry, as compared to 13 in 2012. These companies generated \$162.3 million in

¹⁴ 651 of the 682 jobs created during this time (95.5%) are attributable to factors unique to Tennessee. 31.6% of Tennessee's current industry is owed to this competitive effect.



earnings in 2017 and completed \$504.6 million in sales transactions. Average employee earnings in Tennessee for this industry are \$86,276.

Other highlights include:

- Dyersburg (Ermco, Inc.) has the second highest employment concentration among all MSAs
- Meigs County (Solomon Transformers LLC) has the fourth highest employment concentration among all US counties
- Nashville-Davidson—Murfreesboro—Franklin (Universal Lighting Technologies, Inc.) has the sixth highest employment among all MSAs
- Other important areas in Tennessee include Williamson County (Eaton Corporation) and Gibson County (Reinhausen Manufacturing, Inc.)



Motor and Generator Manufacturing

Motor and generator manufacturers currently employ 773 Tennesseans. Unicoi County (Morrill Motors, Inc.) leads the state for employment. Henry County (Euro Tranciatura USA) is another important area for this industry. Employment declined in Tennessee from 2012-2017, consistent with regional and national trends. Tennessee has 13 manufacturers in this industry, the same number as in 2012. Tennessee's location quotient for this industry is 1.09. In 2017, motor and generator manufacturers in Tennessee earned \$55.4 million and completed \$187.8 million in sales transactions, 9% of which were in-region. Average employee earnings in Tennessee for this industry (\$77,341) are comparable to the regional average.



Companies in this industry manufacture electronic relays and industrial controls for regulating circuits and electric motors. Relays are used to control circuitry in electronic devices like computers and communication devices. Industrial controls, which include motor starters, contactors, control centers, and programmable logic controllers, are switches used to regulate electric motors and systems. Tennessee companies in this industry include Control Technology, Inc. (Knox) and Kanson Electronics Inc. (Lewis).

Relay and industrial control manufacturers employ 116 Tennesseans. Recent declines in this industry are consistent with regional and national patterns. Since 2012, the number of manufacturers declined from 10 to nine. Average establishment size for this industry is the smallest in electrical equipment manufacturing. In 2017, Tennessee companies earned \$8.2 million and completed \$17.1 million in total sales, 30% of which were in-region. Average employee earnings in Tennessee for this industry are \$65,182.

> Developing trends

Demand for industry products is expected to increase in coming years. The residential construction market is rebounding in the US, creating new demand for electric motors and switchboards for devices like heating and cooling units. Relay and industrial control manufacturers will also benefit from growth in the downstream construction market, specifically nonresidential construction. Federal investment in electricity infrastructure upgrade will create new revenue opportunities for the power, distribution, and specialty transformer industry. The recovery of the US economy has led to increased industrial production, which benefits all manufacturers of electrical equipment. The ongoing challenge for US manufacturers is competing with increased import penetration, with more than 52% of all domestic demand being captured by importers.¹⁵

Tennessee's electrical equipment manufacturing industry is predicted to grow in the next several years. By 2022, employment in Tennessee is expected to increase 8.4%. The largest gains are likely to occur in power, distribution, and specialty transformer manufacturing (22.7%), followed by relay and industrial control manufacturing (8.6%) and switchgear and switchboard manufacturing (2.8%). Employment in motor and generator manufacturing may decline slightly in coming years.

Battery Manufacturing

This industry encompasses two types of production: primary battery manufacturing and storage battery manufacturing. Primary batteries, which are discarded after usage, are found in consumer electronic products like watches, flashlights, and TV remotes. Storage batteries include starting, lighting, and ignition batteries, which are commonly used in automobiles; industrial batteries for continuous power supply; and traction batteries for forklifts and other types of equipment.

Currently, primary battery manufacturing is Tennessee's strongest type of battery manufacturing. These manufacturers employ 678 Tennesseans, the third highest employment total in the nation and second in the region behind North Carolina. Unlike North Carolina, Tennessee's primary battery industry has grown in the last few years, and by 2022, Tennessee is predicted to be the largest employer in the region. (North Carolina lost nearly 200 jobs since 2012, which was 21% of its total industry.) Tennessee currently ranks first in the region and third nationally for employment concentration in this industry. The five-year growth rate between 2012 and 2017 (1.6% per year) was one of the strongest in the nation and exceeded both the regional and national rates of growth.

¹⁵ IBISWorld. (2017). *Flickering light: Infrastructure upgrades will spur demand, though imports will dim growth*.



Primary Battery Manufacturing



Primary battery manufacturing is located in four areas in Tennessee: Bradley, Hamilton, Knox, and Shelby County. Manufacturers in Bradley County, the largest of which is Duracell USA's Cleveland plant, employ 538 Tennesseans, an increase of 164 jobs since 2012. Bradley County has the second most employment and third highest employment concentration of any US county. Cleveland employs more in this industry than any MSA in the nation besides Reading, PA. Tennessee added two new manufacturers since 2012, both of which are in Bradley County.



Storage battery manufacturing is a much smaller industry in Tennessee. Currently, these five manufacturers employ 237 Tennesseans. Hamilton County, home to Hawker Powersource Inc. in Ooltewah, accounts for most employment in this industry. Another important area for this industry is Scott County, in which the QCB Company's Oneida facility is located. Scott County has the 11th highest employment concentration of any US county. Sullivan County previously led the state for employment in this industry until the closing of Exide Technologies' Bristol plant in 2013.

In 2017, battery manufacturers in Tennessee generated \$64.0 million in earnings and sold \$236.4 million worth of product. Primary battery manufacturing is more export-oriented than storage battery production. Manufacturers of primary batteries satisfied 58% of local demand with only 20% of total sales. Storage battery manufacturers in Tennessee were unable to capture as much of the regional or national market for their industry.

NAICS	Industry	Average Employee Earnings	2017 Earnings	2017 Sales	% In-Region Sales
335911	Storage Battery Manufacturing	\$74,662	\$16,750,266	\$73,819,778	14%
335912	Primary Battery Manufacturing	\$74,580	\$47,203,932	\$162,563,968	20%
	Total	\$74,601	\$63,954,199	\$236,383,746	18%



Two trends are evident in these industries. Data demonstrates that Tennessee manufacturers enjoy a regional advantage over national competitors, and revenue is likely to grow in the next few years.

> Regional advantage

Berks County, Pennsylvania is the unrivaled leader in primary battery production in the United States. East Penn Manufacturing in Reading, PA employs more than 7,000 workers, which is almost 60% of all industry employment in the nation. Pennsylvania's success in this industry is an anomaly. East Penn became the world's largest battery maker likely because of a superior business strategy rather than advantages intrinsic to Pennsylvania.

When looking at overall regional performance, the Southeast has the strongest performance of any region in the United States. Four of the five top states for employment in primary battery production are located in the Southeast (North Carolina, Tennessee, Georgia, and South Carolina). Every state except North Carolina experienced net job creation since 2012 and demonstrated a clear competitive effect in this industry. The Midwest region, which prior to 2012 was the strongest overall region for primary battery production, saw recent declines in this industry. Michigan, Missouri, and Wisconsin had net job losses that went beyond what could be reasonably considered temporary industry setbacks. The Midwest's competitive effect declined substantially in the last five years.

Location is the main advantage that Tennessee manufacturers have over national competitors. The Southeast is the nation's most populous region and therefore has the largest share of domestic consumers. Primary batteries are mostly used in consumer electronic products. The Southeast is also in close proximity to Mexico, which is a major importer of batteries made in the US.

Tennessee's storage battery industry has struggled in recent years, but manufacturers in the state have unique advantages given the regional automotive hub. Automotive manufacturing is a major downstream market for storage batteries. Tennessee has the potential to re-emerge as a leader in this industry if local manufacturers can become a greater part of the automotive supply chain. These opportunities will grow as the Southeast siphons away more automotive manufacturing from the Midwest.

> Developing trends

Rising disposable income will translate into increased sales of consumer electronic products, creating new demand for primary batteries. Foreign manufacturers of disposable batteries will continue to pose a challenge for domestic producers. Consumers are showing a greater preference for higher-quality batteries with longer lifespans and less environmental impact. American manufacturers, particularly Duracell, have remained competitive through product innovation and creating the most sophisticated batteries on the market. In terms of storage batteries, environmental sustainability and fuel efficiency will be important concerns. Demand for premium, rechargeable batteries for electric vehicles will grow substantially in the next few years.¹⁶

¹⁶ IBISWorld. (2017). *Charging forward: Fuel efficiency trends will increase demand from automakers.*



Exports

In 2017, Tennessee appliance manufacturers exported \$1.31 billion in appliance products, a 50.4% increase since 2011. Major markets are Canada (\$406.7 million), Mexico (\$233.0 million), Japan (\$131.1 million), the United Kingdom (\$82.9 million), and China (\$63.7 million). Sales to these countries accounted for 70.0% of Tennessee's electrical equipment exports in 2017.



Miscellaneous electrical equipment accounts for the most significant percentage of export revenue for Tennessee companies. Tennessee manufacturers exported \$670.3 million worth of these products in 2017. Major markets include Mexico (\$138.1 million), Canada (\$122.4 million), Japan (\$109.0 million), the United Kingdom (\$64.0 million), and the Netherlands (\$32.7 million). Revenue from these exports has more than doubled since 2011. Growth has been particularly strong in exports to Mexico (265.9% increase).

Electrical equipment provides roughly one-quarter of export revenue for this cluster. Tennessee companies exported \$311.4 million in electrical equipment in 2017. Canada is the biggest importer of Tennessee-made electrical equipment. Exports to Canada were \$81.2 million in 2017. Other important markets included Mexico (\$71.0 million), China (\$21.6 million), Japan (\$19.5 million), and South Korea (\$16.7 million). Exports of these products have increased 29.4% since 2011. The largest growth occurred in exports to Japan (a 3,772% increase).

Household appliances account for roughly the same percentage of total exports as electrical equipment. In 2017, Tennessee manufacturers exported \$298.7 million in appliance products. Canada is by far the largest importer of these products. Exports to Canada in 2017 (\$191.3 million) provided nearly twice the revenue of every other export market combined. The other leading markets were China (\$21.4 million), Mexico (\$21.3 million), Germany (\$16.6 million), and Singapore (\$4.6 million). Tennessee exports of household appliances have increased 14.4% since 2011. Nearly all of this growth can be attributed to an increase of exports to Mexico between 2011 and 2012. Revenue increased from \$3.0 million in 2011 to \$23.0 million in 2012 and has remained steady since.



Electric lighting equipment provides the smallest share of total export revenue. In 2017, Tennessee companies earned \$29.4 million in exports of these products. The top markets are Canada (\$11.8 million), Mexico (\$4.6 million), Germany (\$2.2 million), China (\$1.7 million), and Singapore (\$1.2 million). Annual revenue has hovered around \$30.0 million a year since 2012, after a sharp fall from \$42.0 million in 2011. Exports to Hungary, which in 2011 was third larger importer of Tennessee-made electric lighting, slowed greatly in 2012, as did exports to Canada and Germany.

Recent Projects

Since 2011, the Tennessee Department of Economic and Community Development has received 23 project commitments related to the appliances cluster. These projects have resulted in 2,703 new job commitments and \$874.7 million in capital investment in Tennessee.

Company	New Job Commitments	Capital Investment (\$)	County	Date
LG Group	600	\$250,583,000	Montgomery	Clarksville
Mitsubishi Electric Power Products	240	\$207,000,000	Shelby	Memphis
TTI Floor Care North America	211	\$15,000,000	Putnam	Cookeville
Monogram Refrigeration, Llc.	210	\$9,310,052	McNairy	Selmer
Euro Tranciatura USA	173	\$12,550,000	Henry	Paris
Ermco, Inc.	150	\$0	Dyer	Dyersburg
Leroy Somer North America	110	\$8,800,000	Henderson	Lexington
Surface Igniter LLC	108	\$3,863,000	Blount	Maryville
Euro Tranciatura USA	106	\$5,000,000	Henry	Paris
Thomas & Betts Corporation	89	\$20,750,000	Shelby	Memphis

