2020

Electrical Equipment Manufacturing in Northeastern Illinois: An Initial Report

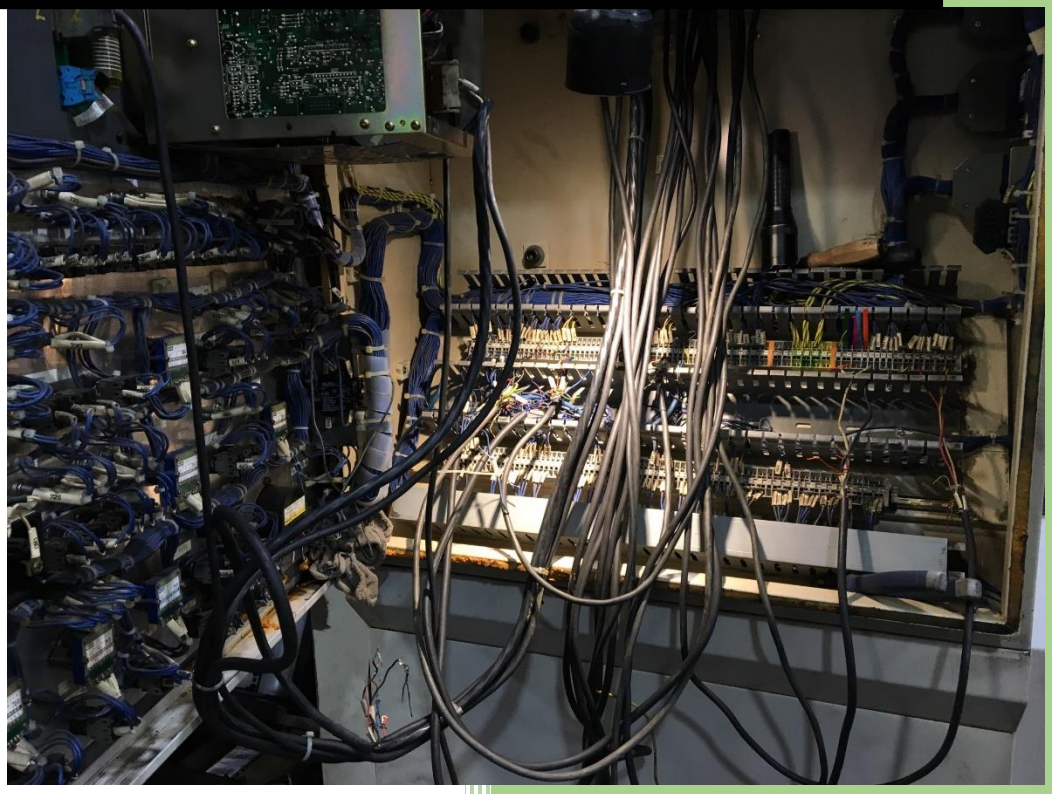

Photo credit: Patrick Rogers

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3/5/2020

Foreword: The larger picture

Electrical Equipment Manufacturing in Northeastern Illinois serves as an initial report in a research series. The purpose of this initial report is to give a profile of electrical equipment manufacturing in northeastern Illinois. My overall research focus is to explore the linkages between the northeastern Illinois manufacturing sector and the growth and maintenance of the United States energy and telecommunications infrastructure. I wrote this report to gather and disseminate information on electrical equipment manufacturing in northeastern Illinois to begin to undertake my research.

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Manufacturing in Northeastern Illinois Past and Present

Manufacturing has impacted Chicago's development since its inception. The opening of the Illinois and Michigan Canal and growth of terminal railroads from Chicago in the 19th century attracted manufacturing entrepreneurs and cultivated the growth of prominent manufacturing businesses in Chicago (Cutler, 2006; Young, 2005). The Chicago area became home to McCormick Harvesting Machine Company (later International Harvester Corporation: Hounshell, 1983; Weber, 2019), Western Electric (Adams & Butler, 1999) and Pullman (Reiff, 2005). These businesses helped Chicago become the center of agricultural, electrical and railroad equipment manufacturing throughout the 19th and 20th centuries. Prominent manufacturing businesses supported the growth of communities within and surrounding Chicago in northeastern Illinois. The loss of these companies to corporate restructuring and relocation devastated the communities they grew (Persky & Wiewel, 2000; Ranney, 2003).

The Chicago Metropolitan Agency for Planning (CMAP) highlighted the importance and health of manufacturing in northeastern Illinois in its 2013 summary report on manufacturing. Northeastern Illinois includes Cook, DuPage, Kane, Kendall, Lake, McHenry and Will Counties. The report stated that the manufacturing sector in northeastern Illinois provides well-paid jobs that in turn supports growth in other industry sectors. The report also highlighted northeastern Illinois's continued strength in electrical, industrial, and freight equipment manufacturing. A closer examination of different manufacturing industries in northeastern Illinois can help CMAP, community leaders and manufacturing businesses foster sustained growth in manufacturing industries.

Purpose of this report

The purpose of this report is to give a profile of electrical equipment manufacturing in northeastern Illinois. Reported data answer the following questions:

- *Which businesses manufacture electrical equipment in northeastern Illinois?*
- *Where are electrical equipment manufacturing businesses located in the seven-county region of Northeastern Illinois?*
- *What is the breakdown of electrical equipment manufacturing businesses by county and by North American Industry Classification System (NAICS) code?*
- *What are historical employment numbers for electrical equipment manufacturing in northeastern Illinois by county?*
- *What is the location quotient for electrical equipment manufacturing in Chicago?*

The location quotient is a simple expression of how well represented an industry is in a location. Location quotients are measured on a numerical scale. A location quotient of less than one indicates that an industry is underrepresented in a certain location within a given region. A location quotient of more than one means that an industry is well-represented in a certain location within a given region. A location quotient of one indicates that location's share of the industry is equal to the larger region (Miller, Gibson & Wright, 1991). Location quotient is calculated with the following equation:

$$\frac{\frac{Ri}{RRi}}{\frac{R}{RR}}$$

The variables for this report are designated as follows:

Ri – number of employees working at electrical equipment manufacturing businesses in Chicago

RRi - number of employees working at electrical equipment manufacturing businesses in Cook County

R – number of employees working at manufacturing businesses in Chicago

RR - number of employees working at manufacturing businesses in Cook County

I break the rest of the report into four sections. The next section defines electrical equipment manufacturing. The subsequent section details the data sources and methods for data organization, mapping and calculations. The data summary section presents maps, tables and graphs to answer the report's questions. I conclude with a layout of future analyses I will undertake in a follow-up report.

What is electrical equipment manufacturing?

The North American Industry Classification System (NAICS) classifies electrical equipment manufacturing as an industry within the manufacturing sector. The NAICS assigns six-digit codes to identify North American industries. The NAICS assigns all businesses in the manufacturing sector with NAICS codes beginning with 31, 32, or 33. Businesses that manufacture products that generate, distribute or use electrical power receive an NAICS code beginning with 335.

This report examines businesses in the electrical equipment manufacturing industry group in northeastern Illinois. Businesses in the electrical equipment manufacturing industry group receive NAICS codes beginning with 3353 and manufacture products that generate and distribute power. The electrical equipment manufacturing industry group contains four industries: power distribution and specialty transformer manufacturing (335311), motor and generator manufacturing (335312), switchgear and switchboard apparatus (335313) and relay and industrial control (335314).

Methods

The methods section details data sources and methods for organizing and mapping the data and performing calculations. I gathered data for this report from multiple sources. I used Excel to organize the data. I used ArcGIS Pro and ArcGIS Online to map the data. I used Excel and ArcGIS Pro to perform data calculations.

I gathered data for this report from Mergent Intellect, Illinois Geospatial Data Clearinghouse and the City of Chicago. I downloaded data on electrical equipment manufacturing and manufacturing businesses from Mergent Intellect. The Mergent Intellect database discloses firm-level data including company location, founding year, primary and secondary NAICS codes, and historical financial information. Historical financial information includes companies' sales revenue, total number of employees and number of employees at specific locations for the previous eight years. Mergent Intellect allows end users to select businesses by industries as indicated by NAICS codes. I gathered data on U.S. electrical equipment manufacturing businesses from the Mergent Intellect database by selecting and downloading information for businesses with NAICS codes beginning with 3353. I gathered data on United States manufacturing businesses by selecting and downloading information for businesses with NAICS codes beginning with 31, 32, and 33. The Mergent Intellect database contained data for 8,911 United States electrical equipment manufacturing businesses and 1,339,541 manufacturing businesses in January 2020. The Mergent Intellect web application gathered the firm-level data on the selected businesses and emailed me the data in Excel spreadsheets. I downloaded the Excel spreadsheets for later use. I downloaded GIS shapefiles for Illinois County boundaries from the Illinois Geospatial Data Clearinghouse. I downloaded

GIS shapefiles for Chicago's boundary from the City of Chicago. I used the GIS shapefiles to select electrical equipment manufacturing and manufacturing businesses in northeastern Illinois.

I organized the downloaded Mergent Intellect spreadsheets in Excel. The downloaded Excel spreadsheets contained two worksheets. One worksheet displayed company details including company name, domestic and global D-U-N-S number, location coordinates, physical address, mailing address, contact information and founding year. The other worksheet contained historical financial information including companies' sales, total employees and employees on location for 2010-2018. Both worksheets contained companies' D-U-N-S number. I cleaned the downloaded data in excel and saved the files as a comma separated value (csv) to prepare the data for export to a file geodatabase.

I mapped the data using ArcGIS Pro and ArcGIS Online. I first created feature classes for U.S. electrical equipment manufacturing businesses and manufacturing businesses using the location coordinates in the company details worksheets. I then joined the company details feature classes with the financial information csv files using the companies' D-U-N-S number. I exported the joined data as new feature classes and added the feature classes to an ArcGIS Pro map. I added the Illinois counties and Chicago polygon feature classes to the map. I queried the Illinois counties feature class to display only the seven counties in northeastern Illinois. I used the counties feature class to select businesses in northeastern Illinois. I used the Chicago feature class to select businesses in Chicago. I symbolized northeastern Illinois electrical equipment manufacturing business data points by their NAICS codes. I shared the ArcGIS Pro map as a web map. I then created a web application from the web map to identify which businesses manufacture electrical equipment in northeastern Illinois. I created a map series in ArcGIS Pro to show the location of electrical equipment manufacturing businesses in Chicago and each of

the seven counties in northeastern Illinois. I describe the web application and map series in the data summary section.

I performed data calculations to answer the remaining research questions using ArcGIS Pro and Excel. I used ArcGIS Pro to count the number of electrical equipment manufacturing businesses in each county by NAICS code to determine the breakdown of electrical equipment manufacturing businesses in northeastern Illinois by county and by NAICS code. I used ArcGIS Pro to find the total, mean and median for the number of employees in electrical equipment manufacturing in northeastern Illinois by county for the years 2010-2018 to determine historical employment numbers for electrical equipment manufacturing in northeastern Illinois by county. I copied the reported data tables to Excel for display. I used ArcGIS Pro to total the number of employees that worked in Chicago electrical equipment manufacturing businesses, Cook County electrical equipment manufacturing businesses, Chicago manufacturing businesses, and Cook County manufacturing businesses. I then copied the reported data tables to Excel to compute the location quotient for electrical equipment manufacturing in Chicago. I list and describe the tables in the data summary section.

Data Summary

The data summary section contains a web application, maps, tables and graph that answer the questions investigated in this report. The data summary follows the order of the report's research questions.

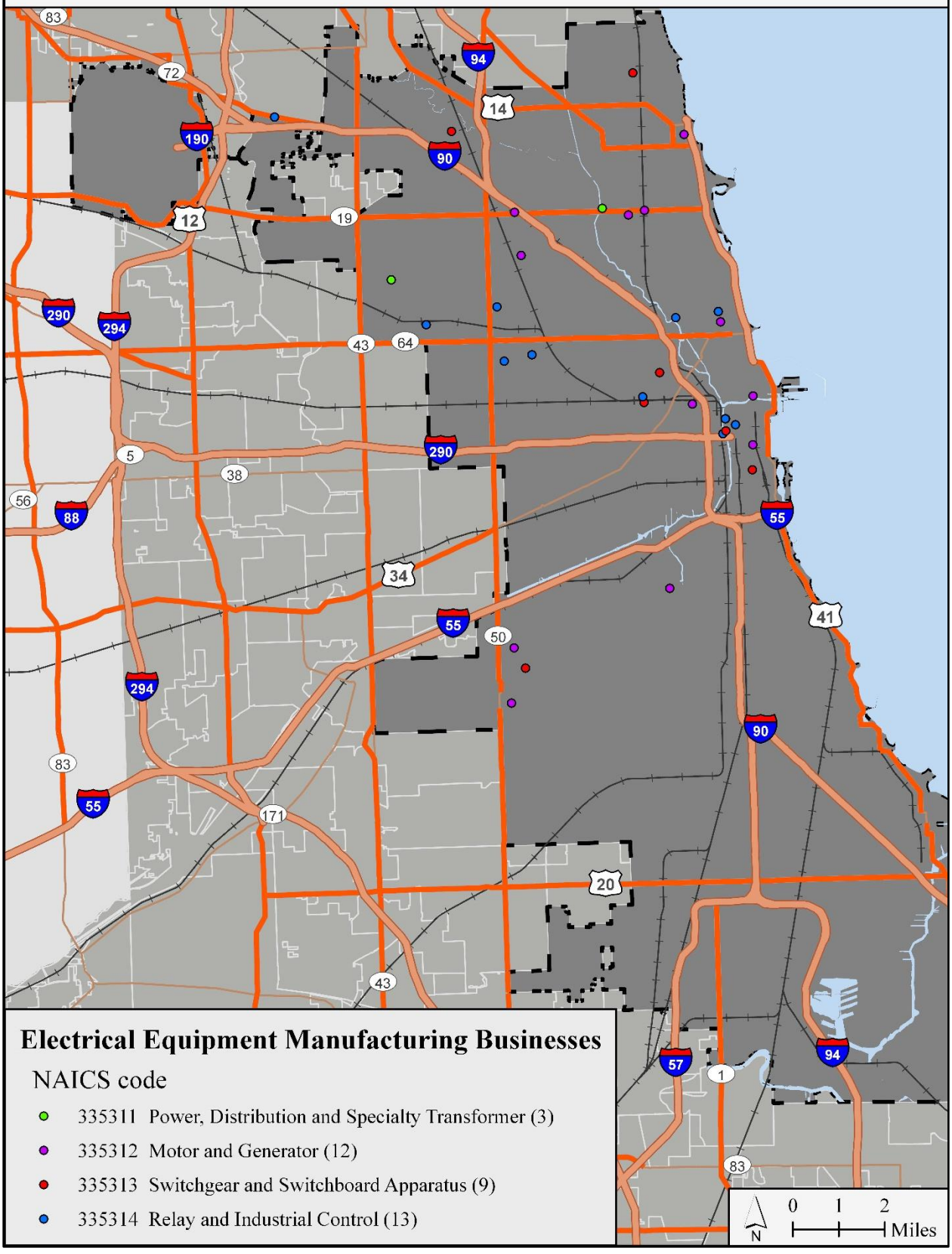
Which businesses manufacture electrical equipment in northeastern Illinois?

I created a web application to identify electrical equipment manufacturing (EEM) businesses in northeastern Illinois. Readers can access the web application by clinking this hyperlink. Clicking a business's data point reveals the business's name, founding year, physical address, primary and secondary NAICS code and the number of employees working on site from 2010 to 2018. The web application contains information for each of the 348 electrical equipment manufacturing businesses in northeastern Illinois. Businesses are symbolized by their primary NAICS codes as in the following map series.

Where are electrical equipment manufacturing businesses located in the seven-county region of Northeastern Illinois?

The following map series shows where EEM businesses settled in the seven-county region of northeastern Illinois. The map series contains eight maps. The first map shows EEM businesses in Chicago. The seven subsequent maps show EEM businesses in the seven counties in northeastern Illinois. Each map shows businesses' proximity to major roadways and railways.

Electrical Equipment Manufacturing in Chicago

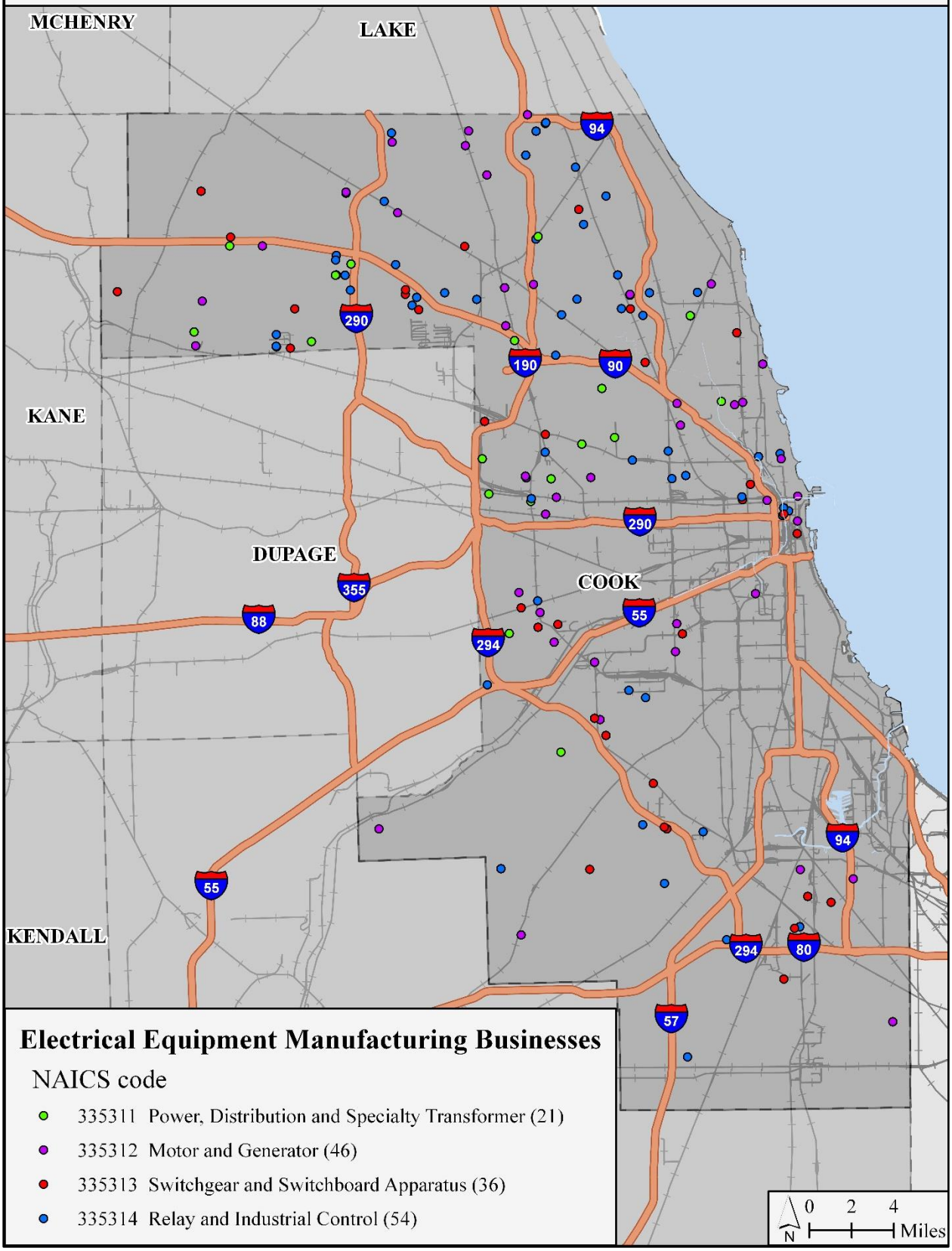


Electrical Equipment Manufacturing Businesses

NAICS code

- 335311 Power, Distribution and Specialty Transformer (3)
- 335312 Motor and Generator (12)
- 335313 Switchgear and Switchboard Apparatus (9)
- 335314 Relay and Industrial Control (13)

Electrical Equipment Manufacturing in Cook County

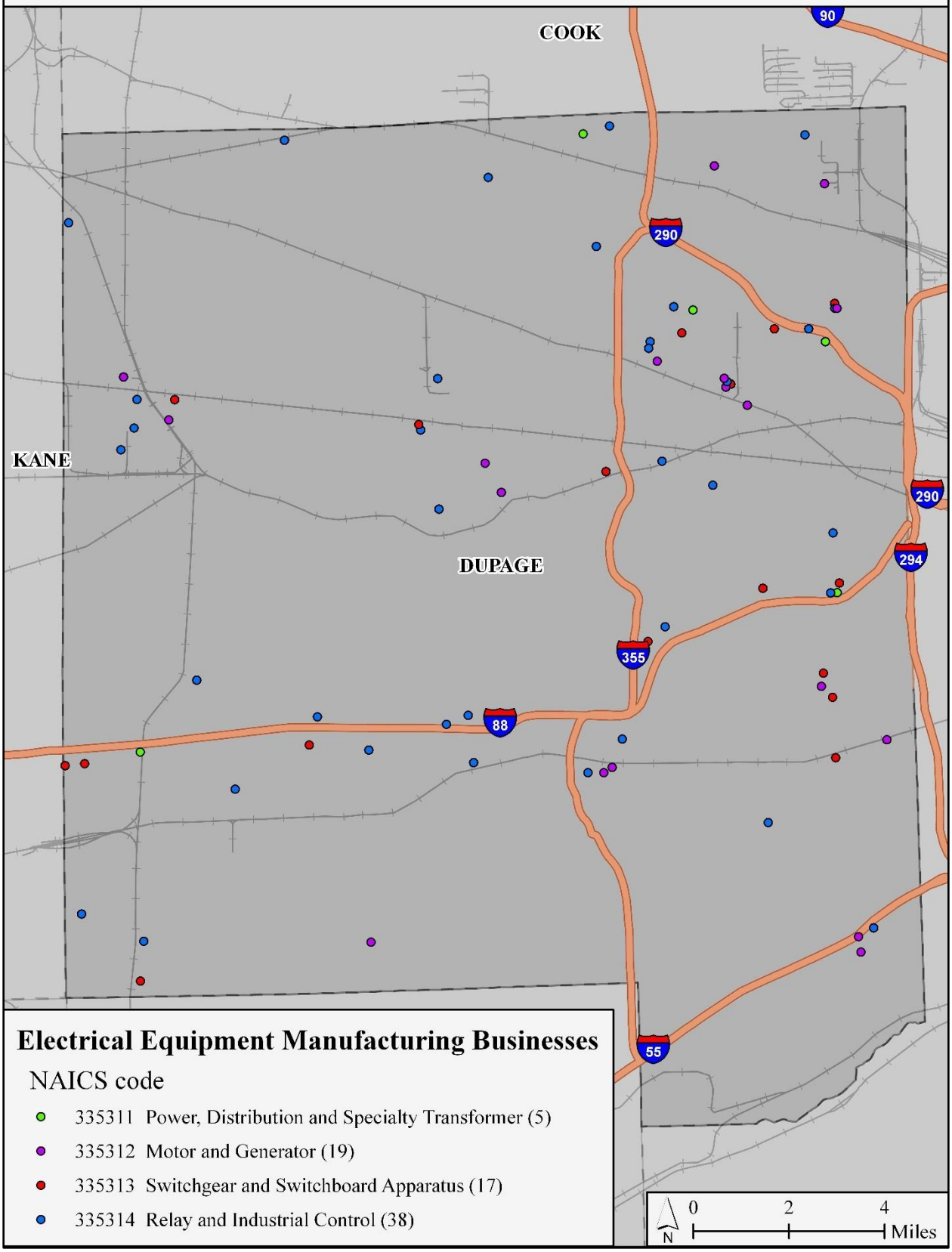


Electrical Equipment Manufacturing Businesses

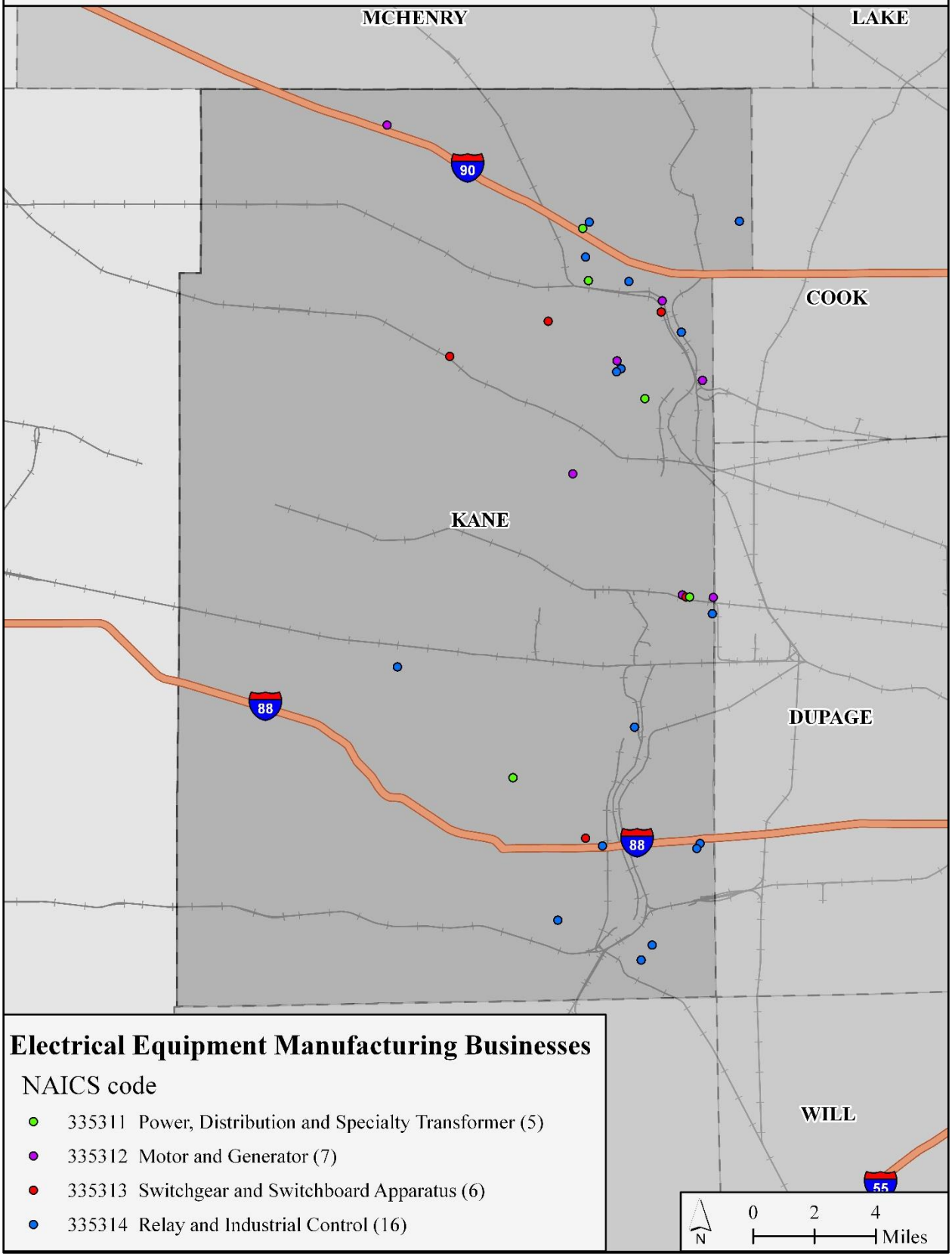
NAICS code

- 335311 Power, Distribution and Specialty Transformer (21)
- 335312 Motor and Generator (46)
- 335313 Switchgear and Switchboard Apparatus (36)
- 335314 Relay and Industrial Control (54)

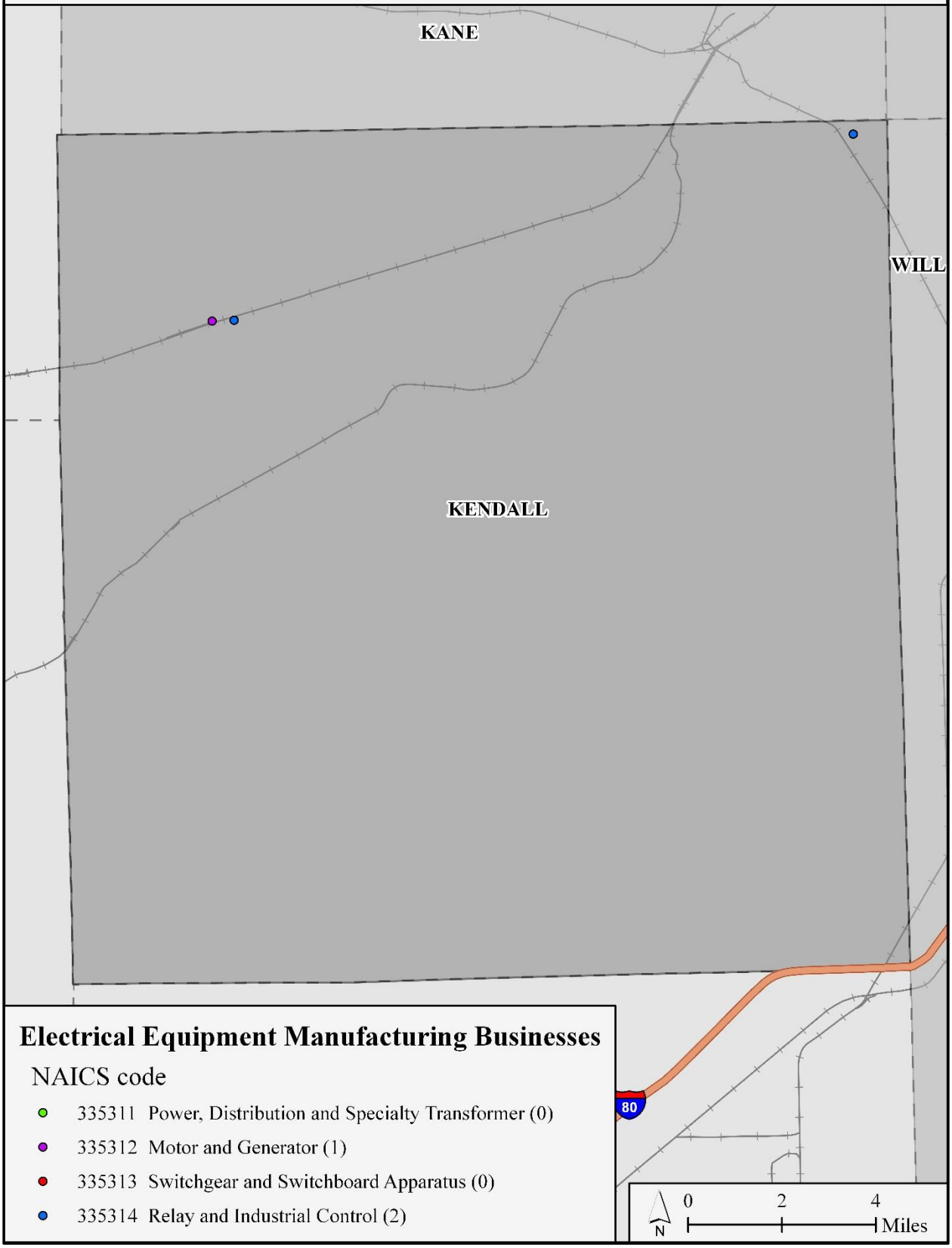
Electrical Equipment Manufacturing in DuPage County



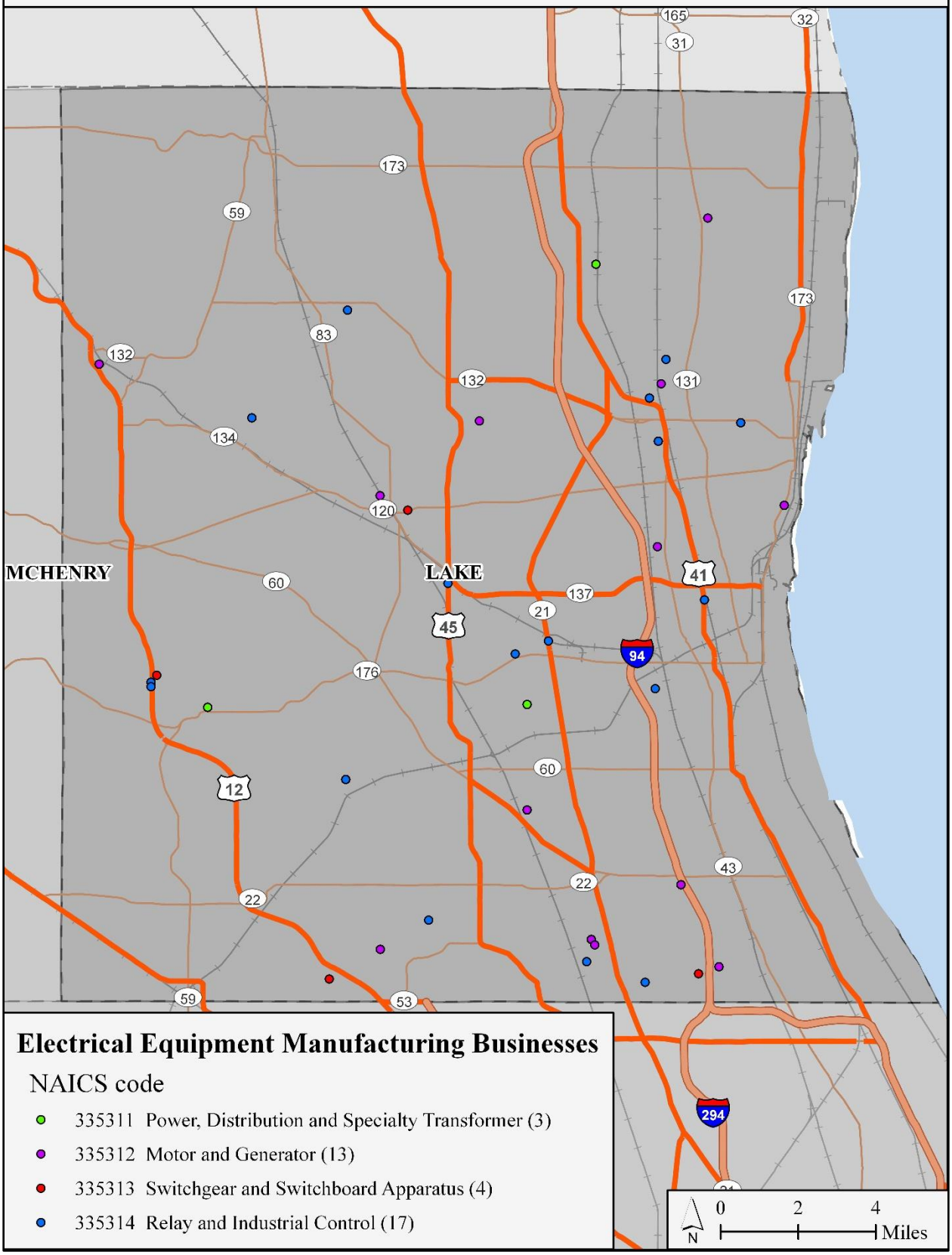
Electrical Equipment Manufacturing in Kane County



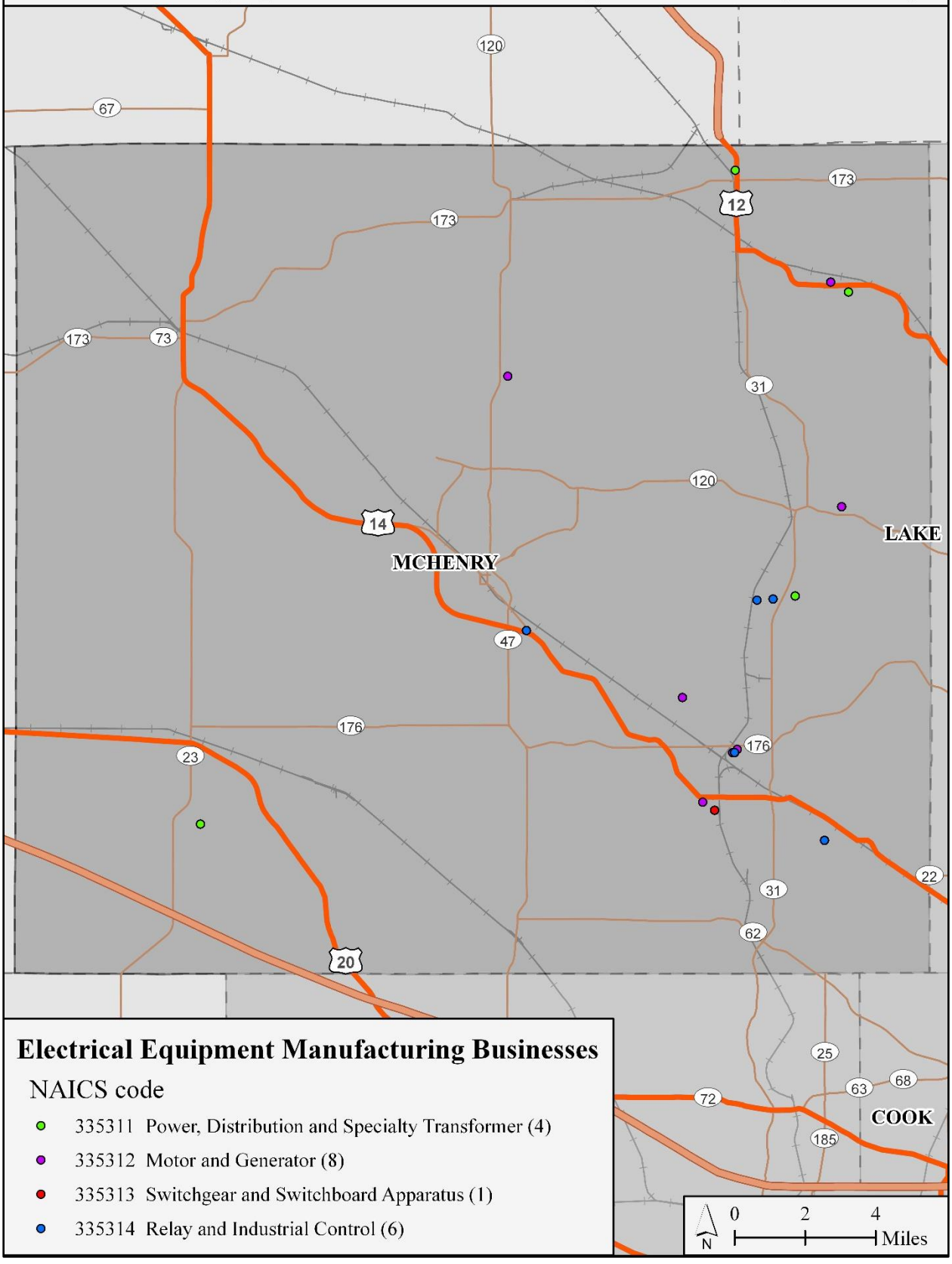
Electrical Equipment Manufacturing in Kendall County



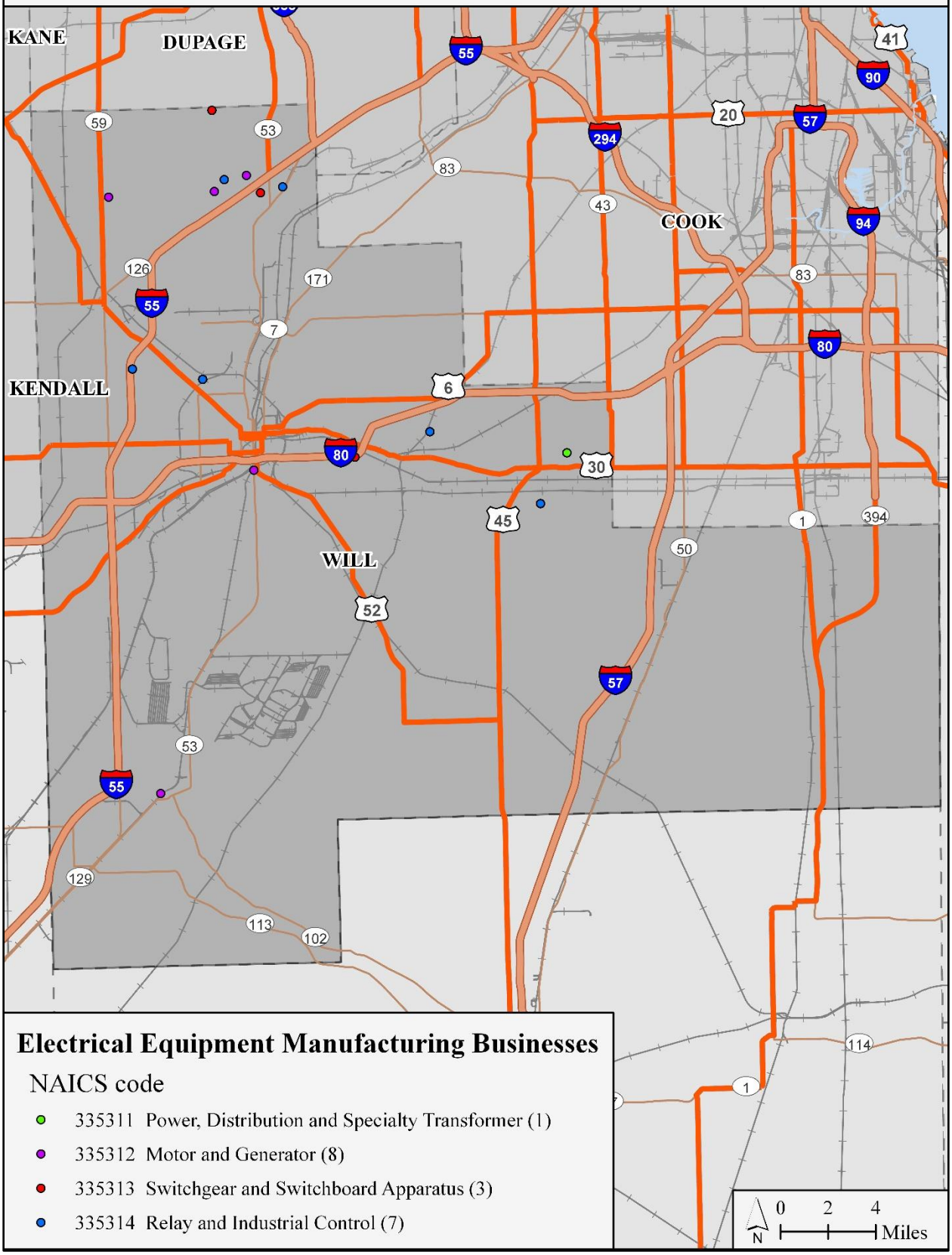
Electrical Equipment Manufacturing in Lake County



Electrical Equipment Manufacturing in McHenry County



Electrical Equipment Manufacturing in Will County



Electrical Equipment Manufacturing Businesses

NAICS code

- 335311 Power, Distribution and Specialty Transformer (1)
- 335312 Motor and Generator (8)
- 335313 Switchgear and Switchboard Apparatus (3)
- 335314 Relay and Industrial Control (7)

What is the breakdown of electrical equipment manufacturing businesses in northeastern Illinois by county and by North American Industry Classification System (NAICS) code?

An examination of the breakdown of EEM businesses in northeastern Illinois by county and by NAICS code reveals that the majority of EEM businesses stand in Cook or DuPage County and have the NAICS codes of 335312 or 335314. Sixty-eight percent of EEM businesses in northeastern Illinois stand in Cook or DuPage County. Seventy percent of EEM businesses in northeastern Illinois have the NAICS code of 335312 or 335314. Table 1 gives the breakdown of electrical equipment manufacturing businesses by county and by NAICS code.

NAICS Code	Description	Cook	DuPage	Kane	Kendall	Lake	McHenry	Will	Seven-county Region
335311	Power, Distribution and Specialty Transformer Manufacturing	21	5	5	0	3	4	1	39
335312	Motor and Generator Manufacturing	46	19	7	1	13	8	8	102
335313	Switchgear and Switchboard Apparatus Manufacturing	36	17	6	0	4	1	3	67
335314	Relay and Industrial Control Manufacturing	54	38	16	2	17	6	7	140
33531	**Total Number of Electrical Equipment Manufacturing Businesses**	**157**	**79**	**34**	**3**	**37**	**19**	**19**	**348**

Table 1. Breakdown of electrical equipment manufacturing in northeastern Illinois by county and NAICS code

What are historical employment numbers for electrical equipment manufacturing in northeastern Illinois by county?

I report the total, response rate, mean, and median employment numbers for electrical equipment manufacturing businesses in northeastern Illinois by county for a nine-year period from 2010-2018. I also list the top five employers for electrical equipment manufacturing to explain discrepancies between counties' mean and median employment numbers.

Table 2 reveals the total number of employees in EEM in northeastern Illinois in the nine-year period and the response rate for reported data by county. The reported data reveals that EEM businesses in Cook County employed over half of the number of workers in EEM businesses in northeastern Illinois. DuPage and Lake County businesses employed about 15% of EEM employees each over the nine-year period. The Mergent Intellect Report did not contain historical employment data for every EEM business. The last column in table 2 shows the response rate for EEM businesses in each county. Readers should note the response rate when interpreting the total, mean and median numbers of employees in EEM in northeastern Illinois.

Table 3 reveals the means and medians for the number of employees working at EEM businesses in northeastern Illinois in the nine-year period by county. A closer examination of the means and medians shows that the means are substantially higher than the medians for the number of EEM employees in Cook, DuPage and Lake Counties. The subsequent report of the top five EEM employers in northeastern Illinois gives reason for the difference between the mean and medians in these three counties.

	Total Number of Employees									
Location	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Response Rate**
Cook County	6314	6315	6573	6635	6705	6841	6805	6650	6666	51%
DuPage County	1230	1265	1266	1275	1154	1320	1634	1564	1542	52%
Kane County	776	805	796	780	703	780	797	811	799	68%
Kendall County	3	3	3	13	12	12	12	19	15	67%
Lake County	1541	1546	1545	1589	1542	1590	1587	1589	1589	70%
McHenry County	265	255	139	139	174	139	139	136	136	63%
Will County	147	151	131	130	132	132	132	129	129	58%
Seven County Region	**10276**	**10340**	**10453**	**10561**	**10422**	**10814**	**11106**	**10898**	**10876**	**56%**

Table 2. Total Number of Employees in Electrical Equipment Manufacturing in Northeastern Illinois by County

	2010		2011		2012		2013		2014		2015		2016		2017		2018	
Location	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**
Cook County	78.93	5.5	77.96	6	82.16	7	92.15	8	91.85	8	93.71	10	88.38	10	86.36	9	86.57	9
DuPage County	30	8	28.75	7	26.38	5	28.98	8	26.23	5.5	28.7	8	35.52	8.5	36.37	8	36.71	8
Kane County	33.74	10	35	20	36.18	20	35.45	15	29.29	9.5	35.45	15	34.65	15	33.79	12.5	33.29	10
Kendall Count	1.5	1.5	1.5	1.5	1.5	1.5	6.5	6.5	12	12	12	12	12	12	9.5	9.5	7.5	7.5
Lake County	59.27	3.5	57.26	4	61.8	5	69.09	6	67.04	6	72.27	6	79.35	6.5	75.67	6	75.67	6
McHenry County	22.08	7	21.25	5.5	13.9	7	13.9	7	15.82	8	13.9	7	13.9	7	15.11	8	15.11	8
Will County	13.36	10	12.58	9	11.91	8	13	9	13.2	9	13.2	9	13.2	9	14.33	10	14.33	10
Northeastern Illinois Seven County Region	**52.7**	**6**	**51.44**	**6**	**52.79**	**6**	**57.71**	**8**	**56.03**	**7**	**58.77**	**9**	**59.39**	**9**	**58.91**	**8**	**59.11**	**8**

Table 3. Means and Medians for the Number of Employees Working and Electrical Equipment Manufacturing Businesses

Table 4 shows the top five electrical equipment manufacturing employers in northeastern Illinois. Three of the top five employers (Progress Rail Locomotive, Inc., S & C Electric Company and Littelfuse, Inc.) stand in Cook County. Siemens Industry, Inc. stands in Lake County. Moon's Industries America, Inc. stands in DuPage County. The high number of individuals employed at each of the top five employers contributed to the substantial difference between the mean and median number of employees at EEM businesses indicated in table 3.

Company	County	Number of Employees								
		2010	2011	2012	2013	2014	2015	2016	2017	2018
Progress Rail Locomotive, Inc.	Cook	1850	1850	1850	1850	1850	1850	1850	1850	1850
S & C Electric Company	Cook	1800	1800	1900	1900	1900	1900	1900	1900	1900
Siemens Industry, Inc.	Lake	1200	1200	1200	1200	1200	1200	1200	1200	1200
Littelfuse, Inc.	Cook	700	700	700	700	700	700	700	700	700
Moon's Industries America, Inc.	DuPage	520	520	520	520	520	520	520	520	520

Table 4. Top Five Electrical Equipment Manufacturing Employers in Northeastern Illinois, 2010-2018

What is the location quotient for electrical equipment manufacturing in Chicago?

I computed the location quotient for Chicago electrical equipment manufacturing using the historical employment numbers for Chicago and Cook County EEM and manufacturing businesses. Table 5 reports the total number of employees that worked at EEM and manufacturing businesses in Chicago and Cook County from 2010 to 2018. The last row reports the location quotient for Chicago EEM. Figure 1 illustrates the change in employment numbers and location quotient over the nine-year period.

A closer examination of the data reveals that the Chicago EEM location quotient declined from 2010-2018. The change in the total number of employees working at EEM and manufacturing businesses in Chicago and Cook County gives context to the location quotient decline. The total number of employees working at EEM businesses in Chicago declined a total of 9.8% from 2010 to 2018. The total number of employees working at Cook County EEM businesses, Chicago manufacturing businesses and Cook County manufacturing businesses increased by 9.5%, 8.7% and 8.8% respectively from 2010 to 2018. The Mergent Intellect Report did not contain historical employment data for every EEM and manufacturing business. Table 6 reports the response rate for the EEM and manufacturing businesses in Chicago and Cook County. Readers should note the response rate when interpreting the historical employment numbers and location quotient.

Employment Numbers	2010	2011	2012	2013	2014	2015	2016	2017	2018
Chicago Electrical Equipment Manufacturing	3248	3252	3314	3312	3213	3237	3180	3174	3197
Cook County Electrical Equipment Manufacturing	6314	6315	6573	6635	6705	6841	6805	6650	6666
Chicago Manufacturing	61995	63067	59602	59448	59111	67225	67912	69320	70685
Cook County Manufacturing	161708	162953	158185	155396	156178	180372	179468	183080	184377
Location Quotient	1.34	1.33	1.34	1.3	1.27	1.27	1.23	1.26	1.25

Table 5. Historical Employment Numbers and Chicago Electrical Equipment Manufacturing Location Quotient

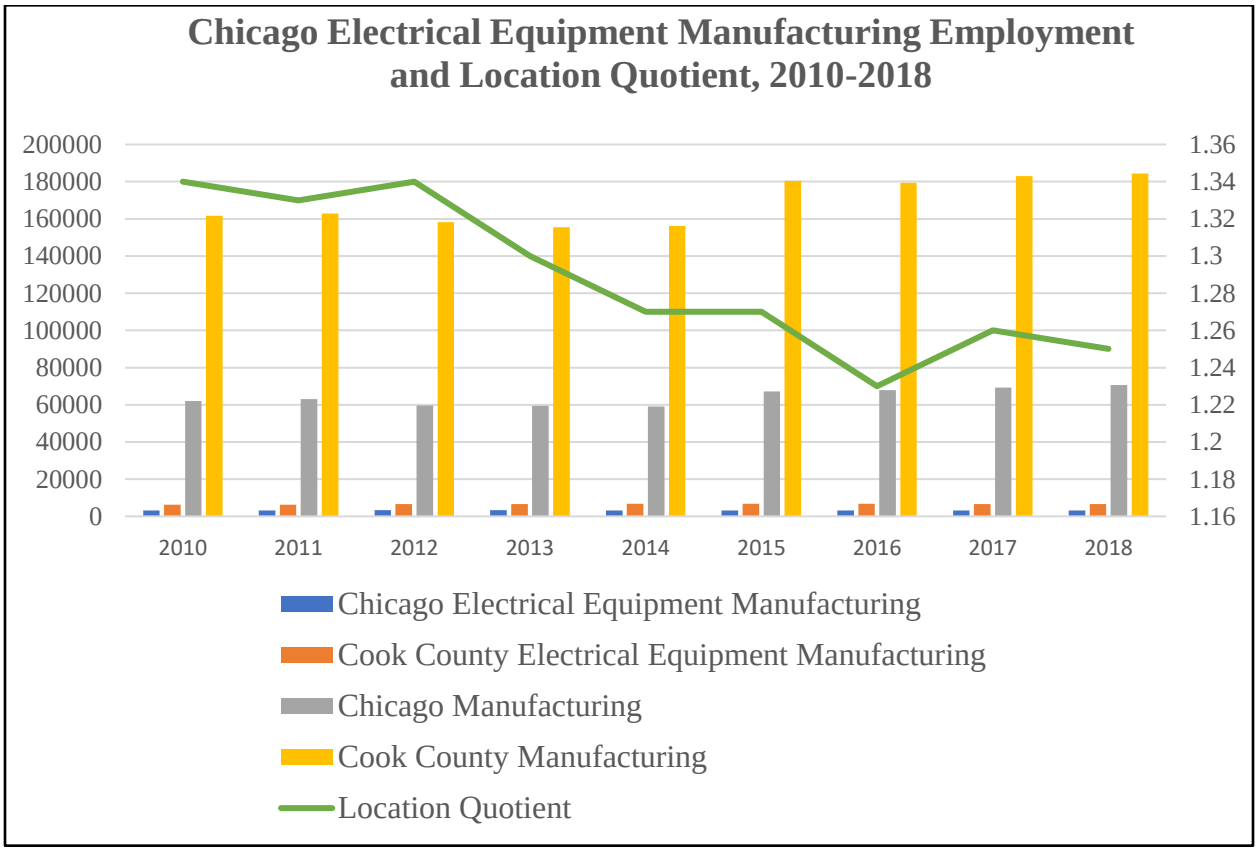


Figure 1. Chicago Electrical Equipment Manufacturing Employment and Location Quotient, 2010-2018

Location and Type of Manufacturing	Number of business	Number of businesses with reported financial information	Response Rate
Chicago Electrical Equipment Manufacturing	37	18	49%
Cook County Electrical Equipment Manufacturing	157	80	51%
Chicago Manufacturing	9963	4391	44%
Cook County Manufacturing	23974	11307	47%

Table 6. Response Rate for Historical Employment Numbers for Chicago and Cook County Businesses

Future analyses

I conclude with a plan for a follow-up report to further analyze electrical equipment manufacturing in northeastern Illinois. The purpose of this report was to give a profile of electrical equipment manufacturing in northeastern Illinois. The purpose of the follow-up report will be to examine how electrical equipment manufacturing relates to infrastructure and community development in northeastern Illinois. I plan to address the following research questions in my follow-up report:

- Is there a relationship between the age of electrical equipment manufacturing businesses and their proximity to transportation routes?
- Is there a relationship between the age of electrical equipment manufacturing businesses and their proximity to Chicago's Loop neighborhood?
- Is there a spatial relationship between the location of power, distribution and specialty transformer manufacturing businesses (335311) and motor and generator manufacturing businesses (335312)?

I invite feedback on this report and suggestions for what to include in my follow-up report. Readers may email me at mcfaddenk231@cod.edu. I plan to release the follow-up report in summer 2020.

References

Adams, S. B., & Butler, O. R. (1999). *Manufacturing the future: A history of Western Electric*. New York, NY: Cambridge University Press.

City of Chicago. Innovation and Technology Department. (2017) Boundaries- City. GIS data. Last accessed 21 September 2019.

Chicago Metropolitan Agency for Planning (CMAP). (2013). *Metropolitan Chicago's Manufacturing Cluster: A Drill-Down Report on Innovation, Workforce, and Infrastructure*.

Cutler, I. (2006). *Chicago: Metropolis of the mid-continent*. Carbondale, IL: Southern Illinois University Press.

Hounshell, D. A. (1983). The McCormick Reaper Works and American manufacturing technology in the Nineteenth Century. In *From the American system to mass production, 1800-1932* (pp. 153–187). Baltimore, MD: John Hopkins University Press.

Illinois Geospatial Data Clearinghouse. (2003). Illinois County Boundaries, Polygons. GIS data. Last accessed 28 January 2020.

Mergent Intellect. *United States Electrical Equipment Manufacturing and Manufacturing Businesses*. College of DuPage. Last accessed 28 January 2020.

Miller, M. M., Gibson, L. J., & Wright, N. G. (1991). Location quotient: A basic tool for economic development analysis. *Economic Development Review*, *9*(2), 65–68.

Persky, J., & Wiewel, W. (2000). *When corporations leave town: The costs and benefits of metropolitan job sprawl*. Detroit: Wayne State University Press.

Ranney, D. (2003). *Global decisions, local collisions Urban life in the New World Order*. Philadelphia: Temple University Press.

Reiff, J. L. (2005). Pullman. In *The Electronic Encyclopedia of Chicago*. Chicago: Chicago Historical Society.

Weber, A. (2019). *Made in Chicago: The windy city's manufacturing heritage*. Charleston, SC: Arcadia Publishing.

Young, D. M. (2005). *The iron horse and the windy city*. Dekalb, IL: North Illinois University Press.