



Prepared for:
OHIO MANUFACTURERS' ASSOCIATION

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**Moving Ohio
Manufacturing
Forward:
Competitive
Electricity Pricing**

**Center for Economic
Development and Energy
Policy Center**

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Executive Summary

Today, the price of electricity has a powerful influence on the competitiveness of manufacturing because manufacturing industries are often electricity's largest consumers. Economic regulation of the electric utility business has changed very little over the last decade while regional and national policy makers debate the volatility of energy markets. The electricity industry, because of the large size of the units of its production, wholesale, and distribution, draws major benefits from the economy of scale. At the same time, energy efficiency has become the by-word of energy-intensive manufacturing businesses, which in the Midwest accounted for 60% of industrial fuel and feedstock energy use in 2006.¹ In 2010, Ohio had the highest level of manufacturing activity among Midwestern states resulting in value added mainly from the energy-intensive sectors such as primary metals, petroleum and coal products, chemicals, food, nonmetallic minerals, paper, and wood products.²

The goal of this report is to define electricity-intensive manufacturing export industries in Ohio that are sensitive to electricity pricing and to illustrate the impact of electricity pricing on manufacturing productivity through the industrial electricity pricing model. The first section of the report identifies Ohio's manufacturing industries that are electricity-intensive as part of their production (high costs of electricity per unit of production) and Ohio manufacturing industries that consume large quantities of electricity overall due to the large size of this industry in the state (high total expenditures on electricity). Some of these industries have a competitive advantage in the state and demonstrate a high Location Quotient (LQ)³ of Gross State Product (GSP) and growth in GSP since the last recession. The second section of this report explores the impact of electricity rates, together with states' efforts to deregulate electricity markets, on the competitiveness of manufacturing industries in Ohio and benchmark states expressed through manufacturing productivity.

Twelve Ohio industries are a part of economic base of the state and manufacture a high number of electricity-intensive products. These industries belong to four industrial sectors: *Primary Metal Manufacturing, Chemical Manufacturing, Food Manufacturing, and Nonmetallic Mineral Product Manufacturing*. Together, these 12 industries employed over 86,000 people in Ohio in 2010.

According to our empirical modeling of industrial electricity pricing, the growth of manufacturing employment is negatively related to manufacturing productivity. At the same

¹ J. Bradbury et al. "Midwest Manufacturing Snapshot: Energy Use and Efficiency Policies." World Resource Institute, Working Paper, February 2012. P.5

² P.4

³ Location Quotient measures the specialization of an industry in a region by comparing it to data in a larger region. For our analysis: $LQ = \frac{g_i}{G_i} \div \frac{g}{G}$ where g_i = The Ohio Gross Product in industry i ; g = Total Gross Product in Ohio; G_i = US Gross Product in industry i ; G = Total US Gross Product. A location quotient > 1.0 indicates specialization in an industry.

time, the presence of large manufacturing establishments in the state is, as expected, positively associated with manufacturing productivity. This analysis indicates that manufacturing productivity might benefit from both economies of scale and the ability of large electricity consumers to negotiate individual contracts with suppliers at, most likely, lower than average market prices. This finding allows us to consider whether enabling a lower market price across the board for manufacturing users might further benefit the productivity of the manufacturing sector in the state.

An increase in the industrial electricity price by 1 cent per kilowatt-hour (16.3%) is likely, in 99% of cases, to decrease average manufacturing productivity in the five selected states,⁴ on average, by \$2,527 of annual gross state product per employee (2.2%). The productivity change associated with the industrial electricity price change has low elasticity: $2.2\%/16.3\%=0.13$. The measure of elasticity below 1 is known as inelastic response. This means that for 1% increase of industrial electricity prices, manufacturing productivity drops by 0.13%.

Description of Ohio Electricity-Intensive Industries

In the first section of the report, a number of variables were analyzed to identify Ohio's economic base. These variables include the LQ of GSP, the growth of GSP, and industries' productivity over three time periods, 2000-2010, 2007-2010, and 2009-2010. With a LQ of greater than 1, fifty-two manufacturing industries (Table 7) potentially represented the economic base of Ohio's economy in 2010.⁵ Ohio's economic base was heavily represented by manufacturing industries of *Food* (NAICS 311), *Chemical* (NAICS 325), *Nonmetallic mineral product* (NAICS 327), *Primary metal* (NAICS 331), *Fabricated metal product* (NAICS 332), *Machinery* (NAICS 333), *Electrical equipment* (NAICS 335), and *Transportation equipment* (NAICS 336).

Twenty-eight manufacturing industries in Ohio experienced positive GSP growth (at least 1%) between 2007 and 2010⁶. With a 51% increase, the *Petroleum and Coal Products Manufacturing* industry (NAICS 3241) had the greatest GSP growth during the study period followed by *Electrical Equipment and Component Manufacturing* (NAICS 3359) and *Pharmaceutical and Medicine Manufacturing* (NAICS 3254) industries which grew by 31% in the same time period.

The industries that were growing from 2007 to 2010 and were likely to have high productivity in 2010 were *Petroleum and Coal Products Manufacturing* (NAICS 3241); *Pesticide, Fertilizer, and other Agricultural Chemical Manufacturing* (NAICS 3253); *Household Appliance Manufacturing* (NAICS 3352); *Pharmaceutical and Medicine Manufacturing* (NAICS 3254); and *Basic Chemical Manufacturing* (NAICS 3251).

⁴ Ohio, Indiana, Kentucky, Michigan, and Pennsylvania

⁵ The industries that represent economic base are also called basic industries.

⁶ For more information see Table 8.

Basic manufacturing industries that use electricity intensively as a part of production (those with electricity expenditures greater than 1% of total expenditures) were categorized as high, moderate, or low electricity-intensive industries. Ten industries were classified as high electricity-intensive industries, with average electricity expenditures greater than 2% of total expenditures. The *Alumina and Aluminum Production and Processing Industry* (NAICS 3313) ranked highest, with electricity expenditures composing 5.7% of total expenditures (Table 1).

There were seventeen moderately electricity-intensive industries, spending at least 1% of their total expenditures on electricity. The *Sawmills and Wood Preservation* (NAICS 3211) industry ranked highest in this group, with electricity expenditures composing 1.9% of total expenditures.

Twenty manufacturing industries were identified as large consumers of electricity by total expenditures on electricity (Table 2). The top industry, *Basic Chemical Manufacturing* (NAICS 3251), spends over \$357 million on electricity per year, followed closely by *Iron and Steel Mills and Ferroalloy Manufacturing* (NAICS 3311) at \$305 million. The top eleven industries in this category spend greater than \$67 million per year on electricity expenditures per industry.

The other nine industries are considered moderate consumers (based on total expenditures) and spend individually between \$41 and \$56 million on electricity per year. This group was led by *Other Fabricated Metal Product Manufacturing* (NAICS 3329), at \$59 million per year in electricity expenditures.

Fourteen industries were identified as both (1) electricity-intensive in regards to the unit of production and (2) high overall consumption of electricity. These manufacturing industries create electricity-intensive products while purchasing large volumes of electricity relative to their size in Ohio. This group consisted of primary metal, chemical, food, paper, glass, and nonmetallic mineral industries.

Eleven nonmanufacturing industries and broader sectors were identified in Ohio as those that have high per-unit electricity costs and high total expenditures on electricity. These industries cover diverse activities – from farming to large institutions and accommodations – and can occur on such a large scale that electricity needs are magnified, such as in museums, hospitals, universities, and warehouses. Electricity costs as a percentage of total expenditures for non-manufacturing industries exceed 1%. The *Accommodation* industry (NAICS 721) is atop of the list of large non-manufacturing energy consumers, spending 2.9% of its total expenditures for electricity. Total expenditures for electricity in this group of industries vary from over \$103 million for *Construction* to over \$15 million for *Newspaper, Periodical, Book, and Directory Publishers*.

Empirical Model

The second part of the report explores the impact of electricity pricing on manufacturing productivity through an industrial electricity price regression model. This model was conducted on the data from five comparable states: Ohio, Indiana, Kentucky, Michigan, and Pennsylvania.

The research team chose neighboring states with economic structures and electricity consumers comparable to those of the state of Ohio as the geographic area for statistical modeling. This analysis seeks to answer two research questions: (1) How does industrial electricity pricing influence the productivity of the manufacturing sector? and (2) What are the influences of electricity market deregulation on the industrial electricity market and manufacturing productivity?

The manufacturing productivity and industrial electricity rates in Ohio, Indiana, Kentucky, Michigan, and Pennsylvania were analyzed for the period between 1990 and 2010 - the latest years for which industrial electricity pricing data were available. A statistical model was built to test the effect of policy variables on manufacturing productivity (industrial electricity price and deregulation variables), controlling for the demand on the electricity market (manufacturing employment and presence of large manufacturing companies), the supply on the electricity market (size of power generation industry), and overall economic conditions (using a business cycle variable to estimate the recession).

The results of this analysis indicate that electricity price had a statistically significant negative effect on manufacturing productivity across the five targeted states between 1990 and 2010. The higher the industrial electricity prices were in the five selected states, the lower manufacturing productivity was in these states in 99% of cases. However, productivity change from the movement of industrial electricity price was inelastic—indicating that electricity is only one of the supply price factors influencing manufacturing productivity.

The deregulation of the electricity market was statistically significant (above the 99% critical value) and positively associated with manufacturing productivity. To further assess the impact of electricity market restructuring, an independent sample t-test⁷ was used to compare industrial electricity prices and other economic indicators between the states that deregulated their wholesale electricity markets and those that did not. Generally, deregulation had a positive effect on the change of industrial electricity prices and some economic variables characterizing the state of manufacturing industries in the five targeted states. The most profound effect of deregulation was a significant drop in industrial electricity prices. However, the model is based on a small sample of five states and did not control for the level of industrial electricity pricing at the beginning of the study period.

The variables characterizing the demand side of the electricity market shows that the growth of manufacturing employment is negatively related to manufacturing productivity with statistical significance only above the 90% critical value. Also, it should be noted that the presence of a considerable number of large manufacturing establishments in the state was positively associated with manufacturing productivity at the 99% critical value, which might reflect the benefits from the economy of scale where many large companies share the regional supply chain.

⁷ The t-test illustrates whether the differences between the states were statistically significant.

The control variable that represents the supply side of the electricity market, capacity of electricity production and distribution, was also positively related to manufacturing productivity and was statistically significant above the 99% critical value. The variable approximating the national recession was negatively associated with manufacturing productivity, indicating that during economic downturns manufacturing productivity was declining.

Based on the results of this analysis, we can conclude that higher industrial electricity rates in Ohio will most likely be associated with lower manufacturing productivity. Moreover, manufacturing productivity is likely to benefit from both economy of scale and the ability of large electricity consumers to negotiate contracts with suppliers at a lower than average market price. Finally, an increase in the state's capacity to generate, transmit, and distribute electricity will most likely support higher productivity in its manufacturing sector.

Introduction

This report is prepared for The Ohio Manufacturers' Association by the Center for Economic Development and the Center for Energy Policy and Applications at the Maxine Goodman Levin College of Urban Affairs at Cleveland State University. The authors of the report would like to acknowledge the research assistance of Ellen Cyran, a senior programmer analyst at the Center for Economic Development for her database support, James Wyles, visiting instructor in GIS and Urban Geography for his mapping, and Joe Andre and Serineh Baboornian, graduate assistants at the Center for Economic Development for their editorial support. We appreciate thoughtful comments by the OMA leaders and staff for their insights and continued support through the duration of this project.

Ohio today faces a considerable challenge in keeping its manufacturing base competitive. Energy-intensive manufacturing, in particular, is threatened by rising electricity costs and the potential need to reduce carbon emissions. One of the responses to mitigate rising electricity prices is developing a model of distributed generation.⁸

In order to examine if electricity rates have a critical influence on Ohio's manufacturing industry, it is imperative to identify Ohio's electricity-intensive manufacturing sector which has comparative advantages across the United States. We present this in the first section of our report, as well as the geographic concentration of electricity-intensive, economic-base manufacturing industries in all Ohio counties. In Ohio's manufacturing base, there are 14 industries that are electricity-intensive industries⁹ and industries that are large consumers of electricity.¹⁰ In particular; atop of this list are primary metal manufacturing; chemical manufacturing; food manufacturing; and paper, glass, and nonmetallic mineral product manufacturing.

In the second part of this report, the researchers empirically estimate the impact of electricity rates coupled with the deregulation of electricity markets, and how these impact Ohio's manufacturing competitiveness.

This study is intended to inform manufacturers about the structure of electricity-intense industries of the manufacturing sector, regional distribution of electricity-intense industries, and the largest consumers of electricity in Ohio. Moreover, this study aims to provide insights on major factors influencing electricity pricing. The study empirically illustrates that industrial electricity price is one of the major factors that negatively impacts manufacturing productivity. The authors hope that the study of the state of electricity-intensive manufacturing industries' help craft better electricity pricing public policies in Ohio.

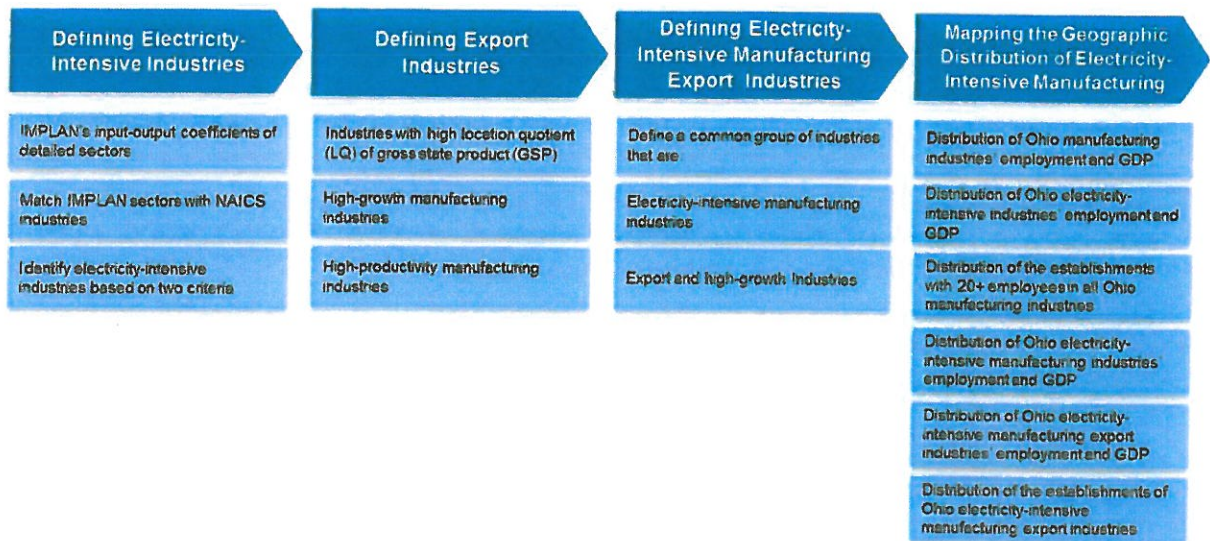
⁸ A. Thomas and I. Lendel, "Distributed Generation as a Response to Rising Electricity Costs in Ohio." February 2013.

⁹ Electricity-intensive are atop of the list of industries defined by the ratio of an industry's expenditure on electricity to the industry's total expenditures in Ohio, measured as unit expense for electricity.

¹⁰ Large consumers of electricity are industries that pay large shares of their total expenditures for electricity, measured in dollars.

Part 1: Analysis of Ohio Electricity-Intensive Manufacturing Export Industries

The goal of the project is to define a group of electricity-intensive manufacturing export industries that could possibly be eligible for special electricity rates. The Center for Economic Development defines and lists these electricity-intensive industries and then analyzes the distribution and concentration of electricity-intensive industries across the state of Ohio. Steps and methodologies of the analysis are as follows:



Defining Electricity-Intensive Industries

In order to identify electricity-intensive industries, IMPLAN's technical input-output coefficients were used. IMPLAN is a proprietary input-output economic model that provides information on supply relationships (backward linkages) between industries. Two indicators signify electricity-intensive industries:

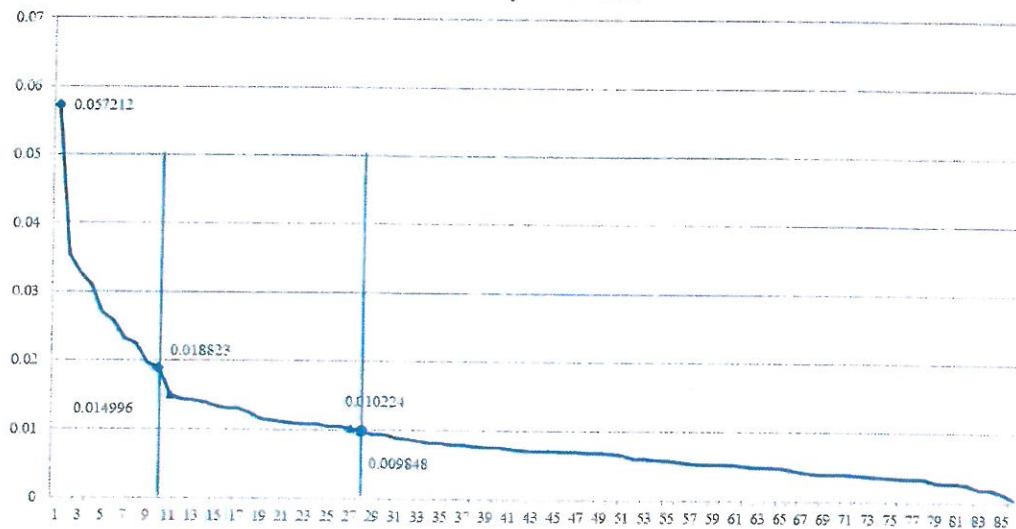
1. The ratio of an industry's expenditure on electricity to the industry's total expenditures in Ohio, measured as unit expense for electricity
2. Industry's total expenditure on electricity (electricity generation and transmission industry), measured in dollars

The indicator unit expenses for electricity reflect the share of electricity cost in \$1 of output of IMPLAN industry *Electric Power Generation, Transmission, and Distribution* (industry code 31). Ohio's manufacturing industries (at the 4-digit NAICS classification) were ranked separately by each indicator: unit expense for electricity (Table 1) and industry's total expenditure for electricity (Table 2).

- ✓ Per each \$1 of expenses, the Alumina and Aluminum Production and Processing industry spends 5.7cents on electric power generation, transmission, and distribution (Table 1)
- ✓ The same industry spent \$144 million in 2009 buying their supply of electricity from Ohio (Table 2)

Using the “natural break” method,¹¹ Ohio's manufacturing industries were classified into three groups of electricity users: high, moderate, and low electricity-intensive industries (Figures 1 and 2). Our definition of High and Moderate Electricity-Intensive industries is consistent with the Energy-Intensive and Non-Energy-Intensive Manufacturing groups defined for Industrial Demand Module of the National Energy Modeling System¹² (see Appendix Table 1).

Figure 1. Illustration of Break-Point Method Based on Ratio of Expenses for Electricity in \$1 of Total Expenditures



¹¹ The “natural break” method is based on identifying the significant change of a ranked dependent variable between two observation points. The significant variation in a dependent variable points to the change of a phenomenon, which this variable illustrates.

¹² Office of Energy Analysis, U.S. Energy Information Administration, 2011.

Table 1. Electricity-Intensive Manufacturing Industries by Unit Expenditures for Electricity

	NAICS	Industry Name	Electricity Expenditures Per \$1 of Industry Expenses
High Electricity- Intensive Manufacturing	3313	Alumina and Aluminum Production and Processing	0.05721
	3221	Pulp, Paper, and Paperboard Mills	0.03534
	3274	Lime and Gypsum Product Manufacturing	0.03280
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	0.03091
	3251	Basic Chemical Manufacturing	0.02702
	3272	Glass and Glass Product Manufacturing	0.02577
	3315	Foundries	0.02311
	3279	Other Nonmetallic Mineral Product Manufacturing	0.02240
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	0.01975
	3271	Clay Product and Refractory Manufacturing	0.01882
Moderate electricity- intensive Manufacturing	3211	Sawmills and Wood Preservation	0.01500
	3117	Seafood Product Preparation and Packaging	0.01432
	3328	Coating, Engraving, Heat Treating, and Allied Activities	0.01429
	3112	Grain and Oilseed Milling	0.01395
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments	0.01343
	3131	Fiber, Yarn, and Thread Mills	0.01309
	3273	Cement and Concrete Product Manufacturing	0.01307
	3132	Fabric Mills	0.01245
	3212	Veneer, Plywood, and Engineered Wood Product Manufacturing	0.01156
	3312	Steel Product Manufacturing from Purchased Steel	0.01132
	3115	Dairy Product Manufacturing	0.01111
	3113	Sugar and Confectionery Product Manufacturing	0.01094
	3114	Fruit and Vegetable Preserving and Specialty Food Manufacturing	0.01086
	3321	Forging and Stamping	0.01082
	3262	Rubber Product Manufacturing	0.01052
	3359	Other Electrical Equipment and Component Manufacturing	0.01047
	3314	Nonferrous Metal (except Aluminum) Production and Processing	0.01022

High Electricity-Intensive Manufacturing Industries

Table 1 includes industries with relatively high unit expenditures on electric power generation, transmission, and distribution. Ranked by this indicator, all manufacturing industries were divided into three groups: High Electricity-Intensive Manufacturing, Moderate Electricity-Intensive Manufacturing, and Low Electricity-Intensive Manufacturing. The High Electricity-Intensive Manufacturing group includes ten manufacturing industries that annually spend 2% or more of their total expenditures on electricity. The *Alumina and Aluminum Production and Processing* Industry (NAICS 3313) alone spends 5.7% of all expenditures on electricity. This is

almost twice the next High Electricity-Intensive Manufacturing Industry, *Pulp, Paper, and Paperboard Mills* (NAICS 3221), which spends 3.5% of all expenses annually on electricity. The top ten electricity-intensive manufacturing industries include three groups of industries: metal-product manufacturing, chemical manufacturing, and paper-producing industries. Two out of three groups historically have had a large presence in Ohio.

Moderate Electricity-Intensive Manufacturing Industries

The 17 industries that belong to the Moderate Electricity-Intensive Manufacturing group spend at least 1% of their total expenditures for electricity. *Sawmills and Wood Preservation* (NAICS 3211) and *Seafood Product Preparation and Packing* (NAICS 3117), the two top industries in this group, are not typical for Ohio. The rest of this cohort represents industries related to metal and equipment manufacturing, food manufacturing, resin and rubber industry, and cement and concrete manufacturing. The 17 industries included in the High and Moderate Electricity-Intensive Manufacturing groups are the subject of further investigation.

Figure 2. Illustration of Break-Point Method Based on Indicator of Total Industry Expenses for Electricity

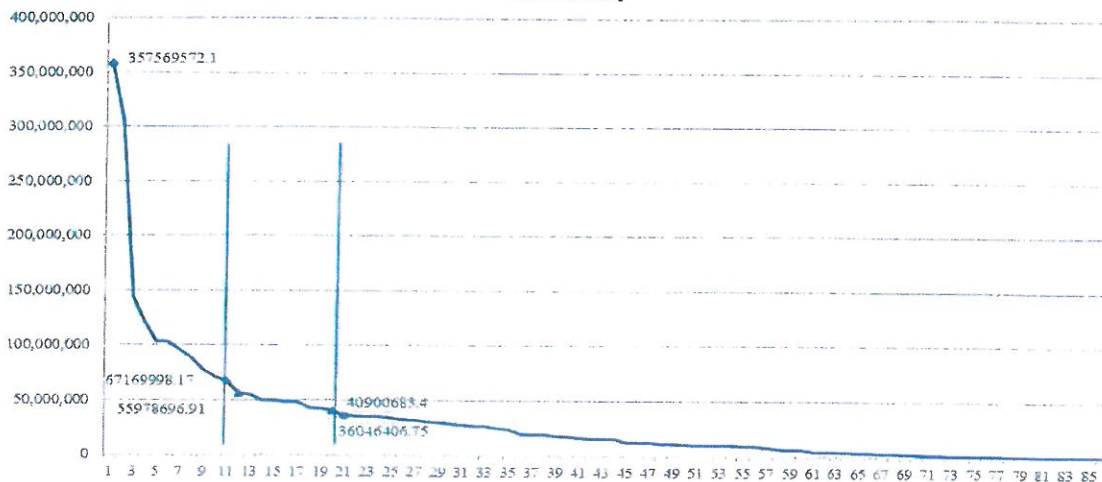


Table 2. Large Consumers of Electricity Identified by Indicator of Total Expenditures for Electricity in Ohio

	NAICS	Industry Name	Total Industry Expenditures for Electricity in OH
High Electricity-Consuming Manufacturing	3251	Basic Chemical Manufacturing	\$357,569,572
	3311	Iron and Steel Mills and Ferroalloy Manufacturing	\$305,430,664
	3313	Alumina and Aluminum Production and Processing	\$144,121,601
	3241	Petroleum and Coal Products Manufacturing	\$120,952,662
	3261	Plastics Product Manufacturing	\$103,429,390
	3363	Motor Vehicle Parts Manufacturing	\$102,961,395
	3221	Pulp, Paper, and Paperboard Mills	\$96,450,783
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments	\$88,811,888
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	\$77,580,568
	3115	Dairy Product Manufacturing	\$71,619,224
Moderate Electricity-Consuming Manufacturing	3315	Foundries	\$67,169,998
	3329	Other Fabricated Metal Product Manufacturing	\$55,978,697
	3114	Fruit and Vegetable Preserving and Specialty Food Manufacturing	\$54,834,373
	3312	Steel Product Manufacturing from Purchased Steel	\$49,857,376
	3222	Converted Paper Product Manufacturing	\$49,737,892
	3272	Glass and Glass Product Manufacturing	\$48,513,642
	3279	Other Nonmetallic Mineral Product Manufacturing	\$48,513,197
	3112	Grain and Oilseed Milling	\$43,094,463
	3314	Nonferrous Metal (except Aluminum) Production and Processing	\$42,555,602
	3361	Motor Vehicle Manufacturing	\$40,900,683

High Electricity-Consuming Manufacturing

Twenty (20) manufacturing industries were identified as the largest consumers of electricity in Ohio. Each of these manufacturing industries spends at least \$40 million per year on electricity supplies. Of those 20 industries, 11 were considered high electricity-consuming manufacturing industries. Each industry in high electricity-consuming manufacturing group spends over \$67 million annually on electricity supplies. This group is led by the industry *Basic Chemical Manufacturing* (NAICS 3251), which spends over \$358 million annually on electricity supplies, followed by *Iron and Steel Mills and Ferroalloy Manufacturing* (NAICS 3311), which spends over \$305 million annually. The other largest consumers of electricity in Ohio belong to industries producing such products as aluminum, petroleum and coal, plastic products, motor vehicle parts, paper, raisin, pesticide and fertilizer, dairy products, and foundries.

Moderate Electricity-Consuming Manufacturing

The Moderate Electricity-Consuming Manufacturing group includes nine industries that spend between \$41 and \$56 million annually on electricity supply. The largest electricity consumer in this group was *Other Fabricated Metal Product Manufacturing* (NAICS 3329), which pays about \$56 million per year for the supply of electricity in Ohio. Other industries in this group include those that manufacture steel products, converted paper products, glass, nonmetallic minerals, motor vehicles, and specialty food. We used both ranked indicators (high unit electricity-intensive and large consumers of electricity) to identify 14 manufacturing industries in Ohio (Table 3).

Table 3. Ohio Manufacturing Industries: Electricity-Intensive and Large Consumers of Electricity

	NAICS	Industry Name
High Electricity-Intensive and Consuming Manufacturing	3313	Alumina and Aluminum Production and Processing
	3221	Pulp, Paper, and Paperboard Mills
	3311	Iron and Steel Mills and Ferroalloy Manufacturing
	3251	Basic Chemical Manufacturing
	3272	Glass and Glass Product Manufacturing
	3315	Foundries
	3279	Other Nonmetallic Mineral Product Manufacturing
	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing
Moderate Electricity-Intensive and Consuming Manufacturing	3112	Grain and Oilseed Milling
	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments
	3312	Steel Product Manufacturing from Purchased Steel
	3115	Dairy Product Manufacturing
	3114	Fruit and Vegetable Preserving and Specialty Food Manufacturing
	3314	Nonferrous Metal (except Aluminum) Production and Processing

Industries that fit both criteria are large, electricity-intensive consumers. This group creates electricity-intensive products and purchases large volumes of electricity due to their industry size in Ohio. Fourteen (14) manufacturing industries are electricity-intensive and large consumers of electricity due to their size in Ohio. These 14 industries include all industries in primary metal manufacturing sector (NAICS 331: NAICS 3311, 3312, 3313, 3314, 3315); three chemical manufacturing industries (NAICS 3251, 3252, 3253); three food manufacturing industries (NAICS 3112, 3114, 3115); and paper, glass, and nonmetallic mineral product manufacturing (NAICS 3221, 3272, 3279).

Table 4. Electricity-Intensive, Non-Manufacturing Industries Identified by Unit Expenses for Electricity

NAICS	Industry Name	Electricity Expenditures Per \$1 of Industry Expenses
721	Accommodation	0.029303
2123	Nonmetallic Mineral Mining and Quarrying	0.028517
1119	Other Crop Farming	0.022541
712	Museums, Historical Sites, and Similar Institutions	0.020142
1112	Vegetable and Melon Farming	0.018514
1113	Fruit and Tree Nut Farming	0.017923
611	Educational Services	0.017522
713	Amusement, Gambling, and Recreation Industries	0.016856
2121	Coal Mining	0.016488
722	Food Services and Drinking Places	0.015693
531	Real Estate	0.015551
493	Warehousing and Storage	0.015231
112	Animal Production	0.013455
623	Nursing and Residential Care Facilities	0.012337
8121	Personal Care Services	0.011442
533	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	0.010497
622	Hospitals	0.010485

To identify electricity-intensive, non-manufacturing industries in Ohio, we applied the same two criteria used for manufacturing industries: unit expenses for electricity and total industry expenditures for electricity. Seventeen (17) 4-digit NAICS non-manufacturing industries and broader industrial sectors spent at least one cent per each dollar of expenses on electricity supply (1% of their total annual expenditures in Ohio). The largest sectors and industries include farming, accommodations, and industries that utilize large commercial buildings, such as museums, universities, hospitals, and warehouses. To identify the large consumers of electricity among non-manufacturing industries, the total expenditures on the electricity indicator was applied to three groups of industries classified by the level of NAICS: 2-digit sectors, 3-digit sectors, and 4-digit non-manufacturing industries (Table 5).¹³

¹³ IMPLAN's industry classification corresponds to a combination of 2-, 3-, and 4-digit NAICS industry classifications for non-manufacturing industries.

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