



ENERGY INNOVATION BUSINESS COUNCIL
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ECONOMIC IMPACT OF RESIDENTIAL/COMMERCIAL ENERGY EFFICIENT PRODUCTS IN MICHIGAN





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EXECUTIVE SUMMARY

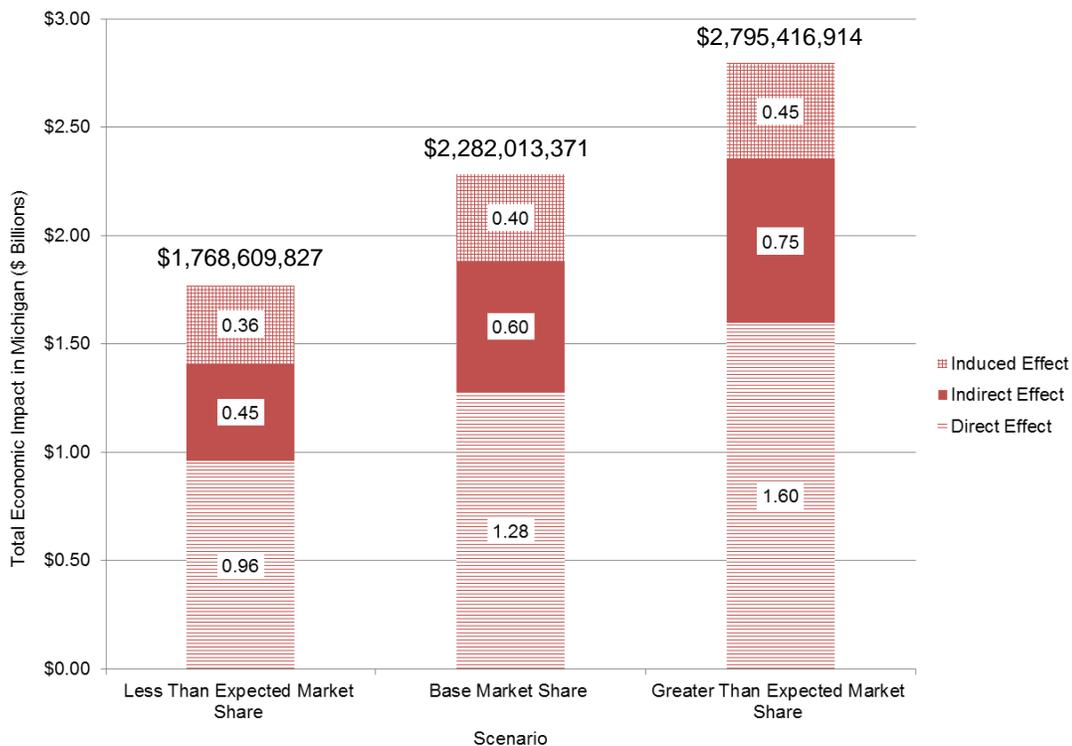
Demand for residential and commercial structure energy efficiency is expected to grow. Reduction of energy costs for homeowners and business owners, public pressure to reduce adverse environmental impacts of unnecessary energy consumption, and federal and state incentives for energy efficient retrofits are all factors that will continue to elevate demand for energy efficient products across the country.

This study, *Economic Impact of Residential/Commercial Energy Efficient Products in Michigan*, begins to quantify the economic impact of energy efficient product manufacturing activity within the State of Michigan.

The study of residential and commercial energy efficient products in Michigan includes a select set of product categories such as building envelope; equipment; heating, ventilation and air conditioning (HVAC); and advanced lighting. This subset of products was selected based on the level of current activity in Michigan and preliminary thoughts on their future importance and significance. This analysis focuses only on the manufacture of the identified products, not on ancillary impacts like social and environmental externalities.

Input-output analysis was utilized to estimate the economic impact of the in-scope activities. This is a demand-driven assessment. Shifts in demand and estimates of supply for each product are used to calculate direct, indirect, and induced economic impacts including total economic output, jobs supported, and tax revenues.

Figure 1. Total Average Annual Output by Scenario



Demand in the United States for the selected products is expected to grow by 2015, and Michigan manufacturers will help meet that demand yielding economic impact for the state. The base market share analysis indicates that the selected activities as a whole could potentially have an annual average impact of \$2,282,013,371 on Michigan, including 9,221 jobs supported and \$71,329,360 in local and state tax revenues.¹

Additional market share scenarios show variation in potential impact from energy efficient product manufacturing on Michigan. The *greater than expected* scenario shows a 25 percent increase in market share over the base case scenario by Michigan firms, resulting in \$2,795,416,914 in total output and 10,263 jobs supported. A *less than expected* scenario, demonstrating the effects of a 25 percent decrease in market share from the base case would produce \$1,768,609,827 in total output and support 8,178 jobs.

Economic impact differs by product for many reasons. Mature industries with well-established local supply chains and significant activity levels within the state have a greater economic impact than less-established manufacturers. Industries with lower projected demand and evolving supply chains have less of an overall impact on Michigan's economy.

State-level programs to encourage investment in this sector, re-trained manufacturing workers, and renovated manufacturing facilities have supported entry into these markets by new firms or existing firms seeking to diversify their products. Today, Michigan has a strong base of manufacturing firms, many of which are significant contributors to state, national, and energy efficiency markets, all of which have a positive impact on Michigan.

There are several approaches Michigan may take to build on its current strengths and encourage the growth of energy efficient product manufacturing within its borders. Mild interventions such as education campaigns promoting energy efficiency and energy efficiency manufacturing may support continued interest in this sector. Enhancing the conversation to focus on economic impacts, not just environmental impacts, may codify support for energy efficiency from a diverse range of stakeholders. More direct interventions such as incentive programs for new entrants, re-tooled incumbents, or local supply chain sourcing could help bolster Michigan's participation in energy efficiency manufacturing. Very direct interventions such as the ongoing Energy Optimization Program may stimulate manufacturers to increase production of products to meet new market demands. Recognizing the current national-level debate over the efficacy of government investment in emerging markets, these approaches and potential strategies should be considered in the context of likely return on investment for the state.

Demand for energy efficiency products is expected to grow, in part due to the volatility with incumbent energy markets and continued focus on environmental sustainability. This appears promising; however, changes in demand for energy efficiency devices will drive economic activity and resulting economic impact. If market demand for these products fails to meet expectations or if firms are unwilling or unable to produce the desired products, then the described impacts may not occur. If Michigan's manufacturers are willing and able to meet market demand, the impact described in this report can occur. This study can be used to inform to policy debates and discussions, but it does not advocate for or against any particular policy, strategy, or investment. These results are intended to add depth to the ongoing conversation by highlighting the magnitude of economic impacts of these manufacturing activities.

¹ Tax revenues use IMPAN data and may not reflect changes in state-level tax policy since the 2010 data set was created.

INTRODUCTION

Demand for residential and commercial structure energy efficiency is expected to grow. Reduction of energy costs for homeowners and business owners, public pressure to reduce adverse environmental impacts of unnecessary energy consumption, and federal and state incentives for energy efficient retrofits are all factors that will continue to elevate demand for energy efficient products across the country.

This growing trend in efficiency is summarized by the United States Department of Energy:

“Today’s building industry appears to be entering another era of change, with a view toward minimizing a different kind of footprint: the energy, carbon, and environmental footprint of commercial and residential buildings. Once again, change is being driven by a need to optimize and conserve resources — this time, clean air, water, and energy as well as land. And, once again, transformative technologies may hold the key to meeting the challenges.”²

For the scope of this study, *Economic Impact of Residential/Commercial Energy Efficient Products in Michigan*, energy efficiency is defined as products which “[minimize the] energy, carbon, and environmental footprint of commercial and residential buildings.”³ As a political talking point, energy efficiency or “green” technology has been used by both conservatives and liberals in the context of environmental impact. **To think of energy efficiency as only an environmental benefit minimizes the economic opportunity from manufacturing the products which enable that benefit.**

The intent of this study is to begin to quantify the economic impact of the manufacture of these products by Michigan firms in response to United States demand. There are many firms large and small within the state participating in the energy efficient product supply chain. Upstream and downstream activities of these firms in the creation of these in-scope products produces direct, indirect, and induced economic impact across the state in the form of total output, jobs supported, and tax revenues.

This study can be used to inform policy debates and discussions, but it does not advocate for or against any particular policy, strategy, or investment. These results are intended to add depth to the ongoing conversation by highlighting the magnitude of economic impacts of manufacturing activities that could occur within Michigan if in-state firms are able to supply products to meet expected market demand.

This study of residential and commercial energy efficient products includes those products within the building envelope; equipment; heating, ventilation and air conditioning (HVAC); and advanced lighting sectors that are regularly installed to make more efficient use of energy or to reduce energy consumption and costs. This subset of products was selected based on the level of current activity in Michigan and preliminary thoughts on their future importance and significance.

² Department of Energy (2008)

³ Department of Energy (2008)

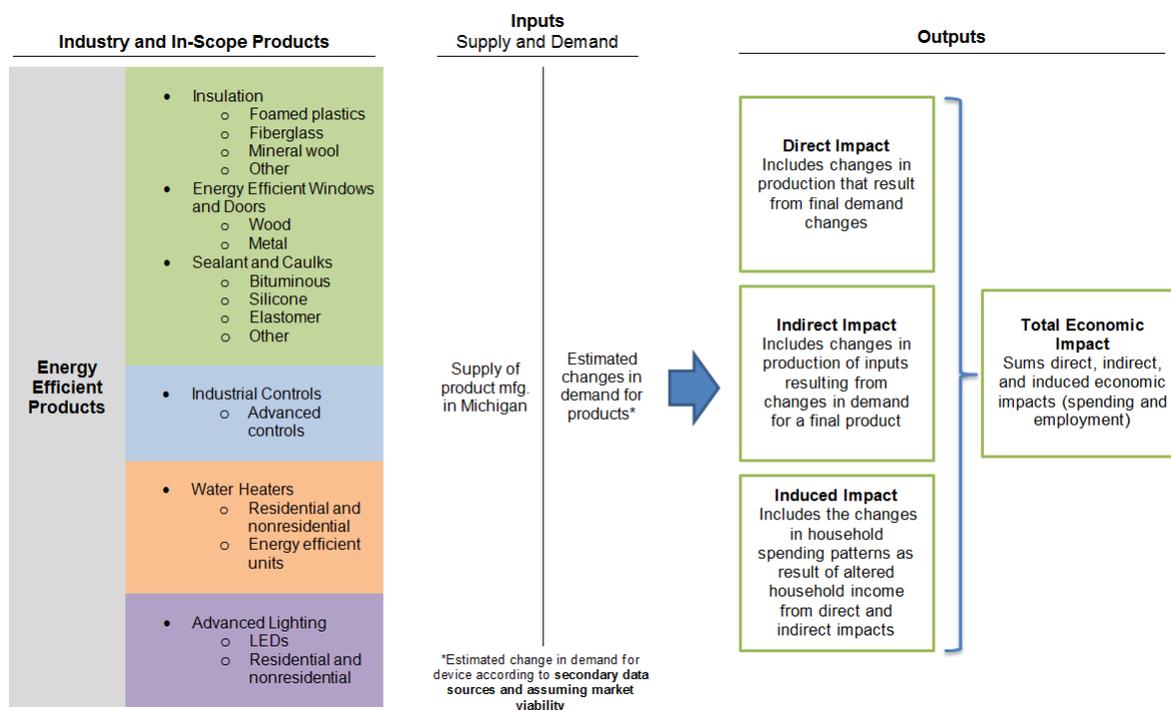
The sample of manufactured products within the scope of this study represent a fraction of all energy efficient products that could be manufactured within Michigan now and in the future and only a portion of the overall device life cycle: the manufacturing process. This does not quantify impact directly from pre-manufacturing activities such as research and development nor post-manufacturing activities such as transportation and on-site assembly. This does not attempt to quantify ancillary economic benefits to energy efficient product manufacturing such as social and environmental externalities.

Impact is estimated using input-output economic impact analysis (including estimates of supply product costs as well as forecasted national demand for, and Michigan’s participation in, the creation of in-scope energy efficient products.) IMPLAN, a software and data package that enables the development of input-output models for a particular geography, is used to quantify direct, indirect, and induced economic effects.

Forecasted demand figures were provided by numerous market research firms.⁴ Michigan market share ratios were established through primary and secondary market research sources.⁵ The study relies heavily on secondary data sources.

Direct, indirect, and induced economic impacts resulting from a shift in spending within the energy efficient products sectors of this study are combined to estimate total economic impact. These shifts in spending are estimates based on secondary research and assumptions of market viability.

Figure 2. Input-Output Economic Impact Model Overview



⁴ The Freedonia Group, Inc. and Air-conditioning, Heating, and Refrigeration Institute,

⁵ AnythingResearch; C.Barnes & Co.; Gotaas, Mary; Navigant; Environmental Protection Agency; Department of Energy; and The Freedonia Group, Inc.

RESIDENTIAL & COMMERCIAL PRODUCTS IN MICHIGAN

Michigan's economy has long-been defined by its strong manufacturing sector. A decade ago, this sector employed more than 800,000 throughout Michigan and comprised over 5 percent of United States manufacturing Gross Domestic Product (GDP). Challenging economic circumstances negatively impacted Michigan manufacturers, reducing manufacturing employment by 42 percent between 2001 and 2010.⁶ New markets for manufacturing, such as energy efficiency, may help revitalize Michigan's manufacturing base.

For the scope of this study, *Economic Impact of Residential/Commercial Energy Efficient Products in Michigan*, energy efficiency is defined as products which improve or reduce the use of energy within commercial and residential buildings. By adding an economic perspective to the ongoing conversation surrounding energy efficiency, this report offers stakeholders an expanded view of the topic.

This study uses input-output analysis to assess the economic impact of energy efficient product manufacturing activities on the Michigan economy. Input-output economic impact modeling calculates the direct, indirect, and induced economic impact on a regional economy based on a shift in economic activity, such as increased production of energy efficient products as a result of a shift in final demand. The model developed for this study calculates impact based on:

- Forecasted changes in demand for each product by 2015
- Estimates of costs for the manufacture of products where necessary
- Estimates of sector-to-sector trade based on IMPLAN software and data

The sections that follow (organized by product category) examine the industry information for each product within the scope of this study. Forecasts of demand for each product to be manufactured by firms in Michigan and state market share numbers by 2015 are used in the model. This information is integral to the development of the input-output economic impact model and analysis of direct, indirect, and induced impacts.

This is a sample of the existing manufacturing activity in Michigan. These product categories were chosen because of their current and potential future impact on the state. Specific products were selected to represent each product category to enable a manageable sampling of the industry.

This study only considers the manufacturing activities associated with these products. This does not include other phases of the product life cycle such as research and development or transportation and assembly.

⁶ Bureau of Labor Statistics (2011)

Building Envelope

Space heating and cooling within residential homes encompasses 42 percent of total energy use. Within nonresidential buildings, this is closer to 30 percent of total energy use.⁷ Focused effort on insulating and sealing buildings allows decreased seepage of heat or cool air from inside to outside. Decreased outflow in turn reduces energy needs for residential and nonresidential buildings.

The Building Envelope of a structure encompasses many products. To narrow the scope of this sector, the study focuses on the product categories of insulation, windows, doors, sealants, and adhesives.

If market demand and price for these products meet forecasted expectations, and if Michigan firms are willing and able to produce the selected products, this study indicates the Building Envelope product category could yield an average annual total economic output of \$1,790,097,816. As a result of these activities, 7,028 jobs may be supported annually and \$54,153,565 of local and state tax revenue may be realized.

Building Insulation

This section of the report covers the manufacturing of insulation for use in new building construction or retrofit. There are many types of insulation available, including cellulose, foam, polyurethane, polystyrene and common fiberglass blankets.

Insulation is not just used to keep out cold but is also used to keep heat in. Residential and nonresidential building, industrial process, piping, and other applications all use insulation for specific purposes.

Included in this report are polystyrene based, foam plastics, fiberglass, and mineral wool insulation manufactured within Michigan.

Table 1. Insulation Industry Information

Code Description	NAICS	MI Employment* ⁸	Firms in MI* ⁹
Thermal insulation, polystyrene, manufacturing	326140	2,410	26
Insulation and cushioning, foam plastics, manufacturing	326150	1,619	45
Mineral wool and fiberglass, manufacturing	327993	462	11

* Employment and firm count are based on NAICS code. NAICS may include other industries and products outside the scope of this study.

Manufacturers in Michigan include the Dow Chemical Company in Midland and Nu-Wool in Jenison. These manufacturers are only a sample of the firms operating within the NAICS code of insulation manufacturing.

⁷ Department of Energy (2011)

⁸ Bureau of Labor Statistics (2011)

⁹ Bureau of Labor Statistics (2011)

Windows and Doors

Traditional windows waste about 30 percent of the energy used to heat or cool a building.¹⁰ Energy efficient windows reduce the seepage of energy through a variety of methods, including tinting and inert-gas insulation. Doors are also improving as a technology through insulation improvements.

These products are not usually installed as part of weatherization assistance programs because of their inability to meet the necessary savings-to-investment ratio.¹¹ To account for this requirement, only energy efficient windows and green doors are included in the analysis of the building envelope.

Table 2. Windows and Doors Industry Information

Code Description	NAICS	MI Employment* ¹²	Firms in MI* ¹³
Wood window and door manufacturing	321911	471	30
Metal window and door manufacturing	332321	987	36

* Employment and firm count are based on NAICS code. NAICS may include other industries and products outside the scope of this study.

Manufacturers in Michigan include Pleotint, LLC in West Olive, Oxbow Window and Millwork Co. in Highland, and Total Door in Waterford. These manufacturers are only a sample of the firms operating within the NAICS code of window and door manufacturing.

Sealants and Adhesives

Sealants and adhesives as a product category are used in conjunction with insulation, doors, windows, and other building materials. These products provide increased air-sealing measures to eliminate cold air from entering heated spaces and warm air from entering cool spaces.

Table 3. Sealants and Adhesives Industry Information

Code Description	NAICS	MI Employment* ¹⁴	Firms in MI* ¹⁵
Construction Adhesives, manufacturing	325520	475	23
Plastic materials and resin manufacturing	325211	6,161	62

* Employment and firm count are based on NAICS code. NAICS may include other industries and products outside the scope of this study.

Manufacturers in Michigan include The Dow Chemical in Midland, MI, Wacker Chemical Corp. in Adrian, MI, ADCO Global in Michigan Center, MI, and Ecosynthetix in Lansing, MI. These manufacturers are only a sample of the firms operating within the NAICS code.

¹⁰ Risser, Roland (2011)

¹¹ Tuck and Nelson (2010)

¹² Bureau of Labor Statistics (2011)

¹³ Bureau of Labor Statistics (2011)

¹⁴ Bureau of Labor Statistics (2011)

¹⁵ Bureau of Labor Statistics (2011)

Equipment

Within residential and nonresidential facilities, electronics, refrigeration, and computers make up over 13 percent of energy use.¹⁶ Nonresidential equipment use can include production machinery, information technology, and a variety of motors, to name a few. A majority of residential facility equipment use, not including HVAC, are refrigerators and other large appliances. This study focuses on industrial controls.

If market demand and price for this product meet forecasted expectations, and if Michigan firms are willing and able to produce the selected products, this study indicates the Equipment product category could yield an average annual total economic output of \$133,796,720. As a result of these activities, 614 jobs may be supported annually and \$4,620,809 of local and state tax revenue may be realized.

Industrial Controls

Controls are a complex set of relays used to switch the flow of electricity on or off. This category is normally defined as controls for motors and systems. Included products within the industrial controls market are motor starters, contractors, control centers, and programmable logic controllers (PLCs). This market includes conventional controls and advanced controls. Conventional controls encompass general-purpose and special-purpose applications.

Advanced controls is the largest demand segment by revenue within the market.¹⁷ These controls use sophisticated information gathering sensors and arrays to process in-time information to manage large-scale systems in which hundreds of variables and factors are simultaneously and continuously controlled.¹⁸ In comparison to the conventional controls, advanced units are capable of storing instructions for complete processes rather than a specific task.

This study will focus on advanced industrial controls. This segment of controls offers the greatest opportunity for energy savings within the industry over conventional control types.

Table 4. Industrial Controls Industry Information

Code Description	NAICS	MI Employment* ¹⁹	Firms in MI* ²⁰
Relay and industrial control manufacturing	335314	856	51

* Employment and firm count are based on NAICS code. NAICS may include other industries and products outside the scope of this study.

Manufacturers in Michigan include Clarkson Control Products in Clarkson, Controls Crew, Inc. in Hazel Park, and Commerce Controls Inc. in Novi. These manufacturers are only a sample of the firms operating within the NAICS code of industrial controls.

¹⁶ Department of Energy (2011)

¹⁷ The Freedonia Group, Inc. (2011)

¹⁸ The Freedonia Group, Inc. (2011)

¹⁹ Bureau of Labor Statistics (2011)

²⁰ Bureau of Labor Statistics (2011)

Heating, Ventilation, and Air-conditioning

Space heating, cooling, and water heating make up 43 percent of energy use in all United States building use.²¹ There is minimal manufacturing activity in the heating, ventilation, and air-conditioning market within Michigan. This section of the report specifically focuses on water heater manufacturing, which is occurring within the state.

If market demand and price for this product meet forecasted expectations, and if Michigan firms are willing and able to produce the selected product, this study indicates the Heating, Ventilation, and Air-conditioning product category could yield an average annual total economic output of \$148,253,218. As a result of these activities, 553 jobs may be supported annually and \$4,558,277 of local and state tax revenue may be realized.

Water Heaters

Water heating accounts for approximately 13 percent of a home's and 4.3 percent of a nonresidential facility's energy use.²² Investing in energy efficient water heaters enables a reduction in base load electricity and gas use for the 8 to 20 year expected lifetime of the product.

Included in this category are water heaters manufactured for residential and nonresidential applications which use either gas or electricity. A variety of water heating appliances exist in the market including storage, tankless, heat pump, and solar. Demand for the approximately 8.5 million water heaters sold in the United States is driven by three factors: lifecycle replacement, new construction, and emergency replacement. This report focuses on high efficiency storage tank water heaters (gas or electric) serving residential homes or nonresidential needs. Solar and heat pump technologies were not considered as part of this because their current market share is only 2.4 percent of the total national market. These technologies are expected to grow and should be evaluated in the future.²³

Table 5. Water Heater Industry Information

Code Description	NAICS	MI Employment* ²⁴	Firms in MI* ²⁵
Water heaters, commercial-type, manufacturing	333319	11,110	60
Water heaters, household-type, manufacturing	335228	Not Provided [†]	3

* Employment and firm count are based on NAICS code. NAICS may include other industries and products outside the scope of this study. [†] Bureau of Labor Statistics does not provide employment numbers for industries under a specified firm number threshold to allow for company anonymity.

Several firms within Michigan produce residential and nonresidential water heaters. Notable among these manufacturers is Bradford White in Middleville, a firm which represents 13 percent of industry market share.²⁶ This is only a sample of firms within the NAICS code.

²¹ Department of Energy (2011)

²² Department of Energy (2011)

²³ Department of Energy (2011)

²⁴ Bureau of Labor Statistics (2011)

²⁵ Bureau of Labor Statistics (2011)

²⁶ Department of Energy (2010)

Advanced Lighting

Incandescent light bulbs are being phased out of residential and nonresidential use. Incremental change will begin with the 100-watt incandescent bulb, then in 2013 the 75-watt bulb, and the 40-watt bulb in 2014.²⁷ This leaves an opening in the market for new entrants. Lighting is a significant opportunity for efficiency. This area accounts for 10 percent of residential energy use and 17 percent of commercial building energy use.²⁸ Innovations are occurring in halogens, compact florescent lamps (CFLs), and solid-state lighting (SSL), which includes light emitting diodes (LEDs).

If market demand and price for this product meet forecasted expectations, and if Michigan firms are willing and able to produce the selected products, this study indicates the Advanced Lighting product category could yield an average annual total economic output of \$209,865,616. As a result of these activities, 1,026 jobs may be supported annually and \$7,996,709 of local and state tax revenue may be realized.

Lighting Fixture Light Emitting Diodes (LED) Manufacturing

Light fixture manufacturing includes products for residential and nonresidential use. These fixtures use the CFL, LED, halogen, and induction lighting technology for use in ballparks, on street corners, and in factories. The reduced heat and utilization of nonhazardous materials makes these products easier to handle and simpler to dispose of once it has reached the end of its useful life.

LEDs are a growing segment within advanced lighting. As a solid-state lighting source, an LED can have life expectancy of over 100,000 hours – more than 11 years, according to industry experts.²⁹ This study incorporates light fixture manufacturing for residential and nonresidential use and the manufacturing of LEDs within the State of Michigan.

Table 6. Advanced Lighting Industry Information

Code Description	NAICS	MI Employment* ³⁰	Firms in MI* ³¹
Residential electric light fixture manufacturing	335121	51	7
Nonresidential electric light fixture manufacturing	335122	328	14
LED (light emitting diode) manufacturing	334413	1,160	23

* Employment and firm count are based on NAICS code. NAICS may include other industries and products outside the scope of this study.

Manufacturers in Michigan include Best Lights in Troy, Flash Bridge Company, Inc. in Holland, Full Spectrum Solutions in Jackson, LED Optical Solutions, LLC in Washington, Lumerica in Madison Heights, and Relume Technologies of Oxford. These manufacturers are only a sample of the firms operating within the NAICS code.

²⁷ Koch, Wendy (2011)

²⁸ Department of Energy (2011)

²⁹ Koch, Wendy (2011)

³⁰ Bureau of Labor Statistics (2011)

³¹ Bureau of Labor Statistics (2011)

ESTIMATING ECONOMIC IMPACT

Overview of Model

The economic impact of manufacturing activities within Michigan's energy efficient product sector was estimated using IMPLAN to quantify direct, indirect, and induced economic effects.

IMPLAN is a software and data package that enables development of input-output economic impact models for a particular geography or study area. Michigan state-level data for the year 2010 (the most recent data available) was used to build the model for this study. The models that are developed in IMPLAN quantify the direct, indirect, and induced economic impacts based on spending changes in a defined industry.

Direct economic impact includes changes in production that result from final demand changes. In this case, direct impact may include but is not limited to increases in firm spending that result from additional purchases of components for the various in-scope energy efficient products.

Indirect economic impact includes changes in production of inputs resulting from changes in demand for a final product. In this case, indirect impact may include but is not limited to new purchases of raw metals and plastics by firms producing in-demand energy efficient products

Induced economic impact includes the changes in household spending patterns as a result of altered household income from direct and indirect impacts. In this case, induced impact may include but is not limited to increased spending by individuals employed by component or end product manufacturers within the scope of this study.

Total economic impact is the sum of direct, indirect, and induced economic impacts for the energy efficient product manufacturing activities included in the scope of this study.

In order to account for various contingencies such as variability in forecasted demand estimates and participation by Michigan manufacturers, several input-output scenarios were developed. These scenarios provide Base Market Share, Greater than Expected Market Share, and Less than Expected Market Share estimates.

Base Market Share scenario was developed through research estimates for average forecasted demand and future output within the energy efficient products sector. This model assumes forecasted demand for in-scope products will be met, in part, by Michigan manufacturers. The estimated average forecasted demand in the base market share scenario represents a case in which Michigan's manufacturers capture a specific set of the U.S. market share. This is an averaged market share over the span of 2012 to 2015, considered the scope of this report.

Greater than Expected Market Share scenario is derived from the base case. The greater than expected market share increases Michigan's market share of forecasted estimates by 25 percent of original market share, which varies by product. Greater than

expected market share could occur if the state's manufacturers captures a greater percentage of the United States market.

Lower than Expected Market Share scenario is derived from the base case. The lower than expected market share decreases Michigan's market share of forecasted estimates by 25 percent of original market share, which varies by product. Less than expected market share could occur if the state's manufacturers captures a lower percentage of the United States and market.

Results

Forecasted estimates were analyzed by the IMPLAN model for their direct, indirect and induced impacts. Results were computed for the three demand scenarios on projected jobs supported, labor income, value added, and total output.

Employment (Jobs Supported) is the total number of jobs supported by the estimated demand.

Labor Income is the sum total of all forms of employment income, including employee compensation (wages and benefits) and proprietor income.³²

Value Added is the difference between the total output and the costs of intermediate inputs, goods, services or purchases imported from outside of the region of study.³³

Output represents the value of industry production. In IMPLAN, these are annual production estimates for the year of the data set and are in producer prices. For manufacturers, this is sales plus/minus change in inventory.³⁴

Tax Impact is the tax revenue generated from the estimated impact. State, local and federal tax is calculated and reported. Contributions are segmented into the following categories: employee, proprietor, business, household, and corporations. Tax revenues use IMPAN data and may not reflect changes in state-level tax policy since the 2010 data set was created.

Scenario summaries found on the following pages show the potential impact energy efficient product manufacturing has on the Michigan economy. This analysis indicates that the selected manufacturing activities as a whole could potentially have an impact of \$2,282,013,371 on Michigan, including 9,221 jobs supported and \$71,329,360 in local and state tax revenue.

Economic impact varies by product category and device for a variety of reasons. Mature industries with well-established local supply chains are shown to have a greater economic impact on Michigan. Less-established industries with lower demand and evolving supply chains have less impact. These numbers may vary, and additional scenarios are examined throughout this study. The following tables provide additional detail on scenarios and impact estimates.

³² MIG Inc. (2011)

³³ MIG Inc. (2011)

³⁴ MIG Inc. (2011)

The summary of impacts for the base market share scenario shows a total output of \$2,282,013,371 and 9,221 jobs supported. See Table 7 for additional base market share impacts.

Table 7. Summary of Base Case Market Share Scenario Impacts

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	3,183	\$236,455,167	\$381,909,087	\$1,276,960,631
Indirect Effect	2,752	\$178,785,930	\$301,710,650	\$603,191,855
Induced Effect	3,286	\$132,634,124	\$242,219,352	\$401,860,885
Total Effect	9,221	\$547,875,222	\$925,839,089	\$2,282,013,371

State and local tax revenue based on the base market share scenario totals \$71,329,360. Tax revenue is calculated based on employee labor income, proprietor income, indirect business tax, as well as household and corporate tax collected. These figures do not take into account any tax incentives currently available to the energy efficient product manufacturing industry. Table 8 lists the state and local tax and federal tax by the specific contributors.

Table 8. Summary of Base Case Market Share Tax Impacts

Impact Type	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Total Federal Tax	\$62,467,524	\$2,534,683	\$9,644,847	\$27,491,315	\$12,715,912
Total State and Local Tax	\$1,237,484	--	\$53,418,448	\$7,638,412	\$9,035,201

Table 9 describes the greater than expected market share scenario. This model increases Michigan market share by 25 percent over the base scenario. Greater than expected market share has an increased impact on the state. For total output and jobs supported, this scenario increases impact to \$2,795,416,914 and 10,263 respectively.

Table 9. Summary of Greater Than Market Share Scenario Impacts

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	3,183	\$236,455,167	\$381,909,087	\$1,596,200,788
Indirect Effect	3,440	\$223,482,413	\$377,138,312	\$753,989,819
Induced Effect	3,641	\$146,946,582	\$268,362,799	\$445,226,307
Total Effect	10,263	\$606,884,162	\$1,027,410,198	\$2,795,416,914

Greater than expected market share will result in state and local tax revenue of \$80,341,410. Federal tax and state and local tax impacts are given in greater detail in Table 10.

Table 10. Summary of Greater Than Expected Market Share Tax Impacts

Impact Type	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Total Federal Tax	\$68,884,514	\$2,943,002	\$10,922,744	\$30,462,777	\$14,097,158
Total State and Local Tax	\$1,364,604	--	\$60,496,144	\$8,464,027	\$10,016,635

The less than expected market share scenario has a reduced effect on the Michigan economy. This scenario is a 25 percent decrease from the initial base case market share. Total output is calculated at \$1,768,609,827. Employment supported is 8,178. Less than expected market share scenario results are detailed in Table 11.

Table 11. Summary of Less Than Expected Market Share Scenario Impacts

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	3,183	\$236,455,167	\$381,909,087	\$957,720,473
Indirect Effect	2,064	\$134,089,448	\$226,282,987	\$452,393,891
Induced Effect	2,931	\$118,321,666	\$216,075,905	\$358,495,462
Total Effect	8,178	\$488,866,281	\$824,267,980	\$1,768,609,827

Total state and local tax revenue for the less than expected market share scenario is \$62,317,308. Table 12 shows results for the less than expected market share. These are lower tax impacts than the base scenario because of the decreases market share ratio.

Table 12. Summary of Less Than Expected Market Share Tax Impacts

Impact Type	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Total Federal Tax	\$56,050,151	\$2,126,346	\$8,366,901	\$24,519,678	\$11,334,606
Total State and Local Tax	\$1,110,355	--	\$46,340,481	\$6,812,748	\$8,053,724

Figure 3 plots the total yearly output for the three market share scenarios. The less than expected market share scenario declines sharply in total output in comparison to the base case.

Figure 3. Total Average Annual Output by Scenario

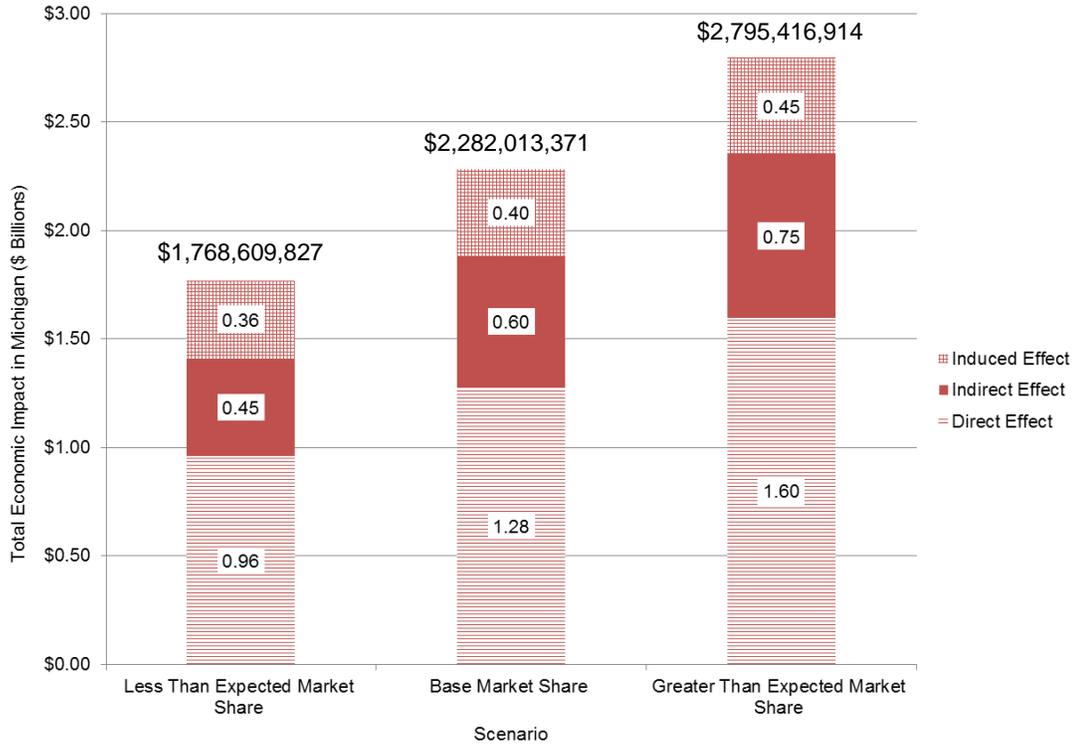


Table 13 shows the summary of impacts associated with the base market share scenario by product. As this data indicates, the total output by product varies.

Table 13. Summary of Base Case Market Share Impacts by Product

Product	Impact Type	Employment	Labor Income	Total Value Added	Output
Insulation	Direct Effect	889	\$55,689,166	\$121,029,723	\$304,496,079
	Indirect Effect	538	\$32,352,557	\$55,682,651	\$123,613,611
	Induced Effect	697	\$28,121,212	\$51,355,478	\$85,202,910
	Total Effect	2,124	\$116,162,936	\$228,067,852	\$513,312,600
Windows and Doors	Direct Effect	459	\$25,720,705	\$36,734,597	\$95,357,082
	Indirect Effect	225	\$12,781,521	\$21,445,705	\$42,011,218
	Induced Effect	305	\$12,304,712	\$22,472,182	\$37,281,538
	Total Effect	989	\$50,806,938	\$80,652,484	\$174,649,838
Sealants and Adhesives	Direct Effect	1,075	\$98,285,419	\$119,892,553	\$602,655,900
	Indirect Effect	1,339	\$91,150,507	\$155,540,460	\$316,025,673
	Induced Effect	1,500	\$60,548,573	\$110,581,529	\$183,453,806
	Total Effect	3,915	\$249,984,499	\$386,014,542	\$1,102,135,379
Industrial Controls	Direct Effect	239	\$20,623,052	\$31,956,178	\$79,255,646
	Indirect Effect	137	\$9,429,367	\$15,287,451	\$25,530,037
	Induced Effect	237	\$9,575,285	\$17,482,769	\$29,011,037
	Total Effect	614	\$39,627,703	\$64,726,398	\$133,796,720
Water Heaters	Direct Effect	180	\$15,388,946	\$35,383,263	\$88,411,128
	Indirect Effect	167	\$10,640,335	\$17,847,272	\$34,687,938
	Induced Effect	206	\$8,302,222	\$15,159,793	\$25,154,152
	Total Effect	553	\$34,331,503	\$68,390,327	\$148,253,218
Advanced Lighting	Direct Effect	340	\$20,747,879	\$36,912,773	\$106,784,796
	Indirect Effect	345	\$22,431,643	\$35,907,111	\$61,323,379
	Induced Effect	341	\$13,782,120	\$25,167,600	\$41,757,441
	Total Effect	1,026	\$56,961,642	\$97,987,484	\$209,865,616
Total Energy Efficiency Manufacturing	Direct Effect	3,183	\$236,455,167	\$381,909,087	\$1,276,960,631
	Indirect Effect	2,752	\$178,785,930	\$301,710,650	\$603,191,855
	Induced Effect	3,286	\$132,634,124	\$242,219,352	\$401,860,885
	Total Effect	9,221	\$547,875,222	\$925,839,089	\$2,282,013,371

Product contributions to overall impact of the energy efficiency sector vary. Mature industries with well-established local supply chains and anchor manufacturers, such as sealant and adhesive manufacturing and insulation manufacturing, are shown to have a greater economic impact on Michigan.

The impact derived from sealants and adhesive manufacturing is a significant portion of the total impact Michigan is forecasted to experience given the base case market share. Figure 4 compares the impact of each product.

Figure 4. Total Output for Base Case Market Share Scenario by Product

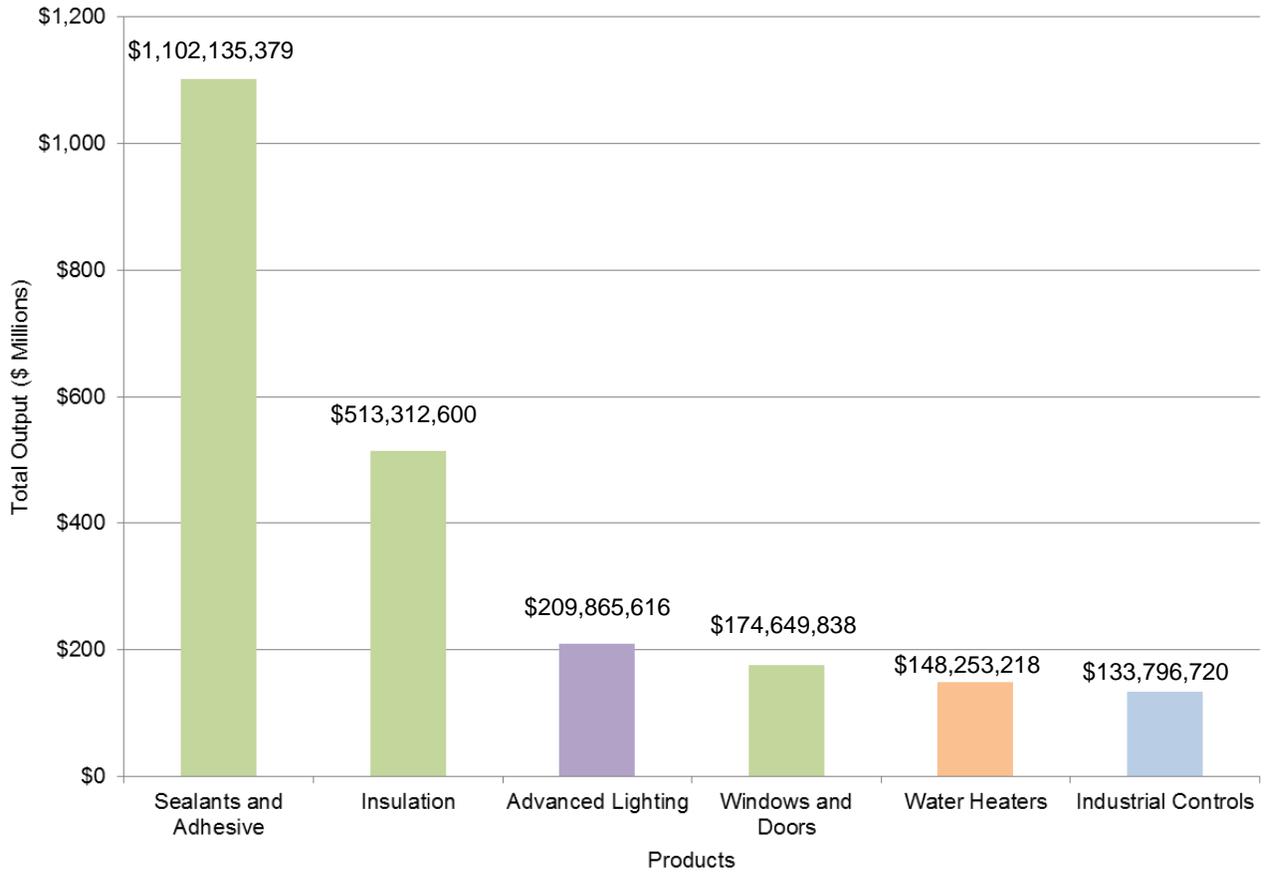


Table 14 is a listing of the tax impacts of each energy efficient product. These impacts are a detailed account of the base case scenario effects. It is useful to understand the potential revenue effects each product category and device will have on the Michigan economy.

Table 14. Summary of Base Case Market Share Tax Impacts by Product

Product	Impact Type	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Insulation	Total Federal Tax	\$13,249,915	\$535,099	\$3,035,387	\$5,828,631	\$3,717,353
	Total State and Local Tax	\$262,481	--	\$16,811,634	\$1,619,475	\$2,641,339
Windows and Doors	Total Federal Tax	\$5,736,047	\$259,792	\$717,510	\$2,551,324	\$1,015,737
	Total State and Local Tax	\$113,631	--	\$3,973,965	\$708,881	\$721,724
Sealants and Adhesives	Total Federal Tax	\$28,155,158	\$1,307,771	\$3,616,400	\$12,555,550	\$4,538,135
	Total State and Local Tax	\$557,755	--	\$20,029,603	\$3,488,537	\$3,224,540
Industrial Controls	Total Federal Tax	\$4,26,121	\$92,839	\$608,591	\$1,981,344	\$852,814
	Total State and Local Tax	\$93,625	--	\$3,370,710	\$550,513	\$605,961
Water Heaters	Total Federal Tax	\$4,018,011	\$113,721	\$565,096	\$1,719,148	\$1,226,113
	Total State and Local Tax	\$79,597	--	\$3,129,812	\$477,662	\$871,206
Advanced Lighting	Total Federal Tax	\$6,582,080	\$225,452	\$1,101,839	\$2,855,232	\$1,365,729
	Total State and Local Tax	\$130,391	--	\$6,102,588	\$793,321	\$970,409
Total Energy Efficiency Manufacturing	Total Federal Tax	\$62,467,333	\$2,534,674	\$9,644,823	\$27,491,227	\$12,715,882
	Total State and Local Tax	\$1,237,480	--	\$53,418,312	\$7,638,388	\$9,035,180

CONCLUSION

The environmental impacts of residential and commercial energy efficiency are broadly-acknowledged, but the ongoing conversation rarely includes the significant economic impact that is realized because firms are manufacturing energy efficient products that eventually are installed through residential and commercial structure retrofits. As energy efficiency continues to grow in popularity and practice, economies will benefit because of this manufacturing activity.

Michigan, specifically, is posted to benefit because a strong base of large and small manufacturers within the state are active contributors to the global energy efficient products supply chain. An existing core of manufacturers, a highly-skilled workforce, and strong industrial supply chains help Michigan firms meet the demand for energy efficient product applications such as the building envelope, equipment, HVAC, and advanced lighting.

Input-output economic impact analysis shows that the in-scope manufacturing activities for the selected energy efficient products in Michigan may have an annual average total impact of \$2,282,013,371 and support 9,221 jobs. Scenario analysis estimating greater than and less than expected market share indicates the total impact between \$1,768,609,827 and \$2,795,416,914 and jobs supported between 8,178 and 10,263.

These impact estimates are not intended to advocate for or against any particular policy, strategy, or investment. These results are intended to inform and add depth to the ongoing conversation by highlighting the tangible economic impacts of these manufacturing activities only.

As policy makers, industry leaders, and other stakeholders begin to understand the economic impact from these activities, the following are potential considerations:

1. Specific energy efficient products may offer more promise than others in terms for overall economic impact, depending upon the existing activity levels within the state. Mature industries with well-established local supply chains and significant activity levels likely have a greater economic impact than less-established manufacturers. As Michigan's economy evolves, the magnitude of impact associated with a particular product may shift positively or negatively.
2. Policy aimed towards development of an agglomeration economy, similar to automobile manufacturing, leveraging production and intellectual assets can make Michigan a significant player in energy efficient products manufacturing. As this report indicates, it may be possible to enhance economic impact by attracting new firms or re-tooling incumbent firms for Michigan's energy efficient product manufacturing supply chain. Agglomeration economies can be cultivated through specific policies aimed at increasing dialogue and partnerships between firms, attracting foreign direct investment in the region, supporting research laboratories and universities, and increasing the ability of firms to raise initial capital.³⁵

³⁵ O'Gorman, Colm and Kautonen, Mika (2004)

3. Efforts to encourage use of local supply chains will help attract new investment from out-of-state end product manufacturers and create efficiencies for incumbent firms. In addition, efforts to relocate out-of-state firms to Michigan to take advantage of the supply chain, a highly-skilled workforce, and a long legacy of manufacturing success would enhance the supply chain and likely increase overall economic impact from the sector.
4. Enhanced firm-level data collection by the State of Michigan may enable enhanced economic impact analysis in the future. Measuring the economic impact of value producing activities within the state such as detailed import/export data and realistic firm-level participation in specific manufacturing processes as well as quantifying public investment will provide stakeholders with the information necessary to evaluate current and developing industries in a consistent manner.
5. A state-level strategy regarding energy efficient products manufacturing should be developed proactively. Any and all strategies should be developed and evaluated in the context of return on investment.

Changes in demand for energy efficient products will drive economic activity and resulting economic impact. If market demand for these products fails to meet expectations or if firms are unwilling or unable to produce the desired products, then the described impacts may not occur. If Michigan's manufacturers are willing and able to meet market demand, the impact described in this report can occur.

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APPENDIX: RESEARCH LIMITATIONS

The following are additional considerations to be consulted while reviewing the results of this study.

- Specific products selected to represent the four product categories are a sample of the current technology and manufacturing activity within the energy efficient products sector. This sample enables an uncomplicated portrayal of the affect the industry is having on the economy. Varying configurations of product and system processes are available within the industry. Devices chosen to represent the product categories do not reflect an endorsement by this study.
- Data and resources used to quantify the supply chain are cited within the references section of this study. These sources are experts in their respective areas. This study chose selected facts and figures from available data to define the product categories, devices, and components. Some data cannot be presented in this report due to its proprietary nature. Assumptions made by primary researchers are reflected in this study.
- Transportation, on-site assembly, and installation are not included in the product costs in many cases. Removal of these aspects of component price allowed for a clearer view of the manufacturing activity involved in this sector.
- Data used for final demand figures was cited from current reliable sources. In some cases, market research companies project conflicting demand levels. When conflicts in data arose, the most conservative estimates were utilized to avoid overestimation.
- Averaging the demand for energy efficient products may skew specific yearly forecasts; however, the average values are critical to assessing economic impact in an efficient manner.
- A growth function was used to project water heater and insulation forecast data to 2015. This assumes consistent growth within the industry using past year performance figures.
- The study relies heavily on secondary data as of a lack of primary data was available to researchers. Primary data would have allowed for a greater degree of definition of the Michigan energy efficient products sector. Modification of the IMPLAN industry margins, ratios, and percentages may allow for the creation of a more exact model should primary data become available.
- Import and export figures for the State of Michigan are calculated by the IMPLAN model. Sector specific figures from primary and secondary sources were unavailable. IMPLAN's default percentages were used to quantify the imported and exported components. These percentages are calculated from the Michigan manufacturing industry and are not sector specific.



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