ENERGY INNOVATION BUSINESS COUNCIL
POWER ADVANCED

Economic Impact of New Energy Manufacturing in Michigan

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EXECUTIVE SUMMARY

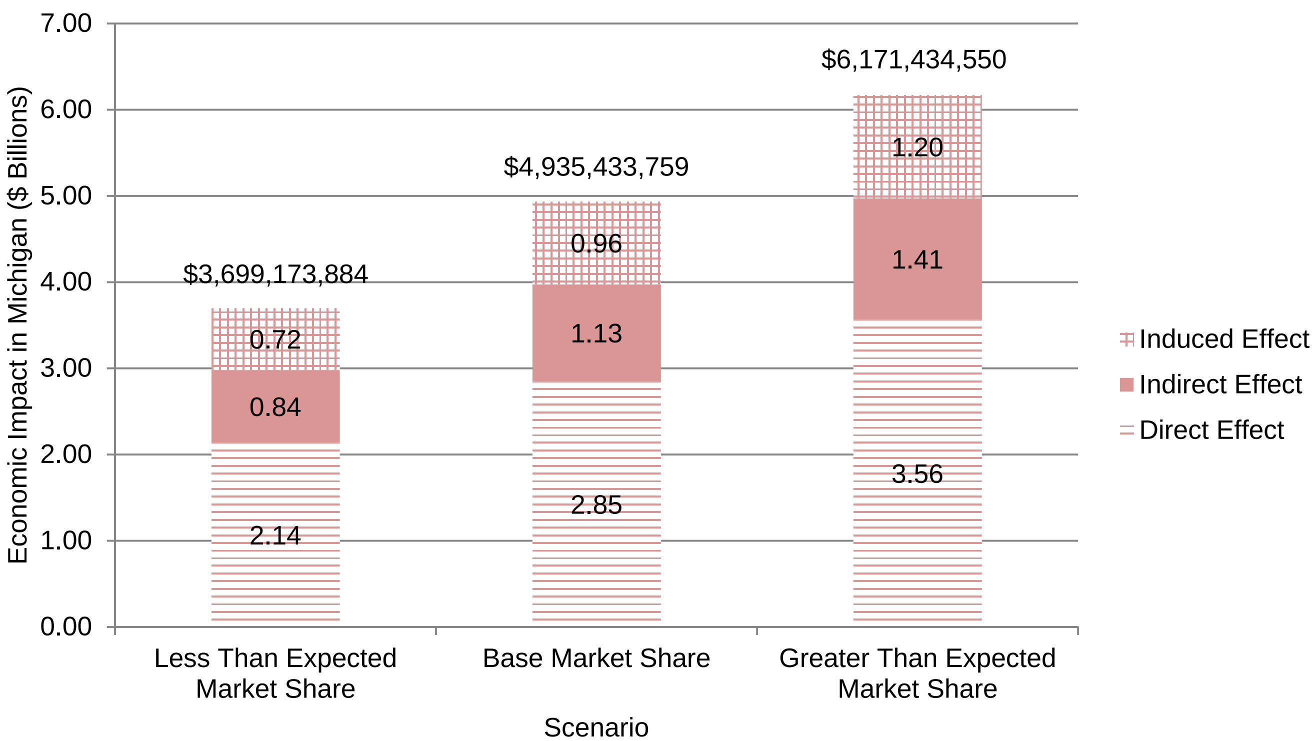
Global demand for renewable energy continues to increase. The infrastructure to meet this demand for new energy markets will require the manufacturing of devices and components that harness renewable resources or make energy utilization more efficient. This study begins to quantify the economic impact of this type of manufacturing activity within the State of Michigan.

This study of new energy manufacturing includes selected devices in the advanced energy storage, biomass, solar, and wind subsectors. This subset of devices 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 manufacturing process, not pre- or post-manufacturing activities or ancillary impacts like social and environmental externalities.

Input-output analysis was utilized to estimate the economic impact of manufacturing activities for these new energy devices in Michigan. Shifts in demand and estimates of supply for each device are used to calculate direct, indirect, and induced economic impacts including total economic output, jobs supported, and tax revenues.

Global, national, and state-level demand for new energy from advanced energy storage, biomass, solar, and wind is forecasted to grow significantly by 2015. The base market share scenario analysis indicates that the selected manufacturing activities as a whole could potentially have an annual average impact of $4,935,433,759 on Michigan, including 20,791 jobs supported and $163,682,339 in local and state tax revenues.

Figure 1. Total Average Annual Output by Scenario



Market share scenarios show the variation in potential impact of the new energy subsector on Michigan. The *greater than expected* scenario demonstrates a 25 percent increase in captured market share by Michigan firms, resulting in $6,171,434,550 in output, a $1,236,000,791 increase over the base, and an increase of 5,206 jobs supported. If Michigan captures a *less than expected* percentage of the market, 25 percent less in modeled scenario, the State will capture $3,699,173,884 in total output and will be able to support 15,585 jobs. As a percentage of total Michigan gross domestic product (GDP), the new energy manufacturing base scenario output would be 1.258 percent; or 7.583 percent of the state's manufacturing GDP.

Economic impact differs by subsector and device for a variety of reasons. Mature industries with well-established local supply chains, such as electric vehicle and wind turbine manufacturing, are shown to have a greater economic impact on Michigan. Industries with lower projected demand and evolving supply chains have less of an overall impact on the Michigan GDP compared to mature devices with established supply chains and demand within the state.

Michigan, unrivaled in its manufacturing prowess, has an opportunity to position itself as the region of choice for these devices and their components by leveraging an existing core of manufacturers, highly-skilled workforce, and strong industrial supply chains. Development of an agglomeration economy, similar to automobile manufacturing, by leveraging production and intellectual assets could make Michigan the hub of new energy manufacturing.

State-level programs to encourage investment in these sectors, re-trained manufacturing workers, and renovated manufacturing facilities (described in the Policy Overview appendix) have supported entry into these markets by new firms or existing firms seeking to diversify their products. Today, Michigan has a strong base of these firms, many of which are significant contributors to state, national, and global new energy 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 new energy manufacturing within its borders. Mild interventions such as education campaigns promoting new energy and new energy manufacturing may support continued interest in this sector. Enhancing the conversation to focus on economic impacts, not just environmental impacts, may codify support for new energy 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 new energy manufacturing. Very direct interventions such as the ongoing Renewable Portfolio Standard (RPS) mandating that 10 percent of all Michigan's energy resources come from new and renewable energy markets by 2015 may stimulate manufacturers to increase production of devices to meet the RPS threshold. Recognizing the current national-level debate over the efficacy of government investment in emerging new energy markets, these approaches and potential strategies should be considered in the context of likely return on investment for the state.

Demand for new energy devices is expected to grow, in part due to the volatility with incumbent energy markets and continued focus on sustainability. This appears promising; however, changes in demand for new energy devices will drive economic activity and resulting economic impact. If market demand for these devices 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.

INTRODUCTION

Global demand for renewable energy continues to increase. The infrastructure to meet this demand for new energy markets will require the manufacturing of devices and components that harness renewable resources or make more efficient use of energy. This study begins to quantify the economic impact of this type of manufacturing activity within the State of Michigan.

Renewable energy is a focal point globally and within the United States and is seen as the future of advanced technology and manufacturing. The new energy market has been defined by the United States Energy Information Administration as "energy sources [that] regenerate and can be sustained indefinitely.[1]" New energy manufacturing as defined for this study, *Economic Impact of New Energy Manufacturing in Michigan*, is a product or system constructed, assembled, or manufactured to harness renewable resources or make more efficient use of energy. As a political talking point, renewable or "green" energy has been used by both conservatives and liberals in the context of environmental impact. **To think of renewable energy as only an environmental benefit to the ecosystem is negating the economic opportunity from harnessing this resource. This study offers the opportunity to quantify a portion of this impact on the State of Michigan**

The intent of this study is to begin to quantify the total economic impact of selected new energy manufacturing activities in the State of Michigan. The results of this study will help manufacturers, policy makers, trade associations, and other concerned stakeholders understand the magnitude of economic impact that these new energy manufacturing activities have on Michigan in terms of total output, jobs supported, and local and state tax revenues.

This study will help inform state-level conversations on new energy manufacturing in Michigan by providing objective evidence that new energy manufacturing can create a direct, indirect, and induced economic effect on the state. This study is not intended to exclusively promote nor deter continued investment in new energy manufacturing. It is meant to add depth to the ongoing conversations within Michigan regarding the future of this sector which, by all accounts, will remain prevalent for years to come.

This study of new energy manufacturing includes selected devices in the advanced energy storage, biomass, solar, and wind subsectors. This subset of devices was selected based on the level of current activity in Michigan and preliminary thoughts on their future importance and significance.

The sample of manufactured devices and their components within the scope of this study represent a fraction of all new energy 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 new energy manufacturing such as social and environmental externalities.

[1] Energy Information Administration (2011)

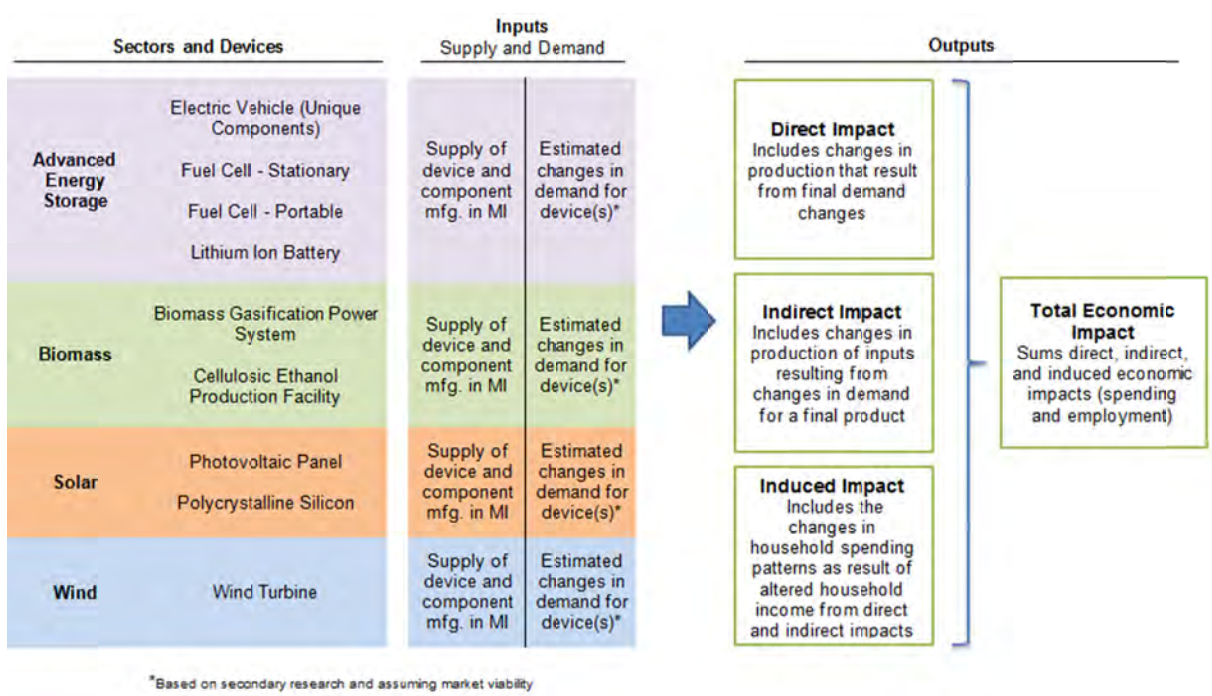
Table 1. Subsectors and Devices within Study Scope

Advanced Energy Storage	**Biomass**
Electric Vehicle (Unique Components) Fuel Cell – Stationary Fuel Cell – Portable Lithium Ion Battery	Biomass Gasification Power System Cellulosic Ethanol Production Facility
Solar	**Wind**
Photovoltaic Panel Polycrystalline Silicon	Wind Turbine

The economic impact of manufacturing activities for these devices in Michigan is estimated using input-output analysis (including estimates of supply of device and component manufacturers and component costs as well as forecasted demand for and Michigan's participation in the creation of new energy devices). IMPLAN, a software and data package that enables development of input-output economic impact models for a particular geography or study area, is used to quantify direct, indirect, and induced economic effects.

Direct, indirect, and induced economic impacts resulting from a shift in spending within the new energy manufacturing 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. For example, the model calculates that resulting economic effect from the manufacture of a particular new energy device using an estimated percentage of Michigan-sourced parts and firms.

Figure 2. Input-Output Economic Impact Model Overview



NEW ENERGY MANUFACTURING 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. [2] New markets for manufacturing, such as renewable energy, may help revitalize Michigan's manufacturing base.

Renewable energy has been a focus globally and within the United States and is seen as the future of advanced technology and manufacturing. This sector has been defined by the United States Energy Information Administration (EIA) as "energy sources [that] regenerate and can be sustained indefinitely."[3] As a political talking point, renewable or "green" energy has been used by both conservatives and liberals but often only in the context of environmental impact. To think of renewable energy as only an environmental benefit to the ecosystem is negating the economic opportunity that exists from harnessing this resource. This study begins to quantify this impact on the State of Michigan by assessing the economic effects of manufacturing of a particular set of devices within the advanced energy storage, biomass, solar, and wind subsectors.

New energy manufacturing for this report is a product or system constructed, assembled, or manufactured to harness renewable resources or make more efficient use of energy. As an industry, this sector has yet to be clearly defined. Currently, the supply chain encompasses an area of manufacturing from automotive to fiberglass and beyond. As a developing industry, the sector will experience a greater degree of classification as it matures.

The State of Michigan recognizes the importance of renewable energy, evidenced by the adoption of Public Act 295 of 2008, signed into law in October of 2008.[4] According to the Department of Licensing and Regulatory Affairs, this act is intended to do the following:

> *"[Promote] the development of clean and renewable energy and energy optimization through the implementation of standards that will cost-effectively provide greater energy security and diversify the energy resources used to meet consumers' needs, encourage private investment in renewable energy and energy efficiency and improve air quality."*[5]

With this act and other state legislation (described in the Policy Overview, Appendix B), Michigan has already made investments in the new energy manufacturing industry. In response, companies have re-tooled factories and retrained a skilled workforce to meet market demands.[6] State lawmakers and manufacturers alike recognize that Michigan's manufacturing supply chain has the potential to create a significant economic impact, which this report begins to quantify.

[2] Bureau of Labor and Statistics (2011)
[3] Energy Information Administration (2011)
[4] Michigan Department of Licensing and Regulatory Affairs (2011)
[5] Michigan Department of Licensing and Regulatory Affairs (2011)
[6] Laviolette (2011)

This study uses input-output analysis to assess the economic impact of new energy 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 new energy devices as a result of a shift in final demand. The model developed for this study calculates impact based on:

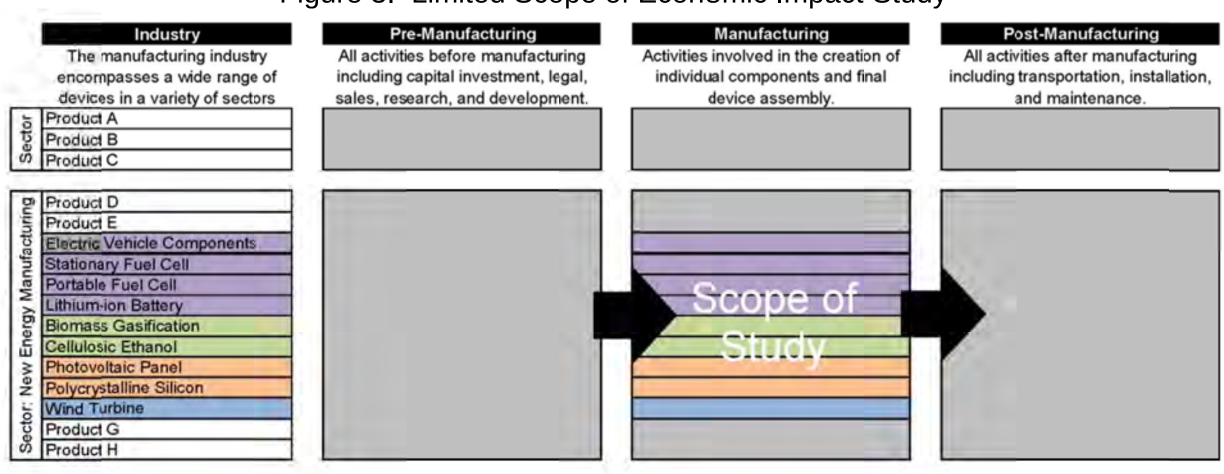
- Forecasted changes in demand for each new energy device by 2015
- Estimates of costs for the manufacture of each new energy device broken out by costs of component parts
- Estimates of sector-to-sector trade based on IMPLAN software and data

The sections that follow (organized by subsector) examine device and component costs for each product within the scope of this study as well as forecasts of demand for each device to be manufactured by firms in Michigan by 2015. Specifically, this data is organized and presented as follows:

- Subsector (i.e. Wind)
  - Device (i.e. Wind Turbine)
    - Component Mapping (i.e. overview of component parts of turbine)
    - Component Cost Model (i.e. overview of costs of turbine components, including the estimated cost of a single unit and as a percentage of total cost)
    - Forecast Model (i.e. anticipated change in demand for turbines and components manufactured by Michigan firms by 2015)

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 subsectors were chosen because of their current and potential future impact on the manufacturing industry. Specific products were subsequently selected to represent each subsector to allow for a manageable sampling of the industry. This study only considers the manufacturing activities associated with these devices and their components. This does not include other phases of the product life cycle, including research and development or transportation and assembly, this scope is depicted in Figure 3.

Figure 3. Limited Scope of Economic Impact Study



Advanced Energy Storage

Advanced Energy Storage is a broad subsector of products that alter the production, storage, and use of energy. Advanced manufacturing of a variety of energy storage mediums is currently occurring within the State of Michigan, though many remain nascent and may not have significant production volume. For this study, the subsector includes the unique components of electric vehicles, the lithium-ion battery, and two types of fuel cells.

Demand for unique components of electric vehicles is forecasted to grow globally to 10,824,351 vehicles by 2015.[7] Demand for stationary and portable fuel cells is forecasted to grow in the United States to $160,000,000 and $215,000,000 respectively by 2015.[8] Market demand for lithium-ion batteries is forecasted to grow to $8,000,000,000 globally by 2015.[9]

If market demand and price for these devices meets forecasted expectations, and if Michigan firms are willing and able to produce the selected products and components, this study indicates the Advanced Energy Storage subsector could yield an average annual total economic output of $2,721,439,532. As a result of these activities, 12,145 jobs may be supported annually and $91,117,504 of local and state tax revenue may be realized.

Electric Vehicle (Unique Components)

The scope of this study includes a sample of the unique components of electric vehicles. This excludes all components that would also be found on a traditional internal combustion engine vehicle. The battery is broken out separately from the electric vehicle and is evaluated in the advanced energy storage section of this report because of the specific nature of the product. As part of this report, we have assumed the electric vehicle technology encompasses all models and technology utilizing a battery to completely or partially propel the system.

Component Mapping

The Idaho National Laboratory in conjunction with the United States Department of Energy (DOE) currently conducts research in the area of advanced energy storage and alternative transportation technologies. Side-by-side comparisons show that up to 70 percent of an electric vehicle may be different than a comparable internal combustion or gasoline powered vehicle.[10] Major electric vehicle components that differ from the internal combustion engines are listed in Table 2. Components are matched with their corresponding North American Industry Classification System (NAICS) codes. Matching was completed through careful consideration of the specific component and the interpretation of the current NAICS.

[7] Omotoso (2010)
[8] The Freedonia Group (2011)
[9] Pike Research (2009)
[10] Idaho National Laboratory (2011)

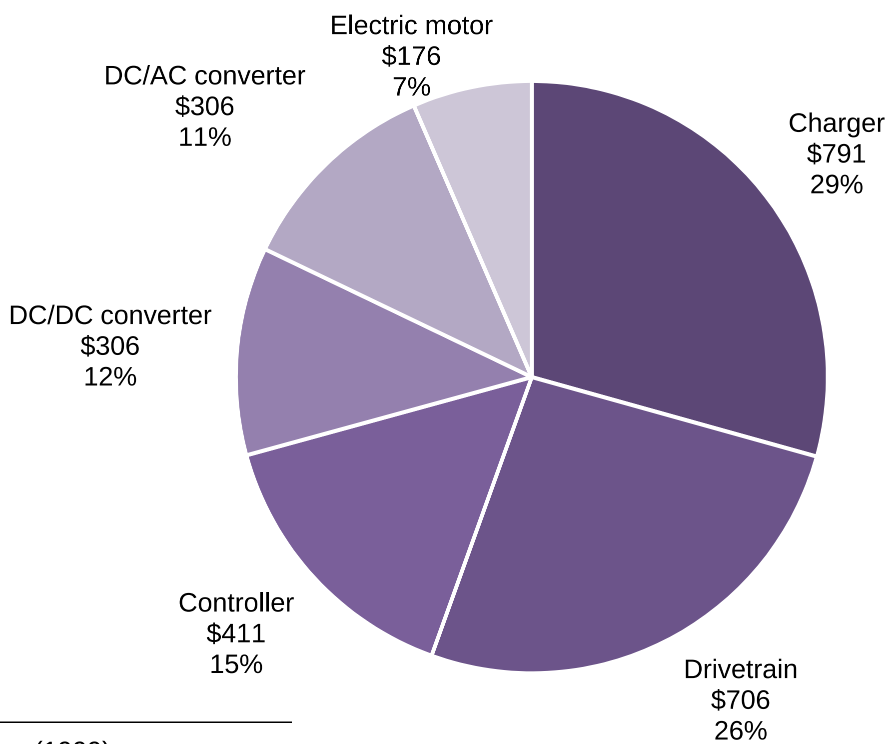
Table 2. Electric Vehicle Components with NAICS Codes

Component	Code Description	NAICS
Charger	Battery chargers	335312
Drivetrain	Transmissions and parts, automotive, truck, and bus, manufacturing	336350
Controller	Motor controls, electric, manufacturing	335314
DC/DC converter	Inverters, solid-state, manufacturing	335999
DC/AC converter	Power converter units (i.e., AC to DC), static, manufacturing	335999
Electric motor	Integral horsepower electric motors manufacturing	335312

Component Cost Model

Thirty percent of the overall price of a typical electric vehicle can be attributed to these specific components.[11] These components are broken down into the specific percentage of the vehicle costs they represent.[12] Component costs were calculated based on the percentage that each component attributes to a standard electric vehicle. Calculations were compared to a baseline price of $41,966 for a current average midsized electric vehicle sedan.[13] Costs are estimated in 2011 dollars.

Figure 4. Electric Vehicle Costs and Percent of Total Cost



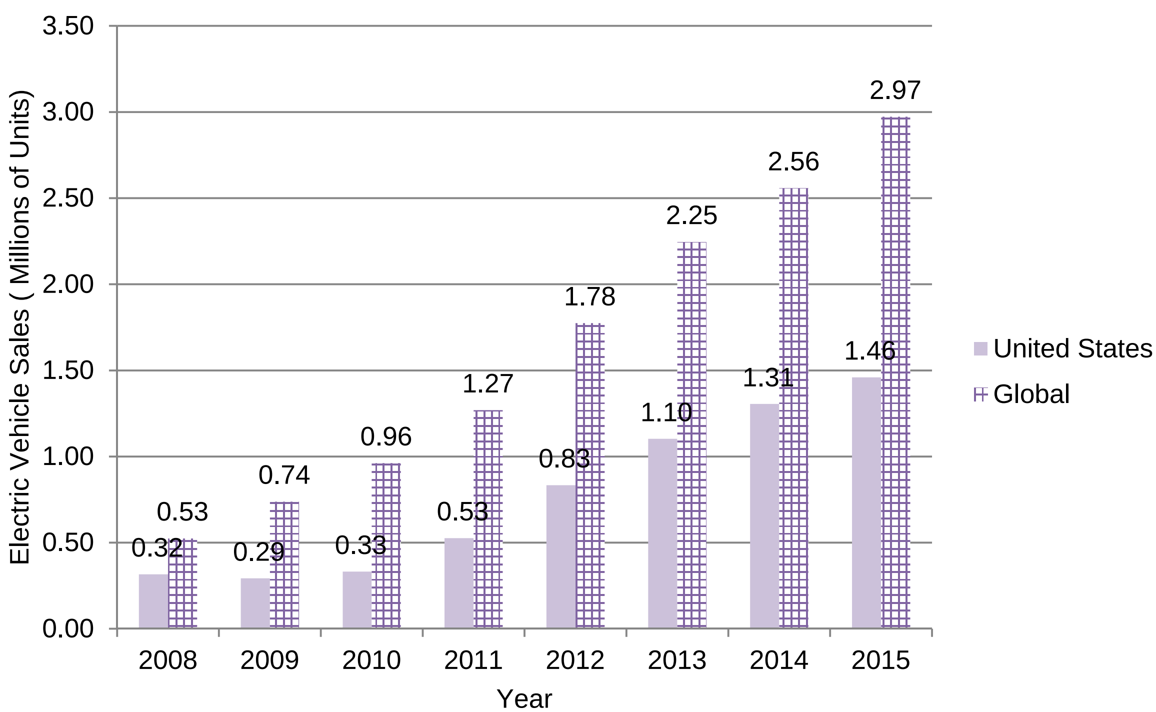
[11] Cuenca (1999)
[12] Center for Automotive Research (2011)
[13] Center for Automotive Research (2011)

Forecast Model

Demand for the electric vehicle was calculated from the total forecasted United States and global demand for the years 2011 through 2015 (5,227,917 and 10,824,351 units respectively).[14] To calculate an accurate global demand, total United States demand was subtracted from total global demand to reach a figure representing world demand for electric vehicle, excluding the United States (this number comes to 5,596,434 units). The total global demand was multiplied by 9.98 percent (the percentage of global sales produced in the United States, 548,450 units).[15] This figure of global electric vehicle demand was then added to the total United States demand to create a new total demand figure for electric vehicles manufactured in the United States of 5,776,367. This figure was multiplied by 24 percent[16], which is the percentage Michigan produces of all vehicles produced within the United States. The resulting number is the forecasted total electric vehicles to be produced within Michigan from 2011 to 2015, assuming market demand and viability. This figure was averaged over the 5 years between forecasts, creating an average base scenario of yearly production of 277,722 vehicles. This averaged forecast model is simplified in the following equation:

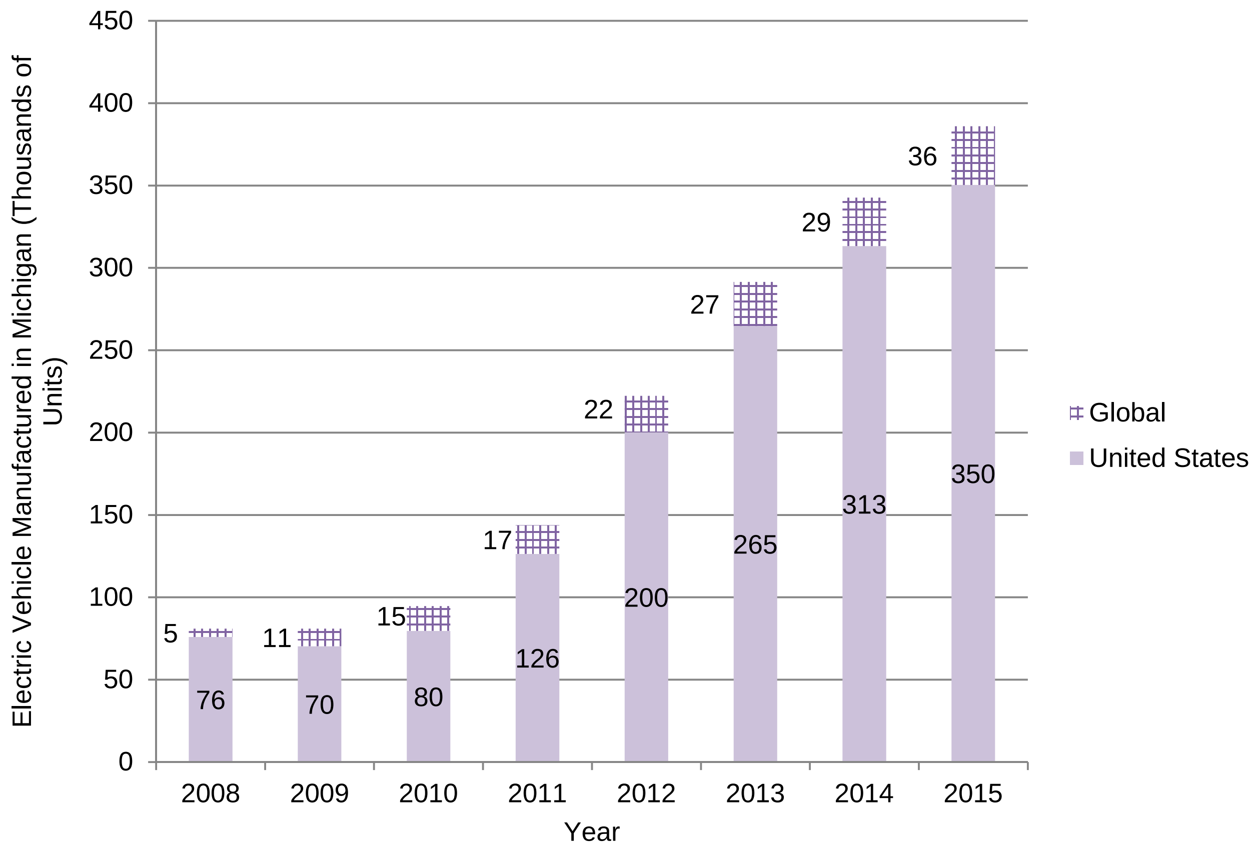
$$\frac{\text{Average Annual Demand (National or Global)}}{\text{Device Cost}} \times \text{Estimated Michigan Manufacturing Market Share} = \text{Estimated Annual Manufacturing Activity by Michigan Firms}$$

Figure 5. Forecasted Electric Vehicle Sales by Year



14 Omotoso (2010)
15 Organization of Motor Vehicle Manufacturers (2010)
16 Michigan Manufacturer's Association (2011)

Figure 6. Portion of Forecasted Electric Vehicle Sales Manufactured in Michigan



Fuel Cell – Stationary

Argonne National Laboratory defines a fuel cell as "electrochemical energy conversion device that converts the chemical energy in a fuel to electrical energy."[17] Currently, the stationary fuel cell is the core fuel cell product being manufactured in Michigan. Non-transportation uses include back-up power, stationary applications, and combined heat and power generation. Portable refers to the mobile application of the fuel cell. Because of their unique production and application, the stationary and the portable fuel cell have been split into two separate devices within the advanced energy storage subsector.

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[17] Argonne National Laboratory (2009)

Component Mapping

This model is based upon a five kilowatt (kW) direct hydrogen polymer electrolyte membrane (PEM) fuel cell.[18] The following table provides a listing of components, NAICS code descriptions and, codes that make up a stationary fuel cell.

Table 3. Stationary Fuel Cell Components with NAICS Codes

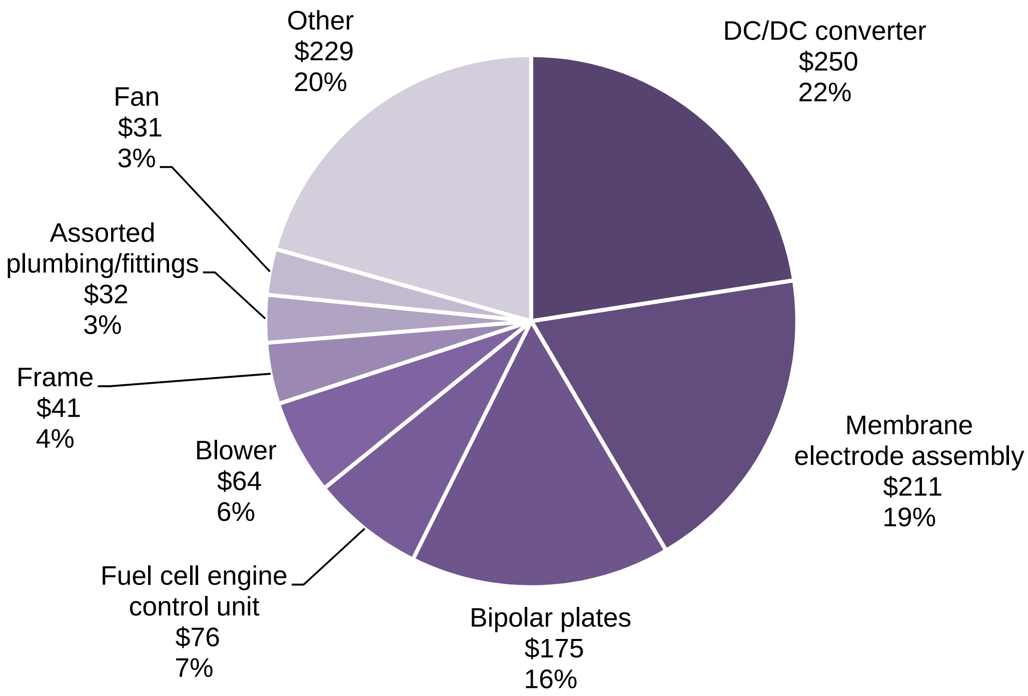
Component	Code Description	NAICS
DC/DC converter	Power converter units (i.e., AC to DC), static	335999
Membrane electrode assembly	Graphite electrodes and contacts, electric, manufacturing	335991
Bipolar plates	Graphite powder, powder metallurgy part manufacturing	332117
Fuel cell engine control unit	Electric and electronic controllers	334513
Blower	Air compressors manufacturing	333912
Frame	Bars, steel, made in iron and steel mills	331111
Assorted plumbing/fittings	Pipe and pipe fittings, cast iron, manufacturing	331511
Fan	Fans, industrial and commercial-type, manufacturing	333412
Blower	Air compressors manufacturing	333912
Relief Valve	Valves, industrial-type, manufacturing	332911
Hydrogen sensor	Gas flow instrumentation, manufacturing	334513
Flow meter	Meters, industrial process control-type, manufacturing	334513
Air filter	Filters, industrial and general line, manufacturing	333999
Stack voltage sensor	Thermal conductivity instruments and sensors	334516
Anode side gasket	Platinum and platinum alloy sheet	331492
Wiring and connectors	Connectors, electric cord, manufacturing	335931
Cathode side gasket	Platinum and platinum alloy sheet	331492
Cooling gasket	Gasket, packing, and sealing devices manufacturing	335991
Stack assembly	Harness assemblies for electronic use manufacturing	334419
Tie rods and hardware	Rods, iron or steel, made in iron and steel mills	331111
Anode purge valve	Valves, industrial-type, manufacturing	332911
End plates	Tie plates, iron or steel, made in iron and steel mills	331111
Enclosure heater	Room heaters manufacturing	333414
Assembly Hardware	Harness assemblies for electronic use manufacturing	334419
Air filter	Filters, industrial and general line, manufacturing	333999
Stack temperature sensor	Primary process temperature sensors manufacturing	334513
Bus bar	Bus bars, electrical conductor manufacturing	335931
Stack current sensor	Thermal conductivity instruments and sensors manufacturing	334516
Hydrogen shutoff valve	Valves, industrial-type, manufacturing	332911
Enclosure heater relay	Relays, electrical and electronic, manufacturing	335314
End gasket	Gasket, packing, and sealing devices manufacturing	335991

[18] Mahadevan, Kathya, et al. (2010)

Component Cost Model

Component costs and percentage of total cost is provided below.[19] These costs and percentages serve as inputs for the economic impact model.

Figure 7. Stationary Fuel Cell Component Costs and Percent of Total Cost



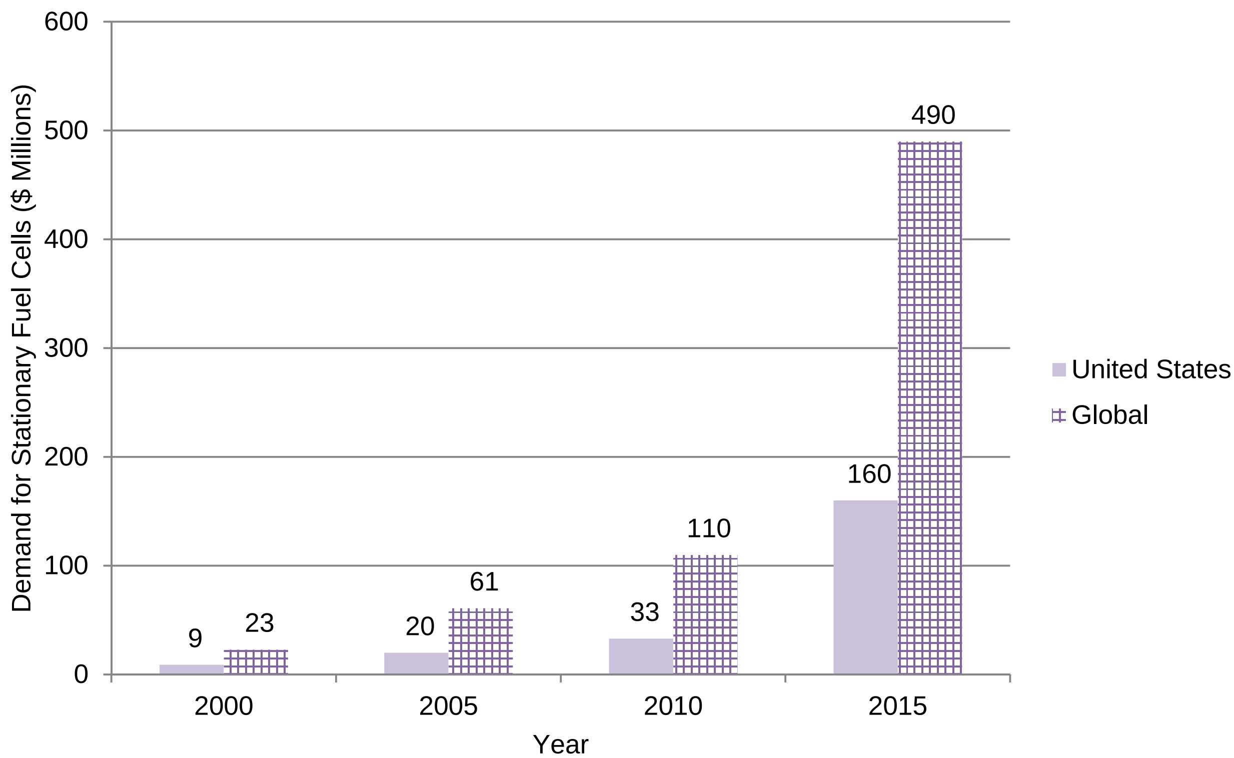
Costs are reported in 2010 dollars. As part of the IMPLAN model, device costs are scaled to the current year using deflator ratios. Fuel cell stack costs are valued at $438 per kW and $670 per kW for the balance of plant. In researching the component cost model breakdown specifically for the stationary fuel cell systems, the DOE's cost model showed a significant decrease to $1,108 per kW ($1,108,000 per MW), not including system assembly, test, and conditioning costs.[20]

[19] Mahadevan, Kathya, et al. (2010)
[20] Breakthrough Technologies (2011)

Forecast Model

Global demand for industrial stationary fuel cells is expected to grow significantly by 2015 to estimated sales of $490 million, up from $110 million in 2010, a change of 345 percent. Demand in the United States is expected to reach $160 million by 2015, up from $33 million in 2010, a change of 385 percent.[21]

Figure 8. Forecasted Stationary Fuel Cell Demand



Demand for the stationary fuel cell device was calculated from the forecasted United States demand for 2010 and 2015, $33,000,000 and $160,000,000 respectively.[22] These figures were averaged over the 6 years between forecasts creating an average yearly demand of $32,166,667. The average yearly demand was converted to MW by dividing by $1,108,000; this is the price per MW calculated for the stationary fuel cell. An average United States demand of 29.03 MW resulted from this calculation. Assuming Michigan market share of 3.8 percent multiplied by the calculated average United States demand, the result in the base scenario is 1.1 MW of manufactured stationary fuel cell within Michigan annually.

[21] The Freedonia Group (2011)
[22] The Freedonia Group (2011)

Fuel Cell – Portable

Portable transportation fuel cells offer a greater degree of flexibility to fuel cell technology. The PEM fuel cell technology provides power to material handling vehicles, light duty vehicles, buses, and other types of transportation.[23]

Component Mapping

This study considers a direct hydrogen PEM fuel cell designed for automotive application to be a portable fuel cell. Material and manufacturing costs are estimated for an 80 kW fuel cell.[24] A fuel cell of this size would be capable of powering a light duty vehicle. NAICS specifically categorizes fuel cell production as a six-digit code, 335999. This code is used by the Department of the Army in its requisition of fuel cells.[25]

Table 4. Portable Fuel Cell Component with NAICS Codes

Component	Code Description	NAICS
Fuel Cell	Fuel cell, electrochemical generators, manufacturing	335999

Component Cost Model

Subcomponent costs ranged from $25 to $145 for the stack and $24 to $81 for the balance of plant when comparing annual production rates of 100 and 500,000 units, respectively.[26] Costs for this study per kW were estimated at $51, an 80 percent cost reduction since 2002 and a 30 percent cost reduction since 2008.[27] These prices result from a manufacturing volume reaching 500,000 units per year.

Table 5. Portable Fuel Cell Costs per kW

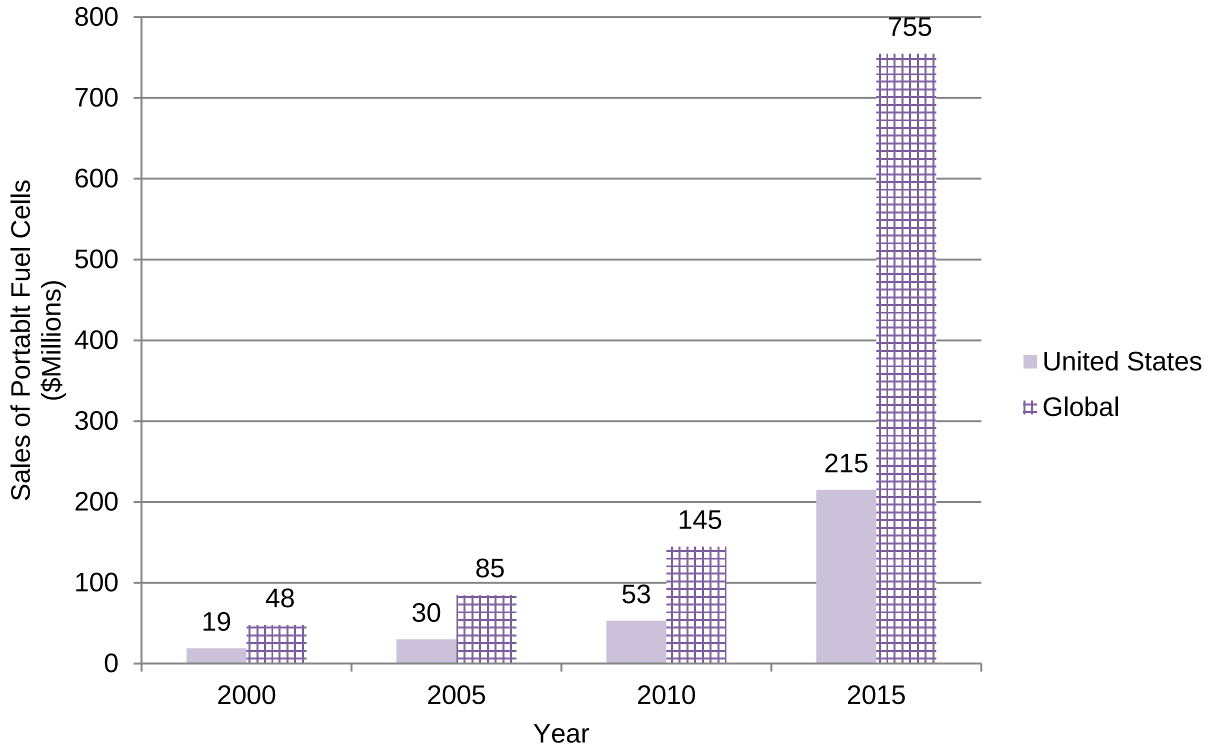
Component	Code Description	Cost %	Cost
Fuel Cell	Fuel cell, electrochemical generators, manufacturing	100%	$51

[23] Breakthrough Technologies (2011)
[24] James, Brian, et al. (2010)
[25] United States Army Test and Evaluation Command(2010)
[26] James, Brian, et al. (2010)
[27] James, Brian, et al. (2010)

Forecast Model

Global demand for PEM fuel cells for application in electric vehicles (the scope of this study) is expected to grow significantly over the next five years with estimated sales of $755 million by 2015, up from $145 million in 2010. In the United States, 2015 sales are estimated at $215 million, up from $53 million in 2010.[28]

Figure 9. Forecasted Fuel Cell Demand for Vehicle Application



Demand for the portable fuel cell device was calculated from the forecasted United States demand for 2010 and 2015, $53,000,000 and $215,000,000 respectively.[29] These figures were averaged over the six years between forecasts creating an average yearly demand of $44,666,667. The average yearly demand was converted to MW by dividing by $51,000; this is the price per MW calculated for the portable fuel cell. An average annual United States demand of 875.8 MW resulted from this calculation. Assuming Michigan's market share of 3.8 percent multiplied by the calculated average United States demand, the result in the base scenario is 33.28 MW of manufactured portable fuel cell within Michigan annually.

[28] The Freedonia Group (2011)
[29] The Freedonia Group (2011)

Lithium-Ion Battery

Lithium-ion batteries supply energy to electric vehicles, provide an opportunity to store excess electricity capacity on the utility grid, and power cell phones and laptops around the world. This study specifically addresses batteries produced for use within electric vehicles.

Component Mapping

Since lithium-ion batteries are components of a larger system, they are treated as such for cost and component classification. Similar to the fuel cell, lithium-ion battery manufacturing has a specific NAICS code, 335912. The United States Army and other federal agencies also recognize this code for the industry.

Table 6. Lithium-Ion Component with NAICS Code

Component	Code Description	NAICS
Lithium Ion Battery	Lithium battery, manufacturing	335912

Component Cost Model

Current research estimates the cost of a lithium-ion battery at $450 per kW.[30] Most battery systems currently in production are 25 kW units for a total of $11,250 per lithium-ion battery. This is down from a 2009 cost of $650 per kW.[31]

Table 7. Lithium Ion Battery Component for Model as Percentage

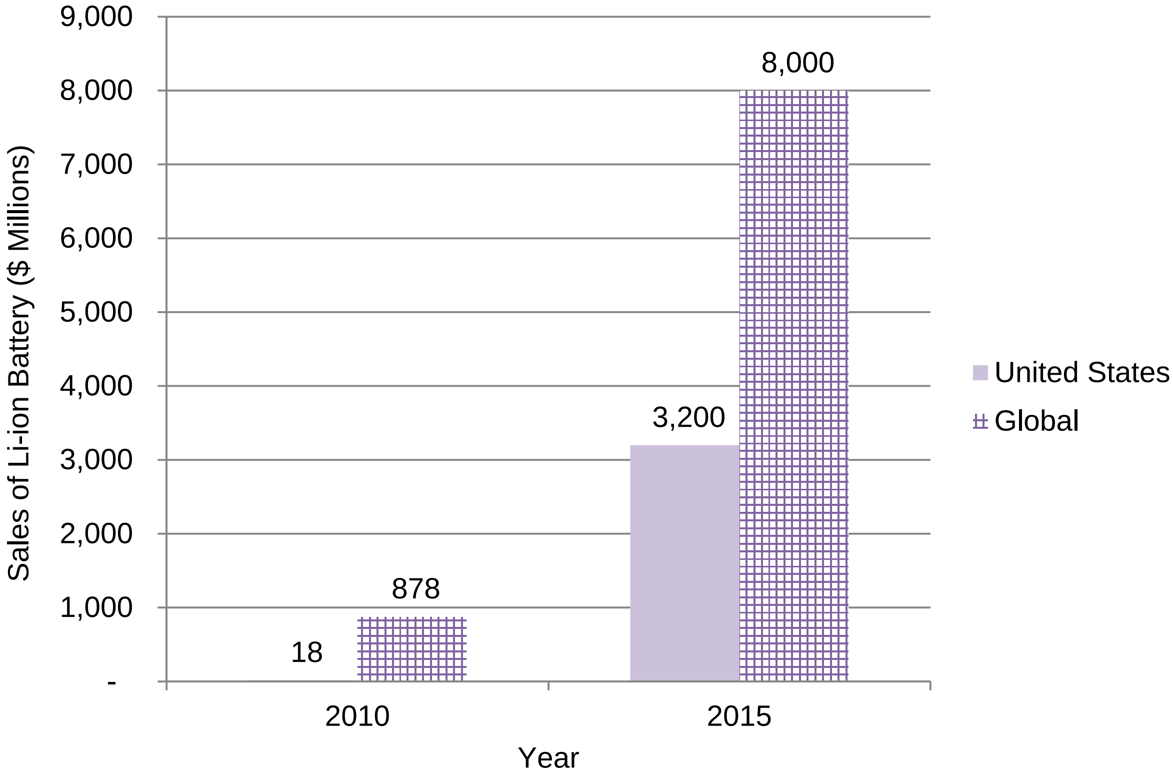
Component	Code Description	Cost %	Cost
Lithium Ion Battery	Lithium battery, manufacturing	100%	$450

[30] Deutsche Bank (2010)
[31] Deutsche Bank (2010)

Forecast Model

The main market driver for lithium-ion battery manufacturing is the electric vehicle. Battery unit sales are estimated through the year 2015. This study assumes that each electric vehicle will require at least one 25 kW lithium-ion battery to operate. It is possible that current and future electric vehicle designs will differ from this assumption.

Figure 10. Forecasted Sales for Lithium-Ion Batteries



Demand for the lithium-ion battery was calculated from the forecasted global demand for 2010 and 2015, $878,000,000 and $8,000,000,000 respectively.[32] These figures were averaged over the six years between forecasts creating an average yearly demand of $1,479,666,667. The average yearly demand was converted to kW by dividing by $450. This is the price per kW calculated for the lithium-ion battery. An average United States demand of 3,288,148 kW resulted from this calculation. Taking the assumed Michigan global market share of 20 percent multiplied by the calculated average United States demand results in the base scenario of 657,629.63 kW of manufactured lithium-ion batteries within Michigan annually.[33]

Although Michigan has seen significant investment within the industry, there is minimal data on estimated market share, actual market share, and detailed manufacturing activity within Michigan.

[32] Pike Research (2009)
[33] Wayland, Michael (2011)

Biomass

The Biomass subsector, unlike the other sectors of this report, covers specific facilities. They are end products or assets held by a company but also produce outputs, gallons of ethanol or electricity to be sold as a commodity. We separate the subsector into two specific categories: biomass gasification systems and cellulosic ethanol facilities. The biomass devices and facilities within the scope of this study are only a sample of biomass technologies, but they are the most prevalent within Michigan at this time. Due to the economic climate delaying further development of ethanol and biodiesel facilities, they are not within the scope of this study.[34]

Demand for biomass gasification power systems is forecasted to add an additional 150 MW of capacity by 2015. Demand for cellulosic ethanol production facilities is forecasted to add an additional 41,000,000 gallons of production capability by 2015.[35]

If market demand and price for these facilities meet forecasted expectations, and if Michigan firms are willing and able to produce the selected components, this study indicates the Biomass subsector could yield an average annual total economic output of $11,321,811. As a result of these activities, 420 jobs may be supported annually and $3,205,023 of local and state tax revenue may be realized.

Biomass Gasification Power System

This section of the report covers the use of biomass as a source of energy generation. Feedstock for this type of facility can come from a variety of supplies depending on the location of the facility. Michigan facilities capitalize on the abundant woody biomass available from forest residue, primary mill residue, and urban wood waste. The biomass gasification system model is based upon the energy generation system of a 56 MW combined cycle power plant.[36] The biomass system produces heat and steam for use in the generation of electricity.

Component Mapping

Biomass gasification system components are broken out in the study into the major cost drivers of the facility.[37] Components listed below make up 80 percent of the total system. These major system components were matched up with the NAICS system codes through careful review of the system specification.

[34] Bobeda (2009)
[35] Galbraith (2011)
[36] Craig, Kevin and Mann, Margret (1996)
[37] Craig, Kevin and Mann, Margret (1996)

Table 8. Biomass Gasification System Components with NAICS Codes

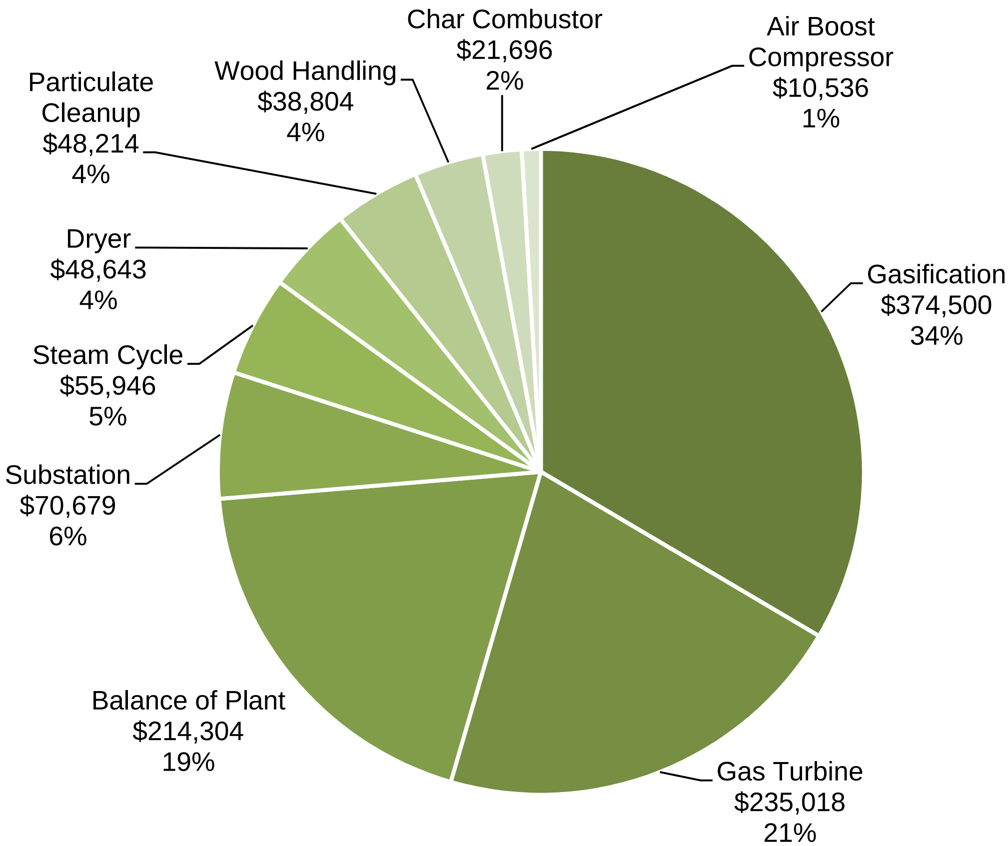
Component	Code Description	NAICS
Gasification	Turbine generator sets	333611
Gas Turbine	Turbine generator sets	333611
Balance of Plant	Industrial machinery manufacturing	333298
Substation	Switchgear and switchboard apparatus	335313
Steam Cycle	Steam turbine manufacturing	333611
Dryer	Power boiler and heat exchangers	332410
Particulate Cleanup	Conveyor and conveying equipment	333922
Wood Handling	Sawmill and woodworking machinery	333210
Char Combustor	Power boiler and heat exchangers	332410
Air Boost Compressor	Compressor, air and gas	333912

Component Cost Model

Component percentages were derived by taking individual component costs divided by the overall equipment capital costs.[38] The figures given for component costs for the biomass gasification system are in 1990 dollars. More recent reports on gasification system development are available; however, the report referenced for these costs provided the most comprehensive and detailed assessment of system components, processes, and costs. Capital equipment costs for the total plant was $62,627,000 which equates to $1,118,339 per MW.[39] As part of the IMPLAN model, device costs are scaled to the current year using deflator ratios.

[38] Craig, Kevin and Mann, Margret (1996)
[39] Craig, Kevin and Mann, Margret (1996)

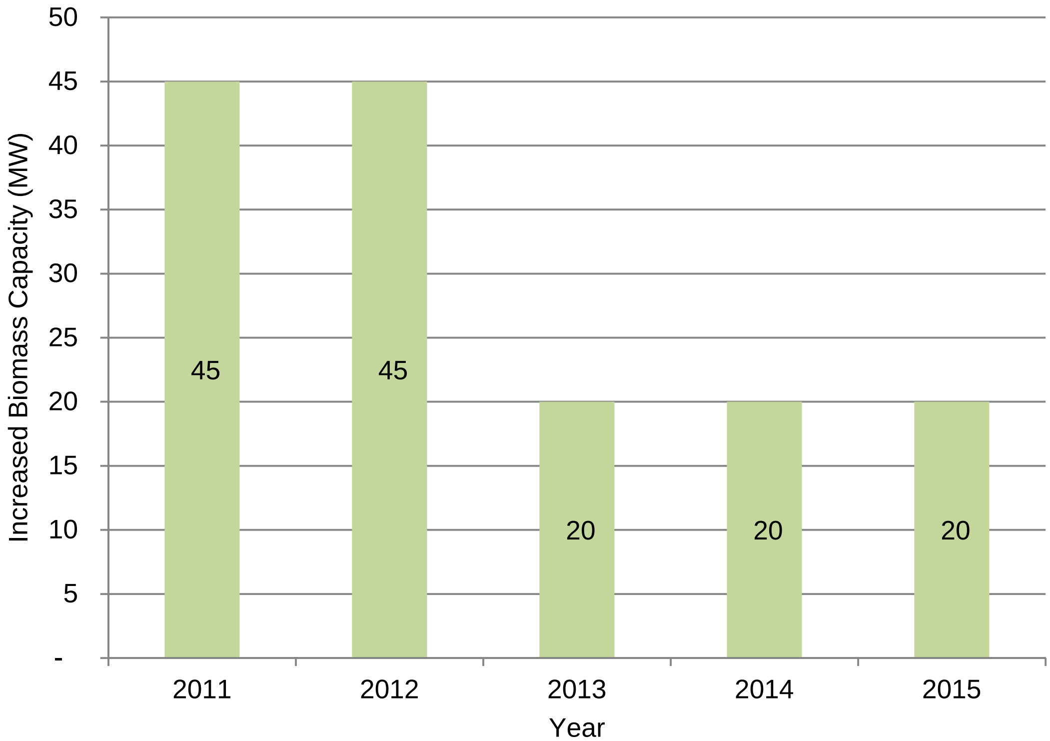
Figure 11. Biomass Gasification Component Costs and Percentage of Total Cost Per MW



Forecast Model

Demand for direct-fire biomass capacity is calculated from currently announced construction and estimated continuous demand. Dow Corning and Verso Paper both announced plans to construct 35 MW and 25 MW facilities, respectively. Interviews with manufacturers, trade associations and other stakeholders have accounted for the base assumption of 20 MW of capacity being built yearly except for the coming year with capacity increasing by 60 MW from announced facilities. Increases for 2011 through 2015 were summed for a total biomass generation increase of 150 MW. This figure was divided by the five years within the study, creating an average yearly demand of 30 MW.

Figure 12. Forecasted Biomass Electricity Generation by Year for Michigan



Cellulosic Ethanol Production Facility

Recently, Michigan has seen its corn ethanol plant construction slow and finally cease.[40] Five separately proposed projects had commenced project scoping and land acquisition across the state in the last several years, but these facilities have been tabled indefinitely or explicitly canceled. A variety of factors have affected this industry, most notably the current economic situation globally and nationally.[41]

Scientific research is moving from starch ethanol produced from the fruit and seed of plants (for example, a kernel of corn) to cellulosic ethanol produced from the entire plant. Examples of cellulosic ethanol feedstock are leaves, stem, and stalk from a corn plant.[42] One reason for this focus on cellulosic ethanol production is the current competition from corn production as a feedstock for fuel manufacturing and the demand for food and feed. In 2004, 3.4 billion gallons of corn ethanol was produced consuming 11 percent of the overall corn harvest for that year.[43] Cellulosic ethanol, on the other hand, is capable of utilizing a variety of feedstock, most of which are seen as byproducts or waste from other commercial enterprises.

[40] Bobeda (2009)
[41] Bobeda (2009)
[42] Natural Resources Defense Council (2006)
[43] Natural Resources Defense Council (2006)

This report utilizes the model developed by the National Renewable Energy Laboratory (NREL). This study is based on a 64.7 million gallons-per-year facility.[44] Capital costs are attributed to a next-generation plant, meaning the costs associated with the model take into account the learning curve associated with a facility after successful construction and operation of additional facilities.[45]

Component Mapping

The NREL study breaks out each stage of the production process into required components.[46] This extensive list of over 150 separate components has been simplified into equipment categories for purposes of this report. This simplification was done to enable component matching to NAICS codes. Pairings between components and NAICS codes was accomplished through a thorough review of the component schematics and the classification system.

Table 9. Cellulosic Ethanol Components with NAICS Codes

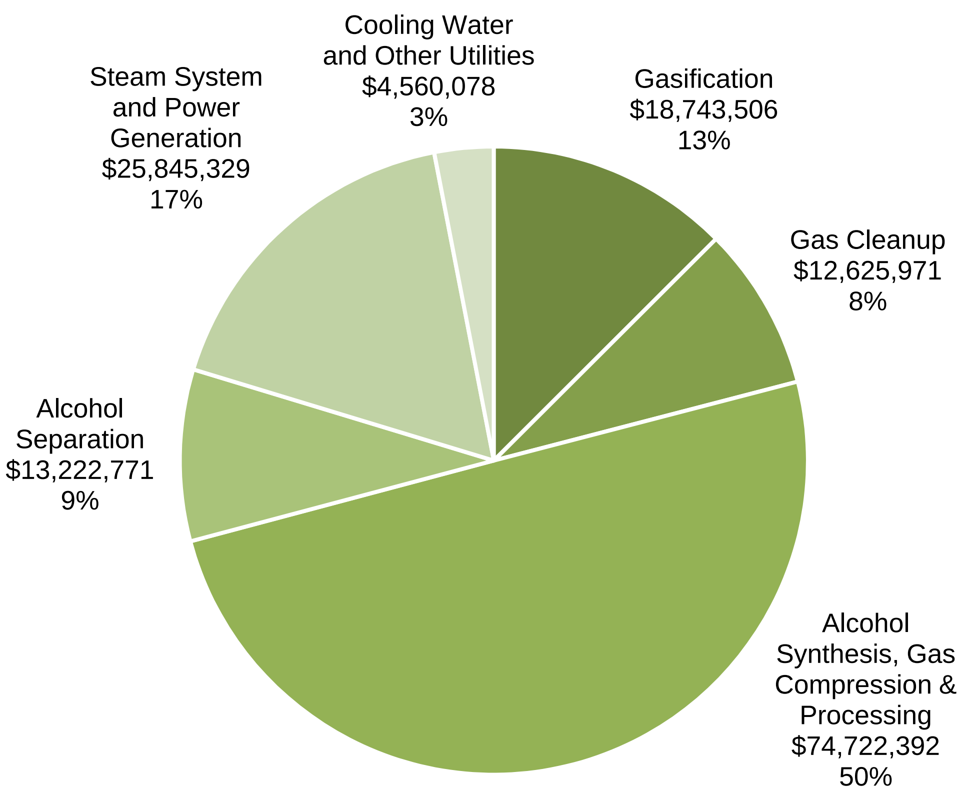
Component	Code Description	NAICS
Compressors	Compressor, air and gas	333912
Gas Compression	Gas liquefying machinery manufacturing	333298
Gas Compression	Gas separating machinery manufacturing	333999
Gasification System	Power boiler and heat exchangers	332410
Turbine	Turbine generator sets	333611
Heat Exchanger	Exchangers, heat, manufacturing	332410
Distillation	Distilling equipment	333298
Process Equipment	Industrial machinery manufacturing	333298
Refrigeration	Refrigeration compressors manufacturing	333415
Tanks	Tanks, heavy gauge metal, manufacturing	332420
Gas Clean-up	Industrial centrifugal fan	333412
Pumps	Industrial pumps	333911
Intercooler	Aftercoolers manufacturing	332410
Boiler	Power boiler and heat exchangers	332410
Scrubbers	Air washers (i.e., air scrubbers) manufacturing	333411
Steam	Steam separating machinery manufacturing	333999
Cooling	Cooling towers manufacturing	333415
Flue	Furnace flues, sheet metal, manufacturing	332322
Material Handling	Bulk material handling belt conveyors	333922
Filters	Filters, industrial and general line	333999

[44] Dotta, A. et al. (2011)
[45] Dotta, A. et al. (2011)
[46] Dotta, A. et al. (2011)

Component Cost Model

Component equipment costs are broken out by the cellulosic production process. Process steps are shown as a percentage of the overall capital costs. These percentages were calculated by allocating the process equipment total by the overall equipment costs provided by the NREL study.[47]

Figure 13. Cellulosic Processes Equipment as Percent of Total Cost



Capital costs attributed to the equipment are in 2007 dollars. Costs are provided by the NREL study.[48] As part of the IMPLAN model, device costs are scaled to the current year using deflator ratios.

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[47] Dotta, A. et al. (2011)
[48] Dotta, A. et al. (2011)

Forecast Model

Demand for the cellulosic ethanol production plant is calculated from the current projected increase in Michigan capacity. March 9, 2011, was the “unofficial” groundbreaking for the Alpena, Mich., biorefinery.[49] The Alpena plant is an American Process Inc. project that will produce 945,000 gallons of ethanol and 700,000 gallons per year of potassium co-product.[50] Michigan will be increasing its capacity for ethanol production with the opening of a new $350 million, 40 million-gallon-a-year cellulosic facility.

The Frontier Renewable Resources facility is projected to break ground within the next year.[51] These two projects add up to 41,945,000 gallons of increased capacity. In order to accurately estimate the costs associated with manufacturing systems for these projects, component costs were prorated based on the costs of a 64.7 million gallon facility and averaged over the five-year study period.[52] Development of the plants is assumed to take place exclusively within Michigan. The IMPLAN model allows for supplies and work to be conducted outside of the study region and then imported.

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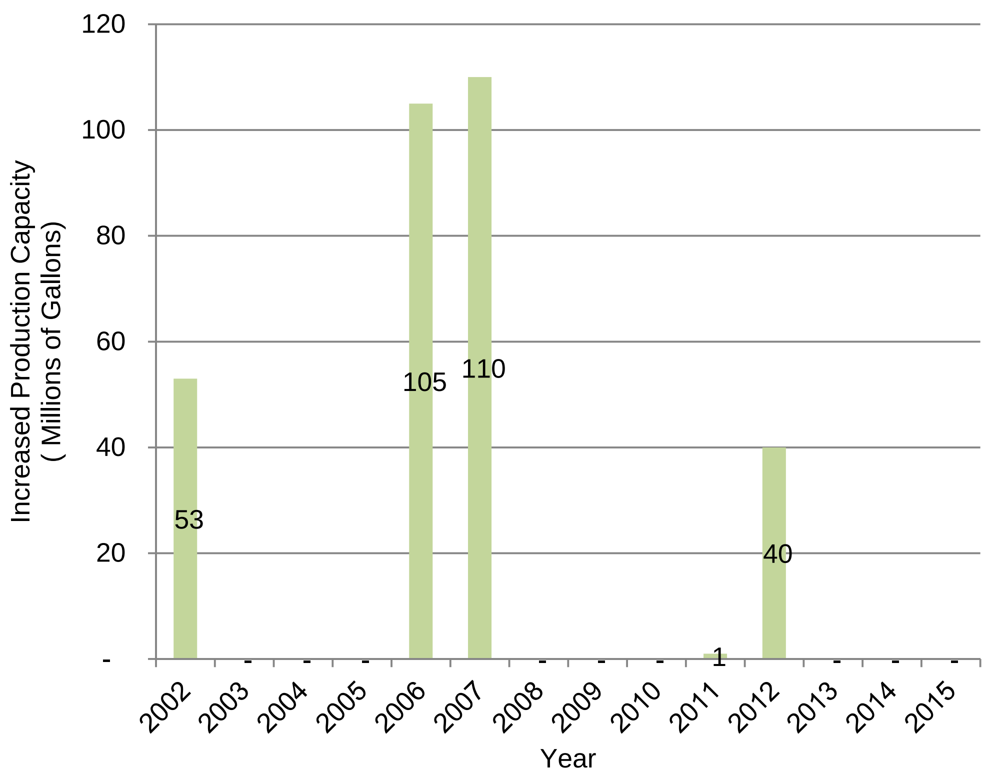
Figure 14. Forecasted Demand for Ethanol Production Plants by Year



[49] Alpenabiorefinery.com (2011)
[50] Alpenabiorefinery.com (2011)
[51] Galbraith (2011)
[52] Dotta, A. et al. (2011)

Solar

Solar energy is the most abundant resource on Earth. The sun delivers enough energy in 40 minutes to the surface of the Earth to satisfy worldwide energy consumption needs for an entire year.[53] With this massive amount of renewable energy, current technologies have successfully converted this energy into electricity for daily use.

Demand for photovoltaic panels within the United States is forecasted to grow to 1,190 MW by 2015.[54] Demand for polycrystalline silicon is forecasted to grow to 219,167 metric tons by 2015.[55]

If market demand and price for these devices meets forecasted expectations, and if Michigan firms are willing and able to produce the selected products and components, this study indicates the solar subsector could yield an average annual total economic output of $1,634,059,513. As a result of these activities, 6,249 jobs may be supported annually and $54,777,331 of local and state tax revenue may be realized.

Photovoltaic Panel

A variety of commercially-available solar technologies are being developed. Within the United States, technologies compete for government incentives, private investment, and public buy-in. The State of Michigan currently has 121 companies participating in the solar supply chain as installer, service providers, and manufacturers.[56] For the purposes of this study, the solar photovoltaic panel system has been chosen. Solar technologies not included within the scope of this study:

- Concentrated Solar
- Parabolic Trough
- Other Photovoltaic Technology

To account for the presence of the world's largest polycrystalline silicon supplier, Hemlock Semiconductor, within the state of Michigan this component is separately evaluated for its economic impact on the state.[57]

Component Mapping

The photovoltaic component map is based upon Renewable Energy Policy Project's (REPP) *Solar PV Development: Location of Economic Activity* report.[58] The report breaks the solar photovoltaic system in two components: module and balance of system. These components are further broken down into subcomponents to allow for identification of corresponding NAICS codes. For this economic impact study, the complete module as a component was removed

[53] Van Coppenolle, Loretta (2011)
[54] Energy Information Administration (2011)
[55] GlobalData (2011)
[56] Environmental Law and Policy Center (2011)
[57] Gunther, Edgar (2011)
[58] Sterzinger and Syrcek (2005)

from the list to allow the model to attribute impact from specific components, allowing for a greater level of detail.

Table 10. Photovoltaic Panel Components with NAICS Codes

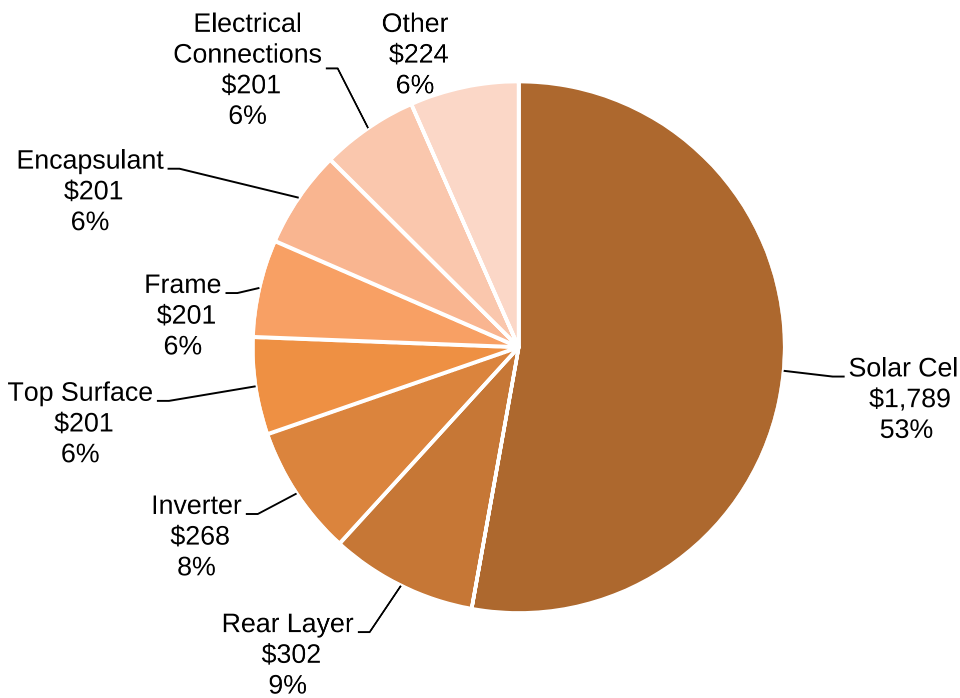
Component	Code Description	NAICS
Solar Cell	Semiconductor and related devices	334413
Rear Layer	Unlaminated plastics film and sheet	326113
Inverter	Electronic equipment and components	335999
Top Surface	Flat glass	327211
Frame	Sheet metal work	332322
Encapsulant	Plastic material and resin	325211
Electrical Connections	Current-carrying wiring device	335931
Batteries	Storage batteries	335911
Blocking Diode	Semiconductors and related devices	334413
Charge Controller	Electronic equipment and components	335999
Meter	Instrument manufacturing	334515
Switchgear	Switchgear and switchboard apparatus	335313
Wiring	Copper wire (except mechanical) drawing	331422

Component Cost Model

The REPP report further describes the photovoltaic panel in terms of component costs as a percentage of total system.[59] Utilizing the basis given in the REPP report, this study assumes that the balance of system including the batteries, blocking diode, charge controller, meter, switchgear, and wiring all contributed an equal percentage of the prescribed percentage. Similarly, the module packaging (estimated as 23 percent of total in the REPP report) was equally attributed to the components top surface glass, frame, encapsulant, and rear layer. For the inverter, solar cell and electrical connections, the original percentages provided by Sterzinger and Syrcek were included.

[59] Sterzinger and Syrcek (2005)

Figure 15. Photovoltaic System Cost and Percentage of Total Cost



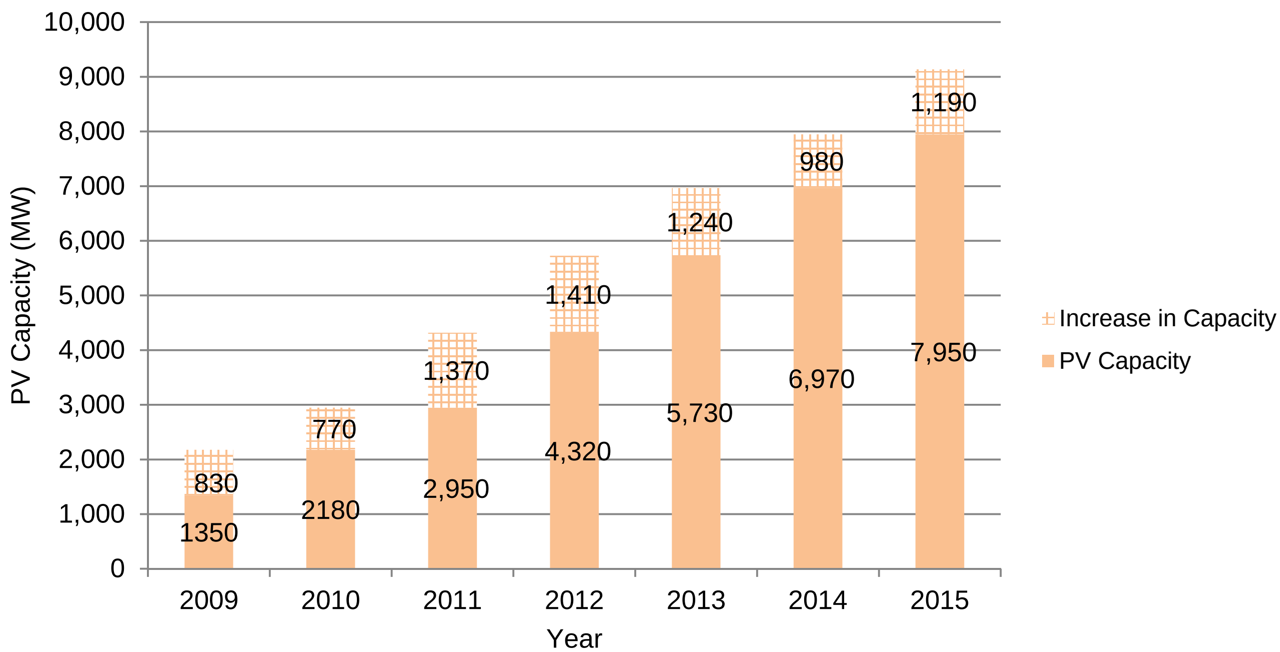
Component costs were calculated using the estimated percentages each component attributed to the costs per kW of panel produced. Using the current market cost per module of $2.65, according to the REPP percentages, the module composes 78 percent of the system cost.[60] This percentage is broken into the solar cells (67.5 percent), electrical materials (8.9 percent), and packaging (23.6 percent) and then attributed to the remaining. These figures allocate the remaining percentage of cost distributed to the balance of system and inverter. Total system costs per kW are $3,399.

[60] "Module Pricing" (2011)

Forecast Model

According to DOE forecasts for net summer capacity for the years 2010 through 2015, there will be an increase in United States capacity of roughly 6,190 MW of installed photovoltaic systems.[61] Using the current cost estimated for a 1 kW photovoltaic panel, there may be an overall investment of $21,010,175,521 within the industry in the next five years.

Figure 16. Photovoltaic Capacity and Increases by Year for the United States



According to *Solarbuzz*, the increased pricing pressure on solar photovoltaic manufacturers will continue within the global market in the near future. The current overcapacity of system manufacturers and the competition from Chinese producers add to this pressure.[62]

Demand for solar photovoltaic panel systems are calculated from the net summer forecasted United States capacity for the years 2011 through 2015, an estimated increase of 6,190 MW.[63] Increases in capacity assumed from year A to year B will be built within the year that is counted (year B in this example). These figures were averaged over the five years included in the forecast, creating an average yearly demand of 1,238 MW nationally. Taking the assumed Michigan market share of 3.8 percent multiplied by the calculated average United States demand results in the base scenario figure of 47 MW of manufactured photovoltaic panels within Michigan.

[61] Electric Power Annual (2011)
[62] Idrischler (2011)
[63] Energy Information Administration (2011)

Polycrystalline Silicon

A major component of photovoltaic panel is polycrystalline silicon. This silicon is historically utilized in semiconductors for computer chips and more recently in solar photovoltaic manufacturing.

Hemlock Semiconductors, the largest polycrystalline silicon manufacturer in the world, is located in Hemlock, Mich. This company is a joint venture between Dow Corning Corporation, Shin-Etsu Handotai Co., Ltd., and Mitsubishi Materials Corporation. Facilities are located in Hemlock and in Clarksville, Tenn.

Component Mapping

Since polycrystalline silicon is a component of the larger photovoltaic panel system, they are treated as such for cost and component classification.

Table 11. Polycrystalline Silicon Component with NAICS Code

Component	Code Description	NAICS
Polycrystalline Silicon	Silicon, ultra high purity	327992

Component Cost Model

Market conditions of increased supplier capacity and silicon oversupply have affected the price of polycrystalline silicon. Current producer prices on average are $33,000 per metric ton. This is down from a March 2008 high of $475,000 per metric ton. It is forecasted that prices will realign with their 2003 prices of $30,000 per ton by the close of the year. [64]

Table 12. Polycrystalline Silicon Component for Model as Percentage

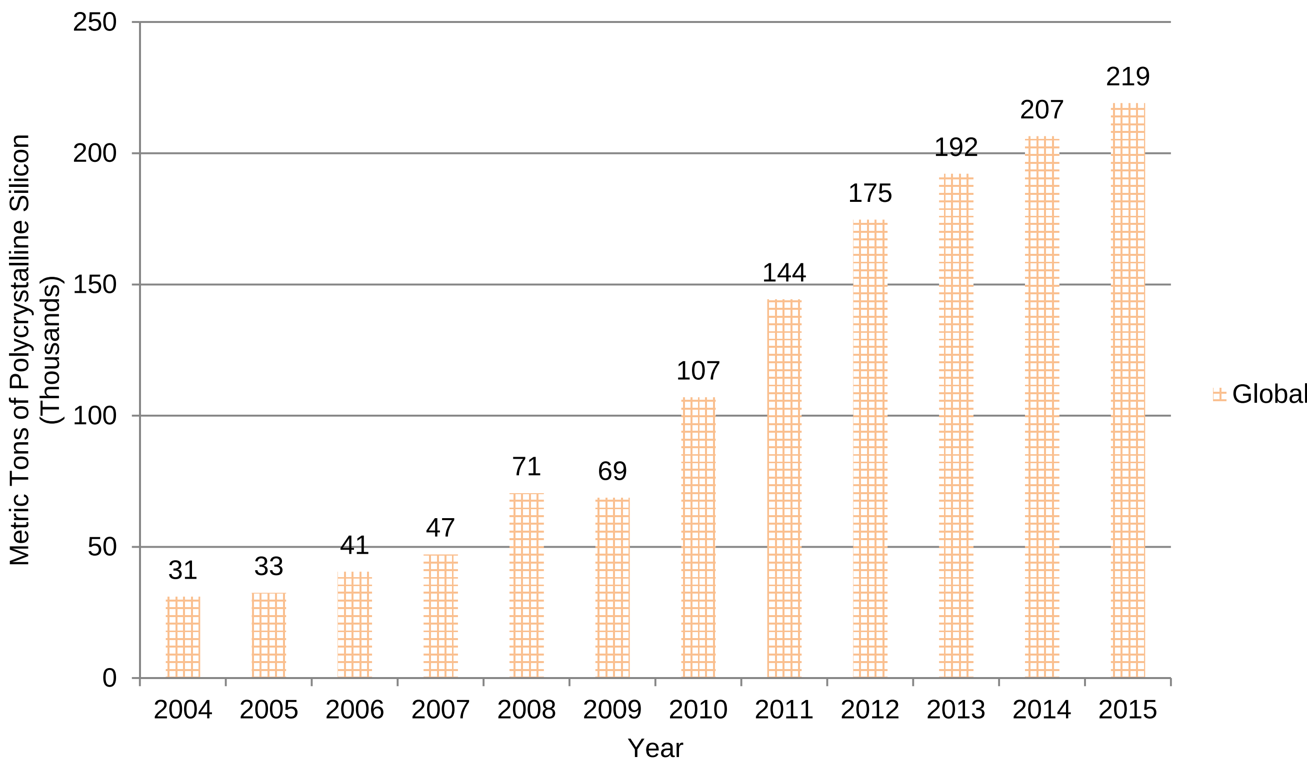
Component	Code Description	Cost %	Cost
Polycrystalline Silicon	Silicon, ultra high purity	100%	$33,000

[64] Roca, Marc and Stills, Ben (2011)

Forecast Model

Global forecasted demand for silicon is projected to increase through 2015. The total market is expected to increase from $6.21 billion in 2010 to $7.89 billion in 2015.[65] Issues of over capacity and supply as well as the competition between semiconductor and photovoltaic consumers will continue to affect prices in the near future.[66]

Figure 17. Forecasted Polycrystalline Silicon Demand by Year



Hemlock Semiconductor is the largest polycrystalline silicon supplier in the world, this study takes into account the capacity for the Hemlock plant.[67] Current capacity for the Michigan facility is 27,500 metric tons per year. Increases in capacity came online in 2009; additional plant development is planned and is not accounted for in this study.

Demand for polycrystalline silicon is calculated from the global forecasted demand 2010 through 2015, an estimated annual average of 174,038 metric tons.[68] The photovoltaic industry utilizes 90 percent of the current market making the quantity needed in solar manufacturing at 156,634 metric tons per year on average.[69] Taking the estimated Hemlock market share of 14.7 percent multiplied by the calculated average global demand, results in the base scenario figure of 23,025.3 metric tons of manufactured polycrystalline silicon within Michigan.[70]

[65] GlobalData (2011)
[66] Roca, Marc and Stills, Ben (2011)
[67] Gunther, Edgar (2011)
[68] GlobalData (2011)
[69] Roca, Marc and Stills, Ben (2011)
[70] GlobalData (2011)

Wind

Wind is currently the fastest growing alternative energy source in the world.[71] Within the United States, wind has also been the fastest growing source of new electricity power generation.[72] An increase in power generation leads to an increase in generation capacity and increased manufacturing of wind turbines. Total capacity in the United States in 2008 was 24,651 MW compared to the 34,296 MW available in 2009.[73] This is an increase of 9,645 MW of capacity or 6,430 1.5 MW turbines. Michigan's current wind turbine supply chain consists of more than 31 component manufacturers.[74]

Demand for wind turbines is forecasted to grow the United States' generation capacity to 50,550 MW by 2015. If market demand and price for these devices meet forecasted expectations, and if Michigan firms are willing and able to produce the selected products and components, this study indicates the Wind subsector could yield an average annual total economic output of $468,612,902. As a result of these activities, 1,977 jobs may be supported annually and $14,582,477 of local and state tax revenue may be realized.

Wind Turbines

Turbines were selected as the sole manufactured good under the subsector of wind. Specifically, the utility-sized 1.5 MW horizontal-axis turbine was selected because of its current basic design and its position as a base for future development for the wind industry.[75] Other wind harnessing technology does exist and is manufactured within the State of Michigan. For the purposes of this study, the most prevalent device within the industry was selected. The following are examples of technology not included:

- Small scale wind turbines
- Vertical-axis wind turbines
- Offshore wind turbines
- Additional turbines sizes .75 MW to 3+ MW

Component Mapping

NREL's *Wind Turbine Cost and Scaling Model* study offers a subcomponent map of the wind turbine and a breakout of component costs.[76] The 2006 report focused on the wind turbine components and subcomponents in an effort to quantify the potential costs and impacts an increase in wind energy production. The report breaks the wind turbine into four components and 16 subcomponents. NREL then matches these components and subcomponents to specific NAICS codes, reported in Table 11. Subcomponents are further broken down into smaller components, allowing for a greater degree of detail in the assessment of the wind turbine. In comparison to the REPP report, the rotor component is broken into three

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[71] Wood, Laura (2009)
[72] Electric Power Annual (2011)
[73] Electric Power Annual (2011)
[74] Wind Energy Facts: Michigan (2011)
[75] Efiong, Asari and Crispin, Andrew (2007)
[76] Fingersh, L, et al (December 2006).

subcomponents and nine specific materials by NREL compared to four subcomponents and materials.

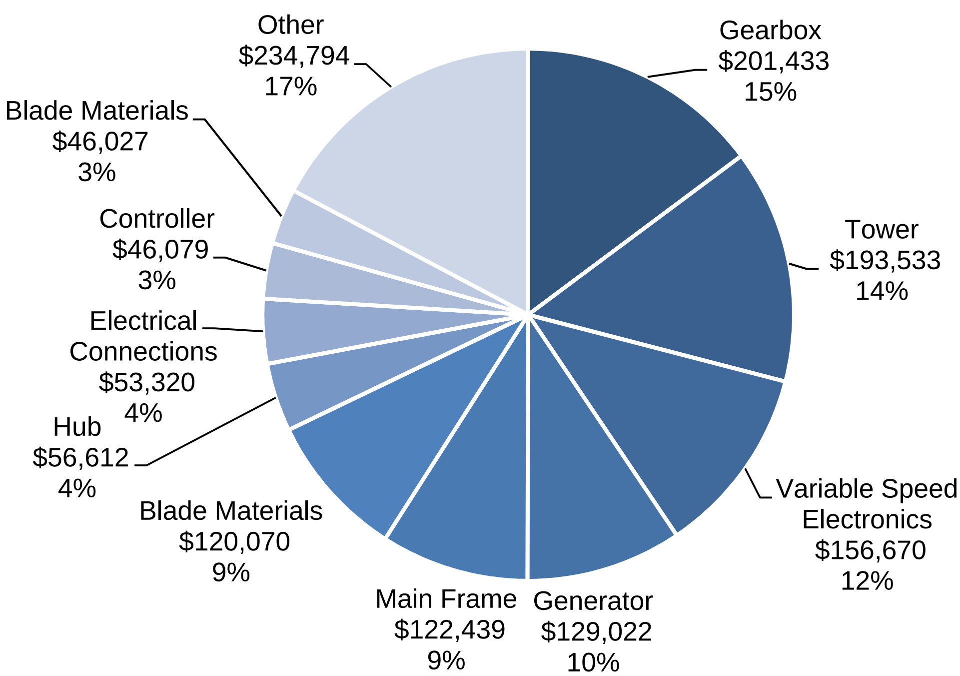
Table 13. Wind Turbine Components with NAICS Codes

Component	Code Description	NAICS
Blade Materials	All other plastic products	326199
	Vinyl type adhesives	325520
	Other fasteners	332722
	Urethane/foam products	326150
Hub	Ductile iron castings	33151
Pitch Mechanisms and Bearing	Bearings	332991
	Drive motors	335312
	Speed reducer	333612
	Control drive	334513
Low-speed Shaft	Cast carbon steel casings	33151
Bearings	Bearings	332991
Gearbox	Industrial high-speed drive and gear	333612
Mechanical Brake, High-speed Coupling	Motor vehicle brake parts/assemblies	333613
Generator	Wind powered turbine generator sets manufacturing	333611
Variable Speed Electronics	Relay and industrial control manufacturing	335314
Yaw Drive and Bearing	Drive motors	335312
	Ball and roller bearings	332991
Main Frame	Ductile iron castings	33151
Electrical Connections	Switchgear and switchboard apparatus	335313
	Power wire and cable	335929
Hydraulic System	Fluid power cylinder and actuators	333995
Nacelle Cover	Fiberglass fabric	326199
	Vinyl type adhesives	325520
Controller	Controller and device, industrial process control	334513
Tower	Rolled steel shape manufacturing - primary products	332312

Component Cost Model

The NREL report matches specific components and subcomponents to manufacturing and installation costs. These costs are estimated in 2002 dollars. As part of the IMPLAN model, device costs are scaled to the current year using deflator ratios. For the purposes of this study, only turbine capital costs are taken into account. Subcomponents are separated into the individual component materials to achieve the greatest level of detail.

Figure 18. Wind Turbine Component Cost and Percent of Total Cost



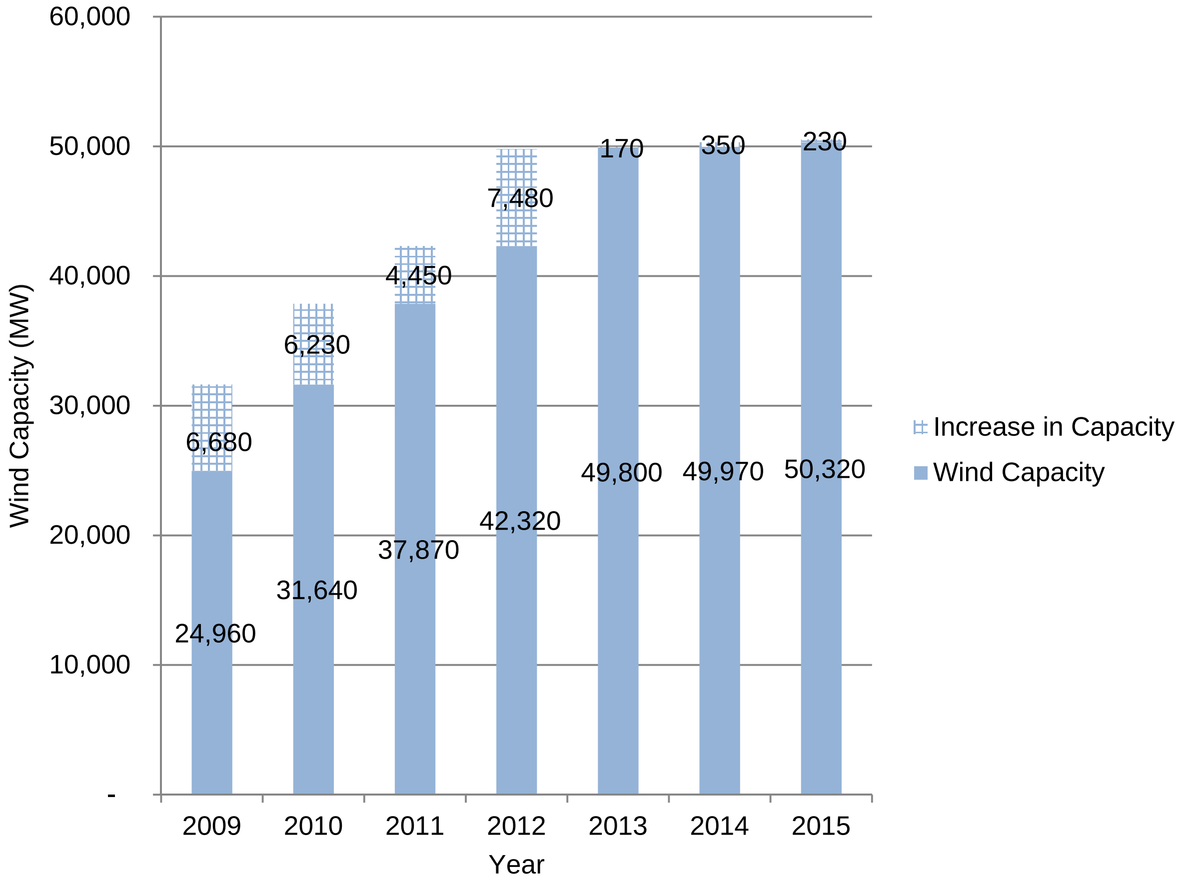
To accurately reflect current costs associated with wind turbine manufacturing, the percentages provided above have been multiplied by the current estimate for onshore wind turbines resulting in a cost of $1,360,000 per MW, according to Bloomberg New Energy Finance Report.[77]

[77] Feinberg, Sarah (2011)

Forecast Model

According to the EIA forecasts for net summer capacity for the years 2010 through 2015, there will be an increase of roughly 12,680 MW of installed wind turbine capacity.[78]

Figure 19. Wind Turbine Capacity and Increases by Year for the United States



Demand for the wind turbine is calculated from the net summer forecasted United States capacity for the years 2011 through 2015, an estimated increase of 12,680 MW.[79] Increases in capacity assumed from year A to year B will be built within the year that is counted (year B in this example). These figures were averaged over the five years included in the forecast, creating an average yearly demand of 2,536 MW nationally. Taking the assumed Michigan market share of 3.8 percent multiplied by the calculated average United States demand results in the base scenario figure of 96.3 MW of manufactured wind turbines within Michigan.

[78] Electric Power Annual (2011)
[79] Energy Information Administration (2011)

ESTIMATING ECONOMIC IMPACT

Overview of Model

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

IMPLAN is a software and data package which 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 increases in firm spending that result from additional purchases of components for in-demand wind turbines, solar panels, biomass conversion devices, or advanced energy storage devices within the scope of this study.

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 new purchases of steel and plastics by firms producing in-demand wind turbines or other new energy devices within this study scope.

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 increased spending by individuals employed by steel, plastic, and wind turbine manufacturing companies or other new energy component or final product manufacturers within the study scope.

Total economic impact is the sum of direct, indirect, and induced economic impacts for the new energy 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 new energy sector. This model assumes forecasted demand for new energy manufacturing will be met by Michigan manufacturers. The estimated average forecasted demand in the base market share scenario represents a case in which Michigan's new energy manufacturers capture a specific set of the United States and global market share. This is an averaged market share over the span of 2011 to 2015, considered the scope of this report.

Market share for the base scenario is set at 3.8 percent of forecasted demand for stationary fuel cell, portable fuel cell and lithium-ion battery devices, and wind, and solar subsectors based on Michigan's manufacturing GDP compared to United States GDP. Michigan's electric vehicle proportion is estimated to compare to the current automotive market share of 24 percent. Biomass market share in Michigan is estimated at 100 percent of capacity increases. Polycrystalline silicon produced within Michigan is estimated at 14.7 percent.

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 device. This scenario is a greater than expected view of Michigan's market share of manufactured new energy products. Greater than expected market share could occur if the State's manufacturers captured a greater percentage of the United States and global market.

Lower than Expected Market Share scenario is derived from the base case. The lower than expected market share decreased Michigan's market share of forecasted estimates by 25 percent of original market share, which varies by device. This scenario is a less than expected view of Michigan's market share of manufactured new energy products. Less than expected market share could occur if the State's manufacturers captured a smaller percentage of the United States and global 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, total output, and tax impact.

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.[80]

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.[81]

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.[82]

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.

Scenario summaries found on the following pages show the potential impact new energy manufacturing potential has on the Michigan economy. This analysis indicates that the selected manufacturing activities as a whole could potentially have an impact of $4,935,433,759 on

[80] MIG Inc. (2011)
[81] MIG Inc. (2011)
[82] MIG Inc. (2011)

Michigan, including 20,791 jobs supported and $163,682,339 in local and state tax revenues. Economic impact varies by subsector and device for a variety of reasons. Mature industries with well-established local supply chains, such as electric vehicle and wind turbine manufacturing, are shown to have a greater economic impact on Michigan. Nascent industries with lower demand and evolving supply chains, such as fuel cells and biomass, 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.

The summary of impacts for the base market share scenario shows a total output of $4,935,433,759 and 20,791 jobs supported. In terms of positions supported, the induced effect supports more jobs than the indirect effect and slightly more positions than the direct effect. See Table 14 for additional base market share impacts.

Table 14. Summary of Base Market Share Scenario Impacts

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	6,786	$628,036,560	$1,154,122,294	$2,850,441,348
Indirect Effect	6,009	$363,758,866	$611,859,877	$1,125,737,913
Induced Effect	7,996	$316,404,669	$577,762,827	$959,254,498
Total Effect	20,791	$1,308,200,095	$2,343,744,998	$4,935,433,759

State and local tax revenue based on the base market share scenario totals $163,682,339. 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 new energy manufacturing industry. Table 15 lists the state and local tax and federal tax by the specific contributors.

Table 15. Summary of Base Market Share Tax Impacts

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Total Federal Tax	$152,544,388	$4,577,850	$21,069,521	$65,527,198	$36,252,932
Total State and Local Tax	$3,021,909	--	$116,694,553	$18,206,613	$25,759,264

Table 16 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 employment supported, this scenario reports increases to $6,171,434,550 and 25,997 respectively.

Table 16. Summary of Greater Than Expected Market Share Scenario Impacts

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	8,485	$785,304,619	$1,443,302,524	$3,564,257,154
Indirect Effect	7,514	$454,859,425	$765,108,340	$1,407,702,668
Induced Effect	9,998	$395,639,950	$722,448,461	$1,199,474,728
Total Effect	25,997	$1,635,803,994	$2,930,859,325	$6,171,434,550

Greater than expected market share will result in state and local tax revenue of $204,675,242. Federal tax and state and local tax impacts are given in greater detail in Table 17.

Table 17. Summary of Greater Than Expected Market Share Tax Impacts

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Total Federal Tax	$190,743,340	$5,725,010	$26,345,394	$81,936,797	$45,339,127
Total State and Local Tax	$3,778,631	--	$145,915,222	$22,765,992	$32,215,397

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 $3,699,173,884. Employment supported is 15,585 and total value added to Michigan is $1,756,552,680. Less than expected market share scenario results are detailed in Table 18.

Table 18. Summary of Less Than Expected Market Share Scenario Impacts

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	5,088	$470,755,706	$864,918,899	$2,136,463,030
Indirect Effect	4,503	$272,637,226	$458,576,354	$843,709,401
Induced Effect	5,993	$237,158,564	$433,057,426	$719,001,453
Total Effect	15,585	$980,551,496	$1,756,552,680	$3,699,173,884

Total state and local tax revenue for the less than expected market share scenario is $122,683,642. Table 19 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 19. Summary of Less Than Expected Market Share Tax Impacts

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Total Federal Tax	$114,340,381	$3,430,473	$15,792,881	$49,115,351	$27,165,595
Total State and Local Tax	$2,265,087	--	$87,469,624	$13,646,611	$19,302,320

Figure 20 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. The greater than expected market share scenario does not increase at the same scale over the base case as the increase from less than expected to base case. Multiple reasons can be attributed to the decreased degree of impact from base scenario to greater than expected market share scenario.

Figure 20. Total Average Annual Output by Scenario

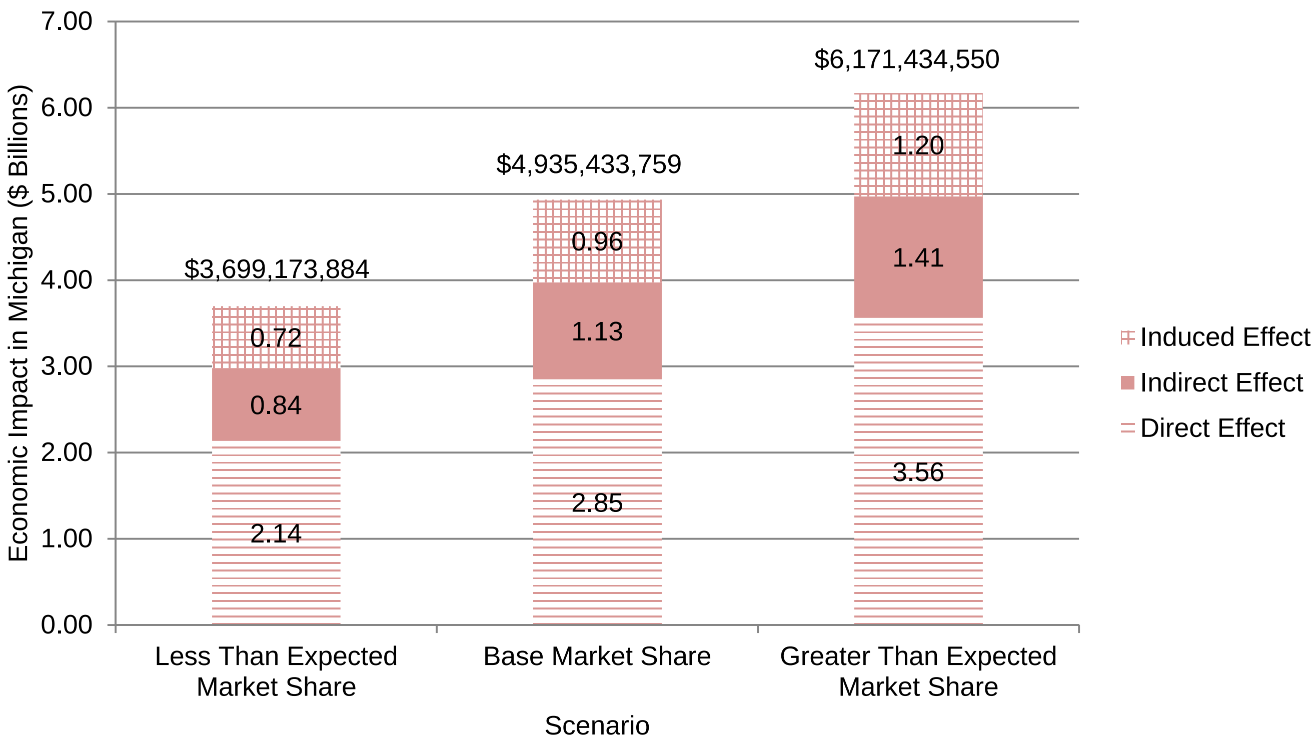


Table 20 shows the summary of impacts associated with the base market share scenario by device. As this data indicates, the electric vehicle device manufacturing process will have the greatest impact on Michigan compared to the other manufacturing activities studied.

Table 20. Summary of Base Case Market Share Impacts by Device

Device	Impact Type	Employment	Labor Income	Total Value Add	Output
Electric Vehicle Components	Direct Effect	3,847	$283,006,675	$455,737,616	$1,296,685,796
	Indirect Effect	2,537	$162,262,463	$266,538,692	$491,795,783
	Induced Effect	3,586	$141,938,929	$259,166,116	$430,316,171
	Total Effect	9,970	$587,208,050	$981,442,424	$2,218,797,723
Stationary Fuel Cell	Direct Effect	4	$288,964	$419,943	$1,223,382
	Indirect Effect	3	$185,322	$322,100	$578,189
	Induced Effect	4	$151,379	$276,433	$458,943
	Total Effect	11	$625,665	$1,018,476	$2,260,515
Portable Fuel Cell	Direct Effect	7	$484,428	$621,072	$1,697,300
	Indirect Effect	4	$241,696	$402,095	$655,466
	Induced Effect	6	$231,472	$422,644	$701,752
	Total Effect	17	$957,595	$1,445,811	$3,054,518
Lithium-ion Battery	Direct Effect	686	$81,594,777	$122,612,767	$297,238,103
	Indirect Effect	557	$30,685,224	$53,061,424	$91,632,757
	Induced Effect	904	$35,664,213	$65,317,299	$108,455,916
	Total Effect	2,147	$148,054,213	$240,991,490	$495,326,777
Biomass Gasification	Direct Effect	80	$11,868,273	$23,967,909	$45,131,159
	Indirect Effect	100	$5,681,962	$9,013,340	$16,348,484
	Induced Effect	142	$5,599,741	$10,225,399	$16,976,955
	Total Effect	321	$23,149,976	$43,206,649	$78,456,598
Cellulosic Ethanol	Direct Effect	19	$1,614,099	$2,923,998	$20,620,285
	Indirect Effect	45	$2,675,007	$4,448,863	$8,090,319
	Induced Effect	35	$1,370,346	$2,502,610	$4,154,609
	Total Effect	99	$5,659,452	$9,875,471	$32,865,213
Photovoltaic Panel	Direct Effect	432	$29,831,916	$52,947,191	$133,987,193
	Indirect Effect	368	$23,243,825	$37,654,313	$67,654,904
	Induced Effect	428	$16,940,902	$30,935,884	$51,360,660
	Total Effect	1,229	$70,016,643	$121,537,388	$253,002,756
Polycrystalline Silicon	Direct Effect	1,078	$158,817,972	$393,763,366	$784,554,318
	Indirect Effect	1,816	$104,392,163	$183,022,876	$341,543,109
	Induced Effect	2,126	$84,095,128	$153,579,882	$254,959,330
	Total Effect	5,020	$347,305,263	$730,366,124	$1,381,056,757
Wind Turbine	Direct Effect	633	$60,529,475	$101,128,431	$269,303,839
	Indirect Effect	578	$34,391,204	$57,396,174	$107,438,902
	Induced Effect	766	$30,302,560	$55,336,560	$91,870,161
	Total Effect	1,977	$125,223,239	$213,861,165	$468,612,902
Total New Energy Mfg.	Direct Effect	6,786	$628,036,560	$1,154,122,294	$2,850,441,348
	Indirect Effect	6,009	$363,758,866	$611,859,877	$1,125,737,913
	Induced Effect	7,996	$316,404,669	$577,762,827	$959,254,498
	Total Effect	20,791	$1,308,200,095	$2,343,744,998	$4,935,433,759

Device contributions to overall impact of the new energy subsector vary. Mature industries with well-established local supply chains, such as electric vehicle and wind turbine manufacturing, are shown to have a greater economic impact on Michigan. Nascent industries with lower demand and evolving supply chains, such as fuel cells and biomass, have less impact.

The impact derived from the electric vehicle category is a large portion of the total impact Michigan is forecasted to experience given the base case market share. As part of the base scenario for the manufactured electric vehicles in the United States, Michigan was attributed a higher market share based on research. Electric vehicles and Michigan's portion of the manufacturing industry are supported by an established and fully mature automotive industry. Electric vehicles benefit from the relationship and partnerships of current manufacturers and suppliers. A robust supply chain has the possible positive effect of increasing market share. Michigan's automotive supply is an example of an agglomeration industry, a strategic grouping of automotive manufacturers and suppliers allowing for efficiencies of scale and transport because of the proximity of location. This mutual arrangement is to the mutual benefit of suppliers and manufacturers in reducing costs, increasing collaboration, and process innovation. Figure 21 compares the impact of each device.

Figure 21. Total Output for Base Case Market Share Scenario by Device

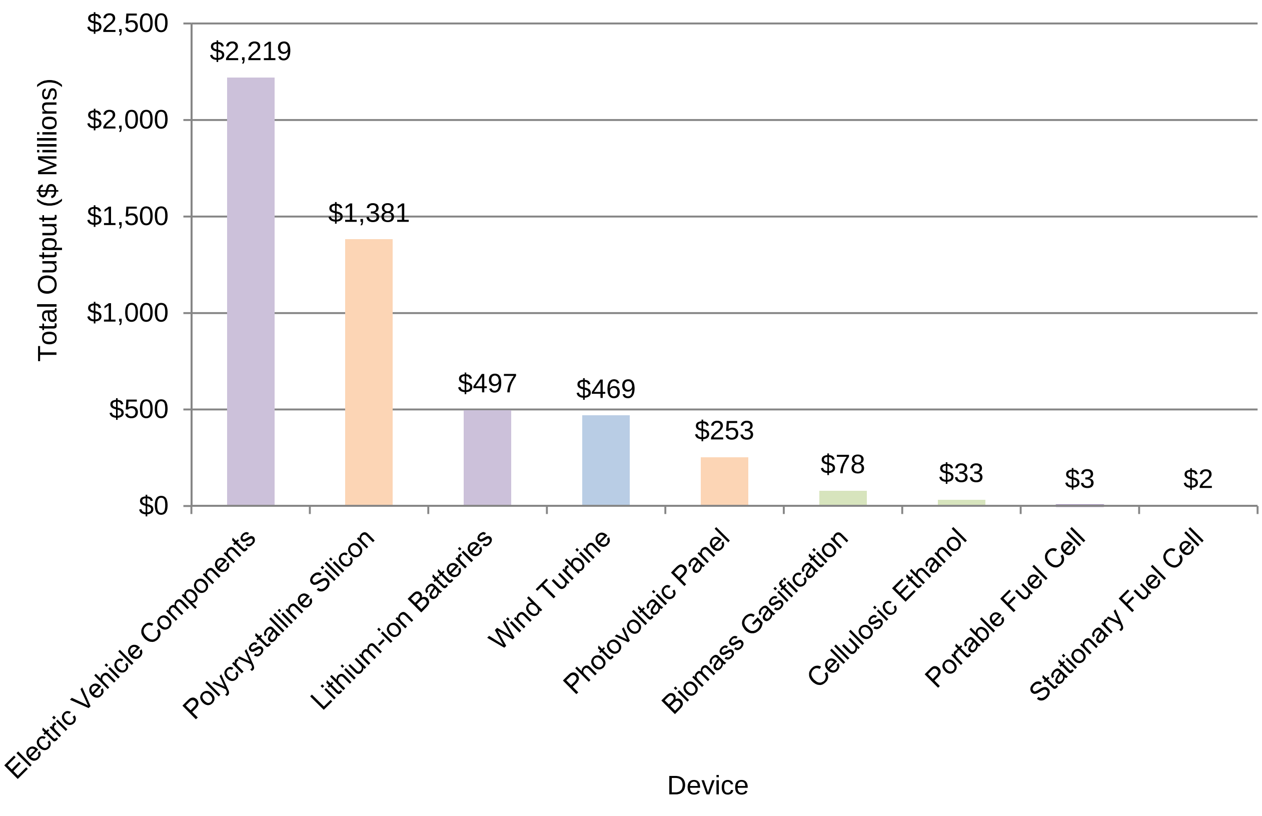


Table 21 is a listing of the tax impacts of each new energy device. These impacts are a detailed account of the base case scenario effects. It is useful to understand the potential revenue effects each subsector and device will have on the Michigan economy.

Table 21. Summary of Base Case Tax Impacts by Device

Device	Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Electric Vehicles (Unique Components)	Total Federal Tax	$69,444,523	$1,631,549	$9,700,348	$29,379,835	$13,358,234
	Total State and Local Tax	$1,375,698	--	$53,725,841	$8,163,134	$9,491,599
Stationary Fuel Cell	Total Federal Tax	$72,336	$2,459	$9,947	$31,360	$13,236
	Total State and Local Tax	$1,433	--	$55,093	$8,713	$9,404
Portable Fuel Cell	Total Federal Tax	$113,211	$2,677	$14,193	$47,913	$15,967
	Total State and Local Tax	$2,243	--	$78,606	$13,312	$11,345
Lithium-ion Battery	Total Federal Tax	$17,660,686	$345,427	$2,449,643	$7,402,443	$3,106,083
	Total State and Local Tax	$349,859	--	$13,567,464	$2,056,755	$2,207,005
Biomass Gasification	Total Federal Tax	$2,692,230	$84,146	$284,247	$1,159,818	$734,851
	Total State and Local Tax	$53,333	--	$1,574,313	$322,253	$522,143
Cellulosic Ethanol	Total Federal Tax	$642,302	$27,477	$97,246	$284,081	$144,569
	Total State and Local Tax	$12,724	--	$538,603	$78,931	$102,723
Solar Photovoltaic	Total Federal Tax	$8,089,845	$277,462	$1,282,834	$3,509,647	$1,741,731
	Total State and Local Tax	$160,260	--	$7,105,038	$975,149	$1,237,575
Polycrystalline Silicon	Total Federal Tax	$39,408,102	$1,689,807	$5,360,534	$17,433,557	$14,052,884
	Total State and Local Tax	$780,676	--	$29,689,573	$4,843,882	$9,985,178
Wind Turbine	Total Federal Tax	$14,421,163	$516,846	$1,870,530	$6,278,543	$3,085,376
	Total State and Local Tax	$285,684	--	$10,360,019	$1,744,482	$2,192,292
Total New Energy Sector	Total Federal Tax	$152,544,388	$4,577,850	$21,069,521	$65,527,198	$36,252,932
	Total State and Local Tax	$3,021,909	--	$116,694,553	$18,206,613	$25,759,264

In order to understand the estimated impacts in the context of Michigan's existing economy, Table 22 compares the base case market share scenario results to overall Michigan Gross Domestic Product (GDP) for 2010 and the Michigan manufacturing GDP for 2010, the most recent data available.[83]

Table 22. Comparison of Estimated Impact Compared to Michigan GDP Figures

	Base Scenario Total Economic Impact	Percent of Total Michigan GDP 2010 ($384,171,000,000)[84]	Percent of Total Michigan Manufacturing GDP 2010 ($65,087,000,000)[85]
Electric Vehicle (Unique Components)	$2,218,797,723	0.578%	3.409%
Stationary Fuel Cell	$2,260,515	0.001%	0.003%
Portable Fuel Cell	$3,054,518	0.001%	0.005%
Lithium-ion Battery	$497,326,777	0.129%	0.764%
Biomass Gasification System	$78,456,598	0.020%	0.121%
Cellulosic Ethanol Production Facility	$32,865,213	0.009%	0.050%
Photovoltaic Panel	$253,002,756	0.066%	0.389%
Polycrystalline Silicon	$1,381,056,757	0.359%	2.122%
Wind Turbine	$468,612,902	0.122%	0.720%
TOTAL	$4,935,433,759	1.285%	7.583%

[83] United States Department of Commerce, BEA (2010)
[84] United States Department of Commerce, BEA (2010)
[85] United States Department of Commerce, BEA (2010)

CONCLUSION

The conversation on new energy is most often in the context of environmental stewardship. While this conversation is important and worthwhile, it often fails to acknowledge the economic impacts that can arise from investments in new energy industries. As this and other studies have shown, however, there is real and tangible economic benefit associated with new energy industry activities, particularly in manufacturing.

In Michigan, unrivaled in its manufacturing prowess, there is great opportunity to leverage an existing core of manufacturers, a highly-skilled workforce, and strong industrial supply chains to build the devices and components integral to the new energy industry.

Global, national, and state-level demand for new energy from advanced energy storage, biomass, solar, and wind is forecasted to grow significantly by 2015. To meet this demand, manufacturers will be called upon to build new turbines, photovoltaic panels, biomass conversion and biofuel development systems, electric vehicles, lithium-ion batteries, and stationary and portable fuel cells, to name a few.

Michigan has pursued strategies to position itself as the go-to region for these devices and their components. State-level programs to encourage investment in these sectors, re-trained manufacturing workers, and renovated manufacturing facilities have all supported entry into these markets by new firms or existing firms seeking to diversify their products. Today, Michigan has a strong base of these firms, many of which are significant contributors to state, national, and global new energy markets, all of which have an economic impact on Michigan's economy.

The sample of manufactured devices and their components within the scope of this study represents a fraction of all new energy products that could be manufactured within Michigan now and in the future and only a portion of the overall device life cycle. Input-output economic impact analysis of this sample of devices indicates that the associated manufacturing activities alone could potentially impact Michigan through $4,935,433,759 of total output, including 20,791 jobs supported and $163,682,339 in local and state tax revenues, according to the base market share scenario.

Economic impact differs by subsector and device for a variety of reasons. Mature industries with well-established local supply chains, such as electric vehicle and wind turbine manufacturing, are shown to have a greater economic impact on Michigan. Industries with lower projected demand and evolving supply chains, such as fuel cells and biomass, have less of an overall impact on the Michigan GDP compared to mature devices with established supply chains and demand within the state.

There are several approaches Michigan may take to build on its current strengths and encourage the growth of new energy manufacturing within its borders. Mild interventions such as education campaigns promoting new energy and new energy manufacturing may support continued interest in this sector. Enhancing the conversation to focus on economic impacts, not just environmental impacts, may codify support for new energy from otherwise uninterested 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 new energy manufacturing. Very direct interventions such as the ongoing Renewable Portfolio Standard (RPS) mandating that 10 percent of all Michigan's energy resources come from new and renewable energy markets by 2015 may stimulate manufacturers to increase production of devices to meet that threshold. Recognizing the current national-level debate over the efficacy of government investment in emerging new energy markets, these approaches and potential strategies should be considered in the context of likely return on investment for the state.

As policy makers, industry leaders, and other stakeholders begin to understand the economic impact from this sample of manufactured new energy devices and components and plan for the future of Michigan's economy, the following are potential considerations:

1. Specific new energy subsectors and devices may offer more promise than others in terms of overall economic impact. The device comparisons of economic impact show a significant potential impact from electric vehicles, a portion of the advanced energy subsector. It is reasonable to assume capitalizing on the current strengths and finding opportunities for traditional manufacturing to collaborate with new energy will yield greater impact results.

2. Policy aimed towards development of an agglomeration economy, similar to automobile manufacturing, leveraging production and intellectual assets can make Michigan the hub of new energy 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 new energy 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.[86]

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 trade association for new energy manufacturers may help enhance collaboration, standardization, and success among Michigan's many new and incumbent firms participating in manufacturing activities for new energy devices and their components.

6. A state-level strategy regarding new energy markets should be developed proactively. Any and all strategies should be developed and evaluated in the context of return on investment.

[86] O'Gorman, Colm and Kautonen, Mika (2004)

7. Demand for new energy devices is expected to grow, in part due to the volatility with incumbent energy markets and continued focus on sustainability. This appears promising; however, changes in demand for new energy devices will drive economic activity and resulting economic impact. If market demand for these devices 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 A: RESEARCH LIMITATIONS

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

- Specific devices selected to represent the four subsectors are a sample of the current technology and manufacturing activity within the new energy sector. The rationale for selecting a sample of devices rather than an entire industry is twofold. It allows for an uncomplicated portrayal of the affect the industry is having on the economy, and the new energy manufacturing sector is currently undefined. A project between the United States Bureau of Labor and Statistics and the Census Bureau is attempting to define the industry.

- 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 subsectors, devices, and components. Assumptions made by primary researchers are reflected in this study.

- Varying configurations of product and system processes are available within the industry. Devices chosen to represent the subsectors do not reflect an endorsement by this study.

- Transportation, on-site assembly, and installation are not included in the device costs in many cases. Removal of these aspects of component price allowed for a clearer view of the manufacturing activity involved in the new energy sector.

- Data used for final demand figures was cited from current reliable sources. 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 new energy manufacturing devices may skew specific yearly forecasts; however, the average values are critical to assessing economic impact in an efficient manner.

- The study relies heavily on secondary data as of a lack of primary data was available to researchers. By relying on secondary sources of data, the study assumes the regions studied within sources are similar to the current Michigan manufacturing environment. Primary data would have allowed for a greater degree of definition of the Michigan new energy manufacturing industry. Modification of the IMPLAN industry margins, ratios, and percentages may allow for the creation of a more exact model should primary data become available.

- Public policy within Michigan and the United States is continuously changing and evolving. The policies covered in this report are currently affecting the new energy manufacturing industry in Michigan. Newly elected officials have proposed large revisions to the current incentive system, moving from focused attention on a select group of industries, including new energy, to a broader perspective on business development. This new viewpoint of investing in business will include new energy sector as well as other industries.

- Model employment and output figures do not take into account the current research and development that is taking place within the State of Michigan. The state currently conducts a wide range of research in universities, private firms, and public institutions. The employment and investment in this area is not calculated as part of this study but may have a correlated effect on the industry.

- 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 new energy specific.

APPENDIX B: POLICY OVERVIEW

There are many potential state-level policy considerations to support new energy manufacturing in Michigan. Various degrees of policy intervention are available to stimulate or encourage growth in new energy manufacturing.[87] Mild intervention, such as education campaigns promoting new energy and new energy manufacturing, may support continued interest in this sector. Enhancing the conversation to focus on economic impacts, not just environmental impacts, may help diversify supporters. More direct intervention such as incentive programs for new entrants, re-tooled incumbents, or local supply chain sourcing could help bolster Michigan's participation in new energy manufacturing. Very direct intervention, such as the ongoing Renewable Portfolio Standard (RPS) mandating that 10 percent of all Michigan's energy resources come from new and renewable energy markets by 2015, may force manufacturers to increase production of devices to meet the RPS threshold.

Detailed information on Michigan's existing incentive programs (mild policy interventions) follows. While the state-level policies included in this section currently exist in Michigan, significant changes are expected to occur under new state leadership. Potential changes include the elimination of the Michigan Business Tax and several tax credit programs. Tax credit programs that may be eliminated in 2012 include the Nonrefundable Business Activity Tax Credit, Refundable Payroll Tax Credit, Refundable Photovoltaic Manufacturing Tax Credit, and the High-Tech MEGA Tax Credit.

Table 23. Overview of New Energy Manufacturing Incentive Programs

Policy	Energy Subsectors	Funding Source	Financial Incentive Terms	Requirements
Nonrefundable Business Activity Tax Credit *Location: Michigan* *Date Effective: January 1, 2003*	Solar, Wind, Biomass, Advanced Energy Storage	Michigan NextEnergy Authority	- Credit amount varies depending on the business' qualified business activity - <u>Maximum Incentive</u>: None	- Qualified business activity is defined broadly to include research, development, or manufacture of an alternative energy technology or advanced energy storage device
Refundable Payroll Tax Credit *Location: Michigan* *Date Effective: January 1, 2003*	Solar, Wind, Biomass, Advanced Energy Storage	Michigan NextEnergy Authority	- Credit amount varies depending on qualified payroll amount and income tax rate - Credit is calculated by multiplying the payroll amount attributable to qualified employees by the income tax rate for that year - <u>Maximum Incentive</u>: None	- Employee must work on alternative energy-related research, development or manufacturing and have a regular place of employment within the NextEnergy Zone

[87] Brussalis (1991)

Innovative Manufacturing Initiative* *Location: National* *Date Effective: 2011*	Solar, Wind, Biomass, Advanced Energy Storage	United States DOE	- $120 million in funding available over a 3-year period to domestic manufacturers as a cost sharing incentive to improve industry processes and materials - Awarded amount varies according to stages of development and Technology Readiness Level (TRL) - Maximum Incentive: United States DOE share not to exceed $1 million for TRL 2-3 projects and $9 million for TRL 4-6 projects	- Manufacturers are expected to discover and/or implement large improvements in industrial and manufacturing energy productivity, environmental performance, product yield, and economic benefits
Clean Energy Advanced Manufacturing Projects *Location: Michigan* *Date Effective: 2009*	Solar, Wind, Biomass	Michigan Energy Office	- Grants available up to 100 percent of the cost of eligible project activities - Average award for total project costs between $2 million and $3 million - Maximum Incentive: $15 million - Terms: Preference to applicants that demonstrate a 50 percent cost share of total allowable project costs	- Small businesses in Michigan seeking to invest and diversify in clean energy sectors, manufacturing renewable energy, and energy efficiency systems/components - 500 employees or less - Meet minimum credit standards
Renewable Energy Renaissance Zones (RERZ) *Location: Michigan* *Date Effective: 2006*	Solar, Wind, Biomass	Michigan State Administrative Board	- 100 percent abatement of Michigan Business Tax, state education tax, personal and real property taxes, and local income taxes - Maximum Incentive: None - Terms: Tax abatements last up to 15 years, phased out in 25 percent increments over last 3 years	- 15 RERZ zones in the state with 5 of them primarily focused on the production of cellulosic biofuels - To become a designated RERZ area a county or community must submit an application to the Michigan Strategic Fund Board - Evaluations based on local economic impacts, job creation, project viability, etc.

Refundable Photovoltaic Manufacturing Tax Credit *Location: Michigan* *Date Effective: September 11, 2008*	Solar	Michigan Economic Growth Authority	- 25 percent of the capital costs for building a qualifying PV manufacturing facility - Maximum Incentive: Total credits for all years may not exceed $75 million - Terms: Credit generally taken over two years in equal installments; minimum capital investment and job creation requirements apply	- Eligible or qualified taxpayer or business (based on criteria related to capital investment and job creation) that constructs a qualifying PV manufacturing facility - Business must enter into an agreement with the Michigan Economic Growth Authority by December 21, 2011, to build a qualifying facility
High-Tech Michigan Economic Growth Authority (MEGA) Tax Credit *Location: Michigan* *Date Effective: N/A*	Advanced Energy Storage	Michigan Economic Growth Authority	- Credit varies based on eligibility of project, total employees, and total project tax - Up to 100 percent of Michigan Business Tax related to project - Maximum Incentive: up to 20 years - 200 percent of the sum of the payroll and health care benefits for the first three years of the credit, multiplied by the personal income tax rate - Maximum Incentive: Cannot exceed a seven-year time period	- Business activity must qualify under "high-technology" definition by the Michigan Economic Development Corporation (MEDC) - 5 new jobs must be created by the time the company collects the credit for the first year and 25 jobs must be created by the fifth year, along with maintenance of base employment
Advanced Vehicle Battery Manufacturer Tax Credits *Location: Michigan* *Date Effective: January 1, 2012*	Advanced Energy Storage	United States DOE	- Credit amount varies based on the produced kilowatt hours of battery capacity - Up to 75 percent of qualified expenses for vehicle engineering to support battery integration, prototyping, and launching - Equal to 50 percent of capital investment expenses for the construction of integrative cell manufacturing facility (job creation requirements apply) - Federal loan guarantees can receive a credit equal to 25 percent of capital investment - Maximum Incentive: N/A	- Qualified batteries must have a traction battery capacity of at least four kilowatt hours, be equipped with an electrical plug for charging purposes, and be installed in a new, qualified plug-in electric drive motor vehicle - Integrative cell manufacturing facility must include anode and cathode manufacturing and cell assembly - Job creation requirements vary from 300 to 500 new jobs

Alternative Fuel and Vehicle Research, Development, and Manufacturing Tax Credits *Location: Michigan* *Date Effective: January 1, 2008*	Advanced Energy Storage	United States DOE	- Credit available for tax liability attributable to researching, developing or manufacturing alternative fuel vehicles and biodiesel blends of at least 20 percent - Businesses operating a qualified activity within the Alternative Energy Zone may also be eligible to receive a refundable payroll credit on their Michigan Single Business Tax - Maximum Incentive: N/A	- Must first file application for a credit to the company's single business tax liability - Michigan NextEnergy Authority must approve the application and certify eligible taxpayers
Battery Innovation Act* *Location: National* *Date Effective: Undetermined*	Advanced Energy Storage	United States DOE	- $2 billion authorized for new grant program - Additional $40 million in grant funding available over four years to support domestic lithium production, processing, and recycling for advanced lithium batteries - Maximum Incentive: N/A	- Supports domestic advanced battery manufacturing base - Emerging United States advanced battery manufacturers that want to build new factories and expand existing facilities - Advanced lithium battery producers and researchers are eligible for additional $40 million in grants
* Federal Grant Program administered by the United States DOE				

More detail on each incentive program follows.

Nonrefundable Business Activity Tax Credit:

The nonrefundable business activity tax credit is an opportunity for businesses engaged in alternative energy research, development, and manufacturing to receive tax credits provided they are certified by the Michigan NextEnergy Authority. The amount varies from business to business depending on the amount of qualified business activity and is calculated as the lesser of the following:

(1) "the amount by which a business' tax liability attributable to qualified business activity for the tax year exceeds the business' baseline tax liability attributable to qualified business activity"

(2) "10 percent of the amount by which the business' adjusted qualified business activity performed in Michigan, outside a Renaissance Zone, for a tax year exceeds such activity for the 2001 tax year under former MCL 208.39e"

The Michigan NextEnergy Authority broadly defines a qualified business activity to include research, development, or manufacturing of an alternative energy marine propulsion system, an alternative energy system, an alternative energy vehicle, alternative energy technology, or renewable fuel.[88]

[88] Database of State Incentives for Renewables & Efficiency, *Nonrefundable Business Activity Tax Credit* (2010)

However, even when certified, businesses are unable to collect these tax credits in any year where its "tax liability attributable to qualified business activity did not exceed the baseline tax liability attributable to qualified business activity in 2001." This program originally took effect in 2003 and was expected to expire in 2007; however the tax credits were renewed without any significant changes or alterations as part of a larger state business tax policy. Additional tax credits may be available for those who meet the qualifying criteria and are also located in the Michigan NextEnergy Zone as it was designated as a Renaissance Zone by the state in 2002. Qualified business activity includes "research, development, or manufacturing" of the following:

- alternative energy marine propulsion system
- alternative energy system
- alternative energy vehicle
- alternative energy technology
- renewable fuel
- fuel cells
- PV
- biomass
- solar thermal heating and cooling
- wind energy
- CHP
- microturbines, miniturbines, and Stirling engines
- electricity storage systems
- clean fuel energy systems powered by methane, natural gas, methanol, ethanol, or hydrogen

Refundable Payroll Tax Credit

The refundable Payroll Tax Credit is available to businesses that are certified by the NextEnergy Authority and are located in the NextEnergy Zone. In order to be eligible, the business must research, develop, or manufacture "alternative energy technologies". The credit amount is that equal to "their qualified payroll amount multiplied by their income tax rate for that year."[89] Only those employees that actively participate in alternative energy-related research, development or manufacturing and have a place of employment within the NextEnergy Zone qualify for inclusion. For any given year, if the credit exceeds the tax liability for the business, the portion that exceeds the tax liability will be refunded. Like the nonrefundable business activity tax credit, the refundable payroll tax credit became effective in 2003 and was extended beyond the 2007 expiration.

The NextEnergy Zone is located at Wayne State University Research and Technology Park in Detroit, Mich. The NextEnergy Zone is a 40,000-square-foot facility that includes laboratory facilities, business incubator space, collaborative meeting space and other facilities that support Michigan's alternative-energy industry.

Innovative Manufacturing Initiative

The Innovative Manufacturing Initiative (IMI) is a DOE funding opportunity of roughly $120 million which is available to domestic manufacturers. These funds are intended to act as a cost sharing incentive to national manufacturers to improve industry processes and materials. More specifically, the IMI seeks solicitation for the following areas of interest:[90]

<u>Innovative Manufacturing Processes</u>

- Reactions and Separations
- High-temperature Processing
- Waste Heat Minimization and Recovery
- Sustainable Manufacturing

<u>Innovative Materials</u>

- Thermal and Degradation Resistant Materials
- Highly-Functional, High-Performance Materials
- Lower Cost Materials for Energy Systems

The DOE hopes to use this funding initiative as a means of solving current technical problems facing domestic manufacturers. Companies receiving funds from the IMI are expected to discover and/or implement large improvements in industrial and manufacturing energy productivity, environmental performance, product yield, and economic benefits. The opportunity is available to companies in all stages of development between research and prototype implementation. Companies involved in applied research and/or proof of concept stages can receive a maximum award of $1 million, whereas projects in testing and prototype development may receive awards of up to $9 million.

Nearly $25 million in funds from the IMI will be awarded in FY2012 to 35-50 participants. Participants are encouraged to form collaborative teams combining technical, commercial, and

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[89] Database of State Incentives for Renewables & Efficiency, *Refundable Payroll Tax Credit* (2010)
[90] United States Department of Energy- Energy Efficiency & Renewable Energy, Industrial Technology Program – Financial Opportunities (2011)

academic expertise. A letter of intent was due on September 1, 2011, and a full application was due on October 5, 2011, to the DOE's Industrial Technologies Program in order to be eligible for funding in FY 2012.[91] Commercialization of these new technologies and processes should be possible within the next five to seven years. The full $120 million will be made available over a period of three years.

Clean Energy Advanced Manufacturing (CEAM) Program

The Clean Energy Advanced Manufacturing (CEAM) program was funded in 2009 under the American Recovery and Reinvestment Act through the Michigan Department of Energy, Labor & Economic Growth (DELEG). The State Energy Program will award a total of $15 million in funding through the CEAM program to assist small manufacturing companies, located in Michigan, to diversify into high-growth clean energy sectors and invest in advanced manufacturing of renewable energy systems and components (i.e. wind turbine systems, solar technology, bio-energy equipment, geothermal heating and cooling systems).[92]

Eligible recipients of these grants are specific to businesses physically located in Michigan with 500 or fewer full-time employees. In order to the keep the focus on small manufacturing companies, the Michigan Energy Program lists the following entities as ineligible CEAM recipients: federal government, state government agencies, local government agencies, institutions of higher education, other nonprofit organizations, and companies with greater than 500 employees statewide.

The Michigan DOE requests that applications focus on building or increasing the production capacity of renewable energy systems or manufacturing components of those systems. Applications are also requested to provide the following information:

- Evidence of commitment from one or more potential customers to buy systems or components produced at the manufacturing facility
- Evidence of supplier commitment
- Evidence of the ability to meet the required production volume to satisfy the demand
- The number of units expected to be produced annually
- Detailed description of the renewable energy manufacturing process and end product
- Approach to product recycling in terms of plans for recovery, transportation of, and reuse of materials within the manufacturing process[93]

During the first round of CEAM awards in December of 2009, five Michigan manufacturing companies received a total of $15.5 million in funding. These funds were awarded to help the recipients expand their manufacturing business and create 713 jobs by 2011 and 1,400 by 2014.[94] In June 2010, the second round of CEAM grants were awarded to nine small manufacturing companies totaling $15 million in funding. The previously referenced CEAM winners in Michigan are listed in the following table and sorted according to the year the grant was awarded.

[91] United States Department of Energy – Energy Efficiency & Renewable Energy, Funding Opportunity Announcement (2011)
[92] Michigan Department of Career Development (2009)
[93] Michigan Department of Career Development (2009)
[94] Morrow, Mario (2010)

Table 24. CEAM Program Grant Recipients

Grant Recipient	City	Grant Amount	Award Date	Description of Manufactured Product
Loc Performance Products, Inc.*	Plymouth	$1,500,000	12/17/2009	planetary gears and gearboxes for wind turbines
Merrill Technologies Group*	Saginaw	$3,000,000	12/17/2009	large scale wind turbine blades and system components
Astraeus Wind Energy*	Eaton Rapids	$7,000,000	12/17/2009	wind turbine blades and hub components
LUMA Resources LLC*	Rochester Hills	$500,000	12/17/2009	residential photovoltaic solar materials
Energetx Composites, LLC*	Holland	$3,500,000	12/17/2009	large scale, advanced composite wind turbine blades
URV USA LLC	Rochester	$3,500,000	6/30/2010	next generation, metal cast, utility scale wind energy system turbine bedplates and hub components
Grid Logic, Inc.	Metamora	$3,500,000	6/30/2010	next generation Fault Current Limiters (FCLs)
Ventower Industries	Monroe	$2,250,000	6/30/2010	structural steel towers used to support commercial sized wind turbines
Great Lakes Industry Gear, LLC	Jackson	$2,000,000	6/30/2010	wind turbine gears and gearboxes
AMPTECH	Manistee	$300,000	6/30/2010	next generation smart combiner box for solar panels
Heat Transfer International	Kentwood	$2,200,000	6/30/2010	next generation biomass gasification power systems
KC Jones Plating Company	Warren	$150,000	6/30/2010	apply next generation surface finishing technology to wind turbine components
Innotec, Inc.	Zeeland	$1,000,000	6/30/2010	PCB-free LED integrated lighting panels
Polar Seal Window Corporation	Grand Rapids	$100,000	6/30/2010	new energy efficient commercial window framing

* Grant amount shown in table may also include clean energy loans awarded to the project

The CEAM program administered by the Michigan DOE has dedicated significant resources to diversify the state into high-growth clean energy sectors and assist small manufacturing companies in manufacturing of renewable energy systems. As of March 2011, Michigan ranked number one in the nation for clean energy patents.[95] As time goes on, the state will be able to assess the effectiveness of this program through the number of manufactured renewable energy systems and components and the jobs created as a result of the companies' expansions.

Renewable Energy Renaissance Zones

The Michigan Renewable Energy Renaissance Zones were created in 2006 by the state legislature to offer tax exemptions to businesses building renewable energy facilities. The facility must research, develop, or manufacture energy, fuels, or chemicals from natural and renewable resources in order to qualify for the tax exemptions. Originally, the law allowed for a designation of up to ten zones, but this was expanded to 15 in order to gain greater focus on the production of cellulosic biofuels.[96]

To become a designated Renewable Energy Renaissance Zone (RERZ), a community must petition the Michigan Economic Development Corporation (MEDC), demonstrating a positive economic impact through the job creation and project viability. The petition will be approved or denied by the Michigan State Administrative Board based upon the recommendation of the MEDC. Approved facilities will receive a tax abatement of:

- Michigan Business Tax
- State education tax
- Personal and real property taxes
- Local income taxes (if applicable)

[95] Environmental Law and Policy Center (2011)
[96] Michigan Policy Network (2008)

These taxes will be exempted for up to 15 years. All tax exemptions will be phased out by 25 percent over the last three years.

The goal of this law is to revitalize the Michigan economy by attracting a strong renewable energy industry to distressed communities within the state. The intended outcomes of the program are private investment and increased job creation by qualifying firms. Proponents of the RERZ law point to numerous domestic and international companies which have located facilities in Michigan.

Critics of the law believe such programs create competition among states to attract businesses. As states compete, the economic benefits for the state that ultimately attracts these facilities decreases. In addition to Michigan, other states that have offered renewable energy incentives include New York, Pennsylvania, Florida, Texas and many others.[97]

The RERZ require companies to locate their renewable energy facility in Michigan. The zones must be distinct, continuous geographic areas supported by the local community in which their facility is located. With the support of the local community and approval from the MEDC, renewable energy facilities will receive significant tax incentives. The tax abatements have allowed Michigan to attract greater private investment in the state and particularly in economically depressed locations. There are currently eight recognized Renewable Energy Renaissance Zones in Michigan. The following table lists the eight RERZ companies in the order of which they became approved by the MEDC.[98]

Table 25. RERZ Companies Overview

Company Name	**Location**	**Energy Subsector**
1. Heat Transfer International, LLC	City of Kentwood, Kent County	Biomass
2. Alpena Prototype Biorefinery	City of Alpena, Alpena County	Biomass
3. Energy Component Group	City of St. Clair, St. Clair County	Solar, Wind, Advanced Energy Storage
4. Component Power, Inc.	City of Holland, Allegan County	Advanced Energy Storage
5. The Dow Chemical Company	City of Midland, Midland County	Advanced Energy Storage
6. Energetx Composites, LLC	Holland Charter Township, Ottawa County	Wind
7. Frontier Renewable Resources, LLC	Kinross Charter Township, Chippewa County	Biomass
8. Grid Logic Incorporated	Lapeer Township, Lapeer County	Advanced Energy Storage

Refundable Photovoltaic Manufacturing Tax Credit

The refundable photovoltaic manufacturing tax credit was established in 2008 to enable businesses involved in the development and manufacturing of photovoltaic (PV) energy, PV

[97] Greene, Richard K. (2009)
[98] Michigan Economic Development Corporation (2011)

systems, or other PV technologies to claim tax credits against the Michigan Business tax. This tax credit enables the eligible taxpayer or a qualified taxpayer to claim a credit against the Michigan Business Tax equal to 25 percent of the capital investment made in the new facility during that given tax year (up to $15 million).[99] The business must enter into agreement with the Michigan Economic Growth Authority (MEGA) by December 31st, 2011 in order to build a qualifying facility.[100] The agreement between MEGA and the eligible and qualified taxpayer differs. The agreements for the respective groups are as follows:

Qualified Taxpayer: "create 500 new jobs and make a minimum capital investment of $50 million, of which $25 million must take place prior to the issuance of a tax credit certificate"

Eligible Taxpayer: "create 250 qualified new jobs and make a minimum capital investment of $100 million, of which $25 million must take place prior to the issuance of a tax credit certificate"

MEGA is able to enter into agreement with only one eligible taxpayer for a credit in excess of $15 million but not greater than $25 million. The total amount of tax credit available is limited to $75M. The taxpayer is able to decide whether the tax credit will be take in one year or spread out over two years in equal installments (most common method). Credits are refundable if they exceed the taxpayer's tax liability for a given year.

High-Technology Michigan Economic Growth Authority (MEGA) Tax Credit

The High-Technology Michigan Economic Growth Authority (MEGA) Tax Credit is a program administered by the Michigan Economic Growth Authority and designed to attract new, innovative and cutting-edge companies that specialize in new technologies. The objectives of the program are to promote the development of high-tech businesses in traditional and emerging industries by offering a tax credit against the Michigan Business Tax (MBT) and aid in the development and diversification of Michigan's economy.[101] The High-Technology MEGA tax credit is awarded to businesses that are primarily focused in a "high-technology activity" or that use at least 25 percent of total operating expenses for research and development.

The High-Technology MEGA Tax Credit requires that companies meet the definition of a "high-technology activity" as determined by the Michigan Economic Development Corporation (MEDC). There are roughly thirteen business activities that qualify to meet the aforementioned definition.[102] The following are the business activities related to the renewable energy subsectors (biomass, wind, solar and advanced energy storage) under review in this economic impact study:

- Advanced materials
- Electronic device technology
- Product research and development
- Advanced vehicles (hybrid or alternative energy vehicles)

[99] Database of State Incentives for Renewables & Efficiency, *Refundable Photovoltaic Manufacturing Tax Credit* (2010)
[100] Database of State Incentives for Renewables & Efficiency, *Refundable Photovoltaic Manufacturing Tax Credit* (2010)
[101] Michigan Economic Development Corporation (2010)
[102] Michigan Economic Development Corporation (2010)

- Tool and die manufacturing

There are several other requirements that a company or project must meet in order to be awarded a high-tech tax credit by MEGA. The project must increase employment opportunities and strengthen Michigan's economy. At least five new jobs must be created within the first year of operations at the project facility, and 25 new jobs must be created within five years.[103] Additionally, the business must maintain the number of jobs it provided in Michigan prior to the expansion in order to remain eligible for the credits.

Each applicant must also include a cost/benefit analysis of the project, illustrating how authorization of the tax credits will result in an overall positive economic impact to the state. The following factors affect the amount and duration of the awarded credit:[104]

(1) The number and average wage level of the new jobs created
(2) The total capital investment in the project
(3) The cost differential between expanding or locating in Michigan versus another state
(4) The potential economic impact of the expansion or location, the cost of the credits and the value of the other state and local assistance provided to the project

The financial benefit of the High-Tech MEGA tax credit against the MBT Act allows a qualifying "high-technology" business to collect up to 200 percent of the sum of the payroll and healthcare benefits for the first three years of the credit, multiplied by the personal income tax rate.[105] The tax credit may be awarded to each business for up to 20 years, unless the business received the maximum 200 percent credit, in which case the awarded credit may not exceed seven years.

Advanced Vehicle Battery Manufacturer Tax Credits

The Advanced Vehicle Battery Manufacturer Tax Credits (AVBM) provides three different tax credits related to the development and application of advanced battery technology in the State of Michigan and will take effect on January 1, 2012. Advanced battery manufacturers in Michigan may receive a tax credit of up to 75 percent of expenses related to vehicle engineering for battery integration, prototyping, and launching. These expenses, however, must be incurred between January 1, 2009, and January 1, 2014. Manufacturers of advanced automotive batteries may receive the same tax credit for its research and development engineering activities.

Similarly, a tax credit of 50 percent is available for construction expenses of an integrative cell manufacturing facility that includes anode and cathode manufacturing and cell assembly, if the project creates more than 300 jobs in the state. If the taxpayer has secured a federal loan guarantee for the project, the tax credit is lowered to 25 percent and the project must create 500 Michigan jobs. These federal loans guarantee taxpayers must operate a project that produces large scale batteries and manufacture integrated power management, smart control, and storage systems.

The AVBM tax credits have been fiercely debated in Michigan as part of a larger conversation concerning industry-specific tax credits and general tax cuts. Supporters in Michigan have

[103] Southwest Michigan First (2005)
[104] Southwest Michigan First (2005)
[105] Michigan Economic Development Corporation (2010)

argued for the continuation of industry specific tax credits, asserting that incentives pay for themselves with job creation. Figures indicate that battery makers created 6,600 jobs and $3 billion in investment in Michigan as a result of tax credits (AVBM and others).[106]

Critics have responded that it is not the government's role to choose industry "winners and losers". They have, instead, proposed an elimination of the Michigan Business Tax altogether (approximately $1.6 billion in revenue) and replaced it with a 6 percent corporate income tax. The logic behind this action is to allow market forces to drive job growth as opposed to government incentives.[107]

Alternative Fuel and Vehicle Research, Development, and Manufacturing Tax Credits

The Alternative Fuel and Vehicle Research, Development, and Manufacturing Tax Credits ("Tax Credits") provide qualified taxpayers in Michigan with an incentive to research, develop, and manufacture alternative fuel vehicles. The tax credits are nonrefundable deductions attributable to business activities and property. The tax credits apply to the following types of alternative fuel vehicles (AFVs):

- Fuel cell
- Electric
- Hybrid electric
- Natural gas
- E85
- Liquefied petroleum gas
- Hydrogen vehicles

The tax credits can also apply to renewable fuel, which in this case primarily refers to biodiesel blends of at least 20 percent.[108]

To qualify for these tax credits, taxpayers must apply for a nonrefundable credit to their single business tax liability and be approved by the Michigan NextEnergy Authority (MNEA). The MNEA is a seven-member board which includes the State Treasurer, State Director of the Department of Management and Budget, State Director of the Department of Transportation, and four private sector appointees.

Additionally, businesses located within the Alternative NextEnergy Zone and operating in a qualified activity (as stated above) may receive a refundable payroll credit on their Michigan Single Business Tax. As previously mentioned, the NextEnergy Zone is an area within Wayne State University's Research and Technology Park.

[106] Alexander, Dave (2011)
[107] Alexander, Dave (2011)
[108] United States Department of Energy. Alternative Fuels and Advanced Vehicles Data Center (2011)

Battery Innovation Act

The Battery Innovation Act (BIA), introduced by U.S. Senator Debbie Stabenow (D-MI), calls for an investment of approximately $2 billion in research and development, raw materials allocation, and manufacturing of advanced battery systems. The bill was introduced in Congress on July 12, 2011, and is under review by the Committee on Energy and Natural Resources.[109] The bill provides a comprehensive plan for advanced battery technology development.

The BIA's primary goal is to lead the development and production of a cost-efficient electric automobile battery. The bill would create competition among researchers to award the first inventor of a 500-mile electric automobile battery. The bill, if passed, would mandate the Department of Interior to conduct an analysis of the raw materials needed for advanced battery production with specific emphasis on United States supply and current reliance of those materials. Because the BIA would attempt to decrease United States reliance on foreign oil, it is necessary to assess United States capacities of common materials used in battery production (i.e. lithium, cerium, and yttrium). In addition, the bill would supply competitive grants to domestic battery manufacturers. The bill allots up to $2 billion for this grant program. The BIA also authorizes up to $40 million in grants that would be made available to advanced lithium battery producers and researchers. Senator Stabenow claims that this bill will not increase the national debt; she intends to propose cuts in other programs, however specific cuts have yet to be determined.[110]

Critics of the Battery Innovation Act believe that government funds will be unnecessarily diverted to no avail. It is believed that these acts will simply duplicate existing automobile infrastructure and shift reliance on foreign oil to reliance on foreign rare materials. Critics point to United States Geological Survey (USGS) reports which indicate that the United States is a negligible producer of lithium and controls less than 10 percent of the world's reserves.[111] The USGS reports that Chile is the leading producer of lithium and China is the leading producer of yttrium.

Electric vehicles currently incur costs around $10,000 for advanced batteries which only last approximately 50 miles per charge. The BIA hopes to provide a breakthrough in the electric vehicle market by offering a more efficient and effective battery for United States automakers. However, determinations must still be made as to whether the United States has the raw materials necessary to become a world leader in advanced battery production. The Battery Innovation Act is currently under review by the Committee on Energy and Natural Resources. It must pass the United States House and Senate, before being signed into law by the President.

[109] GovTrack.United States (2011)
[110] Chandler, Greg (2011)
[111] United States Geological Survey (2011)

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