Clean Energy ROADMAP

EXECUTIVE SUMMARY

PROJECT PARTNERS

MICHIGAN AGENCY FOR ENERGY
NEXTENERGY
OHIO DEVELOPMENT SERVICES AGENCY
TEAM NEO
US DEPARTMENT OF ENERGY

Project Team

The **Michigan Agency for Energy (MAE)** is a government agency within the Michigan Department of Licensing and Regulatory Affairs. MAE coordinates, analyzes, advises on, and advocates for the state's policies, programs, and proposals related to energy.

MAE's purpose is to set Michigan on a path toward affordable, reliable energy. It serves as a single entity dedicated to provide all of state government the information and context they need to support Michigan's energy priorities.

MAE brings together the Air Policy Director and the Retired Engineers Technical Assistance Program from the Department of Environmental Quality; the Michigan Energy Office from the Michigan Economic Development Corporation; and the Michigan Public Service Commission.

The **Ohio Development Services Agency, Office of Energy and Redevelopment (OERD)** works to grow and strengthen Ohio's economy by building upon its strategic investments in the state's energy-based sector. As part of this effort, OERD utilizes U.S. State Energy Program (SEP) funds to connect companies and communities to financial and technical resources in order to deploy renewable energy and energy efficiency technologies throughout the state.

The Ohio Development Services Agency works to grow the economy of the state by connecting companies and communities to financial and technical resources to increase efficiency and reduce costs.

NextEnergy is a 501(c)(3) nonprofit organization established in 2002 to drive advanced energy investment and job creation in Michigan. Located in Midtown Detroit's innovation corridor, NextEnergy serves as a catalyst for advanced energy technology demonstration and commercialization in the state. Since its inception, NextEnergy has helped to attract more than $1.5 billion of new investment, including over $160 million generated by programs in which it has directly participated.

Team NEO is a regional, private-sector organization serving the 18 counties of Northeast Ohio. The organization collaborates with its partners and others to attract new businesses, help those in Ohio to grow, and accelerate the pace and impact of innovation in the region. As one of eleven SBA Regional Innovation Centers, Team NEO has experience in analyzing, roadmapping, developing and supporting the growth of innovation clusters, and has done so successfully with extensive Northeast Ohio roadmapping and cluster development initiatives completed for Flexible Electronics, Water Technologies, Waste and Biomass to Energy, Energy Efficiency, Energy Storage, and Fuel Cells.

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About the Report

The Clean Energy Roadmap is a collaborative effort between Michigan and Northeast Ohio to accelerate the region's clean energy sector. To identify and advance energy efficiency building technologies, products, services and clean energy manufacturing, the authors conducted the following tasks:

- Developed an inventory of regional energy efficient building technology assets
- Identified energy-intensive processes in clean energy manufacturing
- Developed supply and value chain analyses
- Produced technology roadmaps
- Hosted events with clean energy industry partners
- Recommended economic development strategies based on research results

This report shares results and recommendations that can be utilized to build the region's clean energy cluster and accelerate regional economic development.

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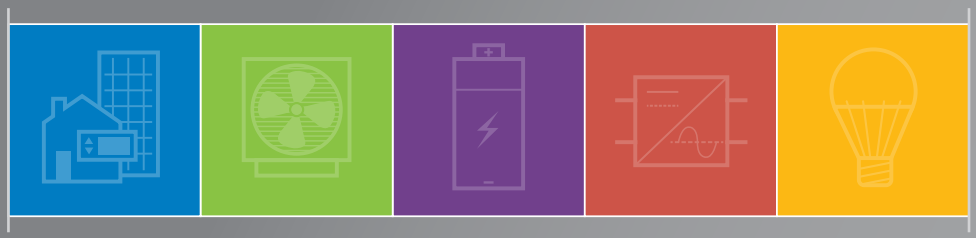



Executive Summary

The market for clean energy technology is growing rapidly and, according to numerous market research firms, that growth is anticipated to continue in the coming years. The combination of new technology, a growing United States economy, greater electricity demands and a need to reduce emissions has helped to push energy efficiency interest and incentive programs.[1] The Clean Energy Roadmap is a collaborative effort between Michigan and Northeast Ohio[2] to accelerate the region's clean energy cluster and capitalize on these trends. Funded by the U.S. Department of Energy (DOE), the Michigan Agency for Energy (MAE) led the project in partnership with the Ohio Development Services Agency, Office of Energy and Redevelopment (OERD) to provide project management and public sector involvement. NextEnergy and Team NEO (formerly NorTech) conducted the technical analysis and provided private sector involvement and perspective. The overarching vision of the project team is to create regional economic development strategies that foster more competitive private-sector clean energy manufacturing and energy efficiency clusters in each state.

To accomplish this vision, the partners focused on two main goals: 1) developing focused strategies for advancing the energy efficient building technology cluster, and 2) developing clear technology roadmaps for several energy-intensive, clean energy manufacturing processes to reduce the energy cost of these processes. The multi-year roadmapping process utilized multiple market research and analysis tools—asset mapping, value and supply chain analyses, and technology roadmapping—to understand and identify the strengths on which to build, the barriers impeding success, and create strategies that will move the region's cluster forward.

First, NextEnergy and Team NEO identified companies within the clean energy and energy efficiency value chain in Michigan and Northeast Ohio, respectively. The teams then conducted primary in-depth interviews, site visits, in-person interviews during events, and quantitative surveys to develop a robust understanding of the energy efficiency building technology (EEBT) value chain and supply chain for specific clusters, including light-emitting diode (LED) lighting in both states, and building automation and heating, ventilation, and air conditioning (HVAC) in Michigan only. At the same time, to examine the energy use in manufacturing for

1 Annual Energy Outlook 2015 – U.S. Energy Information Agency – Accessed Jan. 2016
2 A 21-county region focused on Greater Cleveland and Greater Akron metropolitan areas and including the following counties: Ashland, Ashtabula, Carroll, Columbiana, Crawford, Cuyahoga, Erie, Geauga, Holmes, Huron, Lake, Lorain, Mahoning, Medina, Portage, Richland, Stark, Summit, Trumbull, Tuscarawas, and Wayne.

clean energy and energy efficiency technologies, NextEnergy conducted an analysis of processes used in manufacturing LED lighting, power electronics, and energy storage (batteries) through a combination of interviews and manufacturing site visits. Secondary research on clean energy market drivers showcased the national and local factors that stimulate demand and create an attractive environment to foster clean energy products and services growth. Project findings laid the framework for developing individual state and regional implementation plans including vision, goals, and recommendations for developing the clean energy cluster.

Energy Efficiency Value Chain

It is important to understand the distinction between value chain and supply chain. The value chain refers to all industry stakeholders that are responsible for adding value to a product both pre-and post-sale, including engineering, financing, installation, and service. The supply chain refers specifically to companies that provide services, equipment, or materials that relate to delivery of a product to customers, including raw material suppliers, equipment manufacturers, subcomponent suppliers, and engineering firms.

Each region conducted an analysis on the energy efficiency value chain in varying scopes. In analyzing the overall energy efficiency value chain, NextEnergy identified a total of 2,802 companies and stakeholders that serve the energy efficiency (in residential, commercial or industrial markets), renewable energy, or energy-related software/sensors/controls markets in Michigan. Team NEO research had a narrower scope and focused on the LED lighting, non-fiberglass insulation, and building efficiency services markets, and identified 220 companies and stakeholders in the value chain within Northeast Ohio.

While each state and respective value chain had unique strengths and challenges, findings were also cross-cutting regionally, with strengths including significant robust research and development (R&D) activity, strong engineering and manufacturing talent, a strong network of entrepreneurs and innovation, as well as challenges such as untapped deployment potential. The tools recommended to bridge the deployment gap differed by state due to program preference and available opportunities. In Michigan, strategies may focus on increasing awareness of energy efficiency benefits, reducing barriers to engage in energy efficiency programs, and increasing training in connected systems or building automation. In Northeast Ohio, opportunities lie in helping companies focus on profitable retrofit markets and build consortiums for building envelope and service providers to foster more effective working relationships and a collective voice in the market.

Energy Efficient Building Technologies

As a result of the value chain analysis, more rigorous analysis was conducted for specific EEBT-related sectors that were prioritized on the basis of their potential impacts on the regional clean energy cluster. NextEnergy and Team NEO conducted statewide and regional analyses of the LED lighting sector, and NextEnergy also conducted analyses of the building automation and HVAC sectors.

In the LED lighting market, there are a handful of cross-cutting findings, including a robust and growing supply chain in fixtures and luminaires with limited ability to influence global chip or light engine technology, and robust R&D activities and talent in the LED lighting industry. However, the challenges facing Michigan and Northeast Ohio are also divergent. For example, much of Michigan's luminaire manufacturing process is still manual in nature. Therefore, Michigan's industry can improve manufacturing efficiency through automation. At the same time, Michigan's industry is diversifying with an increased focus on the controls systems in lighting. In Northeast

Ohio, while process automation is a challenge for some, the more urgent challenges lie with organizing the cluster more effectively, which can be addressed by engaging the various levels of the supply chain through more effective collaboration within the cluster and fostering next-generation lighting products in large, global companies in the region. As a result, there are opportunities for the region to leverage the research and development (R&D) pipeline, foster cluster development, and capitalize on greater retrofit and deployment potential.

The building automation and HVAC clusters' analysis is limited to Michigan and finds growing sectors that are still relatively niche markets. There are some similarities between these clusters, but by definition, the building automation market is more heavily focused on software, sensors, and controls developers while the HVAC market includes more manufacturers and hardware developers. At the installation level, HVAC installers may install a portion of the building automation system; however, a comparatively small number of installers and integrators now specialize in incorporating different building systems into building automation systems specifically.

Within the building automation sector, Michigan is home to small, innovative companies with strong deployment potential that require resources and capacity to scale deployment. In addition, the state is strong in web services/data analytics and process automation, which can help advance this sector. To improve the prospects of the cluster, NextEnergy finds that developing a demonstration of the technology and providing regular support from the state or an industry consortium would help to foster growth. The cluster would also benefit from greater software development, as well as contractor training about the systems to help encourage adoption at the customer level.

In Michigan's HVAC cluster, the industry is not centered on the residential sector, instead focusing on commercial and industrial niche products. However, within those sectors, Michigan has a number of manufacturers offering products throughout the HVAC ecosystem. Challenges for the cluster include the unsettled nature of the regulatory environment and difficulty finding the right sales channel. Tools to combat these challenges and grow the cluster overall include developing a combined heat & power (CHP) cluster, fostering control system partnerships, cultivating buy-sell relationships and pushing existing "Buy Michigan" programs.

Clean Energy Manufacturing

By creating more efficient and cost-effective manufacturing processes, clean energy manufacturers will be more competitive globally, which may in turn positively impact growth in the clean energy products industry. To identify areas of manufacturing in clean energy industries that offer potential areas of significant energy use improvement, NextEnergy analyzed the following strong Michigan sectors: energy storage, LED lighting, and power electronics.

In examining the processes required for manufacturing batteries, the energy drivers vary by the type of batteries being manufactured. For example, much of Lithium Ion (Li-Ion) battery manufacturing requires production inside a temperature, humidity, and dust-controlled room that uses a lot of energy. In lead-acid (Pb-A) battery manufacturing, the melting, mixing, and drying of lead is energy intensive. Within LED lighting and power electronics manufacturing processes, the energy use patterns are similar: basic materials, assembly, and testing drive energy use for facilities, but are small on a per unit basis. Therefore, mitigating energy use in these three applications will take significant effort to improve raw material efficiency, improve yield from production, or in the case of Li-Ion, leapfrog the technology to reduce clean room necessity.

Implementation Plans

The focus of the Clean Energy Roadmap is to conduct a baseline assessment of the clean energy cluster ecosystem, as well as create tangible goals and recommendations that can be implemented to directly generate more economic activity within the cluster. The following implementation plans document each state's vision for moving forward, as well as a shared vision for regional cluster development.

Michigan Implementation Plans

After conducting the body of research presented in this report, project stakeholders including MAE, Michigan Economic Development Corporation (MEDC), and NextEnergy assembled to review key findings and outcomes from the EEBT and the clean energy manufacturing research.

Michigan EEBT Implementation Plan

Real opportunities exist to strengthen Michigan's existing energy efficiency ecosystem, specifically, in sectors such as LED lighting, HVAC, and building automation, which are either generating new innovations or manufacturing EEBT products. During the stakeholder meeting, participants crafted a broader vision and specific goals that leverage current strengths in the above areas and help grow each sector where opportunity has been identified. For example, there is an opportunity to strategically coordinate Michigan's broader energy efficiency value chain (service providers) and its specific ecosystems innovating and manufacturing products for LED lighting, HVAC, and building automation. There is great potential to generate a potent combination and advance Governor Snyder's plan to reduce energy waste by creating energy pillars of a strong energy future: affordability, reliability, and environmental protection. The following vision and goals could help realize this possibility.

VISION

Leverage the energy efficiency and EEBT sectors to strengthen and diversify Michigan's economy while eliminating energy waste

GOAL

Strengthen R&D where most intellectual property development and investment occurs

Recommendations

1. Encourage university researchers to pursue federal and non-federal funding opportunities by assisting with partnership collaboration, and matching funds by actively promoting funding opportunities to researchers and continuing the State's current match funding programs

   Next Step:

   - Develop strategy for reaching university researchers and actively promote matching fund opportunities

2. Stimulate venture development by regularly promoting relevant federal R&D funding, such as Advanced Research Projects Agency-Energy (ARPA-E) and Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) and by providing advisors to assist ventures and pull them into the application process

   Next Step:

   - Continue venture advisor support and hold regular webinar session on ARPA-E and SBIR/STTR opportunities

3. Stimulate technology innovation through the regular administration of technology challenges, both through program management support and monetary prizes

   Next Step:

   - Develop a strategy for technology challenge focus areas and secure funding to support program management and prize money

GOAL

Strengthen the energy efficiency value chain

Recommendations

1. Investigate leveraging the MEDC Pure Michigan Business Connect program or another relevant tool that encourages new matchmaking and partnerships within the energy efficiency value chain, both for technology developers and for service providers such as architects, specifiers, and contractors

   Next Step:

   - Schedule planning sessions with the MEDC Pure Michigan Business Connect program to discuss leveraging program

2. Encourage Michigan's current software/IT ecosystem to apply its talent throughout the energy efficiency value chain

   Next Step:

   - Conduct a matchmaking event through local technology accelerators

3. Develop forecasting and economic analysis models of Michigan's energy efficiency ecosystem

   Next Steps:

   - Secure funding and develop forecasting/economic impact data. Continue to track and survey EEBT assets in Michigan on an annual basis to support the energy efficiency value chain
   - Secure funding to continue annual survey of energy efficiency ecosystem.

4. Leverage the MEDC Pure Michigan Talent Connect program and job portal to attract, retain, and connect recent graduates from Michigan-based institutions with Michigan-based companies seeking a trained workforce

   Next Step:

   - Conduct planning session with the MEDC Pure Michigan Talent Connect program

GOAL

Increase deployment efforts

Recommendations

1. Perform an analysis on the opportunity of streamlining existing energy efficiency utility programs into a statewide program to create ease of use, consistent incentives, and eliminate confusion amongst programs – all focused on creating a stronger market

   Next Step:

   - Secure funding to perform analysis of other statewide energy efficiency programs

2. Develop stronger workforce development opportunities for contractors/installers focused both on "selling" energy efficiency technology and on educating contractors on emerging technologies by developing and deploying training sessions through existing utility contractor programs and trade associations

   Next Step:

   - Conduct strategy sessions with contractor and trade associations regarding the development of new training modules

3. Strengthen sales channels for smaller manufacturers and service providers that have niche products or early innovations and are competing against entrenched, out-of-state companies by leveraging the MEDC Pure Michigan Business Connect program, providing sales advisors, establishing a statewide energy efficiency product database, and creating a strong "Buy Michigan" program for State purchases

   Next step:

   - Conduct strategy sessions to develop broader sales channels implementation model that leverages the above recommendations

4. Identify and prioritize "low-hanging fruit" targets (i.e., sectors and building types) that are more easily achievable

   Next Step:

   - Utilize Clean Energy Roadmap research as a basis to conduct a building sector segmentation opportunity analysis

Michigan Clean Energy Manufacturing Implementation Plan

The focus of this work is two-fold: evaluate the manufacturing processes of key clean energy manufacturing sectors and generate tangible goals and recommendations that will lead to a more competitive manufacturing sector. For Michigan, real interest lies in strengthening clean energy manufacturing activity as a means to diversify and strengthen the economy. During the stakeholder meeting, participants crafted a broader vision and specific goals leveraging current strengths in the LED lighting, energy storage, and power electronics sectors with a focus on helping manufacturing activity grow. By implementing the following recommendations, clean energy manufacturing will continue to play a role in advancing Governor Snyder's pillars of a strong energy future: affordability, reliability, and environmental protection.

VISION

Foster clean energy manufacturing activity as a means to both diversify and grow Michigan's economic activity

GOAL

Generate more R&D in materials, components, subsystems, and production processes that will lead to increased clean energy manufacturing activity

Recommendations

1. Increase clean energy manufacturing activities through funding assistance

   Next Steps:

   - Communicate regional industry needs to appropriate DOE and Advanced Manufacturing Office leads in these areas
   - Increase awareness of programs such as the Small Business Voucher program with the National Labs
   - Capitalize on existing state funding programs such as the Michigan entrepreneurial support programs

GOAL

Foster the creation of more competitive clean energy manufacturing products by focusing improvements on design and yield, while still making gains in energy reduction costs

Recommendations

1. Capitalize on automation expertise and industry cross-pollination

   Next Steps:

   - Encourage improving industry cross-pollination during events and including production automation companies in cluster specific activities
   - Continue retooling grants and loans, technology challenges, or other funding opportunities focused in this area

2. Promote increase in yields, design, and integration

   Next Steps:

   - Specifically promote National Lab Small Business Voucher grants targeting yield, design, or integration improvements
   - Set up planning sessions for ways to involve Michigan organizations with experts in improving efficiency in industrial operations like the DOE Industrial Assessment Centers and Michigan Manufacturing Technology Center

GOAL

Strengthen Michigan's export activity

Recommendations

1. Utilize existing Michigan programs for established and mature firms

   Next Steps:

   - Increase awareness and opportunities through Michigan State Export Program
   - Continue and strengthen matchmaking activities through strategic service providers and Pure Michigan Business Connect

2. Assist small clean energy product manufacturers with commercializing their products and establishing sales channels

   Next Steps:

   - Continue and strengthen matchmaking activities through strategic service providers and the MEDC Pure Michigan Business Connect program
   - Launch an accelerator program dedicated to helping commercialize early stage clean energy manufacturing companies
   - Conduct an annual event that showcases clean energy manufacturers' products

Northeast Ohio Implementation Plan

Key stakeholders from the OERD, Team NEO, and NextEnergy discussed the key findings of the EEBT and clean energy manufacturing roadmapping work for Northeast Ohio. The group vetted recommendations based on these findings and determined that a real opportunity exists in the LED lighting sector of the solid state lighting industry. Stakeholders examined the strengths that exist in the region that lend to a burgeoning LED lighting industry, including core parts of the manufacturing supply chain.

Northeast Ohio EEBT and Clean Energy Manufacturing Implementation Plan

The following goals and implementation paths will help move the project beyond the roadmapping phase and further develop the LED lighting industry in Northeast Ohio.

VISION

Continue to establish Northeast Ohio as a co-leader in LED lighting. Strengthen the ability for Northeast Ohio LED lighting manufacturers to connect with the regional supply chain.

GOAL

Provide broad ecosystem support

Recommendations

1. Work with economic development, small business, and entrepreneurial assistance entities to convene events

2. Help develop and support initiatives to emphasize Northeast Ohio companies

   Next Steps:

   - Assist in knitting together a more coordinated cluster development activity to form the majority of a regionally integrated supply chain, a task that original roadmap participants, such as GE Lighting, already indicated would be of interest to regional original equipment manufacturers (OEMs)
   - Take advantage of momentum of Clean Energy Roadmap-related activities before the opportunity to solidify a distinct regional identity has passed

GOAL

Focus on upstream R&D opportunities

Recommendations

1. Capitalize on potential funding opportunities

   Next Steps:

   - Investigate potential channels for matching dollars to help secure awards
   - Focus on attraction, retention, and innovation, including what is necessary to grow companies located in the region and attract companies to the region

2. Assist Northeast Ohio-based companies with funding, collaborations, and establishing meaningful engagements with potential customers within Northeast Ohio, between Northeast Ohio and Michigan, nationally, and globally

   Next Step:

   - Engage in planning sessions with economic development partners and engaged LED companies to foster development and opportunities needed to attract international companies to Northeast Ohio

3. Increase deployment efforts
4. Streamline and improve effectiveness of rebate programs

   Next Step:

   - Work with utilities to analyze and streamline rebate programs

Collaborative Implementation Plan for Michigan and Northeast Ohio

A goal of the Clean Energy Roadmap is to develop the region's clean energy cluster and manufacturing activity. The scope of the regional implementation plan focuses on developing a vision specifically for the LED lighting sector since research findings revealed that both Michigan and Northeast Ohio are home to robust LED lighting sectors. This Plan can be used as a model for cluster growth and replicated in other clean energy-focused sectors. The LED lighting sector drives activity from an EEBT perspective and from a clean energy manufacturing perspective. When looking at the entire LED lighting value chain and supply chain, the activity spans from early innovation and R&D to manufacturing activity to significant implementation activity. Value is created by the development of new intellectual property, manufacturing activity, and ability for energy savings and the associated economic activity resulting from implementing projects.

If both states work together to grow the LED lighting sector and associated manufacturing activity, the region will be positioned as a national and global leader in advanced lighting.

VISION

Leverage the LED lighting sector in Michigan and Northeast Ohio to position the broader region as a leader in LED lighting

GOAL

Stimulate R&D activity

Recommendations:

1. Encourage both matchmaking between university researchers and private sector companies and the pursuit of federal and non-federal funding opportunities

   Next Step:

   - Conduct in-person sector meetings that promote federal funding opportunities and partnership collaboration

2. Building on the diverse LED lighting ecosystem that exists in both states, host technology challenges targeted at both new and existing market segments to strengthen innovation pipelines between entrepreneurs and established supply chain partners

   Next Step:

   - Secure funding to host technology challenges and promote to LED lighting ecosystems in both states

3. Facilitate relationships between larger lighting companies and smaller, entrepreneurial innovators across both regions

   Next Step:

   - Secure funding to host annual multi-state innovation summit

GOAL

Foster lighting cluster development and strengthen the supply chain

Recommendations:

1. Foster better interaction, identify opportunities for partnership, and grow a stronger, multi-state regional LED lighting cluster

   Next Step:

   - Host annual convening event

2. Communicate supply chain capabilities to help foster cross pollination and increased levels of activity throughout the ecosystem on a regional basis

   Next Step:

   - Develop a supply chain capabilities matrix and communicate it across the lighting ecosystems

GOAL

Increase deployment opportunities

Recommendations:

1. Host an annual multi-state advanced lighting conference that provides an excellent opportunity to connect supply chain partners with potential end users

   Next Step:

   - Secure funding and conduct planning for an annual advanced lighting event

2. Leveraging existing utility and trade programs, expand advanced lighting training with contractors in Michigan and Northeast Ohio

   Next Step:

   - Develop a plan and secure funding to expand contractor training

3. Develop Michigan and Northeast Ohio LED lighting product database for local and state governments and utility programs to strengthen purchasing programs of regional lighting products

   Next Step:

   - Conduct inventory of Michigan products and develop database

4. Create synergy and paths to market for Michigan-and Northeast Ohio-made products

   Next Step:

   - Host combined events, training opportunities, and industry days

Conclusion

The Clean Energy Roadmap offers not only a detailed understanding of the current position of the clean energy ecosystem and its assets, but also discusses the current barriers, opportunities, and solutions that capitalize on opportunities moving forward in Michigan and Northeast Ohio. Ultimately, the prospect to grow the clean energy and energy efficiency sectors is strong. While both Michigan and Northeast Ohio face similar challenges across the value chain and within the specific supply chains examined, each have unique strengths, including Michigan's diversity in HVAC, and building automation clusters and Northeast Ohio's large lighting manufacturers shifting focus towards the next generation of solid state lighting. Yet both regions have common strengths that can be leveraged, setting the framework for success.

By capitalizing on each other's strengths and sharing this analysis with agencies that support regional innovation cluster development, including the DOE, the U.S. Department of Commerce Economic Development Agency, and the U.S. Small Business Administration, the region is poised for continued growth. The implementation plans outline a variety of critical steps for developing comprehensive action to advance the region's EEBT cluster and clean energy manufacturing process improvements that will contribute to regional economic growth.

Provided below is the Clean Energy Roadmap Report Table of Contents. The full Report can be found at **michigan.gov/ereports**.

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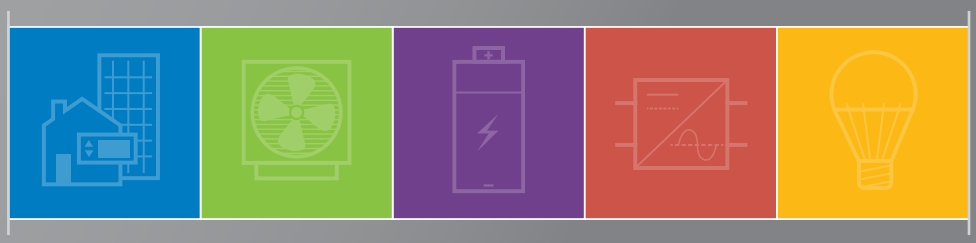

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NEXTENERGY ask us what's next

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