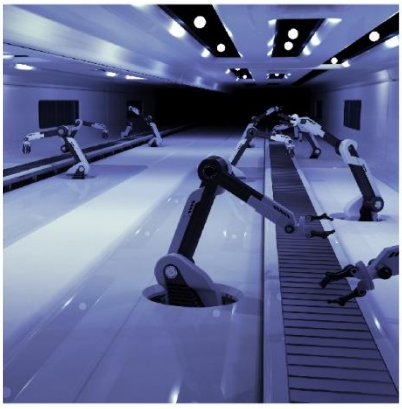
Regional Innovation Ecosystem

Roundtable Series

Michigan



U.S. DEPARTMENT OF ENERGY
Office of TECHNOLOGY TRANSITIONS

MICHIGAN ECONOMIC DEVELOPMENT CORPORATION

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INTRODUCTION

Background

Innovative clean energy technologies can deliver clear benefits to regions across the nation. In 2016, the U.S. Department of Energy (DOE) held a series of events to gather information on regional energy needs and challenges and on the role of innovation in driving regional economic and workforce development. Input from the many participating stakeholders helped to highlight opportunities for regional innovation clusters, clean energy technology innovation, and new technology partnerships to advance regional markets and energy security. The process also identified specific regional strengths that can be leveraged to develop the technologies and energy systems needed to build a 21st century, low-carbon economy.[1]

DOE supports economic development across the United States by providing direct research funding and granting targeted access to the world-class resources of the National Laboratory System. Recent analyses suggest that some regions of the United States may benefit more than others from these resources, a difference attributed to unequal knowledge of DOE programs, processes, and funding opportunities. DOE seeks to increase its national impacts by targeting those regions that show real promise as future economic hubs and innovation ecosystems yet are not fully taking advantage DOE resources and opportunities. As part of this effort, DOE is conducting a series of Regional Innovation Ecosystem Roundtables in areas that could more effectively leverage DOE resources and build technology partnerships beneficial to businesses, the region, and the nation.

Why Michigan?

Michigan's long-standing reputation as a global center for automotive manufacturing and innovation made a strong comeback after confronting a 2009 surge in competition from foreign auto producers. The state has actively encouraged growth in diverse industries—attracting ongoing investment by multinational companies and small businesses. Supportive tax policies, a trained and talented workforce, and a tradition of technological advancement make Michigan a great place for business. The state has one of the highest concentrations of electrical, mechanical, and industrial engineers in the United States, with engineering programs at its major universities ranking among the best in the nation. Michigan's infrastructure investments in utilities, cybersecurity, and telecommunications have created an attractive environment for high- tech companies.

The state has shown impressive resilience and is expanding economically, powered by emerging innovations in such diverse categories as automotive, aerospace, medical devices, renewable energy, information technology, and advanced manufacturing.[2] By encouraging growth in these

[1] *Exploring Regional Opportunities in the U.S. for Clean Energy Technology Innovation. Volume 1:* Summary Report October 2016. U.S. Department of Energy. Accessed here

[2] "This Just In: Michigan continues to rise in national business rankings." Michigan Economic Development Corporation. Accessed June 11, 2020 at www.michiganbusiness.org/press-releases/2020/06/this-just-in-michigan-continues-to-rise-in-national-business-rankings/

areas, Michigan is positioned to continue its comeback and navigate the recent challenges of the COVID-19 pandemic.

Across Michigan, regions with robust technology development resources represent opportunities for DOE and the national labs to engage with local organizations and build effective partnerships. DOE's preliminary discussions with the public and private sectors (including universities, accelerators, incubators, small and medium-size companies, multinational corporations, and state and local officials) underscore the region's readiness to host innovation. Leveraging the state's robust innovation ecosystem and partnering with DOE's national labs can support the new discoveries and inventions that will fuel economic growth and workforce development in Michigan.

Roundtable Scope and Objectives

To gain a clearer understanding of the current and future challenges facing Michigan's innovation ecosystem, DOE conducted two Roundtables with regional stakeholders in late July and early August 2020. The DOE Office of Technology Transitions (OTT) hosted the events, which were preceded by early discussions with public and private sector entities to gain a preliminary understanding of the region's innovation landscape.

Roundtable Focus Areas

- Characterize technologies and sectors most important to a robust innovation ecosystem in Michigan
- Understand challenges to innovation across diverse sectors of the Michigan economy
- Identify pathways to energizing the workforce of tomorrow in Michigan
- Explore new ways to collaborate and build partnerships among industry, academia, DOE, and local government
- Ensure awareness of DOE resources and boost engagement with national laboratories
- Gain insights on the role of DOE in fostering healthy innovation ecosystems in Michigan.

Lake Michigan Lighthouse

The Roundtables attracted more than 70 stakeholders from diverse industries and from academic, state, and federal government organizations (Appendix A). These participants represented a range of sectors, including automotive, aerospace, batteries, manufacturing, electric power, materials, finance, real estate, and information technology, among others. Representatives from major universities across Michigan shared their perspectives on the critical role of education and research in supporting innovation and providing a qualified workforce. Utilities, local governments, and non-profit organizations contributed their insights on grant programs, resource needs, workforce challenges, and the changing landscape for energy, water, and the environment.

This report summarizes the main themes brought up by Michigan stakeholders on how to build and maintain a robust innovation infrastructure. It is not intended to be all-inclusive of viewpoints or current initiatives or an endorsement of those viewpoints. Rather, it represents a snapshot of the perspectives of those who attended the Roundtables.

STAKEHOLDER PERSPECTIVES ON THE MICHIGAN INNOVATION ECOSYSTEM

Key Technologies and Sectors for Innovation

Michigan has long been a center for technology development and innovation. Given the state's rich industrial history, many sectors are closely woven into the Michigan innovation ecosystem, most notably automotive, aerospace, batteries, materials, advanced manufacturing, and electrification.

> ***Focus Question:*** *What areas represent the greatest potential for innovation, industry growth, regional sustainability, and economic impact in the Michigan innovation ecosystem?*

Innovation will play an important role in Michigan's future growth. Some of the technology areas with the greatest potential to spur industry growth and regional impact include mobility applications, advanced manufacturing (AM), advanced materials (e.g., high-strength alloys, carbon and natural fiber composites), and Industry 4.0 (a new paradigm in manufacturing communications, networking, and computational technology).

Mobility

The mobility of people and goods has expanded its dimensions over the last decade and the field continues to transform. The vision for future mobility involves autonomous driving, connected cars, electrification, and smart mobility (ACES). Electric-vehicle (EV) sales are setting records globally, while autonomous vehicles (AVs) are rapidly gaining attention (including cars as a service and smart mobility approaches).[3] Smart mobility is widespread and growing—embracing such diverse modes as ride-sharing, car-sharing, public transportation, walking, scooting, and biking. Connected modern vehicles with multiple sensors, on-board computing, and communications systems operate as a mobile Internet and data source.

Connected cars utilize cellular and 5G networks, advanced sensors, and high-powered computing to monitor location, driver behavior, engine diagnostics, vehicle activity, and the surrounding environment.

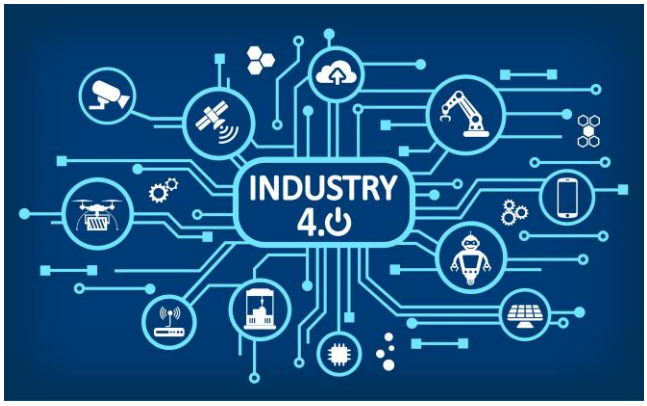
Markets for mobility are also rapidly changing, as are vehicle ownership patterns. Advances in technology and shifting consumer preferences are creating new areas for growth and innovation. During the Roundtable, several mobility areas were identified as potentially important to Michigan, including the following:

[3] The future of mobility is at our doorstep. McKinsey and Company. December 2019. www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-future-of-mobility-is-at-our-doorstep#

- *Connected and smart vehicles*. Mobility needs could be filled by a mix of advanced EVs, AVs (personal, cargo/freight, and fleets), connected cars (i.e., connected to a myriad of external devices), and cars as a service (sending an AV to deliver dinner, pick up groceries, or take you to work).
- *Reliable, secure data and analytics.* Reliable data will be critical for smart vehicles and mobility, including location, engine and vehicle performance (telematics), driver behavior, surroundings (vehicle-to-everything [V2X] communication), and occupant infotainment. Wireless data exchange over advanced networks (e.g., GPS, 5G technology) is key.
- *Greater mobility for underserved communities*. Deployment of mobility technologies in traditionally underserved communities could increase opportunities for jobs, education, and social interactions. Knowledge of what's available, geographic access, and the means to access/pay for services are essential for communities to get the full value of new mobility options and innovations.
- *Resilient electrification infrastructure*. A state-wide infrastructure is necessary to enable affordable, carbon-neutral electrification of connected vehicles. Investments in and by utilities will be needed to improve the reliability, security, and cost of electricity and to support innovations in EVs and mobility.

Manufacturing and Industry 4.0

Manufacturing is at the core of the Michigan economy and has a rich history of technology discovery and innovation. Today, manufacturing supports many sectors of the economy, including automotive, aerospace and defense, metals, machinery, food and beverages, plastics, rubber, biosciences, chemical products, and computers and electronics. Michigan companies manufactured $102.35 billion in products in 2018 and employed about 630,000 people in skilled, high-paying jobs. The sector has seen steady increases in output since 2009. The sectors poised for significant future growth include automotive, medical, machinery, chemicals, plastics, and aerospace.[4]



Industry 4.0 represents a shift to highly connected, smart technologies and increased automation.

Industry 4.0 is transforming the way traditional manufacturers operate and create products. Often referred to as the fourth industrial revolution, Industry 4.0 integrates smart systems and machines, highly connected networks, and advanced information technologies to reinvent products and

[4] Michigan Manufacturing Facts. 2019. National Association of Manufacturers (NAM). www.nam.org/state-manufacturing-data/2019-michigan-manufacturing-facts/

services across the enterprise, from design to manufacturing. The result is more productive, less costly, high-quality manufacturing with accelerated operational efficiency and growth. According to a recent study, an optimal mix of advanced technologies under a 4.0 scenario could save larger companies as much as $16 billion.[5]

At the heart of Industry 4.0 is innovation. Michigan is a leader in the adoption of these innovative manufacturing processes and efficiencies that can be readily adapted to energy infrastructure and operations. Some of the technology areas identified as having potential for high growth in Michigan are shown in Figure 1.

The Internet of Things (IoT) makes it possible to connect thousands of devices—smoothing the digital divide across facilities, states, and regions. In manufacturing, the Industrial IoT (IIoT) includes interconnected sensors, instruments, and equipment networked with computing systems to permit data exchange and analysis. With Industry 4.0 and IIoT, manufacturers can effectively expand process automation, improve communication and self-monitoring of equipment, and implement machines that can analyze and diagnose issues without human intervention. Industry 4.0 also allows for high-throughput customization of products with the flexibility to quickly change specifications.

Creating an innovation ecosystem in manufacturing and Industry 4.0 will require an increased focus in several important areas:

Potential High-Growth Areas

- Artificial intelligence and machine learning
- Machine to machine communication
- Machines as a service (e.g., machines sold by vendor at little or no cost, where vendor receives a small sum for every item or product produced by the machine – or machine can be outsourced to other facilities)
- Additive manufacturing (AM) and materials
- Augmented reality (AR) and virtual reality (VR) for inspection and diagnostics
- Advanced robotics and automation

Figure 1. Technology Growth Areas for Michigan

- *Connecting small and mid-size enterprises (SMEs) with Industry 4.0 technologies.* Smaller firms must not be omitted from opportunities; some are now testing concepts like predictive maintenance, but many lack the resources and expertise to take on artificial intelligence (AI), machine learning (ML), machine to machine (M2M) communication, and other advanced concepts. SMEs need diversified opportunities to grow, skilled employees to hire, and innovative ways to use existing technologies to implement in their plants. In the near term, SMEs may need help to effectively implement advanced sensors, bring legacy

[5] Industry X.0. Combining emerging, connected and smart technologies to digitally transform industry. Accenture Insights. Accessed August 17, 2020. www.accenture.com/us-en/insights/industry-x-0-index?c=us_us_industryxo_10290143&n=psgs_generic_0618&gclid=EAIaIQobChMI5Ij48MGb6wIVDotaBR3xwgksEAAYAiAAEgKodvD_BwE&gclsrc=aw.ds

machines up to modern functionality, and improve productivity—freeing capital for other investments.

- *Pursuing advances in integrated manufacturing technologies.* Exploiting the 'intelligence' aspects of modern manufacturing is the differentiator that enables the United States to stay ahead of global competition. AI, ML, M2M, and other digital technologies will be critical to a robust, reliable manufacturing enterprise, yet these technologies also pose challenges requiring research, development, and demonstration. One future vision of a truly adaptative manufacturing system involves connecting materials to design, manufacturing, and systems in a seamless loop. Significant investments and new partnerships are needed to pursue the innovations required to advance these fields. Foundational sciences such as data analytics and cybersecurity will also be critical to moving these technologies forward.
- *Next-generation manufacturing for energy storage.* New mobility and electrification applications will require advances in energy storage, e.g., new materials and designs for battery storage and lower-cost ways to manufacture lithium ion batteries. Advanced battery technology is needed to support mass market adoption of EVs. Energy storage is also critical for vehicle-to-grid integration; the next generation of grid-connected EVs; and flexible, carbon-neutral electricity grids with many connected, distributed energy resources.
- *Helping automotive and aerospace sectors to collaborate on common problems.* Innovation is spurred through greater collaboration on advanced manufacturing, autonomous systems, composites, light weighting, and other technologies important to both the automotive and aerospace industries. Both now work on similar technologies in separate silos. Time and costs could be saved by developing a collaborative community from these industries.
- *Exploring new trends and business models for expanding manufacturing*. Michigan's talent-rich platform for innovation and investment can take advantage of new approaches for the onshoring of manufacturing. Innovative business models, such as machine-as-a-service, blockchain, and others, should be investigated to support onshoring, modernizing manufacturing enterprises, and encouraging sector expansion in Michigan.

Advanced Materials

Materials, processes, systems, and people enable the industrial base in Michigan. When it comes to innovation, materials provide a vital, crosscutting benefit to many of the emerging technologies in mobility and manufacturing. For example, advances in materials for the automotive sector can potentially be applied to aerospace or to energy storage, medical devices, or construction. The ability to replicate the benefits of new materials across sectors makes them a key focus for the innovation ecosystem.

Some of the high-growth areas for materials innovation in Michigan include the following:

- *Exploring multiple-use materials.* Crosscutting advances in materials (e.g., high-strength composites, resilient or recyclable plastics, lightweight metals, etc.) can be used in multiple applications. Opportunities to pursue innovations in multi-use materials include, for example, novel materials for carbon or hydrogen storage or even construction.

- *Optimizing new and legacy materials.* Researchers can explore new ways to use legacy materials or create new materials to solve old problems. Such opportunities build on the strength of Michigan's universities and private research laboratories.
- *Improving the design and characterization of emerging materials.* Advanced techniques such as Integrated Computational Materials Engineering (ICME) and combinatorial techniques are increasingly used to make the materials design process faster and more efficient. With these techniques, materials design efforts that previously took over a decade can be reduced to several years. The downside is that these virtual paradigms require less physical testing and development, yet manufacturers still need to fully understand the material quality and its performance in specified uses. For example, while additive manufacturing is gaining ground and could boost U.S. competitiveness around the globe, materials for AM are still not well characterized. Physical testing remains a major barrier to the wider use of AM in the manufacturing sector.

Challenges for the Michigan Innovation Ecosystem

With generations of manufacturing know-how, Michigan has fostered a culture of innovation and cutting-edge technology for over a century. The state has an emerging high-tech startup ecosystem, business-friendly environment, a talent-rich workforce, and strong mobility infrastructure. Michigan's reputation as a place for entrepreneurs to start and expand their business is growing. Despite these clear advantages, creating and maintaining a robust and vibrant ecosystem to support innovation is not without challenges. These challenges potentially include deficits in education and workforce development; policies and regulations that may impede innovation; and limits on finance and investment pathways.

> ***Focus Question:*** *What are the current and future challenges facing the Michigan regional innovation system and why?*

Graduate students and post-docs collaborate in a University of Michigan research lab. Photo credit: Marcin Szczepanski, University of Michigan, College of Engineering. Used with permission.

Workforce, Training and Education

Michigan's university system provides a strong underpinning for technology innovation, with nationally recognized research programs in manufacturing, materials science, computer science, and advanced communications and visualization technologies. Multiple workforce training and skills development programs are available—but gaps and challenges exist.

- *Training and education to support advanced manufacturing.* Michigan's workforce could benefit from additional academic programs and concentrations in Industry 4.0 technologies (machine learning, data analytics, AI, AR/VR). Gaps also exist for engineers trained in the disciplines needed for battery development, including graduates to work in battery module/pack engineering (mechanical, electrical and computer engineering).
- *Incentivizing and matching university research for industrial innovation.* To some extent, education, curricula, and graduates can be matched to the needs of industry and technology. Universities can increase their focus on commercial-facing research and rapidly translate findings to help meet industry needs. State and federal governments could help universities become conduits to inform industry about opportunities. Universities may need incentives to conduct industrial R&D, raise awareness, create partnerships, and minimize barriers.
- *Creating and maintaining an innovation talent pool.* Given the stiff competition for skilled executives, Michigan faces some challenges in finding and retaining executive talent for its tech start-ups and incubators. The state can help fill this gap by creating or expanding resources like the Technology Transfer Talent Network.[6] Incentives and messaging may be needed to attract and maintain talent in Michigan. Other talent pools that could be explored are H1B workers and international students, who are mostly in STEM studies.
- *Connecting next-generation workforce with technology.* A compelling story is needed to get those emerging from universities or just entering the workforce excited about innovation. Government could have a role in creating a deeper understanding of where technology is going and its importance. An interdisciplinary approach is important (e.g., fusing business and engineering) as well ensuring inclusivity and diversity in technology innovation.

Policy and Regulation

Michigan policies and incentives have created a relatively attractive business environment and tax structure. While Michigan maintains supportive policies and programs, many are agnostic. Policies are needed to create a level playing field for innovation, such as targeted financing and a tax structure that shores up innovation. Transitioning Michigan's industrial, manufacturing, and mobility operations to zero-carbon status will be a major challenge, and supportive policies can foster this transformation.

[6] Michigan University-wide Technology Transfer Talent Network. Accessed August 19, 2020. www.michigant3n.org/

- *Targeting start-ups and innovation.* Policies that embrace entrepreneurial concepts and provide a supportive regulatory structure are needed to incentivize and support innovation.
- *Facilitating consumer acceptance of mobility and electrification.* Creating an incentive structure and outreach programs can expand public acceptance and use of mobility innovations. Consumers express significant uncertainty over the deployment of EVS, charging facilities, and other infrastructure. They need assurance that the supporting infrastructure will be there if they choose to make the switch. Policies supporting needed improvements to the electrification and mobility infrastructure are critically important to attracting OEM investments.
- *Providing flexible or expedited permitting*. Shortened and/or optimized permitting processes may be needed to support more rapid modernization. For infrastructure, energy and construction projects that impact environment or other resources may involve lengthy processes. Partner with the state to explore innovative concepts that might be applied to navigate building codes or other barriers.

Investment for Innovation

Investment in innovation is important from the early stages through prototyping, production, commercial marketing, and acceptance. Early-stage grants and funding opportunities enable important research to come to fruition and achieve proof of concept. Later-stage investments promote confidence in the technology as a viable commercial product that can successfully go on the market. Challenges to investments in innovation at any stage relate to risk, the complexity of the research or technology, and access to a supportive innovation ecosystem.

- *Expanding access to early-stage funding opportunities.* Filling the gap in early-stage funding for innovation will help entrepreneurs scale their businesses. Investors in Michigan are more likely to invest in less-risky businesses that are further along than in nascent technologies. As a result, early-stage startups often look to more flexible or progressive regions for funding (i.e., leaving Michigan for more supportive markets).
- *Getting the word out on Michigan's strong foundation for innovation.* A compelling and cohesive story that promotes Michigan as an attractive environment for innovation can attract investment dollars and organizations to the State. A robust innovation system requires a strong platform to entice outside investment to support and leverage the rich talent base.
- *Reducing risk for innovation.* Solutions are needed to lower the risk of investing in innovations. Strategies should be explored to de-risk the initial use of a novel technology in manufacturing operations, an environment in which any problems/failures could adversely impact production or product quality, generating high costs. Innovators need a supporting mechanism or bridge to reduce risks as they negotiate the early-stage implementation of new tools. Competition among OEMs and suppliers also elevates the perceived risk in participating in public collaborations. Solutions are needed to increase the value proposition and lower the risk of engagement.

Opportunities to Grow the Michigan Innovation Ecosystem

Companies with a long history in Michigan consider the state to be outstanding or "best in class" as a place to engineer a technology for industrial application. The region is ready to grow economically, and innovation can play a crucial role.

Improving the Innovation Process

The region can take steps to improve funding and incentives for innovation, encourage beneficial partnerships and collaborations, and increase awareness of the resources available through federal and local government. Many of these improvements can be achieved by better coordinating and communicating the opportunities available from diverse organizations.

> ***Focus Question:*** *What could be improved in the underlying process and foundation to support innovation in Michigan? What steps could increase cohesiveness among the innovation clusters that make up the overall Michigan innovation ecosystem?*

- *Enabling greater interaction and discourse among clean energy technology innovators.* Michigan can improve cohesion among its innovation clusters by making a concerted effort to connect and support energy technology innovation. The ecosystem will benefit by creating a connected community that encourages open dialog and generates partnerships and ideas to benefit the entire network, potentially improving access to capital, supply chains, and other important elements. Expanding partnerships can also foster innovation, and could encompass industry, universities, utilities, transmission companies, manufacturing institutes, technology labs, non-government organizations, and state government (e.g., Michigan Economic Development Corporation [MEDC], Michigan Energy Office [MEO]/Michigan Department of Environment, Michigan Office of Future Mobility and Electrification [OFME], Great Lakes, and Energy [EGLE]).
- *Raising SME awareness of available resources.* Tapping into the capabilities of small to mid-sized manufacturers can catalyze innovation. SMEs make up about 90% of manufacturing, but few possess large R&D budgets or engineering departments, and many lack the resources to access DOE programs. While SMEs are often not proactive about applying for grants, they possess diverse capabilities and promising ideas in the proof-of-concept or other early stages. Working with organizations that maintain SME networks, such as the Jackson Area Manufacturers Association, could help SMEs harness opportunities.
- *Expanding mechanisms and technology focus to stimulate innovation.* Successes in other regions may suggest additional ways to stimulate innovation, such as clean tech accelerators, clean tech demonstration funds, collaborations with economic development groups, and demonstration programs. Broadening the focus of innovation can also extend the impacts. Electrification, for example may extend to innovations in renewables, affordable housing construction, and HVAC (e.g., tankless electric hot water heaters, mini split condenser heat pumps, low-value heat recovery, etc.). Innovation focus areas could expand to innovations for agriculture, food processing and waste, packaging, forestry, and other industries with a large footprint in Michigan. The infrastructure focus may include broad opportunities in rail and electrified fleets moving goods and people as well as communications such as 5G (where Michigan may be trailing).

- *Support innovation mechanisms on improved U.S. competitiveness.* Mechanisms that promote innovations and have potential to boost U.S. technology leadership may generate both local and national economic benefits. For example, university spin-offs, which are highly focused and incentivized, are restricted to U.S.-owned or produced-in-U.S. operations. In contrast, some renewable energy technologies built under U.S. research programs are subsequently acquired by foreign entities. DOE demonstration programs could play a role in expanding opportunities that maximize domestic benefits and help to stimulate demand.
- *Reaching across institutional differences to increase opportunities.* Crossing the cultural divides between start-ups, large and small companies, and suppliers can create more opportunities, introduce new ideas, and enable seamless interactions. Larger firms are reluctant to lead technology development and remain focused on incremental innovation, while smaller disruptor technology companies nurture a culture of innovation and change.
- *Incentivizing the demand side of innovation.* Providing incentives for first prototypes can facilitate success in moving technologies to market. Technologies face two 'valleys of death,' once in the early stages of development and again prior to commercialization. Lack of funding at either stage can stall a technology's entry into the marketplace. Matching funds at both stages can shorten the time from lab to market. Much of the available funding targets transformative early-stage research, but funds are also needed to spur the path toward commercialization. Moving R&D into the commercial path faster would encourage

DETROIT, MI – In his remarks at General Motors in Detroit, U.S. Secretary of Energy Dan Brouillette announced $139 million in federal funding for 55 projects across the country that will support new and innovative advanced vehicle technologies. Six of these innovative projects will be led by teams in Michigan. www.michiganbusinessnetwork.com/blog/news-release-doe-announces-139-million-in-funding-for-55-projects and www.energy.gov/articles/us-department-energy-helping-drive-innovation-state-michigan (below photo)

transformative R&D, especially in smaller businesses with limited resources. Government programs often stop short of supporting production, scale up, and commercialization.

Engaging with Government

> ***Focus Question:*** *With regards to DOE opportunities, what is the current level of awareness of these opportunities, the process for accessing, and areas for improvement? Where does Michigan have a role in this process and in engaging DOE?*

- *Facilitating broader industry connections with DOE.* Awareness of and engagement with DOE programs must extend beyond the usual players. The larger companies and industries tend to engage with DOE, participate in research with national labs, or enter into a range of cooperative research agreements. Michigan's automotive industry, for example, maintains a strong relationship with DOE's Vehicle Technologies Program and stays abreast of relevant opportunities, emerging technologies, and resources. Michigan universities are also well-connected with government R&D programs. The challenge is in reaching out to industries and organizations that are less familiar with DOE to help them access DOE resources. Implementing more smart building technologies (which real estate could be pushing) may require partnerships with government as well as industry.

  Small and mid-size companies and start-ups that have not previously engaged with DOE or other agencies need an easy way to connect and find support for their transformative and innovative ideas. One approach is to encourage universities working on DOE programs to partner with and create connections with the broader business community (not just large manufacturers). Another approach is to support rapid demonstration programs for emerging technology, especially in less agile industries.

- *Facilitating connections among innovators, DOE, and local government.* Michigan can support innovation by increasing formal public-private partnerships among industry and DOE/state government agencies, such as EGLE. Targeted initiatives, grant programs, and state government resources could engage a broad segment of industry in a meaningful way to support innovation. For example, the state could issue a 'grand challenge' or other funding opportunity to help Michigan companies put technologies emerging from DOE research (e.g., next-generation materials, AI) to work in their industry (meeting specified performance and cost points). The new MEDC Office of Future Mobility, which coordinates programs in transport (e.g., EVs, energy storage, etc.), could communicate and coordinate directly with industry to help small businesses access national labs and universities.

- *Increasing awareness of local government resources for innovation.* The State of Michigan is committed to investing funds, targeting innovation clusters/zones, and helping industries identify and access the resources best aligned with their objectives. Even with the state's diverse innovation opportunities and clusters, many businesses do not yet understand how to find the local resources and programs they need to move their ideas forward. By better aligning outreach, Michigan can encourage transformative research, foster incremental innovation, and help cultivate and retain talent.

- *Working effectively with the national laboratories*. Raising awareness of lab capabilities and targeted incentives could help to foster partnerships and collaboration between national labs and Michigan innovators. There is a need to increase the suite of public-private partnership lab programs and align technology and innovation with the DOE mission. DOE could sponsor regional meetings with industry, universities, and labs to discuss, network, define, and facilitate new lab partnerships.
- *Encouraging innovation in small business (SB).* The State of Michigan could encourage innovation in small, established firms through a variety of support mechanisms. For example, the state could launch more SB-focused grant programs, such as the Michigan Energy Office's matching program for federal grants. SBs typically find it easier to attain incremental technology improvements that provide near-term impacts, whereas transformative changes may be out of reach. The application process for grants from the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs can be overwhelming for an SB without prior experience. Talented SB engineers who come up with transformative ideas or materials would benefit from a streamlined application process (e.g., DOE prize challenges only require a PowerPoint deck as a proposal). Small and mid -sized companies with limited manpower find greater benefit in spending hours with a customer (definite revenue) than spending hours on a proposal (years away from revenue).

RESOURCES

The results of this workshop underscore the importance of a robust innovation ecosystem and highlight some of the challenges involved in fostering innovation in Michigan.

What Happens Now?

Innovators who are unsure where to begin need not despair—DOE offers dozens of avenues to allow people and organizations to engage with the programs, labs, and facilities across its R&D complex.

DOE Partnering and Funding Opportunities

Lab Partnering Service

OTT's Lab Partnering Service (LPS) connects innovators and investors to preeminent experts, competitive technologies, world-class facilities, and streamlined partnering opportunities at the Department of Energy's National Laboratories. LPS informs investment decisions, increases marketplace competitiveness, and enables technology transfer. Visit https://labpartnering.org to learn more.

The DOE National Laboratory System

- 21 DOE National Labs & Facilities
- Over 1,400 Technology Summaries
- More than 250 National Lab Experts
- 206 User Facilities (from beam lines to 3D printers)

Prizes, Competitions, and Challenges

- OTT's Energy Program for Innovation Clusters (EPIC) https://americanmadechallenges.org/epic/
- Water Security Grand Challenge www.energy.gov/water-security-grand-challenge/water-security-grand-challenge
- Energy Storage Grand Challenge www.energy.gov/energy-storage-grand-challenge/energy-storage-grand-challenge
- Plastics Innovation Challenge www.energy.gov/plastics-innovation-challenge/plastics-innovation-challenge
- ARPA-E Grid Optimization Competition https://gocompetition.energy.gov/

Energy I-Corps

- DOE's entrepreneurial boot camp for lab researchers https://energyicorps.energy.gov/

DOE Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR)

- DOE administers a portion of the Small Business Administration's (SBA's) celebrated small business program.
- DOE awardees now have access to an Energy I-Corps "Lite" curriculum to help them on their journey toward commercialization.
  www.energy.gov/science/sbir/small-business-innovation-research-and-small-business-technology-transfer

Technology Commercialization Fund (TCF)

- OTT administers the TCF program, which allows private entities to share the financial burden of commercializing promising energy technologies with a participating National Laboratory.
  www.energy.gov/technologytransitions/services/technology-commercialization-fund

University Toolkit

- OTT developed the university toolkit to give university students, faculty, and administrators improved access to DOE resources, expertise, funding opportunities, and careers.
  www.energy.gov/technologytransitions/downloads/ott-stem-resources

COVID-19 Technical Assistance Program (CTAP)

- CTAP will provide targeted funding to DOE's National Laboratory System to assist non-DOE entities that are working to combat the coronavirus pandemic. CTAP gives National Lab researchers the ability to offer short-term, limited assistance to U.S.-based entities facing particularly challenging technical hurdles. CTAP applicants should engage directly with the National Laboratory of their choice by visiting LPS.
  www.labpartnering.org/ctap

OTT Regional Stakeholder Engagement and Market Analyses

- OTT's Commercialization Executives and Market Analysis teams integrate "industry pull" into DOE planning and provide high-quality resources to commercial entities that want to engage with DOE.
  www.energy.gov/technologytransitions/office-technology-transitions

DOE's Funding and Partnering Opportunities Resource Library

- OTT and several external partners built an impressive library of resources for innovators who may benefit from connecting and partnering with DOE experts and facilities. View past webinars and discover new opportunities to engage.
  https://fundingopportunities.splashthat.com/

OTT/NNSA Partnership with FedTech

- OTT and NNSA have partnered to work with FedTech, a DC-based accelerator that connects high-potential federal technology with entrepreneurs that are interested in working with

labs to build companies around these technologies. Visit FedTech's website to learn more about FedTech and how to work with them through DOE programs. www.fedtech.io/

MEDC and State of Michigan Resources

The State of Michigan through the Michigan Strategic Board (MSF) funds multiple programs managed by the MEDC that support companies. The Entrepreneurship and Innovation initiative supports technology commercialization.

Commercializing University Technology

University faculty and researchers have access to the following programs to assist in their commercialization efforts.

- **Early Stage Proof of Concept Fund- Advance**: This fund, administered by Michigan State University, is designed to provide a pipeline of de-risked technologies and fundable startup opportunities for further advancement. The program provides matching funds, a strong incentive for faculty with early stage technologies at Michigan universities to engage with their university's Technology Transfer Office (TTO) and commercialization activities. https://innovationcenter.msu.edu/advance
- **Michigan Translational Research and Commercialization (MTRAC) Program**: The MTRAC Program aims to accelerate the transfer of new technologies from Michigan's institutions of higher education into the commercial market by way of licenses or startups. Five Innovation Hubs across the state, in key technology areas, support projects from all institutions of higher education, hospital systems and nonprofit research centers.
    - Michigan State University Agri Bio Innovation Hub
    - University of Michigan Life Sciences Innovation Hub
    - University of Michigan Advanced Transportation Innovation Hub
    - Michigan Technological University Advanced Materials Innovation Hub
    - Wayne State University Advanced Computing Innovation Hub
- **Technology Transfer Talent Network (T3N)**: (T3N) is a statewide university network designed to support, through key talent programs, the commercialization of university technologies through licenses and startups. This program provides critical expertise with mentors in residence and postdocs who are focused on the commercialization strategies of university projects. For more information on the T3N program, please visit www.michigant3n.org

Supporting High Technology Startups

The MEDC funds several service providers and funding programs to assist entrepreneurs in commercializing their technologies and growing their companies

- **SmartZones:** Michigan currently has 21 SmartZones located throughout the state. These SmartZones provide distinct geographical locations where technology-based companies, entrepreneurs and researchers can locate in close proximity to community assets

that assist in their endeavors. The SmartZones include technology business accelerators that provide various services including business development mentoring, feasibility studies, business planning, entrepreneurial training, market analysis, technology assessments, technology mining and more. They also facilitate the commercialization of technologies developed at Michigan universities by partnering with tech transfer offices. For more information, visit MEDC's SmartZone Fact Sheet.

- **Michigan Small Business Development Center (SBDC):** The SBDC provides consulting, training and research for new ventures, existing small businesses and advanced technology companies. Headquartered at Grand Valley State University, representing a long-term collaboration between the Small Business Administration and the State of Michigan, the SBDC operates 11 regional offices and more than 20 satellite offices. The SBDC provides entrepreneurs and business owners with convenient access to consulting and training throughout Michigan at low or no cost. https://sbdcmichigan.org/
- **SBDC Tech Team:** The SBDC provides consulting to innovative tech companies through its "Tech Team" of business consultants who have many years of first-hand experience launching and growing high tech companies. Their background in tech sectors including life sciences, IT, advanced manufacturing, and mobility enables them to provide in-depth support that is essential to the inception and expansion of companies built on cutting-edge technologies. https://sbdcmichigan.org/tech-business/
- **BBC Entrepreneurial Training and Consulting (BBCetc):** BBCetc manages the Michigan SBIR/STTR Assistance Program, which provides group training and one-on-one proposal development consulting to Michigan's technology-based entrepreneurs and early-stage companies. Support covers applications to all 11 participating federal agencies including NIH, NSF, DoD and DoE and requires a non-refundable participation fee of $500, which provides up to 15 hours of one-on-one assistance, access to agency tools and templates as appropriate and a reduced rate for onsite training sessions for all individuals from an organization. https://bbcetc.com/capabilities/sbir-sttr-research-grant-assistance/the-michigan-program/
- **Emerging Technologies Fund (ETF):** The ETF is designed to expand funding opportunities for Michigan technology-based companies in the federal innovation research and development arena by providing match dollars (of up to $25,000 for Phase I and up to $125,000 for Phase II) to eligible Small Business Innovation Research (SBIR) or Small Business Technology Transfer (STTR) proposals. Approved ETF applications receive a letter of support to include with their SBIR/STTR proposal. The ETF is administered by the SBDC. For more information and to apply visit https://www.mietf.org/#/
- **Business Accelerator Fund (BAF):** The BAF is available to participating business accelerators in Michigan's statewide SmartZone network. These funds are used toward the delivery of highly specialized services to their clients that are not otherwise available from these business accelerators. Participating business accelerators engage third party specialists to help advance the client's path to commercialization, company success, and economic impact for the state of Michigan. BAF funds are awarded to accelerators through a competitive review process. BAF is administered by the SBDC. Companies interested in participating are encouraged to contact

the nearest participating business accelerator. https://sbdcmichigan.org/business-accelerator-fund/

- **First Capital Fund:** Entrepreneurs should consider the First Capital Fund as their first investment choice as the First Capital Fund provides "genesis" funds (up to $150,000) to new technology companies at the earliest stages of commercialization in the State of Michigan. The fund is milestone-driven and focused on helping companies achieve follow-on funding from Invest Michigan, angel or venture investors within 12 months. For more information, visit https://investdetroit.com/id-ventures/our-funding/
- **Pre-Seed Fund III (Michigan Rise):** Michigan Rise supports entrepreneurs and technology startups across Michigan through capital support, coaching, assistance with grant funding and more. Funding amounts may be awarded for approved applicants through the fund in the range of $100K to $250K. Learn more at MichiganRise.com

Other resources for SMEs include the **Michigan Manufacturing Technology Center (MMTC),** which provides small and medium-sized manufacturers with operational assessment, process improvement training, mentoring services, website technical assistance and market diversification tactics. For more information, visit the MMTC website .

Other State Supported Programs

Michigan Match Assistance Pilot Program (MMAPP): The Michigan Department of Environment, Great Lakes and Energy (EGLE), offers matching funds to eligible Michigan businesses to partially cover the cost share requirement under competitive federal clean energy technology development grant programs. Individual awards cannot exceed $25,000 annually, and EGLE's commitment cannot exceed three (3) years. For more info visit MMAPP's website.

APPENDIX A: PARTICIPANTS

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