

michigan's growing power

Technologies for
a sustainable future



Green tech, clean tech, alternative energy, sustainability ... no matter what you call it, Michigan is making a major impact on protecting the environment and capturing Earth's natural resources. The state has come full circle, from an automotive manufacturing powerhouse to a champion of sustainability in the auto industry as well as in such areas as advanced battery, solar power, wind energy and more.

In the next few pages, we take a look at some of Michigan's shining stars in diverse industries — the companies, organizations and people blazing new trails on the path to a more sustainable existence.

the auto industry: a greener way to go

BY PETER HAAPANIEMI

Today's auto industry shares a growing sense that sustainable, green technology is vital to its future and to its essential role in addressing environmental problems. "The automotive industry finds itself at the intersection of three critical global issues: the economy, energy and the environment," says Bill Ford, executive chairman of Ford Motor Co. "In response to these issues, new technologies are radically transforming some of the most fundamental elements of the automobile. The companies that lead these changes will create 'green' jobs and profits while reducing fuel use and CO2 emissions."

The rise of sustainable automotive technology is evident in Michigan, where the industry is moving on many fronts — from the design of more fuel-efficient engines to the creation of lighter materials. According to the Alliance of Automobile Manufacturers, there are now more than 50 technologies in today's autos that reduce emissions and increase fuel efficiency, and more than 150 hybrid, clean diesel and flex-fuel vehicle models for sale.

At General Motors Co., more than half of the 1,300 patents filed by the automaker in 2009 involved green innovations, proof of the rapid development of groundbreaking technology by GM researchers and engineers.

According to Alan Taub, vice president of GM global research and development, "The move toward electrification is requiring us to reinvent the DNA of the automobile, requiring massive amounts of innovation. As a result, our green patent portfolio is helping us achieve world-class technological breakthroughs in the energy and environmental space."

THE MANY FACES OF SUSTAINABILITY

The work toward a cleaner, more fuel-efficient future is in full force at a range of Michigan's automotive-related

companies. For example, Detroit's **Clean Emission Fluids** makes systems that provide a cost-effective, practical approach to using biofuels and clean diesel fuel at gas stations and in commercial fleets. Its patent-pending bio-fuel and clean diesel system, known as FAST (Fluids Affordably Stored) stores and blends variable-ratio biofuels and fuel additives through an infrastructure specifically designed for clean diesels, thus lowering the price at the pump and reducing the North American transportation industry's dependence on petroleum.

NextCAT — located at TechTown, Wayne State University's Research and Technology Park in Detroit — is commercializing a class of heterogeneous catalysts to more cost effectively convert oils and fats into biodiesel fuel. Current technology converts highly refined vegetable oils — many of which come from soy — into biodiesel, a very expensive process. In fact, at least 140 of the 176 biodiesel plants in the U.S. currently sit idle because of the high costs of producing biodiesel. The NextCAT solution allows producers to use less expensive feedstocks, including waste oil, animal fats and grease. According to Charles Salley, NextCAT president, the company is currently looking to establish global partnerships to manufacture its biodiesel product.

On the electric front, the **ALTe** manufacturing company recently opened its new 185,000-square-foot facility in a former automotive seating factory in Auburn Hills, MI. There, the company will build a new electric powertrain that can be used to retrofit traditional gas-powered vehicles and, ultimately, reduce emissions and increase fuel efficiency.

ALTe's product is designed to fill a gap in the electric-vehicle marketplace, says CEO John Thomas. Pure battery electric vehicles are still evolving and not quite cost-effective for mass use, he says. ALTe's powertrain, which uses a combination of batteries and a generator to extend driving range, is also higher-priced than traditional internal-combustion powertrains. However,

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— RICH PIROTTA,
COO, ENERGY
COMPONENTS GROUP

it is designed for use by fleets that log a large number of miles, which means the technology can pay for itself relatively quickly. "We're significantly less expensive than a pure battery electric car, and we have no range anxiety — our cars can drive 400 miles," says Thomas. Because it goes in existing vehicles, this powertrain represents a gradual, transitional approach to using alternate power vehicles.

Azure Dynamics, headquartered in Oak Park, MI, develops and builds hybrid electric and electric drive technology for light to heavy duty commercial vehicles and, among other things, offers a hybrid electric shuttle bus. And **NextEnergy**, a Detroit-based research catalyst and business accelerator for alternative and renewable energy, leads partnerships that are developing standards for biofuels and a new generation of hydraulic electric drivetrains that capture the energy lost in braking.

Although automakers continue research on fuel cells, electric vehicles are an area of especially intense focus. Historically, the auto industry has explored a variety of green technologies — often, with varying degrees of intensity. But now, electric vehicles are seen as the fastest and most practical path to sustainable transportation. "There is a much stronger and much more thorough belief that this current electrification of the vehicle trend is going to increase and continue in the future," says Brett Smith, director of the Automotive Analysis Group at the Center for Automotive Research in Ann Arbor, MI.

In Michigan, that view is driving the growth of a burgeoning electric battery industry. In addition, a number of companies will start rolling out electric vehicles late this year. These include **GM's** Chevrolet Volt, which uses a battery combined with a small gas-powered engine that generates electricity when the battery charge runs out after 40 miles. And **Ford** plans to offer the Transit Connect Electric commercial vehicle later this year, followed by an electric Focus model in 2011. Ford is also working with Microsoft on software that will let electric-vehicle owners manage the recharging of their vehicles.

EXPLORING NICHE MARKETS

While large automakers target the mass market, others are exploring smaller niches. **Environmental Transportation Solutions** (EVTs) has developed the EcoV, a zero-emission, electric, low-speed vehicle, and >>

Universities Focus on Green Transportation

Last fall, a group of University of Michigan students took their solar car to Australia and finished third in the Global Green Challenge, a grueling 1,880-mile race across the country. Their car — the Infinium — finished the course in five days, using only solar panels and lithium batteries to move along at nearly 60 miles per hour.

That effort is just one of the numerous sustainable transportation initiatives happening at Michigan's universities. Many of these involve programs designed to educate and train a green-focused engineering workforce. For example, Wayne State University in Detroit recently launched a groundbreaking program that offers undergraduate and graduate degrees in electric-drive vehicle engineering.

The state's universities are also at the forefront of green automotive research. Wayne State has programs exploring fuel economy, emission controls and alternate and renewable fuels. The University of Michigan in Ann Arbor is home to a wide range of research efforts, including the Transportation Energy Center, which looks at everything from hydrogen power to synthetic fuels and advanced chemical energy conversion. Southfield's Lawrence Technological University operates an alternative energy engineering lab focused on integrated fuel cell and hydrogen systems as well as solar, wind and biodiesel technologies. And Flint-based Kettering University's Center for Fuel Cell Systems and Powertrain Integration enables faculty, students and manufacturing suppliers to conduct cutting-edge fuel cell systems research, testing and evaluation.

University research often involves collaboration with the state's private sector. For example, U-M has teamed up with Ford Motor Company to work on computerized hybrid vehicle controls and with General Motors to work on battery research. Last year, the university also announced a new GM/U-M Institute of Automotive Research and Education, which is focused on "re-inventing the automobile and developing the next generation of high-efficiency vehicles powered by diverse energy sources."

This kind of collaboration is vital to effective research. With that in mind, three major universities — Michigan State University in East Lansing, U-M and Wayne State — created the University Research Corridor (URC), an alliance founded to leverage the research power of these institutions. Together, they conduct some \$1.3 billion a year in research, including automotive and alternative energy work.

The URC recently established a transportation research consortium to promote a multidisciplinary, multi-institutional initiative that looks not just at technology, but at planning and policy, as well. As a URC statement on the changing auto industry pointed out, "The work ahead requires a collaborative, interdisciplinary approach utilizing a wide array of disciplines in addition to engineering, including economics, management, social science, policy, law, public health, medicine, natural resources and the sciences. We are committed to expanding our longstanding relationships with the American auto industry in ways that contribute to its competitiveness in the global marketplace."

>> is now partnering with manufacturer **Energy Components Group** (ECG) to begin producing the vehicles in St. Clair, MI. The EcoV is designed for fleet use in neighborhoods, cities and military bases, as well as for individuals.


Unlike most vehicles in this segment, the EcoV is engineered much like its larger cousins in terms of comfort, safety and reliability. "We have taken what is really more of an automobile architecture and made it smaller to fit into this class of vehicles," says Richard Marks, the company's CEO. From a cost perspective, the EcoV pays off as long as gasoline is more than \$1 a gallon, Marks says. "This is one of the very few green energy initiatives that you as an individual can undertake that will save you money. You don't have a 10-year payback or need to do it just because it's green. It saves you money right off the bat."

More broadly, the EcoV may help spread awareness of the practicality of electric vehicles. "We think that the opportunity to experience a zero-emissions, low-speed vehicle is very powerful," says Rich Pirrotta, the COO of ECG.

THE RIGHT INFRASTRUCTURE

Looking ahead, such efforts are likely to expand in Michigan, thanks to the continuing global need for sustainable transportation and the state's unique strengths in helping meet that need. For example, Michigan has more than 330 automotive R&D centers, ranks No. 1 in vehicle-related R&D spending and is home to 47 of the top 50 global automotive suppliers. "We're excited about leveraging the existing supply base here," says ALTe's John Thomas. Auto industry suppliers, he says, "are used to high-volume, low-cost parts that also have to be durable and robust," a set of skills that is not found in most other industries.

That is critical to making the widespread use of sustainable transportation a reality, says the Center for Automotive Research's Brett Smith: "Part of the challenge of the green car and the electric vehicle is taking things that are going from laboratories, like batteries, to high-volume manufacturing. That is absolutely a skill that this region has."

To move transportation into a new, sustainable era, "you need somebody who has designed and worked with cars, and that's what we have here in Southeast Michigan," adds ECG's Pirrotta. "The talent is here, the knowledge is here." 

Incentives Spur Growth in Michigan

On April 21, Gov. Jennifer Granholm announced a \$20 million incentive program aimed at encouraging alternative-energy businesses to invest in Michigan. The \$20 million — \$15 million in grants and \$5 million in loans — was the second round of the Clean Energy Advanced Manufacturing Initiative, which is funded by the Federal Recovery Act. The first round distributed \$15 million to five Michigan companies in December. This government program is just one of several designed to spur the growth of the alternative-energy industry in the state.

Those efforts are paying off as more and more alternative-energy companies move to or expand operations in Michigan, says Jim Saber, vice president of business development for NextEnergy, a leading research catalyst and business accelerator for alternative and renewable energy. He attributes part of that success to "really creative and forward thinking" by the Michigan Economic Development Corporation (MEDC) in terms of incentive offers to alternative-energy companies. "One of the great things that the MEDC has done is to put together structures so that a lot of the incentives kick in as these companies meet their benchmarks."

Another enticement is the contribution of the MEDC, NextEnergy, Automation Alley and other accelerators that help companies connect with strategic partners doing business in Michigan. With that combination, he says, businesses "start to see what the value of doing business in Michigan is all about."

A primary incentive tool is the Centers of Energy Excellence (COEE), which provides direct grant money to companies looking to commercialize or greatly accelerate the commercialization of advancements in alternative-energy technologies, says Eric Shreffler, MEDC's sector development director for advanced energy storage and former sector development manager in the organization's new markets group. The state awarded \$13 million in COEE monies in 2008 to battery companies Sakti3 and A123 Systems. "We looked at those as being the first shots across the bow to say that Michigan was serious about trying to establish itself (within the alternative energy field)."

COEE grants are continuing. In February, for instance, Gov. Granholm announced a COEE designation and \$5 million grant for Dow Chemical Co. to develop materials for application in the wind-energy and transportation sectors. The U.S. Department of Energy is adding a \$5 million match.

Another major incentive program is the Advanced Battery Credits legislation that provides tax credits for energy-storage companies, Shreffler says. "That started off as a \$335 million bill in 2008 and, over the course of the last 12 months, it's now a more-than-\$1 billion bill. A123 Systems, Johnson Controls-Saft, LG Chem and Dow Kokam all received these credits from us to establish their manufacturing facilities in the state, and then they were able to leverage those incentives to put together very strong proposals to the Department of Energy, which had a \$2.4 billion grant opportunity." As it turned out, he says, Michigan projects won more than half of that \$2.4 billion.

Motivated by the rush of new companies, value-chain companies are also giving the state a close look, he says. "For instance, Toda America, a cathode materials supplier, was looking at South Carolina and ended up choosing a site in Battle Creek to be close to its customer base. Techno Semichem, a producer of an electrolyte, plans to open up a Michigan facility called TSC Michigan. Magna Electronics is establishing an electric motor assembly facility in Grand Blanc. Magna E-Car just announced a battery test lab. It goes on and on and on," says Shreffler. "Companies are seeing what's happening in Michigan, and it just makes sense for them to be here."

wind, solar and advanced battery power: building green clout

BY LESLIE MERTZ

The number of advanced-battery and solar- and wind-energy companies opening their doors or expanding in Michigan over the last few years is indeed long, according to Jim Saber, vice president of business development for NextEnergy, a Detroit-based research catalyst and business accelerator for alternative and renewable energy. "We're very well-positioned on a national and an international basis to compete for these businesses," he says.

Michigan's history in the automotive industry is partly responsible for its ability to attract alternative energy-related companies, Saber says. "Think about it this way: There are more computer chips inside an automobile than in any other device in the world, so we already design and build some of the most sophisticated consumer products. And, as the automobile evolves increasingly into a blend of mechanical and electrical components, it has more and more in common with the design, development and control of alternative energy products, such as solar systems and wind turbines."

Plus, the state, federal government and industry have begun to invest heavily in the advanced energy storage companies that go hand-in-hand with wind and solar systems. According to Saber, this combination of investment opportunities and manufacturing know-how makes Michigan very appealing to alternative energy companies and has encouraged expansion among existing businesses, helped spur startups and enticed out-of-state companies looking for facilities to produce their already-developed base products.

WIND ENERGY IS TAKING OFF

"The wind industry in Michigan includes more than 100 active companies manufacturing components for wind turbines, as well as providing engineering design, product development, testing and validation

services," says Steve Bakkal, director of wind energy sector development at the Michigan Economic Development Corp. (MEDC).

"The state possesses unique strengths in its advanced manufacturing and materials expertise to allow it to tackle industry issues that have plagued industrial-scale wind turbines, such as quality of blades, hub castings or drive-train issues," he says. "Our state's attraction efforts are focused on positioning Michigan as not only a great location to manufacture a product, but one that has successfully brought innovative solutions for its customers."

For the Ann Arbor-based **Accio Energy**, Michigan was a natural choice, says Dawn White, president, who has watched her company expand in physical size to a 12,000-square-foot facility and from just two employees in May 2008 to eight now. She anticipates the company will double its workforce in the next year. Accio Energy makes turbineless wind energy systems "that are as silent, stationary and modular as solar panels and as cost-effective as big wind," she says.

"We are in Michigan first and foremost because we like living here. Conveniently, Michigan also happens to have a bundle of resources that are perfect for Accio Energy. These resources include an abundance of talent, mass-production manufacturing capacity and natural resources in the form of superb onshore and offshore wind quality that provide us the opportunity to validate our aerovoltaic technology close to home prior to our global launch."

For wind-energy companies, Michigan government policy can make a big difference, says NextEnergy's Saber. "Michigan has a renewable energy standard — called an RPS, or renewable portfolio standard — that says 10 percent of the electrical power sold to customers has to come from renewables. That helps establish a local market." A local market is important to most wind-turbine companies who find it cost-prohibitive to ship their huge

"Michigan is quickly becoming the heart of North America's alternative energy industry."

THERESE THILL,
MEDC

products long distances, he says. "Manufacturing centers tend to locate close to their markets, and having an RPS puts us in the game for a lot of these companies."

One company planning to manufacture its products for the world market is **Franklin Wind Energy Group**, based in Franklin, MI. Founded in 2008, this small startup has developed its own intellectual property for a horizontal-axis wind turbine, and is in the design stages for a vertical-axis turbine according to Franklin's CEO David Koyle. Besides these products, Franklin has also licensed the exclusive rights to market two other turbine technologies: one is a wind diesel-assist, vertical-axis turbine that can attach to any diesel generator, reducing fuel costs and lowering emissions; the other is a larger horizontal-axis wind turbine to be designed for farmers and the agriculture market.

Danotek Motion Technologies — a developer and manufacturer of advanced generators and components to supply wind energy to the power grid — plans to expand its Michigan operations and relocate from Canton to Plymouth Township to enhance its manufacturing capabilities. The project is expected to create 353 new jobs, including 141 directly by the company. A state tax credit valued at \$2.5 million over 10 years helped convince the company to invest in Michigan over a competing site in Indiana.

According to Dan Gizaw, Danotek president and CEO, "We are gearing up to support the rapid growth of the global wind market. Wind turbine manufacturers and wind farm developers are significantly expanding operations worldwide, particularly in Europe, China and the United States. We design and manufacture advanced permanent magnet generators and power conditioning systems that enable those business ventures to dramatically improve energy efficiency, cut costs and increase revenue." The company also produces motors, drives, pumps and other accessories for electric and hybrid vehicles.

SEEING THE POSSIBILITIES OF SOLAR

Michigan is also drawing a variety of solar companies, says Therese Thill, director of business attraction at the MEDC. "Michigan is quickly becoming the heart of North America's alternative energy industry by bringing together a comprehensive network of programs, assets and incentives that make

it the best location in North America for solar energy companies to locate and grow."

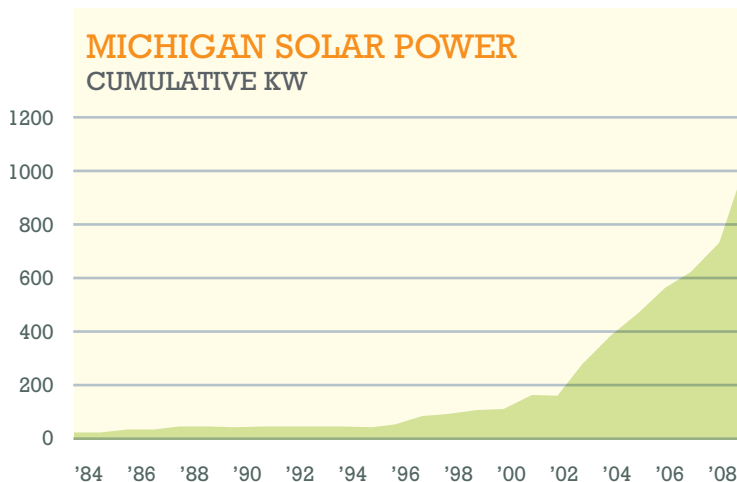
That network includes 119 institutions of higher education that are creating new solar-power technologies and hundreds of research-and-development facilities that are developing innovations in advanced-manufacturing processes to enhance quality, speed and production. In addition, says Thill, the state has more than 900 manufacturers and component suppliers that are "uniquely positioned to meet the demand for the rapidly expanding solar-power industry."

"**NextEnergy** leverages the capacity in Michigan for designing, engineering and manufacturing high-quality components to connect solar system manufacturers with key partners and supply chains," Thill says.

Some of the big names in solar that share a Michigan location but have different business and product approaches are Power Panel Inc., United Solar Ovonic and Clairvoyant Energy.

Located at the NextEnergy center in Detroit, **Power Panel** has been in business for three years. According to company President Garth Schultz, "Power Panel combines the attributes of a photovoltaic (electricity-producing) panel with those of a solar thermal-producing element." From a one-square-meter shape, he says, the panel can generate 120 watts of PV electricity and 450 watts of thermal energy, and is able to produce hot-water-level temperatures even when it's cold outside.

United Solar Ovonic, a wholly owned subsidiary of **Energy Conversion Devices Inc.**, produces a thin, lightweight, flexible solar laminate called UNI-SOLAR. Its weight — about a pound per square foot — allows it to be used on roofs that might not be able to support more traditional glass-faced solar panels, says Mark Trinske, vice president of investor relations and communications. "The flexible element means that an architect can use it to go around curves and build >>



Solar Power Installed in Michigan: The Bureau of Energy Systems has identified 1041 kW of photovoltaic systems installed in Michigan as of the end of 2009. The chart above indicates the cumulative kW that have been installed. Photovoltaic installations started increasing in 1996 and have continued to grow.

>> it into the design of a building instead of placing it on top of the building after the building is done.”

Currently, United Solar Ovonix has three manufacturing facilities in Michigan and a fourth building in Battle Creek, which it hopes to get up and running as the market demands. Why Michigan? “We were founded in Michigan and we’ve always found it to be a place where we could get really high-quality, trained manufacturing labor and really high-quality engineering people,” Trinske says. “We’ve worked very well with the state and have just found it to be a great place to be.”

In contrast, **Clairvoyant** is an out-of-state company that is bringing its solar-panel production to the former Ford Wixom assembly plant. Clairvoyant will share the facility with **Xtreme Power Inc.**, a manufacturer of battery-storage devices, and other renewable companies. Clairvoyant CEO David W. Hardee anticipates the company will employ some 4,500 workers within a couple of years of the plant opening in the fourth quarter of 2011. Overall, Clairvoyant and Xtreme Power expect to invest \$856 million over four phases in the plant, and the venture will generate 10,000 indirect jobs.

ALL EYES ON ENERGY STORAGE

Storage for the energy produced by both solar and wind products is paramount. This is also true for the automobile industry, according to Eric Shreffler, MEDC’s sector development director for advanced energy storage. In fact, he says, “For many companies, their initial target markets and probably the bulk of at least their initial business is going to be transportation.”

Compact Power is one such company. A subsidiary of LG Chem, it moved to Troy, MI, in 2005, where it employs 120. It is a major designer, developer and manufacturer of low-weight, high-energy/high-power lithium-ion batteries for hybrid electric vehicles. Other major companies include Massachusetts-based **A123 Systems**, which has three plants in operation or in the works in Southeast

Michigan, and University of Michigan-associated **Sakti3**. Both of these advanced energy storage companies received multi-million-dollar state grants from the incentive program called Centers of Energy Excellence (see sidebar, page 30).

Dow Chemical Co. of Midland, MI, is also in the battery business through a joint venture with Kokam America. Supported by a Department of Energy Reinvestment and Recovery Act grant, **Dow Kokam** is scheduled to begin the first of two phases of construction for an 800,000-square-foot, highly automated, large-format battery manufacturing facility in Midland this summer, says Dow Kokam spokesperson Kristina Schnepf. “When both phases are complete, the facility will employ as many as 800 people and will have the capacity to manufacture 1.2 billion watt-hours of large-format prismatic cell and batteries annually, enough to power 60,000 fully electric or hybrid electric vehicles per year (assuming a 20 kWh battery system).”

Besides Dow’s historic ties to the community, Dow Kokam chose the location in mid-Michigan for several reasons, Schnepf says. “First, Midland has traditionally been an attractive, business-friendly community for the location of new operations. Second, there is robust existing infrastructure — roads, utilities, city services — that will expedite our ability to begin operations. Third, the region has an exceptional base of qualified workers.”

In addition, she says, the State of Michigan has been “unwavering in its support of the development of a vibrant advanced energy storage industry.”

This support is just one more reason for the growing list of advanced-battery, solar- and wind-energy companies. NextEnergy’s Jim Saber says is coming to Michigan. “Sometimes, we don’t talk the right way about ourselves as a state, but I can list 15 or so companies that are doing business and making investments in Michigan in a major way that weren’t around five years ago, so I think we’ve got a great thing going.” 🌱

Lighting up in Michigan

The Michigan Solid-State Lighting Association (MSSLA), launched in 2009, is on a mission to establish the state as a global leader in solid-state lighting manufacturing and research and development. Based in Detroit, the association is leveraging the intellectual properties and technical expertise of its members to promote environmentally friendly lighting options and to advance the organizations it represents: Michigan-based corporations, universities and agencies.

One of the group’s founding member companies, **ilumisys, Inc.**, develops and produces next-generation solid-state lighting technology, with products that are designed for 100 percent reuse and recycling. The Troy, MI-based company, formed in 2007 as a spin-off venture of **Altair Engineering**, has received a \$4 million tax credit to expand its LED (light-emitting diode) technology R&D and ramp up manufacturing operations in Michigan. Combined with **ilumisys’** planned investment of \$7.4 million, the tax credit is expected to help create 213 new jobs at **ilumisys** and an additional 342 new jobs throughout the state.

Another MSSLA founding company, **Relume Technologies** of Oxford, MI, was the recent recipient of a seven-figure investment by **Beringea**, a venture capital firm based in Farmington Hills, MI. **Relume Technologies** makes LED lights for streetlights, crosswalks, traffic control panels, parking garages and more. The company has also developed a smart-grid technology that enables streetlights to be dimmed or causes lights along roads to flash to signal an emergency exit route.

The growth of the MSSLA — and the companies it represents — parallels the lighting industry’s current and forecasted growth. According to MSSLA President Dave Simon, “The more companies that become involved in the MSSLA, the more we will be able to help ensure Michigan has the greatest opportunity to emerge as the leader in producing the next level of energy-efficient lighting.”

Other MSSLA founding members include **DTE Energy**, **LEDOS**, **LumaSmart**, **Midwest Circuits**, **Michigan Department of Energy, Labor & Economic Growth**, **University of Michigan**, **Wayne State University** and **XUS LED Lighting**.