By Brian Donahue

The Age Of Alternative Energy Arrives

Locations across the country have made alternative energy central to their economic recovery strategies. The clean energy future is here, and the race is on to claim a leadership position in solar, wind, geothermal and biofuel technology and manufacturing.

In a converted IBM plant in Tucson, AZ where it manufactures crystalline and thin-film solar modules and massive photovoltaic systems for the emerging North American solar market, SOLON Corp. recently designed the largest solar electric array worldwide for another Tucson company, Global Solar Energy. In turn, Global's system will generate more than 1.1 million kilowatt-hours of renewable electricity annually, using a technology that is expected to drive down solar energy prices and bring renewable energy to the general population.

In Eastern Tennessee, a first-of-its-kind cellulosic ethanol production facility opened this year with the capacity to convert switchgrass or corncobs into 250,000 gallons of ethanol annually, further developing a value chain whereby local farmers supply the feedstock for biorefineries to produce affordable, renewable fuels. Meanwhile, in New Mexico, the 40-foot-tall wind turbines of the High Lonesome Mesa that went into steady motion last year generate enough electricity to meet the needs of 24,000 homes, the latest development in a wind industry that rivals natural gas as the leading source of new electricity generation in the U.S.

During one of the worst years in economic history, the three benchmark energy technologies—solar, biofuels and wind—grew in global revenue by 11 percent in 2009, totaling $139.1 billion, and they are projected to grow to $325.9 billion within a decade. They are part of a renewable energy industry that has come to be more than just a sign of hope amid a backdrop of shuttering financial market leaders and the desperate measures of governments worldwide to stave off full-blown depression.

The alternative energy industry has become a driving force for economic recovery. According to a report issued in March by Clean Edge Inc., a research and publishing firm for the clean-tech sector, biofuels and wind power each saw increased revenue last year, though solar experienced its first decrease due to a decline in solar PV pricing. While total venture activity was down in the U.S. in 2009, clean energy ventures increased to 12.5 percent of total venture activity. The firm's research shows that wind power, with global installations reaching 37,500 megawatts last year, will expand from $63.5 billion in 2009 to $114.5 billion in 2019.

The biofuels market, consisting of more than 23.6 billion gallons of ethanol and biodiesel production worldwide, reached $44.9 billion in 2009 and is projected to grow to $112.5 billion by 2019. And solar PV, including modules, components and installation, will grow from a $30.7 billion industry to $98.9 billion by 2019, according to Clean Edge projections. Wind energy is of particular note, as it is the fastest growing energy source in the world.

The installation of nearly 10,000

PHOTO CREDIT: WWW.IREOM.ORG; DESIGN: MEGAN KNIGHT, GROUP C ART DIRECTOR


Downtown Tucson, AZ

megawatts of new generating capacity last year, enough to serve more than 2.4 million homes, broke all previous records, thanks in part to federal stimulus dollars. Recovery Act funding spurred the growth of construction, operations and maintenance, as well as management jobs. But according to the American Wind Energy Association (AWEA), the U.S. is barely tapping this resource. Current wind installed capacity is at 35 gigawatts, whereas onshore U.S. wind resources could generate nearly 37 million gigawatts, more than nine times the country's current electricity consumption. While several states have adopted and are working to meet a renewable energy standard (RES), the AWEA is calling for a national standard with aggressive targets. This would create thousands of new American jobs and spark the manufacturing of the 8,000 component parts that go into a modern wind turbine. With the federal government providing billions in tax breaks for renewable projects, and many states spurring development through tax incentives and the establishment of renewable energy standards, clean energy is running on plenty of momentum.

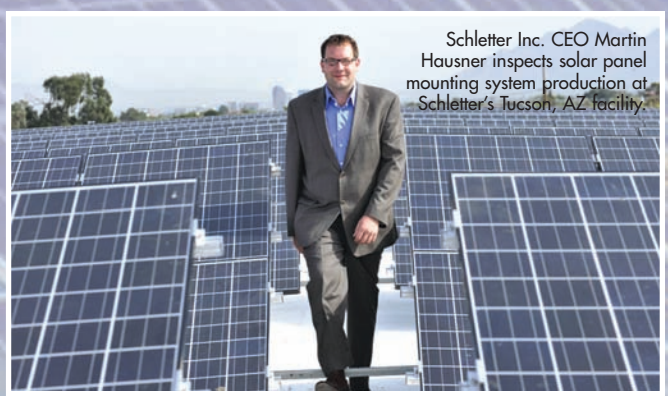
"From the smart grid and energy efficiency to renewable energy generation and advanced battery storage, clean tech continues to be a major driver of regional job growth, economic recovery and technological competitiveness," says Ron Pernick, Clean Edge co-founder and managing director.

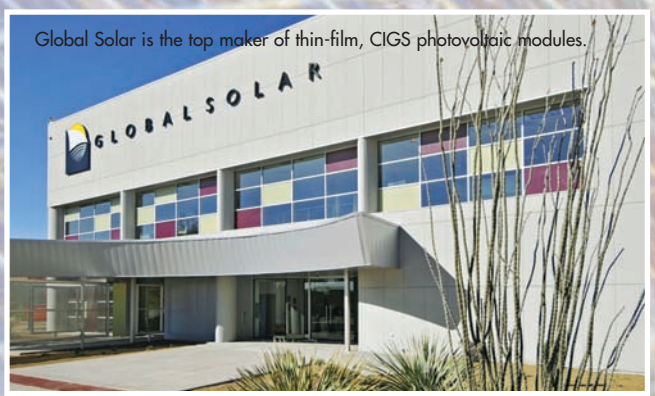
ARIZONA IS THE SUN KING

Arizona's vast desert areas offer the highest solar power potential in America. It's enough sun, in fact, to provide power for the entire country, given the necessary technology. With the opportunity to lead the world in solar technology development in the next five to 10 years, Arizona has been working numerous tracks—manufacturing, university research, regulatory and political—to build toward its potential. And the state has come a long way in a short amount of time.

Tucson today is the U.S. home to some of the world's leading photovoltaic manufacturers, including Schletter Inc., which designs and manufactures solar mounting systems, Global Solar Energy; the leading manufacturer of thin-film CIGS photovoltaic modules; and SOLON, which like Schletter is German-owned. SOLON's operation, Arizona's first for the manufacturing of photovoltaic equipment, could serve as the cornerstone of the growing solar economic development market in Southern Arizona. The state's solar push began a decade ago when the public utility regulator, the Arizona Corporation Commission (ACC), began to aggressively pursue solar resources. ACC later announced that 15 percent of regulated utilities' retail sales must come from renewable energy sources by 2025. It is now about 1 percent statewide.

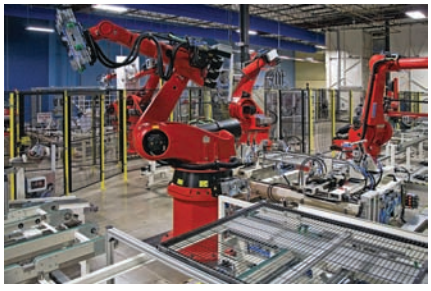
The state released its Solar Electrical Road Map Study in 2007, leading to the creation of the Arizona Research Institute for Solar Energy (AZRise) at the University of Arizona, which serves as a solar energy center of excellence. Arizona has shown its commitment to meeting the 15-percent renewable energy


Schletter Inc. CEO Martin Hausner inspects solar panel mounting system production at Schletter's Tucson, AZ facility.



Global Solar is the top maker of thin-film, CIGS photovoltaic modules.

PHOTO CREDITS: WWW.TREOAZ.ORG



German-owned SOLON was Arizona's first facility for the manufacturing of photovoltaic equipment, and is now a cornerstone of the burgeoning solar-energy industry in the state. The Tucson plant makes heavy use of robotics (center photo) and produces the solar-energy components in a laboratory-like setting (right).

standard. Tucson Electric Power (TEP) already has developed almost 10 megawatts of company-owned renewable energy generating capacity, and is on track to add another 3.4 megawatts of company-owned capacity and to purchase 31.5 megawatts in the coming years. Some of the power TEP will buy will come from a 5-megawatt concentrating solar power system being built by Bell Independent Power Corp. at the University of Arizona Science and Technology Park in Tucson. TEP will purchase another 25 megawatts from a photovoltaic system owned by Fotowatio Renewable Energies.

The state's targeted incentives make it one of the most effective places to do business in the nation, according to Laura Shaw, senior vice president of marketing and communications for Tucson Regional Economic Opportunities (TREO). "In the midst of this economic downturn, Arizona has truly increased its competitiveness," Shaw tells *Business Facilities*.

Arizona Gov. Jan Brewer last year signed the Renewable Energy Tax Incentive Program to encourage renewable companies to invest in the state. The program provides $350 million in incentives for new and expanding renewable energy manufacturing plants and headquarters. The legislation provides qualified companies in solar, wind, geothermal and other fields with a refundable income tax credit and a reduction in property taxes. Income tax credits are up to 10 percent of qualified capital investment based on jobs creation to capital investment ratio. Tax credits must be taken over five years in equal installments. Property taxes can be reduced by 70 to 80 percent for up to 10 years if the company pays more than half of its employees 125 percent of median state wage on average, or up to 15 years if it pays at least 200 percent of median state wage on average.

TREO has seen an increased number of inquiries from renewable energy firms as a result of the legislation. In the last six months, some 30 alternative energy firms have begun looking at Tucson for business expansion or relocation, Shaw notes.

Parking lots throughout Arizona, like the two Tucson facilities pictured here, are joining the march to solar energy.

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The growing cluster of some 50 solar industry companies already located in the Tucson area have added more than 400 direct new jobs in recent years, bringing the total to about 2,000 direct and indirect employees in the metropolitan region's solar industry.

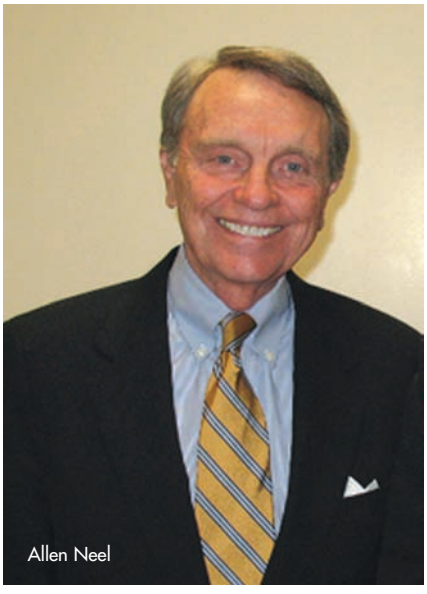
TREO's Solar Economic Impact Study found in late 2009 that the industry was producing an annual economic impact of $403 million, primarily from manufacturing, design and installation. Shaw noted that every dollar of economic activity or production value by solar companies creates $830,000 to $950,000 in additional demand in the local economy, and every job in the solar industry supports 1.2 additional jobs, with wages well above Pima County's average annual wages. Companies are also attracted to the Tucson region due to the University of Arizona's engineering, computer science and business programs. The university, ranked No. 1 in the country by the National Science Foundation for physical sciences research expenditures, has 37,000 students, and Pima Community College has 75,000 enrolled. Also, Shaw notes the low cost of living and low business operating expenses in Tucson.

Elsewhere in Arizona, Suntech Power Holdings Co., the world's largest manufacturer of crystalline silicon PV modules, recently announced that its first U.S. plant will be located in the City of Goodyear, near Phoenix. The plant will have an initial production capacity of 30 megawatts and is expected to begin operations later this year. The 80,000- to 100,000-square-foot facility will allow for long-term growth of manufacturing capabilities to meet increasing American demand for solar power. Arizona has a good chance to receive almost $9.5 billion of the $500 billion that the federal government is expected to invest in clean energy over the next decade, and Shaw says this would result in an estimated 75,100 new direct and indirect jobs in the state, with many of those coming to Tucson.

TENNESSEE AIMS TO BE THE 'SILICON VALLEY' OF SOLAR

Is the Volunteer State the new "Silicon Valley" for the solar energy industry? State officials and economic development agencies say it is, and they've got the research, the funding and the project announcements to back them up.

In the past year, three major solar power manufacturing investments were announced in Tennessee. First, Hemlock Semiconductor revealed it would locate in Clarksville, followed swiftly by Wacker Chemie AG, which will operate its plant near Chattanooga. The two investments, worth more than $2.2 billion, will not only bring the world's two biggest makers of polysilicon for solar panels to Tennessee, they represent an opportunity to extend the solar industry value chain across the state.


Allen Neel

Sure enough, in January, Confluence Solar Inc. announced it will build a $200-million plant in Clinton. The 200,000-square-foot manufacturing, warehousing and distribution facility will be located on 25 acres in the Clinton/I-75 Industrial Park, creating about 250 jobs. The Hazelwood, MO-based company considered several other states for the

The Oak Ridge National Laboratory has been at the forefront of efforts that are transforming Tennessee into a national leader in alternative energy development.

PHOTO CREDITS: WWW.KNOXVILLEOAKRIDGE.ORG

plant, but cited Tennessee's growing role in the solar energy field, its budding solar infrastructure, the work being done at Oak Ridge National Laboratory, and the planned University of Tennessee Solar Institute as major advantages. Wacker and Hemlock will supply Confluence with polysilicon ingots, which will be used to create monosilicon ingots.

"It's like everything else, it all connects," Allen Neel, president of the East Tennessee Economic Development Agency, tells *Business Facilities*. "That's beginning to happen, and I think we're all trying to capitalize on that as a state and certainly as a region here, and I assume other areas are too." As previously reported by *Business Facilities*, a critical factor for at least one of the solar power manufacturers, Hemlock, was Tennessee's proactive position regarding the price of electricity. State officials and the Tennessee Valley Authority worked closely to address this issue. Also, Tennessee expanded its Green Energy Tax Credit, which permits these manufacturers to eliminate uncertainty and risk associated with potential rising electricity costs as well as any future federal carbon tax that may be enacted. The credit was extended in 2009 to green-energy supply chain manufacturers who have made a capital investment in excess of $250 million in qualifying facilities.

> Tennessee, which expanded its Green Energy Tax Credit, has aggressively established a leadership position in the green-energy supply chain, from raw materials to finished products.

Solar energy is just another component of Tennessee's effort to be a leader in the renewable energy field. The state has long been a player in the biofuels sector, and in January the world's first cellulosic ethanol

production facility opened in Vonore. The 74,000-square-foot demonstration plant, located in the Niles Ferry Industrial Park, has the capacity to convert switchgrass or corncobs into 250,000 gallons of ethanol annually.

The technology developed at the plant, if ramped up for large-scale production, could allow the U.S. to produce as much as 16 billion gallons of biofuel by 2022. The project represents the culmination of years of corporate research and development and a $40.7 million investment from the state. The DuPont Danisco Cellulosic Ethanol (DDCE) plant is a joint venture of DuPont and Danisco's Genecor division. Genera Energy, a corporation established by the University of Tennessee to manage the construction project, partnered with DuPont Danisco to set up the pilot-scale refinery.

The opening of the DDCE plant is a big step in the creation of new alternative fuels, and comes almost 10 years after plans were first developed to convert switchgrass to fuel. Officials said the use of locally grown switchgrass for raw material will allow small farmers in Tennessee to survive. One of the goals of the project is to develop low-cost ways for farmers to harvest and transport switchgrass to the facility for processing, and the University of Tennessee has been working with farm machinery producers such as John Deere to develop equipment that can chop the switchgrass at the farmer's location, reducing bulk and saving fuel needed to transport the material.

DDCE's partners have invested more than $100 million in technology development related to transforming plant matter—in the case of the Vonore plant, first corn cobs, then switchgrass—into transportation fuel.

"The region here is very interested in being viewed from an alternative energy standpoint. We've got a lot of history working in the field of energy …when you look at the Oak Ridge National Lab and the University of Tennessee," Neel says. "The ethanol plant down there, I think it's an exciting opportunity for us [and] certainly the research that will come out of it will help further advance the use of ethanol and that whole alternative energy area."

Meanwhile, the University of Tennessee Biofuels Initiative, funded largely by the state, continues to be recognized as among the nation's leaders in biofuel development. The UTBI is completing the harvest of some 2,600 acres of locally grown switchgrass, and 3,000 additional acres were planned for planting this spring.

The recent award of $2.35 million in federal research grants will allow for additional farmer incentives to grow another 1,000 acres. The UTBI estimates that Tennessee farmers could produce enough switchgrass by 2025 to yield more than a billion gallons of ethanol annually on some 1 million acres without displacing the production of food and fiber crops.

The region is motoring ahead in another burgeoning sector—electric cars. In February, the U.S. Department of Energy closed a $1.4-billion loan agreement with Nissan North America Inc. for the modification of Nissan's Smyrna, TN manufacturing plant to produce the Nissan LEAF, a zero-emission, all-electric vehicle, and the lithium-ion battery packs to power them. When fully operational, the vehicle assembly plant will have the capacity to build 150,000 Nissan LEAF electric cars per year, and along with 200,000 batteries.

"I think what we're seeing here is that this region is very suited for alternative energy kinds of projects," Neel says, stressing that the industry is new and just beginning to evolve. "There's a research component that we're obviously interested in here, as well as the product manufacturing, so we're trying to look at it from all sides. We're excited about it, but once again I think it's also got to be cost-competitive so we can all take advantage of the alternative energy sector, not just here but in this country. So, I expect some subsidies to be needed for some time to come."

For the time being, Tennessee will celebrate the recent achievements, and the state has good reason to hope for a brighter future. Neel expects more announcements in 2010 than were made last year.

NEBRASKA NURTURES A WIND-ENERGY AND ETHANOL BOOM

Nebraska is in prime position to capitalize on growth in the wind energy industry, considering it is ranked sixth among states in wind-energy potential, but 18th in actual wind-energy production.

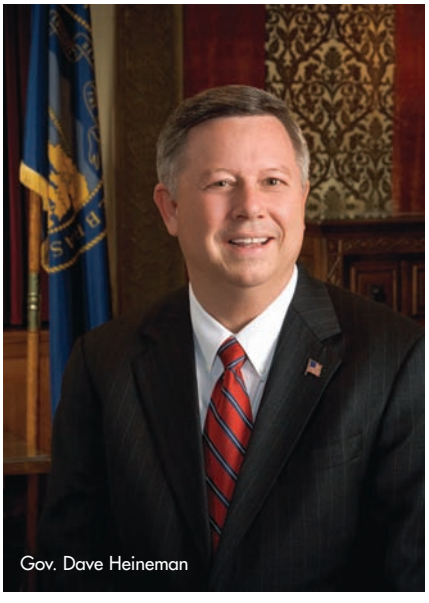
"We've got some making up to do in terms of being able to close that gap," Richard Baier, director of the Nebraska Department of Economic Development, tells *Business Facilities*.

In hopes of luring more wind energy companies, the Nebraska Legislature recently gave first-round approval to a bill that would allow the Nebraska Power Review Board to approve wind-energy operations designed to export energy. Baier expects the bill to pass, and believes it will result in a spurt of wind energy developments.

"There's been a real concerted effort between the wind energy [companies], the Legislature, the governor's office and the public power district to do the things that will support the growth of wind without impacting our longstanding tradition for public power in this state," he says.

Having publicly owned power companies has created a few obstacles in the wind development area, since only private companies have been able to enjoy federal tax incentives for installing wind farms. But Gov. Dave Heineman has created incentives that have resulted in a steady growth in the wind and other renewable energy industries. In 2008, Katana Summit opened a facility in Columbus to manufacture wind turbines, a $20-million investment that created 200 jobs. And there is talk of another major project, as TPI Composites, based in Scottsdale, AZ, is considering locating in Grand Island. Though there has been no official word, the company is entitled to more than $5 million in federal tax credits for the "next generation" wind turbine blade manufacturing facility. Baier notes that many wind companies are struggling with a lack of financing.

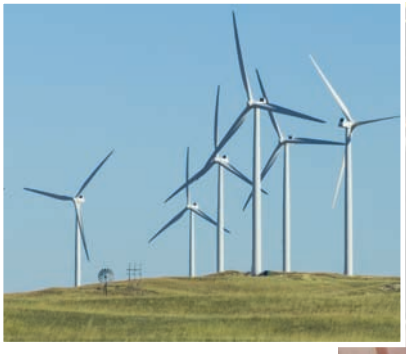
"They're kind of all sitting around waiting. At some point something will sort of open the credit floodgate and things will begin to move very,

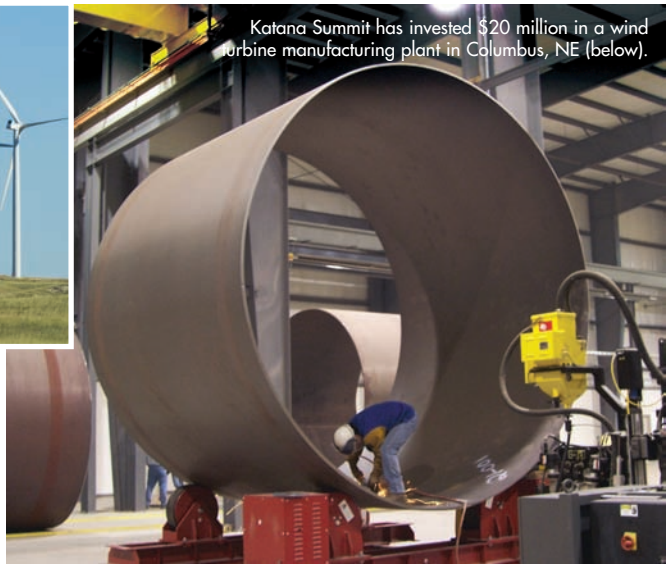


Gov. Dave Heineman

PHOTO CREDIT: WWW.WIKIPEDIA.COM

very quickly, and you're going to see a real rush to get these folks up and operating," Baier says. "We're gonna see significant growth [in wind energy]," he says. "We believe in wind development in our state, especially wind for export, which is really what we're focused on—how do we take a resource that exists in our state, be able to capitalize on it and use it as a revenue source for Nebraska and for our investors."



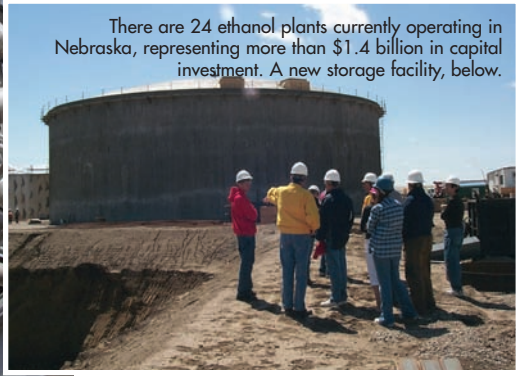


Katana Summit has invested $20 million in a wind turbine manufacturing plant in Columbus, NE (below).

Nearly two dozen ethanol plants have sprung up around Nebraska, which is the second-largest producer of ethanol in the U.S. The newest will be Denmark-based Novozymes, which is building a $200 million manufacturing facility in Blair that will produce enzymes used to make advanced biofuels.

"The ethanol industry has been exceptionally important to our state in terms of development over the last few years," Baier says. "First and foremost it's been able to bring significant amounts of venture and angel and equity investment capital to Nebraska. Most of these plants [cost] $150-million to $200-million. What we've got now is a strong enough cluster that's attracting other kinds of development in the related industries. So, it's been really great for us."

Baier notes that many of the plants are located in small, rural communities where quality jobs are essential to economic stability. "You have an awful hard time finding any other kind of industry to move into a town of 5,000 that will bring $100 million in investment and 50 really good high-tech jobs," he says.



There are 24 ethanol plants currently operating in Nebraska, representing more than $1.4 billion in capital investment. A new storage facility, below.

Federal tax credits have played a role more recently for renewable energy developers—Novozymes learned in January that it will receive a $28.4 million Advanced Energy Manufacturing tax credit for its facility in Blair—but the multi-incentive Nebraska Advantage program has resulted in massive capital investment in the state since introduced in 2006. The package provides performance-based tax breaks to businesses, based on six tiers that relate to capital investment and job creation.

Initially, the tax incentives were available to companies in four sectors —biotechnology, telecommunications, financial services and manufacturing. "We've also been able to use some of our stimulus funds to do railroad enhancements at sites around the state," Baier says. "That's really been our focus, making sure there is sound infrastructure of transportation. The other thing we've done is

PHOTO CREDIT: WWW.NREL.GOV

we've created an educational infrastructure that we think will support this industry over the long term."

MICHIGAN'S TRIPLE PLAY

In a state as impacted by the economic downturn as Michigan, green is gold. And the rush to cash in is on, as solar, wind and lithium-ion battery manufacturers and suppliers bring new, vital industry to the state.

Case in point is the triple announcement that came in February from Dow Chemical Co., Michigan's biggest corporate investor. Dow plans to develop wind, solar and alternative battery power projects totaling more than $1 billion and creating 2,500 direct jobs and 4,400 spinoff jobs.

Dow Chemical is ramping up to produce solar-panel roofing shingles in Midland, MI.

The Michigan Economic Development Corp. (MEDC) awarded Dow $61.3 million in tax credits over 15 years for the projects. On the solar end, Dow will build its first full-scale production facility for its Powerhouse® Solar Shingle in Midland. The company's revolutionary

PHOTO CREDIT: MEDC