By Ed McCallum, Senior Principal, McCallum Sweeney Consulting, Inc

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Ed McCallum, a senior principal in McCallum Sweeney Consulting, provides site selection services and economic development consulting to companies and organizations worldwide.

Mr. McCallum's 23 years of experience in the site selection industry includes a myriad of industrial, headquarters, and warehousing site selection endeavors. Before starting McCallum Sweeney Consulting, Inc. in August of 2000, Mr. McCallum was the Managing Principal of Fluor's Global Location Strategies Group, having dedicated 14 years performing site selection and economic development consulting. Major clients included Mercedes-Benz, Navistar, Caterpillar, US Bioscience, Human Genome Science, Taiwan Semiconductor, Shell Chemical, Flowserve, Florida Power & Light, New Jersey Power & Light, and GAF Materials.

Mr. McCallum has assisted clients in a wide variety of industries at McCallum Sweeney as well, from manufacturing to warehousing and distribution. Recent clients include American Titanium Works (metals), Alstom (energy), Nordex, (wind energy), Aquion, Zarges Gmbh (wind energy), PACCAR (engine manufacturing), LM Wind Power (wind energy), Austal (shipbuilding), Atlantic Marine (maritime transportation), BP (petrochemical spin off), Weil McLain (hydraulic heating), Boeing (aeronautics), Kasle Steel (steel blanking auto supplier), Mitsubishi (auto assembler), Tower Automotive (auto frame assemblies), Vought/Alenia (aircraft manufacturing) and Iternational Shipholding Corporation (headquarters relocation).

In 1954, Bell Labs, located in the United States, introduced the first solar photovoltaic (PV) device that produced a useful amount of electricity. This device was more of a novelty than a practical solution to large-scale energy needs, as it was only able to convert 6% of the light that hit the PV device into electricity. Fast-forward nearly 60 years, research and development has led to solar cells reaching more than 40% efficiency which makes solar technology a viable energy source. Through technology advancements and reduction of total system costs, the solar industry is transitioning into a more substantial generation technology.

Growth in the solar industry over the last five years has been phenomenal. Installation has grown from 3.1 GW in 2007 to 31.5 GW in 2012, which is quite a feat considering that the total installed capacity was only about 62 GW in 2011. Although installation growth has been significant, solar still represents less than 1% of energy production. In comparison, a single nuclear power plant produces about 1.3 to 1.5 GW of power. Although solar energy has yet to reach parity with other means of power generation, there are promising technologies that could substantially reduce the cost. According to a recent study at MIT, the cost per kilowatt-hour of solar energy could decrease from the current range of 15 to 25 cents per kilowatt-hour down to 6 cents in sunny areas by the end of this decade.[1] In fact, the estimate is that by 2015, the cost of solar power generation will fall by more than 50% to under 10 cents per kilowatt-hour. The study claims that early-stage technologies, if employed together, could significantly reduce the cost of making solar panels. The industry will be changing dramatically in terms of cost structure and manufacturing, so those involved in capital planning and plant location decision should be paying close attention, as the future for the solar industry is bright.

The similarities between the semiconductor and PV industries should not go unnoticed. In addition to both sharing certain basic materials such as silicon, solar cell manufacturing is also following the semiconductor industries' footsteps by producing product overseas. At one time, American semiconductor companies produced chips domestically, but when the cost to manufacture became too expensive to remain competitive, production moved to Taiwan, China, Korea, and other Asian countries. It has been said that in general, PV manufacturing using current design technology is a high-volume, low-margin building-material commodity. In many respects this statement is true, and unfortunately for the United States and Canada, much of the manufacturing and assembly is continuing to migrate overseas (one exception is Stion, who just opened a factory in Mississippi to make solar panels using copper-indium-gallium-selenide cells). Even with production offshore, there are still more than 16,000 people employed in the semiconductor business in Austin, Texas, so there is still great potential for the solar industry to thrive in the United States.

The solar industry includes both big players with deep wallets and smaller firms new to the market. It should not be lost on the reader that companies like Lockheed Martin, with prior experience in designing solar arrays for satellites, has entered the utilities-scale solar market. They partnered with Starwood Energy to offer engineering/construction expertise and financing help. Bechtel and Chevron have both entered the fray as well. All of these companies have enormous balance sheets and can hold on until the shakeout in the supplier industry is over. Solyndra, SpectraWatt, and Evergreen Solar will probably not be the last bankruptcies to occur as the supplier market is established. Whether these companies are making a play on the technology side or the project management and installation piece remains to be seen, but the fact that they all have entered the market makes a tremendous statement about its future. Probably the loudest message that comes out of this is that Chevron, one of the world's largest producers/refiners of oil, understands that its inventory does have a shelf life and is not inexhaustible.

There is, and will continue to be, fierce competition among PV producers. The

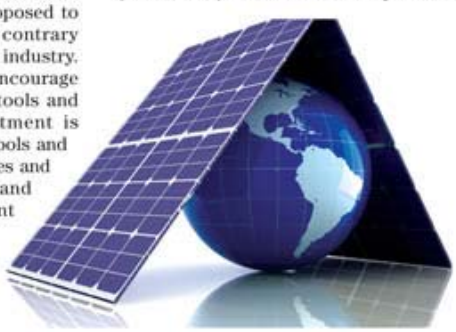
sector requires economies of scale and high levels of capital expenditure. Due to price competition and decreasing prices, low-cost producers that achieve economies of scale and have access to capital will prosper. Many high-cost producers will struggle and may go bankrupt. Most likely, the sector will consolidate with big players vertically integrating to save costs. Smaller players will be acquired or will operate only in niche markets where they can compete. The difficulty is for new entrants to jump into the game because of the huge financial backing requirement. This large investment is usually much more than what venture capital firms are willing to risk. Companies will need to look to states that have funds capable of being invested in projects from an equity standpoint like Ohio, as well as states where the state retirement systems are looking for good investments such as Alabama and South Carolina.

For manufacturers in the solar sector, addressing both the cost of manufacturing and the ability to recruit and retain talent are critical concerns. The trend in PV manufacturing is to develop and implement more advanced technology in order to reduce waste, increase productivity, and maintain a competitive cost advantage – which means less labor intensity and more automation. The United States and Canada cannot compete with China on labor costs using current production methods, so the only alternative is automation and advanced technology. Most state incentive packages are heavily weighted towards the creation of new jobs as opposed to capital investment, which is contrary to the evolving nature of this industry. Understanding which states encourage innovation through incentive tools and policies that promote investment is important. Examples of these tools and policies would be minimum sales and property taxes on purchases and equipment, capital investment tax credits against income, and upfront, as well as ongoing, incentives that can improve corporate balance sheets.

Competition in the PV solar sector is high, so high-cost producers who cannot make it to grid-parity[2] will fail, while low-cost, high-volume producers will prosper and expand.

In addition, making sure that the location supports the solar industry at both the state and federal level is important, which is demonstrated through policy. If legislators do not believe in a state Renewable Portfolio Standard (RPS) nor support a federal Production Tax Credit (PTC), this demonstrates how a state feels about the renewable industry – or simply that they have a lack of understanding that these programs are intended to accelerate the progress of renewables until such time when these policies are no longer needed. A recent exception is Stion recently locating to Mississippi, which is a non-RPS State, but the cost-competitive environment seemed to have weighted the location decision in the state's favor.

The ability to recruit and retain talent is equally as important as the cost of manufacturing, particularly at locations where both research and development occur alongside manufacturing. An environment that grows and fosters talent is equally as important as a location with a good quality of life. Examples of locations who have excelled in talent recruitment, research and development, and quality of life are Puget Sound, WA (the aerospace industry), Boston, MA (bio-pharmaceutical), Austin, TX (semiconductors), and Greenville, SC (automotive). All of these examples have



strong ties to a university system that are unique and special as innovation and creativity do not happen in a vacuum. Having alliances with local universities is an attractive feature for not only recruiting employees, but also for collaboration in research and development. Collaboration should not be reserved for only electrical, mechanical, and materials engineering degrees. A holistic approach should be taken that considers other degrees such as building/construction sciences, program management, and technical education degrees and certifications that support installation and deployment of solar PV projects. Companies need to make sure to understand the state and community's willingness to commit substantial educational resources to develop workforce talent at all levels.

Determining the best location for a future manufacturing location should take into consideration not only what is necessary and appropriate for the company at present, but also what is likely to be required in the future as the industry matures. Being competitive in the solar sector will mean driving out costs in the production process and capturing economies of scale in order to maintain a competitive edge in the marketplace. The ability to rapidly change production processes and tooling is a necessity, so an adaptive business environment must exist to accomplish this change. The ability to transition is a reality that must be incorporated into the business climate so industries are encouraged to invest and grow with an equal emphasis on both job creation and capital investment. This will require a state and community that understands that these changes will be constant and ongoing, and the company must insist on a long-term guarantee that this will occur.

A state and community's commitment to help a solar company be successful means more than just providing workforce training and a jobs-based incentive package. A substantial investment in education at all levels that includes research and development as well as innovation will be required, along with an understanding that incentives must go beyond traditional taxes, grants, abatements, etc. The location must also be supportive of the industry as a whole by supporting RPS and PTC.

[1] *http://www.technologyreview.com/mit-news/410624/bright-days-for-solar*

[2] *The Holy Grail for solar power has always been something called "Grid Parity." The concept is that if solar power costs the same or less than coal or gas to make, then the market would naturally choose solar as the main method of making electricity; and the energy wars would be over. The mystical crossing point where the solar cost goes down and the coal line goes up is called "grid parity."*