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Statement of Dr. Frank J. Calzonetti, Vice President for Research Development

On Behalf of The University of Toledo

**Before the Committee on Health, Education, Labor, and Pensions
United States Senate**

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Decades ago, Midwestern U.S. cities led the world in innovation and industrial might. Automobiles, glass, steel, and other manufactured goods were sold throughout the world and the cities attracted new workers eager to join a growing middle class. The comparative advantage once held by these cities was largely lost as businesses moved or expanded operations in lower cost, or less unionized, locations first in the south then overseas. In addition, new entrants into the marketplace, such as Asian automotive companies, offered products in demand by American consumers, such as inexpensive and fuel efficient vehicles, resulting in a loss of market share and related employment. Job losses also occurred as manufacturing plants automated in order to increase efficiency and enhance quality. These factors, among others, mean that high paying, secure jobs in manufacturing could no longer be the primary pathway to support families in most Midwestern cities. This led people to abandon their Midwestern roots to follow jobs to lower cost positions in other states, resulting in a significant population decline across the Midwest.

In recent decades, these cities, along with their state governments, have been struggling to identify new pathways to provide renewed job growth, firm formation, investment, and a reversal of population decline. For instance, in the Milken Institute's listing of the top performing cities of 2007, not one Midwestern city was among the top twenty-five ranked performing cities in the nation. According to the Brookings Institution's Metropolitan Policy Program (2007) study of the economic conditions of 302 U.S. cities, only one Ohio city, Columbus, was ranked among the top 200 (#122). Other Ohio cities were ranked in the following order: Akron (#217); Canton (#246); Cincinnati (#263); Dayton (#283); Mansfield (#257); Springfield (#262); Toledo (#261); Youngstown (#282); and Warren (#294).

Despite efforts by state and city governments, most Midwest cities are still in a state of distress. Why can't the economies of these cities be revitalized? It has been shown that changing a development trajectory into a future economy is a difficult task. The tendency is to work to restore and retain the previous industry that brought jobs and prosperity in the past. As noted by many students of this phenomenon (e.g., Boschma and Lambooy; Asheim and Isaken), leaders in "declining" manufacturing regions must redirect thinking away from the view that competing on the basis of low-cost manufacturing or attracting new manufacturing operations will return the area to previous greatness. Toledo and other Midwestern cities are working to move in a different direction to utilize the talents, skills, and infrastructure that built our earlier economy into a new economy that is directed to rapidly expanding industries that are steeped in science and technology grounded by our research universities. Our view is not "rust to bust", as noted in Richard Longworth's 2008 book on the U.S. Midwest *Caught in the Middle*, but rather "rust to renewables", a phrase coined by Solar Fields CEO Norm Johnston, a Perrysburg Ohio company which graduated from the University of Toledo Clean and Alternative Energy Incubator.

Toledo is in the early stages of building a new advanced renewable energy economy that is extending in a new direction the economy of our recent past. Toledo, still by known by many as the “glass city”, once led the world in innovations and manufacturing in glass. Driven by the energy of talented entrepreneurs and creative inventors, Toledo brought forth many new inventions that made Toledo’s glass companies world leaders. For instance, the automated glass bottling machine, created in Toledo by Michael Owens, has been called the most significant invention in glass for over 2,000 years.

We have taken a hard look at what is driving new economies and are putting it into practice in Toledo. The driver is research and development which is translated into innovations, entrepreneurship, cluster development, and leading positions in growing markets. First, innovation is driving many regional economies throughout the world. We understand the important role of university research as a primary source of discoveries, talent, and opportunities that can support innovation-based economies. The University of Toledo is still emerging as a major research university so it is unrealistic for a research budget of \$60 million a year to transform a \$24 billion Toledo economy. The University has focused its attention in areas where it has particular faculty strengths that supplement regional assets that are also likely to emerge as important to our global economy. Thus, we have focused resources on building world-class programs in advanced renewable energy and the environment. In particular, we have focused on building preeminent programs in solar energy.

Entrepreneurship is needed to transition discoveries into the marketplace either through the establishment of new enterprises or through the development of new initiatives within existing firms. Toledo has a history of entrepreneurship in glass which continues today with contemporary solar energy entrepreneurs. Although telecommunication technology provides a free flow of information throughout the globe, research shows that knowledge is still localized and grows through various mechanisms of knowledge transfer. Thus, a clustering of sources of innovation (e.g., research universities, governmental and industry R&D laboratories), along with entrepreneurs, existing business enterprises, supportive government organizations and agencies, service providers, and other supportive organizations help to provide a region with leadership in technological areas that drive competitive advantage and workforce development around the clusters’ needs.

Toledo was well positioned for leadership in solar energy. Solar energy, particularly thin-film photovoltaics (*light* and *electricity*), builds upon Toledo’s glass industry and early entrepreneurial moves into solar energy made over twenty years ago. Photovoltaic (PV) cells, or solar cells are devices that are capable of generating electrical energy under exposure to light. It was not until the mid twentieth century that the first solar cell was patented at Bell Labs in New Jersey and not long after, commercial activity began and solar cells found use in space applications. As PV became a critical source of power for satellites and other space craft, the first oil shock of the early 1970s spurred interest in the development of terrestrial applications of PV technology. One of the first entrepreneurs to identify and act upon this opportunity was Toledoan Dr. Harold McMaster. McMaster, with his partner Norman Nitschke (another prolific Toledo inventor) formed Glasstech, Inc. in the Toledo neighboring city of Perrysburg. They constructed a new machine for "tempering" glass that increased its strength and crumbled instead of breaking into shards and Glasstech grew into a leader in the manufacture of furnaces for

tempered glass. In 1984, McMaster formed Glasstech Solar, Inc to produce efficient solar cells by coating glass with thin layers of chemicals. Glasstech initially worked on thin film silicon technology at its Wheatridge, Colorado location. Their research led to thin films based on cadmium telluride in Toledo as the new company Solar Cells Inc. was formed. In 1999, True North Partners LLC, renamed the company First Solar after they purchased a controlling interest.

The University of Toledo also took early steps for support the development of this new industry. As McMaster and his colleagues at Glasstech advanced their technology, they sought out assistance from The University of Toledo. In 1987, The University of Toledo hired Dr. Alvin Compaan into the Department of Physics and Astronomy. Under Compaan's direction, the University, with McMaster's company as a collaborator, won two State of Ohio Edison awards to address processing issues in thin film solar cell development. These awards were the first of a long series of continuous funding from state and federal agencies to support solar energy research and development in Toledo. In 2001, the University made a decision to place solar energy research as a top institutional priority by placing additional positions, supporting new laboratories, and seeking congressional assistance for projects in this area.

The University, in 2002, took a leadership position to develop a cluster around this technology with the National Science Foundation funded "Northwest Ohio Partnership on Alternative Energy Systems." This project provided support to seed new research projects, explored the opening of an alternative energy incubator, and established new partnerships with industry and other organizations to made Northwest Ohio a leader in alternative energy research, manufacturing, and use. We determined that there would be a tremendous growth in the renewable energy industry in the future and we wanted to be in front of this wave. Our choice turned out to be a good one and solar energy is booming throughout the world, and according to McKinsey & Company (June 2008) global installed solar capacity is to be 20 to 40 *times* its current level. The University of Toledo's Clean and Alternative Energy Incubator was opened in January 2005, and this facility is now a focal point for linking university research to the formation of new companies, and well as providing a place for meetings and workshops on solar and other renewable energy technologies.

Northwest Ohio has a strong foothold as a leader in solar energy. At UT, we have the \$18.6 million Wright Center for Photovoltaics Innovation and Commercialization, we have just been awarded another \$8.5 million from the State of Ohio (both proposals led by Professor Robert Collins) to hire four additional solar energy faculty members. In addition, our local industry sector is rapidly expanding and diversifying. First Solar, the company that grew from Harold McMaster's Solar Cells Inc. and was developed in laboratories at The University of Toledo, is now the largest solar cell producing company in the United States with an output of 307 MW in 2007 and employment of 700, which will be increased by another 134 new jobs with a new expansion at its Perrysburg location. Two additional solar cell companies recently graduated from the Clean and Alternative Energy Incubator. Solar Fields formed a joint venture agreement with Q-Cells, the world's largest solar cell manufacturer, to form Calyxo USA; Xunlight, which only graduated from the incubator in August 2007, now has more than 70 employees at its new Toledo location.

We are making progress positioning Toledo the place to go for advanced research and manufacturing on solar cells. We have more to do to build our economy. One task ahead is to build a new workforce for our new economy. Toledo has much talent and expertise to offer and we see opportunities for solar installers, solar cell manufacturing plant workers, technicians, scientists, engineers, and a host of other opportunities in upstream and downstream industries. Toledo has faced problems as its economy is moving through this transition, but we are optimistic that we have the talented entrepreneurs, the research universities, the supporting infrastructure, and indeed the workforce to make Toledo the national leader in solar and other advanced renewable technologies.