Executive Summary

Date:	**October 6, 2010**
Subject:	**Proposal for the US Department of Energy Photovoltaic (PV) Manufacturing Initiative Funding Opportunity: DE-FOA-0000259**
Topic Area:	**University-Focused PV Manufacturing Initiative**
Title:	**Great Lakes PV Manufacturing Collaborative**
Tracking Number:	8073
Applicant:	Oakland University

As worldwide demand for photovoltaic (PV) energy systems continues to grow at an unprecedented rate, much of the PV production to supply this demand has come from regions other than the United States (US), such as Europe, China, and Taiwan. US PV manufacturing capacity is growing, but at a much slower rate than elsewhere in the world (Fig. 1). As foreign governments support the implementation of PV systems, and installation costs continue to fall towards parity with conventional fossil fuel energy sources, PV demand will most likely continue on its exponential growth pattern.

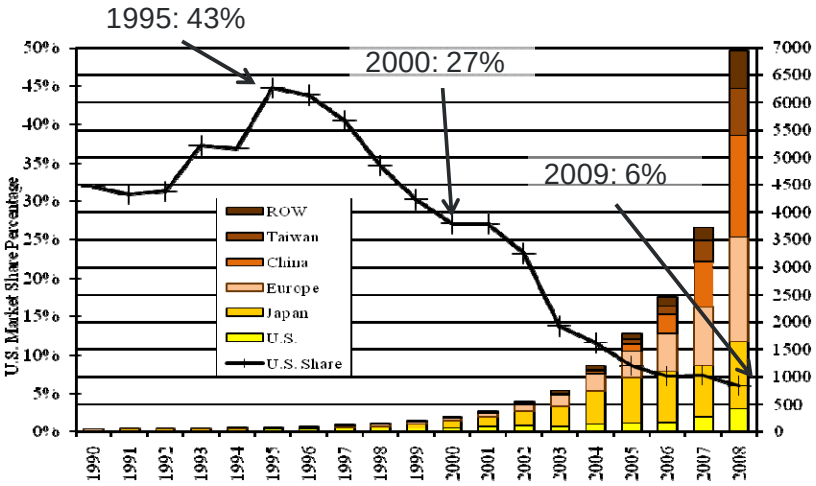

Figure 1. Global & U.S. Annual PV Production by Region
Source: US DOE Solar Energy Technologies Program

This proposal seeks to establish a Great Lakes PV Manufacturing Collaborative (or "the Collaborative") to foster and accelerate the development of a strong PV manufacturing industry and supply chain in the US. The Collaborative will create an industry/academia cross-cutting organization to further the goals of the Department of Energy's Solar Energy Technologies Program to support the creation of a robust US PV manufacturing base, develop a highly trained workforce with the critical required skills, and speed the implementation of new cutting edge technologies. The challenge is to take a continued US leadership in PV technology research and development (R&D) and create this Collaborative that will help transition these technologies into an accelerated increase in domestic-based PV manufacturing.

Oakland University's Dean of the School of Engineering and Computer Science, Dr. Louay Chamra, and renewable energy researcher, James Leidel, with Fraunhofer USA executive director, Stefan Heinemann will lead this University Focused program. Oakland University is located in SE Michigan's automaton alley, a convenient hub for this Collaborative, centered near Michigan's top - tier research universities as well as major and small PV manufacturers. This

region is home to an informal PV industry corridor between Michigan and Ohio, with easy road, rail, and shipping access to US and global markets.

Thin film (TF) technologies are expected to be a major research topic within the Collaborative due to the heavy concentration of TF PV manufacturers in the Great Lakes Region. Aside from TF, Collaborative projects will be directed toward other areas in the PV supply chain where the US has shown leadership, such as polysilicon production, encapsulants, films, glass, and optics. However, overall, the Collaborative will seek to be technology neutral and unbiased towards funding of any one particular technology, project, or institution. Instead, the Collaborative will be directed through its membership – industry participants – to solicit and fund university – led projects to meet specific industry needs identified by the Collaborative members.

In accordance with the US Department of Energy Photovoltaic Manufacturing Initiative, this university-focused Collaborative will solicit, fund, and conduct industry relevant R&D projects related to PV manufacturing. The Collaborative will be administered by Oakland University with founding partner Fraunhofer USA serving as Chief Techical Officer (CTO). The University of Michigan is also committed to supporting the Collaborative, as are several Michigan-based academic institutions and industry entities including Michigan State University, Saginaw Valley State University, Wayne State University, and Western Michigan University. Oakland University is an ideal candidate to be the administrative head of the Collaborative due to its unbiased, neutral position among the PV industry and research community.

Michigan's prestigious public university system, research institutions, the Great Lakes regional and US PV industry, several community colleges, governmental agencies and several energy service companies will form a robust Collaborative in which to conduct this industry relevant R&D as well as workforce development for the manufacturing sector. Cognizant of the fact that over half of the jobs created in the PV industry come from the installation sector (Figure 2.), a smaller, but vital effort will also be undertaken to advance workforce training for PV system installers and to work with energy service companies on creative financing models to install PV systems.

With US DOE PVMI support of $3M per year for five years to launch the Collaborative, a self-sustaining business model will be employed. Partnerships will be sought with the National Renewable Energy Lab (NREL) and the State of Michigan Bureau of Energy Systems, Advanced Manufacturing Program as important elements of projected long-term sustainability of the Collaborative.

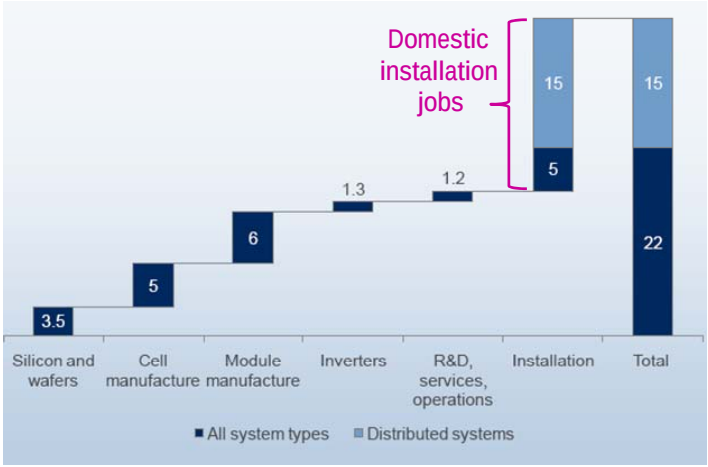

Figure 2. Jobs per Megawatt of PV installed
22-37 direct jobs per MW installed in the US
(2X multiplier when factoring entire value chain)
Source: US DOE Solar Energy Technologies Program

Collaborative objectives focus on the two main areas for US job sustainment and growth: installation and cell/module manufacturing. The US has by far the highest investment in start-ups worldwide, but due to rapidly advancing PV manufacturing in Europe, China, Taiwan, and elsewhere, the US is continuously losing market share.

To address these challenges, the Collaborative objectives include:

1. Manufacturing research and development
    a. Provide technology support and research capabilities through universities for start-up PV companies, helping them to more quickly transition into successful manufacturing operations
    b. Support mature PV cell and module manufacturing companies, well-established in the market place, to solve manufacturing challenges which will enhance their ability to expand manufacturing, as well as to evaluate, test and certify new technologies
    c. Support PV supply chain companies such as PV material supply or PV manufacturing equipment,
2. Training and education
    a. Workforce training of skilled labor for the manufacturing sector in partnership with community colleges and the State of Michigan
    b. Workforce training of installers and installation energy service companies in partnership with community colleges, the State of Michigan, and industry groups
    c. Education for the architectural and engineering community ranging from ranging from engineers who plan, budget, design and install PV systems to architects for PV integration in buildings and landscapes
    d. Education of the consumer and building owners to increase the awareness and acceptance of PV

The Collaborative will work with existing programs at Community Colleges, other Universities, and not-for-profit agencies such as the Great Lakes Renewable Energy Association to create or modify existing curricula as needed. We will work with US DOE Solar Cities (Ann Arbor), the State of Michigan Energy Systems Bureau, the US Congress, and multiple energy service companies to establish high visibility demonstration projects.

While it will remain technology neutral, the Collaborative anticipates industry needs specifically related to thin film (TF) technologies for improved performance and industry challenges related to high yield manufacturing and long-term performance. Other PV technologies will be considered for university led R&D based on priority of industry-identified research and development needs. The Collaborative will issue solicitations seeking universities to perform research, leveraging existing facilities and expertise.

Activities that will be undertaken by the Collaborative include:

- Creation of an industry expert Advisory Board as well as an independent and impartial Subaward Selection Committee
- Annual solicitations to universities for manufacturing R&D projects that support specific industry expressed needs
- Annual solicitations for educational and/or workforce training programs
- An annual PV Manufacturing Collaborative Conference
- Quarterly newsletter updates on the program activities
- Creation and maintenance of a Collaborative website

The Collaborative will make use of the model created by the Michigan Universities Commercialization Initiative (MUCI) Challenge Fund to ensure organizational sustainability. Several PV entities have stated their support for this project and are expected to participate in the Collaborative, including but not limited to: Applied Materials, Aspect Automation, Blue Harbor Energy, Clairvoyant Energy, Energy Systems Group, eVjump, Jenoptik, KUKA Systems Corporation North America, LUMA Resources, Solargystics LTD, Solarflex, and Uni-Solar.

Date: **October 5, 2010**

Subject: **Proposal for the US Department of Energy Photovoltaic (PV) Manufacturing Initiative Funding Opportunity: DE-FOA-0000259**

Topic Area: **University - Focused PV Manufacturing Initiative**

Title: **Great Lakes PV Manufacturing Collaborative**

Tracking Number: **8073**

Applicant: **Oakland University**
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Introduction

As worldwide demand for photovoltaic (PV) energy systems continues to grow at an unprecedented rate, much of the PV production to supply this demand has come from regions other than the United States (US), such as Europe, China, and Taiwan. US PV manufacturing capacity is growing, but at a much slower rate than elsewhere in the world (Fig. 1). As foreign governments support the implementation of PV systems, and installation costs continue to fall towards parity with conventional fossil fuel energy sources, PV demand will most likely continue on its exponential growth pattern.

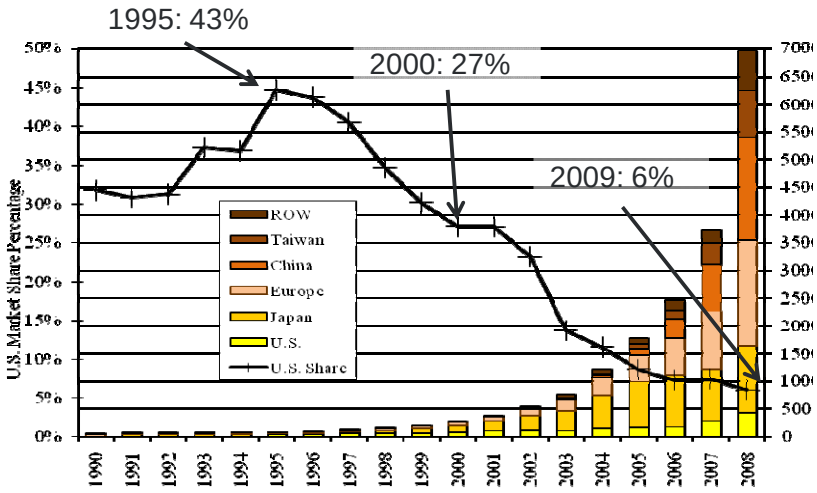


Figure 1. Global & U.S. Annual PV Production by Region
Source: US DOE Solar Energy Technologies Program

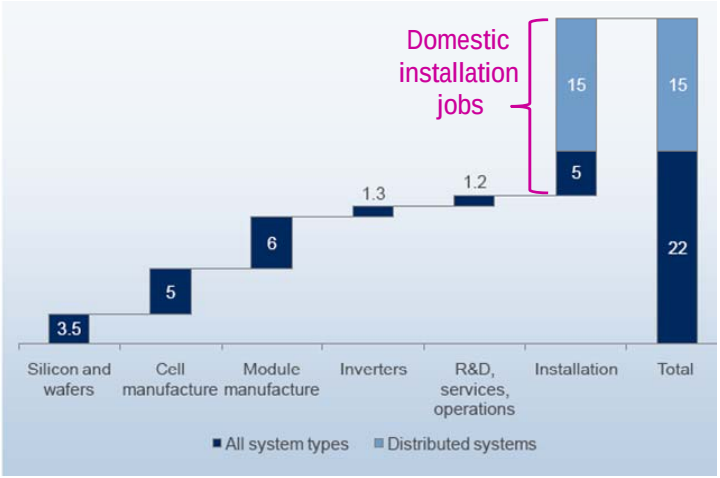
This proposal seeks to establish a Great Lakes PV Manufacturing Collaborative (or "the Collaborative") to foster and accelerate the development of a strong PV manufacturing industry and supply chain in the US. The Collaborative will create an industry/academia cross-cutting organization to further the goals of the Department of Energy's Solar Energy Technologies Program to support the creation of a robust US PV manufacturing base, develop a highly trained workforce with the critical required skills, and speed the implementation of new cutting edge technologies. The challenge is to take a continued US leadership in PV technology research and development (R&D) and create this Collaborative that will help transition these technologies into an accelerated increase in domestic-based PV manufacturing.

Thin film (TF) technologies are expected to be a major research topic within the Collaborative due to the heavy concentration of TF PV manufacturers in the Great Lakes Region. Aside from TF, Collaborative projects will be directed toward other areas in the PV supply chain where the US has shown leadership, such as polysilicon production, encapsulants, films, glass, and optics. However, overall, the Collaborative will seek to be technology neutral and unbiased towards funding of any one particular technology, project, or institution. Instead, the Collaborative will be directed through its membership – industry participants – to solicit and fund university-led projects to meet specific industry needs identified by the Collaborative's members.

In accordance with the US Department of Energy (DOE) Photovoltaic Manufacturing Initiative, this university-focused Collaborative will solicit, fund, and conduct industry relevant R&D projects related to PV manufacturing. The Collaborative will be administered by Oakland University with founding partner Fraunhofer USA serving as Chief Techical Officer (CTO). The University of Michigan is also committed to supporting the Collaborative, as are several Michigan-based academic institutions and industry entities (see Letters of Support, Appendix 12). Oakland University is an ideal candidate to be the administrative head of the Collaborative due to its unbiased, nuetral position among the PV industry and research community.

Michigan's prestigious public university system, research institutions, the Great Lakes regional and US PV industry, several community colleges, and several energy service companies will form a robust Collaborative in which to conduct this industry relevant R&D as well as workforce development for the manufacturing sector. Cognizant of the fact that over half of the jobs created in the PV industry come from the installation sector (Figure 2.), a smaller, but vital effort will also be undertaken to advance workforce training for PV system installers and to work with energy service companies on creative financing models to install PV systems.

With US DOE PVMI support of $3M per year for five years to launch the Collaborative, a self-sustaining business model will be employed through an initial ten-year business plan. Partnerships will be sought with the National Renewable Energy Lab (NREL) and the State of Michigan Bureau of Energy Systems Advanced Manufacturing Program as important elements of projected long-term sustainability of the Collaborative.



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Merit Review Criteria Discussion

Criteria 1: Organizational Objectives

The Collaborative objectives will accelerate development of the US PV Industry through focused research and development in topics relevant to high volume manufacturing. The scope of this proposal is structured in a way that supports the US PV industry to gain market share and to create jobs. Appendix 12 includes major and start-up manufacturers, such as Unisolar and Solargystics, already supportive of this Collaborative.

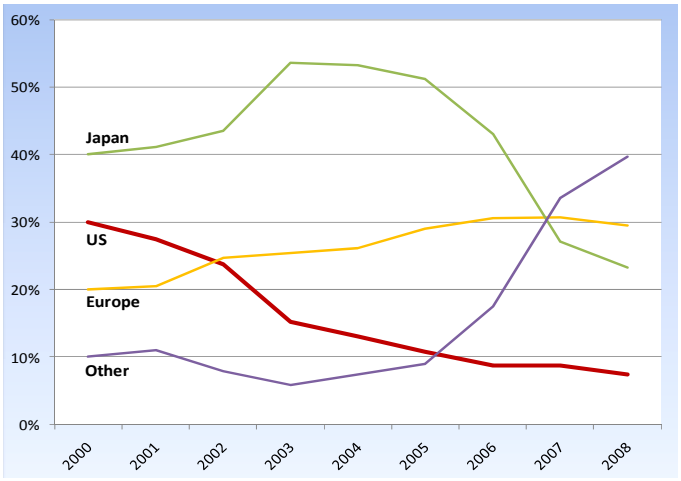

Figure 3. Worldwide PV Market Share by Country: 2000-2008 PV cell/module shipments
Source: Mints and Tomliinson / Navigant Consulting

The two main areas for US job sustainment and growth are installation and cell/module manufacturing. The US has by far the highest investment in start-ups worldwide, but due to rapidly advancing PV manufacturing in Europe, China, Taiwan, and elsewhere, the US is continuously losing market share.

To address these challenges, the Collaborative objectives include:

1. Manufacturing research and development
    a. Provide technology support and research capabilities through universities for start-up PV companies, helping them to more quickly transition into successful manufacturing operations
    b. Support mature PV cell and module manufacturing companies, well-established in the market place, to solve manufacturing challenges which will enhance their ability to expand manufacturing, as well as to evaluate, test and certify new technologies
    c. Support PV supply chain companies such as PV material supply or PV manufacturing equipment,
2. Training and education
    a. Workforce training of skilled labor for the manufacturing sector in partnership with community colleges and the State of Michigan
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    c. Education for the architectural and engineering community ranging from ranging from engineers who plan, budget, design and install PV systems to architects for PV integration in buildings and landscapes
    d. Education of the consumer and building owners to increase the awareness and acceptance of PV
    e. The Collaborative will work with existing programs at Community Colleges, other Universities, and not-for-profit agencies such as the Great Lakes Renewable Energy Association to create or modify existing curricula as needed. We will work with US DOE Solar Cities (Ann Arbor), the State of Michigan Energy Systems Bureau, the US Congress, and multiple energy service companies. to establish high visibility demonstration projects.

While it will remain technology neutral, the Collaborative anticipates industry needs specifically related to thin film (TF) technologies for improved performance and industry challenges related to high yield manufacturing and long term performance. Thin film technologies in this context refer to Cadmium Telluride (CdTe), Copper Indium Gallium Selenide (CIGS), and amorphous silicon based solar cells and modules. Other PV technologies will be considered based on priority of industry-identified research and development needs.

The global solar market is dominated by crystalline cells, but the growth in thin film cell manufacturing is very strong. According to a market study published by Displaybank.com [1], global crystalline cell production will increase by 31.3% from 2008 to 2010, whereas thin film based cells will see a production increase of 171%. The US solar cell manufacturing base is heavily weighted towards thin film technologies and, globally, TF cells are expected to gain a 23.4% market share by the end of 2010. It is therefore the goal of this proposal to create a sustainable resource for TF cell manufacturers utilize university resources to study, test and improve products and production methods. The Great Lakes region, particularly Ohio and Michigan, is the center for TF PV and raw material supply worldwide, but lacks the cohesive, collaborative testing and development environment and broad basic research for improved performance and manufacturing methods, as well as training and education required to sustain and expand the current market position. In creating this environment the Collaborative will both advance PV industry success in the US and increase workforce development among graduate students and post-graduate researchers working on the Collaborative's university-led PV projects.

Creating this environment will improve throughput, yield, performance and cost-competitiveness of thin film technologies. The Collaborative will develop and proof novel cell technologies using specifically large-area, high throughput production methodologies and equipment. Research and development efforts will be led by the partnering universities. Fraunhofer USA, Inc. as a nonprofit applied research entity will act as the designated commercialization partner between the universities and industry partners. Module manufacturing, testing, and certification is available through Fraunhofer's link to an existing consortium of industrial partners, lead by Fraunhofer CSE and focusing on crystalline cells and module manufacturing as well as through our industry partners.

The Collaborative will assemble an industry board with members from leading TF, other PV, and small companies to guide the Collaborative and ensure industry relevance. The board will also be comprised of members from leading research institutions, such as University of Michigan, providing input on technology capabilities. The board will also oversee the Request for Qualifications (RFQ) process to solicit research and development projects. A review board of unbiased professionals will be installed for awarding individual projects through the Collaborative.

The proposed consortium will focus in two areas, which need to be addressed concurrently; photovoltaic equipment manufacturing and education targeting successful implementation of photovoltaic devices.

Manufacturing research

An anticipated primary area of research, though not the only area of research for the Collaborative, is the development of thin film solar cell/module manufacturing technologies throughout the supply chain, from glass and material manufacturers all the way to cell manufacturing concept validation, product testing and implementation. For start-up and developing companies the Collaborative will offer applied R&D to reduce the lead time from the concept/idea to a product which will be manufactured using with most cost competitive processing capabilities available. These processes include technologies developed within projects related to the Collaborative and other state-of-the-art processes not accessible to many start-ups due to budget or IP reasons. The capability to develop and test various processes and select the most competent mix for manufacturing is anticipated to reduce the idea-to-product time in the short term, and help companies develop their manufacturing base using best practices, leading to long term competitive advantages.

For well-established companies, the Collaborative offers - through the close collaboration with universities, test facilities and other companies in the supply chain - the possibilities to a) improve and re-align the up- and downstream supply chain to better provide not only the technologies and products to be supported now, but also forecast future products and their requirements by means of elements like materials and properties, and b) create more productive and short turn-around product and process development support in dedicated laboratories. A vast, well-organized research Collaborative has the capability to increase the rate of development, test novel products and verify the applicability of these in various environments; a key success factor for new thin film products and other PV technologies.

As noted above, the Collaborative anticipates industry interest in addressing challenges in TF technologies, which presently offer the lowest cost approach [$/W] to producing photovoltaic energy. TF PV is a field led by US-based FirstSolar and populated by a large number of strong developing and start-up companies based in the United States focusing on nanomaterials and

thin crystalline cells. The main drawback for TF PV is its power production capability per unit area when compared to crystalline silicon cells and modules. It is therefore commonly stated that silicon-based modules will dominate roof-top installments and applications where the space for solar modules is restricted. Thin-film modules are better suited for solar fields and grid-production, where the advantage is low price per watt, but surface area does not restrict installed capacity.

Even though thin film module manufacturing is efficient and inexpensive, the price still does not compete successfully against other modes of power generation, such as wind and coal. There is thus a great deal of room for improvement in the technology and even more importantly, the technology cannot be led by only a handful of large companies in the long run. Rapid market penetration and growth of developing companies is essential for increasing PV production capacity as well as the support of a strong, productive and profitable supply chain, distribution, installation and after market. In this respect the Collaborative has a pronounced responsibility.

The Collaborative is prepared to offer the technical research focus to address the following areas established as key areas of improvement for the thin film industry [2]:

1. Science and engineering support
    a. Derive measurable material properties and their effect on performance
    b. Modeling the relationship between film growth and material delivery
    c. Couple this knowledge into industrial processes; process uniformity, reproducibility
2. Long-term stability
    a. Both main TF technologies (CdTe and CIGS) have shown good long term stability, but some modules fall short on performance
    b. Challenges: encapsulation, diffusion, unknown effects
3. In-situ process diagnostics and control
    a. Science-based knowledge of material properties is inadequate to serve as a solid foundation from which diagnostic tools can be developed
    b. Real time control; large area sensors, feedback control
    c. Higher through-put and yield; continuous and roll-to-roll processes
4. Thinner absorbers
    a. Need for less material due to availability and pricing of Te and In
5. Need for High-throughput, low cost processes
6. Improvement of Open-Circuit Voltage in CdTe devices
7. Novel materials and cells for improved performance and lower cost manufacturing

Additional areas of research have been identified related to glass manufacturing, material supply, even production equipment, and lasers optics. A more detailed research plan will be derived based on sessions among the industrial advisory board of the Collaborative to ensure key industry needs are included and that all identified needs are prioritized.

Education and training

The main purposes for the Collaborative's education and training task are:

1. Increase solar energy markets through education, public awareness, and efficient marketing
2. Increase solar energy markets through educating designers and architects to accept solar modules as a integral part of new developments
3. Develop work force to meet the increasing demands for installation and maintenance

For residential PV systems 54% of jobs are in installation. This is an integral element of PV deployment and cannot be outsourced out of the country. However, the Collaborative addresses the reality that these jobs will increase substantially together with the manufacturing industry when PV systems become more competitive with other energy sources and especially, when the awareness of PV systems is heightened. The Collaborative will address these needs through public education and marketing, education of designers and architects, and workforce development needs. By concurrently addressing these areas of need, all key components of PV deployment will be achieved. In this way, industry needs are met as PV technologies are designed as part of new residential and commercial developments, structures, even vehicles, and seen as a desired feature for homebuyers and commercial building developers.

Efficient solar energy deployment also requires a vast maintenance sector, responsible for electronic operation as well as cleaning and replacement. Therefore, the Collaborative does not only concentrate on PV manufacturing, but also supports the education and training of personnel working in sales and marketing, installation, solar cell manufacturers (supply chain), architecture for solar installments and raising awareness of solar power generation within the whole population, especially targeting children and youth, and new families.

Sales and marketing

The consortium will work together with community colleges and universities to leverage existing and orchestrate new courses in responsible energy marketing and create leading data through market research. The energy field requires a new kind of sales force and tactics. Ongoing energy marketing focuses on the price of energy, and especially during the current economic situation, the price is the main driver. For future purposes, marketing and sales professionals need to offer customers a suitable energy mix, which fits specific user needs. Instead of drawing the line between cheap and green, there is an immediate need for unbiased marketing tactics that will pave the way for higher usage of photovoltaic energy. This transition cannot be made with current sales and marketing tactics, which focus on solely on price. Future marketing professionals need training in environment, climate change and sustainability, which have not been traditionally emphasized in business education. Supporting ‘green marketing’ will improve marketing efforts in the field of green energy technology; a field which for a long time to come cannot compete with price without government incentives or with the advertisement budgets of big energy corporations. Marketing and sales development also includes market research studies that are available to the industry, making market data available for all companies to streamline their strategies and promote sales. A vital constituent of the marketing plan is working with state legislative and Solar Cities to raise public awareness and to make PV investments attractive. This includes working with state representatives on public campaigns and creating financial and societal incentives as well as PV installations of high public visibility, such as outfitting an energy research institute or public building with PV. Including the public and students from different sector, from architecture to engineering will have a high impact on educating the work force, future engineers and demonstrating the benefits to a large population.

Longer term plans include a solar energy business institute within a the leading universities, which will provide unbiased market, environmental, and economic data to consumers and corporations. The institute will work with the complete photovoltaic supply chain to survey the demand for professionals in different fields, and coordinate education and training for the needs of the industry.

Installation

As mentioned, PV system installation is the industry sector that cannot be outsourced. The Collaborative will leverage existing and create new training programs in cooperation with

vocational institutes and community colleges specializing in solar installation and maintenance. The goal of these programs is to train the workforce to install and maintain the increasing solar energy capacity, and provide continuous education to builders on how solar modules can be designed into buildings efficiently, instead of the current state of the market - adding PV modules into existing buildings. Fostering this interest among students in the construction trades and builders crosses over into the marketing component of this project, as offering PV installations as options for home buyers and commercial developers, the interest in solar usage is expected to rise. In this way the deployment of solar windows, roof top installations, and architectural components in landscaping, art and functional structures will grow and succeed.

Architecture and industrial design

Solar energy has huge potential in buildings, high-rises, functional structures, machinery, transportation and modern architectural development projects. Current applications only scratch the surface of the myriad ways solar panels can be used as functional and decorative elements of buildings, construction, vehicles, and solar parks. Since the scope of the DOE PVMI is increasing the competitiveness of photovoltaic manufacturing, the Collaborative's architecture component will focus on the intelligent use of photovoltaics in buildings in addition to the common-place instruction on passive solar building design.

The Collaborative will cooperate with universities to create more innovative ways to implement PV modules in buildings - as solar windows, in shading, glazing, facades, wall materials, and in landscaping. The creation of this education structure will ensure new and retrained architects and designers are fully aware of how these technologies can be integrated into and add value to their industry sector. This education can further lead to entrepreneurialism formed around the field of solar architecture and design.

Today, PV modules on rooftops are sometimes considered unnatural, unattractive and difficult to clean. With extensive training in architecture and design these devices can be made an integral, cosmetic part of all modern buildings and many other structures. Examples of new design have already emerged around the globe, such as the Toyota Prius solar roof providing electricity for vehicle air conditioning, Montreal-Trudeau airport solar gain and daylight control system, and the Belmar solar parking structure. For these types of projects to become mainstream, though, requires continuous and increasing education proposed by the Collaborative.

Life-long learning

In the US market-driven environment, speeding the deployment of sustainable energy products such as PV products, depends on two factors - government incentives and corporate and consumer acceptance. As a university-focused consortium, the Collaborative has excellent capabilities to educate the public in solar awareness and increase the market demand. High visibility projects will be created with funding from the member organizations to educate the public about the benefits of energy conservation, renewable energy sources and environmental awareness. This will be done in cooperation with different levels of schools starting from K-12, resembling the strong efforts towards recycling in many European nations in late 1990s and early 2000s. Due to such programs and government regulations, recycling is considered a normal practice even among young children. In the long run, similar education in energy is the key success factor.

Specific Collaborative Activities

Activities that will be undertaken by the Collaborative:

- Creation and regular consultation with several committees
    - Advisory Board
    - Subaward Selection Committee
    - Subcommittee on PV industry workforce training
    - Subcommittee on PV project financing and demonstration project installations
- Annual solicitations to universities for manufacturing R&D projects that support specific industry expressed needs
- Annual solicitations for educational and/or workforce training programs
- Administration, review, and support of all sub-award activities
- An annual PV Manufacturing Collaborative Conference for:
    - updates and presentations from subawardees
    - discussion of the state of the industry, markets, and educational programs discussion of future R&D needs
- Quarterly newsletter updates on the program activities
- Creation and maintenance of a Collaborative website
- Reports to the Department of Energy, Solar Energy Technologies Program

Refer to Appendix 6 “Organizational Timetable” for more information on the proposed timing and frequency of the above activities.

Criteria 2: Management & Business Plan

Management Plan

An administrative office will be created and maintained at Oakland University with a modest staff at the launch of this program.

The program will be managed by the Dean of the School of Engineering and Computer Science, Dr. Louay Chamra, with the assistance of PhD candidate and renewable energy researcher, James Leidel. The combined efforts of these two individuals will be equivalent to one full time directorship. The director role will initially focus on the creation of the program, formation of the Advisory board and various committees, and coordinating with the Collaborative partners to create the year one solicitations.

A Chief Technical Officer has been identified, Dr. Stefan Heinemann, from Fraunhofer USA, a subsidiary of Fraunhofer-Gesellschaft, Europe’s largest application-oriented research organization. Along with Dr.

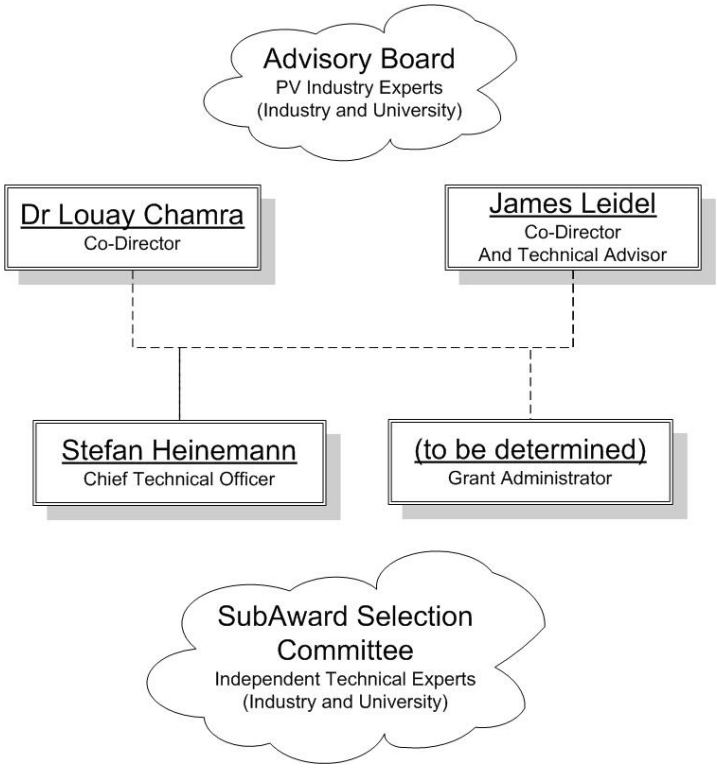


Figure 4. Organizational Chart

Heinemann's personal expertise, he will bring to bear the vast resources of Fraunhofer to the Collaborative which include SE Michigan offices, a US based Center for Sustainable Energy Systems, as well as a world renowned Institute for Solar Energy Systems.

Lastly, a grant administrator will be brought on board to handle solicitations, reports, and monitoring of the subaward process.

Business Plan

The year one budget for this administrative component of the Collaborative is $411,500. With indirect overhead, this becomes $424,020, or less than 14% of the $3,000,000 per year grant request. Additional indirect overhead will be charged against the subawards per the established indirect rate agreement of 48% of the first $25,000 per subaward. Oakland University will cost match 10% of the total indirect overhead back to the Collaborative budget. Additional cost match from large and small industry partners and university collaborators will provide a year 1 – 5 overall cost share of 23% as detailed below.

Below is the proposed overhead budget for year one. The master budget will escalate this at 3% per year.

Michigan PV Collaboration Administration (Year 1)				% Effort		
Director		$100,000	per year	100%	$100,000	per year
Administrative Staff		$50,000	per year	100%	$50,000	per year
Fringe Benefits for above	41%	$61,500			$61,500	per year
Supplies					$20,000	per year
Travel					$10,000	per year
Other Expenses - Conferences & Communications					$20,000	per year
Chief Technical Officer (Subcontract to Fraunhofer-Gesellschaft)		$150,000	per year	100%	$150,000	per year
Subtotal for Administration Direct Costs					**$411,500**	
Modified Direct Costs (using only $25,000 of Fraunhofer CTO)					**$286,500**	
University Indirect Overhead	48%				$137,520	
TOTAL					**$424,020**	

Solicitations will be created and issued on an annual basis to four different categories as described below. All of the awards will be issued to universities with the expectation of an industry specific issue or problem to resolve. The exact construct and requirements of these solicitations will be left open for the Collaborative management and Advisory Board to determine, but a private industry partnership or involvement will be expected. Therefore, the larger resources available to larger capital, more established companies, requires a 20% cost match, while small capital companies as well as startups, technology R&D topics, educational, and training programs will all require a 10% cost match.

Subaward Category	**Annual Funds**	**Award Size**	**Number per Year**	**Cost Match**
Large Cap Company Projects	$1,500,000	$250,000 to $500,000	3 to 6	20%
Small Cap Company Projects	$1,000,000	$100,000 to $250,000	4 to 10	10%
Technology R&D Projects	$300,000	$10,000 to $100,000	3 to 30	10%
Education / Training	$100,000	$10,000 to $50,000	2 to 10	10%
TOTAL	**$2,900,000**		**12 to 56**	

Please note in that the first Education/Training solicitation will be scheduled for year two, allowing the program to focus on manufacturing R&D projects and also fully assess the educational needs of the various PV industry sectors.

The parameters to differentiate between an established, large capitalized industry partner project, and a small capitalized industry partner project will be determined by the Administration and the Advisory Board prior to the first solicitation. Established, large companies will be asked to cost share 20% to allow for small companies, start-ups, and small technology R&D efforts to be burdened with a smaller 10% cost share.

Additionally, criteria will be established to allow for a repayment of grant funds to the Collaborative for project ventures that are successfully result in profit for the industry partner. This will most likely be in the form of Collaborative royalties of 20% per year once a threshold of successful profit taking has been met. The industry partner will be asked to repay 100% of the initial subaward funds back to the collaborative.

Total Collaborative Cost Share Summary - Years 1 to 5 Only (in millions of dollars)

$4.086	Total Industry and University Partner Cost Match
$0.390	Total OU Cost Match
$4.476	Total OU + Partner Cost Match
$19.476	DOE Funding + Total Cost Match
23%	Total Cost Match to Satisfy Grant Requirements

Membership Fees

The Advisory Board and Administration will determine an annual membership fee schedule for the different levels of participation in the program. For year one, an estimated $50,000 in total will be collected, increasing to an annual estimate of $100,000 for the life of the Collaborative. This will cover costs for conferences and part of the administrative functions of the Collaborative.

Grant Repayment Mechanism & Collaborative Sustainability

Following the model of the Michigan Universities Commercialization Initiative (MUCI) Challenge Fund, if a subaward results in a financially successful business operation, a formula will be created which will require the industry partner to repay the grant amount over a period of time. This mechanism, coupled with user fees, and potentially other State funding into the program will create a sustainable business model after the initial five year federal funding expires.

The actual amount and timing of repayment funds as well as any possible State of Michigan funding to be applied for by the Collaborative cannot be known at this time. Therefore, for a truly sustainable Collaborative, these revenue sources will need to be balanced against the year six and future subaward funds. If it is desired to keep the Collaborative active beyond the described ten-year budget, this is easily done by the adjustment in annual subaward levels.

The business model assumes that these repayment funds will not be seen until later in the Collaborative life cycle. An estimate of 5% repayment of the previous five year total award funds is made starting year five of the Collaborative. This is increased to 10% per year in year seven of the Collaborative.

The amount of repayment funds and / or additional State or other grant funds will determine the year five and beyond subaward funding level. This can be adjusted as needed to allow for a self sustaining program.

For the ten-year budget described in this proposal, the $15M requested from the DOE PVMI will be leveraged with cost match and grant repayments to provide a ten-year total of $24M in projects.

Experience Derived from the MI Universities Commercialization Initiative Challenge Fund

The Collaborative members' previous experience, particularly with the Michigan Universities Commercialization Initiative (MUCI) Challenge Fund, supports the concept of making pre-seed and early stage investments in projects that may have long term economic impact. MUCI awarded over $7M in awards between September 2001 and November 2008. Forty-seven start-up companies grew out of the funded technologies, many of them becoming suitable venture capital investments. For instance, Lycera Corporation was formed for discovery, development, and commercialization of small molecules that control diseases characterized by abnormal cell growth, activity, and survival such as lupus, psoriasis, rheumatoid arthritis, and cancer. The University of Michigan received an extremely modest ($550) MUCI award in September 2001 for this effort. The company formed in 2006, and in 2009 raised $36M in investments – the 2nd largest venture capital deal in the State of Michigan since 2007.[3] Today, Lycera is creating US jobs here in Michigan and hiring high-wage scientists. Velcura Therapeutics, Inc. received a small MUCI Challenge Fund award ($2,514) in September 2001, and was officially founded in 2002 (as Osteomics). The company spun-out from the University of Michigan in 2004. Since its founding, Velcura has raised $11M of non-dilutive capital and another $4.1M in in-kind contributions. MUCI-funded technologies have brought over $150M in follow-on funding to Michigan and the start-up companies that grew up to commercialize these technologies have created over 300 US jobs.

Proposed PV Manufacturing Initiative (dollars in millions)

			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
1	**Administration and Expenses (with 3% annual escallation)**													
2	PV Collaboration Administration Staff Total		$0.150	$0.155	$0.159	$0.164	$0.169	$0.174	$0.179	$0.184	$0.190	$0.196	**$0.80**	**$1.72**
3	PV Collaboration Administration Staff Fringe Total	41%	$0.062	$0.063	$0.065	$0.067	$0.069	$0.071	$0.073	$0.076	$0.078	$0.080	**$0.33**	**$0.71**
4	Supplies		$0.020	$0.021	$0.021	$0.022	$0.023	$0.023	$0.024	$0.025	$0.025	$0.026	**$0.11**	**$0.23**
5	Travel		$0.010	$0.010	$0.011	$0.011	$0.011	$0.012	$0.012	$0.012	$0.013	$0.013	**$0.05**	**$0.11**
6	Other Expenses - Conferences & Communications		$0.020	$0.021	$0.021	$0.022	$0.023	$0.023	$0.024	$0.025	$0.025	$0.026	**$0.11**	**$0.23**
7	Fraunhofer CTO Subcontract		$0.150	$0.155	$0.159	$0.164	$0.169	$0.174	$0.179	$0.184	$0.190	$0.196	**$0.80**	**$1.72**
8	**Subtotal for Administration Direct Costs**		**$0.412**	**$0.424**	**$0.437**	**$0.450**	**$0.463**	**$0.477**	**$0.491**	**$0.506**	**$0.521**	**$0.537**	$2.18	$4.72
9	Modified Direct Costs (using only $25,000 of Fraunhofer CTO Subcontract)		$0.287	$0.295	$0.304	$0.313	$0.322	$0.332	$0.342	$0.352	$0.363	$0.374	**$1.52**	**$3.28**
10	PV Collaboration Administration Indirect Overhead	48%	$0.138	$0.142	$0.146	$0.150	$0.155	$0.159	$0.164	$0.169	$0.174	$0.179	**$0.73**	**$1.58**
11	Estimted Indirect Overhead for Subawards (48% of first $25k per award)*	4.0%	$0.112	$0.115	$0.119	$0.122	$0.126	$0.130	$0.134	$0.138	$0.142	$0.146	**$0.59**	**$1.28**
12	**Subtotal for Administration and Expenses**		**$0.661**	**$0.681**	**$0.701**	**$0.722**	**$0.744**	**$0.766**	**$0.789**	**$0.813**	**$0.837**	**$0.862**	$3.51	$7.58
13	PV Collaboration Administration - OU Cost Match	10%	($0.073)	($0.076)	($0.078)	($0.080)	($0.083)	($0.085)	($0.088)	($0.090)	($0.093)	($0.096)	**($0.39)**	**($0.84)**
14	**TOTAL ADMINISTRATION COST to the PROGRAM**		**$0.588**	**$0.605**	**$0.623**	**$0.642**	**$0.661**	**$0.681**	**$0.702**	**$0.723**	**$0.744**	**$0.767**	$3.12	$6.74
15														
16	**Subaward R&D Funding to Collaboration Partners**													
17	Subaward funding for large company manufacturing R&D projects		$1.500	$1.500	$1.500	$1.500	$1.500	$0.500	$0.500	$0.500	$0.500	$0.500	**$7.50**	**$10.00**
18	Subaward funding for small company manufacturing R&D projects		$1.000	$1.000	$1.000	$1.000	$0.500	$0.200	$0.200	$0.200	$0.200	$0.200	**$4.50**	**$5.50**
19	Subaward funding for technology R&D projects		$0.300	$0.300	$0.300	$0.300	$0.300	$0.150	$0.150	$0.150	$0.150	$0.150	**$1.50**	**$2.25**
20	Subaward funding for ciriculla development or training		$0.000	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	$0.050	$0.050	**$0.40**	**$0.80**
21	**TOTAL SUBAWARDS**		**$2.800**	**$2.900**	**$2.900**	**$2.900**	**$2.400**	**$0.950**	**$0.950**	**$0.950**	**$0.900**	**$0.900**	$13.90	$18.55
22														
23	**Cost Match from Subawards**													
24	Industry Partner Cost Match (% of line 17, large company)	20%	$0.375	$0.375	$0.375	$0.375	$0.375	$0.125	$0.125	$0.125	$0.125	$0.125	**$1.88**	**$2.50**
25	Industry Partner Cost Match (% of line 18, small company)	10%	$0.111	$0.111	$0.111	$0.111	$0.056	$0.022	$0.022	$0.022	$0.022	$0.022	**$0.50**	**$0.61**
26	Industry Partner Cost Match (% of line 19, technology R&D)	10%	$0.033	$0.033	$0.033	$0.033	$0.033	$0.017	$0.017	$0.017	$0.017	$0.017	**$0.17**	**$0.25**
27	University Partner Cost Match (% of lines 17 + 18 + 19)	10%	$0.311	$0.322	$0.322	$0.322	$0.267	$0.106	$0.106	$0.106	$0.100	$0.100	**$1.54**	**$2.06**
28	**TOTAL SUBAWARDEE COST MATCH**		**$0.831**	**$0.842**	**$0.842**	**$0.842**	**$0.731**	**$0.269**	**$0.269**	**$0.269**	**$0.264**	**$0.264**	$4.09	$5.42
29														
30	**Funding Sources**													
31	Estimated Grant Fund Percentage Repayed to Collaboration		0%	0%	0%	0%	5%	5%	10%	10%	10%	10%		
32	Estimated Grant Funds Repayed (line 31 x previous 5 yrs of lines 17, 18, 19)		$0.000	$0.000	$0.000	$0.000	$0.675	$0.578	$0.960	$0.765	$0.570	$0.425	**$0.68**	**$3.97**
33	Previous Year End Balance		$0.000	$0.493	$0.929	$1.348	$1.747	$3.192	$2.507	$2.185	$1.647	$0.937	**$4.52**	**$14.99**
34	DOE PV Manufacturing Initiative Funding		$3.000	$3.000	$3.000	$3.000	$3.000	$0.000	$0.000	$0.000	$0.000	$0.000	**$15.00**	**$15.00**
35	Outside Funding (State of Michigan or MEDC)		$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	**$0.00**	**$0.00**
36	Estimated Collaboration Member Dues		$0.050	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	**$0.45**	**$0.95**
37	Total Subawardee Cost Match (line 28)		$0.831	$0.842	$0.842	$0.842	$0.731	$0.269	$0.269	$0.269	$0.264	$0.264	**$4.09**	**$5.42**
38	**TOTAL ANNUAL FUNDING SOURCES**		**$3.881**	**$4.435**	**$4.871**	**$5.289**	**$6.253**	**$4.139**	**$3.837**	**$3.320**	**$2.581**	**$1.726**	$24.73	$40.33
39														
40	**YEAR END BALANCE (line 38 - 14 - 21)**		**$0.493**	**$0.929**	**$1.348**	**$1.747**	**$3.192**	**$2.507**	**$2.185**	**$1.647**	**$0.937**	**$0.059**		
41														
42	**Total Subaward Project Funding**													
43	Collaboration Subawards plus Cost Match (lines 21 plus 28)		**$3.631**	**$3.742**	**$3.742**	**$3.742**	**$3.131**	**$1.219**	**$1.219**	**$1.219**	**$1.164**	**$1.164**	$17.99	$23.97

***** Note from Line 4: The number of future subawards is not known; therefore an indirect overhead estimate of 3% of line 21 total is used.

Criteria 3: Research & Development (R&D) / Operations Management Plan

Collaborative R&D Proposal Solicitation

The Collaborative solicitation research topic selection will be based on the input and survey from industry and academia leaders as well as the Collaborative industry members. The request for proposal (RFP) will be issued once every year covering a broad range issues and challenges that the US PV industry is facing. The RFP will be circulated electronically to a broad list developed during the early months of the project timeline, and posted in research databases. Depending upon scope, projects will span either one year or up to two years in duration.

Panel Selection

The Collaborative industry board will determine a review panel from the pool of academic as well as industry experts. Panel members will be required to declare any conflicts of interest, which would then be applicable to conflict of interest stipulations set forth in the Collaborative business and management plans. Prior to the panel discussion, the reviewers will submit a written evaluation, which will be discussed among the panel members. Based on the evaluation criteria presented below, the proposals will be ranked (HR: Highly Recommended, R: Recommended, and NR: Not Recommended) for funding and the recommendation will be sent to the Collaborative industry board. Upon completion of the review process the applicants will be notified of the panel's decision and can access the review results online at the Collaborative webpage. The reviewers will be required to write objective and constructive comments without any personal bias. Should the occasion arise, the panel moderator will intervene and modify the written comments to remove any personal attack and derogatory comments before they are published.

Proposal Evaluation Criteria

All proposals will be evaluated in accordance with the following evaluation factors and the respective point values assigned. An award will be made to the responsible offeror whose proposal conforms to the solicitation requirements and is most advantageous to the broad US PV manufacturing industry.

Evaluation Criteria	Points
1. QUALITY OF TECHNICAL PROPOSAL	65
A. The technical proposal demonstrates the offeror's clear understanding of the solicitation, tasks outlined in the Statement of Work, and clearly shows how the offeror’s partners, if any, will contribute to the tasks.	25
B. The technical proposal shows the offeror has expert knowledge of the state of the art and has reviewed the literature adequately. If the offeror lacks knowledge in one or more of the areas, the technical proposal will show that the offeror has established partnerships with other individuals or organizations to supply the missing expertise.	15
C. The technical proposal discusses a realistic impact of the proposed outcomes on the long-term vitality of the broad US PV manufacturing industry.	20
D. The technical proposal includes a statement describing how the proposer will address organizational and other conflicts of interest for persons who are consultants or who work for organizations with potential conflicts.	5
2. QUALITY OF KEY PERSONNEL	20
A. The technical proposal clearly shows that the key personnel have the technical skill and experience required for the functions, activities, and tasks described in the Statement of Work.	10

B. The technical proposal adequately describes the staff hours needed for each task and that the offeror has dedicated adequate staff hours sufficient to complete the requirement according to the established timeline.	10
3. QUALITY OF MANAGEMENT PLAN	5
The technical proposal will provide clear, logical, and specific plans, with provisions for identifying and correcting deficiencies, and a process for ensuring quality and timeliness of the final product, and evaluating success.	5
4. EXPERIENCE AND CAPABILITY	10
The technical proposal describes the offeror's relevant past and current experience in projects of comparable size, complexity, and similarity to the objectives of this requirement.	10
TOTAL POSSIBLE SCORE	100

Post award project management

Typically, the funding will be provided to selected research and development teams in two installments; first at the beginning of the approved project and the second after the completion of the third quarter based on the individual project timeline. Awardees will be required to submit quarterly reports to the Collaborative. Reports should address the following three components (in addition to any US DOE PVMI reporting requirements):

- Clear statements of measurable objectives for the project and its components, for which indicators can be defined.
- A structured set of indicators, covering outputs of goods and services generated by the project and their impact on beneficiaries.
- The hurdles if any towards achieving the objectives and the necessary measures taken to overcome the hurdles.

Should the awardee falter in deliverables, the board will intervene and seek help from resources at its disposal to steer the project towards success. If a workable arrangement cannot be established the contract will be terminated. The Collaborative will develop institutional arrangements for gathering, analyzing, and reporting project data, and for investing in capacity building to sustain the momentum and the evaluation findings will be fed back into Collaborative decision-making.

Communications

Information will be shared via regular meetings, including multimedia conferencing as needed.

A Collaborative website will be created and maintained, quarterly newsletters will be disseminated, and an annual conference will be hosted to bring all Collaborators together to present and review all aspects of the program.

Criteria 4: Intellectual Property (IP) Management Plan

The Collaborative will employ intellectual property rules similar to those used by other consortia that have successfully encouraged high-impact research by connecting world-class university researchers with the private sector firms best positioned to commercialize new intellectual property. The IP provisions take into account the policies of the US Government, the interests of Collaborative members and the interests of universities that will be performing research and developing new technology.

The Collaborative is subject to the Protocol signed on November 17, 2009. That international agreement requires that any joint research project (a project with a specific scope of work jointly funded by China and the United States of America) to be undertaken in the performance of the Collaborative be subject to a Technology Management Plan for that joint research project agreed to by China and the USA. Each Technology Management Plan shall be entered into only after consultation with the Collaborative Advisory Board. Consistent with the goals of the Oakland University Clean Energy Center and in recognition of the contributions to be provided by each institution, each plan shall seek to minimize any diminution of the intellectual property rights normally retained by the institution. The international agreement also applies to a research project that includes a visiting researcher from China or the US participating in a research project of the other country and any national laboratory participation.

This Intellectual Property Plan will be the basis of the relevant section of the operating guidelines for the Collaborative and the Technology Management Plan to be submitted for approval by the Collaborative Advisory Board.

Successful demonstration of the proposed PV technologies will depend not only on the quality of research, but also on strategic partnerships with industry and national laboratories. The Collaborative will establish partnerships with leading OEMs in the transportation sector, including suppliers and innovation-based companies. In addition, the Collaborative and members have established collaborative ties with Fraunhofer USA, Sandia National Laboratory, and Oak Ridge National Laboratory. Existing relationships will be used as leverage to expand the network, and provide additional avenues for technology transfer.

Accordingly, a key component of the IP management strategy is to promote rapid dissemination of intellectual property developed through the Collaborative and to contribute to dramatic improvements in PV technology. This IP Plan will increase the success of this vision by implementing the following objectives:

- Support and conduct of high-quality research that has commercial relevance to Collaborative members
- Addressing the technical needs of industry members pursuing new products and production processes
- Growing and nurturing entrepreneurial enterprises for IP that is not licensed to member companies
- Contributing to the expansion of a technologically proficient workforce in the United States, particularly related to graduate and post-graduate workforce and PV installation and maintenance workforce development.

IP Management

For IP resulting from projects not covered by a separately negotiated agreement with an industry member, the Collaborative will provide a simplified means for industry to negotiate licenses and other agreements by centralizing these activities with a lead institution.

Collaborative university members may enter into a separate inter-institutional (IIA) licensing/royalty-sharing/commercialization agreement for the implementation of centralized licensing and subsequent royalty distributions. The IIA will allow the designated lead institution for an invention to negotiate commercial licenses or sublicenses to relevant collaboration IP.

The IIA will also address the details of royalty distribution from the licensing of bundled or jointly owned patents. Licensing and partnering shall be conducted in a manner that promotes the rapid deployment of the technology for the public benefit and recognizes the interests the partners.

If the Collaborative administrative board decides, in conjunction with technology transfer offices to file a patent application, then each partner who acquires more than Internal Use rights will share in the cost of patent prosecution and maintenance.

Licensing of Collaborative IP

Projects under the umbrella of the Collaborative will include projects solely funded by a industry partner. The Collaborative sees a benefit of PVMI award funding under a TIA so that university Collaborative members can negotiate IP rights in the solely funded projects that are compatible with maximizing the incentives to the industry partner to rapidly develop resulting inventions for the public benefit. University Collaborative members will take advantage of existing agreements with the industry members, where applicable and avoiding conflicts of interest, to make the negotiation process efficient and beneficial to the Collaborative.

The remainder of Collaborative projects will be funded in whole or in part with DOE PVMI support. For these projects, each Collaborative member will be granted a non-exclusive, royalty-free license to resulting inventions for its internal use. For this purpose "Internal Use" means the right to use the technology for research and development purposes, to evaluate the intellectual property, and to use it in manufacturing and design processes. Internal use does not include the right to incorporate the Intellectual Property into a product or service offered for sale or purchase and does not include the right to sublicense any of these rights. It is expected that Collaborative members will wish to take advantage of DOE's willingness to issue, a "patent waiver" that would assure that those members not subject to the Bayh-Dole Act will also have the option to retain title to their own inventions, subject to rights retained by the Government.

Any Collaborative member desiring more extensive rights than internal use will have an opportunity to evaluate the invention and elect to take a royalty-bearing license for commercial use in a designated filed of use. The scope of these licenses and the royalty will be determined by the Collaborative's administrative board in conjunction with the respective technology transfer offices of the partner institutions that employ the inventors and will depend, in part, on how many partners request commercial rights.

For licensing of any Collaborative technologies the following licensing principles will apply:

Before executing any license agreement, the lead licensing institution will evaluate the capabilities of the potential licensee to determine that the company has the expertise and capital needed to further the development of the technology and successfully bring the technology to market in the fields of use in which a license would be granted. Collaborative IP will be licensed on a non-exclusive basis when, in the reasonable judgment of the lead licensing institution, this allows the technology to be adopted most successfully by the market.

The Collaborative will license IP to companies only in the fields of use (FOU) in which the company is capable and committed to bringing the technology to market, saving other FOUs for additional licensees.

Any licensee granted exclusive rights in Collaborative IP in any field of use must agree to and meet diligence (performance) requirements to successfully develop and market the technology.

If the licensee is not able to meet these requirements, the license will be reduced to a nonexclusive license or be terminated.

Licensing Revenue Allocations

Each Collaborative member institution that is an IP owner of licensed Collaborative IP is entitled to a percentage of any royalties or other income from such licenses. Licensing income from each license will be distributed In accordance with the policies of the inventing institutions and the terms of any applicable IIA.

Information Sharing

It is the intention of the Collaborative that the fruits of its research be widely and promptly disseminated, with a goal of maximizing the impact of the research and its long-term benefit to the US and to society. Even in those situations in which protection of inventions is desirable, such inventions are also expected to be widely and promptly disseminated.

All Collaborative team members that have executed a mutual nondisclosure agreement (NDA) will be able to receive access to the data and results of all Collaborative projects, regardless of funding source as soon as reasonably available.

Reporting to DOE

Each Collaborative member institution shall require its researchers to report all inventions in a manner consistent with reporting requirement of federally funded research.

Criteria 5: Capabilities & Resources

Although an equipment matrix was not compiled at this time do to the bredth and complexity of the vast resources availale to the Collaboritve membership, this could be done at a later date if this would be of value to the Department of Energy. Below is a list of resources available to the University partners and Fraunhofer.

Fraunhofer

Fraunhofer is a worldwide operating non-profit organization providing applied research to private industry and the public sector. It bridges the gap between university and industry and has established itself as a premier organization for rapid technology transfer of innovative technologies developed at university laboratories. Fraunhofer offers state-of-the art facilities and highly trained engineers and scientists working closely with students and faculty as well as industrial customers. This enables work on the whole value chain of technology development from proof of concept through prototype to validation in production. Fraunhofer is organized in 21 knowledge-based alliances and the energy alliance with more than 1,500 engineers develops new technologies and validates production processes for renewable energy solutions. Solar technology with more than 700 engineers is a major research field within this alliance. Fraunhofer's work in the field comprises all aspects of PV, ranging from efficiency records of different cell designs, module technologies, development and validation of production equipment, testing and certification as well as societal and legislative issues.

Fraunhofer USA is headquartered in Plymouth, Michigan and operates seven centers at different locations. The proposed effort builds on the expertise of Fraunhofer and specifically of the Center for Laser Technology (CLT), also located in Plymouth, Michigan, the Center for Sustainable Energy Systems (CSE), located in Cambridge, MA and the Center for Coating

Technologies (CCL). CLT focuses on manufacturing technologies and components for cell manufacturing, CCL on thin film coatings, and CSE focuses on module manufacturing, reliability, testing and certification.

CLT's facilities include clean room facilities, laboratories for optical component and system development, a precision CNC machine shop, and laser development laboratory. Full-scale wafer manufacturing is accessible through its partnership with Wayne State University. The Smart Sensor and Integrated Microsystems Group (SSIM) operates a state-of the art clean room for manufacturing electrical and optical Si and SiC based devices up to 6" diameter. Nano imprinting down to 35nm structures, photolithography, wet and dry chemical etching, CVD, MOCVD, diffusion furnaces, RIE, metallization and a wide variety of characterization devices are available. CLT further has unique software infrastructure established that links optical and thermal modeling as well as mechanical design with CAD/CAM capabilities. Precision machining with tolerances <20mm and laser micromachining are established. CLT thus has all the infrastructure available that is required for cell manufacturing.

CLT also operates a fully equipped electronics laboratory allowing development of microcontroller based, SMD based and discrete electronics circuitry for development test set-ups as well as production equipment. Controls expertise includes Labview, industrial controllers and micro-controls. Fraunhofer thus has optical, mechanical, controls and prototype manufacturing under one roof, allowing the performance of complex development and automation projects.

CLT focuses on developing and validating new manufacturing processes enabling high yield and cost effective production of solar cells and batteries. In collaborative research projects production processes are developed based on new product designs and taken from proof of concept to validation in production. CLT combines its expertise in device design with electrical, optical and mechanical design and engineering to develop innovative manufacturing techniques. Process monitoring/control and device testing at different stages of the production line are a core expertise of CLT.

Recent projects of cell manufacturing include high productivity Emitter Wrap Through (EWT) processes tripling the productivity by optimizing the laser drilling process and the machine control, laser doping for shallow contacts minimizing impedance losses, surface texturing of cells and module cover glass for enhanced light absorption showing more than 1% efficiency improvements as well as basic research developing thin film polycrystalline cells with atmospheric deposition processes. Roll-to-roll processing and real time process monitoring complement research activities in the field.

CCL operates a variety of PVD and CVD reactors and develops new reactors for high throughput vacuum coating processes. A specific expertise of CCL are carbon coatings and clean, electrically doped diamond coatings. Microwave processing and micro-/nano structuring and manufacturing are applied to the coated structures.

CSE's Photovoltaic Module group works on collaborative research projects with PV module manufacturers, materials suppliers, components suppliers, equipment vendors, national laboratories and universities. The research team includes expertise in materials characterization, polymer processing, surface and interface science, module performance testing, failure analysis, module design and module manufacturing techniques. The PV Modules group's capabilities include full size PV module production, module performance measurement and characterization, and environmental reliability and accelerated aging testing. The PV

Module group has module production and characterization facility located in Cambridge, MA and a reliability test facility co-located with new CFV Solar Test Laboratory for module certification in Albuquerque, NM. The PV Modules group is an interdisciplinary team of PV modules, materials and reliability experts that provide technical support to module manufacturers and their suppliers.

Fraunhofer CSE's PV module research is organized into four main areas. Research projects are often interdisciplinary, combining elements from more than one focus area reflecting the inherent interdependence of module technologies, designs, manufacturing processes, materials, components and field performance. The four focus areas are:

a) Module Reliability – developing industry accepted methodologies to reduce technical risk of introduction of new material and technologies while maintaining 25+ years lifetime.
b) Module Manufacturing – supporting advanced manufacturing concepts and developing new process metrology methodologies
c) Module Performance – advancing technologies and new materials that improve electrical, thermal, mechanical and optical performance of modules
d) Advanced Module Concepts – performing pre-competitive research into technologies that support the development of flexible, back contacted, BIPV, CPV, OPV and new module designs.

Fraunhofer CSE is organizing an industrial consortium for the Department of Energy's Photovoltaic Manufacturing Initiative (PVMI). The CSE proposal brings together a diverse team of manufacturers to form the Solar Module Technology Alliance (SMTA). As a key part of the SMTA, the Fraunhofer PV Module Laboratory will become the nation's premier institution for PM module manufacturing technology research. Our university lead consortium will seek the cooperation with SMTA creating an even broader network with many synergies. Extended research and development capabilities will be linked to and extended supplier and manufacturing network.

Industry

We have assembled a consortium of industrial partners and will have access to their facilities under terms to be negotiated. Equipment industry includes Kuka Solar System, Applied Materials, Jenoptik, Aspect Manufacturing and Clairvoyant, who submitted a LOI. End users and many suppliers expressed strong interest and anticipate participation upon award of the Collaborative.

Oakland University

Centers and Labs

The School of Engineering and Computer Science has centers for product development and manufacturing and laboratories for systems design, real time computer systems, robotics, controls research, artificial intelligence, tribology, fluid mechanics, and thermodynamics.

Centers

- Clean Energy Research Center
- Center for Robotics and Advanced Automation
- Fastening and Joining Research Institute (FAJRI)
- Product Development and Manufacturing Center (PDMC)

Laboratories in Computer Science and Engineering

- High Performance FPGA Systems Laboratory

- Embedded System Lab
- Virtual Reality Lab
- Microprocessor System Lab
- Software Design Lab
- Computing Lab
- High Speed Digital Communications, Multimedia, and Distance Learning Laboratory
- Real Time Computer System Lab
- Software Verification Lab (EDS Supported)

Laboratories in Electrical and Computer Engineering

- Applied EM and Wireless Laboratory
- Instrumentation and Measurements, Microwaves, Chamber and EMC
- Control Research Lab
- Robotics Systems Research Lab
- Computer Vision/Digital Signal Processing Research Lab
- Active Suspension System Lab (Supported by the Ross Family)
- Control Systems Lab & Micro Computer Based Control
- Automotive Mechatronic Systems Lab (Ford Motor Company Supported)
- Electronic Circuit Design & Advanced Electronics (120 SEB)
- Digital Systems Design
- Microelectronics Systems Design Lab
- Communications, Electric Machines, Power and Industrial Electronics
- Real Time Embedded DSP Systems Lab
- Virtual Vehicle Systems Simulation (VVSS) Lab (General Dynamics Supported)
- Electric Circuits Lab

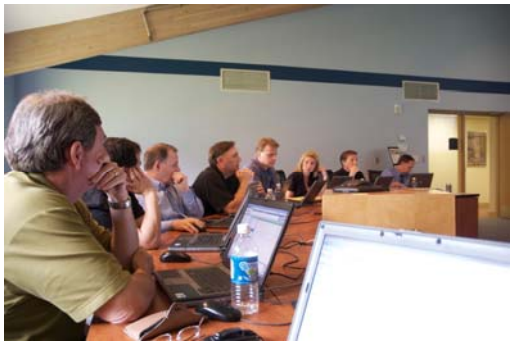
Laboratories in Industrial and Systems Engineering

- Stephan and Rita Sharf Computer Integrated Manufacturing Laboratory
- Computer Simulation Lab
- Ergonomics Lab
- Enterprise Computing Lab

Laboratories in Mechanical Engineering

- Statics and Dynamics Laboratory
- Thermodynamics Laboratory
- Fluid Mechanics Laboratory
- Mechanics of Materials Laboratory
- Material Properties Laboratory
- Mechanical Systems CAD/CAM Laboratory
- Manufacturing Processes Laboratory
- Tribology Laboratory
- Two-phase Flow Research Laboratory
- Thermal Science Research Laboratory
- Optical Measurement and Quality Inspection Laboratory
- Laser Interferometry Application Laboratory
- Holographic Applications Laboratory
- Optical Non-destructive Testing Laboratory
- 3-D Computer Vision Laboratory
- Computational Fluid Dynamics and Heat Transfer Research Lab

The Oakland University Collaboratory



The consortium will be virtually based at the Oakland University Collaboratory at the OU Business INCubator. This multimedia, virtual meeting space is an electronic decision support system environment that empowers group work teams to simultaneously brainstorm information and ideas in order to foster collaboration, categorization, prioritization and consensus building. Session participants will sit at computer stations set up in two large, half-circle conference tables or connect remotely via teleconference/webinar. A facilitator will guide the group through a list of activities, often including brainstorming and evaluation tools, which will allow participants to enter comments and votes directly into the system from their computer station. Collaboratory sessions are meant to encourage honesty and efficiency. All sessions have the option of running in "anonymous mode," meaning all feedback that is entered into the session (comments, votes, etc.) is completely anonymous, or "name tag mode," where all comments are tagged with the commenter's name. Oral discussion complements participation via computer station.

University of Michigan

The University of Michigan (UM) is home to the Center for Solar and Thermal Energy Conversion (CSTEC), an Energy Frontier Research Center (EFRC) supported by the US Department of Energy (DOE). The goal of CSTEC is to discover and develop the science necessary to maximize the energy conversion efficiencies of photovoltaic (PV) and thermoelectric (TE) devices through integrated theoretical, experimental, and computational strategies. The central energy challenges to utilizing renewable energy sources revolve around efficient energy conversion, storage, and efficient use. Improving the efficiencies of energy conversion devices will require important scientific breakthroughs that enable understanding the structure of materials at length scales smaller than nanometers and understanding and controlling processes that occur as fast of a few femtoseconds (~ time scales a trillion times shorter than the blink of an eye). To this end, the mission of the center is to investigate the science necessary to elucidate and to mitigate energy loss processes in low dimensional, and/or complex nanostructured, organic, inorganic, and hybrid materials for high efficiency photovoltaic (PV) and thermoelectric (TE) energy conversion. State-of-the art microscopes, x-ray diffraction, and neutron and light scattering techniques (including ultrafast), complemented by detailed computer simulations/theory, are exploited to understand molecular and electronic structure and dynamics over a wide range of spatial and temporal scales. CSTEC is led by Peter F. Green, The Vincent T. and Gloria M. Gorguze Professor of Engineering and Chair of Materials Science and Engineering, and two associate airectors, Rachel Goldman, Professor of Materials Science and Engineering, and Ctirad Uher, Professor of Physics. An additional 26 members of the faculties of the departments of Materials Science and Engineering, Chemistry, Physics, Chemical Engineering, Mechanical Engineering and Electrical Engineering, at the University of Michigan serve as Principal and Senior Investigators in CSTEC.

The Optoelectronic Component and Materials Laboratories (OCM Labs) is a collection of graduate students, post doctoral fellows, visiting scientists and research staff who are engaged in investigating an enormous variety of phenomena and devices related to electronic materials and optics. Some of the work involves the basic physics of new semiconductor and organic materials, some focuses on devices using these materials, and yet other work looks at the

system impact of optical devices and structures. The unifying goal of OCM Labs' work is the realization of practical optoelectronic devices. OCM Labs continually seek the optimal combination of materials and devices to make functional elements, which perform advanced optoelectronic functions, which ultimately will find use in photonic systems. The group has maintained a staff of 15 or more graduate students, complimented by a number of professional researchers (post docs, visiting scientists, and research staff). The research emphasis can be divided into two general areas: III-V optoelectronic integrated devices, and organic thin film optical devices. There are also projects, which integrate the advantageous properties of both of these materials systems.

Wayne State University

Under the direction of Professor James Woodyard, Wayne State University can offer the Collaborative a full array of state-of-the-art analytical techniques for characterizing materials, devices and thin films in the Chemistry Department and the College of Engineering as listed below:

- Apparatus and temperature controlled stages for the measurement of light and dark current-voltage characteristics of devices.
- Photothermal Deflection Spectrometer (PDS) for the measurement of optical absorption coefficients as low as unity in thin films.
- Constant Photocurrent Method (CPM) for the measurement of the optical and transport properties of devices and materials.
- Optical apparatus for the measurement of the wavelength dependence of the quantum efficiency, transmission and reflection of photovoltaic devices and materials. Spectral biasing may be used to measure the quantum efficiency of multi-junction devices.
- Optical/electrical/vacuum apparatus for the measurement of the temperature dependence of light and dark conductivities in air and vacuum. The apparatus is also used for annealing studies.
- Dual source solar simulator with associated instrumentation for measuring the current-voltage characteristics of photovoltaic devices.
- Spectral radiometer calibrated with standards traceable to the National Institute of Science and Technology.
- Photoluminescence and electroluminescence apparatus for measurements in the 10 to 373 Kelvin temperature range.
- Raman spectrometer for measurement of spectra of solid, liquid and gaseous samples following excitation with a five watt krypton or one watt argon laser.
- State-of-the-art numerical modeling for simulation of device properties.
- Thin-film thickness measurement apparatus
- Volume and surface resistivity measurement apparatus
- The following equipment is available in the laboratory for the implantation modification and deposition of thin films, devices, contacts and coatings:
    - A three-chamber plasma enhanced chemical vapor deposition system with five gas channels and state-of-the-art gas handling and scrubbing for device fabrication and thin-film studies,
    - Evaporator for the sputter and thermal deposition of materials for contacts, optical coatings, devices and thin films,
    - Load-locked ultrahigh system with a 0-2000 eV Kaufman ion source for the hydrogenation and modification of devices and thin-film materials, and
    - 200 keV/1.0 Ma ion/electron accelerator.

Western Michigan University - Center of the Advancement of Printed Electronics

Professor Margaret Joyce is the Director of CAPE, Center of the Advancement of Printed Electronics. WMU's CAPE consists of a multidisciplinary team of 13 faculty members in various engineering departments, chemistry and physics. Besides an established multidisciplinary team, the great strength of the CAPE is its capabilities for multilayer printing of electronic materials by gravure, flexography, inkjet, screen and offset printing. The lab presses are ideally suited to perform printed PV research because they require low ink volume to obtain a sufficient number of test prints. Equipment to fully characterize the ink properties, substrate properties and ink/substrate interactions is available. Measurements of the attributes of printed structures are routinely performed and their relationship to device performance determined. Software to model ink transfer on press is available. Pilot scale rotogravure and flexographic presses are also available for scale-up. The ink delivery systems of these presses have been modified to accommodate small quantities of electronic materials (300-1500 ml). CAPE with its AccuPress (by Daetwyler R&D) is the only facility in the US capable of gravure printing on rigid and flexible substrates within a registration tolerance of 5 microns. Dip coating, spin coating can also be performed and an evaporator for making organic solar cells is also available. The facility has extensive electronic testing equipment, which includes equipment to determine the performance parameters of PV devices using current-voltage (I-V) measurements. I-V measurements under dark to determine the PV's diode properties and series and shunt resistances can also be performed. Other instrumentation includes UV/vis spectrometers and a commercial solar simulator, furnaces, refrigerators and environmental chambers to allow the characterization of materials over a wide range of temperatures and RH.

APPENDIX 1: BIBLIOGRAPHY & REFERENCES CITED

[1] Noufi, R. & Zweibel, K. High-Efficiency Cd-Te and CIGS Thin-Film Solar Cells: Highlights and Challenges. IEEE 4th World Conference on Photovoltaic Energy Conversion.

[2] 2009 Global Thin Film Solar Cell Market Share Show Sharp Increase Y/Y to 19.8%. available: http://www.displaybank.com/eng/info/sread.php?id=5730

[3] AnnArbor.com Business Review, November 7, 2009

[4] R. Margolis, R. Mitchell, and K. Zweibel, “Lessons Learned from the Photovoltaic Manufacturing Technology/PV Manufacturing R&D and Thin-Film PV Partnership Projects”, Technical Report NREL/TP-520-39780, Sept 2006.

Appendix 2: Budget Summary

The Form 424A Budget Information - Non Construction Programs describes the first five years of the Collaborative business model. However, this form does not easily account for the full business model with membership dues, subaward repayments, and year end balances that roll over to the next year's budget.

The total estimated funding income to the project from all sources is shown below.

Estimated Funding Sources (in millions of dollars):

	5 Year Estimate	10 Year Estimate
Federal DOE:	$15M	$0
Partner Cost Match:	**$4.09**	**$5.42**
Membership Fees:	**$0.45**	**$0.95**
Subaward Repayments:	**$0.68**	**$3.97**
TOTALS	**$20.22**	**$10.34**

Administrative Overhead

The year one budget for this administrative component of the Collaborative is $411,500. With indirect overhead, this becomes $424,020, or less than 14% of the $3,000,000 per year grant request. Additional indirect overhead will be charged against the subawards per the established indirect rate agreement of 48% of the first $25,000 per subaward. The actual number of subawards is not know at this time, therefore a percentage of 4% indirect overhead to the total subaward budget has been used for this business model. The number of subawards can be from 12 to 56 per year with the funding model shown in the table below.

Oakland University will cost match 10% of the total indirect overhead back to the Collaborative budget. Additional cost match from large and small industry partners and university collaborators will provide a year 1 – 5 overall cost share of 23% as detailed below.

Below is the proposed overhead budget for year one. The master budget will escalate this at 3% per year.

Staff include three positions. Two will be internal Oakland University positions for the directorship and the grant administrator. To launch the Collaborative, a co-directorship will be utilized with Dr. Louay Chamra and Jim Leidel, both of Oakland University. A third position will be subtracted to Fraunhofer USA for the service Dr. Stefan Heinemann.

Michigan PV Collaboration Administration (Year 1)				% Effort		
Director		$100,000	per year	100%	$100,000	per year
Administrative Staff		$50,000	per year	100%	$50,000	per year
Fringe Benefits for above	41%	$61,500			$61,500	per year
Supplies					$20,000	per year
Travel					$10,000	per year
Other Expenses - Conferences & Communications					$20,000	per year
Chief Technical Officer (Subcontract to Fraunhofer-Gesellschaft)		$150,000	per year	100%	$150,000	per year
Subtotal for Administration Direct Costs					**$411,500**	
Modified Direct Costs (using only $25,000 of Fraunhofer CTO)					**$286,500**	
University Indirect Overhead	48%				$137,520	
TOTAL					**$424,020**	

Supplies for the Collaborative are estimated at $20,000 per year.

Some modest travel is expected to both the DOE for project reporting as well as site visits to individual projects on a periodic basis. Therefore, a $10,000 per year travel budget has been included.

An annual Collaborative conference will be held for all of the team members, DOE, and interested parties. A web site, newsletters, and other printed materials will also be expected from the Collaborative. Therefore, a budget of $20,000 per year has been included for these purposes.

Solicitations will be created and issued on an annual basis to four different categories as described below. All of the awards will be issued to universities with the expectation of an industry specific issue or problem to resolve. The exact construct and requirements of these solicitations will be left open for the Collaborative management and Advisory Board to determine, but a private industry partnership or involvement will be expected. Therefore, the larger resources available to larger capital, more established companies, requires a 20% cost match, while small capital companies as well as startups, technology R&D topics, educational, and training programs will all require a 10% cost match.

Subaward Category	**Annual Funds (Yr2)**	**Award Size**	**Number per Year**	**Cost Match**
Large Cap Company Projects	$1,500,000	$250,000 to $500,000	3 to 6	20%
Small Cap Company Projects	$1,000,000	$100,000 to $250,000	4 to 10	10%
Technology R&D Projects	$300,000	$10,000 to $100,000	3 to 30	10%
Education / Training	$100,000	$10,000 to $50,000	2 to 10	10%
TOTAL	**$2,900,000**		**12 to 56**	

Please note in that the first Education/Training solicitation will be scheduled for year two, allowing the program to focus on manufacturing R&D projects and also fully assess the educational needs of the various PV industry sectors.

Below is the estimated subaward total funds for all categories for years one through five.

	Year 1	Year 2	Year 3	Year 4	Year 5
Estimated Subaward Totals	**$2.800M**	**$2.9M**	**$2.9M**	**$2.9M**	**$2.4M**

Total Collaborative Cost Share Summary - Years 1 to 5 Only (in millions of dollars)

$4.086	Total Industry and University Partner Cost Match
$0.390	Total OU Cost Match
$4.476	Total OU + Partner Cost Match
$19.476	DOE Funding + Total Cost Match
23%	Total Cost Match to Satisfy Grant Requirements

Membership Fees

The Advisory Board and Administration will determine an annual membership fee schedule for the different levels of participation in the program. For year one, an estimated $50,000 in total will be collected, increasing to an annual estimate of $100,000 for the life of the Collaborative.

This will cover costs for conferences and part of the administrative functions of the Collaborative.

Grant Repayment Mechanism & Collaborative Sustainability

Additionally, criteria will be established to allow for a repayment of grant funds to the Collaborative for project ventures that are successfully result in profit for the industry partner. This will most likely be in the form of Collaborative royalties of 20% per year once a threshold of successful profit taking has been met. The industry partner will be asked to repay 100% of the initial subaward funds back to the collaborative.

Following the model of the Michigan Universities Commercialization Initiative (MUCI) Challenge Fund, if a subaward results in a financially successful business operation, a formula will be created which will require the industry partner to repay the grant amount over a period of time. This mechanism, coupled with user fees, and potentially other State funding into the program will create a sustainable business model after the initial five year federal funding expires.

The actual amount and timing of repayment funds as well as any possible State of Michigan funding to be applied for by the Collaborative cannot be known at this time. Therefore, for a truly sustainable Collaborative, these revenue sources will need to be balanced against the year six and future subaward funds. If it is desired to keep the Collaborative active beyond the described ten-year budget, this is easily done by the adjustment in annual subaward levels.

The business model assumes that these repayment funds will not be seen until later in the Collaborative life cycle. An estimate of 5% repayment of the previous five year total award funds is made starting year five of the Collaborative. This is increased to 10% per year in year seven of the Collaborative.

The amount of repayment funds and / or additional State or other grant funds will determine the year five and beyond subaward funding level. This can be adjusted as needed to allow for a self sustaining program.

For the ten-year budget described in this proposal, the $15M requested from the DOE PVMI will be leveraged with cost match and grant repayments to provide a ten-year total of $24M in projects.

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	5 YR TOTALS	10 YR TOTALS
1	**Administration and Expenses (with 3% annual escallation)**		**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**		
2	PV Collaboration Administration Staff Total		$0.150	$0.155	$0.159	$0.164	$0.169	$0.174	$0.179	$0.184	$0.190	$0.196	**$0.80**	**$1.72**
3	PV Collaboration Administration Staff Fringe Total	41%	$0.062	$0.063	$0.065	$0.067	$0.069	$0.071	$0.073	$0.076	$0.078	$0.080	**$0.33**	**$0.71**
4	Supplies		$0.020	$0.021	$0.021	$0.022	$0.023	$0.023	$0.024	$0.025	$0.025	$0.026	**$0.11**	**$0.23**
5	Travel		$0.010	$0.010	$0.011	$0.011	$0.011	$0.012	$0.012	$0.012	$0.013	$0.013	**$0.05**	**$0.11**
6	Other Expenses - Conferences & Communications		$0.020	$0.021	$0.021	$0.022	$0.023	$0.023	$0.024	$0.025	$0.025	$0.026	**$0.11**	**$0.23**
7	Fraunhofer CTO Subcontract		$0.150	$0.155	$0.159	$0.164	$0.169	$0.174	$0.179	$0.184	$0.190	$0.196	**$0.80**	**$1.72**
8	**Subtotal for Administration Direct Costs**		**$0.412**	**$0.424**	**$0.437**	**$0.450**	**$0.463**	**$0.477**	**$0.491**	**$0.506**	**$0.521**	**$0.537**	**$2.18**	**$4.72**
9	Modified Direct Costs (using only $25,000 of Fraunhofer CTO Subcontract)		$0.287	$0.295	$0.304	$0.313	$0.322	$0.332	$0.342	$0.352	$0.363	$0.374	**$1.52**	**$3.28**
10	PV Collaboration Administration Indirect Overhead	48%	$0.138	$0.142	$0.146	$0.150	$0.155	$0.159	$0.164	$0.169	$0.174	$0.179	**$0.73**	**$1.58**
11	Estimted Indirect Overhead for Subawards (48% of first $25k per award)*	4.0%	$0.112	$0.115	$0.119	$0.122	$0.126	$0.130	$0.134	$0.138	$0.142	$0.146	**$0.59**	**$1.28**
12	**Subtotal for Administration and Expenses**		**$0.661**	**$0.681**	**$0.701**	**$0.722**	**$0.744**	**$0.766**	**$0.789**	**$0.813**	**$0.837**	**$0.862**	**$3.51**	**$7.58**
13	PV Collaboration Administration - OU Cost Match	10%	($0.073)	($0.076)	($0.078)	($0.080)	($0.083)	($0.085)	($0.088)	($0.090)	($0.093)	($0.096)	**($0.39)**	**($0.84)**
14	**TOTAL ADMINISTRATION COST to the PROGRAM**		**$0.588**	**$0.605**	**$0.623**	**$0.642**	**$0.661**	**$0.681**	**$0.702**	**$0.723**	**$0.744**	**$0.767**	$3.12	$6.74
15														
16	**Subaward R&D Funding to Collaboration Partners**													
17	Subaward funding for large company manufacturing R&D projects		$1.500	$1.500	$1.500	$1.500	$1.500	$0.500	$0.500	$0.500	$0.500	$0.500	**$7.500**	**$10.000**
18	Subaward funding for small company manufacturing R&D projects		$1.000	$1.000	$1.000	$1.000	$0.500	$0.200	$0.200	$0.200	$0.200	$0.200	**$4.500**	**$5.500**
19	Subaward funding for technology R&D projects		$0.300	$0.300	$0.300	$0.300	$0.300	$0.150	$0.150	$0.150	$0.150	$0.150	**$1.500**	**$2.250**
20	Subaward funding for ciriculla development or training		$0.000	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	$0.050	$0.050	**$0.400**	**$0.800**
21	**TOTAL SUBAWARDS**		**$2.800**	**$2.900**	**$2.900**	**$2.900**	**$2.400**	**$0.950**	**$0.950**	**$0.950**	**$0.900**	**$0.900**	**$13.900**	**$18.550**
22														
23	**Cost Match from Subawards**													
24	Industry Partner Cost Match (% of line 17, large company)	20%	$0.375	$0.375	$0.375	$0.375	$0.375	$0.125	$0.125	$0.125	$0.125	$0.125	**$1.875**	**$2.500**
25	Industry Partner Cost Match (% of line 18, small company)	10%	$0.111	$0.111	$0.111	$0.111	$0.056	$0.022	$0.022	$0.022	$0.022	$0.022	**$0.500**	**$0.611**
26	Industry Partner Cost Match (% of line 19, technology R&D)	10%	$0.033	$0.033	$0.033	$0.033	$0.033	$0.017	$0.017	$0.017	$0.017	$0.017	**$0.167**	**$0.250**
27	University Partner Cost Match (% of lines 17 + 18 + 19)	10%	$0.311	$0.322	$0.322	$0.322	$0.267	$0.106	$0.106	$0.106	$0.100	$0.100	**$1.544**	**$2.061**
28	**TOTAL SUBAWARDEE COST MATCH**		**$0.831**	**$0.842**	**$0.842**	**$0.842**	**$0.731**	**$0.269**	**$0.269**	**$0.269**	**$0.264**	**$0.264**	**$4.086**	**$5.422**
29														
30	**Funding Sources**													
31	Estimated Grant Fund Percentage Repayed to Collaboration		0%	0%	0%	0%	5%	5%	10%	10%	10%	10%		
32	Estimated Grant Funds Repayed (line 31 x previous 5 yrs of lines 17, 18, 19)		$0.000	$0.000	$0.000	$0.000	$0.675	$0.578	$0.960	$0.765	$0.570	$0.425	**$0.675**	**$3.973**
33	Previous Year End Balance		$0.000	$0.493	$0.929	$1.348	$1.747	$3.192	$2.507	$2.185	$1.647	$0.937	**$4.518**	**$14.985**
34	DOE PV Manufacturing Initiative Funding		$3.000	$3.000	$3.000	$3.000	$3.000	$0.000	$0.000	$0.000	$0.000	$0.000	**$15.000**	**$15.000**
35	Outside Funding (State of Michigan or MEDC)		$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	**$0.000**	**$0.000**
36	Estimated Collaboration Member Dues		$0.050	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	$0.100	**$0.450**	**$0.950**
37	Total Subawardee Cost Match (line 28)		$0.831	$0.842	$0.842	$0.842	$0.731	$0.269	$0.269	$0.269	$0.264	$0.264	**$4.086**	**$5.422**
38	**TOTAL ANNUAL FUNDING SOURCES**		**$3.881**	**$4.435**	**$4.871**	**$5.289**	**$6.253**	**$4.139**	**$3.837**	**$3.320**	**$2.581**	**$1.726**	**$24.729**	**$40.330**
39														
40	**YEAR END BALANCE (line 38 - 14 - 21)**		**$0.493**	**$0.929**	**$1.348**	**$1.747**	**$3.192**	**$2.507**	**$2.185**	**$1.647**	**$0.937**	**$0.059**		
41														
42	**Total Subaward Project Funding**													
43	Collaboration Subawards plus Cost Match (lines 21 plus 28)		**$3.631**	**$3.742**	**$3.742**	**$3.742**	**$3.131**	**$1.219**	**$1.219**	**$1.219**	**$1.164**	**$1.164**	**$17.986**	**$23.972**
44														
45														

46	**Michigan PV Collaboration Administration (Year 1)**				% Effort		
47	Director		$100,000	per year	100%	$100,000	per year
48	Administrative Staff		$50,000	per year	100%	$50,000	per year
49	Fringe Benefits for above	41%	$61,500			$61,500	per year
50	Supplies					$20,000	per year
51	Travel					$10,000	per year
52	Other Expenses - Conferences & Communications					$20,000	per year
53	Chief Technical Officer (Subcontract to Fraunhofer-Gesellschaft)		$150,000	per year	100%	$150,000	per year
54	**Subtotal for Administration Direct Costs**					**$411,500**	
55	**Modified Direct Costs (using only $25,000 of Fraunhofer CTO)**					**$286,500**	
56	University Indirect Overhead	48%				$137,520	
57	**TOTAL**					**$424,020**	
58							

59 *** Note from Line 4: The number of future subawards is not known, therefore an indirect overhead estimate of 3% of line 21 total is used.**

APPENDIX 3: INTELLECTUAL PROPERTY (IP) AGREEMENTS

IP agreements will be issued and signed by selected universities performing research under the Collaborative. IP agreements will be drafted based on the IP management language as described in the Project Narrative.

APPENDIX 4: SITE, ACQUISITION, DESIGN AND DEVELOPMENT PLAN

Headquarters

The Collaboration will have its administrative headquarters at Oakland University, occupying existing space. Future recipients of funding through Collaborative solicitations will be required to have sufficient facilities available to faculty, students and staff for the research topics as they will be pursued. Should University of Michigan be selected through a Collaborative solicitation, for example, The Michigan Memorial Phoenix Energy Institute, which occupies 6,000 square feet of hood intensive research space with a focus on energy generation and storage in the Phoenix Memorial Laboratory. An additional 6000 sq. ft. of laboratory space, and a 10,000 sq. ft addition to create suitable collaboration and meeting spaces will come online during the later stages of this award. Such facilities would be considered suitable for Collaborative funded projects.

Appendix 5: Funding Plan

Funding Sources:

Federal DOE:	$3,000,000 per year for years 1 – 5
Partner Cost Match:	10% for small company, techn. R&D, and educational projects 20% for large company projects
Membership Fees:	The fee structure has yet to be determined
Subaward Repayments:	Estimated to start in program year five at an annual 5% repayment of the previous 5yr subaward total funds, escalating to 10% repayment annually (of previous rolling 5yr subaward totals funds) by program year seven.

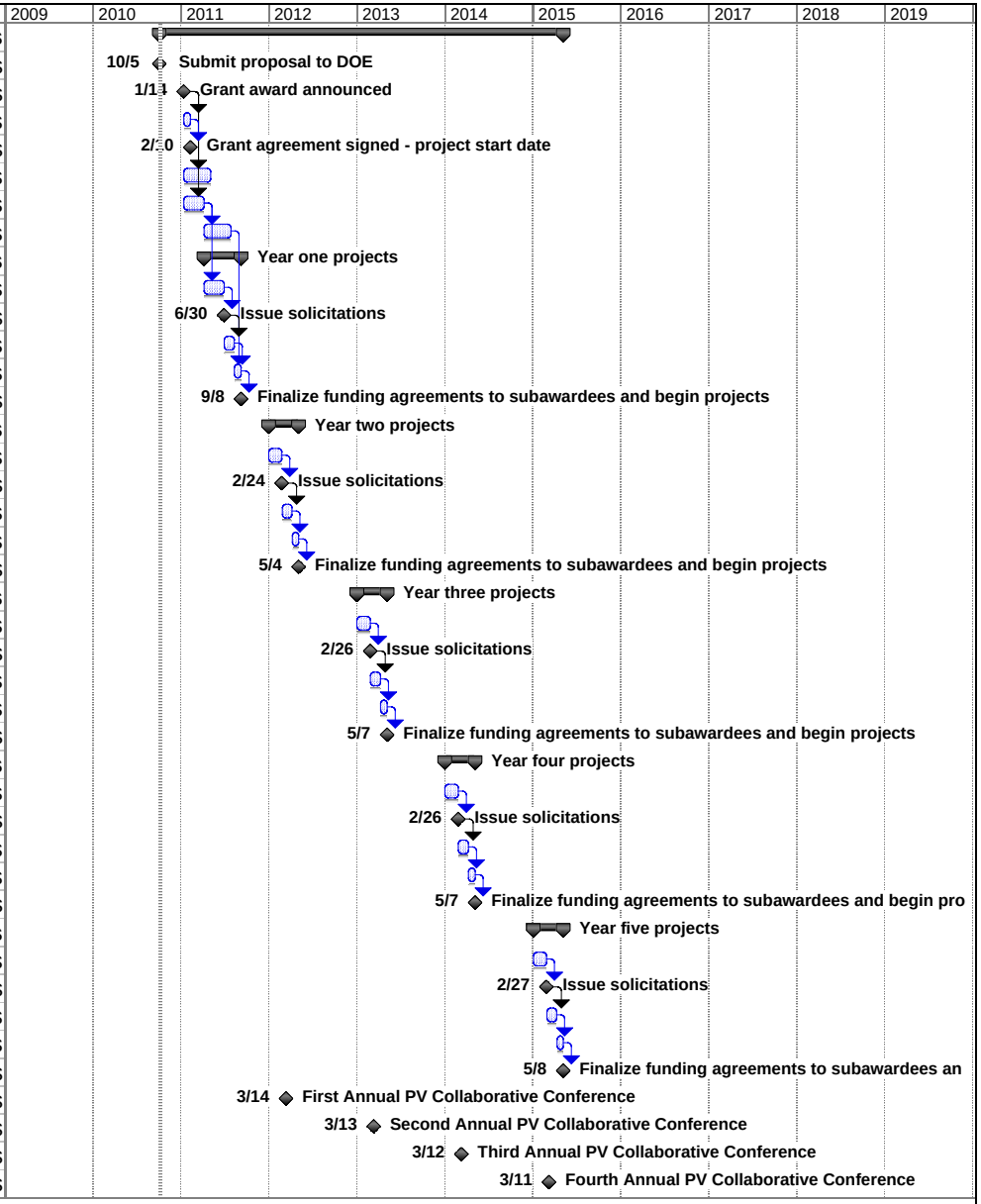
Estimated Funding Sources (in millions of dollars):

	5 Year Estimate	10 Year Estimate
Federal DOE:	$15M	$0
Partner Cost Match:	**$4.09**	**$5.42**
Membership Fees:	**$0.45**	**$0.95**
Subaward Repayments:	**$0.68**	**$3.97**
TOTALS	**$20.22**	**$10.34**

The ramification of these funding sources can be seen in the ten year business plan discussed in Appendix 2. Year five and beyond program years subaward levels can be adjusted as needed to account for the actual dollar amounts brought back to the Collaborative from the membership fees and subaward repayment process.

Other State of Michigan or grant programs will be investigated to supplement the program income as well. No other sources are available for a firm commitment at the present time, however several programs have been identified as likely matches to the mission of the Collaborative. These include the Michigan Economic Development Corporation's (MEDC) Center for Energy Excellence program. This program will match federal funds 50:50 for commercialization R&D projects exclusively in the clean energy sector. Also, the State of Michigan, Energy Systems Bureau has and Advanced Manufacturing Program which has been periodically issuing solicitations for manufacturing projects in the clean energy sector as well. Letters of support from both the MEDC and State of Michigan, Energy Systems Bureau are included in this proposal.

ID	Task Name	Duration
1	**GREAT LAKES PV MANUFACTURING COLLABORATIVE**	**1199 days**
2	Submit proposal to DOE	0 days
3	Grant award announced	0 days
4	Negotiate final terms and sign grant agreement	4 wks
5	Grant agreement signed - project start date	0 days
6	Create position for Grant Administrator - Fill Position	16 wks
7	Create initial Advisory Board	12 wks
8	Form the initial SubAward Selection Committee	16 wks
9	**Year one projects**	**110 days**
10	Create project solicitations	12 wks
11	Issue solicitations	0 days
12	Receive proposals	6 wks
13	Select and negotiate funding agreements	4 wks
14	Finalize funding agreements to subawardees and begin projec	0 days
15	**Year two projects**	**90 days**
16	Create project solicitations	8 wks
17	Issue solicitations	0 days
18	Receive proposals	6 wks
19	Select and negotiate funding agreements	4 wks
20	Finalize funding agreements to subawardees and begin projec	0 days
21	**Year three projects**	**90 days**
22	Create project solicitations	8 wks
23	Issue solicitations	0 days
24	Receive proposals	6 wks
25	Select and negotiate funding agreements	4 wks
26	Finalize funding agreements to subawardees and begin projec	0 days
27	**Year four projects**	**90 days**
28	Create project solicitations	8 wks
29	Issue solicitations	0 days
30	Receive proposals	6 wks
31	Select and negotiate funding agreements	4 wks
32	Finalize funding agreements to subawardees and begin projec	0 days
33	**Year five projects**	**90 days**
34	Create project solicitations	8 wks
35	Issue solicitations	0 days
36	Receive proposals	6 wks
37	Select and negotiate funding agreements	4 wks
38	Finalize funding agreements to subawardees and begin projec	0 days
39	First Annual PV Collaborative Conference	0 days
40	Second Annual PV Collaborative Conference	0 days
41	Third Annual PV Collaborative Conference	0 days
42	Fourth Annual PV Collaborative Conference	0 days



Project: Appendix6_Organizational_Tim
Date: Mon 10/4/10

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

Biographical Sketch Resume:

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Office: (248) 370.2217

Education and Training:
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BOOK

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Education and Training:
Purdue University, BSME – Mechanical Engineering
University of Michigan, MSME – Mechanical Engineering
Oakland University, PhD Candidate in Mechanical Engineering

Academic Experience:
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Oakland University
Research Topic: "DESIGN AND comparative analysis of a HYBRID, BUILDING INTEGRATED PHOTOVOLTAIC THERMAL SOLAR COLLECTOR"

Professional Experience:
Energy Manager **Oakland University** **Rochester, MI**
2001-Present
• Manage $7M utility budget & all energy procurement
• Energy reporting to management and departmental billing
• Identify and implement various energy conservation & HVAC projects
• Engineering support for facilities operations department
• Design & procurement of campus wide utility submetering
• Obtained funding & negotiated numerous projects, including: $11M energy services project, $600k utility submetering network, $1.3M bio-diesel generator plant, and 10kW PV roof project
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Education and Training:
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PhD in Electrical Engineering, Technical University, Munich, Germany

Professional experience:

2001-2009	Chief Technical Officer & Co-Founder, Visotek Inc., Livonia, MI
1998-Present	Executive Director, Fraunhofer Center for Laser Technology, Plymouth, MI
1994-1997	Director of R&D, Jenoptik Laserdiode (Jena, Germany)
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7. Heinemann, S.; Lewis, B.; Regaard, B.; Schmidt, T.; Semi-automated Production of single Emitter Based High Brightness Diode Laser, 22nd Annual Solid State and Diode Laser Technology Review (SSDLTR), June 29-July 2nd, 2009, Newton, Massachusetts
8. Pantsar, H; Laakso, P; Aikio, M; Huopana, J; Herfurth, H; Heinemann, S. Advanced beam steering in helical drilling. 28th International Congress on Applications of Lasers & Electro-Optics ICALEO 2009, November 2-5, 2009, Orlando, Fl, pp 23-29.
9. Pantsar, H; Lauterborn, T; Knorz, A; Herfurth, H; Heinemann, S. High Rate Fiber Laser Drilling and Texturing of Silicon for Solar Cells. 28th International Congress on Applications of Lasers & Electro-Optics ICALEO 2009, November 2-5, 2009, Orlando, Fl, pp. 1266-1275.
10. Pantsar, H; Herfurth, H; Heinemann, S; Laakso, P; Penttila, R; Liu, Y; Newaz, G. Laser microvia drilling and ablation of silicon using 355 nm pico and nanosecond pulses. 27th International Congress on Applications of Lasers and Electro-Optics, 20-23.10.2008, Temecula, CA. Proc. ICALEO M507 pp. 278-287.

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5. Jaus, J; Pantsar, H; Duell, M; Herfurth, H; Doble, D. Formation of a Conductive Grid on Thin Film Module Glass by Laser-Patterning for increased Module Efficiency. 35th IEEE Photovoltaic Specialists Conference, June 20-25, 2010, Hawai'i, USA.
6. Regaard, B.; Kaierle, S.; Heinemann S.; Welding Head for Self guided Laser Welding, 28th International Congress on Applications of Lasers & Electro-Optics ICALEO 2009, November 2-5, 2009, Orlando, Fl
7. Heinemann, S.; Lewis, B.; Regaard, B.; Schmidt, T.; Semi-automated Production of single Emitter Based High Brightness Diode Laser, 22nd Annual Solid State and Diode Laser Technology Review (SSDLTR), June 29-July 2nd, 2009, Newton, Massachusetts
8. Pantsar, H; Laakso, P; Aikio, M; Huopana, J; Herfurth, H; Heinemann, S. Advanced beam steering in helical drilling. 28th International Congress on Applications of Lasers & Electro-Optics ICALEO 2009, November 2-5, 2009, Orlando, Fl, pp 23-29.
9. Pantsar, H; Lauterborn, T; Knorz, A; Herfurth, H; Heinemann, S. High Rate Fiber Laser Drilling and Texturing of Silicon for Solar Cells. 28th International Congress on Applications of Lasers & Electro-Optics ICALEO 2009, November 2-5, 2009, Orlando, Fl, pp. 1266-1275.
10. Pantsar, H; Herfurth, H; Heinemann, S; Laakso, P; Penttila, R; Liu, Y; Newaz, G. Laser microvia drilling and ablation of silicon using 355 nm pico and nanosecond pulses. 27th International Congress on Applications of Lasers and Electro-Optics, 20-23.10.2008, Temecula, CA. Proc. ICALEO M507 pp. 278-287.

Oakland UNIVERSITY

Office of the Dean

School of Engineering and Computer Science
Rochester, Michigan 48309-4478
(248) 370-2217 Fax: (248) 370-4261
www2.oakland.edu/secs

October 4, 2010

Subject: Proposal for the US Department of Energy Photovoltaic (PV) Manufacturing Initiative
Funding Opportunity – DE-FOA-0000259
University-Focused PV Manufacturing Initiative
Great Lakes PV Manufacturing Collaborative
Tracking Number: 8073

To Whom It May Concern:

The Oakland University School of Engineering and Computer Science has recently established a Clean Energy Research Center (CERC). The focus on the CERC will be in the areas of biomass, CHP, and solar energy technologies. With the large number of startup PV technology companies, as well as a substantial investment by established PV companies in the State of Michigan, the CERC is working to expand our capacity for R&D in this area.

This letter is to confirm my commitment to this project for a period of not less than five (5) years. At a minimum, I commit staffing to serve as the Co-Director. The Co-Director will provide 20% of his time towards this project.

Sincerely,

Louay M. Chamra, Dean

Fraunhofer USA

To Whom It May Concern

Center for Laser Technology (CLT)
Fraunhofer USA, Inc.
46025 Port Street
Plymouth, Michigan 48170
Phone 734-738-0500
Fax 734-354-3335
Email: sheinemann@clt.fraunhofer.com

October 4th , 2010

RE: Proposal for the US Department of Energy Photovoltaic (PV) Manufacturing Initiative

Funding Opportunity: DE-FOA-0000259

Topic Area: University-Focused PV Manufacturing Initiative

Title: Great Lakes PV Manufacturing Collaborative

Tracking Number: 8073

To Whom it May Concern:

This letter serves as a statement of commitment by the undersigned reflecting individual level of time commitment to this project for a period not less than five years.

At a minimum the undersigned commit staffing to serve as the Collaborative's Chief Technical Officer. The Chief Technical Officer will provide 100% of his/her time toward this project.

Sincerely

Stefan Heinemann
Executive Director

Appendix 9: Current and Pending Support

The principal investigator on this project, Dr. Louay Chamra does not have any active or pending projects that are receiving federal support.

Jim Leidel is the principal investigator administering a DOE Geothermal Heat Pump Program grant for $2,738,100 under the solicitation DE-FOA-0000116.

This project is a demonstration, ground source heat pump project for a new facility. Jim Leidel is merely managing the grant activities and providing future reporting and monitoring of the system performance. 20% of his time is budgeted to this grant program.

Project Title:	RECOVERY ACT: HUMAN HEALTH SCIENCE BUILDING GEOTHERMAL HEAT PUMP SYSTEMS
Award Number:	DE-EE0002970

There are no other pending federal or non-federal supported projects for Jim Leidel or Dr. Stefan Heinemann, of Fraunhofer USA

APPENDIX 10: FACILITIES AND OTHER RESOURCES

The Collaborative's organizational resources exhibit various capabilities, and will be bolstered by subawardee resources to perform the effort proposed. Facilities and facility capacities, pertinent capabilities, relative proximity, and extent of availability to the Collaborative's project are described below. Other resources available to the Collaborative's project are also described below. Major items of equipment already available to this project, their location(s), and pertinent capabilities are also described below.

The extensive and diverse nature of these resources makes the cataloging of individual pieces of equipment impractical at the present time. If the Department of Energy would find value in an exhaustive list of equipment all of the many partner facilities, this could be accomplished if the Collaborative is funded.

Industry

We have assembled a consortium of industrial partners and will have access to their facilities under terms to be negotiated. Equipment industry includes Kuka Solar System, Applied Materials, Jenoptik, Aspect Manufacturing and Clairvoyant, who submitted a LOI. End users and many suppliers expressed strong interest and anticipate participation upon award of the Collaborative.

Fraunhofer

Fraunhofer is a worldwide operating non-profit organization providing applied research to private industry and the public sector. It bridges the gap between university and industry and has established itself as a premier organization for rapid technology transfer of innovative technologies developed at university laboratories. Fraunhofer offers state-of-the art facilities and highly trained engineers and scientists working closely with students and faculty as well as industrial customers. This enables work on the whole value chain of technology development from proof of concept through prototype to validation in production. Fraunhofer is organized in 21 knowledge-based alliances and the energy alliance with more than 1,500 engineers develops new technologies and validates production processes for renewable energy solutions. Solar technology with more than 700 engineers is a major research field within this alliance. Fraunhofer’s work in the field comprises all aspects of PV, ranging from efficiency records of different cell designs, module technologies, development and validation of production equipment, testing and certification as well as societal and legislative issues.

Fraunhofer USA is headquartered in Plymouth, Michigan and operates seven centers at different locations. The proposed effort builds on the expertise of Fraunhofer and specifically of the Center for Laser Technology (CLT), also located in Plymouth, Michigan, the Center for Sustainable Energy Systems (CSE), located in Cambridge, MA and the Center for Coating Technologies (CCL). CLT focuses on manufacturing technologies and components for cell manufacturing, CCL on thin film coatings, and CSE focuses on module manufacturing, reliability, testing and certification.

CLT’s facilities include clean room facilities, laboratories for optical component and system development, a precision CNC machine shop, and laser development laboratory. Full-scale

wafer manufacturing is accessible through its partnership with Wayne State University. The Smart Sensor and Integrated Microsystems Group (SSIM) operates a state-of the art clean room for manufacturing electrical and optical Si and SiC based devices up to 6" diameter. Nano imprinting down to 35nm structures, photolithography, wet and dry chemical etching, CVD, MOCVD, diffusion furnaces, RIE, metallization and a wide variety of characterization devices are available. CLT further has unique software infrastructure established that links optical and thermal modeling as well as mechanical design with CAD/CAM capabilities. Precision machining with tolerances <20mm and laser micromachining are established. CLT thus has all the infrastructure available that is required for cell manufacturing.

CLT also operates a fully equipped electronics laboratory allowing development of microcontroller based, SMD based and discrete electronics circuitry for development test set-ups as well as production equipment. Controls expertise includes Labview, industrial controllers and micro-controls. Fraunhofer thus has optical, mechanical, controls and prototype manufacturing under one roof, allowing the performance of complex development and automation projects.

CLT focuses on developing and validating new manufacturing processes enabling high yield and cost effective production of solar cells and batteries. In collaborative research projects production processes are developed based on new product designs and taken from proof of concept to validation in production. CLT combines its expertise in device design with electrical, optical and mechanical design and engineering to develop innovative manufacturing techniques. Process monitoring/control and device testing at different stages of the production line are a core expertise of CLT.

Recent projects of cell manufacturing include high productivity Emitter Wrap Through (EWT) processes tripling the productivity by optimizing the laser drilling process and the machine control, laser doping for shallow contacts minimizing impedance losses, surface texturing of cells and module cover glass for enhanced light absorption showing more than 1% efficiency improvements as well as basic research developing thin film polycrystalline cells with atmospheric deposition processes. Roll-to-roll processing and real time process monitoring complement research activities in the field.

CCL operates a variety of PVD and CVD reactors and develops new reactors for high throughput vacuum coating processes. A specific expertise of CCL are carbon coatings and clean, electrically doped diamond coatings. Microwave processing and micro-/nano structuring and manufacturing are applied to the coated structures.

CSE's Photovoltaic Module group works on collaborative research projects with PV module manufacturers, materials suppliers, components suppliers, equipment vendors, national laboratories and universities. The research team includes expertise in materials characterization, polymer processing, surface and interface science, module performance testing, failure analysis, module design and module manufacturing techniques. The PV Modules group's capabilities include full size PV module production, module performance measurement and characterization, and environmental reliability and accelerated aging testing. The PV Module group has module production and characterization facility located in Cambridge, MA and a reliability test facility co-located with new CFV Solar Test Laboratory for module certification in Albuquerque, NM. The PV Modules group is an interdisciplinary team of PV modules, materials and reliability experts that provide technical support to module manufacturers and their suppliers.

Fraunhofer CSE's PV module research is organized into four main areas. Research projects are often interdisciplinary, combining elements from more than one focus area reflecting the inherent interdependence of module technologies, designs, manufacturing processes, materials, components and field performance. The four focus areas are:

a) Module Reliability – developing industry accepted methodologies to reduce technical risk of introduction of new material and technologies while maintaining 25+ years lifetime.
b) Module Manufacturing – supporting advanced manufacturing concepts and developing new process metrology methodologies
c) Module Performance – advancing technologies and new materials that improve electrical, thermal, mechanical and optical performance of modules
d) Advanced Module Concepts – performing pre-competitive research into technologies that support the development of flexible, back contacted, BIPV, CPV, OPV and new module designs.

Fraunhofer CSE is organizing an industrial consortium for the Department of Energy's Photovoltaic Manufacturing Initiative (PVMI). The CSE proposal brings together a diverse team of manufacturers to form the Solar Module Technology Alliance (SMTA). As a key part of the SMTA, the Fraunhofer PV Module Laboratory will become the nation's premier institution for PM module manufacturing technology research. Our university lead consortium will seek the cooperation with SMTA creating an even broader network with many synergies. Extended research and development capabilities will be linked to and extended supplier and manufacturing network.

Oakland University Centers and Labs

The School of Engineering and Computer Science has centers for product development and manufacturing and laboratories for systems design, real time computer systems, robotics, controls research, artificial intelligence, tribology, fluid mechanics, and thermodynamics.

Centers

- Clean Energy Research Center
- Center for Robotics and Advanced Automation
- Fastening and Joining Research Institute (FAJRI)
- Product Development and Manufacturing Center (PDMC)

Laboratories in Computer Science and Engineering

- High Performance FPGA Systems Laboratory
- Embedded System Lab
- Virtual Reality Lab
- Microprocessor System Lab
- Software Design Lab
- Computing Lab
- High Speed Digital Communications, Multimedia, and Distance Learning Laboratory
- Real Time Computer System Lab
- Software Verification Lab (EDS Supported)

Laboratories in Electrical and Computer Engineering

- Applied EM and Wireless Laboratory
- Instrumentation and Measurements, Microwaves, Chamber and EMC
- Control Research Lab
- Robotics Systems Research Lab
- Computer Vision/Digital Signal Processing Research Lab

- Active Suspension System Lab (Supported by the Ross Family)
- Control Systems Lab & Micro Computer Based Control
- Automotive Mechatronic Systems Lab (Ford Motor Company Supported)
- Electronic Circuit Design & Advanced Electronics (120 SEB)
- Digital Systems Design
- Microelectronics Systems Design Lab
- Communications, Electric Machines, Power and Industrial Electronics
- Real Time Embedded DSP Systems Lab
- Virtual Vehicle Systems Simulation (VVSS) Lab (General Dynamics Supported)
- Electric Circuits Lab

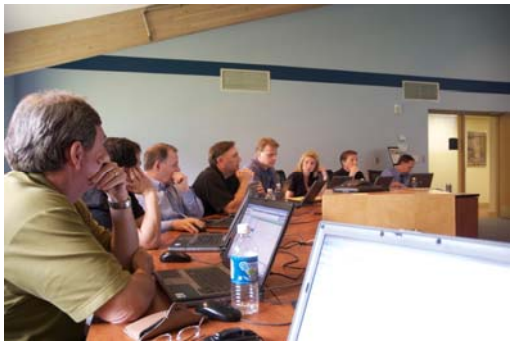
Laboratories in Industrial and Systems Engineering

- Stephan and Rita Sharf Computer Integrated Manufacturing Laboratory
- Computer Simulation Lab
- Ergonomics Lab
- Enterprise Computing Lab

Laboratories in Mechanical Engineering

- Statics and Dynamics Laboratory
- Thermodynamics Laboratory
- Fluid Mechanics Laboratory
- Mechanics of Materials Laboratory
- Material Properties Laboratory
- Mechanical Systems CAD/CAM Laboratory
- Manufacturing Processes Laboratory
- Tribology Laboratory
- Two-phase Flow Research Laboratory
- Thermal Science Research Laboratory
- Optical Measurement and Quality Inspection Laboratory
- Laser Interferometry Application Laboratory
- Holographic Applications Laboratory
- Optical Non-destructive Testing Laboratory
- 3-D Computer Vision Laboratory
- Computational Fluid Dynamics and Heat Transfer Research Lab

The Oakland University Collaboratory



The consortium will be virtually based at the Oakland University Collaboratory at the OU Business INCubator. This multimedia, virtual meeting space is an electronic decision support system environment that empowers group work teams to simultaneously brainstorm information and ideas in order to foster collaboration, categorization, prioritization and consensus building. Session participants will sit at computer stations set up in two large, half-circle conference tables or connect remotely via teleconference/webinar. A facilitator will guide the group through a list of activities, often including brainstorming and evaluation tools, which will allow participants to enter comments and votes directly into the system from their computer station. Collaboratory sessions are meant to encourage honesty and efficiency. All sessions have the option of running in “anonymous mode,” meaning all feedback that is entered into the session

(comments, votes, etc.) is completely anonymous, or “name tag mode,” where all comments are tagged with the commenter’s name. Oral discussion complements participation via computer station.

University of Michigan Expertise

The University of Michigan (UM) is home to the Center for Solar and Thermal Energy Conversion (CSTEC), an Energy Frontier Research Center (EFRC) supported by the US Department of Energy (DOE). The goal of CSTEC is to discover and develop the science necessary to maximize the energy conversion efficiencies of photovoltaic (PV) and thermoelectric (TE) devices through integrated theoretical, experimental, and computational strategies. The central energy challenges to utilizing renewable energy sources revolve around efficient energy conversion, storage, and efficient use. Improving the efficiencies of energy conversion devices will require important scientific breakthroughs that enable understanding the structure of materials at length scales smaller than nanometers and understanding and controlling processes that occur as fast of a few femtoseconds (~ time scales a trillion times shorter than the blink of an eye). To this end, the mission of the center is to investigate the science necessary to elucidate and to mitigate energy loss processes in low dimensional, and/or complex nanostructured, organic, inorganic, and hybrid materials for high efficiency photovoltaic (PV) and thermoelectric (TE) energy conversion. State-of-the art microscopes, x-ray diffraction, and neutron and light scattering techniques (including ultrafast), complemented by detailed computer simulations/theory, are exploited to understand molecular and electronic structure and dynamics over a wide range of spatial and temporal scales. CSTEC is led by Peter F. Green, The Vincent T. and Gloria M. Gorguze Professor of Engineering and Chair of Materials Science and Engineering, and two associate airectors, Rachel Goldman, Professor of Materials Science and Engineering, and Ctirad Uher, Professor of Physics. An additional 26 members of the faculties of the departments of Materials Science and Engineering, Chemistry, Physics, Chemical Engineering, Mechanical Engineering and Electrical Engineering, at the University of Michigan serve as Principal and Senior Investigators in CSTEC.

The Optoelectronic Component and Materials Laboratories (OCM Labs) is a collection of graduate students, post doctoral fellows, visiting scientists and research staff who are engaged in investigating an enormous variety of phenomena and devices related to electronic materials and optics. Some of the work involves the basic physics of new semiconductor and organic materials, some focuses on devices using these materials, and yet other work looks at the system impact of optical devices and structures. The unifying goal of OCM Labs' work is the realization of practical optoelectronic devices. OCM Labs continually seek the optimal combination of materials and devices to make functional elements, which perform advanced optoelectronic functions, which ultimately will find use in photonic systems. The group has maintained a staff of 15 or more graduate students, complimented by a number of professional researchers (post docs, visiting scientists, and research staff). The research emphasis can be divided into two general areas: III-V optoelectronic integrated devices, and organic thin film optical devices. There are also projects, which integrate the advantageous properties of both of these materials systems.

University of Michigan facilities exemplary of desired capabilities for project sites include:

Center for Ultrafast Optics (CUOS)

The Center for Ultrafast Optical Science (CUOS) is an interdisciplinary research center in the College of Engineering at the University of Michigan in Ann Arbor. CUOS was sponsored as a Science and Technology Center by the National Science Foundation during 1990-2001 and has remained sustainable to the present date. COUS' mission is to perform multidisciplinary

research in the basic science and technological applications of ultrashort laser pulses, to educate students from a wide variety of backgrounds in the field, and to spur the development of new technologies. CUOS researchers develop optical instrumentation and techniques to generate, manipulate, and detect ultrashort and ultrahigh-peak-power light pulses. They use these ultrashort pulses to study ultrafast physical phenomena in atomic, nuclear, plasma, and materials physics, in solid-state electronics, in high-energy-density physics, and in biomedicine.

Electron Microbeam Analysis Laboratory (EMAL)
The University of Michigan Electron Microbeam Analysis Laboratory (EMAL) and X-ray Microanalysis Laboratory (XMAL) is a university-wide user facility for the microstructural and microchemical characterization of materials. This world-class facility now showcases a JEOL 2100F CS-Corrected Analytical Electron Microscope.

Lurie Nanofabrication Facility (LNF)
The Lurie Nanofabrication Facility (LNF) at the University of Michigan is one of the leading centers worldwide on micro electromechanical systems (MEMS) and microsystems. It provides facilities and processes for the integration of Si integrated circuits and MEMS with nanotechnology, with applications in biology, medical systems, chemistry, and environmental monitoring.

Michigan Ion Beam Laboratory (MIBL)
The Michigan Ion Beam Laboratory (MIBL) for Surface Modification and Analysis is part of the Department of Nuclear Engineering and Radiological Sciences in the College of Engineering. The laboratory was created for the purpose of advancing our understanding of ion-solid interactions by providing unique and extensive facilities to support both research and development in the field. Researchers have available to them several instruments for conducting ion beam surface modification and ion beam surface analysis under a wide range of conditions. Experiments can be conducted at high or low temperature, in ultra-high vacuums, in a reactive gas and in short turnaround times.

Wayne State University
Under the direction of Professor James Woodyard, Wayne State University can offer the Collaborative a full array of state-of-the-art analytical techniques for characterizing materials, devices and thin films in the Chemistry Department and the College of Engineering as listed below:

- Apparatus and temperature controlled stages for the measurement of light and dark current-voltage characteristics of devices.
- Photothermal Deflection Spectrometer (PDS) for the measurement of optical absorption coefficients as low as unity in thin films.
- Constant Photocurrent Method (CPM) for the measurement of the optical and transport properties of devices and materials.
- Optical apparatus for the measurement of the wavelength dependence of the quantum efficiency, transmission and reflection of photovoltaic devices and materials. Spectral biasing may be used to measure the quantum efficiency of multi-junction devices.
- Optical/electrical/vacuum apparatus for the measurement of the temperature dependence of light and dark conductivities in air and vacuum. The apparatus is also used for annealing studies.
- Dual source solar simulator with associated instrumentation for measuring the current-voltage characteristics of photovoltaic devices.

- Spectral radiometer calibrated with standards traceable to the National Institute of Science and Technology.
- Photoluminescence and electroluminescence apparatus for measurements in the 10 to 373 Kelvin temperature range.
- Raman spectrometer for measurement of spectra of solid, liquid and gaseous samples following excitation with a five watt krypton or one watt argon laser.
- State-of-the-art numerical modeling for simulation of device properties.
- Thin-film thickness measurement apparatus
- Volume and surface resistivity measurement apparatus
- The following equipment is available in the laboratory for the implantation modification and deposition of thin films, devices, contacts and coatings:
    - A three-chamber plasma enhanced chemical vapor deposition system with five gas channels and state-of-the-art gas handling and scrubbing for device fabrication and thin-film studies,
    - Evaporator for the sputter and thermal deposition of materials for contacts, optical coatings, devices and thin films,
    - Load-locked ultrahigh system with a 0-2000 eV Kaufman ion source for the hydrogenation and modification of devices and thin-film materials, and
    - 200 keV/1.0 Ma ion/electron accelerator.

Western Michigan University - Center of the Advancement of Printed Electronics

Professor Margaret Joyce is the Director of CAPE, Center of the Advancement of Printed Electronics. WMU's CAPE consists of a multidisciplinary team of 13 faculty members in various engineering departments, chemistry and physics. Besides an established multidisciplinary team, the great strength of the CAPE is its capabilities for multilayer printing of electronic materials by gravure, flexography, inkjet, screen and offset printing. The lab presses are ideally suited to perform printed PV research because they require low ink volume to obtain a sufficient number of test prints. Equipment to fully characterize the ink properties, substrate properties and ink/substrate interactions is available. Measurements of the attributes of printed structures are routinely performed and their relationship to device performance determined. Software to model ink transfer on press is available. Pilot scale rotogravure and flexographic presses are also available for scale-up. The ink delivery systems of these presses have been modified to accommodate small quantities of electronic materials (300-1500 ml). CAPE with its AccuPress (by Daetwyler R&D) is the only facility in the US capable of gravure printing on rigid and flexible substrates within a registration tolerance of 5 microns. Dip coating, spin coating can also be performed and an evaporator for making organic solar cells is also available. The facility has extensive electronic testing equipment, which includes equipment to determine the performance parameters of PV devices using current-voltage (I-V) measurements. I-V measurements under dark to determine the PV's diode properties and series and shunt resistances can also be performed. Other instrumentation includes UV/vis spectrometers and a commercial solar simulator, furnaces, refrigerators and environmental chambers to allow the characterization of materials over a wide range of temperatures and RH.

APPENDIX 12: COMMITMENT LETTERS FROM THIRD-PARTIES

At the time of submission additional cost share sources have not required.

The cost share from future subawards has been outlined and shared with all collaborators during the solicitation of interest from all parties.

The letters included here denote supporters' understanding that the Collaborative will have a tiered member contribution as described in the business plan of the project narrative. These cost shares will be formally committed to during the subaward solicitation process.

Letters of support are included here from:

PV Manufacturer's or Supply Chain Partners

- Applied Materials
- Aspect Automation
- Clairvoyant Energy
- eVjump
- Jenoptik
- KUKA Systems Corporation North America
- LUMA Resources
- Solargystics LTD
- Solarflex
- Uni-Solar, United Solar Ovonic

Energy Service Companies (involved in PV installations)

- Blue Harbor Energy
- Energy Systems Group

Universities

- Michigan State University
- Saginaw Valley State University
- University of Michigan
- Wayne State University
- Western Michigan University

Governmental Agencies

- Michigan Economic Development Corporation
- State of Michigan – Department of Energy Labor and Economic Growth
    - (Bureau of Energy Systems)

APPLIED MATERIALS

3050 Bowers Avenue | P.O. Box 58039
Santa Clara, California 95054, U.S.A.
Telephone: 408 727 5555
www.appliedmaterials.com

September 29, 2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led
Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Applied Materials would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

Applied Materials is a leading tool supplier to the solar, display, and semiconductor industries. Applied Materials is a leading supplier of PECVD deposition tools for the thin-film solar and flat-panel display industries, and is a leading supplier of printer, wire saw, and passivation tools for the crystalline-silicon solar industry. Applied is interested in the type of research projects that could be funded in this consortium, such as: high-rate scalable deposition of microcrystalline-Si, new thin-film silicon architectures for improved stabilized efficiencies, laser micromachining and processing of crystalline-or thin-film silicon, advanced machining technologies for slicing silicon wafers, etc.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry. Our contributions are subject to the execution of a definitive Consortium Agreement between Applied Materials and the Great Lakes PV Manufacturing Initiative.

Sincerely,

James M. Gee
Chief Scientist, Solar

Aspect
AUTOMATION

677 Transfer Road | St. Paul, MN 55114 USA
651-643-3700 *direct* | 651-642-5665 *fax*
www.aspectautomation.com

Date: September 28, 2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Aspect Automation would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

Aspect Automation has been designing and building automated systems for 61 years. These systems are found in a variety of industries such as medical devices, pharma, filtration, electronics, etc. One of Aspect's core competencies is web handling applications as well as film coating. We believe that our experience in this type of technologies would be an asset to the thin film manufacturers.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Sincerely

Juan Cardenas
Director of Sales & Marketing

BLUE HARBOR ENERGY

Date: October 05, 2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led
Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Blue Harbor Energy, LLC would like to offer our support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

Blue Harbor Energy is a co- developer of renewable energy projects and developer of energy savings projects. We are affiliated with a renewable energy investment bank, Sigma Capital Group, and the creative financing of energy projects is our core business. Sigma Capital is one of a few investment banks specializing in the renewable energy sector and has reviewed over $25 Billion of cleantech plans.

We believe that the addition of medium to large scale PV installations to the Great Lakes PV Manufacturing Initiative will add an indispensable component to the program. Creative financing for real world installations can provide a test bed for the product coming out of the collaboration membership and manufacturing base. Pilot and full scale installations will be required to prove technologies, business models, and creative financial mechanisms.

The Blue Harbor /Sigma Capital team intends to attempt to use outside financing and resources to finalize these installations. Creative financing of these technologies and projects will yield a substantial multiplier effect with grant funding going into the program.

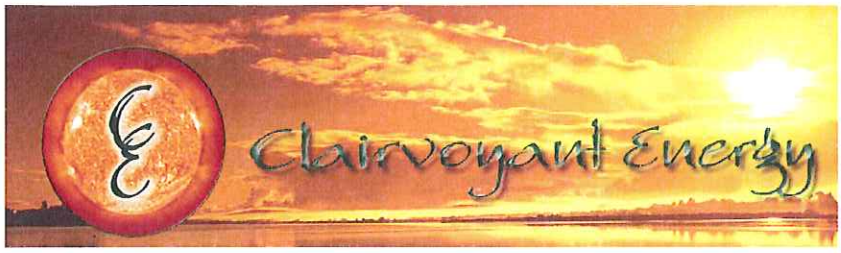
We realize the core focus of the funding for this collaboration will be to university conducted projects aimed at resolving manufacturing challenges. However, we believe that the amount of job creation potential involved with installations and systems integration will likely surpass the job creation in the manufacturing sector. Coupling both of these sides of the business together in one initiative along with workforce training will be of significant value to the US PV industry.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Sincerely,

Bruce Woodry

Bruce Woodry
Chairman and CEO



Date: September 27, 2010

To: U.S. Department of Energy

Golden Field Office

Subject: Letter of Support for the Oakland University Led

Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Clairvoyant Energy would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Best Regards,

John Abkemeier

John Abkemeier

Chief Development Officer

445 Vista de la Playa Santa Barbara, California Phone 805 886 5079 Fax 805 299 4575

ESG ENERGY SYSTEMS GROUP

7804 Francis Court
Suite 210
Lansing, MI 48917
Tel 517- 627- 9372
Fax 517- 627- 9374

Date: October 6, 2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Energy Systems Group would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

Energy Systems Group, as a for profit company, can bring forth innovative financing solutions with the use of tax credits and depreciation to help reduce the cost of implementation, and in some cases, as much as 50%.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Sincerely,

Jeffry Durham
Michigan District Manager
October 6, 2010

330 East Liberty, Lower Level
Ann Arbor, MI 48104 USA

Date: September 29, 2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led
Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

eVjump Solar Inc. would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this existing new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

eVjump Solar is in the development of an innovative CIGS solar cell technology on a polymer substrate. The development of a new way to produce extremely low cost solar cells will require process development to meet the initial targeted cost of 0.53 cents per watt peak. eVjump would solicit collaborative R&D efforts by consortium members in the following areas:

- Polymer substrate material additives for weight, strength and post formability
- Rapid Thermal Processing for formation of absorber layer within 2-3 seconds
- Micro inverter technology investigation to be embedded as part of the substrate
- Simple electrical interconnect scheme for a unique solar cell concept
- CIGS non-toxic buffer layer material R&D with potential for enhanced efficiency
- CIGS Superstrate cell development using all green materials
- Investigate CIGS tandem cell concept as part of the cell manufacturing process
- Encapsulation techniques for polymer substrate for 25-year life; film or spincoat
- Substrate surface texture development for increased photon absorption

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Arthur D. Harmala
CEO and Founder
eVjump Solar
Cell: +1 734-277-5075 aharmala@eVjump.com

JENOPTIK Lasers & Material Processing
JENOPTIK Laser Technologies USA Corp. · 8020 Kensington Court · 48116 Brighton, MI · USA

Date: September 29, 2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led
Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Jenoptik Laser Technology Corporation would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

We are pleased to help support the PV manufacturing initiative in the field of laser processing. Jenoptik is one of the world renowned laser machine builders for thin film solar applications; we have build 250 production laser machines in the last ten years with 15% placed in thin film production plants around the world. We have laser resources and capabilities to support materials as CIGS, CdTe, a-Si, c-Si; substrate materials as glass, stainless steel, plastic, ribbon; and the process steps as P1/ P2/ P3 scribing (laser and mechanical), Laser Edge Delete, laser glass cutting, laser hole drilling, laser annealing for crystal growth, and cells singulation. The other value we bring to the table is the knowledge of industry machine standards for thin film processes and the efficiency effects that are directly proportional to the laser process.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Jenoptik Laser Technology Corporation

Bernd Kretzschmar, President

9/29/2010
Date

Systems Corporation North America
6600 Center Drive
Sterling Heights, Michigan 48312
Tel: 586-795-2000 Fax: 586-649-4428
http://www.kukausa.com

Date: September 29, 2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led
Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

KUKA Systems Corporation, North America, would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

KUKA Systems Corporation provides manufacturing solutions to the solar module industry for thin film, crystalline and CPV. We see the future requirements for solar in finding new materials that are readily available that can improve panel efficiency. KUKA can provide expertise and direction for high volume automation required for these up and coming ideas.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Sincerely,
KUKA Systems Corporation, North America

Robert Giaier
Vice President

Detlev Ziesel
Group Manager

LUMA RESOURCES
ECOPOWER FOR THE NEXT GENERATION
888-SEE-LUMA (733-5862) www.LumaResources.com

Date: September 30, 2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led
Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Luma Resources would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

LUMA Resources is a start up company that has receiver a manufacturing grant from the State of Michigan for its award-winning design. The building integrated photovoltaic solar shingle is available to the public and is recognized by several certifications including UL 1703 and CEC. Luma Resources has a proven track record and would like to expand the current product line.

One exciting product development we are pursuing is to modify the LUMA Resources solar shingle (LRSS) by creating an air space for hot air convection. Attached is a system conceptual drawing of the application of this new product for the commercial HVAC market. Luma Resources is seeking support in the research and development needs to modify a proven photovoltaic system and create a robust hybrid solar thermal and electric system for generating clean renewable power in urban environments. This system would be perfect for standard building walls and also decorative screen walls.

Attached are:

- Conceptual drawing for the solar enhanced HVAC system on commercial buildings
- Data Sheet of the (LRSS)

The specific R & D needs for this project include:

1. Investigation of optimum PV materials for this application
2. Development of manufacturing capability for this new product
3. Analysis of manufacturing costs for this product
4. Market analysis for this commercial application worldwide

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Thank you,

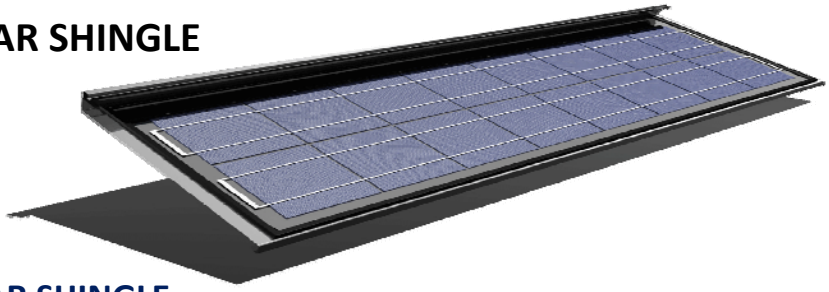
Gary Allen
LUMA Resources, LLC

LRSS

LUMA RESOURCES
ECOPOWER FOR THE NEXT GENERATION

HIGH EFFICIENCY POLYCRYSTALLINE BUILDING INTEGRATED PHOTOVOLTAIC SOLAR SHINGLE

UL LISTED
E327331



LUMA RESOURCES SOLAR SHINGLE

A solar kit for steep roofing applications of pitches 3:12 and steeper. The kit consists of LRSS units which, once installed, will compose the roof and works with most other roofing products. The area under the system allows for air flow and wire harnesses. Only one penetration is required for the wires to go through the roof deck.

LRSS: QUALIFICATIONS

- UL 1703 Listed
- CEC (In Process)
- Miami-Dade County NOA (in process)
- Size: L 54.37 x W 15.62 x H 2 inches
- Size: L 138.61 x W 39.68 x H 5.08 cm
- Weight: 26.5 Lbs 12.02 kg

SPECIFICATIONS

Electrical Performance under Standard Test Conditions (STC)

Maximum Power (Pmax)	60 W	Max System Voltage	DC 600 V
Maximum Power Voltage (Vmp)	8.08 V	Temperature Coefficient of Voc	-0.34% / °C
Maximum Power Current (Imp)	7.55 A	Temperature Coefficient of Isc	0.09% / °C
Open Circuit Voltage (Voc)	9.80 V	Power Temperature Coefficient	-0.37% / °C
Short Circuit Current (Isc)	8.11 A	Power Tolerance Range	+/ - 3%
Series Fuse (ADC)	15 amp		

Cells

Number per Module	16	Strings	2 of 8

Junction Box (Yukita UL E307322)

JYB15		MC Connectors	

METAL SHINGLE QUALIFICATIONS

Made from metal that maximizes energy efficiency and displays a beautiful color finish

Metal shingle that the solar laminate is mounted to: (MMS125)

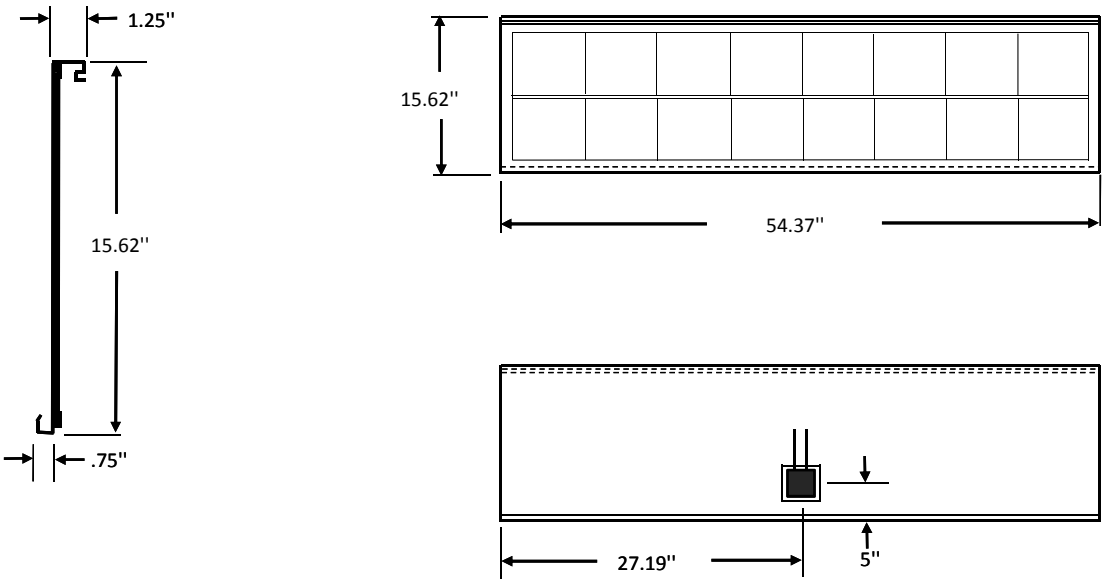
UL Listed Fire Test Class A (ANSI/UL 790) R25847

UL LISTED

- Metal: 24 ga Galvalume coated steel sheet
- Size: L 54.37 x W 15.62 x H 2 inches
- Size: L 138.61 x W 39.68 x H 5.08 cm
- Paint: Valspar Fluropon **SR**
- Weight: 7.5 Lbs 3.4 Kg

PHYSICAL SPECIFICATIONS

LRSS



LIMITED WARRANTY

- 5 Year Limited warranty on materials and workmanship
- 25 Year on Power Output at 80%

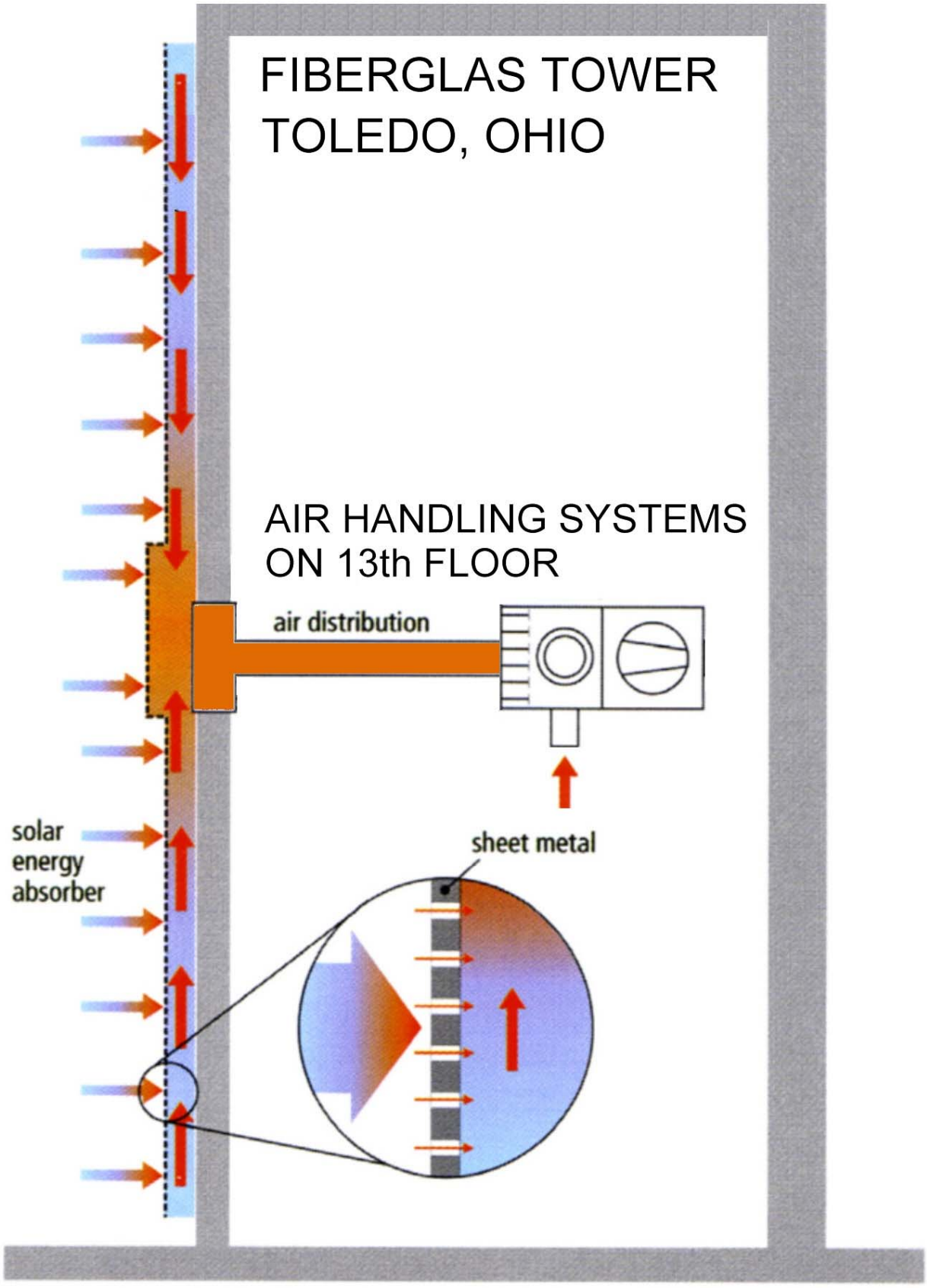
Manufacturer's power warranty:

- Coverage on power degredation greater than 10% for 10 years.
- Coverage on power degredation greater than 10% for 25 years.

The warranties do not cover damages due to:

- Malfunctions or service failures caused by obvious abuse or misuse.
- Power failure surges, lightning, fire, flooding, etc...
- Action of third parties and other events or accidents beyond reasonable control and not occuring under normal operating conditions.

LUMA Resources,LLC., 2691 Leach Rd.
Rochester Hills, MI. 48309, U.S.A.
Phone: +1 888 733 5862. Fax: +1 248 852 7122
www.lumaresources.com


FIBERGLAS TOWER
TOLEDO, OHIO
AIR HANDLING SYSTEMS
ON 13th FLOOR
air distribution
solar
energy
absorber
sheet metal

MICHIGAN STATE
UNIVERSITY

Date: 01 October 2010

To: U.S. Department of Energy
Golden Field Office

From: J. Ian Gray
Vice President for Research and Graduate Studies

Subject: Letter of Support for the Oakland University Led Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Michigan State University would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

Michigan State University has been investing in our capacity to conduct fundamental research in complex materials for energy storage and conversion. This is represented by a recent investment of six (6) faculty positions in this area within the College of Engineering and the College of Natural Science. In addition, the College of Natural Science is seeking a further four (4) new faculty members this year and the College of Engineering has plans to expand its capacity in this area within the next few years. Several of the faculty hires have direct bearing on photovoltaic materials; in particular Dr. Richard Lunt of the Department of Chemical Engineering and Material Science. His PhD research involved organic materials for photovoltaic conversion.

Michigan State University has also initiated, and centrally-funded, a Center of Research Excellence – CORE: Complex Materials – to coordinate scholarly activity in areas of energy materials including photovoltaic research. This center is led by Prof. Phil Duxbury of the Department of Physics and includes key faculty from across campus including Prof. James McCusker (Chemistry) and Prof. Larry Drzal (Chemical Engineering and Material Science). This latter group is engaged in a National Science Foundation project to improve dye-sensitized materials for photovoltaic energy conversion. Further details of regarding the activities of this center can be found at: http://www.pa.msu.edu/cmp/CORE-CM/CORE-CM.html.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

OFFICE OF THE
VICE PRESIDENT FOR RESEARCH AND GRADUATE STUDIES
J. Ian Gray
Vice President
Michigan State University
232 Administration Building
East Lansing, MI
48824-1046
517/355-0306
FAX: 517/432-1171
www.msu.edu/unit/vprgs

300 N. WASHINGTON SQ.
LANSING, MI 48913

517.373.9808

MICHIGANADVANTAGE.ORG

MICHIGAN
Economic Development
Corporation

October 4, 2010

The Honorable Steven Chu
Secretary
United States Department of Energy
Washington, DC 20585

Dear Secretary Chu:

The Michigan Economic Development Corporation is writing in support of Oakland University's application for funding under US DOE Photovoltaic (PV) Manufacturing Initiative, Funding Opportunity: DE-FOA-0000237 (0000259).

Oakland University is requesting DOE funding to help establish the **Great Lakes - University Photovoltaic Manufacturing Initiative** which will comprise a University-focused consortium for photovoltaic manufacturing technologies. They believe that this organization will accelerate the development and commercialization of PV technologies and products by speeding the commercialization of new manufacturing techniques. They intend to collaborate with industry partners to provide direction and create opportunities to conduct R&D to address the challenges associated with advanced and emerging PV manufacturing technologies.

We encourage you to review Oakland University's application and give it consideration as you work to distribute funds through this program.

Sincerely,

D. Gregory Main
President and Chief Executive Officer

cc: Oakland University

Ovshinsky Solar LLC
1050 East Square Lake Road
Bloomfield Hills, Michigan 48304
Tel: (248) 540-0245 Fax: (248) 540-1983

Date: September 29, 2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Ovshinsky Solar LLC would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exciting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

We expect that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and we look forward to taking part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

As we progress in our development of a unique method of coating thin-film layers of high quality amorphous silicon we expect to be able to greatly benefit from the application of university-level expertise to provide ancillary technology solutions involved in the incorporation of our materials into full photovoltaic device structures. This proposed collaborative resource could be of significant benefit to us.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Respectfully,

David Strand
COO
Ovshinsky Solar LLC

SAGINAW VALLEY STATE UNIVERSITY.

(989) 964-4000 • From Midland: 695-5325
7400 Bay Road • University Center, MI 48710 • USA
www.svsu.edu

Date: October 5, 2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led
Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Saginaw Valley State University would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

Saginaw Valley State University currently offers two accredited baccalaureate degrees: one in Mechanical Engineering and the other in Electrical & Computer Engineering. These departments, along with the university's departments of Chemistry and Physics, are currently focused on the development of undergraduate and graduate programs. The intent of such programs is to emphasize solar PV, as the university is located near three major producers of solar PV materials: Dow Chemical, Dow Corning, and Hemlock Semiconductor. In support of that effort, the department of Electrical & Computer Engineering recently hired a new professor that has industrial experience with solar PV

We welcome the opportunity to support the proposed PV Manufacturing Initiative, an initiative that is vital to the economic health of the region.

Chris Schilling ph. D.

Christopher Schilling, Ph.D.
C.J. Strosacker Professor and Chair of Engineering
telephone: (989) 964-2601
email: schillin@svsu.edu

SOLARGYSTICS LTD.

3545 Silica Road, Suite C
PO Box 452
Sylvania, OH 43560-9889
419.517.4094 (tel.)
419.517.0054 (fax)

Date: 1 October 2010

To: U.S. Department of Energy
Golden Field Office

Subject:: **Letter of Support for the Oakland University Led Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)**

Solargystics, Ltd, would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exciting new collaborative effort to support the accelerated development of the Great Lakes region PV industry by offering guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

Solargystics sees Oakland University's manufacturing initiative as complementary to the technology in development by our company that will result in not only low cost PV but rather "lowest cost" PV thus enabling a clean, low environmental impact power generation technology to economically complement traditional power generation technologies.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Sincerely,

President & CEO

solarflex

Letter of Support
for the Great Lakes / US DOE Photovoltaic (PV) Manufacturing Initiative

Date: 10/03/2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led
Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Solarflex, LLC would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

In order for the Solar technology to make substantial inroads commercially, without any Governmental subsidies, the cost and ease of installation should come down quite a lot and the payback period should be reduced from decades to two or three years. This makes a strong case for the third generation thin film PV technology (which Solarflex, LLC is heavily involved in) if the two major drawbacks of quantum efficiency and longevity are overcome. We have some exciting results that could take us quite a way towards this goal.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

10.3.10

Dr. Swaminathan Ramesh
President
Solarflex, LLC

37651 Schoolcraft Road, Livonia, MI 48150 (734) 953-5034 (w) 734 834-2994 (c)

JENNIFER M. GRANHOLM
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENERGY, LABOR & ECONOMIC GROWTH
LANSING

ANDREW S. LEVIN
ACTING DIRECTOR

October, 4, 2010

Dr. Leon B. Fabick, Project Officer
Department of Energy
Golden Field Office
1617 Cole Boulevard
Golden, Colorado 80401-3305

Subject: Letter of Support for the Oakland University Led Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

Dear Dr. Fabick:

The Department of Energy, Labor and Economic Growth, Bureau of Energy Systems, would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

Further, Michigan believes the proposal put forth by the Oakland University which focuses on the research and development of cost effective LED technologies aligns with Michigan's Clean Energy Advance Manufacturing (CEAM) Program. The CEAM Program provides financial support to small businesses in Michigan to retool and manufacture next generation renewable energy (RE) systems and RE components. The CEAM Program compliments the DOE's effort to accelerate the development and deployment of RE technologies such as PV into the marketplace which ties directly to Oakland's proposal.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Sincerely,

Amy A Butler

Amy A. Butler, Bureau Director
Bureau of Energy Systems
517-335-2823

cc: Mr. Andrew S. Levin, Director
Mr. Robert Jackson, DELEG

UNI-SOLAR.
United Solar Ovonic

United Solar Ovonic LLC
2956 Waterview Drive
Rochester Hills, MI 48309
Tele: 248/293-0440
Fax: 248/844-1214
Website: www.uni-solar.com

Date: October 3, 2010

To: U.S. Department of Energy
Golden Field Office

Subject: Letter of Support for the Oakland University Led Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

United Solar Ovonic (USO), a Michigan-based company which is the world's largest manufacturer of flexible solar laminates, would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

In order to achieve USO's goal to reach grid parity using solar electricity, there is a great deal of innovation that is needed in further development of thin film silicon technology and PV systems. We expect to collaborate with the academia under this program to meet this goal.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Best regards,

Subhendu Guha
Chairman

STEPHEN R. FORREST
VICE PRESIDENT FOR RESEARCH

UNIVERSITY OF MICHIGAN

4080 FLEMING ADMINISTRATION BUILDING
503 THOMPSON STREET
ANN ARBOR, MICHIGAN 48109-1340
734 764-1185 FAX: 734 763-0085
stevefor@umich.edu

October 1st, 2010

U.S. Department of Energy
Golden Field Office

To Whom It May Concern:

It is my pleasure to lend my strong support and institutional commitment to the proposed Great Lakes PV Manufacturing Initiative to be led by Oakland University, in partnership with the University of Michigan, Wayne State University, Fraunhofer USA, and other university and industry collaborators. The vision for the Great Lakes PV Manufacturing Initiative is to establish a robust framework to support and enhance the significant PV manufacturing and innovation already underway in the State of Michigan and elsewhere. Through this initiative, extensive university resources will be made more accessible to our PV industry partners in a more cohesive way, and our vast regional potential for interdisciplinary manufacturing innovation will be brought to bear on PV as it historically has in other sectors.

The development of alternative energy sources may be society's greatest challenge, and it is one that requires collaborative efforts between academia and industry to overcome. The University of Michigan and its partners have a strong tradition of excellence in clean energy research in general, and PV development specifically. The University of Michigan is home to a U.S. DOE Energy Frontier Research Center (EFRC) that explores new materials to better convert solar energy to electricity. We are also home to the Solid-State Electronics Laboratory (SSEL) at the University of Michigan, one of the largest and oldest academic research and educational laboratories in the country working on the development of electronic and micro machined devices, technologies and systems. Our Additive Manufacturing Process Laboratory (AMPL) at UM-Dearborn is actively assisting PV industry partners in solving manufacturing challenges, and our Michigan Memorial Phoenix Energy Institute (MMPEI) is coordinating significant additional PV research across multiple laboratories.

Connecting these existing efforts and assets with our academic and industry partners will create a unique team capable of addressing the most challenging PV manufacturing issues. On behalf of the University of Michigan, I offer our full institutional support to this initiative and its potential for job creation and the development of our rapidly growing PV industry.

Sincerely,

Stephen R. Forrest

WAYNE STATE UNIVERSITY

Date: September 30, 2010

To: U.S. Department of Energy

Golden Field Office

Subject: Letter of Support for the Oakland University Led Photovoltaic (PV) Manufacturing Initiative (DE-FOA-0000259)

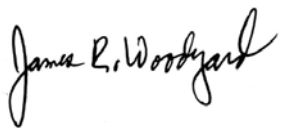
Wayne State University would like to offer its support to the Great Lakes PV Manufacturing Initiative and will be a member of this exciting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

Wayne State University has a long history of research in photovoltaics that has been supported by a number of companies and NASA over the past twenty years. Currently we are studying the problems associated with the manufacturing of CIGS solar cells on ultra-light plastic substrates. Preliminary work has been done in collaboration with eVjump Solar, Inc. We would welcome the opportunity to continue our collaboration with eVjump Solar as a partner in the Great Lakes PV Manufacturing Initiative Attached is a list of the equipment available through Wayne State University.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

We look forward to supporting this exciting new opportunity and the potential for job creation and the development of our quickly growing photovoltaic industry.

Sincerely,



James Woodyard,
Associate Professor of Electrical and Computer Engineering

Department of Electrical and Computer Engineering
5050 Anthony Wayne Dr., Suite 3100
Detroit, Michigan 48202
Telephone: 313-577-3920 ~ Fax: 313-577-1101
www.eng.wayne.edu

WESTERN MICHIGAN UNIVERSITY

Department of Paper Engineering, Chemical Engineering, and Imaging
College of Engineering and Applied Sciences

September 29, 2010

Dr. Leon B. Fabick
Project Officer
Department of Energy
Golden Field Office
1617 Cole Boulevard
Golden, Colorado 80401-3305

RE: Great Lakes / US DOE Photovoltaic (PV) Manufacturing Initiative

Dear Dr. Fabick:

I am currently the director of the Center for the Advancement of Printed Electronics, CAPE at Western Michigan University. CAPE consists of 13 researchers from the departments of Paper Engineering, Chemical Engineering and Imaging, Electrical and Computer Engineering, Manufacturing Engineering, Mechanical Engineering, Physics and Chemistry. For the last five years, the CAPE team has been performing research to address the many challenges of printing electronic materials. CAPE is the only facility in the US that can print both rigid and flexible substrates using multiple printing platforms. The center has laboratory inkjet, screen, rotogravure, offset and flexographic presses and two web-fed pilot presses. It is the only facility in the US with a four-unit rotogravure press and a three color flexographic press. The center also has extensive electronic testing equipment and expertise in device design. Current CAPE research involves various aspects of flexible electronic devices, including organic solar cells, thin film transistors and sensors. I believe CAPE research activities will benefit from this consortium, and as a result, I would like to offer the center's support to the Great Lakes PV Manufacturing Initiative and will be a member of this exiting new collaborative effort to support the accelerated development of the Great Lakes region PV industry. We will offer guidance and support to the collaboration.

It is expected that the collaboration will issue periodic solicitations for industry-relevant research and development projects related to PV manufacturing, education, and training, and our organization will take part in this process. We understand that a tiered cost share of dollars or in-kind services will be required and intellectual property and proprietary issues will be addressed by the collaboration.

Sincerely,

Dr. Margaret Joyce
Director of CAPE
www.margaret.joyce@wmich.edu

Parkview Campus, Kalamazoo, MI 49008-5462
PHONE: (269) 276-3500 FAX: (269) 276-3501
INTERNET: www.wmich.edu/pci

DEVICE MATERIALS LABORATORY

CHARACTERIZATION TECHNIQUES AND EQUIPMENT

Professor James R. Woodyard.

Department of Electrical and Computer Engineering

Wayne State University, Detroit, MI 48202

Telephone: Voice (313) 577-3758; FAX (313) 578-5831

E-mail woodyard@wayne.edu

Apparatus and temperature controlled stages for the measurement of light and dark current-voltage characteristics of devices.

Photothermal Deflection Spectrometer (PDS) for the measurement of optical absorption coefficients as low as unity in thin films.

Constant Photocurrent Method (CPM) for the measurement of the optical and transport properties of devices and materials.

Optical apparatus for the measurement of the wavelength dependence of the quantum efficiency, transmission and reflection of photovoltaic devices and materials. Spectral biasing may be used to measure the quantum efficiency of multi-junction devices.

Optical/electrical/vacuum apparatus for the measurement of the temperature dependence of light and dark conductivities in air and vacuum. The apparatus is also used for annealing studies.

Dual source solar simulator with associated instrumentation for measuring the current-voltage characteristics of photovoltaic devices.

Spectral radiometer calibrated with standards traceable to the National Institute of Science and Technology.

Photoluminescence and electroluminescence apparatus for measurements in the 10 to 373 Kelvin temperature range.

Raman spectrometer for measurement of spectra of solid, liquid and gaseous samples following excitation with a five watt krypton or one watt argon laser.

CHARACTERIZATION TECHNIQUES AND EQUIPMENT (cont.)

State-of-the-art numerical modeling for simulation of device properties.

Thin-film thickness measurement apparatus

Volume and surface resistivity measurement apparatus

The following equipment is available in the laboratory for the implantation modification and deposition of thin films, devices, contacts and coatings:

A three-chamber plasma enhanced chemical vapor deposition system with five gas channels and state-of-the-art gas handling and scrubbing for device fabrication and thin-film studies,

Evaporator for the sputter and thermal deposition of materials for contacts, optical coatings, devices and thin films,

Load-locked ultrahigh system with a 0-2000 eV Kaufman ion source for the hydrogenation and modification of devices and thin-film materials, and

200 keV/1.0 Ma ion/electron accelerator.

Wayne State University has a full array of state-of-the-art analytical techniques for characterizing materials, devices and thin films in the Chemistry Department and the College of Engineering.

Department of Electrical and Computer Engineering
5050 Anthony Wayne Dr., Suite 3100
Detroit, Michigan 48202
Telephone: 313-577-3920 ~ Fax: 313-577-1101
www.eng.wayne.edu

Budget Justification

(of Budget Information - Non Construction Program Form 424A)

			Year 1	Year 2	Year 3	Year 4	Year 5	TOTALS
1	**Administration and Expenses (with 3% annual escallation)**		**2011**	**2012**	**2013**	**2014**	**2015**	
2	PV Collaboration Administration Staff Total		$0.150	$0.155	$0.159	$0.164	$0.169	**$0.80**
3	PV Collaboration Administration Staff Fringe Total	41%	$0.062	$0.063	$0.065	$0.067	$0.069	**$0.33**
4	Supplies		$0.020	$0.021	$0.021	$0.022	$0.023	**$0.11**
5	Travel		$0.010	$0.010	$0.011	$0.011	$0.011	**$0.05**
6	Other Expenses - Conferences & Communications		$0.020	$0.021	$0.021	$0.022	$0.023	**$0.11**
7	Fraunhofer CTO Subcontract		$0.150	$0.155	$0.159	$0.164	$0.169	**$0.80**
8	**Subtotal for Administration Direct Costs**		**$0.412**	**$0.424**	**$0.437**	**$0.450**	**$0.463**	**$2.18**
9	Modified Direct Costs (using only $25,000 of Fraunhofer CTO Subcontract)		$0.287	$0.295	$0.304	$0.313	$0.322	**$1.52**
10	PV Collaboration Administration Indirect Overhead	48%	$0.138	$0.142	$0.146	$0.150	$0.155	**$0.73**
11	Estimted Indirect Overhead for Subawards (48% of first $25k per award)*	4.0%	$0.112	$0.115	$0.119	$0.122	$0.126	**$0.59**
12	**Subtotal for Administration and Expenses**		**$0.661**	**$0.681**	**$0.701**	**$0.722**	**$0.744**	**$3.51**
13	PV Collaboration Administration - OU Cost Match	10%	($0.073)	($0.076)	($0.078)	($0.080)	($0.083)	**($0.39)**
14	**TOTAL ADMINISTRATION COST to the PROGRAM**		**$0.588**	**$0.605**	**$0.623**	**$0.642**	**$0.661**	**$3.12**
15								
16	**Subaward R&D Funding to Collaboration Partners**							
17	Subaward funding for large company manufacturing R&D projects		$1.500	$1.500	$1.500	$1.500	$1.500	**$7.50**
18	Subaward funding for small company manufacturing R&D projects		$1.000	$1.000	$1.000	$1.000	$0.500	**$4.50**
19	Subaward funding for technology R&D projects		$0.300	$0.300	$0.300	$0.300	$0.300	**$1.50**
20	Subaward funding for ciriculla development or training		$0.000	$0.100	$0.100	$0.100	$0.100	**$0.40**
21	**TOTAL SUBAWARDS**		**$2.800**	**$2.900**	**$2.900**	**$2.900**	**$2.400**	**$13.90**
22								
23	**Cost Match from Subawards**							
24	Industry Partner Cost Match (% of line 17, large company)	20%	$0.375	$0.375	$0.375	$0.375	$0.375	**$1.88**
25	Industry Partner Cost Match (% of line 18, small company)	10%	$0.111	$0.111	$0.111	$0.111	$0.056	**$0.50**
26	Industry Partner Cost Match (% of line 19, technology R&D)	10%	$0.033	$0.033	$0.033	$0.033	$0.033	**$0.17**
27	University Partner Cost Match (% of lines 17 + 18 + 19)	10%	$0.311	$0.322	$0.322	$0.322	$0.267	**$1.54**
28	**TOTAL SUBAWARDEE COST MATCH**		**$0.831**	**$0.842**	**$0.842**	**$0.842**	**$0.731**	**$4.09**
29								
30	**Funding Sources**							
31	Estimated Grant Fund Percentage Repayed to Collaboration		0%	0%	0%	0%	5%	
32	Estimated Grant Funds Repayed (line 31 x previous 5 yrs of lines 17, 18, 19)		$0.000	$0.000	$0.000	$0.000	$0.675	**$0.68**
33	Previous Year End Balance		$0.000	$0.493	$0.929	$1.348	$1.747	**$4.52**
34	DOE PV Manufacturing Initiative Funding		$3.000	$3.000	$3.000	$3.000	$3.000	**$15.00**
35	Outside Funding (State of Michigan or MEDC)		$0.000	$0.000	$0.000	$0.000	$0.000	**$0.00**
36	Estimated Collaboration Member Dues		$0.050	$0.100	$0.100	$0.100	$0.100	**$0.45**
37	Total Subawardee Cost Match (line 28)		$0.831	$0.842	$0.842	$0.842	$0.731	**$4.09**
38	**TOTAL ANNUAL FUNDING SOURCES**		**$3.881**	**$4.435**	**$4.871**	**$5.289**	**$6.253**	**$24.73**
39								
40	**YEAR END BALANCE (line 38 - 14 - 21)**		**$0.493**	**$0.929**	**$1.348**	**$1.747**	**$3.192**	
41								
42	**Total Subaward Project Funding**							
43	Collaboration Subawards plus Cost Match (lines 21 plus 28)		**$3.631**	**$3.742**	**$3.742**	**$3.742**	**$3.131**	**$17.99**
44								
45								

46	**Michigan PV Collaboration Administration (Year 1)**				% Effort		
47	Director		$100,000	per year	100%	$100,000	per year
48	Administrative Staff		$50,000	per year	100%	$50,000	per year
49	Fringe Benefits for above	41%	$61,500			$61,500	per year
50	Supplies					$20,000	per year
51	Travel					$10,000	per year
52	Other Expenses - Conferences & Communications					$20,000	per year
53	Chief Technical Officer (Subcontract to Fraunhofer-Gesellschaft)		$150,000	per year	100%	$150,000	per year
54	**Subtotal for Administration Direct Costs**					**$411,500**	
55	**Modified Direct Costs (using only $25,000 of Fraunhofer CTO)**					**$286,500**	
56	University Indirect Overhead	48%				$137,520	
57	**TOTAL**					**$424,020**	
58							

59 *** Note from Line 4: The number of future subawards is not known, therefore an indirect overhead estimate of 3% of line 21 total is used.**

Excerpt From FORM 424A, Section B.6.

a. Personnel	$796,370
b. Fringe Benefits	$326,512
c. Travel	$53,091
d. Equipment	
e. Supplies	$106,183
f. Contractual	$12,676,863
g. Construction	
h. Other	$106,183
i. Total Direct Charges (sum of 6a-6h)	$14,065,202
j. Indirect Charges	$934,798
k. Totals (sum of 6i-6j)	$15,000,000

a. Personnel

The director position will begin at $100,000 per year at 40 hours a week x 52 weeks per year at a rate of $48.08. This is escalated at 3% per year for the five year budget period.

The grant administrator position will begin at $50,000 per year at 40 hours a week x 52 weeks per year at a rate of $24.04. This is escalated at 3% per year for the five year budget period.

The total personnel for the five year grant period sums to $796,370.

b. Fringe

A fringe benefit rate of 41% is applied to both positions for each of the five years.

The total personnel for the five year grant period sums to $326,512.

Please refer to the, federally approved, facilities and administrative rate sheet appended to this document.

averaged to get one fringe rate. NOTE: The fringe rate should be applied to both the Federal Share and Recipient Cost Share.

c. Travel

A year one travel budget of $10,000 is requested, and this is escalated at 3% per year for five years for a total request of $53,091.

This will cover travel for two Collaborative members to travel to DOE review meetings each year, in addition to a small amount of domestic travel to projects sites to overview subawards.

d. Equipment
No funds for equipment are requested.

e. Supplies
A year one supply budget of $20,000 is requested, and this is escalated at 3% per year for five years for a total request of $106,183.

These funds will include materials for printed materials, computing, and consumables for the Collaborative operations administrative staff.

f. Contractual
Contractual funding will include all of the R&D subawards as well as the Fraunhofer Chief Technology Officer subcontract. The subcontract will begin in year one at $150,000 per year to be escalated at 3% per year for five years.

The business model expects to issue the following total schedule of subawards.

	Year 1	Year 2	Year 3	Year 4	Year 5
Estimated Subaward Totals	**$2.800M**	**$2.9M**	**$2.9M**	**$2.9M**	**$2.4M**

The combined total contractual for the subawards plus Fraunhofer for is $12,676,863

g. Construction
No construction funds.

h. Other
An annual Collaborative conference will be held for all of the team members, DOE, and interested parties. A web site and newsletters will be produced by the Collaborative. Therefore, a budget of $20,000 per year has been included for these purposes. This is escalated also at 3% per year for five years for a total request of $106,183

i. Total Direct Charges
The combined total for the above is $14,065,202 in total direct charges.

j. Indirect Charges
A modified total direct charge sum for the five years if calculated using on the first $25,000 of the Fraunhofer subcontract and all of the salary and fringe. A 48% rate is applied to this sum and an additional 4% of the total five year subaward sum is also assessed as indirect to manage these contracts.

The total indirect charge is therefore $934,798 for the five year period.

Oakland University will cost match $389,938 over the five year period.

The total cost match estimate for the entire project over the first five years is calculated here.

Total Collaborative Cost Share Summary - Years 1 to 5 Only (in millions of dollars)

$4.086	Total Industry and University Partner Cost Match
$0.390	Total OU Cost Match
$4.476	Total OU + Partner Cost Match
$19.476	DOE Funding + Total Cost Match
23%	Total Cost Match to Satisfy Grant Requirements

DEPARTMENT OF HEALTH & HUMAN SERVICES

Program Support Center
Financial Management Service
Division of Cost Allocation
Central States Field Office

1301 Young Street, Room 732
Dallas, Texas 75202
(214)-767-3261
FAX: (214)-767-3264

February 19, 2010

Mr. James Hargett
Manager of Accounting
Oakland University
Office of Finance & Administration
520 O'Dowd Hall
Rochester, MI. 48309-4401

Dear Mr. Hargett:

The original and one copy of a facilities and administrative cost and fringe benefit rate agreement are being faxed to you for signature. This Agreement reflects an understanding reached between your organization and a member of my staff concerning the rate(s) that may be used to support your claim for facilities and administrative costs on grants and contracts with the Federal Government.

Please have the agreement signed by an authorized representative of your organization and fax it to me, retaining a copy for your files. Our fax number is (214) 767-3264. We will reproduce and distribute the Agreement to the appropriate awarding organizations of the Federal Government for their use.

The Fixed Fringe Benefit cost rate(s) for the fiscal year ending June 30, 2010 are based on actual costs for the fiscal year ended June 30, 2008. They included the following under-recovered (-) or over-recovered (+) costs:

Full-Time Employees	-	-0-
Part-Time/Temporary Employees	-	-0-

The fixed rate(s) for fiscal year ended June 30, 2008 is considered final.

The Fixed Fringe Benefit cost rate(s) for the fiscal year ending June 30, 2011 are based on actual costs for the fiscal year ended June 30, 2009. They included the following under-recovered (-) or over-recovered (+) costs:

Full-Time Employees	-	($474,134) - Under-recovered
Part-Time/Temporary Employees	-	($19,124) - Under-recovered

The fixed rate(s) for fiscal year ended June 30, 2009 is considered final.

A Fringe Benefit cost proposal, together with supporting information and the certified audit financial statement, is required each year. Thus, your next Fringe Benefit cost proposal based on actual costs for the fiscal year ending June 30, 2010 is due in our office by December 31, 2010. Your next facilities and administrative cost rate proposal based on actual costs for the fiscal year ending June 30, 2011 is due in our office by December 31, 2011.

Since this is an integral part of the Negotiation Agreement, please note your acceptance by signing in the space provided below.

Thank you for your cooperation.

Sincerely,

Henry Williams
Director
Division of Cost Allocation
Central States Field Office

Enclosures

ACCEPTANCE

Name John W. Beaghan
Vice President for
Finance and Administration
Title

February 25, 2010
Date

COLLEGES AND UNIVERSITIES RATE AGREEMENT

EIN #: 1381714400A1

DATE: February 19, 2010

INSTITUTION:
Oakland University
Office oF Finance & Administration
520 O'Dowd Hall
Rochester MI 48309-4401

FILING REF.: The preceding Agreement was dated November 18, 2008

The rates approved in this agreement are for use on grants, contracts and other agreements with the Federal Government, subject to the conditions in Section III.

SECTION I: FACILITIES AND ADMINISTRATIVE COST RATES*

RATE TYPES: FIXED FINAL PROV.(PROVISIONAL) PRED.(PREDETERMINED)

TYPE	EFFECTIVE PERIOD FROM	TO	RATE(%)	LOCATIONS	APPLICABLE TO
FINAL	07/01/05	06/30/08	44.5	On Campus	Organized Research
FINAL	07/01/05	06/30/08	44.5	On Campus	Instruction
FINAL	07/01/05	06/30/08	26.0	On Campus	Other Spon. Act.
FINAL	07/01/05	06/30/08	26.0	Off Campus	All Programs
PRED.	07/01/08	06/30/12	48.0	On Campus	Organized Research
PRED.	07/01/08	06/30/12	48.0	On Campus	Instruction
PRED.	07/01/08	06/30/12	31.0	On Campus	Other Spon. Act.
PRED.	07/01/08	06/30/12	26.0	Off Campus	All Programs
PROV.	07/01/12	UNTIL AMENDED	Use same rates and conditions as those cited for fiscal year ending June 30, 2012.		

*BASE:
Modified total direct costs, consisting of all salaries and wages, fringe benefits, materials, supplies, services, travel and subgrants and subcontracts up to the first $25,000 of each subgrant or subcontract (regardless of the period covered by the subgrant or subcontract). Modified total direct costs shall exclude equipment, capital expenditures, charges for patient care, tuition remission, rental costs of off-site facilities, scholarships, and fellowships as well as the portion of each subgrant and subcontract in excess of $25,000.

INSTITUTION:
Oakland University
Office oF Finance & Administration

AGREEMENT DATE: February 19, 2010

SECTION I: FRINGE BENEFITS RATES**

RATE TYPES: FIXED FINAL PROV.(PROVISIONAL) PRED.(PREDETERMINED)

TYPE	EFFECTIVE PERIOD FROM	TO	RATE(%)	LOCATIONS	APPLICABLE TO
FIXED	07/01/09	06/30/10	40.0	All	Full-Time Employees
FIXED	07/01/09	06/30/10	7.5	All	PT/Temp Employees
FIXED	07/01/10	06/30/11	41.3	All	Full-Time Employees
FIXED	07/01/10	06/30/11	7.8	All	PT/Temp Employees
PROV.	07/01/11	UNTIL AMENDED	Use same rates and conditions as those cited for fiscal year ending June 30, 2011.		

INSTITUTION:
Oakland University
Office oF Finance & Administration

AGREEMENT DATE: February 19, 2010

SECTION II: SPECIAL REMARKS

TREATMENT OF FRINGE BENEFITS:
The fringe benefits are charged using the rate(s) listed in the Fringe Benefits Section of this Agreement. The fringe benefits included in the rate(s) are listed below.

TREATMENT OF PAID ABSENCES:
Vacation, holiday, sick leave pay and other paid absences are included in salaries and wages and are claimed on grants, contracts and other agreements as part of the normal cost for salaries and wages. Separate claims for the costs of these paid absences are not made.

OFF-CAMPUS DEFINITION: For all activities performed in facilities not owned by the institution and to which rent is directly allocated to the project(s), the off-campus rate will apply. Grants or contracts will not be subject to more than one F&A cost rate. If more than 50% of a project is performed off-campus, the off-campus rate will apply to the entire project.

Equipment Definition -
Equipment means an article of nonexpendable, tangible personal property having a useful life of more than one year and an acquisition cost of $5,000 or more per unit.

FRINGE BENEFITS:

FICA
Retirement
Disability Insurance
Worker's Compensation
Life Insurance
Unemployment Insurance
Health Insurance
Dental Insurance
Optical
FSA-Employer Match
Longevity
Sick time Payout
Tuition Waivers

INSTITUTION:
Oakland University
Office oF Finance & Administration

AGREEMENT DATE: February 19, 2010

SECTION III: GENERAL

A. LIMITATIONS:
The rates in this Agreement are subject to any statutory or administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the organization were included in its facilities and administrative cost pools as finally accepted: such costs are legal obligations of the organization and are allowable under the governing cost principles; (2) The same costs that have been treated as facilities and administrative costs are not claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment; and (4) The information provided by the organization which was used to establish the rates is not later found to be materially incomplete or inaccurate by the Federal Government. In such situations the rate(s) would be subject to renegotiation at the discretion of the Federal Government.

B. ACCOUNTING CHANGES:
This Agreement is based on the accounting system purported by the organization to be in effect during the Agreement period. Changes to the method of accounting for costs which affect the amount of reimbursement resulting from the use of this Agreement require prior approval of the authorized representative of the cognizant agency. Such changes include, but are not limited to, changes in the charging of a particular type of cost from facilities and administrative to direct. Failure to obtain approval may result in cost disallowances.

C. FIXED RATES:
If a fixed rate is in this Agreement, it is based on an estimate of the costs for the period covered by the rate. When the actual costs for this period are determined, an adjustment will be made to a rate of a future year(s) to compensate for the difference between the costs used to establish the fixed rate and actual costs.

D. USE BY OTHER FEDERAL AGENCIES:
The rates in this Agreement were approved in accordance with the authority in Office of Management and Budget Circular A-21 Circular, and should be applied to grants, contracts and other agreements covered by this Circular, subject to any limitations in A above. The organization may provide copies of the Agreement to other Federal Agencies to give them early notification of the Agreement.

E. OTHER:
If any Federal contract, grant or other agreement is reimbursing facilities and administrative costs by a means other than the approved rate(s) in this Agreement, the organization should (1) credit such costs to the affected programs, and (2) apply the approved rate(s) to the appropriate base to identify the proper amount of facilities and administrative costs allocable to these programs.

BY THE INSTITUTION:

Oakland University
Office of Finance & Administration
(INSTITUTION)

(SIGNATURE)

John W. Beaghan
(NAME)

Vice President for
Finance and Administration
(TITLE)

February 25, 2010
(DATE)

ON BEHALF OF THE FEDERAL GOVERNMENT:

DEPARTMENT OF HEALTH AND HUMAN SERVICES
(AGENCY)

(SIGNATURE)

Henry Williams
(NAME)

DIRECTOR, DIVISION OF COST ALLOCATION-
(TITLE) CENTRAL STATES FIELD OFFICE

February 19, 2010
(DATE) 5061

HHS REPRESENTATIVE: Narendra B. Gandhi
Telephone: (214) 767-3230

Center for Laser Technology (CLT)
Fraunhofer USA, Inc.
Plymouth, Michigan 48170
46025 Port Street
Phone 734-738-0500
Fax 734-354-3335
Email: sheinemann@clt.fraunhofer.com

October 5th ,2010

Oakland University
Attn.: Jim Leidel

P R O P O S A L No. 1010 04 "Technical Director for PVMI"

Dear Jim:

We appreciate your interest in our services and are pleased to submit the following quotation to serve as the chief technical officer of your PVMI initiative.

Fraunhofer will provide the resources to serve as the Chief Technical Officer of the PVMI consortium.

Annual Cost: $150,000

We are looking forward to working with you.

Stefan Heinemann
Executive Director

Appendix D - Non-Disclosure Agreement (NDA)

To protect certain Protected Data and Proprietary Information, Oakland University and Fraunhofer, hereinafter referred to individually as “Member” or collectively as “Members” hereby agree:

1. Disclosing Member/Receiving Member: Proprietary Information and Protected Data may be mutually shared by the Members, which may include subcontractors to the Members and Limited Members.
2. “Employee” includes professors, principal investigators, visiting scholars, trainees, postdoctoral appointees, graduate students, undergraduate student assistants, support services contractors, and staff employees.
3. “Award” means each Member’s agreement with the U.S. Department of Energy for this PV Manufacturing Initiative award entitled **Great Lakes PV Manufacturing Initiative**
4. "Proprietary Information" means Limited Rights Data and Restricted Computer Software, which are defined in each Member’s award as follows: Limited Rights Data means data (other than computer software) developed at private expense that embody trade secrets or are commercial or financial and confidential or privileged. Restricted Computer Software means computer software developed at private expense and that is a trade secret; is commercial or financial and confidential or privileged; or is published copyrighted computer software; including modifications of such computer software.
5. “Protected Data” is defined in each Member’s award as technical data or commercial or financial data first produced in the performance of the award which, if it had been obtained from and first produced by a non-federal Member, would be a trade secret or commercial or financial information that is privileged or confidential under the meaning of 5 U.S.C. 552(b)(4) and which data is marked as being protected data by a Member to the award.
6. “Consortium” means a team composed of a prime awardee and one or more subawardees under this Award.
7. “Consortium Lead” means the prime awardee under this Award.
8. Protected Data and Proprietary Information disclosed hereunder may not be used by any Member other than the Disclosing Member for any purpose other than as stated herein.
9. Receiving Member shall protect only Disclosing Member's Protected Data and Proprietary Information, which is either:
    a. disclosed in writing or other tangible form and plainly marked as the Disclosing Member's Protected Data or Proprietary Information.
    b. disclosed in another manner and identified as business sensitive or proprietary at the time of disclosure, and summarized and designated business sensitive or proprietary in a written memorandum delivered to Receiving Member within thirty (30) days of the disclosure; in which case the information contained in the summary (not information contained solely in the non-tangible disclosure) shall be subject to the restrictions herein.
10. Receiving Member shall:
    a. protect the Disclosing Member's Protected Data and Proprietary Information by using the same degree of care, but no less than a reasonable degree of care, as Receiving Member uses to protect its own Protected Data and Proprietary Information of a like nature.
    b. not disclose the Disclosing Member's Protected Data or Proprietary Information to any

third Member without the written consent of the Disclosing Member.

c. restrict disclosure of the Disclosing Member's Protected Data and Proprietary Information to employees or contractors who have a need to know the same and who have been advised of Receiving Member's obligations under this Agreement.

d. not remove the restrictive markings from any of the Disclosing Member's Protected Data or Proprietary Information.

11. The Members acknowledge that U.S. Government employees have the right to inspect all written Protected Data and Proprietary Information provided to any Management & Operating Contractor for a National Laboratory or Federally Funded Research and Development Center upon reasonable notice and that such information shall be protected against further disclosure by U.S. Government employees under 18 USC 1905.

12. The obligations of nonuse and nondisclosure set forth in this Agreement shall not apply to any information which:

a. is or becomes part of the public domain otherwise than as a consequence of breach of obligations under this Agreement;

b. was already known to the Receiving Member prior to receipt from the Disclosing Member;

c. is lawfully disclosed by the Disclosing Member to a third-party without restriction;

d. is disclosed by a third-party to the Receiving Member without restriction and otherwise than as a consequence of breach of obligations of a nondisclosure Agreement; ~~or~~

e. is at any time developed by Receiving Member independently without the use of Disclosing Member Protected Data or Proprietary Information; or

f. which is disclosed in response to a judicial or administrative order or a freedom of information request or as otherwise required by law.

13. No license to a Member, under any patent, trademark, copyright, mask work or any other intellectual property right, is either granted or implied by the conveying of Protected Data or Proprietary Information to such Member. None of the Protected Data or Proprietary Information which may be disclosed or exchanged by the Members shall constitute any representation, warranty, assurance, guarantee or inducement by a Member to any other Member of any kind, and, in particular, with respect to the non-infringement of patents or any other intellectual property rights, or other rights of third persons or of the Members hereto.

14. Neither this Agreement nor the disclosure or receipt of Protected Data or Proprietary Information shall constitute or imply any promise or intention to make any purchase of products or services by any Member, or any commitment by any Member with respect to the present or future marketing of any product or service.

15. Upon termination or expiration of this Agreement as to any Member, such Member will, within a reasonable period of time thereafter and upon receipt of a written request to do so by the Disclosing Member, return to such Disclosing Member all Protected Data and Proprietary Information received from that Disclosing Member under this Agreement and copies made thereof, or certify by written memorandum that all such Protected Data and Proprietary Information has been destroyed; provided, however, that the terminating Member may retain an archival copy to be used only in case of a dispute concerning this Agreement.

16. The Receiving Members acknowledge that they will not export or disclose to any non-resident foreign person or entity, any technical data without first complying with U.S.

Government export control laws and regulations such as the International Traffic Arms Regulations and the Export Administration Regulations, including requirements for obtaining export licenses, regardless of whether the transfer occurs within the U.S. or abroad. Each Receiving Member further agrees that it will not export, directly or indirectly, any Protected Data or Proprietary Information it receives under this Agreement without the written consent of the Disclosing Member.

17. This Agreement shall be in full force and effect for as long as the Consortium exists. Each Member may terminate this Agreement by giving thirty (30) days' prior written notice to the other Members. However, the obligations undertaken by a Receiving Member with respect to specific items of Proprietary Information received hereunder shall survive until the passage of five (5) years after the date of disclosure regardless of the expiration of the Agreement or the exercise of the right to terminate upon thirty-days' written notice by a Member hereto.

18. The obligations undertaken by a Receiving Member with respect to specific items of Protected Data received hereunder shall survive until the passage of five (5) years after the date of disclosure, or the date upon which the data are no longer protected under the Award, whichever comes sooner, regardless of the expiration of the Agreement or the exercise of the right to terminate upon thirty-days' written notice by a Member hereto.

19. Addition of new Members: When a new Member is proposed to be added to the Consortium and this Agreement, the Consortium Lead shall transmit an abstract via fax or electronic mail regarding the new Member to all current Members to the Agreement for a comment and consent period not to exceed 30 days from the date the abstract is transmitted. The Consortium Lead shall collate and disseminate to all Members all comments regarding the addition. All Members shall make a good-faith effort to resolve any issues regarding the addition, and shall not unreasonably withhold their consent to the addition. The Consortium shall reach a decision regarding the addition based on the delineated procedure in its organizational charter. Upon acceptance of the addition, the Consortium Lead shall provide the Agreement for the new Member's signature. Members will not be required to re-circulate the Agreement for signing by all Members when a new Member is added. Upon addition of a new Member, the Consortium Lead shall send a courtesy copy to all Members of the Agreement reflecting the addition.

20. This Agreement will be binding on Members, and their professors, principal investigators, visiting scholars, trainees, postdoctoral appointees, graduate students, undergraduate student assistants, support services contractors, subcontractors, and staff employees.

21. All notices and/or correspondence hereunder, shall be mailed, faxed or hand-delivered and addressed to:

Kathryn Wrench
Director of Grants, Contracts, and
Sponsored Research
501 Wilson Hall
Oakland University
Rochester, Michigan 48309
(248) 370-3789
wrench@oakland.edu

Stefan Heinemann
Director, Center for Laser Technology
Fraunhofer USA
46025 Port Street
Plymouth, MI 48170
Ph: 734-738-0500
sheinemann@clt.fraunhofer.com

University of Michigan (obtaining contact)

22. This Agreement shall be construed in accordance with the laws of the United States of

America.

23. The Members acknowledge that, with respect to National Laboratory and Federally Funded Research and Development Centers Management & Operating Contractors, this Agreement and all information received hereunder by said Members, may be transferred to their respective successor contractors if the Management & Operating Contracts are terminated.

24. This Agreement contains the entire understanding of the Members regarding the treatment of Protected Data and Proprietary Information. Any previous agreements or understanding regarding the Protected Data and Proprietary Information, whether written or oral, are superseded. The waiver, amendment or modification of this Agreement will not be effective unless in writing signed by authorized representatives of all of the Members. Amendments and modifications as discussed in this Paragraph do not include the addition of new Members, which will be conducted pursuant to Paragraph 19.

25. Reproduction of this agreement, with all signatures affixed, shall be deemed a duplicate executed original of this agreement.

IN WITNESS WHEREOF, the authorized representatives of the Members have executed this Agreement as set forth below.

_____

Bradley Roth
Interim Vice Provost
501 Wilson Hall
Oakland University
Rochester, Michigan 48309
(248) 370-2552
roth@oakland.edu

_____

Stefan Heinemann
Director, Center for Laser Technology
Fraunhofer USA
46025 Port Street
Plymouth, MI 48170
Ph: 734-738-0500

Applicant Name: Oakland University Award Number:

Budget Information - Non Construction Programs

OMB Approval No. 0348-0044

Section A - Budget Summary

Grant Program Function or Activity	Catalog of Federal Domestic Assistance Number	Estimated Unobligated Funds		New or Revised Budget		
		Federal	Non-Federal	Federal	Non-Federal	Total
(a)	(b)	(c)	(d)	(e)	(f)	(g)
1. PV Manufacturing Initiative	81.087			$15,000,000		$15,000,000
2.						$0
3.						$0
4.						$0
5. Totals		$0	$0	$15,000,000	$0	$15,000,000

Section B - Budget Categories

6. Object Class Categories	Grant Program, Function or Activity				Total (5)
	(1)	(2)	(3)	(4)	
a. Personnel			$796,370		$796,370
b. Fringe Benefits			$326,512		$326,512
c. Travel			$53,091		$53,091
d. Equipment					$0
e. Supplies			$106,183		$106,183
f. Contractual			$12,676,863		$12,676,863
g. Construction					$0
h. Other			$106,183		$106,183
i. Total Direct Charges (sum of 6a-6h)	$0	$0	$14,065,202	$0	$14,065,202
j. Indirect Charges			$934,798	$389,938	$1,324,736
k. Totals (sum of 6i-6j)	$0	$0	$15,000,000	$389,938	$15,389,938
7. Program Income					$0

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Section C - Non-Federal Resources

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) Totals
8. PV Manufacturing Initiative				$0
9.				$0
10.				$0
11.				$0
12. Total (sum of lines 8 - 11)	$0	$0	$0	$0

Section D - Forecasted Cash Needs

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th quarter
13. Federal	$3,000,000	$750,000	$750,000	$750,000	$750,000
14. Non-Federal	$73,447	$18,362	$18,362	$18,362	$18,362
15. Total (sum of lines 13 and 14)	$3,073,447	$768,362	$768,362	$768,362	$768,362

Section E - Budget Estimates of Federal Funds Needed for Balance of the Project

(a) Grant Program	Future Funding Periods (Years)			
	(b) First	(c) Second	(d) Third	(e) Fourth
16. PV Manufacturing Initiative Federal	$3,000,000	$3,000,000	$3,000,000	$3,000,000
17. PV Manufacturing Initiative Non-Federal	$75,650	$77,920	$80,258	$82,665
18.				
19.				
20. Total (sum of lines 16-19)	$3,075,650	$3,077,920	$3,080,258	$3,082,665

Section F - Other Budget Information

21. Direct Charges
14,065,202

22. Indirect Charges
1,324,736

23. Remarks

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Instructions for the SF-424A

General Instructions
This form is designed so that application can be made for funds from one or more grant programs. In preparing the budget, adhere to any existing Federal grantor agency guidelines which prescribe how and whether budgeted amounts should be separately shown for different functions or activities within the program. For some programs, grantor agencies may require budgets to be separately shown by function or activity. For other programs, grantor agencies may require a breakdown by function or activity. Sections A, B, C, and D should include budget estimates for the whole project except when applying for assistance which requires Federal authorization in annual or other funding period increments. In the later case, Sections A, B, C, and D should provide the budget for the first budget period (usually a year) and Section E should present the need for Federal assistance in the subsequent budget periods. All applications should contain a breakdown by the object class categories shown in Lines a-k of Section B.

Section A. Budget Summary Lines 1-4 Columns (a) and (b)
For applications pertaining to a **single** Federal grant program (Federal Domestic Assistance Catalog number) and **not requiring** a functional or activity breakdown, enter on Line 1 under Column (a) the catalog program title and the catalog number in Column (b).

For applications pertaining to a **single** program **requiring** budget amounts by multiple functions or activities, enter the name of each activity or function on each line in Column (a), and enter the catalog number in Column (b). For applications pertaining to multiple programs where none of the programs require a breakdown by function or activity, enter the catalog program title on each line in **Column** (a) and the respective catalog number on each line in Column (b).
For applications pertaining to **multiple** programs where one or more programs **require** a breakdown by function or activity, prepare a separate sheet for each program requiring the breakdown. Additional sheets should be used when one form does not provide adequate space for all breakdown of data required. However, when more than one sheet is used, the first page should provide the summary totals by programs.

Lines 1-4, Columns (c) through (g)

For new applications, leave Columns (c) and (d) blank. For each line entry in Columns (a) and (b), enter in Columns (e), (f), and (g) the appropriate amounts of funds needed to support the project for the first funding period (usually a year).

For continuing grant program applications, submit these forms before the end of each funding period as required by the grantor agency. Enter in Columns (c) and (d) the estimated amounts of funds which will remain unobligated at the end of the grant funding period only if the Federal grantor agency instructions provide for this. Otherwise, leave these columns blank. Enter in columns (e) and (f) the amounts of funds needed for the upcoming period. The amount(s) in Column (g) should be the sum of amounts in Columns (e) and (f).

For supplemental grants and changes to existing grants, do not use Columns (c) and (d). Enter in Column (e) the amount of the increase or decrease of Federal funds and enter in Column (f) the amount of the increase or decrease of non-Federal funds. In Column (g) enter the new total budgeted amount (Federal and non-Federal) which includes the total previous authorized budgeted amounts plus or minus, as appropriate, the amounts shown in Columns (e) and (f). The amount(s) in Column (g) should not equal the sum of amounts in Columns (e) and (f).

Line 5—Show the totals for all columns used.

Section B. Budget Categories
In the column headings (a) through (4), enter the titles of the same programs, functions, and activities shown on Lines 1-4, Column (a), Section A. When additional sheets are prepared for Section A, provide similar column headings on each sheet. For each program, function or activity, fill in the total requirements for funds (both Federal and non-Federal) by object class categories.

Lines 6a-i—Show the totals of Lines 6a to 6h in each column.

Line 6j—Show the amount of indirect cost.

Line 6k—Enter the total of amounts on Lines 6i and 6j. For all applications for new grants and continuation grants the total amount in column (5), Line 6k, should be the same as the total amount shown in Section A, Column (g), Line 5. For supplemental grants and changes to grants, the total amount of the increase or decrease as shown in Columns (1)-(4), Line 6k should be the same as the sum of the amounts in Section A, Columns (e) and (f) on Line 5.
Line 7—Enter the estimated amount of income, if any, expected to be generated from this project. Do not add or subtract this amount from the total project amount. Show under the program narrative statement the nature and source of income. The estimated amount of program income may be considered by the federal grantor agency in determining the total amount of the grant.

Section C. Non-Federal Resources

Lines 8-11—Enter amounts of non-Federal resources that will be used on the grant. If in-kind contributions are included, provide a brief explanation on a separate sheet.

Column (a)—Enter the program titles identical to Column (a), Section A. A breakdown by function or activity is not necessary.

Column (b)—Enter the contribution to be made by the applicant.

Column (c)—Enter the amount of the State's cash and in-kind contribution if the applicant is not a State or State agency. Applicants which are a State or State agencies should leave this column blank.

Column (d)—Enter the amount of cash and in-kind contributions to be made from all other sources.

Column (e)—Enter totals of Columns (b), (c), and (d).

Line 12—Enter the total for each of Columns (b)-(e). The amount in Column (e) should be equal to the amount on Line 5, Column (f) Section A.

Section D. Forecasted Cash Needs

Line 13—Enter the amount of cash needed by quarter from the grantor agency during the first year.

Line 14—Enter the amount of cash from all other sources needed by quarter during the first year.

Line 15—Enter the totals of amounts on Lines 13 and 14.

Section E. Budget Estimates of Federal Funds Needed for Balance of the Project

Lines 16-19—Enter in Column (a) the same grant program titles shown in Column
(a), Section A. A breakdown by function or activity is not necessary. For new applications and continuation grant applications, enter in the proper columns amounts of Federal funds which will be needed to complete the program or project over the succeeding funding periods (usually in years). This section need not be completed for revisions (amendments, changes, or supplements) to funds for the current year of existing grants.
If more than four lines are needed to list the program titles, submit additional schedules as necessary.

Line 20—Enter the total for each of the Columns (b)-(e). When additional schedules are prepared for this Section, annotate accordingly and show the overall totals on this line.

Section F. Other Budget Information

Line 21—Use this space to explain amounts for individual direct object-class cost categories that may appear to be out of the ordinary or to explain the details as required by the Federal grantor agency.

Line 22—Enter the type of indirect rate (provisional, predetermined, final or fixed) that will be in effect during the funding period, the estimated amount of the base to which the rate is applied, and the total indirect expense.

Line 23—Provide any other explanations or comments deemed necessary.