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DOE request for information (RFI) DE-FOA-0000153 PV manufacturing initiative: Summary report

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DOE Request for Information (RFI) DE-FOA-0000153 PV Manufacturing Initiative

February 2010

Summary Report

DOE Request for Information (RFI)
DE-FOA-0000153
PV Manufacturing Initiative



Summary Report

DATE: February 2010
FROM: DOE Solar Energy Technologies Program
TO: Public Release and Distribution

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I. Summary

Last year, the U.S. Department of Energy (DOE) Solar Energy Technologies Program began exploring concepts for a “PV Manufacturing Initiative” to facilitate the development of a strong photovoltaic (PV) manufacturing industry in the United States. As an integral part this effort, and to inform the creation of a new funding opportunity in this area, DOE sought feedback from the PV industry.

This document summarizes the results of the PV Manufacturing Request for Information (RFI), DE-FOA-0000153. (See Attachment 1.) The RFI was posted on <http://www.grants.gov> on 4 September 2009 and the NREL Web site on 9 September 2009. Respondents were asked to submit RFI inputs to PVManufnit@go.doe.gov by 30 September 2009. A total of 58 responses were received. The 58 responses consisted of 30 Industry, 11 University, 11 Consortia, 2 National Lab, and 5 noncompliant inputs.¹ The responding organizations and their contact information are provided in Attachment 2.

This document summarizes the inputs as a set of common themes from the responses. The specific answers, recommendations, and suggested approaches from each respondent were also captured and individually summarized, but are not included in this document because they are identified with specific respondents.

II. RFI Response Themes:

Based on a review of the submitted responses there were several themes and observations that ran throughout. They are summarized as follows:

- 1) The existence of local markets is very important to the development of U.S.-based PV manufacturing. Preparing the domestic manufacturing base for increased productivity via the PV Manufacturing Initiative may have little impact without increased demand for PV systems in the United States. Several respondents recommended stimulating market demand through feed-in-tariffs, investment tax credits, and various taxes that inflate the relative cost of traditional energy sources as a complementary approach to the PV Manufacturing Initiative.
- 2) The respondents were broadly supportive of the establishment of this program as a way to increase U.S.-based PV manufacturing.
- 3) In general, industry responses advocated Industry-led consortia, universities advocated University-led consortia, and equipment manufacturers were proponents of Manufacturing Development Facilities (MDFs). Similarly, thin-film manufacturers recommended a focus on thin-film technologies because they have the highest future potential and the United States has a lead in thin-films, whereas silicon manufacturers preferred a focus on their technologies due to the dominant position of crystalline silicon (c-Si) in the industry.
- 4) Several respondents requested a clearer statement of the goals and objectives of the initiative, especially for the Industry-led consortia. Such a statement might include a description of the technologies, barriers, and/or stages of commercialization the initiative is intended to address.
- 5) There was approximately equal support for Industry-led consortia and MDFs as good models, with a few responses advocating a combined or hybrid industry consortia / MDF

¹ Non-compliant responses did not address the questions posed in the RFI, nor any of the concepts or merits of the PV Manufacturing Initiative more generally. They typically contained only background or promotional information on the responding company.

model, stating that manufacturing process and equipment development was integral to success for both models.

- 6) Some industry respondents expressed concern that University-led consortia might not be responsive to industry and manufacturers' needs, or timely in their response. Several respondents referred to the disparity between the goals and time constraints of universities and of industry, and to the need to proactively address the issue. The proposed approaches were for Industry-led consortia to include universities, or if University-led consortia are chosen, to require strong industry advisers, participation, and oversight.
- 7) The role of universities in producing a well-trained, domestic PV workforce was emphasized.
- 8) Different PV technologies, and technologies at different stages of development, may be best suited to different consortia models.
- 9) In general, intellectual property (IP) issues were perceived as the most difficult barrier to overcome. Industry / for-profit entities were perceived as being at a disadvantage in this respect due to self-interest overwhelming the process. Universities and MDFs were thought to be less competitive entities for IP rights and better positioned to address the IP issue. Suggested methods to approach the IP issue included funding only pre-competitive research or focusing on module issues common throughout the industry.
- 10) The approach to IP within a consortium or facility should be clearly resolved and documented in the proposal, at the outset. Alternate approaches should be allowed, such as a "pool and draft" model, terms that allow for exclusivity under certain conditions, etc.
- 11) Handling of IP ownership among different companies may be simpler when they hold non-overlapping positions in the value chain.
- 12) Sharing of IP may lead to a watering down of results, in that companies with the most innovative approaches may not participate. The result would be projects funded for the least interesting technologies.
- 13) Small companies, in particular, are reliant upon retaining the rights to their IP and may be reluctant to join Industry-led consortia requiring IP sharing. Collaborations with universities may be more appealing to start-up companies.
- 14) In any model, member access to industrial scale equipment and expertise is vital, with pilot lines being important to proving commercial and manufacturing viability. Metrology, testing, and benchmarking capabilities were also noted as important. Funds may need to be allocated for investment in capital equipment.
- 15) Some respondents suggested that any RFP should include guidelines on how to specify project goals, milestones, and management methods within the consortium or facility. These management specifications might include the role of the consortium leader, timelines for pilot-scale and/or volume manufacturing of new technologies, and technology transfer plans for university participants.
- 16) Multiple respondents indicated that PV standards development may occur naturally within the consortium framework, without suggesting that such development be a requirement for a successful consortium. There was a favorable stance on the importance of standards development at this point in the industry's maturity, though opinion was not uniform.

- 17) Overall the respondents favored fewer awards with higher funding so the awardees can reach critical mass for impacting the industry, though some advocated a balance between larger and smaller awards. Additionally, the point was made several times that PV manufacturing is capital intensive and so the proposed funding may not be adequate. The funding falloff over three years for MDFs may be too fast considering the time and capital expenditures required to become self-sustaining.
- 18) Respondents mostly favored having no restriction on the number of consortium participants, preferring to let the needs and goals of the proposed consortium dictate appropriate size.
- 19) Two respondents indicated the Technology Pathway Partnership (TPP) program was an example of a successful Industry-led consortia program. SEMATECH was also suggested as an Industry-led consortium model. A few mentioned the NREL Thin-Film Partnership program as a model of success. Several specific centers for collaboration, IP sharing, and tech transfer between universities and companies were also named as successful models.
- 20) Several respondents recommended the PV industry supply chain to be modeled like that of the semiconductor industry.
- 21) Universities tended to report that a 20% cost share was prohibitive and/or difficult to meet. Some stated that in-kind contributions of equipment or equipment time from industry partners needed to count toward the cost-share. Additionally, a few respondents suggested that the 50% cost-share percentage should be lower for small companies.

Attachment 1. PV Manufacturing Initiative RFI



DOE Request for Information (RFI)

DE-FOA-0000153

PV Manufacturing Initiative

Program Manager/Area

JoAnn Milliken, Acting Program Manager, Solar Energy Technologies Program, Office of Energy Efficiency and Renewable Energy.

Background and Rationale

The mission of the Department of Energy's (DOE) Solar Energy Technologies Program (SETP) is to accelerate the wide-spread adoption of solar electric technologies across the United States through a program of applied research and development, demonstration, and market transformation activities. This mission aims to diversify the Nation's electricity supply options, increase national security, and improve the environment. The SETP mission is consistent with the Energy Policy Act of 2005 and DOE's Strategic Plan.

During the past decade, worldwide demand for and production of photovoltaic (PV) energy systems has been growing at a compound annual growth rate of more than 30%. This growth has taken place in response to government support programs in Germany, Spain, and other countries outside the United States. Demand for PV products has the potential to also grow in the United States due to new and emerging Federal and State support programs and favorable solar conditions, as well as declining system costs. The United States, however, is not currently a major manufacturer of PV products, and therefore, not well-positioned to take advantage of this opportunity's potential to create a strong domestic industry.

The "PV Manufacturing Initiative" is intended to coordinate stakeholders and technology development efforts across the solar community to facilitate the development of a strong PV manufacturing industry in the United States. The primary goals of this initiative include supporting the creation of a robust United States-based PV manufacturing technology including infrastructure and supply chain base, developing a highly trained workforce with the critical skills required to meet the needs of a rapidly growing industry, and speeding the implementation of new cutting edge technologies.

Three separate models are currently under consideration: (1) university-led consortia guided by industry that would conduct industry-relevant manufacturing research projects; (2) collaborative industry-led consortia that will develop and implement manufacturing research projects with shared intellectual property (IP); and (3) manufacturing development efforts, possibly implemented through common facilities, for equipment and process development with individual companies maintaining exclusive ownership of IP.

Proposed Strategy

This funding opportunity announcement (FOA) will enable DOE to launch a major PV Manufacturing Initiative that will accelerate development and provide a strong base for a domestic United States PV industry. DOE anticipates that up to \$30M will be available to fund the PV Manufacturing Initiative in the first year. Of that, DOE anticipates that approximately \$5M will be devoted to a single or multiple awards for University-Led Consortia. The remaining \$25M may be used to fund single or multiple awards for Collaborative Industry-led Consortia and/or Manufacturing Development Facilities.

All proposals to implement Initiative models will be evaluated according to a competitive award process. In all cases, successful proposals will be expected to maximize the number of alternative funding sources, provide geographic diversity, incorporate a broad base of the PV industry, and have a detailed plan for the management of intellectual property, consortium membership (if a consortia is proposed), and other governance issues. All PV technologies (i.e., wafer, thin film, and concentrator) and combinations of technologies may be considered. The industry-led models (the collaborative industry consortia and manufacturing development facilities) are intended to allow the integration of universities and workforce development; likewise, the university led model should have strong ties to industry. All model approaches are also intended to allow for the technical participation of national laboratories, as defined in Section 2 of the Energy Policy Act of 2005. Regarding financial participation, each model encourages inclusion of state economic development or other funding organizations.

Entities who apply for multiple awards should be able to demonstrate that they can complete all the work proposed.

Below are characteristics of the three models being considered to implement the goals of the Initiative.

University-Led Consortia:

DOE would maintain a constant level of funding over the first 5 years for each University-Led Consortium, with the option to extend for 5 years either through an extension of the existing award, or as a subsequent competitive opportunity. Additional sources of funding would be expected by industry participants and universities. The consortia would select projects proposed by the universities in consultation with industry.

The specific problems to be addressed will be identified through rigorous planning and implementation of industry-relevant collaborative research plans. Based on the development opportunities identified, the consortia will fund development projects with the expectation of delivering new offerings to market within 2-5 years. Participation in standards or roadmap planning activities could be considered part of the scope of these consortia.

Successful consortia will provide interested graduate-level and post-doctoral students with opportunities for direct experience in research and development (R&D) projects and hands-on training in industrially viable manufacturing processes. The consortia would also address how its relationship with the PV industry is expected to produce graduates from the university that have a thorough understanding of PVs from materials to systems, excellent proficiency in device, module and system aspects of PVs, and the technical communication skills that are highly valued by the industry.

Collaborative Industry-Led Consortia

DOE support for each Collaborative Industry-Led Consortium would fund initial projects in combination with other funding sources, with the DOE share of support gradually decreasing over 5 years and industry and other parties assuming a greater share over that time span. Additionally, it is expected that all industry participants could equitably share in the intellectual property developed through each consortium.

The specific problems to be addressed will be identified through rigorous planning and implementation of industry relevant collaborative research plans. Based on the development opportunities identified, the consortia will fund development projects with the expectation of delivering new offerings to market within 2-5 years. Because of the anticipated membership of diverse companies across the PV industry, it may be desirable for these consortia to serve as a major resource and leading contributor to industry-wide standards and roadmap development.

Manufacturing Development Facilities:

DOE funding for Manufacturing Development Facilities would provide initial awards to set up the facilities, with additional funding for these facilities also expected to come through the organizing entity, user fees, equipment providers, and other participants. DOE funding would be gradually reduced over 1-3 years with other participants assuming a greater share. Manufacturing Development Facility awards could be executed with an organization with ties to the PV industry, industry-led consortium, or as a separate entity. Either new or retooled manufacturing development facilities could be established. These facilities will assist potentially a wide-range of PV companies in making the transition to commercial production. In contrast to the Collaborative Industry-Led Consortia, intellectual property developed through these facilities will be owned by user companies.

Manufacturing Development Facilities could be implemented with some or all of the following characteristics: provide tools with common uses to innovate around and test processing parameters; facilitate matchmaking between process innovators and the development facilities of equipment manufacturers; enable users to access process development and characterization capabilities to aid benchmarking and troubleshooting manufacturing processes; and give users access to technical expertise and manufacturing equipment to speed development to full commercial manufacturing capability.

Participation in standards or roadmap planning activities could be considered part of the scope of work for the Manufacturing Development Facility awardees.

Award and Financial Information

Total Estimated Cost of the Project: \$125,000,000 - \$200,000,000 (DOE and Cost share) depending on mix of models selected.

Total DOE Funding Anticipated: \$100,000,000

Initial Funding: \$30,000,000

Anticipated level of required cost share:

University Led Collaborative Consortia, 20%

Collaborative Industry Led Consortia, 50%

Manufacturing Development Facilities, 50%

Fiscal Year of Initial Funding: FY10

Estimated Project Period of Awards:

University-Led Consortia, 5 years

Collaborative Industry-Led Consortia, 5 years

Manufacturing Development Facilities, 1-3 years

Qualifications or Restricted Eligibility:

The University-Led consortia is restricted to domestic universities. Industry participants for the Collaborative Industry-Led Consortia must have United States-based PV research facilities and demonstrated intent for United States manufacturing within 3 years. All other participants must be United States-based organizations.

DOE Laboratory Involvement:

National laboratories may not apply as prime applicants but may apply as team members.

Request for Information Guidelines

Respondents are asked to specifically comment on the questions below. Respondents are also encouraged to comment on the general concept, potential benefits or obstacles, the overall merits of this idea, alternatives, and the relative priority of this activity. DOE will evaluate responses to this RFI to determine the best approach to move forward.

Questions

1) Concept:

- Please comment on the three models comprising the PV Manufacturing Initiative. How well is the problem framed, and are the models identified correct possible solutions? Will the models identified accomplish the goals of the Initiative? Are there other, more expedient approaches to achieving the goals? Should the models be modified? Do any of the models have higher priority? Are there other models that have been left out that should also be considered?
- What PV technologies would most likely succeed using these or other models?
- What are the most likely organizational barriers that may arise (e.g. IP sharing issues), and are there solutions DOE should consider?

2) Benefits:

- What do you see as the greatest contributions the PV Manufacturing Initiative can make to establish a strong manufacturing base and supply chain for the United States PV industry?

3) Eligibility

- Do you agree with the eligibility for the leads and participants for the University-Led Consortia? What about the Collaborative Industry-Led Consortia? And the Manufacturing Development Facilities?
- Should “for profit” consortia be considered or only non-profit entities?
- Should there be a minimum number of partners required by DOE for award or could a consortium be contained within one institution with far-reaching activity?

4) Funding:

- Would it be better to fund more awards at lower levels or fewer awards at higher levels?
- Does the level of funding seem appropriate given the amount and type of work anticipated?
- Does the level of cost share seem appropriate?

DOE will not pay for information provided under this Request for Information (RFI), and there is no guarantee that a project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives.

A response to this RFI will not be viewed as a binding commitment to develop or pursue the project or ideas discussed. DOE may also decide at a later date to issue Funding Opportunity Announcements (FOAs), based on consideration of the input received from this RFI or to not issue this opportunity at all.

Respondents are requested to provide the following information at the start of their response to this RFI:

- **Company/institutional name,**
- **Company/institutional contact,**
- **Type of Business or Institution**
- **Address, phone number, and e-mail address**
- **Brief description of the operations and mission of business or institution (several sentences will suffice)**

All responses to this RFI must be delivered electronically in **Microsoft Word (.doc) format as an attachment to an email** sent to the following email address: **PVManuflnit@go.doe.gov**. Emails should have the subject line **“PV Manufacturing Initiative Response”**.

Any questions about the content of this RFI must be sent to the following email address: **PVManuflnit@go.doe.gov**. Emails should have the subject line **“Question”**.

Responses to this RFI must be submitted by 11:59 PM Eastern Time on September 30, 2009.

Responses should be limited to 5 pages. However, more than one response is allowed per respondent. **Please identify your answers by responding to a specific question if possible.** We welcome other comments as well. Identifying the comment with the item to which it refers will facilitate aggregating all the responses. Any information obtained as a result of this RFI is intended to be used by the Government on a non-attribution basis for program planning and procurement strategy development. Information or data that is restricted in any way or limited for use by the Government is not solicited and will not be considered. **Please do not respond with any information you deem proprietary or confidential. Responses to this RFI are not confidential and may be published publically on a non-attribution basis.**

DOE has no obligation to respond to those who submit comments, and/or give any feedback on any decision made based on the comments received, as there is potential for a future Funding Opportunity relative to this subject.

DOE thanks you for your assistance and comments in helping accomplish its mission.

Attachment 2. Responding Organizations and Contact Information

Industry Respondent Contact Information								
Respondent	Contact	Contact Title	Street Address	City	State	Zip	Phone Number	Email
1Soltech	Zak Fardi	Executive V.P.	671 North Plano Rd, Suite #202	Richardson	TX	75081	972-231-1158	Zak.fardi@1soltech.com
Abound Solar	Anders Olsson	SVP of R & D	-	-	-	-	970-619-5340	aolsson@abound.com
	alt: Doug Schatz, CEO		-	-	-	-		
Applied Materials	Nag Patibandla, Ph.D.	Director, External Programs	3225 Oakmead Village Dr, P.O. Box 58039, M/S 1240	Santa Clara	CA	95052	408-563-5224	nag_patibandla@amat.com
BandGap Engineering	Chris Hobson	Chief Operating Officer	1344 Main Street	Waltham	MA	02451	-	-
BASF Corp	Dr. Timea Marsalko	-	1609 Biddle Ave	Wyandotte	MI	48192	734-324-6692	timea.marsalko@basf.com
BP Solar	John Wohlgemuth		630 Solarex Court	Frederick	MD	21703	301-698-4375	
CH2M Hill	Michael O'Halloran	-	2020 SW 4th Ave	Portland	OR	97201	503-224-6040	michael.ohalloran@ch2m.com
	Nathan Monosoff	-	2020 SW 4th Ave	Portland	OR	97201	503-224-6040	nathan.monosoff@ch2m.com
Cimitrex	Dave Faulkner	Executive VP	6979 South High Tech Drive	Salt Lake City	UT	84047	-	dave.faulkner@cimetrix.com
Dupont	Jeffrey Sternberg	Research Manager	Experimental Station, E500/2210A P.O. Box 80500	Wilmington	DE	19880-0500	302-685-4309	jeffrey.a.sternberg@usa.dupont.com
EcoPower Design	Ken Scott	CEO	830 Stewart Drive Suite 222	Sunnyvale	CA	94085	408-457-7966	kscott@ecopowerdesign.com
GT Solar	David C. Gray	VP of Strategic Development	243 Daniel Webster Highway	Merrimack	NH	03054	603-681-3825	David.Gray@GTSolar.com
Heliovolt	Dr. B.J. Stanbery	-	6301 E Stassney Lane, Bldg 8 , Ste 100	Austin	TX	78744-1604	512-767-6067	-
Intermolecular	Craig Hunter	-	2865 Zanker Road	San Jose	CA	95134	408-416-2300	chunter@intermolecular.com
Micron Technologies	John Maculley	-	8000 S. Federal Way, MS-36-206T	Boise	ID	83707	208-363-5218	jmaculley@micron.com
MidWest Curtain Walls	Mr. Donald F. Kelly, Jr.	President	5171 Grant Avenue	Cleveland	OH	44126	216-641-9053	dfk@midwestcurtainwalls.com
NAVSEMI	Babu Jain	-	5205 Prospect Rd, #135-127	San Jose	CA	95129	408-465-5521	Babu.jain@navsemi.com
nCrypt	Rebecca Couchon	Business Contact	3251 Progress Drive, Suite D	Orlando	FL	32856	407-275-4720	rcouchon@nscryptinc.com
	alt: Kenneth Church	Technical Contact						kchurch@nscryptinc.com

Industry Respondent Contact Information (cont.)								
Respondent	Contact	Contact Title	Street Address	City	State	Zip	Phone Number	Email
Plextronics	James Dietz	Vice President of Business Development	2180 William Pitt Way	Pittsburgh	PA	15238	412-423-2030 ext. 103	jdietz@plextronics.com
RNY Solar	Jim Munro	CTO	4567 Ontario Center Road	Walworth	NY	14568	585-503-5180	jfmunro@rnysolar.com
Semprius	Bob Conner	VP, Photovoltaics	4915 Prospectus Drive, Suite C	Durham	NC	27713	919-757-6825	bob.conner@semprius.com
Solaicx	Peter V. Schwartz, Ph.D.	Vice President of Engineering	5102 Calle del Sol	Santa Clara	CA	95054	408-988-5000	pschwartz@solaicx.com
Solarma	Vishal Shrotriya, Ph.D.	Director, Business Development	3445 Fletcher Avenue	El Monte	CA	91731	626-456-8090 ext. 312	vishals@solarmer.com
Solar World	Dr. James A. Moreland	Vice President of Technology	25300 Evergreen Road	Hillsboro	OR	97124	-	Jim.moreland@solarworld-usa.com
SRI International	Eric Pearson	Vice President, Physical Sciences Division	333 Ravenswood Avenue	Menlo Park	CA	94025-3493	650-859-3072	eric.pearson@sri.com
Underwriters Laboratory	Claire A. Kammer	Manager, Government Affairs	1850 M Street, Suite 1000	Washington	DC	20036-5833	202-286-8092	claire.a.kammer@us.ul.com
United Solar Ovonics	Dr. Subhendu Guha	-	3800 Lapeer Road	Auburn Hills	MI	48326	248-364-5709	sguha@uni-solar.com
Veeco Instruments	Jeff Hohn	Vice President Business Development	Veeco Instruments Inc., Terminal Drive	Plainview	NY		516-677-0200 ext. 1073	jhohn@veeco.com
William DeMarco	Bill DeMarco	-	901 Ponderosa Dr.	Fort Collins	CO	80521	585-230-7372	william.demarco@gmail.com
Dow Corning	Rebecca S. Lauer	-	2200 W. Salzburg Rd. P.O. Box 994	Midland	MI	48686-0994	989-496-5222	becky.lauer@dowcorning.com
Focus Materials	Nick Bagatelos	-	2750 Redding Ave	Sacramento	CA	95820	916-364-3600	nbagatelos@bagatelos.com
IBM	Kevin J. Hutchings	Vice President, Alliances		Hopewell Junction	NY	12533	845-892-5265	kevinh@us.ibm.com
FlexTech Alliance	Michael Ciesinski	CEO	3081 Zanker Road	San Jose	CA	95134	408-993-8111	michael.ciesinski@flectech.org
Linde LLC,	Richard Hogle	Technical Fellow	1970 Diamond St	San Marcos	CA	92078	760-471-3456	rich.hogle@linde.com
Koch Solar Consultancy (KoSolCo GmbH)	Dr. Wolfgang Koch	-	-	-	-	-	-	w.koch@kosolco.de
Universitat Konstanz,	Giso Hahn	-	-	-	-	-	-	Giso.Hahn@uni-konstanz.de

University Respondent Contact Information								
Respondent	Contact	Contact Title	Street Address	City	State	Zip	Phone Number	Email
ASU	Stuart Bowden	-	7700 S River Pkwy	Tempe	AZ	85284	480-727-9162	sgbowden@asu.edu
ASU Flexible Display	Nick Colaneri	Center Director	7700 S. River Parkway	Tempe	AZ	85284	480-727-8971	Nick.Colaneri@asu.edu
	alt: Doug Loy	Director of R&D					480-727-8932	dloy@asu.edu
Georgia Inst. of Tech.	Dr. Ajeet Rohatgi	-	777 Atlantic Drive	Atlanta	GA	30360	404-894-7692	ajeet.rohatgi@ece.gatech.edu
Georgia Tech	Steven Danyluk	Professor	813 Ferst Drive, N.W.	Atlanta	GA	30332	404-894-9100	steven.danyluk@marc.gatech.edu
	alt: Shreyes Melkote	Professor					404-894-8499	smelkote@gatech.edu
MIT	Tonio Buonassisi	Professor	77 Massachusetts Ave., 35-213	Cambridge	MS	02139	-	buonassisi@mit.edu
Oregon State University	Brian Paul	Professor	-	Corvallis	OR	97331-4501	541-737-7320	Brian.Paul@oregonstate.edu
	alt: Skip Rung	Pres and Exec Dir, Oregon Nanoscience & Microtechnologies	P.O. Box 2041	Corvallis	OR	97339	541-713-1348	skip@onami.us
South Dakota University	Dr. Shawn Decker	Director	501 East Saint Joseph St.	Rapid City	SD	57701	605-394-5210	Shawn.Decker@sdsmt.edu
Univ. of Albany, SUNY	Dr. Pradeep Haldar	-	257 Fuller Road	Albany	NY	12203	518-437-8684	phaldar@uamail.albany.edu
	alt: Michael Fancher	-					518-437-8670	mfancher@uamail.albany.edu
	alt: Alain Diebold	-					518-437-8685	adiebold@uamail.albany.edu
Univ. of Delaware, IEC	Robert Birkmire	Director	106D IEC Building	Newark	DE	19716	302-831-6220	rwb@udel.edu
Univ. of Michigan	Dennis N. Assanis	Director	2609 Draper 2nd Floor Engineering Programs Building	Ann Arbor	MI	48109-2101	734-763-7401	assanis@umich.edu
	alt: Arthur F. Thurnau	Professor						
Univ. of South Florida	Chris S. Ferekides	Professor	4202 E. Fowler Ave	Tampa	FL	33620	813-974-4818	ferekide@eng.usf.edu
Univ. of Toledo	Frank J. Calzonetti	VP for Research and Economic Development	2801 Bancroft Street	Toledo	OH	43606	-	FCalzon@UTNet.UToledo.Edu
NC State	George Rozgonyi	Professor		Raleigh	NC	07695-7907	919-515-2934	rozgonyi@ncsu.edu

Consortia Respondent Contact Information

Respondent	Contact	Contact Title	Street Address	City	State	Zip	Phone Number	Email
Fraunhofer CSE	Ryan Williams	Director of Research Development	25 First Street, Suite 101	Cambridge	MA	02141	617-757-7260	rwilliams@fraunhofer.org
SEMI North America	Dan Martin	EVP for Photovoltaics	3081 Zanker Road	San Jose	CA	95134	408-943-7030	dmartin@semi.org
Standards Tech. Group	Rick Sokoloff	VP Business Development	P.O. Box 1525	Williston	VT	05495	-	rsokoloff@standardstech.com
SVT Assoc.	Peter Chow, Ph.D.	-	7620 Executive Drive	Eden Prairie	MN	55344	952-934-2100	chow@svta.com
SVTC Technologies	Stephen Empedocles, PhD	-	3833 N. 1st St	San Jose	CA	95134	650-776-7089	Steve.empedocles@svtc.com
Clean Energy Group	Lewis Milford	President	50 State Street	Montpelier	VT	05602	802-223-2554	lmilford@cleanegroup.org
Natl. Center for Manf. Sci. (NCMS)	Chuck Ryan	Vice President, Technology	3025 Boardwalk Dr.	Ann Arbor	MI	48108	734-995-4905	chuckr@ncms.org
SEMATECH	Dan Holladay		2706 Montopolis Drive	Austin	TX	78741	512-356-7139	Dan.Holladay@sematech.org
SRC	Bob Havemann							Bob.Havemann@src.org
The Solar Energy Consortium	Wendy Arienzo	Research, Development and Engineering	434 Old Neighborhood Rd	Kingston	NY		203-470-0761	wendy.tsec@gmail.com

National Lab Respondent Contact Information

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