

The Solar Energy Consortium – TSEC

Congressional Earmarks

DE-FG36-08GO88011

EEE-0000332

EEE-0000282

Project Title

Program Team PV - SYSTEM DEVELOPMENT AND MANUFACTURING

Presenter

Organization
Contact Info

TSEC – THE SOLAR ENERGY CONSORTIUM
V. COZZOLINO CEO / FOUNDER

Date

845-336-0100
May 26, 2010

Mandatory Overview Slide

Timeline

June 2008 – December 2009 (GO88011)	100% complete
Sept 2009 – December 2012 (EEE0000332)	30% complete
Sept 2009 – December 2010 (EEE0000282)	20% complete

Total Budget	GO88011	EEE0000332	EEE0000282
DOE	\$1.472 M	\$1.9M	\$475K
COST SHARE	\$1.175M	\$511K	\$118K
Sub-recipients	PST*	PST*	IBM
PST*– Prism Solar Technologies		IBM Clarkson University SUNY at New Paltz	

Funding Received FY09	GO88011	EEE0000332	EEE0000282
DOE	\$480K	\$655K	\$2.6K
COST SHARE	\$680K	\$121K	\$ -

Barriers addressed

Modules

- Material Utilization and Cost Reduction
- Manufacturing Processes

Systems Engineering and Integration

- Systems Engineering

Partners

Industry

- 70 + industry partners

University

- Binghamton University
- Clarkson University – Center for Advanced Materials Processing
- Cornell University
- Rensselaer Polytechnic Institute - Center of Architecture Science and Ecology
- State University of New York (SUNY) at New Paltz – School of Science and Engineering
- City University of New York (CUNY) - College of Engineering and Center for Sustainable Energy (CSE)

Sub-recipient partners

- IBM
- Clarkson University
- State University of New York (SUNY) at New Paltz
- Prism Solar Technologies

- Deployment of solar electricity and other renewables in NYS has been hampered by cost, difficulty in system integration, and limited / inefficient supply chain for the devices required.
- TSEC overcomes these barriers through the following initiatives: Solar Innovation and R & D, Enable Manufacturing, Solar Solutions and sub-recipient research project management.
- Overcoming the barriers in NY will positively effect solar energy deployment throughout the US.

Objective:

The Solar Energy Consortium's objectives align with those of the DOE by improving the performance and reducing the cost of solar energy systems (*Solar Innovation and R & D*), contributing towards a clean reliable and flexible US Energy Supply (*Enable Manufacturing*), and accelerating large scale usage of Solar Energy (*Solar Solutions*)

DOE Objectives	Technical Barriers	TSEC initiatives	Initiative Description	TSEC Approach	Milestones	Progress and Results
Improve Performance and Reduce Solar Cost	<p>Modules: Materials Utilizations & Cost Reductions</p> <p>Manufacturing Process</p>	Solar Innovation and R & D	<p>UMG Characterization</p> <p>Novel PV Materials</p> <p>Supply Chain Innovation</p>	<p>Project to determine optimum performance & cost points for various Si blends</p> <p>Assess polarizing films</p> <p>Investigate cost drivers in value chain and compare analysis of turnkey lines</p>	<p>Production UMG blends</p> <p>Characterization</p> <p>Manufacture PV devices</p> <p>Forensic/Economic analysis of Blend vs performance</p> <p>University / Industry Collaboration</p> <p>5X decrease of solar costs in 5 years</p>	<p>Blends produced</p> <p>Characterization</p> <p>Evaluated material properties</p> <p>Actions identified</p> <p>Checkpoint 9/10</p>
US Energy Supply	<p>Modules: Manufacturing Processes</p>	Enable Manufacturing	<p>Build NYS capacity</p> <ul style="list-style-type: none"> • • • 	<p>Fund & support manufacturing ramp-up</p> <p>Re-commission Equipment</p> <p>Re-mission high tech factories</p> <p>Purposed Solar Products</p>	<p>Solar Products & jobs</p> <p>PV Production</p> <p>Solar Products & jobs</p> <p>Solar Appliances</p>	800 renewable energy jobs 2009 -2010
Solar Energy Deployment	<p>Systems Engineering & Integration</p>	Solar Solutions	<p>Create Solar Thermal Roadmap</p> <p>Analyze and recommend energy options</p>	<p>Solar Thermal Consortium formed</p> <p>23 solar application projects</p>	<p>Roadmap</p> <p>Implementation or Analysis</p>	<p>May 11, 2010</p> <p>11 closed</p> <p>12 open</p>

Solar Innovation and R & D University and Industry Collaborations

Improving performance and reducing costs through collaborative research

TSEC grows solar innovation through its industry / industry and university / industry partnerships managing solar projects by identifying research topics translated from industry needs and addressing these through university collaborations. The expected outcome is technology transfer to industry

- Raw Materials
- Energy Storage
- Supply Chain Innovation
- Novel Photovoltaics
- Sub-recipient Research Projects (Prism, IBM and Clarkson University)

Enable Manufacturing

Contributing to a clean and flexible US energy supply by developing a strong manufacturing base

TSEC will drive new business process development for new solar products and technologies, attract businesses to the solar industry, encourage specific product development for NYC and NYS markets, site solar product manufacturers, and remove market barriers for solar in NYS. The expected outcome is solar industry attraction to and job creation as well as intra-industry collaboration on renewable energy technologies

- Prism Solar Technologies - equipment acquisition
- Job Creation and Retention
- Supply Chain Innovation
- Solar Market Development

Solar Solutions

Accelerating solar energy deployment

TSEC is developing Solar Solutions for various practical applications. Working with Industry and university partners, TSEC analyzes the unique energy requirements and barriers to solar energy implementation in these applications. The barriers to implementation often require applied research and novel approaches. These projects are a cross section of real solar implementation problems that, when solved, will create the opportunity for broader use of solar

- 23 Solar Solution Projects

Lead the collaboration of industry, university and government agencies to perform solar innovation & research, to enable production of renewable energy products and deploy solar solutions

- Unify NYS resources and renewable energy efforts
- Foster partnerships within the industry to accelerate innovation

Consequence: renewable energy manufacturing job creation

800 jobs by year end 2010

Approach

DOE Objectives	Technical Barriers	TSEC initiatives	Initiative Description	TSEC Approach	Milestones	Progress and Results
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Solar Energy Deployment	<p>Systems Engineering & Integration</p>	Solar Solutions	<p>Create Solar Thermal Roadmap</p> <p>Analyze and recommend energy options</p>	<p>Solar Thermal Consortium formed</p> <p>23 solar application projects</p>	<p>Roadmap</p> <p>Implementation or Analysis</p>	<p>May 11, 2010</p> <p>11 closed</p> <p>12 open</p>

Solar Innovation and R & D - University and Industry Collaborations

TSEC manages solar R & D by identifying research topics translated from industry needs and addressing these through collaborations with universities and or other industry partners

Material Utilization and Cost Reduction - Raw Materials

Sub-recipients IBM and Clarkson University are working on characterization and development of new materials and processes necessary for decreasing the cost of silicon based photovoltaic devices. Various blends of upgraded metallurgical grade (UMG) Si with photovoltaic (PV) solar grade Si are being examined to determine optimum performance and cost points for various blends. Performance improvements methods such as gettering for these materials will also be investigated.

Manufacturing Processes - Supply Chain Innovation

TSEC is participating with IBM and industry partners in the development of a major solar industry initiative which is targeted at driving a 5X decrease in solar electric costs over five years. IBM is looking at all cost drivers in the value chain, from raw materials through cell, module, balance of system, and installation. The idea is to innovate through out the PV process, from raw materials to grid connect, and drive semiconductor experience and improvement approach into solar PV industry.

Sub-recipient IBM is performing a cost and technology comparison of production equipment (turnkey) available to produce crystalline (mono, multi, poly) Si PV cells. Forensic analysis and characterization of each crystalline Si based technology will determine the most promising approach with respect to cost, efficiency and reliability of solar cell manufacturing. Comparisons of PV, along with a technical roadmap for moving forward will be generated. Comparisons of the various currently available techniques and materials will be used as a starting point for moving the technology forward at a much faster pace.

Solar Innovation and R & D - University and Industry Collaborations

[Material Utilization and Cost Reduction](#)- Novel Photovoltaic Materials

Clarkson University and TSEC coordinated an assessment of an industry partner's claim of improved photovoltaic efficiency through utilization of a polarizing film. With the help of NREL, the assessment concluded that material had some fundamental instabilities and required basic research to get an understanding on how to attain stability. Work has been underway at Clarkson University to determine how to address this basic research requirement. The polarizing film is now in prototype stage. After the preliminary assessments, Clarkson and the patent holder followed through with research and prototype development.

An industry partner worked with TSEC and collaborated with Clarkson University to test and validate an extrudable polymeric manufacturing conversion process for solar cell production. Additionally Clarkson University plans to assist in co-polymer development with nanoparticle incorporation for conductivity. Clarkson has developed a conceptual proposal for this activity and is awaiting feedback from the industry partner.

Enable Manufacturing – Development of a Strong Manufacturing Base

TSEC will drive new business process development for new solar products and technologies, attract businesses to the solar industry, encourage specific product development for NYC and NYS markets, site solar product manufacturers, and remove market barriers for solar in NYS. The expected outcome is solar industry attraction to and job creation as well as intra-industry collaboration on renewable energy technologies

Manufacturing Processes – Sub-recipient Prism Solar Technologies - Solar Panel Manufacturing Equipment Acquisition and Job Creation

Prism Solar Technologies (“PST”) received \$1.0M of DOE funding and contributed an equal cost share amount toward equipment purchases that will be used in the development of their manufacturing process and line to produce photovoltaic (“PV”) modules, integrating their novel holographic concentrator film. The equipment acquisition made it possible for PST to produce their unique module adding to NYS renewable energy capacity.

Equipment Re-commission

Prism Solar Technologies purchased a recently closed Panasonic plasma screen TV R & D and pilot manufacturing facility in Highland, NY in which to manufacture their product. PST is currently in the process of the evaluation and the possible re-commissioning the plasma screen TV manufacturing equipment to PV module and holographic concentrator film production, a research project being separately funded under DOE award EEE0000332. The re-commissioning of existing manufacturing equipment to renewable energy uses affords opportunity to explore novel manufacturing processes.

Manufacturing Processes – Job Creation and Retention

High Technology Factory Re-mission

Precision Flow Technologies, a traditional semiconductor equipment manufacturer, re-missioned their manufacturing focus to equipment build for CIGS solar and LED through collaborative efforts with TSEC and industry partners

Enable Manufacturing – Development of a Strong Manufacturing Base

Manufacturing Processes - Job Creation and Retention

TSEC works closely with NYS economic development agencies to attract and / or grow renewable energy industry in New York. TSEC offers access to other industry partners and universities

Manufacturing Processes - Solar Market Development

TSEC has 70+ active renewable energy industry partners. TSEC offers opportunity for these industry partners to collaborate on products and to access university researchers to assist in technology advances in their products and manufacturing processes

TSEC worked closely with NYSERDA (New York Solar Energy Research and Development Authority), university and industry partners to form a Solar Thermal Consortium to draft a Solar Thermal Roadmap for New York State with a goal to further develop NYS thermal industry.

TSEC produces a daily renewable energy e- bulletin reaching a diverse and growing distribution of readers including TSEC partners, university partners and researchers, town, county , state and federal officials and federal agencies such as the DOE , Department of Justice, Members of Congress. The bulletin covers current topics such as advances in solar energy from novel PV, smart grid applications and storage to news of large and small solar applications. The bulletin provides heightened awareness of solar energy as well as simultaneous receipt of information to it readers

Solar Solutions – Accelerating solar deployment through novel applications

Systems Engineering & Integration

TSEC is developing Solar Solutions for various practical applications. Working with industry and university partners, TSEC analyzes the unique energy requirements and barriers to implementation of solar energy in these applications. The barriers identified often require applied research and novel approaches. TSEC seeks out, advises and manages high profile solar application projects that require key enabling technologies, which may then be developed. TSEC is accessing its university partners to provide these unique solutions and advance solar technology research.

These projects are a cross section of real solar implementation problems that, when solved, will create the opportunity for broader use of solar. The expected outcome is the proliferation of solar systems in high visibility installations and greater public awareness and acceptance of the practicality and usefulness of solar energy as a viable means of energy generation.

TSEC wishes to acknowledge the State University of New York at New Paltz and the senior electrical engineering students participating in the TSEC Solar Solution Projects. Solar Solution activities provided applied field experience in renewable energy and energy management supplementing traditional studies for senior electrical engineering students. Those students who elected to apply the field work activities to their senior design project received 2 credits in senior design. Several senior design projects have been implemented in Solar Solution projects.

Accomplishments / Progress / Results

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Solar Innovation and R & D University and Industry Collaborations

Material Utilization and Cost Reduction – Raw Materials

TSEC, Clarkson University Center for Advanced Materials Processing and Globe Specialty Metals (GSM) collaborated to assist Globe in their Silicon purification manufacturing process.

Progress / Results: Activity complete. Clarkson University and GSM successfully developed a unique manufacturing process which is both less energy intensive as well as achieving a higher solar grade silicon product. The assistance allowed Globe to reach the necessary purity to make Solar-grade silicon in a new product line for Globe.

Sub-recipients IBM and Clarkson University are working on characterization and development of new materials and processes necessary for decreasing the cost of silicon based photovoltaic devices: Composites of Upgraded Metallurgical Grade (UMG) Si with Photovoltaic (PV) solar grade Si.

IBM Progress: The UMG-blend solar cells fabricated at Schmid were analyzed in greater detail, including electrical parameters such as Voc, Jsc, FF, and efficiency, series and shunt resistance components, and diode J01, J02 measurements, with the purpose of determining the main efficiency limiting parameters.

Imaging such as lifetime maps, LBIC, luminescence, and thermography were employed as diagnostic techniques. Gettering of UMG blended material was carried out using phosphorus diffusion at various times and temperatures.

Clarkson University Progress: Standardized experimental procedures necessary to resolve the effects of illumination and light-generated temperature on PV parameters using potentiodynamic and IS techniques.

Studied temperature and illumination controlled A.C. response characteristics of a commercial Si (n+-p-p+) cell to check the experimental strategies for resolving photo-thermal and photo-electric effects

Preliminary Results :UMG can produce cells with efficiencies similar to solar grade material, if the right UMG silicon is used. Gettering is shown to improve minority carrier lifetimes by 30-40X. Processing parameter variation can significantly affect shorts and shunts at small angle grain boundaries

Solar Innovation and R & D University and Industry Collaborations

Manufacturing Process - Supply Chain Innovation

Improvements in the economics of PV cells alone without consideration of the entire supply chain; raw materials to grid connect, will not maximize cost reduction for photovoltaic electricity. This is a total “systems” approach to solar electric generation. The idea is to innovate throughout the solar energy supply chain, from raw materials to grid connect, and drive semiconductor experience and improvement approach into solar PV industry.

Progress / Results: Areas for improvement have been identified. TSEC is currently seeking university partners and solar PV supply chain companies to participate.

Sub-recipient IBM – An economic and engineering “side-by-side” analysis will be done on currently available cell and module processing technology, along with the roadmaps needed to push each particular option forward. Variations in turnkey line processes and procedures can and do result in finished solar cell device performance. Together with variations in starting material quality, the result is a distribution of efficiencies. Reducing this distribution variation as well as moving the entire distribution upward is a major goal of solar cell manufacturing and turnkey line production. Forensic analysis and characterization of each crystalline Si based technology will determine the most promising approach with respect to cost, efficiency and reliability for solar cell manufacturing. A comprehensive report showing advantages and disadvantages of what is currently available in Si PV, along with a technical roadmap for moving forward will be generated. Comparisons of the various currently available techniques and materials will be used as a starting point for moving the technology forward at a much faster pace.

Progress / Results: Technical and economic discussions and exchanges are occurring with appropriate personnel from “turnkey” suppliers (process and equipment) based on particular Silicon material sets. Initial “paper” evaluation of available turnkey providers with preliminary comparisons and suggested follow-up investigations are complete. Initial “skeleton” report generated with plans to fill existing gaps in information.

Enable Manufacturing – Development of a Strong Manufacturing Base

Manufacturing Process – Sub-recipient Prism Solar Technologies

As a sub-recipient, PST received \$1.0M of DOE funding and contributed an equal cost share amount toward equipment purchases that will be used in the development of their manufacturing process and line to produce photovoltaic (“PV”) modules, integrating their novel holographic concentrator film.

Progress / Results: Purchases complete. The majority of this equipment has already been installed with plans to install the remainder in the 2nd quarter 2010. In pilot production now.

During the course of the award period, Prism Solar Technologies purchased a recently closed Panasonic plasma screen TV R & D and pilot manufacturing facility in Highland, NY in which to manufacture their product. PST is currently in the process of the evaluation and the possible re-commissioning the plasma screen TV manufacturing equipment to PV module and holographic concentrator film production, a research project being separately funded under DOE award EEE0000332.

Progress / Results: All equipment has been evaluated and tested where appropriate for its potential use in the module manufacturing process. The work continues on a total of eight tools, four of which prototype work is currently active and underway. The other four await parts or manpower to be completed. Documentation of the use and assessments of the equipment under consideration and the disposition of equipment reviewed under this contract will be in the form of a report available for review. Prism Solar Technologies currently has 40 employees. PST projects that it will add about 180 more jobs to the local economy during its first few years of operation. It should be noted that Prism Solar Technologies was able to hire back most of the laid off Panasonic plasma screen TV manufacturer employees.

Enable manufacturing – Development of a Strong Manufacturing Base

Manufacturing Process - Job Creation and retention

TSEC engaged numerous renewable energy companies across NYS amounting to the aggregate creation of 800 new jobs in the renewable energy manufacturing sector in 2009/2010. TSEC helped other companies, possessing transferrable technology skills, transition into the clean tech space.

Progress / Results: Growing a renewable energy manufacturing base continues. These renewable energy companies project a combined job creation of 800 jobs by year end 2010. Some examples below:

Precision Flow Technologies – Semiconductor equipment manufacturer re-missioning to solar supply chain

Spectrawatt – Start up cell manufacturer in pilot production

Solartech Renewables – Start up PV module manufacturer in commission

Globe Specialty Metals – Solar grade Si manufacturer in production

The manufacturing capabilities of Globe Specialty Metals, Spectrawatt, Prism Solar Technologies, Solartech Renewables and Precision Flow Technologies, when viewed together, represents the entire PV supply chain from equipment build to raw materials to solar modules all based in New York State.

Enable Manufacturing – Development of a Strong Manufacturing Base

[Manufacturing Process](#) - Solar Market Development

TSEC engaged its industry and university partners as well as NYSERDA to collaborate on a development roadmap (technology and application) for NYS solar thermal industry.

Progress / Results: The activity spurred the creation of a Solar Thermal Consortium comprised of the roadmap development participants. TSEC actively participated in the Solar Thermal Consortium's development of a White Paper entitled "The Development of a Solar Thermal Market in New York State" which was submitted to NYSERDA. Subcommittees were formed to address the following topics: private sector roles and issues, training and workforce development, the usage of New York's assets for technology development, public sector roles, issues and consumer education and consumer awareness. The results of subcommittee activities as well as presentation of the Solar Thermal Roadmap will occur at the NYSEIA (New York State Energy Industry Association) conference scheduled May 12-13, 2010 in Albany, New York.

In order to create demand for a developing solar products manufacturing base, TSEC provided a forum for coordination of potential New York State utility scale solar farm developer activities. This action was initiated in response to a Request for Expression of Interest from the New York Power Authority (NYPA): RFP for 100 MW Solar Power Initiative in New York State. The submitted NYPA response compiled the varying requirements and success criteria of these potential large solar facility providers.

Progress / Results: TSEC participates with solar farm developers for utility scale solar farms in NYS. A forum was held on February 3, 2010. A NYPA representative, potential NYS solar farm developers, town supervisors, local utilities and industry partners attended.

Solar Solutions – Accelerating solar deployment through novel applications

Systems Engineering and Integration

TSEC is developing Solar Solutions for various practical applications. Working with Industry and university partners, TSEC analyzes the unique energy requirements and barriers to solar energy implementation in these applications. The barriers to implementation often require applied research and novel approaches. These projects are a cross section of real solar implementation problems that, when solved, will create the opportunity for broader use of solar

Progress / Results: 23 applications analyzed with renewable energy recommendations. 12 projects are in various stages of evaluation / implementation. 3 Examples will be given:

Project: Air National Guard Base at Stewart Airport:

The 105th Airlift Wing of the New York Air National Guard is based at Stewart Air National Guard Base and is located in Newburgh, New York. It's home to the 105th Airlift Wing whose mission is to provide peacetime and wartime inter-theater airlift operations using the C-5A "Galaxy" cargo aircraft. Newburgh is approximately 100 miles due south of Albany, the capital of New York State. The base encompasses 267 acres and contains 36 buildings, amounting to approximately 757,000 square feet.. The day-to-day base population is approximately 660 personnel

Objective: Explore solar lighting, solar thermal and photovoltaic applications for the Stewart Air National Guard Base.

Personnel: TSEC, College interns and professors from The State University of New York at New Paltz, independent contractors, Base personnel.

Status: Solar wall approach: proposal and analysis was submitted for the Department of Defense organization responsible for base facilities to do an analysis. Solar powered street lighting: researched and analyzed the success and failure of solar powered street lighting as a prelude to implementation of alternative energy lighting at the Air National Guard Base. Utility scale solar Farm: Site assessment performed, capped landfill potential location of solar farm

Follow on Work: Solar wall approach: Awaiting the results of the DOD analysis. Solar powered street lighting: Base reviewing proposal. Utility Scale Solar farm approach: Preliminary site assessments complete. Prime PV panel manufacturing engaged in the project as well as the engineering / construction firm. Funding has been made available for the site construction through Department of Defense.

Solar Solutions – Accelerating solar deployment through novel applications

[Systems Engineering and integration](#)

Project: Health Alliance - Senior Design Project

Health Alliance is a non-profit healthcare entity providing a wide range of inpatient and outpatient services through the affiliation of three regional hospitals: Benedictine Hospital, Kingston Hospital and Margaretville Hospital located in Ulster and Delaware counties respectively. Service area includes the Hudson Valley and Eastern New York. Objective:

Implement alternative energy approaches for these three regional hospitals Benedictine, Kingston and Margaretville

Personnel: TSEC, College interns from SUNY New Paltz, independent contractors and hospital personnel.

Status: HRSA funding implementation of proposal with a combination of transportation, solar thermal, LED lighting and solar electric signage. Hospitals administrating procuring process to purchase equipment and construction services. Realization of the project will begin 1Q10.

Follow on Work: Renewable energy approaches are being implemented. LED and solar thermal applications were recommendations generated from senior electrical engineering student design projects

Solar Solutions – Accelerating solar deployment through novel applications

Systems Engineering and Integration

Project: SUNY New Paltz Solar Race Car - Senior Design Project

State University of New York (SUNY) at New Paltz is a regional state–assisted university college for liberal arts / professional studies, serving approximately 7,000 undergraduate and 1,500 graduate students a semester. SUNY at New Paltz is located in the scenic Hudson Valley of New York State. In 2007, the electrical engineering department formed a Solar Car Student organization.

Objective: Enable SUNY New Paltz students to apply electrical engineering and solar energy skills to the building and racing a solar race car.

Personnel: TSEC, a solar car build consultant and a professor and students from The State University of New York at New Paltz.

Status: One car was upgraded and a student team successfully competed in the Formula Sun, Collegiate Solar Car Race in Cresson, TX placing 6th in a field of 11 competitors. A second car will be used in 2010 and is in the process of being built. Initial funding in place from student activities fund. Two cars are to be used in the project. A donated one was upgraded to be used in the 2009 activities. The second one to be used in 2010 is being constructed. High School, Board of Cooperative Educational Services, and a local community college also assisted in the design.

TSEC personnel are facilitating the student, schools and private industry activity.

Follow on Work: Complete build of the second car. Prepare for the 2010 solar car competition. TSEC continues to provide technical assistance and industry support to the effort. The solar car effort has generated considerable interest and opportunities for outreach and educational activities about solar energy are being planned.

- Explain project plans for the rest of FY10 (and for FY11 if applicable).
 - TSEC is funded to continue programmatic work through 2012.
 - Support ramp-up of new PV module manufacturer (anticipated year end 2010)
 - As the manufacturing base matures in NYS, services to support it will be developed
 - Expanding outreach and education to municipalities and other agencies
 - Expand TSEC scope beyond NYS
 - Align with DOE and DOD energy goals through existing federal programmatic opportunities
 - Increase collaboration with universities beyond NYS and federal labs with industry partners
 - Develop opportunities for utility scale solar farming in NYS
- Highlight upcoming key milestones
 - Prism Solar Technologies will be in PV module production by year end 2010
 - Plasma Screen TV manufacturing equipment will be re-commissioned for PV module manufacturing by 3rd QRT 2010
 - UMG characterization research results will be completed and will be presented at the 25th European Photovoltaic Solar Energy Conference and Exhibition (25th EU PVSEC) and 5th World Conference on Photovoltaic Energy Conversion (WCPEC-5) in Valencia Spain in 3rd QRT 2010
 - Job targets should be reached by 4th QRT 2010
 - Turnkey analysis and results completed by 4th QRT 2010
- Address how you will deal with any decision points in FY10 and FY11 and any remaining issues, including any alternative development pathways under consideration to mitigate risk of not achieving milestones.
 - TSEC works closely with sub-recipients in their respective research projects and current milestones are on schedule and should be met. Alternative pathways would involve adding more time to a project to ensure milestone achievement.

Industry- NDAs are in place with partners, all receive the daily bulletin, weekly communications on active and potential projects

70 + industry partners

University – NDAs are in place, all of the universities listed have participated in some capacity on projects

Binghamton University

Clarkson University – Center for Advanced Materials Processing

Cornell University

Rensselaer Polytechnic Institute - Center of Architecture Science and Ecology

State University of New York (SUNY) at New Paltz – School of Science and Engineering

City University of New York (CUNY) - College of Engineering and Center for Sustainable Energy (CSE)

Sub-recipient partners – Agreements / contracts in place with respect to funded research

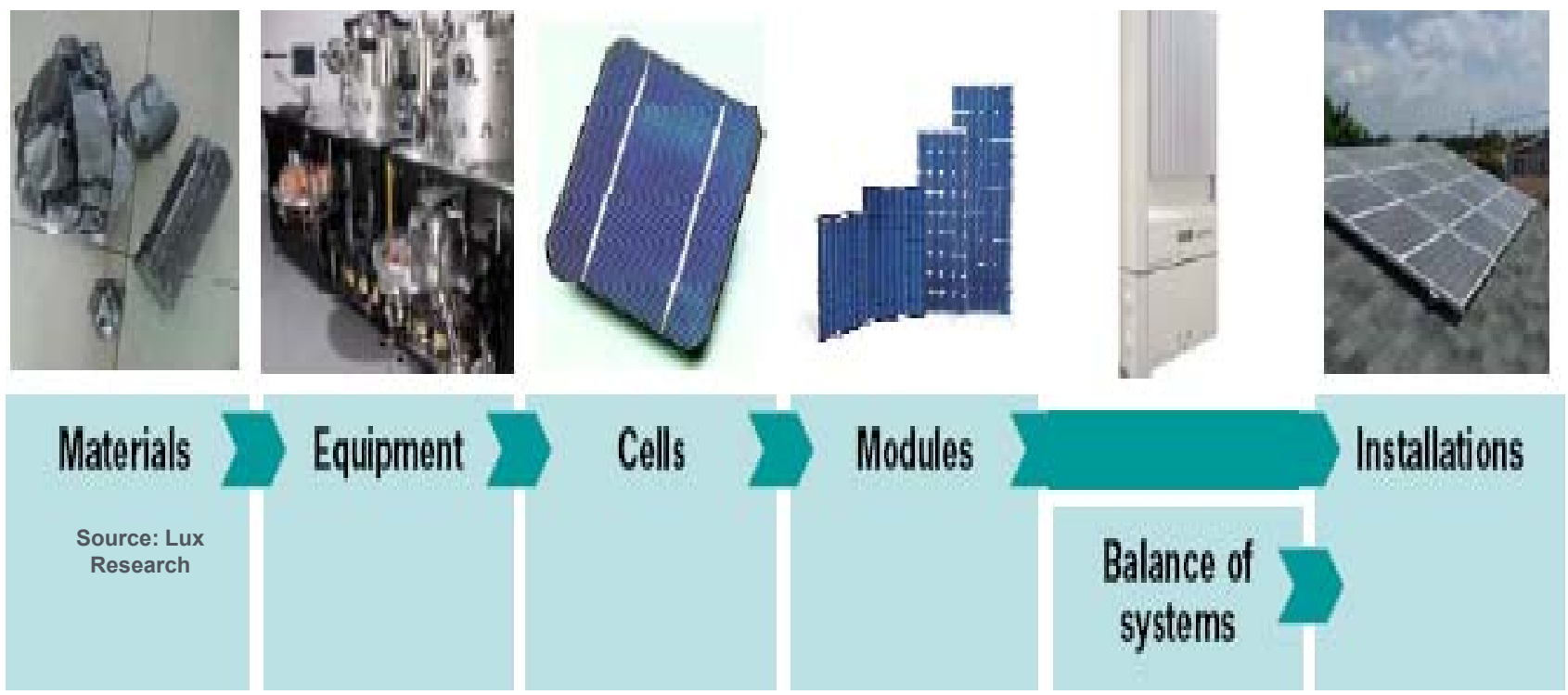
IBM

Clarkson University

State University of New York (SUNY) at New Paltz

Prism Solar Technologies

Solar Energy Value Chain



Building Solar Industry in NYS
Overcoming Technical and Marketplace Barriers
Job Creation
Solar Deployment