PHOTOVOLTAIC MANUFACTURING IN THE UNITED STATES: A ~~THE~~ UNIVERSITY PERSPECTIVE

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How can our research universities contribute most effectively?

Research Universities

Success of U.S. PV manufacturing to date, especially in silicon and thin-film technologies, is at least partially the result of the intellectual base in science and engineering at our research universities.

University researchers have a high level of intellectual vitality. They tend to be highly creative, well versed in the literature, skeptical of conventional wisdom, and interactive by nature.

Universities have much to contribute to future PV success in the U.S. Our responsibility is to most effectively integrate university strengths into the national PV program.

Foundational Research

Foundational research is basic research directed towards specific problems. Happens at universities, but also at national laboratories and within companies.

Photovoltaic examples:

- Analysis of optical losses
- Minimization of forward-current losses
- Control of uniformity and stoichiometry during fabrication
- Identification of unintentional energy barriers
- Correction of degradation problems

University foundational research often includes development of unique fabrication and measurement equipment.

It also allows labor-intensive exploration of broad parameter space.

Issue: Much of our university PV funding now comes through industrial subcontracts. This model, which is often useful, can detract from the breadth and the independence of university research.

Students

Highly skilled university graduates are the future of PV manufacturing.

PhD graduates in particular will likely be the source of the most creative ideas for future PV products.

PhD students need stability in their research focus for 3-4 years.

Issue: Student focus on individual-company interests is not compatible with unrestricted dissemination of results and often not with a thesis schedule.

Suggestions: (a) fund a solid base of university PV research and students directly (does not preclude additional industrial support), and (b) expand the opportunities for PV thesis research at the national labs.

Communication and Collaboration

The university culture encourages information exchange and collaboration with other research institutions, partly because a single university rarely has the resources and expertise to do it all internally.

A collective approach to PV research problems involving universities, national labs, and industry will cross-fertilize and synthesize new ideas that may elude individual investigators.

There are already strong regional collaboration centers and nationwide networks of researchers in specific technologies.

Suggestions: (a) construct proposal solicitations to encourage collective and consortium submissions, and (b) support the organization of small topical workshops in different PV areas.

Leadership

Many at universities are skilled in strategic planning and are an excellent source of expertise in the national PV planning process.

Many faculty are also skilled in critical evaluation of research proposals and are an excellent resource for the review process.

Issue: There is a potential conflict of interest when one both submits and reviews proposals. A natural consequence is a scarcity of well-qualified reviewers.

Suggestions: (a) utilize university research leaders in the national PV planning process, and (b) manage rather than try to eliminate potential conflicts of interest.

Specific Issues

(1) International:

The U.S. has lost its lead in PV at both the commercial and foundational levels. As we rebuild, do we view other countries as competitors or partners?

(2) The "gap" in U.S. PV research:

We tend to invest in (a) highly fundamental research with a very long-term horizon, or (b) short-term industrially driven work. There is limited support for research to advance current PV technologies in the 2015 time frame.

(3) Overuse of "generations":

First generation: crystalline cells (high efficiency, reasonable cost)
Second generation: thin films (low cost, reasonable efficiency)
Third generation: creative new ideas (very low cost or very high efficiency)

My opinions: (a) All of the above need foundation research and critical review.
(b) We should not assume that one "generation" will replace another.

(4) Cost-share requirements:

In contrast to other university research, typically 20% cost-share is required for many DOE projects. This can be a disincentive to work in the PV area.

University Strengths

What do U.S. universities have to offer PV manufacturing?

(1) Intellectual vitality and creativity
(2) Talent pool for foundational research in PV
(3) Source of graduates with PV experience
(4) Specialized equipment (can support industry directly)
(5) National planning leadership
(6) Incisive review of proposed ideas
(7) Ability to help solve specific industrial problems

Primary Suggestions:

(1) Restore independence to a larger fraction of university research
(2) Encourage student participation in most funded university projects
(3) Facilitate multi-university collaborations
(4) Relax the restrictions on reviewer selection
(5) Remove cost-share requirements from universities