

## Renewable Energy Panel

The discussion focused on the following four areas and solar energy was used as the exemplar

- 1) *Materials Challenges*
- 2) *R&D*
- 3) *Manufacturing*
- 4) *Deployment*

Three actionable topics emerged from the discussion

- 1) *Materials Availability*
- 2) *Sustainability*
- 3) *Codes and Standards*



**Recommendation 1:** MRS should develop international and public-private partnerships to generate the Google Prospector. Funding is required to develop the tools to identify the location and estimate the size of local material reserves, to map their distribution, and to provide local validation.



**Recommendation 2** – the MRS needs to champion educational outreach programs touting the necessity of end-of-life materials recovery practices. MRS should make life cycle materials engineering a focus area within its current portfolio of symposia and workshops.



**Recommendation 3:** Establish continental testing and validation centers (ie., NREL-Sandia, AIST, Fraunhofer-ISE, Africa, China, Australia, India, Mexico) to ensure a level playing field and consumer confidence. Implement a series of international workshops to establish the framework of this new international network. Need to establish network of funding sources (i.e., governmental and private trade associations) to support these centers and activities).



**Recommendation 4** – In symposia and workshops directed toward planning for renewable – grid interconnectivity, we need to reserve discussion for the special opportunities of developing areas and not focus exclusively on established grids.



**Recommendation 5** - MRS should set up a competition to identify the best groups in organic photovoltaics from around the world and connect them via an international coordinating framework funded to make progress in this area. A funding level of \$25 M per year for 5 years to support each team is appropriate.



## Overall Objective of Panel

- Describe the current state of the technology
- Identify a long-term vision or goal (e.g. to achieve by 2030)
- Prioritize major research and technological needs and opportunities in support of that vision
- Suggest how research developments will lead to progress toward that vision
- Suggest where international cooperation is needed to accelerate developments
- Identify impediments, hindrances, and stumbling blocks to international cooperation
- Identify policy, support, outreach, and promotion opportunities
- Determine recommendations/open questions



## Research and Development

### 1) Organic PV Development

Organic photovoltaics are among the most promising and most challenging solar cell technologies. Their rapid progress in raising efficiency to near 10% (is this right?) shows their technical promise, while the diversity and complexity of the organic materials available for donors and acceptors shows their technical challenge. The promise of low cost flexible solar cells, the wide horizon of basic materials challenges and the early, precompetitive stage of research justifies a strong and coordinated international development effort. An international research community with a footprint in many countries is already established.

A host of foundational questions abounds. Can non-crystalline organic films achieve “device quality” properties? Can they be incorporated into conventional device designs? Are there alternative device designs that can be utilized? What will the sustainable manufacturing challenges be? What will the end-of-the-life issues be? Though fundamental to eventual scale-up and deployment, these issues remain largely unexplored and are ripe for coordinated pre-competitive research attention.

Recommendation: MRS should set up a competition to identify the best groups in organic photovoltaics from around the world and connect them via an international coordinating framework funded to make progress in this area. A funding level of \$25 M per year for 5 years to support each team is appropriate.



## Research and Development

### 2) Materials Availability

There is strong international demand for a global inventory of the availability in the earth's crust of critical materials needed for renewable energy technologies. Such an inventory or "Google Prospector" would guide basic materials research for innovative renewable energy technologies to focus on earth-abundant materials capable of scale-up to TW production levels and away from materials whose scarcity limits the ultimate energy impact of associated new technologies to insignificant or token levels. The Google Prospector should be in the public domain and cover all renewable energy materials being used or under consideration for new technologies. The strong interaction of mining and production of primary and secondary (by-product) materials is a key feature of the proposed Google Prospector analysis; restrictions and opportunities arising from this byproduct interaction have not been adequately explored. The restriction of innovative alternative energy technologies to earth abundant materials capable of scale up to TW proportions is one of the most important strategic R&D conditions for effective renewable energy development.

Recommendation: MRS should develop international and public-private partnerships to generate the Google Prospector. Funding is required to develop the tools to identify the location and estimate the size of local material reserves, to map their distribution, and to provide local validation.



## Materials Development

End-of-life recovery of critical materials is a key feature of renewable energy practice that must be designed into the lifecycle of a product before its birth. End-of-life materials recovery minimizes environmental impact while reducing the use of critical materials that may limit the scale of deployment of renewable energy technologies. The many approaches to end-of-life materials recovery, including re-use, re-manufacturing and recycling, need to be carefully analyzed and applied at the design stage. These kinds of end-of-life reverse engineering to allow materials recovery are fundamental design principles that need widespread international support to become standard practice.

Recommendation – the MRS needs to champion educational outreach programs touting the necessity of end-of-life materials recovery practices. MRS should make this a focus area within its current portfolio of symposia and workshops.



## Manufacturing and Deployment

### 1) Codes and Standards

Global network of institutions to identify and established necessary codes and standards, including those needed to verify performance and reliability.

Recommendation: Establish continental testing and validation centers (ie., NREL-Sandia, AIST, Fraunhofer-ISE, Africa, China, Australia, India, Mexico).

Implement a series of international workshops to establish the framework of this new international network.

Need to establish network of funding sources (i.e., governmental and private trade associations) to support these centers and activities).

***This is best formulated by the solar experts on the panel-gwc***



## Manufacturing and Deployment

The broad potential for international cooperation in renewable energy must be tempered by the recognition of different national or regional needs depending on the stage of energy development. For example, the needs of the developed and developing world for electricity may be strikingly divergent. The developing world often cannot afford the resources or time required to establish and extend a grid to serve every village. Instead, distributed power based on a microgrid or independent solar cells with a high reliance on local storage brings the greatest benefit to the greatest number in the shortest time. In the longer term, new grids need to be planned that will form a coherent whole instead of the disorganized patchwork typical of the developed world. Lacking a grid legacy, the developing world can plan a much more rational and economic route to a modern and effective grid superior to those in the developed world. Costing models for the disparate applications in the developed and developing world need to be explored.

Recommendation – In symposia and workshops directed toward planning for renewable – grid interconnectivity, we need to reserve discussion for the special opportunities of developing areas and not focus exclusively on established grids.

