Direct Use Solar Technologies R&D Brainstorming Session

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Southeast Solar Summit
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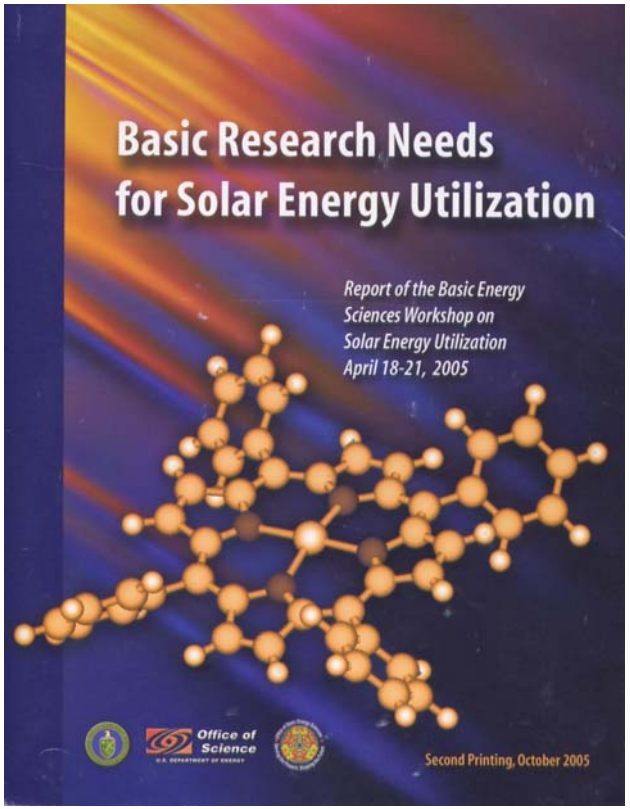
Today's federal solar energy R&D paradigm

<u>Steps in identifying innovation gaps:</u>

- **Understand existing systems-level paradigm**
- Locate where existing R&D portfolio fits in the big picture
- Look outside-the-box for new high-impact areas of innovation



"All routes for utilizing solar energy exploit the functional steps of <u>capture, conversion, and storage</u>."

Report of the Basic Energy Sciences Workshop on Solar Energy Utilization; April 18–21, 2005; P. 3.

Today's federal solar R&D market space

Steps to identify gaps:

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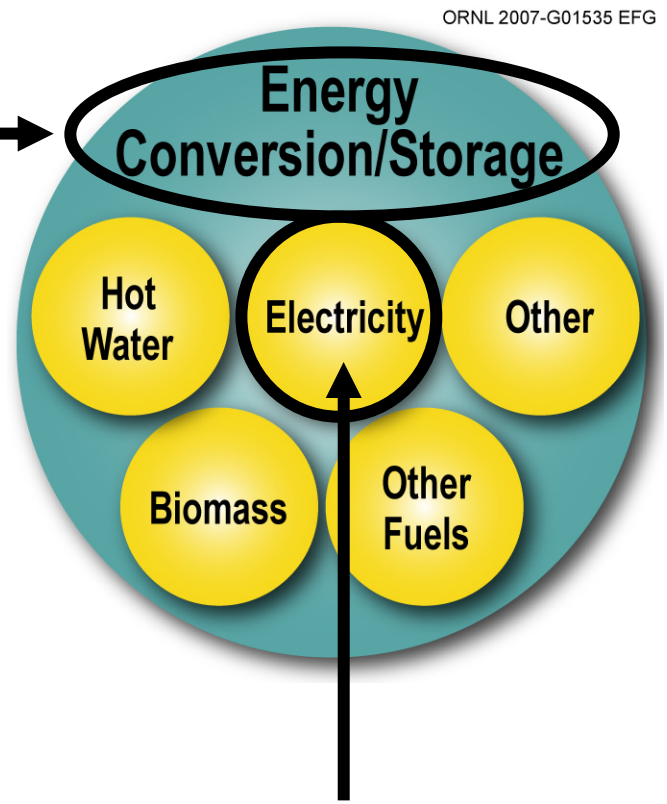


"The mission of the Solar America Initiative is to help lower the cost of solar electricity so that it is cost-competitive across all U.S. market sectors by 2015."

http://www1.eere.energy.gov/solar/solar_america/mission_approach.html

Looking outside today's paradigm and market space for disruptive technologies is not easy

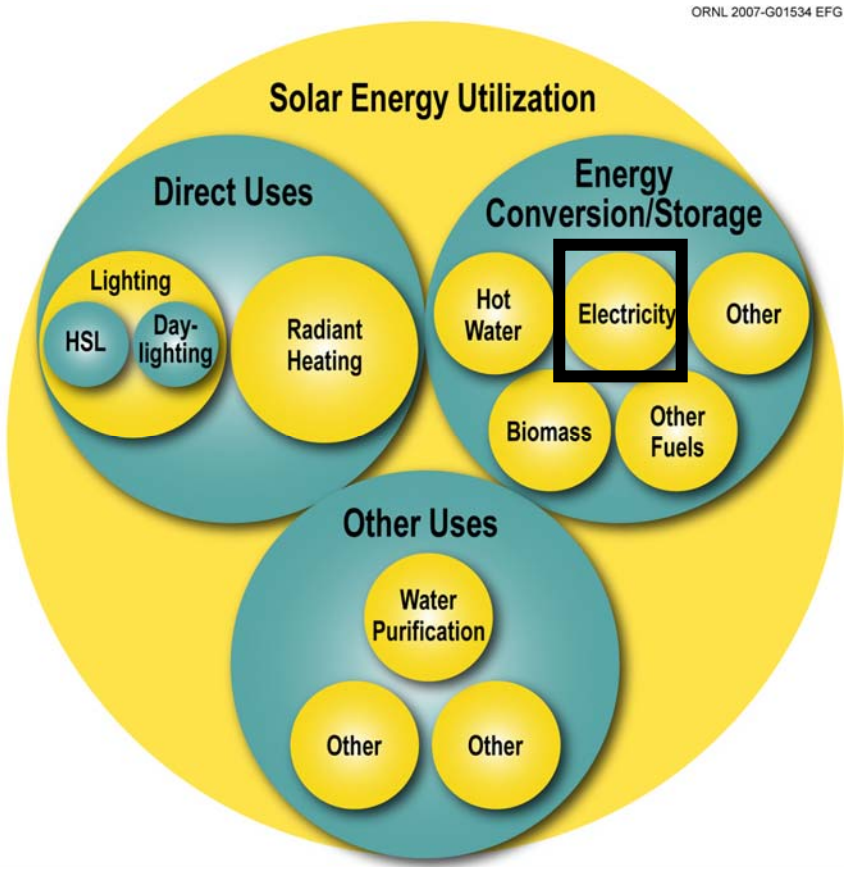
Typical indicators of transformational ideas:

- **Originate with outsiders** having little or no vested interest in existing system or R&D pathway
- **Resisted by insiders** having established personal and or institutional interest in existing system or R&D pathway
- **Cross organizational boundaries;** usually don't fit neatly in existing R&D programs
- **Often very old (and dismissed) or completely new ideas** made possible by recent S&T advancements in other fields

Goal of this brainstorming session

Identify R&D gaps:

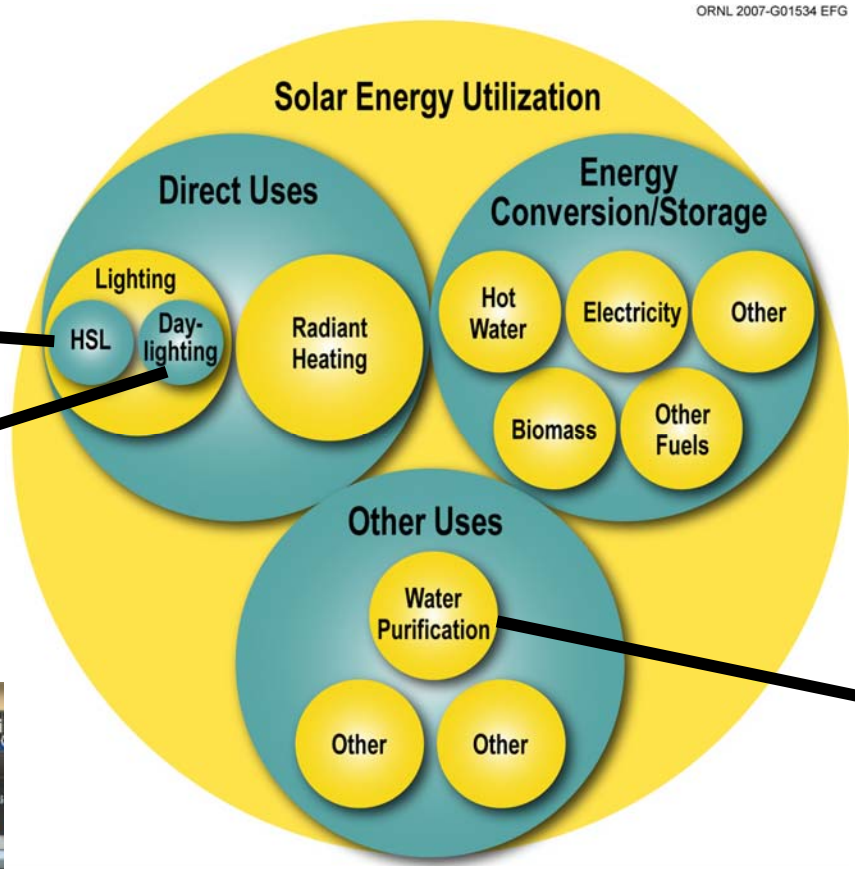
- Understand existing systems-level paradigm
- Locate where existing R&D portfolio fits in the big picture
- **Look outside-the-box for new high-impact areas of innovation**



Innovation that falls outside of today's paradigm & R&D market space (direct-use technologies, etc.)

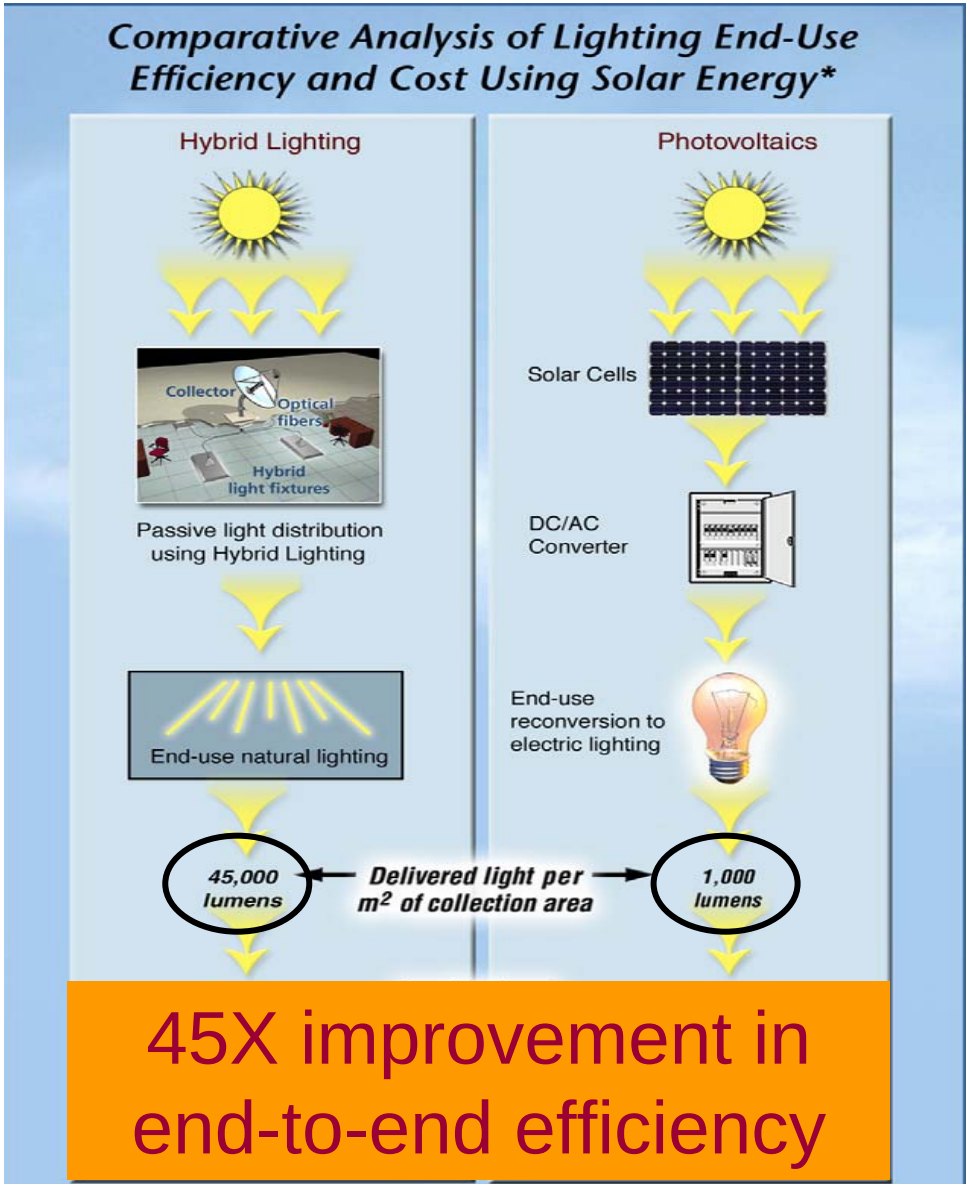
Innovation in other steps of the product delivery process beyond "capture, conversion, and storage."

Not all routes for using solar energy require the steps of conversion and storage



<u>Question #1:</u> What are other possible uses of solar energy?

Bypassing conversion leads to radical improvements in solar energy utilization



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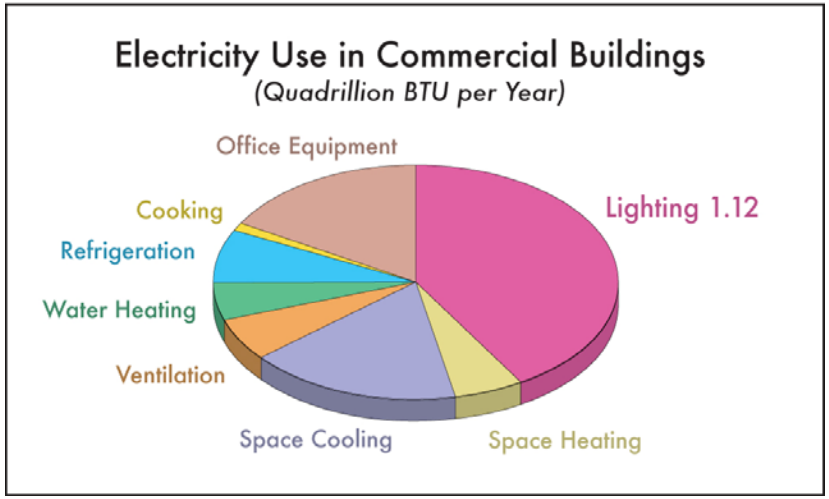

<u>Question #2:</u> What are other ways we could use sunlight in its natural form as UV radiation, visible light and/or radiant heat (IR)?

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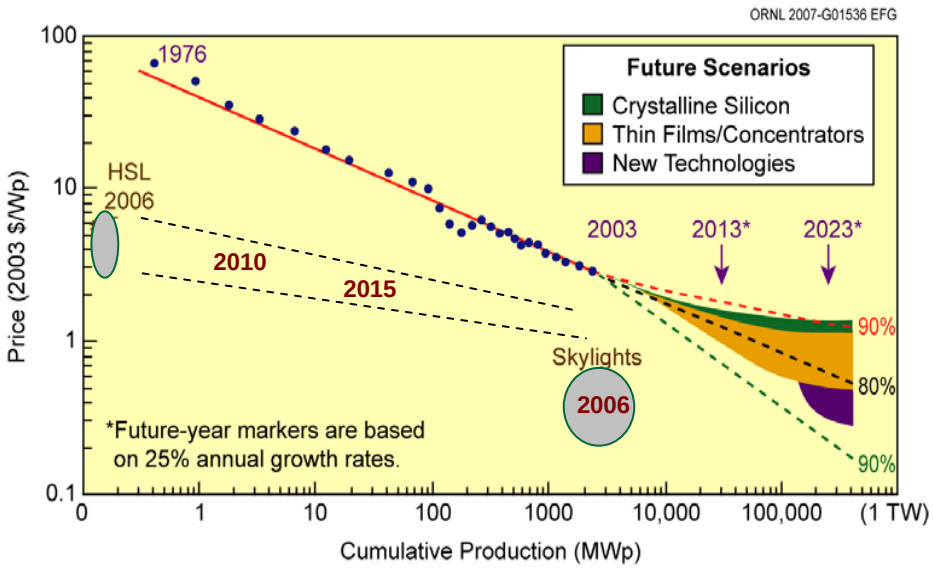
Use of solar energy in lighting



Question #3: What are the research needs in various approaches to using sunlight in lighting?

Skylights, fiber optics, light pipes, light fixtures, other fenestration options, controls, other

What about radiant heating?

Question #4: Where can sunlight be used in various lighting applications?

- **General illumination**
- **Task lighting**
- **Direct / Indirect**
- **Other**

“Out-of-the-box” ideas can come from other steps in the product delivery process

Steps:

- Fabrication
- Manufacturing
- Assembly
- Integration
- Installation
- Operation
- Maintenance
- Marketing / Sales
- Financing
- Others

Functional steps:

1. Capture
2a. Distribute & use
2b. Convert & store

Question #5a: What are other steps in the product delivery process for direct-use solar technologies?

Question #5b: Can you think of innovations in these areas that would enable greater use of direct-use solar technologies?

A few examples where transformation may be possible

Other steps:

- Fabrication
- Manufacturing
- Assembly
- Integration
- Installation
- Operation
- Maintenance
- Marketing / Sales
- Financing

→ **Pre-wiring comm. buildings w/ fiber optic distribution systems**

→ **Self-cleaning, optically-transparent polymers**

→ **Financing strategies for skylights similar to other solar technologies**

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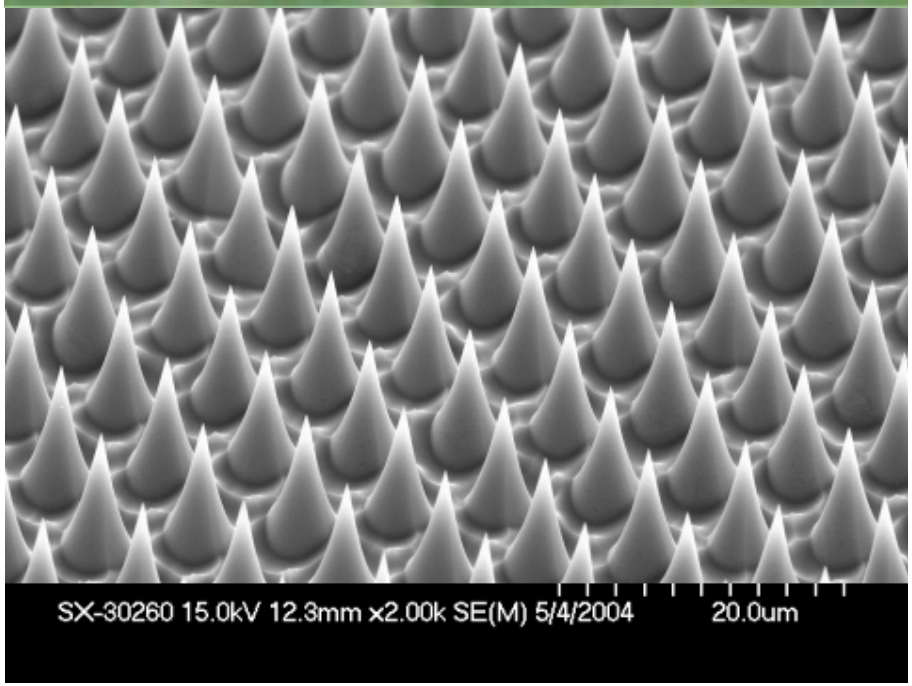
Example: Self-cleaning, optically-transparent materials

- Use proprietary techniques to make nanocone arrays
- Coat with hydrophobic self-assembled monolayer to make material super-hydrophobic
- Create nanoscale tips.
- Water sits on cone tips.



<u>Possible Payoff:</u>
Significant Improvement in overall performance and reduction/elimination of labor required for cleaning.

Are there opportunities for making solar energy systems multifunctional?

End-Uses

Multi-functional Solar Energy System Capable of Producing…..

- **Lighting of interior spaces**
- **Radiant heating of occupants**
- **Electricity and/or**
- **Hot water**

….and adapting in real-time to optimize performance based on end-use needs

Existing HSL platform

Challenges

- **Double the coverage area of HSL technology through transformational waveguide development**
- **Double the end–to-end solar energy utilization efficiency per unit area of sunlight collected**

Possible Research Focus Areas:

- **Smart, adaptive optical- & spectral- switching techniques and control methodologies – "optical switch yard"**
- **Low cost, flexible IR-transmitting waveguides**
- **Air-clad, liquid-core fibers using superhydrophobics**

A recap of areas where we'd like your input

Name: _____
E-mail address: _____

- **Other possible uses of solar energy**
- **Other ways we could use sunlight in its natural form as UV radiation, visible light and/or radiant heat (IR)**
- **Research needs in various approaches to using sunlight for lighting or radiant "point-of-use" heating:**
  - **Identify: a) R&D goal(s), b) possible technical approach, c) anticipated technical challenges, etc.**
- **Other lighting applications beyond general illumination**
- **Other steps in the product delivery process for direct-use technologies where innovation opportunities may reside**
- **Opportunities and configurations for developing multifunctional solar energy systems**