



2011 World Materials Summit

Panel Discussion Report

Panel on Buildings and Lighting



Current state of the technology (Bird's eye view)

- there is a gap between the needs of the building sector (for energy demand and savings/efficiency with equal amenity) and the current focus of materials scientists.
- In China and emerging markets, the state of the technology is sufficient for major changes in energy efficiency...Enormous potential for the built environment to achieve dramatic energy use reductions



Long-term vision or goal (toward 2030)

- *Relationships will be strengthened among materials scientists, building scientists, building designers (architects), the building materials industry, and policy makers, all working together so as to achieve a 50% reduction in global energy consumptions in buildings by 2030.*
- [This is also in alignment with AIA 2030 (American Inst. of Architects) and DoE stated goals.]



Major research and technological needs and opportunities in support of vision

- Understand location-specific dynamics and location-dependent material demands,
- Develop better whole building systems-scale simulation and optimization tools with easy user interfaces – provide tools to the building designer
- Expand research in phase change materials,
- Develop cost-effective semiconductor materials and devices for sensors, lighting, communications, power electronics
- Develop cost-effective other materials for integrative sensors, microelectronics, lighting, energy harvesting, communications and controls



Major research and technological needs and opportunities in support of vision (cont.)

- Expand thin film research into meso-scale thickness range (200 nm - 5 micron) and variable porosity (from compact to 50%) films for heat exchange fins, ionic exchange membranes, photovoltaic thin films, electrochromic films, etc.
- Increase efficiency of HVAC systems with novel heat exchange technologies, working fluids, innovative dehumidification technologies, making use of low-grade thermal energy (e.g. Devap)
- Develop materials with controllable and variable surface optical properties (with spectral control) to optimize the interface between the building the environment
- Develop adaptive vapor retarders (sometimes an impermeable humidity barrier, sometimes allowing moisture vapor permeability)



Connection of research developments to achieving vision/goals

- **Basic materials researchers should understand the state of the art within industry:** real bottlenecks, challenges to deployment or bridging the valley of death, recognizing IP issues that serve as barriers to collaboration and learning both regionally, nationally, and internationally.
- **Basic materials researchers should develop much greater understanding and appreciation for Life Cycle Assessment.** We recommend developing strengths/skills in Life Cycle Inventory for materials (database generation) and Life Cycle Assessment—both of which are critical to the building industry.



Connection of research developments to achieving vision/goals (cont.)

- **Recommendation to increase the dialogue between building designers, building scientists, policy makers, and materials producers/manufacturers around regulations.** [e.g. example of porous cement from the The Inst. of Technical Supervision and Research for the Building Materials Industry]
- [e.g. also changing building codes to minimum cost points]



Opportunities for international cooperation to accelerate developments in this field

- **International Cooperation:** Western researchers do not typically have a strong familiarity with the Chinese built environment and social considerations, especially in rural areas. In order to accelerate mutual understanding, we recommend establishing professional society offices in China to encourage exchange of information. Also consider matching funds with China to increase research scientist visiting fellowships to China.
- **Major opportunity:** in developing insulation in China, for low-cost flame-retardant, high performance and long-lasting properties. There is great potential for deployment, with key emphases on applications, processing and reproducibility. Likely this applies to other building technologies as well.



Impediments/hindrances/stumbling blocks to international cooperation

- A crucial stumbling block in the building industry is in assuming that all buildings exist in that singular country—while building scientists emphasize that climate and cultural norms are important in making materials decisions for highest utility.
- Lack of recognition for IP issues is a barriers to collaboration and learning both regionally, nationally, and internationally.



Policy, support, outreach, and promotion opportunities

- **Recommend connecting to grid and storage panel priorities.** Building energy control systems must be integrated with the grid for demand response mechanisms. There is long-term work developing for agent based system in a building to negotiate for power vs costs/value, and this extension is being explored for the grid as well.



- **Open questions:** Developing building research testbeds in major housing types (most are large, multifamily structures), and factories, and in different climatic areas of China as international collaborations.



Concluding/summary slide

Top points from this committee:

- Building scientists (which includes systems simulation specialists) must work together with materials scientists in alignment with industrial materials providers and integrators.
- Basic materials researchers should develop much greater understanding and appreciation for Life Cycle Assessment.
- Advances are needed in thermal exchange materials and advanced optical/optoelectronic materials, but must be constrained by extremely low costs and high performance.



Panel Members

- Jerry Simmons, Sandia National Labs: lead
- Jeffrey Brownson, Penn State: scribe
- Eric Amis, United Technologies: co-lead
- Dujin Wang, Institute of Chemistry, CAS
- Claes Göran Granqvist, Uppsala University
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