

4th U.S.-China
Energy Efficiency Forum
September 25, 2013

Compiled Presentations from Track 1,
Breakout Session 1/Morning
**High Performance Buildings
Technologies: LEDS and BEYOND**



US – China Clean Energy Research Center Building Energy Efficiency Consortium (CERC-BEE)

September 25, 2013



*Lawrence Berkeley National Laboratory of the United States and
MoHURD Center of Science and Technology of Construction of China, with:*



中国建筑科学研究院
China Academy of Building Research





U.S. – China Collaboration with Real World Impact



- Initiated between U.S. President Obama and Chinese President Hu in 2009
- Over a dozen high visibility, cost-shared, US-China projects in the buildings sector
 - Engaging industry
 - Creating partnerships
 - Government, academia, and private sector
 - Software, tools, guidebooks, early commercialization of technologies, codes, policies
- \$50M, five year program funded by U.S. and China:
 - \$5M/year from government
 - \$5M+/year from private industry (cash, in-kind)





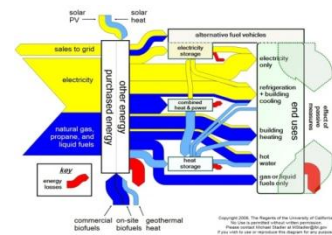
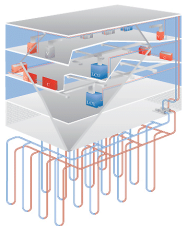
An Ambitious and Pioneering US-China Collaboration



Vision: To Achieve Wide Spread Adoption of Very Low Energy Buildings

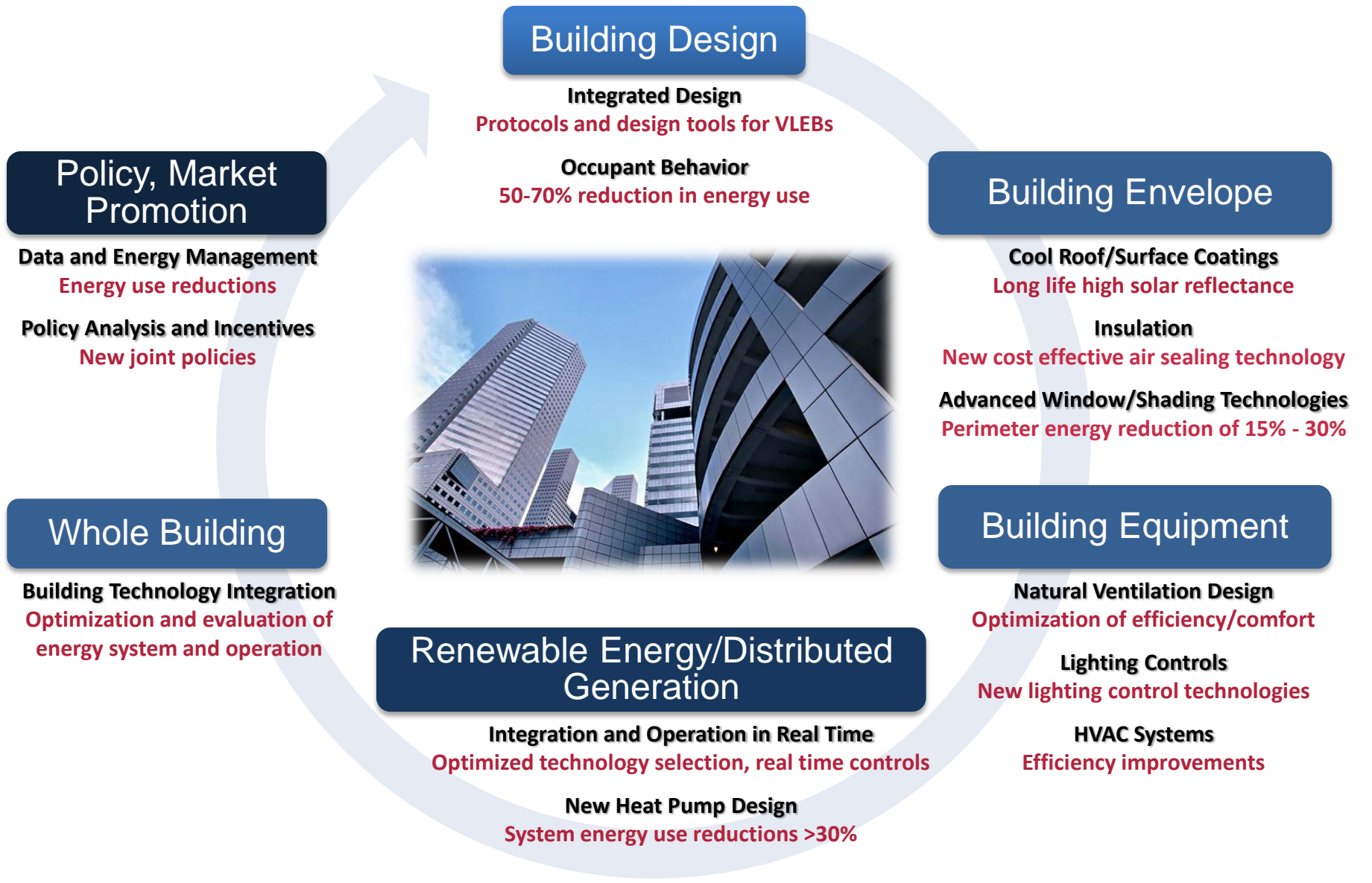
Mission: Build partnership, and make real world impact

- Engage industry in R&D and bring technologies to market
- Create a sustainable platform and building partnerships
- Involve various stakeholders such as government, academia, and private sector covering whole business model
- Deliver outputs including software, tools, guidebooks, early commercialization of technologies, codes, policies





Strategic Approach to Achieving Very Low Energy Buildings





A Sustainable Platform Creating US-China Research & Development Partnerships



United States



Lawrence Berkeley
National Laboratory



Oak Ridge National
Laboratory



Natural Resource
Defense Council



ICF International



Massachusetts Institute
of Technology

China



MoHURD Center of
Science & Technology of
Construction



Tsinghua University



China Academy of
Building Research



Chongqing
University



Tongji University



Tianjin University



China Society for
Urban Studies



Enhanced R&D Industrial Partnerships Bring Technologies to Market



US Industry Partners



Roofing Technology,
New Insulation



Low-e Window
Technology & Design



Integrated Design,
Modeling



Ground Source Heat
Pump



Energy Systems for
Buildings, Behavior



Lighting Control Systems



Policy, Market
Promotion

Chinese Industrial Partners

- CONVERTERGY (Shanghai)
- East-West Control Group (Shenyang)
- ENN Group (Tongji)
- Ever Source Technology Development (Tongji)
- Fullshare Energy (Tongji)
- Guangdong Provincial Academy of Building Research (Guangzhou)
- Huaqing Geothermal (Tongji)
- Jiangsu DISMY GSHP (Tongji)
- Lampearl Photoelectric Co., Ltd (Guangzhou)
- LANP Electrical Co. (Zhejiang)
- LatticeLighting (Nanchang)
- Leye Energy Service (Beijing)
- LH Technology Co., Ltd
- Liaoning Solar Energy R&D Co., Ltd (Tongji)
- NARI Technology Development (Nanjing)
- National Center for Quality Supervision Test of Building Energy Efficiency (Beijing)
- Persagy (Tsinghua)
- Shanghai Futian air conditioning equipment Co., Ltd (Tongji)
- Shenzhen Institute of Building Research (Shenzhen)
- Singyes Solar (Tongji)
- SOLATUBE Daylight Technology, CECEP (Suzhou)
- Telchina (Beijing)
- Tongguang Construction Group (Shanghai)
- Vanke Building Technology (Tianjin)
- Wall Insulation Committee in China Association of Building Energy Efficiency (Beijing)
- Xinjiang Green Messenger (Urumqi)
- Yingli Energy, Beijing (Tongji)



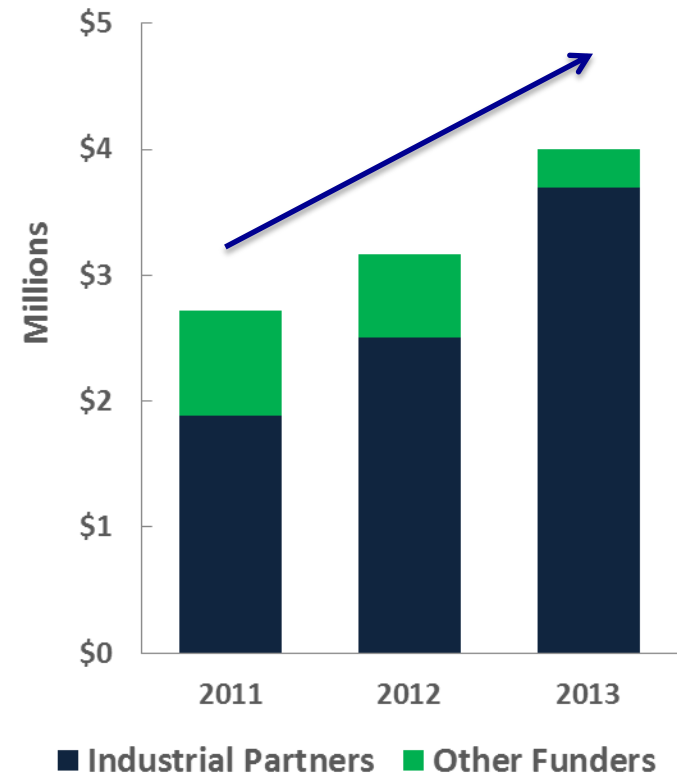
US Industry Engaged, Aligned, and Supported by Unique Intellectual Property Protections



- 1. US and Chinese businesses and research teams match up** to accelerate invention and commercial success.
- 2. Industry partners assume central roles** in research, development, deployment, and commercialization.
- 3. “Technology Management Plan” enhances protection for IP rights;** endorsed by both governments, it establishes rights to own or license IP for commercial purposes, leverages complete research portfolio, and facilitates demonstration and introduction of products to large new markets

U.S. Industrial Partner Contribution

+40% Annual Average Growth Rate





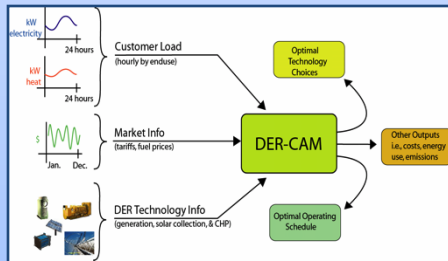
Research Portfolio Outcomes



Technologies



Software



New Patent Applications

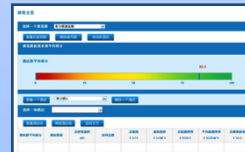
Demonstration Buildings



Commercial Impact



Tools and Guidebooks



Market

Wide Adoption of Cost Effective VLEBs



Policy



Comprehensive Technical Achievements Include IP, Innovative Tools and Models, June '12 - June '13



Monitoring and Simulation

- On-line comparative energy benchmarking tool
- Energy data model and analysis of measured data from real-time monitoring
- **Occupant behavioral impacts integrated into simulation models**

Envelope

- **Patent filed by Dow for liquid flashing, “method for sealing fenestration openings”**
- **Cool Roof provisions for Chinese national BEE standards, 2 invention disclosures**
- New designs for fenestration systems, advanced standards, and demonstrations

Equipment

- Integrated control strategies for natural ventilation
- **Advanced algorithms and demonstration programs for lighting**
- New advanced evaporative cooling systems

Renewables

- **Cloud tool for microgrids based on technologies, load and tariffs**
- Evaluation and competitiveness of renewable energy systems
- **10% GSHP system efficiency improvement, 20-30% cost savings, R&D100 award, patent in 2014**

Whole Buildings

- **Real time strategies for cost & peak load reduction**
- Comparative research on energy use of U.S. and Chinese high efficiency buildings

Policy

- Methodologies for energy cap and trade system in buildings and quota system for public buildings
- Policy recommendations to promote EE, renewable energy, and green buildings



Example: Low-cost, Superhydrophobic Roof Coatings for Energy Savings and Roof Lifetime



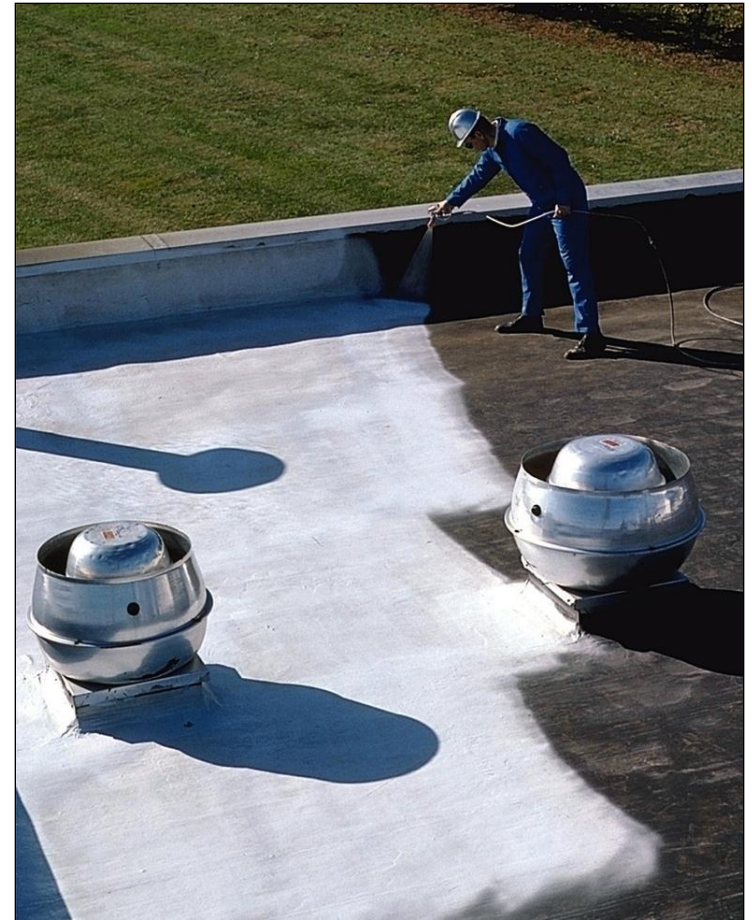
Objectives

- **Quantify** the energy and environmental benefits of cool surfaces
- **Create white roof coatings** with superior reflectance and durability for U.S. and China markets
- **Demonstration** of cool roofs in China

Market Size: 3B m² upgradeable by 2025 (U.S. + China)

Key milestones:

- China cool-roof simulations (completed)
- China cool-roof demonstrations (ongoing)
- New coating product yields IP (2013)
- Cool roofs in Chinese building energy standards (2015)
- New coating product achieves sales in China and the United States (2016)



Joint Research Team:





Pilot Demonstration and Joint R&D Collaboration – Delivering Technology to Market



- China planning 5 demonstration buildings
- Multiple CERC-BEE technologies included in each pilot
- Strong support and involvement from the US Industrial Advisory Board

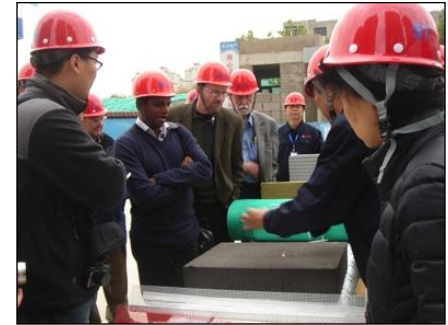
US Engagement:

- Design Review
- Simulation
- IAB's Technologies
- Evaluation





- **Pioneering R&D Consortium**
 - Governments, researchers, and industry
 - Involves key government policy makers
- **Huge Potential Impact**
 - CO₂ emissions reductions
~100 MtCO₂/year by 2025
 - Cost savings of \$2B/ year by 2025
 - U.S. / China construction market ~ 2B square meters (~ \$50B/year)
- **Long Term Platform**
 - Creating opportunities for sustainable U.S. - China R&D on building energy efficiency



U.S. - China Technical Review Meeting, Site Visit

Fundamental Criteria

adopted by U.S. & China:

1. Benefits to both countries
2. Innovative
3. Impact on market
4. Significant reduction of energy demand and carbon dioxide emissions



Energy Savings Opportunities

Presented by

Dr. Robert Nachtrieb

Lead Scientist, Lutron

Chair, CERC-BEE Industrial Advisory Board (US)

Presented at

4th US-China Energy Efficiency Forum

25 September 2013



Save energy with Lutron™

50 Years in Light Control

1961

- Introduced the first electronic dimmer

Today

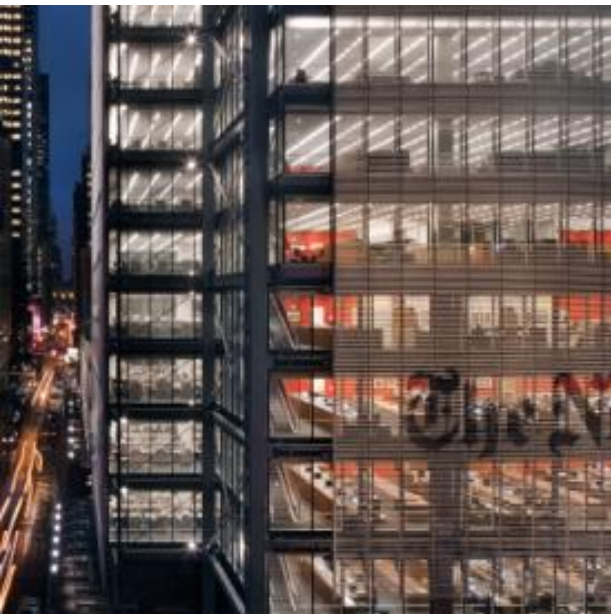
- 15,000 products
- Energy-saving solutions for residential and commercial applications
- Light, shade, temperature, and small appliance control for a single room or throughout a whole home or building
- Convenient control from keypads, wireless controls, tablets, and mobile devices
- Projects in more than 80 countries



Global Presence



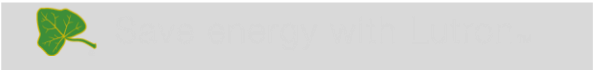
Global Project Solutions – United States



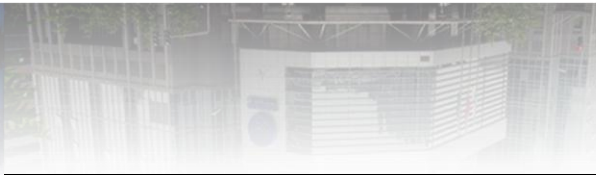
New York Times Building

United States Capitol

NASA, Cape Canaveral



Global Project Solutions – China



**Bank of China,
Beijing**
中国银行总部大楼

**China Mobile HQ,
Beijing**
北京中国移动总部大楼

**Agriculture Bank of China HQ,
Beijing**
北京中国农业银行总部大楼



US-China CERC-BEE

- Joint Research Activities
 - Quantify Energy Savings from different Lighting Control strategies in demonstration facilities
 - Options for Low-Cost installation
- Anticipated Benefits/Outcomes
 - Motivation for development of new technologies
 - Access to China market
 - Future and strengthened collaboration with China
 - Regular joint US-China IAB meetings (First joint IAB mtg. held in Zhuhai, December 2012)



Expandable Solutions

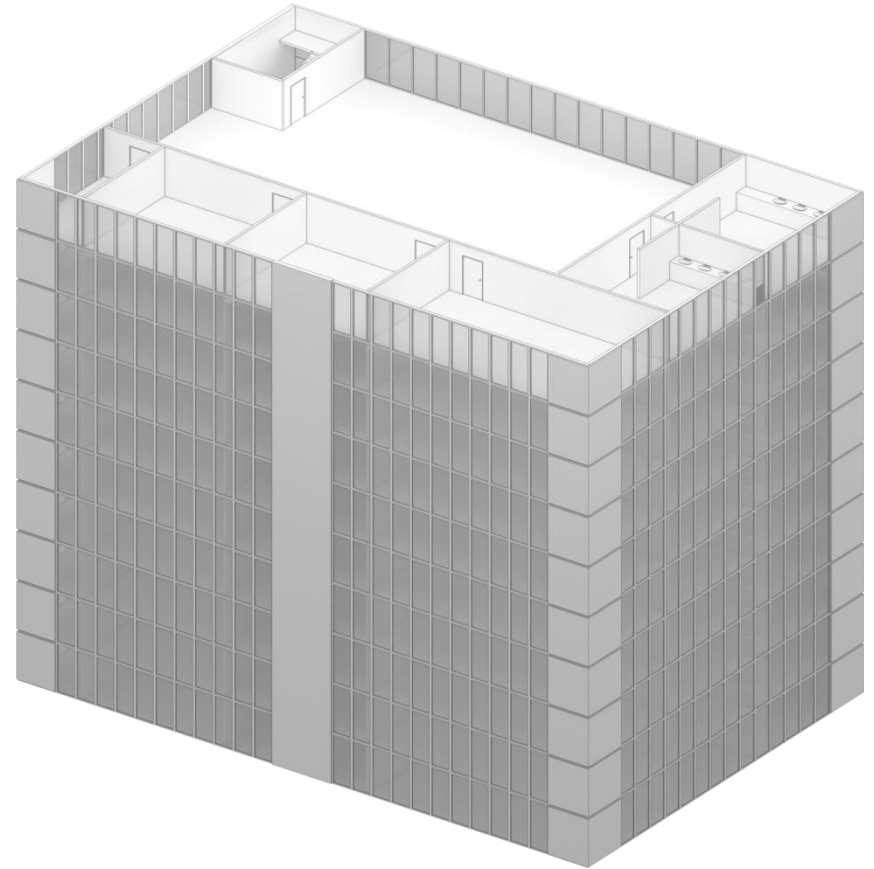
Basic standalone solutions

Single-space solutions

Small area solutions

Multi-room or entire floor solutions

Whole building solutions



Expandable Solutions

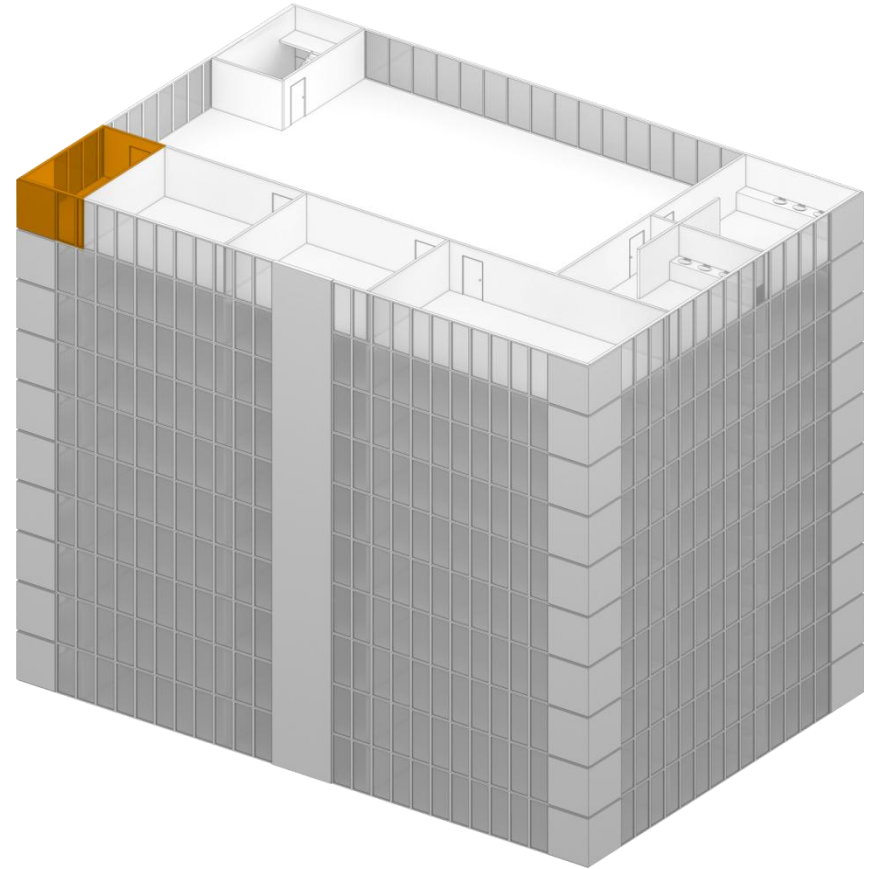
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Expandable Solutions

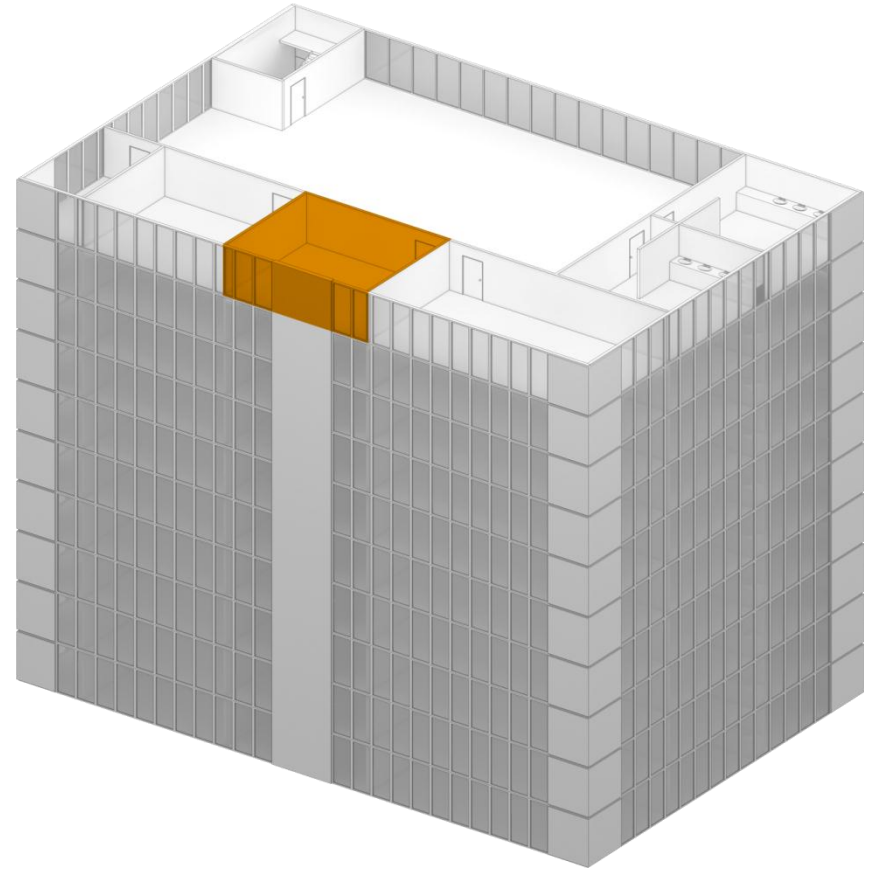
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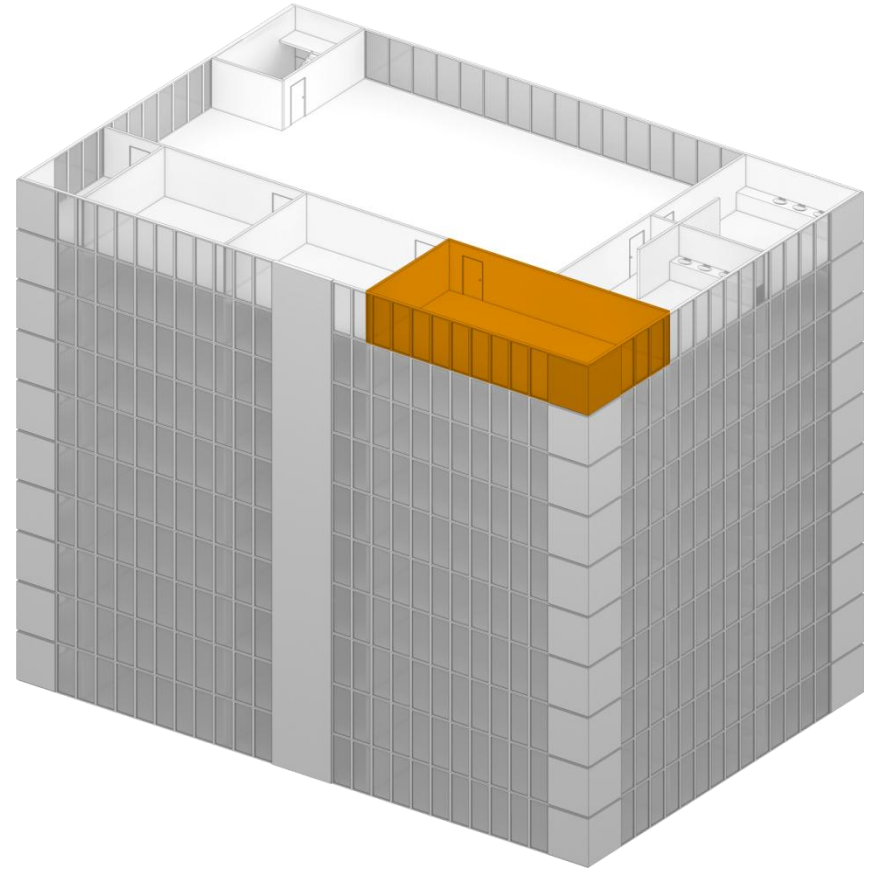
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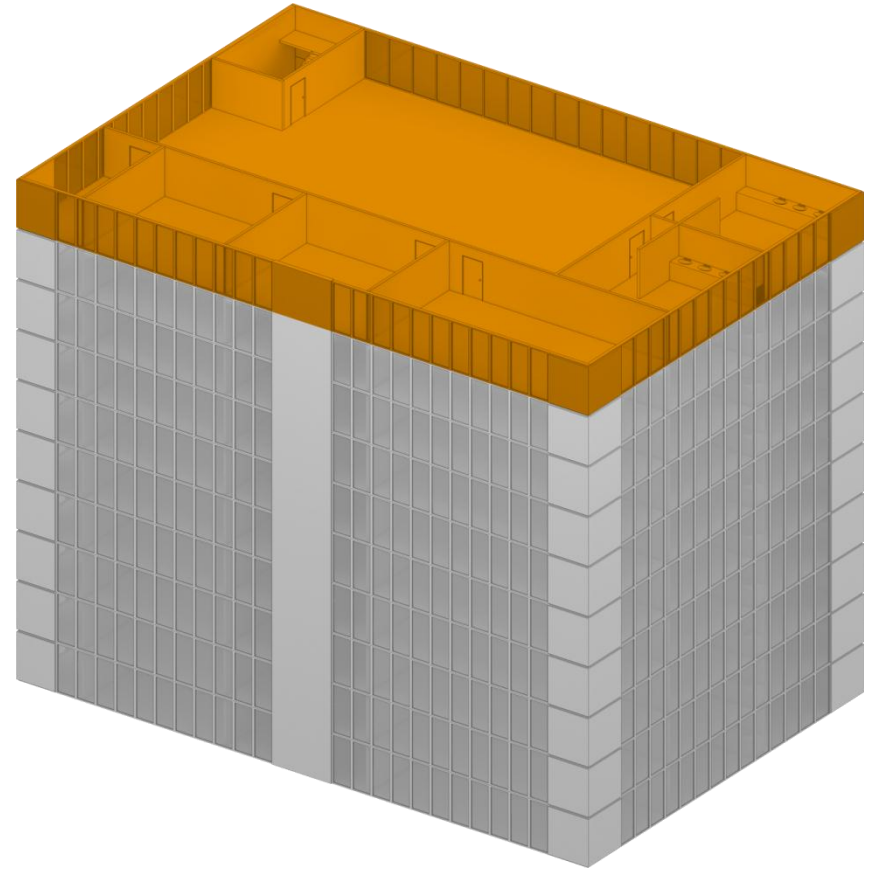
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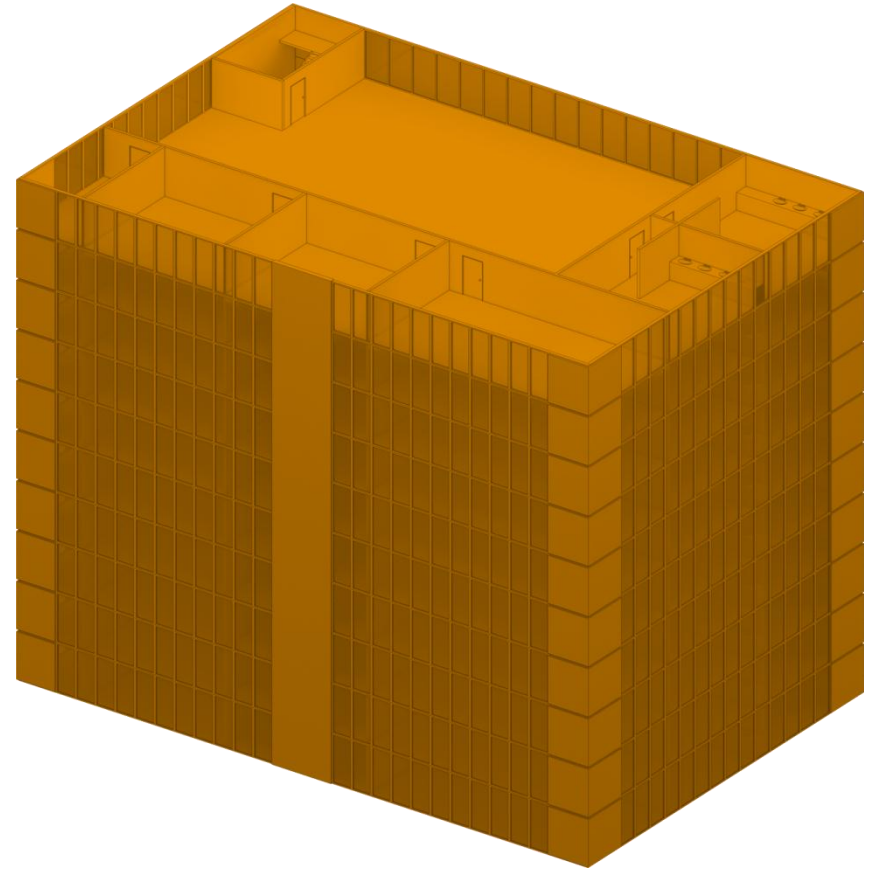
Basic standalone solutions

Single-space solutions

Small area solutions

Multi-room or entire floor solutions

Whole building solutions



Standalone & Single-Space Solutions

switches, sensors, modules

Maestro Wireless® switch



Radio Powr Savr™ wireless occupancy/vacancy sensor



NEW PowPak® dimming module with EcoSystem®



Energy-saving strategies that can be used in the space

Occupancy or vacancy sensing	(15% lighting) ¹
Daylight harvesting	(15% lighting) ²
Appliance control	(15% plug load) ³

Potential lighting energy savings

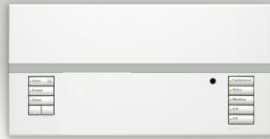
30%



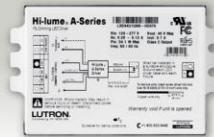
Small Area Solutions

controls, sensors, drivers, shades

GRAFIK Eye® Wireless
with EcoSystem®



Hi-lume® A-Series
LED driver



Sivoia® QS Wireless shades



Energy-saving strategies that can be used in the space

High-end trim	(20% lighting) ⁴
Occupancy/vacancy sensing	(15% lighting) ¹
Daylight harvesting	(15% lighting) ²
Personal dimming control	(10% lighting) ⁵
Controllable window shades	(10% AC) ⁶
Timeclock scheduling	(variable) ⁷

Potential lighting energy savings

60%



Multi-Room and Entire Floor Systems

controls, sensors, ballasts, shades

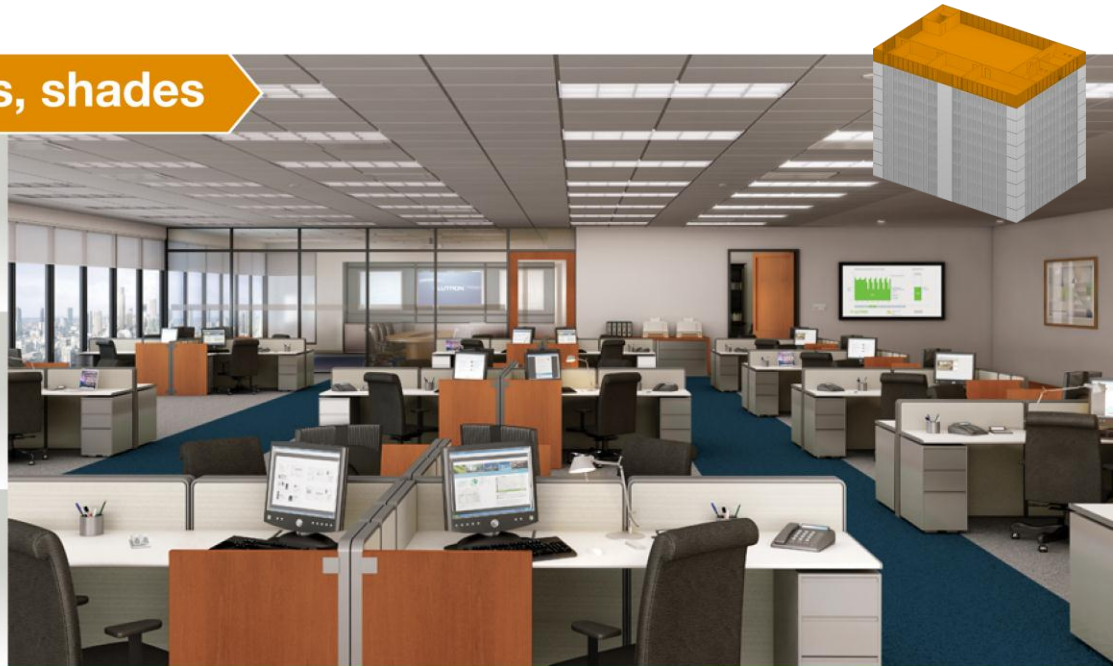
Radio Powr Savr™
wireless daylight sensor



Energi Savr Node™
with EcoSystem®



EcoSystem H-Series
digital dimming ballasts



Energy-saving strategies that can be used in the space

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Personal dimming control	(10% lighting) ⁵
Controllable window shades	(10% AC) ⁶
Timeclock scheduling	(variable) ⁷

Potential lighting energy savings

60%



Whole-Building Solutions

controls, sensors, ballasts, shades, and systems

Quantum® hub and
Green Glance®



Q-Manager™ server



Hyperion™ solar-adaptive
shading with Sivoia® QS shades



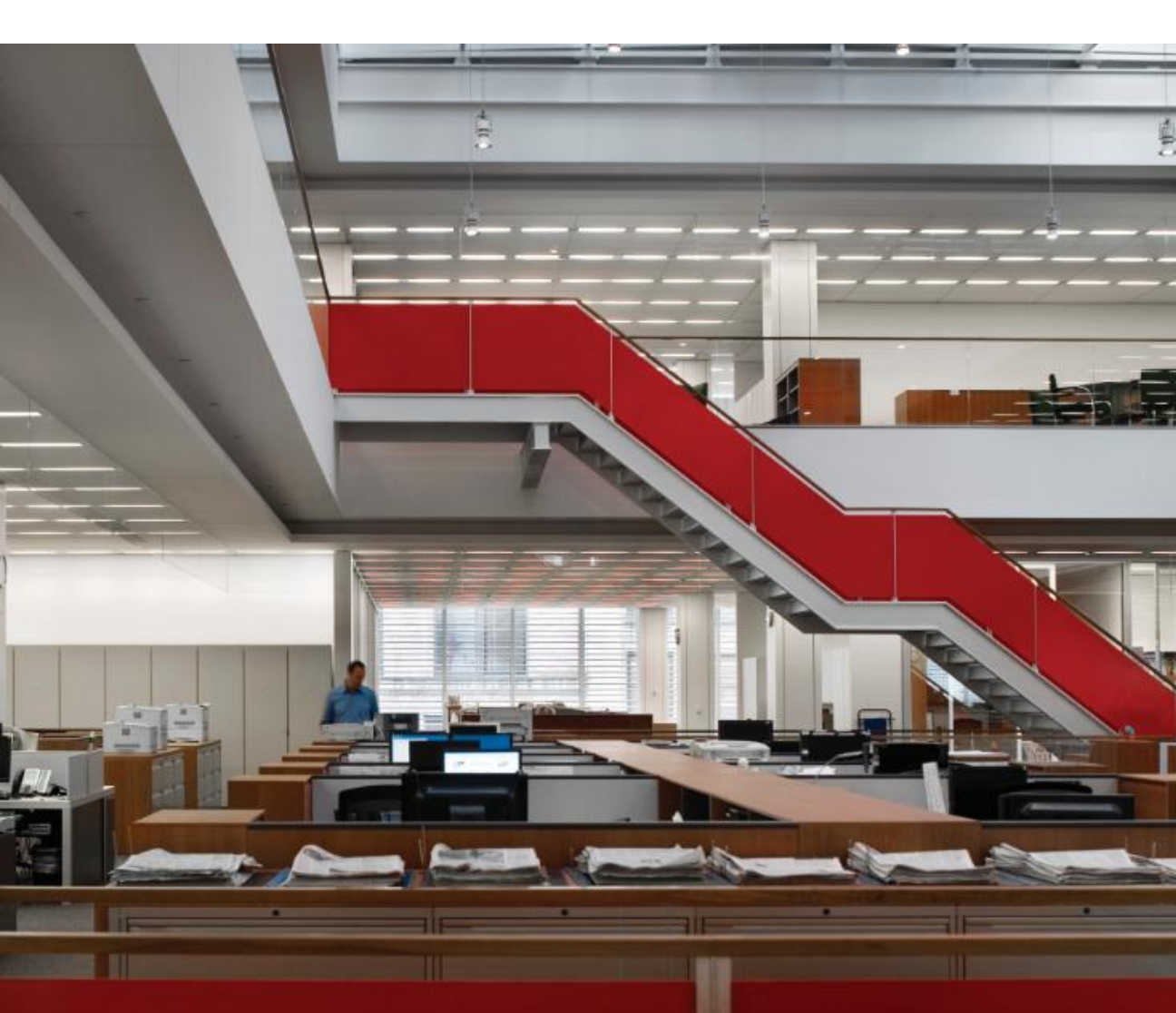
Energy-saving strategies that can be used in the space

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Personal dimming control	(10% lighting) ⁵
Controllable window shades	(10% AC) ⁶
Timeclock scheduling	(variable) ⁷
Demand response	(variable)

Potential lighting energy savings

60% +





Lighting Savings:
3.9 kWh/sqft/yr
(56%)

HVAC Savings:
2.6 kWh/sqft/yr
(51%)

Occupied:
628,000 sqft

Reference: Lee et al, LBNL, 2013
<http://buildings.lbl.gov/sites/all/files/lbnl-6023e.pdf>

New York Times, New York 纽约时报总部大楼



Thank You
rnachtrieb@lutron.com



Industrialized Green Building A State-of-Art Precast Concrete Building

September 25, 2013

Dr. Hongxi Yin, Ph.D.

Chief Technology Officer, Broad Homes Industrial Co.

Director, Digital Laboratory, Broad Homes Industrial Co.

What does Broad Homes Produce?

We produce the following products:

- precast concrete building and component;
- prefabricated indoor components, such as bathroom, kitchen, and MEP system
- automated precast concrete manufacturing lines;

We provide the following services:

- urban planning, architectural and engineering design
- Design Build / General Contractor
- construction management
- green building consultancy





Maximize efficiency in

- Energy
- Material
- Water
- Time
- Labor
- Cash Flow

High Performance Building

Building Operation Performance



70%
Energy Efficiency



80%
Water Saving



20%
Material Saving



Indoor
Environmental
Quality



20%
Land Saving

Production & construction Performance

Labor Saving—90% of the work done by robots and automation manufacturing lines

Time Saving - 70%

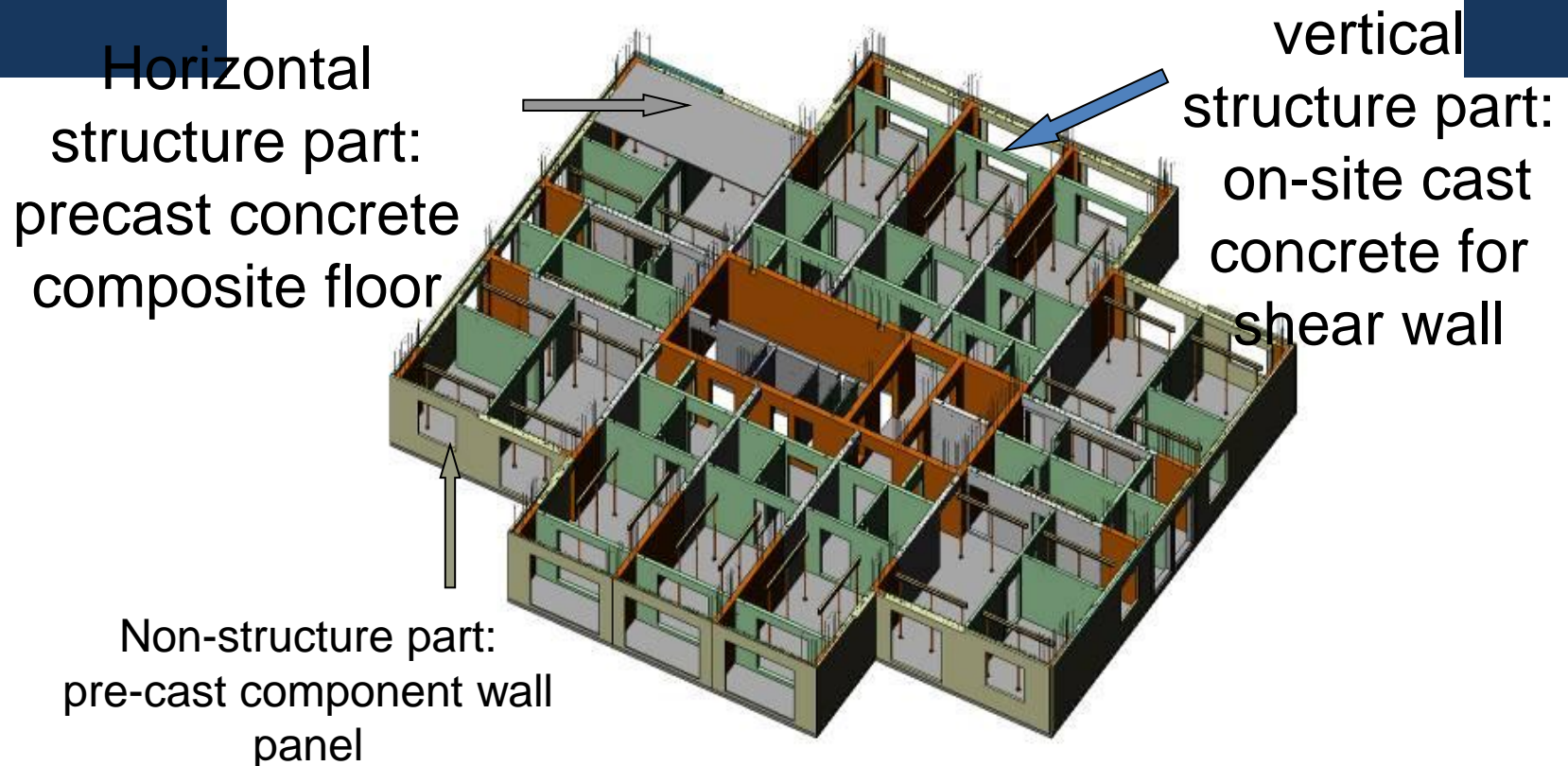
Construction Cost Saving—100% to 200%

First Cost Saving—30%


Industrial Product Quality



High-rise Structure



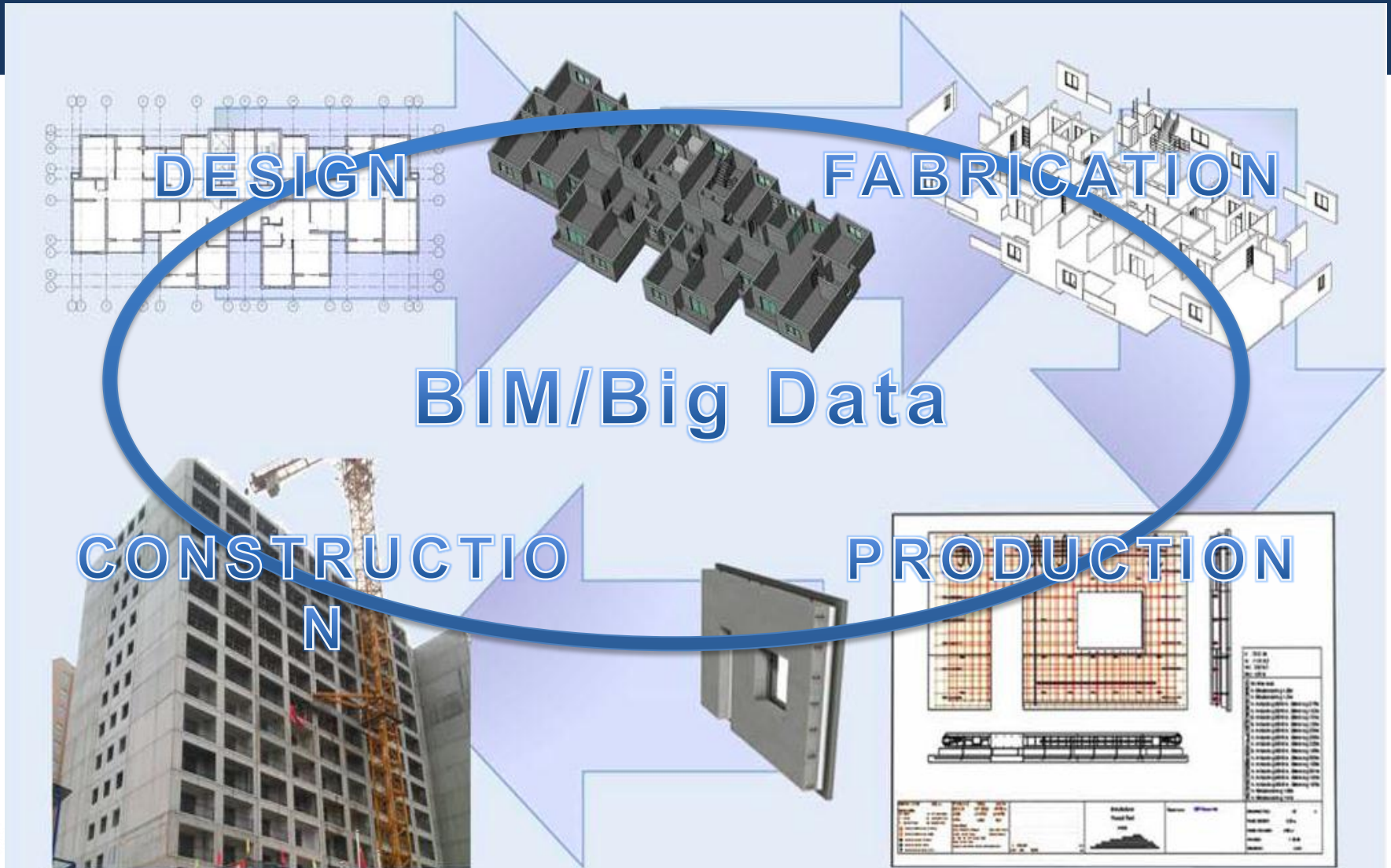
Meet all three National Building Standards:

- "Structural Load Specification" GB 50009
- "Buildings Seismic Design Specification " GB 50011
- "High-rise building concrete structural design Specification" JGJ 3
- All PCI Design Standards and Guidelines (North America) 

Green Interior Finishing



Design Automation



Streamlined Production Line





Dow Chemical Company CERC-BEE Research Program Overview

Overview by Greg Bergtold
Dow Building & Construction

Advantages to Industrial Partners Working within CERC-BEE Program

- Access to World Class Researchers within Lawrence Berkeley and Oak Ridge National Laboratories in a cost share model
- Access to cross section of Research areas within Building Energy Efficiency market segment.
- Access to China Researchers.
- Access to China Developers for demonstration projects to showcase our technologies.



CERC-BEE Task B-3/3-6

Superhydrophobic Elastomeric Roof Coatings CRADA

Dow Chemical: Joe Rokowski, Jeff Hansbro, Ligeng Yin
ORNL: Scott Hunter
LBNL: Ronen Levinson

September 4th, 2013

Superhydrophobic Technology for Cool Roofs Project

Objective

Maintain high reflectance of roof coating materials and their integrity over prolonged exposures (>10 years), giving an increased energy savings (up to 2x) and service life.

Issues

- Asphalt roof products are water resistance but deficient due to low albedo and poor exterior durability.
- Acrylic coatings have excellent reflectance and UV resistance but are only water resistant and not waterproof.
- Reduced reflectance and retained moisture in roof surface coatings due to:
 - Soiling due to dust, dirt, bird droppings, etc.
 - Microbial growth (fungi, moss, bacteria, etc.)

Solution

- Coatings made from Superhydrophobic Extenders (SHE) can prevent roof surfaces from wetting, inhibiting soiling and microbial growth.
- Development of environmentally friendly water based SH coatings.

Technical Development within CERC

- ORNL will continue to provide technical support to Dow in the development and production of SH materials for the company's latex based cool roof paint development effort.
- ORNL will develop an accelerated microbial testing protocol and test facility to test proposed new modified SH materials and coatings.
- ORNL will continue internal development work on the coating optimization and testing of panels with SH coatings
- Dow will substantially increase S.H. in aqueous coatings by direct blending or through reformulation to achieve higher water resistance properties.
- Dow, ORNL and LBNL will characterize coupons coated with these acrylic resins for water repellency and optical properties

Commercial Impact Expected

Quantification & demonstration of cool roof benefits in the US and China.

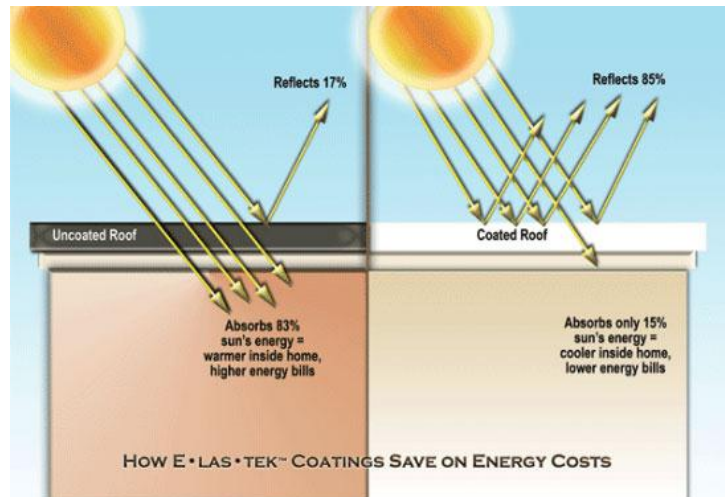
Widespread use of cool roofs in China and the US

- About 50% of the population in both countries live in hot-summer climates.
 - Could upgrade 3B m² of roofs by 2025 at no cost (end-of-service-life replacement).
 - Saving 120 TBTU/y source energy and with a reduction of 10 Mt/y CO₂.
- The estimated global market size for roof coatings is estimated to be \$800M with an annual growth rate of 3-5%.



Accomplishments to Date

- Dispersability of ORNL SH Extenders into aqueous acrylic roof coatings can be achieved using dispersants and high shear mixing.
- Significant improvement in dirt resistance, a surface property, was demonstrated





■ CERC-BEE Liquid Flashing Project Update

Jeff Hansbro, Katherine Faber, Diana Hun
September 4th, 2013

Progress in Development of IP and Commercial Impact Achieved for Liquid Flashing

- Residential launch for window flashing has occurred in U.S. Market in 2013
- The estimated market size for flashing materials used around the rough window openings and over board joints in the commercial construction market is \$143MM.
- Next development phase is in Commercial Weather Resistive Barrier markets and flashing markets

Planned Participation in China Demonstration Projects

- Proposals have been submitted to participate in the CABR (Beijing), Rixin Tech (Wuhan) and Kelong Insulation (Jilin) demonstration buildings.
- The partnership is subject to Dow and ORNL deciding after we get construction details, sequencing and timing, if the demo building is appropriate for the proposed Liquid Flashing.



Accomplishments To Date and By End of CERC-BEE

- The team has conducted voice of the customer, refined the scope of the project and defined application CTQ's for the Liquid Flashing coating for both the US and China.
- By the end of CERC-BEE, a sprayable, waterborne Liquid Flashing will be sold into the US residential and commercial construction markets. Features of this flashing include competitive cost, ease of installation and durability. The flashing has the potential to greatly decrease energy consumption by improving air tightness and durability of US homes and buildings.



Questions?