The Role of Nature in our Future Built Environment
BUILDINGS OF THE FUTURE SCOPING STUDY: PANEL DISCUSSION

2–3:30PM (ET) / 11–12:30AM (PT)
March 18, 2015

MODERATOR:
Nora Wang, Ph.D, LEED AP (Pacific Northwest National Laboratory)

PANELISTS:
Mary Ann Lazarus, FAIA, LEED AP BD+C (HOK)
Chris Garvin, AIA, LEED AP BD+C (Partner, Terrapin Bright Green)
Thomas Knittel, AIA, LEED AP BD+C (Design Principal, HOK Los Angeles)

Project Website Updates

Visit us at futurebuildings@pnnl.gov

New Project Brochure (including an overview, panel discussion guide, and upcoming events)

A Research Framework to guide our vision development
https://spcollab.pnnl.gov/sites/fb/SiteAssets/Buildings%20of%20the%20Future_20150303.pdf

Our Partners
Agenda

- Overview – 10 minutes
  - “Buildings of the Future” Scope and Research Framework

- Panel Presentations – 35 minutes
  - Strategies of Resilience: Drawing from Natural Systems
  - Biophilia: Seeking the Bond Between the Built Environment and Other Living Systems
  - Biomimicry: Drawing Inspiration from Natural Systems

- Panel Discussions – 15 minutes
- Interactive Discussions (with webinar attendees) – 25 minutes
- Summary and Upcoming Events – 5 minutes

Scope

The Buildings of the Future Scoping Study will develop a vision for what U.S. mainstream commercial and residential buildings could become in 100 years.

Essential factors that should be measured or tracked to ascertain building quality:
- Energy and water consumption
- Greenhouse gas emissions and other waste
- Material use
- Resilient design
- Occupants’ health and productivity
- Cyber and physical security

Topics that indirectly impact the long-term trajectory of buildings:
- Modes of urban transportation
- Grid modernization
- Information technology development

Actors and infrastructure that influence the way buildings are designed, built, and operated:
- Utility infrastructure
- Real estate market dynamics
- Occupant needs
- Building control and communication
- Regulations
- Construction and procurement
- Environmental concerns
Building Stock Turnaround

Today's average building
High efficiency building (>10 years old)
Zero net energy building
Zero emission building
"Future building" 1.0
"Future building" 2.0

TODAY 2030 (in 15 years) 2050 (in 35 years) 2080 (in 65 years) 2115 (in 100 years)

Commercial (Based on CBECS 2012 Preliminary Data)

Residential (Based on RBCS 2009 Data)

Assuming 80 years of average service life; NOT including added building volume.

An Integrated Vision

The path is unclear due to the lack of an integrated vision.

Group 1
-Identified metrics (how to measure)
-Quantitative targets (what to achieve)
-Mostly known processes (how to achieve)
-Some overlaps

Group 2
-Identified metrics
-Quantitative targets
-Partially known processes
-Little overlap

Group 3
-Unclear metrics
-Qualitative targets
-Learning process
-Some overlaps
A Proactive, Coherent Paradigm

Energy and Building Services
(Today’s model)

Polling Questions # 1, 2, 3
Future Context

✿ Environment and Climate Change
According to the Intergovernmental Panel on Climate Change's Fifth Assessment Report (IPCC 2014), many aspects of climate change and associated impacts will continue for centuries, even if anthropogenic emissions of greenhouse gas are stopped. It is very likely that:

- heat waves will occur with a higher frequency and longer duration;
- occasional cold winter extremes will continue to occur;
- mean precipitation will decrease in dry regions;
- sea level will rise in more than about 95% of the ocean area;
- climate change will undermine food security and reduce renewable surface water and ground water resources in most dry sub-tropical regions.

✿ Population Growth
Population in the U.S. is projected to increase from 321 million in 2015 to 420 million in 2060 (U.S. Census Bureau, 2014) and 462 million in 2100 (United Nations, 2012). In 2014, 81% of the population lived in urban areas; in 2050, 87% will live in urban areas (United Nations, 2014)

STRATEGIES OF RESILIENCE
DRAWING FROM NATURAL SYSTEMS
Mary Ann Lazarus, FAIA, LEED AP BD+C
HOK
Resilience

The Role of Nature in Our Future Built Environment:
RESILIENCE

3.8 Billion Years x 30-100 Million Species = Highly Adapted Design
EARTH’S OPERATING CONDITIONS

- Earth is Water-Based
- Earth is Subject to Limits and Boundaries
- Earth is in a Dynamic State of Equilibrium
RESILIENCE IS....

**Ecosystem resilience** is a measure of how much disturbance an ecosystem can handle without shifting into a qualitatively different state. It is the capacity of a system to both withstand shocks and surprises and to rebuild itself if damaged.

Stockholm Resilience Centre
RESILIENCE IS....

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Stockholm Resilience Centre

the capacity to adapt to changing conditions and to maintain or regain functionality and vitality in the face of stress or disturbance.

The Resilient Design Institute

ACUTE v CHRONIC

Acute

Chronic

Source: A Framework for Resilient Design

Etkew+Dumeez+Ripple

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SURVIVABILITY

PROTECT

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SEEKING THE BOND BETWEEN THE BUILT ENVIRONMENT AND OTHER LIVING SYSTEMS

Chris Garvin, AIA, LEED AP BD+C
Partner, Terrapin Bright Green

Biophilia

Biophilia is humankind’s innately biological connection with Nature.
Biophilia

Connect Humans to Natural System

Biophilia

PRIVATE SECTOR OPERATING COSTS

PRODUCTIVITY COSTS ARE 87 TIMES GREATER THAN ENERGY COSTS IN THE WORKPLACE.

ENERGY 0.8%
REN 8.9%
ABSENTEEISM 2.7%
PRESENTEEISM 1.3%
UNPRODUCTIVE SALARIES & BENEFITS

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NATURE IN THE SPACE
PLANTS, WATER, AIR, LIGHT, AND ANIMALS IN THE BUILT ENVIRONMENT

NATURAL ANALOGUES
OBJECTS, MATERIALS, AND PATTERNS THAT EVOKE NATURE
NATURE OF THE SPACE
DIFFERING SPATIAL CONFIGURATIONS OF THE BUILT ENVIRONMENT

Establish Ecological Functions and Processes On-site and Align The Built Environment To Regional Ecosystems
Biophilia

Integrate Outsourced Ecosystem Impacts Into Design Planning and Decision Making
Biomimicry: Drawing Inspiration from Natural Systems

Thomas Knittel, AIA, LEED AP BD+C
Design Principal, HOK Los Angeles

biomimicry
2. Water

From Nature to Built Environment

- Photosynthesis: Energy conversion from sunlight to chemical energy
- Osmosis: Water movement through membranes
- Archimedes' Principle: Buoyancy and floatation
- Convection: Heat transfer through fluid motion
- Allometry: Proportional growth
- Heat Pump System: Energy efficient heating and cooling
- Composite Panel: High-strength, lightweight materials
- Solar Energy: Conversion of sunlight to electricity
- Construction of Glass Buildings: Structural and thermal properties
- Energy Efficiency: Reduced energy consumption
- Ventilation: Improved indoor air quality
- Rainwater Harvesting: Sustainable water management

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biomimicry
Biomimicry

Building Character: Option 1

Fractal
Systems of self-similar parts from macro to micro

Concept Principles

Distribution of Green Rooms: distributed porosity
Biomimicry

1 kg of recycled plastic replaces 100 kg of concrete. Low cost and sustainable.

Weaving and void forming soils and concrete.

Newwood technologies.
Expected Outcomes

This vision development will explore:

- the dynamic, multi-dimensional resource and information exchange within and between buildings, utility infrastructure, environment, and occupants;

- the ‘value-added’ opportunities that come from understanding the human/building interface;

- a full suite of comprehensive, transparent building performance metrics to describe the value proposition of future buildings.
Upcoming Events

March 30
IEA EDC Annex 66 Expert Meeting (Berkley, CA)
Clint Andrews/Rutgers
Steve Solkowitz/LBNL
Cary Chan/Swire Properties
Hui Zhang/UC Berkeley CBE
Led by: Jared Langewisch/DOE
Occupants Behavior and Enabling Technologies

April 2
Living Future unConference (Seattle, WA)
Panel Discussion (Morning)
Nora Wang/PNNL
Pat Phelan/DOE
Steve Shankho/PNNL
Workshop (Afternoon)
PNNL partnered with ZGF Architects,
New Building Institute, EcoDistricts
Building-Grid Integration
Connected Building
Districts
Information Technologies
Real Estate Market Dynamics

April 14
DOE BTO Peer Review Meeting (D.C.)
Dave Rouse/DOE
Jason Christopher/DOE
Liz York/CDC
Nora Wang/PNNL (Moderator)
Urban Planning
Security
Public Health

May 4
New York City Workshop
Led by:
Edward Bogucz & Chenna Chiamise/Syracuse CoE
Jorge Gonzalez/CUNY
Masood Ghandehani/NYU
William Wexler/Stony Brook University
Occupants
Smart City
Urban Informatics
Building Controls

THANK YOU!

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Proposed Propositions

1. Physical, financial, and social integration via robust communication
   • An integrated view of the links and hierarchies between the various aspects of buildings will help the building community create harmonious solutions.
   • A fully integrated vision includes the technical, economic, societal, and environmental aspects of building design, construction, and operation.

2. Anticipatory and participatory buildings at district level
   • Buildings of the future need to anticipate the changing landscapes. These include new building typologies, ownership, building development process, etc.
   • A community of buildings may provide greater capability, reduce environmental burdens, and effectively and sustainably use limited natural resources.

3. Scalable technologies and processes
   • A scalable solution calls for new measures of return (to people, community, and society), measures of wellbeing, and new value propositions based on complete, reliable building performance data.
   • This vision development effort will emphasize a norm for buildings in the future.