Integrated Systems – Industry Needs and Approaches
Our Requirements

Our Drivers

Minimize Energy Use

Maximize Comfort, Productivity

Maximize Operating Bottom Line

Buildings Today
Inefficient, Static
High energy use
High peak demand

Annual Energy Use Today
106 kBtu/ft² (9.6 MJ/m²)

Future Buildings:
Efficient, Dynamic
50-80% less energy
Integrates with grid

Sensor Rich
Integrated / Networked
Flexible / Dynamic
Model-Based Control

Annual Energy Use in 2030
53 kBtu/ft² (4.8 MJ/m²)
## Challenges

**Whole building solutions** difficult to determine energy and comfort performance, interactive effects, and integration issues ahead of commitment at full building scale.

**Simulation tools** have not been validated.

**New technology performance not validated**

## Challenges

**Component level ET reaching cost-effective maximum potential**

**System level ET presents untapped deep energy savings** but don’t fit their program design.

**Field demos unsuited for systems assessment** – too complex and variable.

## Market Challenges for Deep EE at Scale

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<th>Utilities</th>
<th>Owners, Operators, Designers, Contractors</th>
<th>Manufacturers</th>
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<td><strong>Challenges</strong></td>
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<td>• Integrated systems and solutions are not packaged for market – technologies are very siloed by end use (HVAC, lighting, etc.)</td>
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<td>• Products and solutions need validated performance against baselines for integration into codes and standards</td>
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<td>• Design tools need to accurately represent ET</td>
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GPA – Transforming All Buildings

Public Private Partnership for Sector Transformation, a new market enabling business model

Opportunity to lower energy costs is $1.2 Trillion*

Energy Efficiency holds the most promise for GHG reduction: 10 – 15% of US emissions.

For Market Transformation, we cannot be Business as Usual
Dynamic Communication and Aggregation

Enable new markets
Oh My!
Here’s What We Say!

Bring it on!
I can do this all day
New Initiatives Will Deliver, Guarantee and Maintain Performance

Guaranteed Performance

Integrated Systems

Internet Building Operating Systems

MEASURED EUI vs. DESIGN EUI

0 20 40 60 80 100 120

0 2 4 6 8 10

100% 80% 60% 40% 20% 0%
Persistence of Value = Market Impact

Standardized Practices for Risk Analysis and Management

Performance monitoring and uncertainty analysis
Business and financial modeling and risk analysis
Legal and contractual frameworks

ENABLING GUARANTEES FOR EVERYONE

NEW CAPITAL

LOW TRANSACTION COSTS

NEW BUSINESS MODELS

NEW REVENUE

A Vast New Market of Products and Services for Guaranteed Performance

Performance insurance for vendors and service providers and more....

ESPCs for everyone, not just MUSH market

enables

resulting in

Increased Investment in Building Performance

Better Performance Persistence and Assurance
Evolution of Operating Systems

Windows  Linux  Android  iBOS
Internet Building Operating System

Services Manager:
- Energy Management
- Financial Analytics
- Grid Communications & Resources
- Visibility & Analytics
- Diagnostic & Resource Management

Application Layer:
- Security Functions
- Scheduling
- Caching & Logging
- Weather

REST API Layer:

Component API Layer:

Abstraction Layer:
- High Speed Low Latency Messaging
- Hardware Abstraction & Presentation

Adaptation Layer:
- Lighting
- HVAC
- Envelope
- Storage
- PV

Create Allocate Analyze Integrate
Integrated Systems Enhance Building Value

Reduce energy & costs – portfolio approach
Increase employee productivity
Capitalize on long-term financial value
Create new revenue opportunities
Enhance deployed asset value

Networked & Optimized Integrated Systems

Src: Graphic Concept Schneider Electric
System in Integrated System

- **Multiple components** coupled together with controls
  - Rooftop units coupled with energy recovery ventilators
  - Dimmable lights coupled with automated shades
- **End use distributed systems** (HVAC, lighting, etc.)
  - Zonal lighting systems
  - HVAC airside distribution systems – Air handlers, ducts, terminal units, dampers, diffusers
  - HVAC wetside distribution systems – Pumps, valves, coils
  - HVAC central plants
    - Cooling tower & pumps, Chiller & pumps
    - Cooling tower coupled with chillers
- **Whole building systems** integration
  - HVAC systems integrated with automated shades & occupancy controls
  - Power distribution systems - DC power, lighting integrated with renewables, efficient transformers
- **Grid integration systems**
  - Building to Grid, e.g. demand response, energy storage
  - Building to EV
Develop, test and validate IS technologies
• Deployable packages of IS technologies and controls
• Adaptive, flexible, networked controls strategies for DSM, DR, grid and building service management

Develop, test and validate Integrated networked sensors and sub-metering
• Serve multiple system needs, measurement of building services, quality of environment
• Sensing and measurement strategies, data analysis methods and algorithms

Develop and validate simplified methods for deployment
M&V strategies for utilities and regulators
Evaluation tools for utility DSM programs and REEOs
Design and delivery methodologies and practices for large and SMBs
Making it Possible - FLEXLAB™ @ LBNL

FLEXLAB™, DOE’s unique facility

• Developing and applying new test methods and solutions for **highly-efficient, integrated building systems** under realistic operating conditions

• Our focus
  
  – **Systems integration** at end use, whole building, and grid interaction levels
  
  – **End use integration and component interactions** (e.g., HVAC, lighting, windows, envelope, plug loads control systems)
  
  – **Controls hardware and sensors**
  
  – **Simulation and tools** for design through operations

• Commercial buildings focus, with applications relevant to retail, educational, multi-family
  
  – New construction and retrofit

• Energy efficiency studies, including thermal and visual comfort and occupant engagement
FLEXLAB Comparative Testing Made Possible

**Controlled environment**
- Capabilities to simulate other climates, sun angles
- Controlled internal loads

**Well instrumented and metered facility**
- High granularity of power measurement
- High accuracy sensors – temperature, pressure, air and water flow, heat flux, etc.

**Highly flexible test-beds – interior and exterior**
- HVAC, lighting, glazing, skylights, shading, etc.

**Mockup new construction and retrofit conditions**
- First fit outs represent 1980s, current code and net zero

**Provides access to multiple flexible systems**
- Many manufacturers don't have testing facilities to integrate controls with other systems
Engagement – Genentech & Webcor

• Performance based mockup of 250k sf building
• **Optimization** of shading, lighting, controls systems, interiors design for energy use, visual and thermal comfort
• Pre-vetting of O&M needs of systems, opportunities for improvement
• Pre-Cx system review – accelerate the commissioning process in construction
• Constructability experience with systems

https://www.youtube.com/watch?v=hZ_5sJswyz4
What Did We Learn – Genentech & Webcor

- Lower energy building design, **optimized comfort**, lowered construction and operating costs – **Real estate and space Recovery**
- **Thermal comfort** improvement shading, interior layout, occ
- **Light quality and visual comfort**

East Facing, Automatic Shading
GPA – Accelerating Depth Speed Scale

“Multi discipline, Multi vendor market forum for Sector transformation from slow, fragmented, expensive to Faster, Better, Cheaper”

“We need to add momentum to new technology adoption”
— Stephanie Rico, VP, Environment, Wells Fargo

“FLEXLAB is about improving certainty and reducing risks”
— Jes Pedersen, CEO, Webcor

“13% as Class A Commercial stock is green, we need to address the rest of 87%”
— David Pogue, Head of Global Sustainability, CBRE
Small Business Voucher Pilot Program
DOE Small Biz Voucher Pilot Program

• Solicitation released in March
  – $19.3M in prospective funding
  – 3-5 Labs will be awarded “pilot lab” status

• Funding per lab will be $2M – 7.5M
  – This will fund research up to $300k per research project
  – 20% cost-share is required

• Timing
  – Deadline for submission was Monday 4/27
  – Proposal Review/Determinations: Mid-June 2015
  – Launch of successful lab pilots between Aug/Oct 2015
Thank you!

Alecia Ward
Program and Business Development
Energy Technologies Area
Lawrence Berkeley National Laboratory
award@lbl.gov
(510) 486-4540