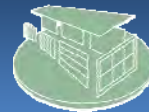


# Integrated Systems – Industry Needs and Approaches



U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



**FLEXLAB**  
FACILITY FOR LOW ENERGY EXPERIMENTS IN BUILDINGS

**GLOBAL PARTNERSHIP ALLIANCE**

# Our Requirements

## Our Drivers

Minimize **Energy Use**

**Buildings Today**  
Inefficient, Static  
High energy use  
High peak demand

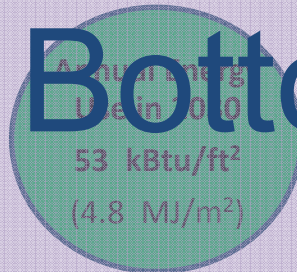
Sensor Rich  
Integrated / Networked  
Flexible / Dynamic  
Model-Based Control



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

Maximize **Comfort, Productivity**

Maximize **Operating Bottom Line**



# Market Challenges for Deep EE at Scale

## Utilities



### 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

## Owners, Operators, Designers, Contractors



### 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**

## Manufacturers



### Challenges

- **Integrated systems and solutions are not packaged for market** – technologies are very siloed by end use (HVAC, lighting, etc.)
- Products and solutions need **validated performance** against baselines for integration into codes and standards
- **Design tools** need to accurately represent ET

# GPA – Transforming All Buildings

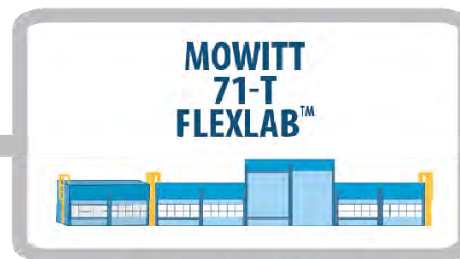
## OUR FUTURE



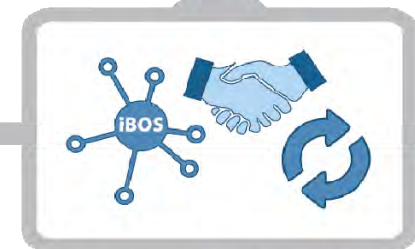
Public Private **Partnership** for Sector Transformation, a new **market enabling** business model



**PARTNERING WITH INDUSTRY TO ACCELERATE SOLUTIONS**



**LBNL WORLD CLASS RESOURCES**



**MARKET MOVING INITIATIVES**



**CURRENT PROBLEM**

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



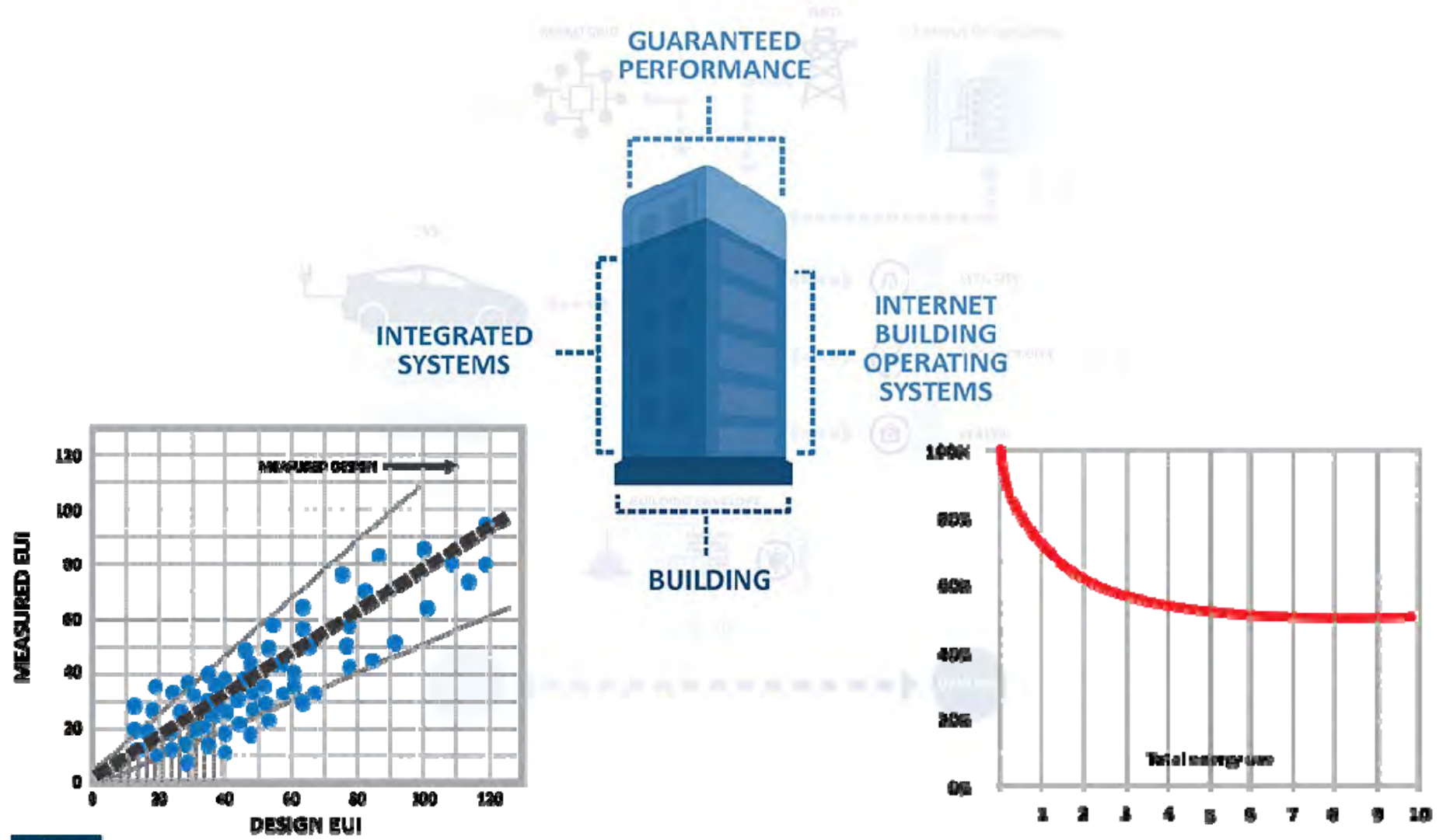
Oh My!



# Here's What We Say!



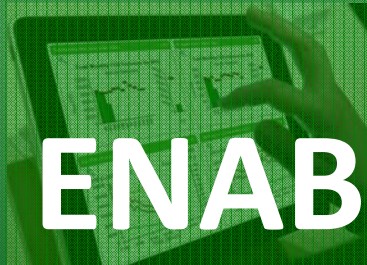
# New Initiatives Will Deliver, Guarantee and Maintain Performance





# Persistence of Value = Market Impact

Standardized Practices for Risk Analysis and Management



## ENABLING GUARANTEES FOR EVERYONE

Performance monitoring  
and uncertainty analysis

Business and financial  
modeling analysis

Legal and contractual  
frameworks

*enables*



### NEW CAPITAL

A Vast New Market of Products and Services for Guaranteed Performance

### LOW TRANSACTION COSTS

Highly performing products and services for everyone, not just MUSH market

### NEW BUSINESS MODELS

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

*resulting*



### NEW REVENUE

Investment in  
Building Performance



Better Performance  
Persistence and Assurance



# Evolution of Operating Systems



Windows

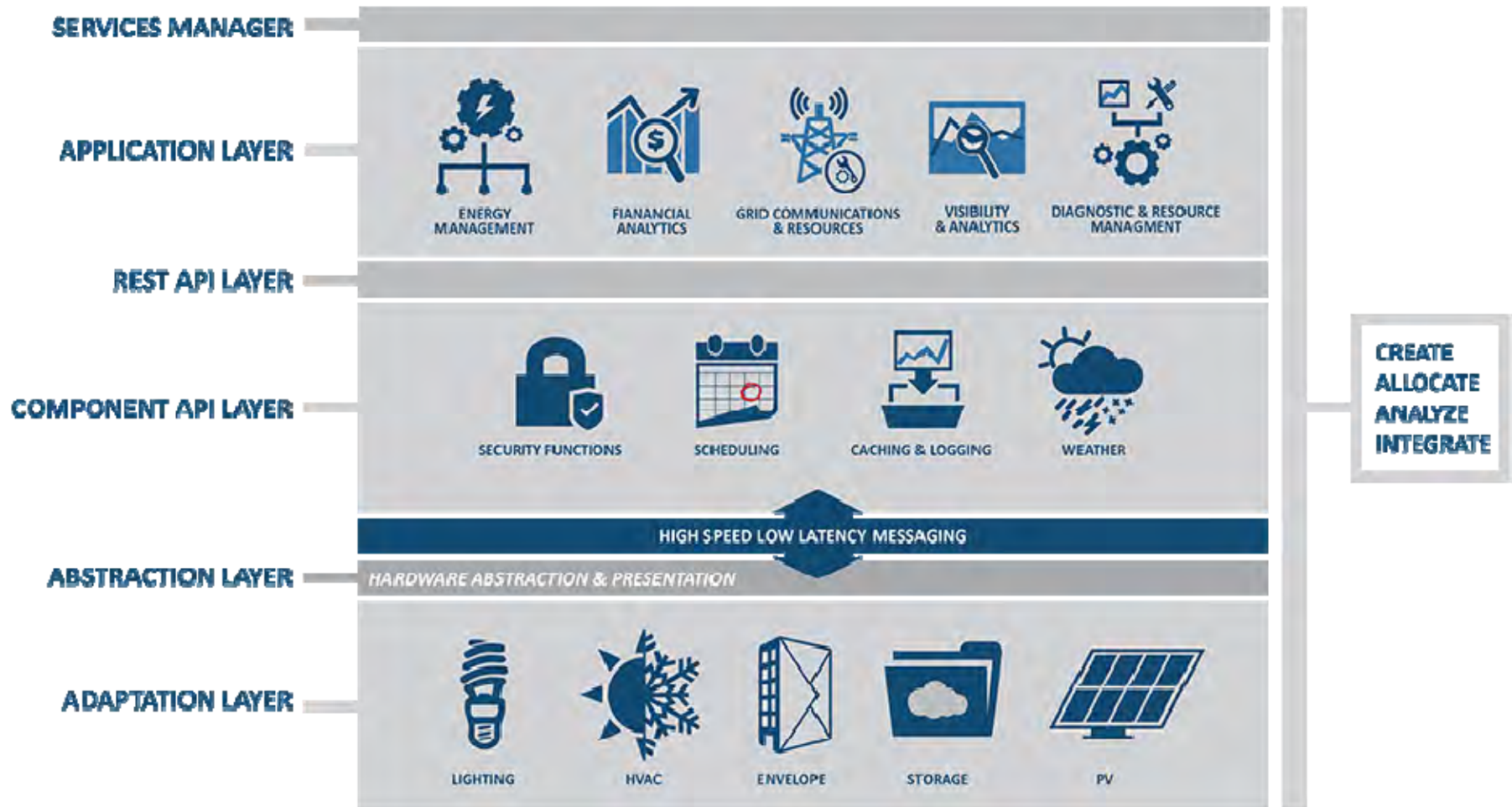
Linux

Android

iBOS



# Internet Building Operating System



# Integrated Systems Enhance Building Value

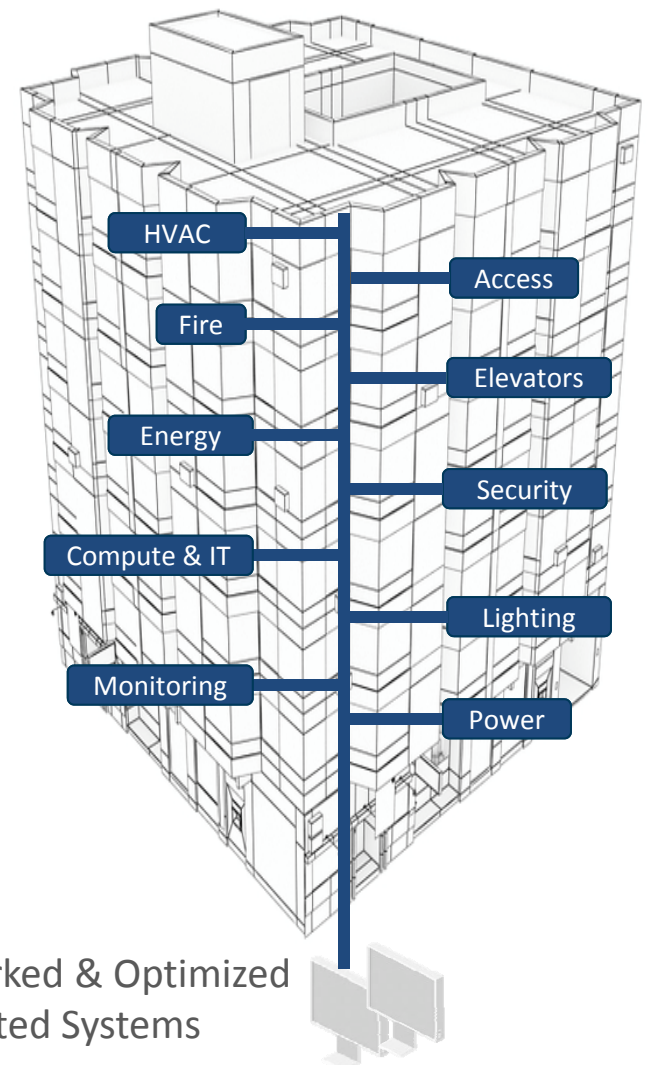
Reduce energy & costs – portfolio approach

Increase **employee productivity**

Capitalize on **long-term** financial value

Create new **revenue opportunities**

Enhance deployed asset **value**



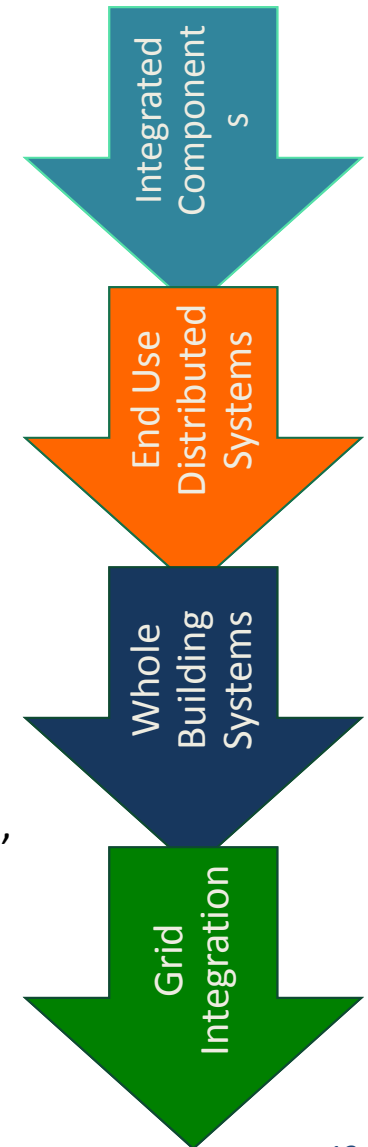
Networked & Optimized Integrated Systems

Src: Graphic Concept Schneider Electric

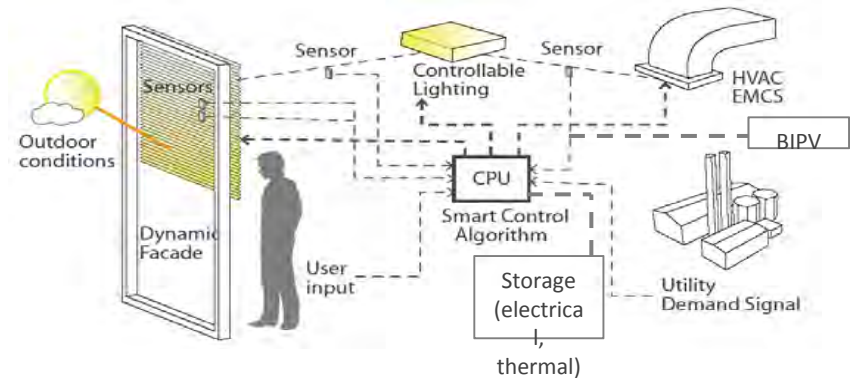
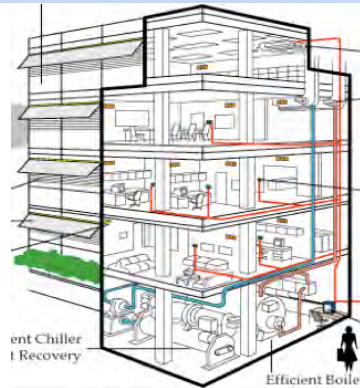


# System in Integrated System

- **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



# Integrated Systems – Systematic Approach



Technology

## 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

Delivery

**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™: THE WORLD'S MOST ADVANCED BUILDING EFFICIENCY TEST BED



**FLEXLAB CLOSES THE ENERGY-EFFICIENCY ACHIEVEMENT GAP FOR BUILDINGS**

[FLEXLAB.LBL.GOV](http://FLEXLAB.LBL.GOV)

*This facility could be the most important building in the country.*

JES PEDERSEN  
CEO, WEBCOR BUILDERS



# 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

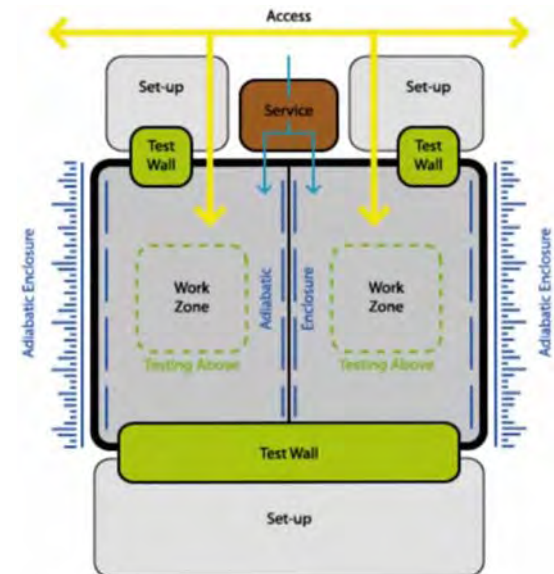
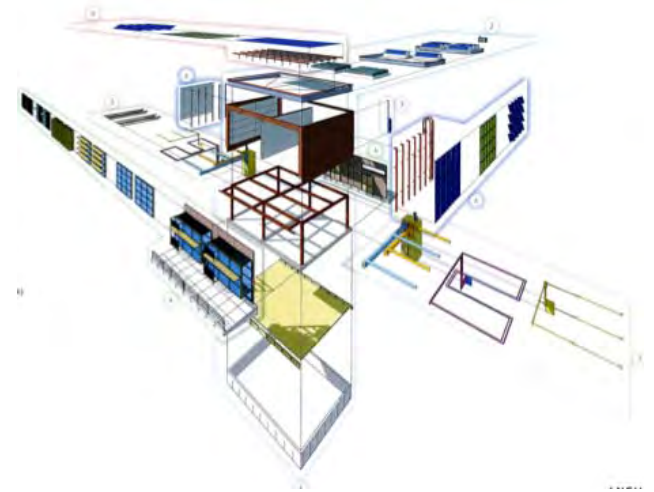
- HVAC, lighting, glazing, skylights, shading, etc.

## 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



Getting Comfortable with Energy Efficiency

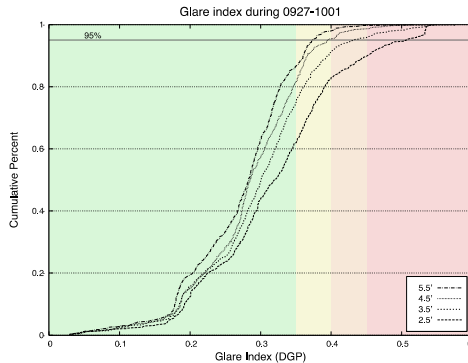
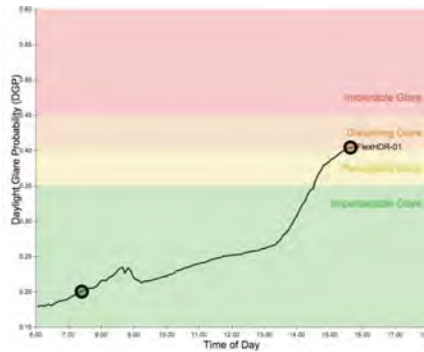
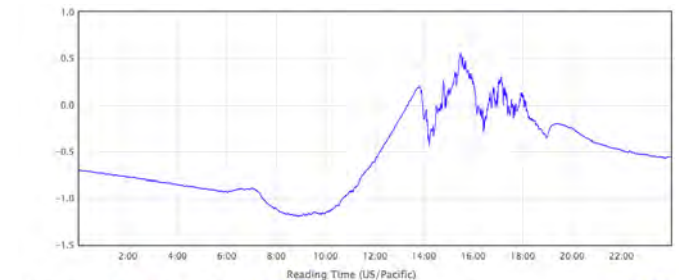
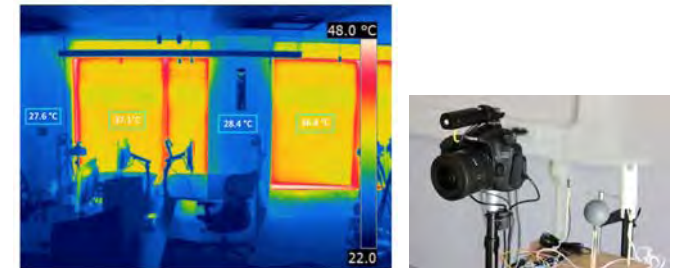


[https://www.youtube.com/watch?v=hZ\\_5sJswyz4](https://www.youtube.com/watch?v=hZ_5sJswyz4)

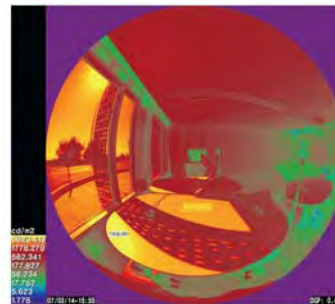


# What Did We Learn – Genentech & Webcor

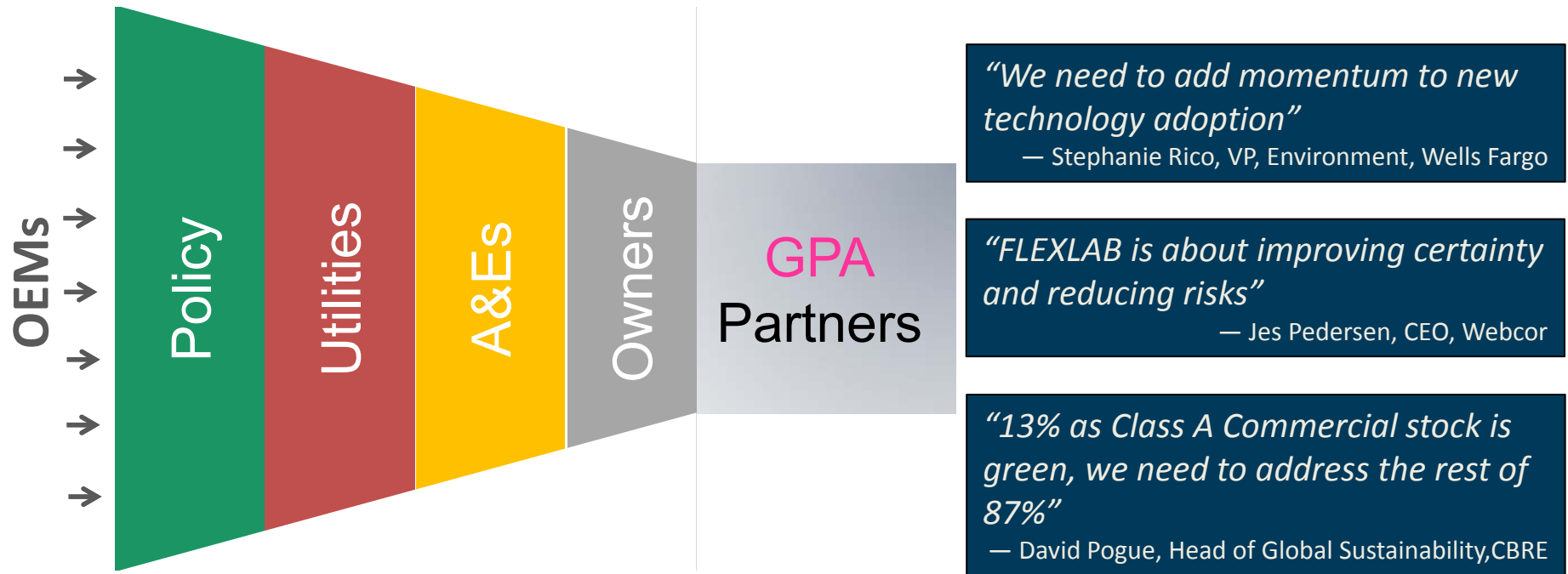
- Lower energy building design, **optimized comfort, lowered construction and operating costs – Real estate and space Recovery**
- **Thermal comfort** improvem shading, interior layout, occ
- **Light quality and visual con**



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**





**LabSTAR**

## **Small Business Voucher Pilot Program**

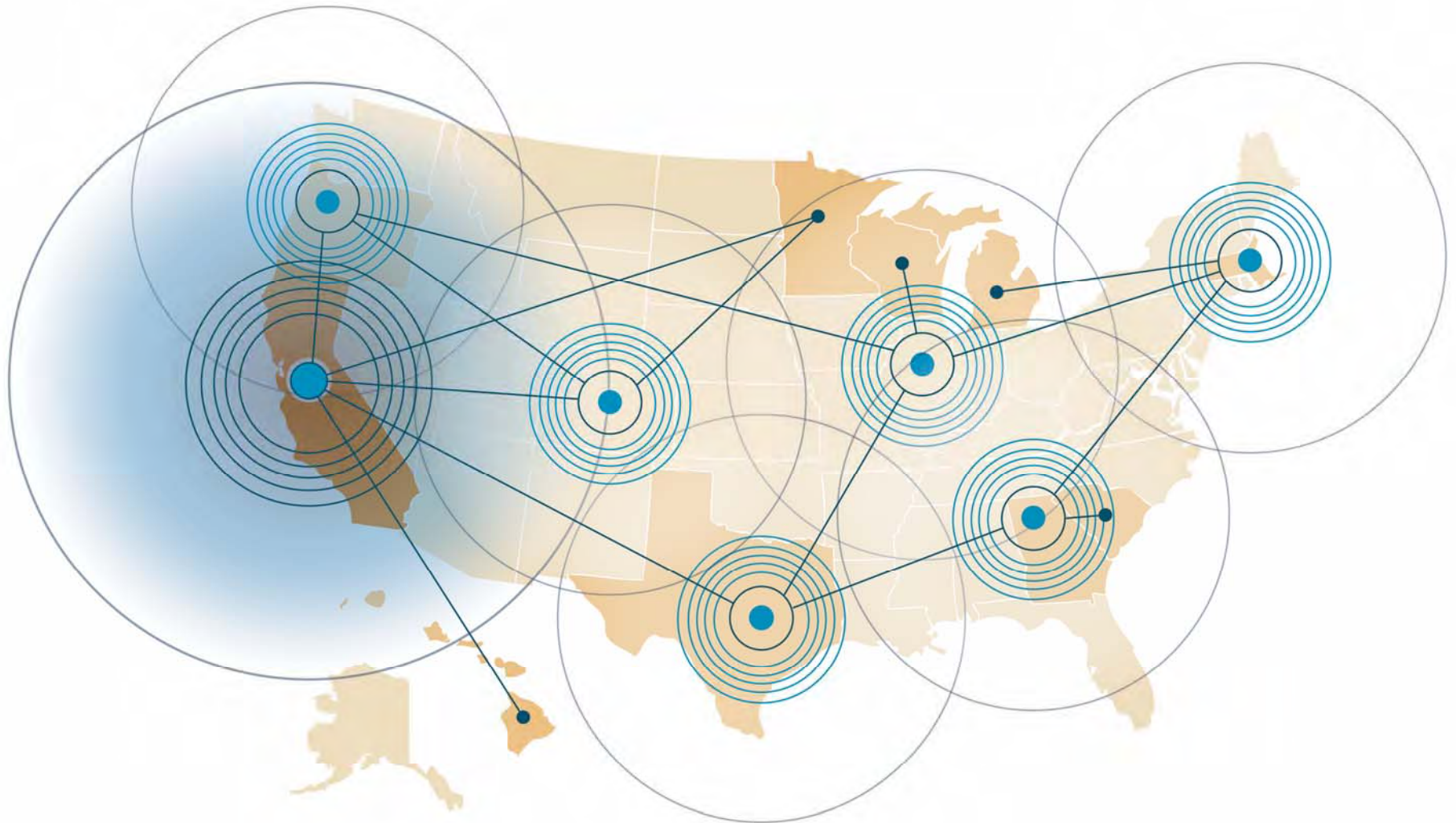
# DOE Small Biz Voucher Pilot Program

- 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

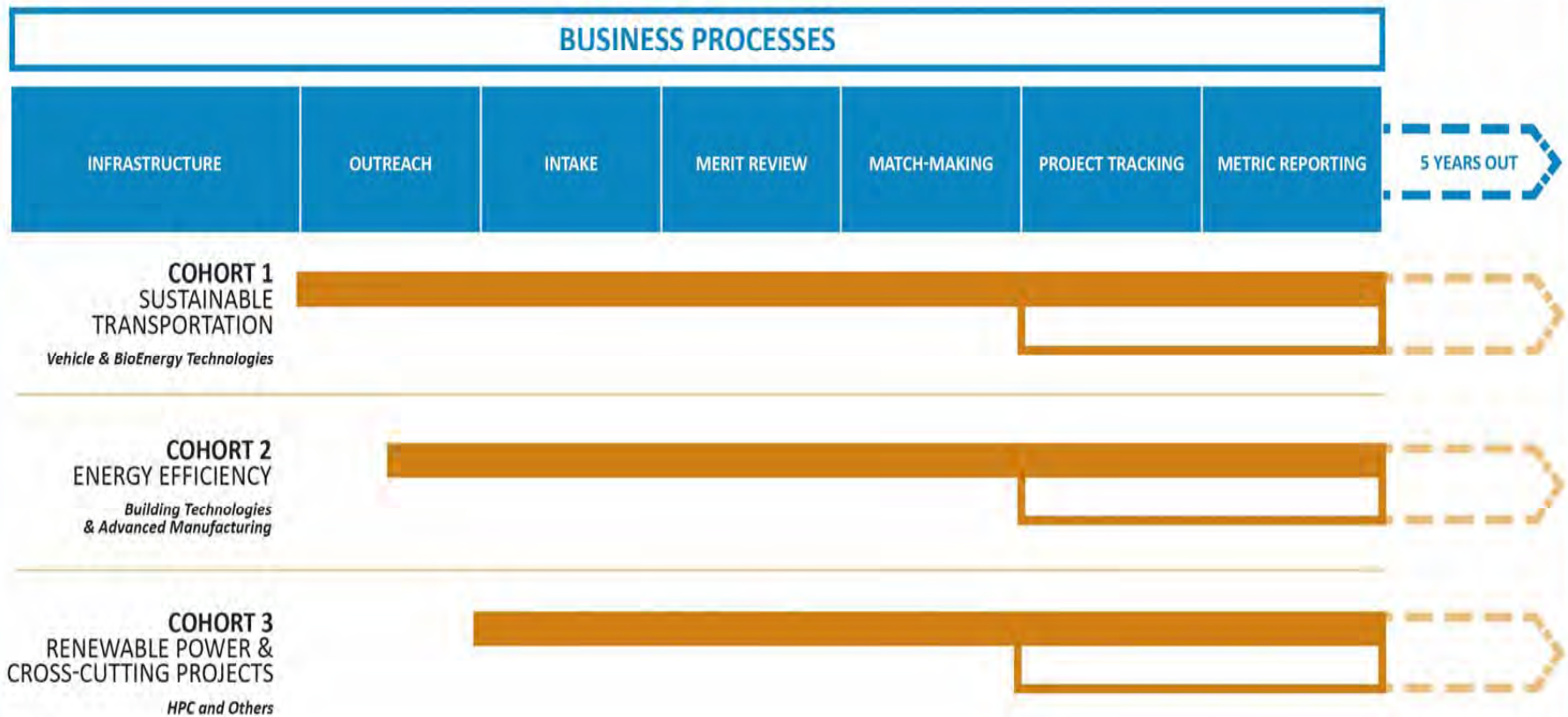




# LabSTAR



# TIMELINE OF ACTIVITIES





# Thank you!

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