U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

High Impact Technology: Technology for Building Systems Integration and Optimization

Navigant Consulting

Matt Guernsey, Associate Director

Matt.guernsey@Navigant.com

Photo Source: energy.gov

Project Summary

Timeline:

Start date: December 2013

Planned end date: TBD (annual go/no-go)

Key Milestones

1. Landscape Report [complete]; January 2018
2. Hit Matrix Update [complete]; April 2018
3. Workshops; May 2018
4. Finalize HIT list; June 2018

Budget:

Total Project $ to Date:

- DOE: ~$324k (3/16-3/18)

  Includes work on HIT process development support, HIT list development and update, and HIT deployment plan development

Total Project $:

- DOE: $TBD

Key Partners:

BBA Members	Building Owners
Equipment OEMs	Trade Associations
National Labs	Professional Societies
Research organizations	Utilities

Project Outcome:

Developed a framework for characterizing technology solutions that enable commercial buildings and systems to better connect, communicate, store, evaluate, & automate across the different elements within the building-energy value chain.

MYPP Goal #3: **Proving Solutions via Market Partnerships in Existing Buildings:** Prove with market leaders that, by 2020, it is possible to cost-effectively reduce average commercial buildings by at least 25% relative to 2010 levels.

Challenge

This project initiates a programmatic focus on early stage technology innovation, with an emphasis on how components and systems work together and how buildings are integrated and optimized.

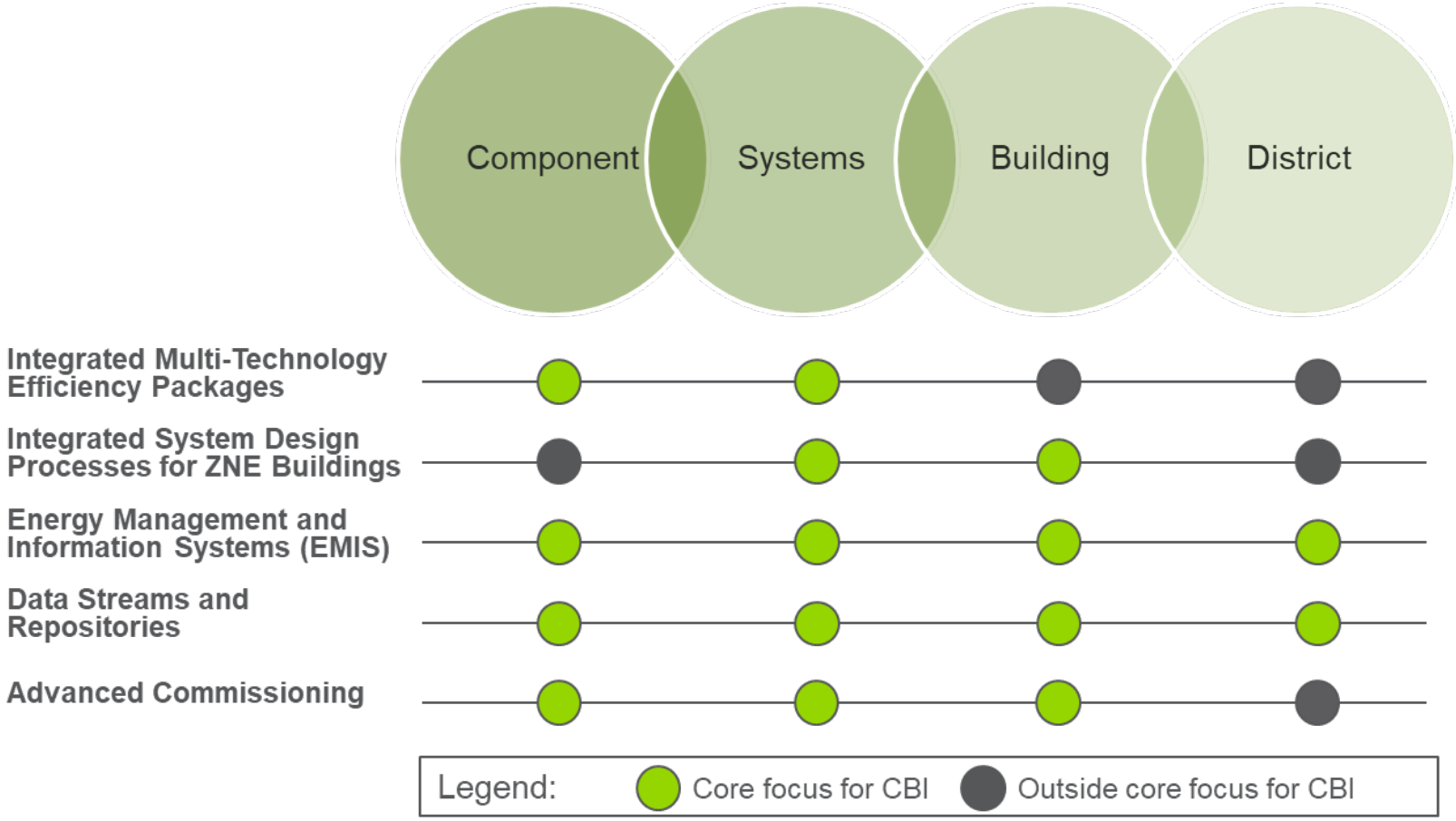
Project objective: Develop a framework for characterizing the landscape of capabilities and solutions supporting integration and optimization in commercial buildings.

This project seeks to:

- Provide insight into technology solutions that enable buildings and systems to better connect, communicate, store, evaluate, & automate across the different elements within the building-energy value chain.
- Support CBI's energy savings goals and lay the groundwork for enabling zero-net energy and ultra-low energy commercial buildings of the future.

Approach: Proposed Framework

The basic framework we developed comprises 5 topic areas (rows) and 4 scales of building integration (columns).



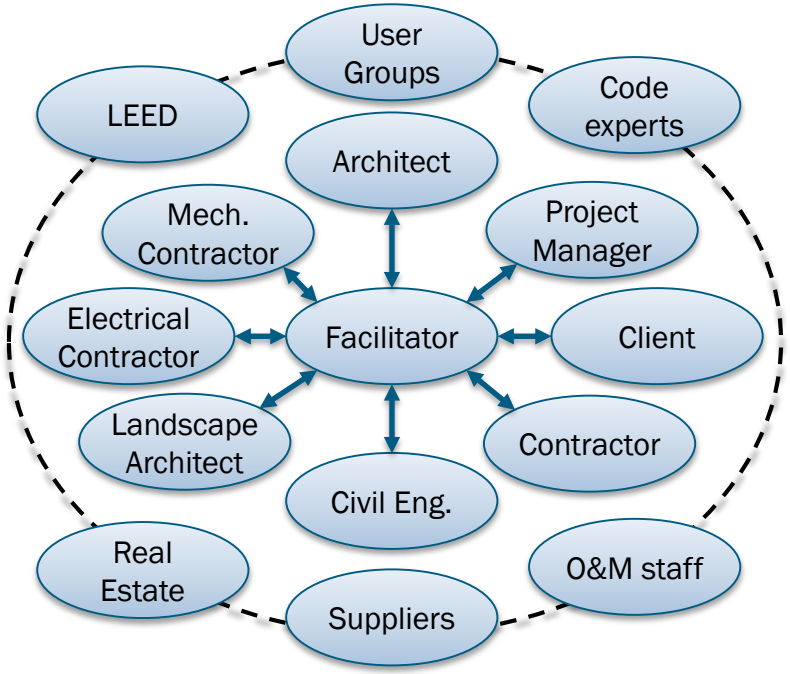
Each topic area is described in detail in the following slides

Integrated Multi-Technology Efficiency Packages

- **Packaged integration of 2+ building systems**
- **Capture energy savings from opportunities that exist at the intersection of systems**
- **Provides savings & value beyond that of the individual technologies from:**
  - Load reduction
  - Equipment downsizing
  - Ease of integration with storage and generation technologies
  - Alignment of divergent but related building data streams
  - Improved whole building communications and control

Example solution	Description
Dynamic Building Façade	• Combination of lighting, controls, connected glazing & shades • Controls light levels to optimize HVAC and lighting loads
Combination water heater, dehumidifier, and cooler	• Membrane-based absorption system • Primary end use is water heating – other functions secondary

Integrated System Design Processes for ZNE Buildings

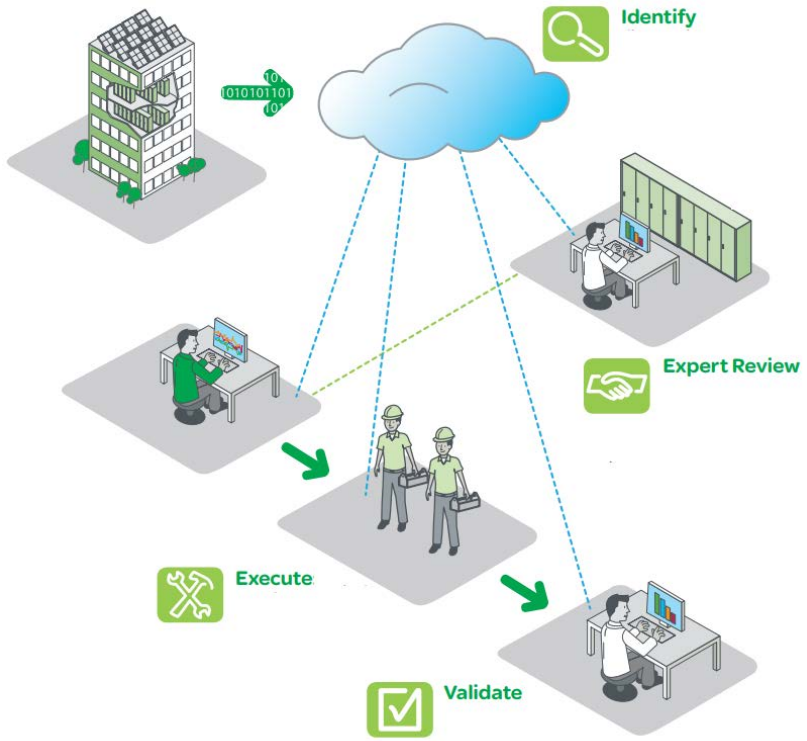


- **Focuses on next-generation holistic design, construction and operational methods to enable whole building energy optimization.**
- **Solutions enable:**
  - Measuring/tracking of component, system, and building energy targets
  - Validating & track key systems that enable autonomous operation & high performance
  - Modeling rapid, cost-effective design, construction and operations

Example solution	Description
Modeling tools	• Building automation design, co-simulation, and analysis • Building information modeling (BIM) for shared knowledge resource
ASHRAE design guides	• Building guides with steps detailing implementation of integrated design as it relates to: load reduction, system optimization, regenerative systems, renewable systems, and more.

Energy Management and Information Systems (EMIS)

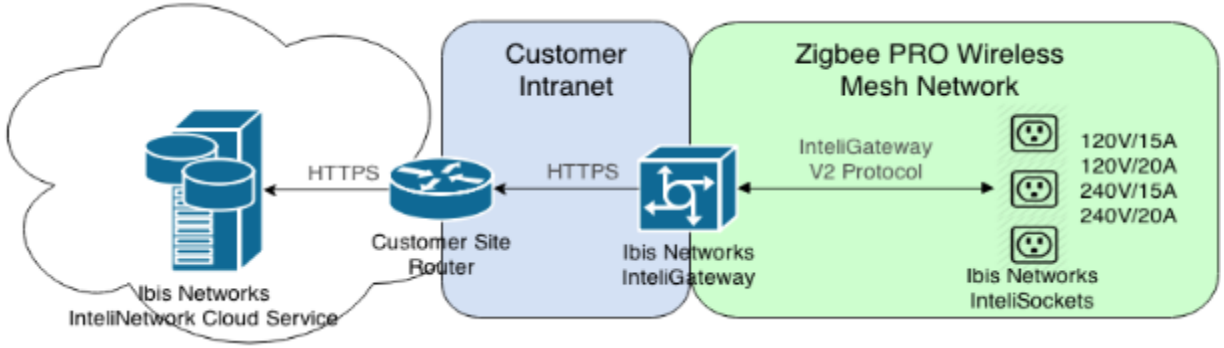
- Combined hardware and software products that comprise a broad family of tools and services to manage commercial building energy use
- May encompass tools for:
  - Benchmarking and analytics
  - Utility bill analysis
  - Energy information systems (EIS)
  - Building automation system (BAS)
  - Equipment-specific fault detection & diagnostics (FDD)
  - Automated system optimization (ASO)



Example	Description
Building controls and automation	• System for integrating, controlling, and monitoring HVAC, lighting, security, and other building systems via single interface
Intelligent energy platforms	• Data capture and analysis, advanced building energy modeling, M&V, and predictive controls

Data Streams and Repositories

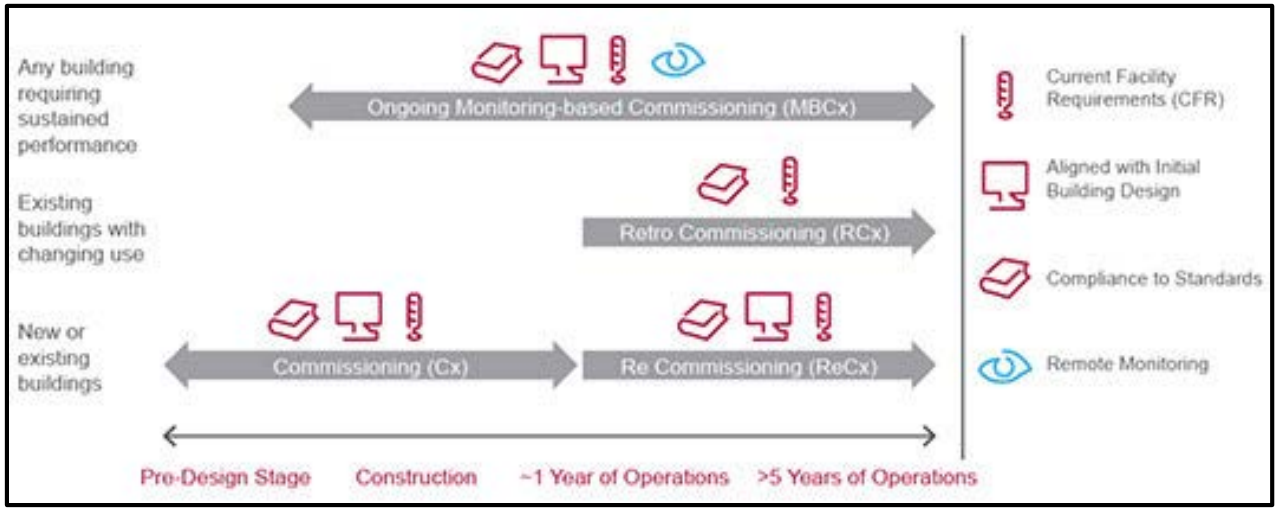
- Building-data hardware and back-end software solutions that enable data access and end-users (e.g., modelers/designers, operators, utilities, etc.)
- Data is retained for access by software solutions such as model-predictive controls, autonomous control, active demand management, and grid-responsive building systems.



Example solution	Description
Networked lighting control (NLC) database	• Database for collection and storing of data from NLC systems • Maps project data to standardized data fields/formats
Building energy data exchange specification (BEDES) & BuildingSync	• BEDES facilitates data transfer of building energy use and characteristics by standardizing terms, definitions & field formats • Leverage BuildingSync Schema for standardization of audit data

Advanced Commissioning

- Solutions seek to remedy and/or avoid operational deficiencies
- Ongoing process, as opposed to one-time traditional commissioning
- Encompassing software and hardware tools and processes
- Includes continuous (CCx) & monitoring-based commissioning (MBCx)



Example solution	Description
NIST AFDD using standard hardware	• Novel software algorithms to enable AFDD utilizing data typically found in standard control hardware in existing systems
MBCx	• Software packages to manage data streams from building systems, prioritize improvement tasks, and convert to actionable work orders

Impact

As CBI continues to evolve in its efforts to achieve its goals, a clear understanding of the operating environment and nature of potential solutions is vital to all stakeholders.

This project is expected to contribute to program goals by providing a foundational framework for:

- Scoping the current state of technology and science as it relates to R&D investments (e.g., FOAs) in system efficiency
- Highlighting areas of need
- Articulating CBI role within the broader BTO mission
  - Research and development opportunities that improve building system optimization for whole building energy savings.
  - Products that need field validation to understand operation, integration and interoperability within dynamic real world conditions.

Progress

The report is complete and available online; we are now seeking feedback on the framework.

Tell us:

- What is your reaction to the framework?
- Are things missing?
- What refinements might you recommend?
- How well does it serve CBI's needs?

Stakeholder Engagement

We continue to gather feedback from stakeholders, and will continue to do so as part of integration into the HIT Catalyst program.

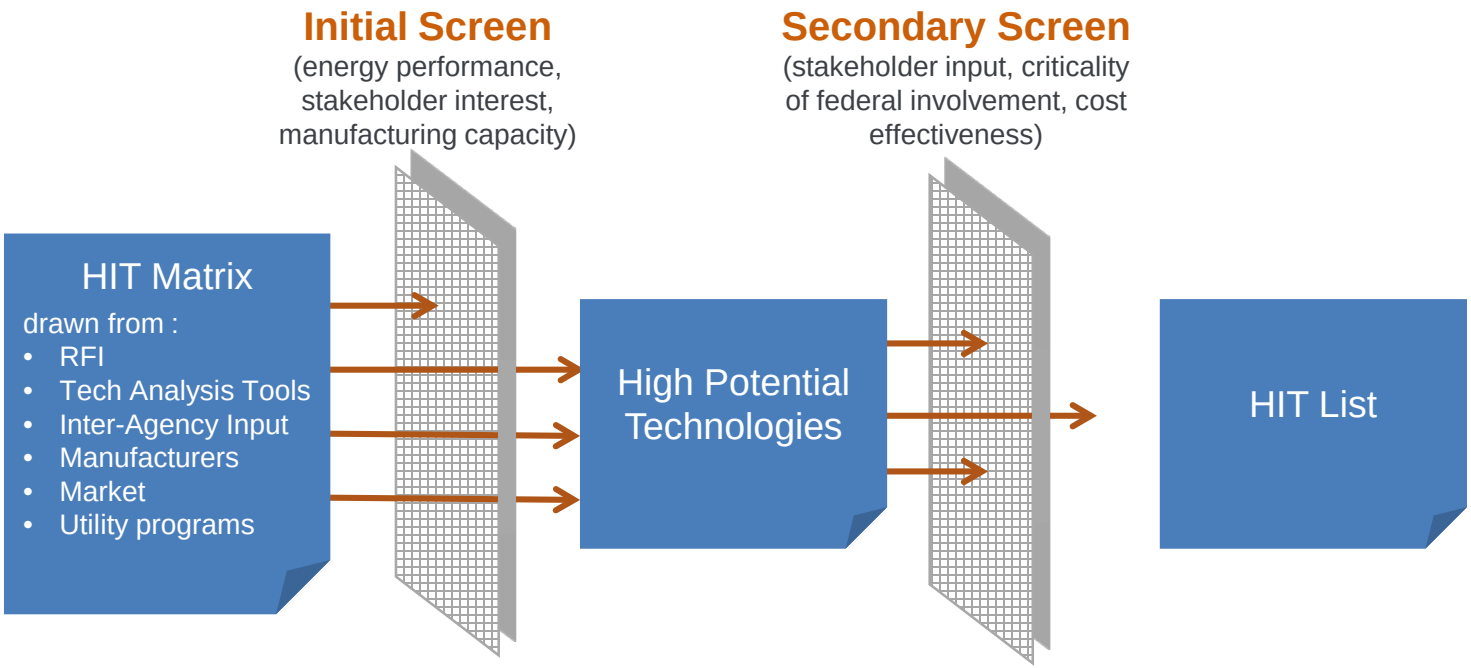
Planned outreach with relevant stakeholders to:

- Gather feedback on existing definitions, products, resources and research in systems efficiency,
- Enable strategic collaboration with other key industry players

Remaining Project Work

The next step is to translate this new framework into the HIT catalyst program.

- This High-Impact Technology Catalyst program utilizes the HIT matrix, which is a repository of technologies that improve building efficiency. This Landscape Report initiates updates to HIT Matrix to reflect opportunities for systems integration.



Thank You

Navigant Consulting, Inc.
Matt Guernsey, Associate Director
Matt.guernsey@Navigant.com

REFERENCE SLIDES

Project Budget

Project Budget: See table below
Variances: None
Cost to Date: See table below
Additional Funding: None

Budget History					
FY2016 – FY 2017 (past)		FY 2018 thru Mar 2018 (current)		FY 2019 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
~$249k	N.A.	~$75k	N.A.	TBD	N.A.

Budget values include work on HIT process development support, HIT list development and update, and HIT deployment plan development.

Project Plan and Schedule