



# Zero Net Energy Buildings: Building Automation Driving Success



## CABA Intelligent & Integrated Buildings Council (IIBC) Multi-Client Boutique Research 2014

This proposal builds on the expertise of New Buildings Institute (NBI) in the Zero Net Energy (ZNE) and emerging technologies markets and investigates the use of energy information and building automation systems in leading edge buildings.

### **Background**

Growth for new products and applications often follow the lead of early adopters and innovators. These individuals and organizations serve as a 'bell-weather' on next gen trends and characterize the leading edge of technologies, tools and user interface that can pull both products and policies forward.

The real estate industry has been riding a wave of green building over the past 15 years. LEED or LEED equivalent buildings are now standard practice in some markets and required by policy in others. Design firms, owners, operators and occupants are all familiar with the term 'green' building. And, although they may define it differently, it has accelerated the expectation and adoption of energy efficient technologies.

**Next Gen. Buildings.** Now there's a new kid on the block – Zero Net Energy<sup>1</sup> (ZNE) – that has captured the attention and engagement of leading practitioners in design, construction, real estate, and policy. The first ZNE building was built 12 years ago as a demonstration effort on a university. Slowly other universities, public buildings and non-profits followed suit with small examples of the feasibility of ZNE.

Now NBI has the largest database in North America of Zero Net Energy Buildings. Our recent study – [\*The 2014 Getting to Zero Status Report\*](#) – found a much higher penetration of building energy monitoring, energy management and operator/tenant feedback than in the general building population. While this is of little surprise given the growth in the use of these systems across all, and particularly high performance, commercial buildings, these buildings represent the leading edge of owners and practitioners. The strategies and technologies applied in these 160 ZNE buildings are looked to as best practices and can become the references for programs and requirements. The study also showed an increase of ZNE buildings developed by the private sector (26%), and a wide range of sizes (20% are >50,000 sf), diverse building types and locations in every US climate zones (36 of the states).

**Policy Drivers.** Although these numbers remain very small in relation to overall commercial floorspace it is an upward trend with market leaders influencing peers and it is beginning to gain policy momentum as well. Cities and states, as well as investments by foundations, have mandates to reduce carbon emissions toward climate change mitigation. Zero net energy buildings, as a pathway to low carbon, is already an adopted policy statewide in California where all new commercial buildings must be ZNE by 2020 and all existing commercial buildings ZNE by 2030. Similar considerations for ZNE and/or outcome-based codes are in place or underway in Colorado, Massachusetts, Minnesota, New Mexico, Vermont and Washington.

**Technology Drivers.** To get to zero buildings must operate, not simply be designed, at very low energy use. In offices, of example, where the US average building has an energy use intensity (EUI) of 93 the ZNE

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<sup>1</sup> Also called Net Zero Energy. ZNE buildings have greatly reduced energy loads such that, averaged over a year, 100% of the building's energy use can be met with onsite renewable energy.

dataset averages an EUI of just 19. This is a measured result! How did they get there? In all cases the building teams cited their building monitoring system and feedback as **critical** to achieving their targets. In many cases the systems included some form of occupant engagement or information to help address this group of energy users. In buildings designed to be at the highest energy performance over 50% of the energy use now lies in the hands of the operations and the occupants.

## Purpose of the Research

The research has two primary purposes:

1. **Characterize Monitoring Systems in ZNE Buildings:** Identify the selection criteria, methodology, technology attributes, user preferences and role of the building automation and energy monitoring and information systems (broadly called EIS-type systems here) in ZNE buildings.
2. **Market Influence:** Use the above information to create a greater “pull” toward the adoption of energy monitoring and feedback systems that drive low energy outcomes.

## Research Scope

The scope of the project focuses on addressing three key areas of inquiry regarding EIS-type systems and occupant/operator feedback systems installed in Zero Net Energy buildings:

- 1) **The Selection and the System.** What were the selection criteria, method and the actual attributes of the EIS-type system installed at a set of ZNE buildings<sup>2</sup>?
- 2) **The Use and User Experience.** How is it being used? What role does the system play with the operator and the occupants? What are the most desired and applied functions? What is missing?
- 3) **The Energy Impact.** What savings were attributed to the EIS-type system in the energy models? Were various systems evaluated or considered on an energy impact basis? How is the system influencing post-construction energy use (monitoring-based commissioning, occupant feedback, control settings, FDD etc.).

The research results will then, in turn, be documented in a final report and the scope will include connecting the results in various forms to targeted parties determined in conjunction with the funders.

## Approach and Methodology

The research approach leverages an existing inventory of ZNE buildings by NBI combined with solicitation of the key information needed through a variety of outreach, survey and communication methods.

NBI’s ZNE database includes the tracking of Ultra-low energy buildings – those with equivalent low energy outcomes or targets, design strategies and technologies as ZNE buildings but without the offset of 100% of energy use by renewables. The database consists of approximately 220 ZNE and ultra-low energy buildings. The target buildings for this research are suggested to be offices and community centers with floorspace of 20,000 square feet (sf) or more. These are considered the research ‘sites’. Each site has numerous design team members, owners, operators and occupants which will comprise the ‘study group’. An estimate of the sites and study groups are identified within the initial task. The research will proceed through four tasks as described below.

Table 1: Research Tasks

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<sup>2</sup> NBI’s ZNE internal database does, in some cases, identify the presence of EIS-type systems but with no details on the equipment and not consistently across the full set of buildings. This research will address that gap.

Task	Description
Task 1	Research Development
Task 2	Outreach and Inquiry
Task 3	Findings Analysis and Reports
Task 4	Market Connections

### Task 1: Research Development & Management

- **Reporting, Invoicing and Project Management.** All aspects of research project management, progress reporting, deliverable quality assurance and invoicing happen in this task.
- **List of Target Sites.** Review the previous inventory, recent registry, tracking xls and other sources to establish the list of target sites.
- **List of Study Groups.** Utilizing existing lists, relationships and preliminary phone contacts identify all architect, engineer, contractors, owners, operators and occupants of the target site buildings. Rank the likelihood of the study group or individual(s) to be responsive the research topics and in what format.

Table 2: Estimated Target Buildings Sites by Type and Size

ZNE and Ultra-low Energy Bldgs	20-50k	50-100	100+	Totals
Offices	13	2	4	19
Education Centers - Community		4	1	5
Total Study Sites:				24

- **Matrix of Building Information.** Review existing in-hand sources and conduct secondary research to develop the working matrix for the target buildings, characteristics and contact information for the study group.
- **Technical Review of Target Equipment.** Research staff to conduct secondary research to ensure familiarity and representation of the characteristics of the target range of EIS-type equipment.
- **Survey Questions.** Draft, vet and finalize the research questions specific to each audience and relevant to various types of equipment. Determine what survey methods are best suited to the target groups including individual or group phone call, online survey (occupant-focused), or survey form through email.

Table 3: Estimated Quantities and Targets for Sites and Study Groups

Research Area	Estimated Available #	Target Quantity
Target Building Sites	25-30	20
Study Groups	500	100

### Task 2: Outreach and Inquiry

The outreach phase of the research will include multiple methods to investigate the topics and secure feedback and strong response rates. The research includes 3-5 in-person site visits to conduct surveys, observe systems in operation, collect performance data and gather anecdotal statements and site photos.

- **Survey Implementation.** Conduct customized surveys, phone calls, on line and other web-based outreach and in-person meetings to collect the research information.
- **Mid-Course Project Review.** The team will prepare a briefing document for assessment of the research progress and to consider any gaps and resulting adjustments in the scope and/or approach.

### **Task 3: Findings Analysis & Report**

- **Report Outline.** Development of the report Outline will act as a guide to prioritize the review and drafting of the research findings.
- **Compilation of Results.** All results will be compiled within a framework determined through Task 1.
- **Analysis of Findings.** Research team review of the results and development of report narrative and graphics.
- **Draft and Final Report.** Delivery of a draft and a final Report on the findings.

### **Task 4: Market Connections**

- **Target Markets and Methods.** In conjunction with NBI's Communication Director and funders as desired the research will identify a set of key target audiences and communications methods and create a Market Connection Plan to deliver the research results.
- **Market Connections Actions.** Deliver the results per the Market Connection Plan and represent the summary of actions taken.

## **Objectives**

The research has 5 objectives:

1. Determine the frequency, types and characteristics of EIS-type systems in ZNE buildings.
2. Identify the methodology used to determine a) the inclusion of an integrated EIS (did they use LCC would be a natural inquiry linked to the CABA LCC findings) and b) the selection of specific systems.
3. Represent the operator and occupant user preferences, and anticipated versus actual interface roles and applications.
4. Establish energy savings estimates attributable to the EIS and their role toward the ZNE target
5. Deliver, in conjunction with input from funders, the results through various market connection opportunities and pathways in order for the results to have market impact (eg. media, e-news, utility programs, policy makers etc).

## **Deliverables**

The key interim (I) and final (F) deliverables are:

- Progress Reports and Mid-Course Progress Briefing (I)
- Survey questions for review and finalization (I)
- Lists of participant buildings, firms, owners and other contacts (I)

- Market Connection Plan and Actions (F)
- Report addressing the full scope and findings (F)

## Sponsorship Opportunities

### The cost of sponsorship is only: \$10K

Each sponsor will be on the Steering Committee and allowed to:

- Define the research scope and methodology
- Provide feedback and input regarding the direction of the study
- Participate in Steering Committee conference calls.
- For research exclusivity, the Steering Committee will be allowed to decide on the length of the embargo period.

## Timeline

The research is planned for a 9 month period.

Task	Description	Month Following Contract Agreement								
		1	2	3	4	5	6	7	8	9
Task 1	Research Development	Ongoing Research Mgmt and CABA reporting								
Task 2	Outreach and Inquiry									
Task 3	Findings Analysis and Reports							Draft	Final	
Task 4	Market Connections					Develop MC Plan			Market Conn Action	

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