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NEEA Existing Building Renewal: Process Review Results

Prepared by:
Navigant Consulting, Inc.
1375 Walnut St., Suite 200
Boulder, CO 80302

And

Rocky Mountain Institute
1820 Folsom St.
Boulder, OR 80302

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
FAX
503-688-5447
EMAIL
info@neea.org

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Prepared for:
Northwest Energy Efficiency Alliance

Prepared by:

Navigant Consulting, Inc.
1375 Walnut Street, Suite 200
Boulder, CO 80302

Rocky Mountain Institute
1820 Folsom Street
Boulder, CO 80302

www.navigant.com

www.rmi.org

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Executive Summary

The Northwest Energy Efficiency Alliance (NEEA) engaged Navigant Consulting, Inc. (Navigant) and its project partner, the Rocky Mountain Institute (RMI), to conduct a Process Review of NEEA's Existing Building Renewal (EBR) Initiative Demonstration Projects. The EBR initiative aims to address the barriers and opportunities for the commercial office building market in the Northwest to conduct whole-building *deep energy retrofits* (DER) of existing assets, rapidly revamping existing stock to achieve a minimum energy savings of thirty-five percent, but targeting fifty percent or more. NEEA goals for the four Demonstration Projects — one deep energy retrofit demonstration in each of the four NEEA states — are to: a) inform development and refinement of its "integrated measures package" (IMP) tool to be used in the scaling the DER EBR initiative to the full Northwest market, b) to offer proof of technical and market viability, and c) to provide case studies for future education, training, and marketing.

The goals of the RMI led Process Review were two-fold. The first was to assess how well the Demonstration Projects are meeting NEEA's stated objectives. While the NEEA staff is very involved and knowledgeable about how the projects are going, they required a third-party perspective to assess the progress of the projects toward their objectives. The second goal is to provide recommendations for NEEA to effectively address market barriers at scale based on Demonstration Project stakeholder experiences, and informed by RMI's depth of market experience with deep energy retrofit buildings.

RMI/Navigant conducted the bulk of the research beginning in 2013 with final interviews completed in the first quarter of 2014.

As Table ES-1 illustrates, the Demonstration Projects took place in a variety of market settings and engaged a variety of owners. The one common theme for all the demonstration buildings was that they met NEEA's stated EBR initiative target market definition of being: (1) privately owned, (2) commercial office buildings, (3) larger than 20,000 ft^2, with (4) a majority of leased floorspace (i.e., less than fifty percent owner-occupied) by multiple tenants.

Table ES-1: Description of Demonstration Projects

	Project A	Project B	Project C	Project D
State	Idaho	Montana	Oregon	Washington
City Population	150,000 – 250,000	<150,000	>500,000	>500,000
Market Classification	Tertiary	Tertiary	Secondary	Secondary
Market Location	Central business district location	Central business district location	Central business district location	Central business district location
Owner Classification	Private	Private	Public REIT	Private
# Buildings in Owner's Portfolio	<10	<10	10–100	10–100
Energy Retrofit Experience	Experienced	Inexperienced	Experienced	Experienced
Current Project Status	Implementation	Implementation	Building owner approval	Building owner approval

Stakeholders on the projects included members of ownership teams, NEEA contractors and consultants, NEEA staff, and utility representatives. Overall, these stakeholders felt that the demonstration projects provided them with significant benefit, including owners gaining experience in identifying all the value of deep retrofits and the retrofits generally expanding the value proposition for energy efficiency. Stakeholders also suggested that the Demonstration Project process possessed several unique characteristics in relation to other retrofit activities in the target market, including the IMP integrated design packages of energy efficiency measures and a convincing business case that hinged on the acknowledgement of non-energy benefits.

Findings on owner motivations suggest a local green market is not the only driver for deep energy retrofits, and that optimizing capital projects to potentially improve market position and asset value are motivations for owners across the NEEA region. Table ES-2 provides an overview of owner motivating factors for each project.

Table ES-2: Owner Motivational Factors

Motivational Factor	Project A	Project B	Project C	Project D
Optimizing Capital Projects	●	●	●	●
Asset Value	●	●	●	●
Replicating Good Past Experiences with NEEA	●	○	●	●
Energy Cost Savings	●	●	●	○
Market Positioning	○	○	●	●
Community Level Development	○	○	●	●
Owner Reputational Goals	○	○	○	●
Thermal Comfort	○	●	○	○
Existing-Tenant Interest	●	○	○	○

As NEEA expected, the projects experienced some process- and market-oriented challenges. Owners experienced two primary challenges, both of which occurred in projects in the tertiary markets (or non-major metropolitan and non-secondary real estate investment markets). One challenge emerged during owner discussions with a major tenant to implement their portion of the integrated measures package. The second challenge was with implementation, rooted in selection of an installer who was not qualified to install the equipment.

The utility representatives interviewed expressed concern with the phased implementation plans of the Demonstration Projects and urged the need to ensure that the complete package of measures is fully implemented over the entire project timeframe, which may extend over a several year period. In addition, some utility representatives were not clear on how the EBR initiative, with its whole building integrated measures packages, could compliment and be supported by the utility's existing incentive programs.

The process review identified deep energy retrofit best practices that appear to be able to address nearly all of the main challenges. In addition, these best practices would, if implemented on future deep energy retrofits, increase the likelihood of replicating the Demonstration Project successes. The best practices, most of which were effectively used on the Demonstration Projects, range from selecting an integrated design-experienced team to presenting all value and risk.

The Process Review also uncovered many useful considerations for scaling deep retrofits. In order to overcome market barriers and scale deep energy retrofits, the EBR initiative must find ways to support the implementation of best practices at minimal time and cost for design and analysis. The process review provides considerations on how to reduce the level of assistance required on the projects, how to automate the assistance, and the challenges of automation.

The Process Review shows that overall it appears that the Demonstration Projects are on track to meeting their objectives. The Process Review has provided a process description, best practices, and considerations for scaling retrofits—all of which inform tool development and confirm the availability of quality content for case studies. Moreover, the projects at their current stages appear to demonstrate market and technical viability of deep energy retrofits.

While the projects are on track to meet their objectives, two market-oriented challenges emerged that NEEA staff should consider in moving forward with the Existing Building Renewal Initiative: 1) tenant value acknowledgement, and 2) coordination with utilities. The RMI/Navigant team recommends NEEA build market-wide value acknowledgement for tenants as well as owners as the EBR initiative rolls out regionally. This will help implement integrated measure packages fully in tenant spaces. The RMI/Navigant team also recommends NEEA continue their conversations with utility representatives to strategically deepen and align the EBR initiative with utility programs.

1. Introduction

The Northwest Energy Efficiency Alliance (NEEA) receives support from and works in collaboration with the Bonneville Power Administration, the Energy Trust of Oregon and more than one-hundred Northwest utilities on behalf of more than twelve million energy consumers. NEEA uses the market power of the region to accelerate the innovation and adoption of energy-efficient products, services and practices.

The NEEA Existing Building Renewal (EBR) initiative aims to address the barriers and opportunities for the commercial office building market in the Northwest to conduct whole-building *deep energy retrofits* of existing assets, rapidly revamping existing stock to achieve a minimum energy savings of thirty-five percent, but targeting fifty percent or more. While many of the region's utilities offer incentives for equipment retrofits, either alone or in combination with other measures, the EBR initiative seeks to enable significantly more aggressive energy and operating cost savings through synergies. It addresses the integration of strategies across building systems to achieve large load reductions through highly optimized systems, resulting in much greater energy savings per building.

NEEA hired Rocky Mountain Institute (RMI)—a non-profit experienced in driving the adoption of deep energy retrofits across the U.S.—and Navigant to conduct a Process Review of the EBR initiative Demonstration Projects. RMI/Navigant synthesized qualitative data from interviews with Demonstration Project stakeholders to document the retrofit project process with regard to motivations, decision-making, best practices, benefits, and challenges; as well as to provide tool/resource development considerations for scaling deep energy retrofits.

This report presents the results of this Process Review. The results include a complete documentation of the process from the perspectives of each Demonstration Project stakeholder group, regarding each step of the process as well as for the overall project. It also includes a summary of Demonstration Project best practices that can be used for further deep energy retrofit projects. Further, the report provides considerations for scaling deep energy retrofits, focusing specifically on the tools and resources the industry requires for scaling. These considerations come from both Demonstration Project stakeholder as well as RMI perspectives. Finally, the report assesses the progress the Demonstration Projects have made against the NEEA staff objectives and provides recommendations for NEEA to address challenges that emerged on the Demonstration Projects.

1.1 Background

NEEA selected as the target market for the EBR initiative private, commercial office buildings larger than 20,000 ft^2 that are majority leased (i.e. less than fifty percent owner-occupied) by multiple tenants. Within this target market, the EBR initiative seeks to overcome barriers of:

- The high cost and long length of time to study the feasibility of deep energy retrofits

- The perceived lack of investment value and difficulty quantifying non-energy benefits associated with deep energy retrofits
- A lack of skillsets, tools, information, and general market capacity for deep energy retrofits

NEEA deployed four deep energy retrofit Demonstration Projects to explore solutions to overcome these barriers and is creating tools and resources that reduce the time and cost of analyzing deep retrofit opportunity. The tool and resources will also help identify all of the investment value of deep energy retrofits.

1.2 Objectives of the Demonstration Projects

The Demonstration Projects will contribute to NEEA's limited collection (from aggressive research contracted with New Buildings Institute) of recent deep energy retrofit examples in the Northwest. Yet the value of the Demonstration Projects goes beyond simply creating additional case studies. NEEA staff views the Demonstration Projects as a way to produce their own projects with which they are intimately familiar, and to create a group of deep-retrofit-experienced contractors and owners who are willing to share their perspectives and lessons learned. In this way, NEEA staff considers the four Demonstration Projects as a learning ground to inform their future work in the EBR initiative.

The specific objectives of the demonstration projects are three-fold:

- **Objective One**: Inform tools to scale the adoption of deep energy retrofits in the market
- **Objective Two**: Offer proof that deep energy retrofits are technically and financially viable
- **Objective Three**: Provide case studies for education, training, and marketing during later stages of the EBR initiative

If successfully met, these three objectives will provide the technical and market information needed to help NEEA move forward with the EBR initiative.

2. Process Review Approach

2.1 Goals

The goals of the Process Review are two-fold. The first is to assess how well the Demonstration Projects are meeting NEEA's stated objectives. While the NEEA staff is very involved and knowledgeable about how the projects are going, they required a third-party perspective to assess the progress of the projects toward their objectives. The second goal is to provide recommendations for NEEA to effectively address market barriers at scale, based on Demonstration Project stakeholder and RMI experiences with deep energy retrofits.

2.2 Description of Demonstration Projects

RMI/Navigant conducted the Process Review based on the experience of stakeholders with the four Demonstration Projects. As Table 2-1 illustrates, the Demonstration Projects took place in a variety of market settings and engaged a variety of owners:

Table 2-1: Description of Demonstration Projects

	Project A	Project B	Project C	Project D
State	Idaho	Montana	Oregon	Washington
City Population	150,000 – 250,000	<150,000	>500,000	>500,000
Market Classification*	Tertiary	Tertiary	Secondary	Secondary
Office Type	Central business district location	Central business district location	Central business district location	Central business district location
Owner Classification	Private	Private	Public REIT	Private
# Buildings in Owner's Portfolio	<10	<10	10–100	10–100
Energy Retrofit Experience	Experienced	Inexperienced	Experienced	Experienced
Current Project Status	Implementation	Implementation	Building owner approval	Building owner approval

* Secondary markets are large cities such as Seattle and Portland. Primary are major metropolitan areas such as New York City and Los Angeles. Tertiary markets are all other markets in U.S.

2.3 Key Activities

The Demonstration Projects include eight steps: 1) Recruitment, 2) Preliminary Assessment, 3) Technical Analysis, 4) Financial Analysis, 5) Building Owner Approval, 6) Implementation, 7) Measurement & Verification, and 8) Final Documentation. NEEA prototypes for EBR tools and resources include the Integrated Measure Package Builder, Integrated Property Assessment

Tool, and Deep Retrofit Playbook.[1] The RMI/Navigant process review focused on the first six process steps because Measurement & Verification and Final Documentation for the first of the four demonstration projects was still in-progress at the time of this report and this aspect of the project had not yet begun for the other three demonstrations.

Table 2-2: Summary of Process Review Interviewees Role on Demonstration Projects

Stakeholder Type	Role in Demonstration Projects
NEEA Staff	Demonstration Projects Manager
	EBR Product Manager
	EBR Initiative Manager
Contractors & Consultants	Owner Liaison
	Alternate Owner Liaison
	Cost Estimator
	Technical Lead
	Mechanical Engineer
	Real Estate Finance Consultant
	Lighting/Envelope Consultant
	Audit Engineer
Building Ownership Teams	Owner/Owner Representative
	Facility Director
	Project Architect
	Property Manager
	Project Engineer
Utilities	Utility Representative

Table 2-3 describes the key activities and lists the objective for each activity. During this period, the RMI/Navigant team wrote three interim memoranda about interviews with stakeholder groups. The memoranda described preliminary findings from the NEEA staff interview, contractor and consultant interviews, as well as building ownership team and utility representative interviews. Following each set of interviews, RMI/Navigant submitted these three interim memoranda to NEEA for review.

RMI/Navigant also held a webinar with NEEA staff to discuss initial findings from the Process Review and inform the framework for the final report.

[1] Tables in the NEEA Staff Memorandum (included in the Appendix) describe the process steps and tools/resources, respectively, in greater detail.

Table 2-3: Process Review Key Activities and Objectives for Each Activity

Activity	Objectives
Two-Hour Interview with NEEA Staff	• Clarify the goals/objectives and scopes for the Demonstration Projects and the Process Review
1st Memo: Project Check-In Re NEEA Staff Interview	• Document the goals/objectives for the Demonstration Project and the Process Review • Describe RMI/Navigant's approach for conducting the Process Review
One-Hour Interviews with NEEA Project Contractors and Consultants	• Understand the experience of contractors and consultants with each step of the Demonstration Project process • Assess progress towards achieving the objectives of the Demonstration Projects • Identify considerations for developing tools/resources for implementing deep energy retrofits at scale
2nd Memo: Findings from the NEEA Project Contractor and Consultant Interviews	• Document the experience of contractors and consultants with each step of the Demonstration Project process and report their thoughts on NEEA's development of tools and resources • Present preliminary findings to NEEA about the benefits, challenges, and recommendations for each process step from the perspective of NEEA project contractors and consultants
One-Hour Interviews with Building Owners and Utility Representatives	• Understand the experience of building owners and utilities with each step of the Demonstration Project process • Identify considerations for developing tools/resources for implementing deep energy retrofits at scale
3rd Memorandum: Findings from the Building Owner and Utility Interviews	• Document experience of building owners and utilities with each step of the Demonstration Project process and report their thoughts on NEEA's development of tools and resources • Present preliminary findings to NEEA about the benefits, challenges, and recommendations for each process step from the perspective of owners and utility representatives
Two-Hour Webinar with NEEA Staff	• Present initial findings, conclusions, and recommendations • Discuss and agree upon a framework for the final report

2.4 Data Quality

Actions RMI/Navigant took to ensure data quality included discussing interview questions with NEEA staff, providing interviewees the questions in advance of interviews so they could prepare their thoughts, and writing memoranda after each interview to capture detailed findings and data.

The high quality and scope of responses during the interviews illustrated that all interviewees were very motivated to support NEEA's important and challenging work. Interviewees appeared to answer all questions honestly and without inhibition.

Although RMI/Navigant provided each interviewee an agenda prior to the interview, and also took steps to ensure that it asked similar questions to members of a given stakeholder group, RMI/Navigant framed questions in a way to facilitate open-ended responses that introduced variety to the depth of findings. For example, owners that did not offer information about the preliminary assessment did not provide data for that aspect of the process. Interviewees had the opportunity to elaborate upon aspects of their experience that were particularly relevant to them. Comments on aspects of the process with which they did not have experience were not considered high quality data and thus de-emphasized as findings.

3. Process Documentation

3.1 Stakeholder Perspectives

3.1.1 Primary Benefits, Challenges, and Recommendations

Owners, utility representatives, NEEA project contractors/consultants, and NEEA staff offered their perspectives about the primary benefits, primary challenges, and related recommendations for the Demonstration Project process. This section documents the most significant takeaways from stakeholders' experience with the Demonstration Project as a whole. Section 3.2 presents the secondary benefits, secondary challenges, and recommendations (as well as effective components) associated with each process step.

As a whole, stakeholders found the Demonstration Project to be extremely valuable, insightful, and effective. Stakeholders also suggested that the Demonstration Project process possessed several unique characteristics, including the integrated design packages of energy efficiency measures and the convincing business case that accounted for both energy and non-energy benefits.

Owners

Owners made the ultimate decision about whether to invest in a deep energy retrofit. It is crucial that owners believe the benefits from deep retrofits justify the scale of investment they require. Owners expressed utmost satisfaction with the contractor and consultant teams NEEA assembled: they found the use of integrated design teams to provide a comprehensive perspective to deep energy retrofits. In owners' eyes, NEEA assembled a "dream team" of contractors and consultants that offered expertise for the projects and helped build owner confidence in the technical and financial analysis.

Owners learned how to take a holistic perspective on their building's energy use and how deep retrofits achieve multiple benefits through a single expenditure. For example, an owner learned about how a better-sealed building makes it possible to not only save energy but also install downsized equipment that is less expensive and more energy efficient.

Owners experienced two primary challenges, both of which occurred in projects in the tertiary markets (or non-major metropolitan and non-secondary real estate investment markets). One challenge emerged during discussions with a major tenant to implement their portion of the integrated measures package. The tenant is a branch office of a corporation with a headquarters outside the state. The local real estate manager recognized that the efficiency package would support company-wide office standards not related to energy use; however, because the corporation could not directly value the contribution to the new office standards, costs overall would go up due to the nature of the gross lease. Thus, the tenant could not fully invest in the integrated measure package. The second challenge occurred during Implementation and resulted from the selection of an installer unqualified to install the equipment. The installer made major mistakes that resulted in major implementation delays and reduced rental income.

In response to challenges associated with Implementation, owners recommended that NEEA provide them greater support in selecting qualified installers and planning for phased implementation. Owners did not have a recommendation for the tenant-oriented challenge.

NEEA Project Contractors and Consultants

NEEA Project contractors and consultants provided services to owners during each step of the Demonstration Project process. They offered technical and financial expertise that helped owners achieve maximum energy savings and capture the full value of deep energy retrofits. Project contractors and consultants found the most crucial of the Demonstration Project to be how the process more generally, and the financial/technical analysis in particular, showed owners the multiple benefits that deep energy retrofits provide and how a deep retrofit increases the value of buildings. They also stressed the importance of a strong business case rather a detailed technical analysis in securing owner approval.

Utility Representatives

Utility representatives articulated strong interest in working with NEEA to strategically align the Demonstration Projects and EBR initiative with utility programs. The major benefit they saw from the Demonstration Projects was in expanding owners' understanding of the financial value of energy efficiency, and encouraged NEEA to drive this financial methodology into the market.

The phased implementation plans of the Demonstration Projects posed a major concern for utility representatives. The representatives urged the need to ensure the full implementation of the integrated measure package over multiple phases, which may extend several years. In addition, some utility representatives were not clear on how deep energy retrofits as a utility-supported initiative could complement existing incentive programs. They felt that creating phased implementation plans is already part of an existing "strategic energy management" program, and expressed confusion as to how the approach was different.

NEEA Staff

NEEA staff created and oversaw the Demonstration Projects as well as assembled project contractor and consultant teams. The primary benefits of the Demonstration Projects that NEEA staff identified include the confirmation of the potential for at least thirty-five percent energy savings among participating buildings and showing a convincing business case for owners to invest in deep energy retrofits.

Table 3-1 summarizes the primary benefits, challenges, and recommendations that each project stakeholder group identified for the Demonstration Project process.

Table 3-1: Summary of Primary Benefits, Challenges, and Recommendations

Stakeholder	Primary Benefits	Primary Challenges Experienced	Primary Recommendations Ψ*
Owners	1. Owners Gaining Experience in Identifying All The Values and Risk of The Deep Energy Retrofit Investment 2. Owners Learning How to Take A Holistic Perspective On Their Building's Energy Use 3. Owners Having A "Dream Team" of Contractors and Consultants	1. Owners Finding Capable Installers 2. Owners Convincing Tenants to Buy Efficiency (Split Incentive)	Provide Greater Support on Installer Selection
Utility Representatives	NEEA Expanding The Value Proposition for Energy Efficiency Investments	Uncertainty on How Utilities Will Support Deep Energy Retrofits	Provide Support on Phased Implementation
Contractors / Consultants	Owners Learning How a Deep Retrofit Could Address Multiple Building Needs and Create Market Value	(Contractors / Consultants Did Not Acknowledge Experiencing Any Major Challenges)	Because Energy Savings Alone Would Not Compel An Owner to Invest, The Level of Detail Involved in The Energy Analysis May Be Unnecessary for Reaching Owner Approval
NEEA Staff	1. The Team Confirming The Potential for Thirty-Five Percent Savings 2. The Team Creating A Convincing Investment Case	Owners Not Always Forthcoming About Intention and Ability To Finance	Conduct More Due Diligence Before Continuing The Process with Owners

Ψ Note: all of the content in this table directly and only reflect stakeholder views/comments

* Note: recommendations do not necessarily address each challenge

3.1.2 Owner Motivations

A unique assortment of motivational factors affected each owner's decision to invest in deep energy retrofits. Two motivational factors were common to each owner's investment decision: optimizing capital projects and asset value. Market positioning (driven by a local green market) was a motivator for only two projects. These findings suggest a local green market is not the only driver for deep energy retrofits, and that optimizing capital projects to potentially improve asset value are possible motivations for owners across the NEEA region.

Table 3-2 summarizes the motivational factors that compelled owners of the four Demonstration Projects to move forward with their deep retrofit investment.

Table 3-2: Owner Motivations to Invest in Deep Energy Retrofits

Motivational Factor	Project A	Project B	Project C	Project D
Optimizing Capital Projects	●	●	●	●
Asset Value	●	●	●	●
Replicating Good Past Experiences with NEEA	●	○	●	●
Energy Cost Savings	●	●	●	○
Market Positioning	○	○	●	●
Community Level Development	○	○	●	●
Owner Reputational Goals	○	○	○	●
Thermal Comfort	○	●	○	○
Existing-Tenant Interest	●	○	○	○

The list below explains each motivational factor:

- *Optimizing Capital Projects*: the owner believed the deep energy retrofit would improve capital projects already underway/planned
- *Asset Value*: the owner believed the deep energy retrofit would increase the asset value of a building
- *Replicating Good Past Experience with NEEA*: a positive prior experience working with NEEA prompted the owner to move forward with the deep energy retrofit demonstration
- *Energy Cost Savings*: the owner believed the deep energy retrofit would lead to significant energy cost savings
- *Market Positioning*: the owner believed the deep energy retrofit would produce a highly sustainable building that helps maintain or improves the building's local market position
- *Community Level Development*: local developments in the building's surrounding community that emphasize community revitalization and sustainability prompted the owner to move forward with the deep energy retrofit
- *Owner Reputational Goals*: the owner believed that the deep energy retrofit would improve the company's sustainability reputation and leadership
- *Thermal Comfort*: the owner believed the deep energy retrofit would improve the thermal comfort of the building for tenants
- *Existing-Tenant Interest*: tenants supported and/or encouraged the owners to invest in a deep energy retrofit

3.1.3 Owner Decision Making

Upon receiving the integrated measure package options, owners generally took four or fewer steps to make the decision to move forward with implementation of the deep energy retrofit. The variance in steps taken suggests a range in types of decision making for building investor-owners. Overall, owners in tertiary markets appeared to require less research and analysis than owners in the secondary markets.[2]

Table 3-3: Owner Decision Making for Deep Energy Retrofit Implementation

Decision-Making Process	Project A	Project B	Project C	Project D
Step 1: Discuss Assumptions	●	●	●	●
Step 2: Request Additional Research	○	○	●	●
Step 3: Request Sensitivity Analysis	○	○	●	●
Step 4: Design and Cost Estimates	●	●	●	●

Step 1: Discuss Assumptions

- Owners asked NEEA about assumptions, primarily focusing on the financial analysis assumptions
- Across all projects, owners also tested the assumptions of the technical analysis, though to a lesser extent

Step 2: Request Additional Research

- Owners in secondary markets requested additional analysis, specifically with regard to speaking to more brokers about the estimates in rent price as part of the financial analysis
- Owners in tertiary markets did not appear to request additional research either for the technical or financial analysis

Step 3: Request Sensitivity Analysis

- Owners in secondary markets requested a sensitivity analysis with regard to energy cost savings, rental price, and other value elements
- Owners in tertiary markets—where the motivation for market positioning was less relevant—did not appear to request this analysis

Step 4: Design and Cost Estimates

- In order to produce construction documents and move forward with implementation, owners contracted (or will contract) with their own design and construction teams
- For projects that required permitting, the professionals providing sign-off required making their own design and cost estimates—using the NEEA design as a starting point—in order to reduce their risk

3.2 Process Description

This section documents stakeholder perspectives about the effective components, secondary benefits, secondary challenges, and recommendations for each process step. The findings

[2] The owner inexperienced with energy retrofits in a tertiary market received additional assistance on green leasing and obtaining federal tax incentives, which RMI/Navigant categorizes not as decision making but rather as an *effective component* of the implementation step (see Section 3.2.6).

displayed in the tables below combine the perspectives of interviewees relevant to the Demonstration Project process steps.

Stakeholders described the following for each process step in the tables displayed in Section 3.2:

- *Effective Components*: aspects of the process step that worked well
- *Secondary Benefits*: specific ways in which the process step delivered value to project stakeholders, secondary to the "Primary Benefits" of Section 3.1.1
- *Secondary Challenges*: aspects of the process step that delayed or impeded the deep energy retrofit, secondary to the "Primary Challenges" of Section 3.1.1
- *Recommendations*: specific ideas from stakeholders on how to address the secondary challenges and improve the process step

3.3 Recruitment

Table 3-4: Effective Components, Secondary Benefits, Secondary Challenges, and Recommendations for Recruitment

Recruitment	Process Step Documentation
Effective Components	• NEEA's Trusted Brand • Clear, Well-managed, and Time-Efficient Owner Engagement
Secondary Benefits	• Owners Realized They Have Numerous Motivations to Invest in A Deep Energy Retrofit
Secondary Challenges	• The Term "Deep Energy Retrofit" Confused Owners • Owners Took More Time than Expected to Move Forward with Deep Retrofit Process
Recommendations	• Describe Deep Energy Retrofit as A "Renewal" That Makes The Building Competitive to New Construction • Tell Owners The Situations When A Deep Retrofit Makes Sense to Let Them Decide on Their Own Time

3.3.1 Preliminary Assessment

Table 3-5: Effective Components, Secondary Benefits, Secondary Challenges, and Recommendations for Preliminary Assessment

Preliminary Assessment	Process Step Documentation
Effective Components	• Confirmation of The Potential for at Least Thirty-Five Percent Energy Savings • Identification of Broad Needs That Address Problems and Improve Buildings
Secondary Benefits	• Owners Learned How A Deep Retrofit Could Address Multiple Building Upgrade Needs (Such as Failing Equipment and Poor Thermal Comfort), Which Made The Investment Case More Compelling • Property Managers Learned about Energy Saving Opportunities and How to Find More
Secondary Challenges	• Property Managers Were at Times Hard to Engage about Building Operations Practices
Recommendations	• Establish Expectations Upfront That Property Managers Will Play a Role in The Retrofit

3.3.2 Technical Analysis

Table 3-6: Effective Components, Secondary Benefits, Secondary Challenges, and Recommendations for Technical Analysis

Technical Analysis	Process Step Documentation
Effective Components	• Detailed and Comprehensive Analysis of New Opportunities for Energy Savings That Show The Technical Feasibility of Deep Energy Retrofits • Providing Owners Both Minimum and Optimum Integrated Design "Packages" of Energy Efficiency Measures
Secondary Benefits	• Owners Learned about Opportunities for Deep Energy Savings and New Energy Efficiency Measures • The Manual IMP Builder Reduced Upfront Cost of Initial Design/Analysis and Identified The ~Thirty Most Valuable Energy Efficiency Measures for Buildings (in Different Combinations) • The Analysis Prompted Additional Energy-Saving Actions by Owners
Secondary Challenges	• Multiple Changes To The Design Required Cost Estimator To Redo Work • Team Had To Estimate The Performance Of A "Code Compliant" Building for Utility Incentives When The Owner Did Not Need That Information
Recommendations	• (Stakeholders Did Not Offer Specific Recommendations for The Technical Analysis)

3.3.3 Financial Analysis

Table 3-7: Effective Components, Secondary Benefits, Secondary Challenges, and Recommendations for Financial Analysis

Financial Analysis	Process Step Documentation
Effective Components	• NEEA's Consideration of All The Costs, Value Components, Risks, and Financial Return of The "Packages" • High-Accuracy Cost Estimates from Local Contractors
Secondary Benefits	• Helped Secure Owner Buy-In and Shifted Owners' Thinking about Deep Retrofits • Owners Learned about The Value of Non-energy Benefits • "Packages" Provided Greater Value to Owners than The Sum of Their Individual Parts
Secondary Challenges	• Owners May Evaluate Measures Individually Rather than as A "Package" And Want to Remove More Expensive Measures • Attributing A Monetary Value to Non-energy Benefits Can Be Difficult • Each Project Required A Custom Approach • Utilities Could Not Commit on Financial Incentives • Changes to Design (Especially As A Result Of Phasing) Led to Many Cost Iterations • The Financial Analyst Did Not Feel the Process Allotted Sufficient Time for This Step • Having A Diverse Stakeholder Team Was Beneficial But Difficult to Manage
Recommendations	• Get Buy-In Early in The Process Among Key Stakeholders • Use Owners' Language to Have More Effective and Productive Conversations • Owners and NEEA should plan to allocate More Time/Resources to Financial Analysis, Especially to More Adequately Account for Phased Implementation

3.3.4 Owner Approval

Table 3-8: Effective Components, Secondary Benefits, Secondary Challenges, and Recommendations for Owner Approval

Owner Approval	Process Step Documentation
Effective Components	• NEEA Team Anticipating and Preparing for Owner Questions and Needs • Owners Individualized the Analysis by Conducting Their Own Due Diligence
Secondary Benefits	• (Stakeholders Did Not Offer Specific Secondary Benefits for Owner Approval)
Secondary Challenges	• Owners Focusing Primarily on First Costs • Ultimate Decision Makers Not Engaged Early in The Process Encountered Difficulties in Understanding The Overall Approach and Analysis Undertaken by Contractors/Consultants • NEEA Management Turnover Caused Delays • The Parent Company of An Anchor Tenant Would Not Allow The Tenant to Negotiate a Higher Tenant Improvement Budget
Recommendations	• Pair Large Capital Cost Estimates with Large Positive Cash Flows To Create An Overall Attractive Investment Case • Engage Owners about Packaging/Non-Energy Benefits Early in The Process to Avoid Owner Approval Problems and Compel Owners to Overcome Obstacles That Arise

3.3.5 Implementation

Table 3-9: Effective Components, Secondary Benefits, Secondary Challenges, and Recommendations for Implementation

Implementation	Process Step Documentation
Effective Components	• Implementation Plans That Show Owners Next Steps • The Use of Phased Implementation over Several Years • Creating Plans to Avoid Tenant Disturbance • NEEA Helping An Owner Inexperienced with Retrofits to Develop Green Leasing Strategies and Capture Federal Incentives
Secondary Benefits	• Owners Have A Multi-Year Plan for Improving The Building • Phasing Will Reduce Tenant Disruption and Help with Financing Options
Secondary Challenges	• Complex Development Issues • Installation Is Only as Good as The Installer; One Owner Experienced Serious Installation Problems • Phased Implementation Demands More Planning, Oversight, and Owner Follow-Through since It Will Take Place over Several Years • Understaffed O&M Teams May Undermine The Expected Impact and Benefits of Deep Energy Retrofit Investments
Recommendations	• Help Owners Ensure There Is Sufficient and Trained O&M Staff for Retrofitted Buildings • Provide Owners Guidance On Installation, Especially For Energy-Retrofit-Inexperienced Owners In Non-"Green" Markets

4. Best Practices

This section identifies best practices for the deep energy retrofit process based on the documentation of stakeholders' experience with the deep retrofit process and RMI's prior work in deep retrofits. Table 4-1 summarizes the best practices for each Demonstration Project process step. Table 4-2 through Table 4-6 go into greater detail about each Demonstration Project best practice by providing a description, the associated RMI deep retrofit best practice, and the effective Demonstration Project process components and stakeholder recommendations that exemplify the best practice. The Appendix offers the list of RMI's 27 deep retrofit best practices based on its national experience with deep retrofits.

Table 4-1: Summary of Best Practices

Process Step	Best Practices Identified in Process Documentation
Recruitment	• Deep Energy Retrofit Triggers • Owner Vision for Deep Energy Retrofit
Preliminary Assessment	• Integrative Design-Experienced Team Selection • Integrative Design Emphasis • Performance Benchmarks and Goals • Identification of The Building, Owner, and Tenant Needs • Contracts That Align The Team*
Technical Analysis	• Definition of Multiple Integrated Measure Packages at Least Soft Cost • Reduce Loads First, Then Accurately Size Equipment • Property Manager Engagement
Financial Analysis	• Identification of All The Benefits and Cost • Finance Options Assessment • Underwriting/ Due Diligence Support
Owner Approval	• Presentation of All Value and Risk • Owners Make The Financial Analysis Their Own
Implementation	• Project Phasing over Multiple Years • Business Interruption Strategy • Tenant Engagement (Value, Green Leasing) • Selection of Capable Installers Early in Design • Commissioning Plan • Operations and Maintenance Plan

* Note: This best practice was not specifically discussed in the process review

4.1 Recruitment

Table 4-2: Best Practices for Recruitment

Demonstration Project Best Practice	Description	Associated RMI Best Practice	Associated Effective Process Components & Stakeholder Recommendations
Energy Retrofit Triggers	Identify the buildings that are ready for deep energy retrofit based on a set of simple indicators that are both building- and owner-related	Energy Retrofit Triggers	• Tell Owners The Situations When A Deep Retrofit Makes Sense to Let Them Decide on Their Own Time
Owner Vision for Deep Energy Retrofit	Develop a vision for the project that explains why the deep energy retrofit opportunity makes sense for the owner; this vision should explain how the retrofit could be financed and the level of return on investment required	Goal-Setting Charrette	• Clear, Well-Managed, and Time-Efficient Owner Engagement • Describe Deep Energy Retrofit as A "Renewal" That Makes The Building Competitive to New Construction • Conduct More Due Diligence before Continuing The Process with Owners

4.2 Preliminary Assessment

Table 4-3: Best Practices for Preliminary Assessment

Demonstration Project Best Practice	Description	Associated RMI Best Practice	Associated Effective Process Components & Stakeholder Recommendations
Integrative Design-Experienced Team Selection	Bring together a diverse team of experts that can provide quality support and analysis for all steps of the process	Team Selection	• Establish Expectations Upfront That Property Managers Will Play A Role in The Retrofit • Owners Having A "Dream Team" of Contractors and Consultants
Integrative Design Emphasis	Emphasize integrative design principles to establish team dynamics/working relationships and reveal potential energy savings.	Integrative Design	• Identification of Broad Needs That Address Problems and Improve Buildings • Establish Expectations Upfront That Property Managers Will Play A Role in The Retrofit
Performance Benchmarks and Goals	Determine the building's energy use baseline to establish a reference point and evaluate the potential to achieve energy savings goals	Performance Benchmarks	• Confirmation of The Potential for at Least Thirty-Five Percent Energy Savings
Identification of The Building, Owner, and Tenant Needs	Identify opportunities to both improve the building's energy performance and address issues owners and tenants want to be addressed in the building	Goal-Setting Charrette	• Identification of Broad Needs That Address Problems and Improve Buildings
Contracts That Align The Team	Create contracts that align the integrated design team around a shared vision, clarify roles, and incentivize performance	Contracts, Insurance, and Legal	• Establish Expectations Upfront That Property Managers Will Play A Role in The Retrofit

4.3 Technical Analysis

Table 4-4: Best Practices for Technical Analysis

Demonstration Project Best Practice	Description	Associated RMI Best Practice	Associated Effective Process Components & Stakeholder Recommendations
Definition of Multiple Integrated Measure Packages	Conduct and present a rigorous and well-supported assessment of integrated design packages of energy efficiency measures to achieve at least thirty-five percent energy savings	Technical Potential Analysis; Design Options Assessment	• Detailed and Comprehensive Analysis of New Opportunities for Energy Savings That Show The Technical Feasibility of Deep Energy Retrofits • Providing Owners Both Minimum and Optimum Integrated Design "Packages" of Energy
Reduce Loads First, Then Accurately Size Equipment	Identify energy-saving opportunities in the right order by reducing energy demand in the building first and then selecting smaller, more efficient equipment; identify design synergies for reducing infrastructure, eliminating equipment, and/or simplifying systems	Reduce Loads and Improve Shells, Then Accurately Size Equipment	• Owners Learning How to Take A Holistic Perspective on Their Building's Energy Use
Property Manager Engagement	Make clear to property managers their role in the deep retrofit and inspire the pursuit of other energy-saving measures	Occupant and Manager Engagement	• Establish Expectations Upfront That Property Managers Will Play A Role in The Retrofit

4.4 Financial Analysis

Table 4-5: Best Practices for Financial Analysis

Demonstration Project Best Practice	Description	Associated RMI Best Practice	Associated Effective Process Components & Stakeholder Recommendations
Identification of All The Benefits and Costs	Conduct and present a rigorous and well-supported assessment of retrofit value and risk.	Deep Retrofit Value Report; Evaluate the Cost of Doing Nothing	• NEEA's Consideration of All The Costs, Value Components, Risks, and Financial Return of The Packages • High-Accuracy Cost Estimates from Local Contractors • Use Owners' Language to Have More Effective and Productive Conversations
Finance Options Assessment	Consider the full array of financing options, including all terms and conditions such as interest rates, financing amount, closing costs and timing, recourse, etc.	Finance Options Assessment	• NEEA's Consideration of All The Costs, Value Components, Risks, and Financial Return of The Packages
Underwriting/Due Diligence Support	Underwriters/due diligence analysts for loans and equity investments are unlikely to have access to the knowledge and data necessary to properly assess the risks and value of a deep retrofit investment. Engage them early to avoid any problems.	Underwriting/ Due Diligence Support	• Get Buy-In Early in The Process Among Key Stakeholders (e.g. Appraisers)

4.5 Building Owner Approval

Table 4-6: Best Practices for Building Owner Approval

Demonstration Project Best Practice	Description	Associated RMI Best Practice	Associated Effective Process Components & Stakeholder Recommendations
Presentation of All Value and Risk	Offer comprehensive analysis and integrated measure packages that resonate with owners and convince them to move forward with the deep retrofit investment	Deep Retrofit Value Report	• Engage Owners about Packaging/Non-Energy Benefits Early in The Process to Avoid Owner Approval Problems and Compel Owners to Overcome Obstacles That Arise • NEEA Team Anticipating and Preparing for Owner Questions and Needs • Pair Large Capital Cost Estimates with Large Positive Cash Flows to Create An Overall Attractive Investment Case
Owners Make The Financial Analysis Their Own	Even if owners trust the business case, they will feel the need to individualize the analysis and conduct their own research and analysis	Deep Retrofit Value Report	• Owners Individualized The Analysis by Conducting Their Own Due Diligence

4.6 Implementation

Table 4-7: Best Practices for Implementation

Demonstration Project Best Practice	Description	Associated RMI Best Practice	Associated Effective Process Components & Stakeholder Recommendations
Project Phasing Over Multiple Years	Intelligently phase project over multiple stages and years, depending on efficiency and expected life of existing improvements, leasing situations, and consideration of future technology/economic conditions that might make currently infeasible measures possible	Project Phasing	• Implementation Plans That Show Owners Next Steps • The Use of Phased Implementation over Several Years
Business Interruption Strategy	Carefully consider and plan the construction phase to avoid disruption to tenants and/or employees	Business Interruption Strategy	• Creating Plans to Avoid Tenant Disturbance
Tenant Engagement (Value, Green Leasing)	Engage tenants early—in the design process as well as during implementation—in order to communicate and create the full value proposition for both owner and tenant	Occupant and Manager Engagement; Green Leasing	• NEEA's Follow-Through to Help Owners Realize Value
Selection of Capable Installers Early in Design	Select contractors (ideally early in design) and other service providers with requisite experience in deep energy retrofits	Contractor / Service Provider Selection	• Provide Support on Phased Implementation • Provide Owners Guidance On Installation, Especially For Energy-Retrofit-Inexperienced Owners In Non-"Green" Markets
Commissioning Plan	Implement commissioning during the design process, and on an ongoing basis to ensure systems and equipment were installed and operating according to design	Commissioning Plan	
Operations and Maintenance Plan	Involve maintenance personnel and facilities operators in any building upgrades from the beginning, so they can help form the energy reduction goals,	Operations and Maintenance Plan	• Help Owners Ensure There Is Sufficient and Trained O&M Staff for Retrofitted Buildings

Demonstration Project Best Practice	Description	Associated RMI Best Practice	Associated Effective Process Components & Stakeholder Recommendations
	understand them, and be more engaged to help achieve them		

5. Considerations for Scaling

In order to overcome market barriers and scale deep energy retrofits, the EBR initiative must find ways to support the implementation of best practices at minimal time and cost for design and analysis. This section provides considerations for scaling deep energy retrofits, from both Demonstration Project stakeholder and RMI perspectives.

The tables below describe the following for each process step:

- ***Opportunities to Reduce Assistance*:** identifies ways to reduce the level of assistance NEEA (or other future program operator) provides on the project
- ***Opportunities to Automate Assistance***: offers ways to automate the process, directly applicable to the design of tools and resources
- ***Difficulties in Automating***: notes challenges to automate the process step or reduce assistance

5.1 Stakeholder Perspectives

Table 5-1: Stakeholder Perspectives for Scaling

Process Step	Opportunities to Reduce Assistance	Opportunities to Automate Assistance	Difficulties in Automating
Recruitment	• Eliminate One-on-One Conversations Between NEEA and Owner in Order to Catalyze Interest in The Project	• Tell Owners The Situations When A Deep Retrofit Makes Sense to Let Them Time It Right • Provide A General Roadmap for Executing a Deep Energy Retrofit • Demonstrate The Investment Case and Typical Capital Cost through Case Studies	• Getting The Owner to Trust That The Process Will Deliver The Claimed Value (i.e. Trust in NEEA)
Preliminary Assessment	• (Stakeholders Did Not Offer A Point Here)	• Offer a Directory/Forum for Selecting Capable Technical, Financial, and Installation Service Providers	• (Stakeholders Did Not Offer A Point Here)

Process Step	Opportunities to Reduce Assistance	Opportunities to Automate Assistance	Difficulties in Automating
Technical Analysis	• Reduce Level of Design Assistance Provided (Because Owners Replicated Design and Costing Effort)	• Leverage IMP Builder for Faster and Least-Cost Analysis	• Getting Owners and Their Design Teams to Trust The Analysis Provided
Financial Analysis	• (Stakeholders Did Not Offer A Point Here)	• (Stakeholders Did Not Offer A Point Here)	• Providing Unique and On-The-Ground Research for Each Building (e.g. interviewing local brokers about lease rates for the particular building)
Building Owner Approval	• (Stakeholders Did Not Offer A Point Here)	• (Stakeholders Did Not Offer A Point Here)	• (Stakeholders Did Not Offer A Point Here)
Implementation	• (Stakeholders Did Not Offer A Point Here)	• Use Online Tool to Provide Two-Way Communication between Owners and NEEA/Others to Track Progress and Enhance Engagement • Identify in General When The Owner's Design Team Needs to Get Involved	• For Phased Implementation, Ensuring That Energy Savings Are Captured over Long Periods of Time

5.2 ***RMI Perspective***

Table 5-2: RMI Perspectives for Scaling

Process Step	Opportunities to Reduce Assistance	Opportunities to Automate Assistance	Difficulties in Automating
Recruitment	• Pre-Qualify Service Providers	• Leverage Performance Disclosure Program and/or Utility Data • Perform Inverse-Model	• Obtaining Supporting Data (e.g. Building Size,

Process Step	Opportunities to Reduce Assistance	Opportunities to Automate Assistance	Difficulties in Automating
		Regression Analysis Using Utility Billing and Weather Data; Support The Use and Integration of Commercially Available Tools That Already Exist; Share Findings as Part of Targeted Marketing	Equipment Age)
Preliminary Assessment	• (RMI Did Not Offer A Point Here)	• Use Self-assessment Checklists to Assess Project Objectives and Building Improvement Needs • Conduct Inverse-Model Regression Analysis; Support the Use and Integration Of Commercially Available Tools that Already Exist	• For Some Sites, Getting Single-Building Utility Data • May Be Most Effective to Pay Vendors for The Analysis
Technical Analysis	• Consider Directing The Team to An “Intervention” with Deep Retrofit Specialists[3] Should The Project Veer Away from The Deep Retrofit Process • Have Deep Retrofit Specialists Provide One Design Synergy Assessment, Which Would Encourage The Team to Seek Out Multiple Uses for A Single Expenditure (e.g. Use Life-Safety Smoke-Exhaust Fans to Support Atrium Ventilation and Cooling) and Reduce Infrastructure,	• Provide Self-Assessment Checklist to Inform and Direct The Process • Allow Owners and Teams to Select and Adopt Tools That Works Best for Them • Focus on Methods and Tools That Support Identifying Integrated, Synergistic Solutions	• Designers Have Greatest Trust in Their Existing Methods • An Integrated Design with Synergistic Solution Often Are Customized Based on The Project Specifics

[3] Deep retrofit specialists could be the technical leads from the EBR initiative demonstration projects, or professionals with similar capability and experience.

Process Step	Opportunities to Reduce Assistance	Opportunities to Automate Assistance	Difficulties in Automating
	Reduce Equipment, Simplify Systems, and Ultimately Lower First Costs • Vary Support Based on Owner and Team Experience		
Financial Analysis	• Have Deep Retrofit Finance Specialist Provide One Consultation on Analysis Results/Feedback	• Provide Self-Assessment Checklist and Report Template to Guide The Consideration of All Value and Risk	• Owners and Designers Have Greatest Trust in Their Own Cost Numbers
Building Owner Approval	• Have Deep Retrofit Finance Specialist Provide One Consultation/Feedback on Presentation to Owner	• Use Checklists to Score Projects to Improve Methods, Reduce Risk, and Increase Access to Capital	• Owners Should Be Able to Rely on The Analytics They Trust Most for Making Decisions
Implementation	• (RMI Did Not Offer A Point Here)	• Provide Guidance on M&V for Deep Retrofits • Incorporate Inverse-Models into M&V Approach • Support Ongoing Success through Regular Utility Billing Assessments • Offer General Principles on How to Phase Projects	• Occupant Behavior Can Have Big Impact in Low Energy Buildings • May Be Most Effective to Pay Vendors for The Analysis

6. Conclusions and Recommendations

Overall, it appears that the Demonstration Projects are on track to meeting their objectives. The Process Review has provided process description, best practices, and considerations for scaling retrofits—all of which inform tool development and confirm the availability of quality content for case studies. Moreover, the projects at their current stages appear to demonstrate market and technical viability of deep energy retrofits.

While the projects are on track to meet their objectives, two market-oriented challenges emerged that NEEA staff should consider in moving forward with the EBR initiative: tenant value acknowledgement and coordination with utilities. RMI/Navigant recommend NEEA build market-wide value acknowledgement for tenants as well as owners. This will help implement integrated measure packages fully in tenant spaces. RMI/Navigant also recommends NEEA continue their conversations with utility representatives to strategically align the EBR initiative with utility programs.

6.1 Assessment of Meeting Project Objectives

6.1.1 Objective One: Inform Tools to Scale the Adoption of Deep Energy Retrofits in the Market

The successful completion of this objective requires collecting information on how well the “manual” technical and financial evaluation tools (IMP Builder and Integrated Property Assessment) worked on the Demonstration Projects and using this information to develop insights for their future development. In order to assess progress towards achieving this objective, RMI/Navigant reviewed the NEEA RFP issued for developing the integrated online EBR toolset, or EBR Tool, and cross-referenced the proposed tool functions with findings from Section 5.

The manual versions of the IMP Builder and Integrated Property Assessment represented the technical and financial analysis steps, respectively. The automated versions of these tools are currently in development and will provide a foundation for the EBR Tool.

The findings from Section 5 directly correlate to the functions NEEA proposes for the EBR Tool and, therefore, the demonstration projects have well-informed tool development. The table below presents the proposed EBR Tool functions and associates them with related steps from the Demonstration Project process. Because each tool function is associated with a process step, the considerations for scaling documented in Section 5 inform each function.

Table 6-1. Mapping Proposed EBR Tool Functions to the Identified Opportunities to Automate Assistance

Proposed EBR Tool Functions	Associated Process Step(s)
EBR Screening & Suitability	Recruitment; Preliminary Assessment
Data Acquisition	Preliminary Assessment
Calculation Engines	Technical Analysis; Financial Analysis
Business Case & Reporting	Technical Analysis; Financial Analysis; Implementation
Supporting Information	Recruitment; Building Owner Approval

6.1.2 Objective Two: Offer Proof That Deep Energy Retrofits Are Technically And Financially Viable

Demonstration Projects that completed construction with positive financial returns will show market viability. Validated energy savings from the Demonstration Projects after implementation of deep retrofits will show technical viability. Showing progress toward completing this objective at this point in the Demonstration Projects means signing MOUs with owners of all four demonstration buildings, as well as developing an integrated measure package that is compelling from both technical and financial viability perspectives. In addition, demonstration project stakeholders should expect a strong financial return for the building owner and at least thirty-five percent savings of the pre-retrofit energy use.

To-date, all four owners have signed an MOU to participate as a demonstration project. Two owners have moved forward with construction of the complete integrated measure package. A third building owner has begun phase 1 implementation; however, the full project approval is pending some changes in building ownership and property management as well as decisions on an adjacent development. The fourth building owner is still considering how to budget the project, as the project is part of a larger development that remains to be finalized.

All project stakeholders expressed confidence that the proposed integrated measure packages will save at least thirty-five percent energy. The owners each expect strong financial returns except for one owner who has experienced major implementation challenges and loss of rental income (see section 3.1.1).

6.1.3 Objective Three: Provide Case Studies For Education, Training, And Marketing During Later Stages Of The EBR Initiative

In order to complete this objective, the Demonstration Projects must provide quality content for future case studies. The case studies should summarize both the technical and financial achievements of deep retrofits. Impactful case studies of the Demonstration Projects will also include descriptions of the effective approaches, challenges, and value of the existing building renewal.

The process review shows the availability of quality content for case studies. Case studies can include content from the process review such as an outline of deep energy retrofit process steps, the benefits of integrated design teams, the need for integrated measure packages, and the importance of providing decision-makers a convincing business case.

6.2 Addressing Market Challenges

The Demonstration Projects appeared to overcome the three market barriers the EBR initiative seeks to address; yet additional challenges emerged. The process best practices identified in this report appear to be able to address all but two of these challenges. The two remaining challenges exist in the market rather than the retrofit process. The table below summarizes the barriers and challenges of the Demonstration Projects. RMI/Navigant recommend that NEEA staff address these market-type challenges in addition to the other barriers and challenges.

The process best practices identified in Section 4 can address the two process-type challenges as shown in the table. The remaining two challenges, while minor, are significant enough to warrant a full discussion about how to address them. As shown in the table, the two market challenges were:

1. Owners Convincing Tenants to Buy Efficiency (Split Incentive)
2. Uncertainty on How Utilities will Financially Support Deep Energy Retrofits

Table 6-2: Deep Energy Retrofit Barriers and Challenges (Overcome and Experienced)

	Barriers and Challenges	Type	How They Were / Can Be Addressed
Barriers Overcome by Demonstration Projects	High cost and long length of time to study the feasibility of deep energy retrofit	Market	Overcome by Demonstration Project: NEEA provided services for free to eliminate cost and used the manual version of the IMP builder to reduce the time for technical analysis
	Owners' perceived lack of investment value	Market	Overcome by Demonstration Project: NEEA identified all value using the manual version of the Integrated Property Assessment tool
	A lack of skillsets, tools, information, and general market capacity for deep energy retrofits	Market	Overcome by Demonstration Project: NEEA assembled a team of highly skilled professionals competent in doing deep retrofits
Primary Challenges Experienced During the Demonstration Projects	Owners Not Always Forthcoming About Intention and Ability to Finance	Process	Best Practices Can Address This Challenge: Project manager can conduct more due diligence before continuing the process with owners (see Section 4 Best Practices)
	Owners Finding Capable Installers	Process	Best Practices Can Address This Challenge: Team can provide greater support on installer selection (see Section 4 Best Practices)
	Owners Convincing Tenants to Buy Efficiency (Split Incentive)*	Process and Market	Best Practices Can Address This Challenge: Can identify engage tenants early in design and implement green leasing (see Section 4 Best Practices) Best Practices Cannot Address This Challenge: NEEA can build tenant knowledge of value proposition
	Uncertainty on How Utilities will Financially Support Deep Energy Retrofits	Market	Best Practices Cannot Address This Challenge: NEEA can continue to work with utilities to drive alignment

* Note: This challenge can also be thought of as tenants' "perceived lack of investment value"

Only one project, in a tertiary market, experienced the first challenge during the implementation step of the deep energy retrofit. A full discussion of this challenge is presented in Section 3.1.1. While the owner and tenant succeeded in negotiating a partial implementation of the integrated measures package, it was clear that the tenant undervalued the investment. As noted in the table above, the deep energy retrofit process can partially address this challenge (namely, by engaging tenants early on in the value proposition and negotiating green leases). However, these process best practices cannot address the dynamic between the tenant and the head office. Owners typically struggle to effectively engage the corporate office of the tenant and do not typically negotiate leases with it.

Therefore, the EBR initiative has an opportunity to address the value proposition of deep energy retrofits for tenants *at the market level*, similar to what the Initiative does for owners. The key objective should be to show tenants *and their head offices* how to appropriately value deep energy retrofits for their spaces. If this challenge remains unaddressed, additional owners may experience similar issues with their tenants, leading to sub-optimal implementation.

All four projects experienced the second market challenge, which Section 3.1.1 fully discusses. While it is clear that there are ongoing conversations between NEEA staff and the utility representatives about how to strategically align the EBR initiative with utility programs and that much work remains, it is necessary to document this challenge in the Process Review.

APPENDIX A. BUILDING OWNER AND UTILITY INTERVIEWS MEMORANDUM

A.1 Owner and Utility Interviews

MEMORANDUM

SUBJECT: Findings from the Building Owner and Utility Interviews

TO: Rita Siong, Emily Moore, John Jennings, Rob Curry (NEEA)

FROM: Mike Bendewald & Doug Miller (RMI)

CC: Jay Luboff (Navigant)

DATE: 5 March 2014

A.1.1 Introduction

Between January 29th and February 26th 2014, RMI/Navigant conducted a series of eleven one-hour interviews, one for each of the building ownership team members and utility representatives.[4] The purpose of these interviews was to document interviewee experience with the Demonstration Projects and to obtain their thoughts on NEEA's development of tools and resources. The interview findings will form the basis for the report that documents the Demonstration Project process and provides recommendations on how NEEA should move forward.

The remainder of this memorandum provides key findings and closing remarks as described below.

[4] Three interviews involved more than one interviewee: Carol Word and Scott Cooney; Oliver Kesting and Spencer Moersfelder; and Javad Maadanian and Lucie Huang.

A.2 Building Owners Interview Approach and Findings: A summary of the approach and findings from the interviews with building owners, including the following:

A.2.1 Hypotheses about the Owners: This section documents RMI/Navigant hypotheses to be tested during the interviews.

A.2.2 Initial Motivations: This section describes owners' initial motivation to participate in the Demonstration Project.

A.2.3 Process Steps: This section describes from the owners' perspective each step of the process and, if applicable, provides owner recommendations for improving the process step.

A.2.4 Tool Development: This section documents owner perspectives on NEEA tool development in order to inform RMI/Navigant assessment of NEEA Staff's completion of Objective 1 for the Demonstration Projects.

A.3 Utility Representatives Interview Approach and Findings: A summary of the approach and findings from the interviews with utility representatives, including process steps and tool development as noted above in the Building Owner Interview section.

A.4 Concluding Remarks – Owner and Utility Interviews: A brief summary of this memorandum and how it will inform the final report.

Note on terminology: In this memorandum the authors will refer to the owner[5] as "owner" and will refer to the owner, facility director, project architect, and project engineer as the "ownership team." In addition, the authors will refer to the entire NEEA project team (including staff as well as NEEA consultants and contractors) as "NEEA" unless otherwise stated.

A.2 Building Owners Interview Approach and Findings

A.2.1 Hypotheses about the Owners

RMI/Navigant's first interview question to building owners was about their real estate business. Answers varied widely, enabling RMI/Navigant to classify the owners (see Table A-1) and to test the following hypotheses during the course of the interviews:

- Smaller portfolio owners that are inexperienced with energy retrofits will require more assistance from NEEA on the Demonstration Project;
- Larger portfolio owners will require more sophisticated financial analysis than smaller portfolio owners; and
- Owners in strong local markets for green buildings will consider values beyond energy cost savings.

Many of the findings presented in later sections refer to these hypotheses, which in order to test required open-ended questioning. The complete set of owner questions for the interviews are in the Appendix.

[5] Due to their close working relationship and the fact that RMI/Navigant interviewed him with Carol Word, the use of the term "owner" in this memorandum refers to Scott Cooney in addition to the owners.

Table A-1: Owner Classifications

Question	Demonstration Project #1	Demonstration Project #2	Demonstration Project #3	Demonstration Project #4
Number of Buildings in Portfolio?	<10, small portfolio owner	<10, small portfolio owner	10–100, larger portfolio owner	10–100, larger portfolio owner
Energy Retrofit Experience?	Experienced	Inexperienced	Experienced	Experienced
Strong Local Market for Green Buildings?	No	No	Yes	Yes

A.2.2 Initial Motivations

Owners noted several initial motivations for getting involved with the Demonstration Projects. As shown in Table A-2 below, optimizing capital projects was the most prevalent motivation among the four building owners. Replicating good past experiences working with NEEA, energy cost savings, and market positioning were also important motivating factors for the owners—the latter of which was only important for owners with a strong local market for green buildings.

Table A-2: Initially Motivating Factors for Owners

Motivational Factor	Number of Mentions*
Optimizing Capital Projects	●
Replicating Good Past Experiences with NEEA	◕
Energy Cost Savings	◕
Market Positioning	◑
Owner Reputational Goals	◔
Thermal Comfort	◔
Existing-Tenant Interest	◔

* Dark circle indicates four out of four owner mentions

The following list of motivating factors provides more context and supporting data for the conclusions presented in Table A-2.

Optimizing Capital Projects

- Three owners described how they were already beginning the process to replace failing, inefficient equipment and were more than willing to have NEEA enhance the process and identify additional energy-saving opportunities
- The fourth owner noted that the deep retrofit would support the strategic use of capital that would need to be spent anyway over the next few decades to maintain building functional performance

Replicating Good Past Experiences with NEEA

- Three ownership teams cited their previous work with NEEA team members as a major factor for their participation in the Demonstration Projects

Energy Cost Savings

- Three owners described energy cost savings as a motivation
  - The owners with gross leases described separate approaches to capturing the energy cost savings value: (1) keep the savings to increase net operating income and (2) pass the savings to the tenants in order to make the building more competitive (lower cost) in the market and potentially increase/maintain occupancy
  - The owner with a triple-net lease did not view energy cost savings as a very strong motivation because the tenants capture a substantial portion

Market Positioning

- Owners in "green" markets expected increased energy performance to improve the market position of the building
  - One owner expects to solidify the building as a class A iconic building in the context of a market and government that demands energy efficiency
  - Another owner expects the increased energy efficiency and LEED rating to attract tenants, and it will support the overall goal of improving the building class from B+ to A
- In contrast, owners without a strong local market for green buildings were not as optimistic that the energy efficiency would substantially contribute to building marketability or tenant attraction

Owner Reputational Goals

- One of the owners sees itself as a local and now national leader in green buildings and saw the Demonstration Project as well-aligned with its work

Thermal Comfort

- One owner indicated the building has had thermal comfort issues for "a long time" and the retrofit would finally fix the problem

Existing-Tenant Interest

- One owner cited existing tenant interest in the energy retrofit as a motivating factor for the retrofit
    - The tenant believed the energy retrofit would support workplace wellbeing efforts

A.2.3 Process Steps

Overall the owners are happy with the Demonstration Project process at this point and have found it valuable—one owner went so far as to say that what NEEA brought to the project was "invaluable." As the RMI/Navigant team expected, the owners experienced some challenges. As a result of owners being largely satisfied with the process, they offered few recommendations on how to improve it. Table A-3 below summarizes the key findings.

Table A-3: Summary of Owner Description, Benefits, Challenges, and Recommendations

Process Step	Description	Benefits	Challenges	Recommendations
Recruitment	Owners Felt Process Was Clear and Time-Efficient	NEEA Explained the Full Value of Deep Energy Retrofits	—	- Consider Enhancing Marketing Statements (the Pitch) - Temper Market Adoption Expectations Based on the Market
Preliminary Assessment	*— a*	*Property Managers Learned How to Find Energy Saving Opportunities*	—	—
Technical Analysis	*Owners Trusted the Analysis Results*	- NEEA Introduced Owners to New Efficiency Measures - The *Analysis Prompted Additional Owner Energy-Saving Actions*	—	—

Process Step	Description	Benefits	Challenges	Recommendations
Financial Analysis	Owners Found the Business Case to be Convincing	- A Full Range of Values Substantiated a Large Deep Retrofit Investment - A Retrofit-Inexperienced Owner Greatly Appreciated NEEA's help to Realize Value	The Analysis Required Back-and-Forth Exchange Between Owners and the NEEA Team, Especially for Larger Portfolio Owners	*Owner Team did not Fully Trust the Energy Analysis*
Building Owner Approval	- *Owners Individualized the Analysis* - Owners in Green Markets Expect Increased Rental Income	Owners Learned how to Consider a Deep Energy Retrofit Investment	*NEEA Management Turnover Caused Delays*	—
Implemen-ation	*Owners Vetted Up-Front Costs*	*Owners Created Plans to Overcome Tenant Disruption and First-Cost Obstacles*	- *Not All Tenants Perceive Full Value of Retrofit* - *Complex Development Issues are Delaying Implementation* - *Installation is Only as Good as the Installer*	- Provide Guidance on Installer Selection, *Especially for Energy-Retrofit-Inexperienced Owners in Non-Green Markets*

The sections below provide more context and supporting data for each of the statements in Table A-3.

A.2.3.1 Recruitment

Owners found Recruitment to be clear and time-efficient, with NEEA providing the information about the full value of deep energy retrofits. Owners offered recommendations on how to tweak the "pitch" and on how to temper deep-retrofit market uptake expectations.

Description

Owners Felt Process Was Clear and Time-Efficient

- At the onset, NEEA clearly described what the expectations should be, who would attend the meetings, what would be covered at meetings, etc. so that no time was wasted

Benefits

NEEA Explained the Full Value of Deep Energy Retrofits

- NEEA created a story around the energy cost savings and non-energy-cost benefits to effectively "sell" the idea of a deep energy retrofit
- An interviewee said that the concrete preliminary information NEEA offered to owners was useful in making a convincing case for deep energy retrofits

Recommendations
Consider Enhancing Marketing Statements (the Pitch)

- An interviewee suggested NEEA describe what the office of the 21st century should look like (LED lighting, electro chromic windows, etc.)

Temper Market Adoption Expectations Based on the Market

- Without knowing NEEA's recruitment plan, one owner said that NEEA should vary its expectations for the rate of adoption by state; this particular owner's building, for example, is located in a state where "there are a lot of slow adopters, so green buildings will take hold more slowly here"

A.2.3.2 Preliminary Assessment

Owners found walking through the building with a technical lead to be valuable, especially for the property managers on the ownership team who learned to notice energy-saving opportunities.

Benefits
Property Managers Learned How to Find Energy Saving Opportunities

- *One energy-retrofit-experienced owner said that NEEA helped the property manager understand and identify a huge airflow problem, that the owner would not likely have otherwise been able to identify*

A.2.3.3 Technical Analysis

NEEA secured owners trust in the results of the technical analysis and introduced owners to new technical measures—even prompting one energy-retrofit-experienced owner to identify and develop an energy-saving opportunity himself.

Description
Owners Trusted the Analysis Results

- Some owners initially did not believe that 35 percent energy savings were possible, and the technical analysis team later convinced them otherwise
- *Owner teams appreciated the NEEA team's clarity of assumptions*
  - *One mechanical engineer on an owner team noted that the NEEA team's estimated reduction in cooling load—while significant—did not require him to conduct his own technical analysis because he understood NEEA's assumptions and agreed with them*

Benefits

NEEA Introduced Owners to New Efficiency Measures

- NEEA staff and the NEEA project team showed owners the value of a holistic view of energy-savings opportunity, including both architectural (i.e. windows, shading, walls, etc.) and equipment measures
  - During this process, owners became aware of the importance of better sealed building envelope for boosting energy savings, improving occupant comfort, and reducing the size of equipment
  - One owner especially appreciated the ability of contractors/consultants to analyze daylighting and electric lighting options

Analysis Prompted Additional Owner Energy-Saving Actions

- *One owner conceived of an additional energy saving measure in the parking lot of the building that, in addition to saving energy and water cost, increased tenant satisfaction and safety, created a cooling effect, and alleviated the need for more parking spaces*

Challenge
Owner Team did not Fully Trust the Energy Analysis

- *One member of an ownership team expressed skepticism in the energy savings estimates of the building envelope improvements to reduce air leakage, largely based on his belief that it is generally difficult to quantify the amount of building air leakage*

A.2.3.4 Financial Analysis

Owners felt that the NEEA team presented a compelling business case for deep energy retrofits, though owners did need to have some back-and-forth exchanges with NEEA in order to reach that result. In addition, owners appreciated the helpful guidance that NEEA provided on how to capture some elements of the value that was not readily available.

Description
Owners Found the Business Case to be Convincing

- Owners gained confidence in the deep energy retrofit investment because NEEA contractors/consultants were careful and conservative in their assumptions for the business case, and comprehensive in their analysis

Benefits
A Full Range of Values Substantiated a Large Deep Retrofit Investment

- According to one owner, *the NEEA project team "looked at everything that would create value" for the owner; including base rent, vacancy, tenant improvement costs, and operating expense*

A Retrofit-Inexperienced Owner Greatly Appreciated NEEA's Help to Realize Value

- *One owner who was inexperienced with energy retrofits said the financial lead helped the owner develop a new leasing structure for tenants (i.e. switching from triple net to gross leases) that would create more value*
- *The same owner indicated the financial lead connected the owner to a consultant for claiming a federal tax incentive for the deep energy retrofit*

Challenge
Analysis Required Back-and-Forth Exchange Between Owners and the NEEA Team, Especially for Larger Portfolio Owners

- One owner described that an initial proposal had an unrealistic ROI and lacked the real estate investment perspective (i.e. focused on capital cost and energy cost savings)
    - Later this proposal was improved to achieve similar energy savings at a fraction of the original total cost, and also presented a full real estate investment perspective
- One larger portfolio owner asked for more due diligence (i.e. speaking to more brokers about the potential for increased rental income) which the NEEA financial analyst was more than willing to provide; this *made the owner more comfortable with the investment*
- One larger portfolio owner worked with the financial analyst to identify how triggering debt over time through a phased implementation of the retrofit improved the expected ROI for the project
- These back-and-forth exchanges overall increased the time required for financial analysis.

A.2.3.5 Building Owner Approval

Owners stated that financial feasibility was at the core of their decision to move forward with implementation. While they trusted and valued the NEEA-produced business case, owners needed to make the analysis their own through conducting their own due diligence. Owners are now expecting significant boosts in net operating income (pending successful construction), but did note that NEEA management turnover complicated and delayed the process to get to that state.

Description
Owners Individualized the Analysis

- *Each owner individualized the financial and feasibility analysis through conducting their own due diligence practices*
    - An owner said the non-energy benefits calculations did not affect the ultimate decision due to the lack of local tenant demand for energy efficient spaces
    - Owners did not believe the deep energy retrofit added risk to investments in energy efficiency; however, the two larger owners actively managed risk through conducting their own sensitivity analysis into the major financial analysis assumptions
    - *An owner said that while confident in the energy savings from the energy model, he would still like an energy services company to model the results and then*

guarantee them; the owner noted that this is standard practice at the owner's company for energy-related investments.

Owners in Green Markets Expect Increased Rental Income

- One owner in a green market expected rents to increased $1 per square foot as a result of the deep energy retrofit
- Another owner in a green market expects rents to increase by $2 with an additional $1 per square energy cost savings for a total of $3 per square foot income
- The other two owners in non-green markets expect a significant value stream from the energy cost savings, but expect minimal value from increased rental income

Benefits
Owners Learned how to Consider a Deep Energy Retrofit Investment

- Owners noted that the final report provides a great template of the questions to ask and things to consider for improving an existing building

Challenges
NEEA Management Turnover Caused Delays

- *While outside NEEA's control, having three NEEA project managers over the course of 18 months created delays and made the process of approving the retrofit more difficult for owners*

A.2.3.6 Implementation

All four building owners have reached the point of considering how to implement the projects. However, thus far two owners have moved forward with construction of the complete IMP. The third building owner has begun Phase 1 implementation; however, the full project approval is pending some changes in building ownership and property management. The fourth building owner is still considering the proposal, as the project is wrapped into a larger development that is still being finalized.

One owner has had serious problems with installation, and recommends NEEA provide owners on future retrofits more help in selecting capable installers.

Description
Owners Vetted Up-Front Costs

- *Each owner had its own team develop a cost estimate*

Benefits
Owners Created Plans to Overcome Tenant Disruption and First-Cost Obstacles

- *Owners discussed the need for a roadmap in order to construct the measures timed with equipment failure and tenant rollover*

 - *All owners are timing implementation of the measures in tenant spaces with tenant rollover or lease renewal*
 - *One owner claims to have "stapled the list of measures" to the wall of the property manager's office, so as building issues come up he can install the measures that would provide a solution; thus the "first cost" of the measures are only incremental to what is needed anyway*
- *One owner team described how it was able to find unique ways to reduce the estimated cost of the measures package through avoiding a costly ceiling demolition to make way for new lighting*

Challenges

Not All Tenants Perceive Full Value of Retrofit

- *One owner described how it will not be possible to approve/implement all the retrofit measures in a major tenant space due to challenges with the tenant's corporate headquarters*
 - *The local manager/tenant thought the retrofit aligned very well with the company's workplace wellbeing efforts and supported implementation of all the retrofit measures*
 - *However, the headquarters was not willing to acknowledge the non-energy-cost savings value, which created the perception that the retrofit increased costs overall and as a result was not financially attractive (the gross lease blocked the tenant from realizing any of the energy cost savings)*

Complex Development Issues are Delaying Implementation

- *One owner described how the demonstration project is on hold right now in order to better align with the strategy for the encompassing "super block" development*
- *Implementation for another demonstration project is on hold (after completing preliminary, envelope-sealing measures in the package) and complicated by the fact that an existing 60-year ground lease will soon end and convert ownership away from the current owner; the company currently holding an ownership stake in the building will, if it wins the next contract, only be in a position of property management*

Installation is Only as Good as the Installer

- *One owner described various mishaps that occurred during the installation process, causing major delays in implementation and decreasing rental income (due to unoccupied spaces)*

Owner Recommendations

Provide Guidance on Installer Selection, Especially for Energy-Retrofit-Inexperienced Owners in Non-Green Markets

- *The owner who experience installation issues thought NEEA could have done a better job in helping choose an installer*

- *This owner is relatively inexperienced with energy retrofits and not located in a "green" market—all are factors that may have contributed to this request for more guidance*

A.2.4 Tool Development

Per RMI/Navigant's role to gather information and insights that inform NEEA's development of tools and resources to scale deep energy retrofits (Objective 1 of the Demonstration Projects), RMI/Navigant also asked owners about tool development.

A.2.4.1 Useful Tool Functions and Characteristics

Owners noted numerous potentially useful functions and characteristics for NEEA-produced tools and resources.

List Service Providers and Technologies

- Owners requested that NEEA provide a listing of experts that could provide the 3rd party service providers they need to plan, design, and implement a deep energy retrofit
  - One owner mentioned that this listing should indicate the varying number/availability of such experts across the Pacific Northwest
  - One owner stressed the need for a resource to identify qualified installers to help ensure the proper implementation of a deep energy retrofit
- In addition to providing information about the consultants and contractors available to owners for deep energy retrofits, owners said it would be useful for NEEA to provide information about available technologies

Focus on Specific Audiences and Empower Them

- One owner stressed the need for tools to be simple to use and to help make the person using the tool look like a hero to his/her supervisors
- One owner recommended that NEEA present information in the preferred style of the target audience; for example, CEOs and other decision-makers prefer executive summaries

Provide a Roadmap for Success

- Owners expressed interest in a tool that lists the steps of the deep energy retrofit process—broken down methodically in a way that shows how to achieve each step and how each step sets up the next one
- One owner would value being able to create a master plan from which the owner could select specific components and hand them to any architect, who will then have enough information to construct the project
  - One owner added to this suggestion by suggesting that a master plan could provide a checklist/roadmap for managers to follow so that when issues emerged managers would know to implement the next step of the deep energy retrofit and then check off the item from the list

Provide Market Outreach and Education

- One owner suggested that it is critical to publicize successes in order for the market to move beyond early adopters and NEEA's tools can play a big role

Give Advice on Broader Approaches to Efficiency

- One owner requested support from NEEA in deciding whether to make a deep energy retrofit investment in one or a small number of buildings in the owner's portfolio, or if the owner should focus on achieving fewer energy savings in more buildings
- One owner requested tools to identify opportunities to reduce water consumption

A.2.4.2 Challenges in Tool Development

In order to the conduct another deep energy retrofit, owners generally wanted the level of support they received from NEEA throughout the Demonstration Project. Achieving this level of support with tools and resources will be challenging for NEEA. Below are the challenges that owners mentioned.

Replicating NEEA's Presence and Active Involvement

- The very presence of NEEA was a strong motivation for owners to participate in the Demonstration Project in the first place
- Owners referred to how NEEA's active involvement over the course of the project process made the deep energy retrofit successful, specifically pointing to:
    - NEEA staff's project/meeting management capabilities
    - NEEA contractor/consultant skill sets

Owners Feeling Inadequate Despite Tools Being Available

- One owner described how his job is not to do energy retrofit projects but rather to manage the building
    - This owner would be comfortable going through the process again with NEEA's direct support, but does not believe he is prepared or has the time to go through this process on his own
- Two other owners echoed the point above about feeling unprepared at the moment to replicate the deep energy retrofit process on their own

A.3 Utility Representatives Interview Approach and Findings

This section provides the perspective of utilities on the Demonstration Projects. Although utility representatives did not participate to a large degree in the process, utilities are a major stakeholder in the EBR Initiative and NEEA Staff greatly value their input. The RMI/Navigant interview approach/questioning is documented in the appendix.

A.3.1 Process Steps

Utility representatives offered their perspectives on the Demonstration Project aspects/steps in terms of a description as well as benefits, challenges, and recommendations. Their comments focused on the recruitment, financial analysis, and implementation steps.

Table A-4: Summary of Utility Representative Description, Benefits, Challenges, and Recommendations

Process Step	Description	Benefits	Challenges	Recommendations
Recruitment	NEEA Is a Trusted Player in Energy Efficiency	NEEA Stretched Owners' Efficiency-Investments Limit	- Markets with Little Upside Limit Potential for Large Efficiency Investment - High Occupancy Buildings Have No Incentive; Low Occupancy Buildings Have No Financing - The EBR Initiative May Clash with Utilities' Work	- Don't Ask Owners a Yes/No Question of Interest in Deep Retrofit; Tell Them the Situation When a Deep Retrofit Makes Sense
Preliminary Assessment	*n/a*	*n/a*	n/a	n/a
Technical Analysis	NEEA Showed Owners New Opportunities for Energy Savings	n/a	n/a	n/a
Financial Analysis	n/a	NEEA Pioneered a Convincing Approach to Considering Non-Energy Benefits	Utilities' Notion of Cost Effectiveness Does Not Match that of	n/a

Process Step	Description	Benefits	Challenges	Recommendations
			the Real Estate Investor	
Building Owner Approval	*n/a*	n/a	*n/a*	n/a
Implemen-ation	*n/a*	*n/a*	Phased Implementation Demands Owner Follow-Through	- Help Owners Plan for O&M Oversight - NEEA Should Commit to the EBR Initiative for the Long-Term

A.3.1.1 Recruitment

Utility representatives acknowledged that NEEA is a trusted player in the market and that NEEA was able to stretch owners' potential for efficiency investment. In moving forward with recruitment, they cautioned NEEA about certain markets that will be particularly challenging for deep-retrofit uptake and advised NEEA to learn where and when deep retrofits make sense and distribute that knowledge to the building ownership community.

Description
NEEA Is a Trusted Player in Energy Efficiency

- This contributed to owners' willingness to work with NEEA
- One utility said that NEEA "has a lot of great people and does great work"

Benefits
NEEA Stretched Owners' Efficiency-Investment Limit

- In asking them to participate in a deep energy retrofit, NEEA asked a lot from owners
- It is valuable for utilities to know how far owners are willing to go with efficiency investment

Challenges
Markets with Little Upside Limit Potential for Large Efficiency Investment

- In markets where Class A offices are the norm rather than the exception, there is a limited opportunity for repositioning and thus building owners will place greater focus on energy savings, limiting the potential for investment

High Occupancy Buildings Have No Incentive; Low Occupancy Buildings Have No Financing

- The EBR Initiative's overall strategy and marketing must consider how buildings with high occupancy will potentially have a lower incentive to invest in a deep energy retrofit and low occupancy building may not have the capital required for the investment
- One utility said that NEEA may want to investigate the opportunity to do holistic retrofit in buildings that have low occupancy rates since implementation would be easier; however, in such situations capital constraints are more likely

The EBR Initiative May Clash with Utilities' Work

- A utility representative expressed some frustration around the implementation of the EBR Initiative because the utility representative believed the EBR Initiative did not compliment the utility's programs and may thereby confuse the market
  - This utility representative expressed a concern that the EBR Initiative now resembles one of its programs
- Two utilities said NEEA should be more welcoming of utility suggestions to better align the EBR Initiative with utilities' work

Recommendations

Don't Ask Owners a Yes/No Question of Interest in Deep Retrofit; Tell Them the Situation When a Deep Retrofit Makes Sense

- Many owners will respond to deep retrofit marketing by saying "Not yet"
- Because it may be difficult to effectively market the EBR, it may be a better use of time to formally identify and market the deep retrofit triggers
- Closely consider the differences in owner decision making across the markets

A.3.1.2 Preliminary Assessment

Utility representatives did not contribute their views about this process step during the interviews.

A.3.1.3 Technical Analysis

Utility representatives stated that NEEA expanded the viewpoint of owners on the energy savings potential.

Benefits

NEEA Showed Owners New Opportunities for Energy Savings

- NEEA's emphasis on sealing a building's envelope expanded the viewpoint of owners
- The EBR enables owners to view a building's energy use holistically by showing them how the building's systems, technologies, and users interact

A.3.1.4 Financial Analysis

Utilities found NEEA's expanded business case for deep energy retrofits to be the most valuable facet of the Demonstration Project. Utility representatives also noted the challenge of getting utilities to support deep retrofits, when utilities do not assess cost effectiveness the same way of real estate investors.

Benefits
NEEA Pioneered a Convincing Approach to Considering Non-Energy Benefits

- Utilities expressed that "there is real value in what NEEA is doing in building the business case for energy efficiency, as this is something we have been struggling with"
- The financial analysis was effective and useful for a hard-to-target real estate market that requires metrics other than just energy savings
- The inclusion of non-energy benefits in financial analyses alleviate the issue of split incentives

Challenges
Utilities' Notion of Cost Effectiveness Does Not Match that of the Real Estate Investor

- Utilities provide incentives for measures that achieving a certain level of cost-effectiveness based on the energy cost savings
- Utilities are unsure how to support the EBR Initiative through either logistical support or financial incentives
    - Utility incentives provide incentives for individual measures rather than holistic Integrated Measure Packages
    - Utilities interviewed do not anticipate moving from single to integrated measure-based incentives

A.3.1.5 Building Owner Approval

Utility representatives did not contribute their views about this process step during the interviews.

A.3.1.6 Implementation

Utility representatives discussed how phased implementation helps owners minimize tenant disruption and, at the same time, it presents challenges. They recommended that NEEA ensure owners capture the expected results of deep energy retrofit investments.

Challenges
Phased Implementation Demands Owner Follow-Through

- Although phasing helps overcome financial hurdles and tenant disruption, the drawback is the need for proactive effort that ensures owners follow-through with implementation; nonetheless, if owners see the value in fully implementing the retrofit, then they will have the incentive to follow-through

Recommendations
Help Owners Plan for O&M Oversight

- Without knowing the extent at which NEEA is currently looking into it, utility representatives thought NEEA should look very deeply into how sustained O&M oversight can enhance EBR Initiative effectiveness

NEEA Should Commit to the EBR Initiative for the Long-Term

- One utility said that in order for the EBR to be successful, NEEA has to be ready to commit at least 15 years to the EBR Initiative

A.3.2 Tool Development

Per RMI/Navigant's role to gather information and insights that inform NEEA's development of tools and resources to scale deep energy retrofits, RMI/Navigant also asked utility representatives about tool development.

A.3.2.1 Useful Tool Functions and Characteristics

As noted above, utility representatives believe NEEA pioneered the development of a highly effective energy retrofit business case. They would like to see NEEA continue to build on this momentum by incorporating it into a tool for owners to use widely. They also recommend marketing the tool to specific building owners where a deep energy retrofit would appear most attractive.

Build the Business Case for Integrated Measure Packages

- Utilities affirmed NEEA's plan to create a tool platform for easy-to-use financial analyses that considers non-energy benefits
- Owners as well as practitioners should be able to use to the tool to convince themselves that an integrated measure package is more valuable than individual measures

Leverage Deep Energy Retrofit Triggers

- Tools should enable owners to identify all of the windows of opportunity for deep energy retrofits
- The tool should quickly demonstrate the business case to owners in response to a trigger so as to not miss a window of opportunity

A.3.2.2 Challenges in Tool Development

Utilities said the primary challenge for tool development is replication.

Find a Balance Between Replication and Customization

- Utilities stressed that NEEA will have to find balance between developing replicable solutions and providing sufficient customization for the project at hand

A.4 Concluding Remarks – Owner and Utility Interviews

This memorandum documents the experience of building owners and utility representatives involved with the Demonstration Projects. The high quality and scope of interviewee responses illustrated how all interviewees appeared very motivated to support NEEA's important and very challenging work. They appeared to answer all questions honestly and with no inhibition.

These high-quality findings from the interviews will inform the recommendations the RMI/Navigant team produces for the final report. RMI/Navigant intend to shape key findings from all of the interviews and produce recommendations over the next two weeks. During week of March 24th RMI/Navigant will hold a webinar to review with NEEA staff those outputs, as well as the key final report topics and content.

A.5 Interview Appendix 1: Agenda for Discussion with Building Owners

The following is a direct reproduction of the discussion agenda sent to building owners.

Introduction
Thank you for agreeing to participate in this telephone discussion. The objectives of this meeting are to document from the building owner perspective:

- Project motivations, expectations, and other experiences with the demonstration project
- Lessons learned and recommendations on how the process experience can be improved

Discussion Questions
a) Background
Please help us understand your business logic for the demonstration project by providing the following information:

- An overview of your company, including the real estate investment strategy
- A description of prior experiences you have had with building retrofits to save energy

b) Motivation
What was your motivation for signing up for the EBR Demonstration Project? What expectations did you have for the project? What factors were you most concerned with; please consider the following:

- Energy cost savings
- Occupant comfort
- Sustainable / green property rating (LEED, Energy Star, etc.)
- Retaining tenants
- Attracting tenants and/or Outreach and marketing
- Asset value
- Financing terms

- Subsidies (tax, finance, entitlement)
- Building codes
- Peer pressure or competitive advantage
- Federal, NEEA, BPA, Energy Trust of Oregon and/or local utility or other programs

c) Project Experiences
Please provide a high level summary of the process as you experienced it, including your specific role and the current project status. Also we would like to discuss the following:

- How did the project materialize?
- What aspects of the project were new for you?
- Where were there challenges?
- Which part of the process/experience did you find most/least valuable?
- Did the project meet your expectations?
- Do you expect to consider and/or implement an EBR for other projects?

d) Project Lessons Learned and Recommendations
Please provide your perspectives that will help NEEA move forward with the Existing Building Renewal Initiative:

- What lessons did you learn on the project?
- How could the process and experience improve?
- What advice do you have for NEEA as they develop the approach to reach the broader market?
- NEEA plans to develop an online tool to help owners and project teams develop an integrated measure package (IMP) and conduct a cursory value analysis of the project on their own. The intention of the tool is to inform owners of the value of an EBR and enable their decision-making to proceed. In your view, what is the most essential feature or function for the tool in doing this? Do you think an online tool could be sufficient to guide you and your team through the decision-making process in the future?

A.6 Interview Appendix 2: Agenda for Discussion with Utility Representatives

The agenda for the discussion with utility representatives covered four basic questions per NEEA Staff input.

1. How did the Demonstration Project benefit the building owner?
2. What was the value of the Demonstration Project from your perspective?
3. What challenges or barriers do you see for the EBR Initiative?
4. What factors do you see as important as the initiative moves forward?

APPENDIX B. NEEA STAFF INTERVIEWS MEMORANDUM

B.1 NEEA Staff Interviews

MEMORANDUM

SUBJECT: Project Check-in Re NEEA Staff Interview

TO: Rita Siong, Emily Moore, John Jennings, Rob Curry (NEEA)

FROM: Mike Bendewald & Doug Miller (RMI)

CC: Jay Luboff (Navigant)

DATE: 10 January 2013

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On December 4, 2013, the Rocky Mountain Institute/(RMI) Navigant Consulting, Inc. (Navigant) team conducted an initial two-hour interview with the Northwest Energy Efficiency Alliance (NEEA) staff on the Existing Building Renewal (EBR) Demonstration Projects. Based on the information gathered at the interview, the RMI/Navigant team was able to make progress in its EBR Demonstration Project Process Review. This memorandum provides:

Current Status of Process Review/Project Team Approach: An overview of the RMI/Navigant team approach to conducting the process review and a status report.

Detailed Interview Results: A documentation of the meeting and insights provided by NEEA staff related to the EBR Demonstration Projects.

The NEEA staff interview yielded insights into both the design/intent and operation of the demonstration projects as well as NEEA staff needs regarding the EBR demonstration process review to ensure the success of the process review effort. These insights help RMI achieve its project objectives as stated in the RMI/Navigant work plan. These are to: 1) Document the EBR Demonstration Project process, including the challenges, lessons learned, etc.; and, 2) Provide recommendations and insights to NEEA that may help NEEA in the development and facilitation of the *EBR Initiative market test* and eventual regional rollout—based on RMI's interviews of Demonstration Project participants as well as its expertise on deep retrofit process and strategy (from owner and service provider perspectives)[6].

The interview and the subsequent RMI/Navigant work to synthesize it yielded excellent content that provided the RMI/Navigant team basic information about the goals and scope of the demonstrations as well as information that will lead to optimal final deliverable recommendations from the RMI/Navigant team to NEEA.

[6] RMI deep retrofit expertise is documented on the RMI website RetroFitDepot.org

B.2 Current Status of Process Review

B.2.1 RMI Three-Step Process Review Approach

Below we list the RMI's stepped-approach to the process review. The three-step approach includes:

Step 1. Identifying the strategic intent of the demonstration projects, including what NEEA staff intended to happen on the projects to make them successful.

Step 2. Documenting what happened during the demonstration projects based on interviews with participants (i.e., NEEA staff, NEEA contractors and consultants, and building owners) with a focus on assessing their level of success in meeting NEEA's stated objectives.

Step 3. Synthesizing findings, incorporating perspectives based on RMI experience and expertise with deep energy retrofits, and developing recommendations for NEEA's next steps.

B.2.2 Step 1 Results

NEEA staff summarized for RMI the overall objectives of the demonstration projects as being three-fold—as listed below.

Objective 1: Develop, test, and inform tools to scale the adoption of deep energy retrofits in the market
Objective 2: Offer proof that deep energy retrofits are technically and financially viable
Objective 3: Provide case studies for education, training, and marketing during later stages of the EBR Initiative

These three objectives if successfully met will provide the technical and market information and demonstration testing needed to help NEEA move forward with the EBR Initiative. The following sections provide more detail on what NEEA is intending on the EBR Demonstration Projects to make them successful.

B.2.2.1 Achieving NEEA Staff Objective 1—Test and Inform Tools to Scale the Adoption of Deep Energy Retrofits in the market

The successful completion of this objective requires NEEA-directed three separate activities:

Testing the technical capability of the Integrated Measure Package (IMP) manual tool

Informing the efficacy (i.e., uses and usability) of the proposed EBR Demonstration Project tools that are being used in the demonstration (in "manual" form) and intended to support regional deep-retrofit scaling

Current Status: The RMI/Navigant team understands that this activity is being met through:

*Testing—*Navigant testing of the efficacy of the current demonstration technical IMP process/approach, i.e., "manual (demonstration) tool," and the final "as developed" technical IMP tool targeted for completion in September 2014.[7]

*Informing Tool Development***—**RMI will use its process documentation efforts through the interviews of project participants to develop insights that inform tool development.

B.2.2.2 Achieving NEEA Staff Objective 2—Offer Proof that Deep Energy Retrofits are Technically and Financially Viable

Financial viability is shows through market acceptance, or owner motivations and willingness to proceed with the project. Technical viability is validated by the energy savings from the demonstration buildings after the retrofits have been implemented. The completion of this objective will thereby be reflected in the signing of Memorandum of Understandings (MOUs) by owners of all four demonstration buildings and owner-team perspectives, as well as in the development of a compelling integrated measure package from both technical and financial viability perspectives.

Current Status: Through the course of the documentation of the demonstration project process, RMI will verify that the projects are expected to achieve at least 35 percent energy savings and thereby meet a key NEEA definition of Deep Energy Retrofit (DER) buildings eligible for the demonstration projects; and as well provide a financially attractive investment to demonstration building owners.

B.2.2.3 Achieving NEEA Staff Objective 3— Provide Case Studies for Education, Training, and Marketing During Later Stages of the EBR Initiative

Completion of this objective will require verification that the demonstration projects can provide quality content for future case studies.

While it is beyond the scope of this effort for either RMI or Navigant to develop case studies from this effort, the RMI/Navigant team will document that needed information for quality case studies is available from the demonstration buildings.

In particular: a) RMI will review the NEEA market characterization report for EBR, prepared by SBW Company from November 2012 as well as other relevant documents to identify key proof points that the market needs for moving forward with DERs; and b) RMI will then seek to identify the status of these proof points in the demonstration projects during the course of its documentation of the demonstration project process.

[7] We note, that it is beyond the current scope of this effort for either RMI or Navigant to review the efficacy of the financial (and other) non-IMP elements of the "as built" software planned for September 2014 completion

B.3 Detailed Results from the NEEA Staff Interview

B.3.1 Step 1 Results and Background

In order to focus RMI's recommendations to NEEA on next steps in developing a deep retrofit program/initiative (see objective #2 in the revised project work plan), RMI sought to better understand the strategic intent of the four demonstration projects. While NEEA explains this intent in the project RFP, the RMI-Navigant team needed to verify it and understand more specifically what NEEA staff intended to happen on the projects to make them successful. This section documents what RMI heard during the NEEA staff interview (and other staff interviews as noted).

B.3.1.1 Overview of the EBR Initiative

NEEA is developing four demonstration projects – in Idaho, Montana, Oregon, and Washington – that are part of the EBR Initiative. The EBR Initiative's goal is to accelerate the market adoption of deep energy retrofits. Per the NEEA definition, a deep energy retrofit must achieve energy savings of at least 35 percent savings over the buildings baseline usage before the retrofit and will sometimes achieve more than 50 percent savings. A deep energy retrofit—which uses holistic, integrated design and analysis—stands in stark contrast to typical piecemeal approaches that yield fewer energy savings. The target market for the EBR Initiative is private, commercial office buildings larger than 20,000 ft^2 and occupied by multiple tenants and majority leased, i.e., less than 50 percent owner-occupied.

The initiative seeks to overcome market barriers of:

- High cost and long length of time to study the feasibility of deep energy retrofits
- Perceived lack of investment value
- A lack of skillsets, tools, information, and general market capacity for deep energy retrofits

To address these barriers, NEEA is creating tools and resources that reduce the time and cost of analyzing deep retrofit opportunity, and that help position deep retrofits as a value creation as well as a cost reduction strategy. NEEA is also deploying deep retrofit demonstration projects to help refine the tools and resources, substantiate the value proposition, and provide content for ongoing activities.

B.3.1.2 Plan for Scaling Deep Energy Retrofits

NEEA staff explained their hypothesis that a well-defined deep retrofit process and a suite of tools—if designed well and combined with effective training and marketing campaigns—will be sufficient to enable widespread adoption of DERs.

To get started on defining a deep retrofit process and the required tools, NEEA staff reviewed existing case studies and developed a first draft of the deep retrofit process and initial concepts for the tools (or "manual tools"). The demonstration projects are meant to "test" this process and serve as vehicles to develop and test the manual tools—they explained in an earlier separate interview that the test was analogous to how Quaker Oats will test a new oatmeal product on a strategically selected focus group. The test will tell NEEA staff how well the process and manual tools worked, and will inform their future development.

B.3.2 Deep Energy Retrofit Process

NEEA staff defined eight steps in the deep retrofit process as demonstrated by the NEEA-led projects (and later provided more detail/refinement via email on January 8, 2014 included in the Appendix below). In addition, NEEA staff identified several intended outcomes that would differentiate a deep energy retrofit from less comprehensive retrofits currently being deployed in the market. Table B-1 below provides a summary of the deep retrofit process and these key outcomes identified by NEEA staff.

NEEA staff identified the use of the integrated measure package as opposed to a list of individual measures as the main differentiating outcome of the NEEA demonstration project. This focus on integrated measure packages encourages building owners to think more holistically about their buildings and to avoid “cherry picking” the measures with quickest paybacks.

To ensure that the projects achieve these outcomes, NEEA is providing demonstration project owners with support in the form of two concepts for tools: the IMP Builder and the Integrated Property Assessment Tool, as well as several support contractors, including two Integrated Design Labs who completed the vast majority of the work. During the projects, NEEA staff’s role included recruiting and motivating the building owners, defining the process, guiding the project teams on a daily basis, providing product research, intervening in technical reviews, reviewing/editing the reports delivered to owners, facilitating team presentations to owners, and maintaining close relations with owners throughout the process.

Table B-1: Deep Energy Retrofit Process and Key Intended Outcomes

Step of Process	Description	Key Intended Outcomes
1. Recruitment	NEEA staff select building owner participants based on a set of criteria including multi-tenant private commercial office buildings >20,000 ft^2, older buildings, and in one case upcoming (or current) tenant turnover. To confirm participation, a project application between NEEA and the building owner is signed.	The building owner is willing to participate and engage with NEEA to use a holistic approach to a building’s relationship with energy. Owner agreed to provide key information for the analysis.
2. Preliminary Assessment	NEEA project contractors/consultants provide an initial assessment of the building through	Verification that the potential for at least

Step of Process	Description	Key Intended Outcomes
	data/document review, as well as a day- and night-time walk-through. Utility records are obtained and any EnergyStar rating information. They establish a baseline energy use index (EUI) and estimate energy savings potential from low-cost operations and maintenance (O&M) improvements, and identify equipment replacement needs based on end-of-useful life.	35% energy savings exists (otherwise project does not move forward).
3. Technical Analysis	NEEA project contractors/consultants develop multiple IMP as investment options, including energy modeling to estimate the energy and cost savings of each option. A cost estimator on NEEA's project team provides capital cost estimates.	A comprehensive and integrated set of measures are developed (as opposed to individual measures).
4. Financial Analysis	The NEEA team's finance expert conducts an Integrated Property Assessment (see tool description above). Included in the assessment is a critical analysis of the potential value of non-energy benefits at a floor-by-floor and lease-by-lease level.	All the costs and value of the efficiency package is considered. Risk is evaluated. Financial return is calculated.
5. Building Owner Approval	The building owner selects an IMP and approves an implementation plan, and signs a memorandum of understanding.	The owner selects an Integrated Measure Package (between 35% and 50%+ savings) that creates value through energy and non-energy benefits. The owner knows the next steps for successful implementation.
6. Implementation	The owner's project team produces construction documents from the selected package and implements the deep energy retrofit over a period of one year or longer.	At least 35% energy savings are achieved.
7. Measurement and Verification (M&V)	With NEEA's assistance, the owner's project team measures and verifies energy savings for up to three years following the completion of implementing the full package. Savings will also be measured on an annual basis during	The owner's project team learns how to assess energy and non-energy benefits.

Step of Process	Description	Key Intended Outcomes
	implementation to capture the impact of interim measures that have been completed. If implementation takes longer than expected (i.e., five years), then it will be unrealistic to do three more years of M&V.	
8. Final Documentation	A marketing contractor produces the final documentation and case studies for the building.	Other buildings realize and are inspired by both the value creation opportunity offered by deep energy retrofits and how this value can be captured.

B.3.3 ***NEEA Tools***

NEEA staff explained that the demonstration projects are meant to inform the development of their concepts for tools, and that they are also interested in gaining the perspectives of the project participants on whether the tools could support the process without the NEEA-team involvement. NEEA staff provided descriptions of the tools being developed during the interview and in the RFP for the demonstration project process evaluation.

Table B-2: Description and Development Status of EBR Initiative Tools

Tool Name	Description	Purpose	Development Status
Integrated Measure Package Builder	References and selects an integrated set of standardized energy efficiency measures developed specifically for the target market buildings with building specific characteristics to develop a semi-customized efficiency package and implementation plan. Includes energy savings and implementation cost estimates.	• Consider more comprehensive and integrated set of measures • Reduce the time and cost of analysis; enable a quick upfront energy savings and cost estimate • Increase service provider capacity for deep retrofits	Concept and structure defined, a measure database is being assembled, and demonstration projects are informing future development.
Integrated Property Assessment	Produces a business case for each of the Integrated Measure Packages produced, including	• Reposition deep retrofits from a cost savings to a value	Concept and spreadsheets created,

Tool Name	Description	Purpose	Development Status
Tool	non-energy benefits and a discounted cash flow analysis (with ROI, IRR).	creation strategy • Produce financial insights that would not otherwise be considered • Incorporate non-energy benefits into financial analyses	demonstration projects are informing future development.
Deep Retrofit Playbook	Provides general guidance for building owners on assessing, planning, and implementing a deep energy retrofit. A screening scorecard is also available to help an owner decide if it is appropriate to proceed with the retrofit investment (based on business and other criteria).	• Provides the information owners need to invest in a DER	Partially developed and was not tested as a motivator for demonstration projects.
EBR Tool	An interactive, web-based resource for assessing deep energy retrofit project opportunities, developing a project scope, illustrating the value created by launching an Existing Building Renewal, and enabling decisions needed to plan and implement EBR projects.	• Integrates the three tools above into an easy-to-use, interactive format	Not yet developed. RFP has been issued.

B.3.3.1 The Demonstration Project Learning Ground

NEEA staff noted that the demonstration projects would contribute to their limited collection (from aggressive research contracted with New Buildings Institute) of recent deep energy retrofit examples in the Northwest. Yet NEEA staff explained that the value of the demonstration projects goes beyond simply creating additional case studies. NEEA staff views the demonstration projects as a way to produce their own projects with which they are intimately familiar, and to create a group of deep-retrofit-experienced contractors and owners who are willing to share their perspectives and lesson learned. In this way, NEEA staff considers the four demonstration projects as a learning ground to inform their future work in the EBR Initiative.

To evaluate and validate their efforts to gain value from the demonstration projects, NEEA has retained the services of Navigant and RMI. NEEA summarized that the overall objectives of the demonstration projects are three-fold, listed below.

Objective 1: Test and inform tools to scale the adoption of DER in the market
Objective 2: Offer proof that deep energy retrofits are technically and financially viable
Objective 3: Provide case studies for education, training, and marketing during later stages of the EBR Initiative

The RMI/Navigant team provided details on how NEEA staff intends to meet these objectives in Section II above.

B.3.4 Step 2 Results

NEEA staff experiences during the course of the demonstration projects yielded excellent content for RMI to later evaluate the demonstration project eight-step process and develop insights that with synthesis will help meet the EBR Demonstration Project objectives. Note that this section only documents NEEA staff experiences and does not provide RMI insight.

B.3.4.1 Recruitment

During the recruitment stage NEEA staff uncovered the types of value propositions that resounded well with building owners. NEEA staff also had some lessons learned on issues of due diligence and expectations on the length of time it takes to gain full commitment from a building owner.

NEEA mentioned a list of motivating factors that proved effective in communications with building owners, which RMI synthesized and listed below. Owners were motivated by loss-avoidance and gain-seeking considerations.

Table B-3: Motivational factors for deep energy retrofits

Motivating Factor	Loss Avoidance	Gain Seeking
Market Repositioning	Reduction of downgrade risk (e.g., class B to A)	Reposition from lower to higher class (e.g., B to A)
Tenant Turnover	Reduce risk of losing tenant	Increase rent price / improve leasing terms
Equipment Replacement	Having to bear full cost of replacement	Reduce cost of replacement through downsizing. Obtain efficiency incentives to help support replacement cost
Occupant Comfort Complaints	Continued complaints/risk of losing tenants/cost to diagnose and address	Diagnose and address complaints through financially subsidized deep retrofit process /show tenants improvements (i.e., increased comfort, etc.)
Asset Value	Not investing in deep energy retrofits – i.e., doing nothing – will diminish the value of a building	Investing in deep energy retrofits will increase the value of a building

NEEA experienced several challenges on the demonstration projects that enable RMI to offer insights for scaling the adoption of deep energy retrofits in the market. These insights include:

- A MOU or equivalent in place early in the process would ensure that DER efforts and related support for building owners are not merely used as a temporary, insincere maneuver by owners in an attempt to retain existing or attract new tenants
    - One owner at risk of losing a major tenant appeared to think he could show interest in NEEA's deep energy retrofit proposal long enough to attract the tenant back for another lease term, with a lack of real intention of following through on the full scale deep retrofit
- Doing due diligence early on to verify that building owners can finance the deep energy retrofit investment helps avoid problems down the road
    - One owner fully committed to the deep retrofit and later during finance negotiations learned that he was overextended and could not secure debt financing

Finally, NEEA staff realized that it takes much longer to secure building owners for the program than they had expected. The extended timeframe is due to several factors including: the large size and complexity of several projects, waiting for lease negotiations to commence and extensive review and refinement of the financial analysis assumptions to suit owners varying financial criteria and drivers. RMI will use the owner and contractor interviews to more completely uncover the factors contributing to the extended timeframe and offer insights.

B.3.4.2 Preliminary Assessment

NEEA staff noted that this step is primarily about determining whether the building had the potential for 35 percent energy savings over the building's usage before the retrofit, using an ASHRAE Level 2 energy audit, or similar. NEEA was surprised as to how much energy savings appeared to be available, indicating that few buildings would struggle to save at least 35 percent.

B.3.4.3 Technical Analysis

During the preliminary assessment of a deep retrofit opportunity, NEEA observed that some of the measures in the IMP Builder were not needed. NEEA reduced the measures to a pool of approximately 30 measures that get recombined in different ways to form that packages that make sense in a given demonstration project building. This refinement may further reduce the time needed to use the EBR Tool when it is scaled to the market. The contractor and owner interviews will provide more detail and insight.

B.3.4.4 Financial Analysis

NEEA staff made the following observations regarding the financial analysis:

- Providing the financial insights as to how projects can be evaluated (i.e., including non-energy benefits) proved essential in gaining building owner buy-in
- Framing the benefits of deep energy retrofits and the overall process in the language used by building owners–such as tenant attraction and retention, asset value, and occupant comfort–allowed for more efficient and productive discussions

- Shifting thinking about deep energy retrofits as a source of value creation rather than only cost savings resonated with building owners
- Asking building owners to consider the costs and risks of business as usual (i.e., just limited O&M and not doing a retrofit) was a powerful approach

B.3.4.5 Building Owner Approval

Following their approval of the deep energy retrofit based on the NEEA team's schematic-level design, owners would need to bring in an A/E or C or perhaps E- or C-led team to conduct further due diligence before moving forward with design development and producing construction documents. In at least one project thus far, however, the owner chose to skip further due diligence.

B.3.4.6 Implementation[8]

NEEA staff made the following observations regarding the implementation phase:

- Divide the retrofit implementation into phases that are sequenced (e.g., operational or passive design measures now, right-sized high efficiency heating and cooling equipment retrofits or replacements later) in a way that enables opportunities to minimize tenant disruption and timed sources of funding
- Current utility incentives offered capital cost reductions for specific measures, yet did not affect the ultimate decision whether or not building owners would invest in a comprehensive DER
- Utilities were challenged on how to treat the comprehensive nature of the DER (individual cost-effective efficiency measures are standard for utilities)

B.4 Interview Appendix 1. Agenda and Discussion Guide for EBR Demonstration Project Process Review Discussion with NEEA Staff

Objective of the Meeting

The objectives of this meeting are threefold:

1. To identify NEEA staff's strategic goals and objectives for the four NEEA demonstration projects
2. To gather process/background information on the key EBR demonstration activities NEEA staff has undertaken to support development of the four building EBR Demonstration—with a focus on eventually implementing a market test of EBR project (prior to EBR initiative rollout)
3. To identify key questions and "must interview" staff from the NEEA contractor and Owner pool of interviewees

[8] Steps 7 and 8 are still in progress and therefore not included here.

Discussion Agenda:

a) NEEA's Intention for the Demonstration Projects (30 min)
b) General Background Information About the Demonstration Projects (30 min)
c) NEEA Staff Experience and Challenges In Developing Specific Project Aspects (45 min)
d) NEEA Staff Input on Proposed Framework for the Owner and interviews (30 min)
e) NEEA Recommendations for Key "Must-Have" Interviews with NEEA contractors and with Owner team members in Montana and Idaho and Seattle and Portland (15 min)

a) Understanding NEEA's Intention for the Demonstration Projects

In order to better provide NEEA with recommendations to move forward after the demonstration projects, it is critical for RMI to better understand their strategic role in NEEA's overall effort. As discussed in the RFP, there are a number of barriers that the EBR initiative must overcome in order to accelerate the adoption of deep retrofits. And the EBR initiative will establish a framework and tools to help owners and project teams, resulting in several outcomes as stated in the Request for Proposals (RFP).

Please describe the role of the demonstration projects in this (or another) overarching strategy. For example, consider the following questions:

(1) What would a perfect demonstration project provide (e.g. technical proof, sales tool, lessons learned)?
(2) How can the demonstrations influence program design and the larger rollout across the Northwest?
(3) What barriers are the demonstrations meant to overcome?
(4) What role can the demonstrations play in a future deep retrofit pitch to owners and contractors?

b) General Background Information about the Demonstration Projects

To provide a better context for the documentation of the demonstration projects, RMI is interested to learn:

(1) What NEEA has done/did to initiate and support development of each of the demonstrations?
Example: General narrative description by NEEA staff with RMI taking notes of the key areas that NEEA staff believe are most important.
(2) What aspects of this role NEEA believes are crucial (rank if possible) for the success of the deep retrofit demonstrations and later on, the EBR Market Test and Initiative rollout?
(3) How NEEA envisions the scaling up (including NEEA's role) of these crucial components in order to drive the larger rollout of deep energy retrofits in the Northwest?

c) NEEA Staff Experience and Challenges in Developing Specific Aspects of the EBR Demonstration Projects -- Understanding NEEA Staff Specific Goals, Approaches, Successes and Challenges Met and Overcome, or Still In-process

(1) Approach to identifying potential demonstration buildings
(2) Project Launch, Design, Finance, Construction, and Operation issues from a NEEA staff perspective—both generally and with regard to the four demonstration projects
(3) Stakeholder engagement:
    - Who were the key players you needed involve?
    - What did NEEA offer them?
    - When did you approach them? When did they sign (or plan to sign on as demonstrations)?
    - Why/what was the owner's motivation from NEEA staff perspective?
(4) At this stage of the EBR demonstration project, how would NEEA staff evaluate the success of the demonstration project?
  - What areas of the approach used have been most successful? Least successful?
  - How would NEEA staff have "done it differently" in relation to the key demonstration project elements of:
  - Program design
  - Stakeholder engagement
  - Value proposition design and explanation
  - Tools and benefits offered to the owner
  - Other areas of and approaches to the project that may not be identified in this question, but that NEEA staff believe are important for RMI/Navigant to understand to fully document the process?

d) NEEA Input on Proposed Framework for NEEA Contractor -- and Owner Team Interviews -- Ensuring that all Important Areas of Enquiry are Covered in the RMI/NCI Process Review

RMI proposes the use of semi-structured interviews with contractors and owners involved in the demonstration projects to facilitate both an open-ended conversation about the demonstration experience as well as gain specific insights on project motivations and process. During the interviews, RMI will:

- Ask interviewees to describe their experience on the demonstration project, touching on each of five process stages—Project Launch (including motivation), Design, Finance, Construction, and Operation
- Follow up with several questions about specific DER practices, ranging from stakeholder engagement to business interruption management, covering the following areas of inquiry:
    - How would you describe your experience?
    - How did the approach and tools/resources employed benefit the project?
    - What were the shortcomings of the approach and tools/resources?
    - Were there factors beyond the control of the project that helped or hindered the retrofit success?
    - How could the experience have been improved?

- Were opportunities for deeper energy savings available beyond what was achieved?

RMI is seeking NEEA staff input to the above approach to ensure that all key issues of interest to NEEA are explored.

e) NEEA Recommendations for Key “Must-Have” Interviews with NEEA Contractors and with Owner Team Members in Montana and Idaho and Seattle and Portland

RMI wishes to ensure that key team members with the most insight into the EBR demonstrations in Montana, Idaho and perhaps Seattle and Portland are interviewed. While we have the names and contacts for key players in each area, the RMI/Navigant team would like NEEA staff to identify critical “must have” interviews to ensure project success. (Work off of the contact list provided earlier by NEEA staff).

B.5 Interview Appendix 2: EBR Demonstration Projects - "Typical" Process

RMI note: the content in this appendix was sent to RMI January 8, 2014

Suitability Screening Criteria

- Building type - office
- Pre-1996 vintage
- EUI >= 75
- Size: > 20,000 SF

Data Gathering and Document Review

- Building and Operational Data
  - Building area (gross and rentable sq.ft.)
  - Utility billing history including interval data as available
  - Energy Star rating, if available
  - Previous energy efficiency studies/proposals/work done
  - Additional available documentation, e.g., as-built construction documents, sequences of operation, testing and balancing reports, O&M manuals
- Financial/Market Data
  - Budget available for retrofit and current O&M budget, and sources
  - Operating Statements
  - Rent roll
  - Lease information (type, rate, duration)
  - Capital structure (including debt load)
  - Ownership structure
  - Market Information
  - Utility price projections
  - Catalogue of LEED/EnergyStar properties in marketplace
  - Financial performance requirements (min. IRR, ROI, max. payback, etc.)

- Interview building owner/property manager (financial data, current owner team and roles including identifying ultimate decision-maker, and any planned work, etc.)
- Interview building facility manager/building operator

Site Visit/Inspection

- Day walk/inspection - observations during occupied hours, e.g., equipment inspections, occupied space walk-throughs and measurements, control system review, cleaning and maintenance schedules.
- Night walk/inspection - observations during unoccupied hours, e.g., internal air handling unit inspections with special attention to openings in building that allow infiltration/exfiltration, tenant space walk-throughs with special attention to lighting and plug loads that are energized at night.
- Follow-up data and trend-logging
- Identify potential O&M measures/savings and estimate potential reductions in electricity/natural gas usage below baseline energy use, resulting from O&M improvements
- Identify additional testing that may be required to assess system/equipment/component performance
- Identify any capital expenditures discovered during the walkthroughs/inspections that are needed to replace end of life systems, equipment, or components
- Site inspection report

Develop baseline/calibrated eQUEST model

- Adjusted for potential O&M savings and/or correction of O&M deficiencies such as inadequate ventilation
- Adjusted to account for data center usage and any other significant process loads

Generate IMP

- Determine measure applicability by comparing measure performance criteria with existing building characteristics
- Convene workshop(s) to review criteria, compare to existing building performance and finalize initial definition of IMPs. Consider generating more than one IMP with different cost and savings performance (one comprehensive solution targeting around 50 percent savings, and one "optimized" solution above 35 percent)
- Prioritize load/demand reduction measures before system measures
- Model energy performance of potential measure packages and see what combination of measures will meet IMP performance threshold (e.g. > 50% or > 35%)
- Define energy savings, energy cost savings, and external energy metrics (Energy Star rating) associated with each of the modeled IMPs
- Estimate the fully loaded costs of qualifying IMPs (e.g., project with contractor general conditions, overhead and profit, applicable taxes, etc.)

IMP Value Assessment

- Understand what measures, if any, are already scheduled/budgeted for next few years and adjust proposed IMP business case accordingly
- Define the potential non-energy benefits that are associated with the various measures and the IMP bundle, assess the value of these benefits and incorporate into business case
- Understand capital position and ownership structure and implications of each on likelihood and ability to invest in EBR measures
- Evaluate tenant mix to ascertain potential value derived from EBR measures and impact on renewal
- Evaluate tenant roll-over timing in order to determine appropriate sequencing, and timing of revenue increases.
- Analyze impact of EBR measures on occupant comfort and building competitiveness (including potential to increase rentable square footage).
- Translate cost savings and revenue impacts into discounted cash flow model to provide investment criteria (Return on Investment [ROI], Net Present Value [NPV], Internal Rate of Return [IRR] and cash on cash return)
- Evaluate and quantify non-energy, non-property related benefits, including carbon reduction, productivity, health and community related impacts
- Conduct sensitivity analysis on bracketed range of benefits
- IPA Report

Owner Presentation(s)

- Schedule progress meetings and presentations to Owner representatives to make sure they are part of the IMP definitions and in concurrence on the business case assumptions and modeling
- Present recommended IMP(s) and the business case for investment to building owner/manager
- Adjust IMP and value assumptions, according to owner/manager feedback (this is an iterative process)
- If necessary, assess both bundled/unbundled or phased scenarios to capture tenant space opportunities over time

Implementation

- Negotiate and finalize IMP project scope with owner.
- Determine tenant disruption limitations (when to work during day or week, during vacancies)
- Develop ***IMP implementation phasing plan*** and/or schedule jointly with Owner. Coordinate with tenant change-over and lease renewals

APPENDIX C. FINDINGS FROM NEEA CONTRACTORS AND CONSULTANT INTERVIEWS MEMORANDUM

C.1 NEEA Contractors and Consultant Interviews

MEMORANDUM

SUBJECT: Findings from the NEEA Project Contractor and Consultant Interviews

TO: Rita Siong, Emily Moore, John Jennings, Rob Curry (NEEA)

FROM: Mike Bendewald & Doug Miller (RMI)

CC: Jay Luboff (Navigant)

DATE: 19 February 2014

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C.2 Introduction

The week of December 16th, 2013, Rocky Mountain Institute (RMI) conducted a series of one-hour interviews, one for each of the eight Northwest Energy Efficiency Alliance (NEEA) project contractors and consultants on the Existing Building Renewal (EBR) Demonstration Project. The purpose of these interviews was to document contractors' and consultants' experience with the demonstration projects.

Beyond the Introduction section, this memorandum provides:

C.3 Demonstration Project Process Documentation: A step-by-step report of the key findings from the interviews related to the process, including the following:

- *Intended Outcomes and Process Description.* This section describes, from the interviewees' perspective, the intended outcomes for this step and the process used to achieve those outcomes.

- *Achieved Outcomes.* This section describes the achieved outcomes and indicates any differences with the intended outcomes.
- *Challenges.* This section indicates any challenges the interviewees experienced during the project in achieving the intended outcomes.
- *Interviewee Recommendations.* This section describes interviewee recommendations on how to address challenges and improve the process step overall.

C.4 Interim Assessment: A RMI/Navigant preliminary assessment of how well the EBR Demonstration projects are meeting the three NEEA staff objectives:

- *Objective 1*: Test and inform tools to scale the adoption of deep energy retrofits in the market
- *Objective 2*: Offer proofs that deep energy retrofits are technically and financially viable
- *Objective 3*: Provide case studies for education, training, and marketing during the later stages of the EBR Initiative

C.5 Concluding Remarks: A brief summary of this memo and how the interviews will inform the final report.

C.3 Demonstration Project Process Documentation

In order to document and learn from the EBR Demonstration Project Process, RMI solicited interviewees to provide a description of each step of the process. RMI also solicited interviewee recommendations for improving the process based on their experiences.

It is important to note that the prior professional expertise or opinion of interviewees rather than their specific experiences with the EBR demonstration project could be the foundation for their comments during the interview. To address this issue and therefore produce more evidence-based findings, RMI/Navigant carefully screened comments that the project team felt did not accurately depict the EBR demonstration project experience.

C.3.1 Recruitment

C.3.1.1 Intended Outcomes and Process Description

Contractors involved in this step intended to help NEEA staff find buildings that met the criteria for the demonstration projects and convince the owners to sign an agreement to participate in the program. Interviewees described the Recruitment process as follows:

- NEEA and contractors conducted a search in various markets to find buildings with an energy use greater than 80–90 kBTU per square foot and approaching obsolescence in their market
- NEEA and contractors held discussions with owners and/or operators of target buildings about the demonstration project opportunity

C.3.1.2 Achieved Outcomes

All interviewees involved in this step noted that they found building owners committed to exploring the Deep Energy Retrofit (DER) opportunity and reached an agreement with them to move forward with the analysis (but not necessarily construct the retrofit).

C.3.1.3 Challenges

Interviewees discussed the following challenges associated with Recruitment:

- "Deep energy retrofit" is a misnomer that has caused some confusion with owners; the EBR Initiative is about building "renewal"
- Building owners desire support tailored to their building yet the DER energy-opportunity analysis is intended to be broadly applied across the entire market

C.3.1.4 Interviewee Recommendations

Interviewees provided the following recommendations for Recruitment based on their experiences with the demonstration projects. These recommendations fall into three categories: the target market (i.e., which buildings to target), gaining initial owner interest in a DER, and owner engagement.

Target Market

- Technical leads noted that the buildings and building situations conducive to DERs include:
    - All or most buildings constructed before 1980
    - Buildings already undergoing or about to undergo capital improvements
    - Buildings with a site energy use intensity greater than 80–90

Gaining Initial Interest

- One interviewee explained that it was effective to describe the DER as a "renewal" that makes the building competitive to new construction and specified the following approaches (pertaining to cost and performance):
    - Compare cost per square foot of DER to that of new construction rather than the cost of inaction, because inaction will lead to the building becoming irrelevant (i.e., comparing the cost of apples and oranges)
    - Emphasize that unlike other potential repositioning investments, DERs increase resource-efficiency performance to the level of newer buildings

Owner Engagement

- Interviewees found that engaging building owners on the following topics made the DER project run smoother later on:
    - The overall DER process and value proposition so that owners knew what to expect and understood the approach to be undertaken by NEEA contractors and consultants

- The role of non-energy benefits in building an all-encompassing financial analysis of a DER project
- The need for "packaging" measures (rather than measure-by-measure financial analysis) to maximize the value proposition of a DER project

C.3.2 Preliminary Assessment

C.3.2.1 Intended Outcomes and Process Description

Contractors wanted to further entice owners with the DER by assessing opportunities at a high level. They also needed to confirm that the building could save 35 percent energy in order to qualify as an EBR Demonstration Project. Finally, contractors wanted to identify no/low cost (operations and maintenance [O&M]) measures that the building owner could address right away.

Interviewees described the Preliminary Assessment with the following characteristics:

- Assessed energy saving opportunities at high level through looking at Energy Star rating, etc.
    - Completed a "needs assessment" (identifying equipment replacement cycles, operations issues)
    - Completed multiple site visits to each building to assess and evaluate building operations during on and off hours
  - Met with property managers to get a better grasp of a building's operations
- Diagnosed problems to better understand opportunities
- Encouraged O&M measures regardless of whether building proceeded with DER investment
- Produced a formal walk-through report that identified building needs

C.3.2.2 Achieved Outcomes

Contractors achieved all of their intended outcomes, including:

- For each building, contractors found at least 35 percent energy savings, achieved through a mixture of O&M as well as capital improvements
- Contractors identified clear needs for end-of-life equipment replacements in some buildings, which made it easier to convince the owner of the need for capital improvements

C.3.2.3 Challenges

Interviewees discussed the following challenges experienced during the Preliminary Assessment:

- One interviewee felt that a property manager was not always forthcoming or even accurate about building operations practices
- On the Boise project, the parent company of the anchor tenant had standards and budgeting constraints that restricted investment in energy efficiency measures both the anchor tenant and local managers wanted to pursue.

- Despite an introduction to the “packages” approach, one interviewee felt that an owner still tended to lean toward evaluating individual measure opportunities. The interviewee thought the presentation of capital cost for each measure in the package caused this.
- One interviewee noted that two building owners did not at first appreciate or trust the energy savings estimates; citing owner expectations for tailor-made, building-specific analysis and owner beliefs that generic energy-saving measures produced the energy savings estimates.

C.3.2.4 Interviewee Recommendations

Interviewees provided the following recommendations for the Preliminary Assessment:

- Most interviewees recommended engaging property managers directly to understand the building better.
- One interviewee suggested conducting independent analysis in addition to asking building operators about building operations.
- One interviewee recommended against a capital-intensive DER for buildings that can save close to 35 percent energy through O&M improvements. However, a different interviewee—a technical lead—seriously doubted that buildings could reach 35 percent energy savings through O&M improvements.[9]
- Multiple interviewees recommended that NEEA use a “gut check” analysis the up-front cost so that owners can decide early in the process whether to proceed with a large investment (>$10/SF).
- Most interviewees recommended the need to prepare a strong defense for non-energy benefits in order to justify the large expenditure.

C.3.3 <u>Technical Analysis</u>

C.3.3.1 Intended Outcomes and Process Description

NEEA asked contractors to produce two different investment packages: a minimum package reaching at least 35 percent energy savings and an optimum package reaching closer to 50 percent savings. One technical contract lead mentioned the team also wanted to identify technical "integrated design" elements to reduce cost and energy usage, such as reducing load to downsize the cooling system. Interviewees described the Technical Analysis as follows:

- Developed a mix of O&M and capital projects with investment-grade accuracy
    - Used the manual method of “Integrated Measures Package (IMP) Builder” to identify generic measures applicable to the building
    - Technical leads believed use of the IMP Builder reduced the upfront cost of initial design and analysis
    - Interviewed local contractors to get cost estimates with high accuracy (+/-5 percent)

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[9] Two interviewees—a technical lead and a technical person involved with preliminary assessment—worked together informally to find a relationship between annual building energy performance and O&M savings opportunity, and were unable to find a relationship. This indicated that buildings with lower energy performance do not necessarily have higher O&M savings opportunity.

    - Conducted energy modeling, using standard energy modeling tools for each project
- Developed cost curves of savings versus capital expenditure, according to one interviewee
- Developed core packages for buildings
    - Contractors identified shallow (35-40 percent energy savings) versus deep (50-60 percent) packages
- Identified non-energy-related property benefits (such as improved thermal comfort) to initiate the related financial analysis
    - A technical analysis documentation piece informed the financial analysis
- While one interviewee said this step took 2–3 months to be completed, another interviewee on a different demonstration project said this step took about 6 months

C.3.3.2 Achieved Outcomes

Contractors developed integrated packages in all cases. For one project, the technical lead explained that the package provided greater value to the owner than the sum of the individual components: the package reduced cooling load enough to create the opportunity to free up space in the mechanical room for an alternate use.

C.3.3.3 Challenges

Interviewees shared the challenges they encountered during the Technical Analysis:

- For one project the technical team struggled to unite around the appropriate mix of O&M versus capital projects in the package
- One interviewee noted that an owner wanted to break apart a package by eliminating a costly window replacement, but then understood the need to retain the windows measure so as to avoid undoing the value proposition of the integrated measures package (IMP)
- Multiple changes to the design required cost estimator to redo work
- One interviewee noted that the team had to estimate the performance of a "code compliant" building for utility incentives when the owner did not need that information

C.3.3.4 Interviewee Recommendations

Interviewees provided the following recommendations for the Technical Analysis:

- It is essential to engage property managers and operators to ensure they know how to run the retrofitted building
- Because energy savings alone would not compel an owner to invest in a DER, the level of detail involved in the energy analysis may be unnecessary for reaching owner approval
- The technical analysis could be used to provide broad-brush depictions of what a prospective project may entail, relying on case studies to provide the evidence for ranges of cost and value

C.3.4 Financial Analysis

C.3.4.1 Intended Outcomes and Process Description

The team needed to show owners the value proposition of DER projects. The financial analyst calculated and presented all the value—both the energy and non-energy benefits—of each integrated measure package. Interviewees described the Financial Analysis as follows:

- The financial analyst produced a discounted cash flow and related financial analysis that included both energy and non-energy benefits
  - Interviewees emphasized evaluating packages of energy efficiency measures because this approach maximizes non-energy benefits like occupant comfort and tenant retention, and elevates the value proposition
  - The analysis helped show the investment logic for the repositioning or renewal of each building
- The financial analysis proved crucial to determining whether owners would proceed with the DER investment

C.3.4.2 Achieved Outcomes

The financial analysis presented the full value of integrated measure packages to owners. The inclusion of non-energy benefits with energy benefits in the analysis elevated the value proposition of the packages and offered a compelling business case for building owners to invest.

C.3.4.3 Challenges

Interviewees discussed the following challenges associated with the Financial Analysis:

- Interviewees disagreed on whether the financial analysis required more time: while one interviewee believed the 1–2 months (generally 6 weeks) allotted for the financial analysis was sufficient, another interviewee thought it rushed the analysis and yielded lower quality results compared to a longer analysis
- Interviewees recognized various difficulties associated with placing a value on non-energy benefits like occupant comfort
- Many cost iterations occurred because every change—especially due to phasing—had ripple effects on expected costs and related analysis
- Utilities could not commit on incentives, though the incentives were insignificant anyway compared to the total project cost and were merely “icing on the cake”
- Each project was completely different in terms of ownership and capital structure, assets, building size, investment groups/partnerships, etc., and required a custom approach each time
- The process of including and engaging stakeholders (the owner, property manager, technical leads, other consultants) was challenging to manage according to multiple interviewees

C.3.4.4 Interviewee Recommendations

Interviewees provided recommendations for the Financial Analysis that fall into categories of communication and analysis.

Communication

- Early and active communication with appraiser(s) helps them better understand the nature of the investment
- Clear articulation on the need for packaging provides owners with an “AHA!” moment in which they understand the overall DER strategy
- Bringing in a real estate person that can speak the language of property ownership and management, leasing, etc. increases the credibility of the business case for DERs

Analysis

- One interviewee recommended that NEEA place greater emphasis on the financial analysis and less on the technical analysis, because the financial analysis was more important for owner decision making and the analysis would benefit from more time
- Based on interviewee comments, NEEA should consider determining an approach to adjusting costs as a result of phasing; multiple interviewees indicated that phasing will increase costs

C.3.5 Building Owner Approval

C.3.5.1 Intended Outcomes and Process Description

At this stage, the NEEA team and building owner worked together to reach a deep retrofit deal. Interviewees described Building Owner Approval as follows:

- The team proposed integrated measure packages to building owners and then owners made a final decision about the DER investment
- The NEEA team organized a large meeting to discuss options and answer owner questions
- The owner gathered his/her own design/build team to get an exact cost estimate and then decided whether to proceed with the investment

C.3.5.2 Achieved Outcomes

For two projects thus far, the NEEA team has successfully achieved the intended outcomes.

C.3.5.3 Challenges

Interviewees discussed the following challenges associated with Building Owner Approval:

- The parent company of an anchor tenant would not allow the tenant to negotiate a higher tenant improvement budget
- Owners not engaged early in the process encountered difficulties in understanding the overall approach and analyses undertaken by contractors

- Owners focused primarily on first cost, creating a challenge to fully exhibit the value proposition

C.3.5.4 Interviewee Recommendations

Interviewees provided the following recommendations for Building Owner Approval:

- Large capital cost estimates should always be paired with large positive cash flows to create an overall attract investment case
- Owner approval will be more likely and involve less effort through the early engagement of owners around packaging and non-energy benefits
- An owner sold on a project early in the process will want to find a way to make the investment move forward, making it easier to overcome obstacles that may arise. For example, if owners fully understand the DER value proposition then they will be more willing to overcome implementation challenges such as phasing improvements over time.

C.3.6 Implementation

C.3.6.1 Intended Outcomes and Process Description

The NEEA team needed to find a way to construct the package in a way that achieved the project's expected financial outcomes, and intended for owners to execute the implementation plan that NEEA helped them prepare.

Interviewees described the Implementation as follows:

- This step began with the consideration of multiple implementation scenarios
- Contractors recommended the immediate adoption of O&M measures
- NEEA helped owners make an implementation plan and owners then executed the plan over several phases
- An owner gathered his/her own design/build team to plan for implementation
- Implementation of the integrated measure packages involved in the demonstration projects will involve phasing
- There was essentially no reliance on or need to coordinate implementation with utility incentives

C.3.6.2 Achieved Outcomes

Building owners began or will in the near future begin implementing the integrated measure packages at demonstration project sites based on the plan NEEA helped them compile. Implementation will occur in phases over several years in order to minimize tenant disruption and due to the availability (or timing) of financing.

C.3.6.3 Challenges

Interviewees discussed the following challenges associated with Implementation:

- It is critical to minimize disruption to tenants; phasing helps achieve this

- The need for phasing implies that implementation will take place over multiple years, demanding continuous planning and oversight from owners
- Owners may not fully implement a project phased over several years, implying the need for continued encouragement and guidance
- The understaffing of many building maintenance teams leads to operations problems both before and after the retrofit; understaffing presents a threat to the successful implementation of DERs

C.3.6.4 Interviewee Recommendations

Interviewees provided the following recommendations for Implementation:

- Phasing is an effective approach to minimize tenant disruption and improve financing availability
- A 3–10 rather than 1–2 year process should be expected for implementation
- DERs could support long-term “strategic energy management”, although it is doubtful that owners would want to do such detailed analysis up front for capital improvements that may not happen for several years
- NEEA should identify the point at which the owner's design/build team should become involved over the course of the phased project; it is likely that the correct time is when major measures draw near
- Buildings must have sufficient staff to ensure a given building operates according to design and ensure tenants satisfaction, otherwise the non-energy benefits of the IMPs will not be fully captured; modifications to the budget may be required to allow for sufficient staff

The interviews did not involve a discussion about the two remaining steps of the process—Measurement & Verification and Final Documentation—because the interviewees have not yet reached this point of the demonstration project process.

C.4 Interim Assessment

As a result of the interviews with NEEA contractors and consultants, RMI offers an interim assessment of the EBR Demonstration Project completely based on interviewee statements pertaining to each of the three NEEA staff objectives.

C.4.1 Objective 1: Test, validate, and inform tools to scale the adoption of deep energy retrofits in the market

As noted in the NEEA Staff Interview memorandum, RMI’s role is to gather information and insights that inform the efficacy (i.e., uses and usability) of the proposed EBR Demonstration Project tools NEEA unveiled during the demonstrations (in “manual” form) and will use to support regional deep-retrofit scaling. RMI asked interviewees directly about the tool development and this section documents the interviewee responses.

Tools the Market Demands

- Two interviewees stated that the financial analysis tool is what the market demands because service providers (including property managers) do not know how to make the value proposition for DERs
- Multiple interviewees said that NEEA should place greater attention and priority on the financial analysis tool (however, it is important to note that interviewees had limited knowledge about NEEA's approach for tool development)

Challenges in Tool Development
Most interviewees noted the great difficulty in creating generic tools that serve buildings that are each unique (especially in the eyes of owners). The challenges for the tools come in the form of:

- Producing results that are sufficiently accurate for the situation (neither too much nor too little accuracy)
- The perceived generic nature of the tools potentially turning off building owners (i.e., owners tend to only trust results based on detailed, building-specific analyses)

In addition, given the current limited knowledge that interviewees had about NEEA's future approaches for tool delivery, many interviewees expressed skepticism that a tool alone could convince an owner to invest in a DER. Interviewees expressed the view that at least in the early stages of gaining marketing adoption of DERs, any tool must be accompanied with face-to-face interaction that motivates the owner and helps build trust.

Useful Tool Functions
Many interviewees also noted numerous potentially useful functions for tools:

- Help raise interest, educate, and provide owners a sense of what a DER would entail for their building(s)
    - Characterize the status of deep energy retrofits by increasing number of other retrofitted buildings
    - Provide owners with a general sense of the scale of the capital investment (the DER will not be right for those unwilling or unable to spend a lot to get a lot in return)
    - Offer broad-brush financial and technical expectations for a deep energy retrofit
- Provide two-way communication and engagement between owners and NEEA (or another group) in order to track the number of interested owners and receive updates on the status of projects
- Provide general guidance for the DER process and advice on how to get started

C.4.2 Objective 2: Offer proof that DERs are technically and financially viable

As described in the NEEA Staff Interview memorandum, RMI's role is to verify that the demonstration projects expect to achieve at least 35 percent energy savings and to provide a financially attractive investment to demonstration building owners.

The demonstration projects showed the technical viability of DERs because the integrated measure packages that contractors developed for each project will achieve energy savings of greater than 35 percent. In addition, the packages appeared to be financially viable as evidenced by building owners who move forward with implementation.

However, the timing of the measures creates a challenge in verifying the technical and financial viability of the 35 percent energy savings. While it is financially viable on paper to attain the level of savings, in nearly all cases the demonstration project implementation requires the use of phasing over several years. Therefore, the investment is not a one-time event as are other (more simple) energy efficiency investments. Project phasing creates some challenges to capturing the entirety of the savings.

C.4.3 Objective 3: Provide case studies for education, training, and marketing during later stages of the EBR Initiative

As noted in the NEEA staff interview memorandum, completion of this objective will require verification that the demonstration projects can provide quality content for future case studies. RMI will identify key proof points that the market needs for moving forward with deep energy retrofits and match them to events/facts of the demonstration projects according to interviewees.

The NEEA market characterization report prepared by SBW Company from November 2012 provides key proof points that the market needs for moving forward with deep energy retrofits. The interviews with NEEA project contractors and consultants indicate the demonstration projects can provide these proof points. The list below presents proof points and relevant findings from the demonstration projects. RMI/Navigant will add and/or edit proof points as interviews with project stakeholders continue.

Overcoming split incentives (i.e., energy cost savings do not accrue to the purchaser of the energy efficiency)
None of the interviewees raised this issue, which indicates that owners were focused on the non-energy benefits and not the energy savings—thus, the incentives aligned.

Ability to get full support for energy efficiency from financial backers
When the financial analyst directly engaged appraisers, it led to a higher appraisal because the appraiser had a better understanding of the value proposition of DERs and acknowledged the benefits of energy efficiency.

Capital improvements for energy efficiency can provide both energy savings and non-energy benefits
Building owners believed that the DER could provide many energy and non-energy benefits.

C.5 Concluding Remarks

This memorandum documents the experience of the NEEA consultants and contractors on the demonstration projects, including process outcomes and challenges, as well as interviewee recommendations on how to improve the process. The memorandum also provides an interim assessment of the demonstration projects in meeting the objectives of NEEA staff.

The high quality and scope of interviewee responses illustrated how all interviewees appeared very motivated to see the greater market adoption of energy efficient buildings (i.e., they align with NEEA's general mission). They appeared to answer all questions honestly with no inhibition. These high-quality findings from the interviews will inform the recommendations the RMI/Navigant team produces for the final report.

C.6 Interview Appendix: NEEA Contractor and Consultant Interview Questionnaire

Part I - General

- *Context*: your background and motivation to be involved in the demonstration projects
- *Experience with the demonstration projects* - your role in the demonstration projects and how it was different from other retrofit projects
- *Process evaluation*: discuss any challenges you experienced and the role of NEEA staff in the process
- *Process recommendations*: how the process/tools could be improved and what tools or resources could possibly replace NEEA

Part II - Role Specific

- Several questions based on your specific role(s) within the demonstration project process

Part III - Key Takeaways

- *Overall evaluation*: how you would rate your experience and what you learned during the demonstration projects
- *Hypothetical: could* a web-based tool could scale deep energy retrofits across the Pacific Northwest and fulfill the role NEEA played during the demonstration projects
- *Value of deep energy retrofits*: Do deep energy retrofits yield greater value than shallow ones? In what situations? Who benefits, and how?
- *Final recommendations*: How should the demonstration project process, tools, and stakeholders change for broad market adoption?

APPENDIX D. RMI BEST PRACTICES

D.1 Rocky Mountain Institute's 27 Best Practices for Deep Retrofits

RMI's prior experience with deep energy retrofits has led to the identification of best practices to mitigate risks and identify deep retrofit value, starting with the launch of the project, all the way through the design, financing, construction, and operation of the building.

D.1.1 Launch

1. ***Energy Retrofit Triggers***: Identify the situations in a building's life cycle that can trigger a deep retrofit analysis, and design a strategic plan accordingly.
2. ***Stakeholder Engagement:*** Engage multiple stakeholders (beyond the building owner and service providers) to identify opportunities with broad perspectives.
3. ***Team Selection***: Select initial team members with energy retrofit expertise, who can find the full potential value of a retrofit and ensure execution cost should not be the only factor.
4. ***Goal-Setting Charrette:*** Determine maximum potential energy performance of the entire building while identifying constraints to shape the project's total potential efficiency savings.
5. ***Performance Benchmarks***: Benchmark the energy and occupant performance of the building to better design the project, set performance targets, and compare proposed approaches. This "before upgrade" view is key to having a reference point to accurately prove improvement.
6. ***Contracts, Insurance, and Legal:*** Write contracts that align the team around a shared project vision, properly designating responsibilities and compensating performance. Ensure that legal and insurance strategies are fully sensitive to the special considerations of deep retrofits.
7. ***Evaluate Cost of Doing Nothing:*** Assess how delaying improvements to your building could raise costs through increased utility bills, erode occupant satisfaction, and exacerbate operational and enterprise risks.

D.1.2 Design

8. ***Integrative Design***: Emphasize integrative design principles to establish team dynamics and working relationships and reveal potential energy savings.
9. ***Reduce Loads and Improve Shell, Then Accurately Size Equipment:*** Reduce capital expenditures and minimize future operating costs by first reducing loads, and then installing efficient, optimally sized systems.

10. ***Occupant and Manager Engagement:*** Incorporate the occupants and the building manager in the design process, and solicit their input on the design and operation of the retrofitted building.
11. ***Technical Potential Analysis***: Analyze the technical potential of the building—the energy/resource use that would result from implementing all of the most cutting-edge efficiency measures possible, without regard to financial or other restraints.
12. ***Design Options Assessment***: Analyze using energy modeling, life-cycle cost analysis, and preliminary deep retrofit value analysis to find which combination of energy-efficiency measures provides the greatest value to the building's owner and occupants.
13. ***Cost Estimation:*** Estimate the gross and net costs of the retrofit.10 This is critical to determining its financial viability, and is most insightful when compared against a baseline and assessed using bundles of energy efficiency measures. Identifying factors that can undermine energy retrofits (short-term lower utility rates, contractor or equipment underperformance, warm weather, unexpected vacancies, operations staff changes, etc.) provides a complete picture of the potential cost.
14. ***Regulation and Code Compliance:*** Be aware of potential regulation and code problems stemming from an energy retrofit, and work with local and state officials to mitigate these risks.
15. ***Project Phasing:*** Intelligently phase project over multiple stages and years, depending on efficiency and expected life of existing improvements, leasing situations, and consideration of future technology/economic conditions that might make currently infeasible measures possible.

D.1.3 Finance

16. ***Finance Options Assessment:*** Consider the full array of financial options available as early in the execution process as possible. Compare alternatives considering all terms and conditions including interest rates, financing amount, closing costs and timing, escrow and hold-back requirements, recourse, etc.
17. ***Utilization of Subsidies***: Take advantage of all government and utility tax, financial, and entitlement-related subsidies in a cost-effective manner.
18. ***Underwriting/Due Diligence Support***: Underwriters/due diligence analysts for loans and equity investments are busy and unlikely to have access to the knowledge and data necessary to properly assess the risks and value of a deep retrofit investment. Therefore, secure well-supported and argued support for deep retrofit value. This may involve third-party reporting plus expert review similar to what is used in other complex risk situations (appraisal, Phase 1 Environmental Site Assessment, Property Condition Assessment engineering report) or new types of insurance (Energy Savings Warranty).
19. ***Deep Retrofit Value Report***: Future best practice for all deep retrofit loans and equity investments will require rigorous well-supported assessment of retrofit value and risk.
20. ***Business Interruption Strategy:*** Carefully consider and plan the construction phase to avoid disruption to tenants and/or employees.

[10] Net costs (but not gross costs) include avoided capital costs, tax incentives, and rebates.

D.1.4 Construct

21. ***Contractor/Service Provider Selection:*** Select contractors (ideally early in design) and other service providers with requisite experience in deep energy/sustainability retrofits.
22. ***Construction Management:*** Utilize specialized construction management strategies to intelligently execute deep retrofit construction and sustainability certification.

D.1.5 Operate

23. ***Operations and Maintenance Plan***: Involve maintenance personnel and facilities operators in any building upgrades from the beginning, so they can help form the energy reduction goals, understand them, and be more engaged to help achieve them.
24. ***Commissioning***: Implement commissioning during the design process, the construction of the retrofit, and on an ongoing basis to ensure systems and equipment were installed and are operating according to design.
25. ***Green Leasing***: Establish a green lease with tenants to enable the sharing of costs and benefits of an energy efficiency project.11 If properly managed, this can increase total energy savings.12 While primarily an investor issue, many owner-occupied buildings have significant amount of sublease space.
26. ***Measurement and Verification***: Carefully think through measurement and verification (M&V) systems in advance and intelligently present them to ensure the proper quantification and ability to verify project energy savings.13
27. ***Stakeholder Communications:*** Fully inform stakeholders of any potential changes to their spaces during and after design and construction, and educate them about their new energy efficient building.

More information about these processes can be found on the RMI website: www.rmi.org/retrofit_depot

[11] http://www.greenleaselibrary.com/
[12] Working Together for Sustainability: The RMI-BOMA Guide for Landlords and Tenants," Rocky Mountain Institute, Building Owners and Managers Association, 2012
[13] Often in order to pay contracts tied to energy performance.

APPENDIX E. MONTANA EXISTING BUILDING RENEWAL (EBR) DEMONSTRATION 2013 ENERGY SAVINGS VALIDATION

Montana EBR Demonstration 2013 Energy Savings Validation Report

Existing Building Renewal

Montana Saving Validation 2013 Results

Prepared for:
Northwest Energy Efficiency Alliance

Navigant Consulting, Inc.
1375 Walnut Street, Suite 200
Boulder, CO 80302
213-670-2724
www.navigant.com

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E.1 Executive Summary

This report summarizes research conducted for the Northwest Energy Efficiency Alliance (NEEA) as part of the evaluation of four Existing Building Renewal (EBR) pilot projects. This evaluation involved a review of the energy efficiency efforts undertaken at the EBR Demonstration Building in Missoula, Montana during the period of September 2012 through December 2013 in order to validate savings. This is the first of four buildings to pilot the Existing Building Renewal initiative which is designed to achieve whole-building deep energy efficiency retrofits of existing assets through the integration of savings strategies across building systems. The specific objectives of this first stage evaluation study are to validate the energy savings estimated as a part of the Integrated Measure Package (IMP) deployed in 2012 and 2013. The IMP is being deployed in phases and this review deals with Phase 1 measures which included:

1. Envelope Sealing
2. Insulation
3. Time Clocks for Exhaust Fans
4. Time Clocks for Existing Air Handling Units (AHU)
5. Test and Repair Broken Dampers
6. Change Filters on Regular Schedule

The installation completed by September 30th, 2012. Navigant used whole building energy use simulation modeling to estimate the gas and electric savings from these measures. The model simulated the energy consumption of the building after these measures were installed and compared it to the baseline model and to actual energy consumption meter data. Navigant calibrated the baseline model using two years of meter data and normalized the usage data using weather data (typical meteorological year or TMY data) for this area of Montana.

Per Navigant's recent communication to NEEA,[14] Navigant discovered that there was significant malfunction in some of the controls and dampers installed as part of the Phase 1 retrofit which significantly effected energy savings. After confirming this malfunction with the building manager, Navigant degraded natural gas savings to 6.6% from 40.2%.

However, to demonstrate both the true savings potential of NEEA's initiative and the validated savings, Navigant created two scenarios; Scenario 1 details savings that would have happened if malfunctioning had not occurred; Scenario 2 is the validated savings after Navigant's evaluation of final savings for each scenario. Navigant presents each scenario in Table E-1, below.

[14] EBR Montana Building Phase 1 Savings Calculation Memorandum, February 4, 2014.

Table E-1: Scenario Savings

	Scenario 1	Scenario 2
Electric Savings	8.9%	8.9%
Natural Gas Savings	40.2%	6.6%
Electric Savings (MWh)	21.9	21.9
Natural Gas Savings (MMBtu)	817.9	128.3
Electric Savings (AMW)	0.0025	0.0025
Natural Gas Savings (AMW)	0.0274	0.0043

Notes: The average number of megawatt (AMW) is equal to 8,760 megawatt-hours. Electric and natural gas savings are savings at the meter and not savings at the source.

The following section describes details of the methodology Navigant used to validate savings.

E.2 Methodology

E.2.1 Data Collection

Navigant utilized three different channels of sources for information to input into the energy models:

- Energy audit reports/drawings[15,16,17,18]
- Integrated Design Lab's (IDL) energy models
- Building owner and manager interviews[19,20]

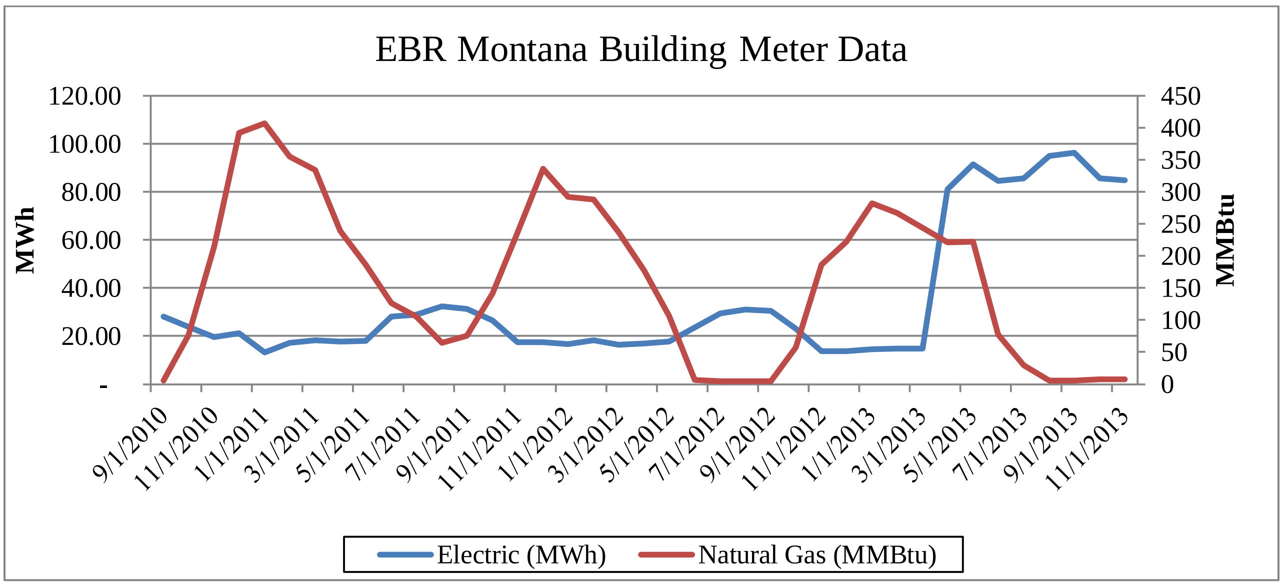
Information provided from energy audit reports informed Navigant about the baseline and post-Phase 1 condition of the building. The IDL's energy models helped to fill gaps in the information that Navigant was not able to extract from the audit reports. Interviews with the building owner and the manager confirmed some of the Navigant's hypothesizes about the building operations. For most of the data collection, Navigant collaborated with Gunnar Gladics from the Idaho IDL, who played a major role and acted as gateway acquiring the necessary data.

[15] Walk Through Audit Report: First Security Building, National Center for Appropriate Technology, June 2011.
[16] Pilot Project Assessment: *EBR Montana Demonstration*, IDL, June 2012.
[17] Preliminary Savings and Costs Estimates: *EBR Montana Demonstration*, IDL, December 2012.
[18] Deep Energy Retrofit: *EBR Montana Demonstration*, BetterBricks, February 2013.
[19] Interview with Carol Word by Gunnar Gladics, December 2013.
[20] Interview with Scott Cooney by Gunnar Gladics, January 2013.

Navigant received three years' worth of monthly gas and electric utility meter data from NorthWestern Energy for the period September 2010 through November 2013 as charted in Table E-2. This meter data provided Navigant with 2 years of pre-retrofit billing data and 1 year of post-retrofit billing data for Phase 1 retrofits and were used to validate the energy savings due to NEEA's initiative, which were completed in September 2012.

However, as seen in Table E-2, electric usage consumption drastically increased beginning in May 2013. From information provided by the IDL, Navigant discovered that pre-March 2013, the building had two separate electric meters; one for the building (main meter), and one for the data center located on the 5th floor of the building. The building owner used the separate meter to bill the data center owners separately from the rest of the tenants. On March 2013, unknown to owner, the electric contractor and utility company unified these two meters into one meter resulting in the dramatic change in the usage trend as displayed in the chart below.

Table E-2: EBR Montana Monthly Building Meter Data



Because NEEA's initiative excluded the data center floor from the building, it was imperative for Navigant to isolate the data center energy consumption from the remainder of the building's energy consumption to ascertain that the final savings estimate representing the savings due to the initiative. The obvious solution would have been to subtract the data center meter data from the main meter data. However, as noted, the data center meter data was not available due to the fact that during the remodel, the data center meter was disconnected from the data center, making this approach untenable. Another approach would have been to extrapolate the historic data center energy usage data to forecast the data center energy usage after the meter was disconnected. Navigant decided this approach would not be appropriate for two reasons: 1) the size of the data center load compared to building electricity load was very large; and 2) the data center could have added or removed servers over the period of the analysis, making this approach problematic. This resulted in only 6 months of available electric data for the post-retrofit case, which Navigant was able to utilize to calibrate its post-Phase 1 energy model. Because of this, Navigant chose to utilize calibrated simulation models (IPMVP: Option D) to validate the savings achieved from Phase 1 measures over the period between September 2012 and September 2013.

E.2.2 *eQuest Inputs*

Navigant used detailed site specific inputs to create baseline and post-Phase-1 whole building calibrated energy use simulation models using eQuest 3.65[21] to verify savings from the measures installed in Phase 1. Navigant used the information from the sources described in the previous section, but also used engineering judgment where data was not available. Navigant later adjusted these assumptions based on the feedback from IDL and NEEA. Navigant further adjusted some unspecified inputs like thermostat setpoints, operating schedules, duct system pressures, and envelope infiltration rates to calibrate the models to the utility meter data.

E.2.2.1 Baseline Model

The EBR Demonstration Building in Missoula is a six-story building built in 1952 located on the northeast corner of the intersection of Broadway and Higgins. The south elevation faces approximately 24 degrees west of true south which is the city grid rotation in downtown Missoula.

The ground level south elevation is comprised of double glazed glass storefront in an aluminum frame which is the lobby for the building. The upper five stories of the south elevation is an aluminum curtainwall system with a horizontal band of ribbon windows and spandrel panels along the floor lines. The north elevation is a blank wall of concrete and brick. The east elevation is a blank brick wall with approximately four foot square glass block windows at each of the interior exit stair landings. The full height elevator, rest rooms, and a mechanical space are also located at the east end of the building. Louvers for the mechanical room are in the horizontal lines of the east end brick component of the south elevation. The lobby for the upper floors is also located in the southeast corner of the building. The west elevation is a blank brick wall with the exception of a three-panel double-glazed unit at the ground level. At the west end of the building there is an electric elevator that travels between the basement and second floor. The floor plates above the first floor are typically single-loaded corridors along the north wall that provide access between the north fire stair and the east fire stair. Office spaces are then located along the south curtainwall[16].

The fifth floor houses a data center and the fourth floor is currently being renovated into a data center. The data center on the fifth floor has a separate HVAC system than the main building

[21] eQuest is an 8760 hour whole building energy model based on the DOE 2 building energy simulation engine developed in collaboration with Lawrence Berkeley National Laboratory (LBNL) .

HVAC system and conditioned air is served by three air handling units compared one air handling unit on other floors. Per the above, the building used to have a separate meter attached to the fifth floor data center servers and HVAC system.

To mimic the main meter data pre-integration of the data center meter to the main meter, Navigant excluded the fifth floor HVAC system and the data center load from the model, meaning Navigant modeled it as an unconditioned space with no occupants. This way the baseline model consumption results were analogous with the main meter data, which allowed Navigant to calibrate model results to meter data. The fourth floor is still under renovation, therefore Navigant modeled it in the same way as it modelled the rest of the floors as conditioned space as for the period of analysis it was occupied and connected to the main meter.

Below Navigant describes the inputs from various resources described in the Data Collection section of this report that Navigant used to create the baseline model. Navigant used the window and wall types described in the energy audit reports, and the final average U-values and window to wall area ratios for each face of the building are listed in Table E-3. Navigant modeled the building to be approximately 22,000 square feet gross with approximately 19,000 square feet conditioned. As mentioned earlier, due to the data center, Navigant modeled the fifth floor as unconditioned. For occupancy, Gunnar Gladics provided Navigant with a timeline showing floor by floor tenancy over the period of the analysis based on his interview with the building owner. For lighting and equipment densities, Navigant utilized the field measurement results for each floor from *Pilot Project Assessment*[16] report. The occupancy, lighting density, and equipment density levels are listed in
Table E-4.

The HVAC system included six multi-zone constant air volume systems with ducted return air; however the system on the 5th floor had been dismantled. Each system contained four zones generally distributed linearly along the length of the building. The HVAC exhaust system was central, while each zone had an individual air intake through a grille in the building wall. A single zone heating and ventilation unit served the basement. Navigant found that the existing controls systems were pneumatic, while cooling was direct exchange air cooled system and heating was a natural gas steam boiler system. Navigant leveraged the system efficiencies and maximum supply temperatures used in IDL's energy models, and adjusted cooling system size to 54 tons and sized heating system to 2.1MMBtu/hr based on the information from audit reports. Please find the inputs for the HVAC system in Table E-5.

Navigant estimated the HVAC setpoints due to the fact that results from the audit reports revealed that thermostats were problematic and the HVAC system were not able to satisfy the supply air temperature setpoints for conditioned air. Navigant compared the energy model results to meter data to determine reasonable estimate for the average thermostat setpoints for the baseline case. Navigant used the same technique to determine the infiltration rate for the building. Infiltration is basically the introduction of outside air into a building, typically through gaps in the building envelope and through use of doors for passage. Infiltration was significant for this building, especially because the building had significant gaps, cracks and holes in the envelope, damage in window gaskets and great deal of leakage through gaps in the curtain wall on south façade.

The fan system consisted of constant volume fans with approximately 6000 cfm cooling capacity per floor. The outdoor air damper positions on all of the air handling units were closed or broken. The building operator mentioned that the outdoor air dampers were shut during the winter and summer, and opened only during the shoulder seasons. The dampers were manually operated and Navigant assumed that this schedule may be unpredictable. So, Navigant modeled outside air flow to be low. Audit reports also indicated both the building exhaust and bathroom fans were operating 24/7[16], which is particularly important as all of the building's outdoor air dampers were shut, the exhaust fans were negatively pressurizing the building, meaning air was being pulled into the building.

For building operations, Navigant modeled the building HVAC system to be on 24/7 including weekends and holidays, except during summer months the boiler is assumed to be disconnected from the system. Navigant modeled the rest of the building operations in line with standard office building operation schedules as defined in eQuest.

E.2.2.2 Phase 1 Model

Navigant developed a Phase 1 model to estimate the energy consumption of the building after the following measures were installed:

- Seal existing leaks in south curtain wall and other areas of the envelope
- Insulate behind the spandrel panels at the south façade
- Add time clocks to exhaust fans and air handling units in the ventilation system
- Test and repair broken dampers
- Improve air flow through conditioning system with cleaner filters

These measures typically are specified as O&M measures and usually do not require significant changes to existing mechanical system. These measures primarily targeted building operations and building envelope. Navigant incorporated the impact of these measures into the calibrated baseline model by adjusting the following fields:

- Fan schedule: Navigant changed the ventilation schedule from continuous (24 hours/day) to 14 hours/day due to installation of time clocks to air handling units.
- Infiltration: Navigant decreased the infiltration rate of the building envelope to incorporate the impact of insulation and sealing of the envelope.
- Fan system total efficiency: Navigant improved the total efficiency of fan system due to filter change. Navigant expects building operators to change filters on regular schedule.
- Fan system static pressure: Navigant increased the static pressure of fan system to exhibit the effects of addition of time clocks to exhaust fans.

- Outside air flow: Navigant increased the outside air flow rates per person since dampers that were broken and in closed state were repaired to operate as expected. Opening the damper allows outdoor air to enter the building.

Navigant lists all these inputs to model in the following tables.

Figure E-1: 3D eQuest Model Image of the Montana EBR Demonstration Building

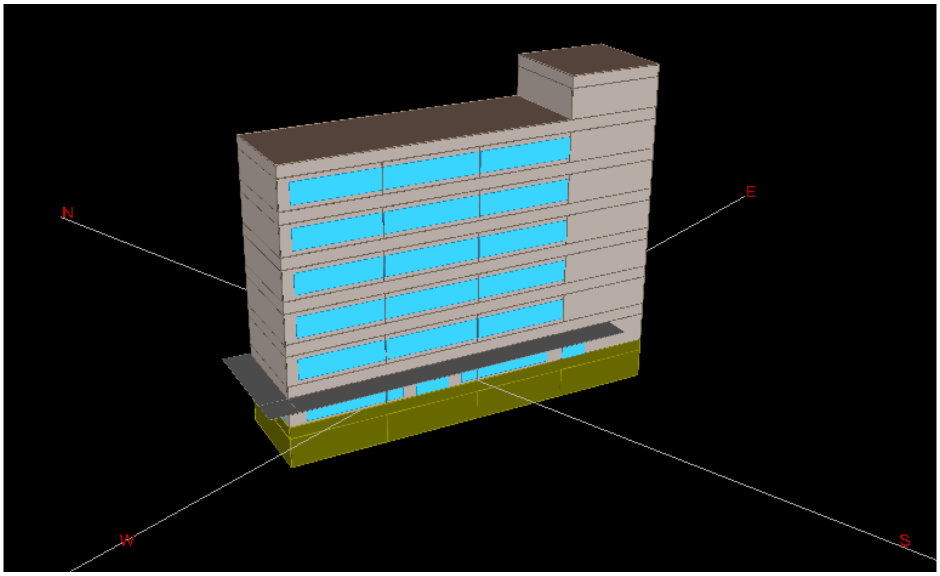


Table E-3: Building Characteristics

	Average U-Value/ Windows (Btu/hr-sqft-F)	Average U-Value/Wall (Btu/hr-sqft-F)	Window to Wall Area Ratio
North	0.000	0.238	0%
East	1.003	0.238	4%
South	0.977	0.238	58%
West	0.980	0.238	4%
Roof	0.000	0.044	0%
Building	0.978	0.182	11%

Table E-4: Floor Characteristics

	Floor Area (sqft)	Floor Type	Occupancy (people)	Lighting (W/sqft)	Equipment (W/sqft)
Basement	3,136	Conditioned	0	0.58	0.304
1st Floor	3,136	Conditioned	7	1.71	0.575
2nd Floor	3,136	Conditioned	12	1.42	0.66
3rd Floor	3,136	Conditioned	3	1.43	0.66
4th Floor	3,136	Conditioned	5	1.21	0.66
5th Floor	3,136	Unconditioned	0	0.55	0.66
6th Floor	3,136	Conditioned	7	1.47	0.66
Penthouse	784	Unconditioned	0	0	0

Table E-5: HVAC System

	Cooling	Heating
System Type	Air Cooled DX Cooling	Boiler
System Sizing	Adjust Load	Adjust Load
System Capacity	Autosized to Design Day	2.1 MBtu/hr
System Efficiency	0.4 EIR[22]	1.5 HIR[23]
Max. Supply Temp. (F)	55	122
Design Temp. (F)	76	70

Table E-6: Modeled Thermostat SetPoints

	Occupied (F)		Unoccupied (F)	
	Cool	Heat	Cool	Heat
Winter Season[24]	76	71	76	71
Summer Season[25]	74	60	74	60

Table E-7: Air Barrier System

	Baseline Condition	Phase-1 Condition
Infiltration (cfm/ft2)	0.16	0.04

22 EIR: Electric-input-ratio
23 HIR: Heat-input-ratio
24 Winter Season: October 1st – April 30th
25 Summer Season: May 1st – September 30th

Table E-8: Fan Schedule

	Baseline Condition	Phase-1 Condition
Weekdays	12:00AM – 12:00AM	6:00AM – 8:00PM
Weekends/Holidays	12:00AM – 12:00AM	6:00AM – 8:00PM

Table E-9: Fan System

	Baseline Condition	Phase-1 Condition
Total Efficiency (η)	0.6	0.7
Fan Control	Constant Volume	Constant Volume
Design Flow (cfm/ft2)	1.0	1.0
Static Pressure (WG)	1.0	1.25
OA Flow (cfm/person)	5.0	15.0

E.2.2.3 Model Calibration

Navigant used detailed site specific inputs to create Baseline and Post-Phase 1 whole building energy models using eQuest. The use of site specific inputs, such as actual weather data and equipment schedules, capacities, and setpoints based on known information about how the building operates, ensures that the energy use of the computer based models closely resembles the actual building energy use.

The calibration process for the Baseline and Post-Retrofit models is as follows:

1. **Information Gathering:** Collect site specific inputs for Baseline and Post-Phase 1 models including
    - Building geometry, composition, and orientation
    - Actual regional weather data for dates aligned with the billing data
        - i. dry bulb temperature
        - ii. percent relative humidity
    - Equipment types and capacities
    - Heating and cooling setpoints
    - Building occupancy and use
    - Weekly, seasonal, and annual equipment operational schedules
2. **Develop Whole Building Energy Models[26]:** use the inputs above to generate the following 8760 hour energy models in eQuest
    - Baseline
    - Post-Phase 1 or Post-Phase 2
3. **Calibrate Whole Building Energy Models by Refining Inputs:** calibrate models according to the procedures in Guideline 14:[27]

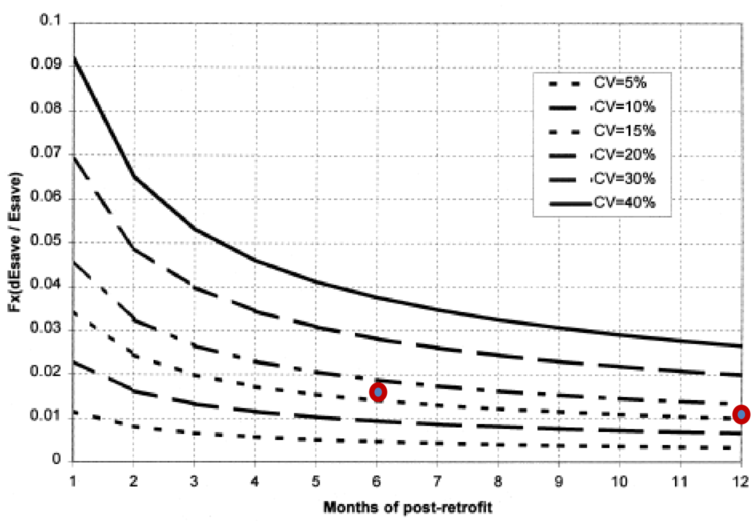
[26] Described in eQuest Inputs Section above.
[27] ASHRAE Guideline 14-2002, Section 6.3.2, p.33.

- Compare monthly modeled annual energy and gas use to actual billing data on a monthly and yearly basis.
- Adjust inputs[28] iteratively until the recommended Guideline 14 metrics are satisfied[29], using an appropriate level of effort relative to the magnitude of the savings being evaluated:
    - i. Coefficient of Variation of the Root Mean Square Error
        1. CVRMSE ≤ 15%
    - ii. Normalized Mean Bias Error
        1. NMBE ≤ 5%

Navigant calibrated the Baseline demonstration model to 21 months of monthly electric and gas billing data, and calibrated the Post-Phase 1 model to 6 months[30] of monthly electric and gas data, resulting in calibrated models with metrics of 14% CV(RMSE) and 2% NMBE, which are within acceptable limits required by ASHRAE Guideline 14[31].

The relative effect of calibrating to 6 months of post-Phase 1 data rather than 12 months can be seen in Figure E-2[32] below to be relatively small. This resulted in an additional uncertainty of 7% in the calculated energy savings, compared to the case where 12 months of Post-Phase 1 data is available.

Figure E-2: Impact of 6 months vs. 12 months Post-Retrofit Calibration



[28] ASHRAE Guideline 14-2002, Section 6.3.3.3.9, p.37.
[29] ASHRAE Guideline 14-2002, p.18.
[30] See Data Collection Section for more information on availability of post retrofit billing data.
[31] ASHRAE Guideline 14-2002, Measurement of Energy and Demand Savings p.18.
[32] ASHRAE Guideline 14-2002, p.108.

Navigant then replaced the historical weather data used to calibrate the models with typical meteorological year (TMY3) weather data[33] for Missoula, Montana, in order to subject building components to identical weather load conditions in the pre and post case that are representative of a typical year, and calculate first year annualized energy savings for Phase 1 measures. The savings reported in eQuest Results Section are the annualized electric and gas energy savings for Phase 1 measures, calculated as the difference between the Baseline and Post-Phase 1 annual calibrated eQuest model utilizing typical weather data (TMY3) for Missoula, Montana.

E.2.3 ***Savings Calculation***

This section discusses the annual energy savings calculation approach, including considerations regarding naturally occurring savings and code requirements.

The International Performance Measurement and Verification Protocol (IPMVP[34]) provides a framework for quantifying total savings attributable to energy conservation measures (ECMs). In cases where it is desirable to calculate the individual impacts of multiple individual ECMs within a facility, where billing data may be incomplete in either the baseline or post-retrofit case, or where the savings may be low, the IPMVP recommends Option D Calibrated Simulation Modeling.[35] Navigant developed the reported total savings for Phase 1 based on Option D using Calibrated Simulation Modeling in eQuest. Total savings results are reported in eQuest Results Section below.

While total savings are the focus of this report (see Figure E-3 below), and net to gross research (NTG) was not in the scope of this evaluation, nonetheless Navigant interviewed several parties involved in the decision making process to understand what would have happened absent NEEA's initiative in order to determine the percent of savings that are attributable to NEEA's intervention.

For some utility programs, it may also not be permissible to report savings that would have occurred due to code compliance for a major renovation, even for an early replacement project, due to the fact that applicable codes and standards, including applicable federal rules, would have been in effect. However, due to the fact that the measures installed in Phase 1 are predominantly O&M measures; Navigant could not find any codes and standards in Montana that would raise the baseline for these measures

[33] National Renewable Energy Lab (NREL), http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/

[34] Reference International Performance Measurement and Verification Protocol (IPMVP)—Concepts and Options for Determining Energy and Water Savings, Volume 1, EVO 1000-1:2012.

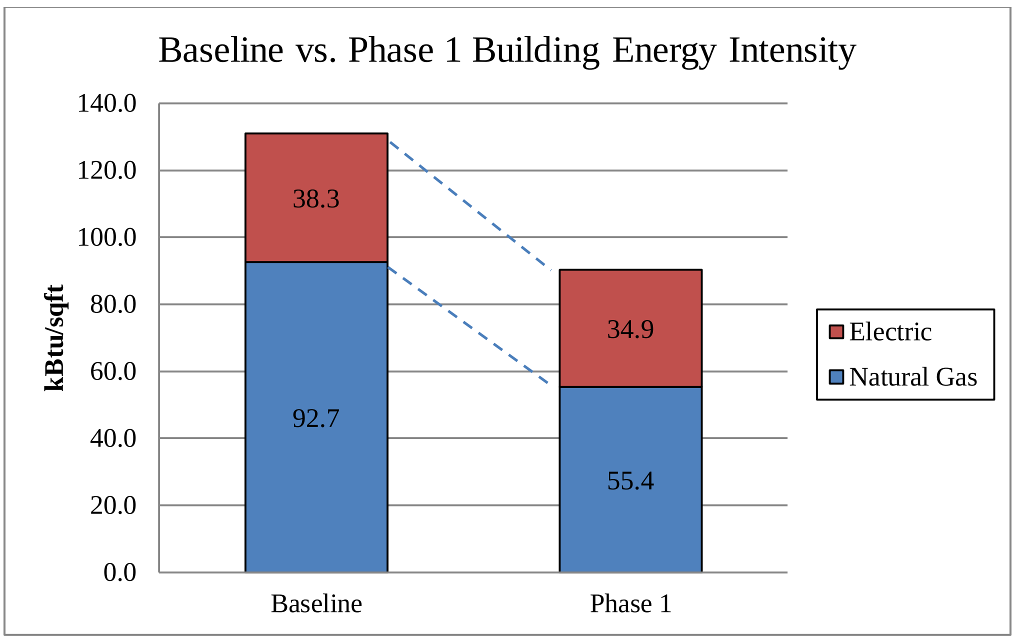
[35] IPMVP P1:2012, p. 33.

E.3 Findings

E.3.1 eQuest Results

This section discusses the annualized electric and gas energy savings for Phase 1 measures, calculated as the difference between the Baseline and Post-Phase 1 annual calibrated eQuest model utilizing typical weather data (TMY3) for Missoula, Montana, and referred as the Scenario 1 savings in this report. Navigant calculated the total electric savings to be 8.9% (21.9MWh) and the total gas savings to be 40.2% (817.9MMBtu) over the baseline energy consumption. The building total savings is equal to 31% (261.5MWh or 892.6MMBtu) which translates into 40.6 kBtu/sq.ft. reduction in the total building energy intensity for gross building area[36]. The chart below illustrates the drop in the building energy intensity due to Phase 1 measures.

Figure E-3: Baseline vs. Phase 1 Building Energy Intensity



Navigant calculated the uncertainty in the gross Phase 1 savings based on the equation expressed in the ASHRAE Guideline 14[38]. The uncertainty in the final Phase 1 savings is approximately 24% of the calculated savings at 68% confidence[37], including the uncertainty due to limited number of months of available billing data, which is significantly better than the maximum

[36] Gross building area (conditioned and unconditioned) is 21,952 sq.ft. Conditioned space area is 18,816 sq.ft.
[37] The uncertainty in the final savings is always dependent on the confidence levels at which the savings are being reported. The uncertainty in the final Phase 1 savings can also be presented as approximately 32% of the calculated savings at 80% confidence, including the uncertainty due to limited number of months of available billing data.

allowed uncertainty of 50% at the 68% confidence interval[39] per ASHRAE Guideline 14. The average modeled savings as a fraction of the baseline usage is relatively low for Phase 1 measures, which results in a higher uncertainty in savings. The savings uncertainty decreases with increasing savings over the baseline, therefore when Phase 2 retrofits are included in the post-retrofit model; the uncertainty in the total savings for both phases is expected to be less than 15% at the 68% confidence level.

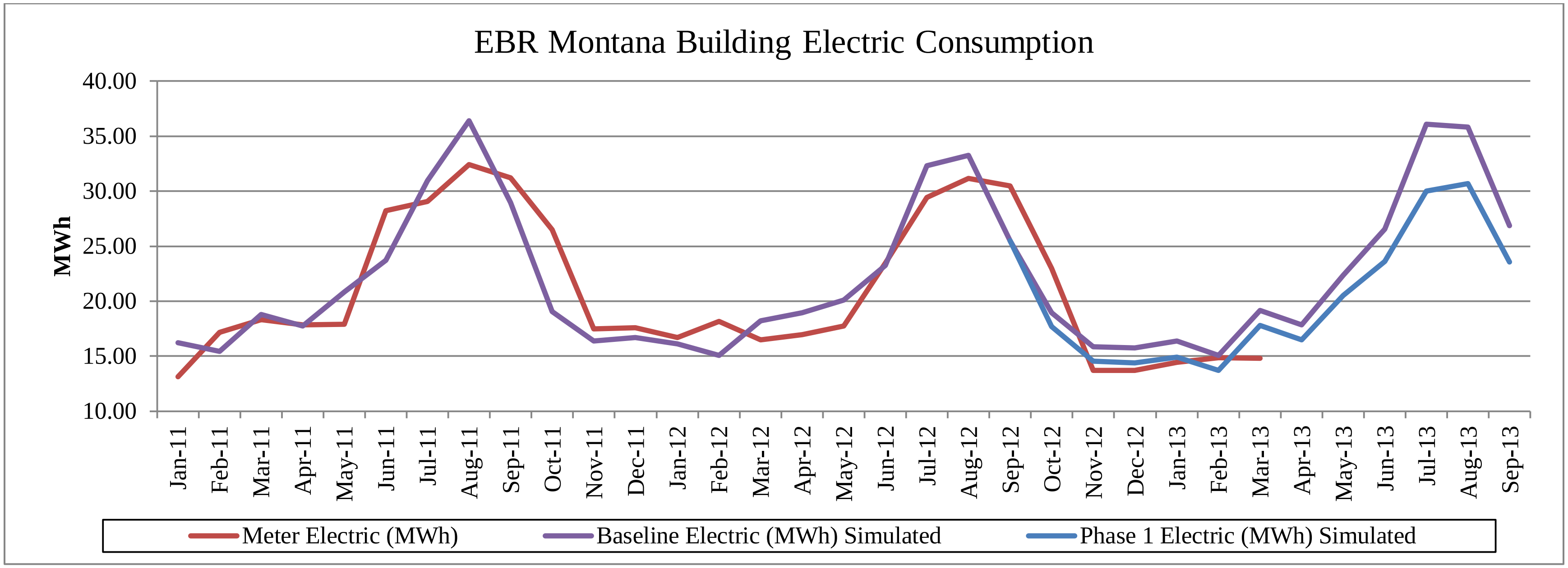
E.3.2 Validated Savings

Navigant compared the calibrated model energy usage to meter energy usage to further validate savings where possible throughout the course of Phase 1 (September 2012 – September 2013).

On the electric consumption chart (Figure E-4), the red line represents the meter data, the purple line represents baseline modeled energy data, and the blue line represents post-Phase 1 modeled energy data. This graph provides a visual of the ASHRAE 14 statistical analysis discussed in the previous section by demonstrating how closely calibrated baseline model shadows the meter data. However, due to the addition of the data center meter into main electric meter on March 2013, the meter data is only available until March 2013. To validate savings for the course of Phase 1 measures, the meter situation led Navigant to use the Phase 1 simulation model in place of meter data. Since Navigant calibrated the baseline data to twenty-one moths and the Phase 1 model to six months, Navigant can report validated savings with only an additional 7% uncertainty compared to savings that would have been validated with traditional IPMVP Option D approach, which requires twelve months of post-retrofit data[38]. Navigant calculated validated electricity savings to be 8.9% (21.9MWh). This can be described as the area between the blue and purple lines in Figure E-5.

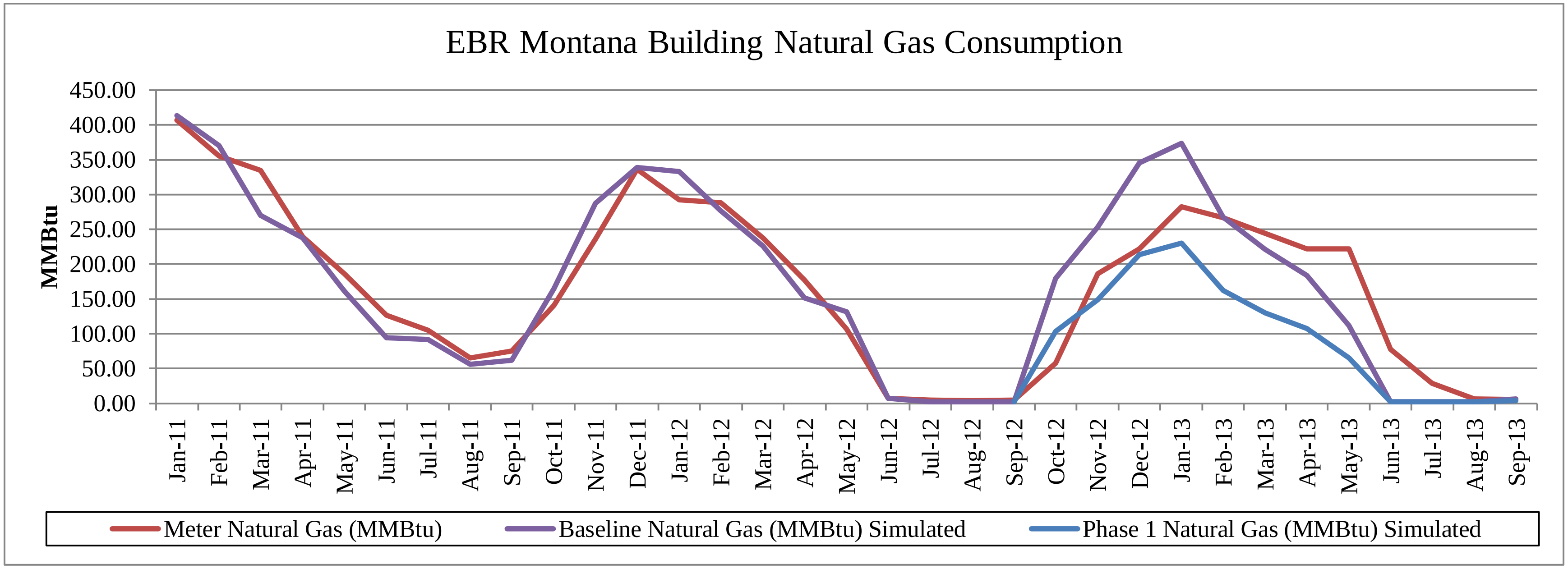
[38] ASHRAE 14 Guideline, Equation B-13a, p.107.

Figure E-4: Building Electric Consumption



On the natural gas consumption chart (Figure E-4), the red line represents the meter data, the purple line represents baseline modeled energy data, and the blue line represents post-Phase 1 modeled energy data. This graph also provides a visual of the ASHRAE 14 statistical analysis discussed in the previous section by demonstrating how closely the calibrated baseline model follows the meter data. For natural gas usage, adequate pre and post-meter data is available and plotted on the chart. However, when compared to simulated baseline energy usage over the course of expected Phase 1 savings; Navigant discovered extremely high and unusual loads in the meter data starting January 2013, see Figure E-5.

Figure E-5: Building Natural Gas Consumption



After reaching out to the building manager, Scott Cooney, Navigant discovered that there was malfunction in some of the controls and dampers starting on January 2013. Scott mentioned three of the time clocks were faulty, two of them were for the AHUs and one of them was for the main building exhaust fan. Navigant predicts the extremely high loads could be due to the main building exhaust fan running day and night, which would pull a lot of cfm, possibly pulling the whole building negative. This mistake potentially wiped out almost all the natural gas savings that could have been achieved from Phase 1 measures. The malfunction had negligible impact on electric savings.

Between September 2012 and September 2013, Navigant estimated 39.9% (778.7MMBtu) natural gas savings could have been achieved using the calibrated modeling approach with the actual weather data for over this period. This is essentially the area between the blue and purple lines in Figure E-5. Based on the conventional calibrated model savings approach described in the previous section, Navigant estimated 40.2% (817.9MMBtu) savings would occur in a typical year. However, due to the malfunction Navigant calculated 6.6% (128.3MMBtu) savings occurred for the same time period. Navigant calculated this savings value from the delta between the meter data and the baseline model data. This is essentially the area between the red and purple lines between September 2012 and September 2013 in Figure E-5.

As a result, Navigant degraded natural gas savings to 6.6% due to the malfunction. So, Navigant created two scenarios, where Scenario 1 is savings that would have happened if malfunctioning hadn't occurred; Scenario 2 is the validated savings after Navigant's evaluation. Final savings for each scenario are shown in Table E-10.

Table E-10: Scenario Savings

	Scenario 1	Scenario 2
Electric Savings	8.9%	8.9%
Natural Gas Savings	40.2%	6.6%
Electric Savings (MWh)	21.9	21.9
Natural Gas Savings (MMBtu)	817.9	128.3
Electric Savings (AMW)	0.0025	0.0025
Natural Gas Savings (AMW)	0.0274	0.0043

Notes: The average number of megawatt (AMW) is equal to 8,760 megawatt-hours. Electric and natural gas savings are savings at the meter and not savings at the source.

Navigant then compared the proposed Phase 1 savings percentages in IDL's *Preliminary Savings and Costs Estimates:* (for the Montana EBR Demonstration Building) *2012* [17] report to final savings percentages determined in Table E-10, and found natural gas savings percentage estimates to be relatively higher and electric savings percentage estimates to be relatively lower than Navigant's results, as shown in Table E-11.

Table E-11: Scenario Savings with Proposed Savings

	Scenario 1	Scenario 2	Proposed Savings
Electric Savings	8.9%	8.9%	2.0%
Natural Gas Savings	40.2%	6.6%	50.5%

E.3.3 Caveats and Limitations

Since the reported uncertainties above are limited to the quantified uncertainty attainable in savings calculated using a calibrated modeling approach, it is important to note the various other sources of uncertainty that have not been addressed in the modeling uncertainty, and which may in fact have a larger impact on the savings.

Examples of additional uncertainties are measure persistence issues and unforeseen changes in load, such as those Navigant discovered by comparing the expected results from the post-retrofit calibrated model, to what the gas billing data showed. While the errors in building operation were discovered due to the calibrated model, in some cases, particularly for less dramatic changes, these errors may never be discovered. The impact of this is to potentially reduce customer participation, since if the energy bills stay the same, or even inexplicably go up, a customer may conclude that the effort and expense of energy efficiency 'is not worth it'. The impact of this type of error is difficult to quantify.

Additional sources of uncertainty[39] in energy efficiency savings calculation include sampling uncertainty (U_s), uncertainty associated with the utility meter accuracy ($RE_{instrument}$), and uncertainty in independent variables (U_{iv}). Navigant did not perform a sensitivity analysis on independent variables as part of this evaluation scope.

E.4 Conclusions

Navigant considered the code requirements at the time the project was permitted, and determined the building owner's intention to make any retrofit to validate the savings that would not have happened without NEEA's intervention. Navigant found Phase 1 measures did not trigger code due to the nature of Phase 1 measures being O&M measures. Navigant also found that the building owner had no retrofit plans prior to NEEA influencing the owner. Therefore, Navigant concluded all the validated savings reported herein are attributable to NEEA's initiative.

[39] ASHRAE Guideline 14-2002, p.15.

On the other hand, this report demonstrates the significance of commissioning building operations and other measures installed in buildings. Due to malfunction, the projected natural gas savings realization rate appeared to be as low as 15%; approximately 700 MMBtu natural gas savings were wiped out. In the long term, commissioning EBR buildings could help ensure NEEA that projects sustain savings at expected levels and that new measures function properly.

E.5 Recommendations

Navigant recommends as next steps to true-up the electric savings from 2013 and to validate the savings for Phase 2 measures that were installed during the last quarter of 2013, that NEEA should implement the following:

- Connect submeters both to data center servers and to HVAC equipment that serves to data centers located in 4th and 5th floor.
- Submeter these two floors separately and find out if there has been any addition to server load between September 2013 and the date submeters are installed.
- Measure the lighting density on each floor to model new lighting fixtures appropriately.
- Calibrate the Energy Management System (EMS) sensors to NIST certified or other calibrated instruments, to include temperature and relative humidity checks at a minimum.
- Perform a point to point visual check of the automatic dampers and valves to ensure that they are operating as expected when controlled by the EMS.
- Export and archive hourly EMS data from the new HVAC control system to ensure accurate trends are available as modeling inputs for thermostat setpoints and supply air temperatures, as well as diagnostic review by facility staff.

E.6 References

ASHRAE Guideline 14-2002. *Measurement of Energy and Demand Savings*, American Society of Heating, Ventilating, and Air Conditioning Engineers, Atlanta, Georgia.

International Performance Measurement and Verification Protocol (IPMVP). *Concepts and Options for Determining Energy and Water Savings*, Volume 1, EVO 1000-1:2012.

E.7 Simulation Results by End-Uses

E.7.1 TMY3 Baseline Results

Electric Consumption (kWh)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	338	994	1,139	2,380	4,623	8,620	12,544	13,700	7,410	3,284	679	164	55,873
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	3,720	3,349	3,698	3,566	3,672	3,528	3,664	3,672	3,517	3,655	3,565	3,716	43,321
Pumps & Aux.	169	148	161	154	157	152	157	157	152	158	158	170	1,893
Ext. Usage	698	490	543	525	326	315	326	583	564	583	675	698	6,323
Misc. Equip.	3,782	3,563	4,253	3,763	4,096	4,074	3,784	4,253	3,759	3,941	3,759	3,782	46,810
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	7,498	7,032	8,329	7,435	8,052	7,989	7,498	8,329	7,435	7,775	7,435	7,498	92,304
Total	16,203	15,575	18,123	17,822	20,926	24,678	27,972	30,694	22,837	19,396	16,271	16,028	246,525

Gas Consumption (kBtu)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	360,048	257,039	237,943	181,184	134,849	6,950	-	-	2,444	181,116	266,369	379,416	2,007,357
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	2,399	2,327	2,784	2,428	2,491	2,350	2,061	2,219	1,969	2,111	2,131	2,278	27,548
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	362,447	259,366	240,726	183,612	137,340	9,300	2,061	2,219	4,412	183,227	268,501	381,694	2,034,905

E.7.2 *3 Phase 1 Results*

Electric Consumption (kWh)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	430	1,149	1,317	2,472	4,385	7,602	10,594	11,435	7,105	3,550	802	214	51,053
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	2,326	2,091	2,306	2,223	2,288	2,197	2,287	2,293	2,188	2,269	2,218	2,321	27,006
Pumps & Aux.	101	88	95	91	93	89	92	92	89	94	94	102	1,120
Ext. Usage	698	490	543	525	326	315	326	583	564	583	675	698	6,323
Misc. Equip.	3,782	3,563	4,253	3,763	4,096	4,074	3,784	4,253	3,759	3,941	3,759	3,782	46,810
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	7,498	7,032	8,330	7,435	8,052	7,989	7,498	8,330	7,435	7,775	7,435	7,498	92,305
Total	14,833	14,412	16,844	16,509	19,239	22,265	24,580	26,986	21,140	18,211	14,984	14,614	224,616

Gas Consumption (kBtu)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	222,109	151,159	138,440	106,635	76,057	3,116	-	-	479	100,708	156,007	234,687	1,189,396
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	2,418	2,343	2,799	2,441	2,500	2,350	2,059	2,216	1,967	2,120	2,145	2,296	27,653
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	224,527	153,502	141,239	109,076	78,557	5,465	2,059	2,216	2,446	102,827	158,152	236,983	1,217,050

E.7.3 2011 Baseline Results

Electric Consumption (kWh)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	312	790	1,811	1,868	4,992	7,712	15,501	19,303	13,091	3,452	828	446	70,105
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	3,729	3,375	3,662	3,527	3,607	3,476	3,699	3,752	3,538	3,574	3,514	3,659	43,111
Pumps & Aux.	183	166	172	165	168	162	167	167	162	168	168	176	2,024
Ext. Usage	698	490	543	525	326	315	326	583	564	583	675	698	6,323
Misc. Equip.	3,782	3,563	4,255	3,917	3,941	4,076	3,782	4,253	3,917	3,784	3,759	3,939	46,967
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	7,498	7,032	8,329	7,712	7,775	7,989	7,498	8,329	7,712	7,498	7,435	7,775	92,582
Total	16,201	15,414	18,773	17,714	20,808	23,729	30,972	36,388	28,983	19,057	16,379	16,693	261,111

Gas Consumption (kBtu)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	411,304	368,170	266,777	235,272	159,008	91,480	89,449	53,565	59,475	162,957	284,900	336,260	2,518,617
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	2,408	2,343	2,805	2,544	2,401	2,339	2,045	2,197	2,022	2,020	2,133	2,385	27,642
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	413,712	370,513	269,583	237,816	161,409	93,820	91,494	55,762	61,497	164,977	287,033	338,645	2,546,259

E.7.4 2012 Baseline Results

Electric Consumption (kWh)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	419	598	1,350	3,672	3,950	7,347	16,971	16,396	10,222	2,975	381	46	64,326
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	3,575	3,228	3,555	3,428	3,529	3,391	3,560	3,553	3,398	3,516	3,426	3,569	41,727
Pumps & Aux.	162	144	155	148	152	147	152	152	147	154	152	162	1,828
Ext. Usage	698	490	543	525	326	315	326	583	564	583	675	698	6,323
Misc. Equip.	3,782	3,563	4,253	3,763	4,096	4,074	3,784	4,253	3,759	3,941	3,759	3,782	46,810
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	7,498	7,032	8,330	7,435	8,052	7,989	7,498	8,330	7,435	7,775	7,435	7,498	92,305
Total	16,133	15,055	18,186	18,971	20,104	23,263	32,289	33,267	25,525	18,943	15,828	15,754	253,318

Gas Consumption (kBtu)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	331,005	274,135	223,104	149,355	129,154	4,554	-	-	120	177,579	251,135	343,357	1,883,497
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	2,356	2,288	2,737	2,385	2,442	2,297	2,006	2,155	1,910	2,058	2,083	2,232	26,950
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	333,361	276,423	225,841	151,740	131,596	6,851	2,006	2,155	2,030	179,636	253,219	345,589	1,910,446

E.7.5 ***2013 Baseline Results***

Electric Consumption (kWh)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	334	318	2,026	2,236	5,888	10,358	20,481	18,679	11,242	4,640	1,288	372	77,862
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	3,872	3,487	3,843	3,711	3,814	3,680	3,862	3,846	3,682	3,797	3,700	3,859	45,154
Pumps & Aux.	175	152	165	159	163	157	162	162	157	163	160	173	1,949
Ext. Usage	698	490	543	525	326	315	326	583	564	583	675	698	6,323
Misc. Equip.	3,782	3,563	4,253	3,763	4,096	4,074	3,784	4,253	3,759	3,941	3,759	3,782	46,810
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	7,498	7,032	8,329	7,435	8,052	7,989	7,498	8,329	7,435	7,775	7,435	7,498	92,304
Total	16,358	15,041	19,160	17,829	22,339	26,573	36,112	35,853	26,839	20,899	17,018	16,381	270,403

Gas Consumption (kBtu)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	370,996	265,076	218,642	181,573	109,243	-	-	-	4,565	173,411	234,384	353,268	1,911,158
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	2,410	2,352	2,814	2,448	2,481	2,307	1,993	2,124	1,884	2,042	2,090	2,263	27,210
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	373,406	267,428	221,456	184,022	111,724	2,307	1,993	2,124	6,449	175,453	236,473	355,532	1,938,368

E.7.6 2012 Phase 1 Results

Electric Consumption (kWh)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	512	708	1,524	3,703	3,939	6,648	13,578	13,573	9,349	3,132	469	69	57,204
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	2,223	2,007	2,206	2,128	2,188	2,101	2,218	2,214	2,109	2,172	2,121	2,217	25,902
Pumps & Aux.	96	85	91	87	89	86	89	89	86	90	90	96	1,073
Ext. Usage	698	490	543	525	326	315	326	583	564	583	675	698	6,323
Misc. Equip.	3,782	3,563	4,253	3,763	4,096	4,074	3,784	4,253	3,759	3,941	3,759	3,782	46,810
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	7,498	7,032	8,330	7,435	8,052	7,989	7,498	8,330	7,435	7,775	7,435	7,498	92,305
Total	14,808	13,884	16,947	17,640	18,690	21,214	27,491	29,041	23,302	17,692	14,549	14,359	229,616

Gas Consumption (kBtu)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	201,403	163,028	129,738	86,447	73,156	1,558	-	-	-	101,154	146,827	211,479	1,114,791
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	2,374	2,304	2,751	2,395	2,450	2,296	2,002	2,151	1,907	2,065	2,096	2,249	27,040
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	203,777	165,333	132,488	88,842	75,606	3,854	2,002	2,151	1,907	103,219	148,922	213,728	1,141,831

E.7.7 2013 Phase 1 Results

Electric Consumption (kWh)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	441	372	2,204	2,407	5,624	8,876	15,958	15,045	9,463	4,858	1,495	497	67,240
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	2,372	2,134	2,348	2,266	2,330	2,248	2,371	2,360	2,248	2,308	2,251	2,359	27,596
Pumps & Aux.	103	89	97	93	94	91	94	94	91	95	94	102	1,135
Ext. Usage	698	490	543	525	326	315	326	583	564	583	675	698	6,323
Misc. Equip.	3,782	3,563	4,253	3,763	4,096	4,074	3,784	4,253	3,759	3,941	3,759	3,782	46,810
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	7,498	7,032	8,330	7,435	8,052	7,989	7,498	8,330	7,435	7,775	7,435	7,498	92,305
Total	14,893	13,680	17,773	16,489	20,521	23,593	30,030	30,665	23,560	19,559	15,709	14,935	241,408

Gas Consumption (kBtu)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	227,514	159,632	127,263	105,218	62,726	-	-	-	1,576	96,563	129,432	210,432	1,120,355
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	2,430	2,368	2,829	2,461	2,488	2,306	1,988	2,120	1,880	2,049	2,102	2,282	27,304
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	229,945	162,000	130,092	107,678	65,214	2,306	1,988	2,120	3,456	98,613	131,534	212,713	1,147,659

APPENDIX F. IDAHO EBR DEMONSTRATION 2013 ENERGY SAVINGS VALIDATION REPORT

To: Kathryn Bae, Rita Siong, John Jennings, NEEA

From: Jay Luboff, Roger Hill, Jan Harris

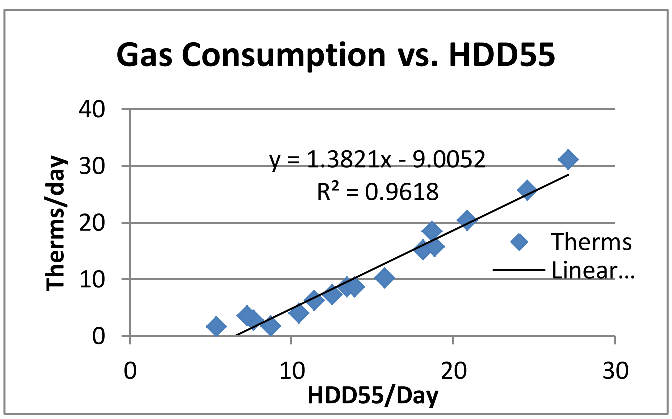
CC: Gunnar Glacis

Date: April 28, 2014

Re: Review of boiler savings for NEEA-EBR Demonstration Building, Boise

In this memorandum, Navigant reviews savings estimate for the NEEA-EBR Demonstration building in Idaho. In Q1 2013 the site retrofitted their existing non-condensing boiler with a condensing type. Gas savings is generated due to the efficiency increase of the new equipment. The October 2013 energy efficiency measure checklist[40] shows that no other measures implemented in the study timeframe and there is no documented reason for a change in building loads. Energy savings were determined by comparing baseline consumption and consumption after the efficiency improvements.

Gas is only used for space heating at the site. Five months of the year show no gas consumption from 2007 through 2011. Winter season consumption data shows wide variation from year to year due to varying severity of weather. To accurately estimate "typical" annual consumption, Navigant correlated daily average consumption with daily average heating degree days over three years. The data show high correlation with the independent temperature variable. In the figure, the Pearson Correlation Coefficient, R, shows high correlation between the independent temperature variable (HDD55) and gas consumption. Given the physical relationship between colder temperatures



[40] Memorandum: Capitol Gateway Plaza Building: EEM Check List and Appendix, Integrated Design Lab University of Idaho, October 3, 2013, page 3.

(increasing HDD55) and gas use for space heating, we conclude a proportional[41] causal relationship for gas use.

Analysis of five years of weather data shows an average of 3275 annual HDD55 for Boise, ID, across an average 240 heating days per year. Normalized annual average consumption prior to the boiler retrofit is 2,367 therms per year.

A new non-condensing boiler operates at about 81-83% efficiency. The existing boiler, when new was likely rated at 80% efficiency. Due to degradation of the equipment over time the study authors from the University of Idaho, Integrated Design Lab estimated an existing efficiency of 75-80% at the time of the retrofit. Navigant agrees with this assessment and settled on an assumed efficiency of 77.5%.

The new condensing boiler was specified with efficiency between 84% and 98% depending on loads and required return water temperatures. Highest efficiencies occur at low partial load and low return water temperatures – both representative of milder conditions when consumption is less. Colder months will have the lower efficiency and higher consumption, thus a weighted average efficiency is about 89%. The following table shows the % savings expected with a range of existing and new boiler efficiencies. Gas savings is determined by using the existing efficiency to determine the actual useful energy required and then applying the new equipment efficiency as summarized in the following equation:

$Therms_{saved} = Therms_{used} \times (1 - eff_{exist}/eff_{new})$

Table F-1: Gas Savings Level Comparison

New Boiler Efficienccy	Existing Boiler Efficiency: 75%	76%	77%	78%	79%
86%	13%	12%	10%	9%	8%
87%	14%	13%	11%	10%	9%
88%	15%	14%	13%	11%	10%
89%	16%	15%	13.5%	12.4%	11%
90%	17%	16%	14%	13%	12%
91%	18%	16%	15%	14%	13%

With the estimated efficiencies above, we see the gas savings from the new boiler is about[42] 13% of the annual average consumption or 305 therms per year.

$Therms_{saved} = 2367 \text{ therms} \times (1 - 0.775/O.89)$
$= 2367 \text{ therms} \times (0.13) = 305 \text{ therms}$

[41] Linear, as shown.
[42] Approximate values due to rounding.