Better Buildings Neighborhood Program

Analysis Leading to Lessons Learned

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Purpose & Objectives - Program

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Problem Statement: Buildings consume 40% of energy in the United States and are responsible for nearly 40% of the country's greenhouse gas emissions. Several well documented barriers have prevented the development of a self-sustaining building energy upgrade market to reduce this energy use.

Impact of Project: Test and demonstrate innovative approaches to overcome key barriers that have prevented the development of a self-sustaining building energy upgrade market. Specific grant goals include:

- Upgrade 100,000 residential and commercial buildings to be more energy efficient
- Save consumers approximately $65 million annually on their energy bills
- Achieve 15% to 30% energy savings from energy efficiency upgrades
- Engage 10,000 to 30,000 contractors in work on energy efficiency upgrades
- Leverage $1 to $3 billion in additional resources.
- Reduce the cost of energy efficiency program delivery by 20% or more
- Develop sustainable energy efficiency upgrade programs

Project Focus: Using funds from the American Recovery and Reinvestment Act (ARRA) and annual appropriations, the Better Buildings Neighborhood Program provided $508 million in one-time grants to states and localities in 2010

Approach - Program

Approach:

- Collect program and building project data from grantees to measure progress, identify successful strategies, and contribute to a national database of residential and commercial building data (BPD) for future study.
- Use empirical data to validate the effectiveness of approaches to program design, driving demand, financing, and workforce development tested by grantees – based on hypothesis that results will persuade future program managers to use more effective strategies to support a self-sustaining building energy upgrade market.

Key Issues:

Use of statistical analysis to validate emerging lessons are dependent upon significant quantity of detailed quantitative and qualitative data.

Distinctive Characteristics:

- A data collection and analysis effort of this size has not been attempted before.
- Large and diverse dataset enables identification of key characteristics of successful programs.

Independent Evaluation:

In addition to this data analysis plan, an independent evaluation is being completed by Research Into Action, NMR Group, Nexant, and Evergreen Economics under contract to LBNL with OMB ARRA evaluation funding.

This effort is charged with completing multiple evaluations of the BBNP as a whole – not of individual grantees.

- January 2013: A preliminary process and market effects evaluation was released.
- Late 2013: A preliminary impact evaluation focusing on the early grantee projects and including a limited market effects analysis is expected.
- Late 2014: A final process evaluation covering the entire program period is expected.
- Late 2014: A final impact evaluation focusing on all grantee projects, including a limited market effects analysis is expected.

The evaluation plans and reports will be peer reviewed.

Approach – Program Grant Recipient Locations

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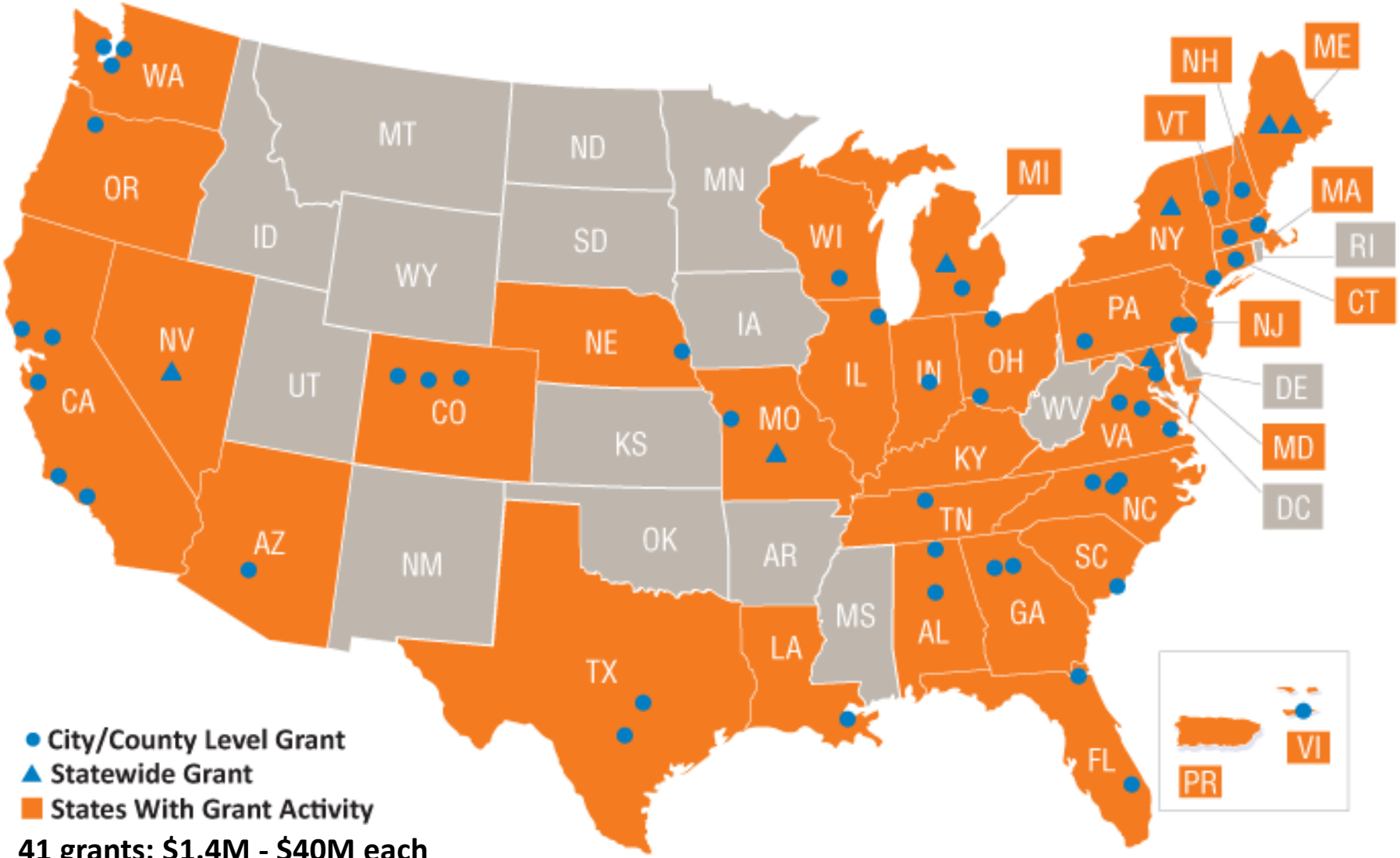

41 grants: $1.4M - $40M each
Timing: mid-2010 through late 2013

www.betterbuildings.energy.gov/neighborhoods

Accomplishments & Progress: Program Data (December 30, 2012)

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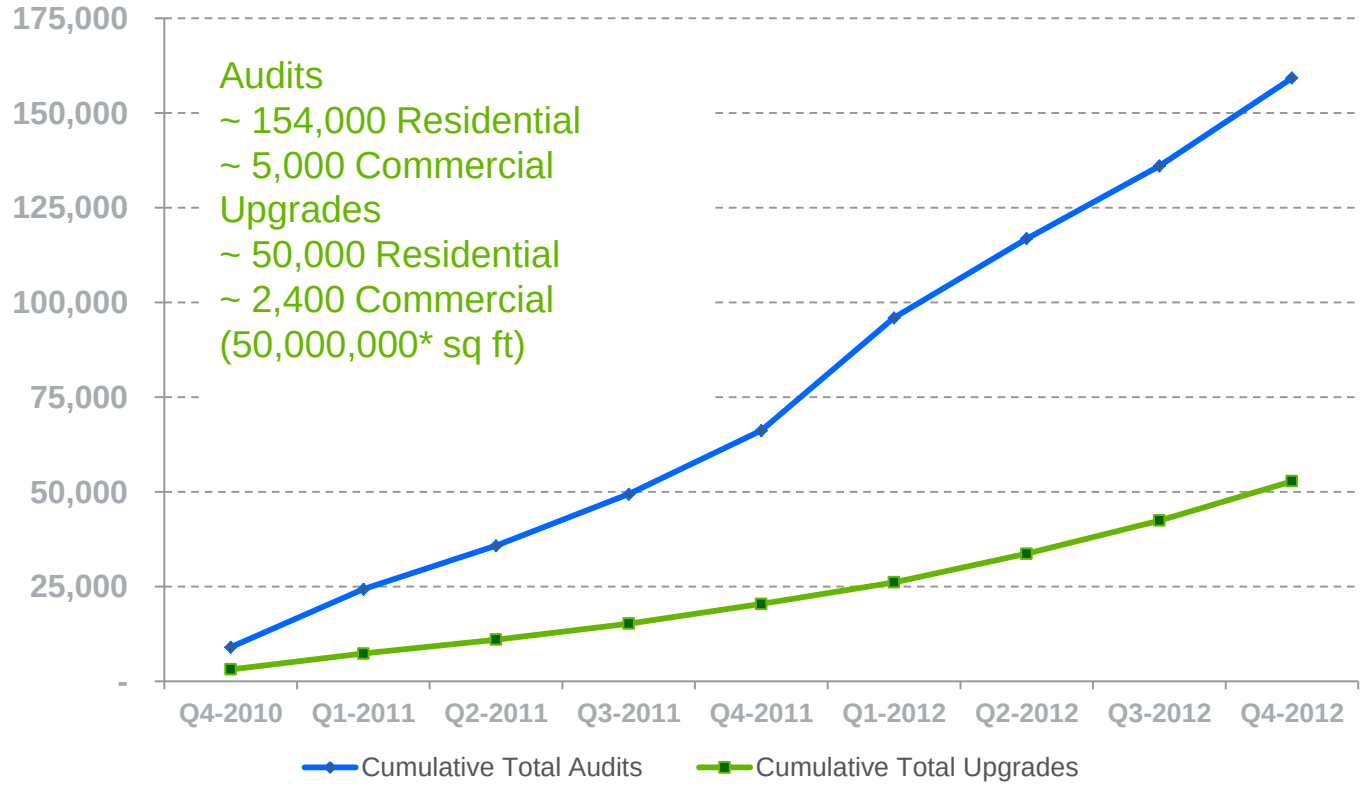
Building Audits & Upgrades Reported Since Program Launch



Total Estimated kWh Savings	Total Estimated Source MMBTU Saved	Total Estimated Site MMBTU Saved
133,405,588	2,969,065	1,754,710

Residential includes single-family homes and multi-family units. Commercial includes commercial, industrial and agricultural buildings.

* Commercial floor area is estimated.

Accomplishments & Progress: Other Highlights

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41 grant recipients launched programs in more than 70 localities to test innovative models

Published 11 DOE and 20+ grantee case studies

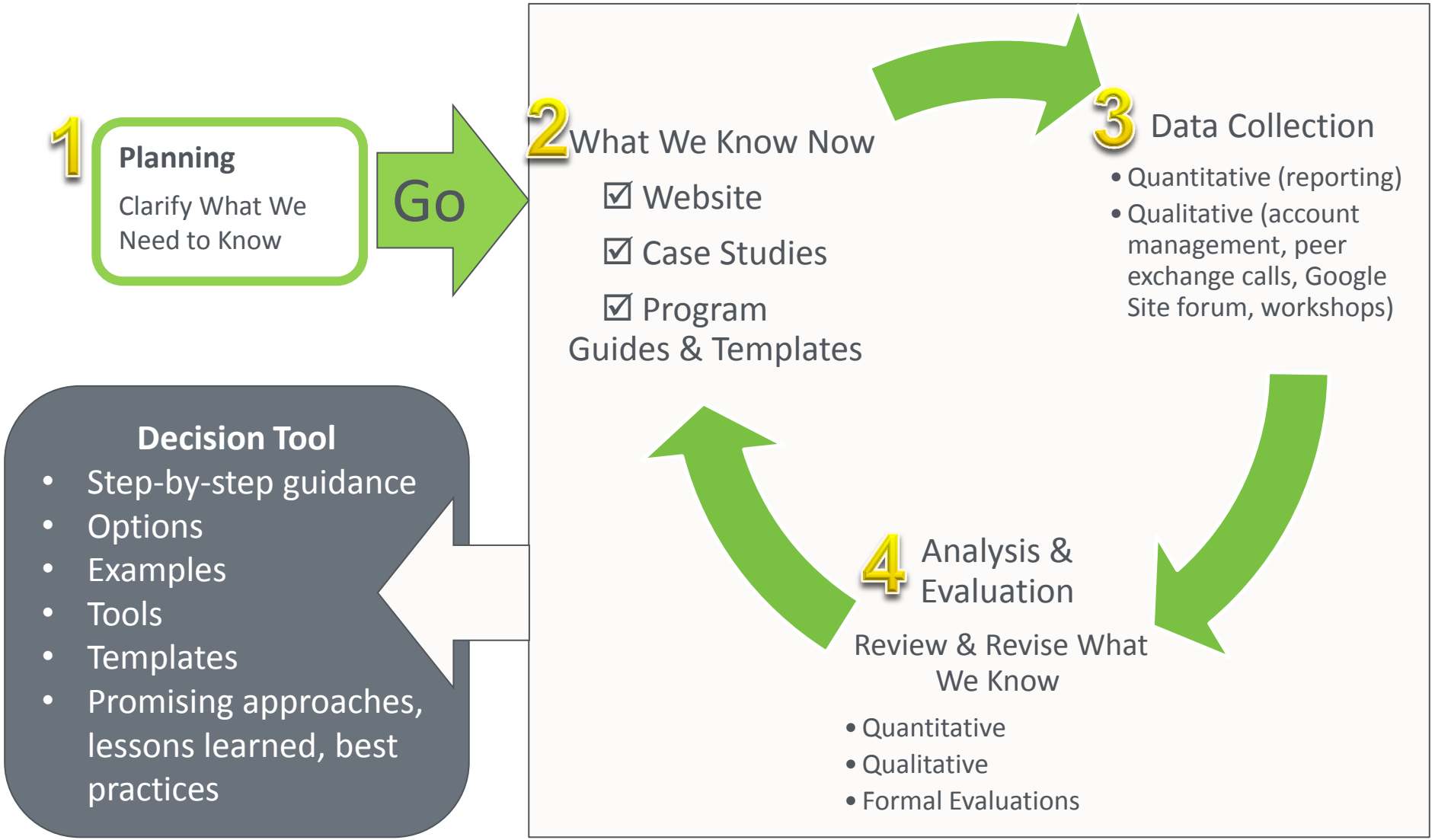
Extensive materials and lessons captured and shared at 6 workshops (7th at ACI)

Shared lessons and challenges in >45 webinars & >60 peer exchange calls

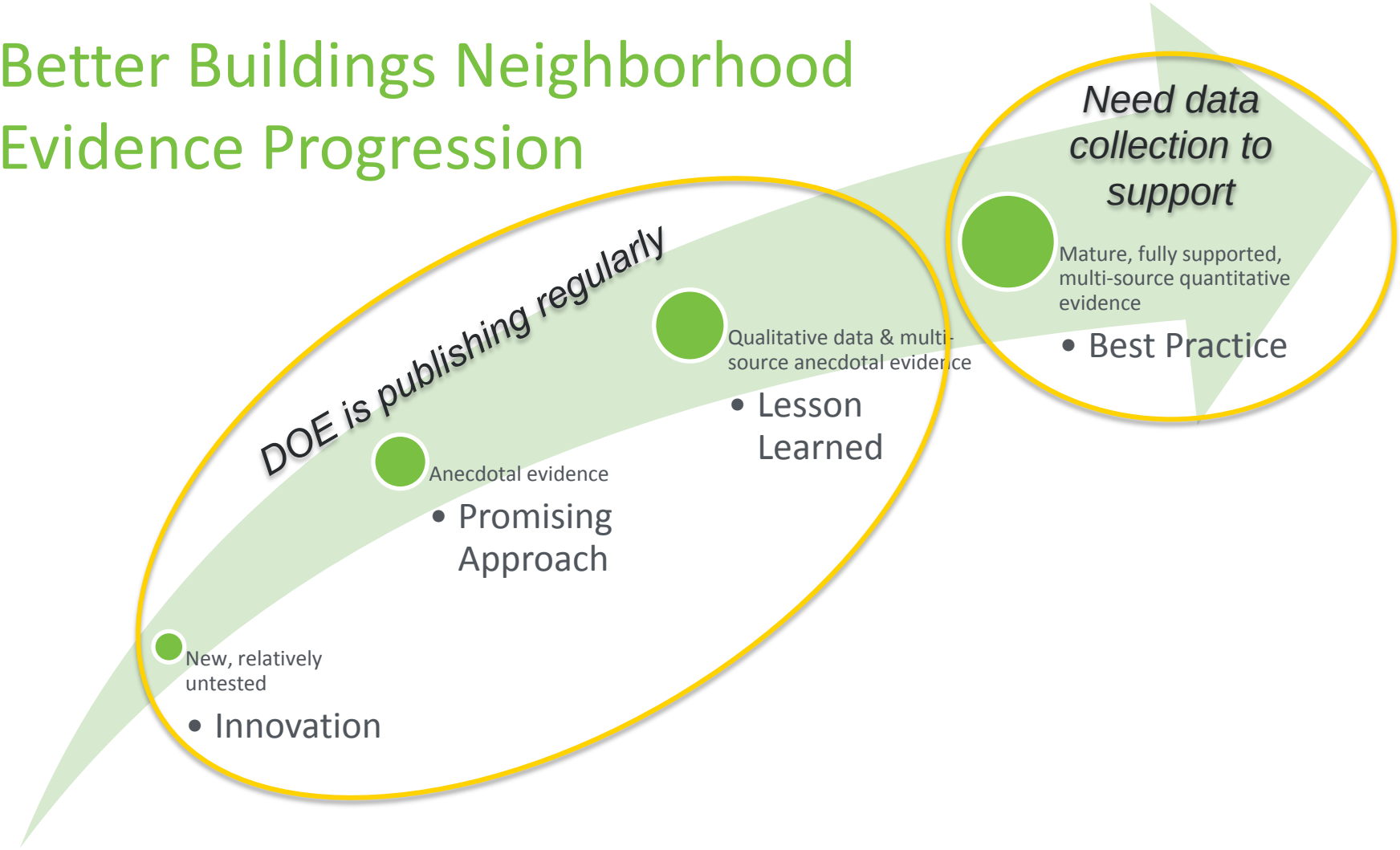
Some programs are seeing 40-80% of leads come from contractors

More than 10 grantees have won national or local awards for their programs

Approach – Program Strategy for Continuous Learning & Sharing



Better Buildings Neighborhood Evidence Progression



Approach - Repository for Lessons Learned

"Decision Tool" Purpose and Scope:

- Share comprehensive lessons for residential energy efficiency programs based on learning from rapid expansion and experimentation in the field
- Provide an easily-accessed, robust location for key resources and knowledge
- Help program administrators plan, implement, manage, and evaluate residential energy efficiency programs as effectively as possible

Beta release at ACI 2013

(April 30-May 3)

Approach - Common Taxonomy for Developing Information

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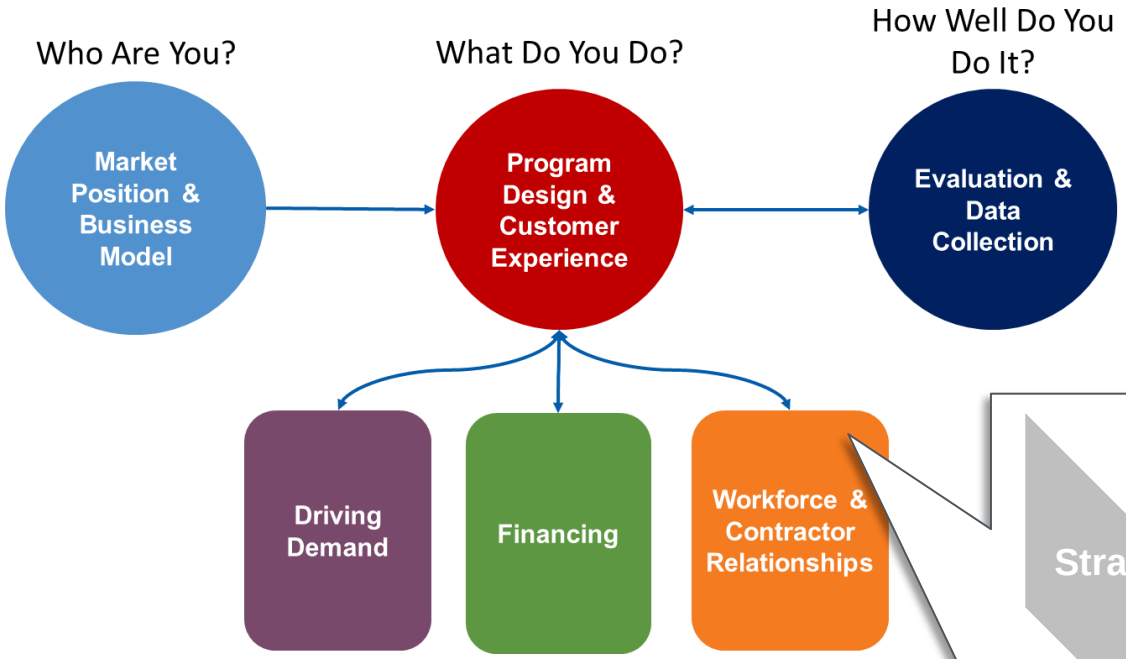

Each component is broken into consistent project management phases

Strategy
- A. Assess the Market
- B. Set Goals & Objectives
- C. Identify Partners
- D. Make Design Decisions

Planning
- E. Develop Implementation Plans
- F. Develop Evaluation Plans

Implement-ation and Evaluation
- G. Develop Resources
- H. Deliver Program
- I. Assess & Improve Processes
- J. Communicate Impacts

Data Analysis Plan: Overview

- Objective
  - Using data available now, start to answer research questions developed at program outset
- Challenges
  - Data quality
    - Incomplete
    - Erroneous
    - Varying interpretations of intended content
    - Gaps in data reporting requirements

Data Collection

Programmatic Data

~50 potential data elements per grantee per quarter

- Obligations
- Outlays (Marketing, Labor & Materials, Other Program Expenses),
- Total Job Hours Worked (SEP)
- # of Individuals Trained and Certified (EECBG)
- Audits Completed (by building sector)
- Total Energy Saved (by energy type)
- Leveraged Funding (fed and non-fed)
- Market Definition (EECBG)
- # of Active Contractors (SEP)
- Marketing and Outreach tactics

mandatory | optional

Retrofit Project Data

~50-60 potential mandatory data elements per project (over 200 total requested, including optional)

- General (ID#, type, zip code)
- Building (energy provider, floor area, year constructed, # of occupants)
- Audit (date, software/type, hours, cost, est. energy savings)
- Retrofit (date, contractor, contractor certification, hours, cost, loan amount, incentives)
- Installed Measures (# of heating, cooling, or energy conservation measures, details)
- Installed Measure Savings (method of prediction, energy savings, energy cost savings)
- Renewable system (type, size, hours, cost)
- Loan Details (date, terms, rate, income, FICO, debt, valuation)

Data Health Report

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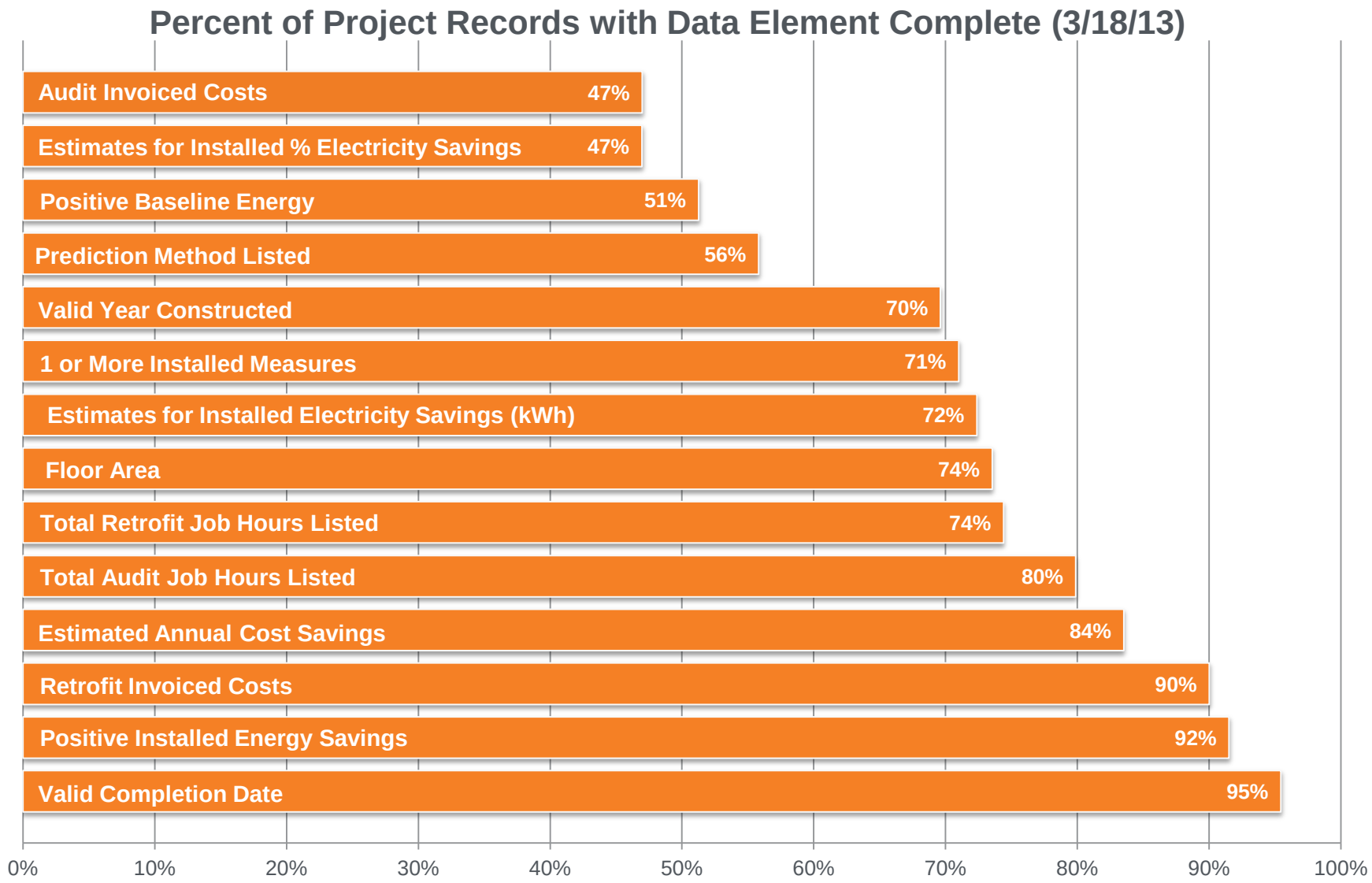


Data Analysis Plan: Overview

1. Review data quality
2. Identify data that should not be included in analysis
3. Identify best method(s) to answer each research question given limitations in current data
4. Conduct analysis
5. Document analysis
6. Develop conclusions for incorporation into Better Buildings Decision Tool

Performance Metrics Used in Original Research Questions

Metric	Definition	Issues
Number of Retrofits	Number of retrofit projects completed by a grantee.	Grantees with greater funding are expected to have greater number of retrofits. Retrofits need to be standardized, for example percent of planned target completed.
Conversion Rate	Ratio of number of completed retrofit projects to number of audits completed.	Need to determine how grantees conducted audits. Possible weighting for different building types.
Energy Savings	Estimated energy savings in BBNIS.	Estimated energy savings need to be validated against utility data, but limited utility billing data available. Need to use percent saved and/or alternate metrics like present value of lifetime savings (PVLS) per project, savings to investment ratio (SIR), or other standardized savings
Cost of Delivery	Program Administration Cost	Program administration costs are reported for the grantee and are not broken out by building sector or program approach. Spending by quarter is divided into three categories: Marketing and Outreach, Labor & Materials and Other Program Expenses. However, costs are not consistently reported in these categories by all grantee. Need to standardize cost of delivery per project.

Marketing Strategies Data Available in BBNIS*

Data: Number of each tactic employed by program, by quarter

- Business organization outreach with attendance
- Contest held
- Contest had participants
- Direct mail
- Direct mail resulted in applications
- Home visits
- People agreed to audits as a result of home visits
- Hotline calls
- Hotline calls resulted in applications
- One-stop-shop visitors
- One-stop-shop visitors requested services
- One-stop-shop visitors actually served
- Online advertising
- Online advertising clicks
- Online advertising resulted in applications
- Meetings at schools, churches or libraries
- Meeting attendees signed up for audits
- Neighborhood meetings
- Social media
- Social media applications
- Telethon direct phone calls
- Direct phone calls were answered
- Direct phone calls resulted in applications
- Traditional advertising on radio
- Traditional advertising in newspapers
- Traditional advertising on TV
- Webinars
- Webinars with participants
- Website set up and visited
- Website application page visited
- Website resulted in applications

* Better Buildings Neighborhood Information System

Financial Incentive Data Available in BBNIS

Data: Whether each grantee offered such incentives

- Residential: Income-qualifying incentives
- Residential: Tiered incentives
- Residential: Grants
- Residential: Rebates
- Residential: Other types of loans
- Residential: Other incentives
- Commercial: Loans
- Commercial: Rebates
- Commercial: Other
- Contractor incentives
- Multifamily incentives

EE Measure Installation Data Available in BBNIS

Data: Whether each measure was installed in each individual building upgraded

- CFLs
- Low-flow showerheads
- HVAC replacement
- Refrigerator replacement
- Dishwasher replacement
- Hot water heater replacement
- Duct sealing
- Duct insulation
- Air sealing
- Insulation
- Window replacement

Analysis Approaches: MLR

- Multiple Linear Regression
  - A method for correlating Y to multiple X's

Dependent variable – the thing we're trying to explain; e.g. a metric of program success

$$Y = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \cdots \beta_n x_n + \varepsilon$$

Independent variables – possible explanatory factors; e.g. efficiency technologies installed

Coefficients – indicator of relative importance of independent variable

Analysis Approaches: Chi-squared Test

- Pearson's chi-squared test
  - A method for testing differences between categories when response is count data (expected frequencies versus observed frequencies)

Category	Non-responders	Responders	Total	Proportion Responders
Method A	45	15	60	0.25
Method B	80	20	100	0.20

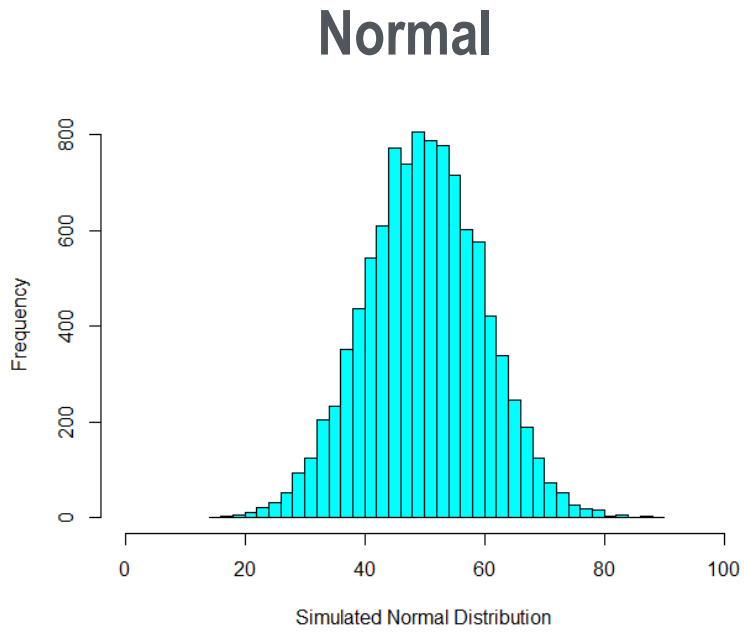
Test used to prove or disprove difference in proportions

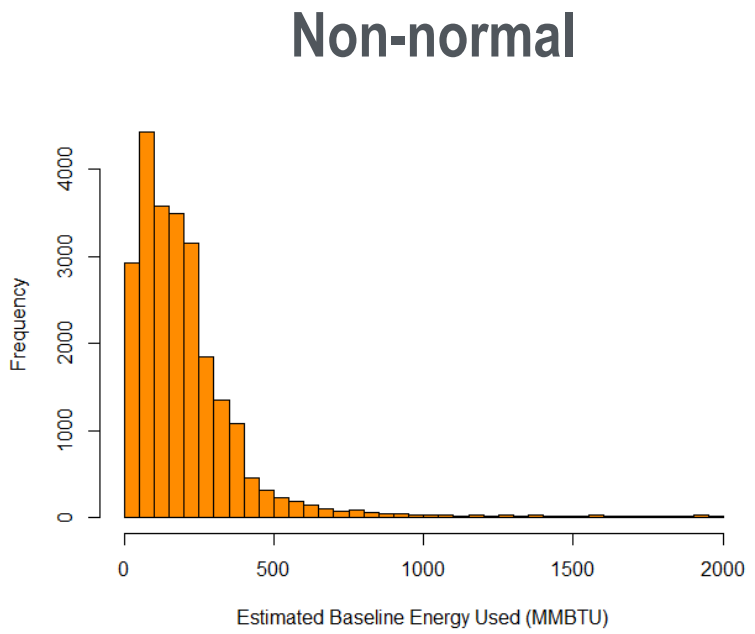
Data needed to perform Chi-squared Test

Note: Chi-squared test applied to above data proved no significant difference between Method A and Method B

Analysis Approaches: Histogram

- Histogram or Distribution Graph
  - A method for showing the variability in a measurement
  - Helpful in detecting outlier observations





Research Questions: Program Design

Original Research Question	Data Quality	Type of Analysis	Issues/Comments
a) Which program delivery models improve performance metrics?	Med	Test correlation using MLR	May only point to delivery models that might be effective; further analysis of specific grantees will be necessary
b) What (funding) partnerships have grantees leveraged?	Unknown	Survey of grantees	DOE will compile a list.

Research Questions: Driving Demand

Original Research Question	Data Quality	Type of Analysis	Issues/Comments
a) Which marketing tactics have been the most successful?	Med	Test correlation using MLR	Need to confirm tactics used by grantees and more detailed analysis at grantee level likely needed
b) Did timing of a marketing campaign impact interest in the program?	Low	Chi-squared test	Need details on marketing campaign timing to determine if response rates have been carefully tracked
c) Did using a trusted messenger approach correlate with higher program interest?	Med	Test correlation using MLR	Need to confirm marketing used by grantees
d) Did limited time offers, competitions, and other deadlines motivate customers to complete upgrades in shorter time periods or invest in a certain level of energy savings?	Low	If offer details known, then average time to completion could be compared to periods with no offers	Need exact details on time of offers, competitions, etc.
e) Has the use of social media affected program metrics?	Med	Test correlation using MLR	Need to confirm use of social media by grantees

Research Questions: Financing & Incentives

Original Research Question	Data Quality	Type of Analysis	Issues/Comments
a) Is there a correlation between financial incentives for the *customer* and program metrics?	Med	Test correlation using MLR	Need to categorize financial incentives
b) Is there a correlation between financial incentives for the *contractor* and program metrics?	Med	Test correlation using MLR	Need to confirm which grantees used contractor incentives
c) Which financial incentives (see slide 11) help programs achieve better program metrics?	Med	Test correlation using MLR	Examine in combination with energy efficiency upgrades

Research Questions: Workforce Development

Original Research Question	Data Quality	Type of Analysis	Issues/Comments
a) Does contractor sales training correlate with program metrics?	Low	Test correlation using MLR	Need to know which grantees did sales training
b) What impact does contractor technical training have on program metrics?	Med	Test correlation using MLR	Need to know which grantees did technical training
c) What impact does contractor certification have on program metrics?	High	Include in MLR or possible separate statistical analysis	BPI certification identified on 36% of projects across most grantees
d) Did programs that actively listened to their contractors have better results?	Low	Test correlation using MLR	Need to determine which grantees actively listened to contractors

Research Questions: Upgrades & Energy Savings

Original Research Question	Data Quality	Type of Analysis	Issues/Comments
a) Which energy savings estimation method have been the most consistent and accurate in predicting actual energy savings?	Med	Comparative of prediction to energy savings from utility data	Evaluate for possible subset of projects where utility data are available
b) What improvements or combination of improvements are most common?	Med	Query and develop distribution data	Multiple descriptions used for similar types of upgrades and consolidation needed
c) What is the distribution of energy cost savings for homes with the same improvements?	Med	Use histograms	Reliant on estimated savings
d) What improvements or combination of improvements contribute to better program metrics?	Med	Test correlation using MLR	Reliant on estimated savings

Project Plan & Schedule

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FY11

- Initial identification of data analysis questions
- Finalized data collection forms & OMB information collection request authorization

FY12

- First Internal Data Analysis Summit
- Development of quarterly progress and data health reports
- Preliminary analysis identifying elements leading to successful programs

FY13

- Second Internal Data Analysis Summit
- Continuous improvement of data health reports
- Data quality calls with grantees
- Data analysis plan
- Peer review
- Complete interim data analysis
- Final effort to obtain best possible data

FY14

- Grant closeout (10/1 – 12/31)
- Complete final data analysis
- Develop conclusions for incorporation into Better Buildings Decision Tool
- Clean, organize, publish releasable data

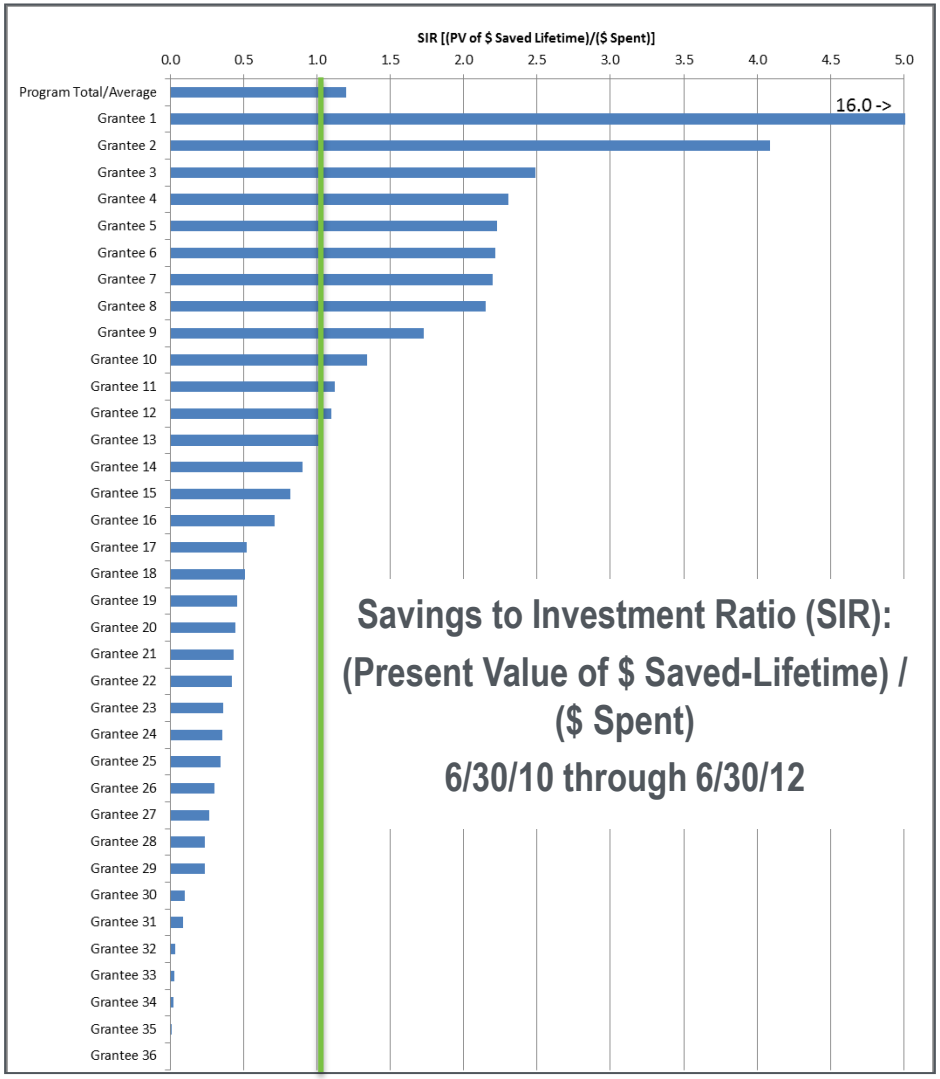
Accomplishments and Progress

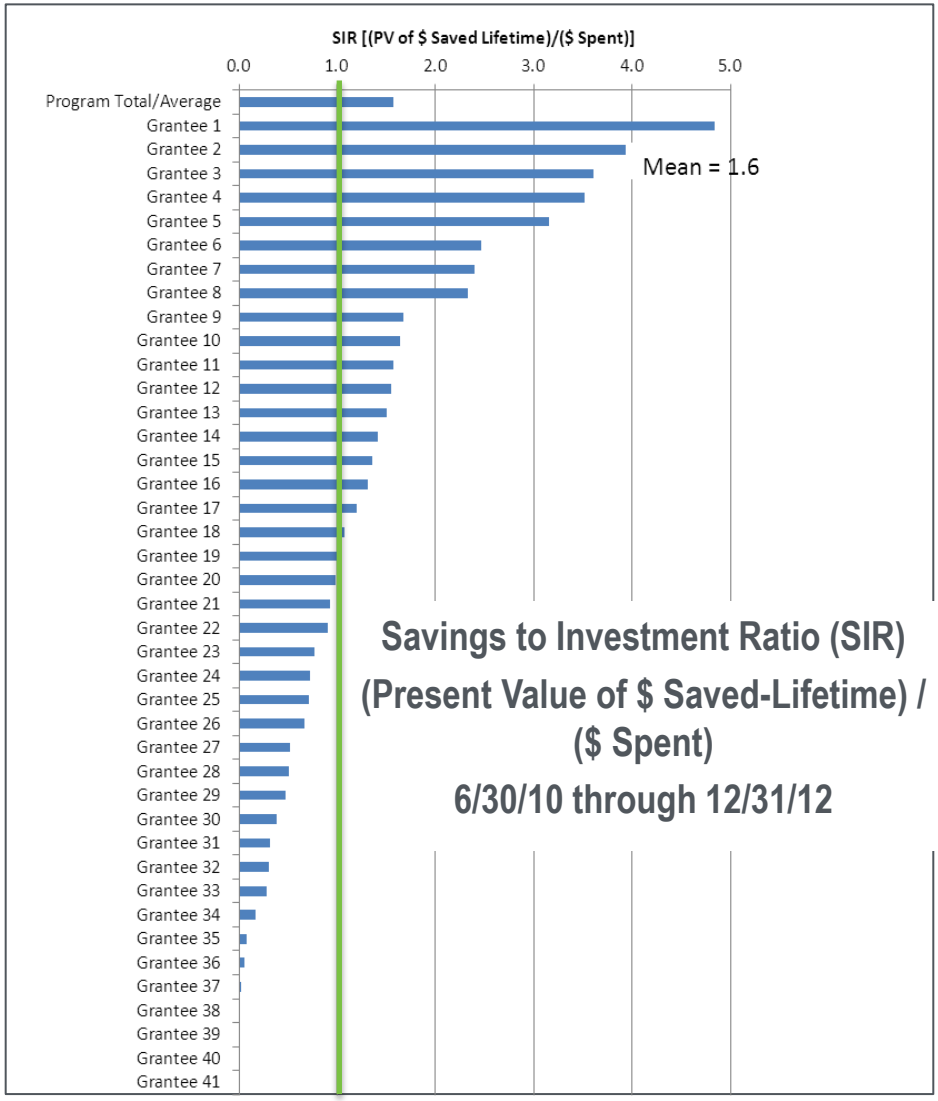
Accomplishments: Preliminary data analysis conducted in FY12 informed development of FY13 Data Analysis Plan. Plan has focused efforts to improve data health and collect additional information and clarification from grantees during remaining grant period.

Progress on Goals: Data have been collected through 8 quarters (CY Q4 2010 – CY Q4 2012). Significant improvements in data quality have been realized through continuous monitoring of data health and feedback to grantees.

Accomplishments and Progress

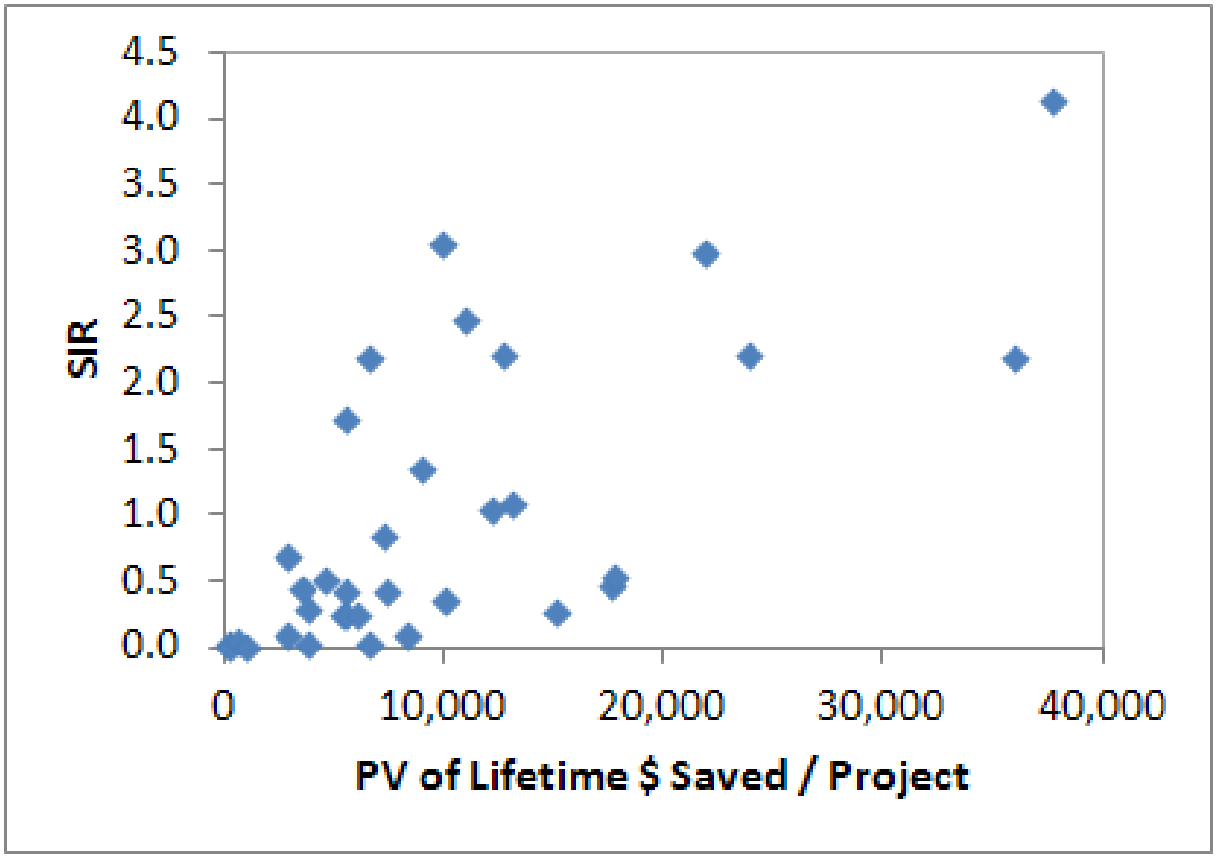
Preliminary data analysis: widely varying performance; rapid improvement





Preliminary data analysis (2011 data)

- Higher performance linked correlates with larger projects



Preliminary data analysis (2011 data)

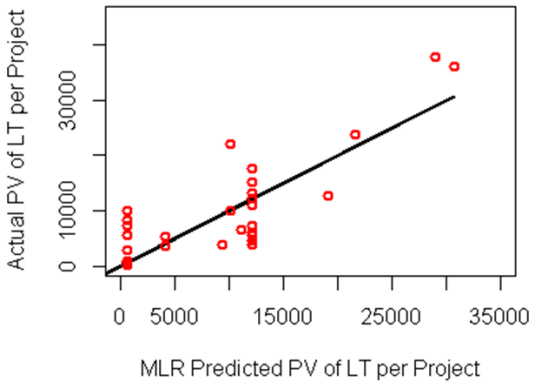
- MLR provides indication of influential program characteristics

MLR for PV of Lifetime $ Saved / Project

Significant Variables and Estimated Coefficients

Variable	Estimate
Direct_Phone	-11,523
Inc_qual_incentives	16,875
Other_incentives	-8,117
Contractor_incentives	18,541
Improve_Type_2	-9,465

Adjusted R-squared: 0.73



- Income-qualifying incentives and contractor incentives correlate with higher PV LT savings /project
- Direct phone and other incentives correlate with lower PV LT savings/project
- Type 2 improvements correlate with lower PV LT savings/project

Project Budget

Project Budget: $450k

Variances: N/A

Cost to Date: $250k

Additional Funding: TBD

Budget History					
FY2011		FY2012		FY2013	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$100k	$0	$100k	$0	$250k	$0

Project Integration, Collaboration & Market Impact

Partners, Subcontractors, and Collaborators: Better Building Neighborhood Program grantees (41), LBNL/Research Into Action, Navigant Consulting, Booz Allen Hamilton

Technology Transfer, Deployment, Market Impact: Impactful conclusions drawn from BBNP data analysis will be incorporated into content in the BBNP Decision Tool.

Communications: Preliminary results were shared with BBNP grantees in a webinar last year. Will present additional results via webinar and published reports in BBNP Decision Tool.

Next Steps and Future Plans

Next Steps and Future Plans:

- Complete data collection (2013)
- Complete data analysis (2013-14)
- Disseminate findings and conclusions (2014+)
- Clean, organize, and publish data (for future research) (2014+)