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Final Report

Evaluation of the Better Buildings Neighborhood Program

Final Synthesis Report, Volume 1

American Recovery and Reinvestment Act of 2009

June 2015

Prepared For:

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy

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Funded By:

Prepared By:

Research Into Action, Inc.
Evergreen Economics
Nexant, Inc.
NMR Group, Inc.

Prepared For:

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Our team of evaluators would like to thank Jeff and Ed for their support and guidance on this project. We would also like to thank the staff of DOE's Better Buildings Neighborhood Program (BBNP). Danielle Sass Byrnett led the staff, with key program support provided by Steve Dunn and Dale Hoffmeyer, as well as by account managers and numerous contractors. We thank Danielle and her staff and contractors for their openness and willingness to talk with us at length and answer numerous email questions.

We interviewed all 41 BBNP grant recipients, as well as 6 subgrantees, and requested project documentation and other information from many of these contacts. The grantees and subgrantees had many people wanting them to explain their activities and their accomplishments during the past five years; although we were one of the many, they were overwhelmingly friendly and cooperative, usually talking with us for several hours to explain what they were doing and what their experiences had been. We anticipate future discussions will continue to illuminate the varied activities and accomplishments of BBNP, and we look forward to those discussions.

We are grateful to the technical advisors that Ed Vine assembled for this research. They guided our detailed evaluation plans and reviewed our draft reports. Their critiques, insights, and interpretations greatly improved the work. Our peer review team comprised Marian Brown, Phil Degens, Lauren Gage, and Ken Keating. Lisa Petraglia and John A. ("Skip") Laitner reviewed the economic impact analysis. Our DOE review team comprised Jeff Dowd and Dale Hoffmeyer. Preliminary research also was reviewed by DOE staff Danielle Sass Byrnett, Claudia Tighe, and Bill Miller.

Finally, DOE staff, their contractors, and LBNL and National Renewable Energy Laboratory (NREL) staff related to BBNP were all extremely responsive to our team's requests for data and were very helpful during the planning and implementation of the evaluation activities. They understood program realities and continually worked to improve the program and its offerings. In addition, they were continually balancing the need for accuracy in reporting without trying to overburden the grantees that are oftentimes short-staffed and over-worked.

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GLOSSARY

Within the body of this report, there are several technical terms that require explanation, as their meanings are specific to energy efficiency activity.

ARRA	American Recovery and Reinvestment Act; provided funding for BBNP.
Audit	A process that obtains information on building (including home) features that affect energy use, identifies energy efficiency measures that appear to be appropriate for the building, and estimates potential annual energy savings; can be conducted on-line or by someone walking through the building. Audits culminate in an audit report describing the findings and opportunities. Also called "energy audit."
Base case scenario	Describes what would have happened in the absence of the program.
BBNP program	Refers to both the federal Better Buildings Neighborhood grant program administered by DOE and to the local programs grant recipients administered in their target markets. To avoid confusion, the text refers to DOE for the federal program and to the grantees for the local programs.
Billing regression	Billing analysis that involves the use of regression models with historical utility billing data to calculate annual energy savings.
Business income	Payments received by small-business owners or self-employed workers; income received by private business owners including doctors, accountants, lawyers, and others. Also called "proprietor income" or "small business income." See "personal income."
Community-based organizations (CBOs)	CBOs are organizations that focus on issues affecting their local communities and offer services benefitting those communities.
Direct install	Installation of energy efficiency measures by program representatives, typically during a building audit.
Funding Opportunity Announcement (FOA)	Issued by DOE to inform the public of the opportunity to apply for BBNP grant funding and outline the application requirements.
Free-rider	A participant who on some level may have used the program regardless of the BBNP influence. Determining free-ridership values is a large component in calculating net-to-gross ratio.
Full-time equivalent (FTE)	Used to estimate job impacts, it converts an estimated number of full-time and part-time jobs into the equivalent number of jobs comprised of people solely working full time (2,080 hours a year).
Grant	BBNP funding provided by DOE. Grant funding requires recipients to make best efforts and adhere to fraud-prevention practices but, unlike contracts, does not require the recipient to deliver a specified outcome.
Grantee	A recipient of an ARRA-funded, DOE-administered BBNP grant.

Gross impacts	Overall impacts traced back to the program. As they do not constitute an estimate of the new or additive impacts from BBNP funding over and above what would have accrued had the funds been used by other federal programs, gross impacts represent an upper bound estimate and net impacts, which account for this next best use of program funds by way of a counterfactual or base case scenario, represent a lower bound estimate.
Gross savings	Total amount of a parameter of interest (kWh, kW, MMBtu, CO_2e, water) saved by a project/program.
Input-output model	A static model that measures the flow of inputs and outputs in an economy at a point in time.
Interest rate buy down	Use of program funds to lower the interest rate on loans to program participants; program participants pay the lender the program-established rate and the program administrator pays the lender the incremental amount necessary to meet the lender's requirements for supporting the program.
Job Impacts	Includes both full- and part-time employment measured in full-time equivalent (FTE) units.
Leveraging	A technique to multiply gains and losses; for BBNP, leveraging refers to grantees obtaining non-DOE funds to complement their BBNP funding and increase or extend program activities.
Loan loss reserve	Money set aside to reimburse a lender for losses made on loans.
Market effects	A change in the structure of a market or the behavior of participants in a market that is reflective of an increase in the adoption of energy efficient products, services, or practices and is causally related to market intervention(s) (Eto, Prahl, and Schlegel, 1996).
Measure spending	Represents spending on efficiency upgrades; allocated to equipment and labor, mapped to North American Industry Classification System (NAICS) codes and then to sectors in the economic impact model.
MMBtu	Millions (MM = one thousand thousands) British thermal units of energy; used in this context to quantify energy savings.
Net economic impacts	Counts only economic stimuli that are new or additive to the economy.
Net savings	Total amount of a parameter of interest (kWh, kW, MMBtu, CO_2e, water) directly saved by a program; calculated by multiplying gross verified savings by the NTG ratio, it takes into account the realization rate and results of the free-rider and spillover analysis to provide a value of energy savings directly related to the program influence.
Net-to-gross (NTG) ratio	A ratio value determined through the process of surveying decision-makers who implemented projects in order to account for free-ridership and spillover effects. The NTG ratio is multiplied by gross verified savings to produce net savings.
Output	The value of production for a specified period of time. Output is the broadest measure of economic activity, and includes intermediate goods and services and the components of value added (personal income, other income, and indirect business taxes); as such, output and personal income should not be added together.

Personal income	The sum of wages and business income.
Program	A group of projects with similar technology characteristics installed in similar applications.
Program administrator	An entity (i.e., BBNP grant recipient, utility, or energy efficiency agency) that administers energy efficiency programs by offering its target market information, supporting services, incentives, and/or financing for energy efficiency, renewable energy, and/or related outcomes, and conducts the activities necessary to deliver these offerings.
Program outlays	Administrative costs incurred by BBNP grantees, in addition to purchased labor and materials, to carry out energy efficiency programs.
Project	A single activity (lighting retrofit, refrigeration replacement, PV system install, etc.) at a single location.
Realization rate	A measure of the amount of verified saving for a project/program compared to the reported savings, defined as the ratio of Gross Verified Savings to Gross Reported Savings: $$Realization\ Rate\ (\%) = \frac{Gross\ Verified\ Savings}{Gross\ Reported\ Savings}$$
Reported savings	Savings calculated and reported by BBNP – in some cases, the evaluation team recalculated these values to accurately reflect true findings.
Retrofit	See "upgrade."
Site energy savings	Savings (gross or net) directly calculated at a facility.
Source energy savings	Savings (gross or net) calculated as the sum of site energy savings and savings from energy not having to be extracted, converted, and transmitted to the facility due to the energy efficiency or renewable energy project. Conversion factors between site and source are: $$1\ kWh_{site} = 3.318\ kWh_{source}$$ $$1\ MMBtu_{site} = 1.047\ MMBtu_{source}$$
Spillover savings	Energy savings from upgrades motivated by the program yet not receiving program incentives.
Subgrantee	An entity that received BBNP funding from a grantee to administer local BBNP programs.
Total savings	Savings of electricity (kWh) and natural gas (MMBtu) combined into a single energy value using the following conversion: $$1\ kWh = 3412\ Btu\ (or\ 0.003412\ MMBtu)$$
Upgrade	Change to a building (including home) that reduces its annual energy consumption, typically by increasing its energy efficiency; the change can be to the building shell (insulation, air sealing) and/or to equipment or systems (HVAC, refrigeration, hot water, appliances, thermal solar, photovoltaic, etc.). Also called "retrofit."
Verified savings	Savings determined by the evaluation team through the collection of data by on-site inspections, phone surveys, and engineering analysis.

Wages	Represents workers' wages and salaries, as well as other benefits such as health and life insurance, retirement payments, and noncash compensation.

PREFACE

This evaluation report is one of a suite of six reports providing a final evaluation of the U.S. Department of Energy's (DOE) Better Buildings Neighborhood Program (BBNP). The evaluation was conducted under contract to Lawrence Berkeley National Laboratory (LBNL) as a procurement under LBNL Contract No. DE-AC02-05CH11231 with DOE.

The suite of evaluation reports comprises:

- *Evaluation of the Better Buildings Neighborhood Program (Final Synthesis Report,* Volume 1)
- *Savings and Economic Impacts of the Better Buildings Neighborhood Program* (Final Evaluation Volume 2)
- *Drivers of Success in the Better Buildings Neighborhood Program – Statistical Process Evaluation* (Final Evaluation Volume 3)
- *Process Evaluation of the Better Buildings Neighborhood Program* (Final Evaluation Volume 4)
- *Market Effects of the Better Buildings Neighborhood Program* (Final Evaluation Volume 5)
- *Spotlight on Key Program Strategies from the Better Buildings Neighborhood Program* (Final Evaluation Volume 6)

The evaluation commenced in late 2011 and concluded in mid-2015. The evaluation issued two preliminary reports:

- *Preliminary Process and Market Evaluation: Better Buildings Neighborhood Program* (December 28, 2012; appendices in a separate volume) (Research Into Action and NMR Group, 2012a, 2012b)
- *Preliminary Energy Savings Impact Evaluation: Better Buildings Neighborhood Program* (November 4, 2013) (Research Into Action, Evergreen Economics, Nexant, and NMR Group, 2013)

Four firms conducted the multi-faceted evaluation:

- Research Into Action, Inc. led the teams and process evaluation research.
- Evergreen Economics conducted the analysis of economic impacts, the billing regression analysis of program savings, and worked with Nexant to estimate program savings.
- Nexant, Inc. led the impact evaluation, conducted project measurement and verification (M&V) activities, and estimated program savings and carbon emission reductions.
- NMR Group, Inc. led the market effects assessment.

LBNL managed the evaluation; DOE supported it.

This document is *Evaluation of the Better Buildings Neighborhood Program, Final Synthesis Report*. Research Into Action was the principal author, supported by each of the other firms.

The Research Into Action team was led by Jane S. Peters and Marjorie McRae, supported by Joe Van Clock, Jordan Folks, Jun Suzuki, Meghan Bean, Ryan Bliss, Mersiha McClaren, Alexandra Dunn, Hale Forster, Doré Mangan,

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The Evergreen Economics team was led by Stephen Grover, supported by Matt Koson, Sarah Monohon, and John Cornwell.

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) administered the Better Buildings Neighborhood Program (BBNP) to support programs promoting whole building energy upgrades. BBNP distributed a total of $508 million to support efforts in hundreds of communities served by 41 grantees. DOE awarded funding of $1.4 million to $40 million per grantee through the competitive portions of the Energy Efficiency and Conservation Block Grant (EECBG) Program ($482 million from American Recovery and Reinvestment Act of 2009 [ARRA, the Recovery Act] funds) and the State Energy Program (SEP; $26 million). DOE awarded grants between May and October 2010, intended to provide funding over a three-year period ending September 30, 2013. In 2013, DOE offered an extension to programs that included a BBNP-funded financing mechanism to operate through September 30, 2014 using BBNP funds exclusively for financing.

While the federal government has issued periodic funding opportunities for energy efficiency, none has been on the scale of BBNP.

State and local governments received the grants and worked with nonprofits, building energy efficiency experts, contractor trade associations, financial institutions, utilities, and other organizations to develop community-based programs, incentives, and financing options for comprehensive energy-saving upgrades. Each of the 41 grant-funded organizations, assisted by 24 subgrantees, targeted a unique combination of residential, multifamily, commercial, industrial, and agriculture sector buildings, depending on their objectives.

This report provides findings from a comprehensive impact, process, and market effects evaluation of the original grantee program period, spanning fourth quarter (Q4) 2010 through third quarter (Q3) 2013. A team of four energy efficiency evaluation consulting firms conducted the evaluation – Research Into Action, Inc. (lead contractor), Evergreen Economics, Nexant, Inc., and NMR Group, Inc. – which was managed by Lawrence Berkeley National Laboratory (LBNL) and supported by DOE. This, Volume 1 of a six-volume suite, is a synthesis of five evaluations presented in depth in Volumes 2 through 6.

EVALUATION OBJECTIVES AND METHODS

The **impact evaluation** involved the development of independent, quantitative estimates of the impacts of BBNP. We conducted the impact evaluation of the three-year BBNP in two phases: a preliminary evaluation that examined program activities between Q4 2010 through Q3 2012 (Research Into Action, Evergreen Economics, Nexant, and NMR Group, 2013) and a final evaluation that examined program activities between Q3 2012 and Q3 2013. We combined the findings from both evaluations to develop a verified energy savings estimate for BBNP.

The impact evaluation comprised two broad activities to determine gross verified savings: 1) Measurement and Verification (M&V) of a sample of grantees and projects using an ex-post analysis (actual savings based on post-retrofit conditions); and 2) billing regression analysis on projects from grantees with sufficient utility bill data. The impact evaluation also constructed an economic impact model of the U.S. economy and estimated the economic impacts of BBNP, including jobs, economic output, income (personal and business), and tax revenue that result from the program spending relative to a base case scenario where BBNP did not exist.

The impact evaluation is presented in *Savings and Economic Impacts of the Better Buildings Neighborhood Program* (Final Evaluation Volume 2).

The **market effects evaluation** sought to identify early indications that BBNP had an effect on the local building improvement markets in which the program operated, and to understand how and why energy upgrade contractors and distributors changed their business practices in a way that promoted greater adoption of energy efficiency. It explored the market for energy efficient products, services, and practices to assess changes in the market or in market actors' behavior resulting from BBNP activities. The study drew on multiple data sources, including phone surveys with energy upgrade contractors and equipment distributors, in-depth interviews with contractors, a secondary data analysis of changes in contractor association memberships and certifications issued by credentialing organizations, surveys with participant and nonparticipant homeowners, and in-depth interviews with financial institutions. By design, the market assessment research investigated indications of local effects, not indications of national effects. Because each grantee market is different, we did not directly extrapolate the market assessment findings from the sample to the full population of grantees. Even so, we reached general conclusions on the presence or absence of early indications of market effects generated by BBNP grantee funding.

The market effects evaluation is presented in *Market Effects of the Better Buildings Neighborhood Program* (Final Evaluation Volume 5).

The **process evaluation** drew on interview and survey information collected from the grantees, DOE program staff and contractors, program participants and nonparticipants, contractors serving participants, and financial institutions working with the grantees. In addition, an extensive review of pertinent literature informs the evaluation. The process evaluation had two broad objectives:

- To assess the degree to which BBNP met its goals and objectives related to program processes and grantee program activity.
- To identify the most effective approaches – including program design and implementation activities – to completing building energy upgrades that support the development of a robust retrofit industry in the U.S.

To support the statistical investigation of effective approaches to delivering residential upgrade programs, we identified 12 diverse quantitative performance indicators, such as average MMBtu savings per project, program cost per upgrade, and progress toward upgrade goal. We then clustered grantees into groups based on their performance on the 12 metrics using grantee-reported residential activity data (Q4 2010 to Q3 2013). The analyses yielded three groups of grantees whose average performance on the 12 metrics were consistent with an interpretation of a most successful group, an average group, and a least successful group.

We emphasize here that the companion volume *Drivers of Success in the Better Buildings Neighborhood Program – Statistical Process Evaluation* (Final Evaluation Volume 3) analysis used the grantee success clustering only to identify programmatic elements associated with stronger performance relative to other grantees, a research objective important to the DOE BBNP team. As we note elsewhere, grantee success during the three-year evaluation period was associated with the length of time programs took to reach optimal functioning; the most successful grantees reached the optimum point in their programs six months sooner than less successful grantees. However, we did not find that grantee success was driven by prior whole home program experience. Nonetheless, were the grantee programs to continue for ten years, we would expect program achievements to be higher in later years than in the initial years as grantees gained experience in their markets and adjusted their programs accordingly.

The process evaluation also included spotlight studies on five program strategies implemented by BBNP grantees. The spotlight studies drew from in-depth interviews with selected grantees implementing the strategies, grantees' Final Technical Reports, third-party evaluations of grantee programs, and similar documentation. These spotlight studies provide a depth of information on specific topics exceeding that provided by the interview and survey research that underpins the broader process evaluation findings given in Volume 4.

The process evaluation is presented in three volumes: *Drivers of Success in the Better Buildings Neighborhood Program – Statistical Process Evaluation* (Final Evaluation Volume 3), *Process Evaluation of the Better Buildings Neighborhood Program* (Final Evaluation Volume 4), and *Spotlight on Key Program Strategies from the Better Buildings Neighborhood Program* (Final Evaluation Volume 6) for a detailed presentation of findings.

BBNP GOALS AND OBJECTIVES

DOE designed BBNP to meet the three principal ARRA goals (Table ES-1), as well as seven objectives developed by DOE staff to guide the BBNP initiative (Table ES-2). Below, we identify which of the three types of evaluation (impact, process, or market effects) provide findings relevant to our assessment of goal and objective attainment.

Table ES-1: ARRA Goals

GOALS	EVALUATION TYPE		
	Impact	Process	Market Effects
Create new jobs and save existing ones	✓	✓	✓
Spur economic activity and invest in long-term growth	✓	✓	✓
Provide accountability and transparency in spending BBNP funds	✓	✓	

Table ES-2: BBNP Objectives

OBJECTIVES	EVALUATION TYPE		
	Impact	Process	Market Effects
Develop sustainable energy efficiency upgrade programs		✓	✓
Upgrade more than 100,000 residential and commercial buildings to be more energy efficient	✓		
Save consumers $65 million annually on their energy bills	✓		
Achieve 15% to 30% estimated energy savings from residential energy efficiency upgrades	✓		
Reduce the cost of energy efficiency program delivery by 20% or more		✓	
Create or retain 10,000 to 30,000 jobs	✓		
Leverage $1 to $3 billion in additional resources	✓		

GOAL AND OBJECTIVE ATTAINMENT

By the end of the three-year evaluation period (Q4 2010 to Q3 2013), BBNP had met the three ARRA goals, as shown in Table ES-3, which presents our findings, including net jobs, net economic activity, and net benefit-cost ratio. For the economic metrics, the term "net" signifies BBNP's contribution to these outcomes above and beyond the outcomes that would have occurred had the BBNP funding been spent according to historical non-defense federal spending patterns.

By the end of the three-year evaluation period (Q3 2013), BBNP met four of the seven BBNP-specific objectives (Table ES-4). Unverified program-reported accomplishments for Q4 2013 through Q3 2014 suggest the program likely was successful in meeting six of the seven objectives by the end of the four-year program period. These findings indicate that BBNP met its objectives to spur energy efficiency upgrade activity, achieve energy savings, and fund the development of programs that expect to continue providing services at the end of the grant period.

Table ES-3: Attainment of ARRA Goals, through Q3 2013

GOALS	METRICS	RESULTS	ATTAINED?
Create new jobs and save existing ones	Number of jobs created and retained	The evaluation estimated 10,191 net jobs resulted from BBNP during the 3-year evaluation period.	Yes
Spur economic activity and invest in long-term growth	Dollars of economic activity; benefit-cost ratio	BBNP spending of $445.2 million in 3 years generated more than: • $1.3 billion in net economic activity (personal income, small business income, other proprietary income, intermediate purchases) • $129.4 million in net federal, state, and local tax revenues Estimated net benefit-cost ratio: 3.0.	Yes
Provide accountability and transparency in spending BBNP funds	Evidence of accountability and transparency	Grantees receiving ARRA funding submitted ARRA expenditure reports. Grant expenditure information was available to the public on *Recovery.gov*. BBNP DOE staff developed and maintained a program tracking database for periodic grantee reporting. Staff worked with grantees to increase the quantity and quality of reported data. Grantees had access to summary data. Evaluator-verified results will be publicly available.	Yes

Table ES-4: Attainment of BBNP Objectives

OBJECTIVES	METRICS	RESULTS	ATTAINED?	
			3-Year Verified	4-Year Unverified*
Develop sustainable energy efficiency upgrade programs	Percent of programs planning to continue after funding Evidence of continuing effects on the retrofit industry	84% of grantees reported that their programs or elements thereof would continue after the 3-year evaluation period. The evaluation found evidence of early indications of market effects, including increased: • Activity in the energy efficiency upgrade market • Adoption of energy efficient building and business practices • Marketing of energy efficiency • Availability of financing Participating contractors reported: • Changing services to be more comprehensive to adapt to BBNP (60%) • Increasing their focus on energy efficiency (46%) • Changing their standard practices in non-BBNP upgrades (34%) • Observing positive impacts on their business and the local energy efficiency market from BBNP (~50%) The Better Buildings Residential Program Solution Center and Better Buildings Residential Network continue to provide examples of replicable comprehensive approaches.	Yes	Yes
Upgrade more than 100,000 residential and commercial buildings to be more energy efficient	Number of upgrades	The evaluation verified the grantee-reported 99,071 upgrades for the 3-year evaluation period. • Unverified, grantees reported 119,404 upgrades for the 4-year program period	No 99%	Likely

Continued…

OBJECTIVES	METRICS	RESULTS	ATTAINED?	
			3-Year Verified	4-Year Unverified*
Save consumers $65 million annually on their energy bills	Energy bill savings ($)	Verified energy savings for the 3-year evaluation period provide over $40 million in annual bill savings. Close to $700 million lifetime energy bill savings are expected (estimated at fuel prices during the program period). Grantees reported: • $60 million in estimated annual bill savings during the 3-year evaluation period • $76 million in estimated annual bill savings through the 4-year program period	No 62%	Unlikely ~ 78% (based on 3-year evaluation findings)
Achieve 15% to 30% estimated energy savings from residential energy efficiency upgrades	Average energy upgrade savings (%)	Verified single-family residential savings: 15.1% Grantees reported 22% estimated energy savings in single-family residential upgrades.	Yes	Yes
Reduce the cost of energy efficiency program delivery by 20% or more	Average program delivery cost per year ($/MMBtu)	Delivery cost for BBNP savings (program-wide $/MMBtu) fell each year of the 3-year program by 30% or more. The third-year program delivery cost was 58% lower than the first-year cost.	Yes	Yes
Create or retain 10,000 to 30,000 jobs	Net number of jobs	The evaluation estimated 10,191 net jobs resulting from BBNP during the 3-year evaluation period.	Yes	Yes
Leverage $1 to $3 billion in additional resources	Dollars leveraged	Evaluation interviews with financial institutions corroborated grantee-reported leveraged loan funds of at least $618 million. Grantees reported leveraged funds from other sources of about $750 million, for an estimated total leveraged funds of about $1.4 billion.	Inconclusive**	Likely

* Our evaluation did not verify fourth-year program achievements. We concluded that objectives that were met by Q3 2013 also were met by the end of Q3 2014. An assessment of "likely" indicates that the unverified data show a trend suggestive of achievement.

** The evaluation addressed financial leverage amounts only; it did not address other grantee-reported leveraged funds.

Our evaluation also demonstrated that BBNP grantee programs met many of the aspirations described in the BBNP Funding Opportunity Announcement (FOA). DOE solicited grantee applications for program approaches designed to, among other things:

- Deliver verified energy savings from a variety of projects in the local jurisdictions of the grantee, with a particular emphasis on energy efficiency improvements in existing residential, commercial, industrial, and public buildings.
- Produce net economic benefits in excess of program cost.
- Form new alliances (local government, financial institutions, contractor associations, community organizations, etc.).
- Serve as pilot building retrofit programs that demonstrate the benefits of gaining economies of scale and begin to identify the most promising marketing and financing approaches.
- Serve as examples of comprehensive community-scale energy efficiency approaches that could be replicated in other communities across the country, even with less or no on-going government support.

Forty-one grantees and 24 subgrantees conducted building upgrades in 34 states and one territory among communities ranging from a subsection of a single city to an entire state. Grantees upgraded residential, low income, multifamily, commercial, public, industrial, and agricultural buildings; 31 grantees upgraded buildings in multiple sectors. The most successful grantees conducted outreach that reached 33% of residential customers in single-family homes that had recently completed or were anticipating completing, a home improvement project.

Grantees were successful in forming alliances to support their programs with utilities, public benefits organizations, financial institutions, local governments, community-based organizations, and educational institutions. With the help of their financial institution partnerships, about 90% of grantees reported using BBNP funds as loan loss reserves, revolving loan funds, and/or for interest rate buy-down approaches to increase the availability of financing.

Half of the grantees were “starting from scratch,” designing and implementing programs in areas where no related program or pilot had been offered. Even the roughly half of grantees whose programs built on prior programs and pilots nonetheless had to create BBNP-specific teams, processes, documents, tracking systems, and other program elements. The grantees collectively reduced their costs to acquire energy savings in each subsequent year, with year-three costs less than half of their year-one costs.

Over one-third of grantees stated that their most senior staff in each of the areas of program design, implementation, green building trades, and financial institution involvement initially had less than four years of experience – relative newcomers to energy efficiency program administration. Thus, BBNP expanded the number of professionals with substantive energy efficiency experience.

This evaluation assesses BBNP performance over a three-year period. Were the funded local programs to continue for ten years, we would expect program achievements to be higher in later years than in the initial years as grantees gained experience.

We conclude here, based on the preponderance of evidence, that BBNP was one of many influences that has made a net positive contribution to transforming U.S. energy consumption markets, a transformation that is well underway according to respected national analysts. However, adequate time has not passed since the launch of the program to determine whether permanent changes have occurred in energy efficiency markets. Further, we do not rule out the competing hypothesis that some factor other than BBNP may have led to the evidence observed.

ENERGY, ENVIRONMENTAL, AND ECONOMIC IMPACTS

We verified source energy savings of 3,887,764 MMBtu gross and 3,534,131 MMBtu net through the third quarter of 2013 (Table ES-5). We estimated the measures installed through Q3 2013 will save 56,725,063 MMBtu over their lifetimes.

Although some grantees conducted agricultural and industrial upgrades, these projects were not included in the evaluation activities due to their small contribution to total program savings and a lack of data provided by grantees to the evaluation team. We also note that we estimated program lifetime energy savings, bill savings, and carbon emission reductions, from the M&V project sample and extrapolated the calculation to the population. Thus, our lifetime estimates do not have the same analytical rigor as the annual savings analysis.

Table ES-5: Verified Gross and Net Energy Savings, through Q3 2013

SECTOR	GROSS VERIFIED SOURCE SAVINGS (MMBtu)	NET VERIFIED SOURCE SAVINGS (MMBtu)	RELATIVE PRECISION (90% CONFIDENCE LEVEL)	NET LIFETIME SOURCE SAVINGS (MMBtu)	VERIFIED ENERGY SAVINGS AS A PROPORTION OF USAGE
Residential	2,084,120	1,960,024	6.9%	36,456,444	15.1%
Multifamily [a]	324,292	322,749	11.4%	6,003,132	13.8%
Commercial	1,479,352	1,251,359	6.4%	14,265,488	4.6%
Total	3,887,764	3,534,131	4.5%	56,725,063	11.0%

* Represents total units treated.

We estimated participants are saving $40 million annually from reduced energy bills (Table ES-6) based on verified net site savings through Q3 2013 and energy prices during the program period as reported by the U.S. Energy Information Administration (EIA). We estimated lifetime bill savings of $668 million based on the measure lifetime savings and the energy prices during the program period, as opposed to forecast prices.

Table ES-6: Annual and Lifetime Bill Savings Associated with Verified Net Energy Savings, through Q3 2013

SECTOR	ANNUAL BILL SAVINGS	LIFETIME BILL SAVINGS
Residential	$ 25,074,800	$ 466,391,273
Multifamily	$ 4,128,644	$ 76,792,784
Commercial	$ 11,002,400	$ 125,427,356
Total	$ 40,205,844	$ 668,611,414

We estimated avoided carbon emissions (carbon dioxide equivalent, or CO_2e) of 478,568 metric tons annually for upgrades through Q3 2013 and 7,216,526 metric tons over the upgrade lifetimes (Table ES-7).

Table ES-7: Verified Annual and Lifetime Avoided Carbon Emissions (CO2e), through Q3 2013

FUEL TYPE	ESTIMATED ANNUAL CO_2e AVOIDED (METRIC TONS)	ESTIMATED LIFETIME CO_2e AVOIDED (METRIC TONS)
Residential	207,721	3,863,613
Multifamily	36,842	685,254
Commercial	234,005	2,667,659
Total	478,568	7,216,526

Using an input-output macroeconomic model, we estimated the gross and net economic activity resulting from the $445.2 million expended by BBNP grantees through Q3 2013 (Table ES-8 and Table ES-9), for which ARRA funds provided 95% of the funding. The gross economic impacts indicate that the ARRA stimulus funds spent on BBNP contributed about $2 billion dollars and 13,000 jobs (full-time equivalent, FTE) to the economy that would not have occurred in the absence of the ARRA stimulus legislation, with a benefit-cost ratio of 4.7. The net economic impacts indicate that spending on BBNP specifically, rather than on typical federal spending as described by historical, non-defense outlays, contributed over $1.3 billion dollars and 10,000 jobs to the economy that would not have occurred in the absence of BBNP, with a benefit-cost ratio of 3.0.

Table ES-8: Estimated Gross and Net Economic Activity and Tax Revenues, Q4 2010 - Q3 2013

IMPACT MEASURE	GROSS IMPACTS ($ MILLIONS)	NET IMPACTS ($ MILLIONS)
Economic Activity	**$2,097.1**	**$1,345.0**
Intermediate Purchases	$947.8	$769.8
Personal Income	$631.5	$230.2
Small Business Income	$141.9	$111.2
Other Property Income	$311.7	$194.7
Other	$64.2	$39.1
Tax Revenues	**$244.5**	**$129.4**
State and Local Taxes	$83.8	$48.6
Federal Taxes	$160.7	$80.8

Table ES-9: Estimated Gross and Net Benefit-Cost Ratio and Jobs Impact, Q4 2010 – Q3 2013

IMPACT MEASURE	TOTAL GROSS IMPACTS	TOTAL NET IMPACTS
Benefit-Cost Ratio	4.71	3.02
Jobs (FTE)	13,331	10,191

EARLY INDICATORS OF MARKET EFFECTS

We found early indications that BBNP may have helped lead to local market effects. We emphasize that these indicators suggest BBNP has initiated market change; they are not proof that the market has changed or that whatever change BBNP has initiated will persist past the funding cycle. Such conclusions await research conducted several years after this study.

Across multiple indicators and from multiple data sources we found early evidence of local market effects influenced by BBNP. Examples of indicators include increased activity in the energy efficiency upgrade market, increased adoption of energy efficient building and business practices, as well as sales of energy efficient equipment, increased marketing of energy efficiency, increased availability of financing, high levels of consumer awareness of BBNP, and mixed evidence of increases in trained contractors.

BBNP appears to have influenced building and business practices among a portion of contractors and distributors in grantee regions. Large percentages of participating contractors (ranging from 46% to 56%) reported that BBNP had positive impacts on their business and the local energy efficiency market. For example, 60% of participating contractors reported that their services had become more comprehensive to adapt to BBNP, and 46% of participating contractors increased their focus on energy efficiency in order to adapt to the program. Further, 34% of participating contractors reported changing their standard practices in non-BBNP upgrades. Fewer nonparticipating contractors (generally 10% or less) reported the same.

In summary, there is evidence of early indications of market effects, but the effects appear to be concentrated largely on a subset of participating contractors, with much smaller estimated effects among nonparticipating contractors and distributors. Further, our findings indicate that BBNP was successful in stimulating some program activity and in eliciting market change at the utility level and among financial institutions. However, BBNP does not appear to have been successful at creating local markets where efficiency occurs in the absence of any subsidies, as most grantees had not yet developed the market presence to continue self-sustaining programs and needed ratepayer and other financial support.

PROCESS EVALUATION KEY FINDINGS

We report here key qualitative process evaluation findings, several of which amplify the statistically identified contributors to success discussed in the preceding section.

- **Evidence of Program Sustainability:** We found the following early indicators of program sustainability: (1) Grantee programs, or program elements, would continue past the grant period. (2) Financing for energy efficiency upgrades would continue to be offered past the grant period. (3) Participating contractors would continue to offer whole home/building upgrades past the grant period. (4) Participating customers highly

rated the value of their upgrades. The most common source of post-grant support was ratepayer funding received by integrating with utility or energy agency home upgrade programs.

- **Effective DOE Program Activities:** The grantees found the account managers provided to them by DOE to be a valuable asset in helping program managers understand and satisfy grant requirements. Grantees also reported conferences and peer-to-peer learning opportunities as helpful because they could form beneficial relationships, learn from experts and each other, and troubleshoot common problems. Responding to the ARRA goal of transparency in the use of funds, account managers helped grantees meet requirements to submit ARRA expenditure reports to *Federalreporting.gov* so that BBNP expenditures could be made available to the public via *Recovery.gov*.

- **Grantee Program Context:** Grantees varied widely in terms of the contracting entity, its partnerships, the roles of these multiple entities, and the communities they served. All grantees formed multiple alliances with a variety of other organizations to support their programs. Bivariate analyses reveal two factors related to success: (1) Program with teams that had at least one highly experienced team member (15 or more years' experience) performed better than programs that did not, and (2) BBNP programs administered by local government staff did not perform as well as programs administered by other organizations. Bivariate analyses indicate that ramp-up time (time from grant award to program functioning at its best) varied significantly as a function of program success, but this relationship lacked significance in the multivariate analyses. Our analyses did not identify factors explaining ramp-up time; ramp-up time was not affected by whether a grantee's program built upon another pilot or program.

- **Effective Designs for Audit and Upgrade Offerings:** Multivariate analyses found that programs that offered multiple audit types (for example, on-line, walk-through, and audits that use diagnostic equipment) were more successful than those that did not, and that installing measures during the audit was associated with program success. The other audit-related factors explored in our analysis did not appear to be associated with success. For grantees offering multiple audit types, some developed a single incentive structure that had sufficiently flexible eligibility requirements to allow for varying comprehensiveness levels while others established distinct participation paths for projects targeting different levels of comprehensiveness, each with an associated audit type, incentive structure, and upgrade eligibility requirements. Bivariate analyses found that more successful programs were less likely to require participants to meet a savings target and instead allowed them to install a minimum number of measures or pursue comprehensive audit recommendations. Bivariate analyses also found that offering upgrade incentives (and relatively lower incentives – on the order of 25% of project costs) and conducting effective quality assurance (QA) and quality control (QC) were associated with program success.

- **Marketing and Outreach to Drive Demand:** Engaging credible messengers – such as respected local governmental personnel or homeowner association presidents – in program promotion influenced individuals in those messengers' social networks to undertake upgrades. Mailing letters to homes and businesses, and using messaging that emphasized comfort were likely to drive participation. Canvassing was rarely an effective approach. Bivariate analyses revealed that programs had greater success when they identified specific target populations within their larger target area, and when they tailored their outreach efforts to the size of the target populations. However, limiting participation to restricted geographic areas was not an effective approach. Grantees successfully drove upgrade demand by engaging community-based organizations (CBOs) to conduct outreach, although CBO engagements differed in their

effectiveness. Successful grantee-CBO collaborations tended to involve motivated CBOs with sufficient resources to recruit retrofit participants from their constituencies using customized outreach approaches based on the CBO's guiding objectives and capabilities.

Multivariate analyses indicated that successful programs sought to increase contractors' sales effectiveness by offering sales training, leveraging the upgrade contractor's pivotal role in the upgrade sale. Finally, the study suggests that program administrators wanting to use a marketing contractor should look for firms with energy efficiency experience; among BBNP grantees, those using a marketing contractor appeared to have no greater success than those that did not.

- **Working with Contractors to Stimulate Supply:** Successful programs had a larger pool of eligible upgrade contractors and relied on them to sell participants on the value of upgrades. Programs that improved the capabilities of contractors through sales and business training were less likely to be in the least successful cluster. Quality assurance and quality control mechanisms also contributed to improved quality of upgrades. In addition, successful programs were more likely than other programs to provide lists of pre-approved contractors, thereby fostering participant trust in contractors, and to allow participants to contract directly with the service provider, thereby affording flexibility.

  The approaches of grantees selected for the contractor training spotlight study commonly shared six attributes: (1) Training content addressing program, technical, and business needs – especially sales training; (2) expert and trusted trainers; (3) flexible access to training (classroom, web-based, on-site); (4) varied timing and duration of training; (5) robust financial support for attending training; and (6) voluntary training options (with enticements such as food and networking opportunities) that allowed contractors to attend trainings that were most important to them.

- **The Role of Financing in Grantee Programs:** Offering financing was associated with grantee success. About 16% of residential participants obtained financing. Given that most participants did not obtain loans, it is important for program administrators to recognize that financial offerings do not guarantee program success; rather, all aspects of the program design contribute to success.

  Greater numbers of financial partners were associated with program success; apparent contributing factors included increased likelihood that participants could obtain loans from financial institutions with which they had established relationships, competition among financial institutions, and variety among financial institutions in populations and geographic areas served.

While these program elements appear to be effective approaches, our process evaluation findings also suggest there are many paths to success. Grantees' local markets, program models, features, and partnerships varied across many dimensions. We did not find a specific program design to work better than other designs; the program elements we identify here are just a very few of the myriad features describing a program's design and implementation approach.

RECOMMENDATIONS

We offer the following recommendations to DOE regarding opportunities to capitalize on the achievements of BBNP:

- **Assess the longer-term outcomes of BBNP.** The three-year grant period was too short for grantees to create local or state markets where energy upgrades occur in the absence of ratepayer or taxpayer

subsidies. Further, our process evaluation assessed early success, which may or may not be associated with long-term success. Given these limitations, we recommend that DOE take steps to assess the longer-term impacts of BBNP. This would require tracking the activities of programs developed as part of BBNP and evaluating their progress at points that allow for an assessment of whether BBNP achieved its intermediate and long-term goals.

- **Use BBNP as a model for providing support to other DOE grantees.** Grantee staff generally provided positive feedback on all of DOE's BBNP support activities, especially the assigned Account Manager and the grantee conferences. Given the success of these activities, we recommend that DOE and other program funders model their grantee support activities on those conducted by BBNP when developing similar programs in the future.
- **Capitalize on the infrastructure created during BBNP.** A great deal of infrastructure was created during BBNP, including the Better Buildings Residential Program Solution Center, the Better Buildings Residential Network, and data tracking and reporting tools. We recommend that DOE continue to refine and make use of this infrastructure in its efforts to support building upgrade programs, policies, and investment, as well as building upgrade activity conducted by owners and the retrofit industry.
- **Find creative ways to continue support.** While we found early indications that BBNP may have helped lead to market effects, the indicators are not proof that the market has changed or that whatever change BBNP has initiated will persist past the funding cycle. Sustained market effects for such an innovative practice (whole home or whole building upgrades) in such a short timeframe (grants lasting three years in duration) are difficult to achieve. As a result, we recommend that DOE consider providing support (technical or financial) to highly successful grantees that are continuing to offer their programs. Additional support could help realize BBNP's objective of sustained market effects in the grantee regions.

We offer the following recommendations to upgrade program administrators:

- **Consider our conclusions identifying effective upgrade program approaches.** We report identified success-related findings statistically associated with program characteristics generally, audits, upgrades, driving demand for upgrade services, stimulating supply of upgrade services, financing, and ongoing program funding. Because this study is unique in its scope of conducting in-depth comparative assessments of over 40 programs, we encourage program administers to consider the extent that application of our study findings might benefit their programs. While we hope our statistical findings on success elements will be useful to program administrators, also we concluded that there is no single approach, no single program feature that is a "must have," nor any that are "avoid at all costs."
- **Develop a program tailored to the unique characteristics of the locale.** It is important for program administers to: understand the experiences of the local contractor population and provide appropriate trainings; tailor messages for subpopulations likely to undergo upgrades; provide multiple participation options; and partner with well-resourced local organizations.
- **Offer multiple pathways to participation.** Consider options for incorporating prescriptive participation pathways – in addition to an energy modeling-based pathway – into whole home retrofit programs, with each pathway designed to encourage participants to install more measures than they might otherwise install.

- **Offer a variety of contractor training.** Training content should address program, technical and business needs – especially sales training – and should be delivered by expert and trusted trainers. Provide training in a variety of formats, duration, and at times of year. Include voluntary training options, allowing contractors to best meet their needs. Offer contractors financial support for training. Develop metrics – such as conversion rates, technology choices or measures included in projects, contractor teaming, and trends in number of contractor projects – to measure training impacts and identify needs for additional training. Look for opportunities to combine training with other program needs – such as quality control activities and obtaining feedback from contractors on program design and implementation – to build mutual communication, understanding, and respect from home upgrade professionals.

- **Carefully design the message and select the messenger to resonate with the targeted group.** Consider using targeted outreach to recruit upgrade participants from among groups with shared social networks and energy efficiency needs. In advance of any geographically targeted outreach, conduct market research to select communities for their likely receptivity to the efficiency message and conduct early educational outreach in those areas to build awareness of energy efficiency benefits before making program offers.

- **Tailor CBO recruitment to the program's needs.** The effective use of CBOs requires program managers to track CBO sign-ups and application assistance, and then make adjustments as needed to recruit and retain only partners that help the program realize its goals. For example, CBOs will differ in their abilities to quickly generate leads or to recruit projects within specific hard-to-reach populations. Allow flexibility in CBOs' outreach approaches; CBO outreach is most effective when CBOs tailor their outreach strategies based on their organization's capacity and mission. Temper expectations for CBO productivity and anticipate the need to provide CBOs support. The value that CBOs provide is based on their position of trust within specific communities, yet such outreach takes time and resources. CBO outreach alone is unlikely to generate sufficient volume to sustain a program.

- **Deep retrofits can be a hard sell; provide clear, flexible program offerings and expect to conduct extensive outreach to generate awareness and understanding.** Deep retrofit programs should build on an existing contractor network and provide technical and sales support to contractors. Collaborate with other program managers offering similar programs to help buy-down the cost of expensive deep retrofits and promote the availability of incentives from multiple sources. Recognize that generating homeowner demand for deep retrofits and a supply of qualified contractors can take several years. Be patient. Periodically revisit previously targeted communities; homeowners who did not initially participate may have gained interest over the interim and early participants may want to pursue additional upgrades.

The grant cycle for BBNP has ended and it is unclear whether or not in the foreseeable future DOE will fund a program on a scale similar to BBNP. Were DOE or another agency to fund a program like BBNP, we offer the following recommendations to foster greater consistency in program expectations, design, tracking, and reporting:

- **Plan and develop a comprehensive and easy to use data tracking and reporting system available to grantees at the time of funding their award.** Due to the size of the funding pool and the needed speed at which it was issued, there was a limited focus on program evaluation and reporting needs when BBNP was designed and launched. The resulting tracking and reporting processes were cumbersome, inconsistent, and frustrating for both grantees and DOE. It is critical that for any future successful and streamlined

program, consideration be given to both the data tracking and reporting needs and the data verification and evaluation needs.

- **Require grantees to ensure the consistency of project-level tracking values with overall report totals.** One of the main reasons the Project-Level data did not match the Program-Level data was that there was no process whereby grantees matched the individual savings totals from each project to the total savings achieved for the reporting period. This inherently created an opportunity for discrepancies.
- **Require consistent documentation procedures across all grantees and programs.** Grantees had varying information on projects implemented through their programs. Future program design should outline documentation procedures and needs for measure-level, project-level, and program-level reporting, and should provide definitions of key terms.
- **Require accountability for quality control practices across programs and provide support to grantees that demonstrate insufficient quality assurance/ quality control.** The evaluation team found a lack of data regarding the reported measures installed at project sites. This is a complex issue and relies on accurate and comprehensive grantee data collection and reporting. In the interest of understanding measure-specific implementation data, there should be more scrutiny on this level of information received.
- **Consider a requirement of timely and accurate reports as a condition of funding payments.** While most grantees complied with stipulations regarding reporting, it appeared that some grantees did not take the time to accurately report their savings. For future programs, DOE could assess whether they should consider a potential model for paying out funding over time as grantees meet certain reporting requirements.
- **Compile a single final dataset to be used for reporting and evaluation purposes to ensure consistency of results across reporting activities.** The program manager should assure data quality by the conclusion of the evaluation period and a single final dataset issued to the evaluation team to avoid evaluation inefficiencies.
- **Recognize that programs take months to design, implement, and ramp-up to optimal performance.** Program goals should anticipate an initial period with little to no goal attainment.

1. INTRODUCTION

The U.S. Department of Energy (DOE) administered the Better Buildings Neighborhood Program (BBNP) to support programs promoting whole building energy upgrades. BBNP distributed a total of $508 million to support efforts in hundreds of communities served by 41 grantees. DOE awarded funding of $1.4 million to $40 million per grantee through the competitive portions of the Energy Efficiency and Conservation Block Grant (EECBG) Program ($482 million from American Recovery and Reinvestment Act of 2009 [ARRA, the Recovery Act] funds) and the State Energy Program (SEP; $26 million). DOE awarded grants between May and October 2010, intended to provide funding over a three-year period ending September 30, 2013. In 2013, DOE offered an extension to programs that included a BBNP-funded financing mechanism to operate through September 30, 2014 using BBNP funds exclusively for financing.

State and local governments received the grants and worked with nonprofits, building energy efficiency experts, contractor trade associations, financial institutions, utilities, and other organizations to develop community-based programs, incentives, and financing options for comprehensive energy-saving upgrades. Each of the 41 grant-funded organizations, assisted by 24 subgrantees, targeted a unique combination of residential, multifamily, commercial, industrial, and agriculture sector buildings, depending on their objectives.

1.1. SYNTHESIS REPORT OVERVIEW

This report provides findings from a comprehensive impact, process, and market effects evaluation of the original BBNP program period spanning fourth quarter (Q4) 2010 through third quarter (Q3) 2013. A team of four energy efficiency evaluation consulting firms conducted the evaluation – Research Into Action, Inc. (lead contractor), Evergreen Economics, Nexant, Inc., and NMR Group, Inc. – which was managed by Lawrence Berkeley National Laboratory (LBNL) and supported by DOE. This, Volume 1 of a six-volume suite, is a synthesis of five evaluations presented in depth in Volumes 2 through 6.

The **impact evaluation** involved the development of independent, quantitative estimates of the impacts of BBNP. These impacts include energy savings, cost savings, greenhouse gas emission reductions, economic impacts, and jobs created or maintained. We conducted the impact evaluation of the three-year program in two phases: a preliminary evaluation which evaluated program activities between Q4 2010 through Q2 2012 and a final evaluation which examined program activities between Q3 2012 and Q3 2013 (Research Into Action, Evergreen Economics, Nexant, and NMR Group, 2013). We combined the findings from both evaluations to develop a verified energy savings estimate for BBNP for the three-year grant period Q4 2010 through Q3 2013. Please see the companion report *Savings and Economic Impacts of the Better Buildings Neighborhood Program* (Final Evaluation Volume 2).

The **market effects evaluation** sought to identify early indications that BBNP had an effect on the local building improvement markets in which the program operated and to understand how and why energy upgrade contractors and distributors changed their business practices in a way that promoted greater adoption of energy efficiency. It explored the market for energy efficient products, services, or practices to assess changes in the market or in market actors' behavior resulting from BBNP activities. The study included multiple data sources, including: phone surveys with energy upgrade contractors and equipment distributors; in-depth interviews with contractors; a secondary data analysis of changes in contractor association memberships and certifications issued by credentialing organizations; surveys with participant and nonparticipant homeowners; and in-depth interviews with financial institutions. By design, the market assessment research investigated early indications of local effects, not indications of national

effects. Because each grantee market is different, we did not directly extrapolate the market assessment findings from the sample to the full population of grantees. Even so, we reached general conclusions on the presence or absence of early indicators of market effects generated by BBNP grantee funding.

The market effects evaluation is presented in *Market Effects of the Better Buildings Neighborhood Program* (Final Evaluation Volume 5).

The **process evaluation** drew on information collected from the grantees, DOE program staff and contractors, program participants and nonparticipants, contractors serving participants, and financial institutions working with the grantees. In addition, an extensive review of pertinent literature informs the evaluation. The process evaluation had two broad objectives:

- To assess the degree to which BBNP met its goals and objectives related to program processes and grantee program activity.
- To identify the most effective approaches – including program design and implementation activities – to completing building energy upgrades that support the development of a robust retrofit industry in the U.S.

[Please see the companion reports *Drivers of Success in the Better Buildings Neighborhood Program – Statistical Process Evaluation* (Final Evaluation Volume 3), *Process Evaluation of the Better Buildings Neighborhood Program* (Final Evaluation Volume 4), and *Spotlight on Key Program Strategies from the Better Buildings Neighborhood Program* (Final Evaluation Volume 6) for a detailed presentation of findings.]

1.2. BBNP DESCRIPTION

DOE administered BBNP to support programs promoting whole building energy upgrades. BBNP distributed more than $500 million to support hundreds of communities served by 41 grantees. While the federal government has issued periodic funding opportunities for energy efficiency, none has been on the scale of BBNP.

DOE issued two competitive funding opportunity announcements for BBNP grants. The first, drawing on EECBG funding, was issued in October 2009. The second, drawing on SEP funding, was issued in April 2010. DOE awarded grants between May and October 2010, intended to provide funding over a three-year period ending September 30, 2013, a period that DOE subsequently extended by a year for programs that included a BBNP-funded financing mechanism to operate using BBNP funds exclusively for financing.

Each grant recipient proposed and implemented unique programs designed to address the energy efficiency needs, barriers, and opportunities within its jurisdiction. However, all of the recipients' programs were broadly designed around three common purposes: 1) to obtain high-quality retrofits resulting in significant energy improvements (retrofits also described as whole building or comprehensive); 2) to incorporate a viable strategy for program sustainability, which DOE defined as continuing beyond the grant period without additional federal funding; and 3) to fundamentally and permanently transform energy markets to make energy efficiency and renewable energy the options of first choice (DOE, 2009).

Through the EECBG Funding Opportunity Announcement (FOA), DOE sought "innovative" and "game–changing"' whole building efficiency programs (DOE, 2009). DOE recognized that innovation is a form of experimentation and is not without risk of failure. The BBNP program at the national level was looking to identify the most effective approaches; DOE was not expecting every local BBNP-funded program to be equally, or even moderately, effective.

DOE provided BBNP grants to 41 recipients operating programs in 34 states and one territory. The jurisdictions recipients served varied widely. Some recipients served only a single city or county, while others served entire states. One recipient, the Southeast Energy Efficiency Alliance (SEEA), funded sub-recipient programs in five states and the U.S. Virgin Islands. The sizes of grants awarded through BBNP also varied, ranging from $1.3 million to $40 million.

Figure 1-1 through Figure 1-4 provide regional maps that show the states with BBNP activity, illustrate whether the grant recipient represented the state or a city or county within the state, and provide the grant amounts per recipient. The figures are unable to illustrate the organizational complexity of two grant recipients. SEEA, shown in Figure 1-2, worked with subgrantees in 13 locations throughout the Southeast spanning three states and one territory. Los Angeles Country, shown in Figure 1-4, worked with subgrantees serving six locations in California.

Appendix A provides tables listing the grantee awards in descending order by size and alphabetically by grantee. Detailed information about each grantee can be found at *http://energy.gov/eere/better-buildings-neighborhood-program/better-buildings-partners.*

Figure 1-1: BBNP Recipient Program Locations - Northeast Region

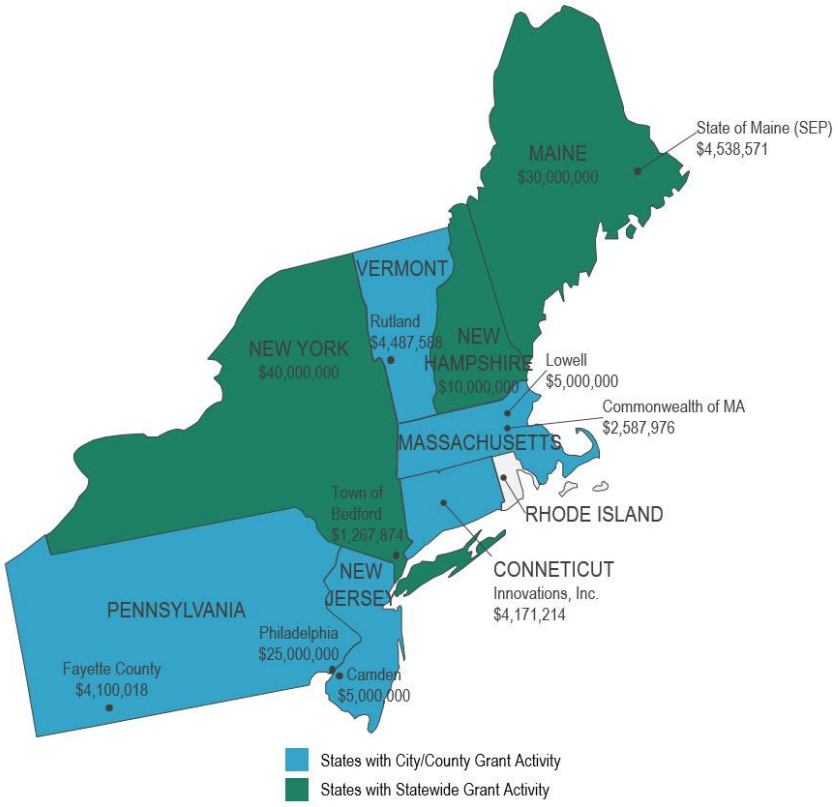


Figure 1-2: BBNP Recipient Program Locations - Southern Region

Figure 1-3: BBNP Recipient Program Locations - Midwest Region

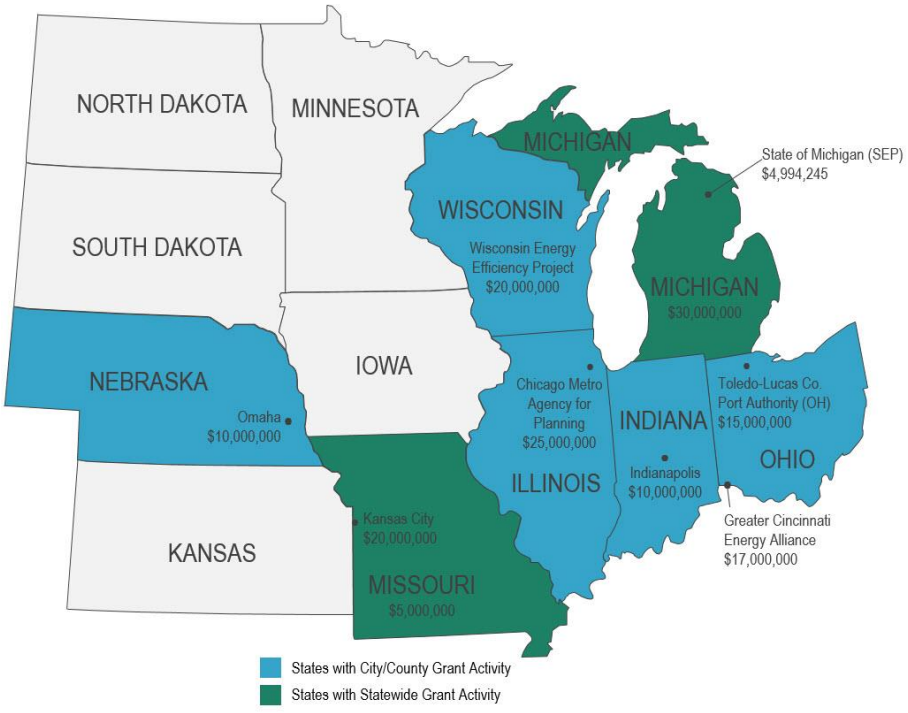


Figure 1-4: BBNP Recipient Program Locations - Western Region

1.3. BBNP GOALS AND OBJECTIVES

DOE designed BBNP to meet the three principal ARRA goals (Table 1-1), as well as seven objectives developed by DOE staff to guide the BBNP initiative (Table 1-2). Below, we identify which of the three types of evaluation (impact, process, or market effects) provide findings relevant to our assessment of goal and objective attainment.

Table 1-1: BBNP ARRA Goals

GOALS	EVALUATION TYPE		
	Impact	Process	Market Effects
Create new jobs and save existing ones	✓	✓	✓
Spur economic activity and invest in long-term growth	✓	✓	✓
Provide accountability and transparency in spending BBNP funds	✓	✓	

Table 1-2: BBNP Objectives

OBJECTIVES	EVALUATION TYPE		
	Impact	Process	Market Effects
Develop sustainable energy efficiency upgrade programs		✓	✓
Upgrade more than 100,000 residential and commercial buildings to be more energy efficient	✓		
Save consumers $65 million annually on their energy bills	✓		
Achieve 15% to 30% estimated energy savings from residential energy efficiency upgrades	✓		
Reduce the cost of energy efficiency program delivery by 20% or more		✓	
Create or retain 10,000 to 30,000 jobs	✓		
Leverage $1 to $3 billion in additional resources	✓	✓	

1.4. BBNP REPORTED ACCOMPLISHMENTS

This section provides program accomplishments *reported* by DOE's BBNP team from data provided by the grantees. **This is unverified grantee data.** This section does *not* provide verified data, such as verified gross and net energy savings, which subsequent chapters present.

1.4.1. REPORTED THROUGH Q3 2013 (THE EVALUATION PERIOD)

This section presents grantee-reported accomplishments from Q4 2010 through Q3 2013 (the evaluation period).

All of the 41 grantees conducted whole home and/or building upgrades. Grantees reported (not verified) completing over 99,000 projects between Q4 2010 and Q3 2013, reportedly saving over 5,800,000 MMBtu annually of energy measured at the source (not site), at a reported cost of $76 per MMBtu of source energy saved (Table 1-3).

Table 1-3: BBNP Reported (Unverified) Progress through Q3 2013*

METRIC	THROUGH Q3 2013 RESULT
Grantees with Projects	41
Projects	99,071
Spending	$449 million
Total Reported Energy Savings (Source, MMBtu)	5,852,275
$/MMBtu Saved (Source)	$76

Source: DOE-provided extract of its Better Buildings Neighborhood Information System (BBNIS), a database of grantee-reported project level data.

* A few grantees reported projects completed prior to Q4 2010.

Grantees reported they conducted upgrades in the residential, multifamily, commercial/industrial, and agricultural sectors (Table 1-4).[1] According to the reports (unverified), the residential sector accounted for more than four-fifths of the projects and half of the energy savings; commercial sector projects comprised 4% of the total and generated nearly 40% of the savings reported.

Table 1-4: BBNP Reported (Unverified) Projects and Energy Savings through Q3 2013*

SECTOR	NUMBER OF PROJECTS IMPLEMENTED	PERCENT OF TOTAL PROJECTS	TOTAL SOURCE ENERGY SAVINGS (MMBtu)	PERCENT OF PORTFOLIO SAVINGS	AVERAGE SOURCE SAVINGS PER PROJECT (MMBtu)
Residential	74,184	74.9%	2,975,346	50.8%	40
Multifamily	21,178	21.4%	603,432	10.3%	29
Commercial	3,546	3.6%	2,240,970	38.3%	632
Agriculture**	163	0.2%	32,526	0.6%	200
BBNP Total	99,071	100%	5,852,275	100%	NA

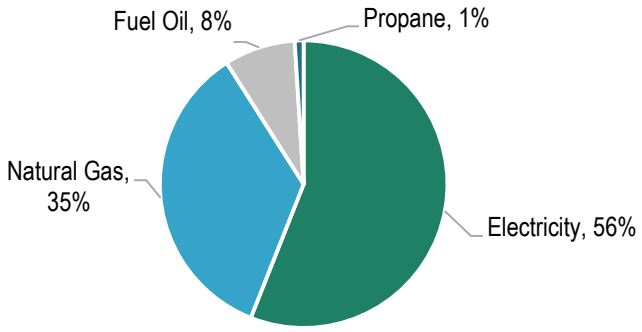
Source: DOE-BBNIS.

* A few grantees reported projects completed prior to Q4 2010.

** Agriculture totals obtained from DOE email dated May 9, 2013, as they are not included in Project Level data.

Grantees reported savings from a number of different fuel types including electricity, natural gas, fuel oil, propane, kerosene, and wood. Electricity and natural gas savings were the most common fuel sources, comprising 92% of the overall reported (unverified) source MMBtu savings (Figure 1-5).

Figure 1-5: Percent of Total BBNP Reported (Unverified) MMBtu Savings by Fuel Type

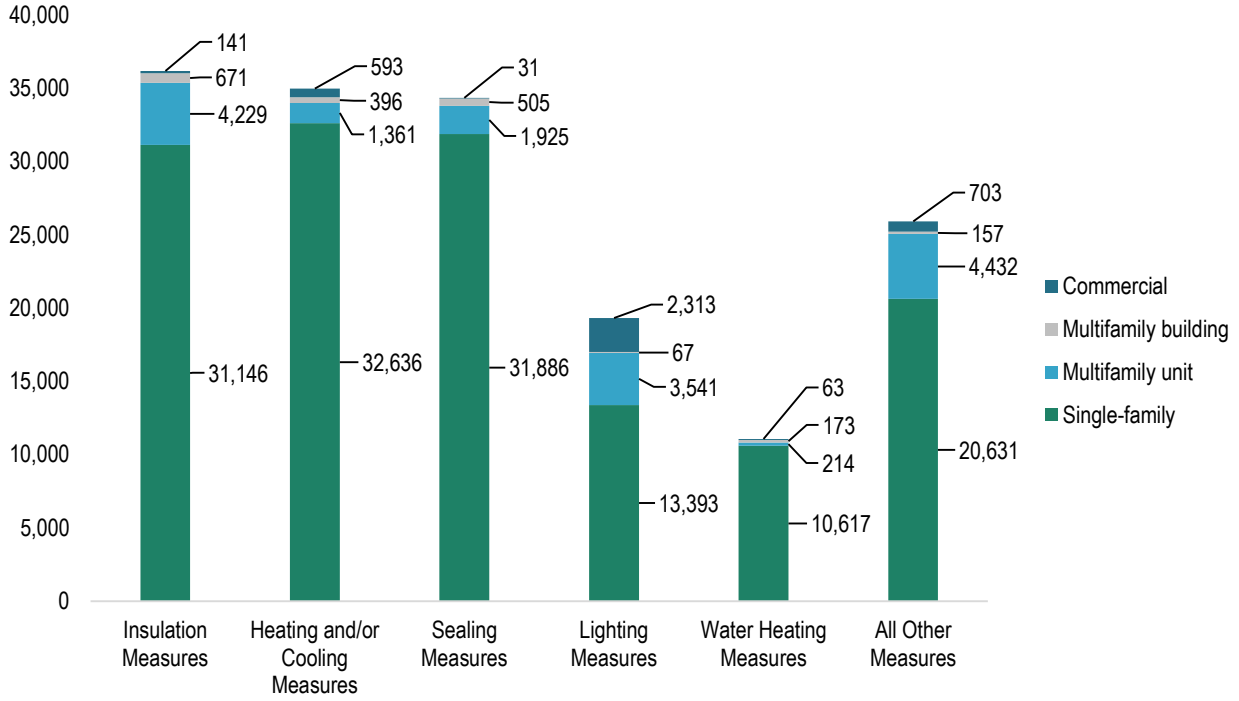


Source: DOE-BBNIS.

[1] Industrial projects were limited to 15 upgrades conducted by one grantee.

Upgrade customers most commonly installed heating and/or cooling systems, insulation, and air sealing measures; these measures comprised 91% of the overall reported (unverified) source MMBtu savings and 81% of installed measures (Figure 1-6).

Figure 1-6: BBNP Reported Installed Measure Counts



Source: DOE-BBNIS.

The DOE BBNP team recognized that upgrade costs preclude some customers from taking action and consequently encouraged grantees to ensure financing was available to (qualifying) prospective participants. According to grantee reports, more than 12,000 BBNP projects received loans, about 14% of all projects (Table 1-5). Grantees varied considerably in the proportion of their projects with loans.

Table 1-5: BBNP Reported Upgrade Projects Receiving Loans

PERFORMANCE METRIC	SINGLE-FAMILY	MULTIFAMILY		COMMERCIAL	AGRICUL-TURAL	TOTAL
		Unit	Building			
Number of Projects with Loans	11,987	63	50	183	0	12,283
Percentage of Projects with Loans	16%	1%	6%	5%	0%	14%

Source: DOE-BBNIS.

DOE implemented BBNP with ARRA funding as part of many activities intended to stimulate economic activity. Grantees reported the number of hours spent by staff and contractors conducting audits equivalent to 152 jobs (full-time equivalent, or FTE) lasting one year (Table 1-6). They reported staff and contractor hours conducting upgrades equivalent to 1,802 jobs (FTEs) lasting one year. Average project costs ranged from just above $7,000 among single-family residential programs to more than $300,000 among commercial programs. Audit costs invoiced to the program averaged more than $300 for single-family programs to about $5,400 for commercial audits.

Table 1-6: BBNP Reported Audit and Retrofit Job Hours and Invoiced Cost

PERFORMANCE METRIC	SINGLE-FAMILY	MULTIFAMILY		COMMERCIAL	AGRICUL-TURAL	TOTAL
		Unit	Building			
Audit Job Hours (Count)*	331,509	42,086	13,269	160,870	2,224	549,958
Audit Job Hours Converted to Jobs (FTEs)**	159	20	6	77	1	264
Retrofit Job Hours (Count)*	2,642,845	958,850	679,435	8,195,267	4,753	12,481,150
Retrofit Job Hours Converted to Jobs (FTEs)**	1,270	461	327	3,940	2	6,000
Number of Retrofit Hours per Audit Hour	8	23	51	51	2	NA
Audit Invoiced Cost (Mean)	$316	$1,194	$2,773	$5,409	$1,172	NA
Retrofit Invoiced Cost (Mean)	$7,214	$12,656	$789,171	$303,337	$72,979	NA

Source: DOE-BBNIS.

* Estimated from grantee-reported hours by imputing missing data with mean value.

** Estimated from count of hours by dividing by 2,080 hours (full-time employment for one year).

1.4.2. REPORTED THROUGH Q3 2014 (THE END OF THE EXTENSION PERIOD)

In 2013, DOE provided an extension to ARRA-funded grantees with ongoing financing programs to operate through Q3 2014. By the end of this period, grantees reported cumulative spending of $508 million and conducting 115,640 upgrades. The following tables summarize BBNP accomplishments over the four-year period from program start through Q3 2014, as reported to the evaluation team by BBNP staff.[2]

[2] Email from D. Hoffmeyer to M. McRae and E. Vine, April 20, 2015.

Table 1-7: Summary of BBNP Reported Upgrade and Loan Accomplishments through Q3 2014

	RESIDENTIAL	COMMERCIAL*	TOTAL
Total Upgrades	115,640	3,764	119,404
Total Loans (count)	20,528	302	20,830
Total Loan Amounts ($)	$225,818,156	$27,929,303	$253,747,458

Source: BBNP staff, personal communication.

* Does not include 187 reported industrial and agricultural projects

Table 1-8: Count of BBNP Reported Residential Upgrades by Calendar Year

YEAR	ANNUAL	CUMULATIVE
2010	3,963	3,963
2011	16,779	20,742
2012	35,665	56,407
2013	44,785	101,192
2014	14,448	115,640

Source: BBNP staff, personal communication.

Table 1-9: Summary of BBNP Reported (Unverified) Energy and Bill through Q3 2014

ELECTRICITY (KWH)	NATURAL GAS (THERMS)	HEATING OIL (GALLONS)	LPG (GALLONS)	TOTAL SOURCE MMBTU SAVED	TOTAL BILL SAVINGS
320,086,742	21,757,373	6,072,183	781,570	7,117,675	$86,921,898

Source: BBNP staff, personal communication.

2. METHODOLOGY

As part of the impact, process, and market effects evaluations, we collected and analyzed data from the grantees and subgrantees, program participants and nonparticipants, participating and nonparticipating contractors, equipment distributors, financial institutions working with the grantees, and DOE program staff and contractors. Table 2-1 provides a summary of our data collection activities for all evaluation activities.

Table 2-1: Summary of Data Collection Activities

POPULATION	METHOD	EVALUATION TYPE			COUNTS
		Impact	Process	Market Effects	
Grantees/Subgrantees	Web Survey		✓		38 grantees 13 subgrantees
	In-depth Interview (In-person and Phone)		✓		40 grantees 8 subgrantees
	Utility Billing Data	✓			21 grantees; 7,513 projects
	Leveraging Interview (Phone)		✓		15 grantees
Participants (all sectors except agriculture)	Desk Review	✓			14 grantees; 305 projects
	Phone Survey	✓			22 grantees; 205 projects
	On-site Visit with Interview	✓			17 grantees; 168 projects
Participant homeowners	Web Survey		✓	✓	24 grantees; 2,399 respondents
Nonparticipant homeowners	Web-Intercept Survey		✓	✓	41 grantees, 2,429 respondents
Multifamily participants	CATI Survey	✓			14 respondents
Participating contractors	Computer Assisted Telephone Interviewing (CATI) Survey			✓	22 grantees (25 grantee programs); 147 respondents
	In-depth Interview (Phone)			✓	10 interviewees
Nonparticipating contractors	CATI Survey			✓	22 grantees (25 grantee programs); 446 respondents
Distributors	CATI Survey			✓	22 grantees (25 grantee programs); 291 respondents
Financial Institutions	In-depth Interview (Phone)		✓	✓	20 financial partners
DOE Staff, Contractors, and Stakeholders	In-depth Interview (In-person and Phone)		✓		12 DOE staff 8 support contractors 5 nongovernmental stakeholders
Program-level	Document and Database Review	✓	✓		41 grantees
	Pertinent Literature		✓		More than 50 documents
Contractor association memberships and certifications	Database reviews			✓	Five contractor associations and certification organizations

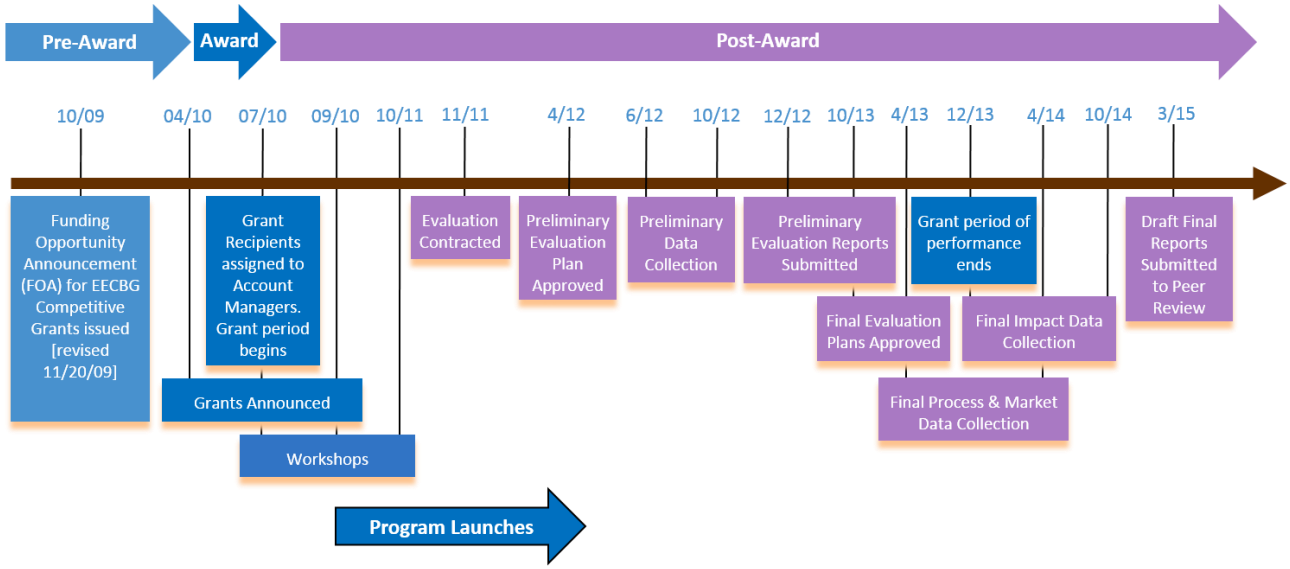
In addition, we conducted an extensive review of pertinent literature that helped us interpret our primary research. Table 2-2 identifies the sources we reviewed. We obtained grantee-specific evaluations that we identified through our interviews with grantees or that DOE staff provided to us. We identified relevant published literature from DOE's *Residential Solutions* member page that later became the *Better Buildings Residential Solutions Center*, papers presented during Better Buildings Peer Exchanges, industry conference proceedings, and websites posting industry evaluations. These latter sources include the International Energy Program Evaluation Conference (IEPEC), the American Council for an Energy-Efficient Economy (ACEEE), the Association of Energy Services Professionals (AESP), the California Measurement Advisory Council (CALMAC), and those of program administrators, including the New York State Energy and Research Development Authority (NYSERDA) and the Northwest Energy Efficiency Alliance (NEEA).

Table 2-2: Catalog of Secondary Literature Items Accessed

TYPE OF SECONDARY LITERATURE	NUMBER OF ITEMS
Statement of Project Objectives, Original 2010-2011	42
Final Technical Reports	50 (includes some sub-grantees and two consortiums)
Grantee Websites (archived while grant was active)	63 grantees / 825 web pages
Grantee-specific Evaluations (typically conducted by consulting firms or universities)	39 (for some grantees, includes multiple reports)
Published Literature	64 (identified by our team through mid-2014)
Peer Learning Webinars or Peer Exchange Calls	45 (approximate number; notes and/or slides)

Figure 2-1 illustrates the timing of key BBNP and program evaluation activities.

Figure 2-1: Key BBNP and Program Evaluation Activities



2.1. IMPACT EVALUATION

The impact evaluation comprised two broad activities to determine gross verified savings: 1) Measurement and Verification (M&V) of a sample of grantees and projects; and 2) billing regression analysis on projects from grantees with sufficient utility bill data. Our M&V approach used an ex-post analysis (actual savings based on post-retrofit conditions) in order to estimate the energy savings for each project in a representative sample selected to provide high confidence and precision. We conducted a billing regression analysis to estimate realized energy savings at the project level. In order to calculate the overall verified energy savings associated with BBNP, the team extrapolated the sample findings to the population through the use of case weights and realization rates. (The billing regression analysis realization rates are defined as the ratio of fuel savings estimated by the billing regression models relative to grantee reported ex-ante savings.) We extrapolated the M&V sample frame and the billing regression analysis sample frame separately, combined the resulting realization rates, and extrapolated to the entire BBNP population.

The impact evaluation also estimated the economic impacts of BBNP. These impacts included jobs, as well as estimates of economic output, income (personal and business), and tax revenue that result from the program spending relative to a base case scenario where BBNP did not exist. We constructed the economic impact model of the U.S. economy using IMPLAN (for IMpact Analysis for PLANning) modeling software, an input-output model that involves mathematical representations of the economy that describes how different parts (or sectors) are linked to one another.[3] This analysis measured the short-term economic impacts approximated for BBNP using information about program outlays, energy cost savings, and measure spending from the BBNP Quarterly Summary Reports.

2.2. MARKET EFFECTS EVALUATION

This study explored the market for energy efficient products, services, or practices to assess changes in the market or in market actors' behavior resulting from BBNP activities. The market effects study focused on several core elements of the market, including contractors, equipment distributors, energy efficiency program administrators, participant homeowners, and financing partners. The study comprised multiple data sources, including phone surveys with energy upgrade contractors and equipment distributors, in-depth interviews with contractors, a secondary data analysis of changes in contractor association memberships and certifications issued by credentialing organizations, intercept interviews with participant and nonparticipant homeowners, and in-depth interviews with financial institutions.

2.3. PROCESS EVALUATION

The process evaluation drew on information collected from the grantees, DOE program staff and contractors, program participants and nonparticipants, contractors serving participants, and financial institutions working with the grantees, as well as an extensive review of pertinent literature. We used these sources to assess BBNP program accomplishments and program activities, and to address the goal of identifying the most effective approaches to completing building energy upgrades that support the development of a robust retrofit industry in the U.S. We used

[3] IMPLAN (for IMpact Analysis for PLANning) was originally developed by the Forest Service of the U.S. Department of Agriculture in cooperation with the Federal Emergency Management Agency and the Bureau of Land Management of the U.S. Department of the Interior in 1993 and is currently licensed and distributed by the Minnesota IMPLAN Group, Inc.

qualitative methods and descriptive statistics to describe BBNP in its entirety, as well as similarities between and variation among individual grantee programs.

Further, we identified elements associated with program success and those associated with falling short of success. To support the statistical investigation of effective approaches to delivering residential upgrade programs, *Drivers of Success in the Better Buildings Neighborhood Program – Statistical Process Evaluation* (Final Evaluation Volume 3) identified 12 diverse quantitative performance indicators, such as average MMBtu savings per project, program cost per upgrade, and progress toward upgrade goal. We then clustered grantees into groups based on their performance on the 12 metrics using grantee-reported residential activity data (Q4 2010 to Q3 2013). The analyses yielded three groups of grantees whose average performance on the 12 metrics were consistent with an interpretation of a most successful group, an average group, and a least successful group. (See Appendix B for additional detail on these analyses.)

We emphasize here that the Volume 3 analysis used the grantee success clustering only to identify programmatic elements associated with stronger performance relative to other grantees, a research objective important to the DOE BBNP team. As we note elsewhere, grantee success during the three-year evaluation period was associated with the length of time programs took to reach optimal functioning; the most successful grantees reached the optimum point in their programs six months sooner than less successful grantees. However, we did not find that grantee success was driven by prior whole home program experience. Nonetheless, were the grantee programs to continue for ten years, we would expect program achievements to be higher in later years than in the initial years as grantees gained experience in their markets and adjusted their programs accordingly.

Finally, the process evaluation included five qualitative spotlight studies on program strategies implemented by BBNP grantees. Data collection for spotlight studies involved review of the grantees' Final Technical Reports, third-party evaluations of grantee programs, and other documentation compiled by DOE and grantee staff, as well as in-depth interviews with program staff. We selected the topics addressed in this volume in consultation with the BBNP evaluation manager and DOE BBNP program staff. Topics addressed in the spotlight studies are: multiple pathways, contractor training, targeted outreach, engagement with community-based organizations, and encouragement of deep retrofits. These spotlight studies provide a depth of information on specific topics exceeding that provided by the interview and survey research that underpins the broader process evaluation findings given in Volume 4.

3. ENERGY, ENVIRONMENTAL, AND ECONOMIC IMPACTS

This section summarizes key findings from the impact evaluation; *Savings and Economic Impacts of the Better Buildings Neighborhood Program* (Final Evaluation Volume 2) present the findings in greater detail.

3.1. ENERGY SAVINGS

This section provides a summary of findings regarding the energy savings, economic benefits, and environmental benefits generated by BBNP. The section also includes intermediate findings from the two broad impact evaluation activities to determine gross verified energy savings: 1) M&V of a sample of grantees and projects; and 2) billing regression analysis on projects from grantees with sufficient utility bill data.

3.1.1. KEY FINDINGS

We verified source energy savings of 3,887,764 MMBtu gross and 3,534,131 MMBtu net through the third quarter of 2013. Table 3-1 presents the sector realization rates (generated from an analysis by fuel type) applied to the population reported savings to estimate the gross verified source energy savings for the residential, commercial, and multifamily sectors. The table also presents net-to-gross ratios determined through surveys of participants and contractors to explore free-ridership and spillover, and the resulting net verified source energy savings. The far right column presents the calculated confidence and precision statistics for the sampling error of the M&V and billing regression analysis studies.

Table 3-1: Verified Gross and Net Energy Savings, through- Q3 2013

SECTOR	REPORTED PROJECTS[a]	REPORTED SOURCE SAVINGS (MMBtu)[a]	REALIZATION RATE (%)[b]	GROSS VERIFIED SOURCE SAVINGS (MMBtu)	NET-TO-GROSS RATIO (NTG)	NET VERIFIED SOURCE SAVINGS (MMBtu)	RELATIVE PRECISION[c]
Residential	74,184	2,975,346	70%	2,084,120	0.94	1,960,024	6.9%
Multifamily [d]	21,178	603,432	54%	324,292	0.99	322,749	11.4%
Commercial	3,546	2,240,970	66%	1,479,352	0.85	1,251,359	6.4%
Agriculture [e]	163	32,526	—	—	—	—	—
Total	99,071	5,852,275	67%	3,887,764	0.91	3,534,131	4.5%

[a] Project Level Databases provided by DOE were used to obtain the reported projects and energy saving values.

[b] The billing regression analysis realization rates are defined as the ratio of fuel savings estimated by the billing regression models relative to grantee reported ex-ante savings.

[c] 90% confidence level.

[d] Represents total units treated.

[e] The agriculture sector was not included in the evaluation activities due to a small amount of activity and a lack of data provided by grantees to the evaluation team.

Although some grantees conducted agricultural and industrial upgrades, these projects were not included in the evaluation activities due to their small contribution to total program savings and a lack of data provided by grantees to the evaluation team. Also, we note that we estimated program lifetime savings from the M&V project sample, as well as the lifetime metrics of bill savings and carbon emission reductions, and extrapolated the calculation to the population. Thus, our lifetime estimates do not have the same analytical rigor as the annual savings analysis.

On average, BBNP achieved 15% residential energy savings, 14% multifamily energy savings, and 5% commercial energy savings, as verified by the evaluation from projects through Q3 2013 (Table 3-2) .

Table 3-2: Verified Energy Savings as a Proportion of Usage, through Q3 2014

SECTOR	GRANTEE-REPORTED	VERIFIED ENERGY SAVINGS
Residential	22.0%	15.1%
Multifamily	26.0%	13.8%
Commercial	7.0%	4.6%
Total	(not reported)	10.9%

We estimated the measures installed through Q3 2013 will save 56,725,063 MMBtu over their lifetimes (Table 3-3), based on the projects sampled for the impact evaluation.

Table 3-3: Verified Net Lifetime Source Energy Savings, through Q3 2013

SECTOR*	NET ANNUAL SOURCE SAVINGS (MMBtu)	LIFETIME SAVINGS FACTOR (YEARS)	NET LIFETIME SOURCE SAVINGS (MMBtu)
Residential	1,960,024	18.6	36,456,444
Multifamily	322,749	18.6	6,003,132
Commercial	1,251,359	11.4	14,265,488
Total	3,534,131	—	56,725,063

We estimated participants are saving $40 million annually from reduced energy bills (Table 3-4), based on verified net site savings through Q3 2013 and energy prices during the program period as reported by the U.S. Energy Information Administration (EIA). We estimated lifetime bill savings of $668 million, based on the lifetime savings factors and the energy prices during the program period, as opposed to forecast prices.

Table 3-4: Annual and Lifetime Bill Savings Associated with Verified Net Energy Savings, through Q3 2013

SECTOR	ANNUAL BILL SAVINGS	LIFETIME BILL SAVINGS
Residential	$ 25,074,800	$ 466,391,273
Multifamily	$ 4,128,644	$ 76,792,784
Commercial	$ 11,002,400	$ 125,427,356
Total	$ 40,205,844	$ 668,611,414

3.1.2. M&V ANALYSIS FINDINGS

We combined the realization rates from the final and preliminary evaluations of BBNP in order to derive an overall M&V realization rate that is representative of the entire evaluation timeframe. We combined the realization rates using weights derived from the total reported savings within the final and preliminary sample frames. Table 3-5 presents the combined realization rates by sector.

Table 3-5: Combined Preliminary and Final M&V Realization Rates for Verified Source Savings

SECTOR	REALIZATION RATE FOR Q4 2010 - Q2 2012*	REALIZATION RATE FOR Q3 2012 - Q3 2013	WEIGHT FOR Q4 2010 - Q2 2012*	WEIGHT FOR Q3 2012 - Q3 2013	COMBINED M&V REALIZATION RATE	CONFIDENCE INTERVAL AT 90%
Residential	83%	82%	0.46	0.54	82%	77%-87%
Multifamily	N/A	95%	0.00	1.00	95%	86%-104%
Commercial	106%	83%	0..32	0.68	90%	83%-97%

* A few grantees reported projects completed prior to Q4 2010.

Table 3-6 provides the combined M&V realization rates for fuel types by sector. We did not report realization rates for the other fuel types (that is, fuel oil, propane, wood), due to the limited number of projects within the sample. In addition, there appeared to be reporting issues from some of the grantees with these other fuel types that created calculation issues (that is, no savings reported for projects that actually achieved savings).

Table 3-6: Combined M&V Realization Rates by Sector and Fuel Type

SECTOR	FUEL TYPE	REALIZATION RATE FOR Q3 2012 - Q3 2013	REALIZATION RATE FOR Q4 2010 - Q2 2012*	WEIGHT FOR Q3 2012 - Q3 2013	WEIGHT FOR Q4 2010 - Q2 2012*	COMBINED M&V REALIZATION RATE	CONFIDENCE INTERVAL**
Residential	Electricity	60%	56%	0.60	0.40	59%	51%-67%
Residential	Natural Gas	89%	85%	0.49	0.51	87%	78%-96%
Commercial	Electricity	84%	104%	0.68	0.32	91%	84%-98%
Commercial	Natural Gas	60%	89%	0.73	0.27	68%	47%-89%
Multifamily	Electricity	81%	N/A	1.00	0.00	81%	69%-93%
Multifamily	Natural Gas	108%	N/A	1.00	0.00	108%	87%-129%

* A few grantees reported projects completed prior to Q4 2010.

** 90% confidence level

We extrapolated the M&V sample results to the population using the sector level realization rates. Following the protocol outlined by the California Evaluation Framework, as described in Section 3 and Appendix B of *Savings and Economic Impacts of the Better Buildings Neighborhood Program* (Final Evaluation Volume 2), we calculated case weights and applied the weights to sampled projects by strata. We divided the weighted verified savings by the weighted reported savings to determine the sector realization rate. We applied the realization rate to the sector's population of reported savings to determine the verified gross savings for the sector, and calculated an error bound at 90% confidence to generate the relative precision for the value.[4]

3.1.3. BILLING ANALYSIS FINDINGS

Table 3-7 presents the results of sector-level billing regression models for both electric and gas. In general, our model results were consistent with expectations. Most coefficients had statistically significant estimates and were of expected magnitude. The variable of interest was *Post*, which represented the change in consumption in the post-retrofit installation period and, therefore, was a reflection of energy savings resulting from the program.

4 See Appendix B for additional information on factors contributing to the realization rate estimate.

Table 3-7: Electricity and Natural Gas Billing Regression Model Summary

MODEL SUMMARY	ELECTRICITY		NATURAL GAS	
	Residential	Commercial	Residential	Commercial
Average Monthly Normalized Fuel Usage	938.61	2,266.20	66.74	89.30
Average Post-Retrofit Billing Months	17.0	19.7	17.5	19.9
Average Pre-Retrofit Billing Months	24.5	35.6	30.1	28.6
Adjusted R-Squared Statistic	0.25	0.25	0.74	0.57
Average Monthly Savings (% of usage)	8.13%	12.11%	12.44%	10.25%

Based on the regression analysis, we estimated realization rates for each sector and fuel type. As discussed above, we used billing data from Q4 2010 through Q3 2013 for the final evaluation. Table 3-8 presents the combined billing regression analysis realization rates by sector in MMBtu.

Table 3-8: Billing Regression Analysis Realization Rate by Sector for Q4 2010 through Q3 2013

SECTOR	REALIZATION RATE (PERCENT)	CONFIDENCE INTERVAL*
Residential	52%	48%-56%
Multifamily	21%	19%-23%
Commercial	42%	24%-60%

* 90% confidence level

The billing regression analysis realization rates are defined as the ratio of fuel savings estimated by the billing regression models relative to grantee reported ex-ante savings. Given that the billing regressions consistently yielded savings equal to approximately 10% of pre-retrofit fuel consumption, a realization rate of 50%, for example, implies that claimed savings (as a percentage) was equal to approximately 20%. Therefore, a realization rate lower than 100% implies that the ex-ante savings estimated by the grantees are higher than observed savings. Table 3-9 presents the billing regression analysis realizations rates by fuel type for each sector.

Table 3-9: Billing Regression Analysis Realization Rate by Sector and Fuel Type

SECTOR	FUEL TYPE	REALIZATION RATE (PERCENT)	CONFIDENCE INTERVAL*
Residential	Electricity	59%	55%-63%
Residential	Natural Gas	47%	43%-51%
Commercial	Electricity	21%	12%-30%
Commercial	Natural Gas	42%	20%-64%

Continued…

SECTOR	FUEL TYPE	REALIZATION RATE (PERCENT)	CONFIDENCE INTERVAL*
Multifamily	Electricity	42%	36%-48%
Multifamily	Natural Gas	21%	19%-23%

* 90% confidence level

3.1.4. COMBINING THE M&V AND BILLING REGRESSION ANALYSIS FINDINGS

The next step in the analysis was to combine the findings from the M&V and billing analyses and extrapolate the combined findings to the population. We weighted the individual realization rates from the M&V and billing analyses based on the proportion of reported savings analyzed by each analysis. Table 3-10, Table 3-11, and Table 3-12 present these weighted realization rates and the overall combined realization rate for each sector.

For the residential sector, we incorporated the results of third party evaluations into the realization rate analysis. We reviewed independent evaluations conducted for BBNP programs that closely matched the impact evaluation timeframe and incorporated independently verified savings via a realization rate. We calculated the weight for the third party realization rate by the same approach used to calculate the M&V and billing weights. We were not able to identify third-party evaluations that were appropriate to inform the commercial or multifamily sectors.

Table 3-10: Residential Combined Realization Rate

ANALYSIS	REALIZATION RATE	WEIGHT	COMBINED REALIZATION RATE
M&V	82%	.58	70%
Billing	52%	.34	
3rd Party Evaluation	60%	.08	

Table 3-11: Commercial Combined Realization Rate

ANALYSIS	REALIZATION RATE	WEIGHT	COMBINED REALIZATION RATE
M&V	90%	.65	66%
Billing	21%	.35	

Table 3-12: Multifamily Combined Realization Rate

ANALYSIS	REALIZATION RATE	WEIGHT	COMBINED REALIZATION RATE
M&V	81%	.50	54%
Billing	26%	.50	

3.1.5. NET-TO-GROSS ANALYSIS FINDINGS

We conducted surveys on a sample of BBNP participating end users (the same sample as the M&V analysis) and contractors in an attempt to understand how (and how much) BBNP influenced their participation. Using this self-report method for free-ridership assessment, we estimate residential net-to-gross (NTG) to be 0.94, multifamily to be 0.99, and commercial NTG to be 0.85, as shown in Table 3-13. We applied these net-to-gross ratios to the sector-level gross verified savings to determine the sector-level net verified savings.

Table 3-13: Sector Net-To-Gross Estimates

SECTOR	NET-TO-GROSS RATIO	RELATIVE PRECISION
Residential	0.94	6.9%
Multifamily	0.99	11.4%
Commercial	0.85	6.4%

3.2. ENVIRONMENTAL BENEFITS

We estimated avoided carbon emissions (carbon dioxide equivalent, or CO_2e) of 478,568 metric tons annually and 7,216,526 metric tons over the upgrade lifetimes for upgrades through Q3 2013 (Table 3-14). We calculated the estimated reductions from verified net source savings for each year over the effective useful lifetime of the projects evaluated.

Table 3-14: Verified Annual and Lifetime Avoided Carbon Emissions (CO_2e), through Q3 2013

FUEL TYPE	ANNUAL NET SOURCE SAVINGS (MMBtu)	ESTIMATED ANNUAL CO_2e AVOIDED (METRIC TONS)	ESTIMATED LIFETIME CO_2e AVOIDED (METRIC TONS)
Residential	1,960,024	207,721	3,863,613
Multifamily	322,749	36,842	685,254
Commercial	1,251,359	234,005	2,667,659
Total	3,534,132	478,568	7,216,526

3.3. ECONOMIC BENEFITS

Using an input-output macroeconomic model, we estimated the gross and net economic activity resulting from the $445.2 million expended by BBNP grantees through Q3 2013 (Table 3-15 and Table 3-16), for which ARRA funds provided 95% of the funding. The gross impacts indicate that the ARRA stimulus funds as spent on BBNP contributed about $2 billion dollars and 13,000 jobs FTE to the economy that would not have occurred in the absence of the ARRA stimulus legislation – for a benefit-cost ratio of 4.7. The net impacts indicate that spending on BBNP specifically, rather than on typical federal spending as described by historical, non-defense outlays, contributed over $1.3 billion dollars and 10,000 jobs to the economy that would not have occurred in the absence of BBNP – for a benefit-cost ratio of 3.0.

Table 3-15: Estimated Economic Activity and Tax Revenues, Gross and Net, Q4 2010 through Q3 2013

IMPACT MEASURE	GROSS IMPACTS ($ MILLIONS)	NET IMPACTS ($ MILLIONS)	NET/GROSS RATIO
Economic Activity	**$2,097.1**	**$1,345.0**	**64%**
Intermediate Purchases	$947.8	$769.8	81%
Personal Income	$631.5	$230.2	36%
Small Business Income	$141.9	$111.2	78%
Other Property Income	$311.7	$194.7	62%
Other	$64.2	$39.1	61%
Tax Revenues	**$244.5**	**$129.4**	**53%**
State and Local Taxes	$83.8	$48.6	58%
Federal Taxes	$160.7	$80.8	50%

Table 3-16: Estimated Jobs and Benefit-Cost Ratio, Gross and Net, Q4 2010 through Q3 2013

IMPACT MEASURE	TOTAL GROSS IMPACTS	TOTAL NET IMPACTS	NET/GROSS RATIO
Jobs (FTE)	13,331	10,191	76%
Benefit-Cost Ratio	4.71	3.02	59%

3.4. LEVERAGING

DOE BBNP staff encouraged grantees to offer potential participants loans to ease the first-cost barrier to home and building owners considering upgrades. Some grantees used some of their grant funding to establish revolving loan funds. More commonly, grantees partnered with financial institutions, a practice also encouraged by BBNP staff. Grantees provided financial partners with loan loss reserve funds and interest rate buy-down funds; the financial partners committed loan capital. Grantees reported leveraged loan funds of $618 million. Based on our interviews with 20 partnering financial institutions[5] and our examination of the patterns of missing data for leveraged financial funds in the program database, we corroborate this figure as representing a lower bound of leveraged financial funds.

Grantees also reported leveraged funds from other sources (excluding financial institutions and other federal funds) of about $750 million. Our evaluation did not verify this figure. Together, the leveraged funds from financial institutions and from other sources total about $1.4 billion.

5 See *Process Evaluation of the Better Buildings Neighborhood Program* (Final Evaluation Volume 4), Appendix M.6, for the financial institution interview guide.

4. EARLY INDICATORS OF MARKET EFFECTS

This section summarizes key findings from the market effects evaluation; *Market Effects of the Better Buildings Neighborhood Program* (Final Evaluation Volume 5) presents the findings in greater detail.

Across multiple indicators and from multiple data sources, we found evidence of early indications of market effects influenced by BBNP. These include increased activity in the energy efficiency upgrade market, increased adoption of energy efficient building and business practices, as well as sales of energy efficient equipment, increased marketing of energy efficiency, increased availability of financing, and high levels of consumer awareness of BBNP. We emphasize that these indicators *suggest* BBNP has initiated market change; these indicators *are not proof* that the market has changed or that whatever change BBNP has initiated will persist past the funding cycle. Such conclusions await research conducted several years after this study.

4.1. UPGRADE ACTIVITY, MARKETING, AND MARKET AWARENESS

Around half of participating contractors reported that BBNP had positive impacts on their business and the local energy efficiency market (Table 4-1). In some cases, while large percentages of participating contractors noted a change in the market, a smaller subset reported that BBNP had a great deal of influence on the change. In contrast, relatively small percentages of nonparticipating contractors and distributors (generally 10% or less) indicated that BBNP had positive impacts on their business and the local energy efficiency market or noted a market change. In addition, BBNP contributed to increased marketing by participating contractors, which in turn led to increased upgrades, but BBNP appears to have affected the marketing practices of only a small percentage of nonparticipating contractors.

When asked to estimate the impacts of BBNP on the number of upgrades they completed, participating and nonparticipating contractors reported that BBNP influence had resulted in a net increase in upgrades. We estimate a total of 23,215 net upgrades influenced by BBNP (net upgrades account for free-ridership and spillover) compared to 16,840 BBNP-supported upgrades (upgrades that went through BBNP) for the 25 sampled grantees. Because there was no onsite verification of the spillover upgrades, it is important to emphasize that the estimated net increase in upgrades provides as only a general indication of the magnitude, rather than a precise quantification, of net upgrades.

Table 4-1 provides additional details on findings regarding upgrade activity, marketing, and market awareness.

Table 4-1: Upgrade Activity, Marketing, and Market Awareness Initial Indicators of BBNP Market Effects

INDICATOR	FINDINGS
Increased activity in the energy efficiency upgrade market	
Contractors report BBNP had a positive influence on their business and the marketplace	More than half (56%) of surveyed participating contractors reported BBNP is having a positive impact on their company and the marketplace in general.
	Indication of small impact of BBNP beyond participating contractors; surveyed nonparticipating contractors reported a positive impact on their business (5%) and the marketplace in general (8%).

Continued…

INDICATOR	FINDINGS
Distributors report BBNP had a positive influence on their business and the marketplace	Just under 10% of surveyed distributors reported that BBNP had a positive impact on their business and marketplace in general.
Contractors report BBNP will have a positive influence on their business and the marketplace over the next two years	Nearly half (46%) of surveyed participating contractors anticipate over the next two years a positive impact on their business and marketplace in general due to BBNP. Higher percentages of contractors from the most and average success residential strata agreed there would be more business both for their companies and for the market in general in the next two years because of BBNP than contractors from the top five commercial stratum (a statistically significant difference).
	Smaller percentages of surveyed nonparticipating contractors indicated there will continue to be positive effects on their business (7%) and the marketplace in general (10%).
Distributors report BBNP will have a positive influence on their business and the marketplace over the next two years	Just under 10% of surveyed distributors anticipate over the next two years a positive impact on their business and the marketplace in general due to BBNP.
Contractors report a net increase in the number of energy efficiency upgrades influenced by BBNP	We estimate a total of 23,215 net upgrades influenced by BBNP (net upgrades account for free-ridership and spillover) compared to 16,840 BBNP-supported upgrades (upgrades that went through the BBNP program) for the 25 sampled grantee programs.
Increased marketing of energy efficiency by contractors	
Contractors report increased energy efficient building practices, equipment, and installation; contractors report the increase was influenced by BBNP	60% of surveyed participating contractors and 36% of nonparticipating contractors indicated that their marketing of energy efficiency and energy efficient features had increased since 2010. Larger percentages of participating contractors from the residential grantees reported increasing their marketing compared to participating contractors from commercial grantees (a statistically significant difference).
	29% of surveyed participating contractors and 3% of nonparticipating contractors reported that BBNP had a great deal of influence on their increased marketing.
End user awareness of local BBNP program	
Nonparticipants report being aware of local BBNP program	About one-third of surveyed nonparticipant homeowners in the home improvement market had heard of their local BBNP program; awareness was highest in the territories of most successful grantees (37%) and lowest in the territories of least successful grantees (21%).
Sources of participant awareness of BBNP program	66% of surveyed participant homeowners heard about their BBNP program through publicity sources and about one-third reported hearing about the program from each of the following sources: professional sources, contractor, program sources, and community sources.

4.2. SUPPLY CHAIN BUILDING PRACTICES AND BUSINESS PRACTICES

BBNP appears to have influenced building and business practices among a portion of contractors and distributors in grantee regions (Table 4-2). For example, 72% of participating contractors made changes to their business practices including 60% percent of participating contractors who reported that their services had become more comprehensive to adapt to BBNP; 46% of participating contractors increased their focus on energy efficiency in order to adapt to the program. Further, 34% of participating contractors reported changing their building practices for non-BBNP upgrades. In addition, we found that distributors estimated sales of high efficiency equipment increased during the 2010 to 2013 period, and that small yet notable percentages of distributors reported a positive impact on sales to BBNP, as well as a positive impact on their businesses and the marketplace in general.

Table 4-2 provides additional details on findings regarding supply chain building practices and business practices.

Table 4-2: Supply Chain Building Practices and Business Practices Initial Indicators of BBNP Market Effects

INDICATOR	FINDINGS
Increased energy efficient building practices and equipment installation and sales	
Contractors report increasing their energy efficient building practices and equipment installation; contractors report that BBNP had a high degree of influence	Surveyed participating contractors reported changing their standard practices to be more energy efficient in both BBNP (41%) and non-BBNP (34%) supported upgrades.
	41% of surveyed nonparticipating contractors reported changing their standard practices to be more energy efficient.
	15% of surveyed participating contractors and 3% of surveyed nonparticipating contractors reported BBNP had a great deal of influence on changes in their standard practices.
Distributors report increasing their sales of high efficiency equipment; distributors report the increase was influenced by BBNP	About one-fifth of surveyed distributors of building envelope materials, HVAC equipment, and lighting equipment indicated that BBNP had a positive impact on their sales (17% to 20% for each equipment type).
	Smaller percentages of surveyed commercial equipment distributors noted positive impacts, ranging from 0% to 19% of distributors across equipment types.
	When asked to rate the level of BBNP's positive influence on their sales, small percentages of both residential and commercial equipment distributors indicated that BBNP had a great deal of influence on their sales, ranging from 0% to 8% of distributors of residential equipment and 0% to 1% of distributors of commercial equipment.
Contractors report adopting a whole home retrofit approach to upgrades in nonparticipating homes	Nearly one-half of all surveyed participating contractors reported BBNP training had increased the number of energy efficient upgrades (46% of participating contractors), the quality of the upgrades (45%), and the comprehensiveness or depth of the upgrades since 2010 (44%). Larger percentages of participating contractors from the residential grantees reported BBNP training had increased the number of energy efficient upgrades and the comprehensiveness of the upgrades compared to participating contractors from commercial grantees (a statistically significant difference).

Continued…

INDICATOR	FINDINGS
Supply chain business practices have increased focus on energy efficiency	
Contractors change their business practices to increase their focus on energy efficiency	72% of surveyed participating contractors made a change to their business practices and reported the change was influenced by BBNP. 60% of participating contractors reported that their services had become more comprehensive to adapt to BBNP, 51% had begun partnerships with other firms or contractors to adapt to the program, and 46% had shifted their business to focus more on energy efficiency to adapt to the program.
Distributors change their business practices to increase their focus on energy efficiency	18% of distributors reported changing their business and stocking practices to be energy efficient.
	4% of distributors reported BBNP had a great deal of influence on changes in their standard practices.

4.3. SUSTAINABILITY INDICATORS: TRAINED CONTRACTORS, AVAILABILITY OF FINANCING, AND PERSISTING ACTIVITY

The study found evidence that BBNP influenced energy efficiency financing, but mixed evidence of impacts on trained contactors (Table 4-3). The surveys found large majorities of participating and nonparticipating contractors believed there was increased availability of trained contractors, with over 40% of participating contractors reporting a great deal of influence to BBNP. In addition, nearly half of participating contractors reported that BBNP training increased the number of energy efficient upgrades (46% of participating contractors), the quality of the upgrades (45%), and the comprehensiveness or depth of the upgrades since 2010 (44%).

However, analysis of contractor membership and training organizations did not find evidence of a greater increase in trained contractors in grantee regions compared to non-grantee regions. BBNP enabled participating contractors and distributors to hire additional employees and retain employees, and the IMPLAN economic analysis estimated positive job impacts of BBNP spending and activities.

Table 4-3 provides additional details on findings regarding energy efficiency training, jobs, financing, and persistence.

Table 4-3: Sustainability Indicators: Trained Contractors, Availability of Financing, and Persistence of Activity

INDICATOR	FINDINGS
Increased availability of trained contractors	
Contractors report an increase in the number of trained contractors; contractors reported the increase in trained contractors was influenced by BBNP	86% of participating contractors and 68% of nonparticipating contractors reported that the number of contractors trained in energy efficient building practices had increased since 2010.
	42% of participating contractors and 6% of nonparticipating contractors reported BBNP training had a great deal of influence on the increased number of contractors trained in energy efficient building practices.

Continued…

INDICATOR	FINDINGS
Increased numbers of trained contractors in BBNP grantee regions	The analysis of changes in energy efficiency organization membership and certifications during the period from 2011 to 2013 did not show any early indications of market effects.
Grantees report trained and certified contractors	21 grantees reported providing program-supported training to 5,056 workers and certifying 2,026 workers; remaining grantees did not report these data.
Increased availability of financing for energy efficiency upgrades	
Financial partners report changes in type and amount of loans for energy efficiency upgrades; financial partners reported the change was influenced by BBNP	About three-quarters of financial partners reported a BBNP-generated demand for energy efficiency upgrade loans.
Participants report that improved access to financing was an important factor in completing the upgrade	16% of participant homeowners received loans; of these, 75% rated the loan as playing an important role in their upgrade decision.
Persistence	
Contractors report continuing to offer upgrades	Interviewed participating contractors reported they would continue to offer upgrades; 4 of the 10 interviewed contractors reported there would be no changes to their practices while the remaining 6 anticipated adjusting their practices by scaling back or seeking out other incentive programs or low-interest financing opportunities.
Programs or program features continue	Of 62 grantees and sub-grantees, 52 reported they would continue some program offerings post-grant: 7 would expand their scope or geographic reach; 13 would continue relatively unchanged; and 32 would continue some elements of program offerings or infrastructure.
Financing for energy efficiency upgrades continues	All but one of the grantees with financing reported that financing would continue. 75% of financial partners interviewed reported that they would continue to offer financing for energy efficiency upgrades post-grant; of these, 53% would offer a product supportive of energy efficient upgrades that is different from their BBNP offering.

5. PROCESS EVALUATION FINDINGS

The process evaluation assessed DOE's BBNP activities and BBNP grantee program design and delivery. This section summarizes key findings from the process evaluation; details are presented in *Drivers of Success in the Better Buildings Neighborhood Program – Statistical Process Evaluation* (Final Evaluation Volume 3), *Process Evaluation of the Better Buildings Neighborhood Program* (Final Evaluation Volume 4), and *Spotlight on Key Program Strategies from the Better Buildings Neighborhood Program* (Final Evaluation Volume 6). We drew our findings from qualitative analysis of interviews with grantee staff and stakeholders, multivariate analyses predicting the most important factors driving residential program success, and bivariate analyses identifying patterns in results that differed as a function of grantee success.

5.1. EVIDENCE OF PROGRAM SUSTAINABILITY

We found the following early indicators of program sustainability:

- Grantee programs, or program elements, would continue past the grant period
- Financing for energy efficiency upgrades would continue to be offered past the grant period
- Participating contractors would continue to offer whole home/building upgrades past the grant period
- Participating customers highly rated the value of their upgrades

The majority of the BBNP-funded grantee programs met DOE's sustainability objective of continuing past the grant period to provide services without additional DOE grant funding; 84% of grantees reported that their programs or elements thereof would continue after the grant period ended. The most common source of support was ratepayer funding received by integrating with utility or energy agency home upgrade programs. About one-third of the grantees reported their programs would continue essentially unchanged or expanded in geographic scope or breadth of services, and half reported one or more program elements – most commonly, financing – would continue beyond the grant period.

Three-quarters of financial partners interviewed as part of the process evaluation reported that they would continue to offer financing for energy efficiency upgrades post-grant. About half of these financial institutions planned to continue the loan product they offered for BBNP participants, while a roughly equal proportion planned to modify the loan product in some way.

We examined grantee cost of saved energy ($/MMBtu) over time and found program costs decreased in each subsequent year. Delivery cost for BBNP savings (program-wide $/MMBtu) fell each year of the 3-year program by 30% or more. The third-year program delivery cost was 58% lower than the first-year cost.

5.2. EFFECTIVE DOE PROGRAM ACTIVITIES

DOE's BBNP team supported grantees in many ways the grantees described as valuable. The most valuable activities, according to the grantees, were providing DOE account managers, conducting conferences, and providing peer-learning opportunities. DOE assigned an account manager to each grantee who was effective in helping grantees to develop and implement energy programs and to understand and satisfy grant requirements. Responding

to the ARRA goal of transparency in the use of funds, account managers helped grantees meet requirements to submit ARRA expenditure reports to *Federalreporting.gov* so that BBNP expenditures could be made available to the public via *Recovery.gov*. BBNP also required extensive monthly, quarterly, and final reporting by grantees. BBNP DOE staff developed and maintained a program tracking database and worked with grantees to increase the quantity and quality of reported data. Grantees had access to summary data.

The BBNP team organized numerous conferences – as well as multiple calls and webinars each month – that provided grantees opportunities to learn from experts and each other, to form relationships useful to their grant activities, and to grapple with challenges in a learning environment. The BBNP team built on these program successes – as well as on the program's significant challenges with data reporting – to create a program support infrastructure that will continue long after the grant period, including the Better Buildings Residential Program Solution Center, the Better Buildings Residential Network, and data tracking and reporting tools.

5.3. GRANTEE PROGRAM CONTEXT

Grantees varied widely in terms of the contracting entity, its partnerships, the roles of these multiple entities, and the communities they served. All grantees formed alliances to support their programs, including with utilities and public benefits organizations (at least 43 grantees and subgrantees), financial institutions (46), local government (33), community-based organizations (CBOs; 26), and educational institutions (11).

The grantees typically described flexible approaches that enabled them to be responsive to both favorable and unfavorable market conditions and program experiences; perhaps as a consequence, no specific set of market conditions emerged as determinants of grantee success in the multivariate analyses. However, bivariate analyses did reveal two factors related to success: (1) Program with teams that had at least one highly experienced team member (15 or more years' experience) performed better than programs that did not, and (2) BBNP programs administered by local government staff did not perform as well as programs administered by other organizations.

For most grantees, launching and ramping up their program to optimal operations took a substantial portion of the grant period (on average, 9 months until launch, and an additional 14 months until optimal operations). We defined program success based on grantee achievements, and programs that accomplished more during the grant period typically mobilized – attained optimal operations – faster than programs accomplishing less (18 months compared to 24 months). Bivariate analyses indicate that ramp-up time varied significantly as a function of program success, but this relationship lacked significance in the multivariate analyses. Our analyses did not identify factors explaining ramp-up time; ramp-up time was not affected by whether a grantee's program built upon another pilot or program.

5.4. EFFECTIVE DESIGNS FOR AUDIT AND UPGRADE OFFERINGS

Multivariate analyses found that programs that offered multiple audit types (for example, on-line, walk-through, and audits that use diagnostic equipment) were more successful than those that did not, and that installing measures during the audit was associated with program success. The other audit-related factors explored in our analysis did not appear to be associated with success.

Bivariate analyses found that more successful programs were less likely to require participants to meet a savings target and instead allowed them to install a minimum number of measures or pursue comprehensive audit recommendations. More successful programs were also more likely than the less successful programs to allow

participants to do more than one project (equivalently, to stage their upgrade activities). Grantees noted that staging projects was especially important for the commercial sector, where project costs were high and upgrade activities often required multiple phases to complete, although a number of grantees also thought that residential programs benefited from this approach.

Bivariate analyses also found that the following program characteristics were associated with success: offering upgrade incentives (rebates); offering relatively lower incentives – on the order of 25% of project costs; and conducting effective quality assurance (QA) and quality control (QC). Effective QA and QC provide a foundation for quality upgrades, and interview findings indicated that effective QA and QC were achieved through numerous program design and implementation decisions and follow-through. Our findings indicate the importance of effective Q/QC regardless of the means through which it is attained.

The grantees selected for the spotlight study examining multiple pathways to participation all offered two or more audit types, including a simple option (such as a checklist) and an in-depth option (using diagnostic equipment and energy modeling as warranted) that incorporated energy modeling. About half of the selected grantees developed a single incentive structure that had sufficiently flexible eligibility requirements to allow for varying comprehensiveness levels. The remaining selected grantees established distinct participation paths for projects targeting different levels of comprehensiveness, each with an associated audit type, incentive structure, and upgrade eligibility requirements.

The grantees selected for the spotlight study examining encouragement of deep retrofits used marketing techniques, tiered incentive structures, financing options, and contractor and participant support to motivate participants to complete deep retrofits. The selected spotlight grantees used performance-based incentives (higher rebates for more energy savings) or tied more generous incentives to the installation of more measures. Because the programs were dependent on generous incentives to spur homeowner pursuit of deep retrofits, the program managers expressed concerns about their long-term ability to offer such incentives; nonetheless, the mangers saw evidence of increasing awareness and interest in deep retrofits as the programs matured and the community became more aware of the program offerings and benefits. The selected spotlight grantees also reported that providing homeowner support to understand the upgrade process contributed to the attainment of deep retrofits. (Section 5.6, *Working with Contractors,* describes these grantees' contractor support activities.)

On the whole, BBNP grantees appear to have provided high quality upgrades to their participants; residential participants rated the value of the upgrade significantly higher than did nonparticipating homeowners who had recently conducted an upgrade that included efficiency features.

5.5. MARKETING AND OUTREACH TO DRIVE DEMAND FOR UPGRADE SERVICES

Statistical analyses revealed a number of factors related to driving demand that were associated with success. Multivariate analyses indicated that successful programs sought to increase contractors' sales effectiveness by offering sales training, leveraging the upgrade contractor's pivotal role in the upgrade sale. Bivariate analyses revealed that programs had greater success when they identified specific target populations within their larger target area, and when they tailored their outreach efforts to the size of the target populations.

However, our findings caution against restricting program services to a small, defined geographic area. Most grantees' that initially engaged in such geographic targeting efforts did not generate expected levels of uptake or reduce the prices of energy upgrade measures through economies of scale, except in cases where latent demand

was geographically concentrated. If pursuing outreach to limited geographic areas, findings suggest it is important to carefully select the areas based on the area's likely receptivity to the efficiency message and to engage in a concerted priming effort in the area before offering program services.

Community-based outreach activities and letters to home and building owners appeared to contribute to success, yet canvassing did not appear to be an effective approach, with the possible exception of small outreach campaigns. Engaging credible messengers – such as respected local governmental personnel or homeowner association presidents – in program promotion influenced individuals in those messengers' social networks to undertake upgrades. Successful grantees also were more likely to promote upgrades on the basis of increased comfort.

Collaborating with CBOs also proved an effective outreach strategy for some grantees. CBOs can provide access to selected groups (that is, CBOs can be a channel for targeted outreach) and can engender trust between the program and the CBO's constituents, which lends credibility to the program. CBOs also are familiar with their constituents and are well positioned to tailor messages and outreach strategies to overcome their constituents' particular barriers and meet their specific needs. Productive collaborations between the selected grantees and CBOs took many forms, but certain organizational characteristics facilitated effective collaboration on upgrade programs, as revealed by the spotlight study that examined working with CBOs:

- Stable and long-standing trusted CBOs were in a position to form a reliable relationship with program managers
- CBOs with developed human resources, an active volunteer network, and connections with contractors were able to convey appropriate information to more people
- CBOs whose mission aligned with energy efficiency more easily articulated upgrade benefits and had constituencies who already understood the importance of energy savings

The selected spotlight grantees found that performance-based financial incentives for CBO recruitment did not stimulate a large number of upgrades. CBOs did not meet thresholds required for reimbursement due to limited capacity or unwillingness to dedicate the resources necessary to spur upgrades.

Finally, the study suggests that program administrators wanting to use a marketing contractor should look for firms with energy efficiency experience; among BBNP grantees, those using a marketing contractor appeared to have no greater success than those that did not.

5.6. WORKING WITH CONTRACTORS TO STIMULATE THE SUPPLY OF UPGRADE SERVICES

The more successful programs had relatively larger pools of eligible upgrade contractors than did less successful programs, as determined by multivariate analyses. Successful programs identified, fostered relationships with, and offered multiple types of training to large pools of contractors. Conversely, less successful programs had smaller contractor pools, offered little training, and had relatively infrequent communication with contractors. Multivariate analyses found offering contractor training was a significant predictor of program success. Bivariate analyses also revealed that successful programs were more likely than other programs to provide lists of pre-approved contractors, thereby fostering participant trust in contractors, and to allow participants to contract directly with the service provider,

thereby affording flexibility. Providing financing or equipment to contractors did not appear to significantly enhance contractor participation and program outcomes.

The grantees selected for the spotlight study examining deep retrofits reported contractors were integral to the achievement of deeper retrofits and were able to motivate homeowners to achieve greater energy savings by taking a holistic approach to home energy upgrades, possessing strong communication skills to explain costs and benefits, and recommending multiple measures for each upgrade. They also described the importance of contractor training.

The grantees selected for the spotlight study examining contractor training all offered multiple training opportunities to contractors. The grantees delivered some of these trainings themselves and also engaged implementation contractors, a government agency, a national training vendor, and manufacturer representatives to deliver training. The training sessions and class offerings addressed topics relating to program requirements, business development, sales training, and building science. The selected spotlight grantees provided trainings in a variety of formats. All of the selected grantees provided classroom training (at the grantee offices) and each grantee also provided two additional attendance options including webinars, on-site trainings (at participant sites), and peer-to-peer networking. All of the selected grantees reduced or eliminated financial barriers to participation by offering free training or training subsidies.

The selected program managers reported that many benefits resulted from the contractor training activities, including improved program processes, more comprehensive upgrades, improved quality control, more effective and efficient installation processes, more effective sales approaches, increased rates of conversion from audit to upgrade, enhanced audit quality, and increased revenues for contractor businesses. The selected grantees' experiences also demonstrate the importance of gathering evidence on the effects of training to ensure that the training is attaining its aims. Related to this, several of the grantees noted the importance of adding or revising training throughout the program cycle.

5.7. THE ROLE OF FINANCING IN GRANTEE PROGRAMS

Nearly all (about 90%) of grantees reported using BBNP funds to increase the availability of financing – in many cases at lower rates than otherwise available to borrowers for upgrade projects. These grantees employed one or more mechanisms to increase the availability and attractiveness of loans for upgrades, including: loan loss reserves ($74.6M, 27 grantees), revolving loan funds ($67.7M, 22 grantees), and interest rate buy-down approaches ($10.5M, 15 grantees). Collectively, grantees allocated about 20% of total BBNP award funding to financing. Most grantees determined that program support (such as interest rate buy down or loan loss guarantee) remained necessary to make financing for energy efficiency available at terms more favorable than those offered for loans for other purposes.

BBNP participants received a total of $154 million in program loans; 16% of BBNP residential projects, 6% of multifamily building projects, and 5% of commercial projects received loans. About three-quarters of interviewed financial partners reported a BBNP-generated demand for energy efficiency upgrade loans, as reported above as an early indicator of market effects.

A minority (16%) of BBNP participants received loans, and yet for most of these participants, the availability of the loan was important in their decision-making to pursue an upgrade. Consequently, it appears that although loans may appeal to a minority of participants and do not guarantee program success, attractive, program-supported financing increased uptake of energy upgrades. Well-designed financing components of upgrade programs attracted financial

partners for upgrade programs (both high success and other). Partnering with greater numbers of financial partners was associated with program success in the bivariate analyses, apparently because participants were able to work with financial institutions they already had relationships with, financial institutions competed for business, and financial institutions covered different populations and/or serve different areas.

6. SUMMARY AND RECOMMENDATIONS

6.1. SUMMARY

6.1.1. GOAL AND OBJECTIVE ATTAINMENT

By the end of the three-year evaluation period (Q4 2010 to Q3 2013), BBNP had met the three ARRA goals. Table 6-1 presents, among other findings, our findings of net jobs, net economic activity, and net benefit-cost ratio. For the economic metrics, the term "net" signifies BBNP's contribution to these outcomes above and beyond the outcomes that would have occurred had the BBNP funding been spent according to historical non-defense federal spending patterns.

Table 6-1: Attainment of ARRA Goals

GOALS	METRICS	RESULTS	ATTAINED?[a]
Create new jobs and save existing ones	Number of jobs created and retained	The evaluation estimated 10,191 direct and indirect jobs resulting from BBNP.[b]	Yes
Spur economic activity and invest in long-term growth	Dollars of economic activity; benefit-cost ratio	BBNP spending of $445.2 million in 3 years generated more than: • $1.3 billion in net economic activity (personal income, small business income, other proprietary income, intermediate purchases) • $129.4 million in net federal, state, and local tax revenues Estimated net benefit-cost ratio: 3.0.[b]	Yes
Provide accountability and transparency in spending BBNP funds	Evidence of accountability and transparency	Grantees receiving ARRA funding submitted ARRA expenditure reports. Grant expenditure information was available to the public on *Recovery.gov.* BBNP DOE staff developed and maintained a program tracking database for periodic grantee reporting. Staff worked with grantees to increase the quantity and quality of reported data. Grantees had access to summary data. Evaluator-verified results will be publicly available.	Yes

[a] *"Attained?"* provides an assessment of whether the evidence generated by the evaluation appears to satisfy the goal. This evaluation does not assess causality. That is, we do not rule out the competing hypothesis that some factor other than BBNP may have led to the evidence observed.

[b] See companion report: *Savings and Economic Impacts of the Better Buildings Neighborhood Program* (Final Evaluation Volume 2), Executive Summary.

By the end of the three-year evaluation period, BBNP met four of the seven BBNP objectives (Table 6-2). Unverified program-reported accomplishments for Q4 2013 through Q3 2014 suggest the program likely was successful in meeting all seven objectives by the end of the four-year program period. These findings indicate that BBNP met its objectives to spur energy efficiency upgrade activity, achieve energy savings, and fund the development of programs that expect to continue providing services at the end of the grant period.

Table 6-2: Attainment of BBNP Objectives

OBJECTIVES	METRICS	RESULTS	ATTAINED?[a]	
			3-Year Verified	4-Year Unverified[b]
Develop sustainable energy efficiency upgrade programs	Percent of programs planning to continue after funding Evidence of continuing effects on the retrofit industry	84% of grantees reported that their programs or elements thereof would continue after the 3-year evaluation period.[c] The evaluation found evidence of early indications of market effects, including increased:[d] • Activity in the energy efficiency upgrade market • Adoption of energy efficient building and business practices • Marketing of energy efficiency • Availability of financing Participating contractors reported:[d] • Changing services to be more comprehensive to adapt to BBNP (60%) • Increasing their focus on energy efficiency (46%) • Changing their standard practices in non-BBNP upgrades (34%) • Observing positive impacts on their business and the local energy efficiency market from BBNP (~50%) The Better Buildings Residential Program Solution Center and Better Buildings Residential Network continue to provide examples of replicable comprehensive approaches.[c]	Yes	Yes

Continued…

OBJECTIVES	METRICS	RESULTS	ATTAINED?[a]	
			3-Year Verified	4-Year Unverified[b]
Upgrade more than 100,000 residential and commercial buildings to be more energy efficient	Number of upgrades	The evaluation verified the grantee-reported 99,071 upgrades for the 3-year evaluation.[e] • Unverified, grantees reported 119,404 upgrades for the 4-year program period	No 99%	Likely
Save consumers $65 million annually on their energy bills	Energy bill savings ($)	Verified energy savings for the 3-year evaluation period provide over $40 million in annual bill savings.[e] Close to $700 million lifetime energy bill savings expected (estimated at fuel prices during the program period). Grantees reported: • $60 million in estimated annual bill savings during the 3-year evaluation period • $76 million in estimated bill annual savings through the 4-year program period	No 62%	Unlikely ~ 78% (based on 3-year evaluation findings)
Achieve 15% to 30% estimated energy savings from residential energy efficiency upgrades	Average energy upgrade savings (%)	Verified single-family residential savings: 15.1%.[e] Grantees reported 22% estimated energy savings in single-family residential upgrades.	Yes	Yes
Reduce the cost of energy efficiency program delivery by 20% or more	Average program delivery cost per year ($/MMBtu)	Delivery cost for BBNP savings (program-wide $/MMBtu) fell each year of the 3-year program by 30% or more. Third-year program delivery cost was 58% lower than first-year cost.[c]	Yes	Yes
Create or retain 10,000 to 30,000 jobs	Net number of jobs	The evaluation estimated 10,191 net direct and indirect jobs from BBNP.[e]	Yes	Yes

Continued…

OBJECTIVES	METRICS	RESULTS	ATTAINED?[a]	
			3-Year Verified	4-Year Unverified[b]
Leverage $1 to $3 billion in additional resources	Dollars leveraged	Evaluation interviews with financial institutions corroborated grantee-reported leveraged loan funds of about $618 million. Grantees reported leveraged funds from other sources of about $750 million, for an estimated total leveraged funds of about $1.4 billion.[c]	Inconclusive[f]	Likely

[a] *"Attained?"* provides an assessment of whether the evidence generated by the evaluation appears to satisfy the goal. This evaluation does not assess causality. That is, we do not rule out the competing hypothesis that some factor other than BBNP may have led to the evidence observed.

[b] Our evaluation did not verify fourth-year program achievements. We concluded that objectives that were met by Q3 2013 also were met by the end of Q3 2014. An assessment of "likely" indicates that the unverified data show a trend suggestive of achievement.

[c] See companion report: *Process Evaluation of the Better Buildings Neighborhood Program* (Final Evaluation Volume 4), Executive Summary.

[d] See companion report: *Market Effects of the Better Buildings Neighborhood Program* (Final Evaluation Volume 5), Executive Summary.

[e] See companion report: *Savings and Economic Impacts of the Better Buildings Neighborhood Program* (Final Evaluation Volume 2), Executive Summary.

[f] The evaluation addressed financial leverage amounts only; it did not address other grantee-reported leveraged funds.

Our evaluation also demonstrated that BBNP grantee programs met many of the aspirations described in the BBNP Funding Opportunity Announcement (FOA). DOE solicited grantee applications for program approaches designed to, among other things:

- Deliver verified energy savings from a variety of projects in the local jurisdictions of the grantee, with a particular emphasis on energy efficiency improvements in existing residential, commercial, industrial, and public buildings.
- Produce net economic benefits in excess of program cost.
- Form new alliances (local government, financial institutions, contractor associations, community organizations, etc.).
- Serve as pilot building retrofit programs that demonstrate the benefits of gaining economies of scale and begin to identify the most promising marketing and financing approaches.
- Serve as examples of comprehensive community-scale energy efficiency approaches that could be replicated in other communities across the country, even with less or no on-going government support.

Forty-one grantees and 24 subgrantees conducted building upgrades in 34 states and one territory among communities ranging from a subsection of a single city to an entire state. Grantees upgraded residential, low income, multifamily, commercial, public, industrial, and agricultural buildings; 31 grantees upgraded buildings in multiple sectors. The most successful grantees conducted outreach that reached 33% of residential customers in single-family homes that had recently completed or were anticipating completing, a home improvement project.

Grantees were successful in forming alliances to support their programs with utilities, public benefits organizations, financial institutions, local governments, community-based organizations, and educational institutions. With the help of their financial institution partnerships, about 90% of grantees reported using BBNP funds as loan loss reserves, revolving loan funds, and/or for interest rate buy-down approaches to increase the availability of financing.

Half of the grantees were “starting from scratch,” designing and implementing programs in areas where no related program or pilot had been offered. Even the roughly half of grantees whose programs built on prior programs and pilots nonetheless had to create BBNP-specific teams, processes, documents, tracking systems, and other program elements. The grantees collectively reduced their costs to acquire energy savings in each subsequent year, with year-three costs less than half of their year-one costs.

Over one-third of grantees stated that their most senior staff in each of the areas of program design, implementation, green building trades, and financial institution involvement initially had less than four years of experience – relative newcomers to energy efficiency program administration. Thus, BBNP expanded the number of professionals with substantive energy efficiency experience.

This evaluation assesses BBNP performance over a three-year period. Were the funded local programs to continue for ten years, we would expect program achievements to be higher in later years than in the initial years as grantees gained experience.

We conclude here, based on the preponderance of evidence, that BBNP was one of many influences that has made a net positive contribution to transforming U.S. energy consumption markets, a transformation that is well underway according to respected national analysts. However, adequate time has not passed since the launch of the program to determine whether permanent changes have occurred in energy efficiency markets. Further, we do not rule out the competing hypothesis that some factor other than BBNP may have led to the evidence observed.

6.1.2. ENERGY, ENVIRONMENTAL, AND ECONOMIC IMPACTS

We verified source energy savings of 3,887,764 MMBtu gross and 3,534,131 MMBtu net through the third quarter of 2013 (Table 6-3). We estimated the measures installed through Q3 2013 will save 56,725,063 MMBtu over their lifetimes.

Although some grantees conducted agricultural and industrial upgrades, these projects were not included in the evaluation activities due to their small contribution to total program savings and a lack of data provided by grantees to the evaluation team. Also, we note that we estimated program lifetime energy savings, bill savings, and carbon emission reductions, from the M&V project sample and extrapolated the calculation to the population. Thus, our lifetime estimates do not have the same analytical rigor as the annual savings analysis.

Table 6-3: Verified Gross and Net Energy Savings, through Q3 2013

SECTOR	GROSS VERIFIED SOURCE SAVINGS (MMBtu)	NET VERIFIED SOURCE SAVINGS (MMBtu)	RELATIVE PRECISION (90% CONFIDENCE LEVEL)	NET LIFETIME SOURCE SAVINGS (MMBtu)	VERIFIED ENERGY SAVINGS AS A PROPORTION OF USAGE
Residential	2,084,120	1,960,024	6.9%	36,456,444	15.1%
Multifamily*	324,292	322,749	11.4%	6,003,132	13.8%
Commercial	1,479,352	1,251,359	6.4%	14,265,488	4.6%
Total	3,887,764	3,534,131	4.5%	56,725,063	11.0%

* Represents total units treated.

We estimated participants are saving $40 million annually from reduced energy bills (Table 6-4) based on verified net site savings through Q3 2013 and energy prices during the program period as reported by the U.S. Energy Information Administration (EIA). We estimated lifetime bill savings of $668 million based on the measure lifetime savings and the energy prices during the program period, as opposed to forecast prices.

Table 6-4: Annual and Lifetime Bill Savings Associated with Verified Net Energy Savings, through Q3 2013

SECTOR	ANNUAL BILL SAVINGS	LIFETIME BILL SAVINGS
Residential	$ 25,074,800	$ 466,391,273
Multifamily	$ 4,128,644	$ 76,792,784
Commercial	$ 11,002,400	$ 125,427,356
Total	$ 40,205,844	$ 668,611,414

We estimated avoided carbon emissions (carbon dioxide equivalent, or CO_2e) of 478,568 metric tons annually for upgrades through Q3 2013 and 7,216,526 metric tons over the upgrade lifetimes (Table 6-5).

Table 6-5: Verified Annual and Lifetime Avoided Carbon Emissions (CO2e), through Q3 2013

FUEL TYPE	ESTIMATED ANNUAL CO_2e AVOIDED (METRIC TONS)	ESTIMATED LIFETIME CO_2e AVOIDED (METRIC TONS)
Residential	207,721	3,863,613
Multifamily	36,842	685,254
Commercial	234,005	2,667,659
Total	478,568	7,216,526

Using an input-output macroeconomic model, we estimated the gross and net economic activity resulting from the $445.2 million expended by BBNP grantees through Q3 2013 (Table 6-6 and Table 6-7), for which ARRA funds provided 95% of the funding. The gross economic impacts indicate that the ARRA stimulus funds spent on BBNP contributed about $2 billion dollars and 13,000 jobs (full-time equivalent, FTE) to the economy that would not have occurred in the absence of the ARRA stimulus legislation, with a benefit-cost ratio of 4.7. The net economic impacts indicate that spending on BBNP specifically, rather than on typical federal spending as described by historical, non-defense outlays, contributed over $1.3 billion dollars and 10,000 jobs to the economy that would not have occurred in the absence of BBNP, with a benefit-cost ratio of 3.0.

Table 6-6: Estimated Gross and Net Economic Activity and Tax Revenues, Q4 2010 - Q3 2013

IMPACT MEASURE	GROSS IMPACTS ($ MILLIONS)	NET IMPACTS ($ MILLIONS)
Economic Activity	**$2,097.1**	**$1,345.0**
Intermediate Purchases	$947.8	$769.8
Personal Income	$631.5	$230.2
Small Business Income	$141.9	$111.2
Other Property Income	$311.7	$194.7
Other	$64.2	$39.1
Tax Revenues	**$244.5**	**$129.4**
State and Local Taxes	$83.8	$48.6
Federal Taxes	$160.7	$80.8

Table 6-7: Estimated Gross and Net Benefit-Cost Ratio and Jobs Impact, Q4 2010 – Q3 2013

IMPACT MEASURE	TOTAL GROSS IMPACTS	TOTAL NET IMPACTS
Benefit-Cost Ratio	4.71	3.02
Jobs (FTE)	13,331	10,191

6.1.3. EARLY INDICATORS OF MARKET EFFECTS

We found early indications that BBNP may have helped lead to local market effects. We emphasize that these indicators suggest BBNP has initiated market change; they are not proof that the market has changed or that whatever change BBNP has initiated will persist past the funding cycle. Such conclusions await research conducted several years after this study.

Across multiple indicators and from multiple data sources we found early evidence of local market effects influenced by BBNP. Examples of indicators include increased activity in the energy efficiency upgrade market, increased adoption of energy efficient building and business practices, as well as sales of energy efficient equipment, increased marketing of energy efficiency, increased availability of financing, high levels of consumer awareness of BBNP, and mixed evidence of increases in trained contractors.

BBNP appears to have influenced building and business practices among a portion of contractors and distributors in grantee regions. Large percentages of participating contractors (ranging from 46% to 56%) reported that BBNP had positive impacts on their business and the local energy efficiency market. For example, 60% of participating contractors reported that their services had become more comprehensive to adapt to BBNP, and 46% of participating contractors increased their focus on energy efficiency in order to adapt to the program. Further, 34% of participating contractors reported changing their standard practices in non-BBNP upgrades. Fewer nonparticipating contractors (generally 10% or less) reported the same.

In summary, there is evidence of early indications of market effects, but the effects appear to be concentrated largely on a subset of participating contractors, with much smaller estimated effects among nonparticipating contractors and distributors. Further, our findings indicate that BBNP was successful in stimulating some program activity and in eliciting market change at the utility level and among financial institutions. However, BBNP does not appear to have been successful at creating local markets where efficiency occurs in the absence of any subsidies, as most grantees had not yet developed the market presence to continue self-sustaining programs and needed ratepayer and other financial support.

6.1.4. PROCESS EVALUATION KEY FINDINGS

We report here key qualitative process evaluation findings, several of which amplify the statistically identified contributors to success discussed in the preceding section.

- **Evidence of Program Sustainability:** We found the following early indicators of program sustainability: (1) Grantee programs, or program elements, would continue past the grant period. (2) Financing for energy efficiency upgrades would continue to be offered past the grant period. (3) Participating contractors would continue to offer whole home/building upgrades past the grant period. (4) Participating customers highly

rated the value of their upgrades. The most common source of post-grant support was ratepayer funding received by integrating with utility or energy agency home upgrade programs.

- **Effective DOE Program Activities:** The grantees found the account managers provided to them by DOE to be a valuable asset in helping program managers understand and satisfy grant requirements. Grantees also reported conferences and peer-to-peer learning opportunities as helpful because they could form beneficial relationships, learn from experts and each other, and troubleshoot common problems. Responding to the ARRA goal of transparency in the use of funds, account managers helped grantees meet requirements to submit ARRA expenditure reports to *Federalreporting.gov* so that BBNP expenditures could be made available to the public via *Recovery.gov*.

- **Grantee Program Context:** Grantees varied widely in terms of the contracting entity, its partnerships, the roles of these multiple entities, and the communities they served. All grantees formed multiple alliances with a variety of other organizations to support their programs. Bivariate analyses reveal two factors related to success: (1) Program with teams that had at least one highly experienced team member (15 or more years' experience) performed better than programs that did not, and (2) BBNP programs administered by local government staff did not perform as well as programs administered by other organizations. Bivariate analyses indicate that ramp-up time (time from grant award to program functioning at its best) varied significantly as a function of program success, but this relationship lacked significance in the multivariate analyses. Our analyses did not identify factors explaining ramp-up time; ramp-up time was not affected by whether a grantee's program built upon another pilot or program.

- **Effective Designs for Audit and Upgrade Offerings:** Multivariate analyses found that programs that offered multiple audit types (for example, on-line, walk-through, and audits that use diagnostic equipment) were more successful than those that did not, and that installing measures during the audit was associated with program success. The other audit-related factors explored in our analysis did not appear to be associated with success. For grantees offering multiple audit types, some developed a single incentive structure that had sufficiently flexible eligibility requirements to allow for varying comprehensiveness levels while others established distinct participation paths for projects targeting different levels of comprehensiveness, each with an associated audit type, incentive structure, and upgrade eligibility requirements. Bivariate analyses found that more successful programs were less likely to require participants to meet a savings target and instead allowed them to install a minimum number of measures or pursue comprehensive audit recommendations. Bivariate analyses also found that offering upgrade incentives (and relatively lower incentives – on the order of 25% of project costs) and conducting effective quality assurance (QA) and quality control (QC) were associated with program success.

- **Marketing and Outreach to Drive Demand:** Engaging credible messengers – such as respected local governmental personnel or homeowner association presidents – in program promotion influenced individuals in those messengers' social networks to undertake upgrades. Mailing letters to homes and businesses, and using messaging that emphasized comfort were likely to drive participation. Canvassing was rarely an effective approach. Bivariate analyses revealed that programs had greater success when they identified specific target populations within their larger target area, and when they tailored their outreach efforts to the size of the target populations. However, limiting participation to restricted geographic areas was not an effective approach. Grantees successfully drove upgrade demand by engaging community-based organizations (CBOs) to conduct outreach, although CBO engagements differed in their

effectiveness. Successful grantee-CBO collaborations tended to involve motivated CBOs with sufficient resources to recruit retrofit participants from their constituencies using customized outreach approaches based on the CBO's guiding objectives and capabilities.

Multivariate analyses indicated that successful programs sought to increase contractors' sales effectiveness by offering sales training, leveraging the upgrade contractor's pivotal role in the upgrade sale. Finally, the study suggests that program administrators wanting to use a marketing contractor should look for firms with energy efficiency experience; among BBNP grantees, those using a marketing contractor appeared to have no greater success than those that did not.

- **Working with Contractors to Stimulate Supply:** Successful programs had a larger pool of eligible upgrade contractors and relied on them to sell participants on the value of upgrades. Programs that improved the capabilities of contractors through sales and business training were less likely to be in the least successful cluster. Quality assurance and quality control mechanisms also contributed to improved quality of upgrades. In addition, successful programs were more likely than other programs to provide lists of pre-approved contractors, thereby fostering participant trust in contractors, and to allow participants to contract directly with the service provider, thereby affording flexibility.

  The approaches of grantees selected for the contractor training spotlight study commonly shared six attributes: (1) Training content addressing program, technical, and business needs – especially sales training; (2) expert and trusted trainers; (3) flexible access to training (classroom, web-based, on-site); (4) varied timing and duration of training; (5) robust financial support for attending training; and (6) voluntary training options (with enticements such as food and networking opportunities) that allowed contractors to attend trainings that were most important to them.

- **The Role of Financing in Grantee Programs:** Offering financing was associated with grantee success. About 16% of residential participants obtained financing. Given that most participants did not obtain loans, it is important for program administrators to recognize that financial offerings do not guarantee program success; rather, all aspects of the program design contribute to success.

  Greater numbers of financial partners were associated with program success; apparent contributing factors included increased likelihood that participants could obtain loans from financial institutions with which they had established relationships, competition among financial institutions, and variety among financial institutions in populations and geographic areas served.

While these program elements appear to be effective approaches, our process evaluation findings also suggest there are many paths to success. Grantees' local markets, program models, features, and partnerships varied across many dimensions. We did not find a specific program design to work better than other designs; the program elements we identify here are just a very few of the myriad features describing a program's design and implementation approach.

6.2. RECOMMENDATIONS

We offer the following recommendations to DOE regarding opportunities to capitalize on the achievements of BBNP:

- **Assess the longer-term outcomes of BBNP.** The three-year grant period was too short for grantees to create local or state markets where energy upgrades occur in the absence of ratepayer or taxpayer

subsidies. Further, our process evaluation assessed early success, which may or may not be associated with long-term success. Given these limitations, we recommend that DOE take steps to assess the longer-term impacts of BBNP. This would require tracking the activities of programs developed as part of BBNP and evaluating their progress at points that allow for an assessment of whether BBNP achieved its intermediate and long-term goals.

- **Use BBNP as a model for providing support to other DOE grantees.** Grantee staff generally provided positive feedback on all of DOE's BBNP support activities, especially the assigned Account Manager and the grantee conferences. Given the success of these activities, we recommend that DOE and other program funders model their grantee support activities on those conducted by BBNP when developing similar programs in the future.
- **Capitalize on the infrastructure created during BBNP.** A great deal of infrastructure was created during BBNP, including the Better Buildings Residential Program Solution Center, the Better Buildings Residential Network, and data tracking and reporting tools. We recommend that DOE continue to refine and make use of this infrastructure in its efforts to support building upgrade programs, policies, and investment, as well as building upgrade activity conducted by owners and the retrofit industry.
- **Find creative ways to continue support.** While we found early indications that BBNP may have helped lead to market effects, the indicators are not proof that the market has changed or that whatever change BBNP has initiated will persist past the funding cycle. Sustained market effects for such an innovative practice (whole home or whole building upgrades) in such a short timeframe (grants lasting three years in duration) are difficult to achieve. As a result, we recommend that DOE consider providing support (technical or financial) to highly successful grantees that are continuing to offer their programs. Additional support could help realize BBNP's objective of sustained market effects in the grantee regions.

We offer the following recommendations to upgrade program administrators:

- **Consider our conclusions identifying effective upgrade program approaches.** We report success-related findings statistically associated with program characteristics generally, audits, upgrades, driving demand for upgrade services, stimulating supply of upgrade services, financing, and ongoing program funding. Because this study is unique in its scope of conducting in-depth comparative assessments of over 40 programs, we encourage program administers to consider the extent that application of our study findings might benefit their programs. While we hope our statistical findings on success elements will be useful to program administrators, also we concluded that there is no single approach, no single program feature that is a "must have," nor any that are "avoid at all costs."
- **Develop a program tailored to the unique characteristics of the locale.** It is important for program administers to: understand the experiences of the local contractor population and provide appropriate trainings; tailor messages for subpopulations likely to undergo upgrades; provide multiple participation options; and partner with well-resourced local organizations.
- **Offer multiple pathways to participation.** Consider options for incorporating prescriptive participation pathways – in addition to an energy modeling-based pathway – into whole home retrofit programs, with each pathway designed to encourage participants to install more measures than they might otherwise install.

- **Offer a variety of contractor training.** Training content should address program, technical and business needs – especially sales training – and should be delivered by expert and trusted trainers. Provide training in a variety of formats, duration, and at times of year. Include voluntary training options, allowing contractors to best meet their needs. Offer contractors financial support for training. Develop metrics – such as conversion rates, technology choices or measures included in projects, contractor teaming, and trends in number of contractor projects – to measure training impacts and identify needs for additional training. Look for opportunities to combine training with other program needs – such as quality control activities and obtaining feedback from contractors on program design and implementation – to build mutual communication, understanding, and respect from home upgrade professionals.

- **Carefully design the message and select the messenger to resonate with the targeted group.** Consider using targeted outreach to recruit upgrade participants from among groups with shared social networks and energy efficiency needs. In advance of any geographically targeted outreach, conduct market research to select communities for their likely receptivity to the efficiency message and conduct early educational outreach in those areas to build awareness of energy efficiency benefits before making program offers.

- **Tailor CBO recruitment to the program's needs.** The effective use of CBOs requires program managers to track CBO sign-ups and application assistance, and then make adjustments as needed to recruit and retain only partners that help the program realize its goals. For example, CBOs will differ in their abilities to quickly generate leads or to recruit projects within specific hard-to-reach populations. Allow flexibility in CBOs' outreach approaches; CBO outreach is most effective when CBOs tailor their outreach strategies based on their organization's capacity and mission. Temper expectations for CBO productivity and anticipate the need to provide CBOs support. The value that CBOs provide is based on their position of trust within specific communities, yet such outreach takes time and resources. CBO outreach alone is unlikely to generate sufficient volume to sustain a program.

- **Deep retrofits can be a hard sell; provide clear, flexible program offerings and expect to conduct extensive outreach to generate awareness and understanding.** Deep retrofit programs should build on an existing contractor network and provide technical and sales support to contractors. Collaborate with other program managers offering similar programs to help buy-down the cost of expensive deep retrofits and promote the availability of incentives from multiple sources. Recognize that generating homeowner demand for deep retrofits and a supply of qualified contractors can take several years. Be patient. Periodically revisit previously targeted communities; homeowners who did not initially participate may have gained interest over the interim and early participants may want to pursue additional upgrades.

The grant cycle for BBNP has ended and it is unclear whether or not in the foreseeable future DOE will fund a program on a scale similar to BBNP. Were DOE or another agency to fund a program like BBNP, we offer the following recommendations to foster greater consistency in program expectations, design, tracking, and reporting:

- **Plan and develop a comprehensive and easy to use data tracking and reporting system available to grantees at the time of funding their award.** Due to the size of the funding pool and the needed speed at which it was issued, there was a limited focus on program evaluation and reporting needs when BBNP was designed and launched. The resulting tracking and reporting processes were cumbersome, inconsistent, and frustrating for both grantees and DOE. It is critical that for any future successful and streamlined

program, consideration be given to both the data tracking and reporting needs and the data verification and evaluation needs.

- **Require grantees to ensure the consistency of project-level tracking values with overall report totals.** One of the main reasons the Project-Level data did not match the Program-Level data was that there was no process whereby grantees matched the individual savings totals from each project to the total savings achieved for the reporting period. This inherently created an opportunity for discrepancies.
- **Require consistent documentation procedures across all grantees and programs.** Grantees had varying information on projects implemented through their programs. Future program design should outline documentation procedures and needs for measure-level, project-level, and program-level reporting, and should provide definitions of key terms.
- **Require accountability for quality control practices across programs and provide support to grantees that demonstrate insufficient quality assurance/ quality control.** The evaluation team found a lack of data regarding the reported measures installed at project sites. This is a complex issue and relies on accurate and comprehensive grantee data collection and reporting. In the interest of understanding measure-specific implementation data, there should be more scrutiny on this level of information received.
- **Consider a requirement of timely and accurate reports as a condition of funding payments.** While most grantees complied with stipulations regarding reporting, it appeared that some grantees did not take the time to accurately report their savings. For future programs, DOE could assess whether they should consider a potential model for paying out funding over time as grantees meet certain reporting requirements.
- **Compile a single final dataset to be used for reporting and evaluation purposes to ensure consistency of results across reporting activities.** The program manager should assure data quality by the conclusion of the evaluation period and a single final dataset issued to the evaluation team to avoid evaluation inefficiencies.
- **Recognize that programs take months to design, implement, and ramp-up to optimal performance.** Program goals should anticipate an initial period with little to no goal attainment.

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APPENDICES

APPENDIX A. GRANTEE AWARDS

Table A-1 provides a list of grantees sorted alphabetically. Table A-2 identifies the grantees in decreasing order of grant award.

Table A-1: BBNP Grant Recipients

GRANTEE NAME	TOTAL GRANTED
ADECA, AL (SEP)	$3,013,751
Austin, TX	$10,000,000
Boulder County, CO	$25,000,000
Camden, NJ	$5,000,000
Chicago Metro Agency for Planning	$25,000,000
Commonwealth of MA (SEP)	$2,587,976
Connecticut Innovations, Inc.	$4,171,214
CSG, Bainbridge Island, WA	$4,884,614
Eagle County, CO	$4,916,126
Fayette County, PA	$4,100,018
Greater Cincinnati Energy Alliance	$17,000,000
Greensboro, NC	$5,000,000
Indianapolis, IN	$10,000,000
Kansas City, MO	$20,000,000
Los Angeles County, CA	$30,000,000
Lowell, MA	$5,000,000
NYSERDA	$40,000,000
Omaha, NE	$10,000,000
Philadelphia, PA	$25,000,000
Phoenix, AZ	$25,000,000
Portland, OR	$20,000,000
Rutland, VT	$4,487,588
San Antonio, TX	$10,000,000
Santa Barbara County, CA	$2,401,309
Seattle, WA	$20,000,000
Southeast Energy Efficiency Alliance	$20,000,000

Continued…

GRANTEE NAME	TOTAL GRANTED
St. Lucie County, FL	$2,941,500
State of Maine	$30,000,000
State of Maine (SEP)	$4,538,571
State of Maryland	$20,000,000
State of Michigan	$30,000,000
State of Michigan (SEP)	$4,994,245
State of Missouri	$5,000,000
State of Nevada (SEP)	$5,000,000
State of New Hampshire	$10,000,000
Toledo-Lucas Co. Port Authority (OH)	$15,000,000
Town of Bedford, NY	$1,267,874
Town of University Park, MD	$1,425,000
VDMME, VA (SEP)	$2,886,500
WDC, WA (SEP)	$2,587,500
Wisconsin Energy Efficiency Project	$20,000,000
Total	*$508,203,786*

Table A-2: BBNP Recipient Grant Recipients in Decreasing Order of Grant Amounts

GRANTEE NAME	TOTAL GRANTED
NYSERDA	$40,000,000
Los Angeles County, CA	$30,000,000
State of Maine	$30,000,000
State of Michigan	$30,000,000
Boulder County, CO	$25,000,000
Chicago Metro Agency for Planning	$25,000,000
Philadelphia, PA	$25,000,000
Phoenix, AZ	$25,000,000
Kansas City, MO	$20,000,000
State of Maryland	$20,000,000
Portland, OR	$20,000,000
Seattle, WA	$20,000,000

Continued…

GRANTEE NAME	TOTAL GRANTED
Southeast Energy Efficiency Alliance	$20,000,000
Wisconsin Energy Efficiency Project	$20,000,000
Greater Cincinnati Energy Alliance	$17,000,000
Toledo-Lucas Co. Port Authority (OH)	$15,000,000
Austin, TX	$10,000,000
Indianapolis, IN	$10,000,000
State of New Hampshire	$10,000,000
Omaha, NE	$10,000,000
San Antonio, TX	$10,000,000
Camden, NJ	$5,000,000
Greensboro, NC	$5,000,000
Lowell, MA	$5,000,000
State of Missouri	$5,000,000
State of Nevada (SEP)	$5,000,000
State of Michigan (SEP)	$4,994,245
Eagle County, CO	$4,916,126
CSG, Bainbridge Island, WA	$4,884,614
State of Maine (SEP)	$4,538,571
Rutland, VT	$4,487,588
Connecticut Innovations, Inc.	$4,171,214
Fayette County, PA	$4,100,018
ADECA, AL (SEP)	$3,013,751
St. Lucie County, FL	$2,941,500
VDMME, VA (SEP)	$2,886,500
Commonwealth of MA (SEP)	$2,587,976
WDC, WA (SEP)	$2,587,500
Santa Barbara County, CA	$2,401,309
Town of University Park, MD	$1,425,000
Town of Bedford, NY	$1,267,874
Total	*$508,203,786*

APPENDIX B. ASSESSING GRANTEE SUCCESS

A primary goal of our evaluation was to identify factors that drove or inhibited success among grantees' and subgrantees' residential upgrade programs. To support the statistical investigation of effective approaches to delivering residential upgrade programs, *Drivers of Success in the Better Buildings Neighborhood Program – Statistical Process Evaluation* (Final Evaluation Volume 3) identified 12 diverse quantitative performance indicators, such as average MMBtu savings per project, program cost per upgrade, and progress toward upgrade goal. We then clustered grantees into groups based on their performance on the 12 metrics using grantee-reported residential activity data (Q4 2010 to Q3 2013). The analyses yielded three groups of grantees whose average performance on the 12 metrics were consistent with an interpretation of a most successful group, an average group, and a least successful group.

We emphasize here that the Volume 3 analysis used the grantee success clustering only to identify programmatic elements associated with stronger performance relative to other grantees, a research objective important to the DOE BBNP team. As we note elsewhere, grantee success during the three-year evaluation period was associated with the length of time programs took to reach optimal functioning; the most successful grantees reached the optimum point in their programs six months sooner than less successful grantees. However, we did not find that grantee success was driven by prior whole home program experience. Nonetheless, were the grantee programs to continue for ten years, we would expect program achievements to be higher in later years than in the initial years as grantees gained experience in their markets and adjusted their programs accordingly.

As we report in Volume 3, using both data that grantees reported to U.S. Department of Energy in partial fulfillment of their grant requirements and data collected by our team, we conducted a series of statistical analyses to develop a quantitative definition of grantee success that corresponds to Better Buildings Neighborhood Program's multiple program objectives and to identify program features and characteristics that predict success.

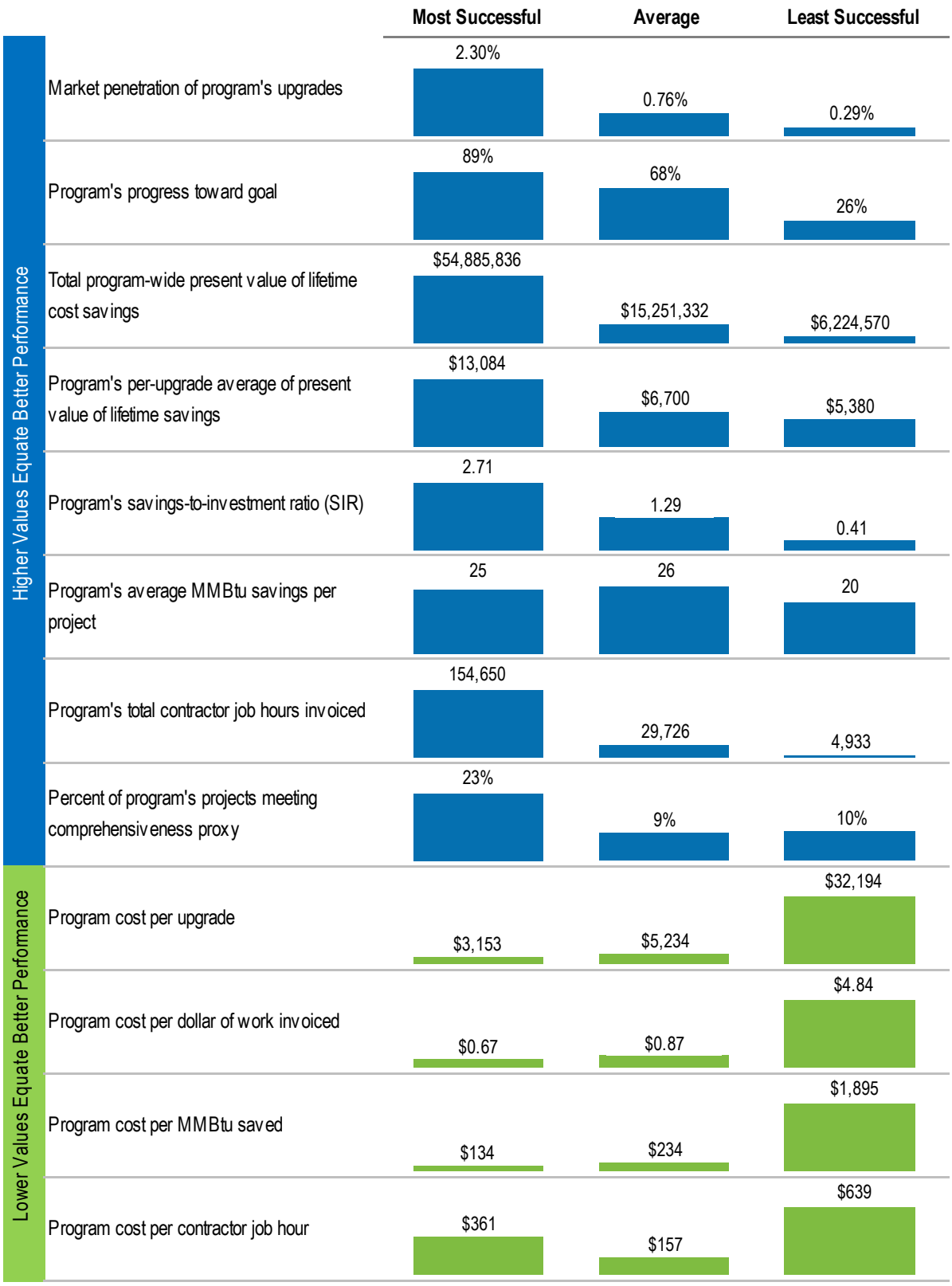
Due to the greater availability of data for residential programs compared with multifamily and commercial programs, the Volume 3 success analysis focused exclusively on residential programs. Further, if a grant recipient had subgrantees that ran separate and distinct programs in mutually exclusive regions, we collected and analyzed data from each individual subgrantee to capture the full diversity of program models, outcomes, and market characteristics. A total of 54 grantees and subgrantees with residential programs were included in these analyses.

First, we defined a broad range of potential measurements of program success based on theory and industry knowledge. From this list, we identified 12 quantitative performance metrics for which there was adequate data. We then conducted latent profile analysis (LPA) to cluster programs into groups that exhibited similar performance on the 12 performance metrics. LPA is an exploratory analytical technique, and our analyses sought to identify groups, or clusters, of grantees that differed meaningfully in their performance on 12 metrics of program success.

The LPA yielded three groups; their average group values on the 12 performance metrics were consistent with an interpretation of a most successful cluster (n = 12), an average cluster (n = 35), and a least successful cluster (n = 7). The most successful cluster generally performed best on each of the metrics, the least successful cluster generally performed worst on the metrics, and the average cluster demonstrated mid-range values on the performance metrics. Thus, the LPA revealed clusters of grantees that were more or less successful relative to one another. Figure B-1, a copy of Figure 3-1 in Volume 3, demonstrates these tiered levels of grantee success by displaying the average cluster means for each of the 12 performance metrics.

Next, we identified grantee and program characteristics that may predict program success and compiled the corresponding data. This dataset also included exogenous variables we deemed as critical control variables, such as weather metrics, average energy price, median income, and other variables that may affect energy use, savings, and participation rates. We used bivariate logistic regression to explore whether any of the proposed predictor variables predicted membership in either the least successful cluster or the most successful cluster, respectively. We report the bivariate findings in companion volume *Process Evaluation of the Better Buildings Neighborhood Program* (Final Evaluation Volume 4). Next, we ran multivariate regression models for each dependent variable (membership in the least successful cluster versus other and membership in the most successful cluster versus other) using the independent variables identified as meaningful predictors in the aforementioned bivariate models. We report the multivariate findings in Volume 3. Findings relevant to the process evaluation will be discussed throughout this volume. For additional information on the methods used to identify the grantee success clusters, please see Volume 3.

Figure B-1: Performance Metric Cluster Means (n = 54)



APPENDIX C. FACTORS CONTRIBUTING TO IMPACT ANALYSIS REALIZATION RATE ESTIMATE

Over the course of the Measurement and Verification (M&V) activities, we uncovered projects with significant differences between the reported values and the gross verified findings. The following describes our understanding of the main reasons for some of the largest discrepancies:

1. **No reported savings.** During the preliminary evaluation, we discovered that some grantees did not report savings for their projects despite our verification of project savings. For the final evaluation, we designed the sample to try and reduce the number of projects with zero reported savings; however, the final evaluation sample had approximately 6% of electricity savings reported as zero and 3% of natural gas savings reported as zero.

1. **Measures installed and not reported.** We encountered grantee projects with incomplete measure reporting. This reduced the amount of savings below what the grantee should have credited for these projects. For some projects, the grantee only reported the energy savings associated with one measure, but our review of their documentation and our participant surveys revealed that numerous measures were actually implemented.

2. **More measures reported than verified.** Conversely, there also were cases of measures reported as installed, where the M&V activities verified that they were not installed. This often occurred where *recommended* measures from an audit were counted as *installed.*

3. **Overstatement of savings.** In a few cases, we identified issues where the energy savings reported by the grantee was more energy than was actually consumed by a typical customer. This likely was due to energy modeling issues, but because the models could not be calibrated or the inputs verified, it was difficult to know the exact reasons.

4. **Heat pump installations.** We encountered projects that resulted in the replacement of a primary heating system, such as a natural gas furnace or resistance heater, with heat pumps. Project documentation usually calculated savings as the displaced energy consumption of the previous system; however, documentation was often lacking as to the energy consumption of the new heat pump, especially with the potential new cooling load provided by the heat pump.

5. **Fuel type reporting issues.** There were cases where grantees reported fuel type savings incorrectly, by either listing the wrong fuel type or listing the wrong units (that is, MMBtu instead of kWh).