Better Buildings
NEIGHBORHOOD PROGRAM
U.S. DEPARTMENT OF ENERGY

Virginia State Energy Program Summary of Reported Data From July 1, 2010 – September 30, 2013

Better Buildings Neighborhood Program

Report Produced By:
U.S. Department of Energy
June 2014

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

ACKNOWLEDGMENTS

This document presents a summary of data reported by an organization awarded federal financial assistance (e.g., grants, cooperative agreements) through the U.S. Department of Energy's (DOE's) Better Buildings Neighborhood Program (BBNP) from July 2010 or September 2010 through September 30, 2013. Although some awards have been extended into 2014, only the data reported through the end of September 2013 are included in this document.

We would like to thank the BBNP recipients who submitted these data, reviewed the information in this document, and provided revisions. We appreciate their perseverance and patience with the reporting process.

We would also like to thank Rebecca Ciraulo and Aayush Daftari at Navigant Consulting and Dave Roberts and Mike Heaney at the National Renewable Energy Laboratory (NREL) for compiling the quarterly information and the graphs and tables for this report.

Please contact Dale Hoffmeyer at betterbuildings@ee.doe.gov with any questions about this report.

VIRGINIA STATE ENERGY PROGRAM SUMMARY OF REPORTED DATA

TABLE OF CONTENTS

Virginia State Energy Program Summary of Reported Data 1

1.1 Introduction 1

1.2 Source of Data 2

1.3 Data Quality 3

1.4 Funding Synopsis 4

1.5 Program Design Synopsis 5

1.6 Driving Demand Synopsis 6

1.7 Financing Synopsis 7

1.8 Workforce Development Synopsis 8

1.9 Estimated Energy Savings Synopsis 9

1.9.1. Estimated Lifetime Energy Savings per Upgrade Analysis 10

APPENDIX A: Glossary of Terms 13

APPENDIX B: Methodology to Calculate Source Energy Savings 18

APPENDIX C: Lifetime Energy Savings Calculations 20

Better Buildings
NEIGHBORHOOD PROGRAM
U.S. DEPARTMENT OF ENERGY

VIRGINIA STATE ENERGY PROGRAM SUMMARY OF REPORTED DATA

VIRGINIA STATE ENERGY PROGRAM SUMMARY OF REPORTED DATA

Awardee Number	Recipient Name	State	Total Grant
4442	Virginia Department of Mines, Minerals and Energy	Virginia	$2,886,500

1.1 Introduction

This document presents a summary of data reported by an organization awarded federal financial assistance (e.g., grants, cooperative agreements) by DOE's BBNP from July 2010 or September 2010 through September 30, 2013. Although some awards were extended into 2014, only the data reported through the end of September 2013 are included in this document.

This document is not an evaluation of the recipient's BBNP program or a final report of the recipient's activities. The purpose of this document is to provide a summary of data reported quarterly by recipients. As the programmatic and building upgrade project data reported quarterly by each recipient is released, it will be available on the BBNP website at http://energy.gov/eere/better-buildings-neighborhood-program/progress. This report may be useful to researchers and others who plan to study what recipients reported.

This document, and one like it for each BBNP award recipient, follows a similar structure with graphs and tables. Each document includes the following sections: Funding Synopsis, Program Design Synopsis, Driving Demand Synopsis, Financing Synopsis, Workforce Development Synopsis, and Energy Savings Synopsis. A similar document showing results from all BBNP recipients titled *Better Buildings Neighborhood Program Summary of Reported Data* is also available on the BBNP website.

Two additional sources of information may be useful to researchers interested in the accomplishments of BBNP award recipients. The first is an independent evaluation of BBNP conducted by Research Into Action, NMR Group, Nexant, and Evergreen Economics. A Preliminary Process and Market Evaluation report was released in December 2012, and a Preliminary Energy Savings Impact Evaluation report was released in November 2013. Final reports will be released in 2014 and 2015. Second, as the recipient's final technical report is completed, it will be available online on the BBNP website. The final technical report was written by the recipient and contains more detailed information about the recipient's accomplishments and lessons learned. Some recipients conducted independent evaluations of their programs, and the final technical report is a source for locating those evaluations.

VIRGINIA STATE ENERGY PROGRAM SUMMARY OF REPORTED DATA

1.2 Source of Data

BBNP included 34 (i.e., 25 Topic 1 and 9 Topic 2) competitively awarded Recovery and Reinvestment Act (ARRA or Recovery Act)-funded Energy Efficiency Conservation Block Grants (EECBGs) and 7 competitively awarded FY10-funded State Energy Program (SEP) cooperative agreements. Topic 1 EECBGs were awarded at the beginning of June 2010, Topic 2 EECBGs were awarded in August 2010, and SEP agreements were awarded in October 2010. The first Quarterly Program Reports were due from recipients for Q4-2010 (grant start date through December 30, 2010) regardless of when the awards occurred.

All BBNP financial assistance agreements were originally set to expire between May and September 30, 2013. Four EECBGs awards were completed in 2013 (i.e., Toledo, Ohio; Connecticut; Omaha, Nebraska; and University Park, Maryland).The remaining agreements were modified to expire in 2014. For awards with an extended expiration date, the BBNP spending in this report will not equal the total awarded amount.

Organizations that received federal financial assistance under BBNP were required to submit a quarterly Federal Financial Report (SF-425), DOE Progress Report, and a BBNP Program Report. Most of the information in this document is based on recipient's' BBNP Program Report submissions. A copy of the BBNP Program Report (Excel Template) may be obtained by emailing betterbuildings@ee.doe.gov. Recipients were also given the option to submit Program Report information via XML Web service.

EECBG awards were funded by the American Recovery and Reinvestment Act (ARRA or Recovery Act). All federal recipients of ARRA funds were required to submit quarterly ARRA reports, in addition to agency-specific reports, via the ARRA federal reporting website. Information reported under the authority of ARRA is available on www.recovery.gov. Estimated job creation information in this report was obtained from www.recovery.gov.

EECBG (34) and SEP (7) awards had slightly different mandatory reporting requirements for BBNP Quarterly Program Reports. For example, reporting job hours worked was mandatory for EECBG awards and voluntary for SEP. Reporting workers trained and certified was mandatory for SEP awards and voluntary for EECBG. Reporting the number of active contractors performing building upgrades under the program was mandatory for EECBG awards and voluntary for SEP.

1.3 Data Quality

The data summary provided in this document is based on information recipients formally submitted to DOE using the BBNP Quarterly Program Report or ARRA report (EECBG only). Recipients reported quarterly totals for some information like spending, estimated energy savings, assessments completed, and workers trained or certified. Information like invoiced cost and loan amount was reported for each upgrade project. A total invoiced cost or loan amount is obtained from summing all the values reported for each upgrade project record that included this information. Estimated energy savings was reported as a total for the quarter and an estimate was reported for each upgrade project. Where appropriate, the percent or quantity of upgrade projects that had complete information has been indicated. These upgrade project records were used to determine some values in the figures and tables.

The data reported by recipients may include three types of errors: non-response, incorrect response, or processing errors.

Non-Response: Although some data in the BBNP Program Report was mandatory and other information was optional, not all recipients consistently reported the mandatory data elements. Missing mandatory data elements can be characterized as not available, not applicable, or not reported.

Incorrect Response: Data reported by recipients could be incorrect because the requested information was not understood; there was a lack of attention to detail; or information was misrepresented.

Processing Errors: Data reported could also be incorrect because of errors introduced when extracting the data from Program Reports and loading it into a central database. Processing errors can also be introduced when querying the central database to provide summary information.

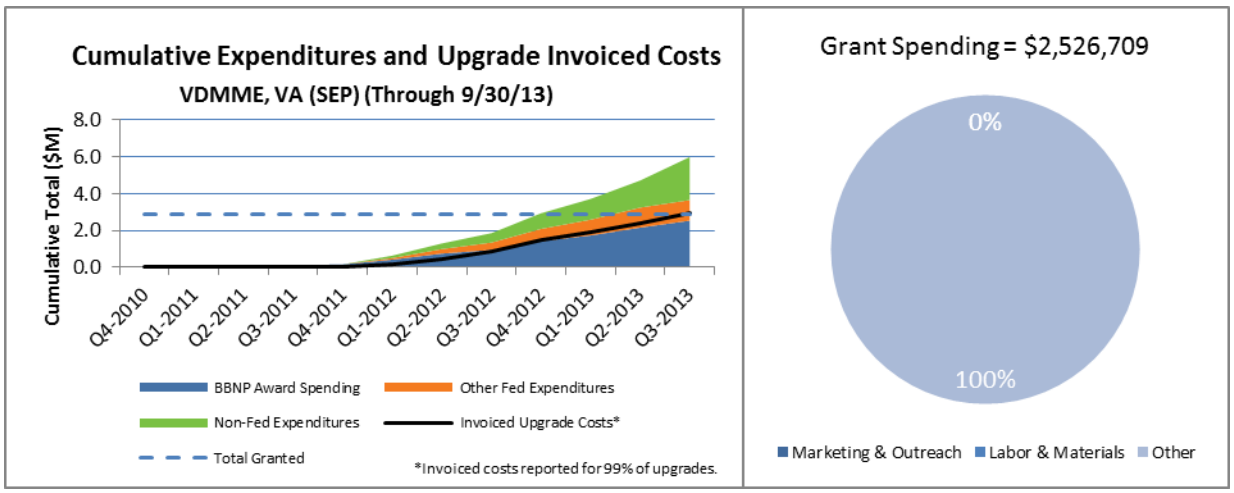
DOE made several attempts to ask recipients to provide missing information and to verify the information that was reported. For example, recipients were provided a summary of what had been reported and a list of data quality issues following each quarterly reporting period, along with numerous requests to correct errors.

VIRGINIA STATE ENERGY PROGRAM SUMMARY OF REPORTED DATA

1.4 Funding Synopsis

The Virginia Department of Mines, Minerals and Energy (VDMME) received a $2,886,500 SEP grant. Figure 1 shows total recipient expenditures, other federal expenditures,[1] and non-federal expenditures[2] (e.g., leveraged spending) compared to the total investment in building upgrades (reported as invoiced cost). The total investments in building upgrades exceeded BBNP spending.

Figure 1. Virginia SEP Cumulative Expenditures and Upgrade Invoiced Costs



The pie chart in Figure 1 shows BBNP spending by category. Due to the multiple program implementers involved in the Virginia program, the BBNP grant spending was not broken down into sub-categories of marketing and outreach, labor and materials, and other program expenses. All spending was reported as other program expenses.

[1] Other federal expenditures may include additional federal financial assistance award funds or loans from DOE or another federal agency.

[2] Non-federal expenditures may include third-party, in-kind contributions and the portion of the costs of a federally assisted project or program not borne by the federal government. This should include building owner contributions to building upgrade project cost.

VIRGINIA STATE ENERGY PROGRAM SUMMARY OF REPORTED DATA

1.5 Program Design Synopsis

The State of Virginia worked with counterparts in Alabama, Massachusetts, and Washington to model a state energy program that could be replicated in other areas of the country. The program tested a variety of efforts to increase homeowner demand for upgrades, provide affordable financing, and create new jobs in Virginia.

The program encouraged homeowners, home improvement professionals, and real estate agents to use the Energy Performance Score (EPS) rating system developed by the Earth Advantage Institute. An EPS assessment provides data on the estimated energy consumption and carbon emissions of a home. Homeowners can use the score to evaluate potential upgrades and monitor their progress over time. Building professionals can use the EPS assessment to determine which energy efficiency upgrades will have the greatest impact on energy usage. Real estate agents can use the EPS to promote the value of energy-efficient homes in the market.

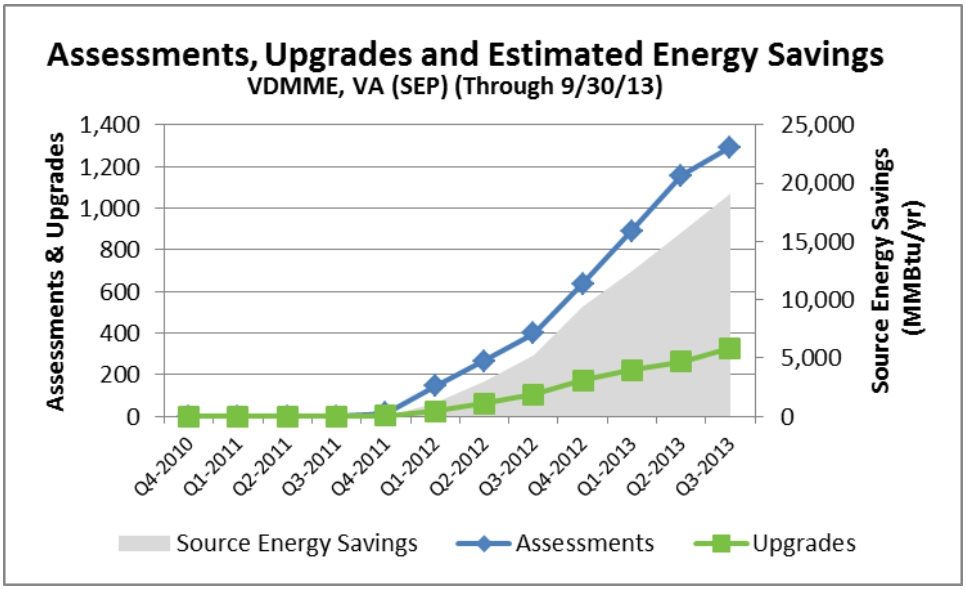
VIRGINIA STATE ENERGY PROGRAM SUMMARY OF REPORTED DATA

1.6 Driving Demand Synopsis

Virginia's program developed marketing tactics to educate homeowners on the benefits of energy efficiency improvements, including lower energy bills and increased comfort. The program partnered with local nonprofit organizations, known as Regional Energy Alliances (REAs), to undertake projects in Charlottesville, Richmond, Arlington County, Blacksburg, and Roanoke.

Virginia's REAs developed community-based social marketing strategies based on research that indicated that homeowners are more receptive to learning about energy efficiency from someone they know and trust in their community. The partner organizations selected had strong relationships with local community leaders and encouraged them to serve as ambassadors for the program. Figure 2 shows the cumulative energy assessments and upgrades reported by VDMME from all building sectors through 9/30/13 and the estimated annual source energy savings[3] (right axis).

Figure 2. Virginia SEP Assessments, Upgrades, and Estimated Savings



	Residential Single-Family	Residential Multi-Family Units	Commercial Buildings	Industrial Buildings	Agricultural Buildings
Assessments	1292	0	0	0	0
Upgrades	327	0	0	0	0

[3] Source energy, also called primary energy, is the amount of fossil fuels and electricity plus the losses associated with the production of electricity (i.e., losses that occur in the generation, transmission, and distribution). Total estimated source energy savings was calculated by DOE. See Appendix B.

VIRGINIA STATE ENERGY PROGRAM SUMMARY OF REPORTED DATA

1.7 Financing Synopsis

Table 1 shows the grant funding investments in revolving loan funds (RLFs), loan loss reserves (LLRs), or interest rate buy-down (IRBDs).

Table 1. Financing Investments and Results (Through September 30, 2013)

Financing Investments and Results (Through 9/30/13)	
RLF (Commercial)	$0
RLF (Residential)	$0
Percent of Total Award Invested in RLF	0%
LLR (Multi-Sector)	$0
LLR (Commercial)	$0
LLR (Residential)	$0
Percent of Total Award Invested in LLR	0%
Interest Rate Buy-Down	$0
Total Financing Investment	$0
Percent of Total Award	0%
Total Capital (Private and Other Non-BBNP) Leveraged for Lending	$0
Results	
Amount Loaned Out (Residential)	**$335,248**
Number of Loans (Residential)	**42**
Average Loan Amount (Residential)	**$7,982**

VDMME established three LLR funds in three different areas of the state to assist homeowners in financing deep energy efficiency retrofits in their homes. Funding for the LLRs of $300,000 was provided by another federal grant (ARRA/EECBG) and is not reflected in Table 1. Leveraging these other federal funds allowed the VDMME to use the BBNP grant to fund homeowner and contractor financial incentives.

VIRGINIA STATE ENERGY PROGRAM SUMMARY OF REPORTED DATA

1.8 Workforce Development Synopsis

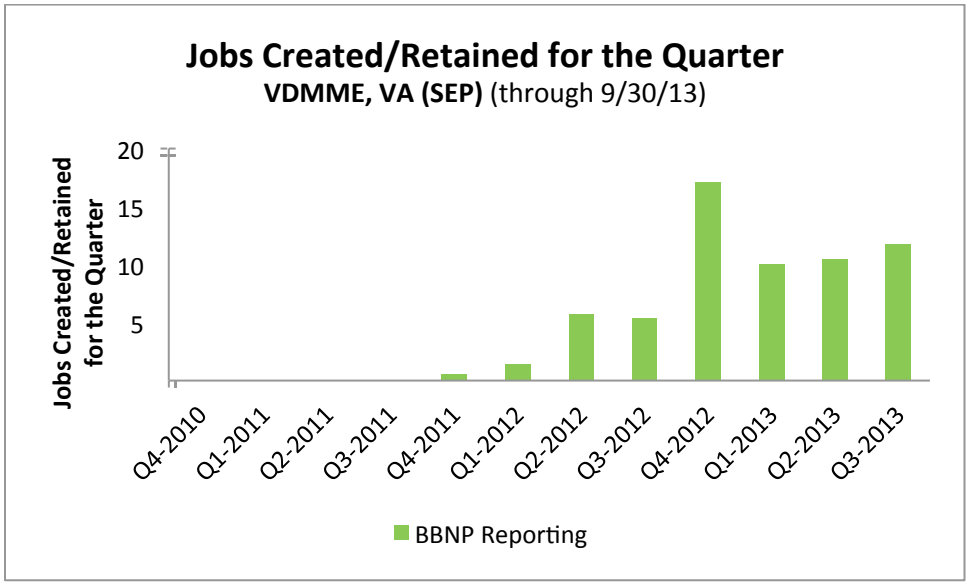
Table 2 shows the total number of workers trained and certified as reported by recipients. Most recipients reported the number of workers trained and certified each quarter; the table shows the cumulative total through September 30, 2013. The table also shows the number of active participating contractors reported by recipients for one quarter. The number of participating contractors may increase or decrease each quarter. However, it is not summed across quarters because many of the same contractors actively participated during multiple quarters. Therefore, only the number of participating contractors reported in the most recent quarter is provided in the table.

Table 2. Workforce Development Results (Through September 30, 2013)

Workforce Development Results[4] (Through 9/30/13)	
Number of Trained Workers	301
Number of Certified Workers	164
Active Participating Contractors (Q3-2013)	49

Figure 3 shows jobs created or retained. This is estimated based on total hours worked during the quarter reported by the recipient divided by 520 hours per quarter.

Figure 3. Virginia SEP Jobs Created/Retained for the Quarter[5]



[4] Reporting the number of trained and certified workers was mandatory for SEP and voluntary for EECBG. Reporting the number of active contractors was mandatory for EECBG and voluntary for SEP.
[5] Reporting job hours worked was mandatory for EECBG and voluntary for SEP.

VIRGINIA STATE ENERGY PROGRAM SUMMARY OF REPORTED DATA

1.9 Estimated Energy Savings Synopsis

Recipients reported estimated energy savings in two ways. First, recipients were asked to report estimated savings data quarterly: total kilowatt-hours (kWh) of electricity, therms of natural gas, gallons of fuel oil, and gallons of propane saved, along with dollars in energy costs saved. Table 3 shows the total estimated annual energy savings of the recipient's activities reported through September 30, 2013.

Table 3. Estimated Annual Energy Savings (Through September 30, 2013), as Reported in Program Summaries

Estimated Annual Energy Savings (Through 9/30/13)	
kWh Electricity	849,439
Therms Natural Gas	70,270
Gallons of Oil	0
Gallons of Propane	15,940
Total Estimated MMBTU Savings (Source Energy)[6]	19,102
Total Estimated Energy Cost Savings	$164,926
Average Percentage Savings per Upgrade/Number of Upgrades Used to Calculate	Residential SF 22%/356

Secondly, recipients were asked to report estimated savings data quarterly for each upgrade project. Table 4 shows the sum of the estimated energy savings of all building upgrade projects reported by the recipient through September 30, 2013. The second column shows the number of upgrade projects that were summed to estimate the energy savings in the third column.

Table 4. Sum of Estimated Annual Energy Savings (Through September 30, 2013), as Reported for Individual Upgrade Projects

Sum of Estimated Annual Energy Savings (Through 9/30/13)		
	Number of Projects Summed	**Sum of Estimated Savings Reported**
kWh Electricity	316	846,339
Therms Natural Gas	160	70,577
Gallons of Oil	20	9,050
Gallons of Propane	5	2,885
Sum of Estimated Annual Energy Cost Savings	320	$197,355
Method(s) of Savings Prediction	AUDITOR, BEACON HOME ENERGY ADVISOR, DEEMED SAVINGS, ENERGY PERFORMANCE SCORE (EPS), SIMPLE	

[6] Total estimated source energy savings was calculated by DOE. See Appendix B.

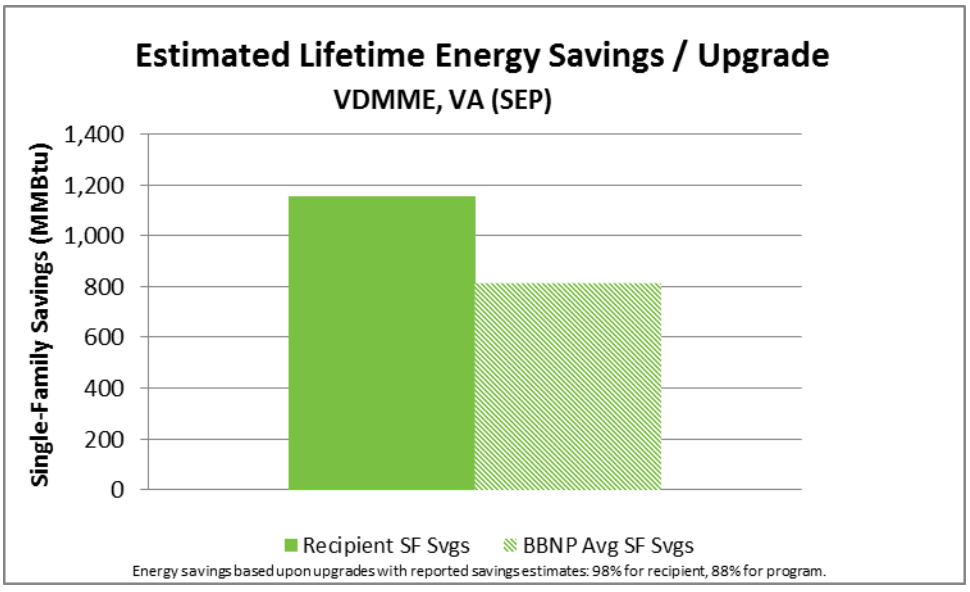
VIRGINIA STATE ENERGY PROGRAM SUMMARY OF REPORTED DATA

The program-reported total in Table 3 will not necessarily equal the sum of estimated savings in Table 4. Recipients were originally asked to only report individual building upgrade projects that were estimated to achieve at least a 20% reduction in total building energy use. Recipients were also told to include estimated energy saving from all upgrades in their program summaries, including upgrades that achieved less than a 20% reduction in total building energy use, in their program totals. In 2012, recipients were given the option to continue to report only building upgrade projects that saved 15% or to report all building upgrade projects so long as the total portfolio of projects (by building sector) achieved an average savings of 20%.

1.9.1. Estimated Lifetime Energy Savings per Upgrade Analysis

From the beginning of BBNP, recipients expressed interest in understanding how their results compared to other recipients. Figure 4 shows an estimated lifetime energy savings per upgrade for the recipient and an average estimated lifetime energy savings per upgrade based on all BBNP-reported projects. This analysis was completed by NREL using recipient-reported project information. The methodology used to complete the analysis is provided in the Appendix C. Eighty-eight percent of the reported BBNP upgrade projects were used in the analysis to calculate the BBNP average because energy savings estimates were missing or incomplete for 12% of reported projects.

Figure 4. Estimated Lifetime Energy Savings per Upgrade[7]



There could be several reasons why a recipient's results are higher or lower than the BBNP average. Recipients implemented a variety of program design approaches, including different

[7] SF is Single-family home.

mixes of energy efficiency measures, and targeted different building types and customer segments. Reviewing the summary report of other recipients may provide insights into program design choices and other factors that could influence results.

In addition to program design decisions, other factors could influence results. For example, programs in more energy-intensive climates may be able to achieve greater savings per upgrade because average energy consumption is higher than the national average. Programs in states with high energy costs may find that customers are more motivated to save more energy than states with low energy costs.

APPENDIX A: GLOSSARY OF TERMS

APPENDIX A: GLOSSARY OF TERMS

ARR or Recovery Act:	American Recovery and Reinvestment Act of 2009
Active Participating Contractors:	Active contractors are qualified (qualified according to the individual recipients' program guidance) contractors who have performed one or more building upgrades in the reporting quarter.
Assessments:	Expert review of building's energy savings opportunities, which typically includes an onsite inspection of the building and its systems and results in recommendations for building energy performance improvements.
BBNP:	Better Buildings Neighborhood Program
BBNP Award Spending:	Total outlay amount for recipients through 9/30/13
Certified Workers:	Number of workers with a nationally-recognized certification. Recipients could choose to adopt an alternative to nationally-recognized certification and provide a justification for the alternative certification chosen.
EECBG:	Energy Efficiency Conservation Block Grant
IRBD:	(Interest Rate Buy-Down) Program administrators provide lenders or investors with an up-front payment when a financial product is originated to reduce the interest rate a customer pays. The payment is typically the present value of the difference between the interest rate the customer will pay and the "market" interest rate of the financial product over the expected life of the financial product.
Invoiced Upgrade Costs:	Total cost of the building energy efficiency upgrades, as invoiced by the contractor performing the work, which includes the building owner's contribution, and any incentives or grants funded by BBNP funds, other federal funds or non-Federal sources intended to reduce the building owner's cost.

APPENDIX A: GLOSSARY OF TERMS

Jobs Created/Retained:	For the purpose of Recovery Act reporting jobs created and retained was estimated based on the job hours directly funded with BBNP funds during a reporting quarter divided by 520 hours per quarter. EECBG recipients were required to report jobs created or retained expressed as ''full-time equivalent'' (FTE) for Recovery Act reporting. The Recovery Act reporting specified direct jobs created and retained by sub-recipients and vendors. For the purpose of BBNP Quarterly Program reporting, jobs created and retained was estimated based on the job hours worked directly funded with BBNP funds and job hours worked funded by other federal funds and leveraged funds (i.e. state and local funds, utilities, financial institutions, private contributions, etc.) during reporting quarter divided by 52 hours per quarter. This includes, but is not limited to; administrative staff, consultants, and contractors involved in the management or deployment of assessment and building upgrade activities. The BBNP Program Report definition was broader than direct jobs reported for the Recovery Act
LLR:	(Loan Loss Reserve) A form of credit enhancement through which a program administrator (or other entity) promises to pay lender some portion (less than 100%) of losses the lender endures on financial product or pool of financial products. 5% to 20% LLRs are common.
Labor & Materials:	Recipient outlays of BBNP award funds incurred as part of an assessment or upgrade directly associated with the installation of energy efficient equipment, appliances, or building components (e.g. insulation, windows, etc.). This includes incentives or grants to reduce a building owner's labor or material costs to complete and energy assessment or upgrade.
Marketing & Outreach:	Recipient outlays of BBNP award funds for communication activities designed to identify, reach and motivate potential customers to participate in a program and learn more (e.g. assessment or other informational activity) about energy efficiency or initiate an energy efficiency upgrade.
MMBtu	One million British thermal units (Btu).
Multi-Family Unit:	unit in a building with multiple housing units--a structure that is divided into living quarters for two or more families or households in which one household lives above or beside another. This category also includes houses originally intended for occupancy by one family (or for some other use) that have since been converted to separate dwellings for two or more families.

APPENDIX A: GLOSSARY OF TERMS

Non-Federal Expenditures:	These may include third-party, in-kind contributions and the portion of the costs of a federally assisted project or program not borne by the Federal Government. This should include building owner contributions to building upgrade project cost.
Other Federal Expenditures:	These may include additional federal financial assistance award funds or loans from the Department of Energy or another federal agency.
Other Program Expenses:	Recipient outlays of BBNP award funds not classified as labor & materials or marketing & outreach. These expenses are often associated with program overhead. Outlays are distinct from DOE's definition of expenditures, which is most relevant with financing programs (i.e., Funds drawn down and provided by the recipient to a third party, to capitalize a loan fund, are considered outlays. Funds drawn down by the recipient to capitalize a loan fund in-house are not considered outlays until the funds are loaned out.).
RLF:	(Revolving Loan Fund) Funds of capital used to provide loans for energy efficiency and renewable energy improvements; loan repayments recapitalize the funding pool to enable additional lending.
SEP:	State Energy Program
Single-Family:	housing unit, detached or attached, that provides living space for one household or family. Attached houses are considered single-family houses as long as they are not divided into more than one housing unit and they have an independent outside entrance. A single-family house is contained within walls extending from the basement (or the ground floor, if there is no basement) to the roof. mobile home with one or more rooms added is classified as single-family home. Townhouses, row-houses, and duplexes are considered single-family attached housing units, as long as there is n household living above another one within the walls extending from the basement to the roof to separate the units.
Source energy:	Also called primary energy, is the amount of fossil fuels and electricity plus the losses associated with the production of electricity (i.e., losses that occur in the generation, transmission, and distribution).
Total Capital (Private and Other non-BBNP) Leveraged for Lending:	Capital committed by one of more third parties for financing energy efficiency building upgrades. This can include federally funded (non-BBNP) revolving loan funds and private capital from credit unions, banks or other financial institutions.
Trained Workers:	Number of workers trained under a nationally-recognized organization or curriculum. Recipients could choose to adopt an alternative to nationally-recognized training and provide a justification for the alternative training chosen.

APPENDIX A: GLOSSARY OF TERMS

Upgrades:	Also called building upgrades or retrofits, an individual or group of measures that a customer undertakes to improve building performance, with benefits including more efficient energy use, improved comfort and indoor air quality, ensured combustion safety, and lower utility bills.

APPENDIX B: METHODOLOGY TO CALCULATE SOURCE ENERGY SAVINGS

APPENDIX B: METHODOLOGY TO CALCULATE SOURCE ENERGY SAVINGS

DOE used the following methodology to calculate source energy savings:

$$E_{svgsv} = \sum_{i=Energy\ Typep} E_{svgs\ source,i}$$

$$E_{svgsvsource,i} = E_{svgs\ site,i} \times CF_{MMB\ u,i} \times CF_{Siteito\ Source,i}$$

where,

E_{svgs} is the total annual energy savings in MMBtu
$E_{svgs\ source,i}$ is the annual source energy savings in MMBtu for each energy type *i* as shown in Table B- 1
$E_{svgs\ site,\ i}$ is the total estimated annual site energy savings for each energy type *i* as shown in Table B- 1
$CF_{MMBtu,\ i}$ is the MMBtu conversion factor for each energy type *i* as shown in Table B- 1
$CF_{Site\ to\ Source,\ i}$ is the site to source conversion factor for each energy type *i* as shown in Table B- 1.

Table B- 1. MMBtu and Site to Source Conversion Factors by Energy Type

Energy Type	MMBtu Conversion Factor	Site to Source Conversion Factor
Electricity	0.00341214 MMBtu/kWh	3.365
Natural Gas	0.1027 MMBtu/ccf	1.092
Natural Gas	0.1 MMBtu/therm	1.092
Fuel Oil (Type 2)	0.14 MMBtu/gallon	1.158
Propane/LPG	0.09133 MMBtu/gallon	1.151
Kerosene	0.135 MMBtu/gallon	1.205
Wood	20 MMBtu/cord	1

APPENDIX C: LIFETIME ENERGY SAVINGS CALCULATIONS

APPENDIX C: LIFETIME ENERGY SAVINGS CALCULATIONS

The Lifetime Energy Savings, LES, is the total source energy savings over the expected life of the installed efficiency upgrades, expressed in MMBtu. An LES value is calculated for each grant recipient as follows:

$$LES_r \times = E_{svgs,r} \times \overline{L}_r$$

where,

LES_r is the Lifetime Energy Savings for grant recipient *r*

$E_{svgs,r}$ is the total estimated annual energy savings for all projects reported by the recipient (MMBtu/yr)

$\overline{L}_r$ is the project weighted lifetime of the efficiency upgrades reported by a recipient, expressed in years and calculated as follows:

$$\overline{L}_r = \frac{\left(\overline{L}_{res} \times E_{svgs,res}\right) + \left(\overline{L}_{com} \times E_{svgs,com}\right)}{\left(E_{svgs,res} + E_{svgs,com}\right)}$$

where,

$\overline{L}_{res}$ is the source energy-savings-weighted lifetime of the residential efficiency upgrades installed for a recipient

$E_{svgs,res}$ is the total estimated annual source energy savings in MMBtu for all residential upgrades reported by the grant recipient

$\overline{L}_{com}$ is the project-count-weighted lifetime of the commercial efficiency upgrades installed for a recipient

$E_{svgs,com}$ is the total estimated annual source energy savings in MMBtu for all commercial upgrades reported by the grant recipient

$\overline{L}_{res}$ is calculated as follows:

$$\overline{L}_{res} = \frac{\sum_{i=1}^{4}\left(Cnt_i \times E_{svgs,i} \times L_i\right)}{\sum_{i=1}^{4}\left(Cnt_i \times E_{svgs,i}\right)}$$

where,

i is the type category of efficiency upgrades installed as shown in Table C- 1.

Cnt_i is the number of energy efficiency upgrades of type *i* installed by a recipient

$E_{svgs,i}$ is the assumed annual energy savings in MMBtu for each energy efficiency upgrade of type *i* as shown in Table C- 1.

L_i is the assumed lifetime in years for energy efficiency upgrades of type *i* as shown in Table C- 1.

APPENDIX C: LIFETIME ENERGY SAVINGS CALCULATIONS

Table C- 1. Residential Project Energy Upgrade Categories, Lifetimes and Energy Savings[8]

Type Category	Description	Assumed Lifetime (Years)	Assumed Source Energy Savings (MMBtu/yr/measure)
R1	Simple direct-install measures including CFL's, low-flow showerheads, water heater blankets, HVAC tune ups and other low cost measures	5	0.5
R2	HVAC replacement, programmable thermostats, refrigerators, dishwashers, hot water heaters and any large appliance	15	7
R3	Duct sealing and duct insulating	15	10
R4	House air sealing, house insulating, window replacement and any other insulating (except duct insulating)	20	20

$\overline{L}_{com}$ is calculated as follows:

$$\overline{L}_{como} = \frac{\sum_{j=1}^{4}(Cn_j \times L_j)}{\sum_{j=1}^{4}(Cn_j)}$$

where,

j is the type category of efficiency upgrades installed as shown in Table C- 2.

Cnt_j is the number of energy efficiency upgrades of type *i* installed by a recipient

L_j is the assumed lifetime in years for energy efficiency upgrades of type *j* as shown in Table C- 2.

[8] Assumed Lifetime for residential measures was estimated by NREL based on a review NAHB Study of Life Expectancy of Home Components, DEER, and consulting with evaluation experts. Assumed Source Energy Savings was estimated/adapted from the Better Building Energy Savings Measure Packages developed by NREL using BEopt. General methodology is documented here: http://www.nrel.gov/docs/fy11osti/50572.pdf

APPENDIX C: LIFETIME ENERGY SAVINGS CALCULATIONS

Table C- 2. Commercial Project Energy Upgrade Categories and Lifetimes[9]

Type Category	Description	Assumed Lifetime (Years)	Assumed Source Energy Savings (MMBtu/yr/measure)
C1	CFLs, faucet aerators and HVAC tune ups	5	100
C2	Commercial kitchen equipment, thermostats	11	6
C3	HVAC (packaged), refrigeration, hot water heaters, LED and linear fluorescent lighting	15	100
C4	Chillers, boilers, PV, solar thermal, insulation, windows	20	100

[9] Assumed Lifetime for commercial measures was estimated by NREL based on a review of DEER and consulting with evaluation experts. Assumed Source Energy Savings was derived using regression analysis of reported commercial projects with energy savings and installed measures. A measure may include several instances of one technology installed in a project.

Better Buildings
NEIGHBORHOOD PROGRAM
U.S. DEPARTMENT OF ENERGY