



Preliminary Impact Evaluation BBNP

LBNL Project Manager: Ed Vine

DOE Project Manager: Jeff Dowd

Project Team:

Research Into Action, Inc.

Nexant, Inc.

Evergreen Economics,

NMR Group

Agenda

- Who are we?
- What are we doing?
- BBNP background
- Impact Evaluation Basics
- Energy Impact Evaluation Methodology
- Energy Impact Findings
- Economic Impact Evaluation Methodology
- Economic Impact Findings
- Lessons Learned
- Recommendations
- Next Steps

Who are we?

We are a team of evaluators...

independent of the BBNP program
with whom DOE has contracted
to assess the performance of BBNP
and identify lessons learned

We are:

*Research Into Action, Nexant, Evergreen
Economics, and NMR Group*

What we are doing?

We are evaluating the national BBNP program, not individual grantees or their programs

- *Program processes*
- *Market effects*
- *Program impacts*

Goal: identify program impacts and what program elements are most successful in inducing market changes that will result in sustainable savings

What we are doing?

Project Deliverables:

- A preliminary process evaluation focused on the early program period (Spring 2013)
- A preliminary impact evaluation focused on grantee projects implemented btw Q4 2010 and Q2 2012 (Fall 2013)
- A final process evaluation covering the entire program period (Summer 2014)
- A final impact evaluation focusing on all grantee projects (Winter 2014)

Today

We are discussing the preliminary impact evaluation report

- What we learned
 - *Key findings*
 - *Challenges*
 - *Recommendations*
- How we learned it (our methods)
- Next steps

BBNP Background

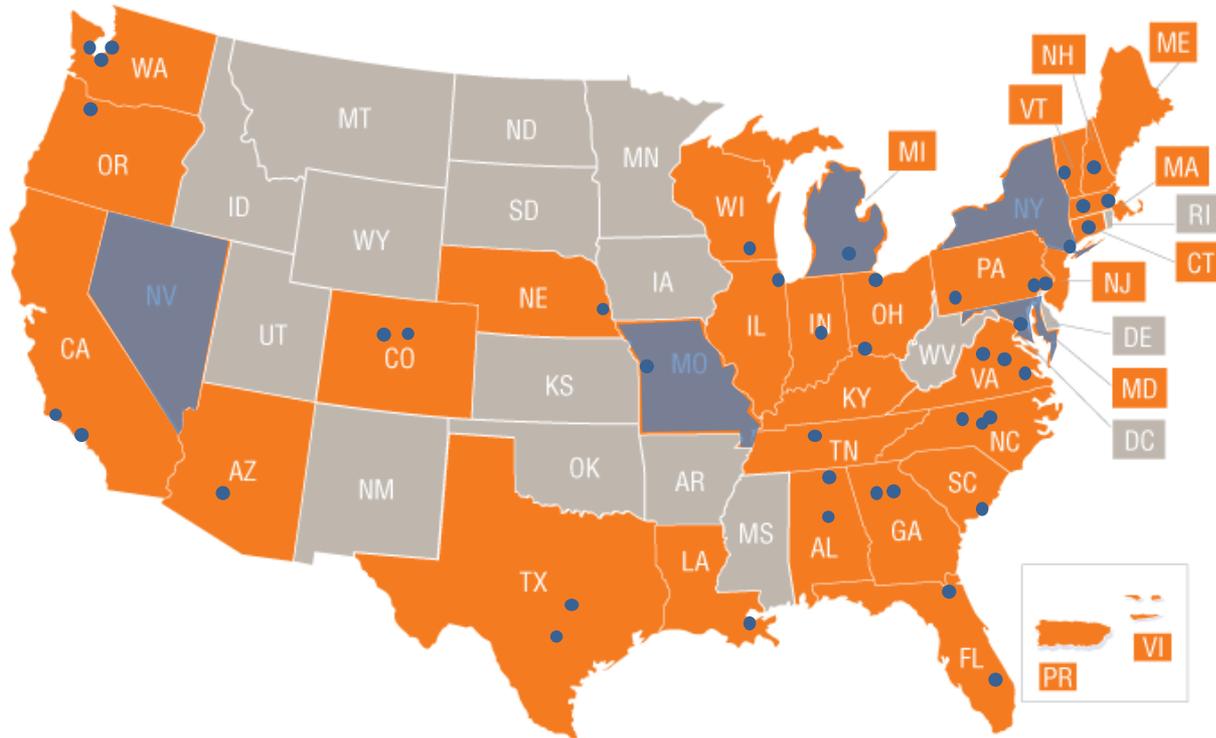
- \$508 million American Recovery and Reinvestment Act (ARRA) funds
- Awarded May-Sept. 2010
- 41 Grantees
 - 30 *Government (State/Local)*
 - 6 *Nonprofits*
 - 4 *Government established corporations*
 - 1 *Utility*
- Grants from \$1.2-\$40 million

BBNP Background

BBNP Goals:

- Initiate building energy upgrade programs, where grantee portfolios save 15%
- Demonstrate sustainable business models for energy upgrades
- Identify and spread effective methods

Grantees By Location



- City/County Level Grant
- Statewide Grant
- States With Grant Activity

BBNP Background

- Grantee designed programs based on:
 - *Organizational types and prior efficiency experience*
 - *Community needs*
 - *Local contractor capability/experience*
 - *Weather*
- Grantee programs are unique:
 - *Buildings/sectors served*
 - *Services and measures offered*
 - Audits, direct install, qualifying measures, rebates, grants, financing, depth of upgrades
 - *Quality assurance activities, when programs launched, etc.*

What is an Impact Evaluation?

- Assessment used to estimate the direct and indirect impacts of an energy efficiency program
- Direct Impacts:
 - *Energy savings*
 - *Demand savings*
 - *Non-energy impacts*
 - Avoided emissions
 - Job creation
 - Cost savings
- Traditionally used by utilities to:
 - *Meet regulatory requirements*
 - *Improve current programs*
 - *Resource planning*
 - *Showcase efforts*

What Did We Measure for BBNP?

KEY METRIC	DESCRIPTION
Number of Energy Units Saved – by Project, by Program	These units include annual and lifetime kWh, kW, therms, gallons of oil, and MMBtus, and will be weather-normalized.
Costs Saved – by Project, by Program	This includes the value of annual and lifetime energy savings, demand reduction, and renewable energy generation at current customer costs.
Number of Energy Efficiency Measures Installed	Based on tracking data provided from grantees, this includes all measures installed in the building retrofit projects.
Number of Households/ Businesses Retrofitted	These totals are based on the tracking data provided from grantees and verified for a sample of projects.
Number of Jobs Created/ Retained	This is measured in person-years of employment and is based on surveys and modeling the impacts against a base case scenario.
Economic Output	This is based on modeling the impacts against a base case scenario.
Personal and Business Income	This is based on modeling the impacts against a base case scenario.
Tax Revenue	This is based on modeling the impacts against a base case scenario.

Goal: Develop independent, quantitative estimates of BBNP's economic impacts and energy savings.

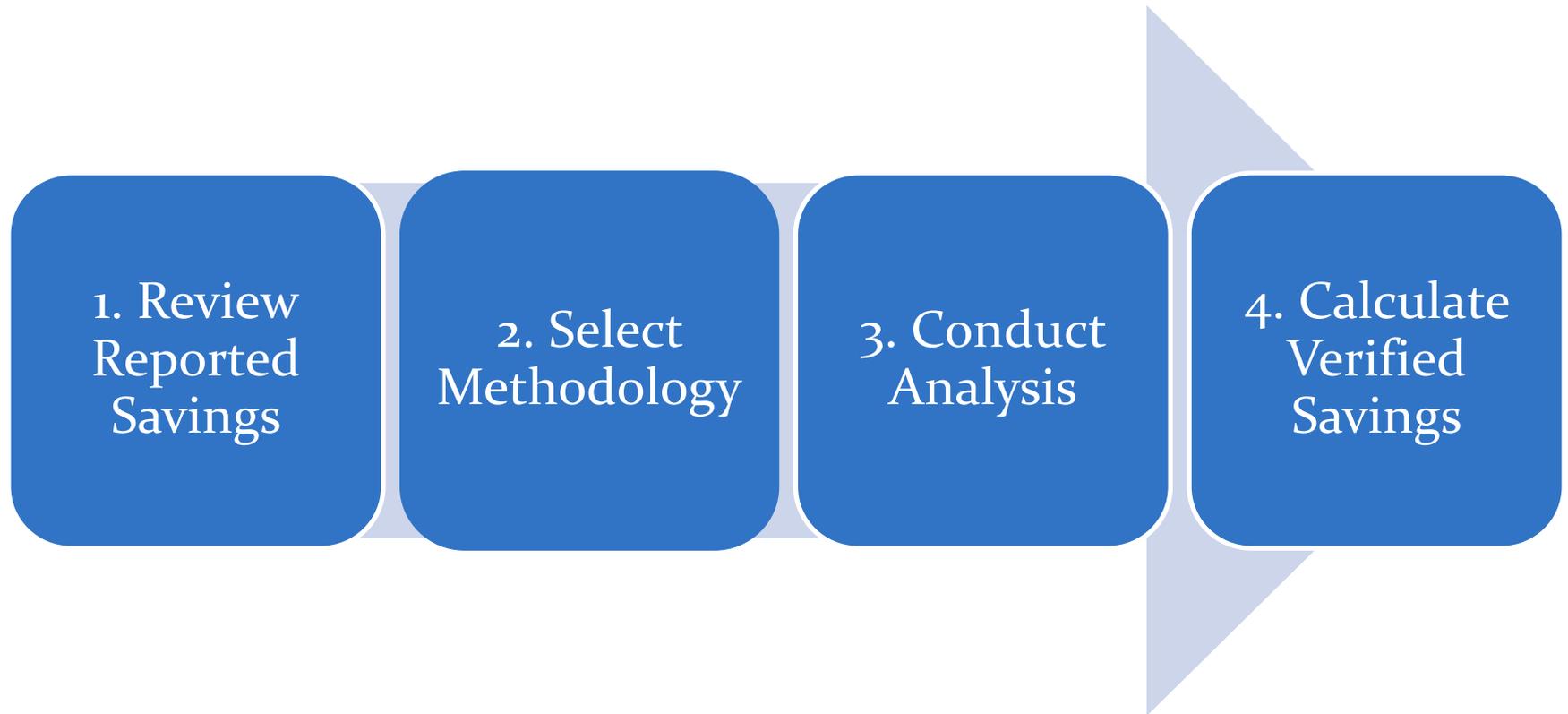
How Did We Measure BBNP's Impact?

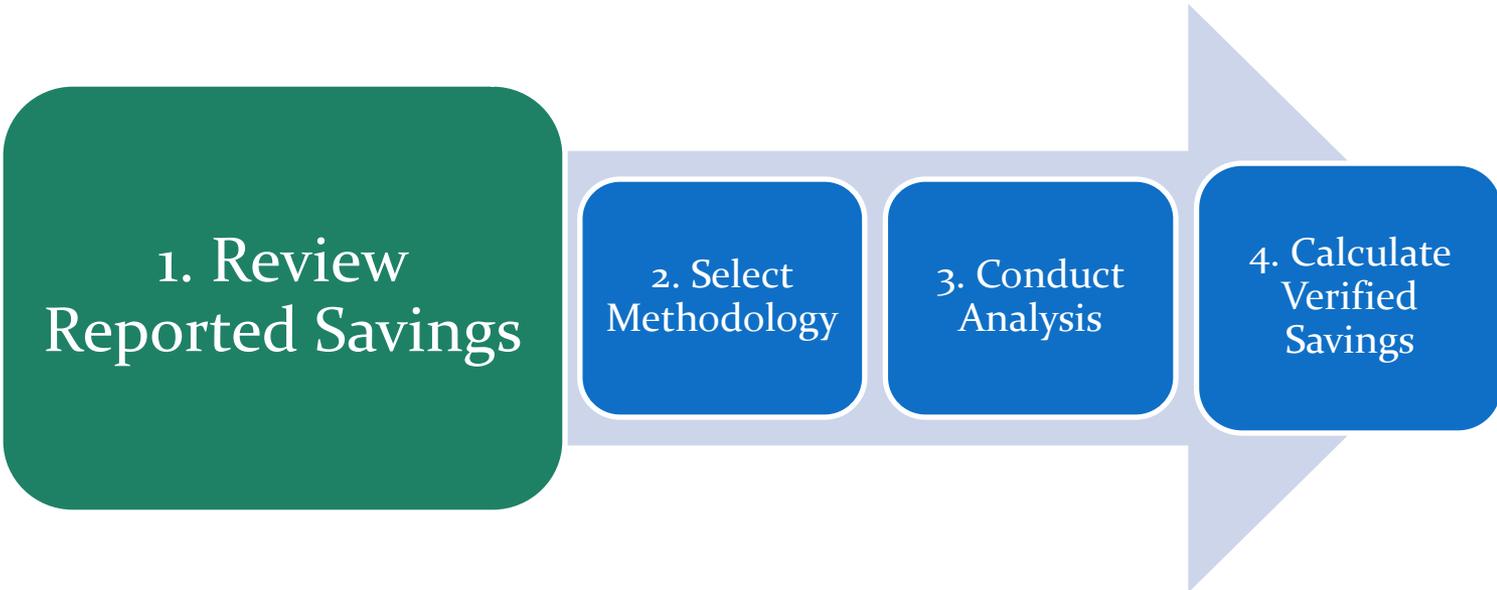
- Energy Savings
 - *Measurement and Verification*
 - Savings determined for representative sample and findings applied to program population
 - *Billing Analysis*
 - Use pre and post installation utility bill data for program population to determine savings
- Non Energy Impacts
 - *Measurement and Verification*
 - Cost savings
 - Greenhouse gas emissions savings
 - *Economic Impact Analysis*

How Did We Measure BBNP's Impact?

- Measured from 4th Quarter 2010 through 2nd Quarter 2012
- Verified Savings for:
 - *Commercial*
 - *Residential*
- Results Presented as Source MMBtus
 - *Represents the sum of the savings at the project site and the savings from the energy not having to be extracted, converted, and transmitted to the site due to the energy efficiency project*

BBNP Energy Impact Evaluation Basics





BBNP Reported Savings – Thru Q2 2012

METRIC	THROUGH Q2 2012 RESULT	OVERALL PROGRAM BUDGET/GOAL	PERCENT TOTAL ACHIEVED
Spending	\$245.7 million	\$508 million	48%
Projects	32,254	172,792	19%
Grantees with Projects	40	41	98%
Total Reported Energy Savings (Source)	1,876,327 MMBtu	—	—
\$/MMBtu Saved (Source)	\$130.9/MMBtu	—	—

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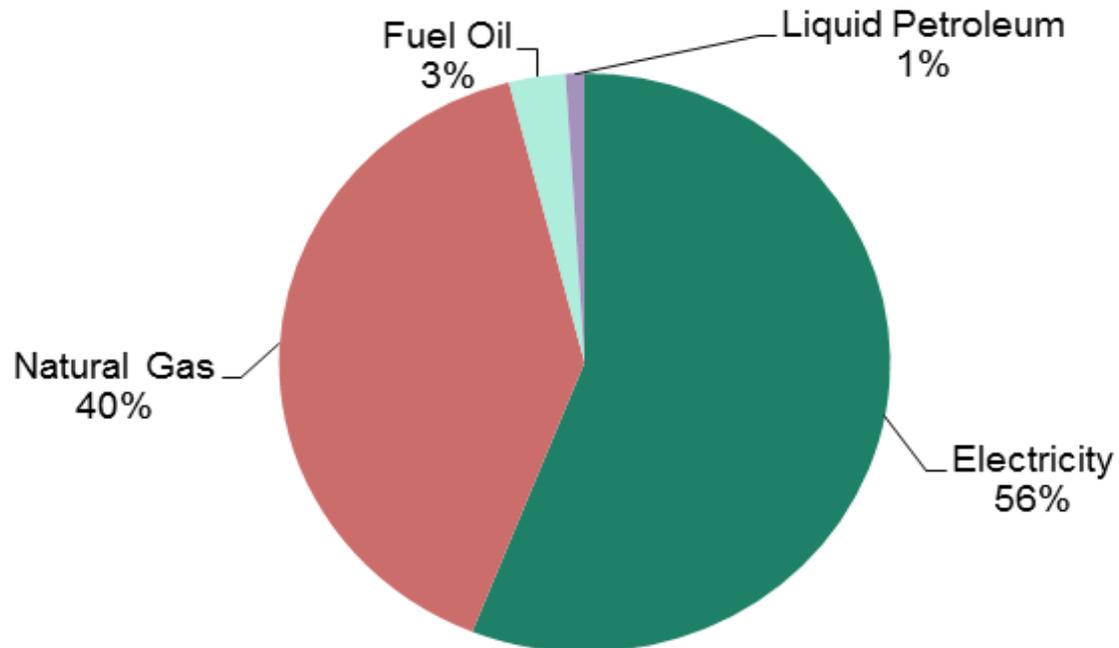
BBNP Reported Savings – Thru Q2 2012

SECTOR	NUMBER OF PROJECTS IMPLEMENTED	PERCENT OF TOTAL PROJECTS	TOTAL SOURCE ENERGY SAVINGS (MMBTU)	PERCENT OF PORTFOLIO SAVINGS
Residential	27,742	86%	1,116,160	59.5%
Multifamily	3,119	9.7%	83,839	4.5%
Commercial	1,334	4.1%	667,108	35.6%
Agriculture	59	0.2%	9,220	0.5%
BBNP Total	32,254	100%	1,876,327	100%

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BBNP Reported Savings – Thru Q2 2012

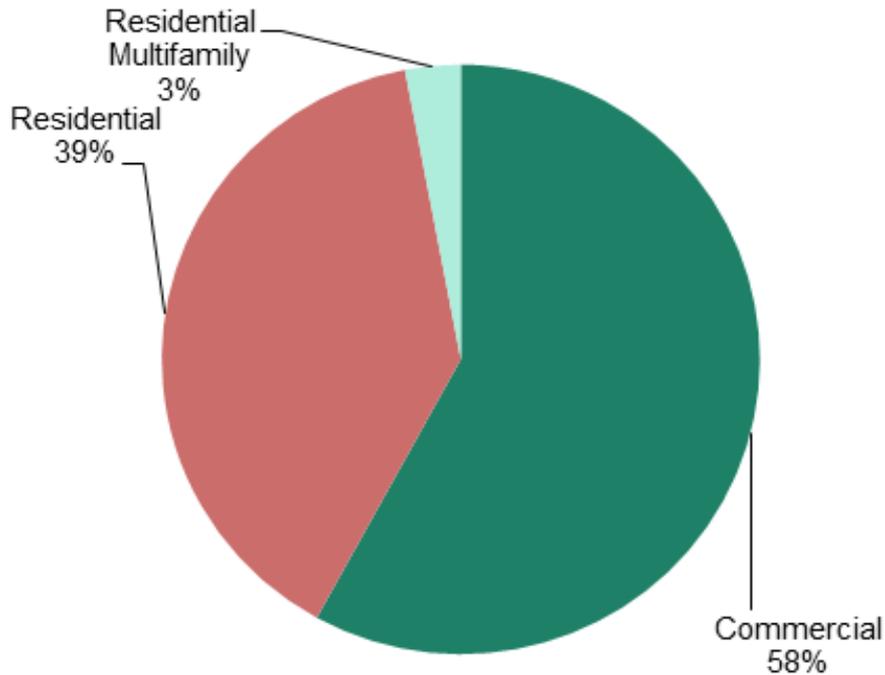
Percent of Total MMBtu Savings by Fuel Type



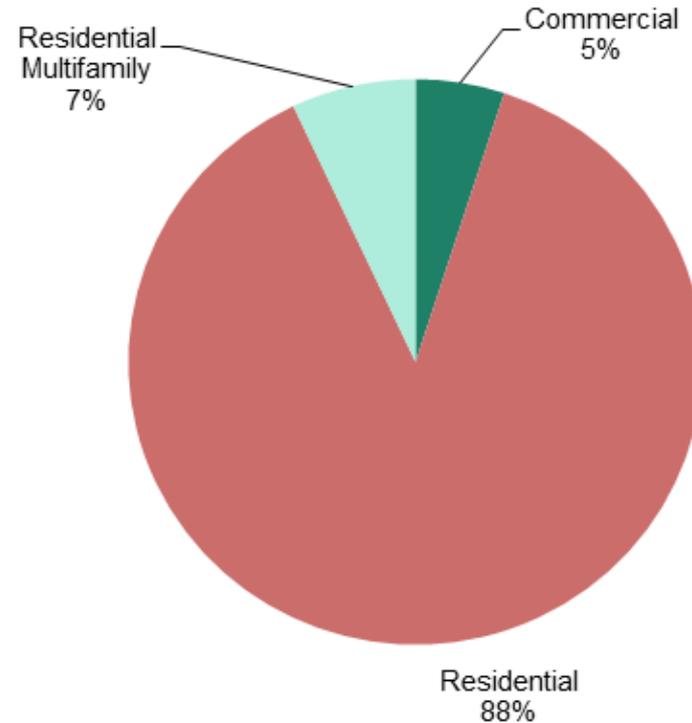
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BBNP Reported Savings – Thru Q2 2012

Electricity Savings by Sector (kWh)



Natural Gas Savings by Sector (therms)



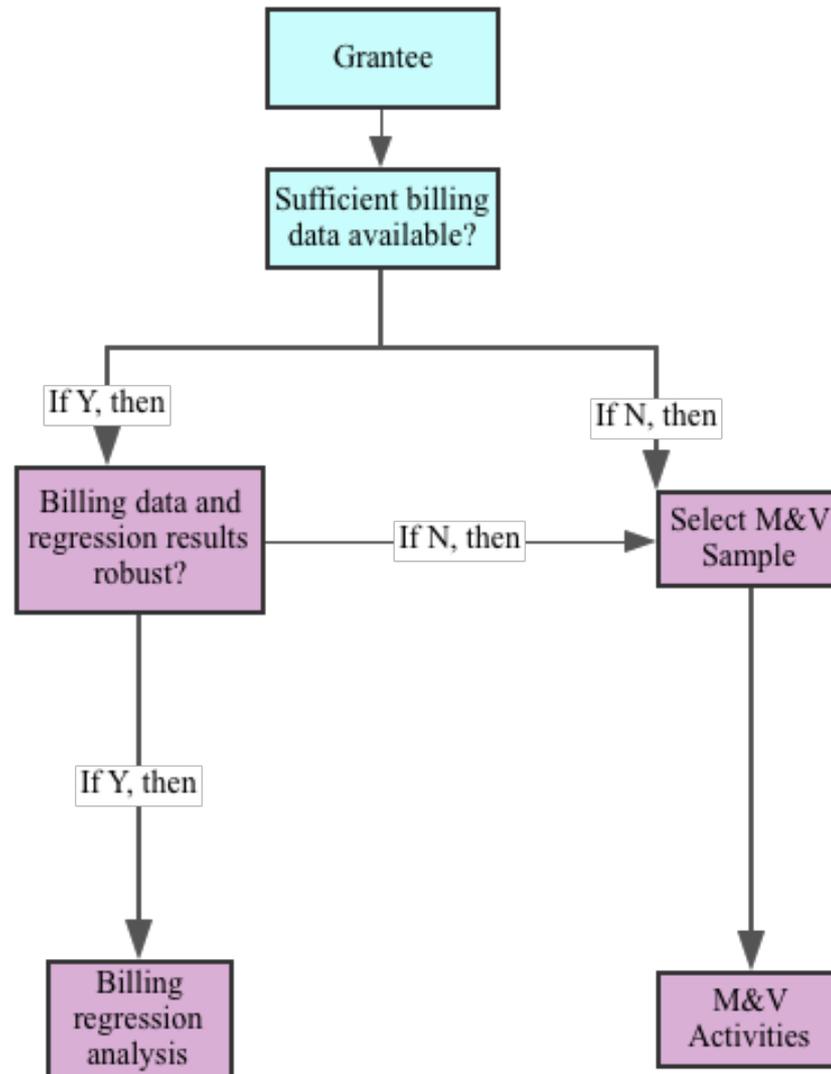
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Select Methodology

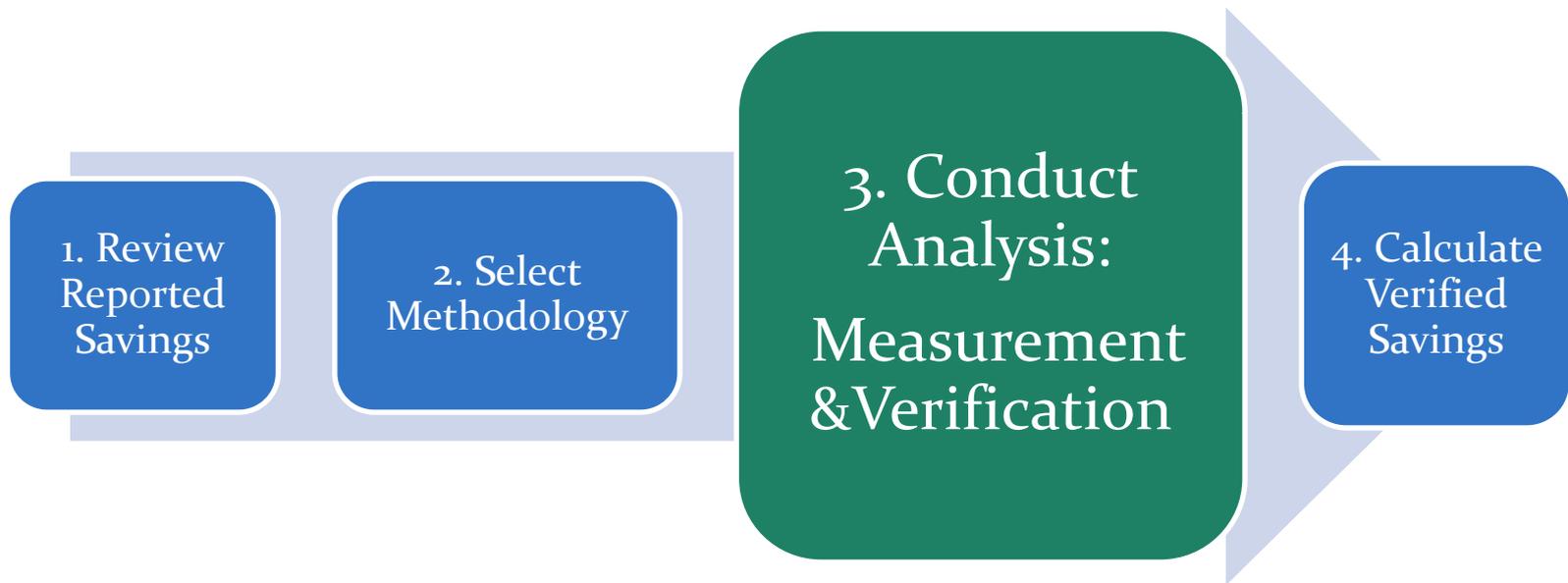
- Measurement & Verification
- Billing Analysis

Select Methodology



Select Methodology

- Measurement & Verification
 - *36 Grantees*
 - *Residential and commercial programs*
- Billing Analysis
 - *4 Grantees*
 - *Residential programs only*



Conduct Analysis: Measurement & Verification (M&V)

1. Select sample (February 2013)
2. Conduct file reviews of sampled projects (March – April 2013)
3. Conduct phone surveys (March – April 2013)
4. Conduct onsite visits for sub-sample (April 2013)
5. Analysis activities (April – June 2013)

M&V: Select Sample

- Obtained DOE project level database
- Selected a random sample of projects across all M&V grantees
 - *Total of 319 projects sampled*
 - *Across 23 grantees*
 - 102 commercial projects
 - 217 residential projects
- Strived to achieve statistical significance in results
 - *90% confidence and 10% precision*

M&V: Project File Reviews

- Primary goals:
 - *Understand savings calculations*
 - *Verify installed measures*
 - *Verify accuracy of reported savings*
- Used a variety of data sources:
 - *DOE project level database*
 - *DOE quarterly summary results*
 - *Grantee provided data*
 - Invoices
 - Assessment Reports
 - Rebate Applications

M&V: Phone Surveys

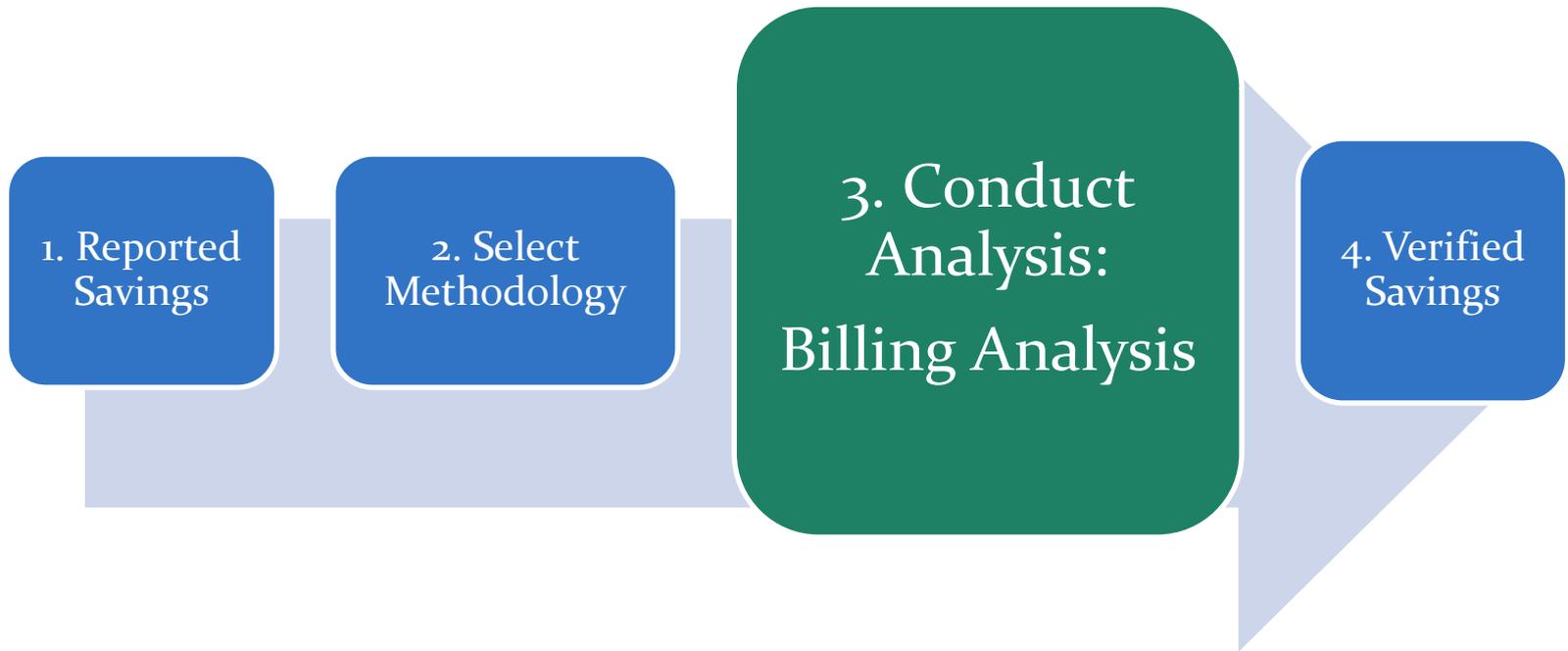
- Goal was to survey all sample projects
 - *201 Residential surveys achieved*
 - *69 Commercial surveys achieved*
- Pre-notification letters sent to all participants
- Survey data sought:
 - *Current heating/cooling information*
 - *Verification of measures installed*
 - *Baseline information*
 - *Usage information*
 - *Attribution*

M&V: Onsite Visits

- Goal:
 - *Verification of measures installed*
 - *Comparison to phone survey data collection efforts*
- Provided \$50 incentive to residential participants
- 47 residential visits across 6 grantees
- 18 commercial visits across 4 grantees

M&V: Analysis

- Goal:
 - *Calculate verified energy savings associated with sampled projects*
- Triangulation approach using data from:
 - *File review*
 - *Phone survey*
 - *Onsite visits*
- Developed and utilized custom calculators
 - *Standardize savings calculations*
 - Uniform Methods Project
 - Local/Regional Technical Resource Manuals
 - Other standard/accepted algorithms
 - *Weather dependent*
 - *Measure dependent*



Conduct Analysis: Billing Analysis

- Utilized where sufficient customer billing and participant tracking data were available
- Model relies on monthly electricity or natural gas consumption data before and after program participation
- 4 Grantees
 - *Boulder County, CO*
 - *Austin, TX*
 - *Philadelphia, PA*
 - *St. Lucie County, FL*
- Residential sector only

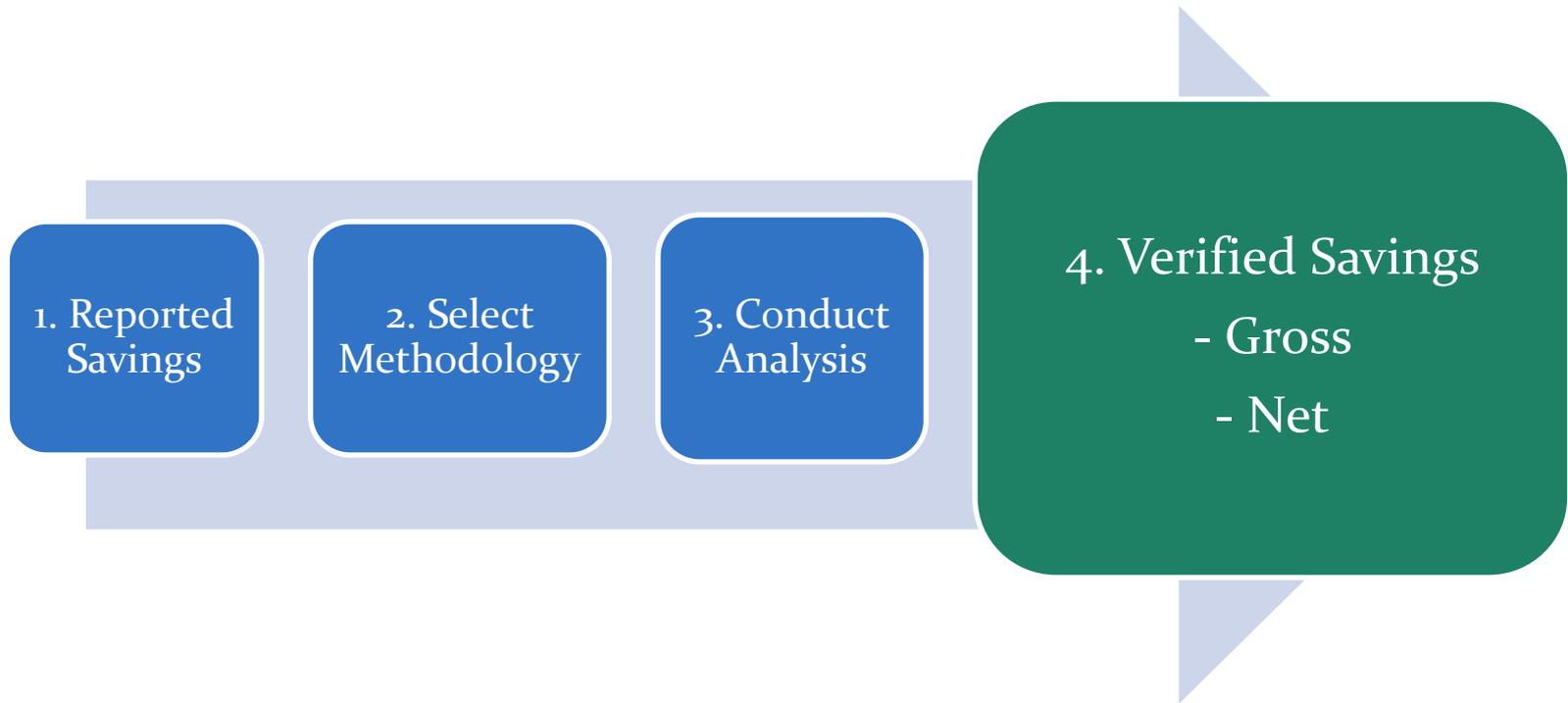
Conduct Analysis: Billing Analysis

- Billing regression uses a fixed effects model specification
- Dependent variable is monthly energy consumption for each participant
- Explanatory variables include:
 - *Weather data (HDD & CDD)*
 - *Monthly indicator variables*
 - *Participation period indicator variable*
 - *Customer-specific constant term*
- Before being used in model, data screened to remove outliers

Conduct Analysis: Billing Analysis

Electricity and Natural Gas Billing Regression Model Summary

MODEL SUMMARY	ELECTRICITY	NATURAL GAS
Average Monthly Normalized Fuel Usage	1,143.09	52.71
Average Post-Retrofit Billing Months	11.5	11.3
Average Pre-Retrofit Billing Months	20.3	19.9
Adjusted R-Squared Statistic	0.90	0.80
Average Monthly Savings (% of usage)	12.00%	11.10%



Gross Verified Savings

- Energy savings calculated as a result of the impact activities (both M&V and billing analysis)
- Used project level verified savings to calculate Realization Rate (RR) of the sample:
 - *Realization Rate = $\frac{\text{Gross Verified Savings}}{\text{Reported Savings}}$*
 - *Calculated for both M&V and Billing Analysis Sample*
 - *Combined M&V and Billing Analysis RR*
- Sample Realization Rate then applied to population reported savings

Net Verified Savings

- Measures the influence of the BBNP on the participant to implement the project
 - *What would they have done if no BBNP?*
- Questions included in phone surveys
- Survey findings used to develop Net to Gross Ratio (NTG)
- Apply NTG to Population Gross Verified Savings

Energy Impact Evaluation Findings



Findings: Gross Verified Savings

SECTOR	REPORTED PROJECTS	REPORTED SOURCE SAVINGS (MMBTU)	REALIZATION RATE (PERCENT)	GROSS VERIFIED SOURCE SAVINGS (MMBTU)	CONFIDENCE / PRECISION
Residential	27,743	1,116,160	79%	883,999	90/7
Commercial	1,333	667,108	106%	706,545	90/12
Multifamily	3,119	83,839	—	—	—
Agricultural	59	9,220	—	—	—
Total	32,254	1,876,327	—	1,590,544	90/7

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- Residential RR of 79% - reported savings overstated
- Commercial RR of 106% - reported savings understated

Findings: Gross Verified Savings

- Issues that impacted the realization rate:
 - *No reported savings*
 - *Measures installed and not reported*
 - *Measures reported but not installed*
 - *Fuel type reporting issues*

Findings: Net Verified Savings

SECTOR	GROSS VERIFIED SOURCE SAVINGS (MMBTU)	NET-TO-GROSS RATIO	NET VERIFIED SOURCE SAVINGS (MMBTU)
Residential	883,999	83%	733,816
Commercial	706,545	92%	646,888
Total	1,590,544	—	1,380,704



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- Residential NTG indicates 17% of customers may have implemented EE projects in the absence of the program
- Commercial NTG indicates 8% of customers may have implemented EE projects in the absence of the program

Findings: Net Verified Fuel Savings

Residential

FUEL TYPE	FUEL UNITS	REPORTED ANNUAL SAVINGS (UNITS BY FUEL TYPE)	REALIZATION RATE (PERCENT)	NET-TO-GROSS RATIO*	NET VERIFIED ANNUAL SAVINGS (UNITS BY FUEL TYPE)
Electricity	kWh	31,632,968	56%	83%	14,725,828
Natural Gas	therm	6,007,011	85%	83%	4,238,723



Commercial

FUEL TYPE	FUEL UNITS	REPORTED ANNUAL SAVINGS (UNITS BY FUEL TYPE)	REALIZATION RATE (PERCENT)	NET-TO-GROSS RATIO*	NET VERIFIED ANNUAL SAVINGS (UNITS BY FUEL TYPE)
Electricity	kWh	55,021,954	104%	92%	52,448,960
Natural Gas	therm	301,989	89%	92%	247,266



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Findings: Net Verified Cost Savings

SECTOR	REPORTED ANNUAL COST SAVINGS (\$)	REALIZATION RATE (PERCENT)	NET-TO-GROSS RATIO	NET ANNUAL COST SAVINGS (\$)
Residential	\$17,415,485	79%	83%	\$11,449,760
Commercial	\$7,140,893	106%	92%	\$6,924,457
Multifamily	\$ 512,412	—	—	—
Total	\$25,068,790	—	—	\$18,374,217

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Findings: Net Verified Greenhouse Gas Emissions Savings

FUEL TYPE	ANNUAL NET SOURCE SAVINGS (MMBTU)	CO _{2E} CONVERSION FACTOR (METRIC TONS/MMBTU)	ESTIMATED ANNUAL CO _{2E} AVOIDED (METRIC TONS)
Electricity	768,547	0.1728	132,782
Natural Gas	489,870	0.0532	26,061
Total	1,258,417	—	158,843

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Calculated using the ENERGY STAR Portfolio Manager Methodology for Greenhouse Gas Inventory and Tracking Calculations

Economic Impact Analysis



Economic Impact Analysis

Model Overview

- Each dollar spent in the community will be spent multiple times
- The IMPLAN input-output model estimates:
 - *Direct Effects: Result directly from initial spending*
 - *Indirect Effects: Secondary impacts from supporting industries*
 - *Induced Effects: Result from spending due to increased income from direct and indirect effects*
- Spending allocated across 440 industry sectors within IMPLAN

Economic Impact Analysis Methods

IMPLAN Model Inputs

- Gross Impact spending inputs include:
 - *Program outlays*
 - *Measure spending*
 - *Reductions in energy consumption*
 - *Reductions in utility revenues*
- Base Case scenario assumes BBNP program dollars are instead allocated to other federal non-defense programs
- *Net Impacts = Gross Impacts – Base Case*

Economic Impact Analysis

IMPLAN Model Outputs

- Economic impacts measured as net changes in:
 - *Jobs (full and part-time employment years)*
 - *Economic output (\$ of goods and services produced)*
 - *Personal income*
 - *State and Local tax revenue*
 - *Federal tax revenue*

Economic Impact Evaluation Findings



Economic Impact Analysis Findings

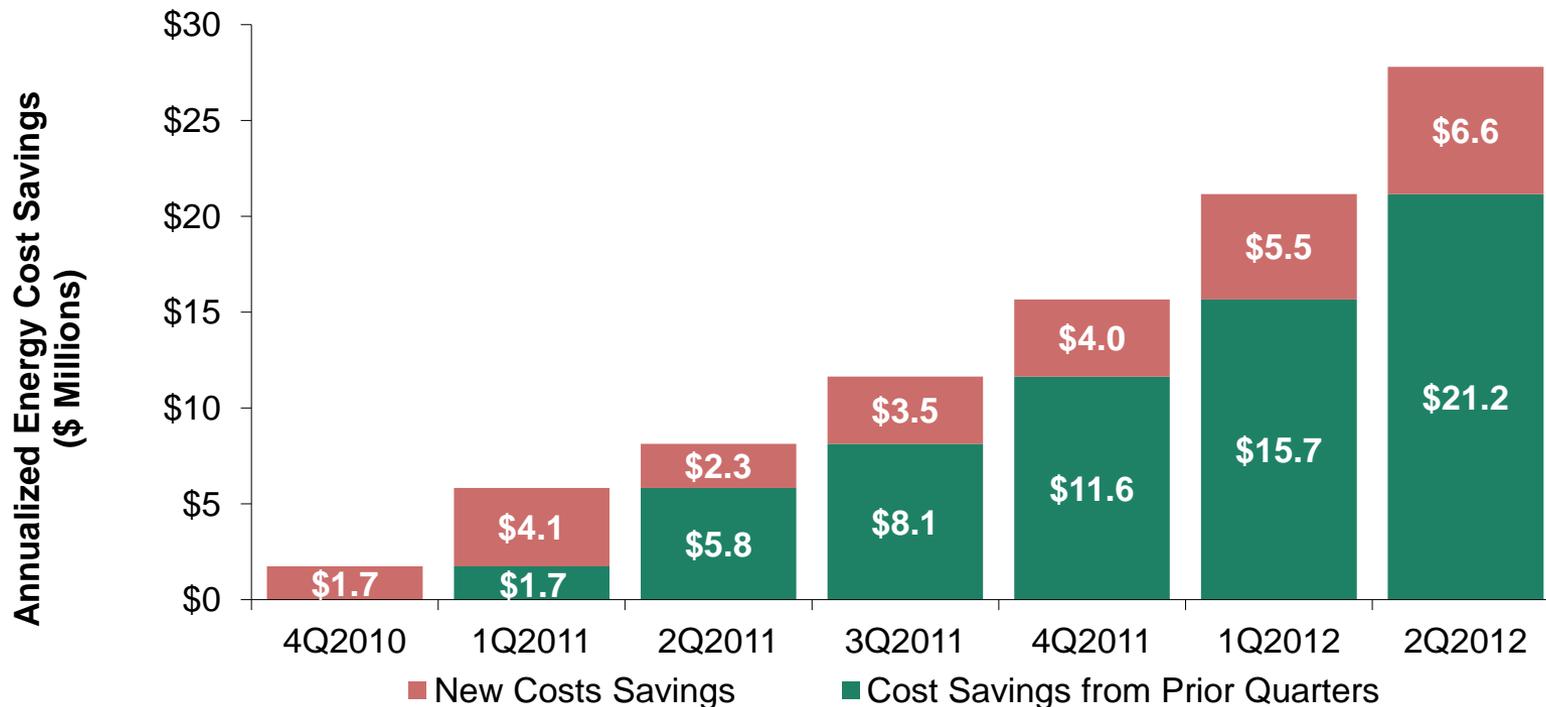
BBNP Total Economic and Fiscal Impacts, Gross and Net, Q4 2010–Q2 2012

IMPACT MEASURE	TOTAL GROSS IMPACTS	TOTAL NET IMPACTS
Output (\$ millions)	\$1,070.7	\$655.6
Personal Income (\$ millions)	\$376.9	\$155.4
Jobs (person-years)	6,681	4,266
State and Local Taxes (\$ millions)	\$42.2	\$24.3
Federal Taxes (\$ millions)	\$68.4	\$30.1

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Economic Impact Cumulative Effects

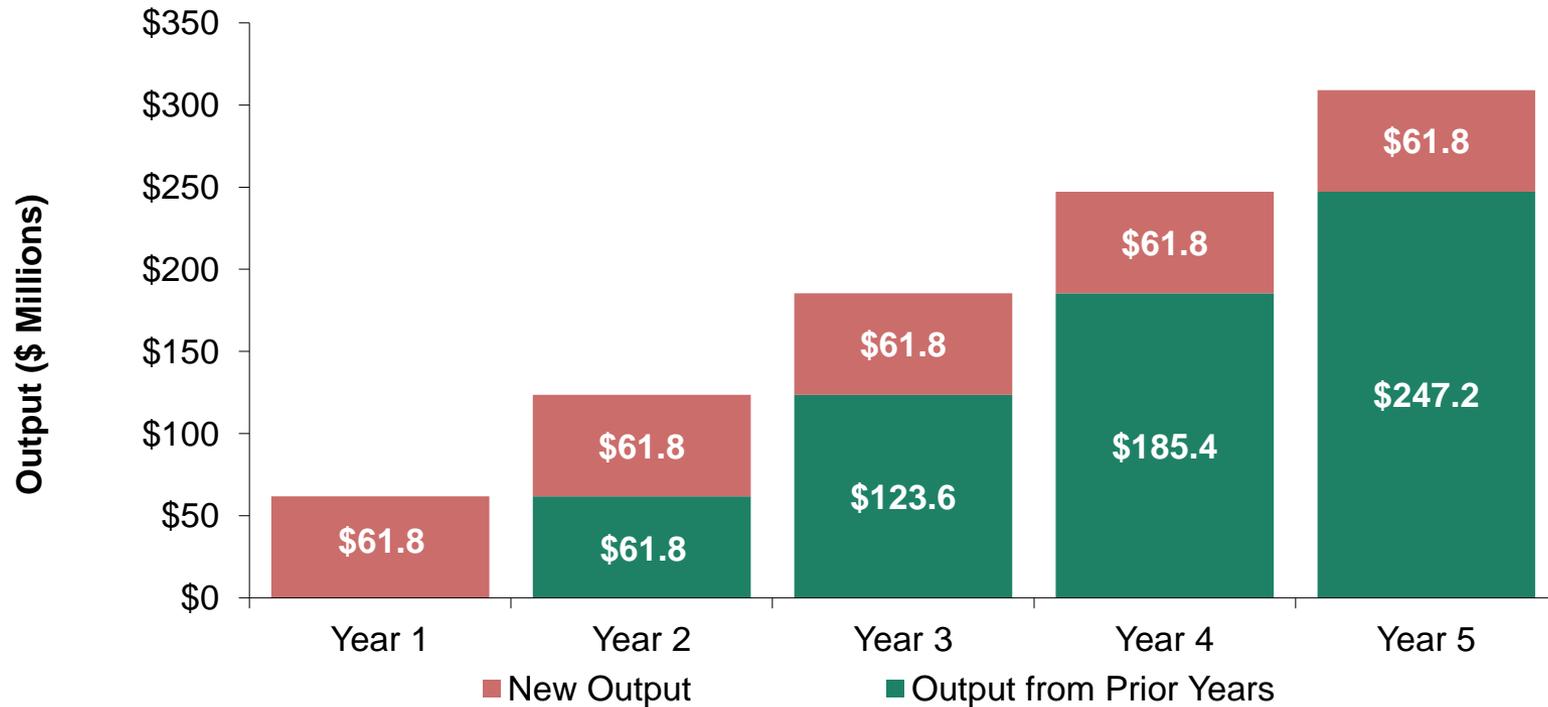
Cumulative Estimated Annualized Energy Cost Savings of Efficiency Upgrades, by Quarter



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Economic Impact Cumulative Effects

Cumulative Output Effects in Post-Installation Years (Five Year Period)



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Overall Findings and Next Steps

Evaluation Challenges

- Large scope and broad scale of the grantee programs
- Difficulty interpreting data
- Issues with reported metrics
- Data collection time constraints
- Limited value of participant phone verification surveys
- Difficulty in obtaining utility bill data

Lessons Learned

- Grantee Interactions
 - *Allow sufficient time*
 - *Clear and concise data requests*
- Sampling
 - *Proper sampling techniques*
 - *Be flexible*
- Evaluation Activities
 - *Phone verifications had limited value*
 - *Onsite verifications were valuable*
 - *Reasons for variances in data were multifaceted*

Recommendations for Final Evaluation

- Reduce participant telephone surveys, conduct more participant onsite visits
- Attempt to ensure the sampling strategy accounts for the end of each grantee's funding cycle by appropriately scheduling necessary data collection activities
- Overlap billing analysis and M&V sample frames

Recommendations For DOE

- Request that grantees match project-level tracking values with overall quarterly tracking values
- Conduct more investigation into the savings where large discrepancies might exist
- Try to reduce or eliminate the reporting of zero savings values for projects that achieved energy savings
- Compile one final dataset to be used for all reporting and analysis in the final evaluation

Next Steps

- Final Impact Evaluation Plan Approved
November 2013
- Data Collection Activities (Dec 2013 – Jan 2014)
 - *Reviewing DOE reports*
 - *Contacting Grantees for project/contact information*
 - *Billing Data*
- Phone Surveys/Onsite Visits (Feb – Mar 2014)
- Project Analysis (Mar – Jun 2014)

Conclusion

Special Thanks:

- All grantees who provided data and assistance during the preliminary activities
- Staff from DOE, LBNL and NREL
- Peer Review Committee

Conclusion

Contact Info:

Kevin Afflerbaugh, Nexant

kafflerbaugh@nexant.com

303-998-2462

Matt Koson, Evergreen Economics

koson@evergreenecon.com

503.741.8086

Steve Grover, Evergreen Economics

grover@evergreenecon.com

(503) 741-8082