Quantification of Non-Energy Impacts for Small Residential Energy Efficiency Programs in New York State

ACEEE Energy Efficiency As a Resource

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Agenda

- **Background**
- **Introduction to the Study**
- **Methodology / Project Tasks**
  1. Secondary NEIs research and translation of NEIs value to NY state
  2. Prominence of Measures with NEIs within NYSERDA Residential Programs
  3. Develop proposed list of NEIs for primary data collection
  4. Primary Research Data Collection Methods
- **Findings and Next Step**

Background & Introduction

Reason for the Project & Project Overview

Where Are We with Regards to NEIs?

- **Approximately 1/3 of states are currently considering the inclusion of NEIs in their cost-effectiveness analysis in some form - Growing number every year.**

- **Different methods for including NEIs into cost-effectiveness analysis:**
  1. A simple, conservative "adder" to the benefits
  2. Quantify "easy to measure" NEBs e.g. water bill savings and O&M cost savings
  3. Quantify all NEBs, or the leading from among several dozen NEBs
  4. A hybrid approach: using an adder and measuring either easy-to-measure benefits, or as many benefits as possible beyond what is included in the adder

- **Example of states that are including an adder into the benefits:**
  - Iowa (10% electric, 7.5% gas, 1999)
  - Colorado (10% adder, 25% low income, 2008)
  - Oregon (carbon $15 / ton; 10% adder, 2008)
  - Washington (10% adder, 2008)
  - Vermont (15% + 15% low income)
  - District of Columbia (10%)

Source: Malmgren & Skumatz (2014), Lessons from the Field: Practical Applications for Incorporating Non-Energy Benefits into Cost-Effectiveness Screening, ACEEE Summer Study

Where Was NYSERDA in 2013 with Regards to NEIs?

- **Prior Research Efforts**
  - NYSERDA previously conducted studies that explored NEIs through conjoint analysis and other participant surveys
  - Other states cite NYSERDA's research for supporting the incorporation of NEIs
- **NEIs in New York State**
  - NYSERDA programs have not counted NEIs in Cost-Benefit Analysis, other than CO^2 and water bill savings if reliable and independently verified numbers are available.
  - "Hard-to-measure" NEIs are neither calculated nor used
  - NYSERDA strongly believes in the importance of NEIs
- **Motivations for this NEI research effort**
  - Lack of reliability and consistency of the NEI estimates that were collected through survey-based approaches – high level of uncertainty
  - Substantive quantification of NEIs associated with EE programs through primary research and direct measurement can supply key market stakeholders with a reliable and comprehensive understanding of EE impacts furthering market transformation

Study of Quantifying NEIs Associated with Small Residential EE Programs in NY

- **Project Goal:**
  - Assist NYSERDA in collecting NEI information through secondary and primary research that can then be used to quantify the value of NEIs and further substantiate the value of NEIs in market transformation, program development, and cost-effectiveness testing.
  - **NYSERDA Residential Programs:**
    - Low-Income Program
    - Existing Home Performance Program
    - New ENERGY STAR Certified Home Program
- **Project Scope:**
  - Phase I: use secondary research and NYSERDA programmatic data to determine the most suitable measure NEIs within NYSERDA programs and identify reliable and cost-effective primary research methods (i.e. Direct measurement).
  - Phase II: conduct primary research to monetize NEIs based on the findings of Phase I.

Phase I - Project Tasks

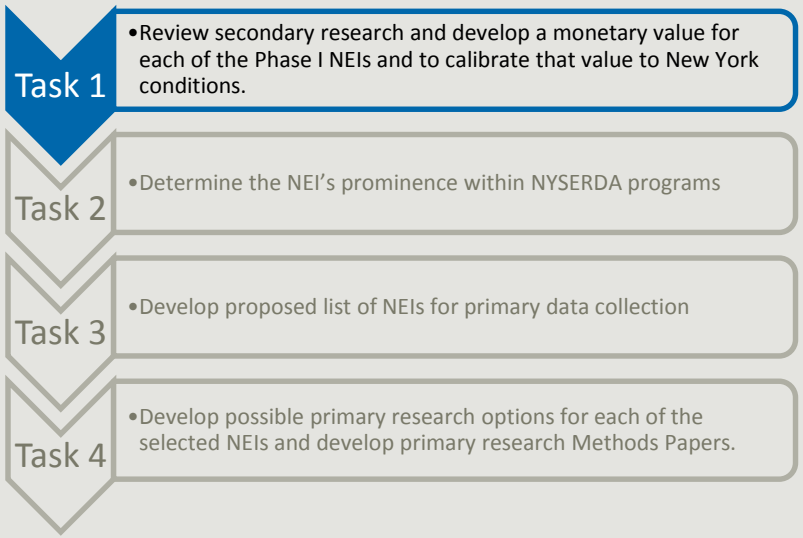
Task 1
- Review secondary research, develop a NEIs database, and translate that value to New York conditions.

Task 2
- Determine the NEI's prominence within NYSERDA programs

Task 3
- Develop proposed list of NEIs for primary data collection

Task 4
- Identify appropriate primary research options for each of the selected NEIs and develop research methods papers.

1. Secondary NEIs research and translation of NEIs value to NY state



Categorization of NEIs

- **Durability and Maintenance**
  - Properly Installed Equipment
  - HVAC Equipment and Distribution
  - Water and Humidity Management
  - Appliances
  - Lighting
- **Health and Comfort**
  - Building Thermal Envelope
  - Air Quality
  - Lighting
  - Increased Habitable Space
  - Reduced Risk of Shutting off Services
  - Lower Monthly Water Bills
- **Improved Safety (Imminent Dangers)**
  - Ambient Air Carbon Monoxide Levels
  - Gas Leaks/Fires
  - Radon
  - Detectors, Ventilation, Air Sealing
  - Lighting
- **Environmental, Societal, and Government Impacts**
  - Recycling and Proper Disposal
  - Infill over Greenfield Building
  - Appliance Recycling
  - Reduced Mobility

NEI Count by Category & Perspective

- Reviewed 84 published papers on NEIs
- Created a NEI database tool with 303 measure-level NEI values
- 96% of collected NEI values were from participant perspective and 6% from societal and utility perspectives
- 86% of NEIs were related to 'Durability and Maintenance' and 'Health and Comfort'

NEI Category	Perspective			Total in Category	% Total
	Participant	Societal	Utility		
Durability and Maintenance	152			152	50%
Environmental, Societal, and Government Impacts	11	6	9	26	9%
Health and Comfort	107		3	110	36%
Improved Safety (Imminent Dangers)	15			15	5%
Total (Perspective)	**285**	**6**	**12**	**303**	
% Total	**94%**	**2%**	**4%**		

NEI Count by State & Normalization to NY Condition

- Quantified NEIs collected across 12 states
- 75% of collected NEIs were from 3 states: MA, NY, and CA

75%

States	MA	NY	CA	MD	OH	CO	IL	WI	VT	CT	GA	NZ	TN
Number of NEIs	137	39	36	12	12	11	9	9	7	6	1	1	1
Distribution %	49%	14%	13%	4%	4%	4%	3%	3%	2%	2%	0%	0%	0%

- Adjust the collected NEIs values to NY condition based on following factors:
  - Climate
  - Home Characteristics (e.g. age, size, condition, number of occupants)
  - Cost of living
  - Inflation

- Residents who live in states that on average use more or less energy per single-family home would value NEIs more or less, in alignment with their energy use due to different climate or home characteristics

Results of Normalized Secondary Research

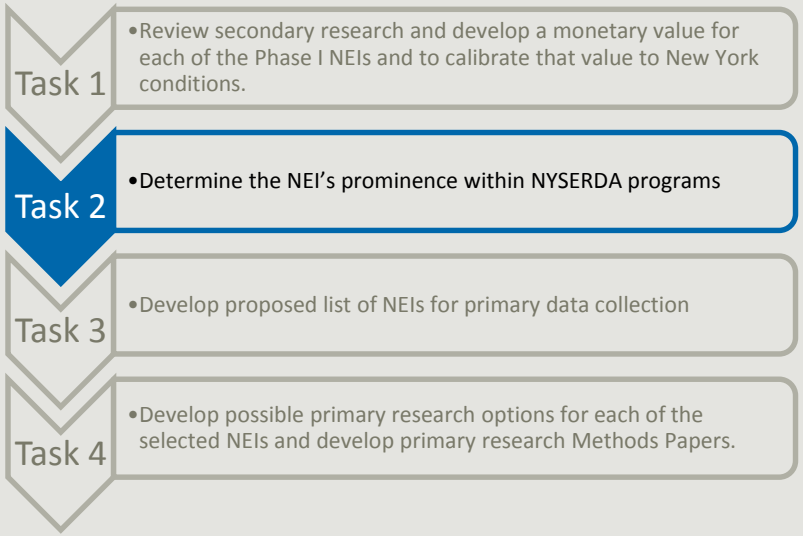
Low Income Program (Empower)	
Measure Name	**Measure NEI (1-Year)**
Insulation	$26.37
Air Sealing	$49.01
Refrigerator	$53.96
CFLs	$5.89
Heating System	$154.17
Lighting Fixture	$10.92
Thermostat	$21.01
Health & Safety	$53.04
Recycled Appliances	$86.32
Shower Heads	$8.73
Heating System Repair	$16.17
LEDs	$0.58
Freezer	$6.37
Hot Water System	$10.97
Clothes Dryer	$9.49

Existing Home Performance Program	
Measure Name	**Measure NEI (1-Year)**
Insulation	$14.39
Boiler	$109.01
Furnace	$130.62
Air Sealing	$16.99
CFLs	$2.62
Hot Water System	$42.56
Central AC	$21.87
Low Flow Fixtures	$9.44
Thermostat	$2.84
Duct improvements	$0.90
Exterior Door & Windows	$1.83
Water Heater Pipe Wrapping	$3.64

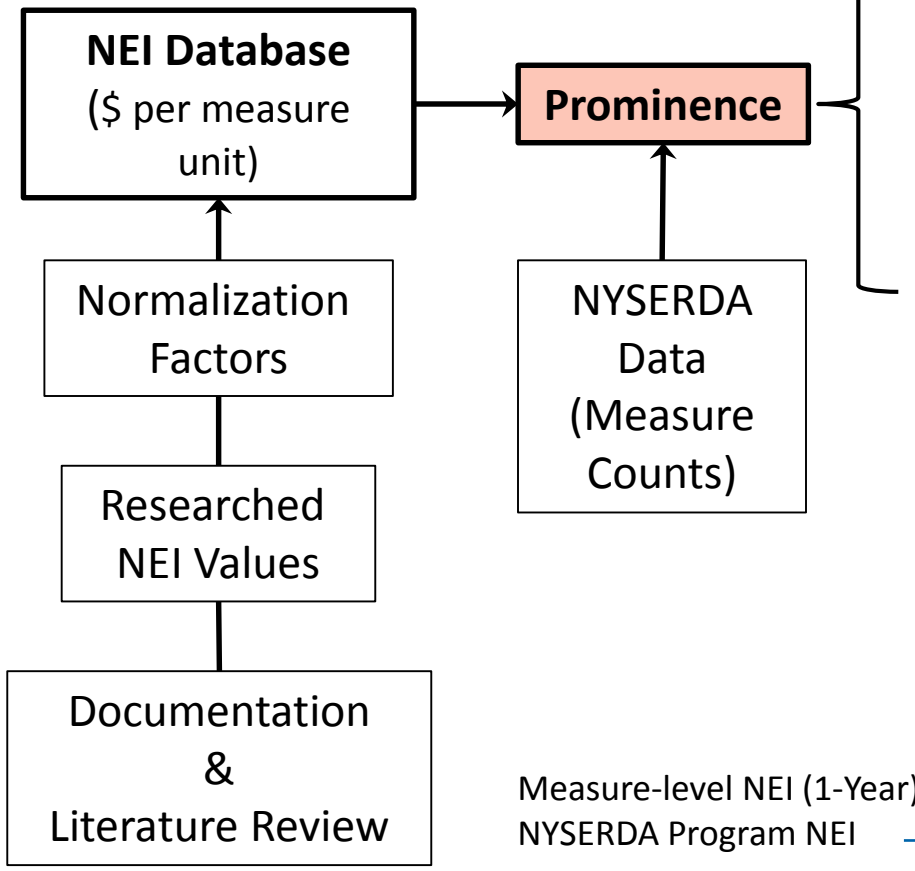
New ENERGY STAR Certified Home Program	
Measure Name	**Measure NEI (1-Year)**
Whole Home - ENERGY STAR	$1,816.47
Whole Home - Infill	$560.06
CFLs	$2.50
LEDs	$0.58

2. Prominence of Measures with NEIs within NYSERDA Residential Programs

Prominence Score



Prominence of Measures with NEIs



NEI	Measure Count	Annual NEI ($)	Lifetime NEI ($)	Prominence
NEI 1	Measure 1	$	$	High
NEI 2	Measure 2	$	$	Med
NEI 3	Measure 3	$	$	Low

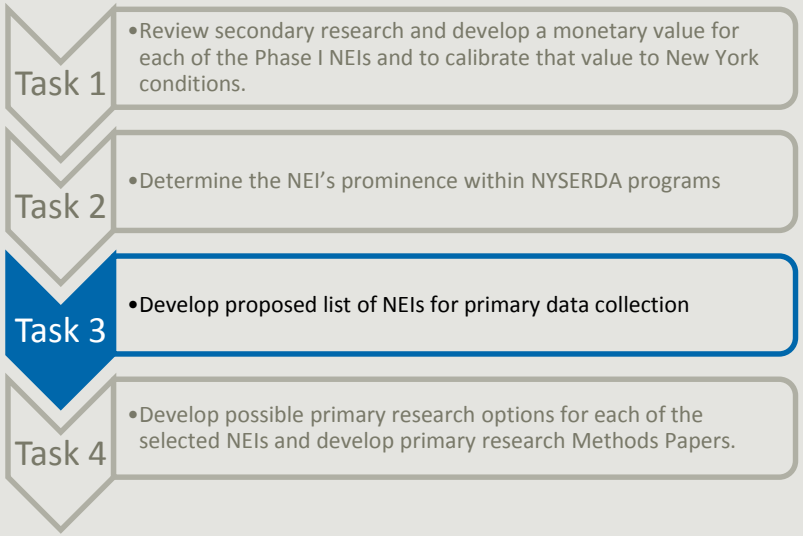
Measure-level NEI (1-Year) * Measure Useful Life* NYSERDA Measure Count = Lifetime NYSERDA Program NEI → ***Lifetime Prominence in NYSERDA Program***

Prominence of Measures with NEIs (Empower – Low Income Program)

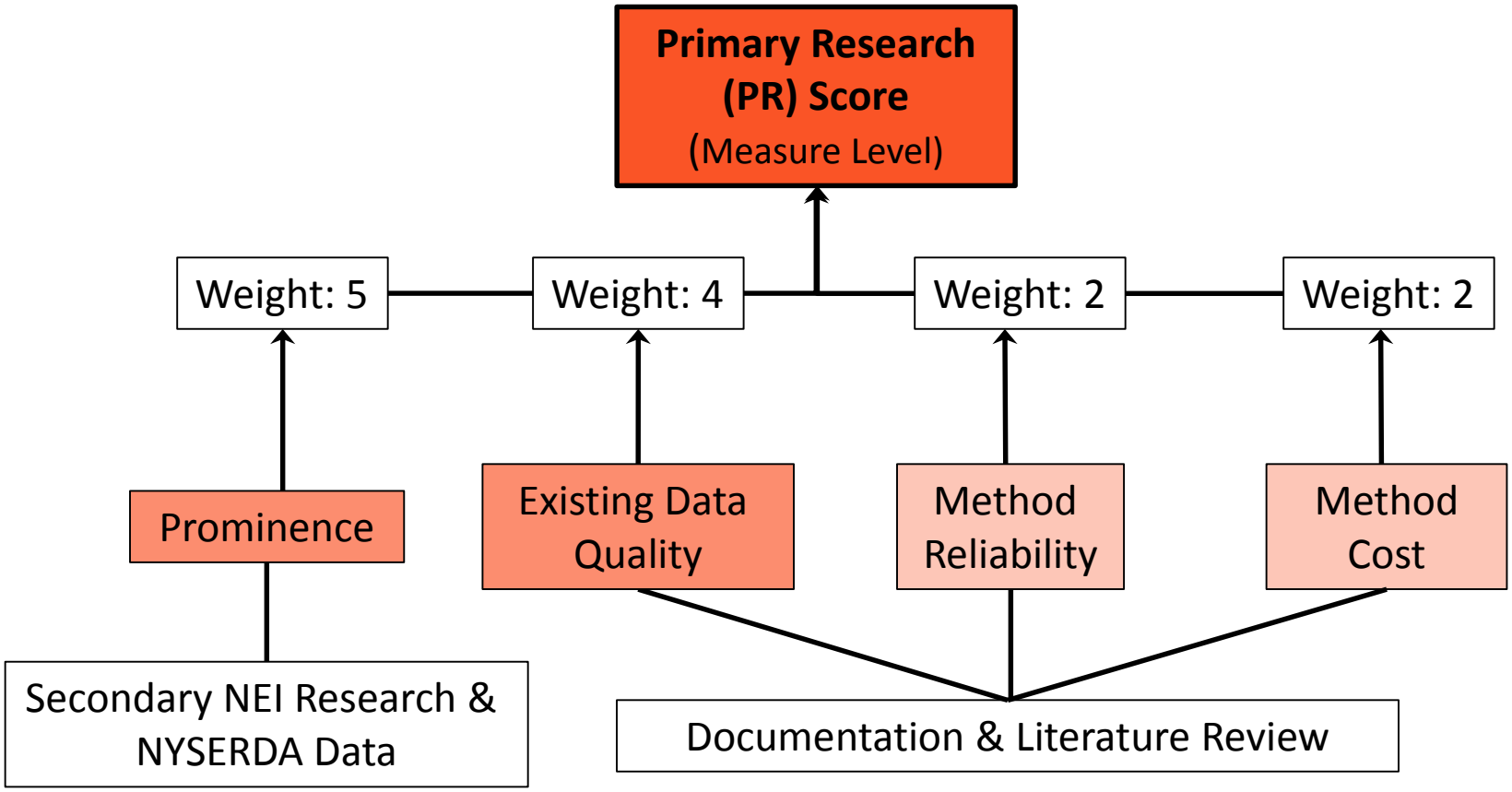
Measure Name	Measure NEI (1-Year)	Measure Useful Life	Measure Count	NYSERDA Program NEI (1-Year)	NYSERDA Program NEI (Lifetime)	Lifetime Prominence	
						Ratio	Score
Insulation	$26.37	30.0	4,449	$117,349	$3,520,462	3.4%	5
Air Sealing	$49.01	15.0	4,426	$216,872	$3,253,084	3.1%	5
Refrigerator	$53.96	17.0	3,206	$173,009	$2,941,1589	2.8%	4
CFLs	$5.89	6.0	42,226	$248,820	$1,492,925	1.4%	4
Heating System	$154.17	18.0	500	$79,760	$ $1,387,517	1.3%	4
Lighting Fixture	$10.92	6.0	7,207	$78,684	$472,102	0.5%	4
Thermostat	$21.01	11.0	1,528	$33,222	$353,051	0.3%	3
Health & Safety	$53.04	1.0	6,268	$332,450	$332,450	0.3%	3
Recycled Appliances	$86.32	4.0	811	$69,993	$279,971	0.3%	3
Shower Heads	$8.73	10.0	2,930	$25,587	$255,871	0.3%	3
Heating System Repair	$16.17	5.0	2,493	$40,309	$197,918	0.2%	3
LEDs	$0.58	20.0	10,563	$6,170	$123,401	0.1%	2
Freezer	$6.37	12.0	570	$3,631	$43,566	0.0%	2
Hot Water System	$10.97	10.0	295	$3,228	$32,403	0.0%	2
Clothes Dryer	$9.49	13.0	183	$1,737	$22,581	0.0%	2

3. Proposed list of Measure NEIs for Primary Data Collection

Primary Research Score



Primary Research (PR) Methodology



Primary Research Data Collection Methods

1. **Direct Calculation and Analysis**
   - Simulation/Model
   - Performance Data (Pre-Test / Post-Test)
2. **Collected Data Analysis**
   - Government Data (Agency Records)
   - Existing Industry Data (Existing Records)
   - Historical Data (Existing Records)
   - Pictures and Videos (Existing Records)
3. **Created Records**
   - Case Studies
   - Reporting
4. **Observations**
   - Direct observation
   - Participant observation
   - Evaluator observation
5. **Interviews**
   - Structured interviews
   - Open-ended interviews
   - In-depth interviews
   - Key information interviews
   - Focus group/panel of experts interviews
6. **Surveys/Questionnaires:**
   - Contingent Valuation (Willingness to Pay/Accept) Survey Analysis
   - Conjoint (Scaling/Scale Rating/MaxDiff) Survey Analysis
   - Conjoint (Ranking/TURF) Survey Analysis

Recommendation of Measure for Primary Research

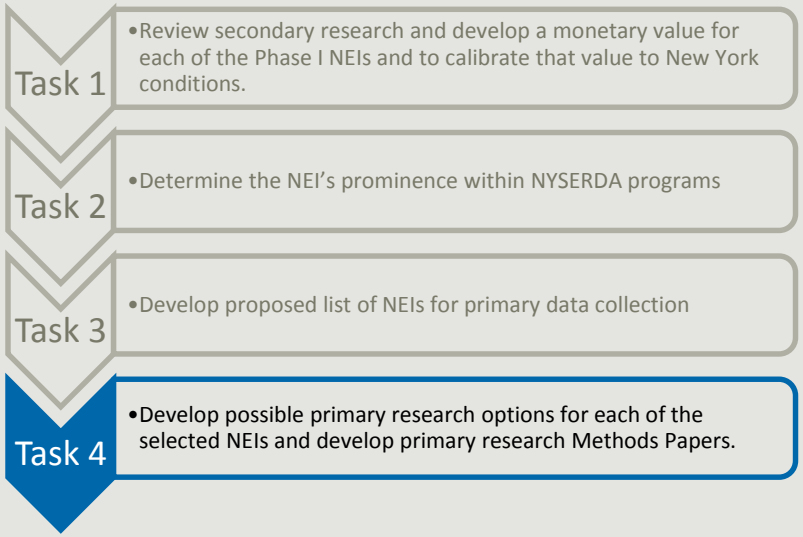
Rank	Measure Name	Prominence Score	Primary Research Score	Lifetime NEI	Recommended For Primary Research
1	Insulation (Existing & Low Income)	5	59.0	$8,412,209	Yes
2	ENERGY STAR Certified Homes (New)	5	58.5	$77,655,477	Yes
3	Air Sealing (Existing & Low Income)	5	54.8	$4,094,613	Yes
4	Refrigerator (Existing & Low Income)	4	54.0	$2,942,750	Yes
5	Heating System (Existing & Low Income)[1]	4	53.2	$4,771,310	Yes
6	Health & Safety (Low Income)	3	48.6	$332,450	Yes
7	Thermostat (Existing & Low Income)	3	47.0	$379,980	No
8	Lighting (New, Existing & Low Income)[2]	4	46.6	$2,507,039	Yes
9	Residential Infill Development (New)	4	45.8	$2,394,293	Yes
10	Hot Water System (Existing & Low Income)	3	45.5	$212,010	No

[1] Heating Systems includes Boilers and Furnaces

[2] Lighting includes CFLs, LEDs and Lighting Fixtures

4. Primary Research Data Collection Methods

Data Collection Approach Score



Primary Research Data Collection Methods

- **Identified data collection methods for each NEI of the selected measures**
  - ENERGY STAR Certified Homes
  - Insulation
  - Appliances
  - Air Sealing
  - Heating Systems
  - Health & Safety
  - Lighting
  - Whole Home - Infill

  - **Example: ENERGY STAR Certified Homes**
    1) Durability & Maintenance:
       - Collected Data Analysis – Industry Data
       - Created Records – Reporting
       - Interviews – Panel of Experts

    2) Health & Comfort:
       - Direct Calculation – Performance Data
       - Direct Calculation – Simulation
       - Collected Data Analysis – Industry data

Primary Research Methods

- **Developed a summary paper for each of identified Primary Research Methods**
  - Approach to collect the base data for analysis and monetizing the impact
  - Estimated duration and cost
  - Examples for data collection methods

- **Scored and ranked methods for each measure based on:**
  - Cost (30%)
  - Duration (30%)
  - Benefits (20%)
  - Concerns (20%)

Method Approach for ENERGY STAR Certified Homes	Method Factor Score (1-10)				Approach Score
	Cost	Duration	Benefits	Concerns	
I. Direct Calculation - Simulation	9	9	10	10	9.4
II. Direct Calculation - Performance Data	7	10	10	10	9.1
III. Collected Data Analysis - Industry & Government Data / Pictures and Videos	10	10	5	7	8.4
IV. Observations - Evaluator & Participant Observation	7	10	8	7	8.1
V. Interviews - Panel of Experts Interviews	7	10	5	7	7.5

Findings & Next Steps

Recommended Data Collection Methods

1. **ENERGY STAR Certified Homes**
   a. Simulation
   b. Performance Data
   c. Industry / Government / Picture / Video Data
   d. Evaluator & Participant Observation
2. **Insulation**:
   a. Industry Data
   b. Simulation
3. **Air Sealing**
   a. Performance Data
   b. Simulation
   c. Evaluator & Participant Observation
4. **Appliances**
   a. Simulation
   b. Direct Program & Participant Observation
5. **Heating System**
   a. Simulation
   b. Performance Data
6. **Lighting**
   a. Simulation
7. **Infill Residential Development**
   a. Industry / Government Data

*** Health and Safety is the only Measure that did not make the recommended Primary Research Methods List.**

Next Step - Phase II: Primary Research

- **Full report will be available in October 2015 on NYSERDA website:**

  http://www.nyserda.ny.gov/About/Publications/Program-Planning-Status-and-Evaluation-Reports/Evaluation-Contractor-Reports/2015-Reports

- **The Clean Energy Fund (CEF) proposal filed with the New York State Public Service Commission includes reference to the use of Non-Energy Impacts/Benefits as possible attributes of future program strategies and measurement and tracking for Cost Benefit Analysis.**

- **Sectors noted in the CEF that could potentially utilize this research as template and as a reference tool for further research include:**
  - Commercial
  - Multifamily

- **The CEF proposal has not been approved as of this presentation**

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