REGIONAL EVALUATION, MEASUREMENT & VERIFICATION FORUM

Incremental Cost Study (Phase One and Phase Two) Reference Sheet

The intent of this document is to provide a high-level overview of the Regional Evaluation, Measurement, and Verification (EM&V) Forum's Incremental Cost Study (ICS) Phases One and Two, and a reference list of measures for which incremental costs have been calculated. More information on the study and a copy of the reports and associated workbooks are available at the Forum website, under Incremental Cost Study.

Purpose
The Regional EM&V Forum (administered by NEEP) undertook the ICS to update costs for common energy-efficiency measures across the New England and Mid-Atlantic regions. The objective of the project was to develop incremental cost assumptions for electric and gas efficiency measures that will improve the ability of efficiency program planners, program administrators, program evaluators and regulators to:

- Retrospectively assess program cost-effectiveness.
- Prospectively estimate potential program cost-effectiveness to inform which measures and/or programs should be part of efficiency program portfolios.
- Inform program design, particularly the determination of financial incentive levels.

Incremental cost studies are usually technically difficult and expensive to undertake. As a result, it made practical economic sense to pool individual member resources to work as a region in undertaking these studies.

Goal
The study's overall goal was to determine baseline and efficiency-measure costs for a series of energy-efficiency measures of interest to the EM&V Forum members and to estimate the incremental costs of moving from baseline to efficiency measures. The incremental cost calculations considered equipment (or material) cost as well as the cost of labor. The Phase Two study fulfilled several purposes: estimating costs of additional measures, updating/validating results from some Phase One measures, and preliminary research on feasibility of valuing non-energy elements of costs in premium residential air conditioning.

Characterization of Results
Below is a characterization of the 18 measures studied by sector and fuel.

Table 1: Breakdown of Measures by Sector and Fuel

Study Phase	Total	Gas	Electric	Residential	C & I
Phase One	13	7	6	10	3
Phase Two	5	0	5	2	3
Total	18	7	11	12	6

A summary of the measure findings is detailed in Table 3 on page 4. Certain measures studied in Phase One were reassessed and updated in Phase Two. The location of final incremental costs numbers in those situations are identified in the column entitled "Source of Final Results." In Phase Two, three measures were investigated but not finalized:

- **Commercial boiler controls:** characterized and found that insufficient retrofits are currently taking place and that controls are now standard on new units.

- **Commercial refrigeration compressors:** the program administrator requesting this measure put a hold on moving forward in order to reinvestigate the baseline and reconfigure the measure offering.
- **Energy management systems:** were found too custom a measure to readily characterize for this project.

Methodology

The incremental cost study focused on states in the northeast region of the United States where Forum-sponsoring organizations are located. These include New England, New York, and the Mid-Atlantic states of Maryland, Delaware, and the District of Columbia. These regions fall within six economic market areas identified by the project team that account for different cost of living and labor rate. The regions presented represent the results of analyzing RSMeans City Cost Index (CCI).

Incremental Cost Study Phases One and Two were conducted in the same manner. A measure characterization was completed for each measure; it consisted of establishing a base case (size, equipment type and efficiency rating) and identifying the most common energy-efficiency alternatives. The baseline condition is defined as the standard equipment that would have been installed without the utility EE activity.

The equation for calculating incremental measure costs is simply:

Incremental measure cost = energy efficient measure cost (material + labor) - standard efficient baseline cost (material + labor)

Equipment and installation costs were collected (via invoice data) for each measure from sponsoring utilities/EE organizations where possible. In many cases, the availability of invoice data was somewhat limited, and it was supplemented by cost data obtained through interviews with relevant industry actors, including retailers and manufacturers who work within the Forum region.

For those measures where the base case was "no" measure (e.g., lighting controls), the full cost of the installation was provided. A few of the Phase Two measures address both scenarios. The data collected and analysis details for each measure are documented in the report as well as on the "Read Me" tab included in each measure Workbook.

Many of the sponsoring organizations provided lists of contractors who participated in their programs; these lists were important sources of contacts for relevant industry actors. Program Administrator measure and cost data (most often held by implementation contractors) and actual invoices were invaluable resources when they could be obtained.

Primary cost data was collected from contractors across four states (MD, MA, NY, and VT). Due to the inherent differences in cost from one region to another (i.e. the cost of labor and materials is greater in NY than in VT), all material and labor cost points where adjusted to represent the Base Cost Factors (BCF) using RSMeans CCI for both labor and material.

The six regional markets have a corresponding separate adjustment factors for material and for labor (termed "Base Cost Factors" or BCFs) developed from RSMeans CCIs. Table 2 (next page) shows the six markets identified and the corresponding BCFs for both material and labor.

Once BCF costs were determined for each measure, the costs were then allocated to each market by multiplying the BCF cost by the individual market labor and material factors. RSMeans recalculates CCI factors annually. For this study, Navigant used the 2012 CCI factors. Additionally, any older data, collected for the ICS Phase One Report or other sources, was updated with the 2012 factors to maintain comparability with data collected in 2012 for the ICS Phase Two.

The cost data gathered in each region were normalized using a regional cost-based factor that allowed the data to be aggregated and analyzed on a single platform. The normalized incremental cost number for each measure was then re-adjusted to the regional cost level using the regional BCF. The Base Cost Factors and the corresponding regions are identified in Table 2.

Throughout this process, a Technical Advisory Group and expert peer review provided quality assurance and periodic reality checks on the data and methodology used in this project. The final incremental cost results were also critically reviewed before issuing the final report.

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ICS Phase 3: The EM&V Forum will identify additional measures for incremental cost development as part of the 2013 agenda.

Table 2: Economic Market Areas and Cost Indices

Market	Market Code	Market Territory	Material Adjustment Factor	Labor Adjustment Factor
Northern New England	1	ME, VT, NH	0.98	0.69
Central/Southern New England	2	MA , RI, most CT	0.99	1.13
New England City	3	Boston, Providence	1.01	1.24
Metro New York	4	NYC, metro suburbs Southwest CT	1.03	1.55
Upstate New York	5	Albany, Buffalo, Rochester, balance of the state	0.99	1.00
Mid-Atlantic	6	MD, DE, DC	1.00	0.89
Base Cost Factor (BCF)*	-	-	1.00	1.00

Source: RMeans

[1]BCF is used to normalize data collected from different markets for analysis on a single platform. RSMeans revises its indices annually, using ongoing surveys.

Table 3: Summary of Incremental Cost Study (ICS) Phase One and Two Measures

	Measure	Sector	Fuel	Application	Cost Type	Source of Final Results	Measure Cost Shelf Life
	Phase 1: Measures September 2011						
1	Air Sealing	Res	Gas/	RET	Full	Phase 1	
2	Air Source Heat Pumps	Res	Electric	RET	Incr	Phase 1	
3	Boilers (300-2,500 kBtu//h)	C&I	Gas	ROB	Incr	Phase 1	
4	Boilers (<300 kBtu/h)	Res	Gas	ROB	Incr	Phase 1	
5	Central Air Conditioning	Res	Electric	ROB	Incr	Phase 1	Medium
6	Combination Heat Hot Water	Res	Gas	ROB/NC	Incr	Phase 2	Frequent
7	Furnace Including ECMs (60-120 kBtu/h)	Res	Gas	ROB	Incr	Phase 1	
8	Indirect Water Heaters (30-65 Gal)	Res	Gas	ROB/NC		Phase 1	
9	Insulation, Attic, Cellulose	Res	Gas	RET	Incr	Phase 2	Stable
10	Lighting Controls	C&I	Electric	RET/NC	Full	Phase 1	
11	On Demand (Tankless) Water Heaters	Res	Gas	ROB	Incr	Phase 2	
12	On Demand (Tankless) Water Heaters (Condensing)	Res	Gas	ROB	Incr	Phase 2	Medium
13	Unitary Air Conditioning	C&I	Electric	ROB/NC		Phase 1	
	Phase 2: Measures January 2013						
14	Dual Enthalpy Economizers	C&I	Electric	RET/NC	Incr, Full	Phase 2	Medium
15	Ductless Mini-Splits	Res	Electric	RET/NC	Incr, Full	Phase 2	Frequent
16	ENERGY STAR Ventilation Fans	Res	Electric	ROB/NC	Incr, Full	Phase 2	Medium
17	Prescriptive Chillers	C&I	Electric	ROB	Incr	Phase 2	Medium
18	Variable Frequency Drives	C&I	Electric	RET	Incr	Phase 2	Medium

KEY:
RET = Retrofit,
ROB = Replace on Burnout
NP = Not Pursued
Incr = Incremental
NC = New Construction

Stable: No expected technology or standards changes. Update for annual inflation only next 3-5 years.
Medium: Codes/Standers changes possible 1-3 years
Frequent: Market/Technology changes will affect measure characterization/costs in 1-3 years.