Large Filing Separator Sheet

Case Number: 09-512-GE-UNC

File Date: 11/15/2010

Section: 1 of 3

Number of Pages: 143

Description of Document: Replies

09-512-GE-UNC

REPLIES FROM VERMONT ENERGY INVESTMENT CORPORATION TO JOINT OBJECTIONS AND COMMENTS TO THE AUGUST 6, 2010 DRAFT TECHNICAL REFERENCE MANUAL FROM OHIO ELECTRIC DISTRIBUTION UTILITIES AND IEU, OHIO GAS UTILTIES, OHIO CONSUMERS'COUNSEL AND OTHER ADVOCACY GROUPS, AND OPOWER, INC.

Submitted to the Public Utilities Commission of Ohio
November 15, 2010

Please submit questions or comments to:
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REPLIES FROM VERMONT ENERGY INVESTMENT CORPORATION
TO JOINT OBJECTIONS AND COMMENTS TO THE AUGUST 6, 2010 DRAFT
TECHNICAL REFERENCE MANUAL FROM OHIO ELECTRIC DISTRIBUTION
UTILITIES AND IEU, OHIO GAS UTILTIES, OHIO CONSUMERS'COUNSEL AND
OTHER ADVOCACY GROUPS, AND OPOWER, INC.

Vermont Energy Investment Corporation (VEIC) respectfully submits the following replies in response to comments and objections filed by interested parties on the Draft Technical Reference Manual filed by the PUCO on August 6, 2010.

A table summarizing our replies is given below, followed by full detailed support and explanation for these replies. Attachments are provided giving additional information as requested; a list of these Attachments is found at the end of this document.

Summary of Replies to Comments & Objections on Draft Ohio TRM		
Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
Comments from EDUs and IEU-Ohio: III. Legal Objections		
1	**Various legal objections**	Defer to the Commission
Comments from EDUs and IEU-Ohio: IV. General Objections		
2	**Various General Objections**	Defer to the Commission
3	**G. TRM Discount Rate**	Disagree; explanation provided
4	**J. Map EFLH Values to Zip Codes**	Agree, with modifications shown
5	**K.2. Building types**	Agree, with modifications shown; and Disagree
Comments from EDUs and IEU-Ohio: V. A. Residential Measures		
	1. Residential ENERGY STAR CFL (Time of Sale)	
6	i. Page 11	Agree; TRM should reflect change
7	ii. Page 12	Disagree; explanation provided
8	iii. Page 13	Disagree; explanation provided
9	iv. Page 14	Disagree; explanation provided
10	iv. Page 14	Disagree; explanation provided
11	iv. Page 15	Agree; TRM should reflect change
	2. Residential Direct Install – ENERGY STAR CFL (Early Replacement)	
12	i. Page 17	Agree; TRM should reflect change
13	ii. Page 17	Disagree; explanation provided
14	iii. Page 17 & 19	Agree; TRM should reflect change
15	iv. Page 18	Disagree; explanation provided
16	v. Page 19	Requested information provided
17	vi. Page 20	Clarification provided
18	vii. Page 21	Agree; TRM should reflect change
	3. Residential HVAC Maintenance/Tune-Up (Retrofit)	
19	i. Page 26	Disagree; explanation provided
20	ii. Page 26	Agree; TRM should reflect change

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Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
21	iii. Page 27	Clarification provided
22	iv. Page 29	Clarification provided
23	**4. Air Source Heat Pump (Time of Sale); Page 33**	Agree; TRM should reflect change
	5. Attic/Roof/Ceiling Insulation (Retrofit)	
24	i. Page 36	Disagree; explanation provided
25	ii. Page 38	Requested information provided
	6. ENERGY STAR Torchiere (Time of Sale)	
26	i. Page 40	Disagree; explanation provided
27	ii. Page 42	Agree; TRM should reflect change
	7. Dedicated Pin Based CFL Table Lamp (Time of Sale)	
28	i. Page 44	Agree; TRM should reflect change
29	ii. Page 44	Disagree; explanation provided
30	iii. Page 46	Agree; TRM should reflect change
	8. Ceiling Fan with ENERGY STAR Light Fixture (Time of Sale)	
31	i. Page 48	Agree; TRM should reflect change
32	ii. Page 49	Clarification provided
33	iii. Page 49	Agree; TRM should reflect change
34	iv. Page 50	Disagree; explanation provided
35	v. Page 51	Agree; TRM should reflect change
36	**9. Efficient Refrigerator – ENERGY STAR and CEE TIER 2 (Time of Sale); Page 53**	Agree; TRM should reflect change
	10. Refrigerator Replacement (Low Income, Early Replacement)	
37	i. Page 56	Agree; TRM should reflect change
38	ii. Page 57	Agree, with modifications shown
39	iii. Page 57	Agree; TRM should reflect change
40	iv. Page 57	Agree; TRM should reflect change
	11. Clothes Washer – ENERGY STAR and CEE TIER 3 (Time of Sale)	
41	i. Page 59	Agree; TRM should reflect change
42	ii. Page 60	Clarification provided
43	iii. Page 60	Agree; TRM should reflect change
44	(continuation of comment above)	Disagree; explanation provided
	12. ENERGY STAR Dehumidifier (Time of Sale)	
45	i. Page 65	Disagree; explanation provided
46	ii. Page 65	Agree; TRM should reflect change
47	iii. Page 65	Disagree; explanation provided
	13. ENERGY STAR Room Air Conditioner (Time of Sale)	
48	i. Page 67	Disagree; explanation provided
49	ii. Page 68	Disagree; explanation provided
50	(continuation of comment above)	Disagree; explanation provided

Summary of Replies to Comments & Objections on Draft Ohio TRM		
Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
51	iii. Page 68	Disagree; explanation provided
52	iv. Page 68	Agree; TRM should reflect change
	14. ENERGY STAR RAC Replacement (Low Income, Early Replacement)	
53	i. Page 71	Disagree; explanation provided
54	(continuation of comment above)	Agree, with modifications shown
55	ii. Page 71	Agree, with modifications shown
56	iii. Page 72	Disagree; explanation provided
57	iv. Page 72	Agree; TRM should reflect change
	15. ENERGY STAR Room Air Conditioner Recycling (Early Retirement)	
58	i. Page 74	Disagree; explanation provided
59	(continuation of comment above)	Disagree; explanation provided
60	ii. Page 73	Disagree; explanation provided
61	iii. Page 74	Disagree; explanation provided
62	iv. Page 74	Agree; TRM should reflect change
	16. Smart Strip Power Strip (Time of Sale)	
63	i. Page 76	Disagree; explanation provided
64	ii. Page 76	Disagree; explanation provided
65	iii. Page 77	Disagree; explanation provided
	17. Central Air Conditioning (Early Replacement)	
66	i. Page 78	Unclear comment; no response
67	ii. Page 78	Agree; TRM should reflect change
68	iii. Page 78	Agree; TRM should reflect change
69	**18. Ground Source Heat Pump (Time of Sale); Page 83**	Agree; TRM should reflect change
70	**19. Heat Pump Water Heater (Time of Sale); Page 87**	Agree; TRM should reflect change
	20. Low Flow Faucet Aerator (Time of Sale, Early Replacement)	
71	i. Page 89	Agree; TRM should reflect change
72	ii. Page 90	Agree; TRM should reflect change
	21. Low Flow Showerhead (Time of Sale, Early Replacement)	
73	i. Page 93	Agree; TRM should reflect change
74	ii. Page 94	Disagree; explanation provided
	22. Domestic Hot Water Pipe Insulation (Retrofit)	
75	i. Page 98	Agree; TRM should reflect change
76	ii. Page 98	Unclear comment; no response
77	iii. Page 98	Disagree; explanation provided
	23. Wall Insulation (Retrofit)	
78	i. Page 100	Agree; TRM should reflect change
79	ii. Page 100	Disagree; explanation provided
80	iii. Page 102	Disagree; explanation provided

Summary of Replies to Comments & Objections on Draft Ohio TRM		
Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
	24. Air Sealing – Reduce Infiltration (Retrofit)	
81	i. Page 104	Agree; TRM should reflect change; and Disagree
82	ii. Page 105	Clarification provided
83	iii. Page 105	Agree; TRM should reflect change
84	iii. Page 105	Agree; TRM should reflect change
	25. ENERGY STAR Windows (Time of Sale)	
85	i. Page 115	Disagree; explanation provided
86	ii. Page 115	Requested information provided
87	iii. Page 115	Agree, with modifications shown
	26. Residential Two Speed/Variable Speed Pool Pumps (Time of Sale)	
88	i. Page 118	Clarification provided
89	ii. Page 118 & 119	Requested information provided
	27. Residential Premium Efficiency Pool Pump Motor (Time of Sale)	
90	i. Page 120	Requested information provided
91	ii. Page 120	Clarification provided
92	iii. Page 121	Agree; TRM should reflect change
93	iv. Page 121	Requested information provided
	28. Water Heaters (Time of Sale)	
94	i. Page 123	Disagree; explanation provided
95	ii. Page 124	Requested information provided
96	iii. Page 124	Agree; TRM should reflect change
	29. Programmable Thermostats (Time of Sale, Direct Install)	
97	i. Page 125	Disagree; explanation provided
98	ii. Page 126	Agree; TRM should reflect change
99	**30. Condensing Furnaces - Residential (Time of Sale); Page 127**	Disagree; explanation provided
	31. Water Heater Wrap (Direct Install)	
100	i. Page 131	Disagree; explanation provided
101	ii. Page 132	Disagree; explanation provided
102	**32. Solar Water Heater with Electric Backup (Retrofit); Page 133**	Clarification provided
	33. Residential New Construction	
103	i. Page 136	Disagree; explanation provided
104	(continuation of comment above)	Agree; TRM should reflect change
105	ii. Page 137	Agree, with modifications shown
106	**Additional Correction Proposed – Temperature Adjustment Factor**	
Comments from EDUs and IEU-Ohio: V. B. Commercial and Industrial		
107	**1. Electric Chiller (Time of Sale); Page 147**	Agree; TRM should reflect change

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Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
	2. C&I Lighting Controls (Time of Sale, Retrofit)	
108	i. Page 150	Disagree; explanation provided
109	(continuation of comment above)	Agree; TRM should reflect change
110	(continuation of comment above)	Disagree; explanation provided
111	ii. Page 151	Disagree; explanation provided
112	iii. Page 152	Agree, with modifications shown
	3. Lighting Systems, Non-Controls (Time of Sale, New Construction)	
113	i. Page 153	Disagree; explanation provided
114	ii. Page 154	Agree; TRM should reflect change
115	iii. Page 155	Disagree; explanation provided
116	iv. Page 156	Disagree; explanation provided
117	v. Page 156	Agree; TRM should reflect change
118	vi. Page 156 - 157	Agree; TRM should reflect change
119	vii. Page 158	Agree; TRM should reflect change
120	viii. Page 158	Agree; TRM should reflect change
121	ix. Page 159	Agree; TRM should reflect change
122	x. Page 160	Agree, with modifications shown
123	xi. Page 161	Agree; TRM should reflect change
124	xii. Page 161	Agree; TRM should reflect change
125	xiii. Page 161	Disagree; explanation provided
126	xiv. Page 163	Agree, with modifications shown
127	xv. Page 165	Disagree; explanation provided
128	xvi. Page 167	Disagree; explanation provided
129	xvii. Page 168	Agree; TRM should reflect change
	4. Lighting Systems, Non-Controls (Early Replacement, Retrofit)	
130	i. General	Agree; TRM should reflect change
131	(continuation of comment above)	Disagree; explanation provided
132	ii. Page 169	Agree; TRM should reflect change
133	iii. Page 170	Agree; TRM should reflect change
134	iv. Page 171	Agree, with modifications shown
135	v. Page 172	Agree, with modifications shown
136	vi. Page 173	Disagree; explanation provided
137	(continuation of comment above)	Agree; TRM should reflect change
138	vii. Page 174	Disagree; explanation provided
139	(continuation of comment above)	Agree; TRM should reflect change
	5. Lighting Power Density Reduction (New Construction)	
140	i. Page 176	Agree; TRM should reflect change
141	ii. Page 178	Agree; TRM should reflect change
142	iii. Page 178	Disagree; explanation provided

Summary of Replies to Comments & Objections on Draft Ohio TRM		
Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
	6. LED Case Lighting With/Without Motion Sensors (New Construction, Retrofit-Early Replacement)	
143	i. Page 180	Disagree; explanation provided
144	ii. Page 181	Requested information provided
145	iii. Page 182	Agree; TRM should reflect change
	7. LED Exit Signs (Retrofit)	
146	i. Page 183	Agree, with modifications shown
147	ii. Page 183	Agree; TRM should reflect change
148	iii. Page 184	Agree; TRM should reflect change
149	iv. Page 184	Agree; TRM should reflect change
150	v. Page 184	Agree; TRM should reflect change
	8. Traffic Signals (Retrofit)	
151	i. Page 185	Agree; TRM should reflect change
152	ii. Page 187	Agree; TRM should reflect change
153	iii. Page 187	Agree; TRM should reflect change
154	**9. Light Tube Commercial Skylight (Time of Sale); Page 189**	Agree; TRM should reflect change
155	**10. Energy Star Room Air Conditioner, Commercial Use (Time of Sale); Page 191-192**	Agree; TRM should reflect change
156	**11. Single-Package and Split System Unitary Air Conditioners (Time of Sale, New Construction); Page 195-196**	Disagree; explanation provided
	12. Heat Pump Systems (Time of Sale, New Construction)	
157	i. Page 197-198	Agree; TRM should reflect change
158	ii. Page 197-200	Disagree; explanation provided
159	iii. Page 199	Agree; TRM should reflect change
	13. Outside Air Economizer with Dual Enthalpy Sensors (Time of Sale, Retrofit - New Equipment)	
160	i. Page 201	Disagree; explanation provided
161	ii. Page 202	Agree; TRM should reflect change
	14. Chilled Water Reset Controls (Retrofit – New Equipment)	
162	i. Page 204	Agree; TRM should reflect change
163	ii. Page 206	Clarification provided
	15. Variable Frequency Drives for HVAC Applications (Time of Sale, Retrofit - New Construction)	
164	i. Page 207-208	Disagree; explanation provided
165	ii. Page 208	Agree; TRM should reflect change
166	(continuation of comment above)	Agree; TRM should reflect change
167	(continuation of comment above)	Clarification provided
168	iii. Page 207-209	Agree, with modifications shown
	16. Cool Roof (Retrofit - New Equipment)	
169	i. General	Agree; TRM should reflect change

Summary of Replies to Comments & Objections on Draft Ohio TRM		
Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
170	ii. Page 210	Agree, with modifications shown
171	iii. Page 210	Disagree; explanation provided
172	iv. Page 211	Agree; TRM should reflect change
173	v. Page 211	Agree; TRM should reflect change
174	vi. Page 211	Agree; TRM should reflect change
175	vii. Page 211	Agree, with modifications shown
176	viii. Page 212	Agree; TRM should reflect change
	17. Commercial Window Film (Retrofit - New Equipment)	
177	i. Page 214	Agree, with modifications shown
178	ii. Page 214	Agree; TRM should reflect change
179	iii. Page 215	Agree; TRM should reflect change
180	iv. Page 215	Agree; TRM should reflect change
	18. Roof Insulation (Retrofit - New Equipment)	
181	i. General	Agree; TRM should reflect change
182	ii. Page 218	Agree, with modifications shown
183	iii. Page 218	Agree; TRM should reflect change
184	iv. Page 219	Agree; TRM should reflect change
185	v. Page 220	Agree; TRM should reflect change
	19. High Performance Glazing (Retrofit – Early Replacement)	
186	i. Page 222	Agree; TRM should reflect change
187	ii. Page 222	Agree; TRM should reflect change
188	iii. Page 222	Agree; TRM should reflect change
189	iv. Page 223	Agree; TRM should reflect change
190	v. Page 224	Agree; TRM should reflect change
	20. Engineered Nozzles (Time of Sale, Retrofit – Early Replacement)	
191	i. Page 226	Requested information provided
192	ii. Page 226	Agree; TRM should reflect change
193	iii. Page 226	Agree; TRM should reflect change
194	iv. Page 227	Agree, with modifications shown
195	v. Page 228	Agree; TRM should reflect change
196	vi. Page 228	Agree; TRM should reflect change
	21. Insulated Pellet Dryers (Retrofit)	
197	i. Page 228	Agree; TRM should reflect change
198	ii. Page 229	Agree; TRM should reflect change
199	iii. Page 229	Agree; TRM should reflect change
200	iv. Page 230	Agree; TRM should reflect change
	22. Injection Molding Barrel Wrap (Retrofit - New Equipment)	
201	i. Page 231	Agree; TRM should reflect change

Summary of Replies to Comments & Objections on Draft Ohio TRM		
Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
202	ii. Page 231	Agree; TRM should reflect change
	23. Energy Star Hot Food Holding Cabinet (Time of Sale)	
203	i. Page 234	Agree; TRM should reflect change
204	(continuation of comment above)	Agree; TRM should reflect change
205	(continuation of comment above)	Agree; TRM should reflect change
206	ii. Page 235	Agree, with modifications shown
207	iii. Page 235	Agree; TRM should reflect change
	24. Steam Cookers (Time of Sale)	
208	i. Page 236	Agree; TRM should reflect change
209	ii. Page 236	Agree; TRM should reflect change
210	iii. Page 236	Agree, with modifications shown
211	iv. Page 236	Agree; TRM should reflect change
212	v. Page 237	Agree; TRM should reflect change
213	vi. Page 238	Disagree; explanation provided
	25. Energy Star Fryers (Time of Sale)	
214	i. Page 239	Agree; TRM should reflect change
215	ii. Page 239	Agree; TRM should reflect change
216	iii. Page 239	Agree; TRM should reflect change
217	iv. Page 240	Agree; TRM should reflect change
218	v. Page 240	Agree; TRM should reflect change
	26. Combination Oven (Time of Sale)	
219	i. Page 241	Agree; TRM should reflect change
220	ii. Page 241	Agree; TRM should reflect change
221	iii. Page 242	Disagree; explanation provided
222	**27. Convection Oven (Time of Sale); Page 244**	Agree; TRM should reflect change
223	**28. Energy Star Griddle (Time of Sale); Page 247-248)**	Disagree; explanation provided
	29. Spray Nozzles for Food Service (Retrofit)	
224	i. Page 250-251	Agree; TRM should reflect change
225	ii. Page 251	Agree; TRM should reflect change
226	iii. Page 251	Disagree; explanation provided
227	**30. Refrigerated Case Covers (Time of Sale, New Construction, Retrofit - New Equipment); Page 253**	Agree; TRM should reflect change
228	**31. Door Heater Controls for Cooler or Freezer (Time of Sale); Page 255**	Agree; TRM should reflect change
229	**32. Energy Star Ice Machine (Time of Sale, New Construction); Page 258**	Agree, with modifications shown
230	**33. Commercial Solid Door Refrigerators & Freezers (Time of Sale, New Construction); Page 262**	Agree; TRM should reflect change
	34. Strip Curtain for Walk-In Coolers & Freezers (New Construction, Retrofit-New Equipment, Retrofit-Early Replacement)	
231	i. General	Agree, with modifications shown

Summary of Replies to Comments & Objections on Draft Ohio TRM		
Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
232	ii. Page 263	Requested information provided
	35. Motors (Time of Sale)	
233	i. General	Agree, with modifications shown
234	ii. Page 265	Agree; TRM should reflect change
235	(continuation of comment above)	Agree; TRM should reflect change; and Disagree
236	iii. Page 265	Agree; TRM should reflect change
237	iv. Page 266	Agree; TRM should reflect change
238	v. Page 266	Agree; TRM should reflect change
	36. High Efficiency Pumps and Pumping Efficiency Improvements (Retrofit)	
239	i. Page 269	Disagree; explanation provided
240	ii. Page 269	Disagree; explanation provided
241	iii. Page 270	Disagree; explanation provided
	37. Efficient Air Compressors (Time of Sale)	
242	i. General	Requested information provided
243	ii. Page 272	Agree, with modifications shown
244	**38. Vending Machine Occupancy Sensors (Time of Sale, New Construction, Retrofit-New Equipment); Page 274**	Agree; TRM should reflect change
	39. Heat Pump Water Heaters (New Construction, Retrofit)	
245	i. Page 276	Agree; TRM should reflect change
246	ii. Page 277	Agree, with modifications shown
247	iii. Page 277	Agree, with modifications shown
248	**40. Commercial Clothes Washer (Time of Sale); Page 279**	Agree; TRM should reflect change
249	**41. Commercial Plug Load – Smart Strip Plug Outlets (Time of Sale, Retrofit-New Equipment); Page 280**	Agree, with modifications shown
	42. Plug Occupancy Sensor (Retrofit)	
250	i. Page 282	Agree; TRM should reflect change
251	ii. Page 283	Disagree; explanation provided
	43. Energy Efficient Furnace (Time of Sale, Retrofit – Early Replacement)	
252	i. Page 284	Agree; TRM should reflect change
253	ii. Page 285	Requested information provided
254	iii. Page 285	Agree, with modifications shown
	44. Tank-less Water Heaters (Time of Sale, Retrofit – Early Replacement)	
255	i. Page 288	Agree; TRM should reflect change
256	ii. Page 289	Agree; TRM should reflect change
257	**45. Stack Damper (Retrofit – New Equipment); Page 291**	Agree, with modifications shown
	46. Energy Efficient Boiler (Time of Sale)	
258	i. Page 295	Agree; TRM should reflect change

Summary of Replies to Comments & Objections on Draft Ohio TRM		
Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
259	ii. Page 296	Agree; TRM should reflect change
260	iii. Page 296	Agree, with modifications shown
Comments from EDUs and IEU-Ohio: V. C. Custom		
261	**#1 – Protocols as guidelines**	Clarification provided
262	**#2 – TRM Section IV**	Clarification provided
263	**#3 – TRM relative to Mercantile Customer Pilot Program**	Defer to the Commission
264	**#4 – Annual calculations and tracking**	Defer to the Commission
265	**#5 – IPMVP for mercantile customers**	Defer to the Commission
266	**#6 – Request for tiered metering**	Clarification provided
267	**#7 – Request for tiered metering**	Clarification provided
268	**#8 – Self-calibrating controllers**	Disagree; explanation provided
Comments from EDUs and IEU-Ohio: V. D. Transmission & Distribution		
269	**#1 – IPMVP for T&D projects**	Disagree; explanation provided
270	**#2 – Individual T&D loss calculations for each utility**	Clarification provided
271	(continuation of comment above)	Disagree; explanation provided
272	(continuation of comment above)	Disagree; explanation provided
273	**#3 – Real-time historical data**	Disagree; explanation provided
274	(continuation of comment above)	Disagree; explanation provided
275	**#4 – Other methods for load data**	Clarification provided
276	**#5 – Measure life usage**	Clarification provided
277	**#6 – Availability of information**	Clarification provided
278	**#7 – Projects providing incremental energy savings**	Defer to the Commission
279	**#8: Pages 340-343 – T&D Loss Reductions-Mass Plant Replacement and Expansion Analysis Protocol**	Clarification provided
280	(continuation of comment above)	Clarification provided
281	(continuation of comment above)	Disagree; explanation provided
282	(continuation of comment above)	Clarification provided
283	**#9: Pages 344-347 – T&D Loss Reductions-Mass Plant Retrofit Analysis Protocol**	Disagree; explanation provided
284	**#10: Page 345 – Base & Efficient Cases**	Clarification provided
285	(continuation of comment above)	Clarification provided
286	(continuation of comment above)	Clarification provided
287	**#11: Pages 348-351 – T&D Loss Reductions-Large Customer Connection Analysis Protocol**	Disagree; explanation provided
288	**#12: Page 349 – Equipment Loading**	Clarification provided
289	**#13: Page 349-350 – Base & Efficient Cases**	Clarification provided
290	(continuation of comment above)	Clarification provided
291	**#14: Page 353 – Equipment Loading**	Clarification provided
292	(continuation of comment above)	Clarification provided
293	**#15: Pages 356-359 – T&D Loss Reductions-System Reconfiguration Analysis Protocol**	Clarification provided
294	(continuation of comment above)	Disagree; explanation provided

Summary of Replies to Comments & Objections on Draft Ohio TRM		
Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
295	(continuation of comment above)	Clarification provided
296	**#16: Pages 360-363 – T&D Loss Reductions-Voltage Conversion Analysis Protocol**	Clarification provided
297	Page 360 – Project Information: Location	Clarification provided
298	Technology Description	Clarification provided
299	(continuation of comment above)	Clarification provided
300	(continuation of comment above)	Clarification provided
301	Pages 360-361 – Equipment Loading, Request for Direction of Flow	Clarification provided
302	Interval-Metered Location along the Line	Clarification provided
303	Hourly Loads in the Report Year	Clarification provided
304	Average Load on Line	Clarification provided
305	Total Energy Delivered to the Line	Clarification provided
306	Hourly Loads for Large Loads	Clarification provided
307	Distribution of Annual Deliveries along the Line	Clarification provided
308	Line Segments within each Segment	Clarification provided
309	Consistent Power Flows	Clarification provided
310	Hourly Average Calculations	Clarification provided
311	Pages 361-362 – Pre-Project and Post-Project Cases	Clarification provided
312	(continuation of comment above)	Clarification provided
313	Pre and Post-Loss Savings Calculations	Clarification provided
Comments from Gas Utilities		
314	**I. Comments**	Defer to the Commission
315	**Attic Insulation – Page 36**	Agree; TRM should reflect change
316	**Showerheads – Page 93**	Agree, with modifications shown
317	**Pipe Insulation – Page 97**	Agree, with modifications shown
318	**Wall Insulation – Page 100**	Agree; TRM should reflect change
319	**Air Sealing – Page 104**	Agree; TRM should reflect change
320	**Duct Sealing – Page 108**	Agree, with modifications shown; and Disagree
	Residential New Construction (New Homes) – Page 136	
321	i. Clothes washers	Agree, with modifications shown
322	ii. Refrigerator usage	Agree; TRM should reflect change
323	iii. Duct system efficiency	Agree; TRM should reflect change
324	iv. Incremental cost assumptions	Agree, with modifications shown
325	**Water Heaters (Time of Sale) – Pages 123-124**	Agree; TRM should reflect change
Comments from Consumers' Counsel and Advocacy Groups		
326	**A. Protocols for Information and Behavioral Norm Programs**	Disagree; explanation provided
	B. T&D Adjustments to TRM	
327	#1: Base case definition	Agree; TRM should reflect change
328	#2: Definition of project/program lifetime	Clarification provided

Summary of Replies to Comments & Objections on Draft Ohio TRM		
Reply #	**Stakeholder Comment Identifier (w/ TRM pages)**	**Disposition**
329	#3: Use of measure life	Clarification provided
330	#4: Protocol for capacitors	Clarification provided
331	#5: Load duration for loss calculations	Clarification provided
332	#6: Upstream loss factors	Clarification provided
333	#7: Transmission peak loss factor	Clarification provided
334	#8: Protocols for conservation voltage reduction	Disagree; explanation provided
335	#9: Loss-driven retrofit	Clarification provided
336	#10: Use of load duration curves	Clarification provided
337	#11: Modeling requirements	Agree; TRM should reflect change
Comments from OPower, Inc.		
338	**Request for inclusion of EM&V protocol for behavior energy efficiency programs, and recommendation**	Disagree; explanation provided

REPLIES TO JOINT OBJECTIONS AND COMMENTS TO THE AUGUST 6, 2010 DRAFT TECHNICAL REFERENCE MANUAL FROM OHIO EDISON COMPANY, THE CLEVELAND ELECTRIC ILLUMINATING COMPANY, THE TOLEDO EDISON COMPANY, COLUMBUS SOUTHERN POWER COMPANY, OHIO POWER COMPANY, DUKE ENERGY OHIO, INC., THE DAYTON POWER AND LIGHT COMPANY AND INDUSTRIAL ENERGY USERS-OHIO

I. Introduction
II. History of the TRM Process
III. Legal Objections to the Draft TRM

1. VEIC defers all responses on the comments in these sections to the Commission.

IV. General Objections to the TRM

VEIC has provided responses to objections G., J., and K.2. below. For these three items, we provide the majority of the original comment below (embedded tables and other additional information have been omitted and can be viewed in the original Objections and Comments filing), followed by VEIC's response.

2. VEIC defers all responses on other objections in this section to the Commission.

G. The TRM's Discount Rate is Not Appropriate.

The TRM assumes a 5% discount factor for all net present value calculations. The TRM does not identify why 5% was selected as the discount factor. A net present value calculation using 5% as the discount factor may or may not be appropriate depending on the nature of the compliance initiative. Thus, the TRM's adoption of 5% is arbitrary.
Appendix C, entered into Case No. 09512-GE-UNC, recommended the use of after-tax weighted average cost of capital ("WACC"). Given the lack of clarity as to the selection of 5%, each EDU should be able to propose its own discount factor as part of its compliance plan, and once approved, rely upon such discount factor or factors for purposes of achieving compliance.

3. Disagree. This discount rate is used in the TRM solely for the calculation of the net present value of any O&M savings associated with specific measures. While VEIC believes that the Commission could allow each utility to use its own current discount factor for these calculations, this would result in additional work that would need to be updated frequently, with little substantive effect. For this reason, we believe that use of a standardized rate is appropriate. The 5% used in the calculations in the TRM is a real rate that translates into a nominal rate of over 8%, which does not appear an unreasonable estimate for this purpose.

J. The TRM Needs to Map EFLH Values to Zip Codes

The TRM fails to include a zip code mapping table which maps all Ohio zip codes to the appropriate reference city listed in the TRM measures. Without this mapping table it is difficult to know which city has the appropriate EFLH for a project in some zip codes.

4. Agree, with modifications shown. The approach to presenting EFLH and other factors by reference city in the TRM follows the approach taken by the EDUs in their Joint TRM (October 15, 2009). While we agree that presenting this information by zip code would make the application of some calculations easier, this work was not contemplated as part of the original work plan for TRM development, and we defer to the Commission to decide whether to support it.

K. Commercial & Industrial Market Sector General Objections: 2. Building Types

Several measures in the TRM include EFLH and coincidence factor ("CF") tables which list distinct hours and CF values according to various building types. However, certain locations at which energy efficiency or peak demand reduction measures are installed will not fit neatly into the listed building types. Further, Respondents recommend using site-specific values if known. Lastly, given that the building types currently included in the draft TRM tables do not cover many applications, Respondents recommend that those tables should be expanded.
[*list omitted*]

5. Agree, with modifications shown. We agree that the current proposed characterizations are somewhat limited in their applicability and should ideally be expanded via additional modeling to cover the additional building types noted. If the modeling runs or additional data can be provided with a reasonable level of effort, we recommend adding this additional detail. If not, the TRM can be expanded through future evaluation efforts. We strongly support the involvement of the EDUs in the ongoing TRM revision process and propose that this change be incorporated as part of that process.

   and

   Disagree. While building modeling can provide outputs for additional building types, the modeling will not provide peak coincidence factors. Additional coincidence factors by building type would need to be developed separately, and this should be taken into account if the decision is made to increase the number of building types.

   We do not agree that site-specific values should be used "if known" as a rule for full load hours, as it can be overly burdensome to collect this data for a prescriptive program. Also, customer-reported hours of use are known to be unreliable. In some cases using customer-reported hours of use is the best approach, but we do not recommend it for most prescriptive measures.

V. Technical Objections and Comments to the TRM – A. Residential Measures

We provide the majority of the original comment below (embedded tables and other additional information have been omitted and can be viewed in the original Objections and Comments filing), followed by VEIC's response.

1. Residential Energy Star CFL (Time of Sale)

Page 11 - If the Delta Watts Multiplier is kept, it should include a calculation for Delta Watts Multiplier.

6. Agree; TRM should reflect change. An explanation of how the 3.25 Delta Watts Multiplier was derived is provided in footnote 6. We agree, however, that additional explanation showing how the EISA legislation affects the multiplier could be provided.

Page 12 - The calculation for adjusted lifetime in Footnote 3 appears to be incorrect. The term (0.2/0.77) should be (0.2*0.77), which would adjust the lifetime to 8.7 yrs, not 9.18.

7. Disagree. Another way to perform the calculation is as follows: 57% of the remaining 20% (or 11.4% of the total) is purchased as spares to replace the CFLs installed. Therefore, we assume that 11.4% out of the 77% of bulbs installed would last 16 years (8 years and then replaced for a further 8 years), and the remainder would last 8 years. Therefore, the measure life is assumed to be (0.114/0.77 * 16) + ((1-(0.114/0.77)) * 8) = 9.18 years.

Page 13 - In Service Rate: This should be higher based on the California Final Upstream Lighting Evaluation Report Volume I, table 72 for CFLs installed over the life of the bulb. The table below [*omitted here*] provides the appropriate percents and proportions from the CA evaluation report. The table below [*omitted here*] uses CA findings (from table 72) and applies them to the proposed Ohio TRM installation rate. The table below [*omitted here*] is linked to Excel with formulas (Note slight rounding differences).

8. Disagree. We are not clear why a California study would be more relevant than one from New England. The final installation rate from both studies is very similar (97% in New England, 99% in California). However, the New England study provides information that suggests that while 97% of the total is eventually installed, not all are replacing incandescent bulbs –some are purchased as spares to replace CFLs once they burn out (57% of the remaining 20%). It is clearly not appropriate to include those bulbs in the In Service Rate since they are not replacing incandescent bulbs. To account for that portion of sales, we have increased the measure life as discussed above. The 43% (of the remaining 20%) that do (at some point) replace incandescent bulbs have been included in the ISR. The existing methodology is based on a well documented evaluation and we believe is a more accurate representation of reality than what is suggested above by the utilities, and so recommend that it not be changed.

Page 14 - The WHFd should be calculated by multiplying by 35% similar to the WHFe to account for the decrease in lighting heat load. This resulting equation should be "WHFd = (1+(0.64*(0.35/3.1)) = 1.07.

9. Disagree. The 35% factor reflects the percentage of annual lighting usage that affects cooling loads. One of the reasons it is less than 100% is there is no cooling load in the winter. However, at the time of system peak, it is by definition a time of cooling, and therefore a 100% of CFLs on at the time of peak are assumed to be providing cooling benefits.

Page 14 - We request the coincidence factor be revised from 0.11 to 0.16 based on Duke CFL savings load shape data normalized to the full population of CFLs.

10. Disagree. In the version of the referenced report that was sent to VEIC, the discussion on loadshapes and Figure 4: 2009 CFL Loadshape (p37) specifically state that "The weekday and weekend hours of use are normalized to the highest weekday value." As such, the highest peak is shown as 100%. It is therefore not possible to determine the actual coincidence factor for the peak hours. The proposed 0.16 appears to have originated from an earlier Duke Energy study ("An Evaluation Energy Star Products Results of a Process and Impact Evaluation of Duke Energy's CFL Promotion and Lighting Logger Programs", September 24, 2008) that measured usage in OH during winter months and Kentucky in spring months, rather than summer months.

    We therefore based the coincidence factor on the Nexus Market Research, RLW Analytics and GDS Associates study; "New England Residential Lighting Markdown Impact Evaluation, January 20, 2009", which we consider to be the best available source.

Page 15 - "Deemed O&M Cost Adjustment Calculation" - The "Efficient Incandescent" heading in table should read "Halogen" to maintain consistency with spreadsheet on page 16.

11. Agree; TRM should reflect change. This is a reasonable suggestion.

2. Residential Direct Install - Energy Star CFL (Early Replacement)

Page 17 - If the Delta Watts Multiplier is kept, please include calculation for Delta Watts Multiplier.

12. Agree; TRM should reflect change. An explanation of how the 3.25 Delta Watts Multiplier was derived is provided in footnote 21. We agree, however, that additional explanation showing how the EISA legislation affects the multiplier could be provided.

Page 17 - "Description" - Include expected hours of use for calculation of this measure.

13. Disagree. The description is simply an explanation of the measure in question and should not include any variables that, pending future relevant evaluations, may be updated and changed. We therefore do not agree that it is appropriate to include the hours assumption in the description, but that it should be presented with all the other variables in the reference section.

Pages 17 and 19 - The deemed Lifetime calculation is based on 1,011 annual hours and energy savings are based on 1,040 annual hours (2.85 hours per day). The value of 1,040 hours should be listed in the TRM, although the lifetime will stay 8 years (rounded up from 7.7 years).

14. Agree; TRM should reflect change. This correction should be made.

Page 18 - In Service Rate (ISR) of 0.81 is lower than the ISR deemed in the Time of Sale section. This is counter-intuitive. The ISR for a direct install program should be higher, since the lamps are installed by a contractor in an appropriate socket. If the circumstances around the data are similar to direct install of auditors, Duke Energy Ohio recommends an ISR rate of 0.89.

15. Disagree. VEIC requested the "Duke Energy Ohio Audit Direct Install program" evaluation, but it was not provided. Instead we received some data that indicated that the 89% proposed was the ratio of bulbs reported to be installed via phone surveys compared to those bulbs whose installation was verified through onsite verification. These data did not appear to capture another component of In Service Rate, namely the difference between bulbs that were actually installed by auditors but that were not reported to be installed via the phone surveys with participants.

    VEIC is not aware of any evaluations that look specifically at the in service rate of directly installed bulbs, other than the LIPA evaluation (provided as Attachment A). One could argue that a lower ISR for a direct installation program is not counter-intuitive – that someone that goes to a store and purchases a light bulb with their own money is more likely to install it and keep it installed than someone who is provided the bulb free of charge. The fact that a contractor installs it does not mean that it is not removed shortly after they leave. We recommend keeping the ISR as provided unless and until future evaluation suggests a modification is appropriate.

Page 19 - Please provide the following data (report): Megdal & Associates, 2003; "2002/2003 Impact Evaluation of LIPA's Clean Energy Initiative REAP Program."

16. Requested information provided (Attachment A).

Page 20 - Citation for "HF" (footnote 29) does not provide enough information to gauge accuracy. Can VEIC clarify how this citation is used?

17. Clarification provided. The HF was derived from building simulation modeling using OH climate information. This seems reasonably clear in the existing footnote. We are not sure what additional information would be useful.

Page 21 - "Deemed O&M Cost Adjustment Calculation" - The "Efficient Incandescent" heading in table should read "Halogen" to maintain consistency with spreadsheet on page 22.

18. Agree; TRM should reflect change. This is a reasonable suggestion.

3. Residential HVAC Maintenance/Tune-UP (Retrofit)

Page 26 - In footnote 42, the calculation of the Summer Peak Coincidence Factor (CF) is incorrect. The referenced report - Energy Center of Wisconsin, May 2008 metering study; "Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research", p32 - indicates that of the 58 air conditioning systems in the study, during the peak operating period 17 were "running flat out" while 11 were not running and 30 were cycling. The average duty cycle was 44 minutes per hour for the 47 systems that operated during the peak period. Thus the Summer Peak Coincidence Factor is the weighted average equal to:
[(47 units * 44 min/hr) + (11 units * 0 min/hr)] / (58 units * 60 min/hr) = 0.594
However, based on the analysis described in the ADM White Paper pertaining to this measure, the CF for Central Air Conditioning (CAC) measures should stay at 0.50, the CF for CAC tune-up measures should be 0.44, and the Maintenance Demand Savings Factor (MFd) for this measure should be equal to the Maintenance Energy Savings Factor (MFe).

19. Disagree. The referenced Wisconsin study appears to provide somewhat conflicting information. In one place in the report it clearly says that the average duty cycle (or coincidence factor) is 50%. However, as noted by the utilities, the report also state that the average duty cycle for the 79% of systems that are operating is 73%. That implies a weighted average duty cycle of 58% (0.79 x 0.73). This is slightly lower than the 59.4% suggested by the utilities because 79% of 58 units analyzed is 46 units that were operating, not the 47 estimated by the utilities. We have been unable to reach the author of the study to clarify this discrepancy. However, given both that (1) the one statement in the study that covers all systems says the coincidence factor is 50%, and (2) the utilities also appear to support using 50%, we suggest maintaining that value in the TRM for all measures affecting central air conditioning consumption and for which a coincidence factor is needed to calculate peak savings (unless and until new information surfaces to suggests a different value).

    We do not agree with the utilities' suggestion that the MFd be equal to the MFe and then multiplied by a 44% coincidence factor for central air conditioner tune up measures, which would imply that savings as a percent of coincident peak demand is similar to savings as a percent of seasonal energy consumption. It has long been recognized that peak savings from correction of refrigerant charge and airflow are lower, in percentage terms, than energy savings. As noted in the Wisconsin study, this is because the efficiency gains are due to a combination of increasing the cooling output and reducing power input. In all cases, reducing power input provides savings at both times of peak and non-peak times. However, while increasing cooling output provides savings when systems are cycling, it does not provide any benefits if systems are running constantly at the time of peak. This is important because the Wisconsin study suggests that roughly half of all peak demand comes from the 28% of central air conditioners that are running constantly at the time of peak. Consider the benefits of correcting airflow. Correcting inadequate airflow will actually result in increasing the watt draw of the fan motor and compressor. However, it will increase capacity even more. Thus, during non-peak times when the system is cycling, there are energy savings. However, for systems running constantly at the time of peak and for which modest increases in capacity will not be enough to allow them to begin cycling (studies suggest 80% of constant running systems fall into this category), consumption will actually increase. The impacts of correcting under-charging are similar to those of correcting inadequate airflow. In contrast, correcting over-charging both decreases watt draw and increases capacity. Thus, for units running constantly at the time of peak, correcting over-charging will provide some peak savings (due just to the benefits of reducing watt draw), but those savings will be lower in percentage terms than the savings provided during non-peak times (when both lower watt draw and increases in capacity provide savings).

Page 26 - We agree the total measure cost is roughly in agreement with the $175 figure currently used in the TRM. A recent survey by CSG of twelve of the larger Dayton area residential HVAC contractors suggests an average Dayton total measure cost for inspection and tune-up of $160 which is in synch with the $175 national average estimate, particularly since southwestern Ohio is a somewhat lower cost region than the national average. The average cost for an inspection alone based on the same Dayton area survey is $96. This would suggest an estimated incremental measure cost of $64 ($160 - $96) for the additional diagnostic and repair work the Real Cool Analyzer system entails. Another way to look at it is to realize that in a significant number of cases the contractor does the work only for the program incentive of $90. This would suggest that in these cases, the incentive cost closely approximates the incremental measure cost. The EDUs would therefore propose that the program should use an average of these estimates, approximately $75 - $80.

20. Agree; TRM should reflect change. The draft TRM was developed under the assumption that the tune-ups were taking place as a result of separate visits to the participating consumers' homes. However, we understand that may not always be the case. Thus, we recommend that the TRM provide two separate incremental cost estimates, one to be used for cases in which the work is completely separate from any other work being conducted by HVAC contractors and another for cases in which the tune-ups are piggybacked on service calls that the contractors would otherwise have performed.

Page 27 - The EDUs could not confirm MFe in source cited in footnote 45. It is not clear that this factor would equally apply to Heat Pump cooling and heating seasons. The Wisconsin study in the footnote is more focused on AC units, not heat pumps. The EDUs recommend the value be subjected to further review by VEIC.

21. Clarification provided. The reference for 5% tune up savings is on page 39 of the Energy Center of Wisconsin, May 2008; "Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research" report, and this has been made more clear in the TRM document. In the limited time available to respond to these comments VEIC has not been able to identify studies that support different savings assumptions for heat pumps than for central air conditioners. It is certainly plausible that they might be different. However, in the absence of references to support differences we suggest that the TRM remain unchanged at this time.

Page 29 - The EDUs could not confirm MFd in source cited in footnote 45. It is not clear that this factor would equally apply to Heat Pump cooling and heating seasons. The Wisconsin study in the footnote is more focused on AC units, not heat pumps. We recommend the value be subjected to further review by VEIC.

22. Clarification provided. As noted in the footnote, the MFd factor was derived based on personal conversation with Scott Pigg, author of the Wisconsin HVAC study, suggesting the average WI unit

system draw of 2.8kW under peak conditions, and average peak savings of 50W. Peak savings factor is therefore estimated as 50/2800 = 0.018 or 2%. With respect to peak demand savings for Heat Pumps, it is not clear to us why this would be different than central AC units, and are not aware of any evaluations that document any differences.

4. Air Source Heat Pump (Time of Sale)

Page 33 - The Definition of Baseline Equipment should include the minimum HSPF required by code (7.7) similar to the Definition of Efficient Equipment.

23. Agree; TRM should reflect change. This is a reasonable suggestion.

5. Attic/Roof/Ceiling Insulation (Retrofit)

Page 36 - Duke Energy Ohio suggests that the simulation approach from the Joint IOU TRM be used in lieu of the cooling degree hours calculation. Consultants can provide more combinations of initial and final R values for this measure to make the algorithm more general.
The degree hour approach is a simple steady-state approach that misses much of the important dynamics of building energy use, including thermostat setback, time-varying internal loads, solar heat gains, and building thermal mass effects. The ASHRAE Handbook^^ states "When the indoor temperature is allowed to fluctuate or when interior gains vary, simple steady-state models must not be used."
In one typical case investigated, the DOE-2 simulations provided energy savings three times larger the calculated kWh and kW savings, and eight times more than the therm savings predicted by the degree hour approach in the TRM.
For example, using the algorithms in the TRM for attic/roof/ceiling insulation:
[*Table omitted*]
DOE-2 simulations using comparable inputs on the DEER prototypes returned 36.5 kWh/kSF, 0.026 kW/kSF and 27.9 therms/kSF.
The algorithms require a site-specific estimate of heating system efficiency, which includes an estimate of the distribution system efficiency. Estimates of distribution system efficiency come from either a duct leakage test or visual inspection combined with the BPI lookup tables on distribution efficiency. Furnace efficiency is estimated from the nameplate AFUE or from a combustion test. This level of data collection is too onerous for a prescriptive rebate measure. There is no guidance provided on cooling system efficiency, for either the air conditioner (or heat pump) or the duct system.

24. Disagree. Firstly, there is an error in the calculation comparing our TRM algorithm method with the DOE-2 simulations. The 3.3 therms/1000SF is actually 3.3 MMBtu/1000SF, or 33 therms/1000SF. This makes our result relatively similar to the 27.9 therms derived from the DOE-2 simulation.

    We also disagree with the notion that providing simulation savings, in the format of a prescribed KWh/SF or MMBtu/SF for different cities in the State, is more accurate than the site specific modeling we have provided. First, it should be clear that no modeling method is perfect. Second, while we agree that "thermostat setback, time-varying internal loads, solar heat gains, and building thermal mass effects" will affect savings to some degree by impacting the delta T between inside and out, we do not believe this will have a huge impact on the conductive losses being calculated here. Third, while simulation models can adjust for such factors, they will only do so accurately if the modeling assumptions for these factors are based on good local, empirical data. We are unaware of any such data that the modelers could have used for Ohio. Fourth, the utility proposed method of providing deemed savings amounts per square foot of area, does not allow for any modification or customization based on the specifics of an actual installation; for example, the actual pre and post R-values (for insulation measures), actual CFM50 reduction and n-factors (to more accurately convert 50-pascal airflows to natural airflows) (for air-sealing measures), and the efficiency of heating/cooling equipment. Fifth, cooling savings are notoriously overestimated in simulations because they do not tend to factor in behavioral effects, such as the fact that most people do not always operate their AC as soon as the outside temperature is 75 degrees (something we account for in the Discretionary Usage Factor). We also believe our method is more transparent and replicable than simply providing deemed savings from a simulation.

It is difficult to comment further without seeing all the modeling assumptions used by the utilities. When we conducted some very simple tests using simulation modeling, we obtain results that were comparable to the engineering formulae we have proposed.

We therefore recommend that the methodology we have proposed remain, and that additional guidance for obtaining the required data points be provided, together with default assumptions if they can not be collected.

Page 38 - "Space Heating Savings Calculation" - If the modeling approach is not approved, the link in footnote 77 should be corrected to verify HDDs. The current link does not work.

25. Requested information provided. The University of Dayton has changed its website address. An updated link is provided here and will be updated in the TRM: http://academic.udayton.edu/kissock/http/Weather/citylistUS.htm

6. ENERGY STAR Torchiere (Time of Sale)

Page 40 - ENERGY STAR uses a measure life of seven years versus the eight used here. The EDUs recommend using the ENERGY STAR value of seven years.

26. Disagree. We believe our source is a reasonable one that is well documented.

Page 42 - the average heating system efficiency nHeat is given as 0.72. However, the calculation in footnote 89 needs an additional set of parenthesis to specify correct order of operations. It could be calculated as 0.78 depending on the order. This should be fixed in all measures containing this factor.

27. Agree; TRM should reflect change.

7. Dedicated Pin Based CFL Table Lamp (Time of Sale)

Page 44 - If the Delta Watts Multiplier is kept, please include calculation for Delta Watts Multiplier.

28. Agree; TRM should reflect change. Although a deemed delta watts was provided in the draft TRM, we believe it would be more accurate to provide the Delta Watts Multiplier as is done for the other lighting measures.

Page 44 - "HOURS" - Based on citation and page number given, average hours came to 901.2 instead of 869. We recommend using the value of 901 hours.

29. Disagree. This measure is for Table Lamps, and in Table 5-14 on page 50 of the referenced report, the value given is 868.9 hours for portable lamps. 901.2 hours is the average of portable lamps and hardwired fixtures.

Page 46 - "Deemed O&M Cost Adjustment Calculation" - The "Efficient Incandescent" heading in table should read "Halogen" to maintain consistency with spreadsheet on page 47.

30. Agree; TRM should reflect change. This is a reasonable suggestion.

8. Ceiling Fan with ENERGY STAR Light Fixture (Time of Sale)

Page 48 - Navigant recommends increasing the CF to 0.16 to account for fan use during peak hours. The CF of 0,11 from the cited study applies to the lighting savings only, and it cannot be assumed that ceiling fan use will coincide exactly with lighting use. The 0.05 increase is based on a conservative assumption that 10% of HVAC CF can be applied by customers choosing to use their fan instead of A/C during peak hours. If this recommendation is not accepted, the savings table for this measure should be amended to state that demand reductions are due only to lighting.

31. Agree; TRM should reflect change. It is reasonable to assume that the fan savings are likely to be more coincident with the system peak than the lighting savings. We suggest additional research be conducted to develop a separate coincidence factor for the fan portion of the savings.

Page 49 - "HOURSfan" - The value of 2.8 hrs/day for 365 days seems high for fan use. The EDUs would like to see the source referenced in footnote 110.

32. Clarification provided. This assumption is also derived from the ENERGY STAR Ceiling Fan Savings Calculator for Ohio's region of the country. This should be made clearer in the footnote.

Page 49 - The assumption of three 60 Watt incandescent lamps in the baseline was expected; however, we would not expect to replace these with three 20 Watt CFLs. This would be equivalent to three 75 Watt incandescent bulbs. The "CFLWatt" value should be adjusted to three 14 Watt CFLs instead.

33. Agree; TRM should reflect change. This proposed change is consistent with the 3.25 delta watts used in the CFL characterization.

Page 50 - The WHFd should be calculated by multiplying by 35% similar to the WHFe to account for the decrease in lighting heat load? This should be WHFd =
(1+(0.64*(0.35/3.1))=1.07.

34. Disagree. The 35% factor reflects the percentage of annual lighting usage that affects cooling loads. One of the reasons it is less than 100% is there is no cooling load in the winter. However, at the time of system peak, it is by definition a time of cooling, and therefore a 100% of CFLs on at the time of peak are assumed to be providing cooling benefits.

Page 51 - "Deemed O&M Cost Adjustment Calculation" - The "Efficient Incandescent"

35. Agree; TRM should reflect change. Assuming this is meant to be the same comment as provided in the other lighting measures – this is a reasonable suggestion.

9. Efficient Refrigerator - ENERGY STAR and CEE TIER 2 (Time of Sale)

Page 53 - "Deemed Lifetime of Efficient Equipment" - The DEER Database has reduced the lifetime to 14 years. This value should be considered.

36. Agree; TRM should reflect change. The ENERGY STAR calculator assumes a 12 year lifetime, so it appears the 17 years may be too high. VEIC thinks 14 years is a reasonable suggestion.

10. Refrigerator Replacement (Low Income, Early Replacement)

Page 56 - "Deemed Lifetime of Efficient Equipment" - The DEER Database has reduced the lifetime to 14 years. This value should be considered.

37. Agree; TRM should reflect change. The ENERGY STAR calculator assumes a 12 year lifetime, so it appears the 17 years may be too high. VEIC thinks 14 years is a reasonable suggestion.

Page 57 - "UECexisting" - The part-use factor cited in footnote 126 is based on a study that provides incentives to recycle spare or secondary refrigerators. For low income applications, it is appropriate to assume that the refrigerators being replaced are not spare or secondary, but in fact primary units. For this reason, we recommend using the "full use" value of 1,995 kWh to calculate UECexisting, for a result of 1,995*0.85=1,696 kWh.

38. Agree, with modifications shown. VEIC agrees with this reasoning provided it is made clear in the characterization that this measure applies only to operating units being replaced.

Page 57 - "UECES" - our calculated average for ENERGY STAR refrigerators was 445kWh based on the ENERGY STAR calculator.

39. Agree; TRM should reflect change. While we do not think a straight average of the model types provided in the ENERGY STAR calculator would necessarily be a good representation of actual sales, absent any better information or data from Ohio, we agree this is a reasonable suggestion.

Page 57— "UECbase" - our calculated average for ENERGY STAR refrigerators was 557kWh based on the ENERGY STAR calculator.

40. Agree; TRM should reflect change. While we do not think a straight average of the model types provided in the ENERGY STAR calculator would necessarily be a good representation of actual sales, absent any better information or data from Ohio, we agree this is a reasonable suggestion.

11. Clothes Washer - ENERGY STAR and CEE TIER 3 (Time of Sale)

Page 59 - The draft TRM assumes that the ENERGY STAR measure will be governed by the 2011 ENERGY STAR specification rather than the current, 2010 ENERGY STAR specification. The EDUs recommend the 2010 ENERGY STAR specifications continue to apply to all units which were manufactured in 2010, because manufacturers and retailers are likely to need 6-12 months to cycle through the inventory of ENERGY STAR 2010 qualified units.

41. Agree; TRM should reflect change. Adding an additional savings level for 2010 ENERGY STAR units is reasonable, to be used for those units in the program that qualified under the 2010 criteria.

Page 60 - The EDUs could not verify coincidence factor or washer volume.

42. Clarification provided. The coincidence factor is based on Itron developed 8760 hourly data for clothes washers. Although the Itron data we have were based on upstate New York, since this is non-weather dependent measure, we assume it is a good proxy. The calculation is adjusted to account for

Ohio peak definitions. For washer volume, in the absence of Ohio-specific program data, VEIC used the average clothes washer volume rebated through Efficiency Vermont's equivalent program.

Page 60 - Water Savings per load should be stated as "Average water savings per load."

43. Agree; TRM should reflect change. This is a reasonable suggestion.

(*Continuation of comment from above*) In addition the value used by ENERGY STAR (16.69) should be used— the EDUs were unable to follow the logic used in the calculation in footnote 140.

44. Disagree. The 16.69 provided in the ENERGY STAR calculator is for the existing ENERGY STAR criteria that is being replaced on January 1st, 2011. Therefore, in order to estimate water savings for the 2011 ENERGY STAR and the CEE Tier 2 specification, the following calculation was performed:

Water Consumption per Load for ENERGY STAR Unit = 14.4 gallons per load
Water Consumption per Load for Conventional Unit = 31.07 gallons per load
(from ESTAR calc)

Water factor of 2010 ENERGY STAR Unit (per cycle gallons per cubic feet of washer) = 7.5

Therefore the ENERGY STAR assumption of cubic feet of washer is 14.4/7.5 = 1.92 cu ft.

Water factor of 2011 ENERGY STAR Unit = 6.0
Therefore Water Consumption per Load of 2011 ENERGY STAR unit = 1.92*6 = 11.5 gallons per load.
Therefore water savings per load = 31.07 – 11.5 = 19.6 gallons.

Water factor of 2011 CEE Tier 2 Unit = 4.5
Therefore Water Consumption per Load of CEE Tier 2 unit = 1.92*4.5 = 8.64
Therefore water savings per load = 31.07 – 8.64 = 22.4 gallons.

In writing this response, it has occurred to us that since for this measure we assume a capacity of 3.23 cubic feet, we should adjust this water savings based on that capacity as follows:

Water Factor of conventional unit = 31.07/1.92 (ESTAR cu ft) = 16.2

Therefore using 3.23 cubic feet, water consumptions per load are as follows:

Conventional unit = 16.2 * 3.23 = 52.3 gallons per load.
2011 ENERGY STAR unit = 6 * 3.23 = 19.4 gallons (32.9 gal savings)
CEE Tier 2 unit = 4.5 * 3.23 = 14.5 gallons (37.8 gal savings)

Assuming 320 cycles a year, annual water savings amounts to:
2011 ENERGY STAR unit = 32.9 * 320 = 10,528 gallons
CEE Tier 2 unit = 37.8 * 320 = 12,096 gallons

If 2010 ENERGY STAR units are added to this characterization, the same calculation will be performed.

12. ENERGY STAR Dehumidifier (Time of Sale)

Page 65 - Deemed Measure Cost" - The source given is a great tool; however, we are unable to change the inputs and it has defaulted to 2012 prices. In addition there are very distinct pricing differences for the various models. This could either be addressed by making a table or the EDUs suggest using the ENERGY STAR calculator for 2010 and 2011 prices to make it more current. ENERGY STAR shows no price difference.

45. Disagree. We believe the data provided in the Department of Energy's Life Cycle Cost analysis spreadsheet is actually based on 2006 dollars and because of the sophistication of the analysis (it was developed during a Federal Standard setting process), we believe it is more appropriate than the ENERGY STAR calculator. Since not all capacity ranges were provided and the range of incremental costs of the capacity sizes is $31 - $56, we believe an estimate of average incremental cost of $45 as provided is appropriate.

Page 65 - VEIC should include "Av Capacity" in the description of algorithm variables.

46. Agree; TRM should reflect change. This is a reasonable suggestion.

Page 65 - "Annual kWh table" - For ">25 to < 35" under Federal Standard, the value should be 798 not 802, and the Savings should be 114 not 117.

47. Disagree. The 1.2 is a rounded value, and when using the actual value for this capacity range of 1.195 the math is correct:
    (30 * 0.473) / 24 * 1620/1.195 = 801.5.

13. ENERGY STAR Room Air Conditioner (RAC) (Time of Sale)

Page 67 - Deemed lifetime is stated as 12 years, which is correct according to document cited, but this is an ENERGY STAR measure and ENERGY STAR states 9 years. The EDUs recommend using the ENERGY STAR lifetime.

48. Disagree. We believe our source is a reasonable one that is well documented.

Page 68 - While the EDUs do agree that in any given locality, annual usage of room air conditioners (RAC) is lower than annual usage of central air conditioners (CAC), an Ohio study or a study from a similar climate zone should be used rather than assuming that the New England ratio of 0.31 for HoursRAC/HoursCAC is appropriate for Ohio.

49. Disagree. While we agree that an Ohio study would be better, we are not aware of such a study. Further we would not expect the ratio to be significantly different in Ohio. One would expect annual usage of RAC to be significantly lower than CAC since they are typically user controlled rather than to controlled by a central thermostat. In addition, they are most likely used to cool one room, for example a bedroom, and so would only be used when that space is occupied.

(Continuation of comment from above) Further, when one applies the draft TRM algorithm to the ENERGY STAR database for Room Air Conditioners, the RAC units with capacities ranging from 8000 Btu/Hr to 13,999 Btu/Hr and EERbase ^ 9.8 have average savings of:

- 22.1 kWh/yr (rather than 18.7 kWh in draft TRM) for the 315 ENERGY STAR-qualified models.
- 40.3 kWh/yr (rather than 26.8 kWh in draft TRM) for the five CEE-qualified models.

50. Disagree. That may be true, and will be due to the ENERGY STAR database including models that are more efficient that the ENERGY STAR minimum criteria. Until there is a sizeable data set of the efficiency of the units rebated through this Ohio program, it is a reasonable conservatism to assume that the in-program unit is at the minimum ENERGY STAR efficiency criteria (and the baseline is at the minimum Federal Standard level). Once this program has been running and if the data show that the purchased units are on average significantly higher than this minimum, it would be appropriate to increase the savings accordingly. In the absence of these data, we believe our recommendation is appropriate. Further, we note that changing the average capacity to 10,000 Btu/Hr will have the effect of increasing average per unit savings to levels comparable to the ENERGY STAR average suggested by the utilities above.

Page 68 - Hours should be broken out by city. This would not be expected to be uniform across the state.

51. Disagree. While it may be true that the hours are not uniform across the state, the magnitude of savings for this measure is relatively small and so the impact of the difference will not be dramatic. We could indeed provide separate assumptions for each city in the state, however the utilities would have to be prepared to track this information and apply the correct savings value accordingly. We predict that the added administrative cost of doing so would outweigh the improvement of accuracy and so recommend retaining the single assumption for the State.

Page 68 - The average size of replaced units (8,500 BtuH) appears low. ENERGY STAR uses 10,000 BtuH. In looking at the referenced study in footnote 155, we found BtuH per square foot, but did not see average size at the unit level. The EDUs recommend using the ENERGY STAR value of 10,000 BtuH.

52. Agree; TRM should reflect change. The 8500 Btuh estimate is from page 22 of the RLW study (provided as Attachment B) and is the average of the highest State in the study (New Hampshire). However, given that the climate in Ohio is warmer than New Hampshire, it is reasonable to expect the average capacity of AC units to be larger. We agree that the ENERGY STAR assumption is a reasonable estimate.

14. ENERGY STAR RAC Replacement (Low Income, Early Replacement)

Page 71 - While the EDUs do agree that in any given locality, annual usage of room air conditioners (RAC) is lower than annual usage of central air conditioners (CAC), an Ohio study or a study from a similar climate zone should be used rather than assuming that the New England ratio of 0.31 for HoursRAc/HourscAC is appropriate for Ohio.

53. Disagree. We do agree that an Ohio study would be better; however we are not aware of such a study and so in the absence of more appropriate data, this was the best estimate we could provide. Further we would not expect the ratio to be significantly different in Ohio. One would expect annual usage of RAC to be significantly lower than CAC since they are typically user controlled rather than controlled by a central thermostat, plus they are most likely used to cool one room, for example a bedroom, and so would only be used when that space is occupied.

(Continuation of comment from above) Further, when one applies the draft TRM algorithm to the ENERGY STAR database for Room Air Conditioners, the RAC units with capacities ranging from 8000 Btu/Hr to 13,999 Btu/Hr and EERbase ^ 9.8 have average savings of:

• 22.4 kWh/yr (rather than 18.7 kWh in draft TRM) for the 315 ENERGY STAR qualified models.

• 86.9 kWh/yr (rather than 73.8 kWh in draft TRM) for the first three years of savings for those same 315 ENERGY STAR-qualified models.

54. Agree, with modifications shown. We propose that the TRM instead provide a deemed calculation that uses actual replaced EERs rather than assuming 10.8EER.

Page 71 - The average size of replaced units (8,500 BtuH) appears low. ENERGY STAR uses 10,000 BtuH. In looking at the referenced study in footnote 166, we found BtuH per square foot, but did not see average size at the unit level. The EDUs recommend using the ENERGY STAR value of 10,000 BtuH.

55. Agree, with modifications shown. We propose that the TRM instead provide a deemed calculation that uses actual capacity rather than assuming a deemed size.

Page 72 - Deemed O&M cost is lacking justification for the 69% multiplier. For a low income program we disagree with this calculation method because the cost difference is $50 and this reduction is incongruent with barriers that face participants.

56. Disagree. The purpose of the O&M adjustment is to account for the value of the benefit to the participant not having to buy a standard unit in 3 years time, because the program has resulted in the unit being replaced now. The measure cost assumed in this measure is the full cost (not the incremental) of the new ENERGY STAR unit, however the deferred cost of replacing the unit with a new baseline unit should also by included in the TRC test.

    To calculate this, we found the ratio of the net present value of the annuity payments from years 4 to 12 of the baseline replacement unit (assumed to cost $170) which equals $117.77, to the actual cost ($170) to get 69%. This factor is then applied to the assumption of the standard unit cost to account for the discounting of future payments. Instead of using the $170 assumption for the standard unit cost, we based this on the known cost of the ENERGY STAR unit minus the increment of $50.

Page 72 - Hours should be broken out by city. This would not be expected to be uniform across the state.

57. Agree; TRM should reflect change. In this program the location of the installed unit will be known. It is therefore appropriate to apply the best estimate of hours for that location. This should be provided in the TRM based on the RAC/CAC method proposed.

15. ENERGY STAR Room Air Conditioner Recycling (Early Retirement)

Page 74 - While the EDUs agree that in any given locality, annual usage of room air conditioners (RAC) is lower than annual usage of central air conditioners (CAC), an Ohio study or a study from a similar climate zone rather should be used rather than assuming that the New England ratio of 0.31 for HoursRAc/HourscAC is appropriate for Ohio.

58. Disagree. We do agree that an Ohio study would be better; however we are not aware of such a study and so in the absence of more appropriate data, this was the best estimate we could provide. Further we would not expect the ratio to be significantly different in Ohio. One would expect annual usage of RAC to be significantly lower than CAC since they are typically user controlled rather than controlled by a central thermostat, plus they are most likely used to cool one room, for example a bedroom, and so would only be used when that space is occupied.

(Continuation of comment from above) Further, when one applies the draft TRM algorithm to the ENERGY STAR database for Room Air Conditioners, the RAC units with capacities ranging from 8000 Btu/Hr to 13,999 Btu/Hr and EERbase ^ 9.8 have average savings of:

• 138.7 kWh/yr (rather than 103.6 kWh in draft TRM) for the 315 ENERGY STAR models.

59. Disagree. The assumption in this program is that the replacement unit is a Federal Standard baseline unit (not an ENERGY STAR unit since that increment of savings would be captured in the products program) to ensure that no double counting of savings takes place. This comment therefore does not apply.

Page 73 - Deemed O&M Costs: This should be calculated as the measure cost plus incentive for the customer. The customer is not seeing these charges and therefore these figures do not apply. See also Vermont TRM, Mid-Atlantic TRM.

60. Disagree. The deemed measure cost is the cost of removing the unit plus the cost of a percentage of participants (76%) replacing the unit with a baseline unit. The O&M benefit is associated with the deferred replacement cost (that would have happened in the absence of the program) in 3 years time.

Page 74 - Hours should be broken out by city. This would not be expected to be uniform across the state.

61. Disagree. The program is unlikely to know where each unit came from, so we believe a standard value for the whole State is appropriate.

Page 74 - The average size of replaced units (8,500 BtuH) appears low. ENERGY STAR uses 10,000 BtuH. In looking at the referenced study in footnote 177, we found BtuH per square foot, but did not see average size at the unit level. The EDUs recommend using the ENERGY STAR value of 10,000 BtuH.

62. Agree; TRM should reflect change. The 8500 Btuh estimate is from page 22 of the RLW study (provided as Attachment B) and is the average of the highest State in the study (New Hampshire). However, given that the climate in Ohio is warmer than New Hampshire, it is reasonable to expect the average capacity of AC units to be larger. We agree that the ENERGY STAR assumption is a reasonable estimate.

16. Smart Strip Power Strip (Time of Sale)

Page 76 - The coincidence factor of 0.8 is unexpectedly high. The 0.8 seems to be reflecting the appliances plugged into the strip, not the savings associated with the strip itself Northwest Council uses CF = 0.2 (www.nwcouncil.org/rtf/measures/cQm/PowerStripsFY10vl O.xls). We recommend using the value of CF = 0.2.

63. Disagree. While we acknowledge that there is not a great source for this value, we do not consider the Northwest Council value to be an improvement. A coincidence factor of 0.2 would imply that 80% of the units being controlled are on and being used at system peak, which intuitively seems high. Also, in this spreadsheet the CF for commercial use is higher at 0.3, which is counterintuitive to us (that fewer units are assumed on during peak in the commercial setting). Having researched the Efficiency Vermont loadshape, we note that we have not adjusted to the Ohio peak definitions. This re-analysis gives 81.3% for TV usage and 46.3% for computer usage, for an average of 64%. We would recommend using this value until an appropriate evaluation provides the savings loadshape from smart strips.

Page 76 - The four year lifetime is not consistent with the Commercial Smart Strip measures with a lifetime of eight years. If anything, it would be expected that the residential strip would get less use and therefore last longer. The EDUs recommend using the eight year lifetime.

64. Disagree. Both characterizations reference the same BC Hydro report (provided as Attachment C), which actually recommends 4 years. We recommend that the Commercial characterization be adjusted.

Page 77 - Hours - This would be for home entertainment, but a different figure for a home office should be used, especially if someone works from home. This number coincides with the fact that the average household watches 4 hours of TV a day. The EDUs recommend VEIC develop a weighted average to account for home office use.

65. Disagree. The hours of use assumption does include home computer use (although it appears this is general use rather than specifically working from home). It is based on the NYSERDA report (provided as Attachment D) that states "The home office computer is assumed to not be in use 85.6% of the time while the home entertainment TV is assumed to not be in use for 77.7% of the time based on the Hiner and Partners survey." Using the average of these values gets 7153 hours (0.856+0.777)/2 * 8760 = 7152.5. Note this does not quite reflect what was in the draft TRM (7129) and so should be adjusted.

17. Central Air Conditioning (Early Replacement)

Page 78 - More information should be given in this section regarding the types of heating and cooling systems that dictate the energy and demand savings values encountered in the reference tables. Not all of this information is available in Appendix A.

66. Unclear comment – no response given. We do not understand this comment. There are no reference tables that dictate energy and demand savings for this measure other than providing Full Load Hour Assumptions.

Page 78 - Please include an early replacement calculation for heat pumps.

67. Agree; TRM should reflect change. This is a reasonable suggestion.

Page 78 - It is extremely difficult to identify the HSPF value for older heat pumps. The EDUs propose a set ratio for HSPF based on the SEER values. Most small residential units should be rated in SEER rather than EER (although the ratio should still be the same because of the EER/SEER ratio).

68. Agree; TRM should reflect change. This is a reasonable suggestion. If instructed to include a Heat Pump early replacement measure, we will provide an appropriate method of determining the HSPF based on the SEER values.

18. Ground Source Heat Pumps (Time of Sale)

Page 83 - The annual energy savings algorithm is missing "/1,000" in the first half of the algorithm.

69. Agree; TRM should reflect change.

19. Heat Pump Water Heaters (Time of Sale)

Page 87 - In footnote 218, the phrase "Discretionary Usage Adjustment of 0.75%" appears to be incorrect, as it appears that VEIC meant to instead provide the value of 0.75 or 75%.

70. Agree; TRM should reflect change.

20. Low Flow Faucet Aerator (Time of Sale or Early Replacement)

Page 89 - "Deemed Lifetime of Efficient Equipment" - As stated, five years is quite conservative. DEER Database suggests ten years, Vermont TRM (2008) suggests nine years. The EDUs suggest using the DEER value often years.

71. Agree; TRM should reflect change. This is a reasonable suggestion.

Page 90 - the 50% value provided for "DR" or "percentage of water flowing down drain" should be replaced by a more appropriate value. The source report referenced in footnote 230 provides two values - 50% for kitchen faucets and 70% for bathroom faucets. The deemed savings algorithm on page 90 should include a weighted average of those values, such as 63% (assuming two bathroom faucets and one kitchen faucet).

72. Agree; TRM should reflect change. This is a reasonable suggestion.

21, Low Flow Showerhead (Time of Sale or Early Replacement)

Page 93 - "Deemed Lifetime of Efficient Equipment" - As stated, five years is quite conservative. DEER Database suggests ten years, Vermont TRM (2008) suggests nine years. The EDUs suggest using the DEER value often years.

73. Agree; TRM should reflect change. This is a reasonable suggestion.

Page 94 - Savings are based on a gas utility study of showerhead replacements, with the savings adjusted for the actual gpm savings relative to the gpm savings associated with the utility study. The TRM deems energy savings at 149 kWh/gpm reduction. An engineering calculation shows higher savings per gpm reduction (244 kWh) when using comparable inputs:
KWh = (GPDbase-GPDee) X delta T x 8.33 x 365 / 3413 / showers per home

74. Disagree. The Ontario evaluation that we used to come up with kWh/gpm estimate is based on actual measured changes in water usage through an extensive pre- and post-metering study with a control group. We consider this to be favorable over a straight engineering assumption. The main reasons why you are likely to see lower savings than the utilities' engineering algorithm might suggest that a) it is difficult to develop an accurate estimate of the number of showers taken, delta T and other variables; and b) there are 'take back' effects from replacing showerheads where people either make the water warmer when there is a reduced flow or take longer showers. We recommend keeping the methodology as is. That said, as discussed further in response to a comment from the gas utilities, there was a conservatism in the way we applied the results of the Ontario study to the draft Oho TRM. Specifically, the Ontario study estimated savings from two different baseline conditions for showerheads. The draft Ohio TRM conservatively based savings estimates from data from the lower of those two baselines. We proposed revising the savings for the Ohio TRM based on a weighted average of the two baselines found in Ontario. That would have the effect of increasing the kWh savings per GPM reduction per showerhead to 173 kWh (about 16% higher than in the draft TRM),.

22. Domestic Hot Water Pipe Insulation (Retrofit)

Page 98 - TRM is inconsistent with Btu/kWh conversion. Here 3,413 is being used but previously 3,412 was. The conversion value of 3,412 Btu/kWh should be used consistently.

75. Agree; TRM should reflect change. This is a reasonable suggestion.

Page 98 - VEIC should resolve formatting issues at the bottom of the page.

76. Unclear comment – no response given. We are not clear to what formatting issues this comment refers. This page looks correct to us.

Page 98 - The average recovery efficiency of a gas hot water heater should be 78.5% not 75% according to footnote 253 calculation.

77. Disagree. The 75% is simply an estimate based on review of the AHRI Directory, where the minimum value found was 70% and the maximum found was 87%, but there were certainly more on the lower end. Furthermore, this measure relates to an existing water heater, so the average would be lower than the average of new units provided in this directory. 75% was chosen as the best estimate.

23. Wall Insulation (Retrofit)

Page 100 - The measure description notes that the auditor should collect heating system efficiency. VEIC may also want to note the auditor should also collect cooling system efficiency, as it is used in the cooling savings equations.

78. Agree; TRM should reflect change. This is a reasonable suggestion.

Page 100 - Duke Energy Ohio suggests that the simulation approach from the Joint IOU TRM be used in lieu of the cooling degree hours calculation. Consultants can provide more combinations of initial and final R values for this measure to make the algorithm more general.
The degree hour approach is a simple steady-state approach that misses much of the important dynamics of building energy use, including thermostat setback, time-varying internal loads, solar heat gains, and building thermal mass effects. The ASHRAE Handbook^^ states "When the indoor temperature is allowed to fluctuate or when interior gains vary, simple steady-state models must not be used."
In one typical case investigated, the DOE-2 simulations provided energy savings > 3 times the kWh and kW savings and > 8 tunes the therm savings predicted by the degree hour approach in the TRM.
For example, using the algorithms in the TRM for attic/roof/ceiling insulation:
[*Table omitted*]
DOE-2 simulations using comparable inputs on the DEER prototypes returned 36.5
kWh/kSF, 0.026 kW/kSF and 27.9 therms/kSF,
The algorithms require a site-specific estimate of heating system efficiency, which includes an estimated of the distribution system efficiency. Estimates of distribution system efficiency come from either a duct leakage test or visual inspection combined with the BPI lookup tables on distribution efficiency. Furnace efficiency is estimated from the nameplate AFUE or from a combustion test. This level of data collection is too onerous for a prescriptive rebate measure. There is no guidance provided on cooling system efficiency, for either the air conditioner (or heat pump) or the duct system.

79. Disagree. Firstly, there is an error in the calculation comparing our TRM algorithm method with the DOE-2 simulations. The 3.3 therms/1000SF is actually 3.3 MMBtu/1000SF, or 33 therms/1000SF. This makes our result relatively similar to the 27.9 therms derived from the DOE-2 simulation.

    We also disagree with the notion that providing simulation savings, in the format of a prescribed KWh/SF or MMBtu/SF for different cities in the State, is more accurate than the site specific modeling we have provided. First, it should be clear that no modeling method is perfect. Second, while we agree that "thermostat setback, time-varying internal loads, solar heat gains, and building thermal mass effects" will affect savings to some degree by affecting the delta T between inside and out, we do not believe this will have a huge impact on the conductive losses being calculated here. Third, while simulation models can adjust for such factors, they will only do so accurately if the modeling assumptions for these factors are based on good empirical local data. We are unaware of any such data that the modelers could have used for Ohio. Fourth, the utility-proposed method of providing deemed savings amounts per square foot of area does not allow for any modification or customization based on the specifics of an actual installation; for example, the actual pre- and post R-values (for insulation measures), actual CFM50 reduction and n-factors (to more accurately convert 50-pascal airflows to natural airflows) (for air-sealing measures), and the efficiency of heating/cooling equipment. Fifth, cooling savings are notoriously overestimated in simulations because they do not tend to factor in behavioral effects, such as the fact that most people do not always operate their AC as soon as the outside temperature is 75 degrees (something we account for in the Discretionary Usage Factor). We also believe our method is more transparent and replicable than simply providing deemed savings from a simulation.

It is difficult to comment further without seeing all the modeling assumptions used by the utilities. When we conducted some very simple tests using simulation modeling ourselves, we got results that were comparable to the engineering formulae we have proposed.

We therefore recommend that the methodology we have proposed remain, and that additional guidance for obtaining the required data points be provided, together with default assumptions if they can not be collected. It may be appropriate for this measure to not be implemented as a prescriptive rebate, but rather the custom savings calculated as we propose be supported with a custom rebate based on the utilities' policies.

Page 102 - If the modeling approach is not used, the Average Net Heating value should be clarified. The current description is vague and leaves too much room for interpretation by customers or contractors and may skew data. VEIC should consider creating constants for people to use or calculations for when there are more than one type of heating system.

80. Disagree. It is difficult to provide detailed instructions in a prescriptive measure such as this, and besides there needs to be left some discretion on the part of the program staff or contractor to address the specifics of the particular site in question. We believe the brief instructions we have provided in the footnote, adequately provide guidance on how to measure the required efficiencies and how to deal with multiple fuels.

24. Air Sealing - Reduce Infiltration (Retrofit)

Page 104 - The energy savings associated with infiltration reduction accounts for sensible heat gains only. Humidity and the impact on latent cooling should also be included to capture the impacts of moisture from infiltration on the cooling loads. The simulation models, with results normalized per cfm reduction, can be used to estimate the savings per cfm accounting for both sensible and latent loads. We recommend the simulation models be used rather than the calculations in the TRM.

81. Agree; TRM should reflect change. We agree that the current draft TRM does not account for savings from reduction in latent loads. That should be corrected.

    and

    Disagree. However, it is far from clear that building simulation modeling is the best way to account for such impacts. In our experience, simulation models do not estimate the impacts of air infiltration on cooling well. Indeed, in some cases they even suggest that, on a seasonal basis, air leakage saves energy (i.e. leakier homes use less energy for cooling). This appears to be because they implicitly assume that people do both operate air conditioners whenever the indoor temperature is at or above a thermostat set-point and that they do not open windows during cooler (e.g. night time hours). Thus, air leakage during cool hours is estimated to provide energy savings that are often estimated to be greater than the energy costs associated with leakage during hot weather. Given the relatively limited time available to respond to the many comments received from the various stakeholders, we have not yet determined the best approach to addressing this measure. We recommend this issue be addressed in the TRM.

Page 105 - The EDUs could not find the LBNL document that shows the N-Factor conversion. Please provide this analysis.

82. Clarification provided. This information is found in the textbook; Krigger, J. Dorsi, C. "Residential Energy" 2004, p.284. This should be clarified in the TRM.

Page 105 - The conversion of 1,000 W to 1 kW should be defined in the calculation of savings.

83. Agree; TRM should reflect change. This is a reasonable suggestion.

Page 105 - The n-factor is defined on page 105 as 29.4 for space cooling, but the space heating calculation uses an n-factor of 17.8 on page 107 without re-defining the value.

84. Agree; TRM should reflect change. This is a reasonable suggestion. A new table should be provided in the heating section showing the n-factor of buildings with different exposure and # of stories.

25. ENERGY STAR Windows (Time of Sale)

Page 115 - Savings from the ENERGY STAR windows vary by which direction they are facing, i.e., south-facing windows will save significantly save more than will north-facing windows. The EDUs recommend adding solar radiation factors to VEIC's algorithm, to calculate total solar radiation (direct versus diffused) as a function of window orientation.

85. Disagree. VEIC developed a REMRate model of a typical home in Columbus, Ohio climate, and split the window area equally between north, south, east, and west facing. Therefore, the savings provided are an average of windows in each direction. Furthermore, Solar Heat Gain Coefficient values are included in the analysis – 0.58 for the baseline and 0.3 for the efficient cases respectively.

Page 115 - The EDUs could not find the source cited for deemed measure cost in footnote 290.

86. Requested information provided. The Alliance to Save Energy paper is provided as Attachment E. It states that for an ENERGY STAR window, "an average cost premium of $1.50/ft2 could be assumed". Since we provide savings per 100 square feet window area, this would equal $150 per 100sq.ft.

Page 115 - No source was listed for the baseline window u-value of 0,49, which doesn't conform to Ohio residential energy code. Baseline u-values should be 0.35 (Ohio code for CZ5) or 0.40 (Ohio code for CZ4).

87. Agree, with modifications shown. We agree that a u-value of 0.35 for zone 5 and 0.4 for zone 4 should be used as the baseline window, provided it is confirmed that an existing window replacement is subject to the same building code (IECC-2006) as for new construction in Ohio. Note this will significantly reduce the savings estimates and may mean that this measure will not screen for cost effectiveness.

26. Residential Two Speed / Variable Speed Pool Pumps (Time of Sale)

Page 118 - The EDUs could not find the coincidence factor cited in the Efficiency Vermont document in footnote 302.

88. Clarification provided. This Efficiency Vermont TRM is in the process of review by the Department of Public Service in Vermont, and so is not yet in the published TRM. As noted in footnote 302, in the absence of empirical evaluation data, the Efficiency Vermont loadshape was based on market feedback about the typical run pattern for pool pumps showing that most people will run their pump during the day, and set a timer to turn the pump off during the night.

Pages 118 and 119 - The EDUs could not locate the document in footnotes 303 and 305 to verify kWh savings figures used.

89. Requested information provided. The CEE Pool Pump memo has been provided as Attachment F. The CEE committee are currently continuing discussions and refining the estimates and so we would recommend that through the TRM update process, this characterization be reviewed at a later date.

27. Residential Premium Efficiency Pool Pump Motor (Time of Sale)

Page 120 - We would like a reference for the Deemed Lifetime estimation.

90. Requested information provided. The source is Pacific Gas & Electric Company, 2008, "California Efficiency Standards; Residential Pool Pump Measure Revision", page 4 (provided as Attachment G). This should be clarified in the TRM.

Page 120 - We could not verify CF without the reference cited in footnote 308.

91. Clarification provided. This Efficiency Vermont TRM is in the process of review by the Department of Public Service in Vermont, and so is not yet in the published TRM. As noted in footnote 302, in the absence of empirical evaluation data, the Efficiency Vermont loadshape was based on market feedback about the typical run pattern for pool pumps showing that most people will run pump during the day, and set timer to turn pump off during the night.

Page 121 - A typo was noted:
"ηPumpBase = Efficiency of premium efficiency motor" should instead be:
"ηPumpBase = Efficiency of baseline motor"

92. Agree; TRM should reflect change.

Page 121 - VEIC should provide supporting documentation for assumptions used. For example, where did motor efficiencies come from? These are not the efficiencies for an EPACT standard 1.5HP motor, nor a NEMA Premium 1.5HP motor. It appears this may be the combined motor and pump efficiency, but there is no mention of this or derivation of the results.

93. Requested information provided. All variables except where noted are based on First Energy's Residential Swimming Pool Pumps document (Attachment H) that was provided to us, as noted in footnote 309.

28. Water Heaters (Time of Sale)

Page 123 - It is not clear why this measure provides savings and assumptions for gas water heaters only. This measure should show savings for the option of efficient electric water heaters as well.

94. Disagree. There are no widely recognized qualifying levels for "efficient" electric resistance water heaters. The implementation of the most recent federal efficiency standards for water heaters rendered any increment in savings between standard products and the most efficient electric resistance models quite small. We have characterized both Heat Pump and Solar Water Heaters, the two electric technologies eligible to earn an ENERGY STAR label.

Page 124 - VEIC should provide the document cited in footnote 319 for BtuHWusage.

95. Requested information provided. We recommend updating this variable with the more recent 2005 EIA Residential Energy Consumption Survey data. This shows that the average MMBtu consumption in the Mid Atlantic region is 23.1MMbtu:
http://www.eia.doe.gov/emeu/recs/recs2005/c&e/waterheating/pdf/tablewh7.pdf

Page 124 - The minimum efficiency of a federal standard gas water heater should be 0.594, not 0.58.

96. Agree; TRM should reflect change. This is a reasonable suggestion.

29. Programmable Thermostats (Time of Sale, Direct Install)

Page 125 - The TRM assigns zero savings for air conditioners controlled by programmable thermostats. Although we realize there is a lack of data on programmable thermostats in cooling applications, the savings are likely not zero. Recent simulations conducted for Duke Energy provided a value of 53 kWh/ton for a 3^F setback from 11p.m. to 6 a.m. in Cincinnati. The Pennsylvania PUC will issue a TRM update soon which will include a programmable thermostat measure. This measure includes a 2% ESF for cooling savings based on a DEER 2005 report (2004 SCE report "Programmable Thermostats Installed into Residential Buildings: Predicting Energy Saving Using Occupant Behavior & Simulation"). This value is based on combining usage from a RASS analysis with D0E2 simulation results. The cooling savings for climate zone 16 (most comparable to OH) was around 2%.
Until such time as an OH simulation model is developed to predict energy savings for cooling, we recommend including a conservative 2% cooling energy savings for programmable thermostats based on this report.

97. Disagree. We reviewed the SCE report referenced in the comment (we obtained a draft, dated November 16, 2004) but when we looked at the results we saw that the ~2% electrical savings found was not for cooling, but rather was a combination of heating and cooling savings. The cooling savings estimate was about 10% savings for the climate zone referenced in the comment. However, the study suggested that heating consumption would increase substantially, largely offsetting the cooling benefits. These finding don't make intuitive sense and seem inconsistent with the actual metering studies around heating savings with which we are familiar. It would be inappropriate to use a source for cooling savings while disregarding its assertions on the heating side. Therefore we would not feel comfortable basing cooling savings upon this study alone.

Page 126 - VEIC should include definitions for the algorithm used.

98. Agree; TRM should reflect change.

30. Condensing Furnaces - Residential (Time of Sale)

Page 127 - High efficiency furnaces are assigned an electricity savings when an EC motor is included in the commercial section. Electricity savings for condensing furnaces with EC motors in residential applications should also be included.

99. Disagree. Not all AFUE-qualifying equipment include EC motors. We suggest that it is preferable to claim the appropriate electrical savings through the stand-alone ECM measure rather than assuming their presence on every unit and having to back out overstated savings. We suggest revisions to the commercial section for consistency.

31. Water Heater Wrap (Direct Install)

Page 131 - The TRM lists the base EF at 0.86. Federal efficiency standards for electric water heaters were 0.864 m 1990 but were increased to 0.904 in 2004. Ohio's water heater EF standard is (0.97-0.00132*volume), which would be 0.917 for a 40 gallon tank and 0.904 for a 50 gallon tank. The value of 0.86 would be appropriate for 80-gallon tanks, but these are not representative of the average population. A baseline EF value of 0.904 would be more appropriate.

100. Disagree. It is stated in the description of this measure that it should be applied only for homes with a water heater that is not well insulated. Newer tanks that comply with the 2004 standard would not be suitable applications for this measure--their higher EF is associated with better insulation and the benefit from the addition of a wrap is negligible under these circumstances. It would therefore be inappropriate to use the higher baseline suggested in the comment.

Page 132 - The annual energy use of 3,460 kWh by electric water heaters seems low, and most likely applies to a small tank on the order of 40 gallon capacity. The California Energy Commission puts the average value closer to 4,900 kWh (http://www.consumcrenergvcenter.org/home/appliances/waterheaters.html), which is also closer to the value used for solar hot water heaters in the next section of the Ohio TRM. This is again confirmed by other sources for an average water heater (~60 gal capacity) (http://www.wapa.gov/es/pubs/fctsheetyWaterHeating.pdf). The EDUs recommend adjusting the annual energy usage to at least the 4,395 kWh used for the solar water heater section. The deemed savings for this measure would have to be adjusted to account for this.

101. Disagree. The 3460 kWh value referenced in the draft TRM comes from analysis conducted for the U.S. Department of Energy as part of its federal standard setting process for water heaters. In our experience, the analyses used to support such processes are extensive and very thoroughly reviewed. We are not aware of any billing analysis or end use metering that yields a value significantly higher than that. Indeed, our proposed value is 15% to 20% higher than the Energy Information Administration's 2005 Residential Energy Consumption Survey estimate of average annual water heating kWh for Ohio's region. As noted in the footnote to the assumed baseline kWh for solar water heaters, we believe a higher than average baseline is appropriate for solar water heaters because they are typically installed in homes with higher than average usage. (Note: no data source was provided at the location links referenced by the comment so we cannot comment on their relative merits).

32. Solar Water Heater with Electric Backup (Retrofit)

Page 133 - A solar water heater cannot provide 100% of hot water needs in most households, unless it is an atypical, oversized solar thermal system with a very large, well insulated storage tank. It is not clear whether the energy-savings algorithm has accounted for the annual hours that the Solar Water Heater is not able to meet the hot water demand.
Therefore the energy-savings algorithm should be clarified and/or expanded to ensure it accounts for the hours per year that a Solar Water Heater does not keep up with the residential hot water demand.

102. Clarification provided. The algorithm relies upon the use of a Solar Energy Factor, but the definition should be more clearly explained in context, rather than in the footnote – TRM should reflect this clarification. The SEF is a ratio of "useful energy out" compared to the "fuel energy in." Eligible systems are certified to standards of performance that should adequately address the issues mentioned in the comment.

33. Residential New Construction

Page 136 - Accredited software may not have all requisite features needed for the Ohio market such as climate zones, weather data for sizing and peak demand calculations and/or construction practices. ADM recommends expanding the definition of qualified software to include enhancements to currently approved software that have demonstrated compliance with the BESTEST evaluation.

103. Disagree. Without an independently approved, referenceable standard, it will be very difficult to ensure the accuracy and consistency of software to model buildings and capture savings. Unfortunately, there is not another robust standard that exists at this time that we are aware of to reference for software tools. All RESNET approved tools should have Ohio climate zones and weather data for sizing construction practices, and many include peak demand calculations. Passing the BESTEST evaluation is part of meeting RESNET requirements. In addition, the ability to generate a HERS rating and software that can auto-generate a reference home and/or UDRH baseline building for calculating savings are critical features for consistently determining savings.

(Continuation of comment from above) For multifamily residences, REM/Rate does not appropriately address the baseline reference home. Either a user-defined multifamily baseline must be developed, or a custom version of the software must be developed specifically for the multifamily market. The EDUs recommend developing a user-defined reference home for immediate use, then over the longer term incorporate the user-defined reference home into a custom version of the software.

104. Agree; TRM should reflect change. REM/Rate should be able to address multifamily buildings since many programs (e.g., NJ, NY, MA, etc.) currently use it in this way. A specific multifamily UDRH should be developed for this class of buildings.

Page 137 - Under "Energy Savings" - it is stated that savings for RNC will be "linearly adjusted based on floor area" from savings calculations of the model home. This seems appropriate for lighting and HVAC (including insulation) measures. However, it should not be assumed that savings from appliances and water measures scale linearly based on floor space.

105. Agree, with modifications shown. This should say "For RNC projects that participate through a RESNET-approved sampling protocol, energy savings *for heating, cooling, lighting, and plug loads* shall be determined based on the savings from the model home, linearly adjusted based on floor area

to all other homes included in that sample set, *and savings for appliances and water heating shall be based on the number of bedrooms.*"

106. Additional correction. VEIC proposes to make a small correction to the calculation of the Temperature Adjustment Factor used to estimate the coincidence factor for all the residential refrigerator measures.

V. Technical Objections and Comments to the TRM – B. Commercial and Industrial

We provide the majority of the original comment below (embedded tables and other additional information have been omitted and can be viewed in the original Objections and Comments filing), followed by VEIC's response.

1. Electric Chiller (Time of Sale) - (146)

Page 147 - The cooling EFLH data on page 147 were developed for a single building type, which is a large office. The EDUs would like to expand the table by providing cooling EFLH data for additional buildings with built-up HVAC systems: Hospital, Hotel, Large Multistory Retail, and University. Data for these additional building types will be developed using existing prototypes customized for Ohio construction practices and run for the seven Ohio cities. The runs could be completed, and data provided to VEIC on request.

107. Agree; TRM should reflect change. We agree that current proposed characterization is somewhat limited in its applicability and should ideally be expanded via additional modeling to cover the additional building types noted. If the modeling runs can be provided, we recommend adding this additional detail. We strongly support the involvement of the EDUs in the ongoing TRM revision process and propose that this change be incorporated as part of that process.

2. C&I Lighting Controls (Time of Sale, Retrofit) - (149)

Page 150 - Coincidence Factors for occupancy sensors appear low. Wisconsin TRM uses CF's between 0.64 and 0.77.

108. Disagree. The Wisconsin TRM actually assumes a CF of 0. Page 4-192 of WI TRM (link below) presents the deemed savings values for "Occupancy Sensors – Wall or Ceiling Mount" in Table 4-160. The demand savings are clearly zero in all cases. We assume this comment refers to the CF values presented in Table 4-162 on p.4-194, but this table is only to be referenced for the lighting operating hours.
http://www.focusonenergy.com/files/Document_Management_System/Evaluation/bpdeemedsavingsmanuav10_evaluationreport.pdf

(Continuation of comment from above) "HOURS" should be defined as annual operating hours instead of total operating hours. To improve the accuracy of impact estimates, we recommend using site-specific values for "HOURS" - if known - and also adding several, more specific categories of buildings.

109. Agree; TRM should reflect change. The description of the "HOURS" parameter should be revised to the following: "annual operating hours of the controlled lighting before the lighting controls are installed. If actual site-specific value is unknown, assume default values dependent on building type as below:"

(Continuation of comment from above) Following is the full list of building types for which we recommend providing distinct annual hours of operation. Building Types (Full List Recommended by Ohio Utilities)
[*list omitted*]

110. Disagree. While we agree that providing estimates of lighting annual operating hours for additional building types would be desirable, we are unaware of any defensible studies that would support such a level of disaggregation.1 We encourage future evaluation work to be performed to support the development of such values for future TRM revisions. (The California PUC 2008 Database for Energy-Efficient Resources (DEER) appears to provide annual operating hours and coincidence factors for the majority of the building types listed above, but we have been unable to determine the source of their derivation. This would require additional effort but may provide a suitable source pending OH evaluation work.)

Page 151 - The ESF table should be reviewed. The Wisconsin TRM uses 41% for Occupancy Sensors and 40% for Daylight controls. Many of these vary greatly by building type. A chart showing savings by building type and sensor type would be more reliable.

111. Disagree. The ESFs were selected as conservative estimates (so as not to overestimate savings) of lighting control savings in the absence of OH specific evaluation work. While it is true that estimates of lighting control savings vary by building type, most efficiency programs assume a single savings factor both for simplicity and to reduce false precision. If future evaluation work in OH supports adopting new energy savings factors by sensor type and building type, the changes should be incorporated as part of the TRM revision process.

Page 152 - "Fossil Fuel Impact Descriptions and Calculations" - It is unclear whether the IFMMBTU factor includes a conversion from kWh to MMBtu. If not, a conversion factor of 0.003412 MMBtu/kWh should be included to convert from kWh to MMBtu.

112. Agree, with modifications shown. The factor already includes the conversion from kWh to MMBtu. The units of "MMBtu/kWh" should be added to the factor description.

3. Lighting Systems, Non-Controls (Time of Sale, New Construction) - (153)

Page 153 - There does not seem to be any benefit to the use of a single multiplier to calculate savings for CFLs. The tracking of wattage is necessary already to apply the Delta Watts Multiplier for different years. The TRM should deem the baseline wattage for the three CFL wattage categories and use the actual ΔW to derive 3 deemed savings values. This eliminates the need to evaluate whether the distribution of CFL wattages in the program was similar to the assumed distribution and apply a realization rate if they were different.

113. Disagree. While it is noted that tracking requirements would facilitate using separate multipliers to estimate savings by wattage category, a defensible estimate of baseline wattage by wattage category is not available for Ohio. We suggest maintaining the single multiplier until Ohio-specific evaluations are performed.

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[1] The California Public Utilities Commission 2008 Database for Energy-Efficient Resources appears to provide annual operating hours and coincidence factors for the majority of the building types listed above, but we have been unable to determine the source of their derivation. This would require additional effort but may provide a suitable source pending OH evaluation work.

Page 154 - "Deemed O&M Cost Adjustment Calculation for Compact Fluorescent Lamps" - the link does not lead to appropriate document.

114. Agree; TRM should reflect change.

Page 155 - See page 153 comment above regarding CFL savings multiplier.

115. Disagree. See the response to the comment referencing page 153.

Page 156 - The High Bay Fluorescent Fixtures measure limits the baseline to only a "metal halide system." This should be expanded to allow other baselines that may be in place, but which are less efficient than the replacement fluorescents.

116. Disagree. We believe the assumed baseline reflects the typical case. It is not the intent of the measure to accommodate every potential combination of baseline and efficient equipment. The measure characterizations attempt to capture the typical case. Future evaluation work should be used to determine if the assumptions are valid or if the measure baseline assumptions require revision.

Page 156 - "Deemed Calculation for High Bay Fluorescent Fixtures" - add "%" character after 88 for ballast efficiency.

117. Agree; TRM should reflect change.

Pages 156-157 - Correct formatting to eliminate excessive white space.

118. Agree; TRM should reflect change.

Page 158 - "Baseline Adjustment" - need to correct formatting error.

119. Agree; TRM should reflect change.

Page 158 - While the rationale for the "Baseline Adjustment" section is appropriate, it should not be applied to this measure. For New Construction the appropriate baseline is Electronic T8s as is listed in Table 5 on page 166. This would result in the full measure life of 15 years as opposed to the reduced 7 year lifetime. This section should be moved to the Lighting Systems (Non-Controls) (Early Replacement, Retrofit) measure and the measure life for "High Efficiency Linear Fluorescent Fixtures ~ 4ft lamps" should be corrected to read 15 years. Current code maximum lighting power densities effectively require the use of electronic ballasts for new construction projects. Therefore Respondents recommend that the baseline for 4' linear fluorescent ballasts be electronic for New Construction and Substantial Renovation measures. For Natural Equipment Replacement and Retrofit measures, the baseline ballast should be magnetic until 2014, at which time a baseline adjustment should be made which adjusts the baseline to electronic ballasts over a period of 4-5 years.

120. Agree; TRM should reflect change.

Page 159 - Measure life for High Efficiency Linear Fluorescent Fixtures - 4ft lamps should be adjusted to 15 years. See the comment above for page 158 regarding baseline adjustment

121. Agree; TRM should reflect change.

Page 160 - Coincidence Factor for Hotel/Motel should be separated out for common areas and guest rooms. Common areas should have a CF closer to 1.0.

122. Agree, with modifications shown. Assuming that fixtures in these areas are typically but not always operating 24 hours/day, we recommend a CF of 0.9 for Hotel/Motel – Corridors/Common Areas until OH specific evaluations can be performed.

Page 161 - "WATTSee" - spelled incorrectly when defined in "Reference Section".

123. Agree; TRM should reflect change.

Page 161 - "HOURS" should be defined as annual operating hours instead of total operating hours.

124. Agree; TRM should reflect change.

Page 161 - See comments above (referencing pages 150-151) in which Respondents recommend expanding the "HOURS" table.

125. Disagree. See the response above to the comments referencing pages 150-151.

Page 163 - "Fossil Fuel Impact Descriptions and Calculations" - it is unclear whether the IFMMBIU factor includes a conversion from kWh to MMBtu. If not, a conversion factor of 0.003412 MMBtu/kWh should be included to convert from kWh to MMBtu.

126. Agree, with modifications shown. The factor already includes the conversion from kWh to MMBtu. The units of "MMBtu/kWh" should be added to the factor description.

Page 165 - Some of the baseline wattages for the high bay lighting appear to be more representative of standard metal halide fixtures rather than pulse start fixtures. Verify baseline wattages are correct.

127. Disagree. The fixture wattages appear reasonable assuming pulse start technology. If future baseline studies indicate that the assumed wattages are high, the TRM should be revised appropriately.

Page 167 - Tables 6 and 7 have very few baseline configurations. These tables should be expanded to cover more configurations.

128. Disagree. If there are specific lighting configurations that are currently offered prescriptively or are planned to be offered in the future, we recommend adding these configurations as part of the TRM revision process. Until such time, we recommend calculating savings for these measures via the custom protocols. We encourage utility involvement to ensure the TRM reflects the OH utilities' varied program offerings.

Page 168 - "Referenced Documents" - adjust formatting.

129. Agree; TRM should reflect change.

4. Lighting Systems, Non-Controls (Early Replacement, Retrofit) - (169)

General question for this measure - If a lamp has burnt out, but the lamp/ballast/fixture is replaced, it would qualify as a retrofit or early replacement; whereas if the ballast burned out, the replace-on-burnout protocol is used. Is this a correct interpretation of the intended protocol for this measure?

130. Agree; TRM should reflect change. Yes, that is the correct interpretation. A third scenario would be the early-retirement of the lamp/ballast/fixture without any component failure due to program intervention.

(Continuation of comment from above) The Respondents understand the reasoning for the discounted lifetime, Pulse Start Metal Halide measure, and agree that the code change must be addressed. The Respondents encourage VEIC to take the analysis a bit further:
Our experience shows that in many cases lighting retrofits cause energy savings in two ways. First, the new fixtures are more efficient than the old; second, the new fixtures often have a lower output than old fixtures. This may be due to lower lumen output per fixture, or due to fewer fixtures than previously installed. In these situations, the component of the energy savings that is attributable to "delumination" can be expected to persist for the typical 15 years, while the portion of the savings associated with improved luminous efficacy should be discounted to 7.5 years.

131. Disagree. This would be an unconventional approach and we are not familiar with any DSM program that uses such a methodology. Furthermore, it is reasonable to assume that this "delumination" would have occurred naturally upon the failure of the existing equipment.

Page 169 - This measure should apply the baseline shift as described on page 158 of the Lighting Systems (Non-Controls) (Time of Sale, New Construction) measure. The measure life for High Efficiency Linear Fluorescent Fixtures should be adjusted to 7 years.
For Natural Equipment Replacement and Retrofit measures, we recommend a magnetic ballast baseline for "High Efficiency Linear Fluorescent Fixtures - 4ft lamps" initially with a baseline shift to electronic ballast over time as described in the "Lighting Systems (Non-Controls) (Time of Sale, New Construction)" measure. This would be based on assumed remaining life of currently installed magnetic ballasts. Although magnetic ballasts have a fairly long EUL, the Energy Policy Act stops the sale of virtually all 4' T12 lamps as of July 14, 2012.
Agree that this change should be made to the final TRM.
Per the draft TRM, "Assuming a typical lamp has a lifetime of 18,000 hours and is operated 3,730 hour's per year, new lamps installed shortly before the impending federal standards take effect will need to be replaced in mid-2017, indicating that savings should be claimed for only 7 years for measures installed in 2010." At that time, all T12 lamps and ballasts will be required to be upgraded because replacement lamps will not be available. The EUL would be reduced by 1 year each year. For example, in 2013 the remaining EUL for a magnetic ballast would be four years. The last year a magnetic ballast could be considered for retrofit would be 2017. It is recognized that not all T12 lamps will have been replaced shortly before the July 14, 2012 phase out of T12 lamps. It is likely that a portion of T12 lamps will bum out each year starting 2013 and will need to be upgraded to then currently available lamp and ballast combinations, with all lamps finally burning out in 2017. It may be justified to reduce the baseline wattage by a fractional amount each year from 2013 to 2017 until the T8 baseline wattage is reached in 2017.

132. Agree; TRM should reflect change.

Page 170 - Coincidence factor - Is the CF for Hotel/Motel based on the load shape for guest rooms? There are opportunities for lighting upgrades in hotel common areas that are over 6000 hours/year, i.e., the CF for common-area lights is much higher than 0.37.

133. Agree; TRM should reflect change. See response to comments above referencing p.160.

Page 171 - See comments above (referencing pages 150-151) in which we recommend expanding the "HOURS" table. The exterior lighting value of 3833 is low. Data from monitored photocell-controlled lighting indicates approximately 4300 hours, which is also used in Pennsylvania TRM.

134. Agree, with modifications shown. The exterior "HOURS" should be increased to 4,300 hours. See the response to comments above referencing pages 150-151.

Page 172 - "Fossil Fuel Impact Descriptions and Calculations" ~ it is unclear whether the IFMMBTU factor includes a conversion from kWh to MMBtu. If not, a conversion factor of 0.003412 MMBtu/kWh should be included to convert from kWh to MMBtu.

135. Agree, with modifications shown. The factor already includes the conversion from kWh to MMBtu. The units of "MMBtu/kWh" should be added to the factor description.

Page 173 - For Table 8, page 173 baseline & efficient wattages, Respondents have a general question. Is each line meant to represent a specific scenario of baseline and efficient lights, or is the table to be used to estimate the wattage of a specified fixture? The table is very useful if the latter interpretation is correct. However, the table would be inadequate to handle the variety of rebates expected to come through the prescriptive lighting program. In other words, is it possible to take baseline from line 4 and measure from line 3, if those are the nearest matching baseline and measure fixture types?

136. Disagree. It was originally intended that each row in Table 8 represent a measure scenario. It was our understanding based on previous communications with the utilities that very little information is collected about the baseline systems for retrofit lighting measures. This led to the limited baseline and efficient equipment configurations presented. If it is feasible to collect the actual baseline system characteristics, we would recommend revising Table 8 to simply present the standard assumed fixture wattages, and program administrators could select the baseline system wattage as appropriate.

(Continuation of comment from above) Respondents recommend the following changes for high-bay fixtures:

- Change the baseline for a 2 lamp HO T-5 from 150 W MH to a 175 W MH
- Change the baseline for a 3 lamp 4ft T-8 from 150 W MH to a 175 W MH

137. Agree; TRM should reflect change.

Page 174 - Table 8, High Bay, MHT, CMH, Delamp, is missing several common baseline options.

138. Disagree. See response above to comments referring to p.173.

(Continuation of comment from above) HEF should include 48" T12 Magnetic - STD ballasts as well for early replacement projects. The measure lifetime would be 7 years and degrade annually.

139. Agree; TRM should reflect change.

5. Lighting Power Density Reduction (New Construction) - (176)

Page 176 - Description includes mention of various control strategies; however, the measure does not include these controls. Mention of controls should be removed from this paragraph.

140. Agree; TRM should reflect change.

Page 178 - "Summer Coincident Peak Demand Savings" equation within the "Reference Section" does not match the deemed savings equation on page 176, which is the correct equation. The equation on page 178 needs to be multiplied by the "AREA" term to determine total savings.

141. Agree; TRM should reflect change.

Page 178 - See comments above (referencing pages 150-151) in which Respondents recommend expanding the "HOURS" table.

142. Disagree. See response above to comments referencing pages 150-151.

6. LED Case Lighting With/Without Motion Sensors(New Construction; Retrofit - Early Replacement) - (180)

Page 180 - Coincidence factor of 92% - This value is apparently from the lighting coincidence factor table in the referenced report, but for retail case lighting the appropriate CF value is 100%. In the ETCC study referenced for other assumptions in this measure, the authors noted "The recorded data support that the lighting operates continuously at regularly scheduled intervals, for approximately 17 hours per day." That seems to be making the case for 100%, or CF = 1.

143. Disagree. The 92% comes directly from a Wisconsin evaluation that concluded that lights in groceries have a 92% coincidence within a 3pm – 6pm peak period. There are multiple reasons that the coincidence factor may be less than one, even though individual lights tend to be on during store hours. When in doubt, coincidence factors from evaluation studies should be used.

Page 181 - The fixture wattage table is poorly supported. The fixture wattages appear high in general or at least do not represent an average of expected fluorescent options or LED options. Include detailed calculations and assumptions for how the fixture wattages were determined.

144. Requested information provided. The PG&E document cited is an appropriate source. See "LED Refrig Lighting ERCO_Talking_Pointsv3.pdf" (Attachment I).

Page 182 - There is no demand savings factor shown in the ΔkW formula. There should be a savings factor for demand.

145. Agree; TRM should reflect change. We will add a demand savings factor of 1.43, based on the graph on page 8 of the referenced report.

7. LED Exit Signs (Retrofit) - (183)

Page 183 - The measure makes an assumption that all existing exit signs are fluorescent models. This is an unrealistic assumption. There are many incandescent exit signs which still need retrofits. The measure should be updated to include savings for incandescent lamps. The Wisconsin TRM assumes incandescent exit signs are 90% of existing stock. See Wisconsin TRM for assumptions.

146. Agree, with modifications shown. The initial assumption that all existing exit signs are fluorescent is an overestimate. However, the assumption from the Wisconsin TRM that only 10% of existing exit signs are fluorescent is almost certainly an underestimate. In the absence of specific market data, we suggest a middle value of 50% fluorescent, 50% incandescent.

Page 183 - Energy Savings formula for AkWh should be adjusted to be consistent with other measures. It should read: AkWh = kWsave x HOURS x ISR x (1 + WHFe) The WHFe factor should be adjusted accordingly.

147. Agree; TRM should reflect change.

Page 184 - Demand Savings formula for AkW should be adjusted to be consistent with other measures. It should read: AkW = kWsave x ISR x (1 + WHFd) The WHFd factor should be adjusted accordingly.

148. Agree; TRM should reflect change.

Page 184 - Why would the WHFe and WHFd factors not be based on similar\ assumptions as the other Lighting (non-controls) measures? The WHFe would then be: WHFe = (0.5 * 0.095 (conditioned) + 0.5 * 0.0 (non-conditioned)) ^ 0.0475 And WHFd would be: WHFd - (0.5 * 0.2 (conditioned) + 0.5 * 0.0 (non-conditioned)) = 0.1

149. Agree; TRM should reflect change.

Page 184 - The kWsave value should be adjusted to account for incandescent fixtures.

150. Agree; TRM should reflect change. The average kWsave value can be updated using deemed values from the 2009 NY State TecMarket Works report.

8. Traffic Signals (Retrofit) - (185)

Page 185 - Replace "baseline" with "efficient when defining Weff for both "Energy Savings" and "Summer Coincident Peak Demand Savings".

151. Agree; TRM should reflect change.

Page 187 - "Traffic Signal Technology Equivalencies" table should be updated to include a demand savings (kW) column.

152. Agree; TRM should reflect change.

Page 187 - Missing Red Arrows fixture type. Consider either using actual wattages from the installed models, if available, or default to ENERGY STAR, which has higher wattages for qualifying LED lights and would thus be more conservative (http://www,energvstar.gov/ia/partners/product specs/eligibilitv/trafficeUg.pdf).

153. Agree; TRM should reflect change. We recommend using the ENERGY STAR criteria, http://www.energystar.gov/ia/partners/product_specs/eligibility/traffic_elig.pdf

9. Light Tube Commercial Skylight (Time of Sale) - (189)

Page 189 - "Annual kWh savings" equation needs to be corrected for both the "Deemed Savings for this Measure" section and the "Energy Savings" section. The equation should be multiplied by "NumFixtures" for both cases to obtain: Annual kWh Savings = NumFixtures * kWj, * 2400 The term NumFixtures should also be properly defined in the "Reference Section". A reference should be provided for the EFLH value of 2400.

154. Agree; TRM should reflect change. The EFLH of 2400 is based on the assumption that the light tube skylight will replace an electrically powered light 8 hours a day, 300 days a year. A footnote should be added with this explanation.

10. Energy Star Room Air Conditioner, Commercial Use (Time of Sale)-(191)

Pages 191-192 - All energy and demand savings equations in this section should be divided by 1000 W/kW. The units of EER are Btu/W*h which would lead to an overall result of W*h for energy and W for demand.

155. Agree; TRM should reflect change.

11. Single-Package and Split System Unitary Air Conditioners (Time of Sale, New Construction) - (194)

Pages 195-196 - Recommend adding a Rated Load Factor (RLF) for all formulas to compensate for oversizing of equipment during design. Typical value is RLF = 0.80. See Engineering Methods for Estimating the Impacts of Demand-Side Management Programs; Volume 2: Fundamental Equations for Residential and Commercial End Uses. Prepared by AEC and Hagler Bailly, Inc.

156. Disagree. The EFLH are from the eQuest simulations run for the joint utilities' TRM, and so it is most likely that they were calculated using the hours the unit was running, weighted by the ratio of current load to design load including oversizing. Since the denominator of that ratio is the design load, and not the maximum load that the AC actually operates, the load factor has already been included in the algorithm within the EFLH term.

12. Heat Pump Systems (Time of Sale, New Construction) - (197)

Pages 197-198 - To appropriately use the savings algorithms and efficiencies based on IECC 2006, the text under the "Deemed Calculation for this Measure" and "Energy Savings" sections should be modified to read: "For air-cooled units with cooling capacities less than 65 kBtu/h..," "For air-cooled units with cooling capacities equal to or greater than 65 kBtu/h, and all other units..."

157. Agree; TRM should reflect change.

Pages 197-200 - Recommend adding a Rated Load Factor (RLF) for all formulas to compensate for oversizing of equipment during design. A typical value is RLF = 0.80. See Engineering Methods for Estimating the Impacts of Demand-Side Management Programs; Volume2: Fundamental Equations for Residential and Commercial End Uses. Prepared by AEC and Hagler Bailly, Inc.

158. Disagree. The EFLH are from the eQuest simulations run for the joint utilities' TRM, and so it is most likely that they were calculated using the hours the unit was running, weighted by the ratio of current load to design load. Since the denominator of that ratio is the design load, and not the maximum load that the AC actually operates, the load factor has already been included in the algorithm.

Page 199 - EFLHcooi and EFLHheat should be studied in Ohio. Respondents would also like to review assumptions and input values pertaining to the "prototypical small commercial building simulation runs" referenced in footnote 504.

159. Agree; TRM should reflect change. The EFLH for heating and cooling currently in the TRM were first developed in the utilities' joint TRM. We did not have full access to the simulation data, and could not develop new data in the available timeframe. We strongly support the involvement of the EDUs in the continuing TRM revision process and propose that this change be incorporated as part of that process.

13. Outside Air Economizer with Dual Enthalpy Sensors (Time of Sale, Retrofit - New Equipment) - (201)

Page 201 - $400 incremental cost - In utilities' Ohio TRM, this is $170/toii, which would be consistent with how the savings are calculated (kWh/ton), and are derived from DEER database. Given that measure capacity could vary from three to 20 tons, Respondents would prefer that VEIC describe the rationale for using a flat incremental cost of $400.

160. Disagree. The $170 per ton in the utilities' TRM is based on an old version of DEER, and is from the wrong baseline (outlet damper rather than an outside air dry-bulb economizer). Also, it doesn't follow that the cost of going from a dry-bulb economizer to a dual-enthalpy economizer should scale linearly with cooling tons, and this is not how most program administrators rebate this measure. We believe $400 is an appropriate incremental cost.

Page 202 - The dual Enthalpy Economizer Savings table should be expanded to include additional building types, or at a minimum to include an "other" category.

161. Agree; TRM should reflect change. We concede that current proposed characterization is somewhat limited in its applicability and could be expanded via additional modeling to cover the additional building types noted. See the response to the comments provided in section IV.K.2. We agree that a category of "other" should be added regardless, derived from the other building types.

14. Chilled Water Reset Controls (Retrofit - New Equipment) - (204)

Page 204 - This measure is effective for a large commercial facility and the project description states that the measure is for larger commercial facilities. However, footnote 513 on page 206 states that the savings value is based on a series of simulation runs using a small commercial building model; is this a typo, or was the wrong building model used?

162. Agree; TRM should reflect change. The footnote should state that the simulation was run using the prototype of a large office. The savings values have not been changed from the utilities' TRM. The language should be updated for clarity.

Page 206 - Please clarify that the AkWton defaults in Table 9 are indeed showing an increase in electrical demand.

163. Clarification provided. The data from the modeling in the EDU's Joint TRM (October 15, 2009) was used. The data does indeed show an increase in demand. Presumably, this is because the controls slightly lower the full load efficiency of the HVAC system.

15. Variable Frequency Drives for HVAC Applications (Time of Sale, Retrofit - New Equipment) - (207)

Pages 207-208 - Consider modifying all energy and demand equations in this section to be based on HP. This would require a modification to the formulas as follows: [*formula omitted*]

164. Disagree. The energy and demand equations are already based on HP. The ESF and DSF in the TRM are from the Connecticut Savings Documentation, and already include a conversion from HP to kW. Rated Load Factor (RLF) should not be included in VFD savings calculations. A lower load factor will indeed increase savings from the VFD, as the VFD will reduce the speed of the motor more over the baseline case with no control – we believe this effect is already incorporated in the savings factors.

Page 208 - HOURS table should vary by Building Type in addition to the pump type. The hours for hot water pump run time seem high. They should be related to building type and full load heating hours. Chilled water FLHs should also be relative to the building type. These data are captured in other tables in both the Ohio TRM and VEIC documents. The same comments apply to fan FLHs.

165. Agree; TRM should reflect change. The hours of operation were originally averaged across building type for the sake of simplicity. The TRM should be modified so that the hours of operation will vary based on building type.

(Continuation of comment from above) A note on the example VFD calculations for kWh and kW using a 5 BHP pump with 95% efficiency. The input efficiency for the example is unrealistic, and VEIC may want to consider using a more reasonable value instead. For a 5 HP motor, a PE required motor efficiency for rebates is 89.5%.

166. Agree; TRM should reflect change.

(Continuation of comment from above) HVAC pump and HVAC fan VFD savings factors - Clarification on how these numbers were derived would be useful. Were they determined from an energy model or data logging experience?

167. Clarification provided. These were taken from Connecticut Light and Power's savings documentation, where there is limited background on how they were developed. While we agree that ideally we would have more information about the savings factors, as well as more Ohio-specific factors, we believe that these numbers are conservative in the Ohio climate, and represent the best available data in the absence of an Ohio-specific evaluation effort. This clarification should be included in the TRM.

Pages 207-209 - The algorithms presented in this section provide savings that are significantly below Duke evaluation study results for HVAC fans. For example, using the TRM calculations for a VFD applied to an air handler with a forward-curved inlet guide vane fan gives savings on the order of 385 kWh/hp. Duke evaluated a C&I program in Ohio using short-term monitoring of VFDs in building fan applications, and estimated an average savings of 1250 kWh/hp. The savings for the air foil/ backward curved fan with inlet vanes is very close to the evaluation study estimate (on the order of 1485 kWh/hp). Respondents believe the ESF for the forward-curved inlet guide vane fan is too low.
The algorithm for VFDs applied to chilled water pumps also predicts savings that appear to be low. The HOURS value in the table on the top of page 208 shows 1852 hours for chilled water pumps. Using the ESF of 0.432 on the top of page 209 results in an energy savings of 842 kWh/hp. Most chilled water plants operate year round, so the 1852 hours appears low. Recent simulations conducted for Duke Energy resulted in energy savings on the order of 3500 kWh/hp; which is similar to the value computed for hot water pumps using the TRM equations (3044 kWh/hp).

168. Agree, with modifications shown. We have not seen the referenced evaluation. If there has been a detailed evaluation close to Ohio, the values from this evaluation could be used instead.

16. Cool Roof (Retrofit - New Equipment) - (210)

More information should be given in this section regarding the types of heating and cooling systems that dictate the energy and demand savings values encountered in the reference tables. Not all of this information is available in Appendix A.

169. Agree; TRM should reflect change. The building prototypes were developed as part of the EDU's Joint TRM (October 15, 2009). We did not have access to the full building modeling files, only what was given in Appendix A.

Page 210 - It should be noted in the Description that the measure is for Low-Slope roofs with roof slope< 2/12.

170. Agree, with modifications shown. If the modeling was done with low-slope roofs, this should be specified in the TRM. However, there is no reason why this measure shouldn't apply to high slope roofs as well – ENERGY STAR has ratings for high-slope roofs as well.

Page 210 - The measure should be based on solar reflectance and emittance rather than just solar absorptance. The DOE, ENERGY STAR and Cool Roof Rating Council all use solar reflectance and emittance, or SRI values.

171. Disagree. While high emittance roofs will provide greater savings than low emittance roofs, ENERGY STAR only references reflectance and the indication is that the modeling was done so that only reflectance is changed. Reflectance is simply 1 – Absorptance. So the TRM should be changed so that it references reflectance rather than absorptance.

Page 211 - Definition of ΔkWhkSF in "Reference Section" should be per 1000 square feet, not 100.

172. Agree; TRM should reflect change.

Page 211 - Example of energy savings should result in 184 kWh, not 192.

173. Agree; TRM should reflect change.

Page 211 - The column heading for the 4th column in the Reference Table starting on page 211 should read ΔkWkSF, not ΔkWhkSF.

174. Agree; TRM should reflect change.

Page 211 - VEIC should allow review of assumptions and input values pertaining to its "prototypical small commercial building simulation runs" referenced in footnote 524, to enable Respondents and evaluators to check values used for "unit energy savings per 100 square feet of roof area" ((ΔkWh100SF) and "unit demand savings per 100 square feet of roof area" (ΔkWh100SF).

175. Agree, with modifications shown. The building prototypes were developed as part of the EDU's Joint TRM (October 15, 2009). We did not have access to the full building modeling files, only what was given in Appendix A.

Page 212 - The Cool Roof table should be expanded to include additional building types, or at a minimum to include an "other" category.

176. Agree; TRM should reflect change. We concede that current proposed characterization is somewhat limited in its applicability and could be expanded via additional modeling to cover the additional building types noted. See the response to the comments provided in section IV.K.2. We agree that a category of "other" should be added regardless, derived from the other building types.

17. Commercial Window Film (Retrofit - New Equipment) - (214)

Page 214 - Please verify whether double-pane clear glass is a valid baseline, i.e., is it representative of Ohio building stock?

177. Agree, with modifications shown. Since we did not have access to the building models used to calculate savings for this measure, we had limited ability to change the measure characteristics. We concede that the U-factor and SHGC for double-pane clear glass used are fairly high, and above the ASHRAE maximums. The DOE benchmark for a primary school constructed before 1980, for example, has window U-factors and SHGCs of 0.59 and 0.385, roughly the ASHRAE values. However, given the limited timeframe in which to complete additional energy simulation modeling, the current characterization is proposed "as is". We strongly support the involvement of the EDUs in the continuing TRM revision process and propose that this change be incorporated as part of that process

Page 214 - More information should be given in this section regarding the types of heating and cooling systems that dictate the energy and demand savings values encountered in the reference tables. Not all of this information is available in Appendix A.

178. Agree; TRM should reflect change. The building prototypes were developed as part of the EDU's Joint TRM (October 15, 2009). We did not have access to the full building modeling files, only what was given in Appendix A.

Page 215 - Correct typo in "Fossil Fuel Impact" to refer to table below instead of above.

179. Agree; TRM should reflect change.

Page 215 - Respondents would like to review assumptions and input values pertaining to the VEIC "prototypical small commercial building simulation runs" referenced in footnote 528, to enable evaluators to check values used for "unit energy savings per 100 square feet of window film" (ΔkWhkSF) and "unit demand savings per 100 square feet of window film" (ΔkWkSF).

180. Agree; TRM should reflect change. The building prototypes were developed as part of the EDU's Joint TRM (October 15, 2009). We did not have access to the full building modeling files, only what was given in Appendix A.

18. Roof Insulation (Retrofit - New Equipment) - (218)

More information should be given in this section regarding the types of heating and cooling systems that dictate the energy and demand savings values encountered in the reference tables. Not all of this information is available in Appendix A.

181. Agree; TRM should reflect change. The building prototypes were developed as part of the EDU's Joint TRM (October 15, 2009). We did not have access to the full building modeling files, only what was given in Appendix A.

Page 218 - "Definition of Efficient Equipment" - The assumption of R-18 as the efficient condition appears low. This does not even bring the roof assembly up to code. It is not clear whether this value represent assembly R-value or insulation R-value. Provide clarification as to which it is.

182. Agree; with modifications shown. The baseline value represents the insulation R-value. The TRM should be updated to reflect this.

We agree that the R-value is somewhat low - IECC mandates R-20 for buildings with insulation entirely above deck, R-19 for metal roof constructions, and R-30 for buildings with attic, compared to R-18 used as the efficient value in the TRM. This measure as written can only apply to retrofits, when the insulation is added to old, poorly insulated buildings.

If the measure were adapted to apply to new construction, the baseline in the models must reflect code, and the efficient R-value has to be somewhat higher than code.

Page 218 - "Definition of Baseline Equipment" - Provide a citation for source of baseline R-values in the table. It is not clear whether these values represent assembly R-values or insulation R-values. Provide clarification as to which it is.

183. Agree; TRM should reflect change. The building prototypes were developed as part of the EDU's Joint TRM (October 15, 2009). We did not have access to the full building modeling files, only what was given in Appendix A.

Page 219 - Respondents would like to review assumptions and input values pertaining to the VEIC "prototypical small commercial building simulation runs" referenced in footnote 532, to enable evaluators to check values used for "unit energy savings per 1,000 square feet of roof area" (ΔkWhksf) and "unit demand savings per 1,000 square feet of roof area" (ΔkWkSF)-

184. Agree; TRM should reflect change. The building prototypes were developed as part of the EDU's Joint TRM (October 15, 2009). We did not have access to the full building modeling files, only what was given in Appendix A.

Page 220 - The Roof Insulation table should be expanded to include additional building types, or at a minimum to include an "other" category.

185. Agree; TRM should reflect change. We concede that current proposed characterization is somewhat limited in its applicability and could be expanded via additional modeling to cover the additional building types noted. See the response to the comments provided in section IV.K.2. We agree that a category of "other" should be added regardless, derived from the other building types.

19. High Performance Glazing (Retrofit - Early Replacement) - (222)

Page 222 - More information should be given in this section regarding the types of heating and cooling systems that dictate the energy and demand savings values encountered in the reference tables. Not all of this information is available in Appendix A.

186. Agree; TRM should reflect change. The building prototypes were developed as part of the EDU's Joint TRM (October 15, 2009). We did not have access to the full building modeling files, only what was given in Appendix A.

Page 222 - "Definition of Efficient Equipment" - The efficient U-value of 0.57 does not even meet the Ohio code U-Value of 0.55. Verify whether it is the intent of this measure to at a minimum meet code.

187. Agree; TRM should reflect change. IECC mandates a U-value of 0.55. This measure as written can only apply to retrofits, with older windows. The efficiency U-value of 0.57 was used for the building modeling in the EDU's Joint TRM (October 15, 2009). We decided this value was acceptable; but ideally the building modeling should be re-run using a value lower 0.55 in order to exceed code.

Page 222 - Please verify whether double-pane clear glass is a valid baseline, i.e., is it representative of Ohio building stock?

188. Agree; TRM should reflect change. Since we did not have access to the building models used to calculate savings for this measure, we had limited ability to change the measure characteristics. We agree that the U-factor and SHGC used are pretty high – well above the ASHRAE maximums. The DOE benchmark for a primary school constructed before 1980, for example, has window U-factors and SHGCs of 0.59 and 0.385, roughly the ASHRAE values. However, given the limited timeframe in which to complete additional energy simulation modeling, the current characterization is proposed "as is". We strongly support the involvement of the EDUs in the continuing TRM revision process and propose that this change be incorporated as part of that process

Page 223 - Respondents would like to review assumptions and input values pertaining to the VEIC "prototypical small commercial building simulation runs" referenced in footnote 536, to enable evaluators to check values used for "unit energy savings per 100 square feet of window space" (ΔkWhkSF) and "unit demand savings per 100 square feet of window space" (ΔkWksf).

189. Agree; TRM should reflect change. The building prototypes were developed as part of the EDU's Joint TRM (October 15, 2009). We did not have access to the full building modeling files, only what was given in Appendix A.

Page 224 - The High Performance Windows table should be expanded to include additional building types, or at a minimum to include an "other" category.

190. Agree; TRM should reflect change. We concede that current proposed characterization is somewhat limited in its applicability and should be expanded via additional modeling to cover the additional building types noted. However, given the limited timeframe in which complete additional energy simulation modeling, the current characterization is proposed "as is". We strongly support the involvement of the EDUs in the continuing TRM revision process and propose that this change be incorporated as part of that process.

20. Engineered Nozzles (Time of Sale, Retrofit - Early Replacement) - (226)

Page 226 - To enable us to complete our review of this measure, please provide the referenced file entitled "Compressed Air Analysis.xls" (see footnote 540 on page 226 of the draft Ohio TRM).

191. Requested information provided. See "Compressed Air Analysis.xls" (Attachment J).

Page 226 - The units do not appear to be correct in the energy equations under sections "Deemed Savings for this Measure" and "Reference Section." Clarify whether there the kWscfm units are kW/cf or kW/cfm. If the units are indeed kW/cf, then the equations do not have the proper units. If they are kW/cfm, then the units are ok.

192. Agree; TRM should reflect change. kWscfm is 'standard cubic feet per minute' – CFM corrected for standardized conditions of temperature, pressure and humidity. This should be added to the factor description. It is essentially equal to CFM.

Page 226 - References for footnotes 539 and 540 could not be found. These are needed to verify assumptions.

193. Agree; TRM should reflect change. Footnote 539 is a holdover from the EDU's Joint TRM (October 15, 2009). This source document was requested, but never received. Lacking a better value we chose to use the original draft TRM value. We agree that these sources should be identified so the assumptions can be verified. Footnote 540: See "Compressed Air Analysis.xls" (Attachment J).

Page 227 - The CF is based on an assumption of peak period 4p-5p. This is a much tighter period than all other measures (3p-6p) and is likely leading to an overly high CF.

194. Agree, with modifications shown. The tighter peak coincidence period (4p-5p) may be leading to an overly high CF, but we expect this to be a minor difference that is acceptable in the absence of better data.

Page 228 - Footnote 541 needs full citation.

195. Agree; TRM should reflect change. Oberg, Erik, et al., Machinery's Handbook : A Reference Book for the Mechanical Engineer, Designer, Manufacturing Engineer, Draftsman, Toolmaker, And Machinist, 25th edition, 1996. http://new.industrialpress.com/products/category_feature/MH

Page 228 - Footnote 543 is a somewhat unsubstantiated assumption. Additional documentation should be found to support the assumption.

196. Agree; TRM should reflect change. The following source can be added: Efficiency Vermont Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions, February 19, 2010. This value is also in line with the 2010 NY State TecMarket Works report. We acknowledge that neither of these sources provide additional justification for the 5% value, but this value seems reasonable in the absence of better data.

21. Insulated Pellet Dryers (Retrofit) - (228)

Page 228 - "Definition of Efficient Equipment should specify the minimum insulation levels that the deemed savings are based on.

197. Agree; TRM should reflect change.

Page 229 - "Energy Savings" - AkWh is defined as "non-coincident demand savings", and should be defined as annual energy savings.

198. Agree; TRM should reflect change.

Page 229 - Unable to find reference in footnote 548.

199. Agree; TRM should reflect change. The coincidence factor and the citation are from the EDU's Joint TRM (October 15, 2009). This is not an optimal source, but very limited research has been done on coincidence factors for industrial process, and we were not able to develop defensible factors in the timeframe required. We strongly support the involvement of the EDUs in future TRM updates, and this value will be a good candidate for future evaluation effort. See 'deeminglighting13nov09_evaluationreport (1).xls' (Attachment K) for the study we believe is being referenced in the EDU's Joint TRM (October 15, 2009).

Page 230 - Provide reference or assumptions used to develop table values

200. Agree; TRM should reflect change. The table was developed as part of the EDU's Joint TRM (October 15, 2009). We attempted to find the source of the savings values, but did not get any response. In the absence of any better available data we left the table as is. We agree that there should be a better citation for the values in the table.

22. Injecting Molding Barrel Wrap (Retrofit - New Equipment) - (231)

Page 231 - "Deemed Savings for this Measure" - equation for "Summer Coincident Peak kW Savings" needs to be multiplied by the CF.

201. Agree; TRM should reflect change.

Page 231 - Unable to locate reference in footnote 550.

202. Agree; TRM should reflect change. This source came from the EDU's Joint TRM (October 15, 2009). This source document was never provided, so, in the absence of a better source we deferred to the original. We agree this source should be tracked down and verified.

23. Energy Star Hot Food Holding Cabinet (Time of Sale) - (234)

Page 234 - Unable to locate CF in source given in footnote 555.

203. Agree; TRM should reflect change. This source came from the EDU's Joint TRM (October 15, 2009). This source document was never provided, so, in the absence of a better source we deferred to the original. We agree this source should be tracked down and verified.

(Continuation of comment from above) "Reference Section" - "Energy Savings" equation should be divided by 1000 instead of multiplied by 1000 to covert from W to kW. This also needs to be changed in demand equation on p. 235. The calculations for deemed savings were carried out correctly, however the typos appear in the equation.

204. Agree; TRM should reflect change.

(Continuation of comment from above) In general, the method here is inconsistent with the other measures due to the intermediate step of computing kWsave for both energy and demand. Consider consolidating these equations by removing the intermediate step and multiplying by "HOURS" for energy and "CF" for demand.

205. Agree; TRM should reflect change.

Page 235 - In the table, the Wfoot base and Wfoot eff values are not consistent with the assumptions stated in the "Definition of baseline equipment" and "Definition of efficient equipment" sections. The ES Calculator uses the following values:
[*Table omitted*]
Default savings should be adjusted to match any updated assumptions.

206. Agree, with modification shown. The definition of the baseline equipment should be updated to reflect the assumption in the reference section table that the baseline W/ft3 is 70. This value was chosen because it is the default 'average' value from the FSTC holding cabinet calculator, found here: http://www.fishnick.com/saveenergy/tools/calculators/holdcabcalc.php

An assumed baseline of 100 W/ft3 would be a very generous assumption as it reflects the lowest idle rate of products available on the market – not the average idle rate of holding cabinets on the market. We believe 70 W/ft3 to be a more accurate assumption.

This same underlying thinking applies to the efficient case as well. The ENERGY STAR standard is not an accurate reflection of actual available products – it is merely the requirement. The values for W/ft3 of the efficient holding cabinets were calculated from the list of qualifying products on the ENERGY STAR website, found here:
http://www.energystar.gov/ia/products/prod_lists/HFHC_prod_list.pdf

Note: We have reviewed and updated this list since the draft OH TRM was submitted, and the resulting efficient W/ft3 are lower than before – the TRM should be updated to reflect this new information.

Full Size	Three-Quarter Size	Half Size
15.2 W/ft3	25.3 W/ft3	33.1 W/ft3

Page 235 - Clean up formatting, realign: (also look throughout the document as this occurs periodically).
[*Equations omitted*]

207. Agree; TRM should reflect change.

24. Steam Cookers (Time of Sale) - (236)

Page 236 - It seems that the title of this measure should be changed to ENERGY STAR Steam Cookers, as all content pertains to ENERGY STAR devices.

208. Agree; TRM should reflect change.

Page 236 - In Description Section, first sentence, the word "label" should be added after ENERGY STAR.

209. Agree; TRM should reflect change.

Page 236 - Incremental cost does not match the ENERGY STAR database, which states an incremental cost in excess of $5000. Unable to access NYSERDA database to verify $2000 figure.
[*link omitted*]

210. Agree, with modifications shown. Given the wide difference between the two sources ($5000 and $2000), we recommend taking a survey of costs for the eligible units listed on the ENERGY STAR site and corresponding baseline units, to determine the average incremental cost. However, the penetration for this prescriptive measure is expected to be quite low, so as an alternative it would be acceptable to use an average incremental cost from the two sources.

Page 236 - Unable to find reference for footnote 560.

211. Agree; TRM should reflect change. This source came from EDU's Joint TRM (October 15, 2009). This source was never provided, so lacking a better source we deferred to the original. We agree this source should be tracked down and verified.

Page 237 - The value for EFOOD should be 0.0308, not 0.038.

212. Agree; TRM should reflect change.

Page 238 - "Reference Tables" - The Idle Energy Rates for Efficient models in the table do not match the ENERGY STAR website. The Heavy Load Cooking Energy efficiency also does not seem to match ES. Verify all values in the table are correct. Please see for correct values:
[link omitted]

213. Disagree. As stated in footnote 567, the efficient values were calculated from the list of ENERGY STAR qualified products found here:
http://www.energystar.gov/ia/products/prod_lists/Steamers_prod_list.pdf

We believe this list represents an accurate sample of the efficient products available on the market, and thus offers a better basis for assumptions about the idle energy rates and cooking efficiency.

25. Energy Star Fryers (Time of Sale) - (239)

Page 239 - Footnote 569 leads to calculator for combination oven, not fryer. Should reference:
[link omitted]

214. Agree; TRM should reflect change.

Page 239 - Footnote 571 refers to a lighting study for the fryer CF.

215. Agree; TRM should reflect change. This source came from the EDU's Joint TRM (October 15, 2009). This source was never provided, so lacking a better source we deferred to the original. We agree this source should be tracked down and verified.

Page 239 - "Reference Section" ~ "IDLE" should be divided by 1000 W/kW to be compatible with the rest of this equation.

216. Agree; TRM should reflect change.

Page 240 - EFLH is given as 4380, which amounts to 12 hrs/day for 365 days per year. On page 239 HOURS are 16 hrs/day for 365 days per year, which would be 5840.

217. Agree; TRM should reflect change. The EFLH should be updated to match the value given in the energy savings calculation.

Page 240 - Footnote 575 should reference:
www.fishnick.com/saveenergy/tools/calculators/cfryercalc.php.

218. Agree; TRM should reflect change.

26. Combination Oven (Time of Sale) - (241)

Page 241 - Provide more complete citation for "NYSERDA Deemed Savings Database" in footnote 578.

219. Agree; TRM should reflect change.

Page 241 - The CF is referenced to a lighting study in footnote 579.

220. Agree; TRM should reflect change. The coincidence factor and the citation are from the EDU's Joint TRM (October 15, 2009). We agree that this is not an optimal source, but very limited research has been done on coincidence factors for commercial kitchen equipment, and we were not able to develop defensible factors in the timeframe required. We strongly support the involvement of the EDUs in future TRM updates, and this value will be a good candidate for future evaluation effort.

Page 242 - The default values from the FSTC calculator do not appear to be representative of actual default operating conditions. The PREEnergys, IDLE, and EFF values do not match EFF's from various performance reports for combination ovens available on the FSTC website. The LB assumption of 200 pounds does not seem to be appropriate either. These values need more support.

221. Disagree. The 60% cooking efficiency matches up well with the more efficient range of combination ovens available, and is in line with the minimum performance for which incentives are offered in other prescriptive programs. The FSTC performance reports are for newer, top of the line ovens, and are not representative of the available market. Even so, the specific ovens evaluated by FSTC have an efficiency range of 58.2% - 80%, and an idle energy rate of range of 1.7 kW to 4 kW – very much in line with the 3 kW idle rate and 60% efficiency used in the TRM. This list of qualifying ovens from Puget Sound Energy also shows that the assumptions in the TRM are realistic.
http://www.pse.com/SiteCollectionDocuments/business/9CombiOvens.pdf

27. Convection Oven (Time of Sale) - (244)

Page 244 - It seems that the title of this measure should be changed to ENERGY STAR Convection Oven, as all content pertains to ENERGY STAR devices.

222. Agree; TRM should reflect change.

28. Energy Star Griddle (Time of Sale) - (247)

Pages 247-248 - Energy savings per year should be 1,797 kWh (rather than the 6,996 kWh value that results from using the incorrect assumptions provided in the draft TRM). The 1,797 kWh value was derived by assuming the following values for baseline and efficient equipment, based on the calculation spreadsheet and underlying assumptions provided by Energy Star - see Energy Star calculation spreadsheet, second tab.
[Table omitted]
The draft TRM for Ohio appears to be using 3ft x 2ft griddle as the standard griddle surface area. If so, the correct table value for OH TRM efficient griddle performance metrics would be the following.

[Table omitted]
Based on these corrected values, the savings should be 1,797.3 kWh (i.e., the difference between 17,077.6 kWh for the base case and 15,280.4 kWh for the Energy Star griddle).

223. Disagree. Baseline values assume a 3ft x 2ft griddle because it is by far the most common size of qualifying models. Efficient values are averages from the list of ENERGY STAR qualifying models available online here:
http://www.energystar.gov/ia/products/prod_lists/comm_griddles_prod_list.pdf

Further, based on a quick calculation and assumed avoided costs, the values suggested for the efficient equipment appear to result in the measure not being cost effective (TRC test) -- in which case it should be dropped.

29. Spray Nozzles for Food Service (Retrofit) - (250)

Pages 250-251 - "Annual kWh Savings" equations need to be corrected. They should be divided by 3412 Btu/kWh in order to obtain a savings m kWh rather than multiplied by 10^{-6}. The corrected equation should be:
[equation omitted]

224. Agree; TRM should reflect change.

Page 251 - The "EFF" factor should be based on a baseline Energy Factor, not thermal efficiency. Most water heater calculations are based on the EF. For electric based water heating, an EF = 0.904 should be used. For fossil fuel based water heating, an EF = 0.58 should be used.

225. Agree; TRM should reflect change.

Page 251 - There would be an expected Summer Coincident Peak Demand Savings when using an electric water heater. This savings should be added

226. Disagree. Spray nozzles for food service are used to pre-rinse dishes, which is almost certainly happening late at night after the peak demand period. However, a peak demand reduction could be added if there are data to support it.

30. Refrigerated Case Covers (Time of Sale, New Construction, Retrofit - New Equipment) - (253)

Page 253 - In the Reference section, the current energy savings equation is incorrect as written. The formula should be divided by COP, not multiplied. The equation should be corrected as shown:
[equation omitted]
This will yield the correct savings. The Annual kWh Savings equation in the "Deemed Calculation for the Measure" should also be modified to:
[equation omitted]

227. Agree; TRM should reflect change.

31. Door Heater Controls For Cooler or Freezer (Time of Sale) - (255)

Page 255 - "Annual kWh Savings" calculation is missing an hours of operation term(8760).

228. Agree; TRM should reflect change.

32. Energy Star Ice Machine (Time of Sale, New Construction) - (257)

Page 258 - The duty cycle assumption of 40% seems quite conservative; Respondents think a higher value could be appropriate. Has any monitoring for this measure taken place in jurisdictions in or near Ohio?

229. Agree, with modifications shown. Given the wide range of duty cycle values, we agree that selecting the lowest value is not justified. We recommend using the mid-range value of 57%, justified by the California field study. We do not know of any monitoring results for this measure in jurisdictions in or near Ohio.

33. Commercial Solid Door Refrigerators & Freezers (Tim© of Sale, New Construction) - (260)

Page 262 - "Reference Section" - "Summer Coincident Peak Demand Savings" – AkW on right side of equation should be changed to AkWh.

230. Agree; TRM should reflect change.

34. Strip Curtain for Walk-In Coolers and Freezers (New Construction, Retrofit - New Equipment, Retrofit - Early Replacement) - (263)

Deemed values and methodology should be updated in accordance with the relevant ADM white paper dated September 2010.

231. Agree, with modifications shown. The savings in the TRM are based on an ADM whitepaper from June, 2010 – and have been adjusted to Ohio's climate. If ADM's methodology has changed since then, and has been applied to a Midwestern climate, the TRM could be updated.

Page 263 - Is the source for footnote 642 published or available anywhere? The results are consistent with the Efficiency Vermont TRM of 2008, which should perhaps be cited instead.

232. Requested information provided. See '99 - Strip curtains for walk-in units.doc' (Attachment L).

35. Motors (Time of Sale) - (265)

If the measure included IE4 Super Premium motors, then in 2011 the baseline could shift to NEMAIE3 Premium motors rather than EPACT. This would allow the Continuation of the measure beyond 2011 assuming Super Premium motors are readily available.

233. Agree, with modifications shown. Super Premium Motors, while planned as a class in the future, are not yet available. Since there are no efficiency levels set yet for super premium motors, we propose leaving the characterization as is and updating it with the super premium classification when they become available (and if found to be cost-effective).

Page 265 -There are multiple punctuation errors in the second paragraph under the "Definition of Baseline Equipment heading.

234. Agree; TRM should reflect change.

(***Continuation of comment from above***) Coincidence Factor (CF) for a motor is dependent on how the motor is being used and the industry type or type of facility in which it is installed. The draft Ohio TRM value of CF 0.38 seems low. For comparison, the California DEER (i.e., the Database for Energy Efficient Resources, which can be downloaded at http://www.energy.ca.gov/deerA uses CF 0.74 for high efficiency motor measures, as does the Pennsylvania TRM (Act 129). The 0.38 CF in the draft Ohio TRM is referenced to "JCP&L metered data" (footnote 649). We would like to review the source document, study and/or report, none of which are provided.
Further, although it's more accurate to have load factors in the savings algorithm, rated load factor should be 80%, as indicated in the following section on pumps, not the 75% cited in the text.

235. Agree; TRM should reflect change. The reference to "JCP&L metered data" came from the EDU's Joint TRM (October 15, 2009). While this source document was requested, it was never provided. We support locating this source document for verification.
Regarding the proposed coincidence factor of 0.74, we agree this is reasonable and should be used in place of the 0.38 value.

and

Disagree. Regarding the proposed load factor of 80%, we disagree. DEER and the Efficiency Vermont TRM use 75%. Both values are widely used, however 75% is less likely to overestimate actual savings.

Page 265 - It would be useful to provide a table to lookup for EFLH based on building type consistent with building types proposed above (put appropriate reference) if the information is not available.

236. Agree; TRM should reflect change. The table could be adapted from the Efficiency Vermont TRM, but should be adjusted for OH weather. For example:

Annual Motor Operating Hours (HOURS)				
Building Type	HVAC Pump (heating)	HVAC Pump (cooling)	HVAC Pump (unknown use)	Ventilation Fan
Office	2,186	2,000	2,000	6,192
Retail	2,000	2,000	2,000	3,261
Manufacturing	3,506	2,000	2,462	5,573
Hospitals	2,820	2,688	2,754	8,374
Elem/Sec Schools	3,602	2,000	2,190	3,699
Restaurant	2,348	2,000	2,000	4,155
Warehouse	3,117	2,000	2,241	6,389
Hotels/Motels	5,775	2,688	4,231	3,719
Grocery	2,349	2,000	2,080	6,389
Health	4,489	2,000	2,559	2,000
College/Univ	5,716	2,000	3,641	3,631
Miscellaneous	2,762	2,000	2,000	3,720
Source: Adapted from Southeastern NY audit data, adjusted for climate variations. Motors must operate a minimum of 2000 hours to qualify.				

Page 266 - The reference in footnote 649 should be cited more thoroughly so that the CF value can be verified. The CF of 0.38 seems low. What applications does the metering study cover and is it appropriate to extrapolate this value to a population as a whole?

237. Agree; TRM should reflect change. The reference to "JCP&L metered data" came from the EDU's Joint TRM (October 15, 2009). While this source document was requested, it was never provided. We support locating this source document for verification.

Page 266 - Motor load factor can be defined as: Load Factor = (Actual motor BHP)/(Rated motor HP). Motor load factor should be the same in the existing and proposed case when comparing same output work energy scenarios and same motor sizes. We are only comparing input work energy, or input kW, in this program. The existing and proposed motors both perform the same output work, or BHP. If the actual needed output BHP is less than their rated HP, then they are partially loaded. However, in both existing and proposed cases the output BHP is the same, and the rated HP is the same for same size motors, so they both should have the same load factor. Only the motor efficiencies (or the factor of output energy/input energy) are different when comparing energy use between existing and proposed motors of the same size.

238. Agree; TRM should reflect change. Instead of "Rated Load Factor" the term "Load Factor" should be used. The same default load factor should be used for both the baseline and efficient cases. The equation should be updated to reflect this.

36. High Efficiency Pumps and Pumping Efficiency Improvements (Retrofit)-(269)

Page 269 - As currently written, the formula does not appropriately apply the ESF as described in the reference 655, The reference is for "typical pumping efficiency improvements" however the ESF is not being used to adjust the pumping efficiency. All formulas should change the term [*omitted*] to [*omitted*]. This will properly apply the ESF as an efficiency improvement to the pump efficiency.

239. Disagree. The numbers cited represent total % reduction in pump system energy use, not % improvement in pump efficiency. However, this reduction represents a case when an industrial process pump was able to be downsized, which also reduced electric draw from the motor. In general, savings for pump efficiency are going to be based not on equipment swap-outs, but on optimizing the pumping system – which requires an analysis anyway. Given this, and since the prescriptive applications already ask for the pump curve, we recommend offering this measure on a custom basis only.

Page 269 - The Coincidence Factor seems low. Consider splitting this into multiple categories and including an HVAC pump category with a CF equal to the chillers.

240. Disagree. Demand reduction for pumping efficiency improvements is going to be highly variable and case-specific, and so we believe a conservative coincidence factor is appropriate so as not to overstate energy savings. However, we recommend offering this measure on a custom basis only.

Page 270 - The general energy savings factor (ESF) of 15% provided doesn't necessarily apply to all common pumping improvements. Respondents suggest adjusting the ESF by measure type where possible and using 15% as a default.
[*Table omitted*]

241. Disagree. Due to the highly site-specific nature of this measure, we recommend offering this measure on a custom basis only. It will be very burdensome to accurately find the manner in which a pump system has been optimized based on a prescriptive application.

37. Efficient Air Compressors (Time of Sale) - (272)

To enable us to complete our review of this measure, please provide the referenced file entitled "BHP Weighted Compressed Air Load Profiles - OH TRM.xls".

242. Requested information provided. See 'BHP Weighted Compressed Air Load Profiles - OH TRM.xls' (Attachment M).

Page 272 - Footnote 657 states "...it is assumed that the compressed air system with load/no load controls utilize an air receiver with a storage capacity of 5 gallons per cubic foot per minute of compressor capacity." Does the deemed incremental cost for a load/no load compressor type include the cost of the necessary receiver? Without a receiver, the measure might ruin the compressor. Respondents recommend specifically stating that the measure must also include a receiver installation,

243. Agree, with modifications shown. This measure was characterized assuming the customer would already have or was already planning to install a receiver with the referenced storage capacity. The measure description should be modified to explicitly state this fact. The cost of the receiver is not considered in the incremental cost. Installation of a primary air receiver is standard practice, and the TRM cannot accommodate all concerns related to the proper installation of equipment. It is implicitly assumed that any and all design work and installation will be performed by qualified personnel who will prevent conditions that may damage equipment.

38. Vending Machine Occupancy Sensors (Time of Sale, New Construction, Retrofit - New Equipment) - (274)

Draft Ohio TRM algorithms provide annual savings values similar to deemed values in the California DEER database. A default savings table should be provided since all components in the equations are specified.

244. Agree; TRM should reflect change.

39. Heat Pump Water Heaters (New Construction, Retrofit) - (276)

Page 276 - Savings formulas should be based on the water heater Energy Factors, not thermal efficiencies as these do not take into account system losses and overall energy consumption. This is different from the methodology used elsewhere, and should be revised for consistency. "Definition of Baseline Equipment" should be adjusted to use EF = 0.904 rather than using a thermal efficiency = 0.98. (source: [*link omitted*]

245. Agree; TRM should reflect change.

Page 277 ~ Energy Savings formula should be modified to use EFbase and EFHP for both the baseline and the heat pump rather than Et,base and COP. It is recommended that the EFHP be derated to account for operating conditions rather than testing conditions

246. Agree, with modifications shown. We agree that EF should be used rather than COP and thermal efficiency. However, the EFHP should only be derated if the baseline heater is derated. We are not aware of any evaluations that have tested how the energy factors of HP water heaters degrade. If desired, this could be a target for future evaluation.

Page 277 - The GPD estimate does not stipulate this is for hot water use only, and that should be clarified. They may also note this value can come from site specific data or ASHRAE estimates, since ASHRAE provides some detail on certain building types.

247. Agree, with modifications shown. The TRM does say that the GPD comes from site specific data. The ASHRAE methodology is a valid way to determine this. We will update the TRM to note that GPD is for hot water use only.

40. Commercial Clothes Washer (Time of Sale) - (278)

Page 279 - "Fossil Fuel Impacts Description and Calculation" - refers to a table when defining ΔMMBtucad- This table is the one from the "Reference Section", but needs to be properly labeled.

248. Agree; TRM should reflect change.

41. Commercial Plug Load - Smart Strip Plug Outlets (Time of Use, Retrofit - New Equipment) - (280)

It is unclear how ΔWhworkday and ΔWhnon-workday were calculated from the table. Respondents were unable to replicate the values or locate the methodology in the references.

249. Agree, with modifications shown. The savings are calculated by assuming the strip eliminates the electric draw from the equipment when it otherwise would have been in standby mode or turned off, and then the value is weighted by the % of total power strips where the piece of equipment can be found. The total savings calculated from the table is slightly different than the delta Wh values shown due to rounding errors. The TRM will be updated so that these rounding errors are fixed and there is a better description of calculation methodology.

42. Plug Occupancy Sensor (Retrofit) - (282)

Page 282 - "Reference Section" - is ΔWsleep reported in Wh per day? This would have to be the case for the equation to be correct, and it should be specified.

250. Agree; TRM should reflect change. ΔWsleep should be specified as Wh per day.

Page 283 - The assumptions used to derive the ΔWsleep = 704 Wh are not reasonable. It would not be expected that both a laser printer and laser multi-function device would simultaneously be plugged into the smart strip. This is in no way representative of actual conditions and should be revised to better represent savings estimates. A weighting of electronic devices that occur in office spaces and are likely to be attached to the smart strip could be used as a reasonable method to estimate savings. It could also be noted that the value of ΔWsleep may be adjusted for known applications, as the devices in "Reference Tables" do not cover all circumstances.

251. Disagree. This measure is intended for 'document stations' (i.e., devices typical of copy rooms, not personal desk stations) where they are controlling multiple pieces of energy intensive office equipment. If this assumption about controlled equipment is false, then we suspect that the measure would not be cost-effective.

43. Energy Efficient Furnace (Time of Sale, Retrofit – Early Replacement) - (284)

Page 284 - Annual kWh Savings and Annual MMBtu Savings algorithms should be corrected to:
[*equations omitted*]
All other algorithms in the measure should be adjusted accordingly.

252. Agree; TRM should reflect change.

Page 285 - "Reference Section" - unable to find the definition of MMBtuecm in reference cited by footnote 700.

253. Requested information provided. See 'ECM-Pigg.pdf' (Attachment N).

Page 285 - EFLH is stipulated at 2408. This appears high. Simulations provided building type weighted EFLH for heating ranging from 713 EFLH in Cincinnati to 1056 EFLH in Mansfield. Simulated EFLH by building type and city are shown below:
[*Table omitted*]

254. Agree, with modifications shown. As stated in the TRM, the 2408 hours for heating were included in the absence of any better available data for Ohio. If the utilities have Ohio specific data, this should be included instead. More detail should be given as to how the new values were developed (i.e., by building modeling).

44. Tank-less Water Heaters (Time of Sale, Retrofit – Early Replacement) - (288)

Page 288 - Annual MMBtu Savings algorithm should be corrected to add standby losses, not multiply by them.
[*equation omitted*]

255. Agree; TRM should reflect change.

Page 289 - Formula on page 289 should also be changed.

256. Agree; TRM should reflect change.

45. Stack Damper (Retrofit - New Equipment) - (291)

Page 291 - Provide a more thorough citation for sources referred to in footnote 714.

257. Agree, with modifications shown. The information from Natural Resources Canada can be found here: http://oee.nrcan.gc.ca/Publications/commercial/pdf/m92-242-2002-10E.pdf. We did not keep a copy of the report from the Minneapolis Energy Office and unfortunately could not find it on-line, although it did not offer much to justify a deemed savings value. We found that the measure is offered in Minnesota, see:

    http://hsptoday.com/staticfiles/CNP/Common/SiteAssets/doc/Commercial_Boiler_Component_Rebate_form.pdf

    http://www.xcelenergy.com/SiteCollectionDocuments/docs/CODSM-Report-Appendices.pdf http://www.xcelenergy.com/SiteCollectionDocuments/docs/2011-co-dsm-plan-Technical-Reference-Manual.pdf

We had adopted the deemed savings value provided in the original draft TRM provided by the utilities. We agree that greater justification is needed, but had not found suitable data or studies to derive a substantiated deemed calculation algorithm. The savings for this measure are significant, so we recommend additional characterization of this measure based on experience in Minnesota (and elsewhere if applicable) to develop a better-justified deemed savings or deemed calculated algorithm.

46. Energy Efficient Boiler (Time of Sale) - (295)

Page 295 - Annual MMBtu Savings algorithm should be corrected to:
[*equation omitted*]

258. Agree; TRM should reflect change.

Page 296 - Formula on page 296 should also be changed.

259. Agree; TRM should reflect change.

Page 296 - EFLH is defaulted to 2408, which appears high, with direction to use site-specific data if available. Please provide additional direction on how to obtain site-specific EFLH. Simulated values for a large office are shown below:
[*Table omitted*]
Values for heating EFLH can be provided for other buildings with built-up systems as mentioned in the electric chiller section above.

260. Agree, with modifications shown. As stated in the TRM, the 2408 hours for heating were included in the absence of any better available data for Ohio, and we agree that this values appears to be too high. However, the hours offered as an alternative should be verified before inclusion in the TRM. In particular, it appears incorrect to state that the boiler full load hours in a VAV system should be one quarter the full load hours in a CV system. We would expect the VAV system heating hours to be considerably closer to the CV system heating hours.

V. Technical Objections and Comments to the TRM – C. Custom

We provide the majority of the original comment below (embedded tables and other additional information may have been omitted and can be viewed in the original Objections and Comments filing), followed by VEIC's response.

1. As an initial matter it is unclear whether the custom protocols included in the TRM are meant to be guidelines or if the utilities are required to use them. For example, the TRM requires meter data to be submitted with an application. However, in instances in which the measurement and verification of a project relies upon alternative approaches such as a calibrated simulation, there will not be meter data to submit. In addition, if the provisions within the TRM are intended to be requirements, some are vague and incapable of implementation.

261. Clarification provided. The Custom protocol includes the requirements for developing accurate custom analysis and, where methodologies may vary depending on the measure type or analysis

approach, it provides guidance regarding the various approaches that may be used. The TRM differentiates between guidelines and requirements by specifically identifying when it is providing guidelines at the beginning of Section IV. This is exemplified on the page cited in the Electric Utilities Entry of 10-4-10 which begins with the following (emphasis added):

TRM pg 308, paragraph 1: "Documentation and metering of custom projects are essential to developing reliable energy savings and Coincident Electrical Demand reduction claims. The following guidelines support the accurate estimation of energy and demand savings."

2. Additionally, Respondents consider TRM Section IV to be usable for situations that are not covered by any other measure included in the TRM.

262. Clarification provided. This is correct; the first paragraph of each of the custom protocols includes a statement to that effect.

3. As discussed above, the TRM should be consistent with the requirements of the Mercantile Customer Pilot Program. To the extent that the TRM is not consistent with the Mercantile Customer Pilot Program, the Pilot Program should override the requirements of the TRM. For example, in the TRM no provision is made in the custom protocols for calculating savings for incentives versus savings for compliance of SB 221. At a minimum, once the Mercantile Customer Pilot Program is completed, the TRM – as a basis for mercantile savings calculations - should be re-evaluated by the Commission and stakeholders.

263. This issue is deferred to the Commission.

4. Lastly, the custom protocols require significantly more documentation, including, but not limited to, non-energy related impacts, interactive effects, operating conditions, load characterization, and their impacts on such things as lifecycle savings. The TRM seems to imply that annual calculations of these effects would be tracked. Respondents believe that only the first year calculation of savings should be done. The additional cost of tracking and measuring marginal changes is costly and does not yield significantly different results.

264. This issue is deferred to the Commission.

5. The TRM does not recognize that O.A.C. § 4901:1-39-05(G)(5), permits mercantile customers to submit, with explanation, projects with methodologies, protocols, and practices used in measuring and verifying program results that deviate from any program measurement and verification guidelines that may be published by the Commission. Rather than specifying measurement and verification of energy and peak demand savings associated with mercantile customer projects, the Commission should (either by order or through incorporation into the TRM) simply require measurement and verification protocols to comply with the International Performance Measurement and Verification Protocol ("IPMVP").

265. This issue is deferred to the Commission.

6. Custom programs are also available to non-mercantile customers. Custom projects can vary greatly in size both in terms of rebate value and projected energy savings. The custom program protocol in the TRM appears to assume that all custom projects are of a significant size and warrant extensive documentation, including a required metering plan. Applying the same level of analysis to all project sizes will hinder program participation and drastically increase the cost of analysis with little benefit added to program results. According to the TRM, metering needs to be performed on all custom measures and the collected data will be used to develop reliable energy savings estimates. Respondents agree that the additional

details are beneficial for larger projects and can tighten the savings values, but this may prove to be not cost effective for smaller projects.
To correct this situation, Respondents recommend implementing a tiered approach to custom documentation/protocol requirements as follows:
[*Table omitted*]
Further, a simplified custom application should be developed for projects with expected energy savings of less than 100,000 kWh per year. Specifically, Sections C and D of the protocol would be financially and administratively burdensome for small projects in the less than 100,000 kWh category.

266. Clarification provided. Because Section IV of the Custom TRM includes "guidance for documentation and metering" it does not preclude the use of a tiered approach by the applicants. Because the TRM is designed to provide a standard that will provide a high likelihood of savings validation by independent third party evaluators, the Utilities may want to meter a statistical sample of their smaller projects in order to internally validate their engineering estimates. We are currently involved in several small projects in which ESCOs are providing pre and post metering for lighting upgrades; this would indicate that the market finds it to be cost effective to meter projects of a smaller size.

7. The TRM recommends maximum metering on variable loads to be carried out for a period of one week with an interval of 5 minutes and the metering equipment must meet PJM manual's metering specification requirements. This requirement limits participation unless a tiered approach, as suggested in item 3 above, is implemented.

267. Clarification provided. As noted above, Section IV provides guidance and multiple options for documenting savings.

8. The TRM also states that the DDC/PLC trend data is acceptable if the sensors are calibrated using calibrated test equipment. The sensors in newer DDC/PLC systems often recalibrate themselves automatically and there may not be a need for calibration for up to 5 years.

268. Disagree. It is the experience of the consulting team that DDC controllers, even "self-calibrating controllers" are often found to be out of calibration when field tested against NIST Certified test equipment. Best practice is to independently validate any site based equipment readings that will be used. Spot testing a statistical sample of DDC sensors should not be burdensome, will provide an added benefit to utility customers and will result in higher accuracy of savings calculations.

V. Technical Objections and Comments to the TRM – D. Transmission and Distribution

We provide the majority of the original comment below (embedded tables and other additional information may have been omitted and can be viewed in the original Objections and Comments filing), followed by VEIC's response.

1. While Respondents believe that utilizing the TRM may provide for consistent reporting of energy savings, there should be provisions that allow the utilities to develop project and program specific M&V plans that are consistent with the protocols outlined in the IPMVP or those supported by typical engineering practice.

269. Disagree. The IPMVP does not appear to provide M&V plans for T&D measures.

2. Given the often unique nature of T&D infrastructure projects, the EDU should be permitted to provide its own method of calculated losses for review.

270. Clarification provided. If the EDU has a "unique" T&D infrastructure project that produces energy savings compared to standard practice, it should propose a protocol for estimating incremental savings. The protocols in the TRM would suffice for all the T&D projects included in the First Energy Program Plan, which are the only projects claimed by EDUs to date.

(Continuation of comment from above) While having hourly real time data along the line may provide better accuracy in some cases, such data does not exist in many applications.

271. Disagree. The protocols assume that the EDUs will have hourly data (whether available in real time or not) for loads on substations and most feeders, as well as for large customers. In the age of the Smart Grid, it is difficult to conceive of a reason for a utility not to monitor load on major distribution equipment. The distribution of load along feeders, as well hourly loads on laterals and secondary equipment, would need to be estimated from (1) hourly data from interval-metered customers, (2) load profiles for other customers, and (3) losses along the line. Hourly load data (metered or profiled) is necessary for competitive power suppliers and ISO energy billing, so all the load data are available.

(Continuation of comment from above) In other cases, such as some transmission projects, it is more appropriate to measure load at the system level.

272. Disagree. The comments do not explain why system load would be "more appropriate" than the actual load on the transmission equipment for estimating losses on the equipment. The correlation between system load and load on any one transmission line or substation varies widely. A particular transmission line may rarely be loaded except at peak load (e.g., a line connecting a peaking plant to the rest of the grid), or may be heavily loaded except at peak load (e.g., a line feeding a load center that usually imports power, but is mostly self-sufficient when local peakers are activated at peak load).

3. The load on a power system is so dynamic based on customer use patterns, temperature variations from year to year, the addition of distributed generation, bulk power transfers between regions, scheduled and unscheduled transmission and generation outages, etc. that real time historical data does not necessarily provide accurate projections of future flows, even if the real time data exists.

273. Disagree. Many of the factors listed (customer use patterns, temperature variations from year to year, scheduled and unscheduled transmission and generation outages) will tend to vary in the future, much as they have in the past. Where the utility is aware that the historical period was atypical, or where the utility expects specific changes in system conditions (e.g., addition of distributed generation, bulk power transfers between regions), it can adjust or replace the historical load data, based on load-flow modeling or other engineering analysis, with an explanation of the changes.

(Continuation of comment from above) Traditional estimating methods, which use peak load estimates, load factors, and load loss factors, have been successfully utilized in the past to determine the reduction in losses and should be used for these types of projects.

274. Disagree. No evidence is presented that those "traditional estimating methods" have in fact been successful in estimating reductions in losses. All engineering references require that the loss computations be based on the actual load on the equipment in question, not on load in some other part of the system (see, e.g., Fink DG and Beaty HW, Standard Handbook for Electrical Engineers, 13th Edition, 1993, pp. 18-107 to 18-109).

4. For some projects 8766 is not available. As stated above, EDUs have traditionally used load loss factors to determine energy losses over a period of time based on losses on peak. The attempt to fine time that method by using hourly actual data, while it theoretically may add another degree of accuracy, it cannot be completed because the load data required for the analysis per this protocol are often not available. In this case, the EDUs should be able to use other methods consistent with the IPMVP or those supported by typical engineering practice.

275. Clarification provided. The protocols discuss the use of available metered load data and "utility load-research data" where metered load data are not available. The IPMVP does not appear to address T&D projects.

5. Measure life should be included exclusively for the purpose of calculating the TRC test associated with the projects.

276. Clarification provided. That is true, with regard to the service life of the equipment. A different concept of measure life is applicable for determining which years the EDU can claim credit for a T&D project. See response to comment 7 below.

6. In several of the measures the TRM states that "For each installation, specify the customer classes (residential, small general service, etc.) served by the equipment, and for non-residential customers, the sector (Industrial, Commercial, Institutional, Multi-family) and type of use (e.g., office, restaurant, dormitory, gas station). This information is not always available at this level of detail.

277. Clarification provided. To the extent the information is available, the EDU should be using it for forecasting load by feeder, as well as evaluating the economics of various T&D efficiency measures. Utilities often have detailed information regarding the customer mix on a feeder. Where detailed information is not available, the EDU should use the best available information on load levels and load shapes.

7. Respondents disagree with the statement that "Discount savings with respect to existing equipment over time, to the extent that the EDU would make this (or a similar) change in configuration in the foreseeable future to meet peak load or reliability requirements." Because a project is completed to meet load or reliability requirements does not mean that it cannot count toward energy efficiency benchmarks. The EDUs intentions regarding the installation of efficient equipment are not relevant information for the quantification of energy savings.

278. This issue is deferred to the Commission. For clarification: Projects that represent standard practice required to maintain reliable service do not represent incremental energy savings. The EDU argument appears to be related to the policy and legal issues raised in their legal arguments. Note that the statute defines an energy efficiency measure as making "makes it possible to deliver a comparable level and quality of end-use energy service while using less energy or less capacity than would otherwise be required." O.A.C. §4901:1-39 (O). Once the same equipment would "otherwise be required" for "maintaining or improving the utility system functionality" (O.A.C. §4901:1-39 (L)), the project no longer provides energy savings.

8. Pages 340-343 –T&D Loss Reductions–Mass Plant Replacement and Expansion Analysis Protocol.

It is unclear why the TRM includes two Analysis Protocol sections for Mass Plant changes,

279. Clarification provided. The "Mass Plant Replacement and Expansion Analysis Protocol" explains that it "defines the requirements for analyzing and documenting loss reductions due to installation of mass utility plant with lower losses than standard equipment, when that equipment is required due to failure, need for increased capacity, or connection of new loads. Where equipment is replaced prior to the end of its rated service life in order to achieve energy savings, the project is classified as Retrofit and the 'T&D Loss Reductions – Mass Plant Retrofit Analysis Protocol' should be used to guide analysis." (TRM, p. 340) The "Mass Plant Retrofit Analysis Protocol" says that it "defines the requirements for analyzing and documenting loss reductions due to replacement of existing mass utility plant with more efficient equipment, prior to the end of the existing equipment's useful life and in the absence of any need for increased capacity." (TRM, p. 343)

(Continuation of comment from above) The equipment listed does not include primary lines; such equipment would be expected to appear on this list.

280. Clarification provided. Primary lines would normally be upgraded for an entire feeder, or a large section thereof. Feeder conductors are covered in the Conductor Analysis Protocol, feeder voltage upgrades in the Voltage Conversion Analysis Protocol, and feeder reconfiguration in the System Reconfiguration Analysis Protocol. The comment does not identify any primary-line upgrade programs that would be similar to the programs described in the Mass Plant protocol.

(Continuation of comment from above) Respondents object to the limit of 500 kVA loads. Such loads are not that uncommon, and with the push to move towards AMI, where all loads will in essence be interval metered, the exclusion of projects from this category would become common. A limit of in excess of 2000 kVA is more realistic.

281. Disagree. If the EDU has hourly data for the specific customer from AMI, the use of those data is unequivocally superior some sort of average class load shape. The comment does not explain why the respondents object to using the best available data. See also the responses to comments 9 and 11.

(Continuation of comment from above) In the $loss_{base}$, $peakloss_{base}$, $loss_{efficient}$, and $peakloss_{efficient}$ equations, the term kVA_t is not defined. Assuming kVA_t is the per-hour load being served by the equipment it is unclear how the multiple individual loads are to be combined for this study.

282. Clarification provided. The total load is the sum of the individual loads on the piece of equipment (e.g., six single family homes on a transformer, two homes on a span of secondary).

9. Pages 344-347–T&D Loss Reductions–Mass Plant Retrofit Analysis Protocol
This protocol does not apply to equipment serving interval metered loads in excess of 500 kVA. 500 kVA loads are not that uncommon. Respondents would recommend a limit of in excess of 1000 kVA as being more realistic.

283. Disagree. The purpose of the cutoff was to distinguish between equipment serving many small customers, whose loads must be profiled, and equipment serving one or a few large customers with actual load data. Using actual load data from customers with 500 kVA load should not be burdensome. See also the responses to comments 8 and 11.

10. Page 345–Base and Efficient Cases
This section details the calculation of energy losses. In the $loss_{base}$, $peakloss_{base}$, $loss_{efficient}$, and $peakloss_{efficient}$ equations, the term kVAt is not defined. Assuming kVAt is the per-hour load being served by the equipment it unclear how the multiple individual loads are to be combined for this study.

284. Clarification provided. See last response to comment 8.

(Continuation of comment from above) The terms ULF and UPLF are not well defined. It appears there is an assumption that ULF would be a straight percentage loss reduction savings.

285. Clarification provided. That is the intent. These would be the upstream portion of the line-losses at peak or averaged over the load curve, as would be used in estimating end-use efficiency savings. Note that ULF should read "UELF." See second response to comment 13.

(Continuation of comment from above) Additional piece-by-piece equipment documentation, i.e., relative to the equipment having been functioning properly, adequate to meet existing loads, and disposition of removed equipment would be burdensome. Similar documentation is not required for equipment being removed for upgrade as part of the prior section (p. 340).

286. Clarification provided. The purpose of the documentation is to establish that the existing equipment would have remained in service, but for the energy-savings project. If the EDU prefers, it can treat the change-out as a replacement under the Replacement and Expansion Analysis Protocol. In general, losses will be lower for new standard equipment than for the replaced equipment; the retrofit protocol was included to allow the EDU to claim larger savings if it was really replacing equipment early.

11. Pages 348-351–T&D Loss Reductions–Large Customer Connection Analysis Protocol
The 500 kVA load limit is too small, and reporting would include too many small installations. This limit should be increased to 1000 kVA.

287. Disagree. A 500kVA customer is hardly a "small installation." Each installation for which the EDU is claiming savings must be accounted for. The only difference between the Large Customer Connection Protocol and the Mass Plant protocols is whether the analysis uses customer-specific interval load data or class-specific profiled load data. Where customer-specific data are available, those are preferable to profiled data. Specifically, the customer-specific data may justify (and recognize the savings from) high-efficiency interconnection equipment for high load-factor customers that would not be cost-effective for average load shapes. See also the responses to comments 8 and 9.

12. Page 349–Equipment Loading
This section requires that we "Provide the hourly customer loads at this location in the report year." Such an hourly load report would generally be specific to one customer, one site. Providing such detailed information about that customer may be in violation of expected customer confidentiality. Any requirement to provide annual billed sales to a customer would also be such a violation.

288. Clarification provided. Confidential customer-specific information may be provided under a confidentiality agreement. If the EDU cannot demonstrate loads on the equipment, it cannot demonstrate energy savings.

13. Pages 349-350–Base and Efficient Cases
In the $loss_{base}$, $peakloss_{base}$, $loss_{base}$, and $peakloss_{base}$ equations the term kVA_t is not defined. Assuming kVA_t is the per-hour load being served by the equipment it is unclear how the multiple individual loads are to be combined for this study.

289. Clarification provided. If more than one large customer is served by the equipment, the total load is the sum of the individual loads. See response to comment 8d.

(***Continuation of comment from above***) The term ULFE and UPLF are not well defined. It appears there is an assumption that ULF would be a straight percentage loss reduction savings (which would not make engineering sense). In prior sections, the term ULF was used for what ULFE appears to stand for in this equation.

290. Clarification provided. It is not clear why the comment suggests that "a straight percentage loss reduction savings… would not make engineering sense." Line losses are attributed to end-use efficiency measures as a straight percentage. The portion of those line losses upstream of a distribution project should similarly be credited to that project. The term ULF should be changed to UELF throughout, for consistency and to avoid confusion with the UPLF for peak losses. See also second response to comment 10.

14. Page 353–Equipment Loading
This section requires that the EDUs "Provide the hourly load the transformer or substation in the current year and identify (1) the maximum load on the equipment and (2) the average load on the equipment on weekdays between 3:00 p.m. and 6:00 p.m., June through August (the coincident peak period)" Such an hourly load report exceeds the current level of load data gathered by the Companies. For many of these sites, the Companies would only have an allocation of a peak load (allocation based on some upstream metering location).

291. Clarification provided. See response to comments 15 and 16. The EDUs should have hourly SCADA data for each substation transformer and most feeders. If some such data are missing, the EDU can explain how they are estimated.

(***Continuation of comment from above***) In the $loss_{base}$, $peakloss_{base}$, $loss_{base}$, and $peakloss_{base}$ equations, the term kVA_t is not defined. Assuming kVA_t is the per-hour load being served by the equipment it is unclear how the multiple individual loads are to be combined for this study.

292. Clarification provided. See last response to comment 8. The "multiple individual loads" would presumably be the loads of various feeders. If the EDU has measured or modeled the load on the transformer, no addition of individual loads would be necessary.

15. Pages 356-39–T&D Loss Reductions–System Reconfiguration Analysis Protocol
This section requires that the EDUs "Provide the hourly loads on each of the major affected network elements for the last full year prior to the installation of the first element of the project." Such an hourly load report exceeds the current level of load data gathered by the EDUs. For many of these sites, the EDUs would only have an allocation of a peak load (allocation based on some upstream metering location).

293. Clarification provided. See response to comments 15 and 16. The EDUs should have hourly SCADA data for each substation and most feeders. If some such data are missing, the EDU can explain how they are estimated.

(***Continuation of comment from above***) The section also requires "For capacitors, provide: (1) the hourly loads in the current year on the substation or other equipment to which the capacitors are attached; and (2) the hours in the current year for which the capacitors were activated at each kVAR level." Again, such hourly load detail exceeds the current level of load data gathered by the EDUs.

294. Disagree. This comment appears to be stating that the EDUs do not keep records of their system dispatch. If true, that would be disturbing, and raise questions about how the EDUs could make prudent decisions regarding additional system investments. Considering recent proposals to install

many thousands of hourly meters on small customers, and the general emphasis of the smart grid, the EDUs should be able to gather and maintain hourly data on dozens of capacitor banks.

(***Continuation of comment from above***) In the $loss_{base}$, $peakloss_{base}$, $loss_{base}$, and $peakloss_{base}$ equations, the term kVA_t is not defined. Assuming kVA_t is the per-hour load being served by the equipment it is unclear how the multiple individual loads are to be combined for this study.

295. Clarification provided. See last response to comment 8. The comment does not identify a situation in which determining the load on the equipment would be problematic.

16. Pages 360-363–T&D Loss Reductions–Voltage Conversion Analysis Protocol
This protocol as written is designed for transmission and distribution projects of limited scope, from a designated point A to point B and where load data could theoretically be available. Voltage conversion projects can also be of a much larger scope than assumed in this protocol, where actual load data may not exist and assumptions are required to estimate losses.

296. Clarification provided. The nature of the perceived problem is not clear. The comment does not provide examples of projects of "a much larger scope," or even examples of transmission and distribution lines that do not run "from a designated point A to point B." Unlike installation of energy-efficiency transformers, for example, voltage conversion cannot be implemented piecemeal, but must be implemented for an entire feeder simultaneously.

    Nor is it clear why load data would be unavailable for larger project; most of the EDU comments on data availability suggest that data are more likely to be available for larger areas. The lack of load data on its T&D system would raise serious prudence issues for the EDU. The Northeast Blackout of 2003 apparently started because First Energy did not have real-time data regarding power flows on its transmission system. If the utility has no load data, it is not clear how it can operate its system or plan and justify any project.

    If some load data are missing, the EDU can explain how it estimated the missing data.

(***Continuation of comment from above***) **Page 360–Project Information: Location**
This section is set up for a project that involves converting a line from one substation to another. It does not provide a method for identifying more complex conversions that might consist of pockets of areas that span multiple miles.

297. Clarification provided. The protocol does not assume that the line runs "from one substation to another." The sample project name is an example for a transmission line; almost all transmission lines run between two substations. A distribution feeder may run between substations (perhaps by a looping interconnection with another line) or terminate. The purpose of the protocol is not to identify potential conversions. In the situation described, the loss reductions should be estimated for each separate segment, which may be aggregated by "pocket."

(***Continuation of comment from above***) **Technology Description:** This description does not account for the complexities that may be involved in a project consisting of several hundred miles.

298. Clarification provided. That would be a very long feeder. The EDU may add more detail; the protocol describes only minimum reporting requirements.

(*Continuation of comment from above*) Some of the transformers being replaced could be 40-50 years old and original manufacturer specifications do not exist. In some cases, the facilities could have been purchased through the acquisition of municipal systems years ago.

299. Clarification provided. A transformer so old that data no longer exist should be treated as a routine replacement, with a baseline equal to standard-efficiency equipment for the pre-project voltage and the post-project kVA rating.

(*Continuation of comment from above*) In addition, the replacement of poles, insulators, sectionalizers, and other equipment do not have any impact on the loss calculations and should not be required.

300. Clarification provided. In general, higher poles and the replacement of insulators, sectionalizers, and other equipment are required to increase voltage class on a feeder. The higher poles provide adequate vertical clearance from the ground and secondary lines, larger insulators are required to insulate the conductors from the supporting poles, and other equipment may need to be upgraded to function with the higher voltage. The documentation is intended to demonstrate that the voltage upgrade occurred and to inform the PUCO regarding the scope and cost of these projects.

(*Continuation of comment from above*) **Pages 360-361–Equipment Loading. Request for Direction of Flow**: Direction does not affect losses and should not be required.

301. Clarification provided. Losses between source and load depends on the distance from source to load. Line-loss computations require that the direction of flow and the location of source and loads be specified. Reviewers will also need that information, to follow the EDU computations.

(*Continuation of comment from above*) **Interval-Metered Location Along the Line:** This data is often not available.

302. Clarification provided. The protocol reads "For each interval-metered location along the line affected..." If there are no such locations, there is nothing to provide. The EDC should have SCADA data for each feeder, so there should be at least one such location.

(*Continuation of comment from above*) **Hourly Loads in the Report Year:** This data is often not available.

303. Clarification provided. If the utility has an interval-metered location, it should have hourly data. The EDUs should not be discarding metering data that may be useful in planning and evaluating projects. If there are no such locations, see 16g.

(*Continuation of comment from above*) **Average Load on the Line Weekdays Between 3:00 PM and 6:00 PM** - The definition of average load on the line is not clear.

304. Clarification provided. Average equals the sum of the hourly loads, divided by the number of hours.

(*Continuation of comment from above*) **Total Energy Delivered to the Line:** Data is often not available for a partial section of the line, and for total circuit, energy delivered is not measured.

305. Clarification provided. It is not clear how an EDU could increase voltage on one section of a feeder, and not on the entire feeder, since the voltage class is determined by the substation transformer(s). The second half of the sentence is unclear; if the EDU has load data for the feeder, it would have energy delivered for the total circuit.

(***Continuation of comment from above***) **Hourly Loads for Large Loads Among the Line**: These values are integrated into the total circuit load data. The definition of large load is not clear.

306. Clarification provided. If there are customers with interval meters along the line, with loads large enough to materially affect the flows on the line, the analysis should include those loads.

(***Continuation of comment from above***) **Distribution of Annual Deliveries Along the Line**: Data is often not available.

307. Clarification provided. The EDU should be able to identify the customers along the line, their annual metered usage, and their locations. The point is that losses along the line depend on whether the load is primarily close to the substation, primarily at the end of the line, or evenly distributed along the line. If the EDU cannot estimate the geographic distribution of load, it cannot estimate the losses before or after a voltage upgrade. As a worst case, the EDU could assume that load is concentrated near the normal-source substation.

(***Continuation of comment from above***) **Line Segments Within Each Segment** - Current is Constant (or change in current per mile) Within the Segment: Often not possible to determine with existing metering capabilities.

308. Clarification provided. The significance of these situations should be obvious to any engineer. Current is constant if there is no load along the segment, and the current declines by the same amount in each mile if load is evenly distributed along the line.

(***Continuation of comment from above***) **Demonstrate that Power Flows on the Segments are Consistent with One Another and the Power Delivered to the Line Input**: It is not clear what information is required.

309. Clarification provided. The power into a segment must equal the power out of the previous segment, and the power out of the segment must equal the power in, minus load and losses along the segment.

(***Continuation of comment from above***) **Take Hourly Average Directly from Data Logs or Compute from Power Flow Data**; This information may be available on distribution at substations only.

310. Clarification provided. If the actual data are not available except at the beginning of the feeder at the substation, the amperage through a segment would be calculated from the flow into the feeder, minus load in previous segments.

(***Continuation of comment from above***) Pages **361-362–Pre-Project and Post-Project Cases.** Amperages flowing into and out of the segment are often not available.

311. Clarification provided. The power flows must be estimated from the flow into the feeder and the loads and losses on each segment. That is the purpose of the analysis of load distribution along the line.

(***Continuation of comment from above***) The following variables are defined but not included in the equations: A_0 and H.

312. Clarification provided. A0 is used in defining k. H should appear in the computation of average peak losses; specifically, the formulae for peak loss should be divided by H, so they are the sum of hourly

losses in the peak period, divided by the number of hours in the peak period. The TRM should reflect this clarification.

(Continuation of comment from above) **Pre and Post Loss Savings Calculations**: The Post-Loss savings (sic) are not necessary to calculate by the proposed equation since the losses will be reduced by the square of the ratio of the voltages. Once the Pre-Losses are calculated, the post-losses can be determined by dividing the pre-losses by $(V_{new}/V_{old})^2$.

313. Clarification provided. The comment does not demonstrate that the post-project losses are not necessary to compute the savings; it simply provides a mathematically-equivalent approach for reaching the protocol estimate of post-project losses. The protocol would not require any additional effort.

REPLIES TO GAS UTILITIES JOINT COMMENTS AND OBJECTIONS REGARDING DRAFT TECHNICAL REFERENCE MANUAL

I. Comments

314. VEIC defers responses to all comments in this section to the Commission.

II. Objections

We provide the majority of the original comment below (embedded tables and other additional information have been omitted and can be viewed in the original Objections and Comments filing), followed by VEIC's response.

Attic Insulation (Draft TRM, p. 36)

Columbia's consultant was unable to match the HDD60 values listed for Toledo, which may point to a similar problem with other city weather data. The consultant downloaded the weather data from the University of Dayton source cited (which is no longer at the URL listed; it has changed to http://academic.udavton.edu/kissock/http/Weather/default.htm) and was unable to match the TRM values. The consultant found an average of 4819 HDD60 per year for the 14 years with at least 360 days of data (it is unclear how the TRM process dealt with missing days from the cited source) yet the TRM lists 4482 HDD60, which is lower than any extended period Columbia could find. The Gas Utilities recommend that the HDD table calculations used throughout the TRM be rechecked and verified.

315. Agree; TRM should reflect change. We have found some variability in the data and support the verification and revision of the tabular HDD60 as needed.

Showerheads (Draft TRM, p. 93)

The TRM savings are based on one fairly detailed metering study done in Canada, but the savings figure may be too low depending on housing characteristics and program design. The TRM takes measured overall DHW savings of 16 therms from homes with existing showerheads using 2.0-2.5 gallons per minute (gpm) and then divides this by the average 2.1 showerheads per home, and further divides this figure by 1.2 change m gpm (2.45 gpm pre -1.25 gpm post) to arrive at 6.6 therms per showerhead per gpm reduction as the savings. But that same study found average savings of 31 therms for homes where the existing showerhead flow rate was measured as > 2.5 gpm. It appears that those saving would be a larger per showerhead per gpm reduction, although the report does not contain sufficient details, citing "personal communication with the authors" as the source of showers per home. (p. 95, fn. 245.)

The biggest issue here is that 2.1 showerheads per home seems high and would be expected to lead to lower savings per showerhead. Replacing showerheads that people actually use should result in savings greater than the 6.6 therms/yr/gpm. Columbia assumes greater savings of 13 therms/yr/showerhead based on the replacement of showerheads actually used. The draft TRM does not provide a basis for assumptions concerning the second and third showerheads per home.

Additionally, the TRM uses high flow rate assumptions (2.87 gpm existing), which are based on full flow of the showerhead. Columbia's consultant's calculations are based on considerably lower flow rates, which are representative of throttled flow. Using the TRM default flow rate of 2.87 and an assumed new flow rate of 1.6 results in savings of 8.4 therms per showerhead. Adopting the TRM would require the use of the TRM's higher flow rate, resulting in less savings.

316. Agree, with modifications shown. The Ontario study that served as the reference for the savings estimate is by far the best recent reference we have seen for this measure in that it actually measured changes in consumption from a sample of homes that had all showerheads replaced. The measurements were taken daily over the course of two years – a year before replacement and a year after. The changes were also adjusted based on similar long-term metering of a control group. With that context, we reply to the specific points raised by the utilities as follows.

First, the proposed savings assumption is based on actual full flow (for the units replaced) and rated full flow for the units installed. We agree that full flow rates overstate actual average consumption of hot water because at least some consumers will not have their showers on "full throttle". However, because the savings estimates were based on changes in metered gas consumption (and not an engineering calculation using full flow assumptions), we believe our approach captures the affects of actual usage patterns.

Second, the utilities accurately note that the savings per reduction in rated flow were based on the ratio from the lower of the two baseline flow rates analyzed in the Ontario study. As noted, that yields an average savings per reduction in GPM full flow rates per showerhead of about 6.6 therms. The utilities are correct that the average reduction per GPM full flow rate for the higher of the two baseline flow rates is a little higher (an average of about 8.3 therms/GPM). The weighted average of the two (based on Enbridge Gas program experience replacing hundreds of thousands of showerheads) is 7.7 therms. That number may represent savings per GPM of reduction more accurately than the conservative 6.6 that is based on a more conservative baseline. We would suggest making that change.

Third, the utilities correctly note that the savings values in the draft TRM were developed by dividing total average household energy savings from the referenced study by the average number of showerheads in the treated home. That was necessary to develop a default value per showerhead because the savings estimated from the study were per household, after replacing all showerheads in the home. We agree that in most homes one showerhead is used more often than others, so replacing that showerhead will yield more savings than we have estimated for the average showerhead. The way this is addressed in the Ontario showerhead program is that the utilities conduct evaluation surveys of the homes treated to estimate the fraction of showers taken by the replaced showerheads. The savings that would accrue per household if all showerheads are replaced are then multiplied by the resulting estimates of the fraction of showers taken by the replaced showerheads. This approach (or something similar) could also be taken in Ohio. Thus, using the example provided by the utilities, if the average showerhead replaced in each home (assuming the 1.6 GPM replacement rate suggested by the utilities) accounted for three-quarters of all showers in the treated homes, the savings per showerhead would be 12.1 therms (7.7 therm savings/GPM reduction/showerhead x 2.1 showerheads/home x 75% usage rate for replaced showerhead) – close to the 13 therms assumed by Columbia. We would support modifying the TRM to allow that kind of adjustment.

Pipe Insulation (Draft TRM, p .97)

The draft TRM calculations appear to be acceptable, assuming that the water heater does not have heat traps to stop thermo-siphoning. However, modern water heaters typically have this feature to boost their energy factor (EF) rating. There is a typo (top of p.98 at footnote 251) where the TRM references outside air temperature, where basement (or DHW pipe area) temperature was probably intended. This should be clarified.

317. Agree, with modifications shown. Anti-thermo-siphoning valves do not completely eliminate losses because there remains conductive heat transfer along the piping in close proximity to the tank. It should also be noted that in the case of valve failure, known to occur to an appreciable degree, the fault condition is thermally identical or worse to not having the valve to begin with. Thus, we suggest developing a separate savings estimate for applications in which heat traps are present and there is no evidence they are not working. We also suggest the typo be corrected as indicated in the comment.

Wall Insulation (Draft TRM, p. 100)

The TRM does not accurately describe how to calculate the R value of an insulated wall. According to the TRM, "An R-value of 5 should be assumed for the wall assembly plus the R-value of any existing insulation." (p. 100.) R-5 is a proper assumption for an un-insulated wall, but the wall does not become R-18 when R-13 insulation is added to the stud cavities. The wall is only about R-13 overall. The TRM should provide a more detailed calculation method based on framing factor assumptions, such as the following formula:
[formula omitted]
Alternatively, the assumed R-value after retrofit should be the rated R value of the cavity insulation. The only directly additive R value would be for insulating sheathing applied to the interior or exterior of the wall surface.
An additional problem with the existing TRM is that both examples show an upgrade to R-20 from wall insulation, which is not representative of what we can be achieved by blown cavity insulation, which is usually done when wall cavities in residential construction are 3.5" to 4" deep.
There is a typo on page 102. In the first sentence beneath the chart at the top of the page, "attic floor" which should be replaced with "wall." There is the same HDD60 problem as mentioned under attic insulation.

318. Agree; TRM should reflect change. The language that described the way that wall's overall insulation value is calculated should be clarified. We suggest that the term "effective R-value" should be properly introduced in the body of the text rather than the footnote. Elaboration on how an appropriate value is determined, and basing savings claims upon the resulting calculation will reinforce the importance of suitably informed installers. We agree that it would be beneficial to revise the example to reflect a more typical cavity-only blown-in cellulose retrofit. The typo mentioned should be corrected, and the verified values of Heating Degree Days used here as in other measures.

Air Sealing (Draft TRM, p. 104)

The TRM cooling savings from air sealing fails to include latent gains, which would increase savings by 3 or 4 fold over the sensible-only calculations used. For heating savings, the TRM does not explain where to derive the N factor for estimating natural air leakage. The TRM only provides a cooling N factor. Also, in the heating example, the TRM uses 4569 HDD60 for Toledo but in the table on the prior page the TRM lists 4482. There is also the same HDD60 problem as mentioned under attic insulation.

319. Agree; TRM should reflect change. The algorithm in the current draft TRM captures only the benefits of reducing sensible heat gain in the summer and, as such, understates total cooling savings. Revisions should be made to ensure the benefits of reducing both sensible and latent heat gain are captured. With respect to the other comments, we agree that a reference for deriving appropriate heating N factors should be added and that HDD60 values should be corrected.

Duct Sealing (Draft TRM, p.108)

The TRM method 1 appears to make little sense. It uses modified blower door subtraction to calculate the CFM50 of duct leakage, but then treats that leakage as a natural leakage rate - implying a 50Pa pressure difference across the leak all the time. This simplified approach does not consider the location of the ducts, the supply/return split, regain factors, the operation of the system, and many other factors. It leads to low estimates for cooling savings but very high estimates for heating savings - a 171 th/yr savings (nearly 25% of heating) for a small 109 CFM50 reduction in duct leakage. There is no reference to any outside source for such a calculation procedure. The TRM also neglects latent loads associated with the air leakage for cooling. Additionally, the TRM method 2 relies on rough estimates from a visual inspection and assumes low cooling loads when such measures might be targeted at homes with high cooling loads.

320. Agree, with modifications shown. There is no perfect method for estimating the savings from duct sealing. In developing the draft TRM we attempted to offer methods that would not be too onerous (e.g., not requiring both a duct blaster and blower door test). That said, we agree that draft Method 1 is deficient for the reasons stated. We suggest instead using the modified blower door subtraction to estimate the CFM50 of duct leakage to the outside, convert that value to delta CFM25 (which is often considered a reasonable proxy for pressures in the ducts when the air handler is operating), and estimate the portion of typical system airflow that the reduction in CFM25 to the outside represents. That portion would be the percentage reduction in both cooling and heating consumption. Algorithms would then be presented for converting that percentage reduction to a reduction in kWh and/or therms of gas.

and

Disagree. We disagree with the statement that TRM method 2 assumes low cooling loads. The full load hour assumptions imply average rather than low loads. As such, they seem reasonable for a prescriptive savings algorithm. That said, it would be reasonable to develop a custom protocol that would enable programs that intentionally target high users to more accurately estimate savings.

Residential new construction (new homes) (Draft TRM, p. 136)

The User Defined Reference Home (UDRH) does not account for clothes washers. Savings from ENERGY STAR clothes washers can be captured and reported along with off-REM coincident peak and related calculations. The TRM should propose values for gas and electric hot water savings as well as direct electric savings from the washer itself.

321. Agree, with modifications shown. Until RESNET includes clothes washers in the HERS rating, this approach makes sense. Once RESNET includes clothes washers in the rating, they should be rolled into the UDRH calculation approach

(*Continuation of comment from above*) The TRM should also confirm that the Gas Utilities should use the stated UDRH refrigerator default usage (585 kWh) as shown in the continuation of Table 3 on page 141 under "Lights and Appliances" when a refrigerator is not supplied by the builder. Otherwise, using the RESNET default will result in negative savings relative to the UDRH default.

322. Agree; TRM should reflect change.

(***Continuation of comment from above***) The TRM should confirm that "0.8 DSE" listed in the continuation of Table 3 on page 141 refers to Duct System Efficiency and that the corresponding UDRH syntax is "DuctLeakageEstimate: Average".

323. Agree; TRM should reflect change.

(***Continuation of comment from above***) The incremental cost assumptions m Table 4 seems high. The cited Massachusetts-based study may not be a good proxy for new home construction costs in Ohio. Research by Columbia's Residential New Construction program DSM implementer suggests that Ohio incremental costs are likely to be lower.

324. Agree, with modifications shown. If there is more appropriate statistically-based Ohio incremental cost information available, it should be vetted by the PUCO for approval.

Water Heaters (Time of Sale) (Draft TRM, pp. 123-24)

The deemed savings for this measure should be clarified. The deemed savings for this measure is shown in the algorithm on page 123 as: Savings AMMBtu = 180 * (1/ EFBase - 1/EFEff). However in the reference section on page 124 the algorithm is shown as: AMMBtu = BtuHWUSAGE * (1-EFBase / EFEff). The TRM should clarify which algorithm is correct.

325. Agree; TRM should reflect change. The algorithms on page 123 and 124 should be revised to the following:

$\Delta MMBtu = MMBtuHW_{USAGE} * (EF_{Eff} - EF_{Base} / EF_{Eff})$

The first variable should be updated to 2005 EIA Residential Energy Consumption Survey data (http://www.eia.doe.gov/emeu/recs/recs2005/c&e/waterheating/pdf/tablewh7.pdf) as follows :
$MMBtuHW_{USAGE}$ = typical household hot water consumption per year
= 23.1

And the example should be:
$\Delta MMBtu = 23.1 * (0.82-0.58)/0.82$
= 6.76 MMbtu

REPLIES TO COMMENTS ON DRAFT TECHNICAL REFERENCE MANUAL
BY
THE OFFICE OF THE OHIO CONSUMERS' COUNSEL,
CITIZENS' COALITION, OHIO POVERTY LAW CENTER, CITIZEN POWER,
SIERRA CLUB OF OHIO, THE NATURAL RESOURCES DEFENSE COUNCIL,
AND THE OHIO ENVIRONMENTAL COUNCIL

The text of the original comments is omitted below – comments can be viewed in the original Objections and Comments filing. VEIC's response follows each heading.

II. Argument

A. Protocols Should be Included in the TRM for Information and Behavioral Norm Programs

326. Disagree. VEIC agrees that programs directed at influencing behavior have been shown to result in verifiable savings. However, each such program will have distinct design, target markets, and impacts, and would need to have a process for verification designed specifically for that program and market. In fact, we were advised by AEP's consultant OPower, who will be designing and delivering a behavioral program for the utility, that results of evaluations undertaken for one of its programs in California are not transferable to this program in Ohio, even though OPower structures such programs in a similar way. And the particular statistical method proposed by OPower is not transferable to every type of behavioral program. Data from reliable impact evaluations will be necessary to support savings claims from such programs – we believe that such initial evaluations fall under the scope of the PUCO Evaluation Consultant. The Commission may direct its Evaluation Consultant to use the experimental method proposed by OPower, or other methods. Once supported, and if appropriate, deemed savings or evaluation protocols for each program can be added to the TRM for future use.

B. Adjustments Should be Made to the Draft TRM (*T&D*)

Recommendation 1: The Base Case Should be Defined for System Reconfiguration Analysis and Voltage Conversion Projects

327. Agree; TRM should reflect change. Good catch. The intention was that these projects would be counted only if they were not needed for reliability.

Recommendation 2: The Ending of Efficiency Projects/Programs Should be Defined

328. Clarification provided. The lifetime of a T&D efficiency project is relevant in two processes: the determination of prudence when the EDU asks the PUCO to include the plant in rate base and the counting of energy savings for compliance with the energy-savings targets. The first purpose involves the expected life of the project, potentially saving energy in the early years and maintaining reliability in later years, and possibly shortened by the need for greater capacity increases before the end of equipment life. The full project life will often exceed the life of the energy savings, and should be assessed as part of the prudence review when the project enters service. The second purpose would be assessed annually, based on actual load on the equipment. If and when load reaches the level at which the utility would normally add capacity, any residual energy savings would be computed from standard practice, rather than the pre-project conditions.

Recommendation 3: The Use of the Measure Life Should be Limited for Proper Measurement of Loss Savings

329. Clarification provided. See response to Recommendation 3.

Recommendation 4: The Protocol for Capacitors Should be Simplified

330. Clarification provided. The proposal has some merit; the utilities and consumer groups might want to work together to develop a simplified methodology. Setting a standard ratio of energy savings per kVAR of capacitor does not appear feasible, since energy savings depend on the line loading in kVA (which depends on both kW and kVAR loads). Certainly, savings over the load curve from the power-factor improvement will differ from those for reduced line resistance. If load is high and power factor low for only a few hours annually, little energy will be saved. For example, the power factor is probably lagging at summer peak, but may be much higher as soon as the air conditioning shuts off. With a fixed capacitor, the power factor may switch from lagging to leading in some hours, and the capacitor may slightly increase losses in those hours. With a switched capacitor, the effect will go to zero in some hours.

Even savings on the circuit peak vary widely, as FirstEnergy said in Appendix B (p.3) of its T&D savings filing, savings can range from "negligible" to four times the average:

The Companies sampled 48 of their 161 existing capacitor banks and found that loss savings benefits ranged from a negligible change to as much as 8 kW/100 kVAR. Taking the average of all of the circuits studied, results in a 2.0 kW per 100 kVAR of capacitor additions at circuit peak load.

Recommendation 5: Load Duration for Loss Calculations Should be Appropriate

331. Clarification provided. The two protocols cited in this comments regard mass plant (e.g., secondary lines, line transformers) for small customers, for which site-specific load duration data will generally not be available. The protocols require the use of best estimates of loads in the "year for which savings are claimed." Any specific recommendations for improving the definition of load shape in these protocols would be welcome.

Recommendation 6: Upstream Loss Factors Should be Appropriately Applied

332. Clarification provided. The use of the term "loss factor" in the protocols is typical of its use in avoided-cost, rate-design, and other ratemaking applications. The protocols will be further clarified, to the extent feasible.

Recommendation 7: The Transmission Peak Loss Factor Should be Appropriately Applied

333. Clarification provided. The use of the term "loss factor" in the protocols is typical of its use in avoided-cost, rate-design, and other ratemaking applications. The protocols will be further clarified, to the extent feasible.

Recommendation 8: Protocols for Conservation Voltage Reduction Should be Established

334. Disagree. It is beyond the scope of the TRM to provide test methodologies for such procedures, particularly when they are not being used in Ohio at this time. Conservation Voltage Reduction (CVR) is an active measure, in which the utility adjusts source voltages downward when (a) supply is

limited and reduced load is necessary to maintain service, even at degraded voltage levels (brownouts), or (b) the source voltage can be reduced while leaving the voltage at the end of the line within normal operating range. Reported savings from CVR vary widely among utilities and feeders within utilities, as well as over time. Fortunately, the utility can determine the CVR savings in any year retrospectively, but comparing load flows before and after CVR implementation, as well as the differences between CVR and non-CVR hours with similar loads. The comparison between hours with similar loads is necessary to determine the extent to which equipment served at lower voltage runs more minutes to achieve the same task (e.g., cooling a building).

Recommendation 9: "Loss-Driven Retrofit" Should be Defined/Explained

335. Clarification provided. The Loss-Driven Retrofit projects in the Large Customer Connection and Conductor Protocols would be those where the EDU is claiming that no equipment replacement would have been required, but for the energy savings. In this situation, the savings are computed from the existing equipment, as in the Mass-Plant Retrofit Protocol. The costs of the project would be the difference between the total installation costs and doing nothing. This situation contrasts with installation of additional equipment to meet load growth or replacement of failed equipment (as in the Mass Plant Replacement and Expansion Protocol), where the savings and costs are computed as the difference between the install equipment and normal practice. The TRM should reflect this clarification.

Recommendation 10: The Use of a Load Duration Curves in All T&D Protocols Should be Specified

336. Clarification provided. This comment concerns the treatment of load in the System-Reconfiguration, Voltage-Conversion, and Conductor Protocols. Both the Voltage-Conversion and Conductor Protocols require that savings be computed by hour, based on hourly load. These protocols thus require the use of the full load-duration curve.

The System-Reconfiguration Protocol assumes that modeling the pre- and post-project loads over the entire system affected by the reconfiguration would be impractical, since loads would change on a large number of lines and substations, including equipment that is not physically reconfigured by the project. The Reconfiguration Protocol therefore requires that the EDU "identify N load patterns, such that each hour within the year is reasonably well represented by a load pattern and N is a tractable number for modeling and evaluation," that the losses be estimated for each load pattern, and that total losses be determined by adding up losses over the load patterns weighted by the number of hours each pattern represents. Annual modeling appears to be excessively burdensome.

Recommendation 11: Modeling Requirements Should be Adjusted

337. Agree; TRM should reflect change. The protocol will be revised to allow the manual computations in the protocol to be replaced by computerized computations.

REPLY TO OBJECTIONS TO THE DRAFT TECHNICAL REFERENCE MANUAL SUBMITTED BY OPOWER, INC.

Reply to OPower objection to the TRM, that the inclusion of an evaluation, measurement and verification (EM&V) protocol for behaviorally energy efficiency programs should be included in the TRM, with specific recommendation given.

338. Disagree. VEIC agrees that programs directed at influencing behavior have been shown to result in verifiable savings. However, each such program will have distinct design, target markets, and impacts, and would need to have a process for verification designed specifically for that program and market. In fact, we were advised by AEP's consultant OPower, who will be designing and delivering a behavioral program for the utility, that results of evaluations undertaken for one of its programs in California are not transferable to this program in Ohio, even though OPower structures such programs in a similar way. And the particular statistical method proposed by OPower is not transferable to every type of behavioral program. Data from reliable impact evaluations will be necessary to support savings claims from such programs – we believe that such initial evaluations fall under the scope of the PUCO Evaluation Consultant. The Commission may direct its Evaluation Consultant to use the experimental method proposed by OPower, or other methods. Once supported, and if appropriate, deemed savings or evaluation protocols for each program can be added to the TRM for future use.

ADDITIONAL DOCUMENTS AND FILES
Attached under separate cover

Attachment A - REAP Impact Eval - draft 1-28-03 revised.doc

Attachment B - RLW Room AC study.pdf

Attachment C - Smart_Strip_BC_Hydro_Power_Smart_and_Accenture_Oct_27_2008[1].pdf

Attachment D - Advanced Power Strip background (2).docx

Attachment E - Estimated Energy Savings with HiR Windows.pdf

Attachment F - 09-06-30 Pool Pumps Exploration Memo.doc

Attachment G - PGE_Updated_Proposal_Information_Template_for_Residential_Pool_Pump_Measure_Revisions.pdf

Attachment H - 28 - Pump and Motor Single Speed.doc

Attachment I LED Refrig Lighting ERCO_Talking_Pointsv3.pdf

Attachment J Compressed Air Analysis.xls

Attachment K deeminglighting13nov09_evaluationreport (1).xls

Attachment L - Strip curtains for walk-in units.doc

Attachment M BHP Weighted Compressed Air Load Profiles - OH TRM.xls

Attachment N ECM-Pigg.pdf

Attachment A:

"REAP Impact Eval - draft 1-28-03 revised"

2002/2003 Impact Evaluation of LIPA's Clean Energy Initiative REAP Program

DRAFT

Submitted to KeySpan Energy Corporation

January 28, 2003

2002/2003 Impact Evaluation of LIPA's Clean Energy Initiative REAP Program

Submitted to KeySpan Energy Corporation
January 28, 2003

By

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With

GDS Associates, Inc.
CMC Energy Services, Inc.
AND Including results from a special refrigerator metering study performed by Ken Tohinaka of Vermont Energy Investment Corporation (VEIC).

Acknowledgments

The authors wish to thank all of the people at KeySpan Energy Corporation, Long Island Power Authority (LIPA), the program implementers at Honeywell DMC, and members of the evaluation assistance team who took the time to support and help with this study. Regrettably, we cannot thank everyone individually, but we do want to acknowledge the contributions made by Margaret Cush Grasso, Ralph Prahl, and Steve Hastie. The data, insight, and support provided by these individuals helped to establish the foundation for this report. Of course, we assume sole responsibility for any errors or omissions.

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Executive Summary

Background

The Long Island Power Authority's (LIPA's) Residential Energy Affordability Partnership Program (REAP) is part of LIPA's Clean Energy Initiatives and is designed to assist low-income customers in greater affordability of their energy bills.

The REAP Program provides:
- Installation of comprehensive electric energy efficiency measures,
- Extensive energy education and counseling, and
- An affordable payment and arrearage plan (in development).

KeySpan Energy Corporation, under contract with LIPA, is managing the program. Presently, it is being implemented for KeySpan by Honeywell DMC. A partnership is also in place with the Community Development Corporation (CDC) for their participation in program implementation. Other players in the process include VEIC for Optimal Energy (consultant) and CSG/Planergy (refrigerator replacement).

LIPA's program has been fully implemented since April 2000. This report is the first complete impact evaluation of this program, as requested and contracted for by KeySpan Energy Corporation on behalf of LIPA.

Overview of Methodology

This report includes two impact evaluation efforts, site visits and a billing analysis.

The site visits were conducted on samples of two groups of participants. The first group consists of those participating customers with electric heat or central air-conditioning and eligible for weatherization services. The second group, are those without these but potentially eligible for lighting, refrigerator, and other measures. There were 30 site visits for each group.

The site visits used data from the program database as a comparison to what was found during the site visit. During the site visit, data on measure suitability; installation according to program procedures; assessing lost opportunities; retention; and customer satisfaction were collected. The data from this effort was provided to program management for their use and put into a datasheet for summary. The summary of findings is provided in this report.

Billing analysis was conducted for the impact evaluation. This evaluation took the approach of being completely inclusive, attempting to maintain all of the participants within the analysis, rather than a sampling approach.

All billing analysis models were a form of ANCOVA SAE model (fixed-effects, Statistically Adjusted Engineering). This means that at a minimum they have coefficients for every account (model set with no intercept), and some form of realization rate on savings estimates. All models used the average daily usage (kWh) as the dependant variable. To obtain an average daily savings estimate that would correspond to the dependent variable of average daily kWh, all savings estimates were divided by 365.[1]

Findings

Refrigerators have an almost 100% retention rate. The site visits found a 100% retention rate and last year's telephone survey of participants found one case where the refrigerator was not there resulting in a 99% persistence rate.

The small refrigerator metering study found that refrigerator savings estimates are probably overestimated given that new Energy Star refrigerators are seeing greater usage in the field among LIPA's REAP participants than the rated usage. Given this, we would expect savings to be around 90% of what had been claimed.

The picture also shows that lighting savings, a large part of program savings, may be significantly less than estimated. Retention alone drops the savings expected to 81% of the program database estimates. Usage changes then are applied to only those retained.

In addition, customers relocate many of the retained CFLs, many of which would likely be moved to less cost-effective locations.

Customers' post-program reported usage is significantly less than was reported to program auditors and included in the program savings estimates, from 10-24% less than what is in the database.

Additionally, customers may be very poor at estimating their actual usage of their lights. A recent light logger study to assess the number of hours that lighting is used in for NSTAR's (Massachusetts) high usage customers also suggests that this could create a large loss of savings. Given the billing analysis results, this factor cannot be ignored for the LIPA REAP program.

The final lighting savings realization rate could be from 20% to 70% of the program estimates. This is a large range and this study cannot be much more definitive than that. Yet, there is a significant loss of savings as CFLs are a large part of program savings and these savings are at least 30% less than originally estimated for the program.

[1] The daily savings estimates for lighting were apportioned heavier in winter months than in summer months, but ensuring that the annual usage was correct.

The billing analysis supports the finding that savings are significantly less than the program estimates. It also provides support that the refrigerator realization rates are likely much higher than the lighting savings realization rates.

Recommendations

The REAP program, its KeySpan management, LIPA personnel and consultants will need to ascertain how to use the information being provided in this report. We would expect that the refrigerator savings estimates would probably be adjusted downward to 90% of their current levels in the future.

The broad range on potential lighting savings realization rates, however, makes a simple adjustment more problematic. At the same time, it is important to recognize that actual lighting savings are probably significantly less than has been reported. This needs to be considered for future program savings reports, program planning, and evaluation planning.

The large range in possible lighting realization rates, all showing significant loss of savings, directs additional evaluation efforts to focus on improving this assessment. The last evaluation effort within this multi-phase REAP evaluation is a process evaluation to be conducted over the next few months. We will revise the customer telephone survey to capture whatever information can help in this process. Nevertheless, this cannot capture actual usage as opposed to customer reported usage. A light logger study, or using NSTAR's study results, might need to be undertaken to narrow the lighting realization rate estimate.

1.0 Introduction to the Evaluation and Program Background

1.1 Introduction

KeySpan Energy Corporation, on behalf of the Long Island Power Authority (LIPA), requested an evaluation of LIPA's Clean Energy Initiative REAP (the Residential Energy Affordability Partnership) Program from an outside consultant to provide both research and analytical services, and an objective evaluation of their program. The evaluation includes both process and impact evaluation and is a multi-year phased evaluation. This report presents the final impact evaluation culminating in the second year of this two-year study.

The first section provides a brief overview of the program and a summary of the evaluation approach for this impact evaluation. The second section presents the methodologies employed. Section 3 presents a summary of the findings from last year's preliminary impact evaluation. Section 4 presents the findings from the site visits. This is followed by the findings of the billing analysis conducted in the fall/winter of 2002 in Section 5. Section 6 presents the use of the impact evaluation findings and recommendations. The report concludes with an appendix of the data collection instrument used in the site visits.

1.2 Program Background

The Residential Energy Affordability Partnership Program (REAP) is one of eleven conservation programs offered by LIPA's Clean Energy Initiative, which was approved by the LIPA Board of Directors on May 3rd, 1999. REAP was fully implemented in April of 2000 and is delivered to LIPA customers by Honeywell DMC, a KeySpan Energy contractor. REAP is designed to increase energy affordability for LIPA's low-income electric customers, while at the same time providing significant electric demand-side management (DSM) benefits to LIPA and all its customers. The program measures and services include: (1) the installation of comprehensive electric energy efficiency measures, (2) extensive energy education and counseling, and (3) and affordable payment and arrearage reduction program. Currently, REAP only serves electrical end use customers. However, efforts are underway to include gas appliances.

The Program establishes a partnership between participating customers and LIPA in which each party agrees to meet each other's needs with respect to energy reduction, energy management, energy efficiency, and bill payment. LIPA provides efficiency measures and an affordable payment plan and the participating customers agree to a plan that includes commitments of energy savings and bill payment responsibilities.

The Program targets two low-income customer segments. The first segment represents the low-income population that qualifies for the Department of Energy's Low-Income

Weatherization Assistance Program (WAP). The second segment includes households whose income level is no more than 60% of the median household income level for the LIPA service area. The focus in the second segment is to attract customers with primary electric space heating and central air conditioning equipment. The program provided services to approximately 1,400 electric household participants in the first two years of implementation. In the future, oil and gas heat customers may also receive weatherization services similar to electric heat customers through this program. Recruitment takes place from recipients of the Low-Income Heating Assistance Program.

The REAP Program measures and services include the following:
1. Consumer Education and Counseling
2. TIER 1 Measures are energy efficiency measures installed on the initial visit by a Honeywell DMC contractor.
3. TIER 2 Measures are energy efficiency measures installed on a follow-up visit and usually requires that these measures be installed by a licensed or a skilled trade's person.
4. Affordable Payment and Arrearage Reduction Plan

Item number 4 is still under development. Items 1 and 2 in the list above are delivered on the initial visit with the program delivery contractor. Item 3 measures are delivered on a post-audit follow-up visit after a customer has been identified as a TIER 2 customer.

The Consumer Education and Counseling service works with participants to identify actions that they can do to lower their electric bills. Participants are required to accept certain responsibilities in order to participate in this program. Through these commitments, the benefits of any installed energy efficiency measure will be maximized. The education component includes information related to:
- Set back thermostat operation and management,
- Inspection, maintenance and replacement of central air conditioning equipment filters,
- Use and value of installed compact fluorescent lighting retrofits,
- Electrically heated hot water conservation measures,
- Electric hot water heater temperature settings, and
- Refrigerator control settings.

The TIER 1 measures include the following:
- High-efficiency screw-in lighting products,
- Selective installation of hard-wired indoor and outdoor replacement lighting fixtures,
- Selective replacement of very inefficient refrigerators with new, ENERGY STAR® rated units,
- Water conservation and electric energy efficiency measures for those with electric water heaters (e.g. aerators, showerheads and electric hot water heater insulating jackets), and
- A combustion systems safety check for those without electric heat.

The TIER 2 measures include the following:

- Wall and/or attic insulation,
- Air leakage sealing,
- Electric heating system maintenance, modification or repair,
- Air conditioning system maintenance and/or modification,
- Ducted distribution system modifications, and
- Other customer measures that are determined to be cost effective.

All measures are installed at no cost to the participant. Only measures that meet cost effectiveness tests are installed. The number of measures installed with any participant is dependent upon the evaluation of their usage and environment. So the measures installed vary significantly from one participant to another.

The Affordable Payment and Arrearage Reduction Plan are designed to assist the participant in reducing the electric energy consumption and to break patterns of payment difficulties. LIPA provides the participant with free installation of energy efficiency measures in exchange for the participant's agreement to assist in the control of his/her consumption habits. LIPA is considering some incentive plan for those participants who display willingness to control their electric consumption and who have consistently made payments according to their collection agreement.

Program delivery starts with program recruitment. Recruitment takes place through three major channels:

- Telemarketing and other direct recruitment by the Program Delivery Contractor,
- LIPA InfoLine or other direct community outreach events, and
- Referrals from the WAP contractor.

Every participant receives a site visit. The Program Delivery Contractor introduces the program, discusses obligations for program participation and conducts an energy education session. A health and safety check of combustion equipment used throughout the house is conducted. Testing and evaluation of TIER 1 and TIER 2 measures are performed. Installation for cost-effective measures is done at this time wherever possible. A second visit is scheduled if there are cost-effective measures that cannot be installed immediately (e.g. hard-wired lighting measures). The education session is also provided during the initial site visit and includes the customers' involvement with the testing and installations being performed.

REAP program activity is tracked using computer software that is specifically designed for the program. The system supports scheduling activities and all site-visit results. Work orders are also tracked including refrigerator replacement, insulation, and other improvement work orders that may be specified. Management reporting on all activities is provided.

MARGARET – DO WE WANT THE FOLLOWING IN HERE? DO YOU WANT TO PUT IN #S FOR 2001 AND 2002 OR JUST 2002?

The REAP program budget for 2001 is $3,390,000 with a participation goal of approximately 3,000 customers. Electric energy and demand savings goals are 3,822 mWh and 0.216 mW, respectively.

MARGARET – THE FOLLOWING TABLE WAS ASKED FOR IN LAST YEAR'S REPORT AND YOU HAD IT COMPLETED BY ELAINE & HONEYWELL. DO WE WANT ONE FOR 2002 IN THIS REPORT & PUT IT HERE? OR WOULD WE WANT ONE THAT HAD 2001 ACHIEVEMENTS (LAST 2 COLUMNS) AND THEN 2 COLUMNS FOR 2002 ACHIEVEMENTS?

Table 5.1 REAP 2001 Goals and Accomplishments

Number of Participants		**2001 Goal**		**2001 Achievement**	
HDMC	Tier 1		2,500		2,934
	Tier 2		500		838
Weatherization CDC of LI	Tier 1		500		478
Participant Total			3,500		4,250
Measures		Measure units	MWh	Measure units	MWh
Screw in CFLs		28,000	1,834	21,712	1,820
Energy Star Fixtures		8,330	796	0	0
Energy Star Torchiere		840	259	152	47
Refrigerator Early Retire		700	916	1,254	1,877
Hot Water Measures		350*	117	282*	97
DHW Blanket		n/a	n/a	31	10
Pipe Insulation (linear ft)		n/a	n/a	1,721	67
Aerators		n/a	n/a	1,078	n/a
DHW Temp Turndown (# of cust.)		n/a	n/a	124	9
		n/a	n/a		
Showerheads				268	94
Air Sealing		420*	343	616*	42
Duct Repair		n/a	n/a	7	0

1.3 Evaluation Approach

On behalf of LIPA, KeySpan Energy Corporation desired an evaluation of the low-income program efforts to guide refinement of program design during the program ramp-up period. Further detailed analysis is being used to support ongoing Program improvement, as well as provide a basis for future program decision-making.

An initial process evaluation and preliminary impact evaluation (including an engineering review) was conducted in 2001 and concluded with a May 2002 report. This report is the first complete impact evaluation. This report provides a summary of the prior preliminary impact evaluation, a summary of the findings from site visits conducted in the fall of 2002, and the findings from the 2002 billing analysis conducted in the fall/winter of 2002.

Section 2 provides the methodologies used for the site visits and billing analysis conducted for this evaluation.

2.0 Methodology

2.1 Methodology for the Evaluation Site Visits

Goals and Data Collection Forms

The goal of the site visits to REAP program participating customers' homes was to provide an objective third-party review of the program's implementation for the purpose of the evaluation. The site visits were designed to examine the following key areas:

- Measure suitability - whether measures installed were appropriate for the given situation.
- Installation – to confirm that measures were installed properly and according to program procedures.
- Lost Opportunities - assess opportunities for other measures that would have been cost-effective to install according to program procedures, but overlooked by program implementers.
- Customer Satisfaction – Customers were asked questions regarding their satisfaction with the program. Also notations were made regarding changes made to the installed measures.

The site visit included a comparison to program records for each customer site visited, a visual inspection of the premises, a comparison to program installation guidelines, metering refrigerators for energy consumption, a blower door test (as applicable) for homes receiving weatherization, and a brief customer interview regarding their satisfaction with the program and the measures received.

Site inspection forms were prepared in advance of the scheduled appointments. The forms were prepared from program information and included the following pieces of data to be used for verification of measurements taken and measures installed.

- Basic participant contact information
- Home information –Structural information collected at the time of the initial home audit (i.e. number of rooms, attic and basement conditioning, heat type/fuel, AC type etc.)
- Measurements taken (i.e. blower door readings, refrigerator metering, square footages)
- Measures installed and location

The forms also provided ample space for the data collection, to include measure specific data. In this way, the inspector had both the brief customer interview questions related to each measure with space provided for appropriate responses. There were brief interview questions designed to probe the customer for additional information and included customers' satisfaction with each measure installed and why measures were removed or replaced (if applicable).

There was also space for the site investigator to comment on the appropriateness and likely cost effectiveness of each measure installed; as well as rating each measure for installation quality. Each measure's installation was rated for quality with a designation of either: "Meets Program Protocol", "Marginal", or "Poor".

Finally, there was ample space allowed on each form for noting any lost opportunities that may have been missed during the initial audit or program implementation.

A copy of the site visit form with example initial program data is provided in Appendix A to this report.

In addition, an electrical energy usage history was prepared for each customer so that site inspectors were able to review pre and post-program participation usage while conducting the site visit.

Site Selection and Sampling

There are to be a total of 60 site visits. Half of these (30) are Tier 1 homes (homes that are often not electrically heated and the measures received may include furnace safety check, compact fluorescent lamps (CFLs), energy efficient fixtures, replacement energy efficient refrigerator, if electric hot water then also water heater tank wraps, pipe insulation, standard and/or flip aerators, and showerheads). The other 30 are Tier 2 homes. These are either electrically heated homes or homes with central air conditioning. These homes may have received attic insulation, air sealing or wall insulation, in addition to those measures seen in Tier 1 homes. The Tier 2 site visits may have received blower door testing and duct blaster testing (for those where ductwork testing is appropriate).

Staff from GDS Associates worked with the Honeywell DMC program database to provide the site visit sample. They also assisted with the creation of the site visit initial data forms to be taken to the field (as described above and shown in Appendix A).

There were only 14 participants that received insulation through this time period. As these customers received the most intense treatment, they were purposefully included in the Tier 2 sample. The remaining samples for the Tier 1 and Tier 2 were randomly selected by strata from October 2000 through December 2001 participants.

From a population of 4,126 customers, a random sample of 200 customers was drawn from three different customer groups: those receiving insulation or air-sealing measures (50 customers), those with no electric space heating and no central air conditioning (95 customers), and those with electric heat and central air conditioning (55 customers).

CMC Energy Services called the clients, scheduled the appointments, and conducted the site visits. The site visits were conducted by Brian O'Connor of CMC Energy Services. The CMC project supervisor was Joseph Iandolo.

There was an initial set of site visits (three were conducted) that served as a "dress rehearsal" and were performed by both Brian O'Connor of CMC and Ken Tohinaka of VEIC. This provided greater background in the program protocols, utility service territory, housing stock, and other background elements for this CMC work. The LIPA REAP program evaluation manager, Margaret Cush Grasso, also attended a few of these and a few of the later site visits.

The customers received a $25 incentive for their participation in the site visits.

The site visit plan called for 30 Tier 1 and 30 Tier 2 site visits, for a total of 60 site visits. In order to ensure meeting this minimum number, CMC scheduled 69 site visits. This resulted in 62 completed site visits as detailed in Table 2.1 below.

Table 2.1 Number of Scheduled and Completed Site Visits

Customer Group	Scheduled	Completed
Insulation and/or Air Sealing	16	15
No Elec Heat Nor Central AC	37	31
Elec Heat or Central AC (w/o insulation or air sealing)	16	16
Total	**69**	**62**

The visitations occurred during the weeks of September 23rd - 27th and October 7th – 11th. Of the seven that were scheduled but not completed, two were cancelled by the customer and four customers simply did not show up for their scheduled site visits. The seventh was cancelled by the CMC due to the fact that the customer had moved.

In another case, the listed customer (contact person) had deceased. However, a family member of the deceased was present and allowed access to the residence in order to complete the site visit.

On average, each site visit lasted for approximately 1 hour and ranged from 40 minutes to 1 hour and 55 minutes.

2.2 Billing Analysis Methodology

Billing Data Preparation

Last year's Process Evaluation and Preliminary Impact Evaluation for the REAP Program (dated May 2002) made several recommendations with regards to the impact evaluation being conducted in 2002/2003. These were:

1. To investigate and institute procedures to ensure a much longer pre and post-retrofit data available for billing analysis.
2. Obtain and utilize the much fuller customer information provided from the program database operated by HDMC to better separate different types of customers and provide variables to better isolate program impacts.
3. Institute a process that provides earlier clean-up and systematic checking of program data prior to undertaking billing analysis (minimizing the possibility of erroneous outliers).
4. Consider a back-up procedure of expanded billing analysis work on a much smaller subset of General Use participants to test methods of data cleaning, lengthening data periods, and other methods to find reasonable billing analysis models.
5. Consider a refrigerator metering study and/or lighting logger study to verify impact evaluation findings or, along with engineering and survey adjustments, in lieu of billing analysis as is found necessary.[2]

As will be presented in this report, these recommendations have been followed. This subsection describes the up-front data cleaning and preparation that was conducted to meet these recommendations.

Two factors were used in order to obtain a participant population with a longer post-period, as recommended in the prior evaluation. Having a longer program history available was a primary factor to make this possible. Yet, in addition to this data sets from a variety of sources were combined. (The on-line billing system at KeySpan only stores 24 records, some of which may be account checks or bi-monthly billing resulting in less than 24 billing periods and possibly only 10 billing periods or less.) These sources were: 1) last year's billing data was combined with 2) a current pull from billing records and 3) historical usage information supplied by the implementation contractor as was pulled from the billing system at the time of the customer audit (up to two years earlier than what would currently be on the billing system). These files were merged to ensure the latest data available for any time period was used (so corrected data was used) and, yet, all were used to obtain the longest participant billing history pre- and post-retrofit as was feasible.

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[2] Megdal & Associates, "Preliminary Process and Impact Evaluation of LIPA's Clean Energy Initiative REAP Program", prepared for KeySpan Services Corporation on behalf of the Long Island Power Authority, May 2002, pages ES-11, and 93.

Keyspan Energy Corporation provided 24 entries from the billing history files for 4,838 participants through May 2002. The original file of 5,018 records from Keyspan contained 180 instances where records were duplicated within the set of data. After omitting these records there were 4,838 participant records remaining. There were several billing entries with "Z" codes reflecting zero consumption and zero billing bays as part of balanced billing records. After removing Z codes from the 4,838 participants billing histories (average 1,122 per billing period), there were 89,190 data records available for analysis.

This set was combined with the dataset from the previous year's analysis. Great care was taken to ensure that the merge of the two years' datasets only retained information from the later file (where billing periods overlapped) and did not create duplicate records.

In addition, a third set of customer electrical usage data was merged into this document. Honeywell DMC had recorded twelve months of pre-program usage for each participant upon entry to the REAP program. This historical usage information was carefully reviewed as a stand-alone dataset prior to merging with the other two billing histories. It was found that within the HDMC's historical usage file of 52,858 records there were some questionable data. For example, there were a number of records (6,840) that either contained no start date associated with the reading period, had end dates that proceeded the start dates for particular billing periods, or had billing periods greater than 365 days. These issues were pointed out and were either corrected or deleted as erroneous records by the contractor. Once a clean dataset was returned it was carefully merged with the prior two datasets, and again was careful not to overwrite billing periods with the old data.

Table 2.2 shows that this year's pre and post-retrofit billing data is both longer for each rate class group and much better balanced with enough pre and post data for seasonal adjustment across both periods. This shows the success obtained in using this technique of combining these three data sources to construct billing analysis datasets. Given this, we recommend that this type of procedure be used periodically to maintain a billing analysis dataset for this program.

Greater incorporation and use of program data was also supplied by HDMC and in the analysis dataset, such as house area (square feet), heat fuel type, appliance metering results and number of residents; and information regarding the measures received such as description, quantities, estimated savings and dates of installation.

Table 2.2 Comparison of 2001 and 2002 Billing Analysis Data Sets

2001 Analysis Average # of Billing Periods	Pre-period	Installation Period	Post-Period
Electric Space & Water Heat	17.4	1	4.1
Electric Space Heat	17.5	1	4.7
Electric Water Heat	12.1	0	4.1
General Use	12.4	1	3.1

2002 Analysis Average # of Billing Periods	Pre-period	Installation Period	Post-Period
Electric Space & Water Heat	12.6	1.8	14.7
Electric Space Heat	15.4	1.2	18.1
Electric Water Heat	10.9	1.5	9.4
General Use	10.8	1.4	9.7

2001 Analysis - # of Participants	Pre-period	Installation Period	Post-Period
Electric Space & Water Heat	229	7	229
Electric Space Heat	43	2	43
Electric Water Heat	103	0	105
General Use	2120	67	2118

2002 Analysis - # of Participants	Pre-period	Installation Period	Post-Period
Electric Space & Water Heat	635	144	637
Electric Space Heat	47	5	47
Electric Water Heat	213	63	213
General Use	3934	1068	3934

Last year's evaluation noted that negative electricity savings were erroneously reported due to typographical errors and database changes. In response to last year's issues and its recommendations, a review of program data was performed prior to the incorporation of a program dataset into the billing analysis dataset. Various tests were conducted on the data files supplied by HDMC. Such tests examined files for missing critical data and data that was suspicious based upon various "reality checks" such as (and not limited to):

- Billing records with end dates that precede start dates;
- Daily hours-of-use higher than 24;
- Negative savings numbers;
- Refrigerator metering data that is possible but, too low or high to be believable (less than 100 kWh or higher than 7,000 kWh);

There were a number of questions and/or issues noted within the program data files. For example, there were records where the refrigerator electricity consumption was recorded to be unreasonably high, and there were savings estimates in excess of 1,000 kWh from the replacement of one showerhead. These apparent errors along with others noted within the program and billing files were returned to HDMC for further investigation and/or correction. A summary of the issues found and addressed is provided in Table 2.3.

Table 2.3 Summary of Program Database Clean-up Issues

Historical Usage	Records with End Dates before associated Start dates
	Records with Billing periods greater than 365 days (a subset of this group had Start Dates prior to 1998)
	Records with no start date associated with the period.
Site Information	Records with incorrect living area (square footage)
Insulation and Air Sealing	Records missing kWh savings estimates
Showerheads	Records with negative savings numbers
	Records with savings (kWh) greater than 1000 from the replacement of 1 showerhead.
	Records with no savings information calculated.
Refrigerators	Records with negative or suspiciously high or low savings numbers
	Records with refrigerator consumption less than 100 kWh per year (some were corrected some were accurate to begin with)
	Records with refrigerator consumption greater than 7000 kWh per year.
	Records that included a time lapse between monitoring start and stop that was negative.
Miscellaneous Appliances	Records either have daily hours of use greater than 24 or no wattage or hours of use information.

Once corrected program data were received from HDMC it was merged into one file and then merged with the billing data. This created variables for a customer's program data on each billing period for that customer's data record.

The process of preparing data for integration with the final dataset for analysis was a painstaking process, but necessary to complete evaluation objectives. Differing file structures necessitated transposing and restructuring of database tables and variables so that the merge of the three datasets could create one dataset that included all necessary information accurately.

There are at least two diverse approaches to further billing data cleaning and inclusiveness for billing analysis, and many options between the two extremes. One is to "clean" the billing data so that all observations are completely logical with one another and with what is expected for the type of housing involved. With large datasets without sampling, this often involves setting many general relationship rules where observations that are not within certain parameters are dropped from the analysis. These can include a minimum and maximum average kWh per day depending on the heating fuel type and HDD for the time period. The opposite approach is to only drop from the analysis those most egregious records that must be errors and to do so only in a completely balanced approach.

The first approach, heavy cleaning, can often find stable and reasonable billing analysis models for a smaller subset population within a very "dirty" or heavily mixed dataset. These types of record omissions could eliminate data entry errors, data correction errors (where these the sum of these two do not result in reasonable usage estimates), differing ways of providing estimated "reads", and rid the analysis dataset of unusual occurrences that are not meaningful to the program evaluation.

At the same time, there are critics of the heavy cleaning approach claiming that it is more likely that "cleanly" routines might not be completely unbiased and could result in biased analyses. This approach rests on the supposition that a few incorrect records should counter-balance one another positively and negatively and overall have no effect. These critics often purport that a more inclusive policy of all records must be maintained; unless a specific and tested reason that can be proven to be completely unbiased in applying high and low users and potential program impact effects can be made for their exclusion.

This study used an inclusive policy as was used in the preliminary impact evaluation conducted last year and has been found to fit the philosophy of one of LIPA's primary evaluation reviewers. Initial data exams did include viewing the distribution of average daily usage per heating degree day (HDD) to ensure that the inclusive approach did not include obvious billing errors.

***Billing Regression Analysis Methodology*[3]**

The impact evaluation analysis for this project included billing analysis utilizing Analysis of Covariance (ANCOVA) and Statistically-Adjusted Engineering (SAE) modeling.

The ANCOVA SAE billing analysis method is state-of-the-art and has been used with many prior energy efficiency program evaluations.

Statistically-Adjusted Engineering (SAE) Models are models that incorporate the engineering estimate of savings, in the regression analysis. The SAE Models were first used, and the term coined, by Dr. Kenneth Train. The percentage of observed change in energy usage that the engineering estimate of savings explains is given in its regression coefficient. As the actual billing data reveals, engineering estimates of savings that are less than (or greater than) the observed savings estimate will have a coefficient of less than (or greater than) one. The SAE model can estimate realization rates for an overall

[3] The regression methodology, and the description presented here, is the same as that performed in the Preliminary Impact Evaluation and presented in the May 2002 evaluation report for this program.

customer savings estimate or for individual measure savings estimates, if these estimates are placed within the model.

An analysis of covariance (ANCOVA) model is also referred to as a "fixed-effects" model. This model allows each individual to act as its own control. The unique effect of the stable, but unmeasured characteristics of each customer is their "fixed-effects"; from which this method takes its name. These fixed-effects are held constant. This greatly controls the amount of variance, or noise the model is faced with, by being able to reflect the fact that each customer has a different baseload, a different response to weather, and a different pattern of consumption changes over time. This approach also provides for a much closer fit to the data than most models, and yet, does not rely on a direct inclusion of prior consumption to predict post consumption.

This type of model makes any customer-specific, non-changing characteristics unnecessary as variables for these models. The customer identification variables (variables B_{5i} through B_{ni} in the model description below) work the same as dummy variables for each customer. This coefficient is estimated for each customer (there is no separate intercept in this model), to pick up all of that customer's individual characteristics that affect his/her "fixed-effect". In terms of energy consumption, with weather variables in the model, the fixed-effect should ascertain the customer's baseload consumption. Interacting the customer identification with the weather variables allows each customer to have its own "fixed-effect" of weather sensitivity. Given this, the ANCOVA model does not need to include unchanging customer characteristics such as: square footage; number of floors; and equipment in the home, etc.

The purpose of ANCOVA is to achieve tighter fitting models with less noise to obstruct obtaining an accurate savings estimate. They are still regression models that best estimate average consumption of the group. They are not intended to, nor can they, accurately project an individual customer's consumption. They do, however, often achieve very high R-squares and a much higher probability of obtaining statistically significant program participation coefficients.

The basic model framework for an ANCOVA SAE model is as follows:

$$E_{it} = B_1 S_{itj} + B_2 HDD_{it} + B_3 CDD_{it} + B_4 i + \ldots + B_{ni} + e_{it}$$

where:

E_{it} = Average daily energy consumption for customer "i", in month "t", from the billing data, with the consumption for the billing cycle, divided by the number of days in the billing cycle.

S_{itj} = Dummy variable = 1 if customer "i", in month "t", had installed measure "j"; = 0, if the conservation measure had not yet been installed. For a SAE model, the measure savings estimates would be included in place of the "1" for the months after installation. For a measure-level SAE model, as proposed here, a variable for each measure-level savings estimate would be used here.

HDD_{it}=	Heating degree days for customer "i", in month "t", as defined by that customer's billing cycle.
CDD_{it}=	Cooling degree days for customer "i", in month "t", as defined by that customer's billing cycle.
$B_{4i}...B_{ni}$=	For ANCOVA, customer "i", included as own control for fixed-effects. The coefficient adjusts for the customer's base usage as differentiated from the usage for the sector based upon the other variables in the model. Interacted with weather, the coefficient adjusts for the customer's weather sensitive usage, as differentiated from the usage for the group as a whole, based upon the other variables in the model.
$B_1...B_3$=	Estimate coefficients.
e_{it} =	Statistical error term, for unexplained variance in observed average daily energy consumption, for customer "i", in month "t".

B_1, the coefficient for "S", should provide either the average daily consumption savings from the measures installation (standard billing analysis), or the percentage of the engineering estimate obtained for an SAE model; depending on whether a dummy variable is used, or whether all sample participants have program engineering estimates available for all measures installed. From this coefficient the average consumption savings can be estimated. The t-statistic provides a direct test of the statistical significance of this estimate.

3.0 Summary of Preliminary Impact Findings from 2001 Study

Last year's preliminary impact analysis was primarily based upon billing analysis similar in regression to this year's (as described in Section 2). Two of the primary differences are in the length of post-retrofit billing data within the analysis and the data cleaning effort undertaken prior to the regression analysis. These were both described in Section 2. The other primary difference is that last year's billing analysis divided participants up by rate code. The 2002 analysis used program data for more accuracy and greater depth of the primary determinants of their usage (e.g., heating and air-conditioning).

Two of the rate code groups had electric space heat and were combined to provide larger sample sizes for this group. This group consisted of those with electric space heat rate codes, both with and without electric water heaters. This created three primary analysis groups, as follows:

1. Electric space and water heat, and electric space heat without electric water heat
2. Electric water heat but no electric space heat
3. General use

The summary of last year's findings are being reported by these rate group categories.

3.1 2001 Study Findings for Electric Heat Participants

The electric space heat participants for the 2001 billing analysis consisted of 275 accounts (participants) for a total of 5,887 observations. Several models were examined. Models are not properly specified when the account identifier coefficients in the ANCOVA specification are found to have several negative coefficients or many insignificant coefficients.

Multi-collinearity can be seen when coefficients on the SAE variables bounce around between specifications, some coefficients are unreasonable high while others are unreasonable low, or some coefficients are positive while some are negative. Placing different measure groups into this billing analysis found problems with multi-collinearity.

The most reasonable SAE ANCOVA model used an account-specific heating response (account interacted with HDD), and overall cooling response (account interacted with CDD). This model found a realization rate on total savings of 81.3% with a t-statistic of 9.11 and a model R^2 of 0.9225. These results are presented in Table 3.1.

Table 3.1 2001 Electric Space Heat Billing Analysis Results

Electric Space Heat – 275 accounts; 5,887 observations

Model: avgkwh=	acct acct*hdd cdd total	$R^2 = 0.9225$
Realization rates:	Total -0.813	t-stat 9.11
Other variables:	CDD 0.00677	t-stat 5.43
Notes: All "acct", & "acct*hdd" are positive and most significant.		

The 2001 overall finding is that the electric space heat model points to a relatively high realization rate of 81% of program estimated savings.

3.2 2001 Billing Analysis Results for Electric Water Heat Customers (with No Electric Space Heat)

The 2001 electric water heat participants without electric space heat provided 109 customers for the billing analysis with 1,680 observations. Several models were examined.

The best models for electric water heat participants used only the account identifier as the class variable (ANCOVA, allowing each participant to have their own basic usage parameters), and overall heating and cooling responses (rather than an individual heating response). This is what would be expected in comparison to the electric space heat model.

The 2001 optimal model for electric water heat customers found a realization rate for total savings of 98% with a t-statistic of 4.18 and an R^2 of 0.5830. This model is shown in Table 3.2.

Table 3.2 2001 Optimal Electric Water Heat Billing Analysis Model

Electric Water Heat – 108 accounts; 1,680 observations

Model: avgkwh=	acct hdd cdd base	$R^2 = 0.5830$
Realization rates:	Total -0.981	t-stat 4.18
Other variables:	CDD 0.00881	t-stat 4.72
	HDD 0.00541	t-stat 7.37
	Notes: All acct positive and significant.	

Base=Total for electric water heat participants.

3.3 Billing Analysis Attempts for General Use Customers

Obtaining believable billing analysis results for the general use customers proved problematic in 2001. The 2001 billing analysis had 2,137 general use participants accounting for 33,008 observations. Given the size of population, more manageable analysis sets were developed based upon the first character of the last names. This allowed smaller datasets that could have massive regression analyses performed on a personal computer while providing a random subsample of the population. (Realization rate by last name assumed to be random.)

The engineering algorithms for the program savings estimates are uniform across rate types. This would suggest that we might expect realization rates to be similar across rate types. This expectation by the evaluation consultant is also supported by the fact that the participant telephone survey found relatively high measure retention rates, participants claiming savings, and that the Engineering Review found the assumptions and algorithms to be generally reasonable.

All of the 2001 general use billing analysis tests had realization rates bouncing wildly between 15-44%. There is a difference of opinion between the evaluation consultant and some of the reviewers of what we might expect to find given what was found in the other billing analysis, the telephone survey, and engineering review. Nevertheless, the erratic and extremely low realization rates seen in the various general use billing analyses created agreement that a final believable billing analysis for the general use participants in this study could not be found given reasonable alternative testing. Two examples of these low realization rates from an otherwise acceptable model are shown in Table 3.3, with realization rates of 35% and 36%.

Table 3.3 General Use Model Results for Customers with A-G Last Names

General Use – 817 accounts; 12,531 observations

Model: avgkwh=	acct total	$R^2 = 0.7528$
Realization rates:	Total -0.3476	t-stat 8.10
Other variables:		
	Notes: All acct positive and significant.	

Model: avgkwh=	acct hdd cdd total	$R^2 = 0.7626$
Realization rates:	Total -0.3601	t-stat 8.53
Other variables:	CDD 0.00791 HDD 0.00207	t-stat 21.93 t-stat 14.91
	Notes: All acct positive and significant.	

Examinations were made at limiting accounts to those that seemed less suspicious of potential data problems (given that extreme outliers might be a small percentage of customers but can have significant impacts on regression analysis). Then separate examinations were made for:

- Those customers receiving new refrigerators,
- Those receiving only lighting measures,
- Those with 6 months pre and post installation data,
- Those most responsive to heating, cooling or neither.

With a record cool summer in 2000, one hypothesis examined was whether this pre-post comparison with unusual weather in the post-period could be causing problems. So models were tested without the summer 2000 data, and then with no summer data. Yet, with all of the aforementioned tests, the results were assessed as untenable.

3.4 2001 Billing Analysis Conclusions

The preliminary conclusions from the 2001 billing analysis was part of the inability to find results we thought were defensible (aligned with reasonable engineering algorithms and participant satisfaction and reported savings) was at least contributed by the short post-period of billing data available. As shown earlier in Table 2.2, the 2001 billing analysis on average had between 3.1 and 4.7 months in the post-period billing analysis for the rate code group analysis. Another important factor could have been the record cool summer of 2000 being a significant part of the billing period. Additionally, the shorter post-period might have meant the weather adjustment elements of the regression could not properly discern program effects from these two occurrences.

The billing analysis findings relied upon those in the electric heat and electric water heat models. With the engineering review and the participant surveys, the overall impact evaluation stated that retention rates should probably be taken into account. Due to lower reporting of customer usage at the time of the survey than as given at the time of program participation, it was also suggested that some lighting savings reduction may also be warranted concerning usage. There were also a few recommendations concerning program savings estimates from the engineering review.

Last year's report provided a list of recommendations to help support this billing analysis. These included recommendations on the following: 1) greater use of program database information (such as the presence of electric heat or air-conditioning in the customer's home), 2) systematic and better program database maintenance and data cleaning prior to use with billing analysis, and 3) developing a method and longer time-series of billing data for the billing analysis participants.

4.0 Findings from Evaluation On-Site Efforts

4.1 Site Characteristics

Most of the information regarding site characteristics gathered from the site visits remains comparable to what was reported in program records. Only a few minor differences were noted regarding the site characteristics reported about each home. A summary of the noted variances are provided in Table 4.1. (A complete set of site visit results for each site visits were provided to the program and evaluation coordinator. These will be used as appropriate for updating program information or follow-up while maintaining confidentiality of customer information and responses to the evaluation.)

Table 4.1 Variance Found in Site Information

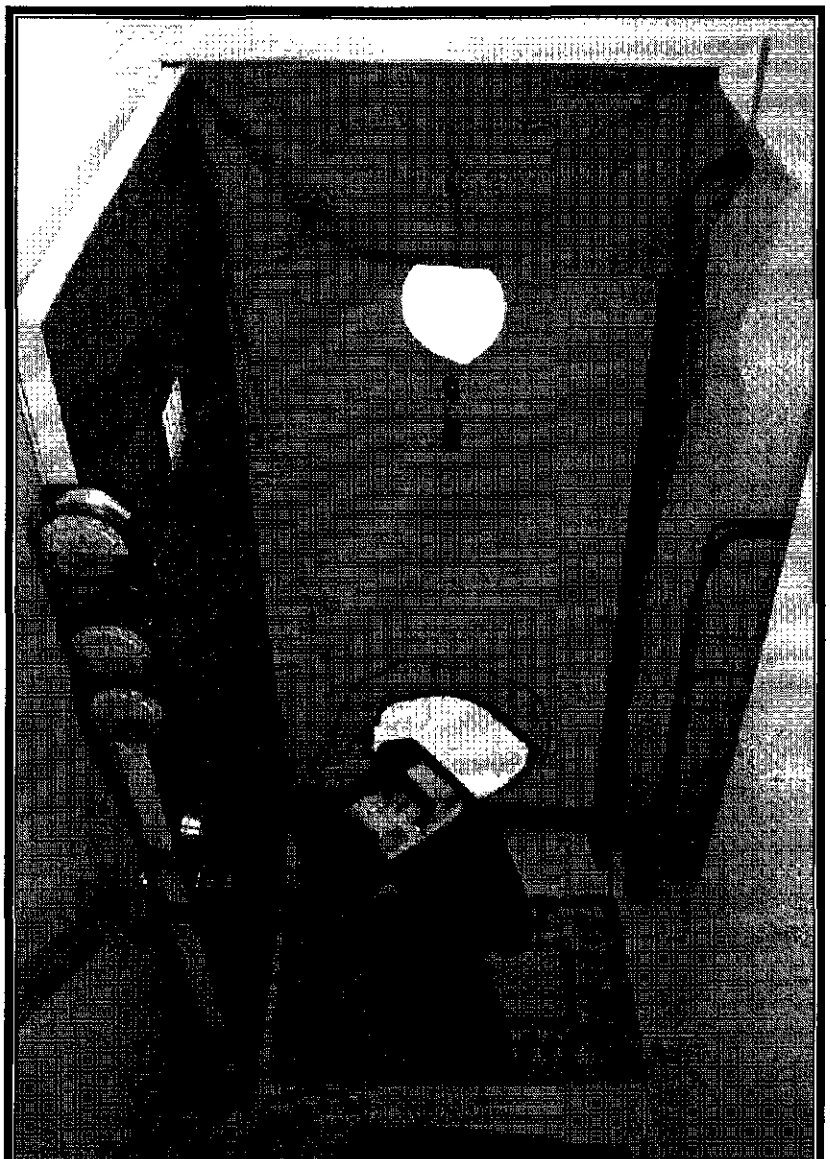
Site Information	Number of Variances
Number of Rooms	3
Number of Stories	1
Size of home (square feet)	11
Primary Heat Fuel	2
Primary Heat Type (Water/Air/Steam)	2
Secondary Heat Fuel	0
Domestic Hot Water (DHW) Fuel	1
DHW Tank Size	8
DHW Temp Setting	16
Room AC Efficiency	7
Central AC Efficiency	0
Is there an Attic?	5
Is there a basement & is it heated?	4

4.2 Blower Door Results

Blower door tests were scheduled for half of the homes visited. There were 6 sites that did not receive the scheduled test; either the customer refused to allow the diagnostic, or the technician opted not to conduct the test due to inclement weather conditions. There were 25 sites with blower door diagnostic results. Twenty of these homes (80%) were shown to have lower blower door readings than the post installation reading taken at the time of program delivery. Of the four reading that were higher at the time of the CMC visit, three were with reasonable ranges of variation, while one was far higher than the original blower door test results. While this particular site had a recorded blower door result of 1962 CFM@50 Pascals, the CMC site visit team recorded a leakage of 950 CFM@50 Pascals. Many factors may affect blower door test readings, such as interior doors being in the same open/closed position during both test periods, differences in set up of each technician's equipment at the same doorway.

Based on the known possible differences in blower door diagnostic results, it appears that most are within acceptable tolerances, and that the effectiveness of the air leakage measures that were installed, persist. This is not to say that there were no opportunities for further house tightening. This has been addressed by the CMC's assessment of lost opportunities.

Figure 4.1 Blower Door Set-up



4.3 Refrigerator Metering from CMC Site Visits

Almost all customer site visits included refrigerator metering. The meters were set in place at the very beginning of the site visit and removed at the very end of the visit to allow for the maximum amount of metering time possible. The average metering time for refrigerators was 57 minutes.

There were fifteen customers from our completed site visits that had received a refrigerator through the program. For these customers the metered energy use (kWh) and metering time from both the CMC site visit and the original site visit were used to calculated annual usage and annual energy savings. These calculated savings were compared with the estimated savings provided within the program records. Our calculated savings were, on average, 97% of the estimated annual energy savings from the program records corresponding to fourteen of the fifteen customers within our sample that had received refrigerators.[4]

Table 4.2 Refrigerator Usage Metering Results from CMC Site Visits[5]

Refrigerator Customer	Metered Annual Usage (kWh)		Estimated Savings		Realization Rate
	Init. Audit	CMC visit	From Program Records	From Pre / Post Metering	
#1	2,444	140	1,959	2,304	118%
#2	1,480	158	1,043	1,323	127%
#3	1,882	315	1,398	1,567	112%
#4	2,113	526	1,626	1,587	98%
#5	2,287	362	1,616	1,925	119%
#6	2,251	272	1,766	1,980	112%
#7	2,104	1,075	1,665	1,029	62%
#8	1,415	175	749	1,240	165%
#9	2,022	201	1,587	1,820	115%
#10	1,910	432	1,473	1,478	100%
#11	1,515	578	1,078	937	87%
#12	1,571	654	1,131	917	81%
#13	1,734	201	1,297	1,533	118%
#14	2,696	1,174	2,213	1,522	69%
#15	1,724	n/a	1,289		0%
Total	**29,150**	**6,263**	**21,892**	**21,162**	**97%**

By documenting the age of the existing refrigerator during the CMC visit, and comparing this to the refrigerator age documented at the time of the original audit we were able to infer that there were eighteen customers that had received a new refrigerator at some point between the initial audit and the CMC visit. The age of the refrigerator at the time of the initial audit was adjusted to account for the passage of time between the customers'

[4] For one customer, there were no refrigerator metering data collected through the CMC visit.

[5] Usage was calculated from metered usage and metering duration and based on 8,760 annual hours of use.

program participation and the CMC follow-up visit. Consequently, in addition to the 15 customers from our sample that had received a refrigerator through the program, there were 3 that owned refrigerators aged less than two years old and apparently, received a new refrigerator, presumably from a source outside the REAP program.

After removing those customers that received a refrigerator through the program, and those where there were no two data points to compare, there were 41 customers where there were comparable before and after metering data. As a result, the comparison of energy use (kWh) for each refrigerator metered during the initial audit and the CMC site visit reveals that most of the usage consumption was shown to be higher during CMC visit. However, there were six outliers within the distribution. There were three customers that showed to have extremely high increases in usage between the two metering dates. It appears that there was one data entry error and some uncertainty of whether the same unit was metered each time. The third high-end outlier could not be explained by the data at hand. In addition, there were three outliers that were shown to have large negative changes in usage between the two dates. Two were apparently due to the refrigerator replacements outside of the program, while the remaining negative outlier is unexplainable and may be erroneous.

After removing these six outliers, about 83% of the refrigerators tested had estimated readings greater than those of the original audit. In fact, 60% had metered usage more than ten percent of the original metered usage. This may represent underlying differences within each auditor's metering protocol, or reinforce the idea that metered refrigerator use is appropriate for program delivery protocol, but somewhat unreliable as a means of estimating program savings from refrigerator replacement.

4.4 Summary of VEIC Refrigerator Metering Effort

One of the recommendations from last year's evaluation was to consider a refrigerator metering study. A small refrigerator metering study was conducted by Ken Tohinaka of VEIC, with research design input from Margaret Cush Grasso of KeySpan, Ralph Prahl as evaluation advisor, and Lori Megdal as the evaluation contractor. Ken Tohinaka provided a separate memo report on this work effort. This section summarizes from that as assists this evaluation.

This investigation used regular program visits by Honeywell DMC with their assistance and then an additional site visit to pick-up long-term metering equipment. This work began in July 2002 and was completed in October 2002. There were 30 sites were metered according to the normal protocol which is to meter the existing refrigerator as long as the site visit lasts (which can range from less than 1 hour to 3 hours or longer). After reading the meter at the end of the site visit, the meters on these 30 sites were left in place with the customers' permission. After seven to ten days in place, the meters were again read then removed.[6]

Ten of these 30 refrigerators qualified for replacement and the replacement refrigerators were also metered beginning with a period two days to two weeks after installation. They were left in place until VEIC conducted a series of QC inspections during the week of October 7th (i.e., roughly two months later). In addition to conducting a routine QC inspection of all work done, the meter at that time was read and then removed.[7]

There were 22 sites with valid refrigerator metering data on existing refrigerators. Mr. Tohinaka's analysis produced the results shown in Table 4.3.

Table 4.3 Existing Refrigerator Metering Study Results from VEIC

Short-term metering results < extended metering results	11 sites
Average annual kWh difference of these sites	440 kWh
Range of kWh difference of these sites	37 – 1451
Short-term metering results > extended metering results	11 sites
Average annual kWh difference of these sites	384 kWh
Range of kWh difference of these sites	33 – 1708
Average projected use from short-term metering	2167 kWh
Average projected use from extended metering	2225 kWh
Average manufacturer rating of annual use	1458 kWh
Units replaced but not qualifying if extended metering used*	3
Units not replaced but qualifying if extended metering used	2
Units qualifying for replacement if manufacturer data used	1
Units qualifying for replacement if extended metering used	9
Units actually replaced	10

*One appears to be the result of a math error by the site technician.

Mr. Tohinaka's conclusions from the existing refrigerator metering study are as follows:

- "For every unit that is replaced that perhaps shouldn't have been, there likely is another unit that was not replaced that should have been.
  Short-term metering allows identification of units whose performance has significantly deteriorated since manufacture.
  Short-term metering should allow projecting program (vs. unit) savings from refrigerator replacement more accurately than using manufacturer data.
- In addition, a review of the data suggests that two units that were replaced were only marginally qualified, at best, given short-term metering results. Of these, one clearly qualified based on extended metering results anyway. The other apparently was replaced due to some sort of mathematical error in translating metering data. It

6 Taken from a memo report by Ken Tohinaka from VEIC dated October 21, 2002.
7 Ibid.

should be noted that the replacement thresholds were established so cost-effectiveness would not be jeopardized in marginal instances."[8]

There was also long-term post-installation metering of program-installed ENERGY STAR® refrigerators. There were five metered refrigerators of this type with usable data within the VEIC study. These received extended metering for approximately 2 months. The overall finding is that in actual practice, "the projected annual consumption is between 5% and 60% greater than manufacturer data, averaging 26% greater".[9] This translates into a reduction in expected saving of 11% or an expected realization rate of 89%.

4.5 Measure Retention from CMC Site Visits

Certain measures such as insulation may be expected to have almost complete retention. As shown in Table 4.4, most measures showed fairly high retention. The lowest retention rate was for a measure with a very small sample size, AC filters.

The greatest expected savings for the site visit sample are CFLs, refrigerators, and insulation. These had retention rates of 81%, 100%, and 100%, respectively. This shows that the loss of CFLs has the greatest impact on savings. The site visit sampling was weighted toward Tier 2 homes versus the program population. For the program, the importance of CFLs is much greater than as implied by the retention table shown here.

Table 4.4 Measure Retention

Measure	kWh Savings	Total Installed	Total Observed	Retention
CFLs	27,017	276	223	81%
Aerators	0	43	41	95%
Pipe Insulation (DHW)[10]	2,950	83	81	98%
Water Heater Temp Setback	600	8	7	88%
Low Flow Showerheads	4,613	13	13	100%
Refrigerators	21,892	15	15	100%
Air Sealing	2,291	27	23	85%
Insulation[11]	10,844	3,450	3,450	100%
AC Filters	0	2	1	50%

Compact fluorescent lamps (CFLs) have an 81% retention rate, causing a significant loss of expected savings. At the same time, this is relatively good retention rate for CFLs. Customers were asked why measures were no longer in place. The main reasons for

8 Memo to Margaret Cush Grasso from Ken Tohinaka dated October 21, 2002, pages 3-4.
9 Ibid, page 7.
10 Pipe insulation quantities are measured in linear feet.
11 Insulation was quantities were measured in square feet.

customers' removal of CFLs were due to lamp failure or dissatisfaction with light quality (either too dim or poor lumen output), as shown in Table 4.5. There were a sizable number of incidents where the customer reported that apparently missing CFLs were not actually installed at the time of the audit. The reasons for removal by room are presented in Table 4.6.

Table 4.5 Reasons Given for CFL removal

Reason for Removal*	Number of CFLs
Burned out/lamp failure	20
Poor Lumen Output / Too Dim	18
Didn't fit existing table lamp	2
Didn't fit new light fixture	1
Not installed	6
No reason provided	2

* This represents only those CFLs that were removed from service. It does not include those removed from their original location and reinstalled elsewhere in the home.

In addition to those shown in Table 4.5, there were instances where CFLs were relocated within the home due to dissatisfaction with the light quality. CFL relocation is discussed in Section 4.6 below.

There were a total of seven CFLs that were not recorded in the program records, but were observed in the site visits. It is uncertain whether the additional lamps were obtained through the program or constitute program spillover. The extra lamps were found to be appropriate and cost effective.

Table 4.6 Reason for Removal by Room

Room	Burned Out	Not Bright Enough	Doesn't fit lamp	Never Installed	Not specified	Total
Kitchen	-3	-3	0	-2	0	-8
Bath	-1	-1	0	0	0	-2
Dining Room	0	-2	0	0	0	-2
Bedroom	-7	-5	0	-2	0	-14
Exterior	-2	0	0	0	0	-2
Family Room/Den/Sitting Room	0	-2	-1	0	0	-3
Hallway	0	0	0	0	0	0
Living Room	-4	-5	-2	-2	-2	-15
Basement	0	0	0	0	0	0
Other	0	0	0	0	0	0
TOTAL	-17	-18	-3	-6	-2	-46

What appears at a first glance to be a loss of one water heater temperature setbacks, actually reflects the replacement of one customer's water heater since his participation in the program. The new heater was not set back to the same temperature.

Although the program records did not indicate any estimated incremental energy savings from the installation of the aerators, there was an observed retention rate of 95%. This is a high retention rate for this measure. Of the two aerators that had been removed, one swivel type aerator was removed because it was too large for the sink basin and posed an obstacle when washing dishes. There was no reason provided for the other aerator that was missing from one bathroom location.

From the homes visited, there was 100% retention of showerheads. This is a measure that has in some programs had retention issues. The full retention here is excellent.

In 3 of the 27 homes that received air-sealing work, there were either no evidence of air sealing work or it had been removed. In the cases where it had been removed, one customer removed it because she thought that it was poorly installed. In another case the foam sealant around through-wall plumbing chases was removed when the building's property manager had done some plumbing work.

4.6 Compact Florescent Lamp Relocation

Of the 223 lamps that were retained and working, a majority (62%) of them were relocated from their originally installed location to another location within the home.[12] The retention by room found by comparing the site visit results and the program database is provided in Table 4.7.

The rooms from where lamps were relocated the most frequently were dining rooms, family rooms, hallways, kitchens and bedrooms. Although we are able to determine the origin and destination of lamps that were moved, we do not have insight into the reason for such moves. For example, we are not able to ascertain whether a lamp was removed for aesthetic reasons or whether the light quality was unacceptable in its original location. Customers were only queried on the reason for a measure's removal when it was removed altogether. However, there were two cases where customers had stated that they were dissatisfied with the light quality and, therefore, relocated the CFLs to other locations.

Table 4.8 displays the counts of CFL that were relocated from one place in the home to another. It shows that living rooms were the largest gainers of donated CFLs. There were 49 CFLs relocated to living rooms from other places and 13 were removed leaving a net gain of 36 CFLs to living room locations. Bedrooms had a net gain of 11, kitchens showed a net gain of 4 and 2 CFLs were moved into basements.

[12] This assumes that both the original auditor and the CMC auditor have identified each room the same way (e.g. living room versus family room).

On the donor side, dining rooms were the largest net losers where all of the 26 CFLs that were installed and retained were moved to other locations. Meanwhile, there were no CFLs relocated from other rooms to dining rooms. Similarly, bathrooms, family rooms, and hallways had net losses of CFLs due to relocation.

Table 4.7 Retention by Room

Location Originally Installed	Quantity Installed and Retained				
	Total	Retained in Same Location		Retained but in Different Location	
		#	Percent	#	Percent
Kitchen	40	16	40%	24	60%
Bath	52	29	56%	23	44%
Dining	26	0	0%	26	100%
Bedroom	35	13	37%	22	63%
Exterior	9	5	56%	4	44%
Family/Den/Sitting Room	10	0	0%	10	100%
Hallway	7	0	0%	7	100%
Living Room	35	22	63%	13	37%
Other / Unidentified	9	0	0%	9	100%
Total	**223**	**85**	**38%**	**138**	**62%**

Of the ten that were moved from Family/Den/Sitting Room locations, 4 were moved into kitchens and 4 were moved into bedrooms. The remaining 2 were recorded as being found in living rooms. This may be factual or it may be a case of two auditors identifying the same room differently.

Table 4.9 provides a by-room exam of net gains or losses from both relocation and removal.

Table 4.8 Origin / Destination Table

Origin \ Destination	Kitchen	Bath	Dining	Bedroom	Exterior	Family Den Sitting	Hallway	Living Room	Basement	Other or Unidentified	Total Origin
Kitchen		6	0	8	0	0	2	8	0	0	24
Bath	11		0	5	0	1	0	6	0	0	23
Dining	4	2		2	0	1	0	17	0	0	26
Bedroom	6	2	0		0	0	3	10	1	0	22
Exterior	1	0	0	1		0	0	1	1	0	4
Family/Den/Sitting Room	4	0	0	4	0		0	2	0	0	10
Hallway	1	2	0	4	0	0		0	0	0	7
Living Room	3	3	0	5	0	0	1		0	1	13
Other / Unidentified	0	0	0	4	0	0	0	5		0	9
Total Destination	30	15	0	33	0	2	6	49	2	1	138

Table 4.9 Total by Room Net Gain/Loss

Room	Net Gain/(Loss from Relocation)	(Loss from Removal)	Total Net Gain /(Loss)
Bath	6	(8)	(2)
Bedroom	(8)	(2)	(10)
Dining	(26)	(2)	(28)
Exterior	11	(14)	(3)
Family/Den/Sitting Room	(4)	(2)	(6)
Hallway	(8)	(3)	(11)
Kitchen	(1)	0	(1)
Living Room	36	(15)	21
Basement	2	0	2
Other / Unidentified	(8)	0	(8)
TOTAL	0	(46)	(46)

4.7 Missed Opportunities

The site visits also looked for missed opportunities where additional energy savings could have been obtained by the program. The results of this exam are displayed in Table 4.10.

Table 4.10 Summary of Missed Opportunities

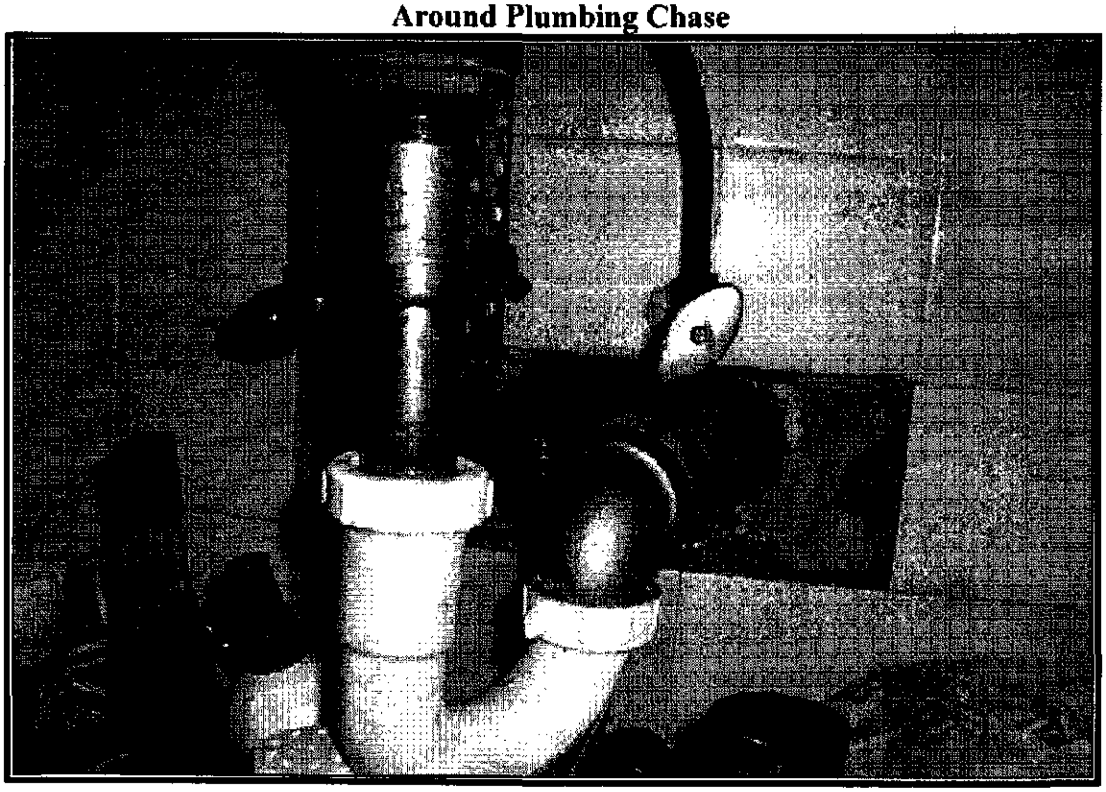
Measure Category	Missed Opportunity	Instances	Comments
Air Sealing	At recessed light fixtures	3	
	At window frames	6	
	At Wall mounted A/C	2	
	At Window mounted AC unit	2	
	Attic access	12	3 w/ Oil Heat
	Chimney Chase	1	
	Doorway to Exterior	4	2 w/ Oil Heat
	Doorway to unconditioned space	2	1 w/ Oil Heat
	Hole in wall	1	
	HVAC chases	2	1 w/ Gas Heat
	Louvers on inoperable house fan remain open	1	
	Plumbing Chase	10	4 w/ Oil Heat
	Total[13]	**46**	
DHW	Aerators[14]	4	
	Showerheads	1	
	Temperature setback (currently 135°F)	1	
	Total	**6**	
Education	Customer Replaced failed CFLs with Incandescent to save $$	1	
HVAC	Duct Insulation	3	
	Duct Sealing	2	
	Malfunctioning Thermostat (82° F for any heat)	1	
	Total	**6**	

[13] 11 of the homes where air sealing opportunities exist are within Non-electrically heated homes.
[14] Of the 4 missed opportunities for aerator installation, 3 were in kitchen locations.

Measure Category	Missed Opportunity	Instances	Comments
Insulation	Attic access	7	1 w/ Oil Heat
	Finished Basement	1	
	Poorly placed attic insulation should be repositioned.	2	
	Total	**10**	
Lighting	Incandescent lamps in high-use fixtures	**3**	

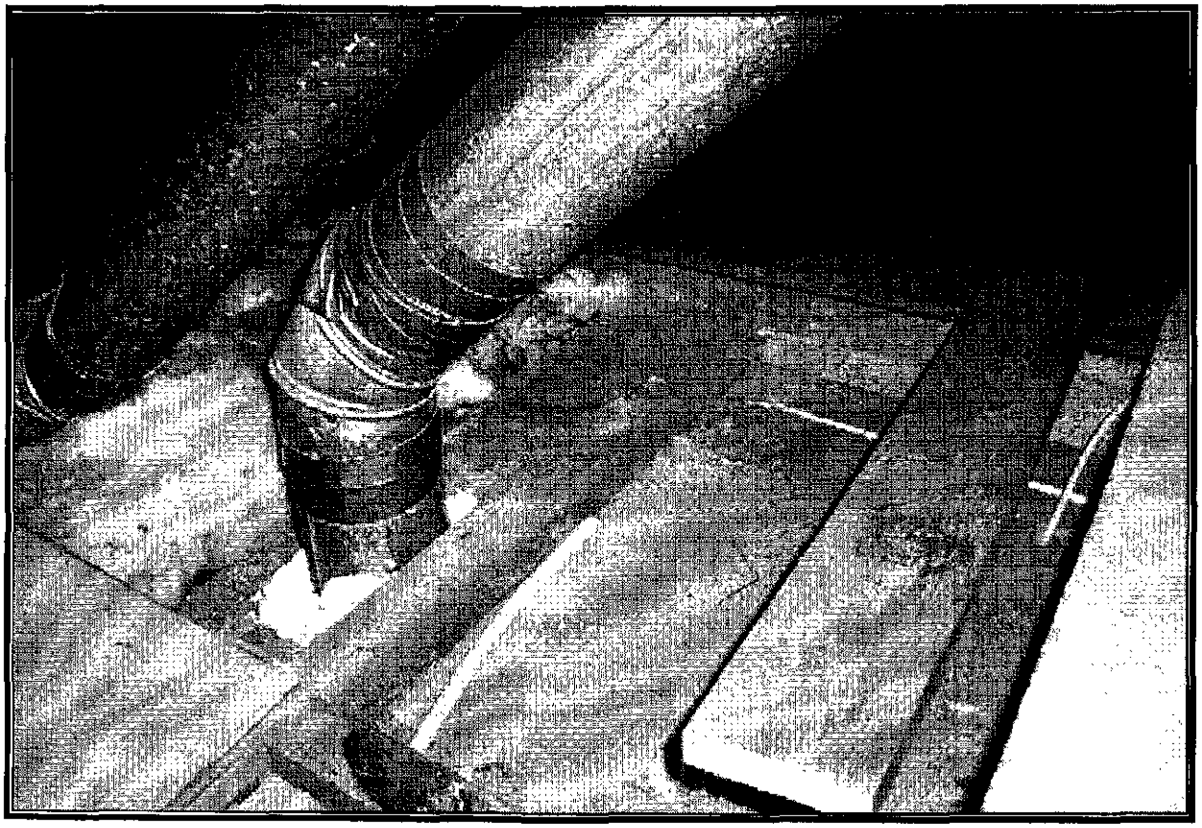
A vast majority of these missed opportunities occur where air-sealing opportunities were overlooked. Most of these cases were where the air infiltration at attic access ways and plumbing chases (many under sinks) was not corrected. An example of this is shown in Figure 4.2.

Figure 4.2 Missed Opportunity for Sealing Air Infiltration Around Plumbing Chase



In two homes there were places where the insulation had been moved or installed improperly and should have been repositioned. In one of these cases, as shown in Figure 4.3, fiberglass batts where not re-installed properly around HVAC ductwork after air sealing was performed.

Figure 4.3 Missed Opportunity for Proper Insulation Around Ductwork.



Missed opportunities for replacement of incandescent lamps with CFLs in high use areas were minimal. There were three homes where CFL opportunities were overlooked (at least six CFLs replacing 40 watt incandescent lamps). Although, there was not a lamp count provided for every home, there was one home where six lamps were noted.

The site visits also found one case where a refrigerator was not preserving food appropriately and may have posed a health and safety issue for the residents.

4.8 Customer Satisfaction

In general, customers were satisfied with the measures received through the program, and several commented that they appreciated the work that LIPA was doing. Some commented that they have been made aware of many ways to reduce their energy burden and have witnessed reductions to their monthly electric bill.

The cases were customers claimed to be at least somewhat dissatisfied with the performance of their measures were with aerators, CFLs, and air-sealing measures.

Customers' main complaint regarding CFLs and low watt incandescent lamps were that they did not last as long as they were told. Secondly, those customers that were dissatisfied with the CFLs were unhappy with the quality of the light; most thought they were too dim.

As mentioned earlier, customers that were less than satisfied with their aerators cited dissatisfaction with the spray or found the aerator to be in the way when washing dishes.

Those customers that gave an unsatisfactory rating for the air-sealing that was performed at their home cited poor installation or they did not think that air sealing was provided where it was needed most.

Although no customers claimed to be dissatisfied with their ENERGY STAR® refrigerator, there were some negative comments received. Most of these were that the refrigerator was smaller than their previous unit. However, there were two cases where the customers claimed having unspecified problems with the freezer portions of their refrigerators.

Table 4.7 Frequency of Customers' Satisfaction by Measure

Measure	Satisfaction Scale					Don't Know
	Unsatisfied------------------Satisfied					
	1	2	3	4	5	
Aerators	0	1	9	19	10	0
Showerheads	0	0	0	7	6	0
Pipe Insulation	0	0	0	11	12	1
Water Heater Temp Setbacks	0	0	0	3	4	1
CFLs	6	7	4	17	27	0
Refrigerators	0	0	4	1	10	0
Air Sealing	2	1	2	7	14	1
Insulation	0	0	0	0	3	0

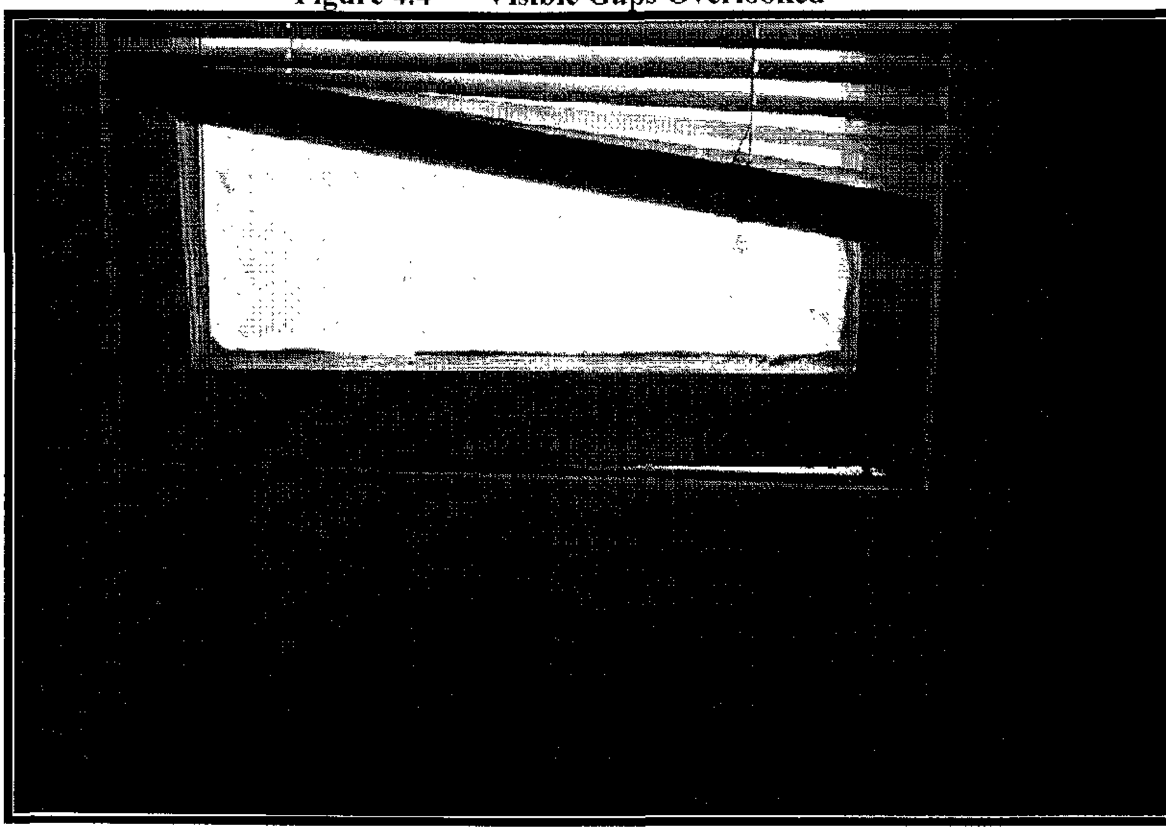
4.9 Quality

Most measures were installed appropriately and were noted to be cost effective installations. However, ten percent of the CFLs installed were found by the CMC auditor to be inappropriate and not cost effective in that they were either only used for 2 hours or less on a daily basis or they were too dim for the their installed application. Two were found in basement locations. Those that were appropriate but not cost effective were replaced or failed before their expected life.

The few domestic hot water (DHW) measures that were found not to be cost effective were due to the customer obtaining a new water heater within two years of program participation.

Quality for each measure was given a rating of either: "Poor", "Marginal" or "Meets Program Protocol". Eleven percent of the more than 300 individual measures that were reviewed received "Poor" ratings. Almost all of these were ratings attributed to CFLs that had failed prior to the end of their design life. There were two air-sealing installations that were given "Poor" ratings and one that received a "Marginal" rating. The "Poor" ratings were due to a "bad installation" or visible gaps being overlooked by the auditor (see Figure 4.4). The only other "Marginal" ratings were for an aerator that did not spray properly and a major unspecified chase found within a home that could have used sealing.

Figure 4.4 Visible Gaps Overlooked



Overall, the quality of the installations met the program protocol.

Most customers remember speaking about energy efficiency with the auditor that came to the home, and took many of the auditor's suggestions into consideration when purchasing equipment. In addition, it was noted that customers were generally aware of energy efficiency and took steps toward modifying their behavior to save energy.

5.0 Findings from Billing Analysis

The 2002 billing analysis work began with the examination and clean-up/explanation of the program database issues. This effort is described in Section 2.2.

The next step in the billing analysis included an extensive effort to link the previous billing data pull from 2001, a current billing data 24-record pull (for the older participants and the new participants), and the billing history pulled as part of program audits (within the program database records maintained by Honeywell DMC). This was accomplished as described in Section 2.2.

This data was then merged with program data. The resulting dataset was then checked for the problems discovered in last year's analysis, such as double-checking to ensure that there were no negative savings values. The average daily usage distributions were examined against those with electric heat, and air-conditioning status. Everything seemed reasonable and nothing was out of the ordinary. This verified that the earlier work on cleaning the program database information first was successful.

5.1 Initial 2002 Billing Analysis Findings

Regression models were tested similar to last year's, with the exception that the groupings of customers were based upon the program database's information identifying whether the participants had electric heat or not, no air-conditioning, window air-conditioning, or central air-conditioning. Using the program database information rather than rate code, as done in 2001, was an improvement recommended in last year's report. The program information is more accurate (as circumstances can change for participants without their rate code being changed) and more detailed (as rate codes do not indicate air-conditioning ownership, an important usage factor that is also strongly related to the need for differing weather adjustments within the regression).

The first tests attempted to replicate the results found in 2001 for electric heat participants. These results could not be duplicated (at 81-98% realization rates). The models were unstable with realization coefficients often being positive (wrong sign) and ranged anywhere from 4.0 to -0.72, and often weather adjustment variables had the wrong signs.

The most reasonable SAE ANCOVA model (in terms of realization rate and least amount of problems for electric heat participants) used an account-specific heating response (account interacted with HDD), and some type of cooling response control variable. The results of these show realization rates of 69% and 73%. These are shown in Table 5.1.

At the same time, however, the coefficient on the cooling degree variable is negative (or mostly negative in the interactive model) when it should be positive (i.e., greater need for cooling causes greater electricity usage). But eliminating the cooling degree variable produces a positive realization rate (an obvious indication of a mis-specified model), more negative coefficients on the account interactive heating response variables, a realization rate of 51%, and a lower corrected R-square.

Table 5.1 2002 Billing Analysis-Optimal Models of Participants with Electric Space Heat and Some Type of Cooling

Electric Space Heat – 558 accounts; 14,749 observations

Model: avgkwh=	acct acct*hdd cdd*acct total	$R^2 = 0.8242$
Realization rates:	Total -0.69	t-stat 10.20
Other variables:	Notes: All acct positive and significant. Almost all acct*hdd positive, yet not significant. But most acct*cdd negative.	

Electric Space Heat – 558 accounts; 14,749 observations

Model: avgkwh=	acct acct*hdd cdd total	$R^2 = 0.7276$
Realization rates:	Total -0.73	t-stat 8.92
Other variables:	CDD -0.93	t-stat 98.34
	Notes: All acct positive and significant. Most acct*hdd positive. Yet, not all and not significant. CDD wrong sign.	

The non-electric heat models had similar difficulties. The models were unstable. The most reasonable produced realization rates from 21% to 52%. Examples of the results for the customers with no-electric heat and no air-conditioning (AC) are shown in Table 5.2. Table 5.3 displays the results for those with non-electric heat and at least some type of AC.

Table 5.2 2002 Billing Analysis-Selected Models of Participants without Electric Heat

Non-Electric Heat, No Window or Central AC–1,392 accounts; 28,312 observations

Model: avgkwh=	acct total	$R^2 = 0.709$
Realization rates:	Total -0.27	t-stat 10.10
Other variables:	None Account positive and most significant.	

Non-Electric Heat, No Window or Central AC–1,392 accounts; 28,312 observations

Model: avgkwh=	acct hdd total	$R^2 = 0.709$
Realization rates:	Total -0.26	t-stat 9.82
Other variables:	HDD -0.0001	t-stat 3.29
	Notes: Account positive and most significant (but less than model without HDD).	

Non-Electric Heat, No Window or Central AC–1,392 accounts; 28,312 observations

Model: avgkwh=	acct acct*hdd total	$R^2 = 0.758$
Realization rates:	Total -0.31	t-stat 12.12
	Notes: Account positive and most significant. 1/3 of HDD*acct are negative.	

Table 5.3 2002 Billing Analysis-Selected Models of Participants without Electric Heat and with AC

Non-Electric Heat with some type of AC – 2,758 accounts; 54,706 observations

Model: avgkwh=	acct total	$R^2 = 0.749$
Realization rates:	Total -0.48	t-stat 27.62
	Notes: All acct positive and significant.	

Non-Electric Heat with some type of AC – 2,758 accounts; 54,706 observations

Model: avgkwh=	acct cdd total	$R^2 = 0.753$
Realization rates:	Total -0.42	t-stat 24.08
Other variables:	CDD 0.003	t-stat 29.46
	Notes: All acct positive and significant. CDD wrong sign.	

Non-Electric Heat with some type of AC – 2,758 accounts; 54,706 observations

Model: avgkwh=	acct acct*cdd total	$R^2 = 0.804$
Realization rates:	Total -0.40	t-stat 24.88
	Notes: All acct positive and significant. Most acct*hdd positive, but ¼ negative.	

Non-Electric Heat with some type of AC – 2,758 accounts; 54,706 observations

Model: avgkwh=	acct cdd hdd total	$R^2 = 0.759$
Realization rates:	Total -0.43	t-stat 24.87
Other variables:	CDD 0.0049	t-stat 43.38
	HDD -0.0008	t-stat 36.63
	Notes: All acct positive and significant. HDD wrong sign.	

Two additional billing analysis datasets were then created containing 1) only those where estimated savings were at least 5% of usage, and 2) only those where estimated savings were at least 10% of usage. If the amount of "noise" in the billing analysis is part of the problem in finding the correct realization rate, restricting the analysis to those where savings is a higher proportion of usage should help the regression models "find" the savings. However, the same difficulties were found in the regression models for these restricted datasets.

5.2 NSTAR Light Logger Study and Redefining Expectations

Ralph Prahl, one of LIPA's overall evaluation consultants, assisted in the review of two light logger studies conducted by NSTAR Services in Massachusetts in 2002. In the residential market, the light logger study was for participants in NSTAR's Residential High Use Program. Dr. Megdal had led an impact evaluation study for this effort in 2001. The billing analysis had been found to be problematic there and, overall, was not too different than what is being reported here. As in this case, the NSTAR program's actual installations are heavily weighted by lighting savings. Both Dr. Megdal and Mr. Prahl became aware that NSTAR found only about half of the usage among their residential participants that they had expected. Knowing this has influenced the additional billing analysis investigation conducted for LIPA's REAP program.

Margaret Cush Grasso, KeySpan's evaluation project manager for this evaluation, spoke with program and evaluation personnel at NSTAR to learn more about the relevant NSTAR light logger study. The NSTAR study is being finalized as this report is being drafted. Ms. Grasso, however, was able to learn the following information about this study.

Xenergy had been selected among competitive proposals for the study costing $74,000 and involved 59 on-site audits and the installation of approximately 250 light loggers for a four-week period in the May to June timeframe (2002). The data was <u>annualized</u> based upon three approaches.

The NSTAR planning models had assumed an average usage of four (4) hours; the program tracking system showed 6 hours (2,175/year). The light logger study, however, found 2.4 hours of use or 870/year (after annualization). This is less than half what was in the program tracking system (which comes from what the customers guess their usage to be as they answer program auditor's questions).

The other evaluation activities in the LIPA-REAP studies can also provide information to help assess and redefine our expectations for the realization rates of the billing analysis.

Last year's telephone survey of participants found a lighting retention rate of 88%.[15] The site visits (reported in Section 4 of this report) obtained a CFL retention rate of 81%. This is a significant loss in expected savings. At the same time, it is the maximum level given usage can only be affected by those that were retained.

The post-retrofit telephone survey in last year's evaluation found of average CFL usage of 3.63 hours per day compared to the program database average hours of use of 4.5 hours per day. This evaluation survey average is 24% less than that of the program database. A direct comparison of those with data from both sources was made, and the post-retrofit reported usage was almost 10% for this smaller sample.

The site visits report (Section 4.6) found that 62% of the retained lamps were relocated by the participants. If the program auditors put the lamps in the locations where they obtained the greatest savings, then these relocations would tend to cause a loss to expected savings (though we can not ascertain from the current data available whether this is a 10% loss or up to a 50% loss).

The most optimistic redefined realization rate for lighting would include the 88% retention rate, the smaller 10% reduction in usage, and only a 10% loss for location. This would yield the optimistic realization rate of 71% (0.88 * 0.9 * 0.9).

The much more conservative estimate would use the lower retention rate of 81%, a 50% loss on reported usage (similar to that found by NSTAR), and a 50% loss due to relocation. That would yield an expected lighting realization rate of only 20%; meaning that the REAP program is obtaining only 20% of its expected lighting savings (0.81 * 0.5 * 0.5).

A reasonable middle ground would be the 81% retention rate, and assume the loss in usage is a combination of the reported hours and relocation such that half of savings are lost due to this combination. This creates a redefined expected realization rate of 40.5% (0.81 * 0.5). This is large decrease in the current expected savings. At the same time, the retention loss alone is a significant part of this; and there are multiple indications that a reduction in usage from that in the program database is likely.

5.3 2002 Billing Analysis Findings for Participants with Refrigerators versus Those with Mostly Lighting Savings

Given the refrigerator metering effort led by Ken Tohinaka and the lower usage findings from the NSTAR light logger study, the next billing analysis investigation

[15] *Preliminary Process and Impact Evaluation of LIPA's Clean Energy Initiative REAP Program*, prepared by Megdal & Associates, April 24, 2002 for KeySpan Energy Services, pages 44-49.

took the approach of examining realization rates differently to assess refrigerator savings apart from lighting savings in the billing analysis.

Where reasonable models could be obtained, the models with participants that received refrigerators generally had significantly higher realization rates that those with participants that did not receive refrigerators (those with the higher proportion of expected savings from lighting). This points to significantly higher realization rates for refrigerator savings in the REAP program than for lighting savings.

Table 5.4 presents selected results for the non-electric heat customers with some type of air-conditioning for those that received refrigerators. Table 5.5 presents the results for the same type of participants but those that did not receive refrigerators. The models shown of those receiving refrigerators had realization rates of 46% - 51%, while the Table 5.5 results have realization rates of 21% - 35%.

Table 5.4 2002 Non-Electric Heated, Some AC Models for Those that Received Refrigerators

Non-Electric Heat, AC, Received Refrigerators–857 accounts; 16,705 observations

Model: avgkwh=	acct total	$R^2 = 0.6832$
Realization rates:	Total -0.508	t-stat 22.94
Other variables:	None. All account positive and most significant.	

Non-Electric Heat, AC, Received Refrigerators–857 accounts; 16,705 observations

Model: avgkwh=	acct cdd total	$R^2 = 0.687$
Realization rates:	Total -0.458	t-stat 20.55
Other variables:	CDD 0.003	t-stat 14.16
	Notes: All acct positive and significant.	

Table 5.5 2002 Non-Electric Heated, Some AC Models for Those that Did Not Receive Refrigerators

Non-Electric Heat, AC, No Refrigerators–1,901 accounts; 38,001 observations

Model: avgkwh=	acct total	$R^2 = 0.7675$
Realization rates:	Total -0.346	t-stat 8.32
Other variables:	None. All account positive and most significant.	

Non-Electric Heat, AC, No Refrigerators–1,901 accounts; 38,001 observations

Model: avgkwh=	acct cdd total	$R^2 = 0.7721$
Realization rates:	Total -0.208	t-stat 5.00
Other variables:	CDD 0.003	t-stat 26.95
	Notes: All acct positive and significant.	

The other groups (those with non-electric heat and no AC, and those with electric heat) did not work as explicitly in support of this hypothesis. Again, the billing analysis results are not stable and vary considerably by model specification.

Testing with the two datasets on significant savers (i.e., those with expected savings at least 5% and 10% of usage) was again performed with these alternative groupings (those with and those without receiving refrigerators). The "with refrigerator" and "without refrigerator" groupings were also tested with early versus later participants.

Identical models for the non-electric heat, no AC, 10% and above savers group provided results exactly as would be hypothesized from strong refrigerator savings but much lower lighting savings. The realization rate for refrigerators is 79%, while lighting measures showed the realization rate of 25%. The level of both of these and their level in comparison to each other are quite plausible given our other analyses. These results are shown in Table 5.6.

Table 5.6 Support of Different Refrigerator and Lighting Realization Rates, Non-Electric Heat with No AC and Savings at Least 10% of Usage

Non-Electric Heat, No AC, Lighting Only–323 accounts; 6,378 observations

Model: avgkwh=	acct total	$R^2 = 0.7797$
Realization rates:	Total -0.247	t-stat 5.03
Other variables:	None. All account positive and most significant.	

Non-Electric Heat, No AC, Refrigerators Only–30 accounts; 614 observations

Model: avgkwh=	acct total	$R^2 = 0.6589$
Realization rates:	Total -0.787	t-stat 5.81
Other variables:	Notes: All acct positive and significant.	

6.0 Summary and Use of Findings, and Recommendations

6.1 2002 Impact Evaluation Conclusions

Refrigerators have an almost 100% retention rate. The site visits found a 100% retention rate and last year's telephone survey of participants found one case where the refrigerator was not there resulting in a 99% persistence rate.

The small refrigerator metering study found that refrigerator savings estimates are probably overestimated given that new Energy Star refrigerators are seeing greater usage in the field among LIPA's REAP participants than the rated usage. Given this, we would expect savings to be around 90% of what had been claimed.

The picture also shows that lighting savings, a large part of program savings, may be significantly less than estimated. Retention alone drops the expected savings to 81% of the program database estimates. Usage changes then are applied to only those retained.

Then customers relocate many of the retained CFLs, which would likely move many into less cost-effective locations.

Customers' post-program reported usage is significantly less than was reported to program auditors (and included in the program savings estimates), from 10-24% less than what is in the database.

Additionally, customers may be very poor at estimating their actual usage of their lights. The NSTAR study suggests that this could create a large loss of savings. Given the billing analysis results, this factor cannot be ignored for the LIPA REAP program.

The final lighting savings realization rate could be from 20% to 70% of the program estimates. This is a large range and this study cannot be much more definitive than that. Yet, there is a significant loss of savings as CFLs are a large part of program savings and these savings are at least 30% less than estimated by the program.

The billing analysis supports that savings a significantly less than the program estimates. It also provides support that the refrigerator realization rates are likely much higher than the lighting savings realization rates.

6.2 Recommendations and Next Evaluation Steps

The REAP program, its KeySpan management, and LIPA personnel and its consultants will need to ascertain how to use the information being provided in this report. We would expect that the refrigerator savings estimates would probably be adjusted downward to 90% of their current levels in the future.

The broad range on potential lighting savings realization rates, however, makes a simple adjustment more problematic. At the same time, it is important to recognize that actual lighting savings are probably significantly less than has been reported. This needs to be considered for future program savings reports, program planning, and evaluation planning.

The large range in possible lighting realization rates, all showing significant loss of savings, directs additional evaluation efforts to focus on improving this assessment. The last evaluation effort within this multi-phase REAP evaluation is a process evaluation to be conducted over the next few months. We will revise the customer telephone survey to capture whatever information may help in this process. Nevertheless, this cannot capture actual usage as opposed to customer reported usage. A light logger study, or using NSTAR's study results, might need to be undertaken to narrow the lighting realization rate estimate.

Appendix A: Site Visit Data Collection Form

LIPA On-Site Inspection

Contact Information

John Q. Customer
123 Maine Street
Long Island Town NY 11555

Enrollment ID D002xxxxxx
Phone: (631) 555-1234
Phone:
Status 8/ 3/2000

Site Information

Structure Type:	Mobile home	**Room AC Efficiency:**	
Age of Structure:	45	**Central Cooling Efficiency:**	
No of	8	**Is there an ATTIC:**	Yes
No. of Open/Unfloored	Two	**Attic type:**	
Total Unit Area (s.f.):	2400	**Is there a basement and**	
Primary Heat Fuel:	Electric	**Is it heated?**	No
Basement			
Heat Type:	Baseboard/Resistance	**Initial blower door**	4680
Secondary Heat		**Final blower door reading:**	4680
DHW	Electric		
DHW tank size:	40		
DHW temp setting:	125		

Refrigerator Monitoring

Metered kWh: 0.323
Time Elapsed: 2
Age of Primary Refrig.: 15

Measures Installed and Actions Taken

Measure Description	Quantity Installed Savings	Quantity Observed	Location
Air Sealing Hours	*1*		
Attic Insulation - R-19 Cellulose Open-Blow Technique	*650*	*566.337*	

Air Sealing Hours 1

On a scale of 1 to 5 how satisfied was the customer with this measure/item? ____________
If the above item was removed or replaced, why? ____________
Was the measure appropriate and likely to be cost-effective? ____________
What is the Quality Rating for this measure? Quality-meets program protocols; Marginal; or Poor? (Make Comments)._ ____________

Attic Insulation - R-19 Cellulose Open-Blow Technique *650* *566.337*

On a scale of 1 to 5 how satisfied was the customer with this measure/item? ____________
If the above item was removed or replaced, why? ____________
Was the measure appropriate and likely to be cost-effective? ____________
What is the Quality Rating for this measure? Quality-meets program protocols; Marginal; or Poor? (Make Comments). ____________

Measure Description	Quantity Installed	Quantity Observed	Location	Savings
Wall Insulation - R-11 Cellulose Tube-Insertion Dense Pack	*2000*	________		*7242.575*

On a scale of 1 to 5 how satisfied was the customer with this measure/item? ____________________
If the above item was removed or replaced, why? ____________________
Was the measure appropriate and likely to be cost-effective? ____________________
What is the Quality Rating for this measure? Quality-meets program protocols; Marginal; or Poor? (Make Comments). ____________________

Aerator - Standard	*1*	________		*0*

On a scale of 1 to 5 how satisfied was the customer with this measure/item? ____________________
If the above item was removed or replaced, why? ____________________
Was the measure appropriate and likely to be cost-effective? ____________________
What is the Quality Rating for this measure? Quality-meets program protocols; Marginal; or Poor? (Make Comments). ____________________

DHW Pipe Insulation (3/4")	*3*	________		*118*

On a scale of 1 to 5 how satisfied was the customer with this measure/item? ____________________
If the above item was removed or replaced, why? ____________________
Was the measure appropriate and likely to be cost-effective? ____________________
What is the Quality Rating for this measure? Quality-meets program protocols; Marginal; or Poor? (Make Comments). ____________________

DHW Temperature Turndown	*1*	________		*75*

On a scale of 1 to 5 how satisfied was the customer with this measure/item? ____________________
If the above item was removed or replaced, why? ____________________
Was the measure appropriate and likely to be cost-effective? ____________________
What is the Quality Rating for this measure? Quality-meets program protocols; Marginal; or Poor? (Make Comments). ____________________

15 Watt Compact Fluorescent		________		*65.7*

On a scale of 1 to 5 how satisfied was the customer with this measure/item? ____________________
If the above item was removed or replaced, why? ____________________
Was the measure appropriate and likely to be cost-effective? ____________________
What is the Quality Rating for this measure? Quality-meets program protocols; Marginal; or Poor? (Make Comments). ____________________

21 Cu.Ft. Energy Star Model	*1*	________	*Kitchen*	*749.12*

On a scale of 1 to 5 how satisfied was the customer with this measure/item? ____________________
If the above item was removed or replaced, why? ____________________
Was the measure appropriate and likely to be cost-effective? ____________________
What is the Quality Rating for this measure? Quality-meets program protocols; Marginal; or Poor? (Make Comments). ____________________

Low Flow Massage Showerhead	*1*	________		*922.573*

On a scale of 1 to 5 how satisfied was the customer with this measure/item? ____________________
If the above item was removed or replaced, why? ____________________
Was the measure appropriate and likely to be cost-effective? ____________________
What is the Quality Rating for this measure? Quality-meets program protocols; Marginal; or Poor? (Make Comments). ____________________

LIPA On-Site Inspection

No of Rooms:	________	Room AC Efficiency:	________
No. of	________	Central Cooling Efficiency:	________
Total Unit Area	________	Is there an ATTIC:	________
		Is it heated?	________
Primary Heat Fuel:	________		
Heat Type:	________	Is there a basement?	________
Secondary Heat	________	Is it heated?	________
DHW Fuel:	________	Blower door reading:	________
DHW tank size:	________		

DHW temp

Refrigerator Monitoring

Primary Refrigerator

Metered kWh: ________
Time Elapsed: ________
Age: ________

Secondary Refrigerator/Freezer

Metered kWh: ________
Time Elapsed: ________
Age: ________

LIPA On-Site Inspection

Lost Opportunities:

Comments