Subject **Focus on Energy Evaluation**

2010 CFL Savings Analysis

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This memo presents estimates of compact fluorescent light bulb (CFL) gross and net energy savings for the residential Focus on Energy (Focus) ENERGY STAR Lighting program for the 2010 program year. These estimates are based on CFL reward data for the period of January 1, 2010, to December 31, 2010.

First, we discuss how annual energy savings are calculated and present the estimated gross and net annual energy savings for the 2010 program year. Next, we present the assumptions and calculations used to determine lifetime energy savings and then present the estimated gross and net lifetime energy savings.

Annual Energy Savings

During the 2010 program year, CFL rewards were paid through one of three methods: buydowns, instant lighting coupons, and mail-in rebates. Because some of the savings assumptions vary by the type of reward, we analyze and present the savings by reward type.

Annual Calculations and Assumptions

Gross annual energy savings, potential gross demand savings, and gross summer peak savings[1] were calculated using the following formulas:

$$Gross\ Annual\ Savings\ (kWh) = \frac{\#\ of\ CFLs \times Installation\ Rate \times \Delta\ Watts \times Daily\ Use \times 365}{1000}$$

$$Potential\ Gross\ Demand\ Savings\ (kW) = \frac{\#\ of\ CFLs \times Installation\ Rate \times \Delta\ Watts}{1000}$$

$$Gross\ Summer\ Peak\ Savings\ (kW) = Potential\ Gross\ Demand\ Savings \times Summer\ Coincidence\ Factor$$

Net annual energy savings and net summer peak savings were calculated using the following formulas:

$$Net\ Annual\ Savings\ (kWh) = NTG\ ratio \times Gross\ Annual\ Savings$$

$$Net\ Summer\ Peak\ Savings\ (kW) = NTG\ ratio \times Gross\ Summer\ Peak\ Savings$$

Table 1 displays the assumptions that feed into the gross energy savings calculations for each of the three types of rewards. An effort was made to identify updated assumptions of hours of use, installation rate, delta watts, and coincidence factor from reports published since the *2009 CFL Savings Analysis*.[2] One such evaluation report from California[3] was reviewed; however, we determined that the assumptions from the 2009 analysis (as shown in Table 1) are more appropriate because they are either from Wisconsin or are derived from studies in New England, which has seasonal daylight patterns similar to Wisconsin.

From the program's CFL rewards database, we determined that a total of 1,224,170 CFLs were rewarded to residential customers in 2010. The installation rates and delta watts values were determined from previous Focus evaluation reports.[4, 5] We assume that the installation rate and delta watts for buydown CFLs are the same as for instant coupon CFLs. CFLs were assumed to be in use an average of 2.77 hours per day, according to an evaluation conducted

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[1] Potential gross demand savings assumes that all installed CFLs are turned on at the same time. The summer coincidence peak factor is an estimate of the percentage of installed CFLs turned on during on-peak summer hours.

[2] Tom Mauldin, Zack Tyler, and Lynn Hoefgen, NMR. *2009 CFL Savings Analysis.* April 22, 2010.

[3] KEMA, Inc. and The Cadmus Group, Inc. *Final Evaluation Report: Upstream Lighting Program Volume 1.* February 8, 2010.

[4] Rick Winch and Tom Talerico, Glacier Consulting Group, LLC. *Compact Fluorescent Lighting Installation Rate Study*. December 27, 2007.

[5] Rick Winch and Tom Talerico, Glacier Consulting Group, LLC. *Analysis of Delta Watts Values for CFLs Rewarded through the Residential Lighting Program during FY07*. March 6, 2008.

in New England.[6] Finally, CFLs were assumed to have an on-peak coincidence factor of 0.108 in the summer.[7]

Table 1. 2010 Gross Energy Savings Assumptions

	Buydown	Instant	Mail-in
Number of CFLs	1,194,738	22,520	6,912
Installation rate	81%	81%	88%
Delta watts (W)	53.3	53.3	55
Daily hours of use	2.77	2.77	2.77
Summer coincidence factor on-peak	0.108	0.108	0.108

Gross and Net Annual Energy Savings

We calculate that the CFLs rewarded during 2010 yield gross annual energy savings of over 53 million kWh. Using the on-peak summer coincidence factor of 0.108, we calculate gross summer peak demand savings of 5,712 kW (Table 2).

Table 2. 2010 Gross Annual Energy Savings

	Buydown	Instant	Mail-in	Total
Gross annual kWh savings per CFL	43.7	43.7	48.9	43.7
Gross annual kWh savings	52,150,398	982,999	338,237	53,471,634
Potential gross kW savings	51,580	972	335	52,887
Gross summer peak kW savings	5,571	105	36	5,712
Gross summer peak kW savings per CFL	0.0047	0.0047	0.0052	0.0047

Table 3 shows the net annual energy savings as well as the net summer peak demand savings. Net annual energy savings were calculated using the net-to-gross ratio of 0.62 from the 2008 program evaluation.[8] In 2010, the program achieved net annual energy savings of 33 million kWh and net summer peak savings of 3,541 kW.

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[6] Nexus Market Research, Inc. and RLW, Inc. *Residential Lighting Markdown Impact Evaluation.* Markdown and Buydown Program Sponsors in Connecticut, Massachusetts, Rhode Island, and Vermont. January 20, 2009.

[7] Nexus Market Research, Inc. and RLW, Inc. *Residential Lighting Markdown Impact Evaluation.* Markdown and Buydown Program Sponsors in Connecticut, Massachusetts, Rhode Island, and Vermont. January 20, 2009. ISO New England defines summer peak periods as non-holiday weekdays between 1 pm–5 pm during the months of June, July, and August. Wisconsin's definition of summer peak periods is the same except the time is 1 pm to 4 pm.

[8] Lisa Wilson-Wright, Chris Russell, and Lynn Hoefgen, NMR Group. *Results of the Multistate CFL Modeling Effort.* March 7, 2010.

Table 3. 2010 Net Annual Energy Savings

	Buydown	Instant	Mail-in	Total
Net annual kWh savings per CFL	27.1	27.1	30.3	27.1
Net annual kWh savings	32,333,246	609,460	209,707	33,152,413
Net summer peak kW savings	3,454	65	22	3,541
Net summer peak kW savings per CFL	0.0029	0.0029	0.0032	0.0029

Lifetime Energy Savings

In order to determine the lifetime energy savings of CFLs, we took into account the likely effects of the Federal Energy Independence and Security Act of 2007 (EISA). EISA calls for a phase-out of most inefficient light bulbs beginning in 2012. EISA's statutory language is based on lumens rather than wattage. In order to determine the wattage of inefficient incandescent bulbs that will be phased out beginning in 2012, we assumed that incandescent efficacy is about 15 lumens per watt. After calculating the incandescent wattages to be phased out, we identified the CFL equivalents for these incandescents in order to calculate the lifetime energy savings of program CFLs. We assumed that incandescent bulbs, on average, have wattages that are 3.9 times higher than equivalent CFLs, based on several common CFL wattages (Table 4).[9]

Table 4. EISA Phase-out Schedule

Effective Date	Lumen Range	Estimated Incandescent Wattage	CFL Equivalent Wattage
1/1/2012	1490–2600	99–173	25.4–44.3
1/1/2013	1050–1489	70–99	17.9–25.3
1/1/2014	750–1049	50–70	12.8–17.9
1/1/2014	310–749	21–50	5.3–12.7

EISA exempts a number of bulb types from the phase-out. Among other bulb types, EISA exempts the following: reflector bulbs, globe shaped bulbs, 3-way bulbs, candelabra-shaped bulbs, and bug lights.

Lifetime Calculations and Assumptions

With the first wave of EISA phase-outs becoming effective in 2012, the lighting market is currently in a state of flux and it is not clear how manufacturers will respond to the EISA requirements. At this point, we anticipate that opportunities for CFL savings, though reduced, will continue, assuming that manufacturers develop EISA-compliant incandescent or halogen bulbs. The lifetime energy savings calculations presented here assume that there are reasonably priced EISA-compliant incandescent or halogen bulbs available at the time that the EISA phase-outs become effective. It also assumes that the potentially lower lumen output of

[9] Rick Winch and Tom Talerico, Glacier Consulting, Group, LLC. *Analysis of Delta Watts Values for CFLs Rewarded through the Residential Lighting Program during FY07*. March 6, 2008.

the EISA-compliant incandescent or halogen bulbs does not result in consumers shifting to higher wattage replacement bulbs.

Based on the EISA phase-out schedule, we assume that non-specialty CFL bulbs that are 25 watts or more will accrue the current annual energy savings until 2012 and will then accrue reduced savings for the remainder of the measure life.[10] Likewise, non-specialty CFLs between 18 and 24 watts will accrue reduced savings after 2013, and non-specialty CFLs of 18 watts or less will accrue reduced savings after 2014. Specialty bulbs will accrue the same annual energy savings for the full measure life.

The following calculation was used to determine gross lifetime savings:

$$\begin{aligned} &Gross\ Lifetime\ Savings\ (kWh) \\ &= Gross\ Annual\ Savings \times PreEISA\ phaseout\ savings\ duration \\ &+ \left[(Measure\ Life - PreEISA\ phaseout\ savings\ duration) \times \frac{\#\ of\ CFLs \times Installation\ Rate \times PostEISA\ \Delta\ Watts \times Daily\ Use \times 365}{1000}\right] \end{aligned}$$

The reduced delta watts values for the post-EISA period were calculated based on EISA requirements as well as common assumptions regarding bulb wattages. For example, a 60-watt incandescent bulb is typically replaced by a 13-watt CFL bulb, which yields a savings of 47 watts per bulb (Table 5). After EISA becomes effective, the maximum wattage allowed for this lumen category is 43 watts, which reduces the savings by 36 percent, to 30 watts per bulb. The average reduction in energy savings across all four wattage categories is 37 percent.

In order to calculate a post-EISA wattage savings for all bulbs, we reduced the pre-EISA wattage savings presented in Table 1 by 37 percent. This reduced the delta watts values from 53.3 watts to 33.6 watts and from 55.0 watts to 34.7 watts.

Table 5. Post-EISA Savings Estimates

Incandescent Wattage	Assumed CFL equivalent (watts)	Pre-EISA CFL savings (watts)	Maximum post-EISA wattage allowed	Post-EISA CFL savings (watts)	Reduction in Savings
40 Watts	9	31	29	20	35%
60 Watts	13	47	43	30	36%
75 Watts	19	56	53	34	39%
100 Watts	25	75	72	47	37%
Average	16.5	52.3	49.3	32.8	37%

Table 6 shows the assumptions used to calculate the gross lifetime energy savings from CFLs rewarded during 2010. To the extent possible, we categorized program CFLs by wattage, bulb shape, and specialty feature. While the instant coupon and mail-in records included wattage, bulb shape, and specialty feature in the tracking database, the buydown CFLs, which represent 98 percent of all rewarded CFLs in 2010, only included this information for 62 percent of

[10] For the purposes of the lifetime energy savings calculations, specialty CFLs include the following: reflectors/floods, globes, 3-ways, candelabras, and bug lights.

records. WECC was able to provide the wattages and model information for an additional 27 percent of the buydown CFLs; cumulatively, model information was available for 89 percent of buydown CFLs. For one retailer for which wattage and model information was not available and for which no comparable retailers existed, we allocated the CFLs to the wattage and specialty categories based on the average proportion of CFLs in each category from all other retailers. Overall, we estimated there were a total of 191,612 non-specialty CFLs of 25 watts or more, 140,542 non-specialty CFLs between 18 watts and 24 watts, 722,054 non-specialty CFLs less than 18 watts, and 169,962 specialty CFLs.

We assumed a lifetime installation rate of 97 percent for the buydown CFLs and 99 percent for both the instant and mail-in CFLs.[11, 12] We assumed a maximum measure life of 6.8 years for the buydown CFLs and 5.5 years for both the instant and mail-in CFLs.[13] Assuming that non-specialty CFLs were installed in mid-2010, we based the pre-EISA savings on the difference between mid-2010 and the middle of the EISA phase-out year.[14] Post-EISA savings for non-specialty CFLs are calculated as the difference between the measure life and the middle of the EISA phase-out year.

Table 6. 2010 Lifetime Energy Savings Assumptions

	Buydown	Instant	Mail-In
Number of CFLs 25W or more (2012 EISA phase-out)	189,237	1,922	453
Number of CFLs 18W–24W (2013 EISA phase-out)	129,195	9,865	1,482
Number of CFLs <18W (2014 EISA phase-out)	708,861	10,022	3,171
Number of specialty CFLs	167,445	711	1,806
Lifetime installation rate	97%	99%	99%
Pre-EISA Delta watts (W)	53.3	53.3	55.0
Post-EISA Delta watts (W)	33.6	33.6	34.7
Daily hours of use	2.77	2.77	2.77
CFL measure life	6.8	5.5	5.5
2012 Pre-EISA phase-out savings duration (years)	2	2	2
2013 Pre-EISA phase-out savings duration (years)	3	3	3
2014 Pre-EISA phase-out savings duration (years)	4	4	4

[11] Nexus Market Research, Inc. and RLW, Inc. *Residential Lighting Markdown Impact Evaluation.* Markdown and Buydown Program Sponsors in Connecticut, Massachusetts, Rhode Island, and Vermont. January 20, 2009.

[12] Nexus Market Research, Inc. and RLW, Inc., *Residential Lighting Measure Life Study*. New England Residential Lighting Program Sponsors. June 4, 2008.

[13] Ibid.

[14] While the EISA ban takes effect on January 1 of each year, we assume that incandescent bulbs will remain available until retailers sell out of existing stock, likely the middle of each year.

Gross and Net Post-EISA Annual Energy Savings

We calculate that the CFLs rewarded during 2010 will yield gross annual energy savings of over 33 million kWh during the post-EISA period. Using the on-peak summer coincidence factor of 0.108, we calculate gross summer peak demand savings of 3,601 kW during the post-EISA period (Table 7).

Table 7. 2010 Gross Annual Post-EISA Energy Savings

	Buydown	Instant	Mail-in	Total
Gross annual kWh savings per CFL	27.5	27.5	30.9	27.5
Gross annual kWh savings	32,875,298	619,677	213,397	33,708,372
Potential gross kW savings	32,516	613	211	33,340
Gross summer peak kW savings	3,512	66	23	3,601
Gross summer peak kW savings per CFL	0.0029	0.0029	0.0033	0.0029

Table 8 shows the net annual energy savings as well as the net summer peak demand savings for the post-EISA period. Net annual energy savings were calculated using the net-to-gross ratio of 0.62 from the 2008 program evaluation.[15] We estimate that the 2010 program will achieve net annual energy savings of nearly 21 million kWh and net summer peak savings of 2,232 kW during the post-EISA period.

Table 8. 2010 Net Annual Post-EISA Energy Savings

	Buydown	Instant	Mail-in	Total
Net annual kWh savings per CFL	17.1	17.1	19.1	17.1
Net annual kWh savings	20,382,684	384,200	132,306	20,899,190
Net summer peak kW savings	2,177	41	14	2,232
Net summer peak kW savings per CFL	0.0018	0.0018	0.0020	0.0018

Gross and Net Lifetime Energy Savings

Table 9 presents the lifetime energy savings for CFLs purchased through the Focus program during 2010. The gross lifetime savings for these CFLs is estimated to be over 368 million kWh. The net lifetime savings, based on a net-to-gross ratio of 0.62, is estimated to be over 228 million kWh.

Table 9. 2010 Lifetime Energy Savings

	Buydown	Instant	Mail-in	Total
Gross lifetime savings per CFL (kWh)	302	253	274	301
Gross lifetime savings (kWh)	360,772,100	5,698,308	1,890,606	368,361,015
Net lifetime savings (kWh)	223,678,702	3,532,951	1,172,176	228,383,829

[15] Lisa Wilson-Wright, Chris Russell, and Lynn Hoefgen, NMR Group. *Results of the Multistate CFL Modeling Effort.* March 7, 2010.