Questions below are regarding the spreadsheet EERE-2014-BT-STD-0031-002 unless otherwise noted.

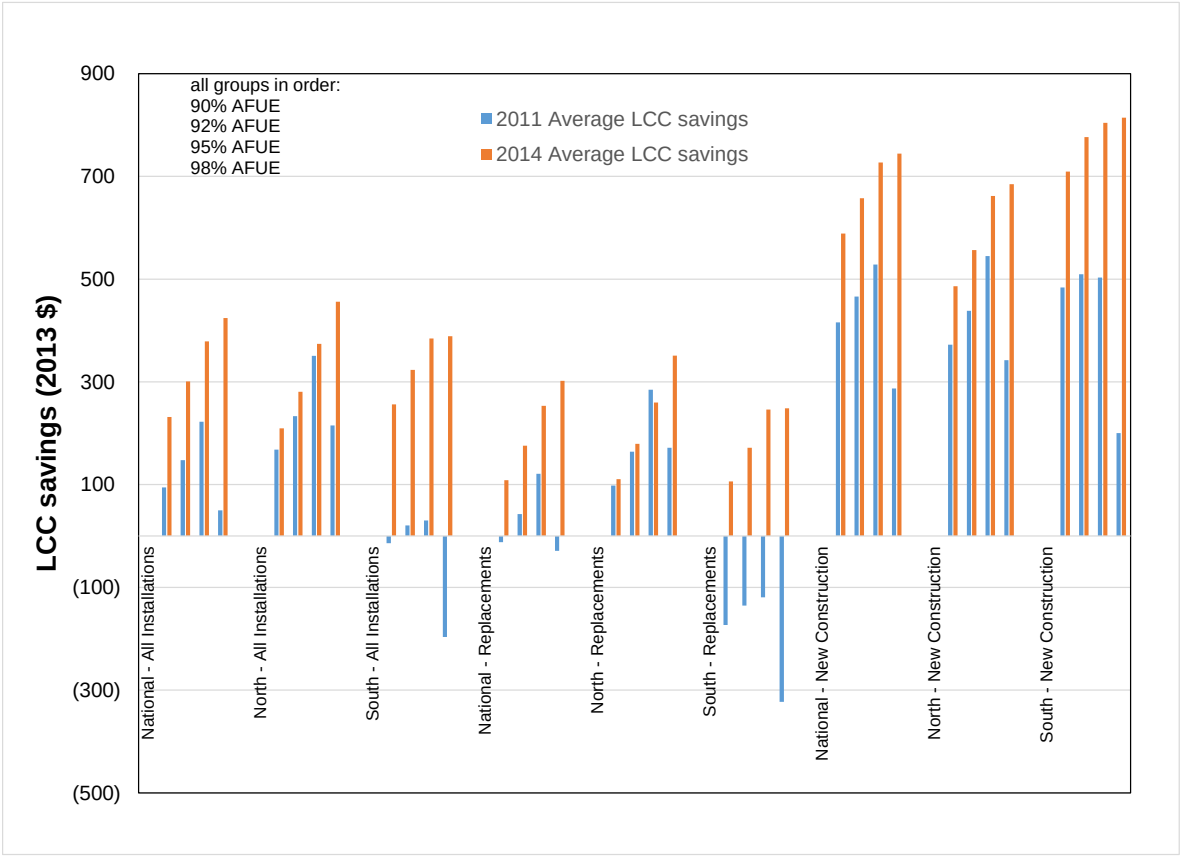
1) **The 2011 LCC spreadsheet predicted lower LCC savings, especially for replacements in the south region and for the highest efficiency (98%) condensing furnace cases, compared to the 2014 LCC spreadsheet even though the 2011 LCC spreadsheet did not include the potential of fuel switching.**

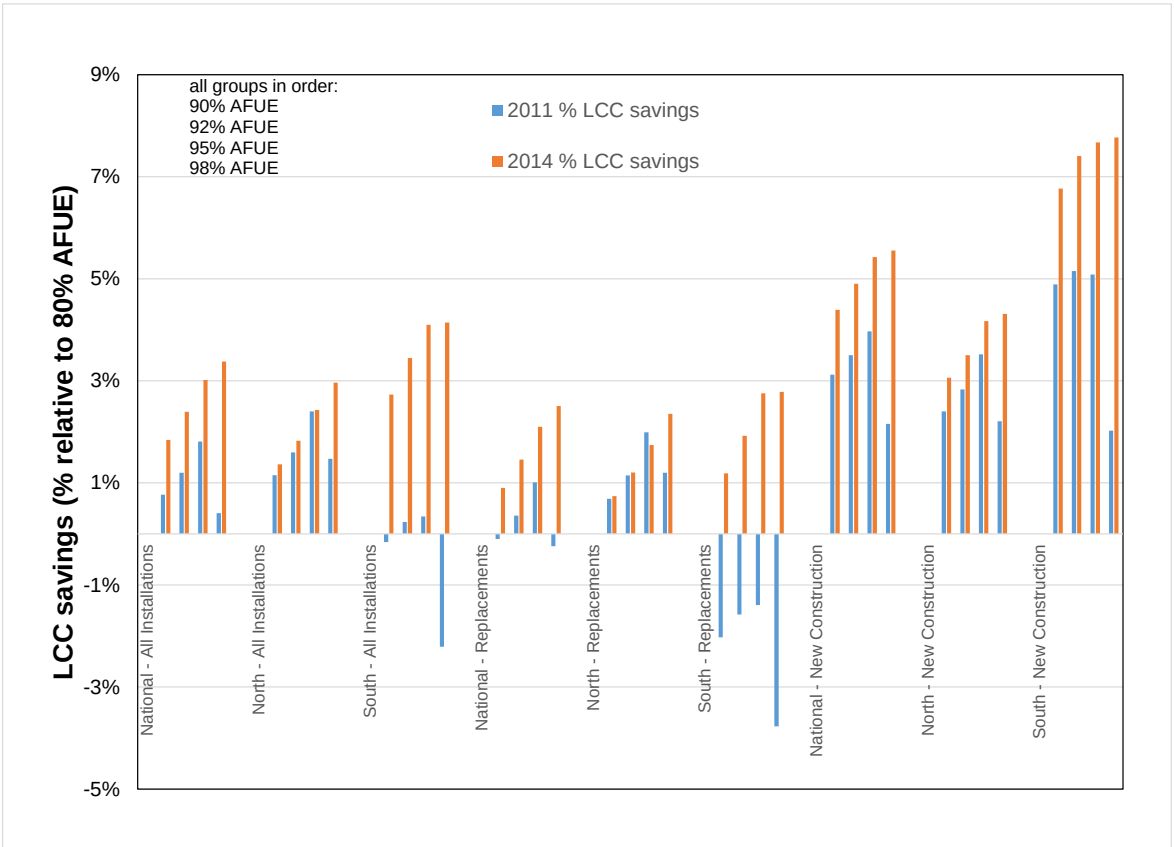
    a) What are the major reasons for the significant changes in LCC savings?

    b) Why do consumer impacts for replacements in the south not sum to 100% in the 2014 LCC spreadsheet?

    c) The 2014 LCC spreadsheet predicts first year operations cost savings averaging between $54 and $88 depending on the mandated efficiency level while the fuel switching impact analysis model provided by AGA and dated 7/11/2104 predicts a first year cost increase of $62 even though both consider fuel switching impacts. What are potential reasons for this significant discrepancy in top level results?

	efficiency	2011 Baseline LCC and Average LCC savings 2013$	2011 % LCC savings	2014 Baseline LCC and Average LCC savings	2014 % LCC savings	2011 Net Consumer Cost	2011 No Consumer Impact	2011 Net Consumer Benefit		2014 Net Consumer Cost	2014 No Consumer Impact	2014 Net Consumer Benefit	
National - All Installations	80% AFUE	12,310		$12,560									
	90% AFUE	94	0.8%	$231	1.8%	25.2%	52.4%	22.4%	100%	21%	47%	32%	100%
	92% AFUE	148	1.2%	$301	2.4%	26.0%	41.8%	32.2%	100%	19%	41%	39%	100%
	95% AFUE	223	1.8%	$379	3.0%	36.2%	16.9%	46.9%	100%	24%	23%	52%	100%
	98% AFUE	50	0.4%	$424	3.4%	64.2%	0.5%	35.4%	100%	41%	0%	59%	100%
		-											
North - All Installations	80% AFUE	14,609		$15,379									
	90% AFUE	168	1.2%	$209	1.4%	10.0%	71.4%	18.6%	100%	11%	67%	22%	100%
	92% AFUE	233	1.6%	$281	1.8%	10.9%	56.5%	32.6%	100%	10%	60%	30%	100%
	95% AFUE	351	2.4%	$374	2.4%	22.8%	22.9%	54.3%	100%	14%	40%	46%	100%
	98% AFUE	215	1.5%	$456	3.0%	58.7%	0.6%	40.7%	100%	38%	1%	61%	100%
		-											
South - All Installations	80% AFUE	8,882		$9,383									
	90% AFUE	(14)	-0.2%	$256	2.7%	47.9%	24.1%	28.0%	100%	33%	24%	43%	100%
	92% AFUE	21	0.2%	$323	3.4%	48.4%	19.9%	31.7%	100%	30%	20%	50%	100%
	95% AFUE	30	0.3%	$384	4.1%	56.1%	8.0%	35.9%	100%	35%	5%	60%	100%
	98% AFUE	(197)	-2.2%	$389	4.1%	72.3%	0.2%	27.4%	100%	44%	0%	56%	100%
		-											
National - Replacements	80% AFUE	11,978		$12,059									
	90% AFUE	(12)	-0.1%	$109	0.9%	31.3%	52.1%	16.6%	100%	28%	46%	19%	92%
	92% AFUE	43	0.4%	$176	1.5%	31.6%	41.6%	26.8%	100%	25%	41%	26%	92%
	95% AFUE	121	1.0%	$253	2.1%	41.2%	16.8%	42.0%	100%	28%	26%	39%	93%
	98% AFUE	(29)	-0.2%	$302	2.5%	67.1%	0.4%	32.5%	100%	45%	0%	59%	104%
		-											
North - Replacements	80% AFUE	14,308		$14,924									
	90% AFUE	98	0.7%	$111	0.7%	12.6%	71.8%	15.6%	100%	14%	67%	19%	100%
	92% AFUE	164	1.1%	$179	1.2%	13.2%	57.0%	29.8%	100%	12%	62%	26%	100%
	95% AFUE	285	2.0%	$260	1.7%	25.0%	22.8%	52.2%	100%	15%	46%	39%	100%
	98% AFUE	172	1.2%	$351	2.4%	60.0%	0.5%	39.4%	100%	40%	1%	59%	100%
		-											
South - Replacements	80% AFUE	8,561		$8,931									
	90% AFUE	(173)	-2.0%	$106	1.2%	58.8%	23.2%	18.0%	100%	42%	22%	19%	83%
	92% AFUE	(135)	-1.6%	$172	1.9%	58.7%	19.0%	22.3%	100%	38%	19%	26%	83%
	95% AFUE	(120)	-1.4%	$246	2.8%	65.0%	7.9%	27.1%	100%	41%	5%	39%	86%
	98% AFUE	(323)	-3.8%	$249	2.8%	77.5%	0.2%	22.3%	100%	50%	0%	59%	109%
		-											
National - New Construction	80% AFUE	13,311		$13,405									
	90% AFUE	416	3.1%	$589	4.4%	6.9%	53.3%	39.8%	100%	3%	49%	48%	100%
	92% AFUE	466	3.5%	$657	4.9%	8.9%	42.4%	48.7%	100%	3%	42%	55%	100%
	95% AFUE	529	4.0%	$727	5.4%	20.9%	17.4%	61.7%	100%	14%	15%	71%	100%
	98% AFUE	287	2.2%	$744	5.6%	55.3%	0.7%	44.0%	100%	29%	0%	71%	100%
		-											
North - New Construction	80% AFUE	15,493		$15,882									
	90% AFUE	372	2.4%	$486	3.1%	2.4%	70.2%	27.5%	100%	2%	65%	33%	100%
	92% AFUE	438	2.8%	$557	3.5%	4.2%	55.0%	40.8%	100%	2%	56%	42%	100%
	95% AFUE	545	3.5%	$662	4.2%	16.2%	23.2%	60.6%	100%	12%	24%	63%	100%
	98% AFUE	342	2.2%	$685	4.3%	54.8%	0.9%	44.4%	100%	33%	1%	67%	100%
		-											
South - New Construction	80% AFUE	9,891		$10,479									
	90% AFUE	484	4.9%	$709	6.8%	13.9%	26.9%	59.2%	100%	5%	30%	65%	100%
	92% AFUE	510	5.2%	$776	7.4%	16.3%	22.8%	60.9%	100%	5%	24%	71%	100%
	95% AFUE	503	5.1%	$804	7.7%	28.2%	8.4%	63.4%	100%	15%	4%	81%	100%
	98% AFUE	200	2.0%	$814	7.8%	56.2%	0.4%	43.4%	100%	24%	0%	76%	100%


LCC savings (2013 $)
900
700
500
300
100
(100)
(300)
(500)
all groups in order:
90% AFUE
92% AFUE
95% AFUE
98% AFUE
2011 Average LCC savings
2014 Average LCC savings
National - All Installations
North - All Installations
South - All Installations
National - Replacements
North - Replacements
South - Replacements
National - New Construction
North - New Construction
South - New Construction


LCC savings (% relative to 80% AFUE)
9%
7%
5%
3%
1%
-1%
-3%
-5%
all groups in order:
90% AFUE
92% AFUE
95% AFUE
98% AFUE
2011 % LCC savings
2014 % LCC savings
National - All Installations
North - All Installations
South - All Installations
National - Replacements
North - Replacements
South - Replacements
National - New Construction
North - New Construction
South - New Construction

2) 2014 LCC analysis Sheet: Statistics and 2011 LCC Sheet: Forecast Cells

a) The annual heating load in the 2014 LCC analysis using the RECS 2009 database is significantly higher, especially in the southern region, than the 2011 LCC analysis (based on the RECS 2005). What is the underlying rationale for the significant increase in heating loads, especially in the South region?

	DOE 2014 (MMBtu/year)	DOE 2014 # Buildings	DOE 2011 (MMBtu/year)	DOE 2011 # Buildings	2014/2011 MMBtu %
Heating Load - NWGF - National	35.296	10,000	31.301	10,000	113%
Heating Load - NWGF - North	44.730	5,299	39.170	5,986	114%
Heating Load - NWGF - South	24.661	4,701	19.565	4,014	126%

b) The LCC spreadsheet contains over 100 Crystal Ball Monte Carlo simulation-controlled variables. It also contains parametric assumptions that are not evident in the spreadsheet, for example:

*The approximate percentage of total heating load in the southern region of the total national heating load for buildings selected for analysis can be estimated by multiplying buildings' LBNL modified weighting factors by their annual heating NG consumption provided in the RECS 2005 database. In the 2011 LCC spreadsheet that numbers is **8.6%.** It is relatively close to the **9.5%** calculated for the same buildings with the RECS 2005 original weighing factors before they were modified by LBNL. This suggests that the ratio of building heating loads in the southern region to the rest of the country in the LBNL sample is similar to RECS 2005 weighting factors.*

*A similar calculation in the 2014 LCC spreadsheet shows that this number is **17%**, or almost double that of the 2011 version. It is also much larger than the **12.2%** calculated with the RECS 2009 original weighing factors demonstrating more aggressive modification of weighting factors in the southern region by LBNL in favor of increasing these loads. The processed/static weighting factor numbers in the 2014 LCC spreadsheet (in contrast to the 2011 version where factors are calculated in the spreadsheet) makes it impossible to evaluate the methodology used.*

What is the methodology that was used to adjust these weighting factors and what is the justification for adjusting them?

3) DOE 2011 Furnace LCC Sheet "Forecast Cells" Installed Price (H8 to H12), 2009 Installed Price
DOE 2014 Furnace LCC Sheet "Labels" (M36 to M40)
DOE 2014 Furnace LCC Sheet "Forecast Cells" sum of non-switching retail price (O3123 to O3127) and installation cost (O3163 to O3167), 2013 Installed Price;

What is the basis of the large differential increase in the installed cost of a baseline 80% NWGF vs. the installed cost increase of condensing NWGFs in the 2014 LCC when compared with the 2011 LCC (in switching or non-switching configuration)?

	No Switching	No Switching	No Switching	
South	DOE 2014	DOE 2011	DOE 2011	2014/2011
	2013 $	2009 $	2013 $	% Change
Retail Price				
NWGF 80%	$1,147.0	$831.2	$902.6	**127.1%**
NWGF 90%	$1,305.1	$1,035.0	$1,123.8	**116.1%**
NWGF 92%	$1,321.5	$1,096.6	$1,190.8	**111.0%**
NWGF 95%	$1,449.6	$1,237.4	$1,343.7	**107.9%**
NWGF 98%	$1,644.9	$1,502.1	$1,631.0	**100.9%**
Inst. Cost				
NWGF 80%	$847.0	$782.8	$850.1	**99.6%**
NWGF 90%	$1,038.1	$1,147.1	$1,245.5	**83.3%**
NWGF 92%	$1,038.1	$1,147.1	$1,245.5	**83.3%**
NWGF 95%	$1,038.1	$1,147.1	$1,245.5	**83.3%**
NWGF 98%	$1,038.1	$1,159.3	$1,258.8	**82.5%**
Total Installed				
NWGF 80%	$1,994.0	$1,614.1	$1,752.7	**113.8%**
NWGF 90%	$2,343.2	$2,182.0	$2,369.4	**98.9%**
NWGF 92%	$2,359.5	$2,243.7	$2,436.3	**96.8%**
NWGF 95%	$2,487.6	$2,384.5	$2,589.2	**96.1%**
NWGF 98%	$2,683.0	$2,661.3	$2,889.8	**92.8%**

	No Switching	No Switching	No Switching	
North	DOE 2014	DOE 2011	DOE 2011	2014/2011
	2013 $	2009 $	2013 $	% Change
Retail Price				
NWGF 80%	$1,178.0	$876.5	$951.7	**123.8%**
NWGF 90%	$1,345.7	$1,083.1	$1,176.1	**114.4%**
NWGF 92%	$1,361.4	$1,145.4	$1,243.8	**109.5%**
NWGF 95%	$1,501.1	$1,294.1	$1,405.2	**106.8%**
NWGF 98%	$1,690.7	$1,537.6	$1,669.6	**101.3%**
Inst. Cost				
NWGF 80%	$1,229.8	$1,024.4	$1,112.3	**110.6%**
NWGF 90%	$1,662.6	$1,390.8	$1,510.2	**110.1%**
NWGF 92%	$1,662.6	$1,390.8	$1,510.2	**110.1%**
NWGF 95%	$1,662.6	$1,390.8	$1,510.2	**110.1%**
NWGF 98%	$1,662.6	$1,405.3	$1,525.9	**109.0%**
Total Installed				
NWGF 80%	$2,407.7	$1,900.8	$2,064.0	**116.7%**
NWGF 90%	$3,008.3	$2,473.9	$2,686.3	**112.0%**
NWGF 92%	$3,024.0	$2,536.2	$2,753.9	**109.8%**
NWGF 95%	$3,163.7	$2,684.8	$2,915.4	**108.5%**
NWGF 98%	$3,353.3	$2,942.8	$3,195.5	**104.9%**

	No Switching	No Switching	No Switching	
National	DOE 2014	DOE 2011	DOE 2011	2014/2011
	2013 $	2009 $	2013 $	% Change
Retail Price				
NWGF 80%	$1,163.4	$858.3	$932.0	**124.8%**
NWGF 90%	$1,326.6	$1,063.8	$1,155.1	**114.8%**
NWGF 92%	$1,342.6	$1,125.8	$1,222.5	**109.8%**
NWGF 95%	$1,476.9	$1,271.3	$1,380.5	**107.0%**
NWGF 98%	$1,669.2	$1,523.3	$1,654.1	**100.9%**
Inst. Cost				
NWGF 80%	$1,049.8	$927.4	$1,007.0	**104.2%**
NWGF 90%	$1,369.0	$1,292.9	$1,403.9	**97.5%**
NWGF 92%	$1,369.0	$1,292.9	$1,403.9	**97.5%**
NWGF 95%	$1,369.0	$1,292.9	$1,403.9	**97.5%**
NWGF 98%	$1,369.0	$1,306.5	$1,418.7	**96.5%**
Total Installed				
NWGF 80%	$2,213.2	$1,785.7	$1,939.1	**114.1%**
NWGF 90%	$2,695.6	$2,356.7	$2,559.1	**105.3%**
NWGF 92%	$2,711.6	$2,418.8	$2,626.4	**103.2%**
NWGF 95%	$2,845.9	$2,564.3	$2,784.4	**102.2%**
NWGF 98%	$3,038.2	$2,829.8	$3,072.8	**98.9%**

	Swiching	No Switching	No Switching	
South	DOE 2014	DOE 2011	DOE 2011	2014/2011
	2013 $	2009 $	2013 $	% Change
Retail Price				
NWGF 80%	$1,147.0	$831.2	$902.6	**127.1%**
NWGF 90%	$1,242.3	$1,035.0	$1,123.8	**110.5%**
NWGF 92%	$1,256.9	$1,096.6	$1,190.8	**105.6%**
NWGF 95%	$1,359.2	$1,237.4	$1,343.7	**101.2%**
NWGF 98%	$1,493.2	$1,502.1	$1,631.0	**91.5%**
Inst. Cost				
NWGF 80%	$847.0	$782.8	$850.1	**99.6%**
NWGF 90%	$1,032.9	$1,147.1	$1,245.5	**82.9%**
NWGF 92%	$1,033.0	$1,147.1	$1,245.5	**82.9%**
NWGF 95%	$1,034.5	$1,147.1	$1,245.5	**83.1%**
NWGF 98%	$1,039.9	$1,159.3	$1,258.8	**82.6%**
Total Installed				
NWGF 80%	$1,994.0	$1,614.1	$1,752.7	**113.8%**
NWGF 90%	$2,275.2	$2,182.0	$2,369.4	**96.0%**
NWGF 92%	$2,289.9	$2,243.7	$2,436.3	**94.0%**
NWGF 95%	$2,393.7	$2,384.5	$2,589.2	**92.4%**
NWGF 98%	$2,533.1	$2,661.3	$2,889.8	**87.7%**

	Switching	No Switching	No Switching	
North	DOE 2014	DOE 2011	DOE 2011	2014/2011
	2013 $	2009 $	2013 $	% Change
Retail Price				
NWGF 80%	$1,178.0	$876.5	$951.7	**123.8%**
NWGF 90%	$1,325.2	$1,083.1	$1,176.1	**112.7%**
NWGF 92%	$1,340.9	$1,145.4	$1,243.8	**107.8%**
NWGF 95%	$1,471.5	$1,294.1	$1,405.2	**104.7%**
NWGF 98%	$1,646.8	$1,537.6	$1,669.6	**98.6%**
Inst. Cost				
NWGF 80%	$1,229.8	$1,024.4	$1,112.3	**110.6%**
NWGF 90%	$1,661.9	$1,390.8	$1,510.2	**110.0%**
NWGF 92%	$1,662.1	$1,390.8	$1,510.2	**110.1%**
NWGF 95%	$1,663.2	$1,390.8	$1,510.2	**110.1%**
NWGF 98%	$1,666.0	$1,405.3	$1,525.9	**109.2%**
Total Installed				
NWGF 80%	$2,407.7	$1,900.8	$2,064.0	**116.7%**
NWGF 90%	$2,987.0	$2,473.9	$2,686.3	**111.2%**
NWGF 92%	$3,003.0	$2,536.2	$2,753.9	**109.0%**
NWGF 95%	$3,134.7	$2,684.8	$2,915.4	**107.5%**
NWGF 98%	$3,312.8	$2,942.8	$3,195.5	**103.7%**

	Switching	No Switching	No Switching	
National	DOE 2014	DOE 2011	DOE 2011	2014/2011
	2013 $	2009 $	2013 $	% Change
Retail Price				
NWGF 80%	$1,163.4	$858.3	$932.0	**124.8%**
NWGF 90%	$1,286.2	$1,063.8	$1,155.1	**111.3%**
NWGF 92%	$1,301.4	$1,125.8	$1,222.5	**106.5%**
NWGF 95%	$1,418.7	$1,271.3	$1,380.5	**102.8%**
NWGF 98%	$1,574.6	$1,523.3	$1,654.1	**95.2%**
Inst. Cost				
NWGF 80%	$1,049.8	$927.4	$1,007.0	**104.2%**
NWGF 90%	$1,366.2	$1,292.9	$1,403.9	**97.3%**
NWGF 92%	$1,366.4	$1,292.9	$1,403.9	**97.3%**
NWGF 95%	$1,367.6	$1,292.9	$1,403.9	**97.4%**
NWGF 98%	$1,371.7	$1,306.5	$1,418.7	**96.7%**
Total Installed				
NWGF 80%	$2,213.2	$1,785.7	$1,939.1	**114.1%**
NWGF 90%	$2,652.4	$2,356.7	$2,559.1	**103.6%**
NWGF 92%	$2,667.8	$2,418.8	$2,626.4	**101.6%**
NWGF 95%	$2,786.3	$2,564.3	$2,784.4	**100.1%**
NWGF 98%	$2,946.3	$2,829.8	$3,072.8	**95.9%**

4) Sheet: Forecast Cells. Rows 3143-3152 and 3183-3192

The installation and retail cost of electric water heating equipment predicted by the model is higher than the cost of gas equipment. This is an unexpected result. For example, RSMeans costs for electric water heaters are lower than for comparable gas water heaters, as expected. What is the rationale for higher electric water heater costs?

												Mean	Median	Min	Max
LCC&PB Calc	R40	Retail Price (($)	Calcs'!$R$40	Retail Price (switching)	Gas Water Heate	0	40	18	6838	8319	680.0	616.6	48.6	3309.5
LCC&PB Calc	R41	Retail Price (($)	Calcs'!$R$41	Retail Price (switching)	Gas Water Heate	1	41	18	6839	8140	675.3	615.6	48.6	3309.5
LCC&PB Calc	R42	Retail Price (($)	Calcs'!$R$42	Retail Price (switching)	Gas Water Heate	2	42	18	6840	8138	674.8	615.2	48.6	3309.5
LCC&PB Calc	R43	Retail Price (($)	Calcs'!$R$43	Retail Price (switching)	Gas Water Heate	3	43	18	6841	8125	674.8	615.6	48.6	3309.5
LCC&PB Calc	R44	Retail Price (($)	Calcs'!$R$44	Retail Price (switching)	Gas Water Heate	4	44	18	6842	8079	674.3	615.2	48.6	3309.5
LCC&PB Calc	R45	Retail Price (($)	Calcs'!$R$45	Retail Price (switching)	Electric Water He	0	45	18	6833	0	---	---	---	---
LCC&PB Calc	R46	Retail Price (($)	Calcs'!$R$46	Retail Price (switching)	Electric Water He	1	46	18	6834	179	844.8	696.7	459.6	3092.6
LCC&PB Calc	R47	Retail Price (($)	Calcs'!$R$47	Retail Price (switching)	Electric Water He	2	47	18	6835	181	871.3	696.7	459.6	3092.6
LCC&PB Calc	R48	Retail Price (($)	Calcs'!$R$48	Retail Price (switching)	Electric Water He	3	48	18	6836	194	884.8	696.7	459.6	3092.6
LCC&PB Calc	R49	Retail Price (($)	Calcs'!$R$49	Retail Price (switching)	Electric Water He	4	49	18	6837	240	907.1	692.2	459.6	3092.6
LCC&PB Calc	S40	Installation C ($)	Calcs'!$S$40	Installation Cost (switching	Gas Water Heate	0	40	19	6456	8319	592.4	589.1	245.4	1155.2
LCC&PB Calc	S41	Installation C ($)	Calcs'!$S$41	Installation Cost (switching	Gas Water Heate	1	41	19	6457	8140	592.6	589.1	245.4	1155.2
LCC&PB Calc	S42	Installation C ($)	Calcs'!$S$42	Installation Cost (switching	Gas Water Heate	2	42	19	6458	8138	592.5	589.1	245.4	1155.2
LCC&PB Calc	S43	Installation C ($)	Calcs'!$S$43	Installation Cost (switching	Gas Water Heate	3	43	19	6459	8125	592.4	589.1	245.4	1155.2
LCC&PB Calc	S44	Installation C ($)	Calcs'!$S$44	Installation Cost (switching	Gas Water Heate	4	44	19	6460	8079	593.0	589.1	245.4	1155.2
LCC&PB Calc	S45	Installation C ($)	Calcs'!$S$45	Installation Cost (switching	Electric Water He	0	45	19	6451	0	---	---	---	---
LCC&PB Calc	S46	Installation C ($)	Calcs'!$S$46	Installation Cost (switching	Electric Water He	1	46	19	6452	179	713.2	716.3	441.3	996.7
LCC&PB Calc	S47	Installation C ($)	Calcs'!$S$47	Installation Cost (switching	Electric Water He	2	47	19	6453	181	716.3	719.6	441.3	996.7
LCC&PB Calc	S48	Installation C ($)	Calcs'!$S$48	Installation Cost (switching	Electric Water He	3	48	19	6454	194	719.0	714.0	426.7	1260.8
LCC&PB Calc	S49	Installation C ($)	Calcs'!$S$49	Installation Cost (switching	Electric Water He	4	49	19	6455	240	698.9	689.3	426.7	1260.8

Retail prices are rows 3143 - 3152

Installation costs are rows 3183 - 3192

The source of equipment cost data in the 2014 LCC spreadsheet is “CAC and HP - 2011 Direct Final Rule; EWH and GWH 2010 Heating Products Final Rule” (see “Equip Price” sheet Table located at Y27 and listed below).

Numbers from this table are first multiplied by local Total Distr./Const. Markup and Sales Tax than by Learning Curve Coeff. and by GDP Deflator. (See “Equip Price” sheet AD8 to 12 and listed below)

Implicit Price Deflators for Gross Domestic Product (Gross private domestic Investment 2013 vs. 2009) used is 1.04039.

Source: http://www.bea.gov/national/pdf/dpga.pdf

Engineering Analysis Data												
	Mnfr. Production Cost (MPC)* (2009$)						Shipping Cost Estimate (2009$)					
	2-Ton	3-Ton	5-Ton				2-Ton	3-Ton	5-Ton			
13 SEER CAC	$573.87	$642.12	$894.62				$16.02	$20.51	$28.42			
14 SEER CAC	$633.96	$705.76	$984.85				$20.30	$24.83	$29.50			
14 SEER HP (HP, Indoor Unit)	$900.47	$1,075.56	$1,352.70				$25.45	$30.54	$38.42			
	30 gal	40 gal	50 gal	66 gal	75/80 gal	119 gal	30 gal	40 gal	50 gal	66 gal	75/80 gal	119 gal
GWH - Default	$172.00	$187.00	$200.00	$537.00	$565.00		$17.00	$20.00	$40.00	$56.00	$61.00	
GWH - Ultra Low NOx	$273.00	$290.00	$303.00	$631.00	$659.00		$20.00	$26.00	$54.00	$56.00	$61.00	
EWH	$142.00	$159.00	$170.00	$569.00	$592.00	$655.00	$21.00	$21.00	$56.00	$64.00	$67.00	$107.00

Source: CAC and HP - 2011 Direct Final Rule; EWH and GWH 2010 Heating Products Final Rule

5) Sheet: NWGF Switching. D48 and D49

a) What is the rationale for choosing a single payback (3.5 years) as the basis of fuel switching decisions?

b) Why is a single time period used for all buildings and owners rather than one dependent on discount rates, income, etc.? For example, there are discount rates in Sheet: Discount Rate. Rows 26-116 that could be used to create a distribution of payback periods for this decision.

6) Sheet: NWGF Switching. Column AG

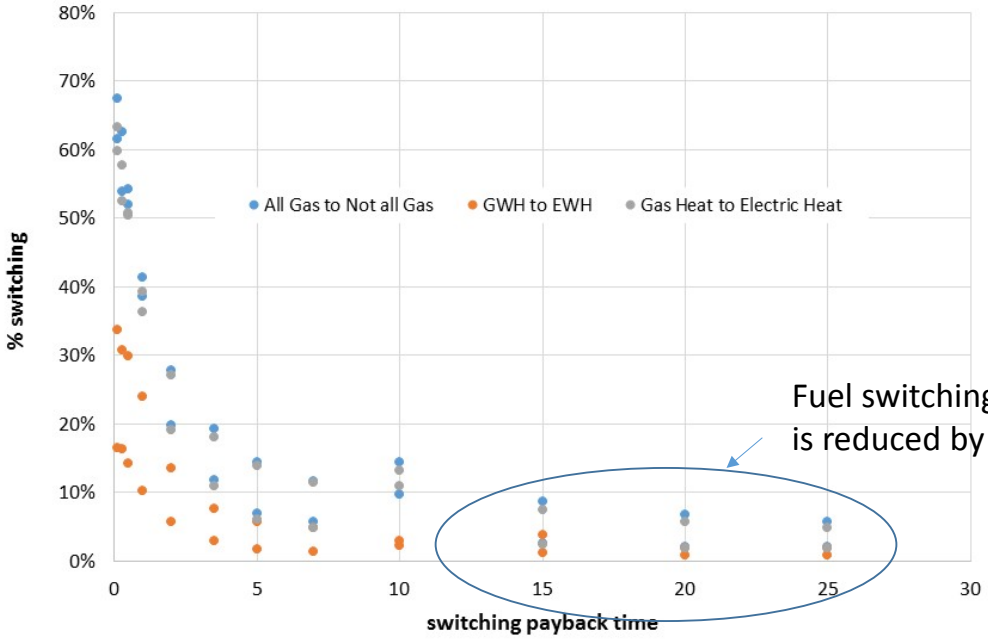
a) What is the decision making criteria for choosing which non-NWGF option is selected when fuel switching occurs?

b) What happens when negative values occur (meaning the first year operations cost of the switching option is lower than the first year operations cost of the high efficiency NWGF)?

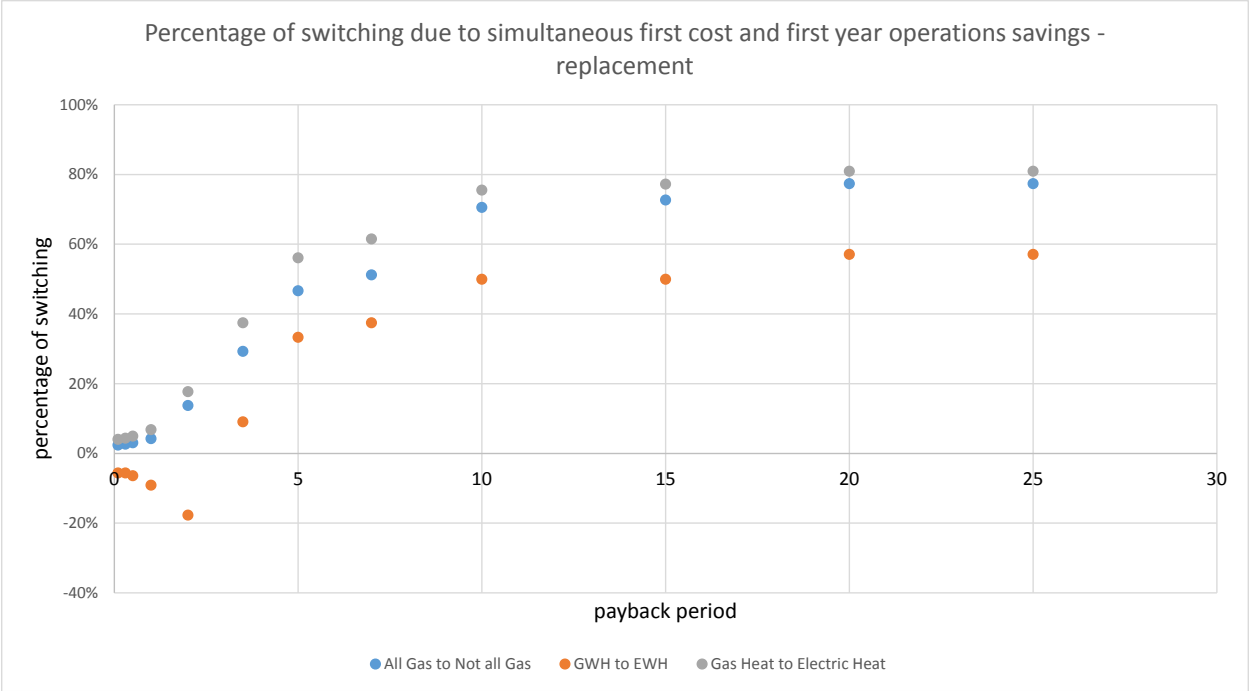
c) Why does fuel switching remain high even at extreme payback times whether negative values are excluded or not?

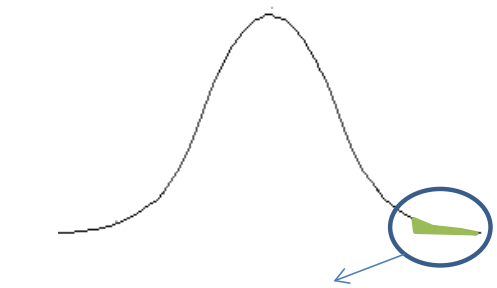
d) Pushing the "payback period" up (changing D48&49 to high values) does not eliminate fuel switching. Even at 15 years it remains around 10 %. In part this is because options that have a negative "payback period" will always allow switching and also because some fuel switching options make economic sense even when considering a long time horizon. This switching behavior is entirely rational. A significant fraction of these switching events would be expected to occur in the absence of a DOE rule. Are these rational fuel switching cases included in an estimate of LCC savings due to a DOE rule change?

e) The switching "payback period" is essentially the ratio of the first cost advantage of a switching option to the annual operation cost disadvantage of same option. Because this analysis is a Monte Carlo analysis this will tend to choose situations which are low operations cost disadvantage and/or high first cost advantage. This is likely to underestimate the true cost of fuel switching. How is this inherent aspect of the Monte Carlo methodology addressed equitably given the "irrational" consumer behavior predicted based on behavioral economics theory?

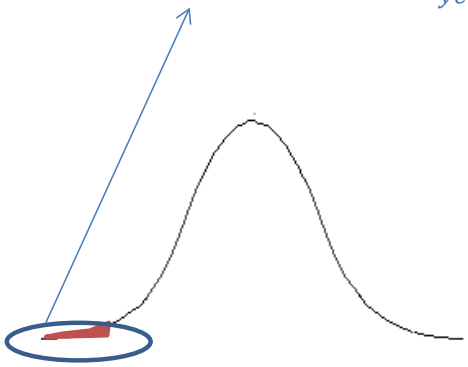


Fuel switching at long times is reduced by about half





$$\frac{First\ cost\ advantage\ (\$)}{operation\ cost\ disadvantage\ (\frac{\$}{year})}$$ ="payback for switching"



When you start bringing the good:bad ratio down it is the overlapping tails of high first cost advantage and low operation cost disadvantage that will cross the threshold.

7) Sheet: Overall Spreadsheet

How are the negatively and positively impacted homes segmented? This includes north/south, and new construction/replacement segments. Included in the segmentation would be replacement costs of different options in different home locations, sizes, and configurations, as well as other factors that would impact consumer classes differently. Averages do not show the marginal affected consumers.

8) Sheet: Summary Switching. Columns H and I

How were the GTI survey numbers processed?

DOE reported GTI results

			Builders				Installation contractors			
			North		South		North		South	
			Pre	Post	Pre	Post	Pre	Post	Pre	Post
Low-eff gas		Gas	12.7%	0.0%	13.6%	0.0%	23.1%	0.0%	45.0%	0.0%
Hi-eff gas		Gas	59.9%	61.7%	46.6%	59.2%	61.6%	78.0%	26.2%	58.0%
El HP		Gas	0.3%	8.4%	9.4%	6.1%	3.6%	7.0%	3.5%	12.4%
El furnace		Gas	0.0%	0.0%	0.6%	0.1%	0.9%	2.2%	1.5%	1.6%
Low-eff gas		Elec	4.3%	0.0%	9.6%	0.0%	1.9%	0.0%	2.6%	0.0%
Hi-eff gas		Elec	18.2%	24.8%	14.1%	26.9%	2.6%	4.0%	3.1%	6.5%
El HP		Elec	1.8%	4.0%	5.4%	6.8%	3.5%	4.5%	8.7%	10.6%
El furnace		Elec	2.5%	0.6%	0.4%	0.5%	0.9%	1.7%	1.7%	1.5%
Other			0.3%	0.5%	0.3%	0.4%	1.8%	2.6%	7.6%	9.3%

GTI results

			Builders				Installation contractors			
			North		South		North		South	
			Pre	Post	Pre	Post	Pre	Post	Pre	Post
Low-eff gas		Gas	16.3%	0.0%	13.7%	0.0%	25.1%	0.0%	39.6%	0.0%
Hi-eff gas		Gas	65.8%	78.8%	54.7%	62.1%	58.0%	77.2%	30.3%	61.2%
El HP		Gas	2.0%	3.2%	3.8%	9.8%	2.9%	6.6%	4.4%	10.9%
El furnace		Gas	0.1%	0.1%	1.1%	0.4%	0.9%	1.7%	1.5%	1.8%
Low-eff gas		Elec	1.6%	0.0%	5.7%	0.0%	2.2%	0.0%	2.7%	0.0%
Hi-eff gas		Elec	9.1%	12.3%	7.9%	13.7%	2.9%	4.8%	3.7%	5.9%
El HP		Elec	2.3%	3.5%	8.3%	9.2%	3.0%	4.0%	9.9%	11.7%
El furnace		Elec	1.2%	0.4%	3.1%	2.7%	1.0%	1.4%	1.8%	1.7%
Other			1.6%	1.8%	1.7%	2.1%	4.0%	4.2%	6.1%	6.9%

DOE

% Switching	Fraction of Non-Condensing NWGF Switching			Fraction of All NWGF Switching		
Replacement	All Gas to	GWH to	Gas Furn to	All Gas to	GWH to	Gas Furn to
Census Div	Not All Gas	EWH	Elec Heat	Not All Gas	EWH	Elec Heat
1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2	2.7%	2.0%	4.2%	2.7%	2.0%	1.4%
3	6.9%	2.0%	8.5%	6.9%	2.0%	2.5%
4	20.4%	5.6%	22.1%	20.4%	5.6%	6.5%
5	20.8%	0.3%	21.5%	20.8%	0.3%	11.5%
6	24.7%	2.5%	29.4%	24.7%	2.5%	16.3%
7	13.4%	2.0%	15.3%	13.4%	2.0%	14.6%
8	8.2%	2.0%	7.4%	8.2%	2.0%	4.4%
9	37.0%	5.4%	35.8%	37.0%	5.4%	27.5%
10	20.0%	5.2%	18.6%	20.0%	5.2%	14.7%
National	15.6%	2.8%	16.658%	15.6%	2.8%	9.0%

New	All Gas to	GWH to	Gas Furn to
Census Div	Not All Gas	EWH	Elec Furn
1	0.00%	0.00%	0.00%
2	9.72%	8.33%	13.79%
3	13.56%	5.93%	16.78%
4	25.00%	22.92%	21.31%
5	13.44%	1.61%	14.41%
6	17.91%	5.97%	16.67%
7	5.80%	2.23%	5.51%
8	12.05%	4.82%	13.83%
9	62.22%	22.22%	58.82%
10	33.85%	11.98%	31.22%
National	19.98%	7.68%	19.94%

GTI

Overall fraction Switching			
	all gas to not all gas	gas water heater to electric water heater	gas heat to electric heat
Replacement	6.8%	1.3%	7.0%
New	5.8%	2.2%	4.4%

Fraction of affected homes switching			
	all gas to not all gas	gas water heater to electric water heater	gas heat to electric heat
Replacement	20.7%	3.9%	21.3%
New	27.4%	10.3%	21.0%

9) Sheet: Bldg Sample and general methodology

The buildings sampled are only those that use natural gas or LPG as a heat source and it is used as a primary or secondary source of heat. Are there any other criteria for selecting buildings to specifically select for buildings where an 80% NWGF would have been installed in the absence of a DOE rule mandating higher efficiencies?

If there is not does this seem reasonable? For example, is the probability of choosing a high efficiency furnace the same in the case of a high income owner with a large home and the case of a low income owner of a small home?

10) Sheet: Summary Switching

Switching statistics should be different for different efficiency levels; however, the spreadsheet shows only one set. Is it a composite, how it is calculated, and how do the statistics look in each group? It appears that this is supposed to be the content of M35 – R58 on the same sheet but these all contain #REF! rather than data.

11) Sheet: Summary Switching, National Summary tables Replacement AC18 and New Construction AC32

Why does the summary of national switching and no switching cases add to 11,129 cases when only 10,000 cases were analyzed?

12) Using the 2014 LCC spreadsheet and allowing fuel switching improves LCC savings compared to disallowing fuel switching if the 'payback' for switching decisions is long (15 years for sheet NWGF Switching cells D48 and D49 is shown below). The effect is even larger in the south. Does this mean that fuel switching should be expected to reduce costs to consumers (e.g., in the South) as a result of the new minimum efficiency level?

Simulation Results NATIONAL - 10000 samples Fuel Switching Allowed — AEO 2014 - Reference Case

			Average LCC Results									Payback Results		
	Level	Description	Installed Price	Lifetime Oper. Cost*	First Year Oper. Cost	LCC	LCC Savings	Simple LCC Savings	Net Cost	No Impact	Net Benefit	Average	Median	Simple PBP
NWGF	0	NWGF 80%	$2,209	$10,369	$644	$12,579	NA	NA	NA	100%	NA			
NWGF	1	NWGF 90%	$2,644	$9,434	$590	$12,079	$227	$500	21%	48%	31%	16.6	10.6	8.1
NWGF	2	NWGF 92%	$2,660	$9,276	$580	$11,935	$292	$643	19%	42%	38%	13.0	8.0	7.1
NWGF	3	NWGF 95%	$2,779	$9,039	$566	$11,818	$367	$760	24%	24%	52%	12.6	8.9	7.4
NWGF	4	NWGF 98%	$2,943	$8,821	$555	$11,764	$421	$815	41%	0%	59%	16.9	12.2	8.2
MHGF	0	MHGF 80%	$1,551	$10,913	$700	$12,463	NA	NA	NA	100%	NA			
MHGF	1	MHGF 92%	$1,722	$9,705	$622	$11,426	$695	$1,037	7%	26%	67%	5.4	1.9	2.2
MHGF	2	MHGF 95%	$1,865	$9,461	$607	$11,326	$774	$1,137	13%	14%	73%	8.5	4.4	3.4
MHGF	3	MHGF 97%	$1,980	$9,339	$599	$11,319	$782	$1,144	25%	0%	74%	12.5	6.7	4.2

Simulation Results NATIONAL - 10000 samples Fuel Switching NOT Allowed — AEO 2014 - Reference Case

			Average LCC Results									Payback Results		
	Level	Description	Installed Price	Lifetime Oper. Cost*	First Year Oper. Cost	LCC	LCC Savings	Simple LCC Savings	Net Cost	No Impact	Net Benefit	Average	Median	Simple PBP
NWGF	0	NWGF 80%	$2,213	$10,347	$645	$12,560	NA	NA	NA	100%	NA			
NWGF	1	NWGF 90%	$2,696	$9,437	$588	$12,133	$169	$427	22%	47%	31%	18.6	12.0	8.5
NWGF	2	NWGF 92%	$2,712	$9,271	$578	$11,982	$243	$578	20%	41%	39%	14.5	8.8	7.5
NWGF	3	NWGF 95%	$2,846	$9,028	$563	$11,874	$311	$687	25%	23%	52%	14.1	9.7	7.7
NWGF	4	NWGF 98%	$3,038	$8,822	$550	$11,860	$324	$700	42%	0%	57%	18.2	13.1	8.7
MHGF	0	MHGF 80%	$1,551	$10,885	$700	$12,436	NA	NA	NA	100%	NA			
MHGF	1	MHGF 92%	$1,721	$9,679	$622	$11,399	$701	$1,037	7%	26%	67%	5.7	1.7	2.2
MHGF	2	MHGF 95%	$1,864	$9,435	$607	$11,299	$780	$1,137	13%	14%	73%	8.8	4.4	3.3
MHGF	3	MHGF 97%	$1,979	$9,313	$599	$11,292	$787	$1,144	25%	0%	75%	12.9	6.5	4.2

13) Sheet: Statistics and Forecast Cells O3043 to O3052

Why is the national annual fuel usage per efficiency group in the 'Statistics' sheet different than the one listed in the 'Forecast Cells' sheet?

14) Sheet: Energy Price, Table Marginal Energy Prices

What is the source of the marginal electric and gas prices? Did the analysis incorporate any of the marginal gas price information provided by AGA based on its member survey? If so, how did it incorporate the AGA member survey results? If not, why not?

15) Sheet: Equip Price. AC50

What is the source of the factor of 1/3 that is multiplied by the cost differential (EF vs. NWGF)?

16) Sheet: Base Case AFUE

What is the source of the distributions of furnace efficiencies (new and replacement)?

17) Sheet: Bldg Sample, E67, E61

Why was a uniform distribution chosen for remaining lifetimes for cooling and water heating equipment?

18) Sheet: Installation Cost, Columns E and F

The source for the assumptions regarding venting options and conditioned vs. unconditioned space is given as "Consultant Report." Is this report available?

19) Sheet NWGF Switching and LCC&PB Calcs

It appears that in NWGF Switching column AA, equipment age related discounting incorporates a present worth factor from columns AJ and AK. But the source of the cost numbers is generated in the LCC&PB Calcs sheet, where the same present worth factor is used to discount costs in cells D44 and D46. Is this double counting the present worth factor?

20) Summary Sheet

a) Why are the National, North and South Region Installed Prices in "Summary" sheet (row K) different (smaller) than the calculated weighted average of Replacement and New values (rows AA and AP)?

b) 2014 LCC CB 10,000 cases default simulation run includes 9,717 residential and 283 commercial buildings. Are the commercial buildings results included in the Simulation Results NATIONAL - 10000 samples tables in the "Summary" sheet? If so, what is the approach to dealing with that unique market segment?