Momentum Savings from

Baseline Adjustment from 2010-2014 Program

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Executive Summary

Bonneville Power Administration (BPA) contracted with Cadmus to quantify Momentum Savings (formerly referred to as "non-programmatic savings") due to baseline adjustments for the 2010 – 2014 program period. These savings will count toward meeting the region's energy savings targets established by the Northwest Power and Conservation Council (the Council) in the Sixth Regional Power Plan (6th Plan).

The Council does not differentiate among the mechanisms that can be used to achieve the Plans' energy savings targets. However, in broad terms, savings can be attributed to one of two categories— program savings and Momentum Savings. Program savings consist of those resulting from utility-sponsored incentive programs as well as market transformation savings from the Northwest Energy Efficiency Alliance's (NEEA's) initiatives.

The Council defines Momentum Savings as electricity savings that are:

- Cost-effective;
- Above the assumed baseline for determining conservation potentials in the 6th Plan;
- Not incented through utility-sponsored energy-efficiency programs; and
- Not part of net-market effects claimed by NEEA.

The Council based its methodology for estimating energy-efficiency potential on the assumption of "frozen" efficiency. That is, the efficiency of the baseline equipment does not change over the planning horizon. The baseline represents the market penetration of efficiency measures at the time the Council produces its forecast and conducts its assessment of remaining regional conservation potential. While the baseline accounts for effects related to codes and standards enacted or scheduled to take effect during the planning period, it does not factor in changes in baseline conditions from proposed codes and standards, market-induced conservation, utility activities, or other Momentum Savings factors.

Momentum Savings may originate from three sources:

1. **Codes and Standards**: Reductions in electricity use due to new energy codes and equipment standards not reflected in in the 6th Plan baselines.

2. **Baseline Adjustments:** Adjustments made to the baseline by the Regional Technical Forum (RTF) that change the baseline from the 6th Plan.

3. **Market-Induced Adoption:** Adoption of efficient technologies by nonparticipants outside of utility programs.

In 2010, BPA commissioned an analysis of both the electric Momentum Savings in the Northwest region and BPA's share of these savings for the 2010 - 2014 planning period. That effort resulted in the report titled, "Methodology for Quantifying Market-Induced, Non-Programmatic Savings." [1]

[1] Cadmus. *Methodology for Quantifying Market-Induced, Non-Programmatic Savings.* Prepared for Bonneville Power Administration. April 2011.

This study used the methodology outlined in that report to quantify Momentum Savings during 2010 – 2014, originating from baseline efficiency adjustments made by the RTF. This study did not look at savings from market-induced adoption. We included Momentum Savings due to new codes and standards only if the RTF updated a measure's baseline efficiency due to implementation of a new code or standard that was above that assumed in the 6th Plan.

Results

Cadmus identified baseline adjusted savings in 2010 - 2014 for two residential measures: (1) clothes washers and (2) refrigerators. None of the commercial measures had baseline adjustments during this period. Table 1 shows the baseline adjusted savings in average megawatts (aMW) by year for the two measures. The RTF did not make any adjustments to the measures reviewed for this study prior to 2011; therefore, there were no baseline adjusted savings for 2010.

Table 1. Summary of Baseline Adjusted Savings for 2010 - 2014

Measure	2010 aMW	2011 aMW	2012 aMW	2013 aMW	2014 aMW	Total aMW
Clothes Washers	0.00	0.15	0.28	0.45	0.13	1.02
Refrigerators	0.00	0.01	0.01	0.03	0.01	0.06
Total	**0.00**	**0.16**	**0.29**	**0.48**	**0.14**	**1.08**

Introduction

To meet the ambitious regional energy-savings targets established in the Northwest Power and Conservation Council's Sixth Regional Power Plan, Bonneville Power Administration has undertaken an aggressive approach to helping its wholesale utility customers deliver cost-effective energy efficiency.

The Council based the conservation supply curves and the targets derived from them on cost-effective efficiency, attainable beyond both the baseline efficiencies and those efficiencies already in the forecast. The forecast includes codes and standards that have already been passed and are scheduled to take effect in the course of the planning period. The baseline represents the penetration of the efficiency measures in the market at the time the Council produced the forecast and developed the supply curves.

The supply curves are indifferent to the manner in which the conservation is achieved. From a resource planning perspective, it is not important which entity pays for the efficiency measure or why the entity installed it. The Council does not differentiate among the mechanisms that can be used to achieve the plans energy savings targets. However, in broad terms, savings can be attributed to one of two categories— program savings and Momentum Savings. Program savings consist of those resulting from utility-sponsored incentive programs as well as market transformation savings from the Northwest Energy Efficiency Alliance's (NEEA's) initiatives. The Council defines Momentum Savings as electricity savings that are:

- Cost-effective;
- Above its assumed baseline for determining conservation potentials in the 6th Plan;
- Not incented through utility-sponsored energy-efficiency programs; and
- Not part of net-market effects claimed by NEEA.

BPA contracted with Cadmus to quantify Momentum Savings from baseline adjustments for the 2010 – 2014 program period.

Background on Momentum Savings

The Council based its methodology for estimating energy-efficiency potential on the assumption of "frozen" efficiency. That is, the efficiency of the baseline equipment does not change over the planning horizon. The baseline represents the market penetration of efficiency measures at the time the Council produces its forecast and develops the conservation supply curves. While the baseline accounts for effects related to codes and standards enacted or scheduled to take effect during the planning period, it does not factor in changes in baseline conditions from new codes and standards, market-induced conservation, utility activities, or other Momentum Savings factors.

Momentum Savings may originate from three sources:

1. **Baseline Adjustments:** Adjustments made to the baseline by the Regional Technical Forum (RTF) that change the baseline from the 6thPlan.

2. **Codes and Standards:** Reductions in electricity use due to new energy codes and equipment standards are not reflected in the 6thPlan baseline.

3. **Market-Induced Adoption:** Adoption of efficient technologies by nonparticipants outside of utility programs. Possible drivers of market-induced conservation could include:

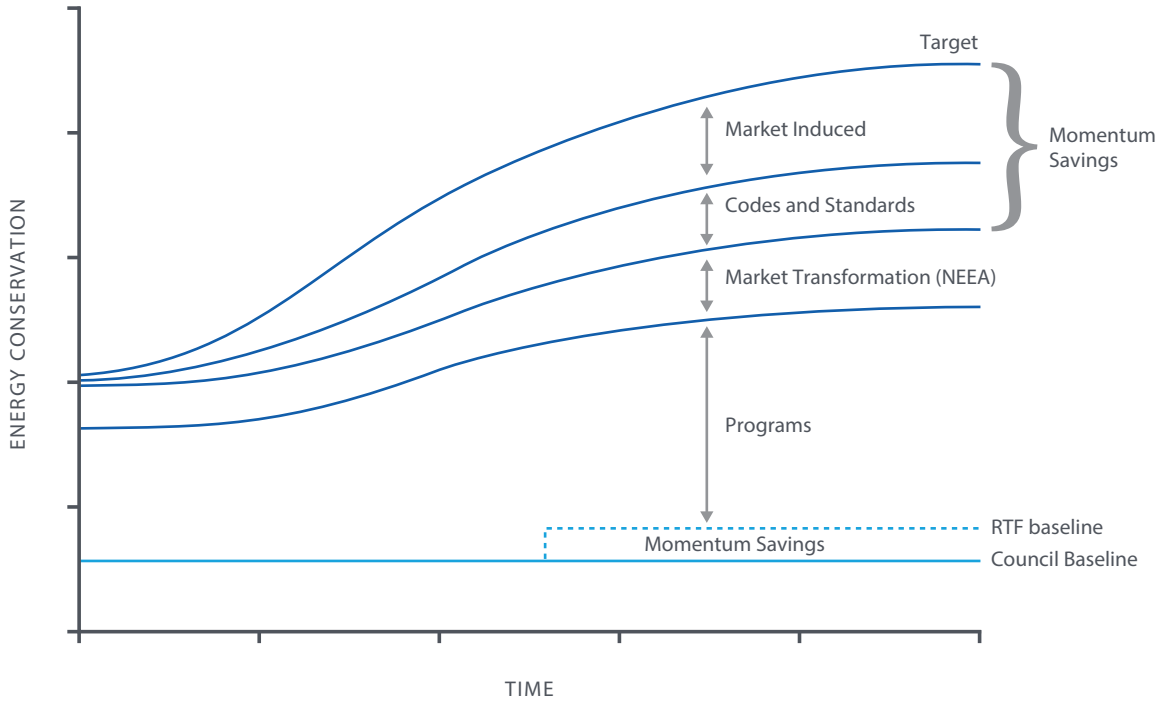
    - **Tax credits or government spending:** State and federal tax credits as well as spending from the American Recovery and Reinvestment Act.

    - **Market transformation:** Outside of NEEA's net market effects, utility spending on programs and infrastructure have altered the marketplace for energy efficiency.

    - **The "Green" movement:** As society places a greater emphasis on green living, energy efficiency has higher visibility and attractiveness for consumers.

Figure 1 illustrates the composition of the regional conservation potential and the role of different sources of Momentum Savings.[2]

Figure 1. Sources of Savings

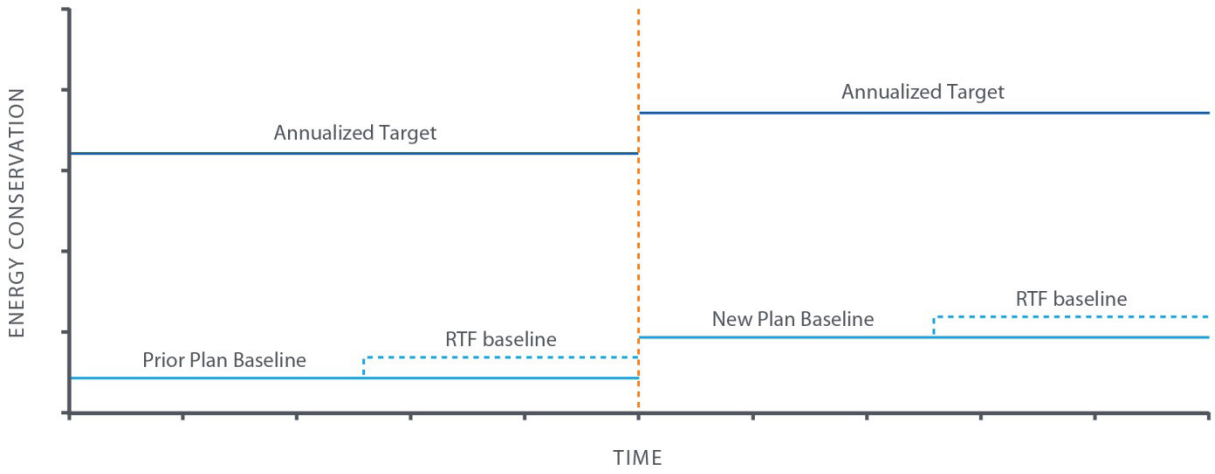


Baseline Adjustments

The RTF reviews calculation of savings for conservation measures with stipulated or deemed values and makes recommendations to BPA on an ongoing basis during the plan period. These reviews often result in revisions to unit energy savings (UES) values based on adjustments to the baseline established in the 6thPlan. Revisions to the baseline are often prompted by the results of new research and new market data on average efficiency levels. While the RTF uses the Council's methodology to determine the baseline for UES measures, it determines the new baseline at a different time than the baseline in the 6th Plan. Revisions to the baseline clearly impact the savings that BPA may claim per unit of measure through program activity and BPA's reimbursement. Figure 2 illustrates the effects of baseline revisions on BPA's saving targets.

[2] This figure is for illustrative purposes only and not meant to be interpreted quantitatively.

Figure 2. Effects of 6th Plan and RTF Revised Baselines



As can be seen in Figure 2, the RTF's adjustment to the baseline during a planning period does not affect the baseline assumed in the 6th Plan, as it continues to be the baseline for calculation of savings targets. However, the program savings per measure may decrease based on the new RTF baseline. Therefore, a UES measure may produce both program savings and Momentum Savings. To quantify the Momentum Savings associated with this baseline shift, BPA will need to assess program achievements and then calculate the additional savings based on the difference between the RTF and 6th Plan baselines. This analysis is based entirely on program achievements, rather than on market activity outside of programs.

New Codes and Standards

When the Council sets the baseline for calculating long-term conservation potential, it takes into account the effects of any current energy codes and standards when their level of efficiency requirements and effective dates are known. These include codes or standards adopted since the previous Regional Power Plan. However, the Council does not include the effects of potential new codes or standards when establishing the baseline. There are usually several (two to five) years between the time a code or standard is adopted and the date it takes effect and these revisions only affect new and replacement stock. Therefore, during the typical five-year period between Plan updates, stock additions and turnover rates are fairly small. As a result, the near-term impacts of new code and standard upgrades are small. However, these impacts are likely to be substantial over the 20-year horizon of the 6thPlan.

Market-Induced Adoption

Market-induced effects refer to the adoption of energy-efficient technologies and practices outside of utility programs, motivated by higher energy prices, macro-economic conditions or shifts in cultural norms (e.g., "green movement"). These savings reflect the adoption of energy-efficient technologies in the marketplace, excluding those associated with codes and standards or utility program incentives. Theoretically, market-induced savings apply to all energy-efficient products and services.

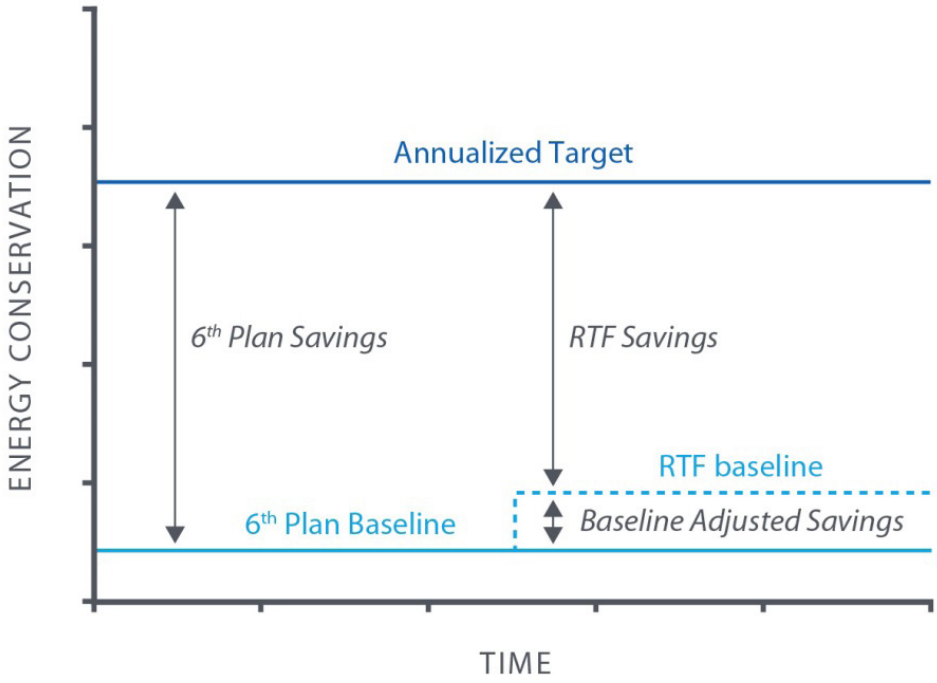
In general, estimates of savings for these measures may be obtained by quantifying the total saturation of a measure, and subtracting number of units incented through utility programs and the initial, assumed saturation (the Council's baseline).

Focus of this Study

In 2010, BPA commissioned an analysis of both the electric Momentum Savings in the Northwest region and BPA's share of these savings for the 2010 - 2014 planning period (Cadmus 2011). This study used the methodology outlined in that report to quantify Momentum Savings during 2010 – 2014, originating from baseline efficiency adjustments made by the RTF due to new research or data regarding baseline efficiency or due to new codes and standards. This study did not look at savings from market-induced adoption. We included Momentum Savings due to codes and standards only if the RTF updated a measure's baseline efficiency due to implementation of a new code or standard that was above the baseline assumed in the 6th Plan.

When the RTF adjusts the baseline for a measure, the BPA utilities then claim measure savings based on the new savings value, rather than on the 6th Plan value upon which the conservation target is based. As shown in Figure 3, a measure's baseline is generally adjusted upward, representing a higher efficiency, causing a decrease in that measure's energy savings, all else equal. Cadmus' goal of this study was to identify measures with baseline efficiency adjustments and quantify the difference between a measure's updated RTF baseline and the 6th Plan baseline so that these baseline adjusted savings can be claimed and counted towards the Northwest's energy conservation goals.

Figure 3. Illustration of Baseline Adjusted Savings



Report Organization

For this study, Cadmus focused on Momentum Savings from any baseline efficiency adjustments that the RTF has adopted since the 6thPlan went into effect. We refer to these savings as "baseline adjusted savings" through the remainder of the report. This report is organized as follows:

- Introduction
- Identifying Measures with Baseline Efficiency Changes
- Quantifying Energy Savings for Measures with Baseline Efficiency Changes
- Summary of Baseline Adjusted Savings

Identifying Measures with Baseline Efficiency Adjustments

As the first step in identifying Momentum Savings, Cadmus compared the 6thPlan to the RTF updates that occurred since the adoption of the 6th Plan. We looked for measures updated between January 1, 2010, and July 1, 2014. We determined the July 1, 2014, cut-off date based on the approximate six-month lag between RTF measure changes and the corresponding updates to BPA's measure list.

For the purposes of this study, Cadmus only looked for changes in baseline efficiency and did not account for other factors that would have impacted baseline measure energy consumption. For example, the hours-of-use assumptions for residential lighting measures were changed based on the availability of better data about usage and not actual changes in underlying efficiency. However, if the

assumption for the baseline wattage for a lighting measure had changed, we would have included this as a source of baseline adjusted savings.

We reviewed each measure in the 6th Plan and compared to the RTF UES database. We began with reviewing the history of RTF decisions for each measure to look for updates in energy savings. In the instances where the RTF decision history noted a change in savings, we then compared the baseline assumptions in the 6thPlan to the RTF UES database workbooks for that particular measure or group of measures. This allowed us to quickly identify measures with a change in energy savings. However, even when the RTF decision list did not show savings changes, there was still a possibility that measure savings changed and RTF did not document in the decision list (as we found was the case for one residential measure). Because of this possibility, we then decided it was necessary to review each measure in the 6th Plan against the corresponding RTF UES database workbook to look for changes in baseline efficiency assumptions.

Commercial Measures

The RTF UES database contained measure updates within the following commercial sector measure categories: appliances, cooking equipment, domestic hot water, grocery, and several other single measure files. There were no or very few updates within the commercial sector for HVAC, lighting, or shell measure categories relative to the 6th Plan measure workbooks.

Updates to the measures included:

- Out of compliance measures (various grocery measures),
- New measures added since the 6thPlan (smart plug power strips),
- Measures under review for compliance (vending machine controllers),
- Deactivated measures (grocery night covers),
- Measures that are no longer cost-effective nor offered to BPA customers (ENERGY STAR Freezers and Refrigerators).

The 6th Plan does not include the new measures and the deactivated measure workbooks on the RTF website did not indicate a change in baseline efficiency. Additionally, deactivated measures are no longer rebated by utilities or BPA and therefore would not have Momentum Savings. We were unable to determine if baseline efficiency adjustments occurred for any of the measures listed as out of compliance.

One reason we could not determine baseline efficiency adjustments for out of compliance grocery measures was because the 6thPlan workbooks for grocery measures generally lacked the level of detail that the updated RTF measure workbooks contained. Furthermore, the 6thPlan repeatedly cited “proprietary information” for the methods used to determine the regional potential and unit savings. Given that many of these measures were out of compliance, it may be possible to obtain better information when the RTF reviews these measures again. The lack of obvious baseline information, combined with no documentation of savings changes for these measures in the RTF UES database, led us to conclude that RTF did not update the baseline for these measures.

The commercial measures with RTF savings updates are electronically commutated motors (ECMs) for display cases, network PC power management, and light-emitting diode (LED) traffic signals. However, reviews of both the 6thPlan and RTF UES database workbooks for these measures reveal no change in baseline assumptions. Rather, these changes are due to other updated measure assumptions. We therefore concluded that no commercial measures had baseline efficiency adjustments during 2010 – 2014.

Residential Measures

The methodology used to determine which residential measures have incurred baseline changes is similar to that used for the commercial sector, with a few differences. Mainly, Cadmus excluded the following measures and measure groups from consideration based on these factors:

- **New construction – ENERGY STAR® new homes.** Any change in baseline efficiency for new homes would be attributable to state energy codes and the savings resulting from code changes are under NEEA's provenance and outside of utility program activities.

- **Weatherization SF, MH, MF, Performance Tested Comfort Systems (PTCS) Duct Sealing.** Since these are retrofit measures, the baseline is the existing condition and will not have changed since the 6th Plan. However, we understand these will likely be updated with the Residential Building Stock Assessment (RBSA) data, and we will review these measures during the next phase of this project.

- **Air Source Heat Pumps.** BPA is conducting a separate market study for residential air source heat pumps and so these are excluded to avoid double-counting those baseline adjusted savings.

- **Ductless Heat Pumps.** The baseline for this retrofit measure is the existing condition (electric resistance heating) and will not have changed since the 6th Plan.

Additional measures we excluded from consideration were those created since the 6th Plan (electronic thermostats), deactivated (room air conditioner (AC), LED holiday lights, smart plug power strips), or found to be out of compliance (drain waste heat recovery). We then followed an analytical pattern similar to the one we used with the commercial measures. First we checked which measures had savings updates, and then we compared measure workbooks from the 6thPlan and the most current workbook in the RTF UES database for each measure with changes listed prior to the July 1, 2014, cut-off date.

We identified six residential measures with baseline efficiency adjustments: clothes washers, freezers, refrigerators, dishwashers, air source heat pumps, and lighting. The next section summarizes the baseline adjusted savings calculations for the measures we identified that incurred baseline efficiency changes.

Quantifying Baseline Adjusted Savings

This section describes the baseline equipment efficiency changes between the 6thPlan and the subsequent updates to the RTF UES database as of July 1, 2014. None of the commercial measures had baseline efficiency changes before July 1, 2014. We identified six residential measures with baseline efficiency changes: clothes washers, freezers, refrigerators, dishwashers, air source heat pumps, and lighting.

Clothes Washers

Clothes washers installed in residential single-family homes feature several distinct measure efficiency levels based upon ENERGY STAR and the Consortium for Energy Efficiency (CEE) tiers. In addition to the improved baseline efficiency for this group of measures, the measure categories also changed from the 6th Plan to the RTF UES database. Specifically, the RTF added one tier with a minimum modified energy factor (MEF) of 2.7 and another tier that included a weighted average of all ENERGY STAR models. Table 2 lists the 15 unique clothes washer measure configurations in the 6th Plan.

Table 2. 6th Plan Clothes Washer Measure Configurations

ENERGY STAR Tier	MEF	Water Heat Fuel	Dryer Fuel
Tier 1	MEF 2.00 - 2.19	Electric	Electric
Tier 1	MEF 2.00 - 2.19	Electric	Gas
Tier 1	MEF 2.00 - 2.19	Gas	Electric
Tier 1	MEF 2.00 - 2.19	Gas	Gas
Tier 1	MEF 2.00 - 2.19	Weighted Avg.	Weighted Avg.
Tier 2	MEF 2.20 - 2.45	Electric	Electric
Tier 2	MEF 2.20 - 2.45	Electric	Gas
Tier 2	MEF 2.20 - 2.45	Gas	Electric
Tier 2	MEF 2.20 - 2.45	Gas	Gas
Tier 2	MEF 2.20 - 2.45	Weighted Avg.	Weighted Avg.
Tier 3	MEF 2.46 +	Electric	Electric
Tier 3	MEF 2.46 +	Electric	Gas
Tier 3	MEF 2.46 +	Gas	Electric
Tier 3	MEF 2.46 +	Gas	Gas
Tier 3	MEF 2.46 +	Weighted Avg.	Weighted Avg.

Baseline Change

Table 3 shows the changes in baseline efficiency assumptions over time since the 6th Plan.

Table 3. Baseline Efficiency Changes for Clothes Washers

Reference	Baseline MEF	Baseline Water Factor
6th Plan	1.66	7.82
RTF UES Database June 2010	1.94	7.02
RTF UES Database November 2012	2.33	4.70
RTF UES Database September 2013	2.36	4.68

Baseline Adjusted Energy Savings per Unit

The RTF baseline update for residential clothes washers occurred in late June 2010. The update also increased the number of unique measure configurations from 15 to 20. To calculate the baseline adjusted energy savings for all 20 measure configurations, we used the 6th Plan baseline assumption of an MEF of 1.66 and a water factor of 7.82. Therefore, the baseline adjusted savings was simply the difference between the measure savings using the 6th Plan baseline and the measure savings using the updated RTF baseline. Figure 4 depicts this calculation for one of the measure configurations.

Figure 4. Clothes Washer Savings Comparison for 2.46+ MEF Electric/Electric Configuration

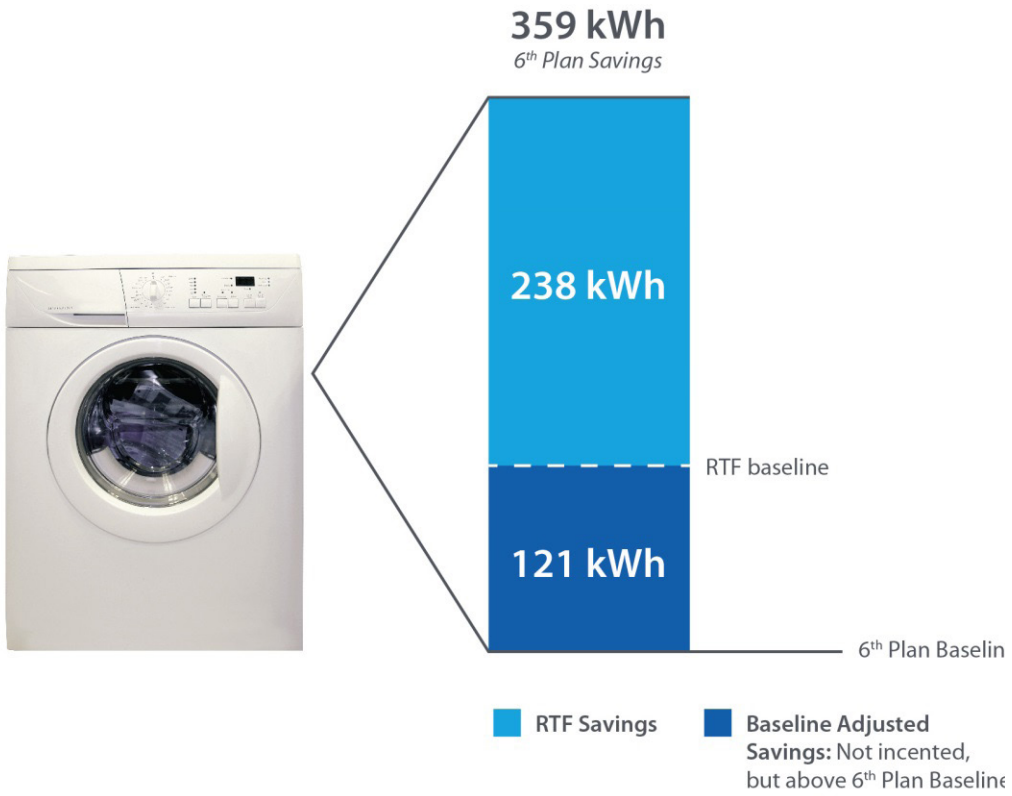


Table 4 provides the EEC reference number for each measure configuration; the combination of MEF, water heat, and dryer heat for that measure, and the RTF UES savings; 6th Plan baseline savings; and the baseline adjusted savings. The baseline adjusted savings is the difference of the RTF UES baseline savings and the 6th Plan baseline savings.

Table 4. Clothes Washer per Unit Savings by Configuration from June 2010 RTF Update

Clothes Washer Configuration				Utility Incented Quantity		Annual Baseline Adjusted Savings (Busbar)	
EEC Reference Number	MEF	Water Heat Fuel	Dryer Fuel	2011 Quantity	2012 Quantity	2011 Savings	2012 Savings
RWHWU10964	Any ENERGY STAR	Electric	Electric	312	596	38,410	73,372
RWHWU10965	Any ENERGY STAR	Electric	Gas	9	5	396	220
RWHWU10966	Any ENERGY STAR	Any	Any	364	412	35,456	40,131
RWHWU10967	2.00 to 2.19	Gas	Electric	39	31	3,596	2,858
RWHWU10968	2.00 to 2.20	Electric	Electric	402	623	48,898	75,780
RWHWU10969	2.00 to 2.21	Electric	Gas		15	0	669
RWHWU10970	2.00 to 2.22	Any	Any	28	188	2,703	18,151
RWHWU10971	2.00 to 2.23	Gas	Electric	99	45	9,107	4,140
RWHWU10972	2.20 to 2.45	Electric	Electric	3,014	2,772	366,093	336,698
RWHWU10973	2.20 to 2.46	Electric	Gas	32	140	1,389	6,078
RWHWU10980	2.20 to 2.47	Any	Any	253	141	24,928	13,893
RWHWU10981	2.20 to 2.48	Gas	Electric	855	984	78,174	89,968
RWHWU10982	2.46 +	Electric	Electric	3,437	6,823	417,544	828,892
RWHWU10983	2.46 +	Electric	Gas	51	219	2,267	9,735
RWHWU10984	2.46 +	Any	Any	488	248	47,367	24,072
RWHWU10985	2.46 +	Gas	Electric	1,721	2,459	157,307	224,763
RWHWU10986	2.70 +	Electric	Electric	522	3,895	63,499	473,809
RWHWU10987	2.70 +	Electric	Gas	282	217	12,605	9,700
RWHWU10988	2.70 +	Any	Any	12	293	1,174	28,655
RWHWU10989	2.70 +	Gas	Electric	395	2,264	36,783	210,830
	Total			**12,315**	**22,370**	**1,347,695**	**2,472,413**

The measure configurations affected by the improved MEF baseline were added to the BPA deemed savings database on April 1, 2011. Therefore, any measure installations after that date would include the new baseline whereas installations prior to that date would include the 6th plan baseline. Table 5 provides the utility-incented quantity and adjusted baseline annual kWh savings for each of the 20 residential clothes washer configurations for the 2011 and 2012 program years.

Table 5. Program Quantities and Baseline Adjusted Savings for Clothes Washers for 2011-2012

Clothes Washer Configuration				Utility Incented Quantity		Annual Baseline Adjusted Savings (Busbar)	
EEC Reference Number	MEF	Water Heat Fuel	Dryer Fuel	2013 Quantity	2014 Quantity	2013 Savings	2014 Savings
RWHWU10964	Any Energy Star	Electric	Electric	943	255	116,091	31,392
RWHWU10965	Any Energy Star	Electric	Gas	6	0	264	0
RWHWU10966	Any Energy Star	Any	Any	747	64	72,762	6,234
RWHWU10967	2.00 to 2.19	Gas	Electric	89	30	8,206	2,766
RWHWU10968	2.00 to 2.20	Electric	Electric	1,078	326	131,124	39,654
RWHWU10969	2.00 to 2.21	Electric	Gas	18	0	803	0
RWHWU10970	2.00 to 2.22	Any	Any	243	53	23,461	5,117
RWHWU10971	2.00 to 2.23	Gas	Electric	68	16	6,256	1,472
RWHWU10972	2.20 to 2.45	Electric	Electric	3,579	785	434,720	95,349
RWHWU10973	2.20 to 2.46	Electric	Gas	154	2	6,685	87
RWHWU10980	2.20 to 2.47	Any	Any	162	50	15,962	4,927
RWHWU10981	2.20 to 2.48	Gas	Electric	1,606	194	146,838	17,738
RWHWU10982	2.46 +	Electric	Electric	10,931	2,694	1,327,953	327,281
RWHWU10983	2.46 +	Electric	Gas	277	23	12,314	1,022
RWHWU10984	2.46 +	Any	Any	303	27	29,410	2,621
RWHWU10985	2.46 +	Gas	Electric	3,602	768	329,239	70,199
RWHWU10986	2.70 +	Electric	Electric	7,335	3,224	892,269	392,185
RWHWU10987	2.70 +	Electric	Gas	284	79	12,695	3,531
RWHWU10988	2.70 +	Any	Any	379	53	37,065	5,183
RWHWU10989	2.70 +	Gas	Electric	3,760	1,390	350,141	129,441
Total				**35,564**	**10,033**	**3,954,256**	**1,136,197**

The second phase of our analysis determined that two subsequent baseline changes were made by the RTF to the residential clothes washer measures. These changes took place in November 2012 and September 2013. However, the clothes washer measures present in the BPA deemed savings database for 2013 and 2014 program years did not undergo a deemed savings value change despite the RTF updates. Each of the deemed measure reference codes for residential clothes washers maintained an effective date of April 1, 2011, which is the same change reflected in the first phase of our analysis. Therefore, the second phase of this analysis can rely upon the same per unit baseline adjusted savings that are shown in Table 4, above. Table 6 provides the utility-incented quantity and adjusted baseline annual kWh savings for each of the 20 residential clothes washer configurations for the 2013 and 2014 program years.

Table 6. Program Quantities and Baseline Adjusted Savings for Clothes Washers for 2013-2014

Clothes Washer Configuration				Utility Incented Quantity		Annual Baseline Adjusted Savings (Busbar)	
EEC Reference Number	MEF	Water Heat Fuel	Dryer Fuel	2013 Quantity	2014 Quantity	2013 Savings	2014 Savings
RWHWU10964	Any Energy Star	Electric	Electric	943	255	116,091	31,392
RWHWU10965	Any Energy Star	Electric	Gas	6	0	264	0
RWHWU10966	Any Energy Star	Any	Any	747	64	72,762	6,234
RWHWU10967	2.00 to 2.19	Gas	Electric	89	30	8,206	2,766
RWHWU10968	2.00 to 2.20	Electric	Electric	1,078	326	131,124	39,654
RWHWU10969	2.00 to 2.21	Electric	Gas	18	0	803	0
RWHWU10970	2.00 to 2.22	Any	Any	243	53	23,461	5,117
RWHWU10971	2.00 to 2.23	Gas	Electric	68	16	6,256	1,472
RWHWU10972	2.20 to 2.45	Electric	Electric	3,579	785	434,720	95,349
RWHWU10973	2.20 to 2.46	Electric	Gas	154	2	6,685	87
RWHWU10980	2.20 to 2.47	Any	Any	162	50	15,962	4,927
RWHWU10981	2.20 to 2.48	Gas	Electric	1,606	194	146,838	17,738
RWHWU10982	2.46 +	Electric	Electric	10,931	2,694	1,327,953	327,281
RWHWU10983	2.46 +	Electric	Gas	277	23	12,314	1,022
RWHWU10984	2.46 +	Any	Any	303	27	29,410	2,621
RWHWU10985	2.46 +	Gas	Electric	3,602	768	329,239	70,199
RWHWU10986	2.70 +	Electric	Electric	7,335	3,224	892,269	392,185
RWHWU10987	2.70 +	Electric	Gas	284	79	12,695	3,531
RWHWU10988	2.70 +	Any	Any	379	53	37,065	5,183
RWHWU10989	2.70 +	Gas	Electric	3,760	1,390	350,141	129,441
Total				**35,564**	**10,033**	**3,954,256**	**1,136,197**

Freezers

The RTF baseline efficiency increased significantly for this measure group, even as the average capacity assumption has increased. The new RTF baseline was more efficient than the equivalent efficient measure specified in the 6thPlan. Both baselines were based on current practice assumptions, as opposed to the federal standard for efficiency.

Baseline Change

Table 7 lists the changes to the baseline assumptions.

Table 7. Baseline Efficiency Changes for Freezers

6th Plan Measure Name	6th Plan Baseline	RTF UES Baseline
ENERGY STAR Freezer - Any Chest w/ Sales Weighted Average Capacity	380 kWh/year; 15.08 cubic feet	344 kWh/year; 20.89 cubic feet
ENERGY STAR Freezer - Any Upright-Manual Defrost w/ Sales Weighted Average Capacity	467 kWh/year; 16.65 cubic feet	409 kWh/year; 20.89 cubic feet
ENERGY STAR Freezer - Any Upright-Auto Defrost w/ Sales Weighted Average Capacity	692 kWh/year; 17.08 cubic feet	575 kWh/year; 20.89 cubic feet

In addition to the change in baseline efficiency, the interaction adjustment used in the RTF is half of that used in the 6th Plan (7% versus 14%). The interaction adjustment is based on the RTF's assumption that only 50% of the participants keep freezers in an air conditioned space.

Baseline Adjusted Energy Savings per Unit

Cadmus did not calculate baseline adjusted savings for freezers because BPA and Cadmus decided it would not be cost-effective to isolate the savings solely due to baseline energy efficiency assumption changes, when numerous other changes had also occurred and savings were expected to be negligible.

BPA uses a weighted average "any freezer" configuration in its deemed savings database since the RTF adopted the baseline change in late June, 2010. The RTF UES contains savings for different freezer configurations.

For each freezer configuration in the RTF UES, the kWh per usage baseline is lower than the 6th Plan supply curve workbooks. This improved consumption baseline is attributable to several key factors. First, the RTF UES database assumes a much lower average adjusted volume for each freezer configuration than the 6th Plan. Second, the market mix of freezer configurations in the RTF UES database has drastically changed since the 6th Plan with a substantially higher market penetration for chest freezers. Since the energy consumption of chest freezers is lowest relative to other measure configurations, the result is a substantial decrease in the baseline consumption for the "any freezer" measure used in BPA's database.

In addition to changes in volume and market mix assumptions, there are two additional changes in the measure analysis. The RTF UES database assumes the baseline is more efficient than the federal standard. For the weighted average "any freezer" configuration, the RTF UES assumes this unit is 1.8% more efficient than the federal standard whereas the 6th Plan supply curves assumes an improvement of 4.3% relative to the federal standard. These baseline values are derived from multiple data sources including the California Energy Commission (CEC) database of refrigerators as well as two other proprietary market data sources.

Lastly, the RTF UES assumes that the average ENERGY STAR unit for the “any freezer” configuration is 12.7% more efficient than the federal standard. However, the 6th Plan supply curves assumed this value is 10%. This change in assumptions indicates lower energy consumption for the average ENERGY STAR model relative to the federal standard.

After analyzing a number of scenarios involving the aforementioned assumption changes, BPA and Cadmus staff decided not to further pursue the possible baseline adjusted savings attributable to residential freezers. If only one or two of the measure assumptions had changed from the 6th Plan to the RTF UES, then it would be possible to isolate the baseline adjusted savings. However, with several changes that lowered the baseline energy usage assumption (updated market mix, smaller average adjusted volume, and lower baseline freezer consumption) and a change that lowered the average ENERGY STAR model consumption (increased Energy Star efficiency relative to federal standard), the task of isolating the savings difference between the 6th Plan and RTF UES baseline becomes a difficult and costly undertaking when the savings may be negligible.

Refrigerators

Baseline efficiencies for refrigerators have improved similarly to those for freezers, although in this case, the RTF’s average capacity assumption was lower than the measure-specific capacity assumptions in the 6th Plan. Although the refrigerator measure configurations in the 6th Plan and the updated RTF UES were similar in their construction and number, the only measure configuration adopted by BPA for its deemed savings database prior to April 1, 2014 was the weighted average configuration for any ENERGY STAR refrigerator. Beginning on that date, BPA added CEE Tier 1, Tier 2, and Tier 3 refrigerators to the deemed savings database in accordance with an RTF UES measure change.

Baseline Change

Table 8 lists the changes in baseline assumptions for refrigerators based upon the RTF's June 2010 decision. The RTF UES baseline usage and assumed average adjusted volume was lower than the 6th Plan baseline. Furthermore, whereas the 6th Plan adjusted average volume sizes differ for each measure configuration, the updated RTF UES assumes the same size for each refrigerator measure.

Table 8. Baseline Efficiency Changes for Refrigerators

ENERGY STAR Refrigerator Configuration	6th Plan Baseline	RTF UES Baseline	6th Plan Savings	RTF Savings (June 2010 Update)
Top Freezer – Ice	555 kWh/year; 25.75 cubic feet	489 kWh/year; 20.98 cubic feet	56	44
Top Freezer - No Ice	458 kWh/year; 21.66 cubic feet	428 kWh/year; 20.98 cubic feet	63	49
Side-by-Side - No Ice	597 kWh/year; 29.53 cubic feet	533 kWh/year; 20.98 cubic feet	70	55
Side-by-Side – Ice	636 kWh/year; 30.34 cubic feet	536 kWh/year; 20.98 cubic feet	62	49
Bottom Freezer – Ice	566 kWh/year; 29.38 cubic feet	470 kWh/year; 20.98 cubic feet	15	49
Bottom Freezer - No Ice	500 kWh/year; 24.56 cubic feet	484 kWh/year; 20.98 cubic feet	40	44
Any Configuration	545 kWh/year; 21.68 cubic feet	469 kWh/year; 20.98 cubic feet	59	47

During the second phase of our analysis, we discovered that the RTF made an additional baseline assumption change in April 2013. Table 9 summarizes the changes in baseline consumption for the "Any ENERGY STAR" configuration from the 6th Plan and the two subsequent RTF measure updates.

Table 9. Baseline Efficiency Changes for Any ENERGY STAR Refrigerator Configurations

Any ENERGY STAR Refrigerator Configuration	Consumption	Size
Sixth Plan Baseline	545 kWh/year	21.68 cubic feet
RTF June 2010 Baseline	469 kWh/year	20.98 cubic feet
RTF April 2013 Baseline	491 kWh/year	24.48 cubic feet

Despite the increase in baseline consumption for the "Any ENERGY STAR" configuration in the April 2013 RTF update, the overall savings for this measure decreased relative to the 6th Plan.

Baseline Adjusted Energy Savings per Unit

The RTF first updated the baseline energy consumption for refrigerators in late June 2010. Although the measure configurations were similar between the 6th Plan and the RTF UES update, the only measure iteration adopted for use in the BPA deemed savings database was the ENERGY STAR refrigerator for "any configuration," which is a market weighted average of all the other measures. Therefore, our analysis only included this configuration as it is the only utility incented iteration that appeared in the BPA database after April 1, 2011, which is when this measure became effective with the updated baseline assumptions.

Figure 5 depicts the difference in the baselines and shows total savings for the weighted average ENERGY STAR refrigerator configuration with the RTF baseline from June 2010

Figure 5. Refrigerator Savings Comparison for Any Refrigerator Configuration

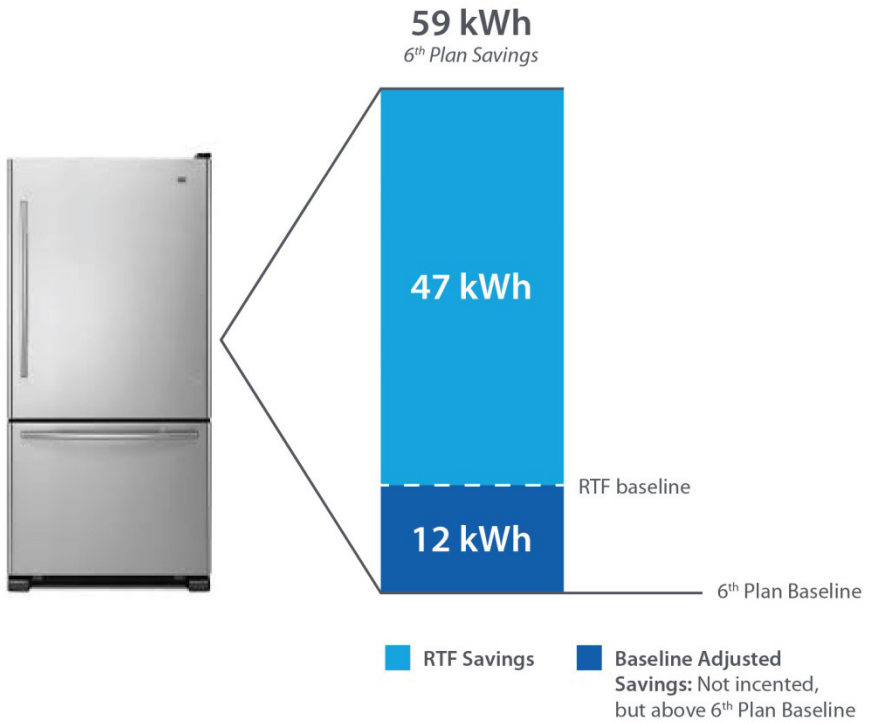


Table 10 provides the EEC reference number, the 6th Plan, RTF UES (June 2010), and baseline adjusted savings values for the ENERGY STAR weighted average configuration for 2011 and 2012. This table also includes the total utility-incented quantities for this measure beginning with its April 1, 2011, effective date through the end of the 2012 fiscal year, September 30, 2012. Lastly, it shows the annual kWh baseline adjusted savings.

Table 10. Refrigerator Savings per Unit and Baseline Adjusted Savings (2011-2012)

Refrigerator Configuration		Per Unit Annual kWh Savings (Busbar)			Utility Incented Quantity		Baseline Adjusted Savings
EEC Reference Number	Measure Description	6th Plan Savings	RTF UES Savings	Baseline Adjusted Savings	2011 Quantity	2012 Quantity	2011-2012 kWh Savings
RRERE10933	Any Refrigerator Any Residential	59	47	12	10,112	6,137	194,988

The BPA deemed measure database was changed on April 1, 2014, to reflect the per unit savings resulting from the RTF's April 2013 refrigerator baseline decision. Table 11 provides the updated RTF UES and baseline adjusted savings for 2013 - 2014. This table also includes the total utility-incented quantities for these measure iterations beginning with the start of the 2013 fiscal year (October 1, 2012) through the end of the 2014 fiscal year (September 30, 2014). Because the change to BPA's deemed savings took place during the 2014 fiscal year, this table summarizes the quantity and savings of each measure iteration for the combined 2013 and 2014 program years.

Table 11. Refrigerator Savings per Unit and Baseline Adjusted Savings (2013-2014)

Refrigerator Configuration		Measure Date	Per Unit Annual kWh Savings (Busbar)			Utility Incented Quantity	Baseline Adjusted Savings
EEC Reference Number	**Measure Description**	**BPA Effective Date**	**6th Plan Savings**	**RTF UES Savings**	**Baseline Adjusted Savings**	**2013-2014 Quantity**	**2013-2014 Savings**
RRERE10933	Any Refrigerator - Any Residential (SF, MF, or MH)	4/1/2011	59	47	12	18,747	224,964
RRERE10933	Any Refrigerator - Any Residential (SF, MF, or MH)	4/1/2014	59	29	31	6,222	83,593
Total						**24,969**	**308,557**

Dishwashers

The baseline changed for dishwashers from the 6th Plan to the RTF UES database. However, this measure was not included in BPA's measure database. Therefore, we did not quantify the baseline adjusted energy savings for dishwashers.

Lighting

The baseline efficiency for residential lighting measures changed due to the Energy Independence and Security Act (EISA). NEEA will quantify and claim these savings; therefore, we did not quantify baseline adjusted savings as part of this study.

Summary of Baseline Adjusted Savings for 2010 - 2014

Cadmus identified baseline adjusted savings in 2010 - 2014 for two residential measures: (1) clothes washers and (2) refrigerators. None of the commercial measures had baseline adjustments during this period. Table 12 shows the baseline adjusted savings in average megawatts by year for the three measures. The RTF did not make any adjustments to the measures reviewed for this study prior to 2011; therefore, we did not identify baseline adjusted savings for 2010.

Table 12. Summary of Baseline Adjusted Savings for 2010 - 2014

Measure	2010 aMW	2011 aMW	2012 aMW	2013 aMW	2014 aMW	Total aMW
Clothes Washers	0.00	0.15	0.28	0.45	0.13	1.02
Refrigerators	0.00	0.01	0.01	0.03	0.01	0.06
Total	**0.00**	**0.16**	**0.29**	**0.48**	**0.14**	**1.08**