Overlap in Momentum Savings: Key Findings and Actions Taken to Avoid Double-Counting

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Contributors

Developed by Angie Lee, Julie Penning, Robert Firme, and David Bluestein, Navigant Consulting, Inc.; Ben Barrington, Robert Carmichael, and Katie Arquiette, Cadeo Group

Developed for the Bonneville Power Administration

Please refer questions to:
Carrie Cobb, clcobb@bpa.gov, 503.230.4985

Executive Summary

Electric customers in the Pacific Northwest have long benefited from the many energy efficiency programs offered by local utilities, cooperatives, and municipalities, as well as entities such as the Bonneville Power Administration (BPA) and the Northwest Energy Efficiency Alliance (NEEA). These programs generate an impressive amount of energy savings, but are not the only source of energy efficiency in the region. Momentum in the market—generated, for instance, when consumers choose a high efficiency technology without receiving an incentive to do so—also leads to energy savings. Regulators in the region allow BPA and other energy efficiency entities to quantify and claim this savings as Momentum Savings. The challenge is properly allocating regional energy savings to either the demand-side programs or Momentum Savings, and avoiding double-counting in the market.

BPA is well aware of this issue and takes careful steps to avoid double-counting in all of their Momentum Savings estimates, including:

- Not claiming any Momentum Savings from measures which other regional market-level programs currently target
- Deducting all overlapping programmatic savings from any Momentum Savings estimates

These steps tend to underestimate savings, however, by assuming that programmatic savings completely overlap with Momentum Savings. This is not always the case and could leave additional Momentum Savings unclaimed. Leaving savings on the table has implications for resource planning and may add to the overall cost of serving energy needs in the Northwest.

The Navigant research team (the research team) followed the steps outlined in the "Methodology to Avoid Double-Counting in Momentum Savings Analyses" memo to identify and quantify overlap between Momentum Savings and other regional savings. This involved scrutinizing BPA's Momentum Savings analyses, implementation manual, and list of custom projects, as well as the Northwest Power and Conservation Council's (the Council) supply curve files and load forecast. The team also reviewed NEEA's Shareholder Savings Reports and ACE Models to identify overlap with NEEA's energy conservation efforts. The research team identified three key areas where overlap between analyses exist:

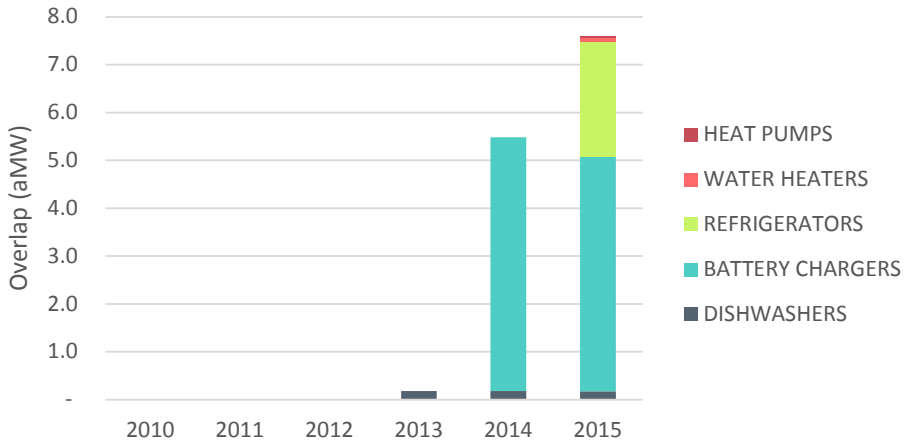
1. **Overlap between different Momentum Savings models.** BPA currently models Momentum Savings using two primary sources: 1) appliance efficiency standards—found in the **Standards Momentum Savings** models—which include gains in efficiency attributable to minimum federal or state standards and 2) natural market momentum—found in **Market Momentum Savings** models—which include all other gains in efficiency not driven by standards. Overlap occurs when a single technology appears in both Momentum Savings models. For example, one Standards Momentum Savings model includes ducted air-source heat pumps covered by the federal standards for residential heat pumps imposed in 2014. The same ducted air-source heat pump technology also appears in the Market Momentum Savings model for residential HVAC equipment as higher efficiency options exist well beyond the minimum federal standard.
2. **Overlap between Momentum Savings estimates and savings from NEEA's regional initiatives.** NEEA estimates savings from several regional initiatives using market-level modeling. NEEA's approach to quantifying these savings is not unlike BPA's estimates of

regional Momentum Savings. The potential for overlap occurs when both agencies estimate savings for the same measures.

3. **Overlap between Momentum Savings estimates and programmatic savings from projects.** Momentum Savings estimates may overlap with efficiency programs when they include the same technologies. However, pinpointing the extent to which Momentum Savings estimates overlap with custom projects is challenging due to a lack of specificity in project data. Custom projects often include building level upgrades and documentation may not always cite the exact technologies involved. As for prescriptive programs, the time lag between a standard's effective date and program implementation of the new baseline might yield overlap if programs are claiming savings from measures with baseline less efficient than standards level. Analysts must scrutinize every possible data source and also rely on professional judgment to make conservative estimates of where double counting overlap exists between these analyses.

Figure 1 and Figure 2 illustrate the overlap between Momentum Savings and NEEA initiatives and between BPA custom projects and Momentum Savings during the Sixth Power Plan period (2010 – 2015).[1]

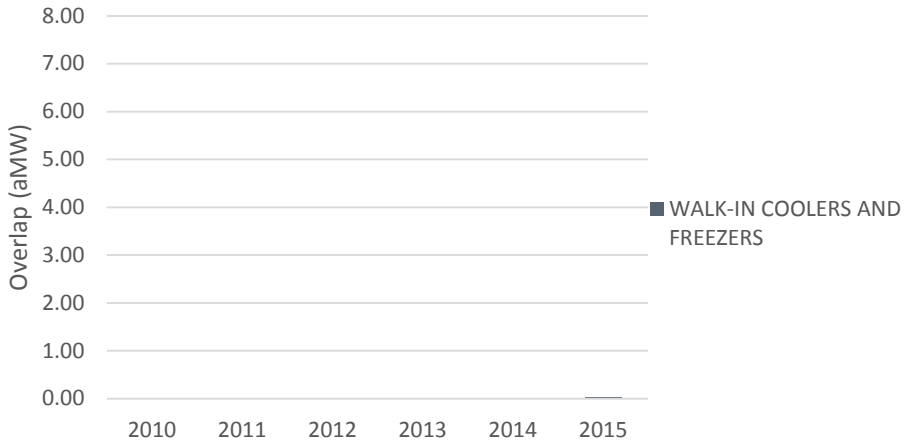
Figure 1: Overlap between NEEA Initiatives and BPA Momentum Savings (2010 – 2015)



Source: Navigant and Cadeo Analysis

[1] Notably absent is a chart depicting overlap between multiple BPA Momentum Savings estimates. In the course of its review, the research team identified no overlap between BPA's Momentum Savings analyses.

Figure 2: Overlap between BPA Custom Projects and BPA Momentum Savings (2010 – 2015)



Source: Navigant and Cadeo Analysis

The overlap between BPA Momentum Savings and savings from NEEA initiatives far outweighed overlap with BPA custom projects. This is largely due to the regional, market-level nature of NEEA initiatives relative to the targeted, individual building focus of custom projects.

To precisely correct for these savings overlaps, BPA should deduct this portion alone from its estimates of Momentum Savings. Using this approach would avoid both double counting and overcorrecting for overlap and acknowledge real Momentum Savings that are otherwise going unclaimed in existing analyses. With new advances in energy efficient appliances, lighting, and heating and cooling technologies entering the market every day, gains in efficiency are expected well into the future. The methods outlined in this report should be used going forward to more precisely measure overlap in future analyses as well.

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Introduction

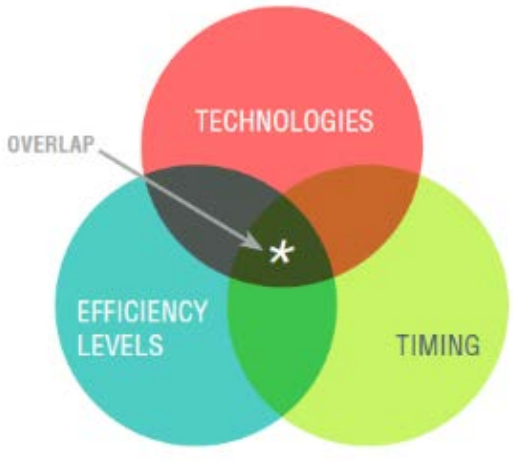
Electric customers in the Pacific Northwest have long benefited from the many energy efficiency programs offered by local utilities, cooperatives, and municipalities, as well as entities such as the Bonneville Power Administration (BPA) and the Northwest Energy Efficiency Alliance (NEEA). These programs generate an impressive amount of energy savings, but are not the only drivers of energy conservation in the region. Momentum in the market—generated, for instance, when consumers choose a high efficiency technology without receiving an incentive to do so—also leads to energy savings. Regulators in the region allow BPA and other energy efficiency entities to quantify and claim this savings as Momentum Savings. The challenge is properly allocating every kilowatt-hour saved to either the demand-side programs or Momentum Savings, and avoiding double-counting in the market.

BPA is well aware of this issue and takes careful steps to avoid double-counting in all of their Savings estimates, including:

- Not claiming any Momentum Savings from measures which other regional market-level programs currently target
- Deducting all overlapping programmatic savings from any Momentum Savings estimates

These steps tend to be on the conservative side however, by assuming that programmatic savings completely overlap with Momentum Savings. This is not always the case and could leave additional Momentum Savings unclaimed. Leaving savings on the table has implications for resource planning and may add to the overall cost of serving energy needs in the Northwest. Overlap only occurs to the extent that two savings estimates find savings from the same efficiency levels of the same technologies at the same time. Figure 3 illustrates this concept.

Figure 3: Modeling Overlap Resulting in Double-Counting



Source: Navigant and Cadeo, 2015

Identifying the degree to which two analyses overlap across these three criteria is critical to refining BPA's corrections to Momentum Savings. BPA tasked the Navigant research team (the research team) with

reviewing the current Momentum Savings models to identify the specific areas of overlap and define ways to more precisely account for them. The research team reviewed regional savings estimates—using the guidance provided in the "Methodology to Avoid Double-Counting in Momentum Savings Analyses" memo—to outline the following three key areas where overlap between analyses exist.

1. **Overlap between different Momentum Savings models.** BPA currently models Momentum Savings using two primary sources: 1) appliance efficiency standards—found in the **Standards Momentum Savings** models—which include gains in efficiency attributable to minimum federal or state standards and 2) natural market momentum—found in **Market Momentum Savings** models—which include all other gains in efficiency not driven by standards. Overlap occurs when a single technology appears in both Momentum Savings models. For example, one Standards Momentum Savings model includes ducted air-source heat pumps covered by the federal standards for residential heat pumps imposed in 2014. The same ducted air-source heat pump technology also appears in the Market Momentum Savings model for residential HVAC equipment as higher efficiency options exist well beyond the minimum federal standard.

2. **Overlap between Momentum Savings estimates and savings from NEEA's regional initiatives.** NEEA estimates savings from several regional initiatives using market-level modeling. NEEA's approach to quantifying these savings is not unlike BPA's estimates of regional Momentum Savings. The potential for overlap occurs when both agencies estimate savings for the same measures.

3. **Overlap between Momentum Savings estimates and programmatic savings from custom projects.** Momentum Savings estimates may overlap with custom efficiency programs when they include the same technologies. However, pinpointing the extent to which Momentum Savings estimates overlap with custom projects is challenging due to a lack of specificity in project data. Custom projects often include building level upgrades and documentation may not always cite the exact technologies involved. As for prescriptive programs, the time lag between a standard's effective date and program implementation of the new baseline might yield overlapping if programs are claiming savings from measures with baseline less efficient than standards level. Analysts must scrutinize every possible data source and also rely on professional judgment to make conservative estimates of where double counting overlap exists between these analyses.

Overlap between different Momentum Savings Models

BPA estimates Momentum Savings using two types of models: **Standards Momentum Savings** models—which derive savings from new appliance efficiency standards, and **Market Momentum Savings** models—which derive savings from other market momentum. These two types of models overlap when they derive savings from the same efficiency levels of the same technology at the same time. The team reviewed the two Market Momentum Savings models—the non-residential lighting model and the residential heating, ventilation, and air-conditioning (HVAC) model—and compared the technologies they covered with the technologies covered by the 28 Standards Momentum Savings models.

Table 1 lists the technologies found in the current Market Momentum Savings models and specifies the Standards Momentum Savings model associated with those same technologies.

Table 1: Market Momentum Savings Technologies, Baselines, and Overlapping Standards

Technologies covered by the Market Momentum Savings Models	Associated Standards Momentum Savings Models
Non-Residential Lighting: LFLs, HIDs, LEDs, CFLs, and INCs for commercial and industrial building interior and exterior lighting, and outdoor non-building lighting	Lighting Standards Model
Residential HVAC Market: Ducted Air Source Heat Pumps in Single Family and Manufactured Homes	Heat Pump Standards: (Effective Jan 2015)

Source: Navigant 2015

When a technology appeared in both the Market Momentum Savings model and the associated Standards Momentum Savings model (e.g., ducted heat pumps appear in both the Residential HVAC Market model, and the Heat Pump Standards model), the research team examined the following elements to account for overlap in the analyses:

- The **baseline** assumed in both models
- The **efficiency levels** identified by both models for the technology in question
- The **timeframe of reported savings** in both models to check for overlapping analysis years

The results section details the research team's findings from this review.

Results

This section presents the results of the research team's detailed review of the overlap between the current Market Momentum Savings models and the corresponding Standards Momentum Savings

models. The team also reviewed the baseline assumptions, efficiency levels, and timing for all other Standards Momentum Savings models—which do not overlap with current Market Momentum Savings models—to lay the groundwork should BPA expand its portfolio of Market Momentum Savings models. Appendix A: Other Appliance Standards Momentum Savings provides the results for these other technologies.

Lighting Market Momentum and Lighting Standards Momentum

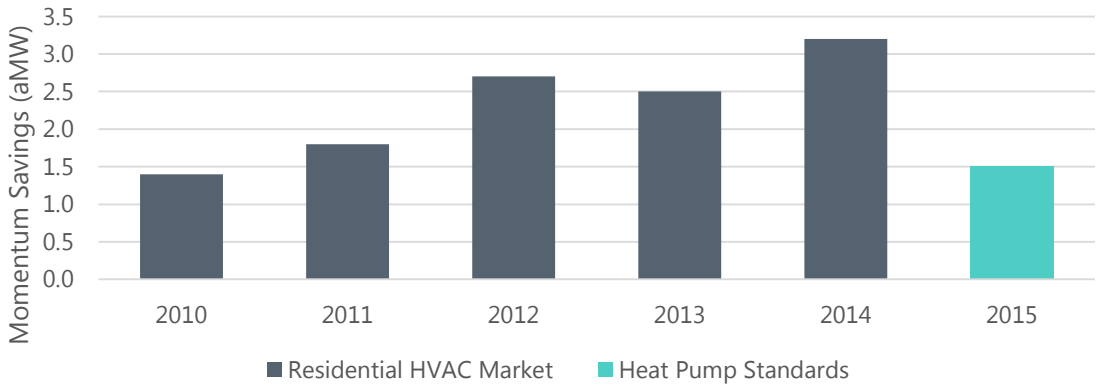
BPA's Lighting Momentum Savings model relies in part on the existing Lighting Standards model. The Lighting Standards model uses a National Lighting Standards model—which the team scaled to reflect the impact of lighting standards in the Pacific Northwest. As a result, BPA's lighting Momentum Savings model includes the effects of both standards and other market momentum in its savings estimate. This precludes BPA from reporting Momentum Savings from lighting standards separate from savings attributable to other market momentum, and eliminates the possibility of overlap.

The team would like to point out that the standards embedded in the non-residential lighting Market Momentum Savings model also affect lamps found in the residential sector. The team recommends analysts review the non-residential lighting model and take a similar and consistent approach when analyzing Momentum Savings in the residential lighting market. This will ensure BPA claims all savings from lighting standards equally across the region.

Residential HVAC Market Momentum and Heat Pump Standards Momentum

Next, the research team compared the heat pump Standards Momentum Savings model to the residential HVAC Market Momentum Savings model. The review showed that while both analyses covered ducted heat pumps (the same technology) and the range of efficiency levels from which each analysis claimed savings overlapped (same efficiency levels), the two analyses are separated by time. Figure 4 illustrates the timelines for both models and shows the residential HVAC Market Momentum Savings analysis stopping in 2014, and the effects of the new heat pump standards taking over in 2015.

Figure 4: Momentum Savings from the Residential HVAC Market and Heat Pump Standards



Source: Navigant 2015

The effects of the new standards in 2015 will certainly diminish the savings from market momentum going forward. However, it will not completely wipe them out as indicated by the Market Momentum

Savings model stopping in 2014. Consumers will likely continue to upgrade and convert HVAC equipment above the minimum standard, therefore generating savings. The research team recommends establishing the residential HVAC Market Momentum Savings baseline at the standard level for ducted heat pumps in 2015 and beyond in order to accurately account for these savings. This entails moving from a market average baseline of 7.8 HSPF[2] to 8.0 HSPF after standards take effect.

Recommendations

BPA can avoid double-counting between Standards and Market Momentum Savings models by proactively constructing them to avoid overlap. The research team identified the following key recommendations to improve the precision by which BPA avoids double counting between Standards and Market Momentum Savings analyses.

1. Adjust the baseline in the Market Momentum Savings model to accurately reflect the impact of efficiency standards. This will ensure that savings tracked in the Market Momentum Savings model will be above those tracked in the Standards Momentum Savings model. It will also allow the Market Momentum Savings model to continue to claim savings at and beyond the point a new standard affects the market.
2. Reflect changes in the efficiency mix of the Standards Momentum Savings model using a "roll-up" instead of a "shift" of equipment sales below the new standard efficiency level.[3] This will prevent savings from Standards from extending into those from movement in the market that happens above the standard level.

Overlap between Momentum Savings and Savings from NEEA's Regional Initiatives

The Northwest Energy Efficiency Alliance (NEEA) coordinates numerous market-wide initiatives to push businesses and consumers in the Pacific Northwest toward higher efficiency technologies and to conserve energy through changes in behavior. These regional initiatives require market-level modeling similar to what BPA uses when estimating Momentum Savings. Overlap occurs when these analyses both include the same efficiency levels of the same technologies and claim savings for the same years.

BPA currently takes the conservative approach to avoid double-counting with NEEA by identifying any overlapping technologies or markets, and subtracting NEEA's claimed savings from BPA's Momentum Savings estimates. This approach assumes that NEEA's estimates already account for 100 percent of BPA's Momentum Savings. Depending on the scope of NEEA's initiative, this may or may not be the case.

[2] The Sixth Plan Baseline for ducted air source heat pumps (single package systems) has the market at 85% HSPF 7.7 (the federal minimum standard from Jan 2006 to Jan 2015), 10% at HSPF 8.5, and 5% at HSPF 9.0; or a weighted average of 7.8 HSPF. This has the opportunity to shift again with the writing of a new Power Plan.

[3] For a detailed account of the "roll-up" and "shift" adjustments to the efficiency mix, see "*Methodology to Avoid Double-Counting in Momentum Savings Analyses",* Rep. Bonneville Power Administration, December 2015. Web.

The research team set out to clearly define where the overlap exists between NEEA's initiatives and BPA Momentum Savings using the three criteria: **technology**, **efficiency levels**, and **timing** as described in the Introduction. NEEA provided a detailed report to BPA and other stakeholders containing data on all savings NEEA reported during the period of the Council's Sixth Power Plan, including counts of units incentivized under each initiative, unit energy savings (UES) and total reported savings for each calendar year.[4] The team used this report to compare overlap with BPA's 28 existing appliance standards Momentum Savings models, as well as the Market Momentum Savings models for residential HVAC and non-residential lighting. The following steps detail this process:

1. **Identify the list of technologies** included in all NEEA initiatives and compare the list to the technologies covered by BPA Momentum Savings models. NEEA's report provided sufficient detail on the types of technologies included in each initiative. The research team used this information to develop a list of Momentum Savings analyses which feature the same technologies as NEEA initiatives and then validated this list with NEEA staff.

2. **Understand the efficiency levels** included in both NEEA's initiatives and BPA's Momentum Savings. Overlap in the ranges of efficiency examined in the two analyses could result in overlapping savings. NEEA's data provided specifics on the efficiency characteristics of each technology associated with the initiative. The research team compared these to the efficiencies used in BPA's Momentum Savings models to determine if NEEA initiatives which feature the same technologies as Momentum Savings analyses, also affect overlapping efficiency levels.

3. **Compare the timing of savings** of each NEEA initiative with the corresponding Momentum Savings model. The research team created a longitudinal table of NEEA savings using the number of units and UES per unit in each year of NEEA's report. The team then compared this timeline to the years in which BPA identified Momentum Savings in its models to determine if the savings identified in each type of analysis overlapped in time.

NEEA staff were very helpful in answering the research team's questions regarding their data such as the timing of certain initiatives, whether the initiative drove standards or the adoption of high efficiency technologies, and why some initiatives reported zero savings. The research team worked closely with NEEA staff to understand why some initiatives were not showing UESs for certain years of analysis. Table 2 lists the NEEA initiatives with zero savings and provides the reasoning NEEA gave for justifying these rates. The research team did not focus on comparing NEEA savings from these initiatives to Momentum Savings analyses as NEEA does not claim savings from them.

Table 2: NEEA Measures with Zero Savings

NEEA Initiative with Zero Savings	Rationale
Commercial Grocery Tier 1	No longer tracking the initiative
Industrial Drive Power - Single Tier	
Commercial Desktop Power Supplies - 80 PLUS	Below the 6th Power Council baseline
Commercial Luminaire Level Lighting Controls	New initiative, therefore NEEA does not report

[4] Note the report had already been filtered to accurately reflect BPA's share (42%) of regional savings.

NEEA Initiative with Zero Savings	Rationale
	the savings forecast
Commercial Fed. Std. Fluorescent Lamp Ballasts	Already included in the 7th Power Plan forecast or a measure baseline. NEEA did not report 6th Power Plan savings from standards not directly related to a voluntary initiative
Residential Lighting Fixtures	No longer tracking the initiative
Residential Super-Efficient Dryers - Energy Star	New initiative, therefore NEEA does not report the savings forecast
Residential Super-Efficient Dryers - Heat Pump	New initiative, therefore NEEA does not report the savings forecast
Residential Clothes Washers MEF 1.26 - 1.41	Below the 6th and 7th Power Council baselines
Residential Dishwashers EF 52	Below the 2010 and 2013 standards, as well as the 6th Power Council baseline
Residential Dishwashers EF 58	Below the 2010 and 2013 standards, as well as the 6th Power Council baseline
Residential Dishwashers EF 65	Below the 2013 standard
Residential Refrigerators ENERGY STAR 2003	Now tracking ENERGY STAR 2008
Commercial Fed. Std. Small Electric Motors	Standard

Source: Navigant 2015

Results

This section presents the results of the review of potential overlap between NEEA initiatives and BPA Momentum Savings models. The research team only found overlap with NEEA initiatives for the following six Momentum Savings models:

1. Residential Refrigerators Standards
2. Residential Dishwasher Standards
3. Residential Heat Pump Standards
4. Residential Water Heater Standards
5. Battery Chargers Standards
6. Non-Res Lighting Market

The following sections provide detail on each of these models including how they overlap with NEEA initiatives over the three criteria: technology, efficiency levels, and analysis timeframe. Table 3 presents the quantified energy savings—in aMW—claimed by both analyses for years 2010–2015.

Table 3: NEEA Initiative Savings and BPA Momentum Savings for Similar Measures

NEEA Initiative Savings (aMW)	2010	2011	2012	2013	2014	2015	BPA Momentum Savings (aMW)	2010	2011	2012	2013	2014	2015
Residential - Refrigerators ENERGY STAR 2008	0.66	0.80	1.01	0.88	1.08	1.12	Residential Refrigerators Standards	-	-	-	-	-	3.16
Residential - Dishwashers Energy Factor 68	0.17	0.17	0.18	0.22	0.25	0.25	Residential Dishwasher Standards	-	-	-	0.18	0.18	0.18
Residential - Ductless Heat Pumps DHP Zonal - Tier 1	1.28	1.12	1.46	1.27	1.22	1.47	Residential Heat Pump Standards	-	-	-	-	-	0.60
Residential - Ductless Heat Pumps DHP FAF - Tier 1	0.02	0.02	0.03	0.20	0.30	0.38	Residential Heat Pump Standards	-	-	-	-	-	0.60
Residential - Heat Pump Water Heaters HPWH (>55 gallons) - Tier 2	-	-	-	0.002	0.001	0.004	Residential Water Heater Standards	-	-	-	-	-	5.962
Residential - Heat Pump Water Heaters HPWH (>55 gallons) - Tier 1	-	-	0.038	0.038	0.015	0.082	Residential Water Heater Standards	-	-	-	-	-	5.962
Residential - Heat Pump Water Heaters HPWH (<=55 gallons) - Tier 2	-	-	-	-	-	0.003	Residential Water Heater Standards	-	-	-	-	-	5.962
Residential - Heat Pump Water Heaters HPWH (<=55 gallons) - Tier 1	-	-	0.049	0.086	0.190	0.485	Residential Water Heater Standards	-	-	-	-	-	5.962
Residential - Other Residential Standards State Std. Battery Chargers – Standard	-	-	-	-	5.62	2.34	Battery Chargers Standards	-	-	-	-	5.31	4.90
Commercial - Reduced Wattage Lamp Replacement - T8 Fluorescent 28W - Tier 1	-	-	-	-	0.16	0.28	Non-Res Lighting Market	(0.50)	8.00	19.00	29.00	31.00	n/a
Commercial - Reduced Wattage Lamp Replacement - T8 Fluorescent 25W - Tier 1	-	-	-	-	0.10	0.18	Non-Res Lighting Market	(0.50)	8.00	19.00	29.00	31.00	n/a
Commercial - Commercial Lighting Solutions – Pilot	-	0.02	0.08	-	-	-	Non-Res Lighting Market	(0.50)	8.00	19.00	29.00	31.00	n/a

Source: Navigant 2015

Residential Refrigerators

NEEA and BPA both identified savings tied to residential refrigerators. NEEA's initiative derives savings from the increase the market penetration of ENERGY STAR® qualified refrigerators from 2010 through 2015.[5] In contrast, Momentum Savings arise from the 2014 federal standard, but BPA only modeled Momentum Savings from refrigerator standards starting in 2015 because the standard only took effect in September 2014 (late in the year). As such, overlap between NEEA initiatives and BPA Momentum Savings can only occur in 2015, after Momentum Savings begin.

To determine the extent of this potential overlap, the team analyzed the efficiency levels associated with the NEEA initiative and those featured in the Momentum Savings model. NEEA claimed savings from increasing market penetration of 2008 ENERGY STAR® (version 4.0) refrigerators which is above the Council baseline. Table 4 shows a comparison of the specifications for the six representative product classes analyzed in BPA's Momentum Savings model for refrigerator and freezer standards (lower numbers indicate higher efficiency).

Table 4: 2008 ENERGY STAR® 4.0 versus 2014 Federal Standards for Refrigerators

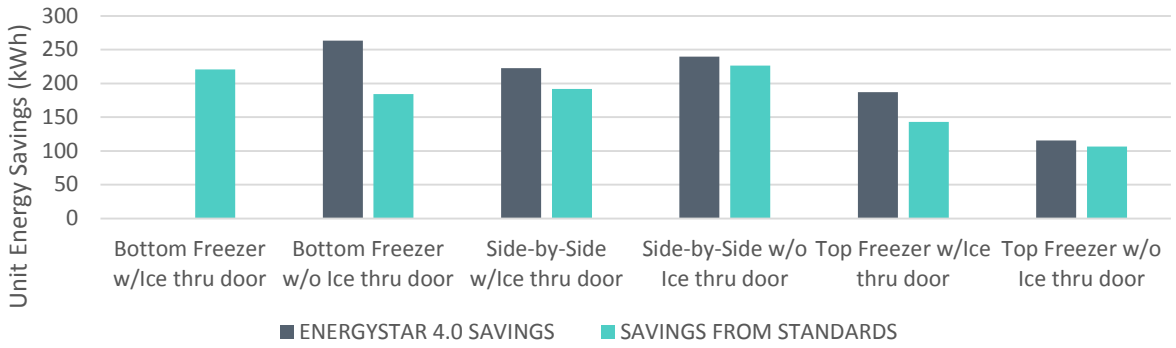
Representative Product Classes	ENERGY STAR 4.0 Requirements (as of April 28, 2008)	Federal Standards (as of September 14, 2014)
Bottom Freezer w/Ice thru door	No Specification	< 9.25*AV + 475.4
Bottom Freezer w/o Ice thru door	< 3.68*AV + 367.2	< 8.85*AV + 317.0
Side-by-Side w/Ice thru door	< 8.08*AV + 324.8	< 8.54*AV + 432.8
Side-by-Side w/o Ice thru door	< 3.93*AV + 406.0	< 8.51*AV + 297.8
Top Freezer w/Ice thru door	< 8.16*AV + 284.8	< 8.40*AV + 385.4
Top Freezer w/o Ice thru door	< 7.84*AV + 220.8	< 8.07*AV + 233.7

Source: ENERGY STAR Program Requirements for Refrigerators and/or Freezers (August 3, 2007) and 2014 DOE Standards Final Rule for Refrigerators and Freezers – Table 2 (September 15, 2011). Requirements are in maximum allowable kWh which are a function of the adjusted volume (AV) of each product.

The refrigerators Momentum Savings model included a shift in efficiency that went above the minimum standards (see Table 10 in Appendix A: Other Appliance Standards Momentum Savings). The post-case market average efficiency is less efficient compared to the ENERGY STAR 4.0 specifications levels. In other words, the unit energy savings (UES) from the baseline to post-standards level is less than the UES from the baseline to ENERGY STAR 4.0 level as shown in Figure 5.

[5] The NEEA Initiative for Residential Refrigerators ENERGY STAR® 2008 was labeled a "standard" by NEEA because of their role in establishing the ENERGY STAR® guidelines.

Figure 5: Refrigerator Unit Energy Savings: ENERGY STAR 4.0 versus 2014 Federal Standards



Source: Navigant 2015

Because the UES from the ENERGY STAR 4.0 units are higher than those from standards[6] they only partially overlap with Momentum Savings. Only the savings up to the standard level count as overlap; anything beyond that is above what is captured in the Momentum Savings estimate. Accordingly, the overlapping savings deducted from BPA Momentum Savings is equal to the UES from BPA's Momentum Savings analysis times the units claimed by NEEA after standards take effect.

In 2015, NEEA claimed savings for 175,890 ENERGY STAR® 4.0 refrigerators. With a UES from standards equal to 118.8 kWh, the total overlap equates to 2.38 aMW. Where BPA identified 3.16 aMW of Momentum Savings tied to the refrigerator standard in 2015, this leaves 0.78 aMW of remaining Momentum Savings.

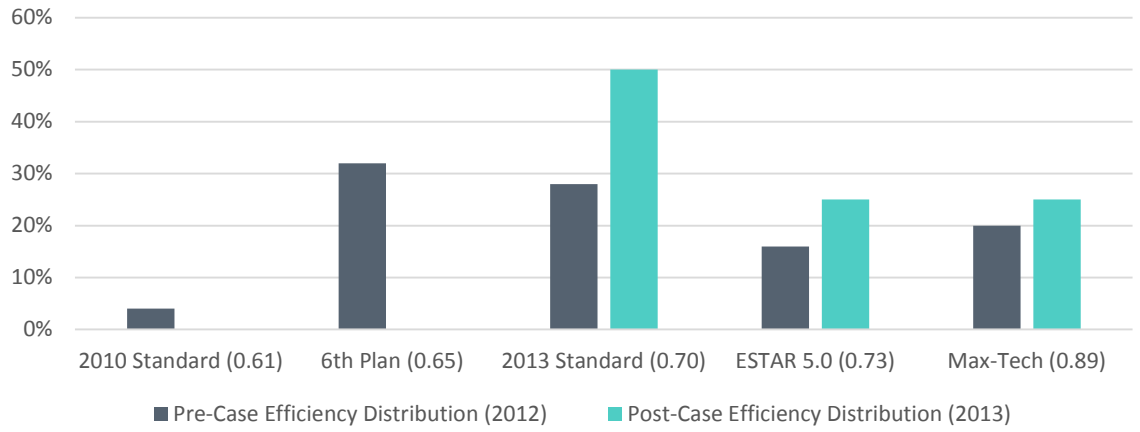
Residential Dishwashers

NEEA and BPA both identified savings tied to residential dishwashers. NEEA's initiative derives savings from the increase in market penetration of Efficiency Factor (EF) 68 dishwashers from 2010 through 2015 whereas Momentum Savings arise from the 2013 federal standard. As such, overlap between NEEA initiatives and BPA Momentum Savings may occur in 2013 through 2015 – after Momentum Savings begin.

[6] Using the same baseline UEC from BPA's refrigerator standards Momentum Savings model.

To determine the extent of this potential overlap, the team analyzed the efficiency levels associated with the NEEA initiative and those featured in the Momentum Savings model. NEEA's initiative derives savings from EF 68 dishwashers, which are above the Sixth Power Council baseline, but below the new 2013 standard of EF 70. NEEA clarified that they were able to claim savings because this level was still above the Council baseline and not included in the council's load forecast. In contrast, Momentum Savings arise from a shift in efficiency distribution relative to a baseline *more* efficient than that included in the Sixth Plan. This higher efficiency baseline is informed by the efficiency distribution included in the shipments analysis of DOE's dishwasher standards rulemaking. See Figure 6 for an illustration of the Pre-Case and Post-Case efficiency distributions assumed in BPA's Momentum Savings analysis of dishwasher standards.

Figure 6: Dishwasher Standards Analysis Pre-Case and Post-Case Efficiency Distributions



Source: Navigant 2015

Because of these mismatched baselines, the UES from BPA's analysis (9.0 kWh) was lower than NEEA's UES (12.7 kWh). As with refrigerators, this relationship would suggest the team calculates the overlap as the number of units claimed by NEEA using BPA's UES. However, issues arise when comparing the number of shipments. BPA had assumed that only 32 percent of the market was at the Sixth Plan baseline and thus would seemingly be eligible for upgrades to EF 68. Moreover, the total shipments estimate from NEEA was greater than that from BPA from 2014 onward. NEEA had arrived at this number by multiplying the market share of EF 68 dishwashers (NEEA equated EF 68 to the ENERGY STAR® specification) by total sales as taken from the Association of Home Appliance Manufacturers. This disagrees with BPA's shipments estimate which was developed using a stock turnover model which pulls on inputs from the Sixth Power Plan housing forecast, Residential Building Stock Assessment appliance saturation figures and appliance lifetime as taken from DOE rulemaking documentation. Table 5 shows a comparison of dishwasher shipments in each analysis between 2010 and 2015.

Table 5: BPA and NEEA Residential Dishwasher Shipments

Year	BPA	NEEA
2010	156,803	118,074
2011	180,777	115,142

2012	156,550	123,443
2013	164,654	151,520
2014	163,637	173,433
2015	161,835	172,352

Source: Navigant 2015

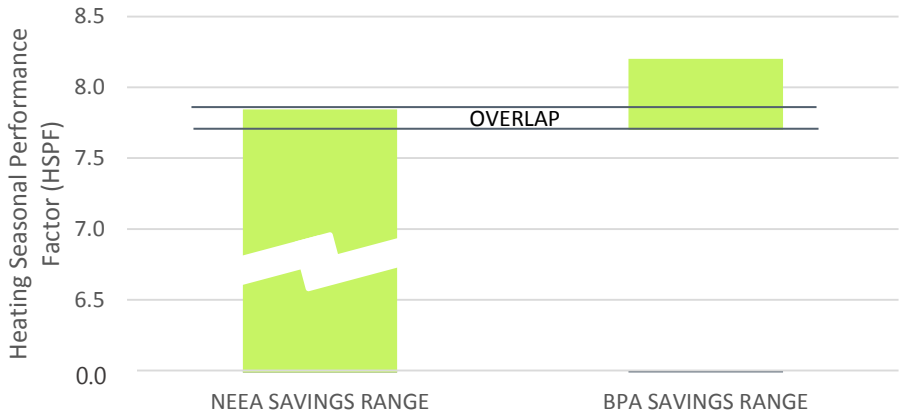
Because NEEA's unit UES is greater than BPA's, and NEEA's shipments estimate are greater than BPA's for 2 out of 3 years in which BPA claims savings from dishwasher standards, the research team believes it remains safest to claim no savings from dishwasher standards as they almost completely overlap with NEEA savings. This is consistent with BPA's current approach.

Residential Ductless Heat Pumps

NEEA and BPA both identified savings tied to ductless heat pumps. Starting in 2008, NEEA has led initiatives directed at increasing the market adoption of ductless heat pumps (DHPs). DHPs were excluded from BPA's Residential HVAC market analysis and so it is clear that there exists no overlap there. However, standards for DHPs (also known as split system heat pumps) do factor into BPA's Momentum Savings estimate for residential heat pump standards. BPA only claims Momentum Savings from heat pump standards in 2015 after new standards took effect and so overlap may only occur beginning in 2015.

The magnitude of overlap depends on the assumed efficiency levels of DHPs in each analysis. The UESs for NEEA's initiative are based on the type of HVAC system replaced—whether it be zonal or a forced air furnace (FAF)—and the prevailing market mix of DHP efficiencies in the Sixth Power Plan. This market mix of efficiencies includes 85 percent at the minimum federal standard heating seasonal performance factor (HSPF 7.7), 10 percent at 8.5 HSPF, and 5 percent at 9.0 HSPF. The weighted average of these values is 7.845 HSPF. In contrast, the UES used BPA's Momentum Savings analysis compares the 2015 standard for DHPs (8.2 HSPF) against the 2006 standard (7.7 HSPF). As such, the range of efficiencies considered in each analysis overlaps as shown in Figure 7.

Figure 7: Overlap between DHP Savings in NEEA and BPA Analyses



Source: Navigant 2015

This analysis suggests that the NEEA initiative overlaps with a little less than one-third (29%) of the UES for DHPs. With a UES of 208.1 kWh per DHP, the overlap equates to 60.3 kWh per unit. NEEA identifies 5,477 DHPs which contributed to their savings in 2015. Since NEEA's initiative is based on replacing forced air furnaces or zonal heating systems, these correspond to new shipments (as opposed to replacements) as categorized in BPA's Momentum Savings analysis. BPA's stock turnover model suggests that only 4,593[7] DHPs were shipped to new installations (not replacements) in 2015. Accordingly, the portion of overlapping savings should be deducted from only these units, or 0.03 aMW total. Where BPA identified 0.60 aMW of Momentum Savings tied to the heat pump standards in 2015, this correction leaves 0.57 aMW of remaining Momentum Savings.

Residential Heat Pump Water Heaters

NEEA and BPA both identified savings tied to residential heat pump water heaters. Starting in 2012 NEEA's initiative derives savings from increasing market penetration of two tiers of products whereas Momentum Savings arise from the 2015 standard, which essentially requires heat pump technology for water heaters with tanks above 55 gallons. As such, overlap between NEEA initiatives and BPA Momentum Savings may occur in 2015 – after Momentum Savings begin.

To determine the extent to which these savings overlap, the team examined the efficiency levels and UESs in each analysis. As mentioned, NEEA's savings come from two tiers of efficiency for heat pump water heaters. Tier 1 requires a minimum efficiency factor of 1.8 and corresponds to the ENERGY STAR® 3.0 levels effective January 2009, whereas Tier 2 increases the requirements and adds several other criteria as specified in Table 6.

Table 6: NEEA Heat Pump Water Heater Tier 1 and Tier 2 Specifications

Tier	Min Northern Climate EF*	Minimum "Northern Climate" Features	Minimum Supported Installation Locations	Sound Levels
Tier 1	1.8	ENERGY STAR® 3.0 Compliance	Semi-conditioned Unconditioned	dBA < 65
Tier 2	2.0	Tier 1 plus: Minimal use of electric heating elements, Freeze protection, Exhaust ducting option with airflow guidance, Compressor shutdown/ notification, 10-year Warranty, Condensate Management	Conditioned Semi-conditioned Unconditioned	dBA < 60

Source: NEEA Specification for Residential Heat Pump Water Heaters Installed in Northern Climates v5.0

It's important to note that the northern climate efficiency indicated in NEEA's specification aligns with the ENERGY STAR® 3.0 specification, which does not vary by climate and requires an efficiency factor of 2.0. Moreover, of NEEA's list of qualified heat pump water heaters, none have an efficiency factor below 2.0.

Where 2015 DOE standards require an efficiency factor no less than 0.95 for water heaters at or below 55 gallons and 1.97 for water heaters above 55 gallons, the products incented by NEEA are still above the new standard. As with refrigerators, this means that the NEEA UES eclipses the UES in the Momentum

[7] 4,593 DHPs corresponds to the total regional new shipments of heat pumps (12,427), scaled to the fraction of the market comprised of DHPs (88%), and scaled to just BPA's portion of the region (42%).

Savings Analysis and a similar approach to calculating refrigerators overlap is appropriate for calculating water heater overlap.

The UES from the BPA Momentum Savings analysis for water heaters was 349.1 kWh. Where NEEA claimed savings from 4,207[8] heat pump water heaters, this amounts to 0.17 aMW of overlap. Where BPA identified 5.96 aMW of Momentum Savings tied to the heat pump standard in 2015, this leaves 5.79 aMW of remaining Momentum Savings. However, these savings will need to be verified to check the market reaction to the new standard, which may cause consumers to choose different water heating equipment.

State Standard for Battery Chargers

NEEA and BPA both identified savings tied to the Oregon State Standard for battery chargers. NEEA made major contributions to the development of this standard. While these regulations are specific to Oregon, California also adheres to the same standard and industry experts expect it to become the de facto standard across the entire Northwest.[9] Therefore BPA's Momentum Savings estimates from battery chargers capture savings for the entire region and not just Oregon.

NEEA based savings estimates for this initiative on BPA's Momentum Savings model. The research team's review of these two analyses found that NEEA's UESs matched BPA's, but the number of shipments differed slightly due to the inclusion of counties in Montana.[10] This small discrepancy and NEEA's involvement in standards development prompts the team to recommend that BPA claim no Momentum Savings from battery charger standards, which is consistent with BPA's current approach.

Commercial Reduced Wattage Lamp Replacement and Commercial Lighting Solutions Pilot

NEEA and BPA both identified savings tied to commercial lighting. In 2014 and 2015, NEEA's reduced wattage lamp replacement (RWLR) initiative derives savings from increasing market penetration of higher efficiency 4 foot linear fluorescent lamps (LFLs). BPA's also includes this technology in the non-residential lighting Momentum Savings model during the Sixth Plan period from 2010 to 2015. These savings have the potential to overlap in years 2014 and 2015.

BPA's non-residential lighting Momentum Savings tracks overall lighting efficiency and covers multiple lighting technologies including linear fluorescents. While both the RWLR initiative and BPA Momentum Savings measure against different baselines—due to different analysis scopes—they embody the same spirit in terms of what standards affect these lamp types and thus what efficiencies create savings in the market. For this reason, savings claimed by NEEA and BPA overlap completely and BPA should deduct all NEEA savings from Momentum Savings.

Prior to RWLR, NEEA offered a commercial lighting solutions pilot from 2011 to 2012. This too has the potential to overlap with BPA's non-residential lighting, but depends on the scope of the initiative. The

[8] 4,207 is the number of Tier 1 heat pump water heaters in NEEA's report to stakeholders. In NEEA's report, Tier 2 is incremental to Tier 1, so Tier 2 units are reflected in the Tier 1 numbers for both units and savings rates.
[9] If the other Northwest states do not adopt the standard, manufacturers would need to maintain parallel compliant and non-compliant product lines, inventories, and distribution channels. Experts do not believe this to be a likely scenario.
[10] Certain counties in Montana were excluded from the Sixth Power Plan supply curves (used to identify climate zones), and were not accounted for by BPA in its estimate of Momentum Savings for battery chargers.

team found that several investor-owned utilities (IOUs) in the region funded this initiative and claimed savings outside of BPA's jurisdiction. The 42 percent correction factor in BPA's Momentum Savings analysis already addresses this overlap and avoids double-counting.

Recommendations

NEEA initiatives vary in their approach to promoting savings. Some initiatives relate to the development of standards, others aim to increase market penetration of efficient technologies above code minimums, while still others focus on piloting emerging technologies and new system solutions. The extent to which these regional initiatives overlap with BPA's Momentum Savings depends on the scope of the two analyses in terms of technology, efficiency, and timeline.

Clearly understanding the scope of NEEA's initiatives is paramount for BPA to accurately compare overlap with future Momentum Savings estimates. The team recommends an open and consistent line of communication between BPA and NEEA to facilitate this process and allow BPA to build savings models that work in conjunction with NEEA's energy efficiency efforts.

Overlap between Momentum Savings and Programmatic Savings

BPA claims programmatic savings originating from either 1) measures with unit energy savings (UES) estimates calculated against the baselines defined by the Regional Technical Forum (RTF) or 2) measures included in custom projects with savings calculated against non-standardized baselines. The research team reviewed all of the baselines for the UES measures and compared them to the baselines in the Standards Momentum Savings models.

For UES measures, the research team found that all RTF baselines are above current federal standards, therefore, there is no savings overlap between them and BPA's Standards Momentum Savings models. The research team recognizes that there is a time lag between standard effective date and program implementation of current RTF UES analyses. The time lag may cause programs to use older versions of UES analyses with baselines below current standards level. Analysts should review program tracking data and subtract savings claimed during the implementation time lag from Standards Momentum Savings.

The Non-Residential Lighting Momentum Savings model addresses overlap with these measures by excluding BPA lighting project savings as detailed below in the Non-Residential Lighting section. Similarly, the Residential HVAC Momentum Savings model deducts programmatic savings collected across the region. Additionally, there can be no double counting of these savings because BPA has simply not yet claimed any Momentum Savings from gains in residential HVAC efficiency to date.

Regarding measures included in custom projects, overlap with Momentum Savings occurs when the two share scope (i.e., both claim savings from the same range of efficiency levels, for the same technology, in the same timeframe). However, custom projects may lack proper documentation on specific technology

data such as type and number of units, making the process of comparing scopes to Momentum Savings a challenge.

Results

The research team reviewed all of BPA's custom projects looking for potential overlap with Momentum Savings analyses. The team found potential for overlap in the non-residential lighting Market Momentum Savings model and the commercial refrigeration equipment (CRE) and walk-in coolers and freezers (WICF) Standards Momentum Savings models. Note that BPA did not complete any custom projects for the residential HVAC market, so no overlapping analysis exists with the residential HVAC Market Momentum Savings model.

Measures with RTF UES Estimates Available

The research team focused on the UES measures with potential overlap with standards Momentum Savings. Commercial clothes washers, residential dishwashers, residential refrigerators and freezers are standards implemented during 2010-2015 with direct impact on UES measures. BPA did not claim Momentum Savings from dishwashers to avoid double counting with NEEA's dishwasher initiative.

Analysts should deduct savings from UES projects occurring between standards effective year and BPA implementation of RTF UES analysis updates for the following measures:

Table 7: Overlapping Energy Savings for BPA's UES projects

UES Measure	Standard Effective Year
Commercial Clothes Washers	2013
Residential Refrigerator	2015
Residential Freezer	2015

Source: BPA Standards Momentum Savings Analysis, 2015

Non-Residential Lighting

The non-residential lighting Market Momentum Savings model shared scope with some of BPA's custom project savings. The research team obtained estimates of programmatic savings from program data provided by BPA, NEEA, Energy Trust of Oregon (ETO), and other non-BPA utilities. However, before the team could subtract these reported programmatic savings from Momentum Savings, they had to reconcile the baselines for each analysis. The non-residential lighting baselines differed in two key ways:

- Custom lighting projects normally use the *pre-condition* baseline—or the energy consumption of the old, replaced system—to calculate savings for the newly installed, custom system.
- The Council's Sixth Power Plan uses the *current practice* baseline—or the average market efficiency of newly installed systems—which is often much higher than the pre-condition

baseline. BPA's current Momentum Savings models use the Sixth Council baseline to estimate energy savings.

Because the current practice baseline is more efficient than the pre-condition, the actual overlap between programmatic and Momentum Savings is actually smaller than the total programmatic savings. To correctly account for this overlap, the programmatic savings baseline must be adjusted to match that in the Momentum Savings analysis. The research team determined how to adjust the program-reported savings to a current practice baseline by estimating the difference between 1) the baseline efficacy as estimated for 2009 and 2) the average efficacy implied in the 2009 CBSA stock mix (a proxy for the pre-condition baseline). The research team approximated the pre-existing condition baseline efficacy for programs using the 2009 CBSA stock mix of T8 and T12 linear fluorescents and the estimated average efficacies of each technology in 2009. The research team then used this average pre-existing condition baseline for linear fluorescent (the bulk of program savings) to determine the share of program savings that accrued above and below the Council baseline. The team removed the portion of program savings below the Council baseline to calculate the final program savings needed in the Momentum Savings calculation.

Commercial Refrigeration Equipment

The analysis team omitted a review of commercial refrigeration equipment (CRE) custom project measures for two reasons: 1) the Sixth Plan already accounted for the Federal CRE standards and therefore, BPA does not claim Momentum Savings from the CRE standard; and 2) Federal standards for CRE (effective January 2010) are not prescriptive in nature. That is to say, the standards do not mandate the efficiency of each subcomponent within a CRE unit, but instead provide general maximum daily energy consumption requirements for the entire system. It is up to the discretion of manufacturers to meet the standard using whatever combination of technology components they desire. The custom project measures, on the other hand, are prescriptive, comprising specific subcomponents within a CRE unit including (but not limited to) door gaskets, efficient compressors, condensers, or evaporators, and interior lighting upgrades.

Walk-in Coolers and Freezers

The team reviewed the standards for Walk-in Coolers and Freezers (WICF), summarized in Appendix B: Summary of the Federal Standards for Walk-In Coolers and Freezers. Note that in contrast to CRE standards, the federal WICF standards are prescriptive. WICF standards regulate specific subcomponents of the unit itself, including but not limited to: wall/ceiling/door insulation, strip doors, and interior lighting.

BPA divides custom projects for WICF into two measure categories: 1) Demand Defrost Controls (DDC), and 2) Non-Demand Defrost Controls (non-DDC). The current federal standard for WICF does not apply to DDC measures; thus, the analysis team focused solely on non-DDC custom projects.

The analysis team also omitted custom projects that:

1. Had non-verified savings, or reported zero post-installation savings,
2. Were comprised of non-refrigeration measures (e.g., reduction in shop/storage space interior lighting, HVAC improvements, etc.), or

3. Were comprised of refrigeration measures that were irrelevant to WICF (e.g., measures relevant to CRE).

For all measures that were relevant to WICF, and were not omitted by the aforementioned criteria, the team cross-checked the custom project measure specifications (if provided), with the specifications indicated by the federal WICF standard. Unfortunately, however, the measure specifications provided by the application forms were not consistent with the specifications stipulated by the federal standards. Without the baseline and efficient measures' UEC information, it was not possible to accurately quantify the amount by which the efficient measure exceeded the standard, if any.

Accordingly, the analysis team conservatively assumed that if the efficient measure's description qualitatively matched the measure description indicated by the federal standard (regardless of the technology specifications), there was likely overlap. Because the custom project rebate application did not explicitly indicate the savings attributed directly to the overlapping measure, the analysis team assumed an overlap amount equivalent to the "Total Interactive Refrigeration Savings" indicated in the application, which included all refrigeration savings, including the overlapping measure in question.

Table 8 summarizes the savings overlap determined by this analysis. There was no overlap between custom projects and the standards Momentum Savings model in 2014.

Table 8: Overlapping Energy Savings for BPA's Custom Projects

Year	Commercial Refrigeration Equipment (aMW)	Walk-In Coolers and Freezers (aMW)
2014	NA	0
2015	NA	0.029

Source: Navigant 2015

Recommendations

Overlap between BPA's custom projects and the standards Momentum Savings model may occur if the technology being replaced is below the current standard. This analysis was an exercise to determine and deduct the overlapping savings in BPA's Standards Momentum Savings model if the custom project's baseline was below the current standard.

To improve future analyses of the overlap between BPA's custom projects and the Momentum Savings model, the analysis team recommends that BPA update its data collection practices for BPA's custom projects.

Custom project rebate applications should request sufficient information regarding the pre-condition levels and of the efficient measure (e.g. equipment specifications), in order to accurately quantify savings overlap with the standards. Current federal WICF standards are prescriptive; they indicate UEC for very specific subcomponents within a WICF system. BPA's custom project rebate applications, however, do not

request this level of detail; they do not request information on the measure specifications that are congruent with federal standards. Instead, the applications simply indicate whole-building energy savings, making it difficult to determine what specific measures overlap, and what portion of the whole-building energy savings is directly attributed to the overlapping measure. Furthermore, the measure descriptions within the rebate were vague; it was often difficult to determine whether or not the implemented measures were specific to WICF without knowing the equipment type or model details.

To this end, the team recommends the following steps to obtain the needed data:

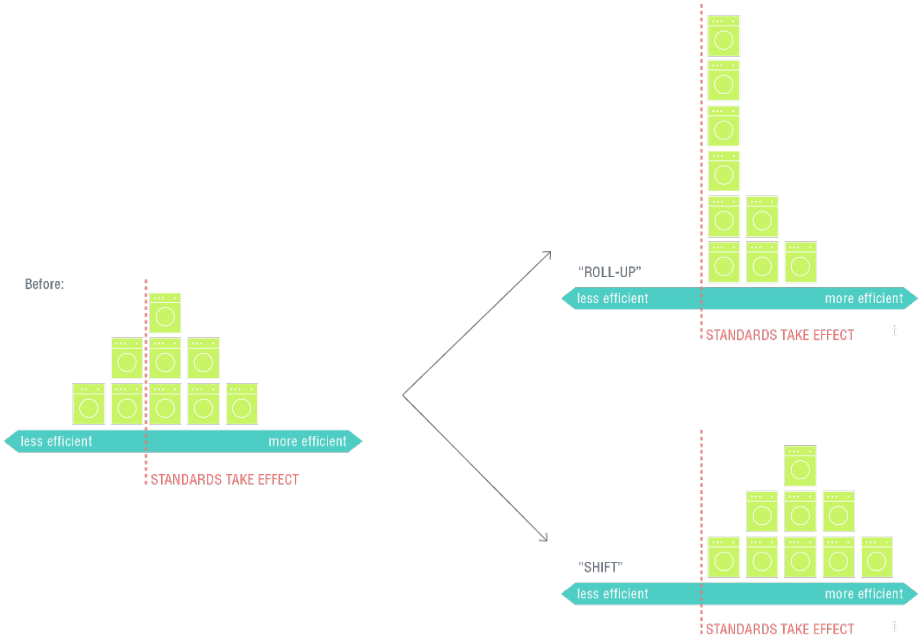
- Request receipts of purchased or installed equipment.
- Request information on the equipment manufacturer, model type, and other nameplate data.
- Request information on the year in which the baseline and installed equipment were manufactured and/or installed (to cross-reference equipment with the standard specified at the time of manufacture or installation).

Lastly, the analysis team recommends that BPA adjust their rebate applications to accommodate future shifts in federal standards. Similar to current CRE standards, federal WICF standards will become non-prescriptive in 2017; that is, DOE will mandate a general efficiency level for the WICF system, instead of regulating the efficiency of individual subcomponents. Accordingly, BPA should consider designing their rebate applications to match and request the same level of detail as sanctioned by the forthcoming federal standards.

Appendix A: Other Appliance Standards Momentum Savings

The research team analyzed appliance standards beyond those included in any current Market Momentum Savings models to assist BPA in future efforts to avoid double-counting. The team identified a key step in the appliance standards models that is the biggest cause for overlap with future market analysis: "shifting" efficiency levels above a new standard.[11] Figure 8 illustrates the two options used in Standards Momentum Savings models when describing the efficiency mix once a new standard impacts the market. Analysts can either "roll-up" the efficiency mix distribution—only effecting efficiency levels below the new standard—or they can "shift" all of the efficiency levels up while maintaining the distribution above the new standard. Unfortunately, "shifting" impacts efficiency levels above the standard and overlaps with Momentum Savings in the market. Customers have the option to purchase higher efficiency equipment above the minimum standard and market momentum claim savings from these decisions. "Shifting" efficiency levels blurs the difference between the impacts from standards and the impact from market momentum and causes double-counting.

Figure 8: Efficiency Distributions Before and After Standards



Source: Navigant 2015

The research team surveyed all appliance standards Momentum Savings models to identify which assumed a "shift" in efficiency. The team found a shift in four residential appliance standards and three commercial equipment standards Momentum Savings models. The rationale or source of data

[11] The "Methodology to Avoid Double-Counting in Momentum Savings Analyses" memo provides detail on the differences between "rolling up" efficiency mixes above a new standard, and "shifting" the entire efficiency mix to be above a new standard.

suggesting the market shift in efficiency following standards for each of these appliances is documented within each model. However, the explanations suggest that the resulting savings cannot all be attributed to standards. Table 9 through Table 12 show the shifts in efficiency above standards (in red) for residential electric water heaters, refrigerators, dishwashers, and room air conditioners.

Table 9: Shift in Efficiency Distribution – Residential Electric Water Heaters

Electric Storage Water Heaters <= 55 gallons		
Efficiency Factor	Efficiency Mix (Pre-Case)	Efficiency Mix (Post-Case)
0.90	30%	0%
0.91	16%	0%
0.92	12%	0%
0.93	28%	0%
0.94	9%	0%
0.95[12] (2015 Standards)	**3%**	**95%**
2.00	2%	4%
2.35	0%	1%

Source: Navigant 2015

As noted in the model for residential water heaters, a market average to market average (a shift) approach was used because the efficiency distribution was relatively broad historically (not all at the standard level). While the majority of the standards impact on the efficiency distribution is to roll all consumers below the new standard up to the new minimum standard, a small portion of consumers who were already at or above the new minimum standard 'shift' up efficiency levels. The theory behind this is that ENERGY STAR® would likely update its specifications, utility programs would work to 'pull' the market up, and manufacturers would develop and market higher tier products as upsells. In this regard, some savings in this model come from sources other than standards. Were BPA to estimate market savings from residential water heaters, the shifted efficiency distribution would need to serve as the baseline to prevent double-counting.

Table 10: Shift in Efficiency Distribution – Residential Refrigerators

Standard Refrigerator with Top Mounted Freezer		
Efficiency Level	Efficiency Mix (Pre-Case)	Efficiency Mix (Post-Case)
1980 Average	0%	0%
1990 Average	0%	0%
2001 Standard	77%	0%
ESTAR 2.0	21%	0%
2014 Standard	**2%**	**95%**
Max Tech	0%	5%

Source: Navigant 2015

[12] The 2015 standard for electric storage water heaters with tank sizes less than or equal to 55 gallons is set per the equation: 0.960-(0.0003 × Rated Storage Volume in gallons). The representative volume for the sub 55 gallon product class is 50 gallons, which equates to an efficiency factor of 0.95.

A market average to market average (shift) approach was also used for residential refrigerators and freezers. While Table 10 only shows the change in efficiency distribution for one product class, this assumption is made across the board for all representative product classes included in the analysis despite already stringent standards which affect nearly the entire efficiency distribution. Future market analyses would need to account for this shift.

Table 11: Shift in Efficiency Distribution – Residential Dishwashers

Electric Storage Water Heaters <= 55 gallons		
Efficiency Level	Efficiency Mix (Pre-Case)	Efficiency Mix (Post-Case)
1990 Stock	0%	0%
1994 Standard (5th Plan Baseline)	0%	0%
ESTAR 3.0	0%	0%
2010 Standard	4%	0%
6th Plan	32%	0%
2013 Standard	**28%**	**50%**
ENERGY STAR® 5.0	16%	25%
Max-Tech	20%	25%

Source: Navigant 2015

Much like residential water heaters, the efficiency distribution for residential dishwashers has been historically broad with a substantial fraction above earlier standard levels. For this reason, a substantial shift to both ENERGY STAR®5.0 and Max Tech levels was modeled in the efficiency distribution following standards. Again, the theory behind this is that ENERGY STAR® would likely update its specifications, utility programs would work to 'pull' the market up, and manufacturers would develop and market higher tier products as upsells. In this regard, some savings in this model come from sources other than standards. Were BPA to estimate market savings from residential dishwashers, the shifted efficiency distribution would need to serve as the baseline to prevent double-counting.

Table 12: Shift in Efficiency Distribution – Residential Room Air Conditioners

Room ACs (without reverse cycle, with louvered sides, and less than 6,000 Btu/h)								
Efficiency Mix (Pre-Case)		Efficiency Mix (Post-Case)						
CEER	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
9.5	69%	0%	0%	0%	0%	0%	0%	0%
10.1	0%	0%	0%	0%	0%	0%	0%	0%
10.6	30%	0%	0%	0%	0%	0%	0%	0%
11.1 (2014 Standard)	**1%**	**100%**	**98%**	**95%**	**93%**	**90%**	**88%**	**85%**
11.4	0%	0%	2%	5%	7%	10%	12%	15%
11.7	0%	0%	0%	0%	0%	0%	0%	0%

Source: Navigant 2015

The shift in efficiency assumed for Room Air Conditioners is unique as the model assumes a pure roll-up in the standards compliance year, but models a phased-in shift thereafter, suggesting the time it takes for the market to react to standards. This essentially is modeling all Momentum Savings associated with Room AC's as it does not decouple the effects of standards and natural momentum in the market. To

avoid double counting, any future market Momentum Savings estimates which include room air conditioners must be above and beyond what has been modeled to date.

Regarding commercial and industrial equipment standards Momentum Savings, central air conditioners – water-evaporative cooled, packaged terminal air conditioners, and distribution transformers all assumed a shift in their efficiency distributions. Both non-residential air conditioning standards models assumed a shift because of prevailing market trends in efficiency. When BPA moves to assess commercial HVAC market Momentum Savings, the analysis must account for this shift above standards. In contrast, the distribution transformers model assumed a shift because a particular technology, amorphous steel cores, which falls above the actual standard level, is assumed to become the de facto standard. For this, BPA will simply need to set the baseline efficiency for any estimate of market savings from distribution transformers at the de facto standard to avoid double counting (should it pursue this analysis).

Appendix B: Summary of the Federal Standards for Walk-In Coolers and Freezers

Standard for Walk-In Coolers and Freezers (WICF)—Effective January 1, 2009	
Each walk-in cooler or walk-in freezer manufactured on or after January 1, 2009 shall:	
1.	Have automatic door closers that firmly close all walk-in doors that have been closed to within 1 inch of full closure, except that this paragraph does not apply to doors wider than 3 feet 9 inches or taller than 7 feet
2.	Have strip doors, spring hinged doors, or other method of minimizing infiltration when doors are open
3.	Contain wall, ceiling, and door insulation of at least R-25 for coolers and R-32 for freezers. This does not apply to glazed portions of doors not to structural members.
4.	Contain floor insulation of at least R-28 for freezers
5.	For evaporator fan motors of under 1 hp. and less than 460 volts - use electronically commutated motors (brushless direct current motors), or 3-phase motors
6.	For condenser fan motors of under 1 hp. - use electronically commutated motors (brushless direct current motors), permanent split capacitor-type motors, or 3-phase motors
7.	For all interior lights, use light sources with an efficacy of 40 lumens/watt or more, including ballast losses (if any), except that light sources with an efficacy of 40 lumens/watt or less, including ballast losses (if any), may be used in conjunction with a timer or device that turns off the lights within 15 minutes of when the walk-in cooler or walk-in freezer is not occupied by people.
8.	Transparent reach-in doors for walk-in freezers and windows in walk-in freezer doors shall be of triple-pane glass with either heat-reflective treated glass or gas fill.
9.	Transparent reach-in doors for walk-in coolers and windows in walk-in cooler doors shall be double-pane glass with heat-reflective treated glass and gas fill; or triple-pane glass with either heat-reflective treated glass or gas fill.
10.	If the walk-in cooler or walk-in freezer has an antisweat heater without antisweat heat controls, the walk-in cooler and walk-in freezer shall have a total door rail, glass, and frame heater power draw of not more than 7.1 watts/ft^2 of door opening (for freezers) and 3.0 watts/ft^2 of door opening (for coolers).
11.	If the walk-in cooler or walk-in freezer has an antisweat heater with antisweat heat controls, and the total door rail, glass, and frame heater power draw is more than 7.1 watts/ft^2 of door opening (for freezers) and 3.0 watts/ft^2 of door opening (for coolers), the antisweat heat controls shall reduce the energy use of the antisweat heater in a quantity corresponding to the relative humidity in the air outside the door or to the condensation on the inner glass pane.

Source: Electronic Code of Federal Regulations for Walk-in Coolers and Walk-In Freezers: http://www.ecfr.gov/cgi-bin/text-idx?SID=a165d9d522b65ec9df29e7f74d4bb4a9&mc=true&node=sp10.3.431.r&rgn=div6