RLPNC 18-4 Products Net-to-Gross Report

FINAL

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SUBMITTED TO:
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ES Executive Summary

The Massachusetts Program Administrators (PAs) and Energy Efficiency Advisory Council Consultants (EEAC consultants) are currently creating the comprehensive three-year program portfolio plan for 2019 to 2021. Part of this process includes the setting of *prospective* net-to-gross ratios (NTGRs) for products offered through various residential programs. The PAs consequently engaged NMR Group to lead a consensus process that would yield recommended prospective NTGRs for 2019 to 2021 program period. The consensus approach rests on the assumption that asking a panel of experts, who represent various stakeholder groups, to review and assess NTGRs will diminish the bias inherent in relying on a single estimate of NTGR or the interpretation of one stakeholder group.

Important inputs in these prospective discussions were self-reported NTGRs derived from primary research conducted in Massachusetts for a variety of products supported by the PAs. NMR included NTGR questions in the web-surveys conducted as part of the RLPNC 17-4 and RLPNC 17-5 studies. The analysis of these questions is included in this report (see Appendix A for more details).[1] The PAs, EEAC consultants, and evaluators also reviewed and discussed retrospective and prospective NTGR estimates and market information drawn from literature reviews, ENERGY STAR market penetration rates, and historical as well as planned specification changes.

After reviewing materials, the consensus panel members developed their own predictions of NTGRs for 2019 to 2021. During a webinar in June 2018, the panel met to discuss predictions and worked together to set prospective NTGRs for products offered through the 2019-2021 Residential Retail Products Program. The group loosely followed a set of guidelines in determining the ultimate prospective NTG values to be applied, as follows:

- Utilize values from primary research conducted in Massachusetts (when available) as a starting point (see Table 4 in Section 3.1 for specific values)
- Utilize national ENERGY STAR market share data (1 – ES Market Share) = NTG as a starting point when primary research conducted in Massachusetts was not available[2]
- Compare the NTG values implied by the market share approach to the NTG values gleaned from the literature review, when primary research conducted in Massachusetts was not available
- Assume a diminishing NTG value of 2-3% annually across the three-year program period unless new standards or specifications are expected during the 2019 – 2021 period

Table 1 presents the recommended prospective NTGRs for the products researched by NMR for RLPNC 18-4.

[1] Self-reported NTGRs based on web-surveys administered as part of RLPNC 17-4/5 may be found in Table 4.
[2] The EPA provides ENERGY STAR Market Share data, which they receive from partner manufacturers.

Table 1: Recommended Prospective NTGRs[3]

	2019	2020	2021
Recommended Product NTGRs for Program Planning			
Freezers	60%	58%	56%
Room Air Cleaners	71%	68%	65%
Clothes Dryers	57%	54%	51%
Dehumidifiers	61%	58%	55%
Room Air Conditioners	63%	63%	63%
Pool Pumps	95%	93%	91%
Tier 1 Advanced Power Strips*	100%	100%	100%
Tier 2 Advanced Power Strips – Infrared	100%	100%	100%
Tier 2 Advanced Power Strips – Infrared & Occupancy Sensor	100%	100%	100%
Temperature Sensing Showerheads	97%	97%	97%
Refrigerators*	N/A	N/A	N/A
Clothes Washers*	N/A	N/A	N/A
Dishwashers*	N/A	N/A	N/A

*The Tier 1 APS NTG values apply to both the Retail and Home Energy Services Initiatives.
**As refrigerators, clothes washers, and dishwashers are not included in the 2019-2021 plan, the consensus panel deferred conversation on these products.

[3] While multiple technological differences exist between the two Tier 2 APS technologies, for the sake of simplicity, we use infrared (IR) and infrared-Occupancy Sensing (IR-OS) as the defining terminology to distinguish between strip types throughout this report. The evaluation team chose the terminology because the presence of an occupancy sensor is a clear technological difference and to remain consistent with previous literature (for example, see: "Energy Savings of Tier 2 Advanced Power Strips in Residential AV Systems," *Prepared for Pacific Gas and Electric by AESC, Inc.* (Feb 2016).

1 Section 1 Introduction and Background

The Massachusetts Program Administrators (PAs); the Energy Efficiency Advisory Council Consultants (EEAC consultants); and the residential lighting, products, and new construction evaluation team, led by NMR Group, Inc., developed key Massachusetts-specific impact factors for general products and advanced power strips and *prospective* net-to-gross ratios (NTGRs) for products offered through the Massachusetts Residential Retail Products Program (the program). This report described their process. The PAs and EEAC consultants will use these prospective NTGRs to help plan the 2019 to 2021 program.

NMR provided the background research summarized throughout this project to help inform a consensus process that would determine prospective NTG values for the various products included as part of the 2019 to 2021 program. The consensus approach rests on the assumption that asking a panel of experts, who represent various stakeholder groups, to review and assess NTGRs will diminish the bias inherent in relying on a single estimate of NTGR or the interpretation of one stakeholder group.

The Residential Consumer Products Core Initiative (the products program) seeks to increase customer adoption of various energy-efficient measures by offering rebates on select products.[4] The motivation for evaluating key Massachusetts-specific impact factors for general products (RLPNC 17-5 General Products Net-to-Gross) and advanced power strips (APS) (RLPNC 17-4 Smart Power Strip Literature Review and Consumer Survey) stems from a characteristic of the program: measures tend to cycle into and out of the products program on a frequent basis, based on the latest information on cost effectiveness, baseline market share, product availability, seasonality of products, and other considerations. While such flexibility has clear program advantages, measures may enter and leave the products program before evaluators can estimate their net impacts. In addition, since some measures may only ever represent a small share of overall portfolio savings, the cost to study them can be prohibitive.

Evaluation findings from other jurisdictions can sometimes be used as proxies, but various challenges (program delivery and target population differences, lack of established evaluation findings, etc.) limit the usefulness of this approach. Therefore, the PAs and EEAC consultants sought an evaluation approach that would provide evaluated gross impact and prospective NTGRs for current product and appliance measures and categories of measures. When adding a new measure to the products program, if there is not a Massachusetts' NTGR evaluation finding for that measure, they would assign the prospective NTGR for the category rather than a specific value for the product. NMR relied on a literature review and participant surveys to provide the necessary information to inform the development of categories for

[4] The Appliance Recycling program also falls under the same core initiative. NMR is currently working with the PAs and EEAC consultants to plan the RLPNC 18-1 Appliance Recycling Impact Evaluation.

evaluated gross impact realization rates, which were then utilized for creating prospective NTGRs through a consensus process.

Table 2 lists the products addressed through surveys and literature reviews. Most of the products that were only addressed in the literature review are not currently supported by the program.

Table 2: Products Supported by Delivery Method

Product	Upstream	On-line	Mail-in	Leave Behind
Addressed in Surveys and Literature Review				
Tier 1 APS	X	X		X
Tier 2 APS - Infrared	X	X		
Tier 2 APS – Infrared & Occupancy Sensor	X	X		
Dehumidifiers			X	
Dryers			X	
Room Air Cleaners	X		X	
Temperature Sensitive Showerheads / Adapters	X	X		
Addressed in Literature Review Only				
Clothes Washers			After HEA	
Dishwashers				
Freezers				
Pool Pumps	X			
Refrigerators			After HEA	
Room Air Conditioners			X	
Showerheads, Low Flow	Fundraiser[2]			

[1] Some measures require a home energy assessment for rebate eligibility.
[2] Offered as a fundraiser product.

The consensus process tasked PAs, EEAC consultants, and evaluators with reviewing and discussing the retrospective NTGR estimates, market information drawn from literature reviews, ENERGY STAR market penetration rates, and historical/planned Federal and ENERGY STAR specification changes. The background documents assisted the consensus process by detailing, aggregating, and laying out values that the PAs and EEAC could use to help inform prospective NTG values. The main factors of interest were the following:

- Self-reported net-to-gross estimates based on web-surveys conducted with program participants (surveys were fielded in October 2017 – January 2018)
- ENERGY STAR Market Share
- Planned changes to ENERGY STAR specifications
- Planned changes to federal standards
- Prospective Net-to-Gross

More specifically, these documents did the following:

- Summarized self-reported product NTGRs based on primary research (2017 product participant surveys)
- Summarized publicly available ENERGY STAR market share (penetration) data
- Overlaid historical NTG ratios for various ENERGY STAR products available from literature based on primary research elsewhere and earlier primary research conducted in Massachusetts
- Prepared a summary of trends from the above data sources, including product-specific data and more general trends across products

2 Section 2 Primary and Secondary Research

To inform the consensus process, NMR conducted both primary and secondary research – relying on web surveys, literature reviews, governmental records (specification changes), and research on ENERGY STAR® product market share. In this section, we provide additional details and background on the research conducted to inform the consensus process. It is important to note that the consensus panel placed the most emphasis on the self-reported NTGR values derived from surveys administered to actual Massachusetts program participants. When self-reported data from program participants were unavailable, the consensus panel relied on results obtained from literature reviews and ENERGY STAR market share data. Table 3 provides a summary of research efforts by product.

Table 3: Sources by Product[1]

Products	Survey of Massachusetts Participants	Literature Review	Review of Standard and Spec. Changes	ENERGY STAR Market Share
Tier 1 Advanced Power Strips [2]	X	X		
Tier 2 Advanced Power Strips – Infrared	X			
Tier 2 Advanced Power Strips – Infrared & Occupancy Sensor	X			
Dehumidifiers	X	X	X	X
Room Air Cleaners	X	X	X	X
Room Air Conditioners		X	X	X
Temperature Sensitive Showerheads and Adapters	X	X		
Low-flow Showerheads	X			
Clothes Washers		X	X	X
Dishwashers		X	X	X
Dryers	X	X	X	X
Freezers		X	X	X
Pool Pumps		X	X	X
Refrigerators		X	X	X

[1] The literature review also examined appliance recycling programs, but these will be reported in the RLPNC 18-1: Appliance Recycling Impact Evaluation, currently being planned.
[2] Distributed through a variety of approaches.

2.1 SELF-REPORTED NTGR (PRIMARY RESEARCH)

Self-reported NTGR values are based on web surveys of two different populations of program participants: (1) those who purchased products via the Mass Save® Website or using a mail-in (or online-submitted) rebate between January 2016 and June 2017, and (2) those who received Tier 1 APS through a direct install program from January to October 2017 (the direct install program did not distribute Tier 2 APS). NMR recruited respondents for the studies as part of the RLPNC 17-4 and RLPNC 17-5 Studies (additional details on survey methodology can be found in Appendix A).

The NTGRs presented in this report were based on web surveys of 1,268 consumer products participants and 250 direct install program participants.

The last three columns of Table 4 provide the results of NMR's analysis of the NTGR questions. The first column provides the NTGR values from the 2016 – 2018 TRM for comparison. The self-reported values were calculated based on an approach that was similar to that outlined in the Illinois Technical Reference Manual (V5), as agreed upon by the PAs and EEAC Consultants. For additional details on self-reported NTGR calculations, please see Appendix A.2.

Table 4: Evaluated Free-Ridership, Spillover, and Net-to-Gross Ratio

Product Name	2016 - 2018 TRM for NTGR	Self-Reported Free-ridership (FR)	Self-Reported Spillover (SO)[2]	Self-Reported NTGR [1 – FR + SO]
Leave Behind APS Tier 1	NA	5%[1]	NA	95%
Online APS Tier 1	100%	8%	10%	102%
Online APS Tier 2 – Infrared	100%	10%	2%	92%
Online APS Tier 2 – Infrared & Occupancy Sensor	100%	9%	2%	93%
Dehumidifiers	100%	41%	2%	61%
Dryers	90%	49%	6%	57%
Room Air Cleaners	75%	31%	2%	71%
Showerheads and Adapters, Temperature Sensitive	100%	5%	2%	97%

[1] Based on likely actions, as program influence and spillover would be conflated with participation in the HEA.
[2] While survey sample sizes were large the incidence of spillover was small. The evaluators agreed to adopt the measured 6% and 10% SO rates. Given the uncertainty, the evaluators chose to use a SO of 2% to represent those clustered around 2-3% rather than indicate false precision.

Literature Review (Secondary Research) NMR reviewed approximately 50 evaluation reports, technical reference manuals (TRMs), and program plans from across the nation to identify NTGRs for APS and select consumer products. We only cataloged values obtained through primary research, rejecting deemed or negotiated values. We examined findings for the products addressed in the Participant Survey, but also for a wider range of products commonly supported by product programs across the nation or discussed in the *RLPNC 16-10 What's Next for Products Study*.[5] Table 5 provides a summary of NTGR values from the literature review.

[5] NMR Group. 2018. *RLPNC 16-10 What's Next for Products*. http://ma-eeac.org/wordpress/wp-content/uploads/RLPNC-16-10-What-Is-Next-for-Products-Market-Scan.pdf (Feb. 9, 2018).

Table 5: Consumer Products NTGR Comparison – Low to Moderate Price Measures

(Shaded Measures Based on Literature Review Only)

Product Name (Sample Size)	Current MA TRM	MA Primary Research			Literature Review	
		FR (CI)	SO	NTGR (CI)	NTG Range, Median	Sources[2]
Low to Moderate Price Measures						
Direct Install Tier 1 APS	N/A	N/A	N/A	N/A	0.86 – 0.96, 0.91 (2 studies)	IL 2015-16; MO 2014
Leave Behind Tier 1 APS[1] (222)	N/A	0.05 (0.03, 0.07)	N/A	0.95 (0.93, 0.97)	0.92 - 1.00, 0.96 (2 studies)	NM 2015; MO 2014
Online/Downstream Tier 1 APS (342)	100%	0.08 (0.06, 0.09)	0.10	1.02 (1.01, 1.04)	0.86 (1 study)	IL 2014
Online APS Tier 2 – Infrared (251)	100%	0.10 (0.07, 0.13)	0.02	0.92 (0.89, 0.95)	N/A	N/A
Online APS Tier 2 – Infrared & Occupancy Sensor (55)	100%	0.09 (0.03, 0.15)	0.02	0.93 (0.87, 0.99)	N/A	N/A
Dehumidifiers (136)	100%	0.41 (0.37, 0.46)	0.02	0.61 (0.56, 0.65)	0.38, 0.38 (1 study)	Eff ME 2014
Room Air Cleaners (126)	75%	0.31 (0.28, 0.35)	0.02	0.71 (0.67, 0.74)	0.38 - 1.04, 0.74 (3 studies)	ComEd IL 2017[3]; Ameren MO 2015; Eff ME 2014
Room Air Conditioners	N/A	N/A	N/A	N/A	0.38 - 0.63, 0.46 (3 studies)	ComEd IL 2017; Ameren MO 2015; Eff ME 2014;
Showerheads & Adapters, Temperature Sensitive (153)	100%	0.05 (0.03, 0.06)	0.02	0.97 (0.96, 0.99)	N/A	N/A

Product Name (Sample Size)	Current MA TRM	MA Primary Research			Literature Review	
		FR (CI)	SO	NTGR (CI)	NTG Range, Median	Sources[2]
Showerheads, Low Flow	100%	N/A	N/A	N/A	0.94 (1 study)	Ameren MO 2014
High Price Measures						
Clothes Washers	100% (HES early retirement)	N/A	N/A	N/A	0.47 - 0.58, 0.52 (2 studies)	ComEd IL 2017; Eff ME 2014
Dishwashers	N/A	N/A	N/A	N/A	0.92 (1 study)	ComEd IL 2017[4]
Dryers (126)	90%	0.49 (0.45, 0.54)	0.06	0.57 (0.52, 0.61)	N/A	N/A
Freezers	65%	N/A	N/A	N/A	0.38 - 0.54, 0.46 (2 studies)	ComEd IL 2017; Eff ME 2014
Pool Pumps	100%	N/A	N/A	N/A	0.61 - 1.04, 0.82 (2 studies)	SDG&E 2016; Ameren MO 2015;
Refrigerators	75% (Most efficient)	N/A	N/A	N/A	0.36 -0.57, 0.46 (2 studies)	ComEd IL 2017; Eff ME 2014

1 This delivery method mirrors that of the Direct Install program in MA.

2 Please refer to Appendix B for full citations of these sources.

3 Although the 2017 ComEd NTG values draw from numerous primary and secondary sources, all the 2017 ComEd values reported in this table were the result of primary research first reported in the PY 8 (2015-2016) ComEd Appliance Survey, except in the case of dishwashers.

4 The dishwasher NTG identified by ComEd in 2017 is based on a forthcoming report from Colorado.

2.2 STANDARD/SPECIFICATION CHANGES AND ENERGY STAR® MARKET PENETRATION (SECONDARY RESEARCH)

Along with the values gleaned through the primary research and literature reviews, the consensus panel utilized ENERGY STAR penetration and specification changes for the products of interest. ENERGY STAR requires its manufacturer partners who distribute products with ENERGY STAR qualification to report annual product shipment data.[6] ENERGY STAR uses this partner shipment data to calculate the market penetration for their products. In this case, *penetration* is defined as the percentage of ENERGY STAR shipments within a certain product market and should not be confused with market level product sales and saturation or with household level penetration or saturation.[7] Table 6 displays ENERGY STAR penetration rates and Massachusetts NTG values for 2003 to 2016 (when available) and also notes when/whether a federal standard or ENERGY STAR specification change occurred.

Specification and standard changes were not consistently followed by market penetration increases or decreases. Across the 13 ENERGY STAR specification changes, market penetration increased the year after the change 47% of the time. Federal standard changes were followed by an increase in market penetration rates (measured the year following the change) 75% of the time. NMR conducted several statistical analyses (correlation analysis, regression discontinuity, and censored linear regression) to ascertain whether a significant relationship between market penetration and specification changes existed, but we found no verifiable relationship. The lack of a consistent relationship indicates that specification and standard changes may not be reliable predictors of changes in market penetration. NMR lists ENERGY STAR specification and federal standard changes planned for the next few years (Table 7), but we do not know if these future changes will have a consistent relationship with penetration rates.

The relationship between market penetration and NTG was also inconsistent. Assuming penetration is a proxy for naturally occurring, efficient market share, it would be possible to also assume that NTG=1-Market Penetration. Our research revealed 28 penetration and NTG pairings (years in which penetration and NTG data are both available). Roughly one-half of the penetration and NTG pairings exceed a value of one, indicating that the additive influence of NTG and penetration exceeds 100% of assumed market share, while a third of the pairings sum to a value near one. The lack of clear relationship between NTG and penetration also indicates that penetration may have limited value in predicting future NTG values.

[6] https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data

[7] Market sales saturation equals ENERGY STAR sales ÷ total sales, household penetration refers to the proportion of households using an ENERGY STAR model of a product, and household saturation refers to the proportion of units used in a household that are ENERGY STAR.

Table 6: Historical ENERGY STAR Market Penetration, Massachusetts NTG Values, and Specification Changes

		Refrigerator	Freezer	Room Air Cleaner	Clothes Dryer	Dehumidifier	Room Air Conditioner	Pool Pump	Clothes Washer	Dishwasher
2003	Penetration	26%	-	-	-	0%	29%	-	23%	57%
	NTG									
2004	Penetration	33%	-	-*	-	76%	35%	-	27%	78%
	NTG									
2005	Penetration	33%	-	13%	-	92%	52%*	-	36%	82%
	NTG						0.69	0.69	0.81	0.41
2006	Penetration	31%	-	14%	-	60%	36%	-	38%	93%
	NTG									
2007	Penetration	30%	-	14%	-	58%+	50%	-	42%	77%*
	NTG									
2008	Penetration	31%*	-	15%	-	75%	43%	-	24%*	67%
	NTG									
2009	Penetration	35%	-	19%	-	82%	36%	-	48%	68%
	NTG									
2010	Penetration	50%	25%	21%	-	99%	33%	-	64%*	100%+
	NTG	0.95					0.365	0.32	0.29	0.225
2011	Penetration	56%	21%	30%	-	99%	62%	-	60%^	96%
	NTG			0.78		0.78	0.78			
2012	Penetration	76%	44%	16%	-	99%**	58%	-	65%	89%*
	NTG	0.86					0.47			
2013	Penetration	74%	29%	18%	-	99%	72%**	-	66%	90%+
	NTG	0.36	0.38					0.61		
2014	Penetration	75%^^	29%^^	22%	-	89%	50%+	30%*	68%	92%
	NTG			0.38		0.38	0.38		0.47	
2015	Penetration	46%	30%	29%	15%^	84%	54%**	33%	56%*	84%
	NTG			1.038			0.456	1.038		
2016	Penetration	48%	35%	33%	32%	63%**	38%	34%	41%	87%^
	NTG	0.57	0.54	0.74	0.62		0.63		0.58	0.92

*ENERGY STAR spec change in first half of year.
**EnergyStar spec change in second half of year.
+Federal spec change.
^Federal spec change and EnergyStar spec change in first half of year.
^^Federal spec change and EnergyStar spec change in second half of year.

Table 7: Future Specification Changes

	Refrigerator	Freezer	Room Air Cleaner	Clothes Dryer	Dehumidifier	Room Air Conditioner	Pool Pump	Clothes Washer	Dishwasher
Next ES Spec Change	-	-	-	-	-	-	-	2018	2019
Next Federal Stan Change	2022	2022	-	2022	2019	2022	2021	2018	2024

3 Section 3 Consensus Process and Results

The consensus approach rests on the assumption that asking a panel of experts, who represent various stakeholder groups, to review and assess NTGRs will diminish the bias inherent in relying on a single estimate of NTGR or the interpretation of one stakeholder group.

The following sections outline the products included as part of the consensus discussion, the relevant background materials for each product, any special considerations that were taken into account when coming to the recommended prospective values, and the values themselves. Note that refrigerators, clothes washers, and dishwashers were not included in the consensus process as they are not included in the 2019 to 2021 Plan.

3.1 Steps in the Consensus Process

The consensus process involved the following steps:

Step 1 Confirmation of Methods to Inform Process: The first step was to confirm the studies and methods that fed into the consensus-building process.

Step 2 Identification and Recruitment of Experts: The PAs, EEAC consultants, and evaluators decided that this internal group should comprise the NTGR consensus process.

Step 3 Compilation of Study Results: After completion of the primary and secondary research, NMR prepared a memorandum and accompanying spreadsheet that summarized the NTGR estimates by source, the standard/specification changes, and the ENERGY STAR market share data. The consensus panelists reviewed the memo, calculations, and results. As previously stated, utilizing values from primary research conducted in MA (when available) as a starting point was a key step in the consensus process, as they represented the best current Massachusetts data available.

Step 4 Setting Consensus Recommended NTGRs: NMR compiled the background materials into a webinar presentation for the consensus panel meeting, held in June 2018. Having reviewed the methods and considered the approaches, the panel engaged in a conversation about the evaluated results and individual predictions of NTGR and the future of the market. They reached consensus regarding the recommended NTGRs for products offered in the 2019 to 2021 program cycle.

Step 5 Reporting: This report represents the last step in the consensus process.

During the consensus meeting, the group loosely followed the guidelines below to help determine prospective NTG values:

- Utilizing values from primary research conducted in Massachusetts (when available) as a starting point
- Utilizing national ENERGY STAR market share data (1 – ENERGY STAR Market Share = NTG) as a starting point when primary research conducted in Massachusetts was not available

- Comparing the NTG values implied by the market share approach to the NTG values gleaned from the literature review, when primary research conducted in Massachusetts was not available
- Assuming a diminishing NTG value of 2-3% annually across the three-year program period unless new standards or specifications are expected during the 2019 – 2021 period

While the group occasionally deviated from the guidelines in specific cases, these general rules helped direct the process of coming to agreed-upon prospective values.

3.2 PRODUCTS WITH MASSACHUSETTS PRIMARY RESEARCH CONDUCTED

3.2.1 Advanced Power Strips

The Massachusetts-specific research conducted on advanced power strips purchased online yielded NTG values of 102% for Tier 1 and 93% for Tier 2 infrared and Tier 2 infrared & occupancy sensor.[8] Secondary market research and interviews with APS manufacturers have shown that the majority of advanced power strips sold in retail are supported and sold through efficiency programs.[9] Group discussion touched on the belief that without program support, consumers have not embraced the advanced power strips, and they are therefore hard to find on store shelves. These previously mentioned factors were taken as rationale for setting a 100% NTG through 2021. The group has agreed to apply these prospective NTG values for APS delivered as part of the Home Energy Solutions and Retail Initiatives.

- MA Evaluated NTG — 102% for Tier 1 and 93% for Tier 2 Infrared and Tier 2 Infrared & Occupancy Sensor
- 2019 Estimate — 100%
- 2020 Estimate — 100%
- 2021 Estimate — 100%

3.2.2 Clothes Dryers

As an emerging technology, NMR found very little ENERGY STAR or specification data for clothes dryers, although ENERGY STAR penetration increased from 2015 to 2016 (Figure 1). The latest clothes dryer standard/specification change was in 2015 and was followed by an increase in penetration in 2016. We could not estimate a correlation between clothes dryer specification changes or penetration due to a lack of data. Table 8 reports that there will be a federal standard change for clothes dryers in 2022.

[8] HES leave-behind APS had a NTGR of 95%; the consensus panel addressed only upstream program delivery.
[9] According to the two largest APS manufacturers, direct online sales (via manufacturer websites or Amazon) account for a small fraction of total sales. However, evaluators were unable to verify online sales as the data were unavailable.

Figure 1: Clothes Dryer ENERGY STAR Market Penetration and NTG

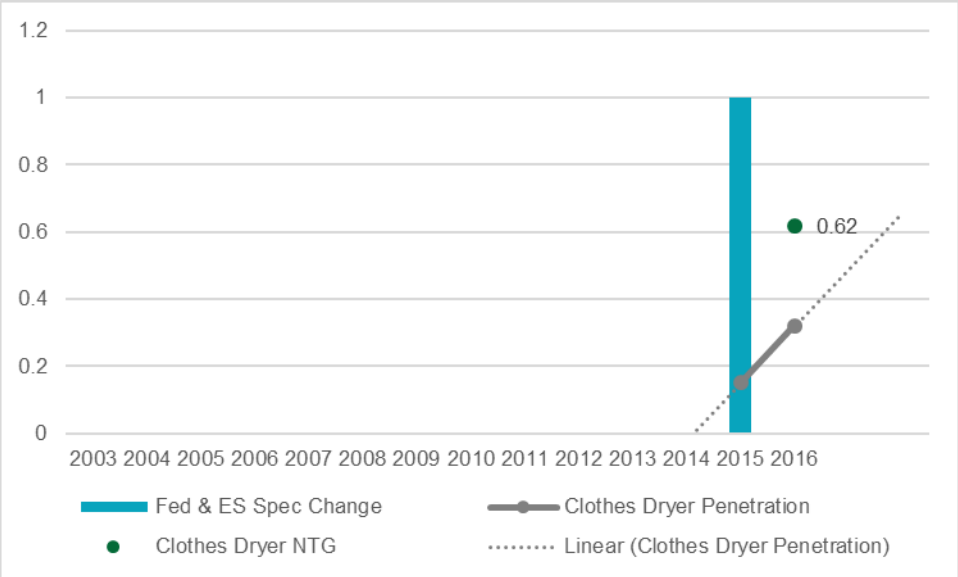


Table 8: Clothes Dryer ENERGY STAR Market Penetration, NTG, and Specification Data

	'15	'16
ENERGY STAR Penetration	0.15	0.32
Secondary NTG Research[1]		0.62
MA 2017 Evaluated NTG	57%	
Spec Change		Fed and ES spec change in 1st half
Future Spec Change	Federal 2022	

[1]All secondary research cited throughout this report only included values that were derived from primary research, not other secondary or negotiated values.

Consensus Discussion In comparison to other products being considered in the consensus process, very little data existed for clothes dryers. The group considered creating a separate value to be applied to more expensive heat pump dryers. The PAs indicated they are actively considering heat pump dryers when they become cost-effective, but that savings opportunities are currently low. The group decided to focus on general dryers first and then, when heat pump dryers are added to the program, work together to set NTG values specific to heat pump dryers.

Given the lack of information on dryers, one consensus member suggested starting at the 57% evaluated value and dropping the value annually by 2%. Another member argued that incremental cost is low, so the natural penetration is likely to go up faster. This member therefore suggested a 3% annual decrease, to which the group all agreed.

- MA Evaluated NTG 57%
- 2019 Estimate 57%
- 2020 Estimate 54%
- 2021 Estimate 51%

3.2.3 Dehumidifiers

Dehumidifier ENERGY STAR market penetration peaked in 2010, stayed at 0.99 for four years, and began decreasing in 2014 (Figure 2). There have been three specification changes for dehumidifiers since 2003. One was followed by a penetration increase and one was followed by a stagnate (near 100%) rate of penetration. Table 9 displays the non-significant negative correlation coefficient between market penetration and specification changes, a weak relationship of -0.07. Table 10 reports that there will be a federal specification change for dehumidifiers in 2019.

Figure 2: Dehumidifier ENERGY STAR Market Penetration and NTG

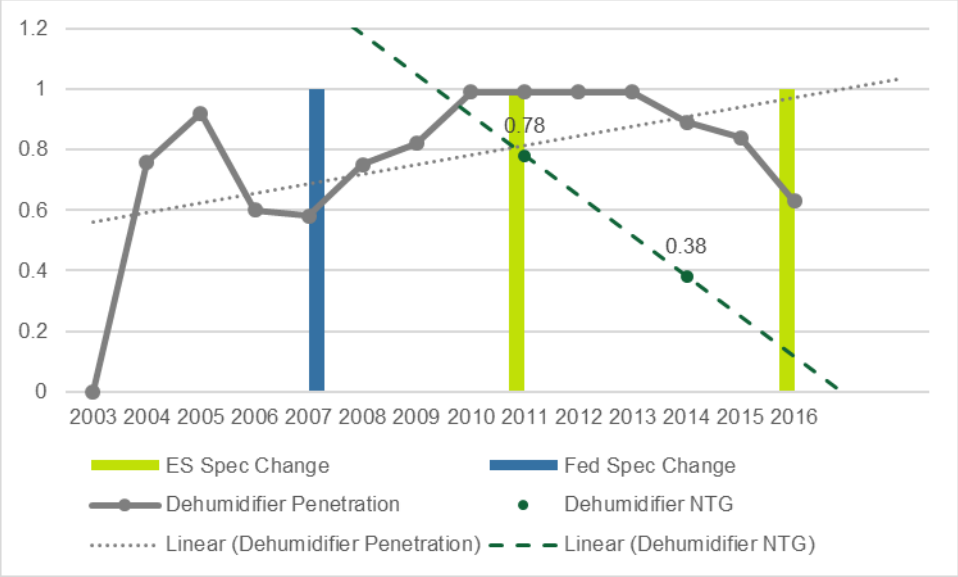


Table 9: Dehumidifier ENERGY STAR Market Penetration and Specification Change Correlation

Measure	Correlation	p-value
Dehumidifier	-0.07	0.81

Table 10: Dehumidifier ENERGY STAR Market Penetration, NTG, and Specification Data

	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16
ENERGY STAR Penetration	0.76	0.92	0.60	0.58	0.75	0.82	0.99	0.99	0.99	0.99	0.89	0.84	0.63
Secondary NTG Research								0.78			0.38		
MA 2017 Evaluated NTG	61%												
Spec Change				Fed					Fed and ES in 2nd half				Fed and ES in 2nd half
Future Spec Change	Federal 2019												

Consensus Discussion Dehumidifiers presented a challenge for the consensus group. While substantial background data exist on the product, the data did not present a clear pattern among specification changes, ENERGY STAR penetration rates, and observed NTGR. One consensus member argued that customers are unlikely to think about the ENERGY STAR label when buying a dehumidifier, and that the high Massachusetts-evaluated NTG of 0.61 was strange. Another member argued for maintaining the current value of 0.61 and not dropping it over the course of 2019 to 2021 because a new specification change is forthcoming.

Most consensus members were amenable to a 0.61 NTG starting point but noted that the last time a specification change occurred the market responded quickly. As such, these group members were not comfortable with a flat rate of 0.61 throughout the entire program span. Additionally, it is not clear whether the specification change in 2019 will actually occur as it has been reported that the current DOE is behind on implementing new standards.[10,11]

Consensus members agreed that the market would likely respond quickly to a potential specification change, and everyone voiced approval at having a drop in NTG values over time. While some felt that the NTG drop would be more precipitous if the specification change did not occur, everyone agreed that a 3% annual drop with the specification change made sense. The group also agreed that any future survey on products should include dehumidifiers, as it was the product the group still had the most questions about.

- MA Evaluated NTG 61%
- 2019 Estimate 61%
- 2020 Estimate 58%
- 2021 Estimate 55%

[10] http://aceee.org/press/2017/12/statement-aceee-and-asap-federal
[11] https://www.reginfo.gov/public/do/eAgendaMain

3.2.4 Room Air Cleaners

Room air cleaner ENERGY STAR market penetration has been rising slowly but consistently since 2012 (Figure 3). The last room air cleaner specification change was in 2004 with penetration in a three-year holding pattern with a slight increase in 2016. These data are insufficient for producing a correlation value because there were no specification changes during the years penetration was observed. Table 11 reports that there are currently no specification changes planned for room air cleaner.

Figure 3: Room Air Cleaner ENERGY STAR Penetration and NTG

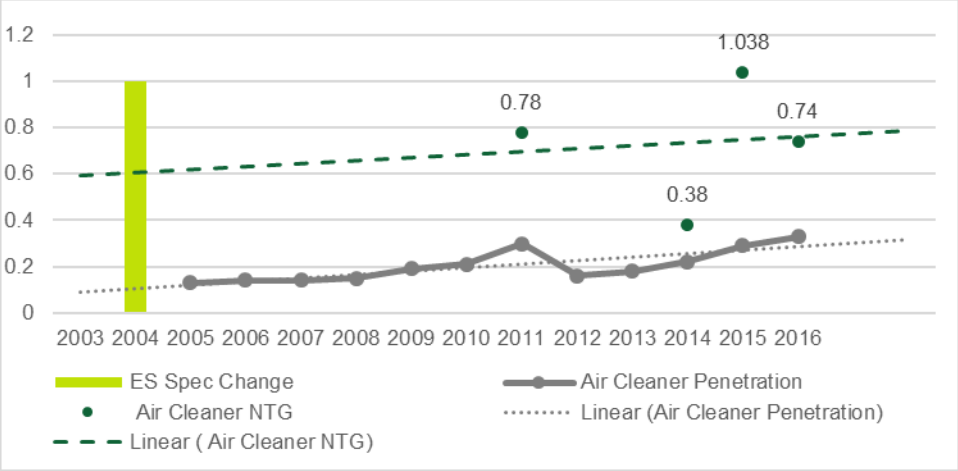


Table 11: Room Air Cleaner ENERGY STAR Market Penetration, NTG, and Specification Data

	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16
ENERGY STAR Penetration		0.13	0.14	0.14	0.15	0.19	0.21	0.30	0.16	0.18	0.22	0.29	0.33
Secondary NTG Research								0.78			0.38	1.038	0.74
MA 2017 Evaluated NTG	71%												
Spec Change	ES 1st half												
Future Spec Change	None planned												

Consensus Discussion Given the overall guidelines discussed above, the consensus team prioritized the evaluated NTG of 71% from Massachusetts. Two consensus members recommended a decrease in NTGR of approximately 3% annually, to which the consensus panel agreed.

- MA Evaluated NTG 71%
- 2019 Estimate 71%
- 2020 Estimate 68%
- 2021 Estimate 65%

3.2.5 Temperature Sensitive Showerheads and Adapters

The Massachusetts-specific research conducted on temperature sensitive showerheads and adapters yielded a NTG value of 97%. The lack of previous research, compounded with few consumer purchases (and the presence of early adopters), led the group to adopt the high NTG value of 97%, which should remain constant through 2021.

- MA Evaluated NTG 97%
- 2019 Estimate 97%
- 2020 Estimate 97%
- 2021 Estimate 97%

3.3 PRODUCTS WITHOUT MASSACHUSETTS PRIMARY RESEARCH CONDUCTED

3.3.1 Freezers

Freezer ENERGY STAR market penetration peaked in 2012 (Figure 4). The last freezer specification change was in 2014 when penetration was in a three-year holding pattern, with a slight increase in 2016. Table 12 displays the non-significant negative correlation coefficient (-0.08) between market penetration and specification changes. Table 13 reports that there will be a federal specification change for freezers in 2022.

Figure 4: Freezer ENERGY STAR Market Penetration and NTG

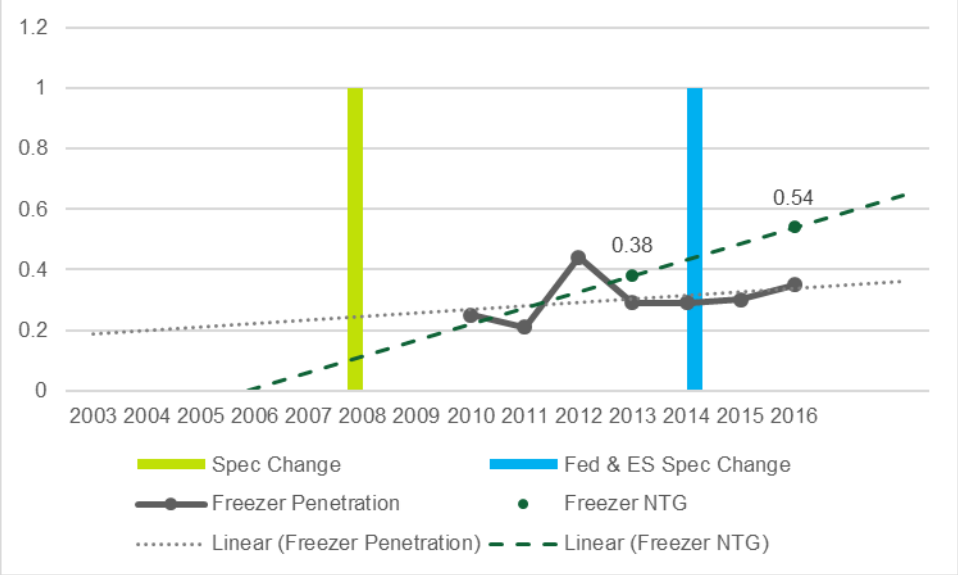


Table 12: Freezer ENERGY STAR Market Penetration and Specification Change Correlation

Measure	Correlation	p-value
Freezer	-0.08	0.85

Table 13: Freezer ENERGY STAR Market Penetration, NTG, and Specification Data

	'10	'11	'12	'13	'14	'15	'16
ENERGY STAR Penetration	0.25	0.21	0.44	0.29	0.29	0.30	0.35
Secondary NTG Research				0.38			0.54
MA 2017 Evaluated NTG	N/A						
Spec Change					Fed and ES 2nd half		
Future Spec Change	Federal 2022						

Consensus Discussion No primary NTG research was conducted for freezers to support this effort, and as such did not have a Massachusetts-evaluated NTG. One consensus member initially offered a suggested value from 0.54 to 0.65 based on the literature value. Another member noted that utilizing a (1-penetration) approach led to a value of about 0.65 (1-0.35). This was also in line with the first member's suggestions. All consensus members ended up agreeing to utilize a midpoint value of 0.6 in 2019 with a declining rate of 2% points each year.

- MA Evaluated NTG N/A
- 2019 Estimate 60%
- 2020 Estimate 58%
- 2021 Estimate 56%

3.3.2 Pool Pumps

Pool pump ENERGY STAR market penetration has been increasing slowly since 2014 (Figure 5). There has been one specification change for pool pumps in 2014. Table 14 displays the non-significant negative correlation coefficient (-0.97) between market penetration and specification changes. The strong relationship of -0.97 is most likely due to attempting to produce a relationship with insufficient data points. Table 15 reports that there will be a federal specification change for pool pumps in 2021.

Figure 5: Pool Pump ENERGY STAR Market Penetration and NTG

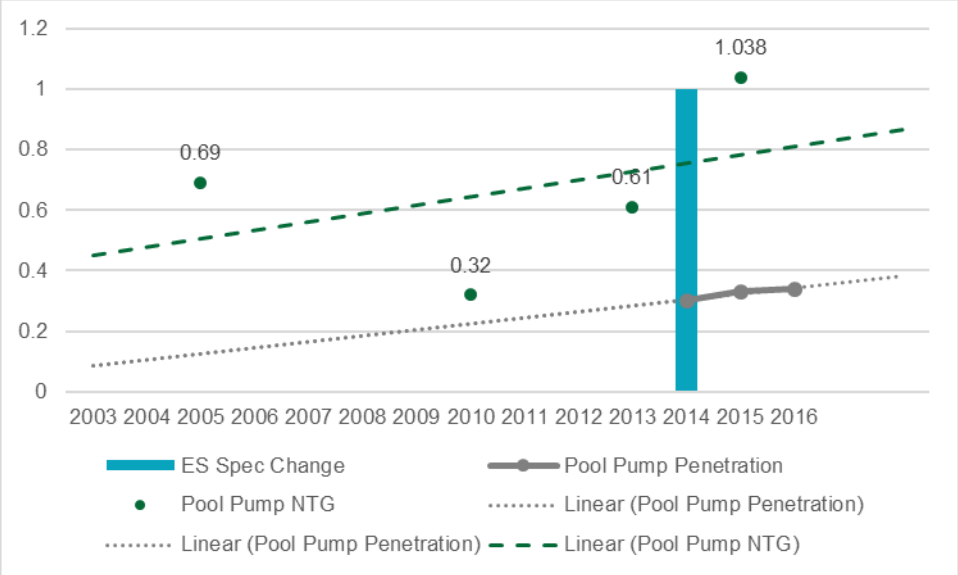


Table 14: Pool Pump ENERGY STAR Market Penetration and Specification Change Correlation

Measure	Correlation	p-value
Pool Pump	-0.97	0.15

Table 15: Pool Pump ENERGY STAR Market Penetration, NTG, and Specification Data

	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16
ENERGY STAR Penetration	-	-	-	-	-	-	-	-	-	0.30	0.33	0.34
Secondary NTG Research	0.69					0.32			0.61		1.038	
MA 2017 Evaluated NTG	N/A											
Spec Change										ES 1st half of year		
Future Spec Change	Federal 2021											

Consensus Discussion No primary NTG research was conducted for pool pumps to support this effort, and the next specification change is set to occur toward the end of the 2019-2021 program cycle. Further, this federal standard change is for a full pool pump, but many customers often only change the motor, which the federal standards do not address. So, while the PAs are focused on a full pump replacement, many contractors may recommend to only change the motor, at a much lower initial cost. As such, the counterfactual is not just replacing with a non-ENERGY STAR pool pump, but with only changing a motor.

One PA noted that they have moved this product upstream and are often dealing with distributors and their stocking practices. The goal is for the distributor to have the efficient technologies on their truck when doing a repair in order to offer it to the customer on the spot. Therefore, the PA felt that 1.0 was a reasonable value. One member suggested 0.95 with an annual decrease of 2% to 3%. The group settled on a 2% decrease annually.

- MA Evaluated NTG N/A
- 2019 Estimate 95%
- 2020 Estimate 93%
- 2021 Estimate 91%

3.3.3 Room Air Conditioners

Room air conditioner ENERGY STAR market penetration has fluctuated since 2003, with a peak in 2013 (Figure 6). There have been four specification changes for room air conditioners since 2003, 75% of which were followed by penetration decreases. Table 16 displays the non-significant negative correlation coefficient between market penetration and specification changes, a weak relationship of -0.26. Table 17 reports that there will be a federal standard change for room air conditioners in 2019.

Figure 6: Room Air Conditioner ENERGY STAR Market Penetration and NTG

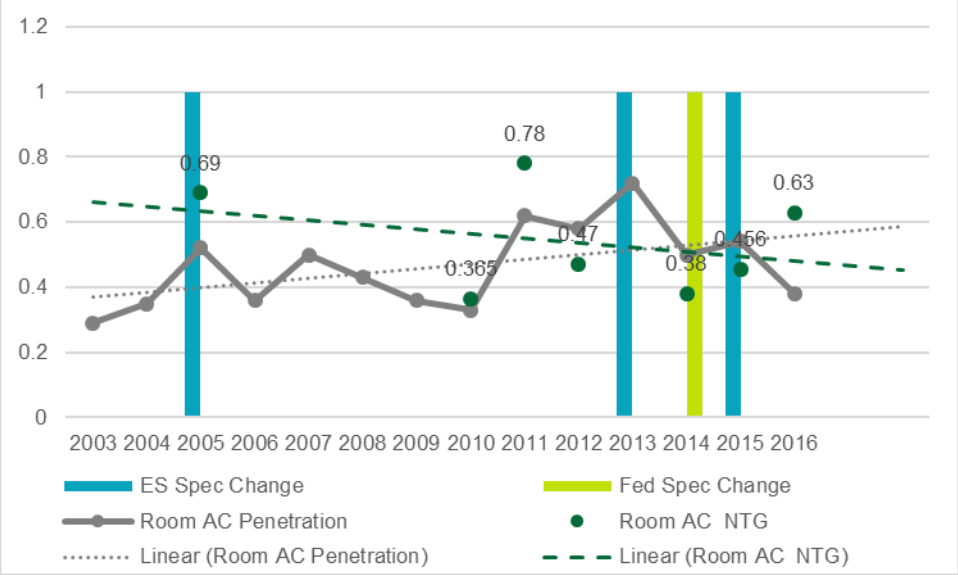


Table 16: Room AC ENERGY STAR Market Penetration and Specification Change Correlation

Measure	Correlation	p-value
Room Air Conditioner	-0.26	0.37

Table 17: Room AC ENERGY STAR Market Penetration, NTG, and Specification Data

	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16
ENERGY STAR Penetration	0.29	0.35	0.52	0.36	0.50	0.43	0.36	0.33	0.62	0.58	0.72	0.50	0.54	0.38
Secondary NTG Research			0.69					0.31-0.42	0.78	0.47		0.38	0.456	0.63
MA 2017 Evaluated NTG	N/A													
Spec Change			ES 1st half								ES 2nd half	Fed	ES 2nd half	
Future Spec Change	Federal 2022													

Consensus Discussion While room air conditioners are a part of the 2019-2021 program, they represent a small portion of program sales. Further, although the group received data on historical market share, there are no specification changes planned until 2022, making it hard to predict how the market will shift from 2019 to 2021. One consensus member suggested utilizing the (1-penetration) technique to get starting NTG values and suggested beginning with 60%. The group considered this but decided on a value of 63% based on the literature review, which most felt would be likely to stay consistent throughout the program years given the lack of a specification change. The group ultimately agreed to go with a flat value of 63% through the 2019 to 2021-time span, with the caveat that the program is likely to move toward mini-splits as the preferred cooling technology in future years.

- MA Evaluated NTG N/A
- 2019 Estimate 63%
- 2020 Estimate 63%
- 2021 Estimate 63%

3.4 SUMMARY OF CONSENSUS-ASSIGNED NTG VALUES

Table 18 displays all the recommended prospective NTG values that came out of the consensus process.

Table 18: Recommended Prospective NTGRs

	2019	2020	2021
Recommended Product NTGRs for Program Planning			
Freezers	60%	58%	56%
Room Air Cleaners	71%	68%	65%
Clothes Dryers	57%	54%	51%
Dehumidifiers	61%	58%	55%
Room Air Conditioners	63%	63%	63%
Pool Pumps	95%	93%	91%
Tier 1 Advanced Power Strips	100%	100%	100%
Tier 2 Advanced Power Strips – Infrared	100%	100%	100%
Tier 2 Advanced Power Strips – Infrared & Occupancy Sensor	100%	100%	100%
Temperature Sensing Showerheads	97%	97%	97%
Refrigerators*	N/A	N/A	N/A
Clothes Washers*	N/A	N/A	N/A
Dishwashers*	N/A	N/A	N/A

* As refrigerators, clothes washers, and dishwashers are not included in the 2019-2021 plan, the consensus panel deferred conversation on these products.

4 Section 4 Products for Future Consideration

The consensus group decided to table the discussion of prospective NTG values for refrigerators, clothes washers, and dishwashers until the program decides to offer these products. However, we provide the background materials collected for this effort to provide context for future discussions.

4.1 Clothes Washers

Clothes washer ENERGY STAR market penetration has been decreasing since 2014 (Figure 7). There have been four specification changes for clothes washers since 2003, half of which have been followed by penetration increases. Table 19 displays the non-significant negative correlation coefficient between market penetration and specification changes, a weak relationship of 0.16. Table 20 reports that there will be both an ENERGY STAR and a federal specification change for clothes washers in 2018.

Figure 7: Clothes Washer ENERGY STAR Market Penetration and NTG

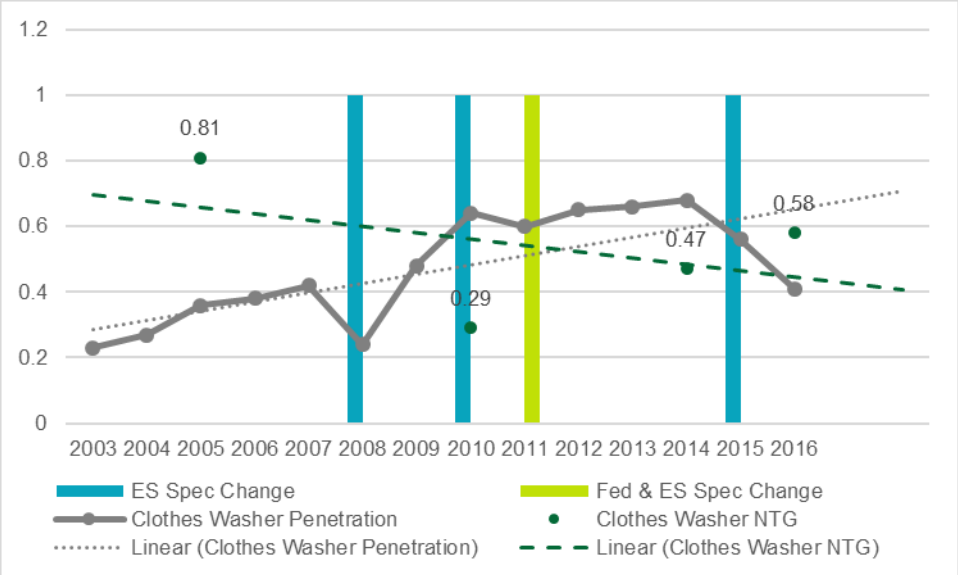


Table 19: Clothes Washer ENERGY STAR Market Penetration and Specification Change Correlation

Measure	Correlation	p-value
Clothes Washer	0.16	0.58

Table 20: Clothes Washer ENERGY STAR Market Penetration, NTG, and Specification Data

	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16
ENERGY STAR Penetration	0.23	0.27	0.36	0.38	0.42	0.24	0.48	0.64	0.60	0.65	0.66	0.68	0.56	0.41
Secondary NTG Research			0.81					0.27-0.31				0.47		0.58
MA Evaluated NTG	N/A													
Spec Change						ES 1st half		ES 1st half	Fed and ES 1st half				ES 1st half	
Future Spec Change	ENERGY STAR 2018, Federal 2018													

- MA Evaluated NTG N/A
- 2019 Estimate N/A
- 2020 Estimate N/A
- 2021 Estimate N/A

4.2 DISHWASHERS

Dishwasher ENERGY STAR market penetration has been above 80% since 2010 (Figure 8). There have been five specification changes for dishwashers since 2003, three of which have been followed by slight penetration increases. Table 21 displays the non-significant correlation coefficient between market penetration and specification changes, a weak relationship of 0.36. Table 22 reports that there will be an ENERGY STAR specification change in 2019 and a federal specification change for dishwashers in 2024.

Figure 8: Dishwasher ENERGY STAR Market Penetration and NTG

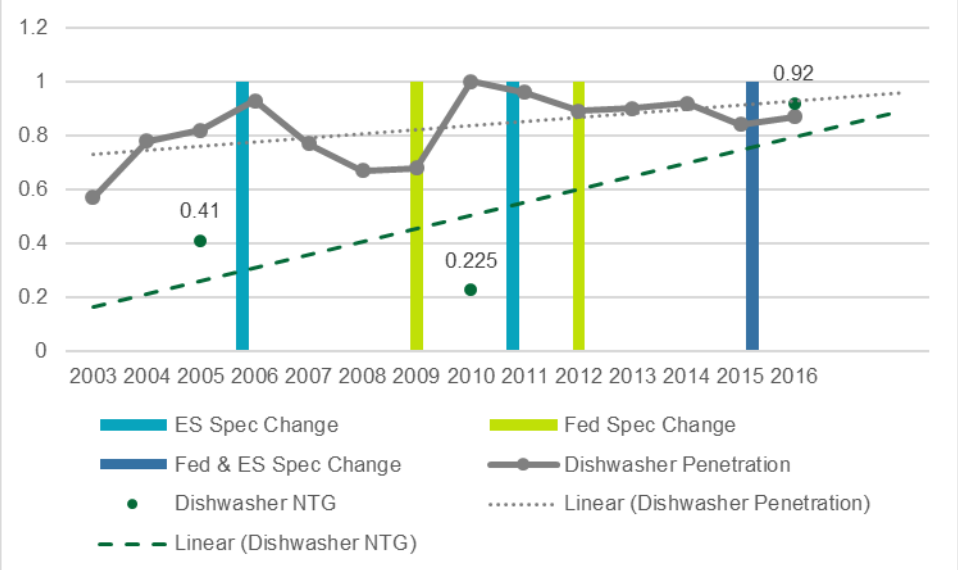


Table 21: Dishwasher ENERGY STAR Market Penetration and Specification Change Correlation

Measure	Correlation	p-value
Dishwasher	0.36	0.20

Table 22: Dishwasher ENERGY STAR Market Penetration, NTG, and Specification Data

	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16
ENERGY STAR Penetration	0.57	0.78	0.82	0.93	0.77	0.67	0.68	1	0.96	0.89	0.90	0.92	0.84	0.87
Secondary NTG Research			0.41					0.2-0.25						0.92
MA Evaluated NTG	N/A													
Spec Change					ES 1st half of year			Fed		ES 1st half of year	Fed			Fed and ES 1st half of year
Future Spec Change	ENERGY STAR 2019, Federal 2024													

- MA Evaluated NTG N/A
- 2019 Estimate N/A
- 2020 Estimate N/A
- 2021 Estimate N/A

4.3 REFRIGERATORS

Refrigerator ENERGY STAR market penetration peaked in 2014, which was also a federal standard and ENERGY STAR specification year. However, penetration decreased 29% in the following year (Figure 9). Table 23 displays the non-significant correlation coefficient between market penetration and specification changes, a weak relationship of 0.16. Table 24 reports that there will be a federal specification change for refrigerators in 2022.

Figure 9: Refrigerator ENERGY STAR Market Penetration and NTG

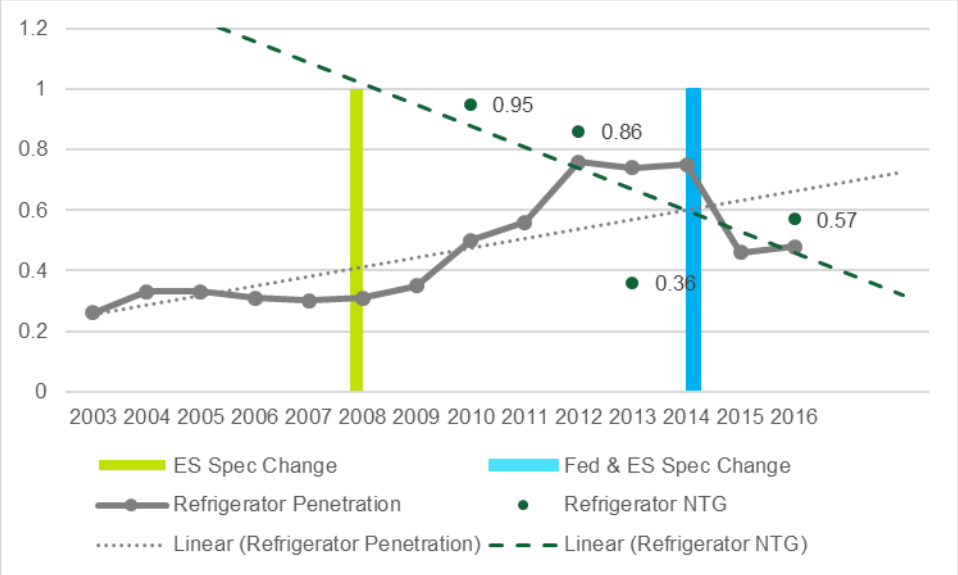


Table 23: Refrigerator ENERGY STAR Market Penetration and Specification Change Correlation

Measure	Correlation	p-value
Refrigerator	0.16	0.57

Table 24: Refrigerator ENERGY STAR Market Penetration, NTG, and Specification Data

	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16
ENERGY STAR Market Penetration	0.26	0.33	0.33	0.31	0.30	0.31	0.35	0.50	0.56	0.76	0.74	0.75	0.46	0.48
Secondary NTG Research								0.95		0.86	0.36			0.57
MA Evaluated NTG	N/A													
Spec Change						ES 1st half						Fed and ES 2nd half		
Future Spec Change	Federal 2022													

- MA Evaluated NTG N/A
- 2019 Estimate N/A
- 2020 Estimate N/A
- 2021 Estimate N/A

Appendix A Products NTG Primary and Background Research

In this appendix, we provide more details on the methods, algorithms, and calculations that fed into both the primary NTG research used as the consensus starting point, and the background research conducted to ascertain deemed NTG values.

A.1 Survey Recruitment

For the surveys of product and direct install participants, the survey firm, RMS, sent out advance letters that included the following:

- a description of the survey and its purpose;
- a web identification number and link to the online survey; and
- a $5 incentive for completing the survey.

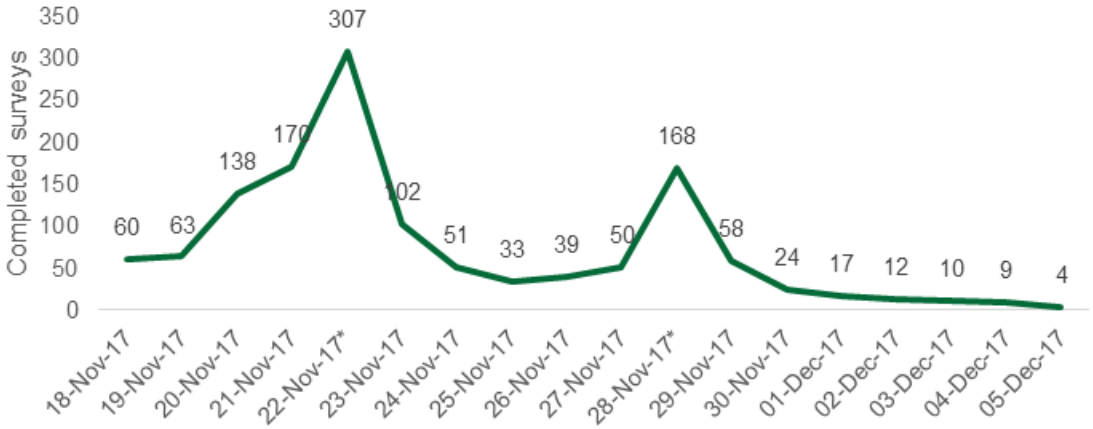
Two follow-up email reminders were sent out to participants with listed addresses to remind them to complete the survey. Table 25 provides the dates for the survey period, advanced letter mailing, and email reminders. A total of 1,268 respondents completed the products survey for an overall response rate of 43%. A total of 250 respondents completed the direct install survey for a response rate of 25%. The lower response rate for direct install participants may be influenced by the nature of the program. During an HES, energy specialists left behind Tier 1 APS, while online APS participants actively purchased the APS, likely increasing their engagement with their APS. In both surveys, nearly all respondents had valid email addresses. To compare with all program participants, 91% of direct install participants, 53% of mail-in rebate participants, and 100% of online purchasers had email addresses in the tracking database. This may suggest a potential of non-response bias among mail-in rebate users, but because most adults now have email addresses (but declined to list them on a rebate form), we do not believe the bias has affected the results.

Table 25: Survey Recruitment Timeline

Survey	Survey Period	Advanced Letter Mailing	Email Reminder 1	Email Reminder 2	Overall Response Rate	Valid emails
Products Program	Nov. 15 - Dec. 5, 2017	Nov. 15, 2017	Nov. 22, 2017	Nov. 28, 2017	43%	98.5%
Direct Install Program	Jan. 5 - Jan. 28, 2018	Jan. 5, 2018	Jan. 11, 2018	Jan. 23, 2018	25%	97.6%

Figure 10 shows the daily completes for the products survey. Note the spikes in the completed survey count that corresponds to the dates when the email reminders were sent out, highlighting the effectiveness of email reminders on survey response rates.

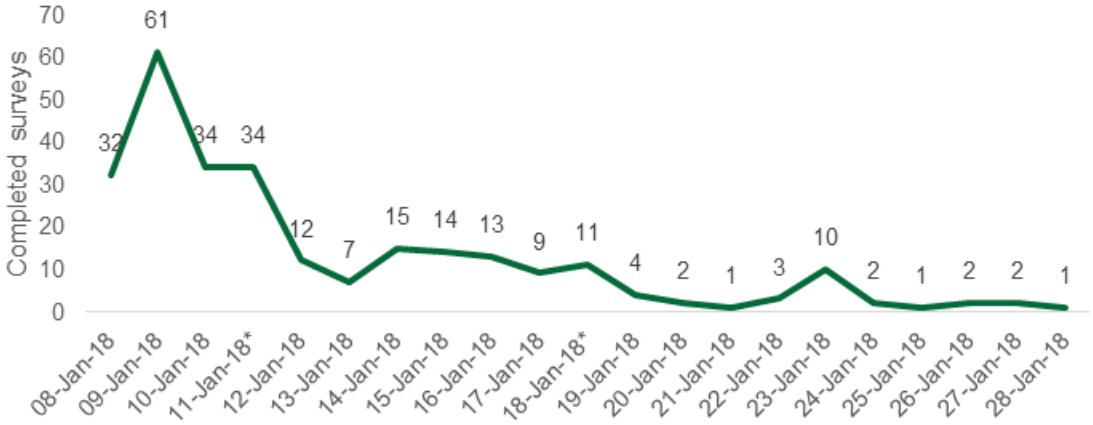
Figure 10: Products and Online APS Survey Daily Completes (n=2,950)



*Email reminder sent

Figure 11 shows the daily completes for the direct install survey. The impact of the email reminders was less pronounced for this survey compared to the products survey. This again suggests that the direct install participants were less engaged with the leave behind APS than the products participants who made the choice to buy APS.

Figure 11: Direct Install Survey Daily Completes (n=1,000)



*Email reminder sent

A.2 NTGR CALCULATIONS

NMR used an approach outlined in the Illinois Technical Reference Manual (V5) to estimate free-ridership and spillover.[12]

A.2.1 Free-ridership Calculations

Figure 12 provides an overview of how NMR calculated free-ridership scores. Survey respondents were asked a series of questions to measure program influence and likely actions in the absence of the program. The survey asked respondents to indicate the level of influence the rebate or discount, Mass Save website, utility, and source of awareness of the program had on their decision to purchase the product or APS (FR1). We used the maximum of these values to obtain the influence score.

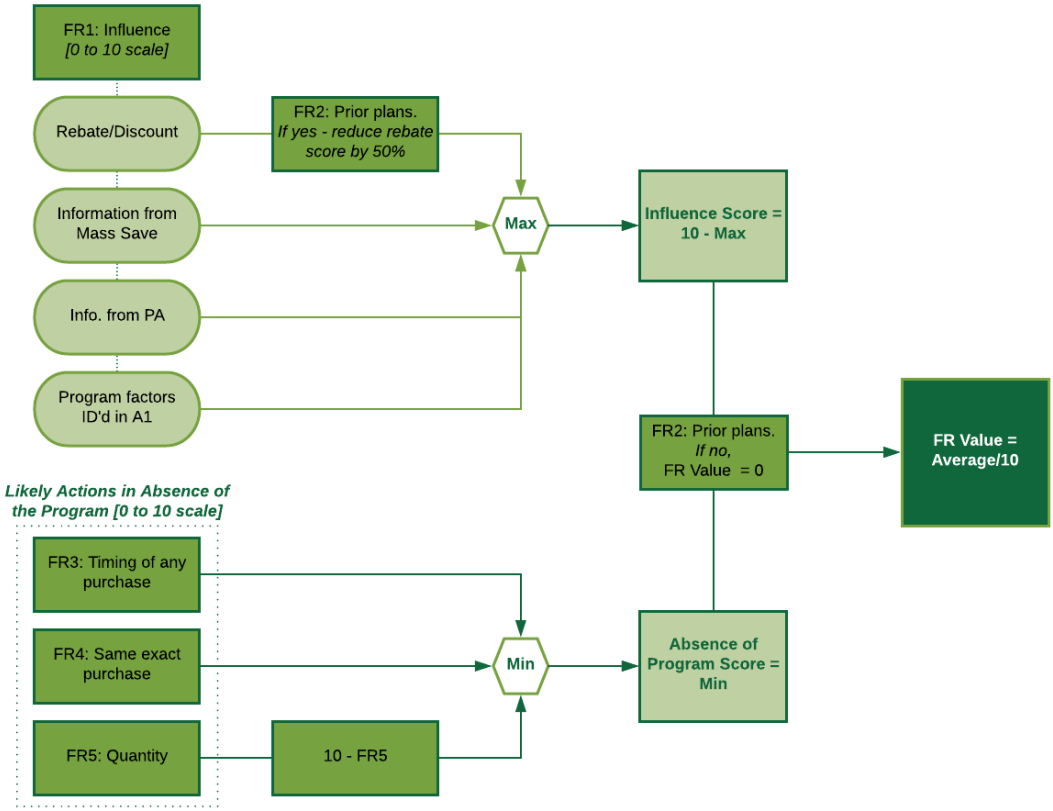
Respondents were then asked to rate their likelihood of doing the following if they had not participated in the program:

- purchasing any product or APS within the next six months (FR3)
- purchasing the same product (FR4)
- purchasing fewer products (FR5)

The minimum of these values was the program absence score. We calculated the free-ridership value by averaging the influence and program absence scores. Respondents who indicated that they had no plans to purchase and install the product or APS prior to learning about the rebate or APS discount were automatically assigned a free-ridership value of zero.

[12] http://www.ilsag.info/il_trm_version_5.html.

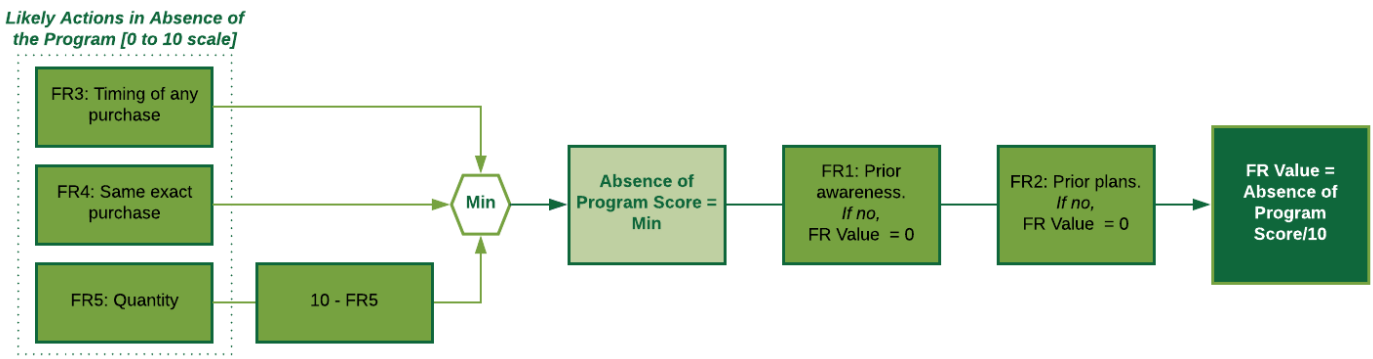
Figure 12: Product and APS Free-ridership Flow Chart



A.2.2 Leave Behind APS Free-ridership Calculations

The leave behind APS free-ridership calculations (shown in Figure 13) did not include an influence score because the APS were left behind by an energy specialist during an HEA, rather than purchased. The same method as that described for the product and APS program absence score was used to calculate the leave behind APS program absence score. Respondents who said that they had never heard of an APS prior to their assessment and/or had no plans to purchase and install a comparable APS prior to receiving the APS were automatically assigned a free-ridership value of zero. Likely actions in the absence of the program followed a similar logic to the products survey.

Figure 13: Direct Install APS Free-ridership Flow Chart



A.2.3 Spillover Calculations

Participant spillover rates were estimated based on the method outlined in the Illinois TRM. Respondents were asked a series of questions to determine whether energy-efficient purchases completed outside of the program were eligible for spillover savings. Respondents with potential spillover had to indicate the following:

1. They purchased and installed additional energy-efficient products;
2. They were influenced by the Mass Save program to make the additional energy-efficient purchase;
3. They did not receive a rebate, discount, or other incentive for the additional energy-efficient product from Mass Save; and
4. They purchased an energy-efficient clothes washer, clothes dryer, room air conditioner, dehumidifier, refrigerator, and/or freezer.
5. Respondents who indicated they only purchased additional room air cleaners, lighting products, showerheads, APS, and/or smart thermostats were excluded as there is high likelihood that these products were obtained via the PAs upstream programs.

Figure 14 highlights the spillover calculation and decision-making process. NMR used savings values from the Massachusetts TRM to calculate overall program and spillover energy and demand savings. Spillover impacts included savings from energy-efficiency measures installed by 45 eligible spillover respondents. NMR used program importance and likely purchase to estimate a spillover score to adjust the spillover impacts for measures that are 0% program-attributable to 100% program attributable. NMR divided the adjusted spillover by the program impacts, summed from all sample respondents, to get the participant spillover rate. Note that we did estimate spillover for leave-behind APS distributed through HES because spillover would likely reflect the influence of the program overall and the combination of measures participants received or adopted through the program.

A.2.3.1 Spillover Measures

Table 26 shows the number of spillover respondents by product, as well as the corresponding spillover measures that were installed. APS Tier 1 had the most spillover measures (28 measures), followed by APS Tier 2 (25 measures) and dehumidifiers (10 measures).

Table 27 shows the calculation by measure considered by the consensus team in assigning the PSE of 2% for most measures, 6% for dyers, and 10% for online Tier 1 APS.

Figure 14: Participant Spillover Flow Chart

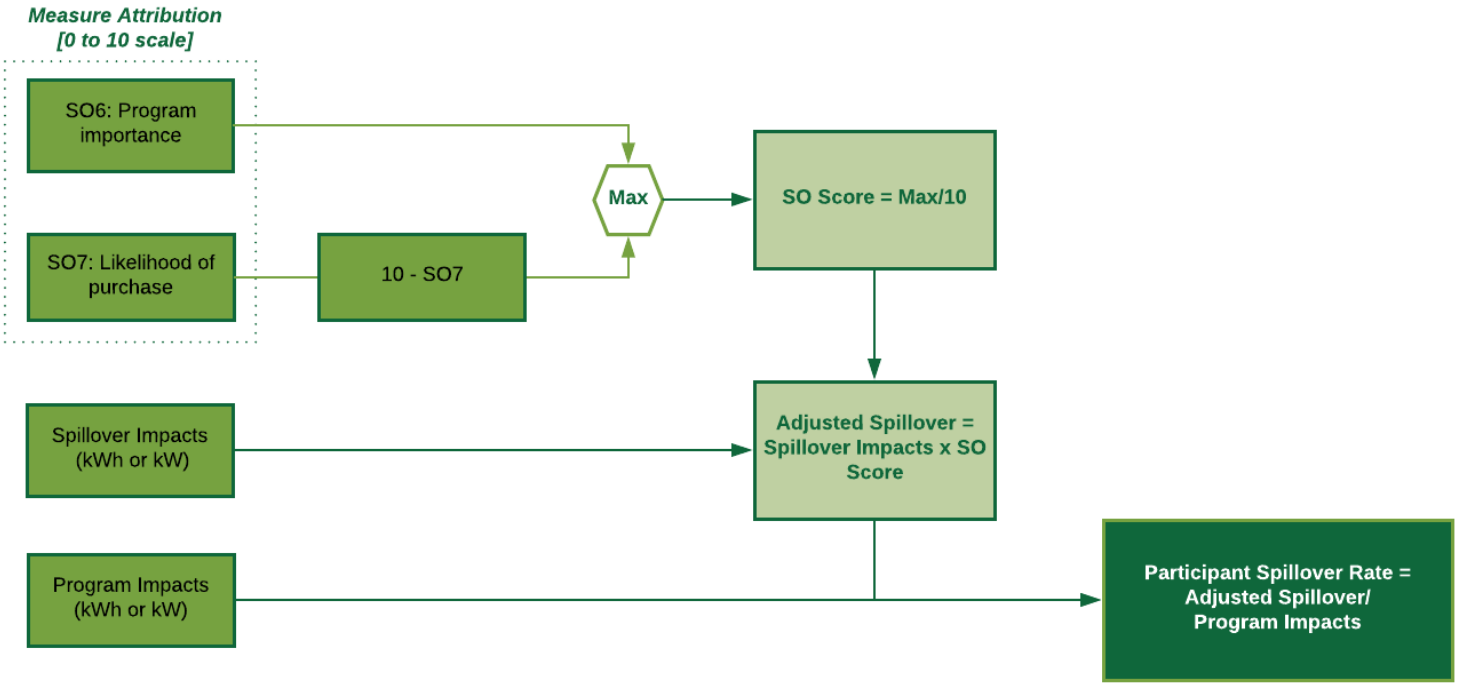


Table 26: Spillover Measure Counts by Product

Product	n	Clothes Washer	Clothes Dryer	Room AC	Dehumidifier	Refrigerator	Freezer	Total
APS Tier 1	14	7	6	2	3	8	2	**28**
APS Tier 2 – Infrared	9	4	4	2	2	5	2	**19**
APS Tier 2 – Infrared & Occupancy Sensor	2	2	2	0	0	1	1	**6**
Dehumidifier	6	4	2	1	1	1	1	**10**
Dryer	7	7	1	2	1	2	0	**13**
Room Air Cleaner	3	1	1	1	0	1	0	**4**
Showerhead	4	3	1	0	0	1	0	**5**
Total	**45**	**28**	**17**	**8**	**7**	**19**	**6**	**85**

Table 27: Measure-specific Spillover Calculations

Product	A. Total Number of Measures	B. Measure kWh Savings	C. Spillover kWh (full measure savings)	D. Likelihood Adjusted Spillover kWh[1]	E. Implied Spillover (D ÷ B)
APS (Tier 1)	596	44,760	5,356	4,357	10%
APS (Tier 2) – Infrared	404	139,784	3,481	3,041	2%
APS (Tier 2) – Infrared & Occupancy Sensor	76	26,296	706	651	2%
Dehumidifier	142	33,938	1,291	1,063	3%
Room Air Cleaner	130	50,830	819	698	1%
Temperature Sensitive Showerheads, Adapters	196	61,980	1,018	814	1%
Dryer	128	20,480	1,871	1,255	6%
Overall	**1,672**	**378,068**	**14,541**	**11,880**	**3%**
Overall w/o Dryer and APS Tier 1	**948**	**312,828**	**7,314**	**6,268**	**2%**

[1] Adjustment is made based on each respondent's unique spillover savings and likelihood and then summed across the sample. Values in the table represent the sum.

A.3 HISTORICAL NTG VALUES

NMR conducted an internet investigation to find historical evaluated NTG values for products. The search concentrated on findings from 2002 through 2016. The purpose of the NTG research was to inform discussion and decision around prospective NTG values. Table 28 lists the values that were collected.

Figure 15 through Figure 23 plot the researched NTG values for each measure to make trend observation simple.

Table 28: Historical NTG Values from Research (sources found in Appendix B)

	Refrig-erator	Refrigerator Recycling	Freezer	Freezer Recycling	Air Cleaner	Dryer	Dehum-idifier	Room AC	Clothes Washer	Pool Pump	Dish-washer
MA Eval. NTG	--	--	--	--	**0.71**	**0.57**	**0.61**	--	--	--	--
Year											
2002[1]		0.35		0.54							
2004-2005[2]								0.69	0.81	0.69	0.41
2004-2005[3]								0.69	0.57	0.69	0.41
2006-2008[4]		0.58						0.31	0.31	0.32	0.25
2006-2008[5]		0.51						0.42	0.3		0.2
2006-2008[6]		0.56						0.37	0.27		0.22
2008[7]		0.7		0.83				1			

	Refrig-erator	Refrigerator Recycling	Freezer	Freezer Recycling	Air Cleaner	Dryer	Dehum-idifier	Room AC	Clothes Washer	Pool Pump	Dish-washer
2008-2009[8]		0.51		0.63							
2009[9]		0.73		0.82				0.72			
2009-2010[10]		0.69		0.59							
2009-2010[11]		0.79		0.82							
2010[12]											
2010[13]	0.95										
2010[14]	0.1							0.1	0.09		0.12
2010[15]		0.67		0.75				0.7			
2010-2011[16]								0.47			
2010-2012[17]		0.68		0.75							
2011[18]					0.78		0.78	0.78			
2011[19]	0.86										
2011[20]	0.12							0.1	0.1		0.12
2011[21]		0.77		0.77				0.58			
2012[22]	0.12							0.1	0.11		0.12
2012[23]		0.67		0.75				0.7			
2012-2013[24]	0.36		0.38		0.38		0.38	0.38	0.466		
2013[25]		0.73		0.82				0.72			
2013- 2014[26]					1.038			0.456		1.038	
2013-2014[27]										0.61	
2014[28]		0.79		0.59				0.5			
2014-2015[29]		0.58		0.71							
2015[30]		0.47		0.56							
2015[31]		0.36		0.48							
2015[32]								0.54		0.54	
2015[33]		0.53		0.57				0.5			
2015[34]	0.86				0.78	0.68			0.68		
2016[35]		0.32									
2016[36]		0.54		0.6				0.5			
2016[37]	0.86		0.86		0.78	0.68	0.78	0.8	0.68	1	0.92
2015-2016[38]		0.48		0.61							
2015-2016[39]		0.21		0.448							
2015-2016[40]		0.34		0.34							
2017[41]	0.57	0.51	0.54	0.58	0.74	0.62		0.63	0.58		0.92

Figure 15: Researched NTG Values for Refrigerators

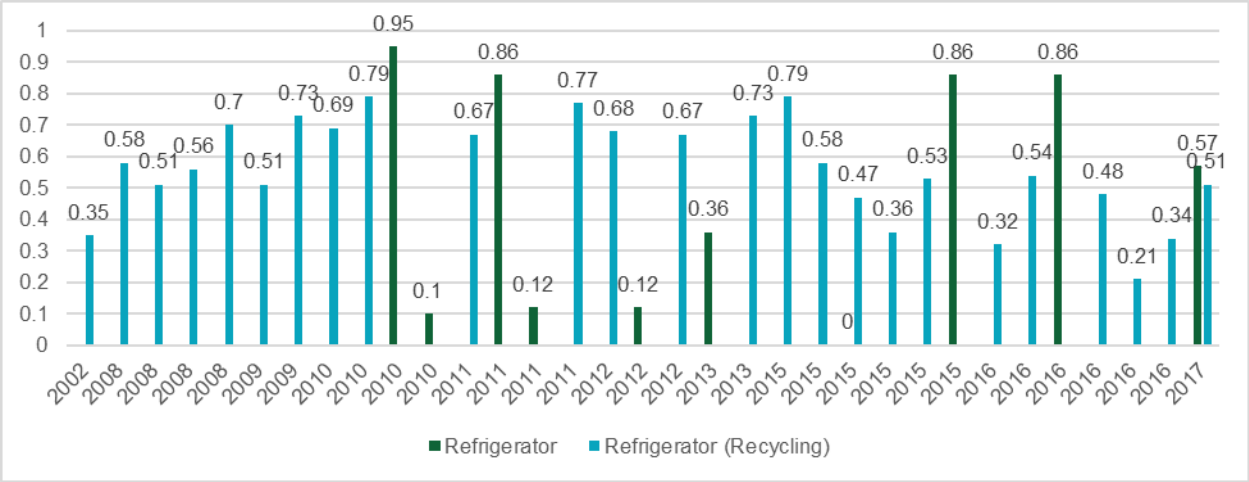


Figure 16: Researched NTG Values for Freezers

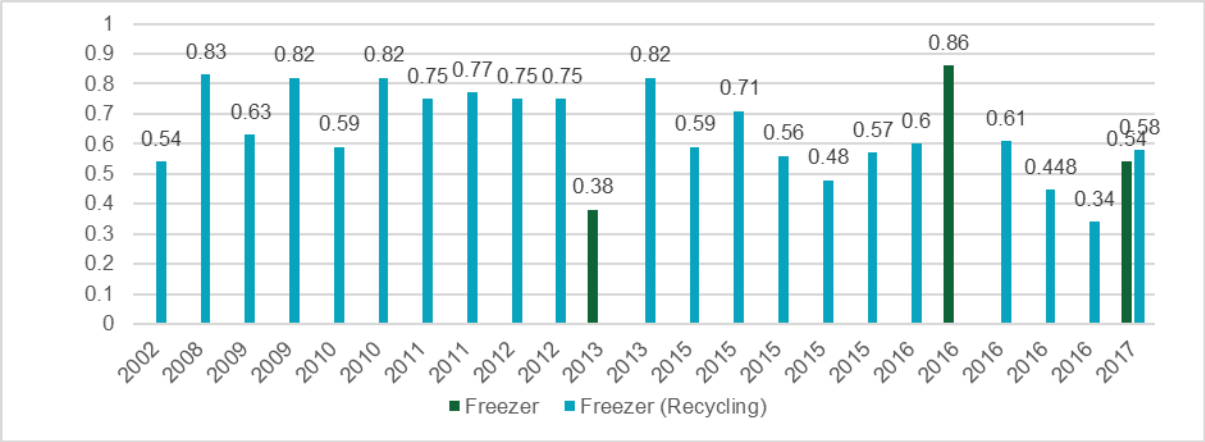


Figure 17: Researched NTG Values for Room Air Purifiers

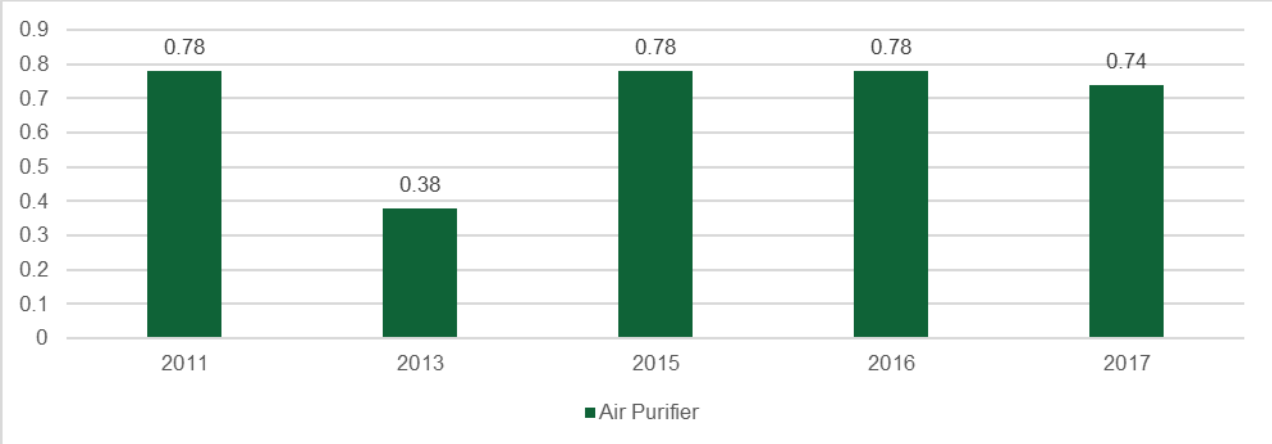


Figure 18: Researched NTG Values for Dryers

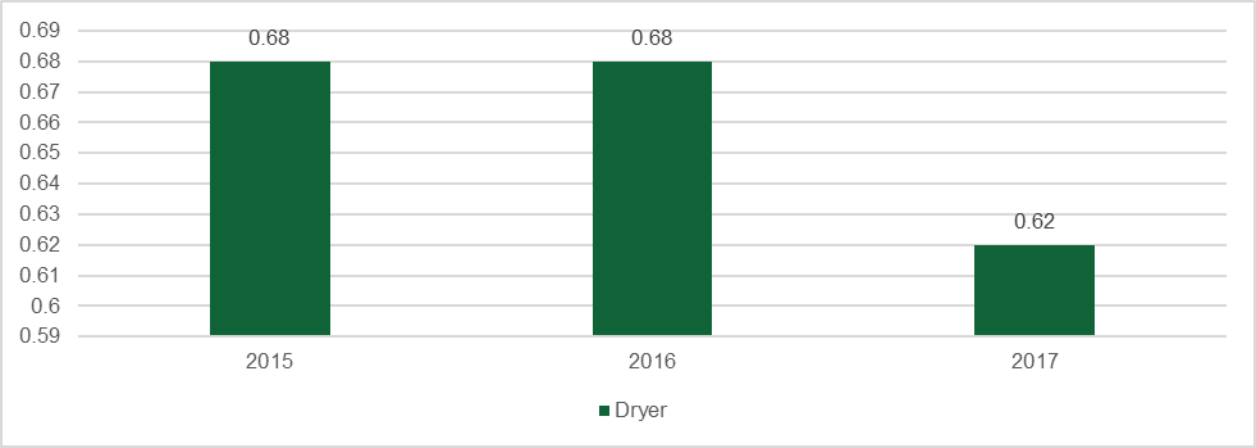


Figure 19: Researched NTG Values for Dehumidifiers

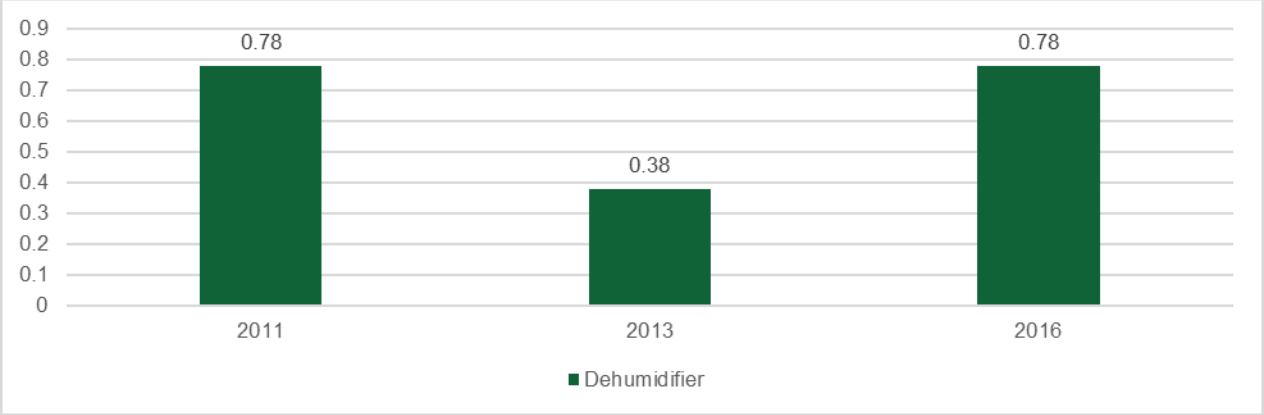


Figure 20: Researched NTG Values for Room Air Conditioners

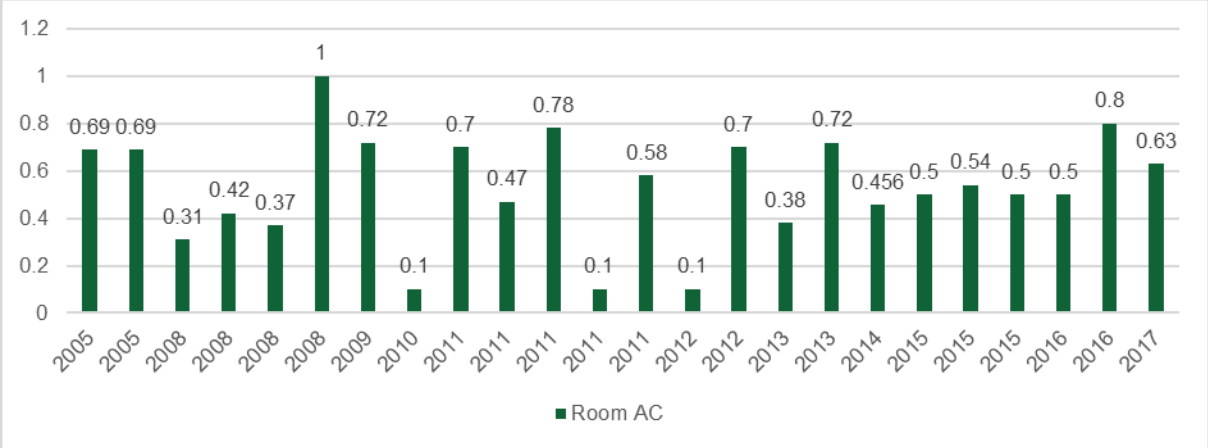


Figure 21: Researched NTG Values for Clothes Washers

Figure 22: Researched NTG Values for Pool Pumps

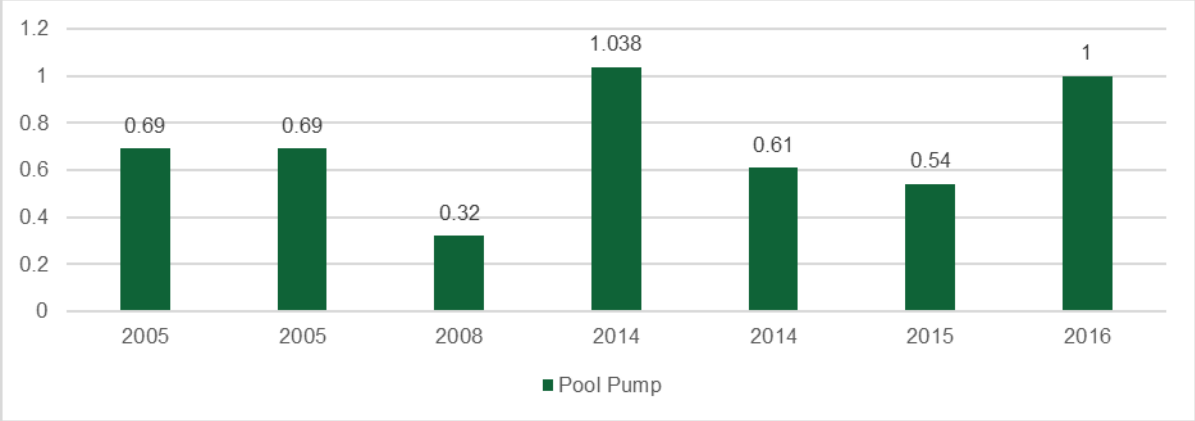
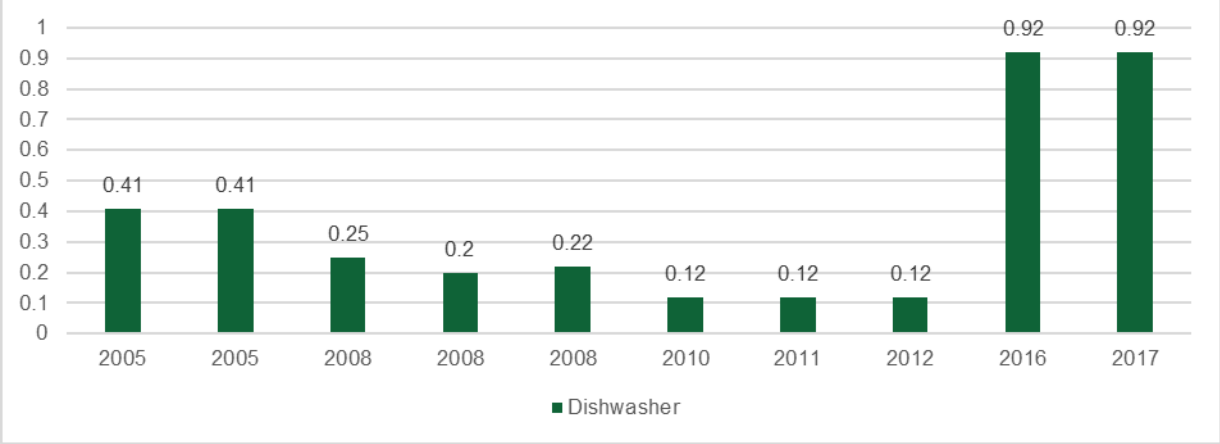


Figure 23: Researched NTG Values for Dishwashers



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