Consortium for Energy Efficiency

Super Efficient Home Appliances Initiative

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1 Initiative Overview

The CEE℠ Super Efficient Home Appliances (SEHA) Initiative seeks to transform residential appliance markets in the United States and Canada by addressing key barriers to increased sales of super efficient products. The Initiative supports efficiency program efforts to encourage the development of and promote the most energy efficient products in the market through creating binational high efficiency specifications, communicating to industry as a collective voice, and sharing program experience to increase the effectiveness of member efforts.

The Initiative accounts for the market’s different players and motivations and embodies the strategic, focused approach that CEE members take together to cost-effectively influence a market shift towards more efficient home appliances. Section 2 explains the Initiative’s history and how it has evolved over time. The current energy savings opportunities associated with residential clothes washers, dishwashers, refrigerators, and room air conditioners are covered in section 3. The key market players and motivations are discussed in section 4 and inform the Initiative goals, approach, and strategies described in sections 5, 6 and 7 respectively. Further details on the selected product categories can be found in section 8. Lastly, section 9 covers Initiative participation requirements, benefits, and measuring impacts.

2 Initiative History

In 1993, CEE began to promote super efficient clothes washers through the CEE℠ National Clothes Washer Initiative. Working with efficiency programs, public interest groups, and government agencies, CEE formulated and endorsed a specification for super efficient clothes washers. In response to this collective effort, three major domestic appliance manufacturers began production of washers meeting the Initiative’s energy criteria.

Bolstered by the success of the National Clothes Washer Initiative and the emergence of the ENERGY STAR® brand in 1995, CEE expanded its clothes washer initiative to include refrigerators, dishwashers, and room air conditioners, thereby creating the CEE℠ Super Efficient Home Appliances (SEHA) Initiative. A companion initiative to the ENERGY STAR appliance program, the SEHA Initiative was designed to promote highly efficient ENERGY STAR appliances, or those that met efficiency levels above the ENERGY STAR level. After 18 months of extensive research and industry outreach, CEE developed efficiency specifications for the appliances covered under the SEHA Initiative and launched the Initiative in June 1998.
The SEHA specifications were, and continue to be, designed to identify the most energy efficient products within each appliance category. Efficiency programs can use these super efficient CEE tiers in their programs to build a demand for higher efficiency among consumers and to encourage manufacturers to create products to meet that demand. While the ENERGY STAR appliance program was initially focused on educating and marketing efficiency to consumers, SEHA worked behind the scenes, targeting manufacturers for outreach and education in an effort to encourage them to increase the efficiency of their products. Efficiency programs participating in the SEHA Initiative also offered retailer training, financial incentives, and consumer education programs to help efficient products penetrate the market.

The Initiative has had considerable success since it was first launched and has maintained a strategy targeted at influencing manufacturers. With the consistent support of efficiency programs across the United States and Canada over the last 21 years, manufacturers have continued to develop products to meet CEE specifications. Due to significant improvements in the efficiency of products in the market, CEE has been able to increase the tiered performance requirements in all appliance categories. One consequence of this success is that the remaining per unit energy savings opportunity for these products is becoming smaller, resulting in reduced payback to consumers. In an effort to continue to transform the residential appliance market, CEE expanded the Initiative in 2019 to include clothes dryers. Clothes dryers long remained a larger untapped opportunity but due to modifications to the DOE test method in 2013, manufacturers began to be able to better distinguish their models with energy efficient features. As a result of this development, ENERGY STAR launched an Emerging Technology Award for clothes dryers in 2013 and 2014 and a specification in 2015. Given the range of in the performance of ENERGY STAR clothes dryers and the potential for additional efficiency improvements, CEE launched a specification for clothes dryers in 2019.

While there has been a decline in the total energy savings from historically SEHA-covered appliances, these products still represent an important savings opportunity in the aggregate, with close to 45 million units shipped in the United States in 2017. In addition, these appliances can play a role in grid balancing, which enables more reliable energy delivery to customers and can delay or even prevent construction of new energy generation facilities.

Ratepayer funded energy efficiency programs’ primary objective has been primarily to deliver traditional energy efficiency. The metrics we used – kWh and BTU – have worked well, but as the needs of the industry have evolved, the locational and temporal value of energy is increasingly important and it’s critical to now consider the complete energy system. CEE members represent a unique obligation to serve the public and provide reliable delivery of energy. The CEE pursuit is now broader than reducing the

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total energy consumed and as a result, energy can no longer be addressed independent of time and location.

In response to aggressive goals around carbon reduction and resiliency, CEE members are tasked with maintaining an efficient and resilient distribution system. In order for the demand side of the equation is to prove relevant for system planners, the SEHA Initiative has begun supporting the development of interoperable ecosystem of energy consuming buildings through the adoption of optional connected criteria for room air conditioners, clothes washers, and clothes dryers. CEE sees a need for a national brand to identify products that serve this broader societal purpose.

3 Energy Efficiency Opportunity

Based on the Energy Information Agency’s Annual Energy Outlook forecast data for 2018, clothes washers, clothes dryers, dishwashers, and refrigerators accounted for almost 14 percent of total residential energy consumption. If we assume that 23 percent of space cooling energy consumption is from room air conditioners, the figure jumps to 17.5 percent. This energy consumption accounts for 115.4 million metric tons of carbon dioxide. According to EPA, if every clothes washer, clothes dryer, refrigerator, and room air conditioner sold in the United States was ENERGY STAR certified, the energy savings could grow to over 60 billion kWh per year and result in 61 billion pounds in greenhouse gas emission reductions annually.

4 Market Overview

4.1 Market Players and Motivations

Figure 1, below, provides a basic overview of how appliance products flow through the United States and Canadian markets. Consumers predominantly purchase appliances through retailers, though in recent years online sales have started to play a greater role.

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4 Calculated based on data from the ENERGY STAR product webpages for clothes washers, clothes dryers, dishwashers, refrigerators, and room air conditioners. ENERGY STAR, energystar.gov/products.
With the economic recession, mergers, and acquisitions, the number of home appliance manufacturers operating in the United States and Canada has noticeably decreased since 2007. In 2017, U.S. market researcher TraQline identified the top five major household appliance manufacturing companies representing 73 percent of the total market share, Samsung, LG Electronics, Whirlpool Corporation, GE, a Haier Company, and Kenmore. During the economic recession, it was common for smaller firms to leave the industry as a result of rapid revenue decline, and larger players gained market share. IBIS World predicted that the industry would become even more concentrated by 2017 as a result of firms like Whirlpool and Electrolux acquiring more companies.⁶

According to U.S. market researcher TraQline, Samsung market share in key household products stood at 19.5 percent of all consumer appliances sold in the North American country. In contrast, Whirlpool Corp., lost market share and placed third after LG Electronics. Whirlpool's share of the U.S. home appliance market stood at 15.4 percent, while LG's numbers stood unchanged at 15.7 percent. The market shares of other

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manufacturers that made the top five list -- General Electric and Kenmore -- stood at 13.5 percent and 9.1 percent, respectively, in 2017.

Figure 2. **United States Appliance Market Share Based on Sales, 2017**

- **Samsung** 19.5%
- **LG Electronics** 15.7%
- **Whirlpool** 15.4%
- **Kenmore** 9.1%
- **General Electric, a Haier company** 13.5%
- **Other** 26.8%

In the retail market, the nation’s 50 largest appliance dealers account for over 90 percent of the entire US market. In 2017, Lowe’s, The Home Depot, Best Buy and the two Sears entities — the top five retailers — together commanded nearly 76 percent of all Top 50 appliance retailer dollars, while the two home improvement chains alone accounted for nearly half (49.6 percent) of the home appliance pie.

1. Lowe’s

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2. The Home Depot
3. Best Buy
4. Sears
5. Sears Hometown Stores
6. Walmart
7. P.C. Richard & Son
8. Nebraska Furniture Mart
9. Costco
10. Abt Electronics and Appliances

To identify how to best enact change across the different market players, namely increase the sales of efficient home appliances, it is important to understand and address the variety of market players’ motivations.

**Figure 3. Market Player Motivations**

<table>
<thead>
<tr>
<th>Manufacturers</th>
<th>Retailers &amp; Distributors</th>
<th>Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Increase profits</td>
<td>1. Increase profits</td>
<td>1. Keep costs—initial and operating—low</td>
</tr>
<tr>
<td>2. Increase market share</td>
<td>2. Increase market share</td>
<td>2. Maintain desired quality</td>
</tr>
<tr>
<td>4. Build customer loyalty</td>
<td>4. Build customer loyalty</td>
<td>4. Take into account societal impacts, including environmental</td>
</tr>
<tr>
<td>5. Comply with standards and rules</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5 Initiative Goals and Objectives

The SEHA Initiative seeks to increase the market adoption of energy efficient home appliances. Its two primary goals are:

1. To facilitate programs in their efforts to increase the sale and market share of super efficient, connected appliances
2. To complement the efforts of the ENERGY STAR program to increase the sale and market share of ENERGY STAR qualified appliances

6 Initiative Approach

In order to achieve lasting change in the appliance market, the SEHA Initiative seeks to engage all market players, from providing manufacturers with support to improve the efficiency of appliances sold to encouraging consumers to purchase these products. By supporting energy efficient appliances through their programs, CEE members provide consumer education, marketing, promotions, and incentives to help consumers more
readily identify energy efficient products at retail, understand their benefits, and, in some cases, purchase them at a lower price. This market support provides manufacturers with partners in promotion of their high efficiency products, which often yields an increased value proposition and an easier time investing in efficiency improvements, as well as the ability to achieve economies of scale more quickly.

6.1 Initiative Scope

Currently, the SEHA Initiative focuses on five major appliance product categories for which high efficiency specifications have been developed. These are:

- Clothes washers
- Clothes dryers
- Dishwashers
- Refrigerators
- Room air conditioners

More detail on each of these appliances can be found in section 8.

7 Initiative Strategies

The SEHA Initiative employs three primary strategies to achieve and increase market impact: developing efficiency specifications, sharing program experience, and communicating to industry as a collective voice. The Initiative leverages the existing ENERGY STAR program and brand and offers specifications with performance thresholds, or tiers, that meet and exceed the ENERGY STAR level for the various appliance categories covered. These specifications provide Initiative participants with a common foundation for designing local or regional programs to enhance consumer awareness and increase demand for super efficient products. A CEE committee of appliance program administrators supports the continued development and market uptake of efficient products by keeping a close watch on product performance, sharing local market trends, and discussing effective marketing messages and tactics. Another key element of the Initiative is maintaining a close relationship with the ENERGY STAR program as well as an open dialogue with appliance manufacturers and the appliance industry association, the Association of Home Appliance Manufacturers (AHAM).

The Initiative’s core components are appliance specifications with super efficient performance tiers that use the ENERGY STAR program as a platform. These tiers serve as a base for energy efficiency programs to promote super efficient products. Differentiated efficiency levels also provide ancillary benefits and opportunities such as:

- Giving initiative participants the ability to exercise third-party technical credibility in a high-profile environment
- Providing consumers with a relative basis to decipher product performance
- Setting clear, binational targets for manufacturers when they design and engineer super efficient products
• Producing leveraged market transformation impacts through the promotion of common specifications by efficiency programs across the United States and Canada
• Allowing initiative participants and partners to benefit from affiliation with high performance and technical superiority
• Helping manufacturers benefit from third-party promotion of their products

In addition to developing common specifications for use in promoting super efficient appliances, the SEHA Initiative provides:

• A forum for sharing lessons learned about super efficient appliance promotion and for suggesting initiative enhancements as appropriate
• Communication to manufacturers, distributors, and retailers summarizing national efforts under the Initiative
• Qualifying products lists for each efficiency tier and connected criteria, as needed
• An opportunity for CEE members to play a role in the process of developing and revising ENERGY STAR specifications as part of a coordinated group of collective interests
• Public promotion of the initiative and coordination with the ENERGY STAR program’s efforts

7.1 Initiative Specifications

Specifications are designed to provide a consistent definition of efficiency and desired performance across the United States and Canada and encourage manufacturers to develop and sell products that meet these established performance levels. In addition to supporting ENERGY STAR criteria for a variety of appliances, CEE has developed specifications for products performing above ENERGY STAR. By developing and supporting efficiency specifications, CEE expects to see an increase in sales of super efficient products, an increase in participation in the ENERGY STAR program by members that have an interest in promoting energy efficient appliances, and an increase in the manufacture and sale of new super efficient appliances. By developing and supporting connected criteria, CEE expects to see an increase in sales of connected appliances that meet CEE member needs in terms of maintaining an efficient and resilient distribution system.

7.1.1 Specification Development Process

CEE efficiency specifications and tiers for appliances and other products are developed through an iterative process involving CEE members, manufacturers, and other stakeholders. In the appropriate CEE committee (in the case of the SEHA Initiative, the CEE Residential Appliances Committee), members evaluate possible tiers, considering a variety of factors, including:

• The technological potential of a given product, based on current knowledge and research
• The distribution of efficiency performance for currently available products, and the resulting energy savings potential
• Operating variances due to regional influences
• Regional variances in energy costs
• Incremental product costs to achieve increased efficiencies
• New federal efficiency standards
• Manufacturer lead times
• The current ENERGY STAR level for a product, and any planned revisions to the ENERGY STAR specification

When the CEE committee agrees on a specification proposal, CEE distributes it to industry and other relevant stakeholders for review and comment. Upon receipt of these comments, the committee considers them and then modifies the specification proposal as members deem appropriate. The committee has the option to hold several comment periods for industry and other stakeholders. Once the committee is comfortable with the specification proposal, CEE staff submits it to the CEE Board for consideration. Further revisions to CEE specifications occur as needed, as identified by the CEE committee, CEE staff, or the CEE Board.

CEE tiers are designed to identify distinct levels of performance in the market that are likely to garner promotion by ratepayer funded efficiency programs due to customer or grid benefits. When CEE members promote these binationally consistent tiers, manufacturers are encouraged to invest in continued product improvement sooner that market conditions would dictate.

• CEE Tier 1 is intended to enable sufficient product volume for programs to achieve cumulative savings goals and to emphasize significant per unit savings over the performance baseline, which is typically the federal minimum efficiency standard.
• CEE Tier 2 provides significant per unit savings above and beyond Tier 1 and reflects the performance of products already available from numerous manufacturers. Though eligible products may be available at higher price points, these performance tiers are intended to yield cost-effective energy savings.
• CEE Tier 3 provides significant per unit savings above and beyond Tier 2 and reflects the performance of products already available from numerous manufacturers. Though eligible products may be available at higher price points, these performance tiers are intended to yield cost-effective energy savings.
• CEE Advanced Tier is a higher level of performance that may not be currently available from multiple manufacturers or for all product types. It is an aspirational level that provides recognition for manufacturers who have developed the most efficient, highest performing models available in the market. It provides a longer-term focus, and as a result products may not yet be cost-effective in all applications or broadly available in the market.
CEE connected criteria is intended to identify appliances that will help consumers realize energy and financial savings, increase the resilience and viability of the grid, and contribute environmental benefits.

Once these specifications are finalized, they help motivate manufacturers, distributors, and retailers to develop and market products that qualify for the designated efficiency levels, connected criteria, and meet consumer demand for energy efficiency.

7.2 Sharing Efficiency Program Approaches

There are a number of potential approaches, using a variety of media, to conveying the value of high efficiency to consumers. The CEE Residential Appliances Committee provides an opportunity for program administrators to discuss successful messaging and tactics, as well as approaches that have been less impactful. As a result, programs are able to increase the impact of their marketing and promotions in their service territories. Program sharing also increases the consistency in the messages being delivered to consumers across the United States and Canada and helps prevent confusion in the market. Most, if not all, efficiency programs use the ENERGY STAR program as a platform in their appliances programs. The ENERGY STAR brand is highly recognized and consumers associate ENERGY STAR products with efficiency. Many programs also make use of ENERGY STAR marketing materials and messaging.

Program sharing also enables members to learn new ways to leverage partnerships with industry stakeholders and other market players. In particular, programs have had success when they recognize and appeal to retailer, distributor, and manufacturer motivations within local program designs. Many programs have recently partnered more closely with appliance retailers in an effort to increase retailer stocking, promotion, and sale of efficient appliances. Lastly, several efficiency programs have formed partnerships with water efficiency programs in their regions, and have successfully developed joint incentive programs.

7.2.1 Program Summaries

Annual summaries of CEE member appliances program activity can be found on the CEE website at cee1.org/content/cee-program-resources. CEE members can use these summaries to learn how their counterparts are promoting efficiency and to help inform their own program design. Manufacturers and others also use these summaries to stay up to date on efficiency program activity.

7.3 Communicating with Manufacturers and Retailers

Since the inception of the SEHA Initiative, CEE has worked to develop a cooperative relationship with the appliance industry. Thus far, CEE has focused its efforts on manufacturers and the Association of Home Appliance Manufacturers (AHAM), the United States appliance industry association. The primary opportunity for CEE to communicate with industry is during the appliance specification revision process, when CEE requests comments from industry on specification proposals (see the Specification
Development Process section above). CEE also interacts with clothes washer, dishwasher, and refrigerator manufacturers in order to maintain the CEE qualifying product lists for these appliances.

CEE is currently investigating whether and how to expand the CEE relationship with appliance retailers. Though CEE members frequently work with retailers at local and regional levels, CEE has not undertaken any work with them at the national level. CEE will determine whether there is a role for CEE to play in working with retailers to complement the work already being done by members at a local level and by the ENERGY STAR program at the national level.

8 Appliance Product Information and Specifications

8.1 Clothes Washers

8.1.1 Market Information

Based on currently available census bureau data in the US and Canada, a significant portion of homes have clothes washers. According to the 2011 United States Census Bureau American Housing Survey, approximately 103 million households in the United States are currently fitted with a clothes washer, representing 78 percent of households.\(^\text{11}\) Data from the Natural Resources Canada 2011 Survey of Household Energy Use indicates a slightly higher penetration rate of clothes washers in Canada, at 88 percent.\(^\text{12}\) With general technology adoption rates, it is expected that these numbers have increased since 2011. Based on Appliance Magazine’s 2016 estimate of the total number of US households, roughly 95 percent of households have a clothes washer.\(^\text{13}\) Based on data compiled in 2016 by EIA on the prevalence and energy consumption of clothes washers, washers represented one percent of total residential electricity use across the United States and eight billion kWh per year.\(^\text{14}\)

According to the 2010 report Energy Consumption of Major Household Appliances Shipped in Canada, the average annual unit energy consumption for non-ENERGY STAR clothes washers was 338 kWh per year, while the average annual unit energy consumption for


ENERGY STAR clothes washers was 154 kWh per year.\textsuperscript{15} Approximately 10 million clothes washers were shipped for sale in 2017, according to \textit{appliance Design}, and on average, units remain in service for 11 years.\textsuperscript{16} ENERGY STAR unit shipment data from 2016 shows that approximately 3.9 million clothes washers shipped that year were ENERGY STAR qualified, yielding an average market penetration of about 41 percent.\textsuperscript{17}

According to data collected by CEE in November 2017, approximately 75 models from eight brands met the CEE specification at that date. Qualified models are broken out by CEE tier in the table below.

<table>
<thead>
<tr>
<th>Tier</th>
<th>Integrated Modified Energy Factor (IMEF)</th>
<th>Integrated Water Factor (IWF)</th>
<th>Number of Models</th>
<th>Number of Brands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Models (&gt; 2.5 cu.ft.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1</td>
<td>2.76</td>
<td>3.2</td>
<td>75</td>
<td>8</td>
</tr>
<tr>
<td>CEE Tier 2</td>
<td>2.93</td>
<td>3.2</td>
<td>47</td>
<td>8</td>
</tr>
<tr>
<td>CEE Advanced Tier</td>
<td>3.10</td>
<td>3.0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Small Volume (≤ 2.5 cu.ft.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1</td>
<td>2.07</td>
<td>4.2</td>
<td>29</td>
<td>11</td>
</tr>
<tr>
<td>CEE Tier 2</td>
<td>2.20</td>
<td>3.7</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

8.1.2 Potential Savings

There remains an opportunity to achieve energy savings from residential clothes washers. Clothes washers qualifying for the most efficient CEE tier could save as much as 322 kWh per unit annually over the 2018 federal standard baseline, which assumes a mixed market share of 70 percent top load models and 30 percent front load models. Maximum gas savings over the baseline are estimated at 10.3 therms per year, and potential per unit water savings are estimated at 3,362 gallons per year. Estimated


\textsuperscript{17} “ENERGY STAR® Unit Shipment and Market Penetration Report Calendar Year 2016 Summary,” ENERGY STAR, \url{https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2016_USD_Summary_Report.pdf?0dc8-f842}.
energy and water savings by CEE tier are provided in the tables below. These figures were calculated using a nominal 3.85 cu.ft. capacity for standard sized models, based on the 2014 average capacity in the AHAM Trends in Energy Efficiency Report\textsuperscript{18}, and a 2.20 ft\textsuperscript{3} capacity for small volume washers, given the prevalence of this capacity on retailer websites. CEE also assumes a total of 295 cycles per year, per the US DOE test procedure for residential clothes washers.

Table 2. Annual Energy and Water Savings: Clothes Washer Used with Electric Water Heater and Electric Dryer

<table>
<thead>
<tr>
<th>Tier</th>
<th>IMEF</th>
<th>IWF</th>
<th>kWh/Year Savings</th>
<th>Gal/Year Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Size Units (&gt; 2.5 cu. ft.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1</td>
<td>2.76</td>
<td>3.2</td>
<td>276</td>
<td>3,135</td>
</tr>
<tr>
<td>CEE Tier 2</td>
<td>2.92</td>
<td>3.2</td>
<td>299</td>
<td>3,135</td>
</tr>
<tr>
<td>CEE Advanced Tier</td>
<td>3.10</td>
<td>3.0</td>
<td>322</td>
<td>3,362</td>
</tr>
<tr>
<td><strong>Small Volume Units (≤ 2.5 cu. ft.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1</td>
<td>2.07</td>
<td>4.2</td>
<td>80</td>
<td>1,142</td>
</tr>
<tr>
<td>CEE Tier 2</td>
<td>2.20</td>
<td>3.7</td>
<td>98</td>
<td>1,467</td>
</tr>
</tbody>
</table>

Table 3. Annual Energy Savings: Clothes Washer Used with Gas Water Heater and Electric Dryer

<table>
<thead>
<tr>
<th>Tier</th>
<th>IMEF</th>
<th>IWF</th>
<th>kWh/Year Savings</th>
<th>Therms/Year Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Size Units (&gt; 2.5 cu. ft.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1</td>
<td>2.76</td>
<td>3.2</td>
<td>182</td>
<td>2.39</td>
</tr>
<tr>
<td>CEE Tier 2</td>
<td>2.92</td>
<td>3.2</td>
<td>197</td>
<td>2.65</td>
</tr>
<tr>
<td>CEE Advanced Tier</td>
<td>3.10</td>
<td>3.0</td>
<td>212</td>
<td>2.92</td>
</tr>
<tr>
<td><strong>Small Volume Units (≤ 2.5 cu. ft.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1</td>
<td>2.07</td>
<td>4.2</td>
<td>53</td>
<td>0.93</td>
</tr>
<tr>
<td>CEE Tier 2</td>
<td>2.20</td>
<td>3.7</td>
<td>65</td>
<td>1.14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tier</th>
<th>IMEF</th>
<th>IWF</th>
<th>kWh/Year Savings</th>
<th>Therms/Year Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Size Units (&gt; 2.5 cu. ft.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1</td>
<td>2.76</td>
<td>3.2</td>
<td>14</td>
<td>9.0</td>
</tr>
<tr>
<td>CEE Tier 2</td>
<td>2.92</td>
<td>3.2</td>
<td>15</td>
<td>9.7</td>
</tr>
<tr>
<td>CEE Advanced Tier</td>
<td>3.10</td>
<td>3.0</td>
<td>16</td>
<td>10.4</td>
</tr>
<tr>
<td><strong>Small Volume Units (≤ 2.5 cu. ft.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1</td>
<td>2.07</td>
<td>4.2</td>
<td>4</td>
<td>2.6</td>
</tr>
<tr>
<td>CEE Tier 2</td>
<td>2.20</td>
<td>3.7</td>
<td>5</td>
<td>3.2</td>
</tr>
</tbody>
</table>

### 8.1.3 Efficiency Parameters

In March 2015, CEE began using Integrated Modified Energy Factor (IMEF) and Integrated Water Factor (IWF) to qualify models for the CEE clothes washer specification. Between 2001 and 2015 CEE used Modified Energy Factor (MEF) and Water Factor (WF) to qualify clothes washers, and prior to 2001, CEE used the efficiency metrics Energy Factor (EF) and Remaining Moisture Content (RMC). EF and RMC are embedded in the MEF and WF metrics, and MEF and WF are embedded in the IMEF and IWF, which also take into account standby and off-state power consumption.

IMEF is a measure of the energy consumption of the total laundry cycle, including both washing and drying, normalized by capacity. It indicates how many cubic feet of laundry can be washed and dried with one kWh of electricity. As IMEF increases, efficiency increases. IWF is the quotient of the total weighted per-cycle water consumption for all wash cycles in gallons divided by the cubic foot (or liter) capacity of the clothes washer. A lower number indicates a more efficient use of water.

### 8.1.4 Efficiency Specification

The CEE clothes washer specification, effective February 5, 2018, is summarized below. The ENERGY STAR levels are referenced but not requirements of the CEE specification. For full details of the CEE specification, see the CEE website at library.cee1.org/content/cee-residential-clothes-washer-specification-february-5-2018/.
Table 5. **CEE Clothes Washer Specification Summary**

<table>
<thead>
<tr>
<th>Efficiency Level</th>
<th>IMEF</th>
<th>IWF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Size Models (＞ 2.5 cu. ft.)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1 (consistent with ENERGY STAR Version 8.0 Front Load criteria)</td>
<td>≥ 2.76</td>
<td>≤ 3.2</td>
</tr>
<tr>
<td>CEE Tier 2 (consistent with ENERGY STAR Most Efficient 2018)</td>
<td>≥ 2.92</td>
<td>≤ 3.2</td>
</tr>
<tr>
<td>CEE Advanced Tier</td>
<td>≥ 3.10</td>
<td>≤ 3.0</td>
</tr>
<tr>
<td><strong>Small Volume Models (≥ 2.5 cu. ft.)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1 (consistent with ENERGY STAR Version 8.0 criteria)</td>
<td>≥ 2.07</td>
<td>≤ 4.2</td>
</tr>
<tr>
<td>CEE Tier 2 (consistent with ENERGY STAR Most Efficient 2018)</td>
<td>≥ 2.20</td>
<td>≤ 3.7</td>
</tr>
</tbody>
</table>

8.1.5 Connected Specification

In addition to efficiency criteria, CEE has developed requirements for clothes washers with connected functionality, as these products can help manage load and reduce demand on the grid. CEE requirements are consistent with the demand response (DR) functionality specified by EPA as part of the ENERGY STAR specification for clothes washers. CEE has imposed additional criteria by requiring a direct, open standards translation within the physical premise of the home for clothes washers with connected functionality. These requirements are intended to identify models that are enabled to support grid objectives, including load reduction and load delay, while supporting the possibility for consumers to further save energy and money through greater knowledge and participation in grid services.

For the full requirements, please see Appendix A.

CEE is also exploring the development of a cloud-to-cloud specification that would serve utility objectives similar to those of the current connected requirements; such a specification would be added to the Initiative as part of a future revision.

8.1.6 Qualifying Products List

CEE maintains a residential clothes washer qualifying products list to enable initiative participants to identify and promote residential clothes washers that qualify for CEE tiers and to increase these clothes washers’ uptake in the market. This list is updated on a monthly basis, typically on or about the 15th of each month, although the timing of its release may vary slightly throughout the year. The list contains models that meet the CEE specification, sorted by CEE tier. Manufacturers must submit the necessary data for each product, including IMEF, IWF, and qualifying CEE tier, to CEE in order for that product to be listed. The list can be found on the CEE website at https://library.cee1.org/content/qualifying-product-lists-residential-clothes-washers.
8.2 Clothes Dryers

8.2.1 Market Information

Based on currently available census bureau data in the US and Canada, a significant portion of homes have clothes dryers. According to the 2017 United States Census Bureau American Housing Survey, approximately 100 million households in the United States are currently fitted with a clothes dryer, representing 83 percent of households.\textsuperscript{19} Data from the Natural Resources Canada 2011 Survey of Household Energy Use indicates a slightly higher penetration rate of clothes dryers in Canada, at 86 percent.\textsuperscript{20} With general technology adoption rates, it is expected that these numbers have increased since 2011. According to the EIA Annual Energy Outlook 2018, dryers represented four percent of total residential electricity use across the United States and 56 billion kWh per year.\textsuperscript{21}

According to the 2015 Energy Consumption Data of Major Household Appliances Shipped in Canada, the average annual unit energy consumption for non-ENERGY STAR clothes dryer was 923 kWh per year.\textsuperscript{22} EPA estimates that ENERGY STAR clothes dryers use 20 percent less energy than conventional units\textsuperscript{23}, which would result in energy consumption closer to 730 kWh per year. Approximately 7.8 million clothes dryers were shipped for sale in 2017, according to appliance Design, and on average, units remain in service for 11 years. ENERGY STAR unit shipment data from 2017 shows that approximately 3.1 million clothes dryers shipped that year were ENERGY STAR qualified, yielding an average market penetration of about 40 percent.

According to data collected by CEE in November 2018, approximately 319 models from 17 brands met the CEE specification at that date. Qualified models are broken out by CEE tier in the table below.

\begin{table}
\caption{Clothes Dryer Energy Star Qualification by Tier}
\begin{tabular}{|c|c|}
\hline
Tier & Number of Models \\
\hline
Tier 1 & 120 \\
Tier 2 & 130 \\
Tier 3 & 69 \\
\hline
\end{tabular}
\end{table}

\textsuperscript{19} https://www.census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html#?s_areas=a00000&s_year=n2017&s_tableName=Table3&s_byGroup1=a1&s_byGroup2=a1&s_filterGroup1=t1&s_filterGroup2=g1&s_show=S


\textsuperscript{22} http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CM&sector=aaa&juris=ca&rn=46&page=1

\textsuperscript{23} https://www.energystar.gov/products/appliances/clothes_dryers
Table 6. **Estimated Number of Models Meeting the CEE Tiers (as of November, 2018)**

<table>
<thead>
<tr>
<th>Product Category</th>
<th>CEE Tier 1</th>
<th>CEE Tier 2</th>
<th>CEE Advanced Tier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard, Vented or Ventless</td>
<td>212</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Compact, 120V, Vented or Ventless</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Compact, 240V, Ventless</td>
<td>17</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Compact, 240V, Vented</td>
<td>0</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>Gas Units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard or Compact, Vented or Ventless</td>
<td>87</td>
<td>N/A</td>
<td>0</td>
</tr>
</tbody>
</table>

8.2.2 Potential Energy Savings

There is an opportunity to achieve energy savings from residential clothes dryers. Clothes dryers qualifying for the most efficient CEE tier could save as much as 309 kWh per unit annually over the 2014 federal standard baseline. Maximum potential gas savings over the baseline are estimated at 7 therms per year. Estimated energy savings by CEE tier are provided in the tables 7 through 11 below. These values are based on the DOE Appendix D2 test procedure, which assumes 8.45 pounds per load of D2 test cloths at the normal cycle, 283 cycles per year, starting moisture content of 57 percent, and a remaining moisture content of two percent for standard units. Three pounds per load is assumed for compact models.

Table 7. **Estimated Energy Use and Savings from Proposed CEE Performance Tiers for Standard, Electric Clothes Dryers**

<table>
<thead>
<tr>
<th>Efficiency Level</th>
<th>Combined Energy Factor (lb/kWh)</th>
<th>Energy Use (kWh/yr)</th>
<th>Energy Savings (kWh/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY STAR Performance Baseline</td>
<td>3.11</td>
<td>769</td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1 / ENERGY STAR</td>
<td>3.93</td>
<td>608</td>
<td>160</td>
</tr>
<tr>
<td>CEE Tier 2 / ENERGY STAR Most Efficient</td>
<td>4.30</td>
<td>556</td>
<td>213</td>
</tr>
<tr>
<td>CEE Advanced Tier</td>
<td>5.20</td>
<td>460</td>
<td>309</td>
</tr>
</tbody>
</table>

Table 8. **Estimated Energy Use and Savings from Proposed CEE Performance Tiers for Compact, 120 V Electric Clothes Dryers**

<table>
<thead>
<tr>
<th>Efficiency Level</th>
<th>Combined Energy Factor (lb/kWh)</th>
<th>Energy Use (kWh/yr)</th>
<th>Energy Savings (kWh/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY STAR Performance Baseline</td>
<td>3.61</td>
<td>235</td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1 / ENERGY STAR</td>
<td>3.80</td>
<td>223</td>
<td>12</td>
</tr>
<tr>
<td>CEE Tier 2 / ENERGY STAR Most Efficient</td>
<td>4.30</td>
<td>197</td>
<td>38</td>
</tr>
<tr>
<td>CEE Advanced Tier</td>
<td>5.20</td>
<td>163</td>
<td>72</td>
</tr>
</tbody>
</table>
Table 9. **Estimated Energy Use and Savings from Proposed CEE Performance Tiers for Compact, 240 V Ventless Electric Clothes Dryers**

<table>
<thead>
<tr>
<th>Efficiency Level</th>
<th>Combined Energy Factor (lb/kWh)</th>
<th>Energy Use (kWh/yr)</th>
<th>Energy Savings (kWh/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY STAR Performance Baseline</td>
<td>2.55</td>
<td>333</td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1 / ENERGY STAR</td>
<td>2.68</td>
<td>317</td>
<td>16</td>
</tr>
<tr>
<td>CEE Tier 2 / ENERGY STAR Most Efficient</td>
<td>3.70</td>
<td>229</td>
<td>103</td>
</tr>
<tr>
<td>CEE Advanced Tier</td>
<td>5.20</td>
<td>163</td>
<td>170</td>
</tr>
</tbody>
</table>

Table 10. **Estimated Energy Use and Savings from Proposed CEE Performance Tiers for Compact, 240 V Vented Electric Clothes Dryers**

<table>
<thead>
<tr>
<th>Efficiency Level</th>
<th>Combined Energy Factor (lb/kWh)</th>
<th>Energy Use (kWh/yr)</th>
<th>Energy Savings (kWh/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY STAR Performance Baseline</td>
<td>3.27</td>
<td>260</td>
<td></td>
</tr>
<tr>
<td>CEE Tier 1 / ENERGY STAR</td>
<td>3.45</td>
<td>246</td>
<td>14</td>
</tr>
<tr>
<td>CEE Tier 2 / ENERGY STAR Most Efficient</td>
<td>3.70</td>
<td>229</td>
<td>30</td>
</tr>
</tbody>
</table>

Table 11. **Estimated Energy Use and Savings from Proposed CEE Performance Tiers for Gas Clothes Dryers**

<table>
<thead>
<tr>
<th>Efficiency Level</th>
<th>Combined Energy Factor (lb/kWh)</th>
<th>Energy Use (therms)</th>
<th>Energy Savings (therms/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY STAR Performance Baseline</td>
<td>2.84</td>
<td>29</td>
<td>5</td>
</tr>
<tr>
<td>CEE Tier 1 / ENERGY STAR</td>
<td>3.48</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>CEE Advanced Tier</td>
<td>3.80</td>
<td>21</td>
<td>7</td>
</tr>
</tbody>
</table>

Based on field testing completed by members of the CEE Appliance Committee, it is likely that clothes dryer load fabrics are heavier and more complex than uniform test cloths and that dryer loads have much greater variation in weight, cycle settings, and starting moisture content than is provided for by the DOE Appendix D2 test procedure. Given this, the energy consumption of a clothes dryer in a home will likely be greater than what is reported through DOE testing. Since CEE relies on DOE energy performance data, the calculated energy savings associated with more efficient machines likely underestimate the energy savings that individual consumers will experience. CEE supports energy efficiency program administrators in their efforts to fully capture energy savings associated with efficient clothes dryers by finding and using data and assumptions that more accurately reflect real-world conditions.

**8.2.3 Efficiency Parameters**

The current metric for clothes dryer efficiency is a combined energy factor (CEF). It is calculated by dividing the test load size by the sum of the machine electric energy use during standby and operational cycles. The test load size is assumed to be 8.45 lbs for standard dryers and 3 lbs for compact dryers.
8.2.4 Efficiency Specification

The CEE clothes dryer specification, effective January 2, 2019, is summarized below. The CEF values are based on the DOE 10 CFR Appendix D2 to Subpart B of Part 430, Uniform Test Method for Clothes Dryers. For full details of the CEE specification, see the CEE website at library.cee1.org/content/cee-clothes-dryer-specification-january-2-2019/.

Table 12. CEE Clothes Dryer Specification Summary

<table>
<thead>
<tr>
<th>Product Category</th>
<th>CEE Tier 1 (CEF)</th>
<th>CEE Tier 2 (CEF)</th>
<th>CEE Advanced Tier (CEF)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electric Units</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard, Vented or Ventless</td>
<td>≥ 3.93</td>
<td>≥ 4.30</td>
<td>≥ 5.20</td>
</tr>
<tr>
<td>Compact, 120V, Vented or Ventless</td>
<td>≥ 3.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compact, 240V, Ventless</td>
<td>≥ 2.68</td>
<td>≥ 3.70</td>
<td></td>
</tr>
<tr>
<td>Compact, 240V, Vented</td>
<td></td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Gas Units</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard or Compact, Vented or Ventless</td>
<td>≥ 3.48</td>
<td>N/A</td>
<td>≥ 3.80</td>
</tr>
</tbody>
</table>

8.2.5 Connected Specification

In addition to efficiency criteria, CEE has developed requirements for clothes dryers with connected functionality, as these products can help manage load and reduce demand on the grid. CEE requirements are consistent with the DR functionality specified by EPA as part of the ENERGY STAR specification for clothes dryers. CEE has imposed additional criteria by requiring a direct, open standards translation within the physical premise of the home for clothes dryers with connected functionality. These requirements are intended to identify models that are enabled to support grid objectives, including load reduction and load delay, while supporting the possibility for consumers to further save energy and money through greater knowledge and participation in grid services.

For the full requirements, please see Appendix B.

CEE is also exploring the development of a cloud-to-cloud specification that would serve utility objectives similar to those of the current connected requirements; such a specification would be added to the Initiative as part of a future revision.

8.2.6 Qualifying Product List

CEE maintains a residential clothes dryer qualifying products list to enable initiative participants to identify and promote residential clothes dryers that qualify for CEE tiers and to increase these clothes dryers’ uptake in the market. This list is updated on a monthly basis, typically on or about the 15th of each month, although the timing of its release may vary slightly throughout the year. The list contains models that meet the
CEE specification, sorted by CEE tier. The list can be found on the CEE website at https://library.cee1.org/content/residential-clothes-dryers-qualifying-product-list/.

8.3 Dishwashers

8.3.1 Market Information

According to the 2011 United States Census Bureau American Housing Survey, approximately 85.8 million households in the United States use a dishwasher, representing 65 percent of all homes.\textsuperscript{24} Data from the Natural Resources Canada 2011 Survey of Household Energy Use indicates a slightly higher penetration rate of dishwashers in Canada, at 68 percent.\textsuperscript{25} According to the 2010 report Energy Consumption of Major Household Appliances Shipped in Canada, the average annual unit energy consumption for non-ENERGY STAR dishwashers was 313 kWh per year, while the average annual unit energy consumption for ENERGY STAR dishwashers was 309 kWh per year.\textsuperscript{26} On average dishwashers consume 28 kWh per household annually and their use represents 2 percent of total residential electricity use across America, according to June 2016 EIA data.\textsuperscript{27} In 2013, Appliance Magazine estimated the average lifetime of a dishwasher at 12 years.\textsuperscript{28} As reported by appliance Design in 2016, approximately 6.36 million dishwashers were shipped for sale in the United States.\textsuperscript{29} ENERGY STAR shipment data from 2015 shows that approximately 6.1 million dishwashers shipped that year were ENERGY STAR qualified, yielding an average market penetration of about 84 percent.\textsuperscript{30} 2009 EIA data also indicates that 51 percent of homes have gas water heaters and 41 percent have electric.\textsuperscript{31}


\textsuperscript{26} Natural Resources Canada, Energy Consumption of Major Household Appliances Shipped in Canada: Trends for 1990-2010, 2012, pg 8.

\textsuperscript{27} U.S. Energy Information Administration, “Frequently Asked Questions,: How is electricity used in U.S. homes?” last updated June 16, 2016: http://www.eia.gov/tools/faqs/faq.cfm?id=96&t=3


\textsuperscript{29} appliance Design January 2017, 5.


\textsuperscript{31} “2009 RECS Survey Data,” US Energy Information Administration, eia.gov/consumption/residential/data/2009/.
**Standard Dishwashers** A standard dishwasher accommodates eight or more place settings. The number of models and brands that meet CEE Tier 1 and ENERGY STAR are provided in the table below.

<table>
<thead>
<tr>
<th>Tier</th>
<th>Maximum kWh/year</th>
<th>Gallons per Cycle</th>
<th>Number of Models</th>
<th>Number of Brands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>270</td>
<td>3.5</td>
<td>535</td>
<td>36</td>
</tr>
</tbody>
</table>

**Compact Dishwashers** A compact dishwasher accommodates fewer than eight place settings. The market for compact dishwashers is small relative to standard dishwashers. According to DOE, it is 13 percent.\(^{32}\) In its analyses, CEE has used a conservative estimate for the compact dishwasher market of 0.5 percent of the total dishwasher market.

In January 2017 there were 15 compact dishwashers on the market in the United States and Canada that met CEE Tier 1, as shown in the table below.

<table>
<thead>
<tr>
<th>Tier</th>
<th>Maximum kWh/year</th>
<th>Gallons per Cycle</th>
<th>Number of Models</th>
<th>Number of Brands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>203</td>
<td>3.1</td>
<td>15</td>
<td>4</td>
</tr>
</tbody>
</table>

### 8.3.2 Potential Energy Savings

**Standard Dishwashers** Potential savings are calculated based comparison with the current federal standard level of 307 kWh/year and 5.0 gallons/cycle. Since the majority of existing dishwashers were purchased before 2013, our savings estimates are likely conservative. Programs may choose to use different baseline levels when calculating savings given the market information available in their local service territory.

The savings also take into consideration the fuel type of the water heater. The first table calculates the savings from electric water heaters, while the second table calculates the energy savings based on the use of a gas water heater. The aggregate savings are based on market size estimates mentioned in the Market Information section above.

<table>
<thead>
<tr>
<th>Tier</th>
<th>Maximum kWh/year</th>
<th>Savings Per Unit (kWh/ year)</th>
<th>Aggregate* Savings (MWh/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>270</td>
<td>37</td>
<td>96,639</td>
</tr>
</tbody>
</table>

---

### Savings from Standard Dishwashers Used With Gas Water Heaters

<table>
<thead>
<tr>
<th>Tier</th>
<th>Maximum kWh/year</th>
<th>Per Unit (kWh/ year)</th>
<th>Per Unit (therms/year)</th>
<th>Aggregate* (MWh/ year)</th>
<th>Aggregate* (Mtherms/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>270</td>
<td>9</td>
<td>0.94</td>
<td>30,817</td>
<td>3,073</td>
</tr>
</tbody>
</table>

### Market Information, above.

### Dishwasher Potential Savings

<table>
<thead>
<tr>
<th>Tier</th>
<th>Maximum kWh/year</th>
<th>Per Unit (kWh/y)</th>
<th>Aggregate (MWh/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>203</td>
<td>19</td>
<td>6,036</td>
</tr>
</tbody>
</table>

### 8.3.3 Potential Water Savings

#### Standard Dishwashers

In 2009, CEE added a water requirement to its dishwasher specification to enhance savings and create additional opportunities for CEE members to work cooperatively with water efficiency programs. The potential water savings are calculated from the baseline of the current federal standard level of 5.0 gallons/cycle. Again, programs may choose to use different baseline levels when calculating savings given the market information available in their local service territory. Potential savings for the one CEE dishwasher tier, Tier 1 are shown in the table below. The estimates of gallons saved per year were calculated assuming 215 cycles per year.

### Standard Dishwasher Potential Water Savings

<table>
<thead>
<tr>
<th>Tier</th>
<th>Water Efficiency (gallons/cycle)</th>
<th>Gallons Per Cycle Saved Over Federal Standard</th>
<th>Gallons Saved Per Year</th>
<th>Aggregate Gallons Saved Per Year (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>3.5</td>
<td>1.5</td>
<td>645</td>
<td>4.1</td>
</tr>
</tbody>
</table>

#### Compact Dishwashers

Potential water savings in the table below are calculated from comparison against the 2013 compact dishwasher federal standard of 3.5 gallons/cycle. The gallons saved per year estimates were calculated using 215 cycles per year.

### Compact Dishwasher Potential Water Savings

<table>
<thead>
<tr>
<th>Tier</th>
<th>Water Efficiency (gallons/cycle)</th>
<th>Gallons Per Cycle Saved Over Federal Standard</th>
<th>Gallons Saved Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>3.1</td>
<td>0.4</td>
<td>86</td>
</tr>
</tbody>
</table>
8.3.4 Efficiency Parameters

CEE accounts for standby power use and uses a maximum annual kWh requirement to qualify models for the CEE dishwasher specification. CEE removed the energy factor metric from the specification in 2016, as it was no longer relevant.

8.3.5 Efficiency Specification

The CEE dishwasher specification, effective January 29, 2016, is summarized below. For full CEE specification details, see the CEE website at library.cee1.org/content/residential-dishwasher-specifications.

**Figure 11. Summary of CEE Dishwasher Specification**

<table>
<thead>
<tr>
<th>Efficiency Level</th>
<th>Maximum Annual kWh</th>
<th>Maximum Gallons Per Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Dishwashers (8 or more place settings)</td>
<td>270</td>
<td>3.5</td>
</tr>
<tr>
<td>Compact Dishwashers (fewer than 8 place settings)</td>
<td>203</td>
<td>3.1</td>
</tr>
</tbody>
</table>

8.3.6 Qualifying Products List

CEE updates its residential dishwasher qualifying product list on a monthly basis, typically around the 15th of each month, although the exact date varies. The list contains models that qualify for the CEE specification, sorted by CEE tier. Manufacturers must submit the necessary data for each product, including annual kWh per year and gallons per cycle, to CEE in order for the product to be listed. The list can be found on the CEE website at library.cee1.org/content/qualifying-product-lists-residential-dishwashers.

8.4 Refrigerators

8.4.1 Market Information

According to the 2011 United States Census Bureau American Housing Survey, approximately, 128.7 million United States households, representing 97 percent of all households, have a refrigerator. Similarly, 99.7 percent of households in Canada have a refrigerator. The average annual power consumption for a refrigerator in 2016 was 106 kWh per unit, according to EIA data, and refrigerators represent an estimated eight

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34 “Survey of household spending (SHS), dwelling characteristics and household equipment as of December 31, three territories and selected metropolitan areas (CANSIM Table 203-0031),” Statistics Canada, 2012, statcan.gc.ca/cansim/pick-choisir?lang=eng&p2=33&id=2030031.
percent of total residential electricity use across the United States.\textsuperscript{35} According to the 2010 report \textit{Energy Consumption of Major Household Appliances Shipped in Canada}, the average annual unit energy consumption for non-ENERGY STAR refrigerators was 432 kWh per year, while the average annual unit energy consumption for ENERGY STAR refrigerators was 420 kWh per year.\textsuperscript{36}

\textit{Appliance Magazine} estimates the average life-span of a standard refrigerator to be 13 years and projected that in 2014, about 9.3 million replacements will occur, followed by 9.7 million replacements in 2015.\textsuperscript{37} The US saturation for standard refrigerators has held steady since 2003 at 99 percent.\textsuperscript{38} According to 2011 Statistics Canada data, 50 percent of main refrigerators in Canadian households are ENERGY STAR models.\textsuperscript{39} 59 percent of the refrigerators shipped in Canada in 2010 were ENERGY STAR qualified.\textsuperscript{40}

\textit{appliance Design} reports that in 2016, approximately 9.01 million room refrigerators were shipped for sale in the United States\textsuperscript{41}. ENERGY STAR shipment data from 2015 shows that approximately 4.7 million refrigerators shipped that year were ENERGY STAR qualified, yielding an average market penetration of about 46 percent.\textsuperscript{42} The market penetration of ENERGY STAR refrigerators declined from 76 percent after September 15, 2014, when a new federal minimum efficiency standard and revised ENERGY STAR Residential Refrigerator Criteria (Version 5.0) became effective. A snapshot of model availability as of January 2017 for standard and compact refrigerators at the current CEE tiers is shown in the tables below. Standard refrigerators are defined as having capacities larger than or equal to 7.75 \text{ft}^3 and compact refrigerators as having capacities smaller than 7.75 \text{ft}^3.

\begin{tabular}{|c|c|}
\hline
\end{tabular}

\textsuperscript{40} Natural Resources Canada, \textit{Energy Consumption of Major Household Appliances Shipped in Canada: Trends for 1990-2010, 2012}, pg 8.
<table>
<thead>
<tr>
<th>Tier</th>
<th>Standard Sized Refrigerators Qualifying for ENERGY STAR Version 5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Improvement Over Federal Minimum Efficiency Standard</td>
</tr>
<tr>
<td>Tier 1</td>
<td>10</td>
</tr>
<tr>
<td>Tier 2</td>
<td>15</td>
</tr>
<tr>
<td>Tier 3</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tier</th>
<th>Compact Refrigerators Qualifying for ENERGY STAR Version 5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Improvement Over Federal Minimum Efficiency Standard</td>
</tr>
<tr>
<td>Tier 1</td>
<td>10</td>
</tr>
<tr>
<td>Tier 2</td>
<td>15</td>
</tr>
<tr>
<td>Tier 3</td>
<td>20</td>
</tr>
</tbody>
</table>

### 8.4.2 Potential Savings

The table below shows the expected average annual energy savings for standard sized refrigerator units at the different CEE tiers.

<table>
<thead>
<tr>
<th>Tier</th>
<th>Energy Savings Over Federal Minimum (Standard Size Refrigerators)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Improvement Over Federal Minimum Efficiency Standard</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
</tr>
</tbody>
</table>

### 8.4.3 Efficiency Parameters

The federal standard for refrigerators is determined by an equation that accounts for interior volume and configuration. Each category of refrigerator has a unique equation that determines the applicable standard, expressed in kWh per year. Due in part to the complexity of the standard, CEE elected to simplify its specification by identifying a set of performance increments above the federal standard, expressed as a percentage, for its tiers. More information on the federal standard for refrigerators is available from the Office of Energy Efficiency and Renewable Energy website at [https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=37&action=viewlive](https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=37&action=viewlive).

### 8.4.4 Efficiency Specification

The CEE refrigerator specification, effective September 15, 2014, is summarized below. The ENERGY STAR level for refrigerators and refrigerator-freezers is 10 percent above the federal standard, and is consistent with CEE Tier 1. For full CEE specification...
details, see the CEE website at library.cee1.org/content/cee-refrigerator-specification-september-15-2014/.

Figure 15. **CEE Refrigeration Specification Summary**

<table>
<thead>
<tr>
<th>Efficiency Level</th>
<th>Percent Improvement Over the Measured* Federal Minimum Efficiency Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY STAR</td>
<td>10</td>
</tr>
<tr>
<td>Tier 1</td>
<td>10</td>
</tr>
<tr>
<td>Tier 2</td>
<td>15</td>
</tr>
<tr>
<td>Tier 3</td>
<td>20</td>
</tr>
</tbody>
</table>

*Measured Minimum Efficiency Standard is defined as the measured energy consumption of the refrigerator according to the DOE test method, prior to the application of any adder (84 kWh/y) for automatic icemakers. For refrigerators with automatic icemakers, the percentage improvement is calculated by dividing the difference in annual energy use by the minimum efficiency standard, less the 84 kWh/y adder.

8.4.5 Qualifying Products List

CEE updates its residential refrigerator qualifying products list on a monthly basis, typically around the 15th of each month, although the exact date varies. The list contains models that qualify for the CEE specification, sorted by CEE tier. Manufacturers must submit the requested data for a given product, including adjusted volume, annual kWh per year, federal standard, and qualifying CEE tier, to CEE for that product to be listed. The list can be found on the CEE website at library.cee1.org/content/qualifying-product-lists-residential-refrigerators.

8.5 Room Air Conditioners

8.5.1 Market Information

While not every home has air conditioning and central air conditioning has grown in popularity, room air conditioners still represent a considerable market in the United States and Canada. Based on 2013 data from Statistics Canada, 55 percent of Canadian households reported having an air conditioner and one third of these households had either room or portable air conditioners, representing approximately 18 percent of Canadian homes.\(^{43}\) This is slightly lower than the United States, where, according to 2013 *Appliance Magazine* data, 29 percent of households had room air conditioners.\(^{44}\) *Appliance Design* reports that in 2016, approximately 6.7 million room air conditioners


were shipped for sale in the United States.\textsuperscript{45} According to the 2009 Residential Energy Consumption Survey (RECS) fielded by the Energy Information Administration (EIA), a total of 25.9 million households in the United States had room air conditioners.\textsuperscript{46}

Based on an ENERGY STAR data package as part of the draft 1 version 4 room AC specification revision process, EPA estimated that room air conditioners use approximately 611 kWh per unit annually.\textsuperscript{47} Given this estimate, room air conditioners likely account for 15.8 TWh consumed per year in the US, representing a considerable savings opportunity and potential for contributing to reductions in peak demand. The potential savings is increased when considering the opportunity over the lifetime of the product. \textit{Appliance Magazine} estimates the average life-span of a room air conditioner to be nine years.\textsuperscript{48}

With recent changes to the DOE and ENERGY STAR standards, there is an additional opportunity to move the market to the most efficient models available. According to ENERGY STAR data, a total of 3,424 ENERGY STAR-qualified room air conditioners were shipped in 2015, which EPA estimates to be 56 percent of total shipments.\textsuperscript{49} The ENERGY STAR criteria changed in October 2015, and the number of room air conditioners able to meet the ENERGY STAR criteria as of November 2016 is provided below.

\textbf{Figure 16. Number of Models and Brands on the ENERGY STAR Product Finder}

<table>
<thead>
<tr>
<th>DOE Capacity (Btu/h)</th>
<th>Combined Energy Efficiency Ratio</th>
<th>Number ENERGY STAR of Models</th>
<th>Number ENERGY STAR of Brands</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 6,000</td>
<td>12.1</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>6,000–7,999</td>
<td>12.1</td>
<td>36</td>
<td>30</td>
</tr>
<tr>
<td>8,000–13,999</td>
<td>12</td>
<td>124</td>
<td>34</td>
</tr>
<tr>
<td>14,000–19,999</td>
<td>11.8</td>
<td>46</td>
<td>22</td>
</tr>
<tr>
<td>20,000–27,999</td>
<td>10.3</td>
<td>28</td>
<td>23</td>
</tr>
<tr>
<td>&gt; 28,000</td>
<td>9.9</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>


\textsuperscript{46} 2009 RECS Survey Data,” US Energy Information Administration, eia.gov/consumption/residential/data/2009/.

\textsuperscript{47} “ENERGY STAR Draft 1 Version 4.0 Room Air Conditioners Data Package,” US Environmental Protection Agency, October 28, 2014.


8.5.2 Scope

The scope of the CEE specification for room air conditioners is limited to window units without reverse cycle. Units with reverse cycle provide the ability to heat as well as cool. Based on 2008 DOE market share data, window units without reverse cycle represent approximately 90 percent of room air conditioner units shipped in the US.

8.5.3 Potential Savings

The table below shows the average annual energy use of and savings from room air conditioners over the appropriate federal standard at the different CEE tiers.

The energy savings values use a DOE representative capacity for each of the six DOE product classes and assume operation of 750 hours per year. The energy savings vary significantly dependent on the capacity of the units. The CEE Tier 1 energy savings range from 31 to 212 kWh/year, while CEE Advanced Tier energy savings range from 44 to 304 kWh/year.

**Figure 17. Room Air Conditioner Energy Use and Savings for CEE Tiers**

<table>
<thead>
<tr>
<th>DOE Representative Capacity (Btu/h)</th>
<th>2014 Federal Standard (kWh/y)</th>
<th>CEE Tier 1 Energy Use (kWh/y)</th>
<th>CEE Tier 1 Energy Savings (kWh/y)</th>
<th>CEE Advanced Tier Energy Use (kWh/y)</th>
<th>CEE Advanced Tier Energy Savings (kWh/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000</td>
<td>341</td>
<td>310</td>
<td>31</td>
<td>396</td>
<td>44</td>
</tr>
<tr>
<td>6000</td>
<td>409</td>
<td>372</td>
<td>37</td>
<td>356</td>
<td>53</td>
</tr>
<tr>
<td>10000</td>
<td>688</td>
<td>626</td>
<td>63</td>
<td>598</td>
<td>90</td>
</tr>
<tr>
<td>18000</td>
<td>1262</td>
<td>1147</td>
<td>115</td>
<td>1097</td>
<td>165</td>
</tr>
<tr>
<td>24000</td>
<td>1915</td>
<td>1741</td>
<td>174</td>
<td>1665</td>
<td>250</td>
</tr>
<tr>
<td>28000</td>
<td>2333</td>
<td>2121</td>
<td>212</td>
<td>2029</td>
<td>304</td>
</tr>
</tbody>
</table>

8.5.4 Efficiency Parameters

CEE uses Combined Energy Efficiency Ratio (CEER) to qualify models for the CEE room air conditioner specification. CEER is obtained by dividing the measured cooling capacity of the unit (BTU per hour) by the measured average annual electrical energy input (watts) and measured annual standby/off-mode power consumption (watts). CEER is expressed in BTUs per watthour.

8.5.5 Efficiency Specification

The CEE room air conditioner efficiency specification, effective January 31, 2017, is provided below. The federal standard and ENERGY STAR level are included as a point of reference but are not requirements on the CEE specification.
### Figure 18. CEE Room Air Conditioner Specification

<table>
<thead>
<tr>
<th>DOE Product Class</th>
<th>DOE Capacity (Btu/h)</th>
<th>2014 Federal Standard (CEER)</th>
<th>ENERGY STAR/CEE Tier 1 (CEER)</th>
<th>CEE Advanced Tier (CEER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &amp; 2</td>
<td>&lt; 8,000</td>
<td>11</td>
<td>12.1</td>
<td>12.7</td>
</tr>
<tr>
<td>3</td>
<td>8,000–13,999</td>
<td>10.9</td>
<td>12.0</td>
<td>12.5</td>
</tr>
<tr>
<td>4</td>
<td>14,000–19,999</td>
<td>10.7</td>
<td>11.8</td>
<td>12.3</td>
</tr>
<tr>
<td>5A</td>
<td>20,000–27,999</td>
<td>9.4</td>
<td>10.3</td>
<td>10.8</td>
</tr>
<tr>
<td>5B</td>
<td>&gt;28,000</td>
<td>9</td>
<td>9.9</td>
<td>10.4</td>
</tr>
</tbody>
</table>

### 8.5.6 Connected Specification

In addition to efficiency criteria, CEE has developed requirements for room air conditioners with connected functionality, as these products can help manage load and reduce demand on the grid. CEE requirements are consistent with the demand response (DR) functionality specified by EPA as part of the ENERGY STAR specification for room air conditioners. CEE has imposed additional requirements by requiring a direct, open standards translation within the physical premise of the home for room air conditioners with connected functionality. These requirements are intended to identify models that are enabled to support grid objectives including spinning reserve and load delay, while supporting the possibility for consumers to further save energy and money through greater knowledge and participation in grid services.

For the full requirements, please see Appendix C.

### 8.5.7 Qualifying Products List

CEE refers to the ENERGY STAR product finder to identify room air conditioners that qualify for the CEE specification. This list is available at [https://www.energystar.gov/productfinder/product/certified-room-air-conditioners/results](https://www.energystar.gov/productfinder/product/certified-room-air-conditioners/results). CEE anticipates maintain a qualifying product list once products are available that meet either CEE connected criteria or the CEE Advanced Tier.
9 Initiative Participation

To be considered an Initiative participant, an energy or water efficiency program must:

1. Support the ENERGY STAR appliances program

AND

2. a. Provide incentives, such as rebates, for appliances meeting at least the Tier 1 efficiency levels described in the Appliance Product Information and Specifications section of this Initiative Description

OR

b. Deploy a significant and focused educational and promotional program that identifies and promotes super efficient appliances meeting at least the Tier 1 efficiency levels described in the Appliance Product Information and Specifications section of this Initiative Description

OR

c. Implement both of the above (a. and b.)

In addition, CEE encourages participants to report specific program details for the CEE annual Appliance Program Summary, which communicates these details to key market players.

9.1 Participant Benefits

Participation in the Initiative provides a number of benefits to efficiency programs, including:

**Participate with other efficiency programs in the CEE forum** CEE provides a forum for efficiency programs to come together, discuss, and come to consensus on a number of issues, including efficiency specifications and comments to ENERGY STAR and other groups.

**Save program resources** An efficiency program that uses the CEE efficiency specification saves labor resources that would otherwise be required for product and program research and planning.

**Encourage manufacturers to produce and market super efficient appliances** If large numbers of programs use CEE efficiency specifications, they provide more encouragement to manufacturers to produce and market super efficient appliances than one program could alone. Though one program may represent a small fraction of the national market, that same program together with other participating programs represents a much larger percentage of the national market.
**Set a clear target for design** Program administrators offering programs with consistent efficiency specifications provide manufacturers with a uniform target, making it easier for them to respond to program and consumer needs.

**Produce positive publicity** CEE undertakes ongoing communication efforts on behalf of the Initiative and its participants and regularly updates the list of participating programs. Efficiency programs receive positive publicity for voluntarily helping customers reduce energy consumption, thus cutting air pollution and greenhouse gas emissions without sacrificing appliance performance and amenities important to the consumer.

### 9.2 Initiative Impact

CEE attempts to measure the impact of the Initiative on the appliance market by looking at a variety of factors. Sources of this data may include: AHAM, *appliance Design* magazine, CEE members, manufacturers, distributors, and retailers. Elements of CEE evaluation and data tracking may include the following:

- Number of CEE members participating in the Initiative
- Number of customers in the United States and Canada served by CEE members participating in the Initiative
- Number of manufacturers or manufacturer brands who have models on the ENERGY STAR and CEE qualifying product lists
- Number of products that meet ENERGY STAR and CEE performance specifications
- Annual product shipments and estimated market share of ENERGY STAR appliances
- Number of revisions to ENERGY STAR and CEE specifications
- Changes in average energy consumption of SEHA appliances over time
- Improvements to minimum efficiency standards for SEHA appliances
Appendix A  Connected Requirements for Residential Clothes Washers

A. Connected Clothes Washer System
To claim compliance with the CEE Connected Specification requirements, a Connected Clothes Washer System shall include the appliance plus all hardware and software elements required to enable communication in response to consumer-authorized energy related commands, not including third-party remote management that may be made available solely at the discretion of the manufacturer. These elements may reside inside or outside of the appliance.

This capability shall be supported through at least two means, as identified in section B.2. The specific design and implementation of the Connected Clothes Washer System is at the manufacturer’s discretion, provided it is interoperable with other devices via open communications protocols and enables economical consumer-authorized third-party access to the functionalities provided for in sections D, F and G.

CEE requires that a product enables economical and direct, on-premises, open standards interconnection. Manufacturers may also choose to provide additional means to connect, including proprietary architecture and protocols.

The product must continue to comply with the applicable product safety standards—the addition of the functionality described below shall not override existing safety protections and functions.

B. Communications
Open Standards—Communication with entities outside the Connected Clothes Washer System that enables connected functionality (sections D, F and G) must use, for all communication layers, at least one of the standards:
- Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards
- Included in the NIST Smart Grid framework Tables 4.1 and 4.2
- Adopted by the American National Standards Institute (ANSI) or another well-established international standards organization such as the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), International Telecommunication Union (ITU), Institute of Electrical and Electronics Engineers (IEEE) or Internet Engineering Task Force (IETF)

Communications Hardware Architecture—Communication with entities outside the Connected Clothes Washer System that enables connected functionality described in sections D through G shall be enabled by either option a, or the combination of option b with options c or d, according to the manufacturer’s preference:
a) Open standards communication port on the appliance combined with open standards communications module
b) Open standards communication within the physical premises of the home
c) Built-in communication technology employing a manufacturer maintained cloud connection
d) Manufacturer-specific external communication module(s) or device(s)

C. Open Access
To enable interconnection with the product, in addition to section B1 that requires open standards, an interface specification, application programming interface (API) or similar documentation shall be made available to interested parties that at a minimum allows transmission, reception, and interpretation of the following information:
- Energy consumption reporting specified in section D that must include accuracy, units, and measurement interval
- Operational status, user settings, and messages specified in section F if transmitted via a communication link
- Demand response specified in section G

D. Energy Consumption Reporting
In order to enable simple, actionable energy use feedback to consumers and consumer authorized energy use reporting to third parties, the product shall be capable of transmitting energy consumption data via a communication link to energy management systems and other consumer authorized devices, services, or applications. These data shall represent the product’s interval energy consumption. It is recommended that data are reported in watt-hours for intervals of 15 minutes or less, however, representative data may also be reported in alternate units and intervals as specified in the product manufacturer’s interface specification or API detailed in section C.

The product may provide additional types of energy use feedback, such as energy use feedback on the product itself, or energy use associated with the previous cycle. Product feedback, if provided, may be in units and format chosen by the manufacturer, for example, $/month.

E. Remote Management
The product shall be capable of receiving and responding to consumer authorized remote requests, not including third-party remote management which may be made available solely at the discretion of the manufacturer, via a communication link, similar to consumer controllable functions on the product. The product is not required to respond to remote requests that would compromise essential performance or product safety as determined by the product manufacturer.

F. Operational Status, User Settings, and Messages
The product shall be capable of providing the following information to energy management systems and other consumer authorized devices, services, or applications via a communication link:
- Operational and demand response status, for example, off or standby, cycle in process, delay appliance load, temporary appliance load reduction.

The product shall be capable of providing the following information on the product to energy management systems and other consumer authorized devices, services, or applications via a communication link:
G. Demand Response
The product shall have the capability to receive, interpret, and act upon consumer-authorized signals by automatically adjusting its operation depending on both signal contents and settings from consumers. At a minimum, the product shall be capable of providing the following for all cycle and setting combinations:

1. Delay Appliance Load Capability: The capability of the product to respond to a signal in accordance with consumer settings, except as permitted below, by delaying the start of an operating cycle beyond the delay period.
   a. Default settings—The product shall ship with default settings that enable a response for at least four hours.
   b. Consumer override—The consumer shall be able to override the product’s Delay Appliance Load response at any time after the requesting signal has been received. If the consumer elects to override, the product is not required to respond to subsequent demand response signals requesting a response in the current operational cycle. However, responses in subsequent operational cycles shall not be automatically overridden.
   c. The product shall be able to provide at least one Delay Appliance Load response per consumer initiated operating cycle.

2. Temporary Appliance Load Reduction Capability: The capability of the product to respond to a signal by providing load reduction for a short time period, typically 10 minutes. Upon receipt of signal and in accordance with consumer settings, except as permitted below, the product shall restrict its average power draw during the load reduction period to no more than 50 watts.
   a. Default settings—The product shall ship with default settings that enable a response period of at least 10 minutes.
   b. The product is not required to provide a response if the consumer selected wash cycle, as indicated in the product user documentation or on the product itself, is explicitly designed or primarily intended for:
      o Sanitization, such as those in cycles compliance with NSF Protocol P172 “Sanitization Performance of Residential and Commercial, Family-Sized Clothes Washers,” or
      o Allergen reduction, such as those cycles in compliance with NSF Protocol P351 “Allergen Reduction Performance of Residential and Commercial, Family-Sized Clothes Washers,” or
      o Laundering of handwash wool articles, such as those cycles in compliance with Woolmark Blue (formerly Gold) or Woolmark Green (formerly Platinum)
   c. Consumer override—The consumer shall be able to override the product’s Temporary Appliance Load Reduction response at any time after the requesting signal has been received. If the consumer elects to override, the product is not required to respond to subsequent DR signals requesting a response in the current operational cycle.
d. The product shall be able to provide at least one Temporary Appliance Load Reduction response per consumer initiated operating cycle.

H. Information to Consumers
   If additional modules, devices, services, or infrastructure are part of the configuration required to activate the product’s communications capabilities, prominent labels or other forms of consumer notifications with instructions shall be displayed at the point of purchase and in the product literature. These shall provide specific information on what consumers must do to activate these capabilities, for example, “This product has Wi-Fi capability and requires Internet connectivity and a wireless router to enable interconnection with an Energy Management System or with other external devices, systems, or applications.”
Appendix B Connected Requirements for Residential Clothes Dryers

I. Connected Clothes Dryer System

To claim compliance with the CEE Connected Specification requirements, a Connected Clothes Dryer System shall include the appliance plus all hardware and software elements required to enable communication in response to consumer-authorized energy-related commands, not including third-party remote management that may be made available solely at the discretion of the manufacturer. These elements may reside inside or outside of the appliance.

This capability shall be supported through at least two means, as identified in section B.2. The specific design and implementation of the Connected Clothes Dryer System is at the manufacturer’s discretion, provided it is interoperable with other devices via open communications protocols and enables economical consumer-authorized third-party access to the functionalities provided for in sections D, F and G.

For a product to claim compliance with the CEE Connected Specification requirements, CEE requires that it enable economical and direct, on-premises, open standards interconnection. Manufacturers may also choose to provide additional means to connect, including proprietary architecture and protocols.

The product must continue to comply with the applicable product safety standards—the addition of the functionality described below shall not override existing safety protections and functions. The appliance must meet the manufacturer’s internal minimum performance guidelines, such as those for drying performance.

J. Communications

1. Open Standards—Communication with entities outside the Connected Clothes Dryer System that enables connected functionality (sections D, F and G) must use, for all communication layers, at least one of the standards:
   - Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards
   - Included in the NIST Smart Grid framework Tables 4.1 and 4.2
   - Adopted by the American National Standards Institute (ANSI) or another well-established international standards organization such as the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), International Telecommunication Union (ITU), Institute of Electrical and Electronics Engineers (IEEE), or Internet Engineering Task Force (IETF)

2. Communications Hardware Architecture—Communication with entities outside the Connected Clothes Dryer System that enables connected functionality described in sections D through G shall be enabled by either option a) or the combination of option b) with options c) or d), according to the manufacturer’s preference:
   e) Open standards communication port on the appliance combined with open standards communications module
f) Open standards communication within the physical premises of the home


g) Built-in communication technology employing a manufacturer-maintained cloud connection


h) Manufacturer-specific external communication module(s) or device(s)

K. Open Access
To enable interconnection with the product, in addition to the open standards required in section B1, an interface specification, application programming interface (API), or similar documentation shall be made available to interested parties. At a minimum, it shall allow transmission, reception, and interpretation of the following information:

- Energy consumption reporting that must include accuracy, units, and measurement interval, as specified in section D
- Operational status, user settings, and messages as specified in section F, if transmitted via a communication link
- Demand response as specified in section G

L. Energy Consumption Reporting
In order to enable simple, actionable energy use feedback to consumers and consumer-authorized energy use reporting to third parties, the product shall be capable of transmitting energy consumption data via a communication link to energy management systems and other consumer-authorized devices, services, or applications. These data shall represent the product’s interval energy consumption. It is recommended that data are reported in watt-hours for intervals of 15 minutes or less; however, representative data may also be reported in alternate units and intervals as specified in the product manufacturer’s interface specification (API), as detailed in section C.

The product may provide additional types of energy use feedback, such as energy use feedback on the product itself or energy use associated with the previous cycle. Product feedback, if provided, may be in units and format chosen by the manufacturer, such as $/month.

M. Remote Management
The product shall be capable of receiving and responding to consumer-authorized remote requests, not including third-party remote management, which may be made available solely at the discretion of the manufacturer via a communication link, similar to consumer-controllable functions on the product. The product is not required to respond to remote requests that would compromise essential performance or product safety as determined by the product manufacturer.

N. Operational Status, User Settings, and Messages
The product shall be capable of providing the following information to energy management systems and other consumer-authorized devices, services, or applications via a communication link:
• Operational and demand response status, such as off or standby, cycle in process, delay appliance load, or temporary appliance load reduction

The product shall be capable of providing the following information on the product to energy management systems and other consumer-authorized devices, services, or applications via a communication link:

• At least two types of messages relevant to the energy consumption of the product; for example, messages for clothes dryers might address a performance issue such as a clogged lint filter or report energy consumption that is outside the product’s normal range

O. Demand Response
The product shall have the capability to receive, interpret, and act upon consumer-authorized signals by automatically adjusting its operation depending on both signal content and settings from consumers. At a minimum, the product shall be capable of providing the following for all cycle and setting combinations:

1. Delay Appliance Load Capability: The capability of the product to respond to a signal in accordance with consumer settings, except as permitted below, by delaying the start of an operating cycle beyond the delay period.
   a) Default settings—The product shall ship with default settings that enable a response for at least three hours.
   b) Consumer override—The consumer shall be able to override the product’s Delay Appliance Load response before or during a delay period.
   c) The product shall be able to provide at least one Delay Appliance Load response per consumer-initiated operating cycle, but is not required to provide more than three Delay Appliance Load responses in a rolling 24-hour period.

2. Temporary Appliance Load Reduction Capability: The capability of the product to respond to a signal by providing load reduction for a short time period, typically 10 minutes. Upon receipt of signal and in accordance with consumer settings, except as permitted below, the product shall restrict its average power draw during the load reduction period to no more than 20 percent relative to the baseline average power draw defined in the ENERGY STAR Clothes Dryer Test Method to Validate Demand Response.
   a) Default settings—The product shall ship with default settings that enable a response period of at least 10 minutes.
   b) Consumer override—The consumer shall be able to override the product’s Temporary Appliance Load Reduction response before or during a load reduction period.
   c) The product shall be able to provide at least one Temporary Appliance Load Reduction response per consumer-initiated operating cycle.

P. Information to Consumers
If additional modules, devices, services, or infrastructure are part of the configuration required to activate the product’s communications capabilities, prominent labels or other forms of consumer notifications with instructions shall be displayed at the point of
purchase and in the product literature. These shall provide specific information on what consumers must do to activate these capabilities, for example “This product has Wi-Fi capability and requires Internet connectivity and a wireless router to enable interconnection with an Energy Management System or with other external devices, systems, or applications.”
Appendix C Connected Requirements for Room Air Conditioners

Q. Connected Room Air Conditioner System

To claim compliance with the CEE Connected Specification requirements, a Connected Room AC (RAC) System shall include the appliance plus all hardware and software elements required to enable communication in response to consumer-authorized energy related commands, not including third-party remote management, which may be made available solely at the discretion of the manufacturer. These elements may reside inside or outside of the appliance.

This capability shall be supported through at least two means as identified in section B.2. The specific design and implementation of the Connected RAC System is at the manufacturer’s discretion, provided it is interoperable with other devices via open communications protocol and enables economical consumer-authorized third-party access to the functionalities provided for in sections D, F, and G.

CEE requires that a product enables economical and direct, on-premise interconnection based on open standards. Manufacturers may also choose to provide additional means to connect, including proprietary architecture and protocols. CEE highly recommends that a product also connect through wireless Internet protocol.

The product must continue to comply with the applicable product safety standards—the addition of the functionality described below shall not override existing safety protections and functions.

R. Communications

1. Open Standards—Communication with entities outside the Connected RAC System that enables connected functionality (sections D, F, and G) must use, for all communication layers, standards:
   - Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards, and/or
   - Included in the NIST Smart Grid framework Tables 4.1 and 4.2, and/or
   - Adopted by the American National Standards Institute (ANSI) or another well-established international standards organization such as the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), International Telecommunication Union (ITU), Institute of Electrical and Electronics Engineers (IEEE) or Internet Engineering Task Force (IETF)

2. Communications Hardware Architecture—Communication with entities outside the Connected RAC System that enables connected functionality (sections D through G) shall be enabled by either option A, or the combination of option B with options C or D, according to the manufacturer’s preference:
a. Open standards communication port on the appliance combined with open standards communications module
b. Open standards communication within the physical premises of the home
c. Built-in communication technology employing a manufacturer maintained cloud connection
d. Manufacturer-specific external communication module(s) and/or device(s)

S. Open Access

To enable interconnection with the product, in addition to section B1 that requires open standards, an interface specification, application programming interface (API) or similar documentation shall be made available to interested parties that at a minimum allows transmission, reception, and interpretation of the following information:

- Energy consumption reporting specified in section D that must include accuracy, units, and measurement interval
- Operational status, user settings, and messages specified in section F if transmitted via a communication link
- Demand response specified in section G

T. Energy Consumption Reporting

In order to enable simple, actionable energy use feedback to consumers and consumer authorized energy use reporting to third parties, the product shall be capable of transmitting energy consumption data via a communication link to energy management systems and other consumer authorized devices, services, or applications. These data shall represent the product’s interval energy consumption. It is recommended that data are reported in watt-hours for intervals of 15 minutes or less. However, representative data may also be reported in alternate units and intervals as specified in the product manufacturer’s interface specification or API detailed in section C. The product may also provide energy use feedback to the consumer on the product itself. On product feedback, if provided, may be in units and format chosen by the manufacturer, for example, $/month.

U. Remote Management

The product shall be capable of receiving and responding to consumer authorized remote requests, not including third-party remote management which may be made available solely at the discretion of the manufacturer, via a communication link, similar to consumer controllable functions on the product. The product is not required to respond to remote requests that would compromise essential performance, or product safety as determined by the product manufacturer.
V. Operational Status, User Settings and Messages

3. The product shall be capable of providing the following information to energy management systems and other consumer authorized devices, services or applications via a communication link:

   Operational / Demand Response status, for example, off or standby, energy saver mode, low cool, max cool, delay appliance load, temporary appliance load reduction.

4. The product shall be capable of providing the following information on the product to energy management systems and other consumer authorized devices, services, or applications via a communication link:

   • At least two types of messages relevant to the energy consumption of the product. For example, messages for room air conditioners might address a performance issue, such as a clogged filter, or reporting energy consumption that is outside the product’s normal range.

W. Demand Response

The product shall have the capability to receive, interpret and act upon consumer-authorized signals by automatically adjusting its operation depending on both the signal’s contents and settings from consumers. At a minimum, the product shall be capable of providing the following for all cycle and setting combinations:

1. Delay Appliance Load Capability: The capability of the product to respond to a signal in accordance with consumer settings, except as permitted below; by increasing the set temperature by at least 4°F for at least four hours.
   a. Maximum Set Temperature—The increased set temperature shall not exceed 85°F, unless authorized by the customer.
   b. Consumer override—The consumer shall be able to override the product’s Delay Appliance Load response without limitation.
   c. The product shall be able to provide at least one Delay Appliance Load response in a rolling 24-hour period.

2. Temporary Appliance Load Reduction Capability: The capability of the product to respond to a signal in accordance with consumer settings, except as permitted below; by disabling compressor operation for at least 10 minutes.
   a. Maximum Set Temperature—The product shall not respond if the set temperature is ≥ 85°F.
   b. Consumer override—The consumer shall be able to override the product’s Temporary Appliance Load Reduction response without limitation.
   c. The product shall be able to provide at least three Temporary Appliance Load Reduction responses in a rolling 24-hour period. The product is not required to
provide more than one Temporary Appliance Load Reduction response per 60-minute period.

X. Information to Consumers

If additional modules, devices, services, or infrastructure are part of the configuration required to activate the product’s communications capabilities, prominent labels or other forms of consumer notifications with instructions shall be displayed at the point of purchase and in the product literature. These shall provide specific information on what consumers must do to activate these capabilities, for example, “This product has Wi-Fi capability and requires Internet connectivity and a wireless router to enable interconnection with an Energy Management System or with other external devices, systems, or applications.”