ENERGY STAR®
Most Efficient 2017 Update and 2018 Criteria

August 17, 2017

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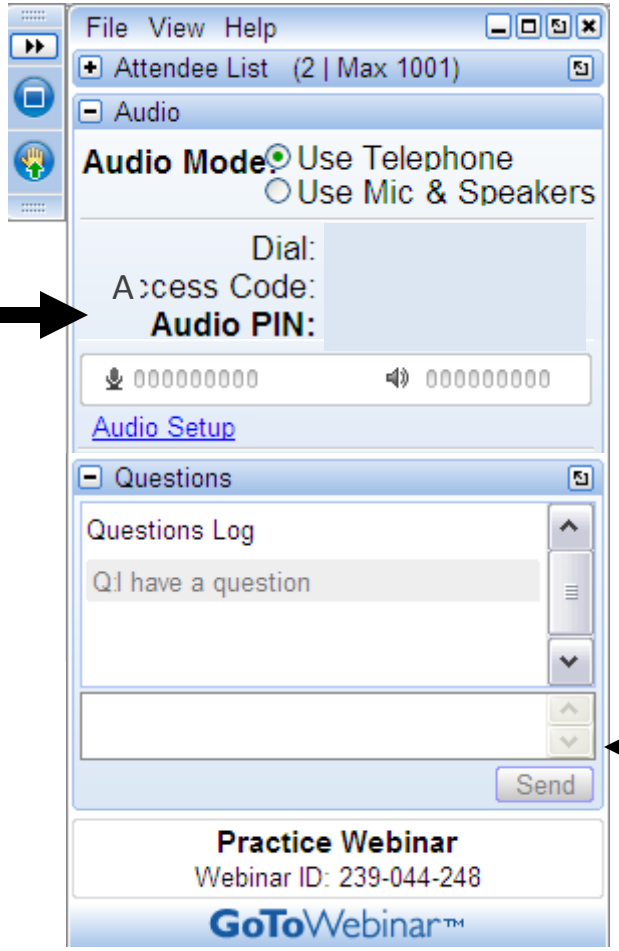

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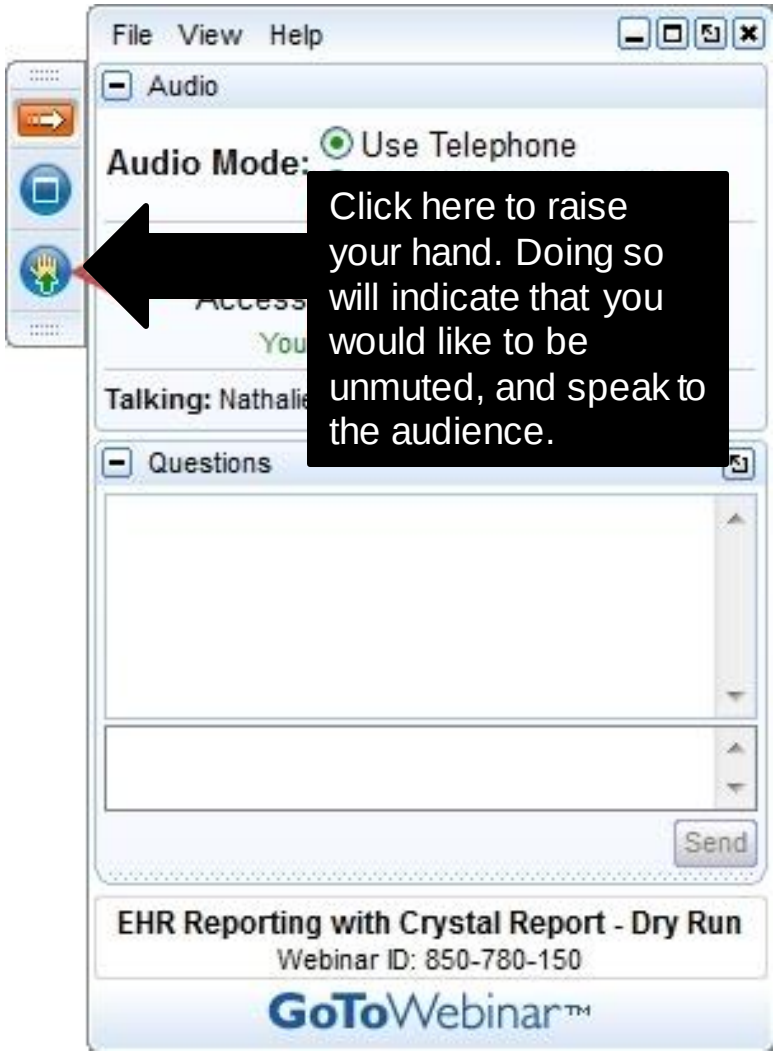


ENERGY STAR® Most Efficient

- An extension of the **trusted** ENERGY STAR brand
- Recognizing the **most efficient** products among those that qualify for ENERGY STAR in a given year
- Target audience: environmentally conscious, early adopters
- Represents **the "best of the best"** in energy efficient products
- Each year, we review our criteria and raise the bar as needed to ensure Most Efficient is awarded to only the top performers

ENERGY STAR® Most Efficient 2017 Update as of July

Product Category	Models	ENERGY STAR Partners
Boilers	371	28
Ceiling Fans	76	10
Central Air Conditioners and Air Source Heat Pumps	136	6
Clothes Dryers	5	2
Clothes Washers	98	7
Computer Monitors	121	20
Dishwashers	47	4
Furnaces	71	7
Geothermal Heat Pumps	230	9
Refrigerators-Freezers	321	27
Ventilating Fans	165	10
Windows	408	39
Total	2049	138

ENERGY STAR® Most Efficient 2017 Update: Growing Utility Collaboration

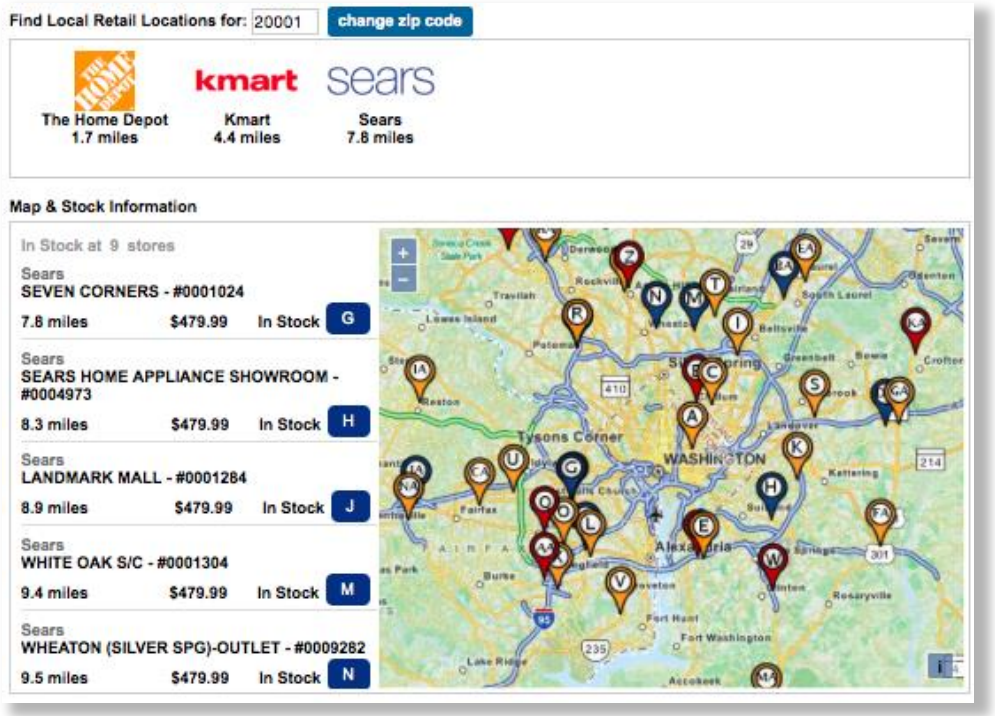
- Utility efficiency program sponsors: 30
  - Partners serve approximately 23 million residential customers, or nearly 34 million consumers
  - Each features one or more product category and reflects diverse geographic spread nationally
- ENERGY STAR Retail Products Platform (ESRPP):
  - Nationally coordinated, market transformation initiative-leveraging ENERGY STAR and ENERGY STAR Most Efficient
  - In 2016, first pilot year, 3 retailers and 8 energy efficiency program sponsors representing 11 states and 18% of U.S. participated
  - By end of 2017, expanded group of participating sponsors and retailers, expected to broaden coverage to approx.1/3 of U.S. market

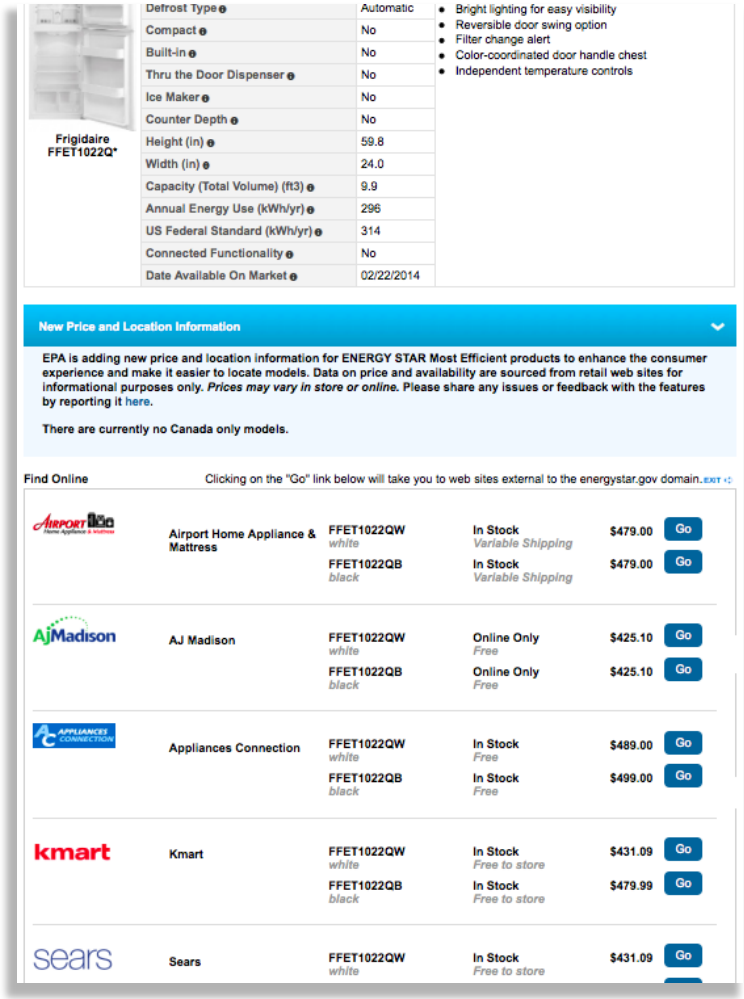
ENERGY STAR® Most Efficient 2017 Web Updates

- ENERGY STAR Most Efficient website:
  - Includes real-time information on retail pricing and where to locate and buy these models, making it easier for consumers to locate and buy
  - Now available for products sold at select major retailers: clothes washers, refrigerators, dishwashers, dryers, monitors, and ventilating fans
  - Available ceiling fans by the end of 2017

Price and Location Feature

- Designed to facilitate online research and in-store purchases consistent with what consumers have come to expect from online shopping tools





ENERGY STAR® Most Efficient Categories in 2018

- Boilers
- Ceiling and Ventilating Fans
- CAC/ASHP
- Clothes Washers
- Computer Monitors
- **NEW: Dehumidifiers**
- Dishwashers
- Dryers
- Furnaces
- Geothermal Heat Pumps
- Refrigerators- Freezers
- Windows

Draft 2018 ENERGY STAR® Most Efficient Recognition Criteria

Clothes Washers

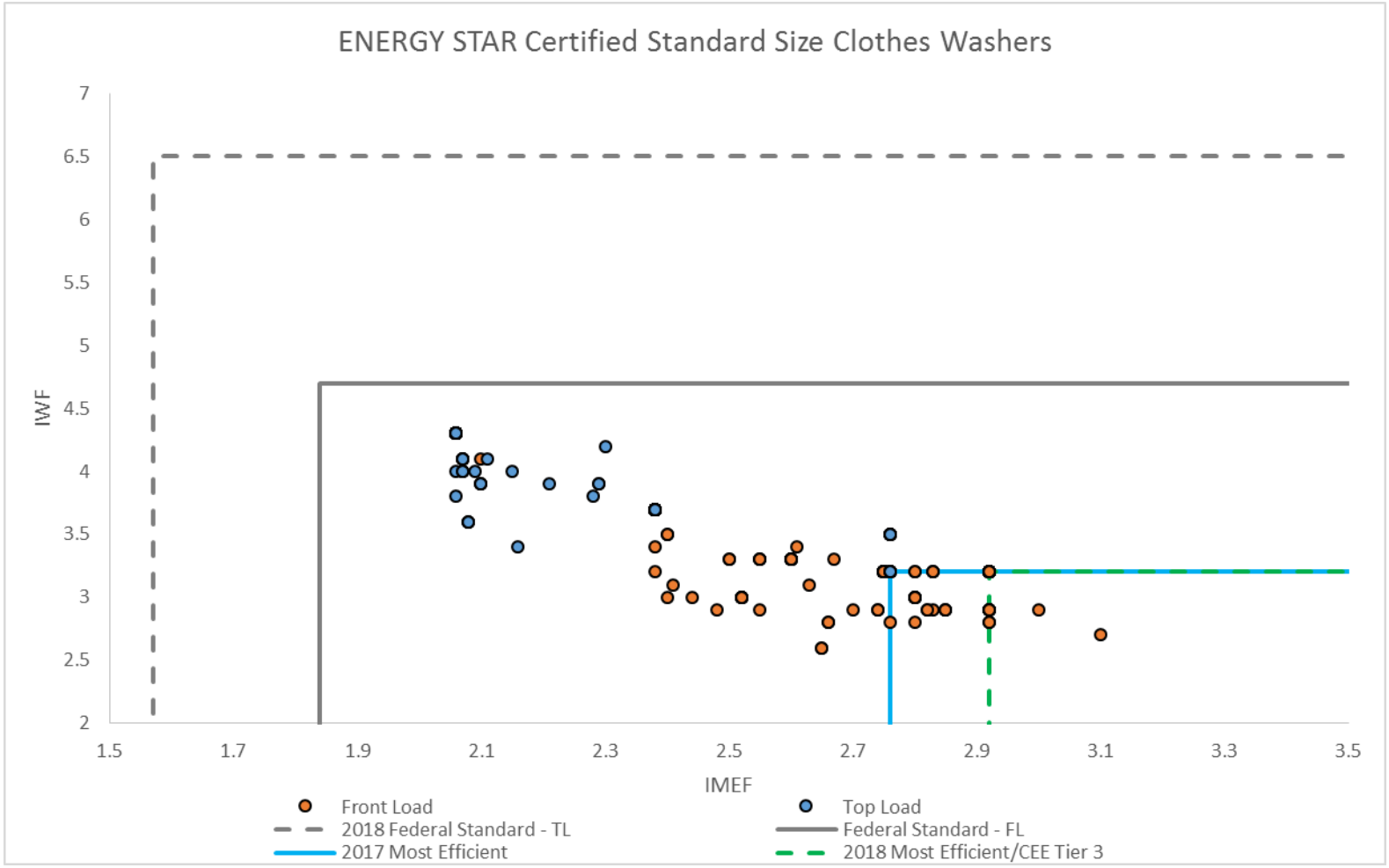
- **2018 Proposal:**

Clothes Washer Capacity	Integrated Modified Energy Factor (IMEF)	Integrated Water Factor (IWF)
≤ 2.5 cu-ft	≥ 2.2	≤ 3.8
> 2.5 cu-ft	≥ 2.92	≤ 3.2

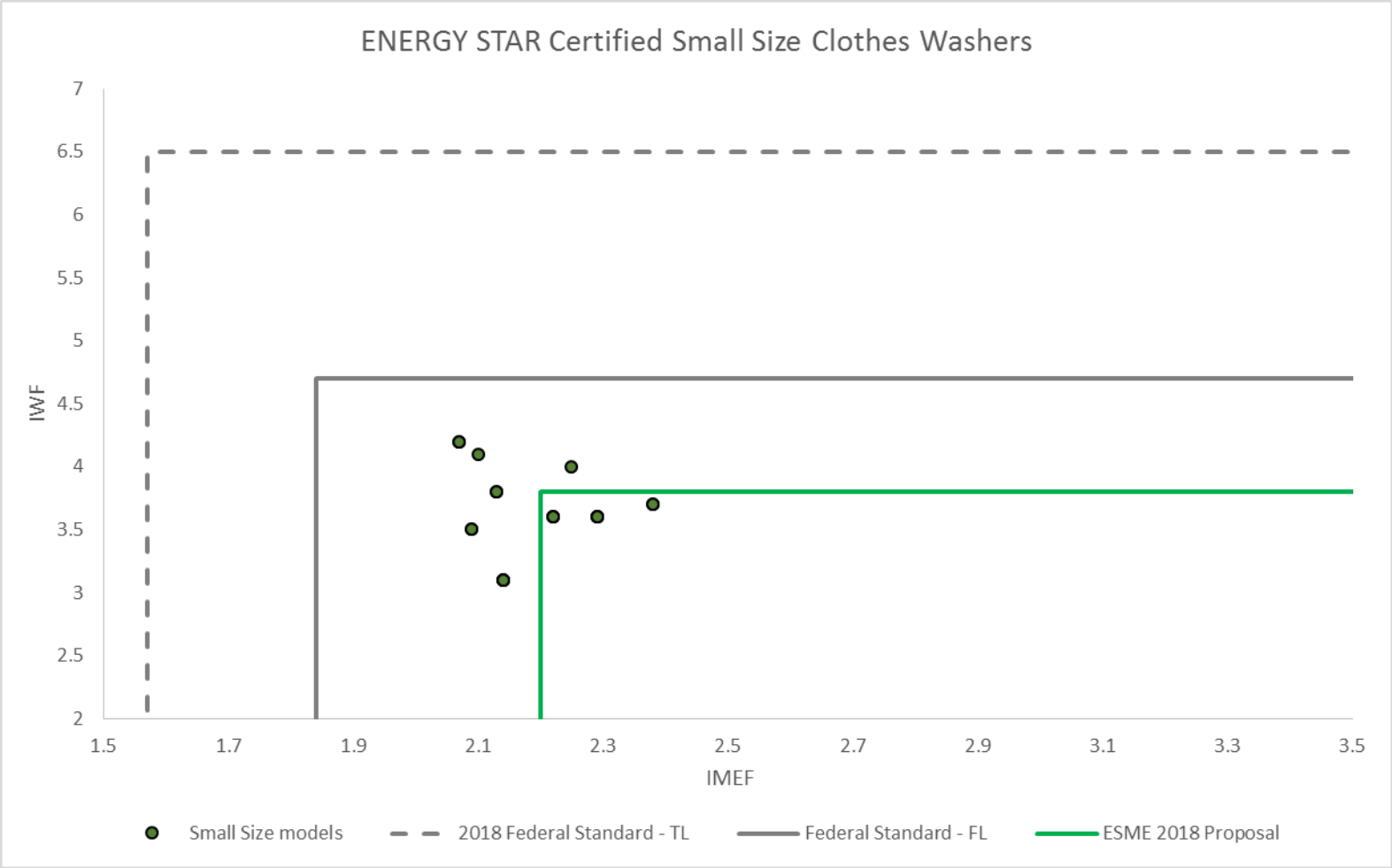
  - Includes small volume (1.6-2.5 cu-ft) washers
  - Continues to exclude compact clothes washers, combination all-in-one washer-dryers, clothes washers with heated drying functionality, commercial clothes washers, and laundry centers

- **Rationale:**
  - The ENERGY STAR V 8.0 front load criteria (effective Feb 2018) will be equivalent to the Most Efficient 2017 criteria
  - Enough differentiation in small clothes washer market to recognize high performing products
  - Recognizes about 22 front load standard base models and 4 small base models
  - Products promoted by 9 partners (standard and small size)
  - Significant average energy and water savings:
    - Standard size: 42% less energy and 44% less water than a conventional model
    - Small volume size: 23% less energy and 34% less water than a conventional model

Clothes Washers- Standard Size



Clothes Washers- Small Size



Dishwashers

- **2018 Proposal:**
  - Maintain current criteria for Standard models
    - Annual Energy Use ≤240 kWh/yr; Water Use ≤3.2 Gallons/cycle
    - Minimum per cycle Cleaning Index of 70, for heavy, medium and low cycles, as assessed under the ENERGY STAR Test Method for Determining Residential Dishwasher Cleaning Performance (Rev. Feb-2014)
      - Submit at the time of certification
      - Average cleaning index for all units in the sample
      - Not subject to verification testing

Dishwashers

- **Rationale:**
  - Product category introduced under 2015 ENERGY STAR Most Efficient
  - Currently 12 base models from 7 brands (Beko, Blomberg, Miele, Samsung, Smeg, Summit, Viking) are on our Most Efficient list – meaning they have met the energy, water and cleaning criteria
    - Represents small percentage of products on the QPL
  - There are 21 base models from 13 brands that meet the energy and water criteria
    - EPA does not have info on whether they would meet the cleaning criteria
    - EPA encourages partners to submit cleaning data
  - A dishwasher meeting the ENERGY STAR Most Efficient 2018 proposal saves 22% energy and 36% water compared to the federal minimum

Refrigerators

- **2018 Proposal:**
  - Maintain current criteria
- **Rationale:**
  - Energy savings of at least 15% relative to a model just meeting the Federal Standard
  - Currently there are 293 products from 28 ENERGY STAR Partners in a range of sizes (9-28 cu-ft) that meet the criteria
    - Of models on the market today this represents:
      - 25% of Top Mounts
      - 5% of Bottom Mounts
      - 2% of Side-by-Sides
  - Being promoted by 16 partners – Avanti, Bosch, Blomberg, Dacor, Daewoo, Danby, Electrolux, Fisher & Paykel, Frigidaire, Haier, Hanover, Insignia, LG, Liebherr, Samsung, and Summit

Clothes Dryers

- **2018 Proposal:**
  - Maintain current criteria

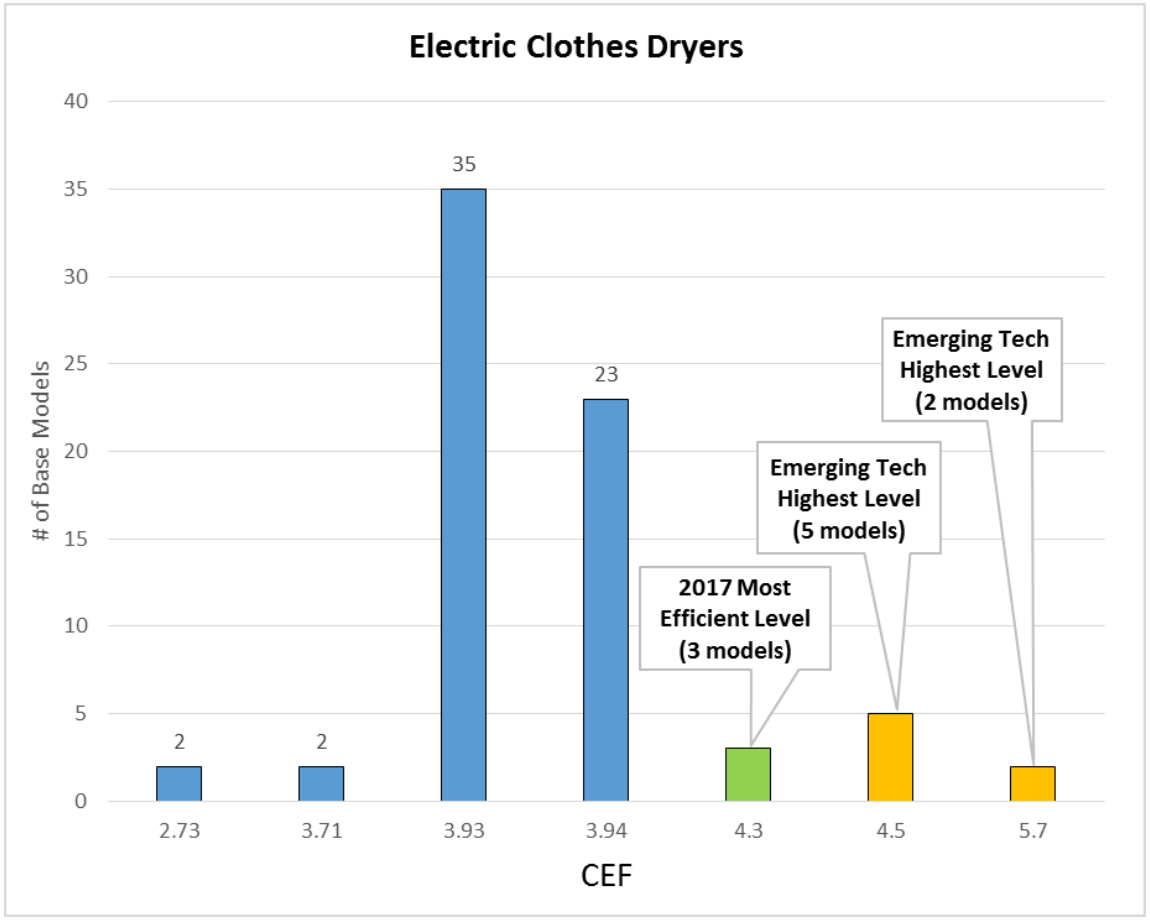
Cycle Setting	Product Type	CEF_{BASE} (lbs/kWh)
Normal	Electric	≥ 4.30
	Gas	≥ 3.80
Normal, Max Dryness	Electric	≥ 3.93
	Gas	≥ 3.48

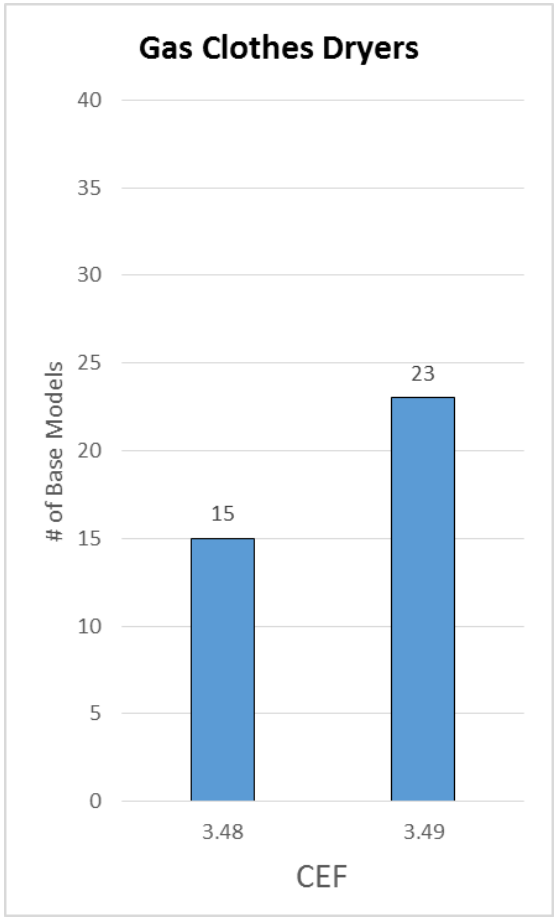
  - For the normal cycle with max dryness setting, the manufacturer shall test the dryer according to the provisions in the DOE test method, but where the dryness setting can be chosen independently of the program, it shall be set to the maximum.
  - Commercial clothes dryers and water-cooled ventless clothes dryers excluded

Clothes Dryers

- **Rationale:**
  - With the addition of the ENERGY STAR dryer category, Emerging Tech Award for dryers, and 2017 Most Efficient recognition, the number of high performing models has grown. As a new category, is not yet ripe for revision
    - There are 10 base models from 5 brands that meet the normal cycle setting criteria.
  - Efficiency levels for both the normal and most energy consuming settings, which will guard against consumers experiencing lower than expected performance
  - A clothes dryer meeting the ENERGY STAR Most Efficient 2017 proposal saves 28% energy for standard-sized electric models, 30% energy for compact models, and 25% energy for gas models compared to the federal minimum

Distribution of ENERGY STAR Clothes Dryer Efficiency





Clothes Dryer Proposal Feedback Received Thus Far:

- One stakeholder requested criteria for individual dryer product classes
  - EPA sees value in enabling more compact heat pump models to earn the Most Efficient designation. Based on available data, drafted separate level for compact ventless electric (240V) dryers, leveraging ENERGY STAR for max dry levels.

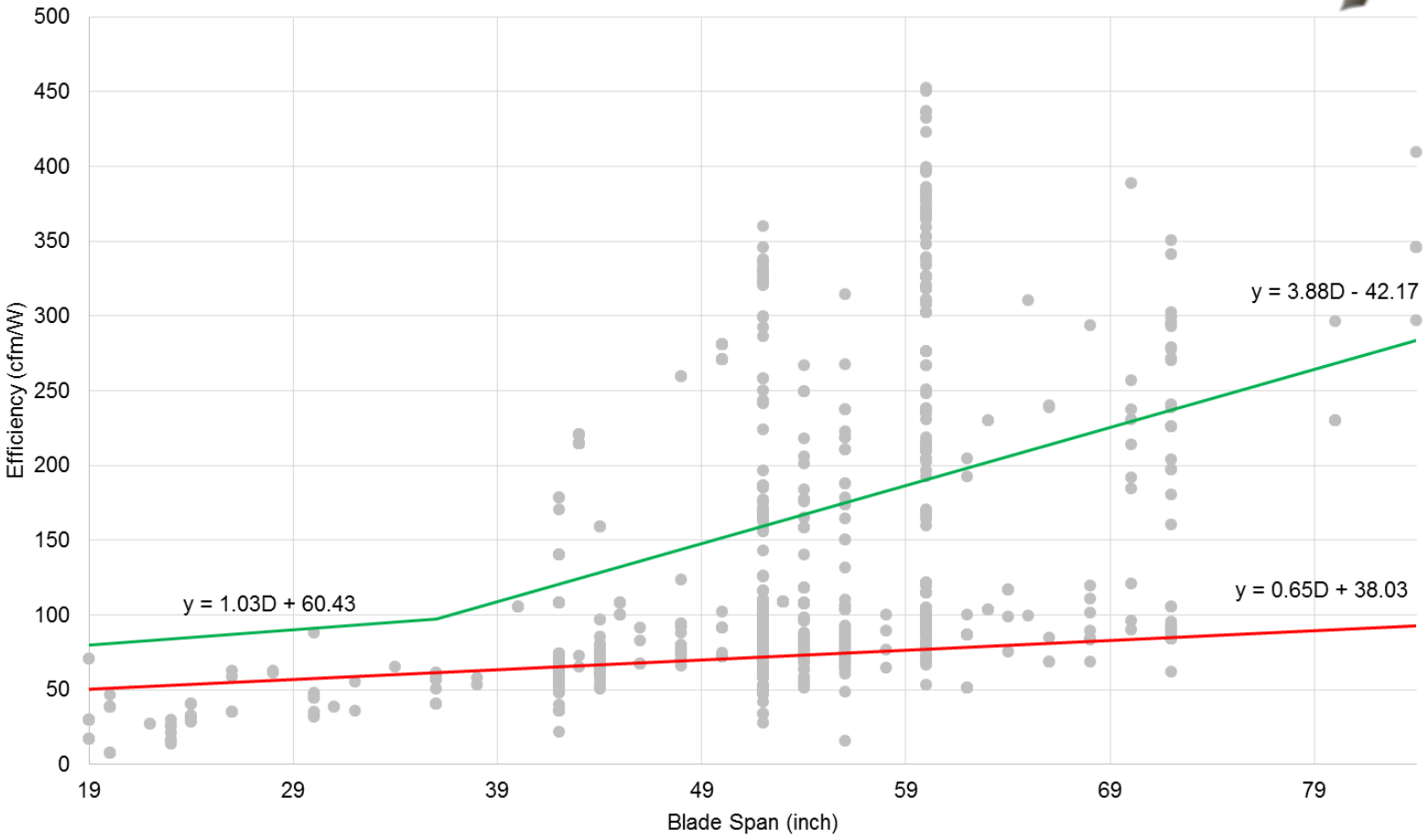
Cycle Setting	CEF_{BASE} (lbs/kWh)
Normal	≥ 3.9
Normal, Max Dry	≥ 2.68

Ceiling Fans

- **2018 Proposal:** Revise efficiency equation for small blade span fans:
  - D ≤ 36 inches: Efficiency ≥ 1.03D + 60.43
  - D > 36 inches: Efficiency ≥ 3.88D – 42.17

  OR
  - ≥ 300 cfm/W per Version 3.0
- **Rationale:**
  - The ESME 2017 equation intersected the new DOE standard level at a diameter of 25 inches
  - To remedy this for future recognitions, EPA established a line for fans less than or equal to 36 inches in diameter that is about 59% more stringent than the DOE level
  - Particularly critical given revision of the ENERGY STAR specification, which will allow in fans with smaller blade spans
  - Savings remain around 64%

Ceiling Fans



Ventilating Fans

- **2018 Proposal:** Maintain B/U room and in-line fans criteria
  - Bathroom/Utility room fans
    - Efficacy at high speed (cfm/W): ≥10
  - In-line fans
    - Efficacy at high speed (cfm/W): ≥ 5
- **Rationale**
  - Criteria for bath/utility room fans continue to represent an exclusive group of fans
  - Airflow savings:
    - 86% for B/U room fans
    - 44% for In-line fans
  - Analysis showed more high efficiency range hoods than in the past, but availability remains limited

System Status and Messaging Criteria

- **2018 Proposal:** Updated messaging language for recommending a specific action for the resident to take
  - "Units shall facilitate display, in plain text, of messages to residents, **without assuming that the resident knows much about their system**. At a minimum, these messages **shall clearly recommend a specific action for the resident to take** if the **air filter** needs to be checked, changed, or cleaned, and if the unit needs **professional service**."
  - Pertains to CAC/ASHP, GHP, Ductless, and Furnaces
- **Rationale:**
  - Updated language reinforces EPA's intention to have units recommend specific actions for the resident to take, assuming the resident has no mental picture of how their system works
  - These criteria, in addition to the applicable efficiency criteria, continue to distinguish leaders among HVAC products
- **Note:** A few currently recognized models will not meet the requirement. EPA will work with manufacturers to maintain recognition while updating.

Ductless Split Air Conditioners and Heat Pumps

- **2018 Proposal:** Maintain current performance and system status and messaging criteria (with slight adjustment); maintain variable capacity requirement
  - 20 SEER; 12.5 EER; 10 HSPF (HSPF for heat pumps only)
  - Products must be able to provide heating and cooling (as applicable) at two or more capacity levels
- **Rationale:**
  - While rated performance requirements are not exclusive, the system status and messaging criteria are:
    - 4.5% of AC models and 2.0% of HP models are recognized among those in AHRI directory within scope

Centrally Ducted Air Conditioners and Heat Pumps

- **2018 Proposal:** Maintain current performance and system status and messaging criteria (with slight adjustment); maintain variable capacity requirement
- **Rationale:**
  - Current criteria continue to recognize a select group of extremely efficient products with features facilitating quality installation and maintenance
  - Percent of products recognized among those in the AHRI directory are appropriate:
    - Centrally ducted split and packaged air conditioners and heat pumps: much less than 1%
    - Geothermal Heat Pumps: less than 3%
  - A review of the ENERGY STAR GHP specification in 2017 did not show an opportunity for revision

Centrally Ducted Air Conditioners and Heat Pumps

System Type	SEER	EER	HSPF	COP
Split AC	18	13		
Split HP	18	12.5	9.6	
Packaged AC	16	12.0		
Packaged HP	16	12.0	8.2	
Closed Loop Water-to-Air GHP		17.1		3.6
Open Loop Water-to-Air GHP		21.1		4.1
Closed Loop Water-to-Water GHP		16.1		3.1
Open Loop Water-to-Water GHP		20.1		3.5
DGX		16.0		3.6

Savings for Air Conditioners and Heat Pumps

System Type	Savings (North)	Savings (South)
Split HP	22%	22%
Split AC	28%	22%
Packaged HP	10%	10%
Packaged AC	13%	13%
Ductless HP	25%	25%
Ductless AC	35%	30%

System Type	Savings
GHP: OL water to water	36%
GHP: CL water to water	28%
GHP: OL water to air	44%
GHP: CL water to air	36%
GHP: DGX	36%

Furnaces

- **2018 Proposal:** Maintain current performance and system status and messaging criteria (with slight adjustment)
  - ≥ 97 AFUE
- **Rationale:**
  - AFUE requirement alone offers great differentiation of products and is aligned with CEE Tier 3
  - No technical difference between 97 and 98 AFUE
  - 1.4% of models recognized among those in AHRI directory

System Type	Savings
Gas	18%

HVAC Narrative Guide Updates

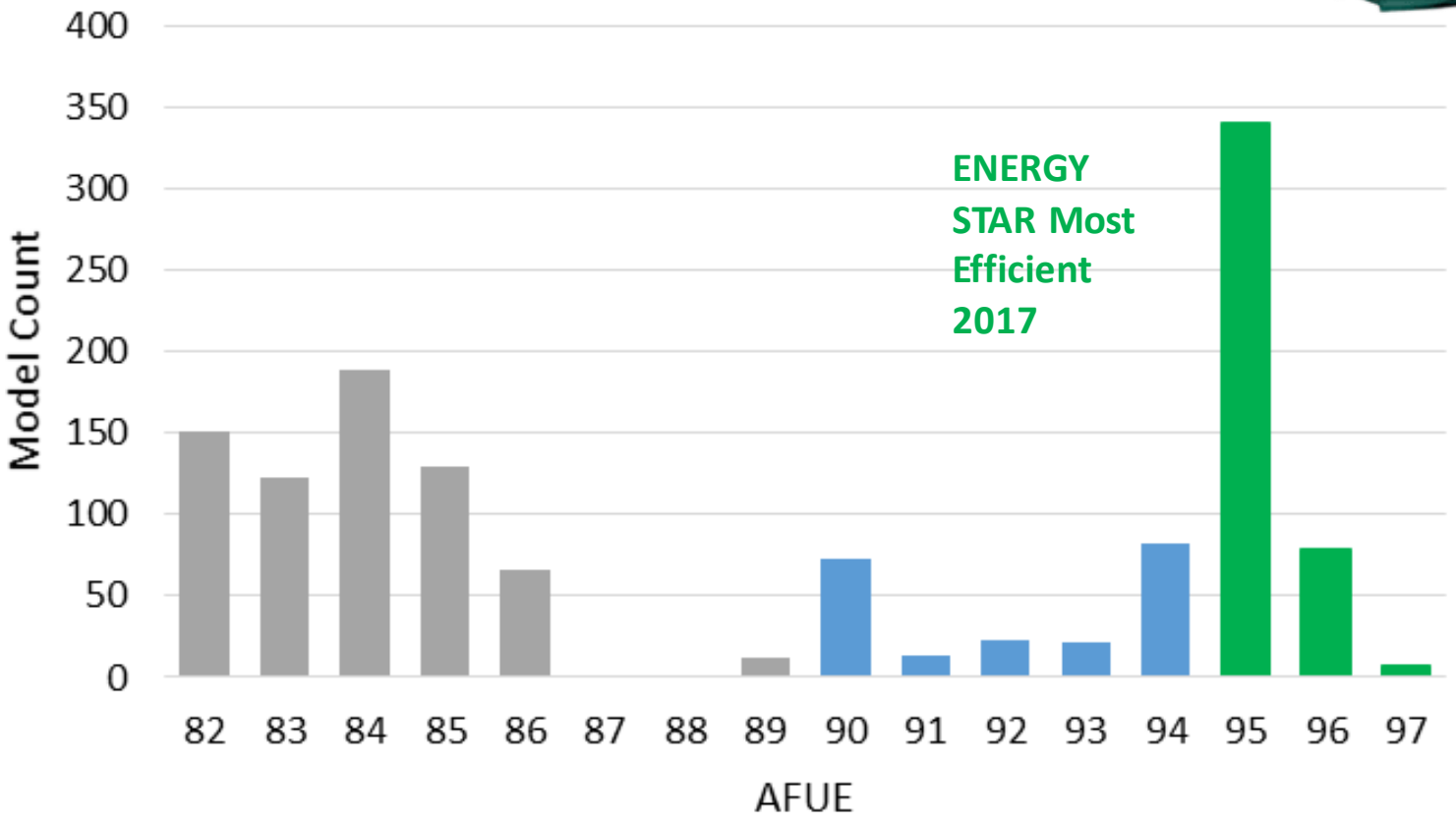
- Updated formatting to ease readability; substance unchanged
- New format aims to make more clear exactly what EPA needs to complete review
- Includes pro tip: Screenshots expected to decrease back and forth and speed up reviews

Boilers

- **2018 Proposal:** Maintain current performance criteria
  - Gas Powered Boilers: ≥ 95 AFUE
  - Oil Powered Boilers: ≥ 90 AFUE
- **Rationale:**
  - Unable to find opportunities for additional distinctions
    - No technical difference between 95 and 96 AFUE
    - No obvious opportunity to improve installation through fault detection and diagnostic program
  - EPA plans to further explore multi-staging and proper installation and sizing

System Type	Savings
Gas	14%
Oil	7%

Gas Boilers


Model Count
400
350
300
250
200
150
100
50
0
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
AFUE
ENERGY STAR Most Efficient 2017

Dehumidifiers

- **2018 Proposal:** Recognize Most Efficient Dehumidifiers (< 75 Pints/day) in 2018 with Energy Factor EF criteria
  - < 75 Pints/day → EF ≥ 2.3 L/kWh
- **Rationale:**
  - Highly efficient dehumidifiers < 75 Pints/day from three ENERGY STAR Partners
  - Significant savings available; ESRPP interest in highly efficient dehumidifiers
  - Limited number of ENERGY STAR models larger than 75 Pints/day, and sales are a small part of market

System Type	Savings
< 75 Pints/day	26%

Computer Monitors

Total Energy Consumption (E_{TEC}) in kilowatt-hours per year shall be calculated as follows:

$$E_{TEC} = 8.76 \times (0.35 \times P_{ON} + 0.65 \times P_{SLEEP})$$

Where:

P_{ON} = measured On Mode power in watts; P_{SLEEP} = measured Sleep Mode power in watts;

Total Energy Consumption (E_{TEC}) shall be less than or equal to Maximum allowable Total Energy Consumption in kilowatt-hours per year calculated as follows:

$$E_{TEC\_MAX} = 1.9 + (0.12 \times A) + [3.1 \times (r + C)]$$

Where:

A = viewable screen area in square inches;

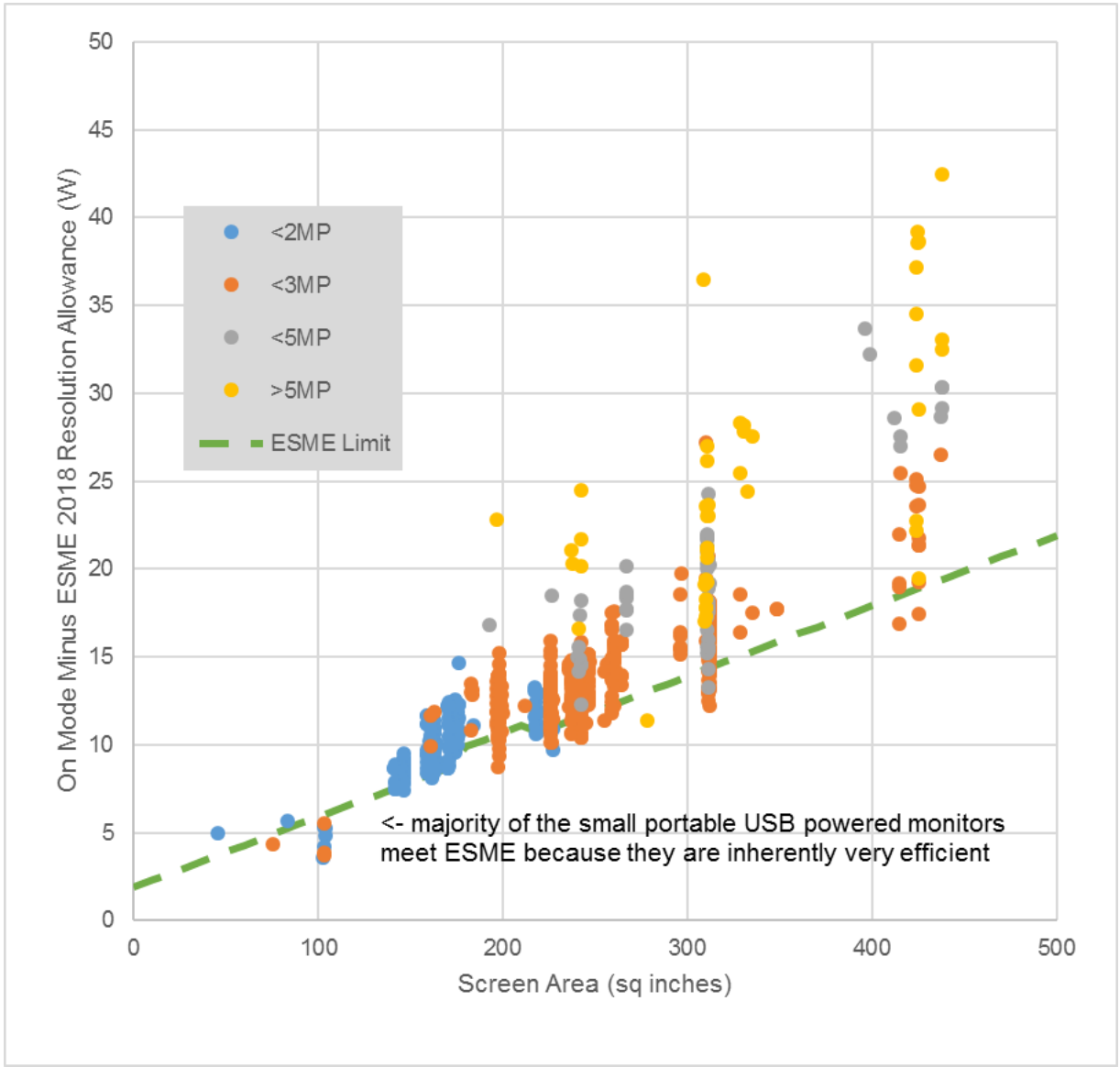
r = Total Native Resolution in megapixels up to 5.0 megapixels total. Products with >5.0 megapixels Total Native Resolution can receive a maximum r of 5 megapixels; and

C	1.9	**if A < 180 in²**
	2.7	if 180 in² ≤ A < 220 in²
	2.0	if A ≥ 220 in²

Computer Monitors

- **Rationale:**
  - ENERGY STAR Most Efficient 2017 models represent 15% of current market, opportunity to increase stringency to recognize very top efficient products
  - 2018 proposal captures to 11%, criteria revised to better capture most efficient products in larger sizes (where majority of manufacturers are investing resources in product features); 46 larger-size models meet ME 2018 vs. 87 current models meet ME2017.
  - 2018 proposal continues to propose a resolution allowance cap of 5MP, no allowances for enhanced performance, ABC, occupancy sensors, or additional sleep functions
  - Dataset updated July 2017: 678 unique computer monitors from 27 manufacturers in dataset

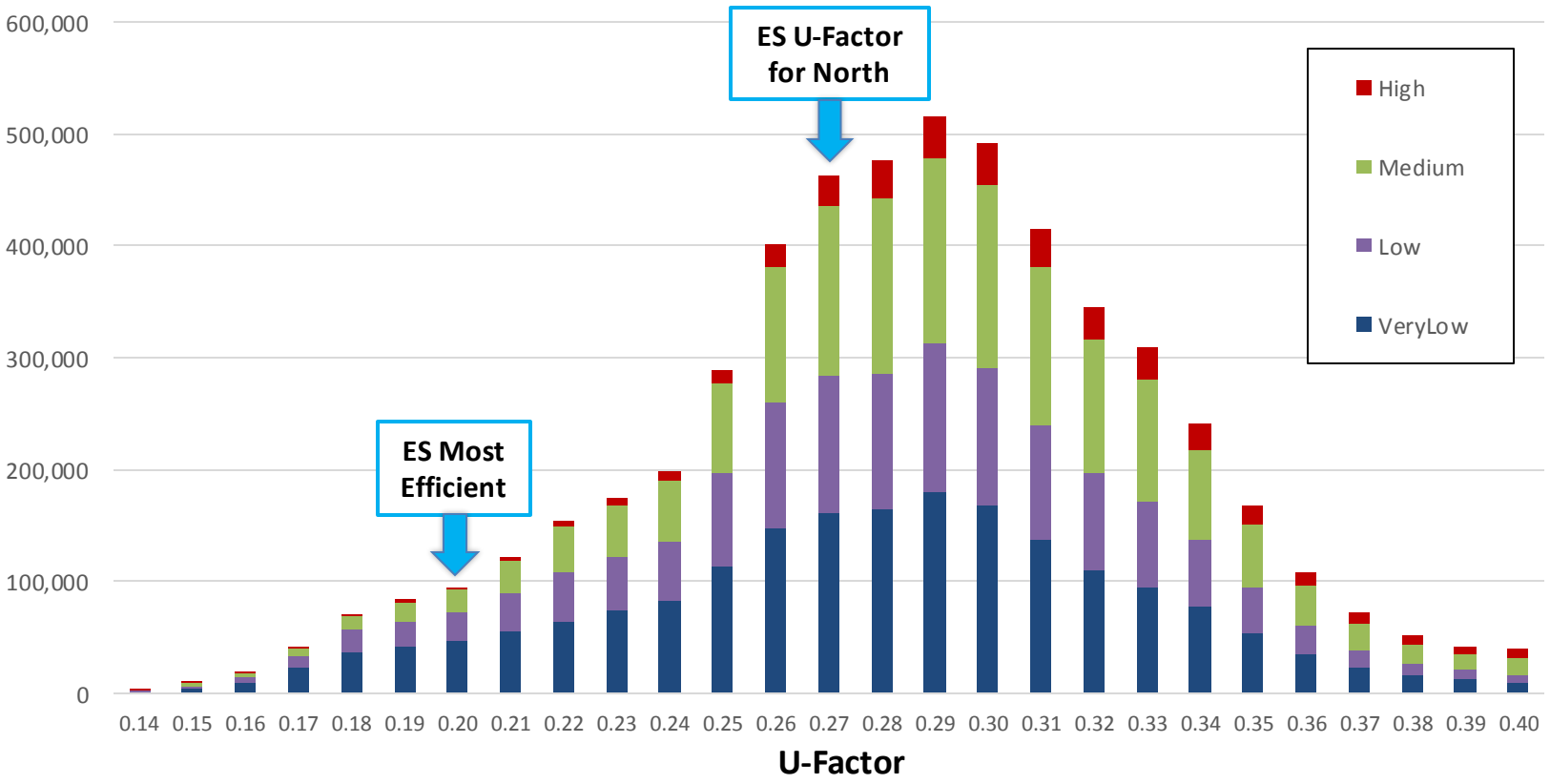
ENERGY STAR Monitors Dataset Overview and Most Efficient 2018 Proposal



Residential Windows

- **2018 Proposal:**
  - Maintain current U-factor and SHGC criteria (No change)
  - NAFS certification still required to help ensure products can support heavier IGUs (Performance Grade ≥ 15)
  - Residential window products only (No doors, skylights, or TDDs)
  - Meaningful savings and improved comfort
  - Verification testing required!
- **Rationale:**
  - Products with performance significantly higher than ENERGY STAR minimum criteria are widely available; but still a relatively small slice of total market
    - 39 manufacturers
    - 408 product lines (of thousands of ENERGY STAR certified product lines available)
- **Future:**
  - EPA and DOE are continuing discussions towards the development of an ENERGY STAR Most Efficient dynamic window products specification

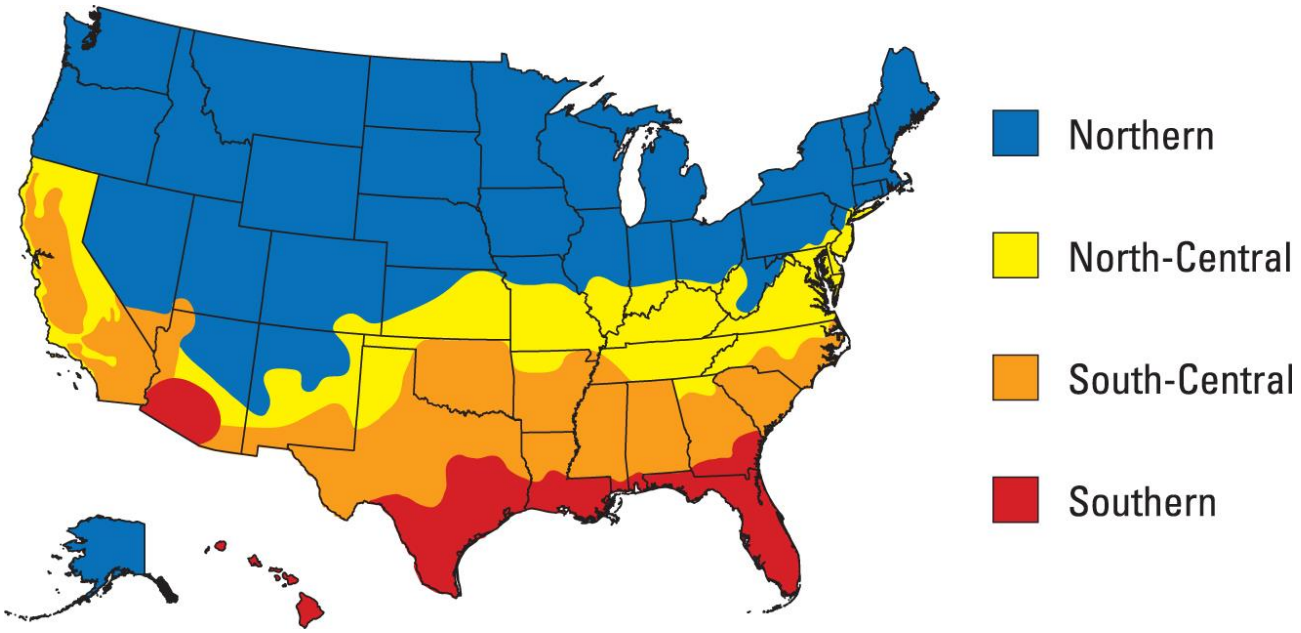
Distribution of ENERGY STAR Certified Residential Window Options
(December 2015 Data)



High SHGC > 0.40 **Medium SHGC** = 0.25 - 0.40
Low SHGC = 0.20 - 0.24 **Very Low SHGC** < 0.20

Residential Windows

Climate Zone	U-factor	SHGC
Northern	≤ 0.20	≥ 0.20
North-Central	≤ 0.20	≤ 0.40
South-Central	≤ 0.20	≤ 0.25
Southern	≤ 0.20	≤ 0.25



Next Steps

- Stakeholder comments due August 28, 2017
- EPA will finalize the 2018 criteria in September 2017
- Products will be recognized as ENERGY STAR Most Efficient 2018 beginning January 1, 2018

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Thank you for your participation today.