



# ENERGY STAR®

## Room Air Conditioners

### Draft Test Method for Room Air Conditioners to Validate Demand Response

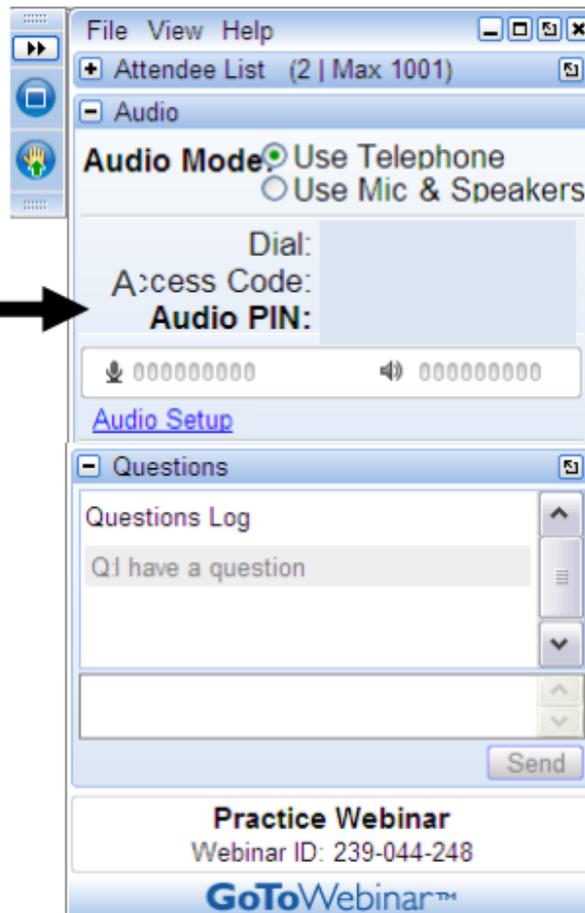
### Stakeholder Webinar February 22, 2017

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# Webinar Logistics

- All phone lines will be muted, **to unmute please press \*6**
- Presented material can be found on the ENERGY STAR Version 4.0 Room Air Conditioner Product Development [webpage](#)



<b>Introduction – Welcome/Goals</b>	Melissa Fiffer, EPA
<b>Draft Test Method for Room Air Conditioners to Validate Demand Response – Presentation &amp; Discussion</b>	
<b>- Background and Overview</b> <b>- Proposed Test Method</b>	Melissa Fiffer, EPA Bryan Berringer, DOE Nadav Singerman, Navigant
<b>Conclude &amp; Next Steps</b>	Melissa Fiffer, EPA



## Webinar Goals

1. Outline and discuss the Draft Test Method for Room Air Conditioners to Validate Demand Response.
2. Solicit stakeholder feedback on outstanding issues/questions identified.
3. Address stakeholder questions about the process and/or changes.
4. Discuss next steps and timeline.

## ENERGY STAR Connected Criteria



- Our goal: Over the long term, ENERGY STAR connected criteria facilitate home energy savings and GHG reductions, while being mindful of consumers.
  - ENERGY STAR criteria leverage the national platform that utilities can rely on and consumers look for, bringing together interested partners and stakeholders.
  - ENERGY STAR criteria provide consistent definitions and approaches, a consistent set of starter functionality, and an emphasis on open standards.
  - ENERGY STAR is a trusted resource that can help consumers find these connected products and identify the benefits they offer.



## Connected Status in ENERGY STAR Specifications

Specification	Connected Criteria	Demand Response Test Method
Refrigerator/Freezer	Final	Final
Clothes Dryers	Final	Need Products for Testing
Clothes Washers	Final	Need Products for Testing
Room AC	Final	Final Draft
Dishwashers	Final	Need Products for Testing
Pool Pumps	Final	Final
Lighting (Lamps and Luminaires)	Final	N/A
Connected Thermostats	Final	N/A
Electric Vehicle Supply Equipment	Final	Final
Commercial Ice Machines	Draft	Need Products for Testing



## ENERGY STAR Certified Appliances with Connected Functionality

- Interested in demand response test methods for other product categories?
  - Consider providing connected products for field testing.
  - *Thank you, Electrolux and Friedrich, for your willingness to participate in the RAC Demand Response test method development process!*
- Current count of ENERGY STAR appliances with Connected Functionality
  - 35 refrigerators / freezers
  - 4 clothes washers
  - 2 clothes dryers



# Steps once the RAC Demand Response Test Method is Final

- To appear (or continue appearing) as Connected on the ENERGY STAR list, and/or to make use of the 5% Connected allowance, RAC models will have to test to the finalized Demand Response Test Method.

ENERGY STAR Certified  
**Residential Refrigerators** Visit the [Residential Refrigerators](#) page for usage tips and buying guidelines.

## Filter Your Results

filter by keyword

### Type

- Top Freezer (227)
- Bottom Freezer (424)
- Side-by-Side (66)
- Freezerless and Single Door (30)
- Compact (527)

### Additional Features

- × Clear selections
- Thru the Door Dispenser (198)
- Automatic Defrost (1012)
- Connected (20)**
- Icemaker (482)
- Built-in (112)
- Counter Depth (350)

## 20 Records Found

- Qualified product list
  - (3) additional fields, on QPL advanced view
    - Connects Using:** Wired Ethernet, Wi-Fi, Zigbee, HomePlug Green PHY
    - Communication Standard Application Layer :** SEP 1.x, SEP2.x, OpenADR
    - Direct on-premises Open-standard Based Interconnection** – Yes/No
- Product finder
  - Product finder would indicate connected Y/N
  - Results of a product finder search would include “connects using” (e.g., Wi-Fi)



## Draft Test Method Agenda

- 1** Background and Overview
- 2** Proposed Test Method
- 3** Next Steps



## ENERGY STAR Eligibility Criteria Version 4.0 – Certification Criteria

- Minimum Combined Energy Efficiency Ratio (CEER) (Section 3.A)

$$CEER_{MIN} = CEER_{BASE} - CEER_{Adder\_Connected}$$

- $CEER_{BASE}$ 
  - Provided for range of configurations and capacities in Tables 1, 2, and 3
- $CEER_{Adder\_Connected}$ 
  - 5% of  $CEER_{BASE}$  for qualifying room ACs
  - Qualification determined using an ENERGY STAR Test Method for Room Air Conditioners to Validate Demand Response
- $CEER_{MIN}$ 
  - Performance determined using DOE test procedure for room air conditioners (ACs) (10 CFR 430, Subpart B, Appendix F)



## ENERGY STAR Eligibility Criteria Version 4.0 – Connected Product Criteria

- Demand Response Signals and Capabilities (Section 4.G)
  - Delay Appliance Load Capability (DAL)
    - Product must increase set temperature by at least 4 °F for at least 4 hours
    - Increased set temperature shall not exceed 85 °F
    - Consumer shall be able to override the DAL response
    - Product shall provide at least one DAL response in a rolling 24-hour period
  - Temporary Appliance Load Reduction (TALR)
    - Product must disable compressor operation for at least 10 minutes
    - Product shall not respond if the set temperature is  $\geq 85$  °F
    - Consumer shall be able to override the TALR response
    - Product shall be able to provide at least three TALR responses in a rolling 24-hour period
    - Product is not required to provide more than one TALR response per 60-minute period



## Draft Test Method Agenda

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## Draft Test Method – Introduction

- Purpose
  - Determine room AC compliance with requirements for demand response functionality.
- Test Requirements
  - DAL Test – No specific test conditions required
  - TALR Test – Ambient temperature maintained at  $95\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$  to ensure continuous compressor operation at set temperature of  $85\text{ }^{\circ}\text{F}$
- Configurations and Communication Setup
  - Unit installed according to manufacturer instructions
  - Connect Appliance Communication Module and Utility Equivalent Communication Device, and verify connection and data transfer



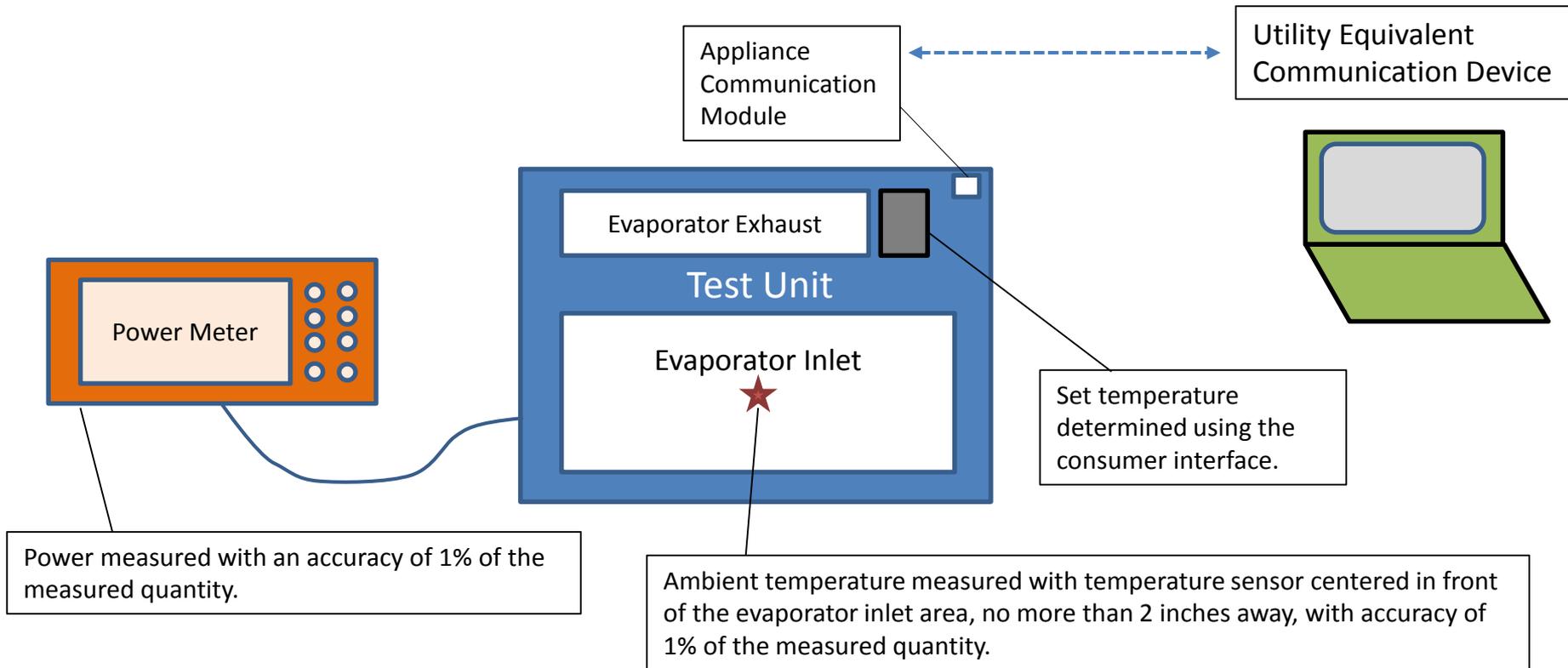
## Stakeholder Feedback – Ambient Test Conditions

Compressor or fan operation are not expected to affect the results of the DAL test (i.e., verification of temperature setpoint adjustment) and therefore, to minimize test burden, DOE and EPA did not specify test conditions for the DAL test.

The ambient conditions for the TALR test were selected to ensure continuous compressor operation at a set temperature of 85 °F, or the next increment above 85 °F. DOE and EPA specified a large tolerance on the TALR ambient temperature to minimize test burden and avoid the need for expensive chamber conditioning equipment.

DOE and EPA invite stakeholder comments on the lack of specific test conditions for the DAL test and the test conditions specified for the TALR test.

# Draft Test Method – Test Setup





## Stakeholder Feedback – Set Temperature Access

Accessing the set temperature may vary among manufacturers and therefore, only general instructions to retrieve the test unit set temperature are specified. Further, DOE and EPA are aware of models for which there is a risk that incorrect use of the consumer interface could accidentally override an ongoing signal response, and therefore require that the set temperature shall not be modified during testing and that the UUT test unit set temperature shall be determined in accordance with manufacturer instructions.

DOE and EPA invite stakeholder comments on the proposed procedure to access the UUT test unit set temperature and potential means to avoid the accidental override of a signal response during testing.



## Draft Test Method – DAL Test

- Standard Response (7.1)
  - Set temperature initially at nearest user-selectable temperature equal to or below 70 °F
  - Verify 4 °F adjustment in set temperature
- High Temperature Response (7.2)
  - Set temperature initially at nearest user-selectable temperature below 85 °F
  - Verify 4 °F adjustment in set temperature but no more than 85 °F
- Upper Temperature Limit (7.3)
  - Set temperature initially at nearest user-selectable set temperature at or above 85 °F
  - Verify no adjustment in set temperature above 85 °F
- Active Override (7.4)
  - Verify standard response and immediate cancellation of response based on consumer override

# 7.1 DAL Standard Response - Example

Set Temperature: Nearest setting  $\leq 70\text{ }^\circ\text{F}$

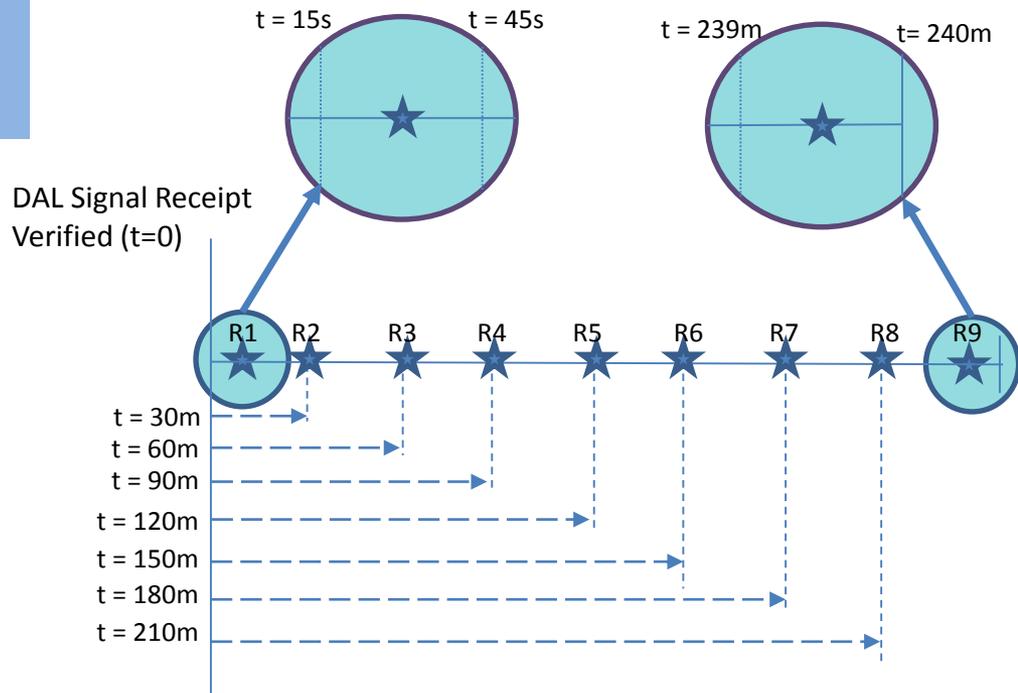
Record set temperature,  $T_1$

Minimum of readings =  $T_{S, \text{min}}$

Maximum of readings =  $T_{S, \text{max}}$

DAL Response Verification  
 $85\text{ }^\circ\text{F} \geq T_{S, \text{max}} \geq T_{S, \text{min}} \geq T_1 + 4\text{ }^\circ\text{F}$

- “R” = Recording
- “s” = seconds
- “m” = minutes
- “t” = test time



## 7.2 DAL High Temperature Response - Example

Set Temperature: Nearest setting below 85 °F

Record set temperature,  $T_2$

Maximum of readings =  $T_H$

DAL Response Verification

$$T_H = 85 \text{ °F if } 85 \text{ °F} > T_2 \geq 81 \text{ °F}$$

Otherwise

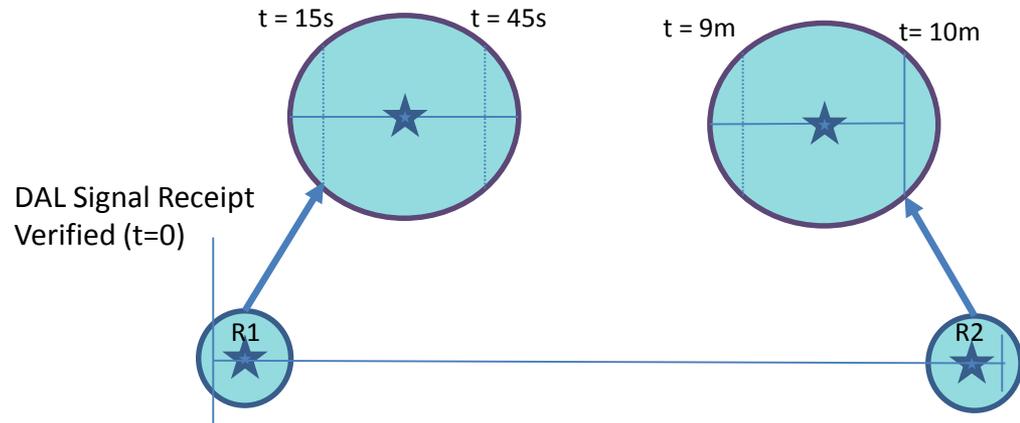
$$85 \text{ °F} > T_H \geq T_2 + 4 \text{ °F}$$

“R” = Recording

“s” = seconds

“m” = minutes

“t” = test time





## Stakeholder Feedback – Unit Response Time

It may take a brief period of time for a unit to adjust the set temperature in response to a DAL demand response signal, once it is received. Therefore, DOE and EPA have included a short 15- to 45-second allowance between verifying that the test unit received the signal and determining if the unit adjusted its set point correctly.

DOE and EPA invite stakeholder comments on this delayed response time allowance to ensure that the unit has time to respond to the received DAL signal.



## Stakeholder Feedback – Consumer Override

Consumer override is a key component of the Demand Response Connected Product Criteria in the ENERGY STAR Program Requirements for Room Air Conditioners, Eligibility Criteria Version 4.0. Therefore, DOE and EPA have developed a test to confirm the override functionality is included and functional.

DOE and EPA invite stakeholder comments on the proposed active override test.

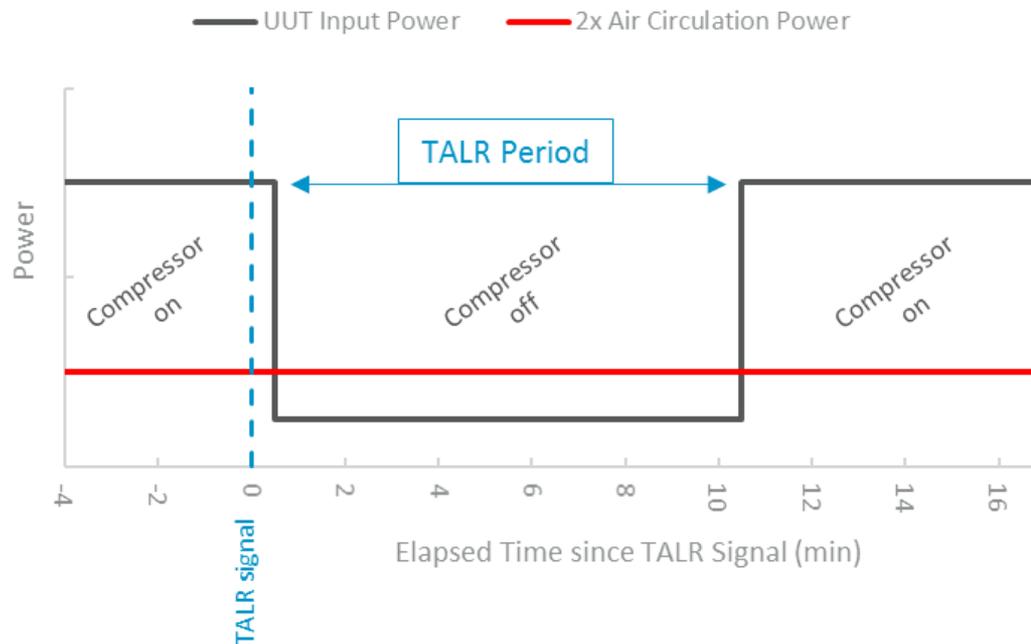


## Draft Test Method –TALR Test

- Air Circulation Mode Power Measurement (8.1)
  - Determine air circulation mode power to enable determination of compressor cessation
- Standard Response (8.2)
  - Set temperature initially at nearest user-selectable temperature equal to or below 70 °F
  - Verify cessation of compressor operation for three consecutive TALR signals 90 minutes apart
- 24-hour Rolling Period (8.3)
  - Following 24-hour period from previous TALR signal, verify one standard response
- Upper Temperature Limit Response (8.4)
  - Set temperature initially at nearest user-selectable temperature equal to or above 85 °F
  - Verify compressor continues to operate throughout the TALR signal duration
- Active Override (8.5)
  - Verify standard response and immediate cancellation of response based on consumer override

## TALR Sample Response

- The power in air circulation mode is used as a benchmark to determine compressor operation
  - If  $P_{\text{UUT}} \geq 2 \times P_{\text{circ}}$ , then the compressor is on
  - If  $P_{\text{UUT}} < 2 \times P_{\text{circ}}$ , then the compressor is off





## Stakeholder Feedback – TALR Compliance Verification

DOE and EPA determined that the cooling mode input power is typically at least two times the input power for other modes in which the compressor is not operating. For that reason, compliance verification is based on the measured power being greater than or equal to two times the input power in air circulation mode, to establish the presence of compressor operation.

DOE and EPA invite stakeholder comments on the method to determine the compressor operating status.



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# Test Method Timeline

Milestone	Date
Draft Test Method Publication	February 9, 2017
Draft Test Method Webinar	February 22, 2017
Draft Test Method Comments Due	March 9, 2017



# Questions?



## Other ENERGY STAR Resources on Connected

- Have technical questions as you are designing connected appliances?
  - EPA has compiled questions from stakeholders in an effort to make its interpretations broadly available - [ENERGY STAR Connected Criteria Q&A](#)
  - We will refresh the Q&A document as questions arise
- To access shared drive, see “ENERGY STAR Connected Appliances” folder on google drive.
  - Folder is restricted access.
  - For access, please fill out this [form](#).



## Contacts – Connected Criteria and Demand Response Test Procedures

### *Appliance Specifications*

- Melissa Fiffer, US EPA  
[fiffer.melissa@epa.gov](mailto:fiffer.melissa@epa.gov)
- Steve Leybourn, ICF  
[Steve.Leybourn@icf.com](mailto:Steve.Leybourn@icf.com)
- Doug Frazee, ICF  
[dfraze@icfi.com](mailto:dfraze@icfi.com)
- [appliances@energystar.gov](mailto:appliances@energystar.gov)

### *Demand Response Test Procedures*

- Bryan Berringer, US DOE  
[Bryan.berringer@ee.doe.gov](mailto:Bryan.berringer@ee.doe.gov)
- Ashley Armstrong, US DOE  
[Ashley.armstrong@ee.doe.gov](mailto:Ashley.armstrong@ee.doe.gov)

### *Connected Thermostats, Pool Pumps*

- Abigail Daken, US EPA  
[daken.Abigail@epa.gov](mailto:daken.Abigail@epa.gov)

### *Lighting*

- Taylor Jantz-Sell, US EPA  
[jantz-sell.taylor@epa.gov](mailto:jantz-sell.taylor@epa.gov)