ENERGY STAR. The simple choice for energy efficiency.

ENERGY STAR®
Electric Vehicle Supply Equipment
Version 1.1 Specification and Test Method
Discussion Guide Webinar

June 4, 2018

ENERGY STAR Products Labeling Program

EPA

Webinar Details

- Webinar slides and related materials will be available on the EVSE Product Development Web page:
  - www.energystar.gov/RevisedSpecs
  - *Follow link to "Version 1.1 is in Development" under "Electric Vehicle Supply Equipment"*

- Audio provided via teleconference:

  Call in: +1 (877) 423-6338 (U.S.)
  +1 (571) 281-2578 (International)
  Code: **773-366** #

  - Phone lines will remain open during discussion
  - Please mute line unless speaking
  - Press *6 to mute and *6 to un-mute your line

Webinar Agenda

- Introductions
- Overview of ENERGY STAR specification development process
- Potential for Energy Savings
- Test Method for DC EVSE
  - Test Setup and Test Conduct
  - Test Procedures
- Specification for DC EVSE
  - Definitions
  - Efficiency Criteria
- Timeline

Introductions

Time	Topic
12:00–12:15	**Introductions and Overview of Specification Development Process**
12:15–12:30	Potential for Energy Savings
12:30–1:00	Test Setup and Test Conduct
1:00–1:45	Test Procedures
1:45–2:00	Specification – Definitions and Scope
2:00–2:15	Specification – Efficiency Criteria
2:15–2:30	Timeline

Introductions

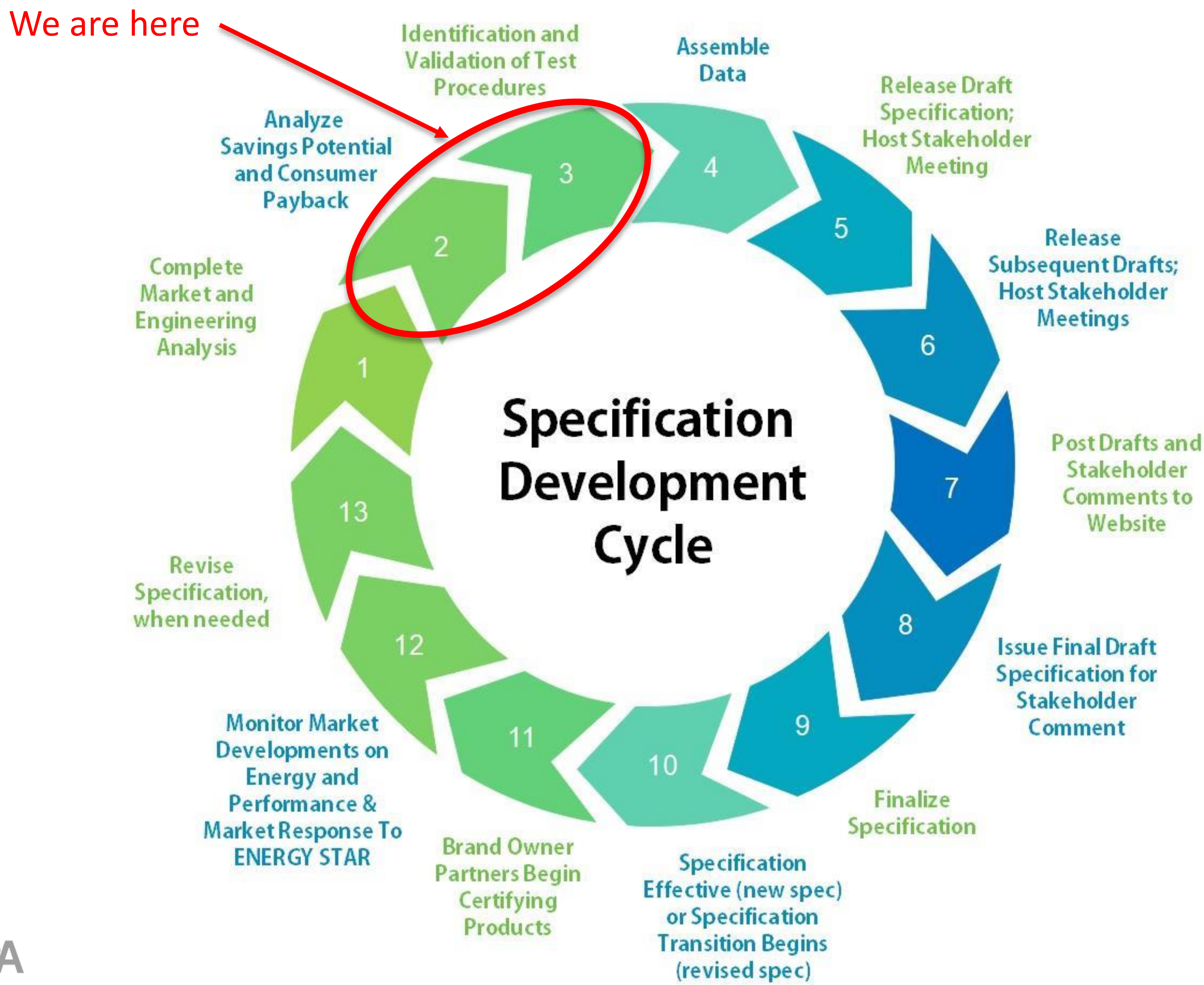
James Kwon
U.S. Environmental Protection Agency

Peter Banwell
U.S. Environmental Protection Agency

Matt Malinowski
ICF

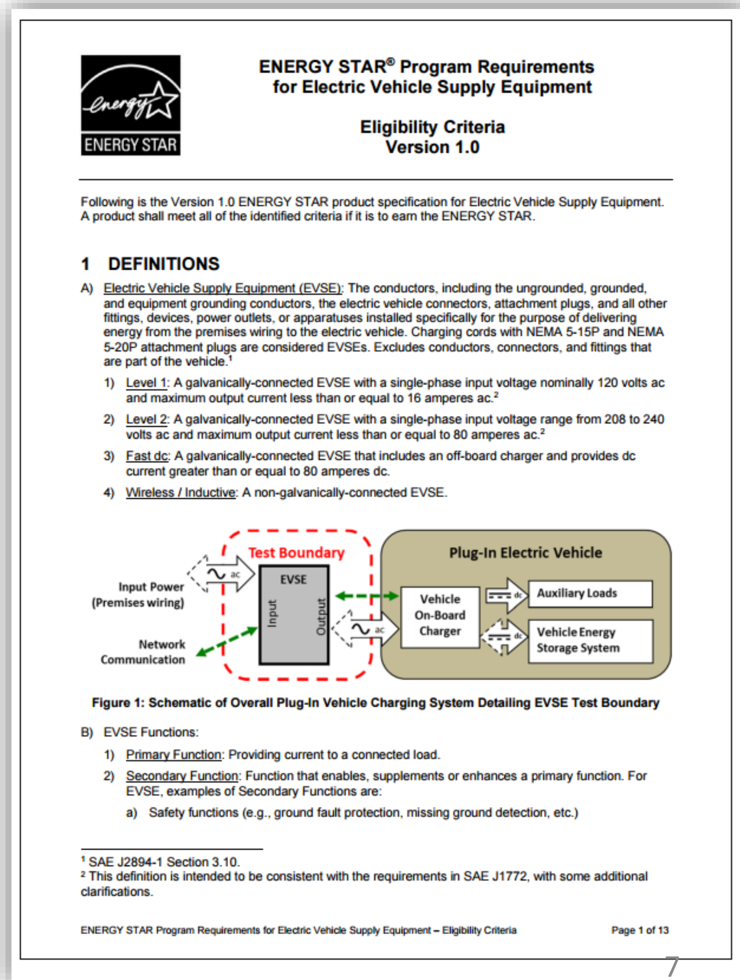
Stacy Noblet
ICF

Emmy Feldman
ICF


We are here
Specification Development Cycle
1
Complete Market and Engineering Analysis
2
Analyze Savings Potential and Consumer Payback
3
Identification and Validation of Test Procedures
4
Assemble Data
5
Release Draft Specification; Host Stakeholder Meeting
6
Release Subsequent Drafts; Host Stakeholder Meetings
7
Post Drafts and Stakeholder Comments to Website
8
Issue Final Draft Specification for Stakeholder Comment
9
Finalize Specification
10
Specification Effective (new spec) or Specification Transition Begins (revised spec)
11
Brand Owner Partners Begin Certifying Products
12
Monitor Market Developments on Energy and Performance & Market Response To ENERGY STAR
13
Revise Specification, when needed

ENERGY STAR Version 1.0 EVSE Specification Overview

- Version 1.0 published on December 27, 2016
- In scope:
  - Level 1 AC
  - Level 2 AC
- Criteria for:
  - No Vehicle Mode
  - Partial On Mode
  - Idle Mode
- Optional Connected Functionality



ENERGY STAR® Program Requirements for Electric Vehicle Supply Equipment

Eligibility Criteria Version 1.0

Following is the Version 1.0 ENERGY STAR product specification for Electric Vehicle Supply Equipment. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1 DEFINITIONS

A) Electric Vehicle Supply Equipment (EVSE): The conductors, including the ungrounded, grounded, and equipment grounding conductors, the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatuses installed specifically for the purpose of delivering energy from the premises wiring to the electric vehicle. Charging cords with NEMA 5-15P and NEMA 5-20P attachment plugs are considered EVSEs. Excludes conductors, connectors, and fittings that are part of the vehicle.[1]

1) Level 1: A galvanically-connected EVSE with a single-phase input voltage nominally 120 volts ac and maximum output current less than or equal to 16 amperes ac.[2]

2) Level 2: A galvanically-connected EVSE with a single-phase input voltage range from 208 to 240 volts ac and maximum output current less than or equal to 80 amperes ac.[2]

3) Fast dc: A galvanically-connected EVSE that includes an off-board charger and provides dc current greater than or equal to 80 amperes dc.

4) Wireless / Inductive: A non-galvanically-connected EVSE.

Figure 1: Schematic of Overall Plug-In Vehicle Charging System Detailing EVSE Test Boundary

B) EVSE Functions:

1) Primary Function: Providing current to a connected load.

2) Secondary Function: Function that enables, supplements or enhances a primary function. For EVSE, examples of Secondary Functions are:

a) Safety functions (e.g., ground fault protection, missing ground detection, etc.)

[1] SAE J2894-1 Section 3.10.
[2] This definition is intended to be consistent with the requirements in SAE J1772, with some additional clarifications.

ENERGY STAR Program Requirements for Electric Vehicle Supply Equipment – Eligibility Criteria Page 1 of 13

Key Features

1. Energy Savings
2. Safety
3. Open Communications

Communications details:

- Grid Communications
- Open Access
- Consumer Override

Photo by Dennis Schroeder, NREL 39251

Applicability of Existing Test Method for DC EVSE

- EPA is proposing to expand the scope of the ENERGY STAR EVSE specification to include DC Output EVSE

- As a result, EPA plans to revise the existing test method as follows:
  - Applying portions of the current Version 1.0 test method for AC EVSE to DC Output EVSE
  - Some requirements remain applicable only for AC EVSE
  - Requirements to be added that will be applicable only for DC EVSE

- In this webinar, EPA will focus on just the requirements applicable for DC EVSE, not those only applicable for AC

Version 1.1 Specification

- As EPA works toward finalizing a test method for DC EVSE, work on the Version 1.1 Specification will commence:
  - EPA plans to retain the Version 1.0 criteria for AC L1 and L2 EVSE
  - Goal of V1.1 Specification will be to include appropriate criteria to recognize the most efficient DC charging
  - Intention to include criteria for:
    - No Vehicle Mode
    - Operation Mode
    - Optional Connected Functionality Criteria

Photo by Kendall Septon, NREL 45635

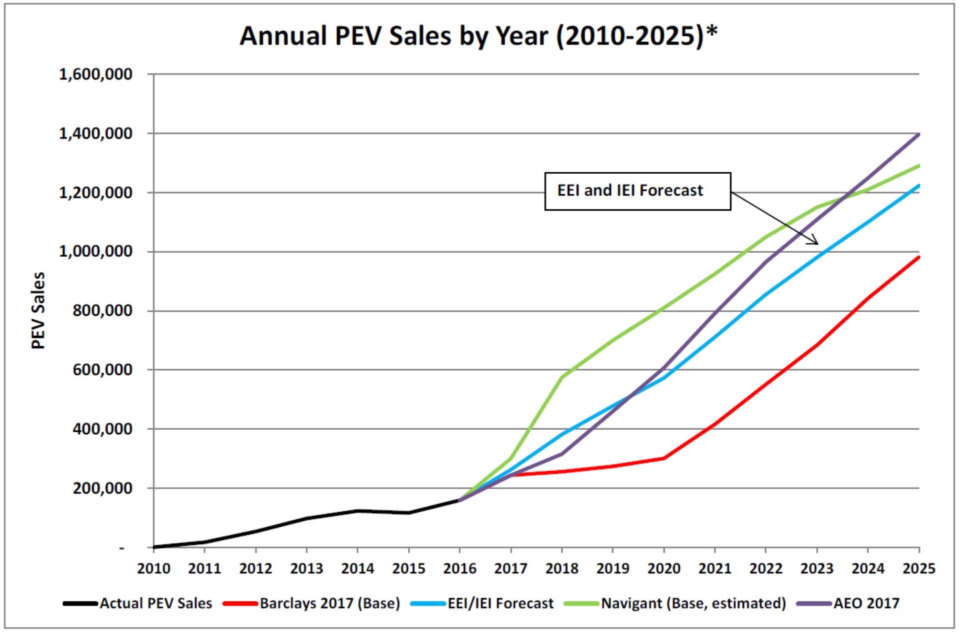
Potential for Energy Savings

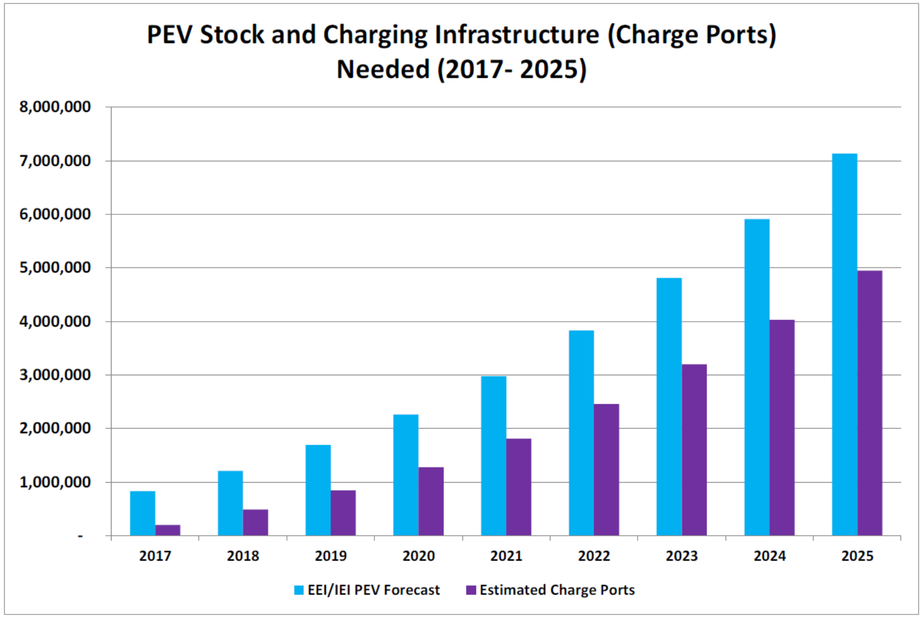
Time	Topic
12:00–12:15	Introductions and Overview of Specification Development Process
12:15–12:30	**Potential for Energy Savings**
12:30–1:00	Test Setup and Test Conduct
1:00–1:45	Test Procedures
1:45–2:00	Specification – Definitions and Scope
2:00–2:15	Specification – Efficiency Criteria
2:15–2:30	Timeline

Electric Vehicle Market Overview

49,000+ Non-residential charging outlets

As of May 2018, Source: U.S Department of Energy, Alternative Fuels Data Center (AFDC)





*Includes battery electric vehicles and plug-in hybrid electric vehicles

EEI and IEI say 7 million EVs on the road by 2025…

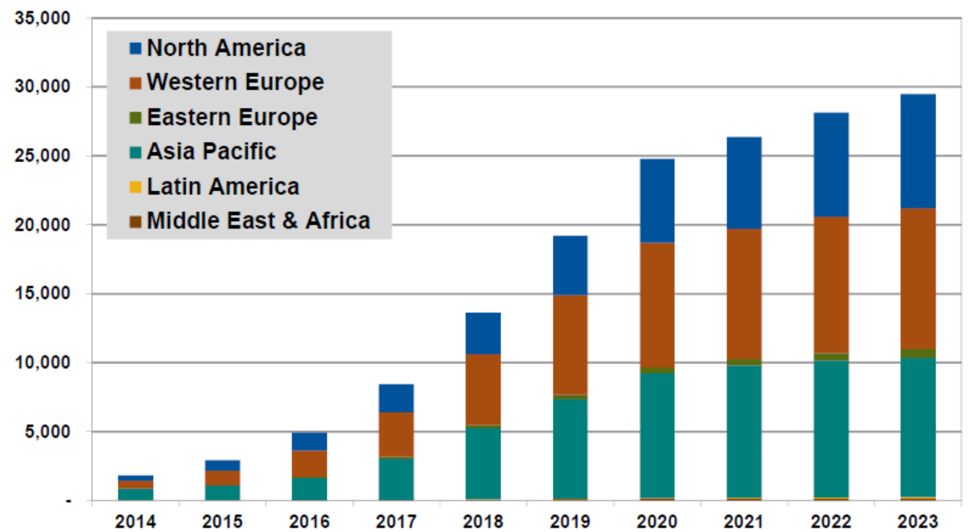
…and 5 million charge ports needed to support them.

Source: EEI and IEI, *Plug-in Electric Vehicle Sales Forecast Through 2025 and the Charging Infrastructure Required,* June 2017

DC Charging Growth

- Reasons for including DC charging:
  - Evolving to provide shorter charge times
  - Potential to increase the range of EVs, especially through efforts to establish EV charging corridors for cross-country EV transportation
  - Differentiating products based on energy efficiency

Chart 6.6 Annual DC EVSE Unit Sales by Region, World Markets: 2014-2023



(Source: Navigant Research)

Test Setup and Test Conduct

Time	Topic
12:00–12:15	Introductions and Overview of Specification Development Process
12:15–12:30	Potential for Energy Savings
12:30–1:00	**Test Setup and Test Conduct**
1:00–1:45	Test Procedures
1:45–2:00	Specification – Definitions and Scope
2:00–2:15	Specification – Efficiency Criteria
2:15–2:30	Timeline

Version 1.0 Test Method – Test Setup

The Test Setup in the V1.0 Test Method covers the following for AC EVSE and will be referenced in the coming slides to describe which of these setup instructions EPA proposes to apply to DC EVSE:

- Test Setup and Instrumentation

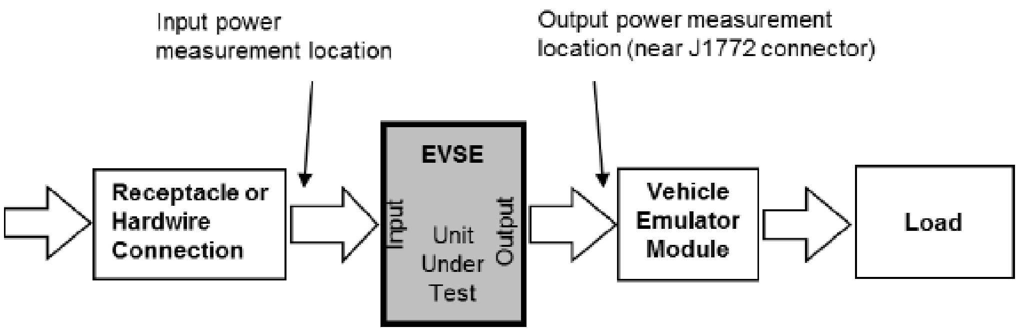


Figure 11: Schematic of test setup connection

- AC input power and input power measurements
- Test load description
- Test conditions like ambient temperature, relative humidity
- Power meter attributes

V1.1 Test Setup for both AC and DC EVSE

- Requirements for both AC and DC EVSE are proposed as follows:
  - Current V1.0 input power measurements
    - Default cables provided by the manufacturer to be used
    - How to connect the EVSE for voltage and current measurements
  - Current V1.0 illuminance meter accuracy requirements
  - Current V1.0 power meter accuracy requirements of +/- 0.1% of reading PLUS +/- 0.1% of full scale

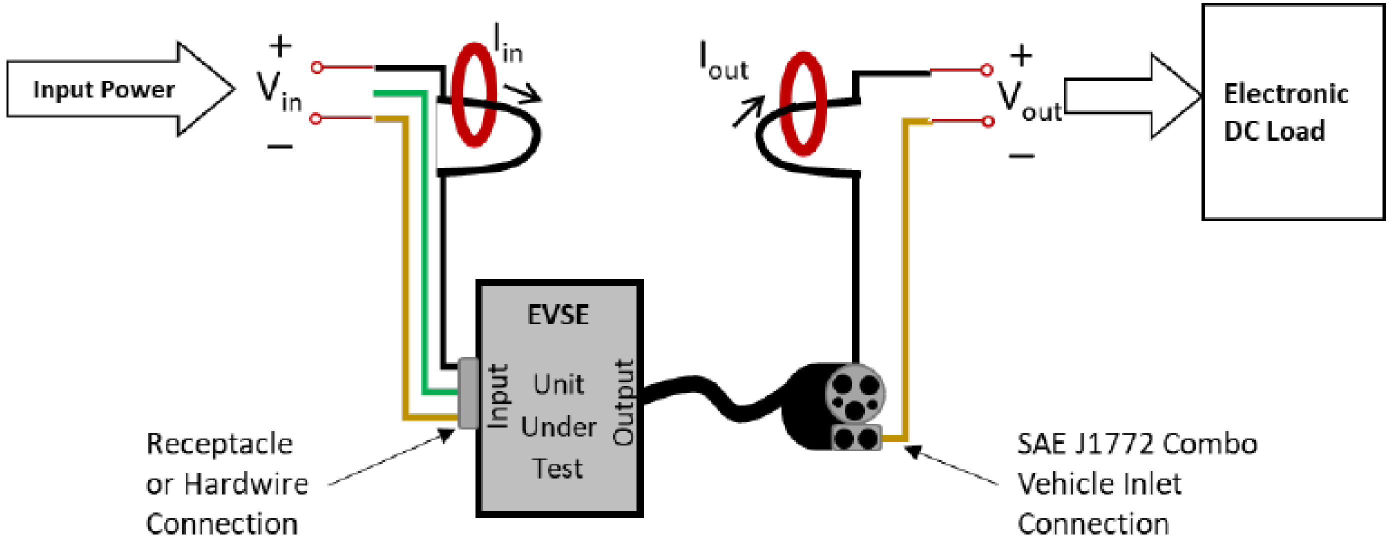
B) Illuminance Meter Accuracy:

1) All illuminance meters shall be accurate to ± 2% (± 2 digits) of the digitally displayed value.

Note: The overall accuracy of a meter is found by taking (±) the absolute sum of 2% of the measurement and a 2 digit tolerance of the displayed value least significant digit. For example, if a meter displays "200.0" when measuring an illuminance of 200 lx, 2% of 200 lx is 4.0 lx. The least significant digit is 0.1 lx. "Two digits" implies 0.2 lx. Thus, the displayed value would be 200 ± 4.2 lx (4 lx + 0.2 lx). The accuracy is specific to the illuminance meter and shall not be considered as tolerance during actual light measurements. Light measurements shall be within the tolerance specified in 4.1.E)3).

Test Setup for DC EVSE

- The following test setup conditions EPA proposes to apply to just DC EVSE
- Schematic of test method connections:



  – Input power measurement taken at input to the EVSE, not at the utility panel

Test Setup for DC EVSE – Input Supply Requirements

- Higher-voltage AC input power required for DC EVSE

Table 1: Proposed Input Supply Requirements for DC EVSE

Voltage and Precedence	Frequency
1. 600Δ V ac	60 Hz
2. 600Y/346 V ac	60 Hz
3. 480Δ V ac	60 Hz
4. 480Y/277 V ac	60 Hz
5. 415Δ V ac	60 Hz
6. 415Y/240 V ac	60 Hz
7. 400Δ V ac	50 Hz
8. 400Y/230 V ac	50 Hz

  - EVSE tested at highest compatible voltage to allow for comparison between EVSE that have slightly different input voltage ranges
  - Includes typical voltages in North America and Europe

Test Setup for DC EVSE

- A DC test load needed for testing DC Output EVSE, combined with a Vehicle Emulator Model that can communicate per SAE J1772 Appendix F and G

- Temperature Testing
  - EPA learned that charging efficiency can vary substantially with ambient temperature due to:
    - Different cooling technologies (air cooling, liquid cooling)
    - Strategies for implementing a cooling system (i.e., when cooling turns on)
  - EPA proposes to conduct No Vehicle and On Mode testing at 3 temperatures based on EPA's Five Cycle Fuel Economy Test

Test Setup for DC EVSE

Table 2: Proposed Testing at Representative Temperatures for DC EVSE

Type of Climate	Representative Temperature
Cold	20° F or –7° C (± 5° F, ± 2.5° C)
Temperate	68° F or 20° C (± 5° F, ± 2.5° C)
Hot	95° F or 35 ° C (± 5° F, ± 2.5° C)

- The cold and hot temperatures were pulled directly from the EPA's Five Cycle Fuel Economy test
- For the temperature condition, EPA chose a temperature at the lower end of the Fuel Economy testing range, to provide more variation from the hot temperature test

Test Setup – Discussion Questions

- EPA is requesting stakeholder feedback on the proposal to test at representative temperatures.

1. Are these temperatures representative of climates across the U.S.?
2. Do labs have atmospheric-controlled testing chambers to test EVSE with a specific ambient temperature? If not, is acquiring this capability doable?
   - Is a +/- 5 °F testing variation feasible?
3. Are there alternative methods for conducting temperature testing that could minimize testing burden?
4. EPA welcomes data on efficiency variations that result from charging in different climates.

Test Setup – Discussion Questions

- For a DC EVSE that has a separate cabinet containing the AC/DC converter, and a dispenser that connects to the vehicle:

  - Should EPA accommodate a lower voltage connection to the dispenser so there may be two input voltages?
  - How should EPA factor in the losses in the DC cable connecting the two enclosures?

AC/DC Converter Cabinet

Dispenser

Test Conduct for AC and DC EVSE

The Test Conduct in the V1.0 Test Method covers the following and EPA proposes that these conditions apply to both AC and DC EVSE:

- Mounting the EVSE per manufacturer installation instructions and testing in the as-shipped condition
- Configuring an EVSE with network connection capabilities

4 TEST CONDUCT

4.1 Guidance for Implementation of the EVSE Test Procedure

A) As-shipped Condition: Unless specified otherwise, the model unit shall be tested in its default configuration as-shipped.

1) The UUT shall be mounted per the manufacturer's installation instructions. If no manufacturer instructions are provided, the UUT shall be tested on a thermally non-conductive surface (e.g., wood or rubber).

B) UUT Configuration and Control:

1) Network Connection Capabilities:

a) Verify the UUT has network connection capabilities:

i. Network connections should be listed in the user manual or installation instructions.

ii. If no connections are specified, verify that the EVSE does not have network capabilities by checking for the absence of physical connections or the absence of network settings in the menu.

2) Peripherals and Network Connections:

Test Conduct for AC and DC EVSE

- Conditions for products with an occupancy sensor
- Accuracy requirements for all measurements

H) Measurement Accuracy for All Products:

1) Power measurements with a value greater than or equal to 0.5 W shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level.

2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less than or equal to 0.01 W at the 95% confidence level.

3) All ambient light values (measured lux) shall be measured at the location of the ABC sensor on the UUT with light entering directly into the sensor and showing the default image that appears as-shipped.

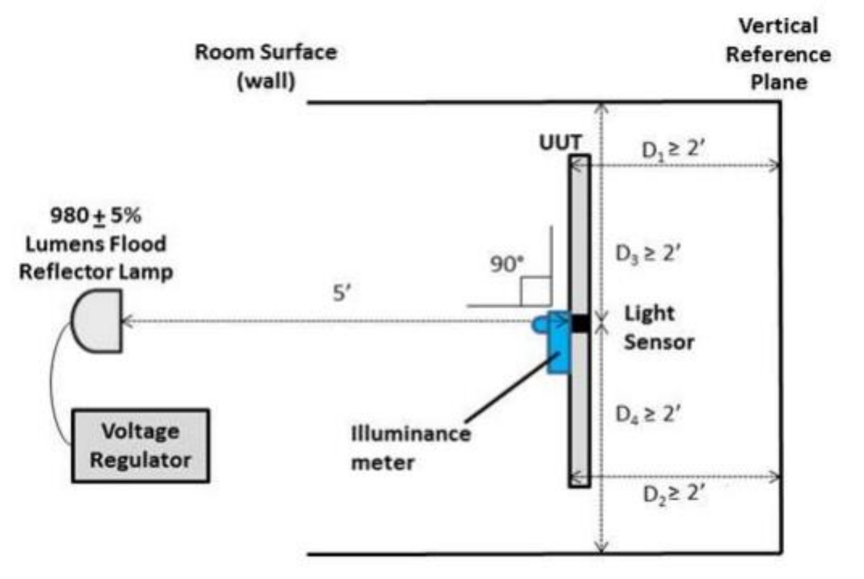
4) Ambient light values shall be measured within the following tolerances:

a) At 10 lux, ambient lighting shall be within ± 1.0 lux; and

b) At 300 lux, ambient lighting shall be within ± 9.0 lux.

Test Conduct for AC and DC EVSE

- For EVSE with a display:
  - Luminance testing at 100% screen brightness and attributes of the luminance meter
  - For products without Automatic Brightness Control (ABC) capability, testing at 65% of maximum brightness
  - For products with ABC, instructions are provided for testing in two illuminance conditions – light and dark – to simulate daytime and nighttime conditions



Test Setup – Top View

Is there variation in luminance of the display or area lighting between DC EVSE?

Test Conduct – Discussion Questions

- Are DC Output EVSE commonly custom-built products?
  - If so, what should EPA propose as a representative configuration for testing in order to minimize testing burden?

Test Procedures

Time	Topic
12:00–12:15	Introductions and Overview of Specification Development Process
12:15–12:30	Potential for Energy Savings
12:30–1:00	Test Setup and Test Conduct
1:00–1:45	**Test Procedures**
1:45–2:00	Specification – Definitions and Scope
2:00–2:15	Specification – Efficiency Criteria
2:15–2:30	Timeline

Test Procedures for AC and DC EVSE

The Test Procedures in the V1.0 Test Method covers the following and EPA proposes that these conditions apply to both AC and DC EVSE:

- Unit Under Test Preparation:
  - Verifying the Vehicle Emulator Module (VEM) and power meter are connected
  - Connecting the input and providing power to the EVSE
- No Vehicle Mode Testing
  - Ensure the output connector is unplugged from the VEM
  - Measure and record the input power
- Full Network Connectivity Testing
  - Determining the presence of full network connectivity for products with networking capabilities

Test Procedures for DC EVSE

- For DC Operation Mode Testing:
  - Reference to the SAE J1772 Appendix F regarding signaling for DC EVSE to specify the power for testing. Testers will need to use test equipment to:

✓ Communicate with the EVSE,
✓ Read its maximum current, and
✓ Perform required handshaking

Photo by Matthew Staver, NREL 39216

Test Procedures for DC EVSE

- Testing at various conditions will demonstrate the efficiency at the maximum power output, and as the charge ramps down when the vehicle no longer accepts maximum current.
- The following Operation Mode testing conditions are based on levels that EPA has seen in the market or understands are under development
  - The voltages are based on popular EV battery pack voltages at full charge

Table 4: Typical Battery Characteristics of Popular EVs

Popular EV	Energy Capacity	Voltage	Battery Range
Vehicle 1	60 kWh	350 V	230 miles
Vehicle 2	40 kWh	384 V	151 miles
Vehicle 3	33 kWh	353 V	114 miles
Vehicle 4	33.5 kWh	325 V	115 miles
Vehicle 5	75 kWh	400 V	259 miles

Test Procedures for DC EVSE

Table 3: Proposed On Mode Test Conditions for DC EVSE

	Test Conditions	Example for 500 kW capable UUT	Example for 350 kW capable UUT	Example for 150 kW capable UUT
Loading Condition 1	Max Available Power Output ± 2% and Voltage = Pout / 0.4 A + 300 V ± 2%.	500 kW	350 kW	150 kW
Loading Condition 2	350 kW ± 7 kW and 900 V ± 18 V	350 kW	Tested above	Do not test
Loading Condition 3	150 kW ± 3 kW and 400 V ± 8 V	150 kW	150 kW	Tested above
Loading Condition 4	50 kW ± 1 kW and 350 V ± 7 V	50 kW	50 kW	50 kW
Loading Condition 5	30 kW ± 0.6 kW and 350 V ± 7 V	30 kW	30 kW	30 kW

Test Procedures for DC EVSE

- Due to the high power levels of DC EVSE, EPA will explicitly allow back-feeding the output into the input, to minimize source requirements.
- The following language is currently used in the ENERGY STAR Uninterruptible Power Supplies (UPS) test method:

Backfeeding the source may be used in place of a test load during testing of UPS systems larger than 100 kW output, provided that an output power factor greater than 0.99 is maintained at all times.

Test Procedures for DC EVSE – Discussion Questions

Table 3: Proposed On Mode Test Conditions for DC EVSE

	Test Conditions	Example for 500 kW capable UUT	Example for 350 kW capable UUT	Example for 150 kW capable UUT
Loading Condition 1	Max Available Power Output ± 2% and Voltage = Pout / 0.4 A + 300 V ± 2%.	500 kW	350 kW	150 kW
Loading Condition 2	350 kW ± 7 kW and 900 V ± 18 V	350 kW	Tested above	Do not test
Loading Condition 3	150 kW ± 3 kW and 400 V ± 8 V	150 kW	150 kW	Tested above
Loading Condition 4	50 kW ± 1 kW and 350 V ± 7 V	50 kW	50 kW	50 kW
Loading Condition 5	30 kW ± 0.6 kW and 350 V ± 7 V	30 kW	30 kW	30 kW

- EPA welcomes feedback on the appropriateness of proposed Operation Mode testing conditions.
- Should EPA consider different testing conditions to determine the efficiency of On Mode charging?
- In addition, EPA welcomes feedback on an appropriate testing voltage for the various testing conditions.

Test Procedures – Discussion Questions

- Are there other relevant modes for DC Output EVSE, besides No Vehicle and Operation Mode, which should be accounted for in this test procedure?

Operational Modes	Most closely related Interface State as Defined in SAE J1772	Further Description
No Vehicle Mode	State A	No Vehicle Mode is associated with State A, or where the EVSE is not connected to the EV. The EVSE is connected to external power.
Partial On Mode	State B1 or State B2	Partial On Mode is associated with State B1 or State B2 where the vehicle is connected but is not ready to accept energy. Sub-state B1 is where the EVSE **is not** ready to supply energy and sub-state B2 **is** where the EVSE is ready to supply energy.
On Mode		
Idle Mode	State C	Idle Mode is associated with State C, where the vehicle is connected and ready to accept energy and the EVSE is capable of promptly providing current to the EV but is not doing so.
Operation Mode	State C	Operation Mode is associated with State C, where the EVSE is providing the primary function, or providing current to a connected load (i.e., the relay is closed and the vehicle is drawing current).

Test Procedures – Discussion Questions

- How should EPA best account for the power required to provide liquid cooling to the cables?
- EPA is interested in learning about cooling strategies to minimize cooling and increase the efficiency of the overall charge.
  - EPA welcomes feedback on the typical operating characteristics of cooling systems and how to structure and sequence tests so they are representative.

Photo by Dennis Schroeder, NREL 22830

Test Procedures – Discussion Questions

- EPA has learned that some EVSE may contain battery banks for the purpose of reducing peak demand (kW). EPA would like stakeholder feedback on the following testing proposals to account for energy loss from the battery itself:
  - How should EPA measure battery efficiency?
    - Should EPA consider conducting a 24-hour test?
    - Should EPA require that the battery is disabled for one test and enabled for a second test?

Test Procedures – Discussion Questions

- For DC EVSE, with a separate cabinet (containing the AC/DC converter) and dispenser (connects to the vehicle), should EPA consider an alternative testing approach that involves splitting up the cabinet and dispenser into separate tests?
  – The No Vehicle Mode testing may be most applicable for the dispenser, perhaps in light and dark conditions, with a variety of temperatures.
  – The Active Mode testing may be more applicable for the cabinet at a variety of output powers (without lighting or temperature variations).

Specification – Definitions

Time	Topic
12:00–12:15	Introductions and Overview of Specification Development Process
12:15–12:30	Potential for Energy Savings
12:30–1:00	Test Setup and Test Conduct
1:00–1:45	Test Procedures
1:45–2:00	**Specification – Definitions and Scope**
2:00–2:15	Specification – Efficiency Criteria
2:15–2:30	Timeline

Specification – DC Definition and Discussion Questions

Electric Vehicle Supply Equipment (EVSE): The conductors, including the ungrounded, grounded, and equipment grounding conductors, the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatuses installed specifically for the purpose of delivering energy from the premises wiring to the electric vehicle. Charging cords with NEMA 5-15P and NEMA 5-20P attachment plugs are considered EVSEs. Excludes conductors, connectors, and fittings that are part of the vehicle.

i. Level 1: A galvanically-connected EVSE with a single-phase input voltage nominally 120 volts ac and maximum output current less than or equal to 16 amperes ac.

ii. Level 2: A galvanically-connected EVSE with a single-phase input voltage range from 208 to 240 volts ac and maximum output current less than or equal to 80 amperes ac.

iii. **DC: A galvanically-connected EVSE that includes an off-board charger and provides DC current greater than or equal to 80 amperes DC.**

iv. Wireless / Inductive: A non-galvanically-connected EVSE.

- Does the above definition for DC EVSE appropriately account for DC Output products?
- The SAE J1772 standard contains definitions for Level 1 and Level 2 DC EVSE. Should EPA align with these definitions?

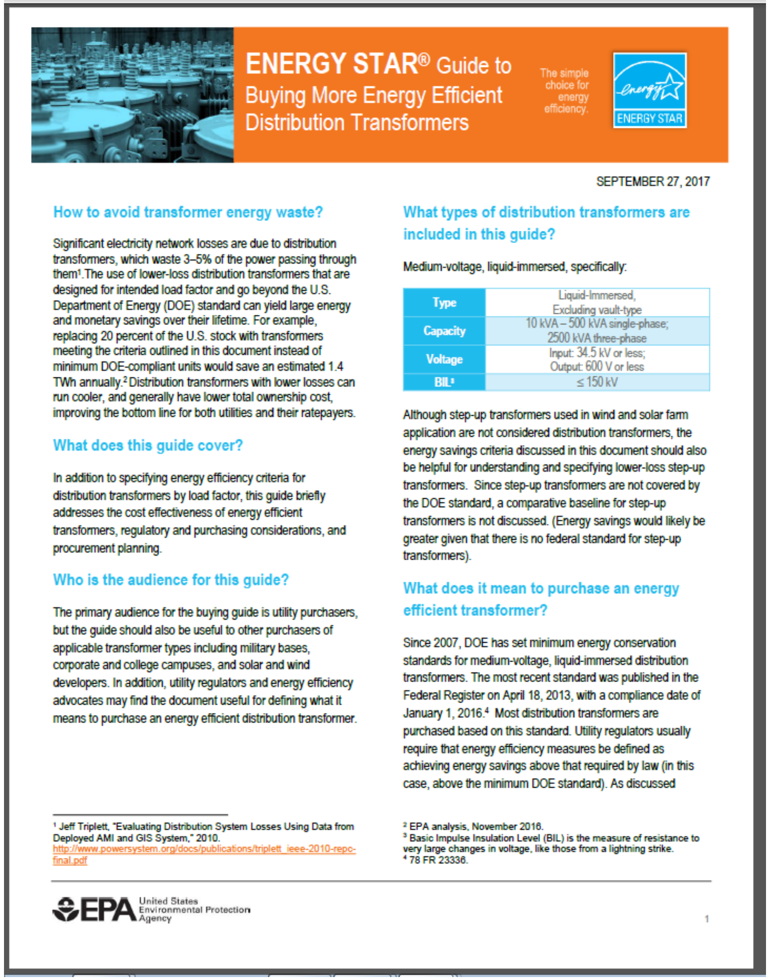
Specification – Scope

- EPA proposes to add DC EVSE to the current Version 1.0 scope:
  1. AC Level 1,
  2. AC Level 2, and
  3. AC Dual Input Level 1 and Level 2

- Other product types/components:
  - **Wireless charging**: Should EPA consider including wireless charging units in Version 1.1? What are the benefits and barriers for this technology that would make it appropriate or inappropriate for consideration at this time?

Specification – Scope Discussion Questions

Distribution transformers: Would purchasers benefit from additional information on more efficient distribution transformers, as presented in the *ENERGY STAR Distribution Transformers Buying Guide* because a transformer may need to be purchased for specific sites where DC EVSE will be installed?



ENERGY STAR® Guide to Buying More Energy Efficient Distribution Transformers

The simple choice for energy efficiency.

SEPTEMBER 27, 2017

How to avoid transformer energy waste?

Significant electricity network losses are due to distribution transformers, which waste 3–5% of the power passing through them[1]. The use of lower-loss distribution transformers that are designed for intended load factor and go beyond the U.S. Department of Energy (DOE) standard can yield large energy and monetary savings over their lifetime. For example, replacing 20 percent of the U.S. stock with transformers meeting the criteria outlined in this document instead of minimum DOE-compliant units would save an estimated 1.4 TWh annually.[2] Distribution transformers with lower losses can run cooler, and generally have lower total ownership cost, improving the bottom line for both utilities and their ratepayers.

What does this guide cover?

In addition to specifying energy efficiency criteria for distribution transformers by load factor, this guide briefly addresses the cost effectiveness of energy efficient transformers, regulatory and purchasing considerations, and procurement planning.

Who is the audience for this guide?

The primary audience for the buying guide is utility purchasers, but the guide should also be useful to other purchasers of applicable transformer types including military bases, corporate and college campuses, and solar and wind developers. In addition, utility regulators and energy efficiency advocates may find the document useful for defining what it means to purchase an energy efficient distribution transformer.

What types of distribution transformers are included in this guide?

Medium-voltage, liquid-immersed, specifically:

Type	Liquid-Immersed, Excluding vault-type
Capacity	10 kVA – 500 kVA single-phase; 2500 kVA three-phase
Voltage	Input: 34.5 kV or less; Output: 600 V or less
BIL[3]	≤ 150 kV

Although step-up transformers used in wind and solar farm application are not considered distribution transformers, the energy savings criteria discussed in this document should also be helpful for understanding and specifying lower-loss step-up transformers. Since step-up transformers are not covered by the DOE standard, a comparative baseline for step-up transformers is not discussed. (Energy savings would likely be greater given that there is no federal standard for step-up transformers).

What does it mean to purchase an energy efficient transformer?

Since 2007, DOE has set minimum energy conservation standards for medium-voltage, liquid-immersed distribution transformers. The most recent standard was published in the Federal Register on April 18, 2013, with a compliance date of January 1, 2016.[4] Most distribution transformers are purchased based on this standard. Utility regulators usually require that energy efficiency measures be defined as achieving energy savings above that required by law (in this case, above the minimum DOE standard). As discussed

[1] Jeff Triplett, "Evaluating Distribution System Losses Using Data from Deployed AMI and GIS System," 2010. http://www.powersystem.org/docs/publications/triplett_ieee-2010-repc-final.pdf

[2] EPA analysis, November 2016.

[3] Basic Impulse Insulation Level (BIL) is the measure of resistance to very large changes in voltage, like those from a lightning strike.

[4] 78 FR 23336.

United States Environmental Protection Agency

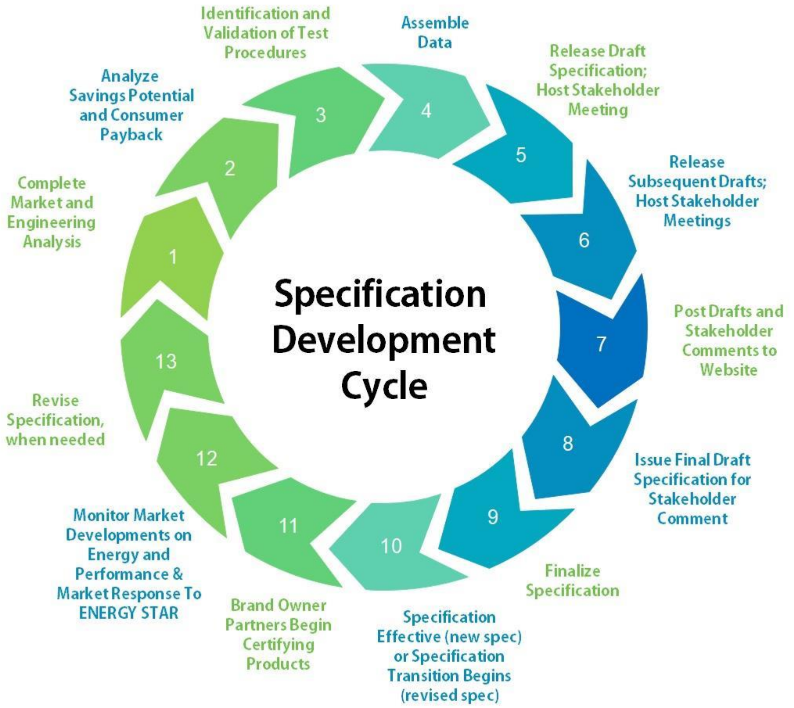
1

Specification – Efficiency Criteria

Time	Topic
12:00–12:15	Introductions and Overview of Specification Development Process
12:15–12:30	Potential for Energy Savings
12:30–1:00	Test Setup and Test Conduct
1:00–1:45	Test Procedures
1:45–2:00	Specification – Definitions and Scope
2:00–2:15	**Specification – Efficiency Criteria**
2:15–2:30	Timeline

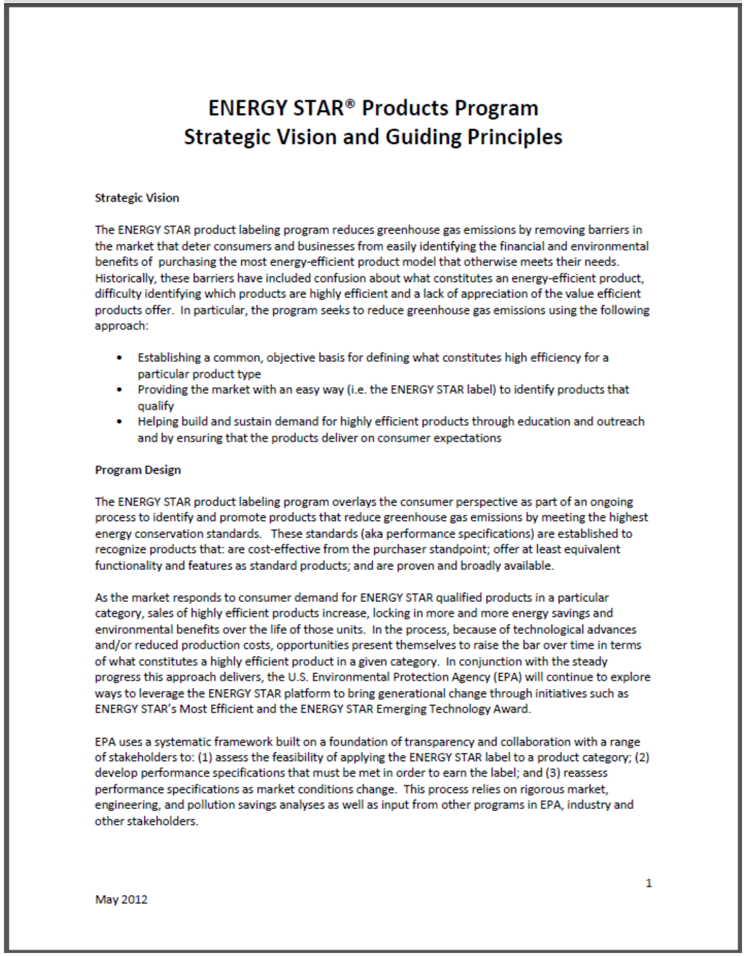
ENERGY STAR Specification Development

- EPA invites stakeholder comments on each draft. Comment periods for draft proposals are at least 30 days for written comments, with a 2-week comment period for a final draft specification.
  - EPA responds to these comments in note boxes in the subsequent draft or in a companion comment response matrix
- EPA frequently hosts stakeholder meetings or conference calls/webinars for further discussion of proposals throughout the process.



ENERGY STAR Specification Development

- The ENERGY STAR Strategic Vision and Guiding Principles Document contains on overview of the goals for each specification development process
- The process is data driven and the criteria is based on available efficiency data
  - EPA shares anonymous datasets with stakeholders
  - Efficiency levels selected are intended to reflect the top 25% of models available on the market



ENERGY STAR® Products Program
Strategic Vision and Guiding Principles

Strategic Vision

The ENERGY STAR product labeling program reduces greenhouse gas emissions by removing barriers in the market that deter consumers and businesses from easily identifying the financial and environmental benefits of purchasing the most energy-efficient product model that otherwise meets their needs. Historically, these barriers have included confusion about what constitutes an energy-efficient product, difficulty identifying which products are highly efficient and a lack of appreciation of the value efficient products offer. In particular, the program seeks to reduce greenhouse gas emissions using the following approach:

- Establishing a common, objective basis for defining what constitutes high efficiency for a particular product type
- Providing the market with an easy way (i.e. the ENERGY STAR label) to identify products that qualify
- Helping build and sustain demand for highly efficient products through education and outreach and by ensuring that the products deliver on consumer expectations

Program Design

The ENERGY STAR product labeling program overlays the consumer perspective as part of an ongoing process to identify and promote products that reduce greenhouse gas emissions by meeting the highest energy conservation standards. These standards (aka performance specifications) are established to recognize products that: are cost-effective from the purchaser standpoint; offer at least equivalent functionality and features as standard products; and are proven and broadly available.

As the market responds to consumer demand for ENERGY STAR qualified products in a particular category, sales of highly efficient products increase, locking in more and more energy savings and environmental benefits over the life of those units. In the process, because of technological advances and/or reduced production costs, opportunities present themselves to raise the bar over time in terms of what constitutes a highly efficient product in a given category. In conjunction with the steady progress this approach delivers, the U.S. Environmental Protection Agency (EPA) will continue to explore ways to leverage the ENERGY STAR platform to bring generational change through initiatives such as ENERGY STAR's Most Efficient and the ENERGY STAR Emerging Technology Award.

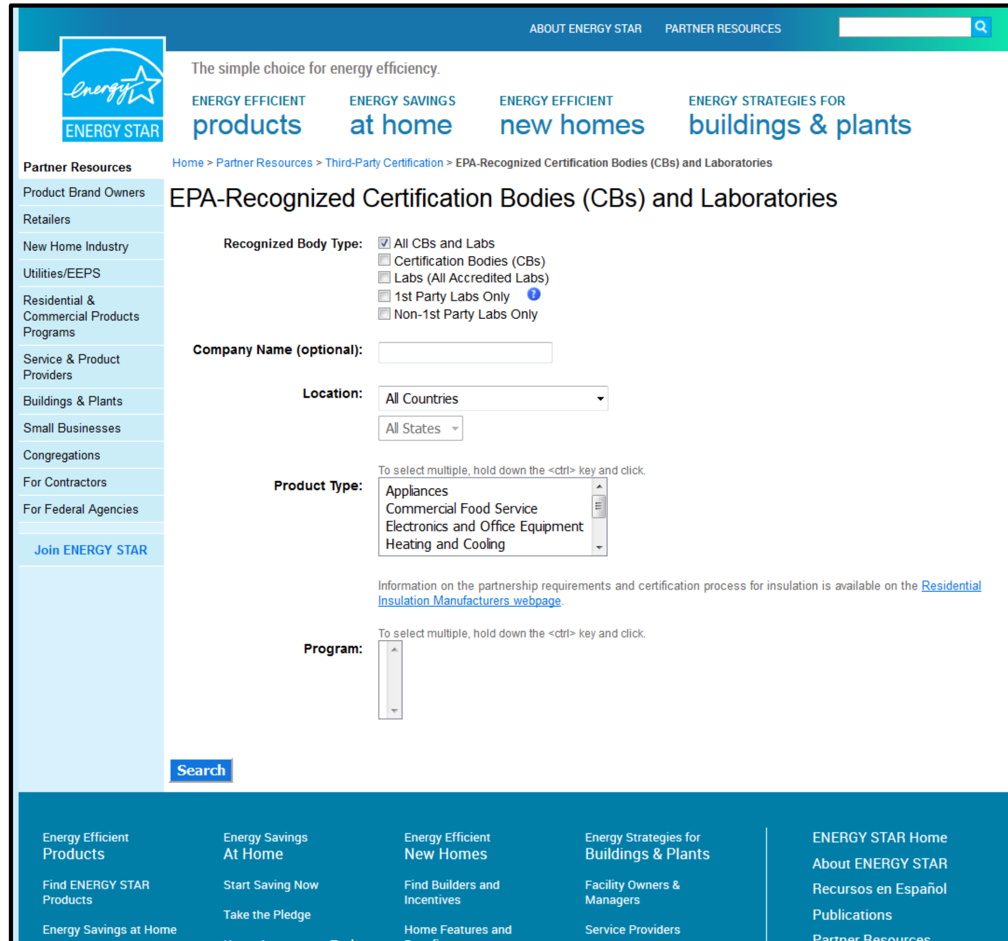
EPA uses a systematic framework built on a foundation of transparency and collaboration with a range of stakeholders to: (1) assess the feasibility of applying the ENERGY STAR label to a product category; (2) develop performance specifications that must be met in order to earn the label; and (3) reassess performance specifications as market conditions change. This process relies on rigorous market, engineering, and pollution savings analyses as well as input from other programs in EPA, industry and other stakeholders.

1

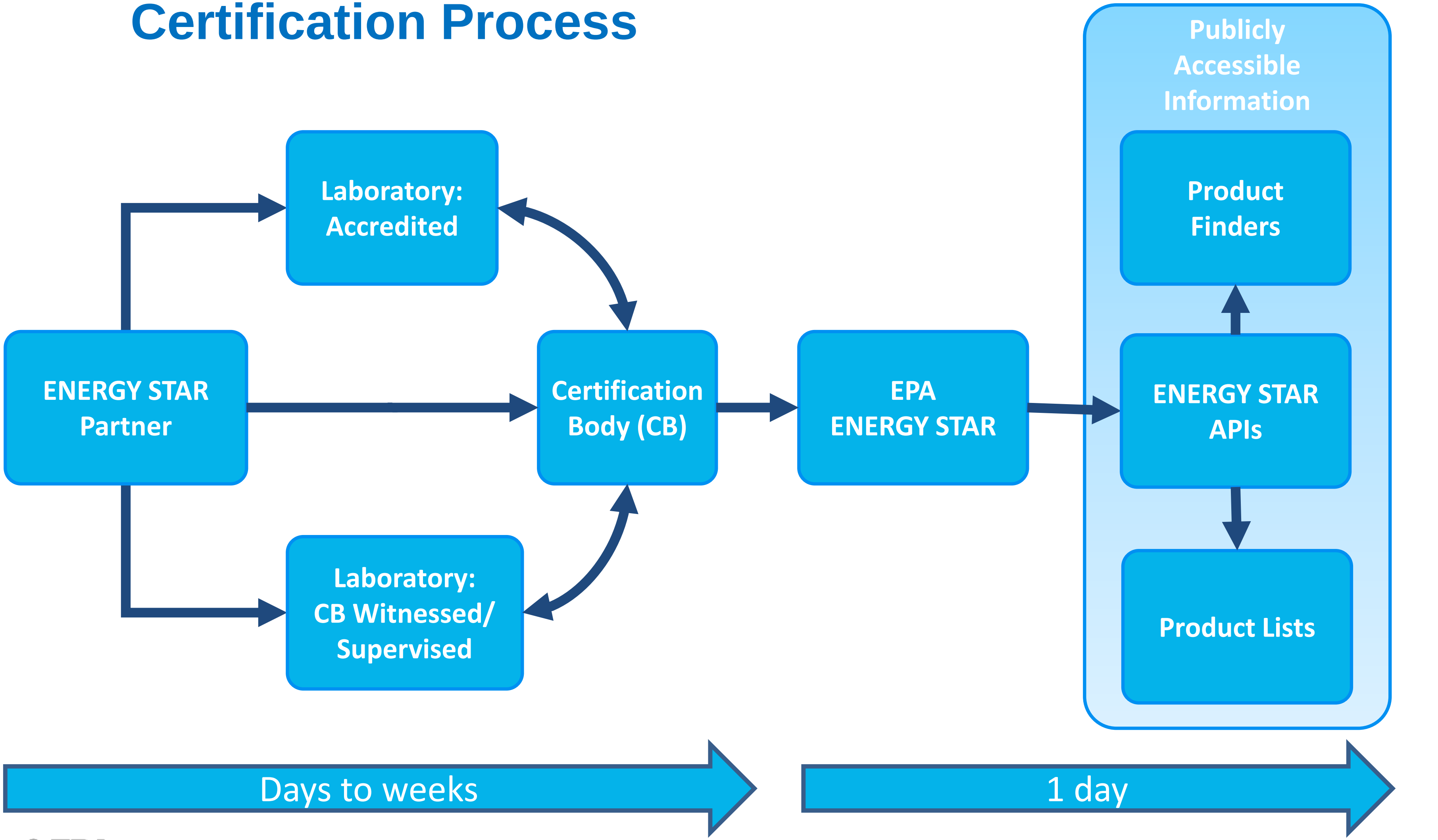
May 2012

ENERGY STAR Certification Process

- To ensure consumer confidence in the ENERGY STAR label and to protect the investment of ENERGY STAR partners, EPA requires all ENERGY STAR products to be **third-party certified**.
- Products are tested in an EPA-recognized laboratory and reviewed by an EPA-recognized certification body before they can carry the label.



Certification Process



Specification – Efficiency Criteria

- EPA gathered available research regarding DC EVSE power use but is not proposing any criteria at this time
- Operation Mode Research
  - Claimed efficiency ranges for DC EVSE on the market appear to be between 92% and 97% during active charging at full output
  - Idaho National Lab (INL) conducted testing on a DC EVSE and found efficiency at 30-50 kW ranging from 91% to 93%, and lower efficiencies at lower power levels
  - The International Energy Agency (IEA) and 4E published the following efficiency information based on manufacturer interviews:

Company interviews

			Active	Standby power			
Name	Type	Overall charge efficiency	Loading cable cooling	Idle	Signalling	Standby heating/cooling	Year
		[%]	[W]	[W]	[W]	[W]	
Company A	50kW DC Fast charge	92,00%	1000	80	unknown	500	2017
Company B	60kW DC Fast charge	95,00%	unknown	40	50	80-100	2017

Specification – Efficiency Criteria

- No Vehicle Mode Research
  - INL testing measurements ranged from 99 W before charging, to 150 W immediately after charging (due to cooling fan), and 110 W after charging
- Secondary and Tertiary Functions Research
  - Ambient lighting: The IEA-4E report noted that a manufacturer had stated that 50 W is needed for LED signal lighting
  - Cooling/Heating: The IEA-4E report concluded that heating and cooling may significantly impact energy use and manufacturers indicated a varying range of potential power consumption from 80 W for heating and 100 W for cooling, to a combined 500 W requirement
  - Liquid cooling of cables: One stakeholder noted that liquid cooling can draw about 1 kW

Specification – Efficiency Criteria

- Secondary and Tertiary Functions Research (continued)
  - High-resolution display
  - Network connection including Wi-Fi, cellular, or others

- EPA is also interested in the power factor associated with each mode

Specification – Efficiency Criteria Discussion Questions

- Do stakeholders have additional information on power consumption to share?
- Are there other features or functions missing from this discussion that should be taken into consideration for setting criteria for maximum power consumption?
  - EPA would welcome data on the power consumption of any of these features.

Secondary and Tertiary Functions: EPA understands that the following functions operate during these modes and is providing any readily-available data on power consumption of these functions:

i. Ambient lighting
   1. The IEA-4E report noted that a manufacturer had stated that 50 W is needed for LED signal lighting[5]. EPA believes that this would be the power required to provide light for multiple DC EVSE at one location, rather than for just one EVSE.

ii. Cooling/heating (depending on the temperature)
   1. Through manufacturer interviews, the IEA-4E report concluded that certain functions, like heating and cooling, may significantly affect the energy performance and need to be considered. Manufacturers indicated a vast range of potential power requirements for heating and cooling, from 80 W for heating and 100 W for cooling, to a combined 500 W requirement[5].

iii. Liquid cooling of the cables
   1. A stakeholder has noted that liquid cooling can draw about 1 kW

iv. High-resolution display

v. Network connection – Wi-Fi, Cellular, other

Specification – Efficiency Criteria

- Modular Products
  - Products that are sold in various configurations, depending on the application
  - These products would most likely be in the same product family but the available configurations vary in size and output capacity

- EPA is considering testing minimum and maximum power configurations to represent in-between configurations, similar to what is required in the Uninterruptible Power Supplies Specification:

Specification – Efficiency Criteria Discussion Question

For qualification of a Modular UPS Product Family where models vary by number of installed modules, the manufacturer shall select the maximum and minimum configurations to serve as Representative Models—i.e., a modular system shall meet the eligibility criteria in both its maximum and minimum non-redundant configurations. If the maximum and minimum configuration Representative Models meet the ENERGY STAR qualification criteria at their respective output power levels, all intermediate configuration models within a Modular UPS Product Family may be qualified for ENERGY STAR.

Would the testing approach outlined here be appropriate for modular EVSE products that can be configured to be larger or smaller depending on the application?

Timeline

Time	Topic
12:00–12:15	Introductions and Overview of Specification Development Process
12:15–12:30	Potential for Energy Savings
12:30–1:00	Test Setup and Test Conduct
1:00–1:45	Test Procedures
1:45–2:00	Specification – Definitions and Scope
2:00–2:15	Specification – Efficiency Criteria
2:15–2:30	**Timeline**


We are headed here
Specification Development Cycle
1
Complete Market and Engineering Analysis
2
Analyze Savings Potential and Consumer Payback
3
Identification and Validation of Test Procedures
4
Assemble Data
5
Release Draft Specification; Host Stakeholder Meeting
6
Release Subsequent Drafts; Host Stakeholder Meetings
7
Post Drafts and Stakeholder Comments to Website
8
Issue Final Draft Specification for Stakeholder Comment
9
Finalize Specification
10
Specification Effective (new spec) or Specification Transition Begins (revised spec)
11
Brand Owner Partners Begin Certifying Products
12
Monitor Market Developments on Energy and Performance & Market Response To ENERGY STAR
13
Revise Specification, when needed

Next Steps

Event	Date
Version 1.1 Discussion Guide Published	*May 24, 2018*
Version 1.1 Discussion Guide Webinar	*June 4, 2018*
Comments Due	**June 25, 2018**
Version 1.1 Draft 1 Test Method Expected	**Late Summer 2018**
Release Subsequent Drafts of Test Method	**Fall 2018**
Release Version 1.1 Draft 1 Specification	**Winter 2018**
Version 1.1 Effective Date	**Summer 2019**

- EPA plans to come close to finalizing the Version 1.1 EVSE Test Method before beginning Version 1.1 Specification development to collect data based on the test method to inform the specification.

Comments

- Again, comments and data are due on **June 25, 2018.**
- Please send all comments to:

EVSE@energystar.gov

- Unless marked as confidential, all comments will be posted to the EVSE product development page at https://www.energystar.gov/products/spec/electric_vehicle_supply_equipment_version_1_1_pd
- Accessible through www.energystar.gov/RevisedSpecs and clicking on "Version 1.1 is in development" under "Electric Vehicle Supply Equipment"

Thank you!

To be added to EPA's stakeholder listserve
to receive specification updates, please email:

EVSE@energystar.gov.

James Kwon
Product Manager, ENERGY STAR
(202) 564-8538
Kwon.James@epa.gov

www.energystar.gov/productdevelopment