ENERGY STAR®
Electric Vehicle Supply Equipment
Test Method and Launch Webinar

July 9, 2015

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/NewSpecs
  - *Follow link to "Version 1.0 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: **322-020** #

  - 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

Time	Topic
11:00–11:45	**Introduction**
11:45–12:15	Definitions and Scope
12:15–12:45	Test Setup
12:45–1:15	Test Conduct
1:15–1:30	Additional Features and Functionality
1:30–1:45	Next Steps
1:45–2:00	Open Comment

Introductions

Verena Radulovic
U.S. Environmental Protection Agency

Barney Carlson
Idaho National Laboratory

Matt Malinowski
ICF International

Ted Bohn
Argonne National Laboratory

Sam Levinson
ICF International

Doug Frazee
ICF International

Bruce Nordman
Lawrence Berkley National Laboratory

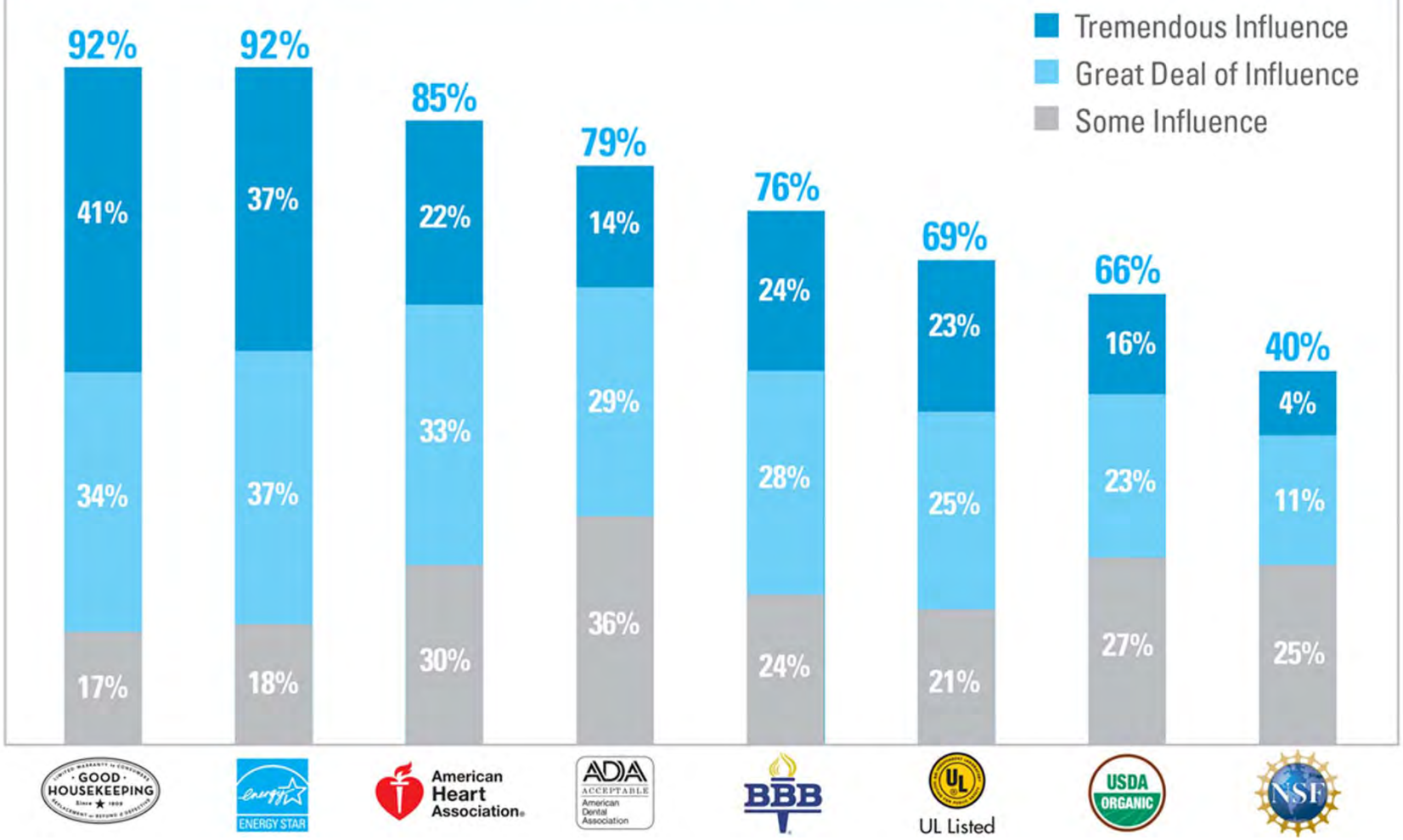
Alan Meier
Lawrence Berkley National Laboratory

Webinar Agenda

- Introduction to ENERGY STAR
  - Tenets of the Program
  - 3rd Party Certification
- Discussion of the EVSE Test Method
  - Definitions
  - Scope
  - Test Set-up
  - Test Conduct
  - Connected Functionality
- Next Steps
- Q/A Session

- Voluntary climate protection partnership with the U.S. EPA since 1992
- Strategic approach to energy management, promoting energy efficient products and practices
- Tools and resources to help save money and protect the environment
- To date, **ENERGY STAR** has prevented 2 billion metric tons of greenhouse gas emissions and saved $300 billion on utility bills

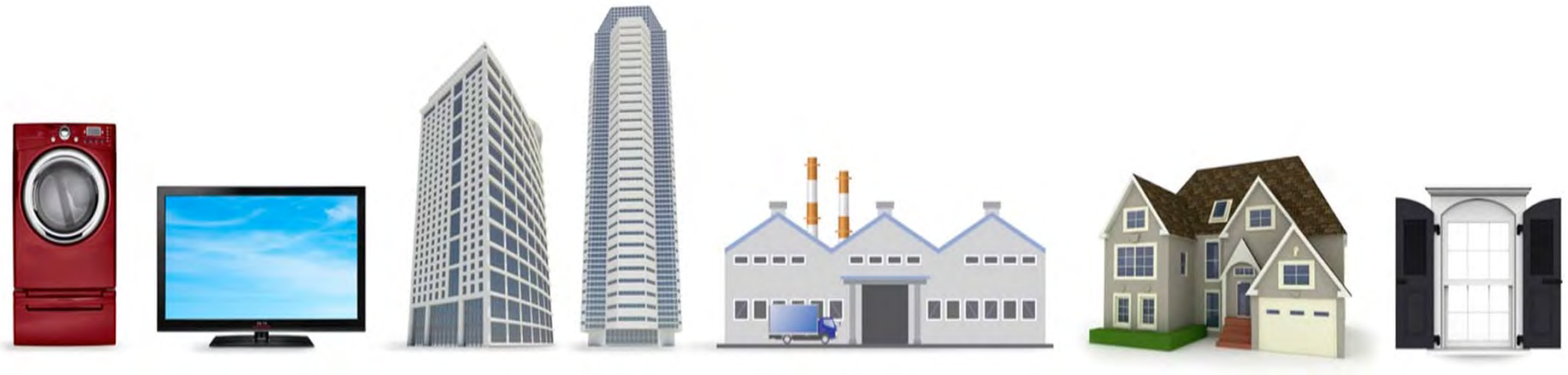
Top-Ranked Consumer Emblem

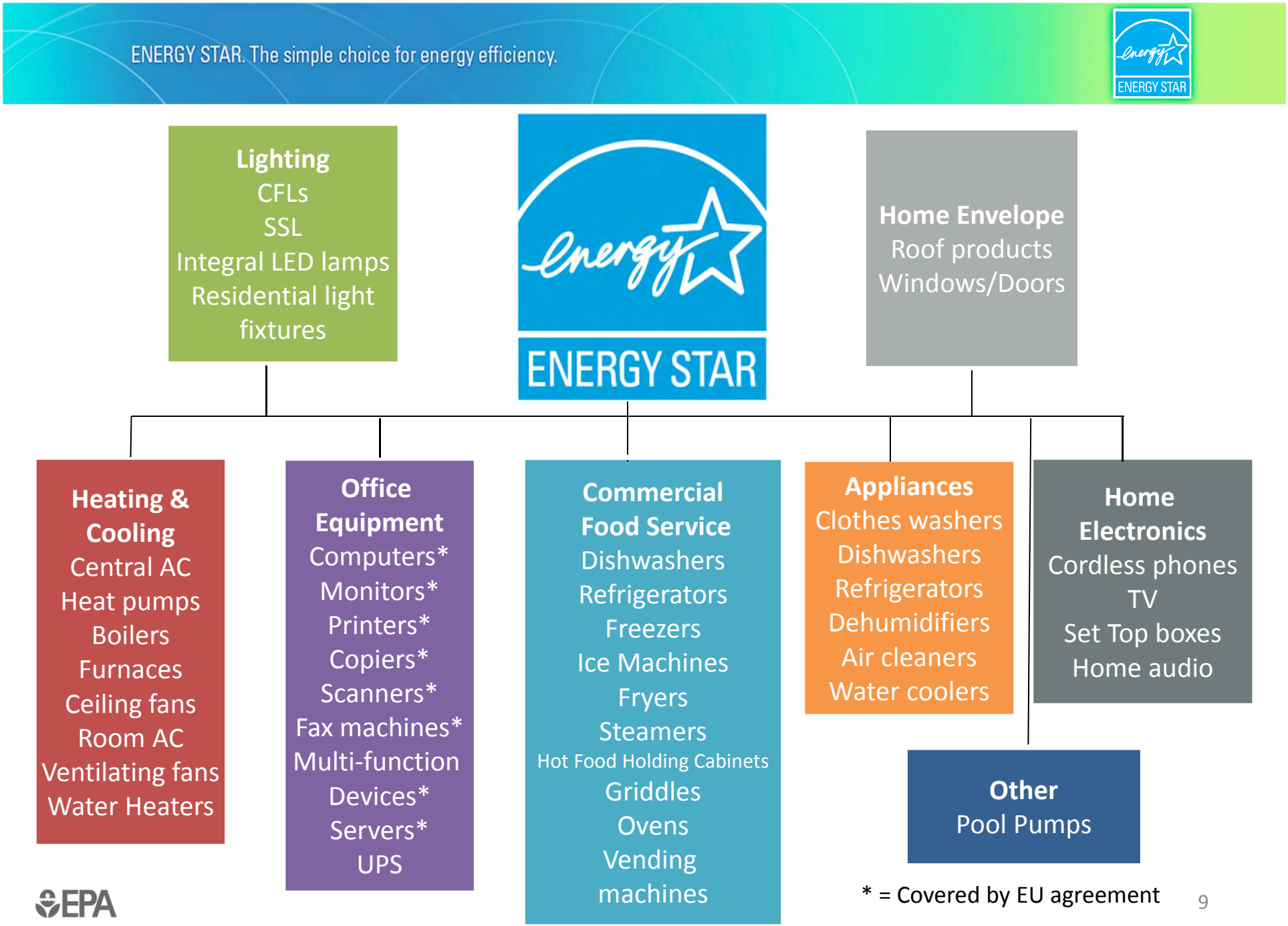


EPA

EPA's ENERGY STAR identifies the most energy-efficient products, buildings, plants, and new homes – all based on the latest government-backed standards.

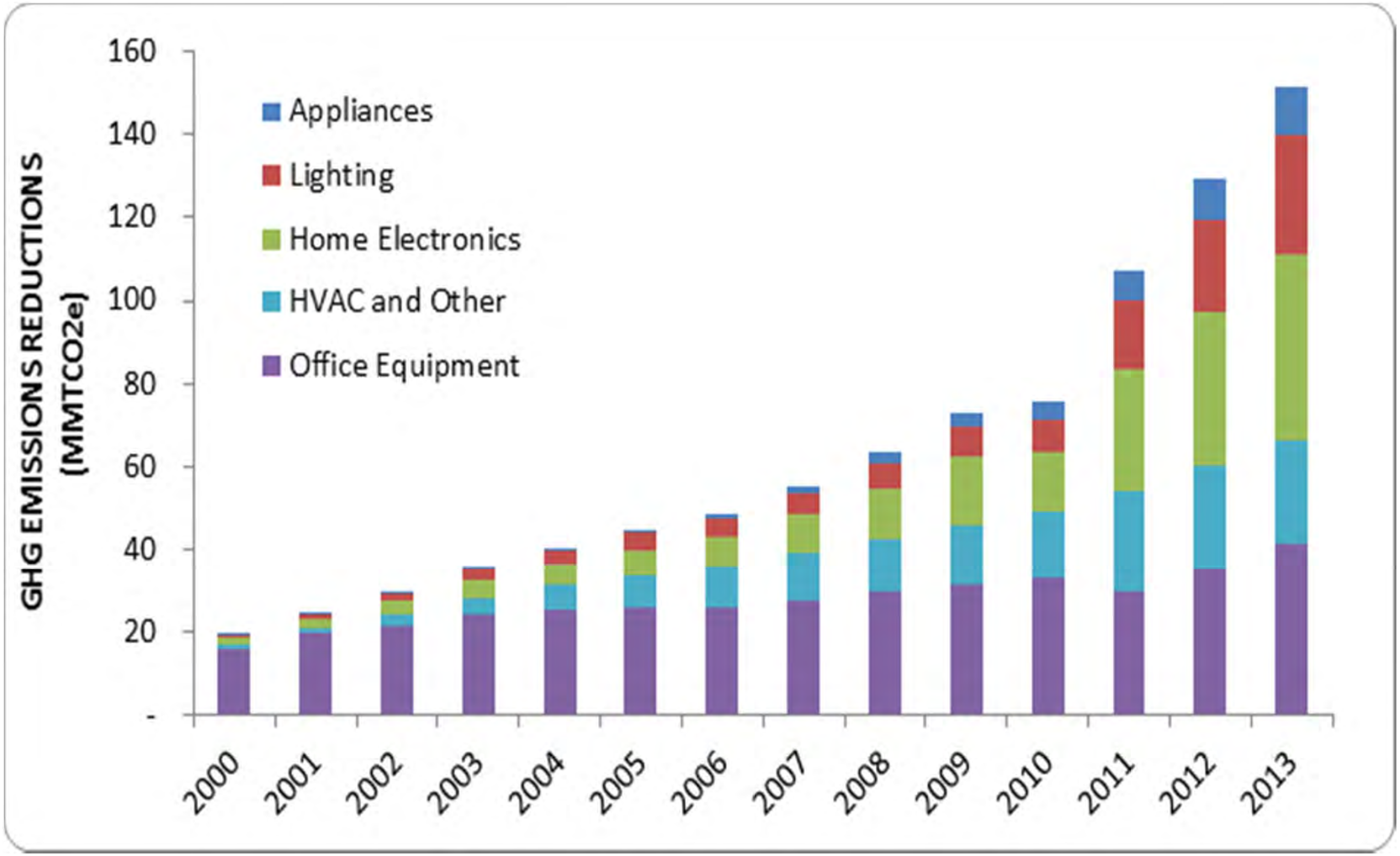
Today, every ENERGY STAR label is verified by a rigorous third-party certification process.





* = Covered by EU agreement

Greenhouse savings by product category



Specification Development Cycle

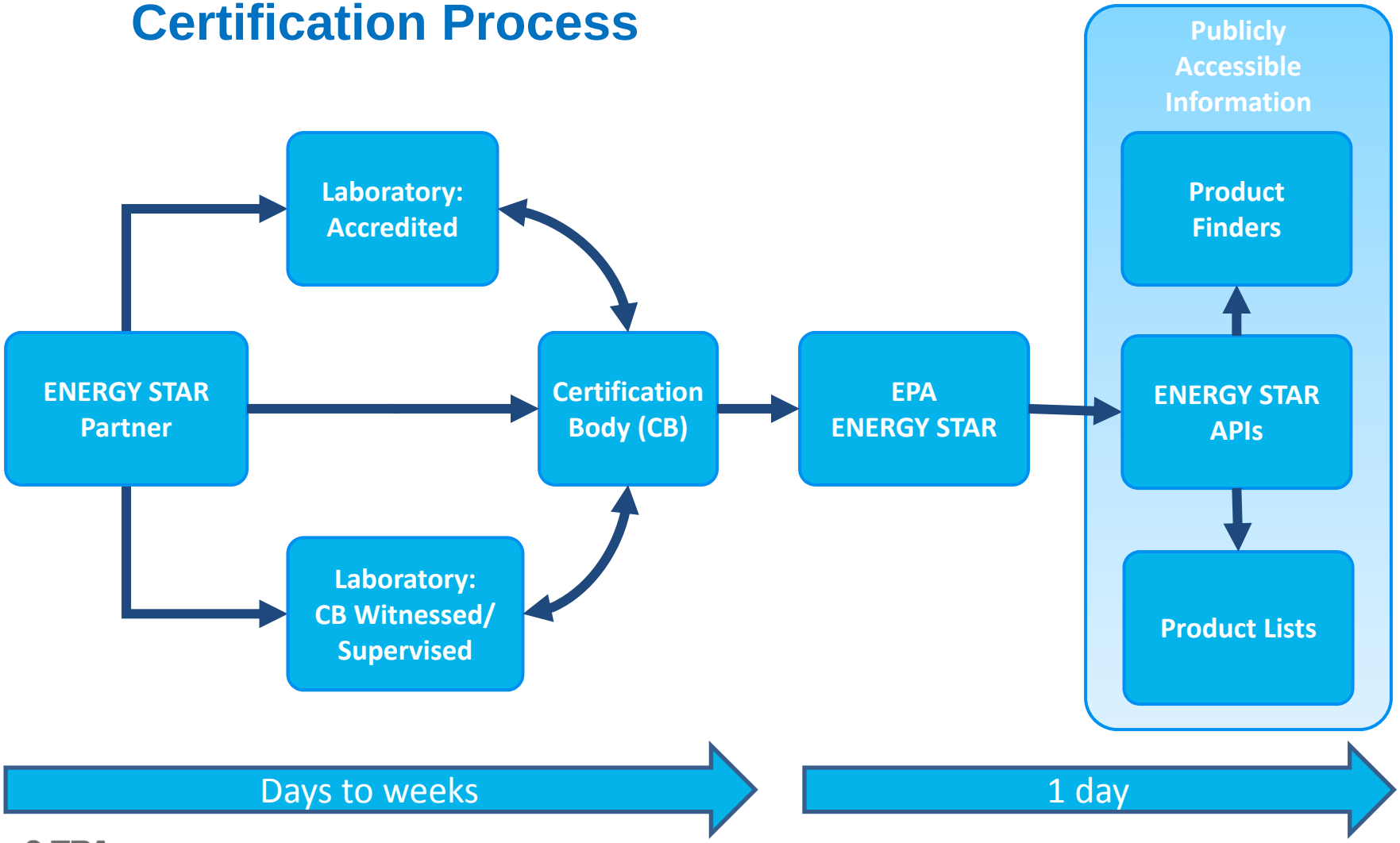
Guiding Principles of Specification Development

- Cost-effective efficiency
- Performance maintained or enhanced
- Significant energy savings potential
- Efficiency improvements are achievable with non-proprietary technology
- Product differentiation and testing are feasible
- Labeling can be effective in the market

3rd Party Certification

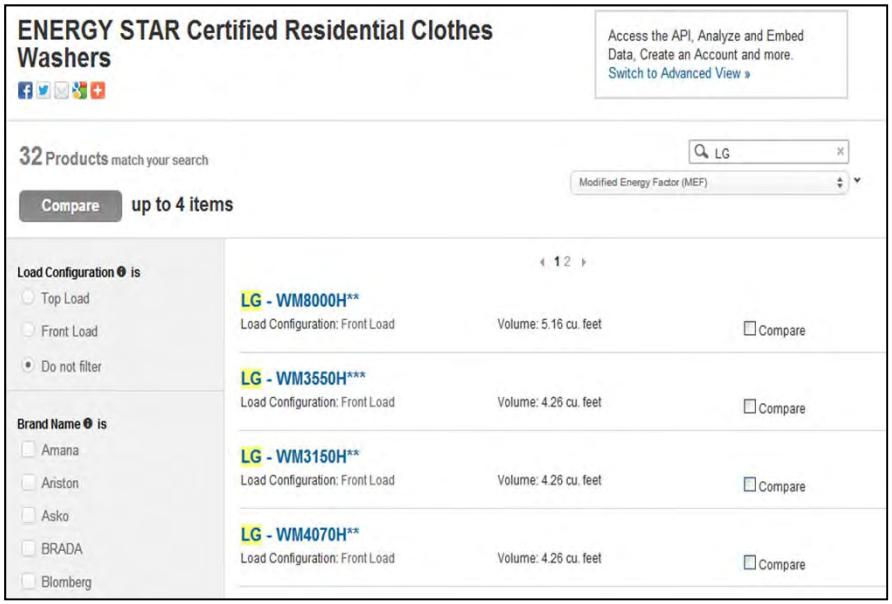
- The U.S. Environmental Protection Agency (EPA) requires all ENERGY STAR products to be third-party certified.
  - Products are tested in an EPA-recognized laboratory and reviewed by an EPA-recognized certification body before they can carry the label.
- Representative models and product families will be established for EVSE
  - Test results from one model can be used to represent other models that have the same core components.
  - Reduces time and testing burden for certification.

Certification Process



Resources - Product Finder Tool

- Public-facing tool consumers, retailers, utilities and other stake-holders use to access product data
- www.energystar.gov/productfinder



Benefits:

- Provide better access to EPA product data for all stakeholders
- Ease finding product data
- Improve data quality
- Model data updated daily
- Models searchable by brand, model name, model number, additional information

EPA

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Introducing ENERGY STAR Draft 1 Test Method for EVSE

- Draft developed with Dept. of Energy's Argonne National Laboratory, Idaho National Laboratory, and Lawrence Berkeley National Laboratory.
  - Brings together expertise in EV-related standards (SAE), EVSE testing and network connectivity.

Addresses:

- Scope
- Definitions
- Set-up to test energy efficiency of different modes
- Set-up to account for network connectivity
- Other features (i.e. occupancy sensing)
- Placeholder for functionality related to smart grid

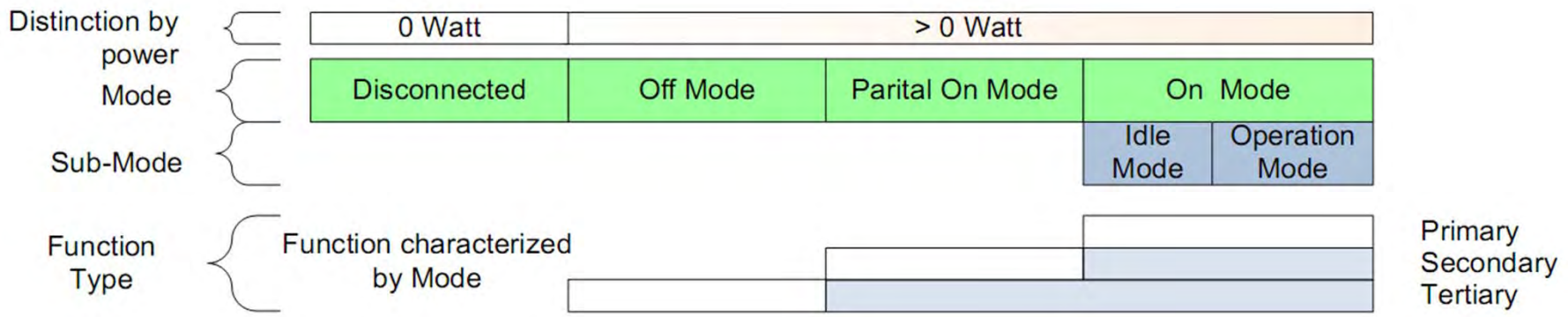
Electric Vehicle Supply Equipment – Product Classification

- EVSE includes the conductors, electric vehicles connectors, attachment plugs and all other fittings devices and apparatuses installed specifically to deliver energy from the premises wiring to the electric vehicle.

- **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.
- **Level 2:** A galvanically-connected EVSE with a single-phase input voltage range from 208 to 240 volts AC and maximum output current greater than 16 amperes AC and less than 80 amperes AC.
  - Level 1 and 2 definitions are intended to be consistent with the requirements in SAE J1772, with some additional clarifications.

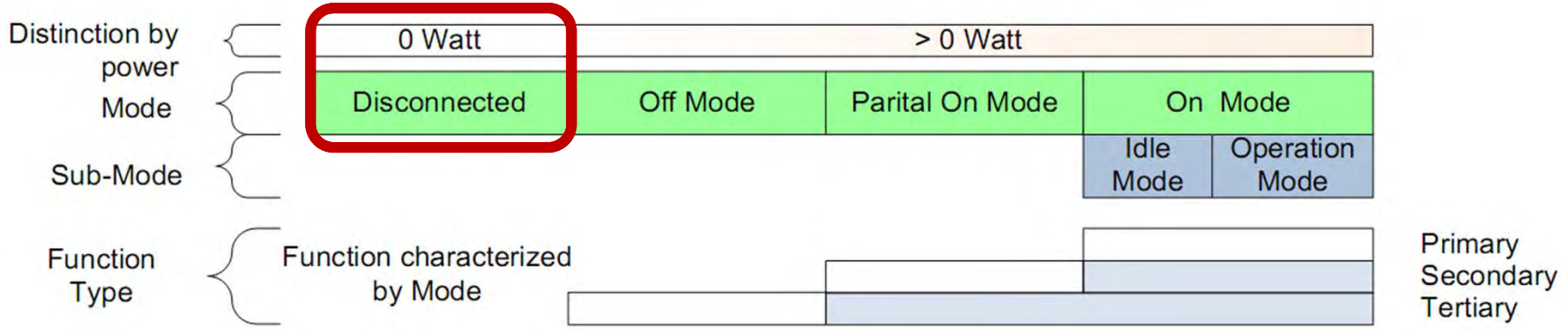
Operating Modes

- Definitions based on the standard operational mode names from IEC 62542 – Environmental Standardization for Electrical and Electronic Products and Systems.
- Consistent operating mode terminology eliminates confusion and ambiguity across product types.



Operating Modes

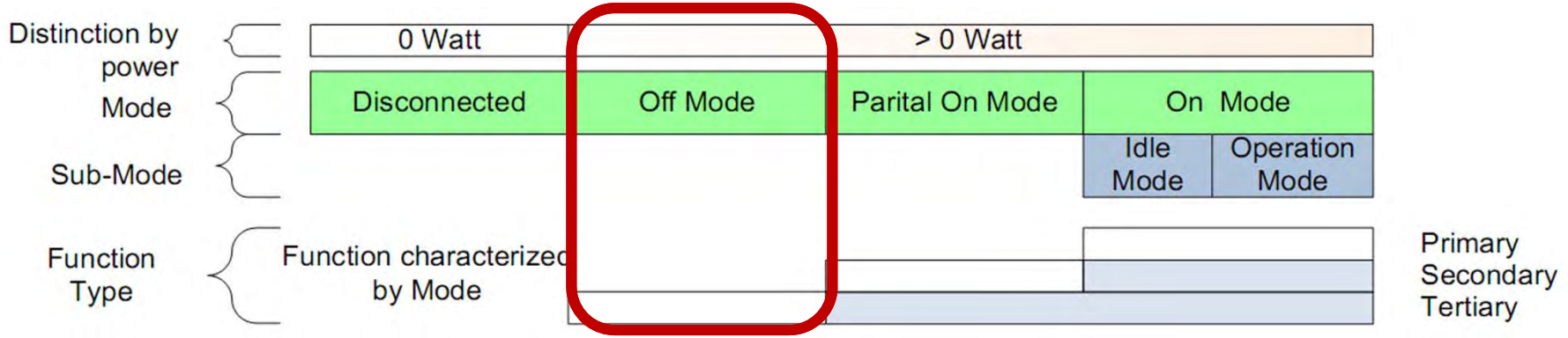
- **Disconnected:** Condition of the equipment during which all connections to power sources supplying the equipment are removed or galvanically isolated and no functions depending on those power sources are provided.



Operating Modes

- **Off Mode:** Condition during which the equipment only provides tertiary function(s).
- **Tertiary Function**: Function other than a primary or a secondary function.

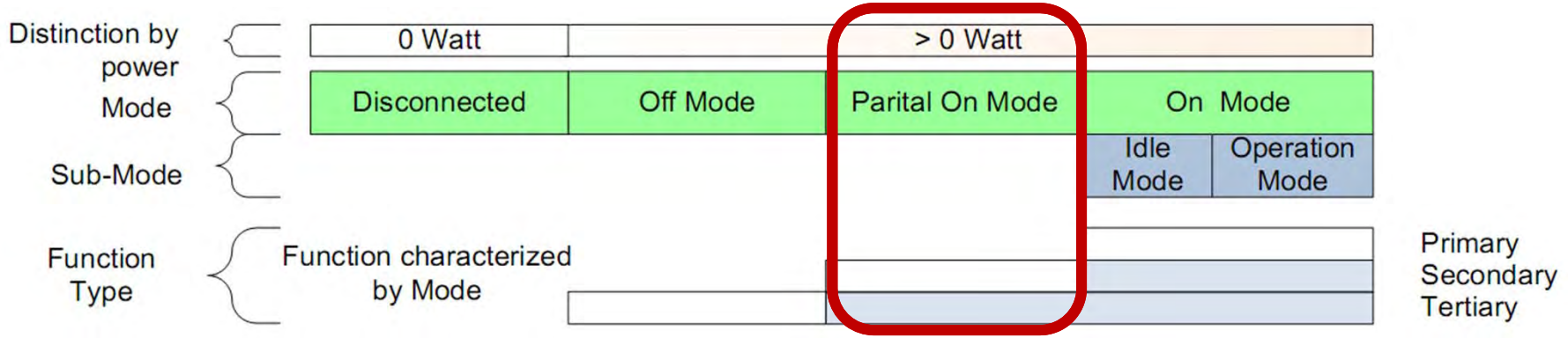
  Example: An EMC filter, status indication, and area lighting if present, provides their function in off mode, partial on mode and on mode.



Operating Modes

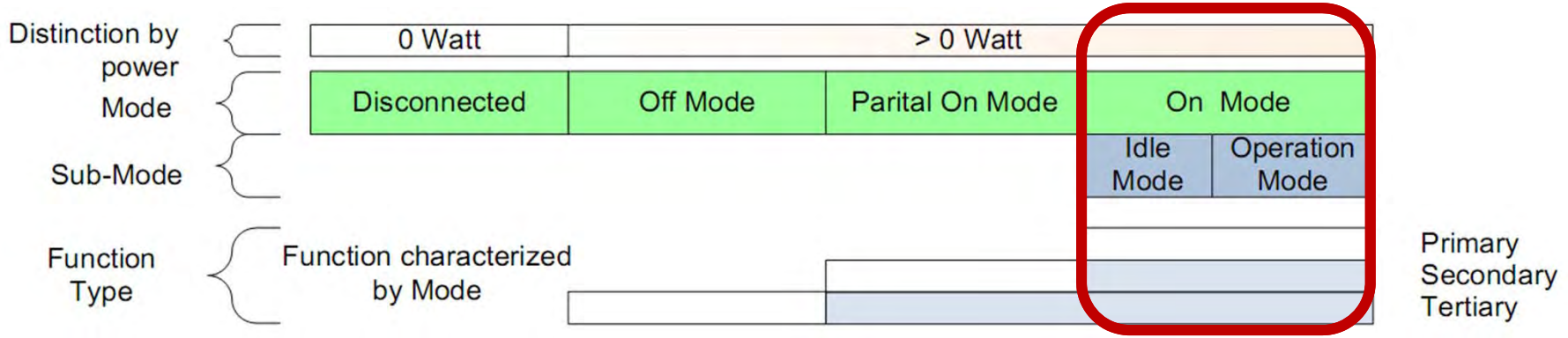
- **Partial On Mode or States A or B1:** Condition during which the equipment provides at least one secondary function but no primary function.
- **Secondary Function:** Function that enables, supplements or enhances a primary function. For EVSE, Secondary Functions are:

  Communicating with the vehicle; Illumination of display, indicator lights, or ambient lighting; Network communication; Public access control (RFID card, authorization, etc.); Use of ABC; Use of Occupancy Sensor; Wake-up function.



Operating Modes

- **On Mode:** Condition during which the equipment provides at least one primary function or can promptly provide a primary function
  - **Operation Mode or State C:** Condition during which the equipment is performing at least one primary function.
  - **Idle Mode or State B2 or C:** Condition during which the equipment can promptly provide a primary function but is not doing so.
- **Primary Function:** Function providing the intended purpose. For EVSE, Primary Functions are: Charging.



Scope

- Included Products: Level 1 and Level 2 EVSE:
  - Have a rated current ≤ 80 amperes
  - Have an SAE J1772 coupler intended for electric vehicle charging
  - Are outside the vehicle

- Excluded Products:
  - Fast DC EVSE
  - Wireless/Inductive EVSE
  - Power components inside the vehicle

  - May be considered in the future

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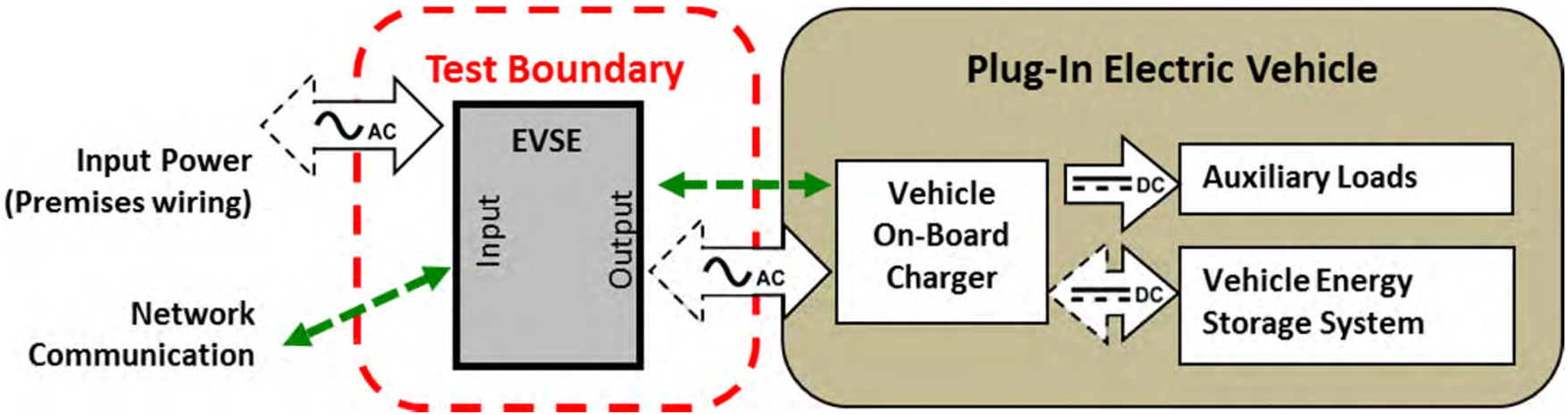
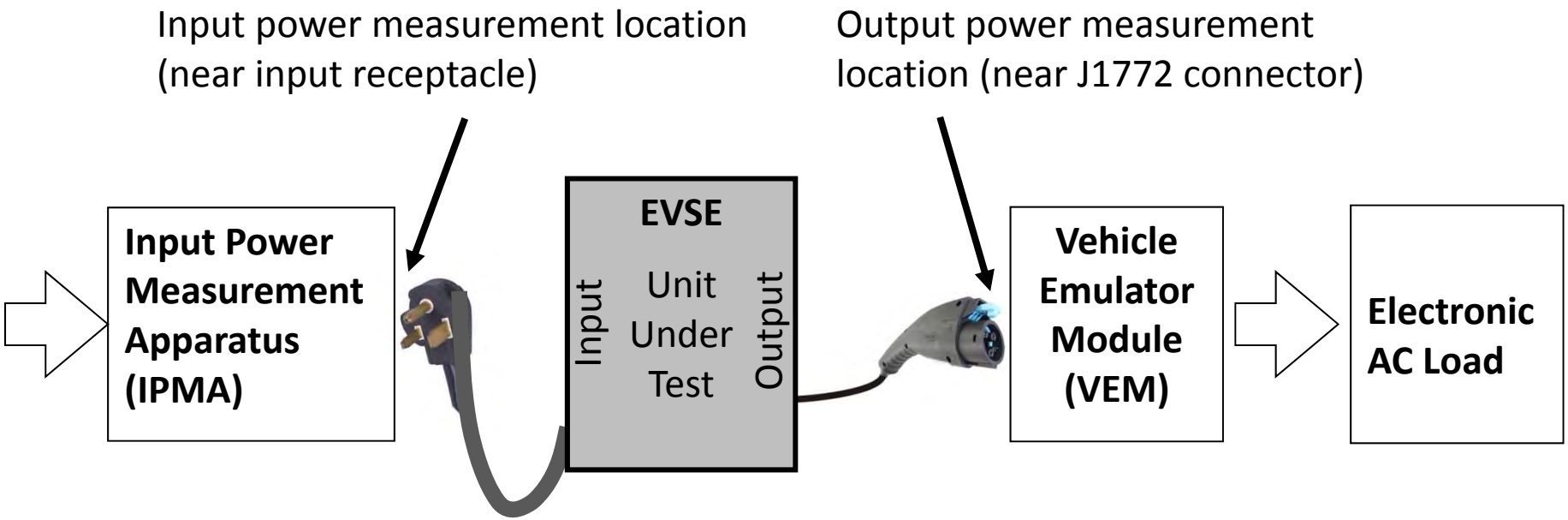
EVSE Test Boundary



Test Setup

- Input Power Measurement Apparatus (IPMA)
- EVSE: Unit Under Test (UUT)
- Vehicle Emulator Module (VEM)
- AC Load



Test Setup – Voltage

- The UUT shall be operated at the first (highest) rated voltage and rated frequency combination specified in Table 1

Table 1: Input Supply Requirements

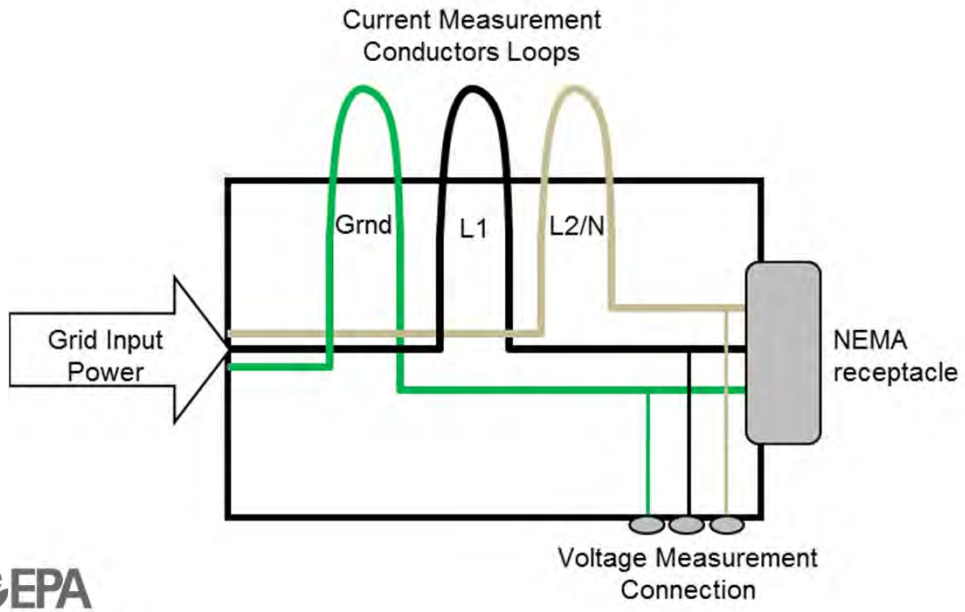
Voltage	Frequency
240 V AC	60 Hz
208 V AC	60 Hz
120 V AC	60 Hz

Table 2: Input Power Tolerances

Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency Tolerance
+/- 4.0 %	5.0 %	+/- 1.0 %

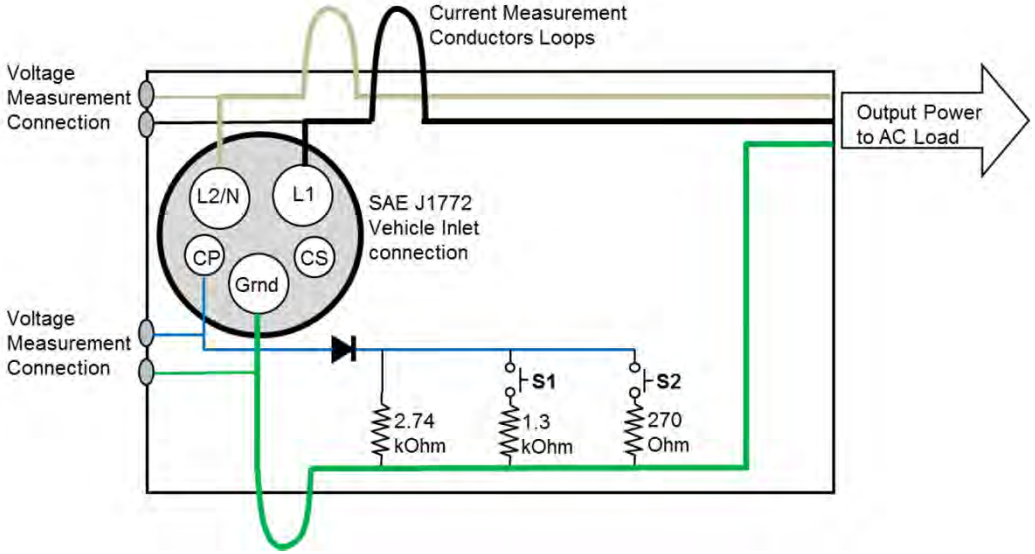
Test Setup – Input Power Measurement Apparatus (IPMA)

- Examples of setup for current and voltage measurement (photos do not show IPMA)
  - Current Loop external to enclosure
  - “Finger safe” voltage taps



Test Setup – Vehicle Emulator Module (VEM)

- Examples of VEM variations S1, S2 (photos do not specifically show VEM)
  - Manual switch for State A, B, C
  - Remotely controlled switches / relays



Test Setup – Measurement Equipment

- Power meter
  - Direct voltage measurement
  - Current clamp-on

    or
  - Shunt current measurements
- Measurements
  1. Input power to Unit Under Test
  2. Input ground current
  3. Output power from Unit Under Test
  4. Control Pilot voltage characteristics
     - Peak DC voltage (State)
     - Frequency (verification)
     - Duty Cycle (max allowable current)

2 Wire Single Bar

Test Setup – Ambient Conditions

- Ambient Temperature shall remain at 25°C ± 5°C.
- Relative humidity shall be between 10% and 80%.

Test Setup – Network Connectivity

- Check for and enable network connections
  - Network connections should be listed in the user manual or installation instructions.
  - 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.
  - If the UUT has network connection capabilities, the capabilities shall be activated using any standard or optional hardware provided by the manufacturer, and the UUT shall be connected to a live physical network
  - The UUT shall maintain this live connection to the network for the duration of testing, disregarding any brief lapses.

Test Setup – Network Connectivity

- The network shall support the highest and lowest data speeds of the UUT's network function.
- An active connection is defined as a live physical connection over the physical layer of the networking protocol.
- If the UUT is equipped with multiple network capabilities, only one connection shall be made in the following order of preference:
  1. **Wi-Fi** (Institution of Electrical and Electronics Engineers - IEEE 802.11- 2007);
  2. **Ethernet** (IEEE 802.3). If the UUT supports Energy Efficient Ethernet Defined in Clause 78 of IEEE 802.3 (originally specified in IEEE 802.3az), then it shall be connected to a device that also supports IEEE 802.3az;
  3. **Cellular modem**; or
  4. Other.

Test Setup – Room Illuminance

- Borrowing from the Displays and Televisions test methods, EPA is proposing a simplified test of Automatic Brightness Control (ABC)
- The simplified test will only test in one condition, dark. This will prove energy savings; however, it will not determine representative power values.
- All products with ABC enabled by default shall be tested in a darkened room or enclosure to simulate nighttime conditions (< 11 lux) .
- Alternatively, the ABC sensor shall be covered with an opaque material to block all light entering the sensor.

Test Setup – Room Illuminance

- Power shall be disconnected from the UUT.
- An illuminance meter shall be placed vertically, parallel to the UUT standing upright such that the meter's sensor faces away from the UUT horizontally.
- The illuminance meter shall be placed immediately in front of the UUT's automatic brightness control (ABC) sensor.
- No test room surface (i.e., floor, ceiling, and wall) shall be within 0.6 m of the center of the UUT's ABC Sensor.
- The ambient light shall be adjusted such that the illuminance meter reads less than 11 lux.

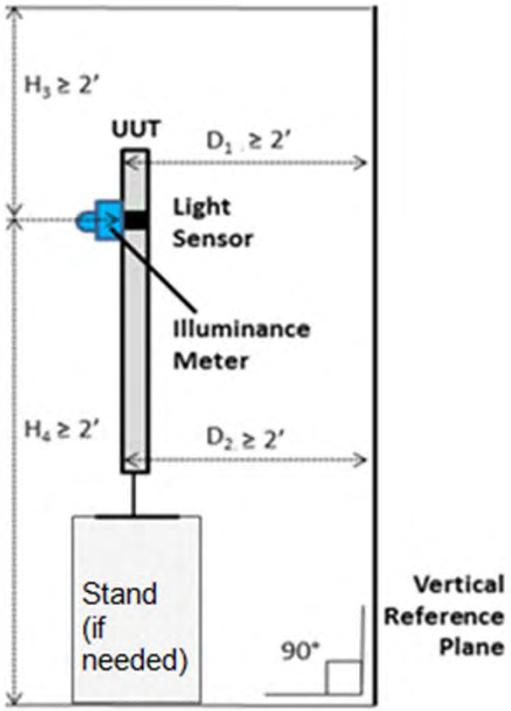


Figure 5: Illuminance Test Setup - Side View

Test Setup – Room Illuminance

- **EPA seeks comment** on:
  - The presence of ABC or occupancy sensing in today's equipment and how best to highlight low-power modes of operation, including sensor design and location that might impact EVSE testing.
  - The prevalence of Advertisement and Area lighting, intended to call attention to an EVSE.

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UUT Preparation

- Connect and power on the Unit Under Test (UUT)
- Test in as-shipped configuration, unless required otherwise

- Power measurements shall be conducted per IEC 62301 Ed. 2.0
  - Sampling (all modes and power states)
  - Average (where mode and power is stable)
  - Direct reading (where mode and power is stable)

- Stability is determined by analyzing the slope between two power measurements, ≥ 10 minutes apart
  - < 10 mW/h, for power measurements ≤ 1 W
  - < 1%, for power measurements > 1 W

Test Conduct—Off, Partial On, and Idle Modes

- **Off Mode:** Measure and report: input power and ground current
- **Partial On and Idle Mode:**
  - **State A (SAE J1772 disconnected):** Input power and ground current
  - **State B (SAE J1772 connected, but vehicle not ready):**
    - Input power
    - Ground current
    - Control Pilot signal
  - **State C (SAE 1772 connected, and vehicle ready):**
    - Input power
    - Ground current
    - Control Pilot signal
    - Output voltage and power (to verify zero output power)

Test Conduct—Operation Mode

- Calculate the available current based on Control Pilot duty cycle:
- If < 90% of the nameplate output current
  - verify the UUT setup
  - if necessary, contact the UUT manufacturer to verify the full current output capability and proper setup
  - verify that there is not an active demand response / current curtailment request

Table 3: Available Current Calculation from Control Pilot Duty Cycle % (SAE J1772)

Duty Cycle (%)	Available Current (A)
10% ≤ Duty Cycle ≤ 85%	% Duty Cycle x 0.6
85% < Duty Cycle ≤ 96%	(% Duty Cycle – 64) x 2.5

Test Conduct—Operation Mode

- Testing conducted in State C (SAE 1772 connected, and vehicle ready)
- Operate at full current for ≥ 30 min

- Test each supported loading condition:

Table 4: Loading Conditions for UUT

	Test Condition Current (A)	Example for 32 A Nameplate UUT	Example for 16 A Nameplate UUT
Loading Condition 1	100% of Full Current Output Current ±2%.	32.0 A	16.0 A
Loading Condition 2	30.0 A ±0.6 A	30.0 A	Do not test
Loading Condition 3	15.0 A ±0.3 A	15.0 A	15.0 A
Loading Condition 4	2.00 A ±0.1A	2.0 A	2.0 A

Test Conduct—Operation Mode

- Measure the following parameters, following a 5 minute/1% stability test of input power:
  - RMS input current;
  - RMS input voltage;
  - Instantaneous input power;
  - Input power factor;
  - RMS input ground leakage current;
  - RMS output current;
  - RMS output voltage;
  - Instantaneous output power; and
  - Calculated efficiency (instantaneous output power / instantaneous input power).

Full Network Connectivity Testing

- For products with data/networking capabilities, the UUT will be tested in Partial On Mode according to section 6.7.5.2 of CEA 2037-A, Determination of Television Set Power Consumption.

- Given that the purpose of network connections in EVSE is often identification or payment processing, EPA welcomes feedback on whether EVSE would accept an external signal from the network (potentially blocked for security reasons) as required by the test.

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Smart Grid Connectivity

- Demand Response
  - Lower peak period consumption, potentially reducing the need for new power plants
  - Increase penetration of clean renewable energy

- **Proposed idea:** ENERGY STAR EVSE would be capable of receiving price signals and adjusting charging in accordance with consumer preferences
- **Proposed idea**: ENERGY STAR EVSE would be capable of transmitting EVSE meter data to consumer authorized devices, apps and services in order to help ensure consumers understand their EV "fuel" costs and to encourage reduced consumption.

- **EPA welcomes thoughts on if/how to test such an approach?**

EVSE as a Hub

- The combination of vehicle electrification, energy storage, and power from photovoltaics present an unique opportunity for product to grid cooperation.
- EVSEs have the potential to evolve into a hub for collecting and distributing DC power in a building. EPA is interested in incorporating and addressing emerging features such as the ability to:
  - Receive DC power, such as from PV panels or local storage
  - Provide DC power to other devices in a building, possibly via USB, Ethernet, or other power transmission medium
  - Supply AC power to a building or specific appliances, whether or not the utility grid is operational
  - Coordinate power distribution with other entities in the building
  - Include electricity storage internal to the EVSE
  - Receive power from a vehicle.

User Interface

- EPA seeks opportunities to promote and encourage adoption of best practices for communicating information to the consumer that may impact the product's energy consumption.

- EPA requests manufacturers to submit information or provide feedback on EVSE user interface elements—words, symbols, colors, and dynamic operation—to better understand their "user-friendliness"

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Next Steps

Test Method:

- Comments and feedback due to EPA on **July 31, 2015.**
- Draft 2 Test Method **late September/early October 2015**, followed by data collection and final draft of test method later in the Fall.
- Final Draft Test Method to be issued in **early spring 2016**

Specification:

- **Fall 2015** develop Draft 1 specification for stakeholder feedback.
- Subsequent Drafts in late **fall 2015, early winter 2016**.
- Anticipate finalizing specification in **spring 2016**.

Comments

- Again, comments and feedback are due on **July 31, 2015.**
- Please send all comments to:

ElectricVehicleSupplyEquipment@energystar.gov

- Unless marked as confidential, all comments will be posted to the EVSE product development page at www.energystar.gov/products/spec/electric_vehicle_supply_equipment_pd
- Accessible through www.energystar.gov/NewSpecs and clicking on "Version 1.0 is in development" under "Electric Vehicle Supply Equipment"

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Thank you!

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

ElectricVehicleSupplyEquipment@energystar.gov.

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