<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Details</th>
</tr>
</thead>
</table>
| 3:00 PM| Welcome and Introductions (5 minutes) | - Agenda review  
- Roll call, by state |
| 3:05 PM| Presentation and Q&A: Electric Power Research Institute (15 minutes) | - Dan Bowermaster, Program Manager for Electric Transportation, will provide a general overview of interoperability, describe the market and what is coming. |
| 3:20 PM| Presentation and Q&A: Greenlots (15 minutes) | - Erick Karlen, Policy Advisor at Greenlots, will discussing charging from the EV industry perspective. |
| 3:35 PM| Presentation and Q&A: EPA ENERGY STAR (15 minutes) | - Stacy Noblet, Senior Director of Transportation at ICF, will present on EPA ENERGY STAR standards for EV chargers from the perspective of both interoperability and energy efficiency. |
| 3:50 PM| Q&A (10 minutes) | - Speakers will take additional questions from working group members |
| 4:00 PM| Closed Door Discussion (30 minutes) | - Working group members will discuss their own views and the actions their states have taken to date. |
| 4:25 PM| Next Steps and Announcements (5 minutes) | |
| 4:30 PM| Adjourn | |
Roll Call – Read from Webinar

Working Group Members

States:
- Arizona
- California
- Colorado
- Connecticut
- D.C.
- Florida
- Georgia
- Hawaii
- Illinois
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Missouri
- Nevada
- New Jersey
- New York
- North Carolina
- Ohio
- Oregon
- Puerto Rico
- South Dakota
- Texas
- Vermont
- Washington
- Wisconsin

National/Federal Partners:
- NARUC
- U.S. DOE
- U.S. EPA

Meet Jasmine McAdams, NARUC Program Officer
Interoperability and Standards for EV Charging

Pre-Read Materials

- Pages 37-38 (on interoperability and open standards) of NARUC's report, “Electric Vehicles: Key Trends, Issues, and Considerations for State Regulators”

- Joint eight-page paper by EPRI, EEI, ATE, APPA, and NRE on Interoperability of Public Electric Vehicle Charging Infrastructure
Electric Transportation

Charging Interoperability

Dan Bowermaster
Sr. Program Manager, Electric Transportation
dbowermaster@epri.com
Mobile: (650) 701-5099

NARUC
August 25, 2020
EPRI’s Mission

Advancing **safe, reliable, affordable** and **environmentally responsible** electricity for society through global collaboration, thought leadership and science & technology innovation

**Independent**
Objective, scientifically based results address reliability, efficiency, affordability, health, safety, and the environment

**Nonprofit**
Chartered to serve the public benefit

**Collaborative**
Bring together scientists, engineers, academic researchers, and industry experts
OVERVIEW
of the EV market
Electric transportation is a global market

The future has more uncertainty than ever

Source: https://mapchart.net/world.html
But purchasing decisions are made locally

Adoption — What does it take for a customer to buy an EV?

1. **Automotive OEMs**

2. **Car Dealers**

3. **Customers**
   - Does it meet my needs?
   - Do I like it?
   - Can I afford it today?
   - How do I fuel it?

Of the top 25 best-selling cars, only one has a plug-in option today

**Wild Card**
Impact of COVID 19 and recession?

Photo credit: Dan Bowermaster, EPRI
US electric vehicle sales exceed 1.5M through April 2020
County-level data shows EV sales progress
June 2019 – May 2020

187 counties in 33 states have new EV market shares > 1.9% (US average)

Source: EPRI analysis of vehicle registration data, July 2020
Trend:
Customer choice of EVs is increasing

127 EVs available by 2023
These trends are also leading to the big EVs

Photo credits: Mark Kosowski, Dan Bowermaster
Electric Vehicle CHARGING
The bulk of EV charging will be done at home and work

Some public charging is DC fast charging

**Home Charging:**
Charge at 120V AC or 240V* AC
* Use an existing dryer outlet or install new circuit

**At-work Charging:**
Extends electric range of PHEVs and short-range BEVs

**Public Charging:**
Necessary for BEVs, but not PHEVs
Public charging infrastructure density is increasing

Network:
- RechargeAccess
- Innogy
- FLO
- Recargo Network
- Shorepower
- Irvine Company
- Sun Country
- CarCharging
- OpConnect
- Webasto
- Volta
- GE WattStation
- EV Connect
- Greenlots
- EVgo
- Blink
- Electrify America
- SemaCharge
- Supercharger
- Tesla Destination
- ChargePoint
- Non-networked

Source: PlugShare, February 2020
Interoperability of Public Electric Vehicle Charging Infrastructure
Co-published with EEI, ATE, APPA, and NCERA, August 2019

This paper distills, at a high level, four key challenge areas related to interoperability:

- **CHARGING NETWORK-TO-CHARGING NETWORK**
- **CHARGING STATION-TO-NETWORK**
- **PHYSICAL CHARGING INTERFACE**
- **VEHICLE-GRID**

https://www.epri.com/research/products:00000003002017164
Interoperability affects numerous stakeholders

Key stakeholders:
• EV drivers
• Businesses
• EV charging site hosts
• EV charging companies
• EV manufacturers
• Electric utilities
<table>
<thead>
<tr>
<th>Vehicle Size</th>
<th>AC Level 1 1.2 to 1.9kW</th>
<th>AC Level 2 Up to 19.2kW</th>
<th>DC Up to 350kW</th>
<th>DC &gt; 350kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light-Duty</td>
<td>Well-developed</td>
<td>Well-developed</td>
<td>Work in progress Test events continue</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Medium- and Heavy-Duty</td>
<td>Not Widely Applicable</td>
<td>Work needed to validate interop</td>
<td>Work needed to validate interop</td>
<td>TBD</td>
</tr>
</tbody>
</table>
## Physical/Electric Interoperability

### Automated Connection Charging

<table>
<thead>
<tr>
<th>Vehicle Size</th>
<th>J3105/1</th>
<th>J3105/2</th>
<th>J3105/3</th>
<th>J3105 /1, /2, /3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medium- and Heavy-Duty</strong></td>
<td>DC up to ~ 450kW</td>
<td>DC up to ~ 450kW</td>
<td>DC up to ~ 450kW</td>
<td>DC &gt; 450kW</td>
</tr>
<tr>
<td>Work needed to validate interop</td>
<td>Work needed to validate interop</td>
<td>Work needed to Validate interop</td>
<td>TBD</td>
<td></td>
</tr>
</tbody>
</table>

*Future – going above 450kW*

*Standard was just approved in January 2020*
Physical Characteristics of Equipment
Lack standard sizes, spacing, etc.

- Common hardware footprints?
- Common mounting schemes?
- No consistent vendor approach especially for high power DC charging
Interoperability

EV charging networks today are largely independent
Introduction: EV Charging Network Phone Apps

– 8 Examples

PlugShare; ChargePoint; Blink; and Greenlots iPhone Apps

Volta; OpConnect; Semaconnect; and Evconnect iPhone Apps
Introduction: What the Future of EV Charging Might Look Like

**NETWORK A**

1. CONSUMER
2. CHARGE STATION
3. BACK-OFFICE
4. CUSTOM WEB or PHONE APPLICATION
5. CLEARING HOUSE
4a. WEB or PHONE APPLICATION

**NETWORK B**

1. CONSUMER
2. CHARGE STATION
3. BACK-OFFICE
4. CUSTOM WEB or PHONE APPLICATION
Looking ahead: Data-related Considerations
EV Charge Management = Intelligent use of Information

- Who has the data?
- How is it protected?
- Where does data flow to?
- Are there standards for data interchange?
- Is there one point of control or is it distributed?

- How does interoperability come in to play?
  - We need standards for data interchange
  - We need standards for control methodologies
  - Vendors need to verify their systems can play together with the standards
Together…

Shaping the Future of Electricity
Audience Questions

Does the working group have any clarifying questions for Dan?
ENERGY STAR® Certified EV Charging Stations

August 25, 2020
Agenda

• ENERGY STAR Program Overview

• Current Program Highlights
  – Key Features of the Current Specification
  – Participating Manufacturers
  – Resources for Utilities, Business Owners, and Consumers

• Specification Updates Underway – DC Fast and Connected Criteria

• Questions
ENERGY STAR Program

For more than 25 years, EPA's ENERGY STAR program has identified 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.
ENERGY STAR Program

- ENERGY STAR has more than 75 residential and commercial product categories (e.g., commercial food service and data center products)

- Consumers, utilities, and retailers rely on ENERGY STAR to highlight products that deliver consumer savings and give partners tools to differentiate their efficient products
  - In 2017, more than 2000 manufacturers and 2500 retailers partnered with ENERGY STAR to make and sell millions of ENERGY STAR certified products
ENERGY STAR EVSE Specification Today

Key Features:
1. Energy Savings, 40% in Standby Modes
2. Safety
3. Open Communications

Communications Details:
• Grid Communications
• Open Access
• Consumer Override

Photo by Dennis Schroeder, NREL 39251
ENERGY STAR Charging Partners

as of August 2020
New ENERGY STAR EV Charging Website

https://www.energystar.gov/products/other/ev_chargers

- Consumer Buying Guidance (including Qualified Products List)
- Online Tools:
  - EV Model Search
  - Incentives List for Electric and Plug-in Hybrid Vehicles
  - Locator Tool for Public EV Charging Stations
- One-pagers for EV-ready Commercial Buildings, Homes, and Charging EVs with Green Power
- Available Research of Electric Models
- Procurement Language for Fleet Managers
Overview of Version 1.1
ENERGY STAR Specification Development Update – Version 1.1

• Reasons for including DC charging:
  – Provide shorter charge times
  – Potential to increase the range of EVs, especially through charging corridors for cross-country EV transportation
  – Differentiating products based on energy efficiency:
    • A 50 kW DC station with a 10% utilization and 92% active charging efficiency, would have 3.8 MWh/year of operation mode losses alone
  – More prescriptive connected criteria
ENERGY STAR Version 1.1 Test Method – Released June 2020

- From 2018 – 2020, EPA worked with stakeholders to develop an appropriate test method to measure energy efficiency before considering criteria to recognize the most efficient products.

- Key Topics addressed in the test method:
  - EPA developed a test procedure for:
    - No Vehicle Mode,
    - Partial On Mode,
    - Idle Mode, and
    - Operation Mode
  - Accounting for various connector types:
Optional Connected Criteria

- **Goal of the Revision**
  - Make connected criteria more useful and add clarity
  - Criteria designed with long dwell time applications in mind, as these provide the most load flexibility resource
Optional Connected Criteria

• **Grid Communications**
  – Open Standard Communication required through use of Open Charge Point Protocol (OCPP), SEP 2.0, CTA-2045A, or OpenADR 2.0

• **Product Requirements**
  – Scheduling – ability for consumers to set and modify a charging schedule
  – Remote Management – capability to receive and respond to consumer authorized remote requests
  – Consumer Feedback – ability to provide at least two types of messages relevant to optimizing energy consumption
  – Consumer Override – capability of vehicle, EVSE, or consumer to override a DR request
Utility Collaboration Opportunities

- **Educate Customers about ENERGY STAR EV Chargers**
  - link to resource, qualified products list
- **Incorporate the ENERGY STAR into EV Programs**
  - procure ENERGY STAR EV chargers
  - highlight ENERGY STAR certified equipment on vendor lists, RFPs
- **Inform Program Developments**
  - Version 1.1 DC EVSE stakeholder process
Contact the ENERGY STAR Team with Questions

- Questions related to ENERGY STAR marketing/promotion:
  - Peter Banwell: Banwell.Peter@epa.gov
  - Stacy Noblet: Stacy.Noblet@icf.com

- Questions related to ENERGY STAR specification development:
  - James Kwon: Kwon.James@epa.gov
  - Emmy Feldman: Emmy.Feldman@icf.com
Context for Connected Criteria

- **Optional:** EVSE do not need to meet these criteria to be certified
  - Those that do meet will be identified as “connected”
- Architectures for connected EVSE:
  - EVSE service provider aggregates load flexibility from groups of chargers and sells load control as a service: for this, the service provider knows what it needs the EVSE to do
  - 3rd party aggregates load control from groups of chargers and sells load control as a service: uniform responses from chargers of various brands makes it easier to integrate chargers, giving customers broader choice of charger brands
  - Utility controls groups of chargers directly: uniform responses from chargers of various brands makes it easier to integrate chargers, giving customers broader choice of charger brands
- ENERGY STAR Connected criteria intended to support the last two cases since standardization isn’t needed for the first
- Appendix A intended to provide a useful framework for aligning the previous requirements with CTA 2045-A, OpenADR 2.0b, and OCPP
Optional Connected Criteria

Demand-Response Requests – the EVSE must support the following open standard defined DR signals:

- **Charge now (Load Up):** If a vehicle is plugged in and it is not fully charged, EVSE will begin charging the vehicle, continuing as normal until the vehicle is fully charged. For use in a case where the scheduling of charging occurs outside of the product, the EVSE service provider has no control over the charging schedule. Both immediate events and events scheduled in advance will be supported.
- **Curtail Charge:** The EVSE will not begin or continue charging at greater than 50% of its maximum rated output power. Both immediate events and events scheduled in advance will be supported.
- **Delay Charge:** The EVSE will not begin or continue charging. Both immediate events and events scheduled in advance will be supported.
- **Return to Normal Operation:** The EVSE will return to default standby mode.

- Are these DR signal appropriate for long dwell time use cases?
- Appropriate percentage level of maximum rated output power to restrict curtailed charge signal?
Audience Questions

Does the working group have any questions for Stacy, Dan, or Erick?

Please type in your questions or raise your hand so we can unmute you to ask.
Facilitators

- Working Group Chair Maria Bocanegra and Illinois Commerce Commission Staff
- Working Group Vice-chair Jason Stanek and Maryland Public Service Commission Staff
1. Has your Commission taken or considered any actions to address EV charging interoperability?
   ▶ Have you provided any direction to utilities investing in chargers re: interoperability or standards (guidance or requirements)?
Discussion Questions

1. Has your Commission taken or considered any actions to address EV charging interoperability?
   ▶ Have you provided any direction to utilities investing in chargers re: interoperability or standards (guidance or requirements)?

2. What collaborations do you think are essential for addressing interoperability issues?
Discussion Questions

1. Has your Commission taken or considered any actions to address EV charging interoperability?
   ▶ Have you provided any direction to utilities investing in chargers re: interoperability or standards (guidance or requirements)?

2. What collaborations do you think are essential for addressing interoperability issues?

3. What role do you anticipate commissions will play in solving EV interoperability issues?
Discussion Questions

1. Has your Commission taken or considered any actions to address EV charging interoperability?
   - Have you provided any direction to utilities investing in chargers re: interoperability or standards guidance or requirements?

2. What collaborations do you think are essential for addressing interoperability issues?

3. What role do you anticipate commissions will play in solving EV interoperability issues?

4. Have you ever personally charged an EV? What type of connection point did it use?
NARUC is looking for your feedback on EV State Working Group activities by 9/4/20.

See EVSWG 8/24 email from Danielle for link to survey: https://www.surveymonkey.com/r/NARUC-EVSWG
Upcoming EV SWG Calls: Always on a Tuesday, 3-4:30pm ET / 12-1:30pm PT

- **Next webinar:** September 22: Regional Coordination
  - Registration link will be live next week; watch listserv
  - Dates for your calendar: October 27, November TBD (likely annual meeting session), December 15 (moved from 12/22)

- EVSWG Listserv: NARUC-EVSWG@lists.naruc.org

- Presentations and recordings of past EVSWG events: www.naruc.org/cpi-1/energy-infrastructure-modernization/electric-vehicles/