

Lessons Learned – The EV Project EVSE Signage

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List of Acronyms

AC	Alternating Current
ARRA	American Recovery and Reinvestment Act
BEV	Battery Electric Vehicle
CFR	Code of Federal Regulations
DC	Direct Current
DCFC	Level 2 Direct Current Fast Charger
DOE	Department of Energy
DOT	Department of Transportation
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
FHWA	Federal Highway Administration
ICE	Internal Combustion Engine
MUTCD	Manual on Uniform Traffic Control Devices
PEV	Plug-in Electric Vehicle
PHEV	Plug-In Hybrid Electric Vehicle
U.S.	United States

1 Company Profile

ECOtality, Inc. (NASDAQ: ECTY), headquartered in San Francisco, California, is a leader in clean electric transportation and storage technologies. Its subsidiary, Electric Transportation Engineering Corporation (eTec) dba ECOtality North America (ECOtality), is the leading installer and provider of charging infrastructure for electric vehicles (EVs). ECOtality has been involved in every major EV or plug-in hybrid electric vehicle, (PHEV) initiative to date in North America and is currently working with major automotive manufacturers, utilities, the United States (U.S.) Department of Energy (DOE), state and municipal governments, and international research institutes to implement and expand the presence of this technology for a greener future.

ECOtality designed and currently manages the world's largest EV infrastructure demonstration - the EV Project. With a budget of over \$230 million, the EV Project will deploy and study Level 2 alternating current (AC) electric vehicle supply equipment (EVSE) stations for residential use, Level 2 AC EVSE stations for commercial and direct current (DC) fast charge (DCFC) stations. This represents thousands of field assets, utilized in concert with the deployment of Nissan LEAF™ vehicles and Chevrolet Volt vehicles.

The EV Project is a public and private partnership administered by the DOE through a federal stimulus grant, made possible by the American Recovery and Reinvestment Act (ARRA) and by the private investment of ECOtality and its partners.

The EV Project is an infrastructure study. The EV Project will deliver to ECOtality, the Government and the general public a wealth of directly-applicable technical and professional experience for jumpstarting regional EV adoption and replicating business models that lead to sustainable, market-based charge infrastructures.

One purpose of the EV Project is to identify potential barriers to the widespread adoption of EVs and the deployment of EVSE to support them. This process identifies topics of national interest in the early deployment of EV charging stations in order to facilitate discussion and resolution. This paper documents the issues associated with and the EV Project's approach to EVSE signage.

2 Statement of Need

There are four major parts to the execution of the EV Project: Planning EVSE infrastructure, installation of that EVSE infrastructure, data collection from the EVSE and vehicles and reporting lessons learned. This document presents one lesson learned in the planning process.

The EV Micro-Climate planning process was followed in the first five major market areas. This process included the development of an Advisory Group facilitated by the local ECOTality Area Manager. The Advisory Group consisted of local stakeholders who may include, but are not limited to, representatives from state and local government, electric utilities, universities, vehicle manufacturers, major employers, property owners/developers, EV enthusiasts, electrical contractors, office building and parking garage operators, non-profits and other entities having demonstrated leadership and/or interest in the deployment of EVs. Input from these various stakeholder groups representing different interests pertaining to EVs is incredibly valuable to the development of a community driven plan. Early in the development of the infrastructure guideline document, the topic of EV signage was presented.

Plug-in Electric Vehicles (PEVs) include both all Battery EVs (BEVs) and PHEVs. The market is new for these vehicles and there is an urgent need for charging infrastructure to support their use. This charging infrastructure can be located in private residences, multi-family residence parking areas, employee parking lots, fleet parking areas, or publicly available in destination locations. Because the location of charging stations is a new concept and the quantity of available units will be small in the early years, signage is necessary to identify, locate, and designate EV charging facilities.

Signage has two primary purposes: way-finding and regulatory. Assisting PEV drivers to locate charging stations is the way-finding purpose. Regulatory signage determines who may park in the designated location and allowed uses of that charging facility.

Early in the planning process of the EV Project, it was learned that there are several different ideas for signage based upon personal preferences, company logos, prior usage, etc. Signage look, location and verbiage were subject to local jurisdictions, hosts and State regulatory agencies. All of these constituencies needed to be accommodated. Recommended signs in one region or for one host might not fit the needs or requirements of others. Although ECOTality did not seek to impose a signage standard, ECOTality did seek to coordinate the various markets in the adoption of standard signage for all the EV Project markets. Consistency in signage in any geographic area is important for the PEV driver in order to avoid confusion and to promote learning among the non-PEV owner population.



Figure 2-1 Electric Vehicle Charging Station Circa 1996

The topic of signage was first addressed in the mid-1990s with the introduction of EVs in select markets. The way-finding and charging station signage used at that time is shown in Figure 2-2.



Figure 2-2 Electric Vehicle Way-Finding Signs Circa 1996

Almost uniformly over the five market areas, the Advisory Groups desired a different sign, from the signage that was prevalent. Suggesting that the symbol on this sign reflected lead acid technology that was outdated, proposals for new sign symbols emerged. In addition, it was found that in the EVSE infrastructure deployment of the 1990s, the general public was confused by the blue sign and often mistook it for accessible parking; not recognizing the charging station or its signage.

The Advisory Groups also considered the regulatory nature of the signage. Lessons learned from the 1990s efforts in EVSE infrastructure deployment also pointed to the need to clearly identify that the parking location was to be specifically designated for EVs. In addition to the mistaken identity of a handicap parking stall, the uninformed public did not understand the nature of an EV parking stall nor the need to keep it available for the use by an EV. Internal Combustion Engine (ICE) vehicles would often park in these locations. Consequently, the regulatory nature of the signage was identified as an important topic for the Advisory Groups to consider.

3 Development

Widespread adoption of EVs will include maps or websites identifying charging locations. It is helpful to post EV parking area signs on adjacent streets and access points directing EV drivers to the charging locations.

The Advisory Groups in the five market areas identified a variety of symbols; some of which are identified in the following figure.



Figure 3-1 Diverse EV Sign Symbols

Seeking consensus on the symbol proved to be a difficult task. Inquiries were made to various state agencies inside and outside the local market area. Guidelines and plans identified by others were researched. In seeking a solution that met the regional requirements for uniformity as well as consideration for a wider geographic appeal, the Federal Highway Administration (FHWA) of the U.S. Department of Transportation (DOT) was consulted.

Regulatory Issues

Recognizing that the regulatory nature of the signage would be a local enforcement action, this topic was addressed differently among the five market areas of the EV Project.

Most of the regional Advisory Groups agreed that regulatory signage is important. The difference between “Electric Vehicle Parking Only” and “Electric Vehicle Charging Only” received a great deal of attention. While some markets considered advocating for towing penalties, others wanted to rely on the courtesy of ICE drivers to yield to EVs.

ECotality has also engaged the wider EV user community in this discussion through messaging and social media. While this helps with awareness of the different signs it will be some time before community consensus begins to have an impact. However during the interim the discussion highlights signage and helps to focus on behaviors around the use of marked parking spaces with EVSE.

The engagement of hosts within this dialogue creates a different perspective, one that is obviously valuable. Consensus among hosts will also evolve over time. Hosts tend to fall into two camps of opinion. The first seeks visibility to their commitment to “clean EVs” and desires visible signs. The second is more concerned with full usage of parking spaces and tends to favor lower key less vigorous signage.

4 Key Options and Alternatives Evaluated

The Manual of Uniform Traffic Control Devices (MUTCD) is published by the FHWA under 23 Code of Federal Regulations (CFR) Part 655, Subpart F. It defines the standards used to install and maintain traffic control devices on all public streets, highways, bikeways and private roads open to the public.

The MUTCD establishes the specific requirements for signs including color, size, shape, letters or other symbols. It also establishes standards for placement of signs to ensure they are visible, legible, and enforceable. The requirements also vary along a freeway that is in open country versus a freeway through a metropolitan area.

The process by which signage is approved allows for “experimentations”. That is, ideas for a new traffic control device or re-application of an existing device can be requested of the FHWA. These experimental suggestions generally originate with state agencies responsible for managing the roadway. The recommendations by the MUTCD can be included in the approved signage managed by the state agencies.

The DOT for the States of Washington and Oregon submitted a request for the FHWA to consider an EV Charging General Service symbol which existed in the 2009 Edition of the MUTCD. The FHWA responded with interim approval as provided in Attachment A.

This approval does not preclude the approval or interim approval of other symbols.

Regulatory Issues

In considering the regulatory purposes of signage, some jurisdictions did not want to publish prohibitions without considering enforcement. That is, if signage existed that prohibited parking by ICE vehicles and an ICE vehicle did park in the location, what corrective action would be applied? If the signage indicated that the space was for EV charging and an EV was parked but not charging, would enforcement actions be required? Would it be obvious to enforcement that a vehicle that was connected was in fact charging? It would also be possible that at the time of parking, the EV was charging, but by the time enforcement arrived, the charging was complete.

On the other hand, it was generally agreed that without regulatory signage, EVs that were in need of a charge and expecting an open stall would be disappointed if such were occupied by an ICE vehicle. ICE drivers could view the EV parking stall to be a preferred parking location and without negative consequences, regularly park in such locations. To the general public, observing ICE vehicles in an EV only stall would reduce confidence that publicly available charging would in fact be available. This becomes more of an issue when reservation systems for EVs are employed.

In the early years of EV adoption, EV parking stalls may be vacant for significant periods of time. The availability of these locations is important for EV driver range confidence and for encouraging the general public that charging is available and that EVs should be considered for personal transportation. At the same time, those opposed to EV adoption would suggest that the high vacancy is indication that EV adoption is not occurring. Thus a secondary discussion revealed that the EV parking stall may not be ideally placed in the most prominent or advantageous location with respect to the facility visited. Rather, secondary choices further from the entrance should be considered. This topic is visited again in lessons learned on Accessibility.

For those locations that did address punitive actions, the severity of those actions received considerable discussion. This is particularly relevant when considering an EV parked in a charging only stall that is not actually charging. The severity of the consequences could have a negative effect on the driving behavior of EV drivers who then avoid these charging locations and thus result in continuously vacant charging stalls. Instead of encouraging the use of publicly available EVSE, the penalties discourage it.

5 Recommendations

5.1 Symbol

The recommendations provided here are designed to streamline the deployment of EVSE infrastructure and to be used as a guide for areas contemplating this deployment. These recommendations are not the only means by which the question of signage can be addressed, but ECotality suggests that the uniform symbol and messaging presented here can have a significant effect in public education and reduce EV driver and non-EV driver confusion. In addition to providing way-finding, the use of the same symbol from highway to local street to parking entrance to above the charging station itself, will create a common visual identity that will increase the general public's awareness of electric transportation. Another advantage of sign consensus is the reduced cost of product and inventory since multiple designs need not be printed or retained. ECotality recommends that this symbol be approved by all jurisdictions as a national symbol.

The recommendations provided here were uniformly adopted by the Advisory Groups in the five EV Project market areas.

The California PEV Collaborative is a multi-stakeholder public-private partnership, working together to ensure a strong and enduring transition to a plug-in electric vehicle market in California. The Collaborative embodies all key California PEV stakeholders including elected and appointed officials, automakers, utilities, infrastructure providers, environmental organizations, research institutions and others. The mission of the Collaborative is in part to facilitate the deployment of PEVs in California to meet economic, energy and environmental goals.

Recently, the PEV Collaborative provided the following statement:

The PEV Collaborative supports the use of standardized signs to minimize confusion and provide the greatest ease of use for EV drivers. To this end, the Collaborative recommends that Cal Trans adopt the use of the candidate signs currently being tested in Oregon and Washington, and that local jurisdictions request the use of those signs during the test period with the expectation that they will ultimately be approved at the federal level and become the uniform standard nationally.

The recommended symbol is shown in Figure 5-1, below.

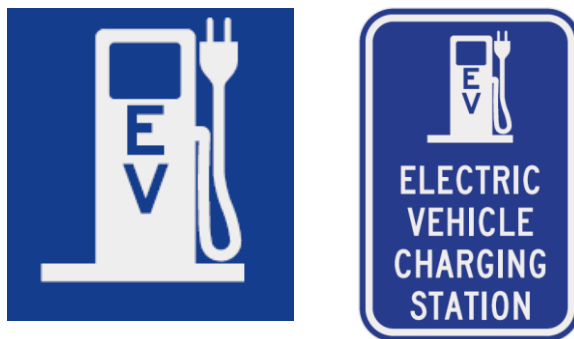


Figure 5-1 FHWA Interim Approved Symbol



Figure 5-2 EV Parking Stall with Recommended Symbol on Pavement



Figure 5-3 EV Parking Stall with Sign at Head of Stall

Location of the symbol on a sign post or painted on the parking surface is a matter of preference but as seen, the parking stalls are visibly clearly identified.

5.2 Regulatory Signs

ECOtality recommends the use of regulatory signs that permit the stall to be used only for the purpose of EV charging. Lacking local ordinance enactment, these signs will largely be informational and rely on acceptance by the public that the parking stall is for this special purpose. Private property owners have the option of taking action but it is likely that a destination facility will overlook the infraction to avoid losing a customer. Once ordinances are in place, the sign should identify that ordinance by number so that the driver is aware that enforcement is by the local authorities rather than the destination owner.

Previous experience has shown that signs that follow the red on white No Parking standards found in the MUTCD work best to keep non-EV drivers from occupying charging station parking spaces. The example in the following figure follows MUTCD standards.

The recommended wording for the No Parking sign is “No Parking Except for Electric Vehicle Charging.” EV drivers in Southern California, where there is an existing network of publicly available charging stations, reported increasing incidences of drivers of Hybrid Electric Vehicles such as the Toyota Prius parking in front of charging stations believing that “No Parking Except for Electric Vehicles” did not apply to them¹. Using “No Parking Except for Electric Vehicle Charging” will help prevent Hybrid Electric Vehicles and conventional Internal Combustion Engine vehicles from occupying a charging station parking space.



Figure 5-4 No Parking Sign

ECOtality has found that combining the symbol and regulatory sign provides an efficient, cost effective and esthetically pleasing appearance to the charging station.

¹ Puget Sound Regional Council | Washington State Department of Commerce, “Plug in America Web-based Electric Vehicle Consumer Survey”, May 4, 2010.



Figure 5-5 Combination Sign

This sign may be accompanied with a sign that identifies the times the station will be publicly available.

As noted previously, in order for the regulatory signs to be enforceable, they must be supported by local ordinances. Many jurisdictions are evaluating the adoption of such ordinances but at this writing, none have been known to have been enacted.

6 Budget/Fiscal/Schedule Implications

Way-finding and regulatory signage are highly recommended for all EV parking stalls. While the cost of the sign is added to the cost of the installation, this can be reduced if the combination sign is used. Marking the pavement with the symbol is a matter of preference, but ECOtality suggests that it is not required. Indeed, it will increase periodic maintenance to continue the appearance following significant use and weathering. It will have the effect of reducing the incidence of ICE vehicles parking in EV Charging locations.

Placement of the sign during the installation of the station will not add significant cost or time delay to the project.

ECOtality suggests that the cost of the sign is minimal compared to the benefit.

7 Lessons Learned

Signage for EV charging infrastructure is an appropriate topic for consideration by local stakeholder groups when preparing for EVs. ECOtality has found that the choice of the symbol can be confusing and even divisive at times with significant difference of opinions. While the recommended symbol may not be universally desired by all stakeholders, it does represent an approved symbol in use by many states. Its adoption early in the evaluation process will significantly reduce the deliberation time. Should local stakeholders select an alternate symbol, it may be used on the EVSE itself or otherwise in conjunction with the standard symbol.

Municipal and State regulatory bodies have a wide range of divergent opinions regarding signage which will hamper wide spread adoption. Some of the divergence will be eroded with time, however it is anticipated that multiple options and diversity in requirements will persist for some time. This will complicate compliance and add to the overall cost of EVSE deployment.

Hosts add another dimension to the process of selection. Their desires are not universal and even for the same host; preference for signage may be different from one location to another. While there needs to be some time for host preference and input to play out over time this will be an easier group to achieve some level of uniformity. Hosts are under agreements, which can be used to narrow the options. The cost of individuality can be borne by host reducing the interest in divergence and mitigating the cost impact on the installer.

Attachment A – MUTCD Interim Approval




U.S. Department
of Transportation
**Federal Highway
Administration**

Memorandum

Subject: **INFORMATION:** MUTCD – Interim
Approval for Optional Use of an
Alternative Electric Vehicle Charging
General Service Symbol Sign

Date: APR 1 - 2011

From: 
Jeffrey A. Lindley
Associate Administrator for Operations

In Reply Refer To:
HOTO-1

To: Federal Lands Highway Division Engineers
Division Administrators

Purpose: The purpose of this memorandum is to issue an Interim Approval for the optional use of a General Service symbol sign that provides road users direction to electric vehicle charging facilities that are open to the public. Interim Approval allows interim use, pending official rulemaking, of a new traffic control device, a revision to the application or manner of use of an existing traffic control device, or a provision not specifically described in the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD).

Background: The Oregon and Washington departments of transportation have requested that the Federal Highway Administration (FHWA) consider alternative symbols for the current Electric Vehicle Charging General Service symbol (D9-11b) sign shown in Figure 2I-1 of the 2009 Edition of the MUTCD in anticipation of deploying electric vehicle charging facilities in these and four other states. The current symbol is a modification of the existing Gas General Service symbol (D9-7), into which the legend EV has been incorporated, similar to Alternative Fuel symbols such as diesel (D), compressed natural gas (CNG), and ethanol (E85). The request was predicated on the presumption that, for electric vehicle charging facilities, the fuel pump and hose of the Alternative Fuel symbols do not apply or could be confusing. Instead, the representation of an electrical cord was thought to be more appropriate. A new symbol was evaluated and subsequently recommended by a Traffic Control Devices Pooled-Fund Study report. However, the requesting agencies believe that the presence of a lightning bolt within this symbol suggests a risk of electrical shock, which would discourage the use of electric vehicles.

Research on the Alternative Electric Vehicle Charging Symbol Sign: In November 2010, a report of the Traffic Control Devices Pooled-Fund Study that evaluated several alternative symbols for electric vehicle charging was released. The symbol that had the greatest comprehension and legibility distance was a modification of the symbol used on the Electric Vehicle Charging (D9-11b) sign in the 2009 MUTCD, with the hose replaced by a power cord and plug and the addition of a lightning bolt within the pump window to convey an electrical charge. A similar version without the lightning bolt element was not



evaluated in the subject study. In March 2011, a comprehension evaluation was completed that evaluated the 2010 Pooled-Fund Study recommended symbol and a modified version that deleted the lightning bolt element. Comprehension was found to be similar both with and without the lightning bolt. Additional questions were asked of the test subjects regarding their perception of the relative risk of electrical shock for the new symbols with and without the lightning bolt. The responses indicated that the presence of the lightning bolt did not increase the perceived risk of electrical shock. In addition, overall, the perceived risk of electric shock at an electric vehicle charging facility was relatively low when compared with other items that could pose risks of electric shock.

The results included in the Final Report for this evaluation showed that the correct meaning of the alternative sign was identified by a sufficient percentage of the survey participants for this application. The removal of the lightning bolt element from the symbol reduces its visual complexity and this modification is expected to provide at least comparable recognition and legibility.

FHWA Evaluation of Results: The Office of Transportation Operations has reviewed the available data and considers the alternative sign (see attachment, p. IA-13-1) to be satisfactorily successful for the application of providing direction to an electric vehicle charging station. The alternative sign provides agencies with a means of directing road users to an electric vehicle charging station without the use of a word legend sign or supplemental plaque, thus reducing the informational load presented to the observer and promoting a uniform symbol for this general service.

The design of the alternative Electric Vehicle Charging symbol sign is not proprietary and can be used by any jurisdiction that requests and obtains interim approval from the FHWA to use the sign. The FHWA believes that the alternative Electric Vehicle Charging symbol sign has a low risk of safety or operational concerns.

This Interim Approval does not create a new mandate compelling the use of this new sign, but will allow agencies to install this sign, pending official MUTCD rulemaking, to provide direction to road users to electric vehicle charging stations.

Agencies may also continue to use the ELECTRIC VEHICLE CHARGING (D9-11bP) plaque as an educational message mounted below the alternative Electric Vehicle Charging symbol sign in a Directional Assembly.

Agencies may use the alternative Electric Vehicle Charging symbol in General Services (D9-18 Series) guide signs.

Conditions of Interim Approval: The FHWA will grant Interim Approval for the optional use of an alternative Electric Vehicle Charging symbol sign (see attachment, p. IA-13-1) to any jurisdiction that submits a written request to the Office of Transportation Operations. A State may request Interim Approval for all jurisdictions in that State. Jurisdictions using the sign under this Interim Approval must agree to comply with the technical conditions detailed below, to maintain an inventory list of all locations where the signs are installed, and to comply with Item D in Paragraph 18 of Section 1A.10 of the 2009 MUTCD, which requires:

“An agreement to restore the site(s) of the Interim Approval to a condition that complies with the provisions in this Manual within 3 months following the issuance of a Final Rule on this traffic control device; and terminate use of the device or application installed under the interim approval at any time that it determines significant safety concerns are directly or indirectly attributable to the device or application. The FHWA’s Office of Transportation Operations has the right to terminate the interim approval at any time if there is an indication of safety concerns.”

1. General Conditions:

The use of the alternative Electric Vehicle Charging symbol sign is optional. However, if an agency opts to use this sign under this Interim Approval, the following design and installation requirements shall apply and shall take precedence over any conflicting provisions of the MUTCD.

2. Allowable Uses:

Installation and use of the alternative Electric Vehicle Charging symbol sign shall conform to the general provisions for General Services signs in accordance with MUTCD Chapter 2I.

3. Sign Design and Size:

- a. The design of the alternative Electric Vehicle Charging symbol sign shall be as shown in the attached sign detail.
- b. The minimum size of the alternative Electric Vehicle Charging symbol sign shall be 24 inches in width by 24 inches in height.
- c. The size of the alternative Electric Vehicle Charging symbol sign shall otherwise be in accordance with those of other D9-11 series signs.

4. Other:

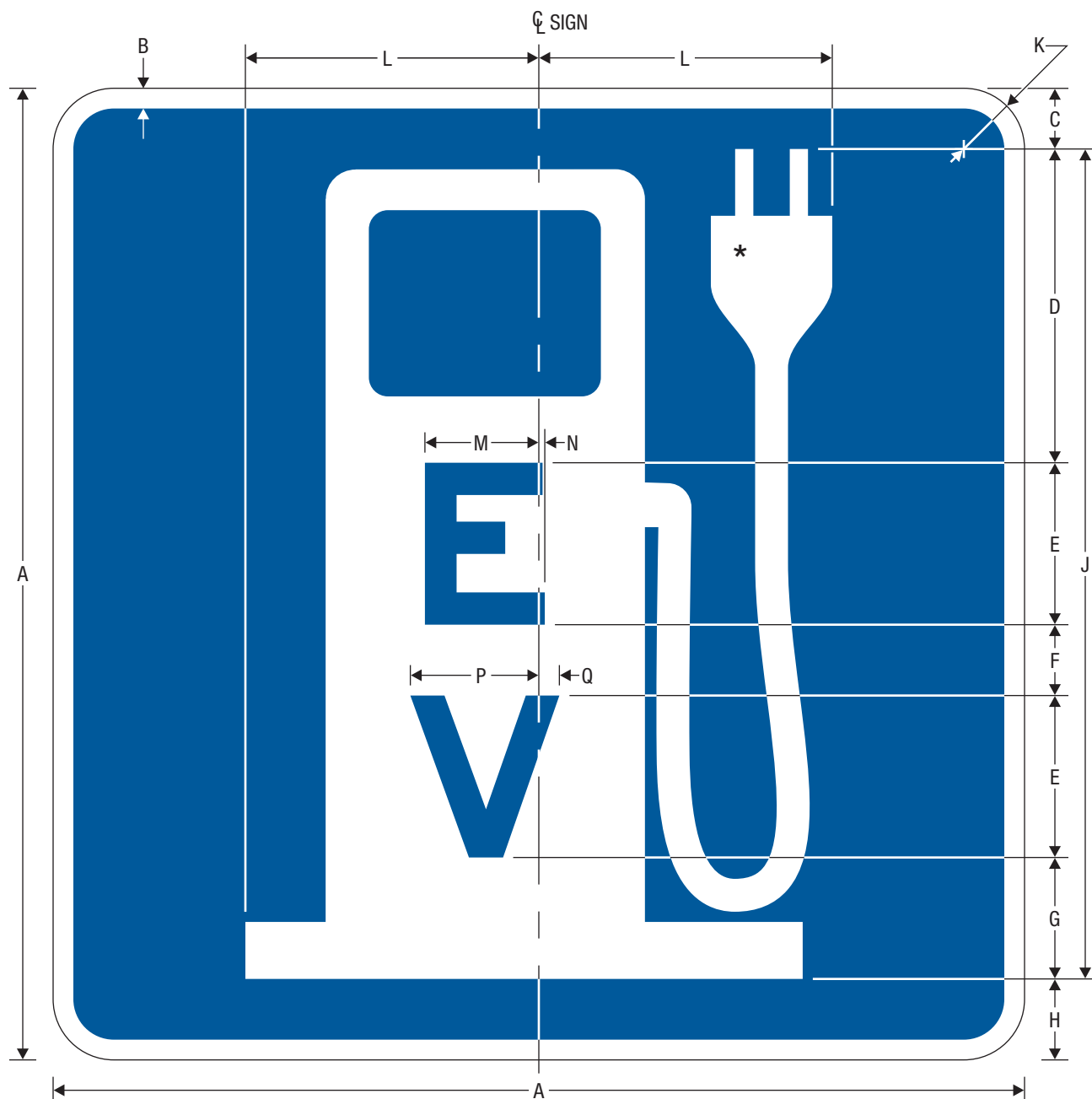
Except as otherwise provided above, all other provisions of the MUTCD applicable to signs shall apply to the alternative Electric Vehicle Charging General Service symbol sign.

Any questions concerning this Interim Approval should be directed to Mr. Kevin Sylvester at Kevin.Sylvester@dot.gov.

Attachment

cc:

Associate Administrators
Chief Counsel
Chief Financial Officer
Directors of Field Services
Director of Technical Services



D9-11b (Alternate)
Electric Vehicle Charging (Alternate Symbol)

	A	B	C	D	E	F	G	H	J	K	L	M
C	24	0.5	1.5	7.75	4 E(m)	1.75	3	2	20.5	1.5	7.25	2.814
	30	0.75	1.875	9.625	5 E(m)	2	4	2.5	25.625	1.875	9.063	3.518

N	P	Q
0.148	3.174	0.507
0.185	3.968	0.635

* See page IA-13-2 for symbol design

COLORS: LEGEND, BACKGROUND — BLUE (RETROREFLECTIVE)
SYMBOL, BORDER — WHITE (RETROREFLECTIVE)

