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# Multi-unit Dwelling Vehicle Charging Education

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**Abstract**

In the recognition of the myriad potential challenges encountered by residents of multi-unit dwellings (MuD) that wished to own a plug-in electric vehicle (PEV) and charging them within their residential communities, the author undertook the development of a workshop to be offered by San Diego Gas and Electric (SDG&E). The workshop is designed to assist the regions multi-unit stakeholders in the identification of issues that need consideration when developing their own unique solutions for their own communities. This paper is an overview of these issues and a brief identification of some of the potential options in approaching plug-in vehicle charging in multi-unit residential communities.

*Keywords: Multi-unit, Residential, Charging*

## 1 Introduction

Residential charging is considered to be the primary parking location for a plug-in vehicle and therefore the prime location/opportunity for vehicle charging. Multi-unit residences are possibly the most challenging of the residential scenarios facing the consumer for plug-in electric vehicle charging. This paper will look at the types of residences, stakeholders and technologies involved and the challenges faced for these consumers and attempt to identify some of the present and future option scenarios for plug-in vehicle charging within these types of communities.

### 1.1 What is a multi-unit residential community?

Multi-unit residential communities span a spectrum of configurations. We are all familiar with high-rise apartment and condominium residences, but the spectrum has a greater span in the U.S. Everything including a duplex or triplex stand alone building, garden and low-rise housing complex, and mobile home parks can easily fall into the category of multi-unit dwellings. Dormitories, timeshare units and hotel/motel accommodations also may cross the line in our thinking about the stakeholders and physical scenarios that this broad area of residences may encompass. More and more we are seeing the development of residential solutions that may incorporate the concepts of "shared spaces" and services. This is the spectrum that will need to be accommodated in order to enable all plug-in vehicle consumers the opportunity to own or lease these vehicles in the future.

### 1.2 Multi-unit Stakeholders

The spectrum of stakeholders that will need to participate in the process of making accommodations for charging these vehicles is almost as broad as the spectrum of types of multi-unit residences. Condominium scenarios will most likely have: owners; Home Owner Associations (HOAs); building/complex owners and property management companies/representatives as base components to their communities. Rental scenarios may substitute rental tenants and Rental Association, but will also usually have property/complex owners and property

management representation as their base arrangement. Complexities for communities where owners may own the structure but lease the land that it rests upon add a slightly different flavour to the residential mix and the resulting codes covenants and restrictions (CC&Rs), resident rights and physical factors that may be encountered.

## 2 Physical Considerations

Issues such as who owns/controls what need to be investigated and determined for each residence and stakeholder. In some condo scenarios, owners may only own from the exterior layer of paint on the walls inward, or residences in high rise buildings may be far removed from unit support services such as electrical metering rooms or vehicle parking. Whether a community has individually metered units or only a single "master" meter for electricity is also a very basic piece of information that must be understood by the stakeholders before engaging in the development of "solutions" and policies for a community and the options that may be available or cost effective.

## 3 Technology available

The range of technologies presently available needs to be considered as well as the vehicle technologies in order to approach the issues for residents.

Electric Vehicle Supply Equipment (EVSE) options include:

- 120V cordsets, usually provided with the vehicle re capable of connecting to standard residential three prong plug sockets
- 240V charging units that require an electrical contractor to install the unit or the 240V socket to connect the unit to

240V charging units can also span a spectrum:

- Basic non-communicating EVSE with no access control (i.e. plug and charge)
- Communicating EVSE that are programmable and can retain/transmit user information and has access control
- Advanced EVSE that are equipped with features that allow: public access charging via EVSE "memberships"; scheduling reserved charging times; able to communicate with mobile apps, etc.

A listing of Nationally Recognized Testing Laboratory (NRTL) approved EVSE equipment can be found at the GoElectricDrive website at: http://www.goelectricdrive.com/Charging/FindanEVCharger.aspx

Plug-in electric vehicle technology spectrums must also be understood by these stakeholders. Vehicles include:

- 100% electric vehicles with bigger batteries and bigger charging potential
- Plug-in hybrid electric vehicles that may have smaller batteries and possibly need less intense charging due to battery size and the alternative gasoline use for power
- On-board charger capabilities for these vehicles are beginning to appear in the general marketplace in two flavours. Most 2010 and 2011 vehicles will have 3.3 kW chargers and charge at rates of 10-14 miles of range per hour of charge to the introduction in 2012 of 6.6 kW vehicles that may charge at rates closer to 20-28 miles of range per hour of charge at Level 2 (L2) AC charging rates (240VAC, 40A standard installation) [1].

Basic understanding of these types of charging approaches, capabilities and technologies is essential for those that will participate in the development of charging policies for their communities. These appreciations need to be established before attempting to design a specific/unique solution for a elements that make up that community. The physical factors/constraints, the existing support infrastructure; garaging/parking policies; and even the traditions/mores of that community will all need to be part of the reference base that stakeholders have to "make it work" for their particular community and its residents.

## 4 Option Spectrum of Charging Station Technology Options and Cost Recovery Models

**Individually assigned units:**

Individual charging unit connected to and metered from particular residential unit wiring – at 120 or 240 V – access security is via honor system, mechanical control, keypad/electronic access, cordset 120V or

240 V valet removable unit. Location can be in assigned/deeded parking space for a

unit or in common area via agreement/insurance requirements that may be in effect (e.g. under the provisions of regulations like Senate Bill 209 and 880 in California for individually assigned charging units located in a common area).

**Multi-unit Residential access units:**

Charging units are provided as a community access resource and there are many users for each unit.

**Equipment:** 120V plug access for cordsets or 240 V EVSE access (permanent installation or "valet" portable unit) Valet units can allow the vehicle to remain stationary and the unit to be moved from plug connection to plug connection.

**Access Security:** access security can be via honor system, mechanical control, keypad/electronic access control

**Cost allocation options:** Monthly flat fee (unmonitored/unlimited use), electronic tracking/reporting of per use utilization and allocation of cost either directly to a user's payment system (e.g. credit card) or to property management for monthly billing to residents. The technology presently exists in higher cost reporting/communicating charging systems for this type of tracking and reporting. New technologies are also being developed to provide these services via specially equipped 120V cordsets, or via local computer interface control programs for access for "non-reporting/communicating EVSE, etc. (e.g. touch screen in garage, user pin access to energize a basic non-communicating on/off type of EVSE).

**Enhancements:**

- Billing for "vehicle connection time" versus "charging time" basis to encourage users to move a vehicle as soon as charging completed. Vehicles left connected beyond active charging continue to incur use fee while occupying charger.

- Use of an on-line reservation capability for charging units which enables scheduling of charging sessions and predetermined "friendly disconnection times" as indicated by the system.

# 5 Suggested Steps from the SDG&E Multi-unit Dwelling Vehicle Charging Workshop

- **Polling** - check the level of interest within your community; who,when might they "enter" the PEV market
- **Explore your options** – learn the vocabulary; the spectrum of vehicle and charging technologies; potential costs, spectrum of business models for charging (Plan to attend one of our workshops)
- **List the challenges** – Is CC&R language restrictive; what are allowed common area uses; metering and wiring configurations/locations; assigned vs. unassigned parking; ADA needs; community traditions
- **Policy Issues –** Reaching internal consensus – who, what, when, where, how s it to be paid for?
- **Consensus on scope of project –** This is the starting point for the contractor – provide the estimated number of spaces; EVSE technology preferences/features, suggested location(s)? Provide information for the contractor to design the project, then reviewed with utility's Project Management (PM) group.
- **Choose a qualified contractor** – When selecting an installer consider their experience; licensing; insurance, have they been trained/oriented? (NECA, UL Training Program for EVSE installations and others)
- **Design/Evaluation phase** – review design layout; load calculations; metering options; infrastructure support (best

reviewed withal multi-unit community stakeholders with the contractor prior to utility review

- **Execution by contractor** – handles permitting; utility service order; scheduling; project coordination; inspections (utility & city)
- **Implementation** - celebrate and share what you have learned through your process with us and others! Email us your success and challenge experiences to **MultiUnit@SDGE.com**

# 6 Figures, Tables and Equations

## 6.1 Figures

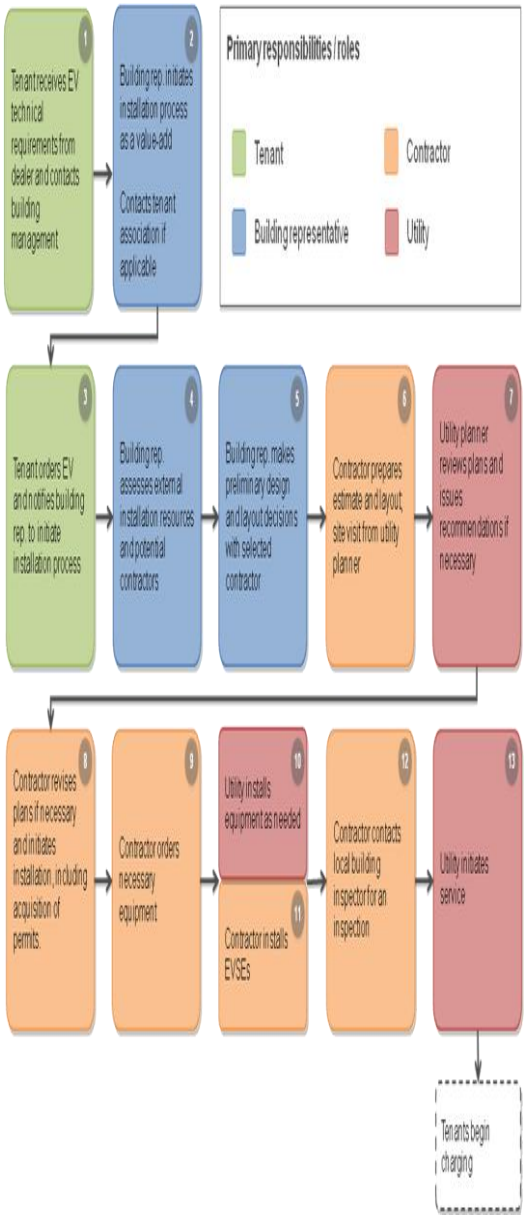


Figure1: Flowchart for Multi-unit EVSE

## 6.2 Tables

Table1: Proposed SAE Charging Configurations and Rating Terminology [1]

**Proposed SAE Charging Configurations and Ratings Terminology**

- AC L1: 120V AC single phase
  - Configuration current 12, 16 amp
  - Configuration power 1.44, 1.92kw
- AC L2: 240V AC single phase
  - Rated Current ≤ 80 amp
  - Rated Power ≤ 19.2kw
- AC L3:TBD
  - AC single or 3ϕ ?
- DC L1: 200 – 450V DC
  - Rated Current ≤ 80 amp
  - Rated Power ≤ 36kw
- DC L2: 200 – 450V DC
  - Rated Current ≤ 200 amp
  - Rated Power ≤ 90kw
- DC L3: TBD
  - 200 – 600V DC ?
  - Rated Current ≤ 400 amp?
  - Rated Power ≤ 240kw?

**Voltages are nominal configuration operating voltages, not coupler rating.**
**Rated power is at nominal configuration operating voltage and coupler rated current.**


# Acknowledgments

I would like to acknowledge the multi-unit stakeholder participants who have attended the SDG&E Workshops I have conducted on "Multi-unit Dwelling Vehicle Charging" for their contributions to my understanding of the broad spectrum of elements and the intricacies that make up their communities.


# References


[1] Gery Kissel, Chair of J1772 Committee ofr SAE, Presentation at EPRI Infrastructure Working Council, Proposed SAE Charging *The hype about Hydrogen*, ISBN 1-55963-704-8, Washington, Island Press, 2005

[2] Joel Pointon, SDG&E and Monica Moriarty, Sacramento Municipal Utility Distric for EPRI guide on Multi-unit Dwelling Vehicle Charging 2008


# Author


Joel Pointon became the Manager of Electric Transportation (ET) for San Diego Gas and Electric (SDG&E) when he was hired to "restart" the program in mid 2006. Prior to that he had been a professional in the field of environmental health consulting for over 25 years. He has served as chairperson of the San Diego's Regional Clean City Coalition, and the San Diego Regional Sustainable Partnership Transportation Committee, and is an active participant in the Electric Power Research Institute's (EPRI) Infrastructure Working Council for Plug-in Electric Vehicles (PEVs). He has also served on the Advisory Board of the UC Davis; Plug-in Hybrid and Electric Vehicle Research Center; and has served on the Board of Directors of the California Electric Transportation Coalition (CaETC) and the Electric Drive Transportation Association (EDTA).