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# **Draft Final Vehicle Grid Integration (VGI) Glossary of Terms**

## **TABLE OF CONTENTS**

### **Executive Summary of Important Terms - pages 2-17**

- VGI vs V2G vs V1G and other similar terms
- EVSP vs Site Host vs Charging station operator vs Network Service Provider and other similar terms
- EV Actors
- Aggregated vs unified vs fragmented and other similar terms
- Use Case vs Requirements vs Application vs Functionality vs Architecture vs Layer vs End-to-End Solution and other similar terms:
- EVSE vs Charging station vs Charging infrastructure vs Make Ready and other similar terms
- Standard vs Protocol and other similar terms
- Charging station market segments
- Interoperability, roaming, authentication, authorization, clearinghouse and similar terms
- VGI benefits and related terms

### **VGI Communications Terms - pages 17-35**

#### **Organizations and Agencies - pages 35-36**

- EV Standards Development Organizations (SDOs) and National/International Standards Bodies (NSBs/ISBs):
- Nationally Recognized Testing Labs
- Alliances
- Agencies

#### **General and Technical Terms in the Utility Industry - pages 36-53**

#### **General and Technical Terms in the EV and Charging Station Industries - pages 53-60**

#### **Standards Descriptions - pages 60-65**

#### **Acronyms - pages 65-69**

#### **References Used for Some Definitions - pages 70-71**

## EXECUTIVE SUMMARY OF IMPORTANT TERMS

- **VGI vs V2G vs V1G and other similar terms**

- Vehicle Grid Integration (VGI): A very broad term that encompasses the many ways in which a vehicle can provide benefits or services to the grid, to society, the EV driver, or parking lot site host by optimizing plug-in electric vehicle (PEV) interaction with the electrical grid. VGI includes both active management of electricity (e.g., bi-directional management, such as vehicle-to-grid [also known as V2G] or unidirectional management such as managed charging [also known as V1G]) and/or active management of charging levels by ramping up or down charging. VGI also includes passive solutions such as customer response to existing rates, design of improved utility rates (e.g. time-of-use (TOU) charges, demand charges and customer fees), design of the grid to accommodate EVs while reducing grid impacts to the degree possible, and education or incentives to encourage charging technology or charging level (e.g. rebates for lower level charging, modifying current allowance policy). See VGI benefits for more detail.
- V1G (or managed or controlled charging): Central or customer control of EV charging to provide VGI benefits including wholesale market services. Includes ramping up and ramping down of charging (AC or DC) for individual EVs or multiple EVs whether the control is done at the charging station, the EV, the EV management system, the parking lot EV energy management system or the building management system.
- V2G (Vehicle to Grid): Energy from the EV battery is converted to an AC current which flows from the EVSE to a facility circuit which is connected to the electric power system, even if there is no net export of power from the facility. V2G assumes a bidirectional energy transfer capability and not just discharging of the battery. The combined EVSE and EV form a distributed energy resource (DER) and all states have special rules that apply to the interconnection of DER to the grid. The AC-DC conversion can be performed on board the EV (Society of Automotive Engineers International (SAE) term V2G-AC) or within the EVSE (SAE term V2G-DC). These are very different DER systems with significantly different communication requirements between the EVSE and EV.
- Vehicle to Home (V2H): SAE defines V2H as the EV battery operating as a backup power source for a home that has been disconnected (islanded) from the grid. The inverter regulates the frequency and voltage for the islanded home just like a standby generator. This can be done using an inverter in the EVSE (SAE type V2H-DC) or using an inverter onboard the EV which connects to the home emergency generator port using an exportable power panel on the EV (SAE type V2H-EPP).

- Vehicle to Building (V2B): This is an alternative term for V2H. SAE only defines V2H for use with any type of facility which has been disconnected (islanded) from the grid and the vehicle battery is providing AC power.
- **EVSP vs Site Host vs CSO vs NSP and other similar terms**
  - Electric Vehicle Service Provider (EVSP): A legal term that means the entity that is responsible for the reselling of the electricity to serve the EV. In many cases this can be the site host (commercial or residential) and not the provider of charging services or charging station manufacturer who may not own the charging station.
  - Site Host: Either the owner or tenant responsible for the parking lot or structure where charging stations are located. Could be a residential or commercial utility account. Although some EVSE is owned and managed by a network, many charging stations are operated by a site host who contracts with a network services provider for services, such as access control, payment processing, and driver communications. In many cases, a site host also works with the network to set pricing and access requirements. For a fee, site hosts receive benefits from EVSE networks, including charging station visibility and availability for drivers, energy monitoring, station usage analysis, automated payments, automated diagnostics, access control, and customer support. Site hosts may set pricing policies based on their business needs (e.g., employees consume electricity for free and visitors pay a fee).
  - Charging Station Operator (CSO): The charging station operator operates the EVSE to facilitate a reliable charging experience for PEV owners. (aka Charge Spot Operator or charge point operator or charging network operator) (Reference 8). The CSO is not necessarily the site host or the installer or the maintainer of the charging station.
  - Charging Service Operator (CSO): Secondary actor responsible for the installation and operation of a charging infrastructure (including charging sites), and manages electricity sourcing to provide the requested energy transfer services. (Source: ISO/CD 15118-1 Ed2)
  - Network Services Provider: A typically broader term than the Power Flow Entity mainly because the NSP can also provide billing, maintenance, reservations, and other non-grid information to charging stations, and is a more commonly used term than power flow entity. 2) The controlling entity that sends the grid commands or messages to the EV or EVSE (e.g., rates information or grid information based on energy, capacity or ancillary services markets and this is sometimes called an electricity grid network services provider). The NSP may send non-grid commands (e.g. reservations, billing, maintenance checks), and this additional service is sometimes called a communication network services provider. The NSP may receive one or more conflicting grid commands from other entities. The NSP may be the POU, IOU, ISO, Aggregator, OVGIP, Clearing House, Site Host, or Charging station operator.

- Utility Residential Customers: Single-family attached homes, single-family detached homes including mobile homes, and multi-family homes that do not use common areas for charging.
- Utility Commercial Customers: Business, industrial, institutional, governmental and agricultural customers including common areas for multi-family homes. Includes AC charging and DC fast charging away from home, fleet charging and multi-unit dwelling charging in common areas.
- **EV Actors**
  - EV Driver: Individual or entity with authority to determine PEV charging preferences and priorities to meet transportation needs. This could be the actual driver or could be the fleet operator (through the use of the BEMS) making choices about the transportation needs & requirements. Examples of choices and decisions include driving range needed, departure time, and acceptable energy price levels. Examples of input devices include, but are not limited to, smart phone app, website, vehicle interface, and EVSE. The EV driver is sometimes called the End User, Owner or Fleet transportation operator.
  - Power Flow Entity (PFE): An off-site entity that is requesting or mandating VGI activities from other actors downstream. PFE may involve more than one off site operation such as utility and aggregator who are responsible for determining grid conditions and communicating the required VGI action to the affected downstream actors to execute the request or mandate. The PFE is broad term than may include the Aggregator, Utility, Site Host, EVSP, or Clearinghouse.
  - EV Battery System (EVBS): The vehicle energy storage management and charge control system that will provide direct interface and communications to process and execute VGI functions. This includes the communications for power conversion functions including AC and DC charging/discharging and DER mode operations.
  - DC Power Converter System: The off-vehicle Power Converter that controls DC energy flow to or from the EV Battery System. The Power Converter works with the on board battery system (EVBS) for power flow. The Power Converter works uni-directional (V1G) or bi-directional (V2G). Sometimes called the Inverter, Rectifier or Bi-directional inverter.
  - EV Supply Equipment (EVSE): 1) The equipment that inter-connects the AC electricity grid at a site to the EV. Can be level 1 or level 2 charging. Incorrectly called the charger. 2) Sometimes used more broadly to mean charging station, whether AC or DC, not including the make-ready infrastructure or other charging infrastructure. Also see charging station / device. May include multiple connectors (called multi-port) to charge several EVs or to serve EVs with different types of connectors (e.g. Type 1 (SAE

J1772-2009, similar to IEC 62196 Type 1), SAE Combo 1, SAE Combo 2 and CHAdeMO). Also called the Energy Connection system (ECS).

- Electric Vehicle Communication Controller (EVCC): embedded system, within the vehicle, that implements the communication between the vehicle and the 381 SECC in order to support specific functions. Note 1: Such specific functions could be e.g. controlling input and output channels, encryption, or data transfer between vehicle and SECC. (Source: ISO/CD 15118-1 Ed2)
- Electric Vehicle Power System (EVPS): Equipment or a combination of equipment providing dedicated functions to supply electric power in both directions of:
  - from an electrical installation or supply network to an EV for the purpose of charging and,
  - from a DER in the EV to supply network or the grid for the purpose of discharging.Note 1: Former function is equal to the EV supply equipment, provided by IEC 61851-1 3.1.1 (similar to SAE J1772). (Source: ISO/CD 15118-1 Ed2)
- Supply Equipment Communication Controller (SECC): Entity which implements the communication to one or multiple EVCCs and which may be able to interact with secondary actors. Note 1: According to ISO 15118-2. Note 2: Further details regarding possible architectures are given in Annex A of ISO 15118-1. Note 3: Functions of a supply equipment communication controller may control input and output channels, data encryption, or data transfer between vehicle and SECC. (Source: ISO/CD 15118-1 Ed2)
- Energy or Electricity Meter (EM): The energy meter is responsible for measuring the PEV charge or discharge (or site) energy. Energy meters may exist as whole house or facility meters, separate submeters, dedicated PEV charging meters, on-vehicle sub-meter or meter, and EVSE embedded meter or submeter, and may be differentiated in their use as decision information for other VGI actors.
- Building Energy Management System (BEMS): A collection of sensors and controls intended to automate management of energy flow and use at a site location or facility. Typically, this is the equipment used by the Utility Customer of Record to implement their choices and automate control of the site electricity. BEMS includes all of the following terms: Site controller, Building site controller, parking lot management system, Energy management system or Home Energy Management System (HEMS),
- Aggregator: Increasingly, aggregators are stepping into a role of facilitating ready interconnections across multiple Charging Station Operators (CSOs) and Market Service Providers (MSPs) and between CSOs and MSPs and the Distribution Network Operators (DNOs) and Transmission System Operators (TSOs) that provide electricity service. Broadly, aggregators serve two roles: to expand the size of charging networks that PEV customers can access seamlessly, facilitating back-office transactions and billing across

networks and 2) aggregating a number of PEVs and CSOs to provide useful grid services to DNOs and TSOs. (8)

- Utility Customer of Record (COR): The person or corporation whose name is on the electric utility bill. May be the property owner or tenant or the charging station operator or aggregator. 2) Individual or entity identified as the meter customer account holder on the utility records with the authority to determine constraints on the utilization of energy at the meter account location. Typically, this is the person or entity making the decisions related to management of charging at the site. The person in whose name service is rendered as evidenced by the signature on the application, contract, or agreement for that service, or, in the absence of a signed instrument, by the receipt and payment of bills or Summary Bills regularly issued in his/her name regardless of the identity of the actual user of the service. A customer may also be a party with whom [UTILITY] is doing business with or without a billing relationship. The entire bill is the responsibility of [UTILITY's] COR. May have an energy supply contract of some type with the Power Flow Entity or 3rd party BEMS operator that is conducting VGI functions at that location.
- Decision and Choice Entities: Includes the EV driver, utility customer of record, and power flow entity.
- Acting Equipment and Hardware: Includes the EV battery system, EV service equipment, building management system, DC power converter system and energy or electricity meter.
- **Aggregated vs unified vs fragmented and other similar terms**
  - Unified Actor: Refers to the case where each of key the elements (vehicle, charging station and facility) is managed by a single entity or multiple entities and there is coordinated vehicle charging in a manner that maintains positive value for all entities. Each of the actors that claim ownership or control of these three parts of the PEV value chain may have different objectives and be affected by each other's actions in VGI. A VGI transaction in this context is relatively simple to coordinate. A single entity would align the actions of each component of the transaction and can collect all the benefits. Costs imposed on a particular element would not necessarily prevent the transaction, because those costs could be weighed against and offset by benefits to other elements, resulting in net benefits that would all accrue to the same entity or that could be fairly distributed among entities. (1)
  - Principal – Agent Problem occurs when one person or entity (the "agent") is able to make decisions on behalf of, or that impact, another person or entity: the "principal." This dilemma exists in circumstances where agents are motivated to act in their own best interests, which are contrary to those of their principals. This is a common problem in energy policy (e.g., residential adoption of efficiency measures in a rental

property). For VGI, this problem is compounded by the ambiguity of which actor is the principal (the entity with the legal capacity to execute VGI) and the agent (the entity that carries out or supports the actions of the principal). (1)

- Fragmented Actor: Also see principle-agent problem. Refers to charging situations, in which all or a subset of decisions or elements (vehicle, charging station, and facility) are owned or controlled by separate entities. This may occasionally result in charging that results in negative value to one of the actors. For example, in workplace charging, the facility account holder, the operator of a networked charging station, and the vehicle may be owned and controlled by different entities. In this case, it is not immediately clear which entity will make decisions about how the VGI resource is used. The actors may have multiple and potentially divergent objectives: to do what is economically optimal for the grid system-wide, the facility's overall costs, or the vehicle's mobility. For example, the charging station may want to provide frequency regulation signals in the afternoon, while a vehicle owner needs energy to return home. Simultaneously, the facility may want to reduce its demand charge. (1)

- **Use Case vs Requirements vs Application vs Functionality vs Architecture vs Layer vs End-to-End Solution and other similar terms:**

- Use Case: Defines a grid problem that can be solved with one or more solutions (technical and/or non-technical) and describes the solutions. Use cases are generally vision documents that help clarify a goal or vision of a project or a solution including its usefulness. The use case is a list of actions or event steps, typically defining the interactions between Actor(s) or Role(s) and a system, to achieve a goal means that each use case, and must be tied to a specific value it is providing (i.e., describe how it is producing that value). Typically, questions include:
  - Is VGI operationally viable for this use?
  - What are the potential benefits of VGI in this use case? Can these benefits be monetized via an existing market structure? If not, how should they be valued?
  - Is VGI cost-effective for this use?
  - What barriers are preventing or slowing deployment of VGI in this use?
  - What are the policy options to address the identified barriers encountered by VGI?
  - Should procurement targets or other policies to encourage VGI be considered for this use?
- Network Architecture: A system that outlines the products and services necessary for the individual components within a data communications network to operate together



It is a set of equipment (EV, EVSE, Servers) with different physical media and applications that ensure a specific sequence of events will occur in a network in the proper order to produce the intended results. A Network Architecture should support simultaneously, multiple client applications, in an end-to-end (Grid to EV) and secure manner to any Network Service Provider's server over multiple paths. See end-to-end solution for synonymous term.

- Mesh Architecture: A networking topology where the individual nodes or devices connect to one another independently and cooperate with one another to route data to and from one another. A key ability is to self-configure and self-route packets using many nodes to relay messages from the originating node to the destination node.
- Application Software: A program that performs tasks on behalf of a user. Often results in 'application layer' data being sent to another application running on a remote system.
- Requirements: Explicit statement that describes what a system must do, how it must behave or any constraints that apply to it. Requirements are typically classified as either functional and non-functional or quality requirements. Requirements are used to develop system designs, support analysis of complicated systems, and verify implementations. Requirements use key words such as SHALL, MUST, SHOULD, etc., typically capitalized, to signify the severity of the requirement. The use of these key words has been standardized by the Internet Engineering Task Force (IETF) at <https://www.ietf.org/rfc/rfc2119.txt>
- Functional Requirement: A type of requirement that describes what functionality is desired from a system or technology. Defines specific inputs, behaviors, outputs or other functions needed to accomplish each use case from a system or technology. These include functions such as authentication, authorization, certification, reporting, and data collection.
- Non-Functional Requirement: A type of requirement that describes how a system is required to operate. Non-Functional requirements are often further sub-categorized as Performance, Security, Usability, Interface, and others. Defines criteria about the use case's operation, rather than specific functions. These include attributes such as scalability, response time, reliability, data integrity, and interoperability, and can describe a system's interface, performance, and usability.
- Layer: Independent parts of a 7-layer communication protocol based on the Open Systems Interconnection model. Each layer takes care of a very specific job, and then passes the data onto the next layer.
- Platform: The base hardware and software upon which software applications run
- Architecture: See network architecture.

- Application Layer (Layer 7): Describes data resulting from interaction with software applications.
- Presentation Layer (Layer 6): Supports communications between differing data formats of application and network layers.
- Session Layer (Layer 5): Describes connections, including initiating and termination, of communication sessions within a communication system.
- Transport Layer (Layer 4): Describes reliability and transfer procedures in one or more communication systems.
- Network Layer (Layer 3): Describes data transfer between two nodes in different networks.
- Link Layer (Layer 2): Describes data transfer between two connected nodes in a communication system.
- Physical Layer (Layer 1): Describes the electrical and physical components of a communication system. Physical Layer: The electronic circuit layer of a network. This layer defines the raw bits and signaling used over a physical link connecting network nodes.
- Protocol: Set of rules and requirements that specify the interactions between communicating entities. Most protocols are voluntary in the sense that they are offered for adoption by people or industry without being mandated in law. Some protocols become mandatory when they are adopted by regulators as legal requirements. 2) A standard method of exchanging data that is used between communicating layers.
- Application-Centric Layers: Layers 5, 6 and 7.
- Network-Centric Layers: Layers 1, 2 and 3.
- Physical Layer Bridge: A **network bridge** is a [computer networking device](#) that creates a single aggregate network from multiple [communication networks](#) or [network segments](#). A bridge operates at Layer 2. (Wikipedia)
- End-to-End VGI Solution: A communication pathway from the electricity grid to the plug-in electric vehicle that may involve several steps and different communication media or protocols. Same as Network Architecture.
- Functionality: Denotes either the operations able to be performed by a device or communicated via a protocol.
- Router: A layer 3 device that transmits data packets between networks. It uses IP addresses and routing tables to determine destination networks.
- Point-to-point: In [telecommunications](#), a point-to-point connection refers to a communications connection between two nodes or endpoints. An example is a [telephone call](#), in which one telephone is connected with one other, and what is said by one caller can only be heard by the other. This is contrasted with a [point-to-](#)

multipoint or broadcast connection, in which many nodes can receive information transmitted by one node. (Wikipedia)

- Gateway: In a communications network, a network node equipped for interfacing with another network that uses different protocols. A gateway may contain devices such as protocol translators, impedance matching devices, rate converters, fault isolators, or signal translators as necessary to provide system interoperability. It also requires the establishment of mutually acceptable administrative procedures between both networks. A protocol translation/mapping gateway interconnects networks with different network protocol technologies by performing the required protocol conversions. Loosely, a computer or computer program configured to perform the tasks of a gateway. (Wikipedia)
  - Controller: In computing and especially in computer hardware, a controller is a chip, an expansion card, or a standalone device that interfaces with a peripheral device. This may be a link between two parts of a computer (for example a memory controller that manages access to memory for the computer) or a controller on an external device that manages the operation of (and connection with) that device. Source: Wikipedia. 2) ISO 15118 defines two controllers: Electric Vehicle Communication Controller (EVCC) and “Supply Equipment Communication Controller (SECC).
  - External Protocol Converter: A device used to convert a standard or proprietary protocol of one device to the protocol suitable for the other device, or tools to achieve interoperability between protocols. (adapted from Wikipedia)
  - Internet Protocol (IP): The principal communications protocol in the Internet Protocol Suite for relaying datagrams across network boundaries. (Wikipedia)
  - Internet Protocol Suite: The conceptual model and set of communications protocols used on the Internet and similar computer networks. It is commonly known as TCP/IP because the foundational protocols in the suite are the Transmission Control Protocol (TCP) and the Internet Protocol (IP). Similar to the OSI model, IPS is a conceptual model that describes end-to-end communications and a suite of protocols used on the internet and similar networks. The IPS consists of 4 layers: Application (Comparable to layers 5-7 of OSI), Transport (Layer 4), Network (Layer 3), and Link (layer 1 and 2).
  - IP version 6 (IPv6): The most recent version of the Internet Protocol (IP); the communications protocol that provides an identification and location system for computers on networks and routes traffic across the Internet. IPv6 was developed by the Internet Engineering Task Force (IETF) to deal with the long-anticipated problem of IPv4 address exhaustion. IPv6 is intended to replace IPv4. (Wikipedia)
- **EVSE vs Charging station vs Charging infrastructure vs Make Ready and other similar terms**
    - EV Supply Equipment (EVSE): 1) The equipment that interconnects the AC electricity grid at a site to the EV. 2) Sometimes used more broadly to mean charging station,

whether AC or DC, but not including the make-ready infrastructure or other charging infrastructure. Also see charging station / device. May include multiple connectors (called multi-port) to charge several EVs or to serve EVs with different types of connectors (e.g. SAE Combo and CHAdeMO).

- Cord set or charging cord set: Portable charging equipment that typically comes with the PEV. Usually Level 1, but can be level 2.
  - Charging station / device: The off-board-the-EV unit that contains a charging connector that is used to connect the EV to the charging station. This is a broad term that includes the AC EVSE, the DC station and charger and may be inductive (e.g. wireless) or conductive charging, and may even be capable of V2G (bi-directional) charging.
  - Charger: Off-board the EV inverter (typically DC) or the on-board the EV inverter (AC).
  - Charging Plaza or Center: A large collection of public-access charging stations.
  - Make-Ready: The behind-the-utility meter infrastructure up-to the stub, but not including the charging station or the utility side equipment. It typically does not include the utility meter or charging station, but may include hardware (panel, trenching, and wiring) and civil work (trenching, planning, and installation).
  - Traditional utility distribution service equipment or utility side-of-the meter infrastructure: Includes the utility distribution system and transformers, and electrical service on the customer property (overhead or underground) up to and including the utility meter.
  - Charging Infrastructure: Includes the make-ready and the utility-side-of the meter infrastructure, but does not include the charging station.
- **Standard vs Protocol and other similar terms**
    - Standards Development Organizations (SDOs) and National/International Standards Bodies (NSBs/ISBs): Organizations that develop consensus technical standards, are accredited, widely recognized, and publish for public use (only charging distribution fees). An SDO is also called a standards organization, standards body or standards setting organization (SSO) and is an organization whose primary activities are developing, coordinating, promulgating, revising, amending, reissuing, interpreting, or otherwise producing technical standards that are intended to address the needs of a group of affected adopters.
    - Nationally Recognized Testing Laboratory: is the term used by the United States Occupational Safety and Health Administration to identify third-party organizations that have the necessary qualifications to perform safety testing and certification of products covered within OSHA and each organization's scopes. The testing and

certification are conducted in accordance with U.S. consensus-based product safety test standards developed or issued by U.S. standards organizations.

- Protocol: Set of rules and requirements that specify the interactions between communicating entities. Most protocols are voluntary in the sense that they are offered for adoption by people or industry without being mandated by law. Some protocols become mandatory when they are adopted by regulators as legal requirements. 2) A standard method of exchanging data that is used between two communicating layers.
- Standard: Broader term than protocol and can apply to many types of equipment (e.g., charging connectors, charging equipment, batteries, communications, signage) and processes (e.g., measurement, charging access). Most standards are voluntary in the sense that they are offered for adoption by people or industry without being mandated in law. Some standards become mandatory when they are adopted by regulators as legal requirements.
- Standard Protocol: Protocol that is developed and maintained by an SDO or NSB but are voluntarily adopted by market participants.
- Formal Standard: Refers to a specification that has been approved by a standards-setting organization.
- De Jure Standard: Refers to a standard mandated by legal requirements or refers generally to any Formal Standard, as defined.
- De Facto Standard Protocol: A protocol that has achieved dominant position by public acceptance or market forces. 2) Specification (or protocol or technology) that has achieved widespread use and acceptance – often without being approved by any standards-setting organization (or receiving such approval only after it already has achieved widespread use).
- Standardization: Implies a mandate requiring a standard or protocol; 2) process where a protocol or standard achieves a dominant position in the market due to public acceptance or market forces.
- Mandated Standard or Protocol: A government agency (e.g., PUC, Air Board, Energy Commission, Weights and Measures [in California called Division of Measurement Standards], Independent System Operator) requires use of the standard or protocol in some way.
- Open Standards: Generally denotes a standard protocol that allowed any entity to contribute to its development and can be used royalty free.
- Proprietary Protocol: A protocol that is developed and maintained by a single organization or individual company.
- Alliance: A member-based organization that develops protocols for its members.

- **Charging segments and related terms**

- Away-from-Home Charging: Includes public-access charging as well as workplace charging, but excludes fleet charging.
- Public Access Charging: Includes level 1, level 2 and DC charging at locations other than private access locations such as fleets, workplaces, and residences with exceptions for visitor parking at workplaces and multi-unit dwellings and mixed-use charging. It includes away-from-home-base DC charging open to members or the public as well as charging at restaurants, retail and service businesses, or destination centers, public streets, public or pay parking lots, mixed use locations and rest-stops.
- Home Charging: Includes charging at single family homes, mobile homes and multi-unit dwellings but excludes commercial fleets. Implies being able to charge off-street in a driveway, carport, garage or similar location by the home.
- Urban DC Fast-Charging Plazas or Centers: Concentrations of DC fast-charge stations at a single site within a metropolitan area or city that may or may not be open to the general public (e.g., membership or rideshare model), may be co-located with other fueling facilities, and could be on a travel corridor. Tesla refers to their Supercharger plazas or centers as Supercharger Stations, with each Supercharger Station having six or more charging station units/the ability to charge six or more vehicles at one time. For purposes of this Glossary and consistency, Tesla's concentrations of DC fast chargers will be referred to as plazas or centers.
- Corridor DC Charging or Intercity DC Charging: Charging stations and charging plazas with DC fast charging located between metropolitan areas, but not within them.
- Mixed-Use Charging: Charging where multiple types of users typically charge. For example, city parking structures used by residents of MUDs, workplaces, city fleet vehicles, and visitors to regional destination centers.
- Multi-Use Charging: 1) Away-from-home, fleet, or multi-unit dwelling charging where more than one EV is charged each day at the same charging station at those locations. 2) Charging stations which support multiple vehicle types, typically differentiating by class of vehicle. For example, a depot charging unit which could charge a bus or a passenger vehicle using the same standard that light duty passenger vehicles use for DC fast charging.
- Multi-Unit Dwelling Charging: Refers to charging stations in common areas of condos and apartments (usually a commercial account for a utility) and excludes single family attached homes (duplexes, triplexes, and townhomes) that do not have common-area parking.
- Restaurant, Retail, and Rest-Stop Charging: Can be level 1, 2, or DC and includes small clusters of charging at those locations but excludes large-scale charging plazas.
- Single-Family Home Charging: Charging stations in driveways, carports or garages in residences designed for individuals or a family. Includes both attached and detached homes, but excludes large apartment and condo complexes without individual garages or carports near the home.

- Street or Curbside Charging: Charging stations (AC or DC) on a curb, or road or street without curbs.
- Visitor Charging: Charging stations dedicated for visitors at a workplace or in a condo or apartment complex.
- Workplace Charging: Charging stations for employees, staff, students, teachers and professors.
- **Interoperability, roaming, authentication, authorization, clearinghouse and similar terms**
  - Interoperability: The ability of systems or software to exchange and make use of information. See Interoperate, Charging Access Interoperability, Site Host Station Interoperability, Front-end EVSE network interoperability, and Roaming.
  - Interoperate: Ability of two or more systems to operate together.
  - Charging Access: The ability to use a charging station even if not a member of the charging network.
  - Charging Access Interoperability: The ability to use a single credential (e.g., RFID card) at any charging station requiring authorization (aka Open Access).
  - Open Access: See Charging Access Interoperability.
  - Roaming: The ability to travel between charging stations operated by different network providers while being billed to one account. Implies that providers share account and billing information for each session.
  - Authentication: The process of verifying the identity of an entity requesting access to information. Often done with the use of user name and password or certificate exchange and public/private key encryption.
  - Authorization: Determination of what information is allowed to be accessed by an authenticated entity.
  - Clearinghouse: An entity that maintains account and billing information to support roaming. A third-party entity that maintains account and billing information to facilitate charging by PEV drivers across networks. Similar to EVSE network roaming, a clearinghouse provides benefits to PEV drivers because it enables them to access charging on multiple networks. Because a clearinghouse is a third-party entity, PEV drivers may be billed by the clearinghouse operator or by the EVSE network. In the United States, billing would have to be negotiated in the interests of the EVSE networks and their customers. In Europe, multiple clearinghouse platforms often serve country- or region-specific markets. A sampling of the major platforms includes e-clearing.net, GIREVE, MOBI.E, ENEL, and Hubject. The Open InterCharge Protocol (OICP) and Open Clearing House Protocol (OCHP) are two common European network-to-clearinghouse data-sharing protocols. Similar to roaming, a clearinghouse would require EVSE networks in the United States to use common data-sharing protocols.
  - Site Host Station Interoperability: Ability of a site host to link different networks at the site or easily upgrade the EVSE of a bankrupt charging station manufacturer or network operator.

- Non-networked EVSE is not connected to the Internet and provides basic charging functionality without advanced communications capabilities. For example, most Level 1 EVSE units are designed to simply charge a vehicle; they are not networked and do not have additional software features that track energy use, process payment for a charging session, or determine which drivers are authorized to use the EVSE. Secondary systems that provide these features can be installed to supplement non-networked EVSE.
- Networked EVSE is connected to the Internet via a cable or wireless technology and can communicate with the computer system of a charging network. Being connected to a network lets station owners or site hosts manage who can access stations and how much it costs drivers to charge.<sup>4</sup> An EVSE network typically manages a group of networked EVSE and uses its communication capabilities to monitor and share real-time station status information and usage data, as well as to control access and facilitate payment. EVSE networks may also provide vehicle-grid integration (VGI) services to electrical utilities, as well as customized services to site hosts or station owners.
- EVSE network is an entity that manages a group of networked EVSE units with access control and payment systems. These EVSE networks are also referred to as network service providers or charging station operators. A sampling of the major EVSE networks includes AeroVironment, Blink, ChargePoint, EVgo, Greenlots, SemaConnect, and Tesla.
- **VGI Benefit Framework terms** (elements from 12 possible frameworks were combined into one – see separate Xcel file for details)
  - VGI Beneficiary: Party or category of parties who receive VGI benefits.
  - Benefit: An advantage or profit gained from something.
  - VGI Benefit Framework: Answers the following questions 1) who needs the benefit, 2) what is the need, 3) what meets the need, and 4) how to meet the need (broadly and exactly).
  - VGI Benefit: Any type of benefit whether monetized or not.
  - VGI Service: A subset of VGI benefits and includes monetized benefits on the utility customer of record's electricity bill and in wholesale markets. Eventually may include monetized benefits in distribution markets when they are set up.
  - Customer Facing VGI Benefits (EV Driver or Site Host): Include TOU-bill management, demand-charge management, back-up power, power quality, market education regarding bill savings, charging and EV options, and increased solar self-consumption to address localized over-generation of solar energy. TOU-bill management benefits can be provided by V1G, V2G, improved TOU rate design for EVs, special rates funded by the Low Carbon Fuel Standard proceeds and passive optimized customer response to education from bills, EV dashboards, apps and other means. Demand-charge management benefits can be provided by policy changes to improve demand-charge



rate design, change allowance policy, or change utility rebates for charging stations to reward lower kW charging or reward charging stations with charge-sharing, charge sequencing, or similar technologies. Increased solar self-consumption to address localized over-generation of solar energy can be provided by V1G or V2G. The market education benefits can be provided by business customer advisory services, websites, rate analyses, broad market education such as radio ads, dealer education and incentive programs, ride-and-drives, conferences and other targeted market education that is provided by utilities, automakers, trade associations, non-profits, and other stakeholders.

- Distribution System VGI Benefits: Include deferral of distribution capacity upgrades, integration of renewables, voltage support, and resiliency services provided by microgrids that can island and eventually reliability services that include back-tie functions. Deferral of distribution capacity upgrades can be provided by V1G, V2G, passive optimized customer response to education from bills, EV dashboards, apps and other means and by policy changes to improve demand charge rate design, improve TOU rate design for EVs, change allowance policy, design special rates funded by the Low Carbon Fuel Standard proceeds, offer new residential demand charges, or change utility rebates for charging stations to reward lower kW charging or charging stations with charge-sharing, charge sequencing or similar technologies. Renewable integration benefits can be also be provided by these same means, except residential demand charges. Reliability services that can provide back-tie benefits can be provided by V2G. Voltage support can be provided by V2G. Resiliency services provided by microgrids that can island can be provided by V2G or V1G.
- Transmission System VGI Benefits: Include deferral of transmission capacity; integration of renewables, voltage support, and inertia primary frequency response and eventually other benefits such operational efficiency and black start services. Deferral of transmission capacity and integration of renewables can be provided by V1G, V2G, passive optimized customer response to education from bills, EV dashboards, apps and other means and by policy changes to improve demand charge rate design, improve TOU rate design for EVs, change allowance policy, design special rates funded by the Low Carbon Fuel Standard proceeds, offer new residential demand charges, or change utility rebates for charging stations to reward lower kW charging or charging stations with charge-sharing, charge sequencing or similar technologies. Renewable integration benefits can be also provided by these same means, except residential demand charges. Voltage support and inertia primary frequency response can be provided by V2G.
- Wholesale Market Ancillary Services: Include ISO market services such as primary and secondary frequency regulation (response), reactive power support, imbalance energy; spinning reserves, non-spinning reserves and replacement reserves. These services can be provided by V1G or V2G.

- Generation Resource Adequacy VGI Benefits: Include system resource adequacy capacity, local resource adequacy capacity, and flexible resource adequacy capacity which is sometimes called ramping or load-following service. System resource adequacy capacity service and local resource adequacy capacity service can be provided by V1G, V2G, passive optimized customer response to education from bills, EV dashboards, apps and other means and by policy changes to improve demand charge rate design, improve TOU rate design for EVs, change allowance policy, design special rates funded by the Low Carbon Fuel Standard proceeds, offer new residential demand charges, or change utility rebates for charging stations to reward lower kW charging or charging stations with charge-sharing, charge sequencing or similar technologies. Flexible resource adequacy service can be provided by V1G and V2G.
- Compliance VGI Benefits: Investor-owned utilities can meet an electricity storage mandate with V2G, and potentially (with rule changes) by other means such as V1G.
- Societal and Environmental VGI Benefits: Include providing net reductions in greenhouse gases (GHG), criteria air pollutants, air toxics and net additions in economic growth and jobs. GHG reduction benefits (net) can be provided by passive optimized customer response to education from bills, EV dashboards, apps and other means and by policy changes to improve demand charge rate design, improve TOU rate design for EVs, change allowance policy, design special rates or rebates funded by the Low Carbon Fuel Standard proceeds, offer new residential demand charges, or change utility rebates for charging stations to reward lower kW charging or charging stations with charge-sharing, charge sequencing or similar technologies. GHG-reduction benefits can be provided by utility programs and behind-the-meter investments to encourage EV adoption generally, as well as special targeted programs designed for people who don't have a consistent place to charge overnight, including urban DC fast charge stations, special lots at workplaces, curbside charging, and charging at large apartments and condos. Air pollution and air toxic reduction programs can be provided by the same, and can also include special programs targeted at medium and heavy duty EVs and non-road EVs. Economic-development and job-creation benefits (net) also can be provided by the above means.

**VGI Communications Terms** (alphabetical)

- Acting Equipment and Hardware: Includes the EV battery system, EV service equipment, building energy management system, DC power converter system, and energy or electricity meter.
- Aggregator: Increasingly, aggregators are stepping into a role of facilitating ready interconnections across multiple CSOs and MSPs and between CSOs and MSPs and the DNOs and TSOs that provide electricity service. Broadly aggregators serve two roles: to expand the size of charging networks that PEV customers can access seamlessly, facilitating back-office transactions and billing across networks and 2) aggregating a number of EVs and

CSOs to provide useful grid services to DNOs and TSOs. (8)Alliance: A member-based organization that develops protocols for its members.

- Application Software: A program that performs tasks on behalf of a user. Often results in 'application layer' data being sent to another application running on a remote system.
- Application Programming Interfaces (API): In computer programming, an application programming interface (API) is a set of subroutine definitions, protocols, and tools for building application software. In general terms, it is a set of clearly defined methods of communication between various software components. (Wikipedia)
- Architecture: See Network Architecture.
- Authentication: The process of verifying the identity of an entity requesting access to information. Often done with the use of user name and password or certificate exchange and public/private key encryption.
- Authorization: Determination of what information is allowed to be accessed by an authenticated entity.
- Back-End EVSE network interoperability: allows systems to exchange and process information about station location and status, pricing, user access, and billing. Sharing this information among networks and with third-party partners would improve the customer experience for PEV drivers trying to find, access, and pay for public charging. Back-end EVSE network interoperability could also help achieve many of the expectations outlined in DOE's *Public Plug-in Electric Vehicle Charging Infrastructure Guiding Principles*.
- Bidirectional converter: is the term used for a device that can convert from AC to DC in one direction to serve as a battery charger and then be capable of being reversed and convert from DC to AC in the other direction to serve as an inverter. (Reference 19)
- Building Energy Management System: A collection of sensors and controls intended to automate management of energy flow and use at a site location or facility. Typically, this is the equipment used by the Utility Customer of Record to implement their choices and automate control of the site electricity. BEMS includes all of the following terms: site controller, building site controller, parking lot management system, energy management system, or Home Energy Management System (HEMS).
- Business Case: Monetary and non-monetary benefit to actors excluding the EV driver or all utility customers.
- Central Control: Describes a charging situation where decisions on how much, how fast, and when to charge and/or discharge are made by an entity other than the EV driver.
- Certification: Certification is a formal testing process used to ensure compliance to some set of requirements via testing. Certification testing usually results in a certificate or mark indicating the tested product meets certain standards.
- Certificate Authority: An entity that issues and manages digital certificates.

- Central Control: Customer allows another party to make decisions regarding the customer's charging and may not require a full charge.
- Certificate Authority: Entity that issues digital certificates.
- Charging Access Interoperability: The ability to use a single credential (e.g., RFID card) at any charging station requiring authorization (aka Open Access).
- Charging Access: The ability to use a charging station even if not a member of the charging network.
- Charging Level Incentives: Tools including rebates for lower level charging, modifying current allowance policy, demand charge design
- Clearinghouse: An entity that maintains account and billing information to support roaming. A clearinghouse is a third-party entity that maintains account and billing information to facilitate charging by PEV drivers across networks. Similar to EVSE network roaming, a clearinghouse provides benefits to PEV drivers because it enables them to access charging on multiple networks. Because a clearinghouse is a third-party entity, PEV drivers may be billed by the clearinghouse operator or by the EVSE network. In the United States, billing would have to be negotiated in the interests of the EVSE networks and their customers. In Europe, multiple clearinghouse platforms often serve country- or region-specific markets. A sampling of the major platforms includes e-clearing.net, GIREVE, MOBI.E, ENEL, and Hubject. The Open InterCharge Protocol (OICP) and Open Clearing House Protocol (OCHP) are two common European network-to-clearinghouse data-sharing protocols. Similar to roaming, a clearinghouse would require EVSE networks in the United States to use common data-sharing protocols.
- Compliance VGI Benefits: Investor-owned utilities can meet an electricity storage mandate with V2G, and potentially (with rule changes) by other means such as V1G.
- Controller: In computing and especially in computer hardware, a controller is a chip, an expansion card, or a standalone device that interfaces with a peripheral device. This may be a link between two parts of a computer (for example a memory controller that manages access to memory for the computer) or a controller on an external device that manages the operation of (and connection with) that device. Source: Wikipedia. 2) ISO 15118 defines two controllers: Electric Vehicle Communication Controller (EVCC) and "Supply Equipment Communication Controller (SECC).
- Customer Control: The EV driver inputs preferences or decisions regarding charging.
- Customer Requirements: Ensure the customer has control over accepting or rejecting VGI services. These requirements can include interaction with the EV charging equipment, a smartphone or computer app, a building management system or some other digital interface.
- Customer Facing VGI Benefits (EV Driver or Site Host): Include TOU-bill management, demand-charge management, back-up power, power quality, market education regarding

bill savings, charging and EV options, and increased solar self-consumption to address localized over-generation of solar energy. TOU-bill management benefits can be provided by V1G, V2G, improved TOU rate design for EVs, special rates funded by the Low Carbon Fuel Standard proceeds and passive optimized customer response to education from bills, EV dashboards, apps and other means. Demand-charge management benefits can be provided by policy changes to improve demand-charge rate design, change allowance policy, or change utility rebates for charging stations to reward lower kW charging or reward charging stations with charge-sharing, charge sequencing, or similar technologies. Increased solar self-consumption to address localized over-generation of solar energy can be provided by V1G or V2G. The market education benefits can be provided by business customer advisory services, websites, rate analyses, broad market education such as radio ads, dealer education and incentive programs, ride-and-drives, conferences and other targeted market education that is provided by utilities, automakers, trade associations, non-profits, and other stakeholders.

- **DC Fast Charging:** Charging at 20 kW and higher using direct current. Direct-current (DC) fast charging provides 50 to 70 miles of range per 20 minutes of charging with an electrical output ranging between 50-120 kW.
- **DC Slow Charging:** Charging below 20kW using direct current.
- **DC Home Charging:** Charging at a residential location (typically at low power, below 20 kW) using an external charger or inverter (in the case of V2G).
- **DC Power Converter System:** The off-vehicle Power Converter that controls DC-energy flow to or from the EV Battery System. The Power Converter works with the on-board battery system (EVBS) for power flow. The Power Converter can operate in a uni-directional (V1G) or bi-directional (V2G) manner. Sometimes called the Inverter, Rectifier, or Bi-directional inverter.
- **Decision and Choice Entities:** Includes the EV driver, utility customer of record, and power flow entity.
- **De Jure Standard:** Refers to a standard mandated by legal requirements or refers generally to any Formal Standard, as defined.
- **De Facto Standard Protocol:** A protocol that has achieved dominant position by public acceptance or market forces. 2) A specification (or protocol or technology) that has achieved widespread use and acceptance – often without being approved by any standards organization (or receiving such approval only after it already has achieved widespread use).
- **Digital Certificate:** Digital identification shared between communicating entities. Usually contains names, serial numbers, expiration dates, and public keys; are digitally signed by Certificate Authorities.
- **Distribution System VGI Benefits:** Include deferral of distribution capacity upgrades, integration of renewables, voltage support, and resiliency services provided by microgrids

that can island and eventually reliability services that include back-tie functions. Deferral of distribution capacity upgrades can be provided by V1G, V2G, passive optimized customer response to education from bills, EV dashboards, apps and other means and by policy changes to improve demand charge rate design, improve TOU rate design for EVs, change allowance policy, design special rates funded by the Low Carbon Fuel Standard proceeds, offer new residential demand charges, or change utility rebates for charging stations to reward lower kW charging or charging stations with charge-sharing, charge sequencing or similar technologies. Renewable integration benefits can be also be provided by these same means, except residential demand charges. Reliability services that can provide back-tie benefits can be provided by V2G. Voltage support can be provided by V2G. Resiliency services provided by microgrids that can island can be provided by V2G or V1G.

- **Driver Control**: Describes a charging situation where decisions on how much, how fast and when to charge and/or discharge are made by the EV driver.
- **Encryption/Decryption**: Transforming data into plaintext or cipher text so that: 1) the data cannot be understood by parties for which it was not intended (Confidentiality); 2) the data cannot be altered without being detected (Integrity); 3) identities can be verified (Authentication); and 4) sources of the data are non-deniable (Non-repudiation). How and why this is done in practice depends on the requirements of the implementation (e.g., security protocol and cipher suite).
- **End-to-End VGI Solution**: A communication pathway from the electricity grid to the plug-in electric vehicle that may involve several steps and different communication media or protocols.
- **Energy Management System**: An Energy Management System is a computer system that can communicate with a PEV or EVSE for the purpose of controlling the charging or discharging of the PEV battery. An EMS can exist at several tiers: customer premises, distribution level, or system level. These computer systems may go by other names, but the term EMS will be used generically in this document. (Reference 19)
- **Energy or Electricity Meter (EM)**: The energy meter is responsible for measuring the PEV charge or discharge (or site) energy. Energy meters may exist as whole-house or facility meters, separate submeters, dedicated EV charging meters, on-vehicle sub-meters or meters, and EVSE embedded meters or submeters.
- **Energy Portal**: Energy Portal is any charging point for a PEV. At a minimum, the Energy Portal is a 120V, 15A outlet but can also be a 240V Electric Vehicle Supply Equipment (EVSE) outlet connected to the premises circuit. This needs to follow the nomenclature in J1772 for L1 and L2 charging. (Reference 19)
- **Energy Transfer Strategy**: A strategy that accounts for all of the electrical energy needs of an EV and the present status of all on-board equipment, including the EV Storage Battery. It determines the rate that energy is to be transferred to the EV and how the ETS shall be operated to accomplish this. (Reference 19)

- EV Battery System (EVBS): The vehicle energy storage management and charge control system that will provide direct interface and communications to process and execute VGI functions. This includes the communications for power conversion functions including AC and DC charging/discharging and DER mode operations.
- EV Driver: Individual or entity with authority to determine PEV charging preferences and priorities to meet transportation needs. This could be the actual driver or could be the fleet operator (through the use of the BEMS) making choices about the transportation needs & requirements of the PEVs. Examples of choices and decisions include: driving range needed, departure time, and acceptable energy-price levels. Examples of input devices include, but are not limited to, smart phone app, website, vehicle interface, and EVSE. The EV driver is sometimes called the end user, owner, or fleet-transportation operator.
- EV Supply Equipment (EVSE): 1) The equipment that inter-connects the AC electricity grid at a site to the EV. Can be level 1 or level 2 charging. Incorrectly called the charger. EVSE is the generic term used to describe the device that is physically connected and provides energy to the vehicle. EVSEs may take several physical forms, and their logical function may likewise differ substantially. Physical forms include a mobile cordset used for 120VAC charging, a fixed or wall-mounted 240VAC charger, or an off-board DC charger. An EVSE may also support reverse power flow (discharging). (Reference 19) 2) Sometimes used more broadly to mean charging station, whether AC or DC, but not including the make-ready infrastructure or other charging infrastructure. Also see charging station / device. May include multiple connectors (called multi-port) to charge several EVs or to serve EVs with different types of connectors (e.g. SAE Combo and CHAdeMO). Also called the Energy Connection System (ECS). 3)
- EVSE network: An entity that manages a group of networked EVSE units with access control and payment systems. These EVSE networks are also referred to as network service providers or charging station operators. A sampling of the major EVSE networks includes AeroVironment, Blink, ChargePoint, EVgo, Greenlots, SemaConnect, and Tesla.
- Electric Vehicle Communication Controller (EVCC): Embedded system, within the vehicle, that implements the communication between the vehicle and the 381 SECC in order to support specific functions. Note 1: Such specific functions could be e.g. controlling input and output channels, encryption, or data transfer between vehicle and SECC. (Source: ISO/CD 15118-1 Ed2)
- Electric Vehicle Power System (EVPS): Equipment or a combination of equipment providing dedicated functions to supply electric power in both directions of:
  - from an electrical installation or supply network to an EV for the purpose of charging, and
  - from a DER in the EV to supply network or the grid for the purpose of discharging.
 Note 1: Former function is equal to the EV supply equipment, provided by IEC 61851-1 3.1.1 (similar to SAE J1772). (Source: ISO/CD 15118-1 Ed2)

- Extensibility: Ensures the hardware or software would not be affected, or would only be minimally affected, if new or modified functionality is added.
- External Power Converter: An electrical or electro-mechanical device for converting electrical energy from one form to another, such as converting between AC and DC; or just changing the voltage or frequency; or some combination of these. (adapted from Wikipedia)
- External Protocol Converter: A device used to convert a standard or proprietary protocol of one device to the protocol suitable for the other device, or tools to achieve interoperability between protocols. (adapted from Wikipedia)
- Formal Standard: Refers to a specification that has been approved by a standards-setting organization.
- Form Factor: An aspect of hardware design which defines and prescribes the size, shape, and other physical specifications of components, particularly in consumer electronics and electronic packaging. A form factor may represent a broad class of similarly sized components, or it may prescribe a specific standard. (Wikipedia)
- Forward Power Flow: means the direction of energy for Charging a Vehicle. While the term “forward” suggests a positive sign convention, care must be used with any communications because the convention for DER devices is to use a positive sign to designate energy produced (discharged) by the DER. (Reference 19)
- Four Quadrant Converter: refers to an electronic device that can produce or absorb both active and reactive power. When a PEV is discharging the device serves as an inverter converting DC current to AC current. It can displace the AC current waveform relative to the AC voltage waveform to generate or absorb reactive power, depending on whether it leads or lags the supplied current relative to the grid voltage. The device converts AC power to DC current to charge the PEV battery. It can also shift the consumed current relative to the grid voltage waveform to produce or absorb reactive power. (Reference 19)
- Fragmented Actor: Also see principle-agent problem. Refers to other charging situations, in which all or a subset of decisions or elements (vehicle, charging station, and facility) are owned or controlled by separate entities. This may occasionally result in charging that results in negative value to one of the actors. For example, in workplace charging, the facility account holder, the operator of a networked charging station, and the vehicle may be owned and controlled by different entities. In this case, it is not immediately clear which entity will make decisions about how the VGI resource is used. The actors may have multiple and potentially divergent objectives: to do what is economically optimal for the grid system-wide, the facility’s overall costs, or the vehicle’s mobility. For example, the charging station may want to provide frequency regulation signals in the afternoon, while a vehicle owner needs energy to return home. Simultaneously, the facility may want to reduce its demand charge. (Reference 1)
- Front-end EVSE Network Interoperability: is also known as open access and is one approach that may allow non-members to access charging outside of their primary network through



alternative authorization and payment options, such as calling customer service for a code or personal identification number (PIN). Open access may improve access for PEV drivers, but it does so at the expense of convenience and does nothing to help EVSE networks exchange and process data about charging on their networks.

- **Functional Requirement:** A type of requirement that describes what functionality is desired from a system or technology. Define specific inputs, behaviors, outputs or other functions needed to accomplish each use case from a system or technology. These include functions such as authentication, authorization, certification, reporting, and data collection.
- **Functionality:** Denotes either the operations able to be performed by a device or communicated to/from a device via a protocol.
- **Gateway:** In a communications network, a network node equipped for interfacing with another network that uses different protocols. A gateway may contain devices such as protocol translators, impedance matching devices, rate converters, fault isolators, or signal translators as necessary to provide system interoperability. It also requires the establishment of mutually acceptable administrative procedures between both networks. A protocol translation/mapping gateway interconnects networks with different network protocol technologies by performing the required protocol conversions. Loosely, a computer or computer program configured to perform the tasks of a gateway. (Wikipedia)
- **Generation Resource Adequacy VGI Benefits:** Include system resource adequacy capacity, local resource adequacy capacity, and flexible resource adequacy capacity which is sometimes called ramping or load-following service. System resource adequacy capacity service and local resource adequacy capacity service can be provided by V1G, V2G, passive optimized customer response to education from bills, EV dashboards, apps and other means and by policy changes to improve demand charge rate design, improve TOU rate design for EVs, change allowance policy, design special rates funded by the Low Carbon Fuel Standard proceeds, offer new residential demand charges, or change utility rebates for charging stations to reward lower kW charging or charging stations with charge-sharing, charge sequencing or similar technologies. Flexible resource adequacy service can be provided by V1G and V2G.
- **Home Area Network (HAN):** is an energy related network, contained within a premises used for communicating with devices within the premises. HANs do not necessarily require connectivity outside the premises, but may be connected to one or more external communication networks (e.g., Utility AMI, internet, cell phone network, etc.) using gateways, bridges and interfaces. (Reference 19)
- **HomePlug powerline adapters** are an alternative solution for having your house completely networked using existing power lines. The advanced HomePlug powerline adapter is capable of transmitting data at up to 200 Mbps channel data rate. The HomePlug powerline

adapter delivers maximum range and speed for voice, Internet, video, and music throughout your home or office. (Reference 19)

- HomePlug Green PHY: The HomePlug Green PHY specification is a subset of HomePlug AV that is intended for use in the smart grid. It has peak rates of 10 Mbit/s and is designed to go into smart meters and smaller appliances such as HVAC thermostats, home appliances and plug-in electric vehicles so that data can be shared over a home network and with the power utility. High capacity broadband is not needed for such applications; the most important requirements are low power and cost, reliable communication, and compact size. GreenPHY uses up to 75% less energy than AV. (Wikipedia)
- Interface: Refer to Application Programming Interface (API). In computer programming, an application programming interface (API) is a set of subroutine definitions, protocols, and tools for building application software. In general terms, it is a set of clearly defined methods of communication between various software components.
- Interop Events: Testing events, usually conducted by standards developers, to ensure accuracy of required functionality/operations and test plans prior to formal certification testing by test houses.
- Interoperability: The ability of systems or software to exchange and make use of information. See Interoperate, Charging Access Interoperability, Site Host Station Interoperability, Front-end EVSE network interoperability, Back-end EVSE network interoperability and Roaming. 2) The condition where components of a system, relative to each other, are able to work together to perform the intended operation of the total system. Information interoperability is the capability of two or more networks, systems, devices, applications, or components to share and readily use information securely and effectively with little or no inconvenience for the user. As an example, a 10-mm box-end hand wrench and a 10-mm socket wrench are interoperable, relative to a 10-mm hex-head bolt. The wrench and the bolt are both parts of a fastening system. The fact that the system will perform as required with either wrench establishes the interoperability of the wrenches and the bolt. (Reference 19)
- Interoperate: Ability of two or more systems to operate together.
- Internet Protocol (IP): The principal communications protocol in the Internet Protocol Suite for relaying datagrams across network boundaries. (Wikipedia)
- Internet Protocol Suite: The conceptual model and set of communications protocols used on the Internet and similar computer networks. It is commonly known as TCP/IP because the foundational protocols in the suite are the Transmission Control Protocol (TCP) and the Internet Protocol (IP). (Wikipedia) Similar to the OSI model, a conceptual model that describes end-to-end communications and a suite of protocols used on the internet and similar networks. The IPS consists of 4 layers: Application (Comparable to layers 5-7 of OSI), Transport (Layer 4), Network (Layer 3), and Link (layer 1 and 2).

- IP version 6 (IPv6): The most recent version of the Internet Protocol (IP); the communications protocol that provides an identification and location system for computers on networks and routes traffic across the Internet. IPv6 was developed by the Internet Engineering Task Force (IETF) to deal with the long-anticipated problem of IPv4 address exhaustion. IPv6 is intended to replace IPv4. (Wikipedia)
- Inverter: AC power is generated from a DC source, such as a traction battery, using a device called an inverter. For operation as an off-grid, standalone power source, the inverter regulates the amplitude and frequency of the AC voltage and the connected loads determine the AC current flow from the inverter. A grid-connected inverter (i.e., utility-interactive inverter) must act as a current source and synchronizes to the frequency of the grid voltage waveform. A bidirectional converter or four-quadrant converter are often just referenced as being an inverter. (Reference 19)
- Latency: In network communication, refers to the time between when a signal is sent and when it is received. It can be affected by such things as distance, physical media, and the number of times it needs to be routed or configured by intermediary systems, such as routers.
- Layer: Independent parts of a 7-layer communication protocol based on the Open Systems Interconnection model. Each layer takes care of a very specific job, and then passes the data onto the next layer.
  - Physical Layer (Layer 1): Describes the electrical and physical components of a communication system.
  - Link layer (Layer 2): Describes data transfer between two connected nodes in a communication system.
  - Network Layer (Layer 3): Describes data transfer between two nodes in different networks.
  - Network-Centric Layers: Layers 1, 2 and 3.
  - Transport Layer (Layer 4): Describes reliability and transfer procedures in one or more communication systems.
  - Session Layer (Layer 5): Describes connections, including initiating and termination, of communication sessions within a communication system.
  - Presentation Layer (Layer 6): Supports communications between differing data formats of application and network layers.
  - Application Layer (Layer 7): Describes data resulting from interaction with software applications.
  - Application-Centric Layers: Layers 5, 6 and 7.
  - Physical Layer Bridge: A network bridge is a computer networking device that creates a single aggregate network from multiple communication networks or network segments. A bridge operates at Layer 2. (Wikipedia)

- Level One Charging: AC Level 1 provides 2 to 5 miles of range per 1 hour of charging using a 120-volt (V) alternating current (AC) plug.
- Level Two Charging: AC Level 2 provides 10 to 20 miles of range per 1 hour of charging using 240 V or 208 V electrical service.
- List: Verb describing the process for being approved by a Nationally Recognized Testing Laboratory.
- Mandated Standard or Protocol: A government agency (e.g., PUC, Air Board, Energy Commission, Weights and Measures [in California called Division of Measurement Standards], Independent System Operator) requires use of the standard or protocol in some way.
- Mesh Architecture: A networking topology where the individual nodes or devices connect to one another independently and cooperate with one another to route data to and from one another. A key ability is to self-configure and self-route packets using many nodes to relay messages from the originating node to the destination node.
- Nationally Recognized Testing Laboratory: is the term used by the United States Occupational Safety and Health Administration to identify third-party organizations that have the necessary qualifications to perform safety testing and certification of products covered within OSHA and each organization's scopes. The testing and certification are conducted in accordance with U.S. consensus-based product safety test standards developed or issued by U.S. standards organizations.
- Near-Field Communication (NFC): is a form of contactless communication between devices like smartphones or tablets and the charging post. Like RFID, using NFC across networks would require common data sharing protocols, as well as some form of roaming agreement.
- Network Architecture: A system that outlines the products and services necessary for the individual components within a data-communications network to operate together. It is a set of equipment (EV, EVSE, Servers) different Physical Media and Applications that ensures that a specific sequence of events occurs in a network in the proper order to produce the intended results. A Network Architecture should support simultaneously, multiple client applications, in an end-to-end (Grid to EV) secure manner to any Service Provider Server over multiple paths.
- Networked EVSE: An EVSE that is connected to the Internet via a cable or wireless technology and can communicate with the computer system of a charging network. Being connected to a network lets station owners or site hosts manage who can access stations and how much it costs drivers to charge.<sup>4</sup> An EVSE network typically manages a group of networked EVSE and uses its communication capabilities to monitor and share real-time station status information and usage data, as well as to control access and facilitate

payment. EVSE networks may also provide vehicle-grid integration (VGI) services to electrical utilities, as well as customized services to site hosts or station owners.

- Network Services Provider: A typically broader term than the Power Flow Entity mainly because the NSP can also provide billing, maintenance, reservations and other non-grid information to charging stations, and is a more commonly used term than power flow entity. 2) The controlling entity that sends the grid commands or messages to the EV or EVSE (e.g., rates information or grid information based on energy, capacity or ancillary services markets and this is sometimes called an electricity grid network services provider. The NSP may send non-grid commands (e.g. reservations, billing, maintenance checks), and this additional service is sometimes called a communication network services provider. The NSP may receive one or more conflicting grid commands from other entities. The NSP may be the POU, IOU, ISO, Aggregator, OVGIP, Clearing House, Site Host or Charging station operator.
- Non-Functional Requirement: A type of requirement that describes how a system is required to operate. Non-Functional Requirements are often further sub-categorized as Performance, Security, Usability, Interface, and others. Define criteria about the use case's operation, rather than specific functions. These include attributes such as scalability, response time, reliability, data integrity, and interoperability, and can describe a system's interface, performance, and usability.
- Non-networked EVSE: An EVSE that is not connected to the Internet and provides basic charging functionality without advanced communications capabilities. For example, most Level 1 EVSE units are designed to simply charge a vehicle; they are not networked and do not have additional software features that track energy use, process payment for a charging session, or determine which drivers are authorized to use the EVSE. Secondary systems that provide these features can be installed to supplement non-networked EVSE.
- Open Access: See Charging Access Interoperability.
- Open Standards: Generally, denotes a standard protocol that allowed any entity to contribute to its development and can be used royalty free.
- Open Protocol: A protocol that is made available license free.
- Open Development: Refers to a process where an Alliance, SDO, or NSB allows all parties to participate in development of a standard or protocol.
- Peer-to-Peer: A type of communication architecture where 2 computers both act as clients and servers.
- Platform: The base hardware and software upon which software applications run.
- Point-to-Point: In telecommunications, a point-to-point connection refers to a communications connection between two nodes or endpoints. An example is a telephone call, in which one telephone is connected with one other, and what is said by one caller can only be heard by the other. This is contrasted with a point-to-

multipoint or broadcast connection, in which many nodes can receive information transmitted by one node. Source: Wikipedia

- Power Flow Entity (PFE): An off-site entity that is requesting or mandating VGI activities from other actors downstream. PFE may involve more than one off-site operation, such as utility and aggregator who are responsible for determining grid conditions and communicating the required VGI action to the affected downstream actors to execute the request or mandate. The PFE is a broad term than may include the Aggregator, Utility, Site Host, EVSP, or Clearing House.
- Plug and Charge: allows a vehicle to connect to EVSE and begin charging without any additional driver interaction. This requires the most transparency, as well as the most network interoperability among back-end networks and the vehicle.
- Plugs: Slang for charging station connector to the EV. 2) The connector for level one or level two AC conductive cord set.
- Principal Agent Problem: occurs when one person or entity (the "agent") is able to make decisions on behalf of, or that impact, another person or entity: the "principal." This dilemma exists in circumstances where agents are motivated to act in their own best interests, which are contrary to those of their principals. This is a common problem in energy policy (e.g., residential adoption of efficiency measures in a rental property). For VGI, this problem is compounded by the ambiguity of which actor is the principal (the entity with the legal capacity to execute VGI) and the agent (the entity that carries out or supports the actions of the principal). (Reference 1)
- Proprietary Protocol: A protocol that is developed and maintained by a single organization or individual company. Typically used in business-to-business application, but could be between the EV driver and the automaker.
- Protocol: Set of rules and requirements that specify the interactions between communicating entities. Most protocols are voluntary in the sense that they are offered for adoption by people or industry without being mandated in law. Some protocols become mandatory when they are adopted by regulators as legal requirements. 2) A standard method of exchanging data that is used between two communicating layers.
- Registration: In communication applications, usually denotes the process of providing identification and other necessary details in order to be authenticated and authorized to access applications or other systems.
- Requirements: Explicit statement that describes what a system must do, how it must behave or any constraints that apply to it. Requirements are typically classified as either functional and non-functional or quality requirements. Requirements are used to develop system designs, support analysis of complicated systems and verify implementations. Requirements use key words such as SHALL, MUST, SHOULD, etc., typically capitalized, to signify the severity of the requirement. The use of these key words has been standardized

by the Internet Engineering Task Force (IETF) at  
<https://www.ietf.org/rfc/rfc2119.txt><https://www.ietf.org/rfc/rfc2119.txt>.

- **Reservation**: Reserving an EV charger for use.
- **Reverse Power Flow**: means the direction of energy for discharging a Vehicle. While the term “reverse” suggests a negative sign convention, care must be used with any communications because the convention for DER devices is to use a positive sign to designate energy produced by the DER. (Reference 19)
- **RFID (Radio Frequency Identification) Cards or Key Fobs**: RFID cards or key fobs are held against a reader on the charging post to enable data exchange. For networks using RFID to authenticate and authorize charging, EVSE networks would likely need to agree on common data protocols and have a roaming agreement in place to ensure data could be exchanged among networks to authenticate and authorize charging by non-members.
- **Roaming**: The ability to travel between charging stations operated by different network providers while being billed to one account. Implies that providers are able to share account and billing information for each session.
- **Router**: A layer 3 device that transmits data packets between networks. It uses IP addresses and routing tables to determine destination networks.
- **Simple Electric Rate Publishing**: Allowing the market to respond to electric rates especially with enhanced, widespread marketing of utility rates to all market participants.
- **Societal and Environmental VGI Benefits**: Include providing net reductions in greenhouse gases (GHG), criteria air pollutants, air toxics and net additions in economic growth and jobs. GHG reduction benefits (net) can be provided by passive optimized customer response to education from bills, EV dashboards, apps and other means and by policy changes to improve demand charge rate design, improve TOU rate design for EVs, change allowance policy, design special rates or rebates funded by the Low Carbon Fuel Standard proceeds, offer new residential demand charges, or change utility rebates for charging stations to reward lower kW charging or charging stations with charge-sharing, charge sequencing or similar technologies. GHG-reduction benefits can be provided by utility programs and behind-the-meter investments to encourage EV adoption generally, as well as special targeted programs designed for people who don’t have a consistent place to charge overnight, including urban DC fast charge stations, special lots at workplaces, curbside charging, and charging at large apartments and condos. Air pollution and air toxic reduction programs can be provided by the same, and can also include special programs targeted at medium and heavy duty EVs and non-road EVs. Economic-development and job-creation benefits (net) also can be provided by the above means.
- **Standard**: Broader term than protocol and can apply to many types of equipment (e.g., charging connectors, charging equipment, batteries, communications, signage) and processes (e.g., measurement, charging access). Most standards are voluntary in the sense

that they are offered for adoption by people or industry without being mandated in law. Some standards become mandatory when they are adopted by regulators as legal requirements.

- Standardization: Implies a mandate requiring a standard or protocol; 2) process where a protocol or standard achieves a dominant position in the market due to public acceptance or market forces.
- Standards Development Organizations (SDOs) and National/International Standards Bodies (NSBs/ISBs): Organizations that develop consensus technical standards, are accredited, widely recognized, and publish for public use (only charging distribution fees). An SDO is also called a standards organization, standards body, or Standards Setting Organization (SSO) and it is an organization whose primary activities are developing, coordinating, promulgating, revising, amending, reissuing, interpreting, or otherwise producing technical standards that are intended to address the needs of a group of affected adopters.
- Standard Protocol: Protocol that is developed and maintained by an SDO or NSB.
- Supply Equipment Communication Controller (SECC): Entity which implements the communication to one or multiple EVCCs and which may be able to interact with secondary actors. Note 1: According to ISO 15118-2. Note 2: Further details regarding possible architectures are given in Annex A of ISO 15118-1. Note 3: Functions of a supply equipment communication controller may control input and output channels, data encryption, or data transfer between vehicle and SECC. (Source: ISO/CD 15118-1 Ed2)
- Telematics or Vehicle Telematics: Telematics is an interdisciplinary field that encompasses telecommunications, vehicular technologies, road transportation, road safety, electrical engineering (sensors, instrumentation, wireless communications, etc.), and computer science (multimedia, Internet, etc.). Telematics can involve any of the following (Source: Wikipedia)
  - the technology of sending, receiving and storing information via telecommunication devices in conjunction with effecting control on remote objects
  - the integrated use of telecommunications and informatics for application in vehicles and with control of vehicles on the move
  - global navigation satellite system technology integrated with computers and mobile communications technology in automotive navigation systems
  - (most narrowly) the use of such systems within road vehicles, also called vehicle telematics
- Time Charge is Needed: is the identification of the end of the potential charge session. This is when the customer wants to use their vehicle for the next drive cycle and the expected recharging is complete. (Reference 19)
- Time of Departure: The time at which an EV driver has determined they must stop charging and drive the vehicle.



- Transmission System VGI Benefits: Include deferral of transmission capacity; integration of renewables, voltage support, and inertia primary frequency response and eventually other benefits such operational efficiency and black start services. Deferral of transmission capacity and integration of renewables can be provided by V1G, V2G, passive optimized customer response to education from bills, EV dashboards, apps and other means and by policy changes to improve demand charge rate design, improve TOU rate design for EVs, change allowance policy, design special rates funded by the Low Carbon Fuel Standard proceeds, offer new residential demand charges, or change utility rebates for charging stations to reward lower kW charging or charging stations with charge-sharing, charge sequencing or similar technologies. Renewable integration benefits can be also provided by these same means, except residential demand charges. Voltage support and inertia primary frequency response can be provided by V2G.
- Unified Actor: Refers to the case where each of key the elements (vehicle, charging station, and facility) is managed by a single entity or multiple entities and there is coordinated vehicle charging in a manner that maintains positive value for all entities. Each of the actors that claim ownership or control of these three parts of the PEV value chain may have different objectives and be affected by each other’s actions in VGI. A VGI transaction in this context is relatively simple to coordinate. A single entity would align the actions of each component of the transaction and can collect all the benefits. Costs imposed on a particular element would not necessarily prevent the transaction, because those costs could be weighed against and offset by benefits to other elements, resulting in net benefits that would all accrue to the same entity or that could be fairly distributed among entities. (Reference 1)
- Use Case: Defines a grid problem that can be solved with one or more solutions (technical and/or non-technical) and describes the solutions. Use cases are generally vision documents that help clarify a goal or vision of a project or a solution, including its usefulness. Use Case is a list of actions or event steps, typically defining the interactions between Actor(s) or Role(s) and a system, to achieve a goal, and each use case must be tied to a specific value it is providing (i.e., describe how it is producing that value). Typically, questions include:
  - Is VGI operationally viable for this use?
  - What are the potential benefits of VGI in this use case? Can these benefits be monetized via an existing market structure? If not, how should they be valued?
  - Is VGI cost-effective for this use?
  - What barriers are preventing or slowing deployment of VGI in this use?
  - What are the policy options to address the identified barriers encountered by VGI?
- Should procurement targets or other policies to encourage VGI be considered for this use?

- Utility Customer of Record (COR): The person or corporation whose name is on the electric utility bill. May be the property owner or tenant or the charging station operator or aggregator. 2) Individual or entity identified as the meter customer account holder on the utility records with the authority to determine constraints on the utilization of energy at the meter account location. Typically, this is the person or entity making the decisions related to management of charging at the site. The person in whose name service is rendered as evidenced by the signature on the application, contract, or agreement for that service, or, in the absence of a signed instrument, by the receipt and payment of bills or Summary Bills regularly issued in his/her name regardless of the identity of the actual user of the service. A customer may also be a party with whom [UTILITY] is doing business with or without a billing relationship. The entire bill is the responsibility of [UTILITY's] COR. May have an energy supply contract of some type with the Power Flow Entity or 3rd party BEMS operator that is conducting VGI functions at that location.
- Utility-Interactive Inverter: is an inverter intended for use in parallel with an electric power system to supply common loads and sometimes deliver power to the utility. This is also called a grid-connected inverter. (Reference 19)
- Vehicle Grid Integration (VGI): A very broad term that encompasses the many ways in which a vehicle can provide benefits or services to the grid, to society, the EV driver, or parking lot site host by optimizing PEV interaction with the electrical grid. VGI includes both active management of electricity (e.g., bi-directional management, such as vehicle-to-grid [also known as V2G] or unidirectional management such as managed charging [also known as V1G]) and/or active management of charging levels by ramping up or down charging. VGI also includes passive solutions such as customer response to existing rates, design of improved utility rates (e.g., TOU charges, demand charges, and customer fees), design of the grid to accommodate EVs while reducing grid impacts to the degree possible, and education or incentives to encourage charging technology or charging level (e.g., rebates for lower level charging, modifying current allowance policy). See VGI benefits for more detail.
- VGI Beneficiary: Party or category of parties who receive VGI benefits.
- VGI Benefit: An advantage or profit gained from something.
- VGI Benefit Framework: Answers the following questions 1) who needs the benefit, 2) what is the need, 3) what meets the need, and 4) how to meet the need (broadly and exactly). (Available at [www.cpuc.ca.gov/vgi](http://www.cpuc.ca.gov/vgi))
- VGI Benefit: Any type of benefit whether monetized or not.
- VGI Service: A subset of VGI benefits and includes monetized benefits on the utility customer of record's electricity bill and in wholesale markets. Eventually may include monetized benefits in distribution markets when they are set up.
- V1G (or managed or controlled charging): Central or customer control of EV charging to provide VGI benefits including wholesale market services. Includes ramping up and

ramping down of charging (AC or DC) for individual EVs or multiple EVs whether the control is done at the charging station, the EV, the EV management system, the parking lot EV energy management system or the building energy management system.

- Vehicle to Grid (V2G): Energy from the EV battery is converted to an AC current which flows from the EVSE to a facility circuit which is connected to the electric power system, even if there is no net export of power from the facility. V2G assumes a bidirectional energy transfer capability and not just discharging of the battery. The combined EVSE and EV form a distributed energy resource (DER) and all states have special rules that apply to the interconnection of DER to the grid. The AC-DC conversion can be performed on board the EV (SAE term V2G-AC) or within the EVSE (SAE term V2G-DC). These are very different DER systems with significantly different communication requirements between the EVSE and EV.
- Vehicle to Home (V2H): SAE defines V2H as the EV battery operating as a backup power source for a home that has been disconnected (islanded) from the grid. The inverter regulates the frequency and voltage for the islanded home just like a standby generator. This can be done using an inverter in the EVSE (SAE type V2H-DC) or using an inverter onboard the EV which connects to the home emergency generator port using an exportable power panel on the EV (SAE type V2H-EPP).
- Vehicle to Building (V2B): This is an alternative term for V2H. SAE only defines V2H for use with any type of facility which has been disconnected (islanded) from the grid and the vehicle battery is providing AC power.
- Vehicle to Load (V2L): describes the capability of a PEV with an onboard inverter to provide power to tools or other loads which are not connected to a home or the grid. The inverter regulates the amplitude and frequency of the AC voltage and the power is routed to NEMA receptacles on an exportable power panel. (Reference 19)
- Web-Based Communication: Some EVSE networks allow access to their charging via third-party web applications. Because this is an interaction between the network and a third party, it can offer the accessibility and convenience of charging across networks without requiring interoperability among EVSE networks. EVSE networks have not been strongly supportive of this model because it may add cost to both the PEV driver and the EVSE network to have a third party involved in the charging transaction.
- Wholesale Market Ancillary Services: Include ISO market services such as primary and secondary frequency regulation (response), reactive power support, imbalance energy; spinning reserves, non-spinning reserves and replacement reserves. These services can be provided by V1G or V2G.
- Wi-Fi: A facility allowing computers, smartphones, or other devices to connect to the Internet or communicate with one another wirelessly within a particular area.
- Wireless Power Transfer (WPT): Transfer of electrical energy from a power source to an electrical load via electric and or magnetic fields or waves between a primary and a

secondary device. (Source: ISO/CD 15118-1 Ed2)

- ZigBee: A wireless technology developed as an open global standard to address the unique needs of low-cost, low-power wireless machine-to-machine networks. The ZigBee standard operates on the IEEE 802.15.4 physical radio specification and operates in unlicensed bands including 2.4 GHz, 900 MHz and 868 MHz.

## **Organizations and Agencies**

### • EV Standards Development Organizations (SDOs) and National/International Standards Bodies (NSBs/ISBs):

- Society of Automotive Engineers (SAE)
  - Institute of Electrical and Electronics Engineers (IEEE)
  - National Electrical Manufacturers Association (NEMA)
  - International Electrotechnical Commission (IEC)
  - International Organization for Standardization (ISO)
  - Organization for the Advancement of Structured Information Standards (OASIS)
  - National Fire Protection Association (NFPA)
- Nationally Recognized Testing Labs (NRTLs)
    - Underwriters Laboratories Inc. (UL)
    - Bay Area Compliance Laboratories
    - Canadian Standards Association (CSA) (also known as CSA International)
    - Communication Certification Laboratory, Inc. (CCL)
    - Curtis-Straus LLC (CSL)
    - FM Approvals LLC (FM) (formerly Factory Mutual Research Corporation)
    - International Association of Plumbing and Mechanical Officials EGS (IAPMO)
    - Intertek Testing Services NA, Inc. (ITSNA) (formerly ETL)
    - MET Laboratories, Inc. (MET)
    - Nemko USA, Nemko North America, Inc.(NNA)
    - NSF International (NSF)
    - QAI Laboratories, LTD (QAI)
    - QPS Evaluation Services, Inc. (QPS)
    - SGS U.S. Testing Company, Inc. (SGSUS) (formerly UST-CA)
    - Southwest Research Institute (SWRI)
    - TUV Rheinland PTL, LLC (TÜVPTL)
    - TUV SUD America (TÜVAM)
    - TUV SUD Product Services GmbH (TÜVPSG)
    - TUV Rheinland of North America (TÜV)
  - Alliances
    - Open Charge Alliance
    - Home Plug Alliance

- Wi-Fi Alliance
- Blue Tooth Alliance
- Zigbee Alliance
- Agencies
  - California Public Utilities Commission (CPUC)
  - California Air Resources Board (CARB)
  - California Energy Commission (CEC)
  - California Independent System Operator (CAISO)
  - Governor's Office of Business and Economic Development (GO-BIZ)
  - United States Department of Energy (USDOE)
  - California Division of Measurement Standards: (DMS) is part of the Department of Food and Agriculture (CDFA) and oversees the 58 county Weights and Measures organizations. DMS is also commonly called Department of Weights and Measures:
- Authority Having Jurisdiction (AHJ): Usually refers to the city or county that controls building and electrical standards and permits, but can also apply to large public facilities such as military bases and college campuses.

**General and Technical Terms in the Utility Industry** (alphabetical):

- 3-phase 480 volts +: Three-phase electric power is a common method of alternating current electric power generation, transmission, and distribution. It is a type of polyphase system and is the most common method used by electrical grids worldwide to transfer power. It is also used to power large motors and other heavy loads.
- Ampere or Amp: The basic unit of electrical current in the International System of Units (SI), equivalent to one coulomb per second, formally defined to be the constant current, which if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed one meter apart in a vacuum, would produce between these conductors a force equal to  $2 \times 10^{-7}$  newton per meter of length.
- Advanced Distribution Management Systems (ADMS): Are software platforms that integrate numerous utility systems and provide automated outage restoration and optimization of distribution grid performance. ADMS functions can include automated fault location, isolation, and service restoration (FLISR); conservation voltage reduction; peak demand management; and volt/volt-ampere reactive (Volt-var) optimization. In effect, ADMS transitions utilities from paperwork, manual processes, and siloed software systems to systems with real-time and near-real-time data, automated processes, and integrated systems. (Reference 3)
- Advanced Metering Infrastructure (AMI): Typically refers to the full measurement and collection system that includes meters at the customer site, communication networks between the customer and a service provider, such as an electric, gas, or water utility, and

data reception and management systems that make the information available to the service provider and the customer. (Reference 3)

- Ancillary Services: The services needed to maintain system reliability and meet WSCC/NERC operating criteria, including spinning, non-spinning, and replacement reserves, regulation, voltage control and black start capability.
- Balancing Authority (BA): The responsible entity that integrates resource plans ahead of time, maintains load-interchange-generation balance within an electrically-defined Balancing Authority Area (BAA), and supports interconnection frequency in real time. A utility TSO or an ISO/RTO may be a balancing authority for an area. (Reference 3)
- Base Load: The minimum amount of electric power delivered or required over a given period at a constant rate. (Reference 9)
- Behind-the-Meter: Equipment, infrastructure, devices on the customer-side of the utility owned meter. (Aka beyond-the-meter.)
- Black Start: In the event of a grid outage, black start generation assets are needed to restore operation to larger power stations in order to bring the regional grid back online. In some cases, large power stations are themselves black start capable. (Reference 7; Also see Reference 9)
- Bulk Electric System: Unless modified by the lists shown below, all transmission elements operated at 100 kV or higher and real power and reactive power resources connected at 100 kV or higher. This does not include facilities used in the local distribution of electric energy. Inclusions:
  - I1 - Transformers with the primary terminal and at least one secondary terminal operated at 100 kV or higher unless excluded by application of Exclusion E1 or E3.
  - I2 – Generating resource(s) including the generator terminals through the high-side of the step-up transformer(s) connected at a voltage of 100 kV or above with: a) Gross individual nameplate rating greater than 20 MVA. Or, b) Gross plant/facility aggregate nameplate rating greater than 75 MVA.
  - I3 - Blackstart Resources identified in the Transmission Operator’s restoration plan.
  - I4 - Dispersed power producing resources that aggregate to a total capacity greater than 75 MVA (gross nameplate rating), and that are connected through a system designed primarily for delivering such capacity to a common point of connection at a voltage of 100 kV or above. Thus, the facilities designated as BES are: a) Limits on connected generation: The LN and its underlying Elements do not include generation resources identified in Inclusions I2, I3, or I4 and do not have an aggregate capacity of non-retail generation greater than 75 MVA (gross nameplate rating);b) Real Power flows only into the LN and the LN does

not transfer energy originating outside the LN for delivery through the LN; and  
c) Not part of a Flowgate or transfer path: The LN does not contain any part of a permanent Flowgate in the Eastern Interconnection, a major transfer path within the Western Interconnection, or a comparable monitored Facility in the ERCOT or Quebec Interconnections, and is not a monitored Facility included in an Interconnection Reliability Operating Limit (IROL).

- E4 – Reactive Power devices installed for the sole benefit of a retail customer(s).  
Note - Elements may be included (Reference 9)
- Capacity Benefit Margin: The amount of firm transmission transfer capability preserved by the transmission provider for Load-Serving Entities (LSEs), whose loads are located on that Transmission Service Provider's system, to enable access by the LSEs to generation from interconnected systems to meet generation reliability requirements. Preservation of CBM for an LSE allows that entity to reduce its installed generating capacity below that which may otherwise have been necessary without interconnections to meet its generation reliability requirements. The transmission transfer capability preserved as CBM is intended to be used by the LSE only in times of emergency generation deficiencies. (Reference 9)
- Capacity Markets Service: Capacity, as it relates to electricity, means there are adequate resources on the grid to ensure that the demand for electricity can be met at all times, and means that a utility or other electricity supplier is required to have the resources to meet its customers' demand plus a reserve. Providing capacity in a competitive market for an Independent System Operator is a capacity markets service.
- Cascading: The uncontrolled, successive loss of System Elements triggered by an incident at any location. Cascading results in widespread electric service interruption that cannot be restrained from sequentially spreading beyond an area predetermined by studies. (Reference 9)
- Competitive Wholesale Energy Markets: Electricity is produced by independent power producers and sold in competitive wholesale markets. Broadly the provision of electricity is separated into three types of markets: 1) energy markets for the sale of the electricity itself, 2) capacity markets to ensure sufficient generation capacity is available to meet peak demands and 3) Imbalance Energy and Ancillary Service markets to balance supply and demand in real-time and ensure reliable operation of the transmission system. (Reference 8)
- Critical Peak: Refers to extreme peak-load days in the year. Typically, in the summer for utilities in hot or mild climates.
- Customer Backup Power: In the event of grid failure, energy storage paired with a local generator can provide backup power at multiple scales, ranging from second-to-second power quality maintenance for industrial operations to daily backup for residential customers. (Reference 7)

- Customer Information System (CIS): Used to maintain customer data, which is available to a grid operator's or utility's customer service representatives so that they may answer inquiries from customers. (Reference 3)
- Customer Relationship Management (CRM): A system that allows a utility to track and adjust marketing campaigns, forecast participation rates, and move customers from potential participants to fully engaged customers. (Reference 3)
- Customer Side: See Behind-the-Meter.
- Curtailement: A reduction in the scheduled capacity or energy delivery of an Interchange Transaction. (Reference 9)
- Daily Peak: Maximum instantaneous flow of electricity recorded in a 24-hour period.
- Day-Ahead Pricing: Hourly- or time-increment price schedules that are communicated to the customer 24 hours in advance of the pricing event.
- Day-Ahead Energy Markets: Wholesale market whereby energy bids are optimized with forecasted load one day prior to the actual operating day. Market that receives buy and sell bids, balances supply and demand, sets a clearing price, and settles the transactions. Typically opens seven days in advance of the day the trading will occur, and closes the morning of the day before the energy will be used.
- DC Service: The utility, instead of providing AC service to the customer, provides a DC service drop and meter, which means the power inverter is on the utility side of the meter. A few examples exist today, but this was more common many decades ago.
- Demand: Active power being used at one point in time. Measured in Watts.
- Demand Charges: Portion of the utility bill resulting from a calculated peak load (demand) of a customer, typically \$/kW. The time and calculation vary depending upon rate structure.
- Demand Leveling / Demand-Charge Reduction: Changes in customer behavior which modify, typically downward, the recorded demand that is used to calculate the demand charge.
- DER Disconnect Command: A control signal meant to cause a DER system to be de-energized or galvanically isolated from the electrical system.
- Demand Response Auction Mechanism (DRAM): Pay-as-bid auction where an IOU seeks a monthly demand response (DR) system capacity, local capacity, and flexible capacity for the year.
- Demand Response (DR): Customers changing their electricity usage (typically reducing use or shifting use to other times in the day) at certain times in response to economic incentives, price signals, or other conditions.
- Demand-Side Management: All activities or programs undertaken by a load-serving entity or its customers to influence the amount or timing of electricity usage. (Reference 9)
- Direct Load Control Management: End-use, or load, under direct control of a LSE or aggregator for use in demand-side management activities, such as demand response.



- Dispatch Order: A set of dispatch rules such that given a specific amount of load to serve, an approximate generation dispatch can be determined. To accomplish this, each generator is ranked by priority. (Reference 9)
- Distributed Energy Resources (DERs): Include distributed generation resources, distributed energy storage, demand response, energy efficiency and electric vehicles that are connected to the electric distribution power grid. (Reference 3) 2) A Distributed Energy Resource is a small generation source or energy storage system (ESS) that connects to the distribution grid. A rooftop photovoltaic (PV) system is one of the most common types of DER. The combined EVSE and PEV form an ESS type of DER. (Reference 19)
- Distributed Energy Resource Management System (DERMS): A software-based solution that increases an operator's real-time visibility into the status of DERs and allows distribution utilities to have the heightened level of control and flexibility necessary to more effectively manage the technical challenges posed by an increasingly distributed grid. (Reference 3)
- Distribution Capacity Services: Load modifying or supply services that DERs provide via the dispatch of power output (megawatts, MW) for generators or a reduction in load that is capable of reliably and consistently reducing net loading on desired distribution infrastructure. These Distribution Capacity Services can be provided by a single DER resource and/or an aggregated set of DER resources that reduce the net loading on a specific distribution infrastructure location coincident with the identified operational need in response to a control signal from the utility. Examples of traditional "wires" equipment that currently support providing this type of service and include, but are not limited to, transformers, overhead and underground line conductors, circuit breakers, and line and substation switches. (Reference 12)
- Distribution Management System (DMS): A utility operating system capable of collecting, organizing, displaying and analyzing real-time or near real-time electric distribution system information. A DMS can also allow operators to plan and execute complex distribution system operations in order to increase system efficiency and prevent overloads. A DMS can interface with other operations applications such as geographic information systems (GIS), outage management systems (OMS), and customer information systems (CIS) to create an integrated view of distribution operations. (Reference 3)
- Distribution System: The portion of the electric system that is composed of medium voltage (69 kV to 4 kV) sub-transmission lines, substations, feeders, and related equipment that transport the electricity to and from customer homes and businesses and that link customers to the high-voltage transmission system. The distribution system includes all the components of the cyber-physical distribution grid as represented by the information, telecommunication and operational technologies needed to support reliable operation (collectively the "cyber" component) integrated with the physical infrastructure comprised

of transformers, wires, switches and other apparatus (the “physical” component).  
(Reference 3)

- Distribution Grids: Today are largely radial, with sectionalizing and tie switches to enable shifting portions of one circuit to another for maintenance and outage restoration. Some cities have “network” type distribution systems with multiple feeders linked together to provide higher reliability. (Reference 3)
- Distribution Services Attributes: Attributes of the needed distribution services further describe the required response from a DER. These distribution service attributes include: 1) locational specificity as to where on the distribution system that the desired DER response is needed, 2) level or magnitude of the DER response that is required, 3) timing and duration of when the DER response is desired, and 4) DER availability and assurances of the ability to provide the services. (Reference 12)
- Distribution System Operator: An entity that is responsible for developing and maintaining the distribution system and ensuring its interconnection with other systems.
- Distribution Services Performance Requirements: To ensure that DERs are able to provide distribution services in a safe and reliable manner, a DER will be required to meet certain performance standards that can be measured by the utility. Depending on the location and attributes of the local distribution area where DERs are providing these distribution services and the type of DER, these performance requirements may vary. However, these DER performance requirements will include at a minimum the following: 1) System Availability 2) Data Availability 3) Response Time Following a Utility Command Signal 4) Quality of Response (e.g., measurement if DER provided required output for specified duration and frequency as defined by agreement) (Reference 12)
- Distribution Utility or Distribution Owner (DO): A state-regulated private entity, locally regulated municipal entity, or cooperative that owns an electric distribution grid in a defined franchise service area, typically responsible under state or federal law for the safe and reliable operation of its system. In the case of a vertically integrated utility, the distribution function would be a component of the utility. This definition excludes the other functions that an electric utility may perform. This is done in order to concentrate on the distribution wires service without confounding it with other functions such as retail electricity commodity sales, ownership of generation, or other products or services, which a vertically integrated utility may also provide. (Reference 3)
- Distribution Upgrade Deferral: Lower level charging or charging load management may be used to delay or avoid investments in new infrastructure (replacing overloaded transformers or re-conductoring distribution lines) that is otherwise necessary to maintain adequate capacity to serve load. The step-wise increase in capacity associated with new infrastructure implies that the measure will, for a large part of its useful life, be underutilized. VGI in this application could extend the usefulness of existing infrastructure.

A related application is to use storage to accommodate the system peak. (1) Delaying, reducing the size of, or entirely avoiding utility investments in distribution system upgrades necessary to meet projected load growth on specific regions of the grid. (Reference 7)

- Dual Phase or Split Phase Power: Also Single Phase because it's a two wire Alternating Current (AC) power circuit. In the US, this is the standard household power arrangement with two (Phase A, Phase B) 120V power wires (180 degrees out of phase with one another) like two bicycle pedals and one neutral wire. Phase B) 120V power wires (180 degrees out of phase with one another) like two bicycle pedals and one neutral wire. See table 1 below.
- Duck Curve: Daytime oversupply of solar powered electricity causes low use of traditional power plants followed by a steep increase (ramping) of traditional power plants before and after sunset. See figure 6 from VGI white paper (Reference 1).
- Dynamic Pricing: See Real Time Pricing.
- Dynamic Reactive Support: A control function in which the DER system supports the grid during short periods of abnormally high or low voltage levels by feeding reactive current to the grid until the voltage either returns within its normal range, or the I- DER system ramps down, or the I- DER system is required to disconnect.
- Economic Bid: A Bid that includes quantity (MWh or MW) and price (\$) for specified Trading Hours. (Reference 12)
- Economic Dispatch: The allocation of demand to individual generating units on line to effect the most economical production of electricity. (Reference 9)
- Electricity Load or Demand (kW or MW): The flow of electricity used at one moment in time, i.e., power.
- Electricity Usage (kWh or MWh): The electric load expended for 1 hour, i.e., energy or work.
- Energy Arbitrage: The purchase of wholesale electricity while the locational marginal price (LMP) of energy is low (typically during nighttime hours) and sale of electricity back to the wholesale market when LMPs are highest. Load following, which manages the difference between day-ahead scheduled generator output, actual generator output, and actual demand, is treated as a subset of energy arbitrage. (Reference 7)
- Energy Charges: The portion of utility bill resulting from energy consumed, typically expressed in \$/kWh.
- EV Rate: An electricity tariff that applies to residential or commercial customers who drive plug-in electric cars, trucks, buses and non-road equipment. Includes rates with separate meters or sub-meters and rates designed with EVs in mind, but without separate meters or sub-meters, such as a whole house time-of-use rates.
- EV Load Shape: The aggregated charging pattern in kW of EVs at a particular site or in a particular category (e.g., fleets, workplaces) over a day or longer time period.
- Feed-in Tariff: A payment for electricity supplied to the grid from a renewable energy source.

- Firm Demand: The portion of the Demand that a power supplier is obligated to provide, except when system reliability is threatened or during emergency conditions. (Reference 9)
- Flexible Resource: A resource that is operationally able to respond to dispatch instructions to manage variations in load and variable energy resource output.
- Forced Outage: 1) The removal from service availability of a generating unit, transmission line, or other facility for emergency reasons. 2) The condition in which the equipment is unavailable due to unanticipated failure. (Reference 9)
- Frequency Regulation: The immediate and automatic response of power to a change in locally sensed system frequency, either from a system or from elements of the system. Regulation is required to ensure that system-wide generation is perfectly matched with system-level load on a moment-by-moment basis to avoid system-level frequency spikes or dips, which create grid instability. (Reference 7)
- Frequency Response: The ability of a system or elements of the system to react or respond to a change in system frequency. If related to the system, the sum of the change in demand, plus the change in generation, divided by the change in frequency, expressed in megawatts per 0.1 Hertz (MW/0.1 Hz). (Reference 9)
- Frequency Watt Mode: An autonomous functionality whereby the DER system reduces real power to counteract frequency excursions beyond normal limits.
- In-front-of-the meter: is a term that defines traditional utility owned assets.
- Integrated Grid: An electric grid with interconnected DERs that are actively integrated into distribution and bulk power system planning and operations to realize net customer and societal benefits. (Reference 3)
- Independent System Operator (ISO) or Regional Transmission Organization (RTO): An independent, federally regulated entity that is a Transmission System Operator (TSO), a wholesale market operator, a Balancing Authority (BA), and a Planning Authority. (Reference 3)
- Interconnection Agreement: A contract between a utility and a power developer that formally approves connecting a facility to the distribution system; or a contract between the ISO and a resource owner formally approving the interconnection of a resource to the ISO-controlled grid.
- Internet of Things (IOT): The network of physical objects (or "things") embedded with electronics, software, sensors, and connectivity that enables the object to achieve greater value and service by exchanging data with operators, aggregators and/or other connected devices. Each object has a unique identifier in its embedded computing system but can interoperate within the existing Internet infrastructure. (Reference 3)
- Limit Maximum Active Power Mode: A control signal intended to limit the maximum power output of a DER system

- Load: An end-use device or customer that receives power from the electric system. (Reference 9)
- Load Factor: The ratio of the annual average system load (average load) and the annual peak system load (peak load).
- Load Following / Ramping Support for Renewables: V1G or V2G may be used to dampen the variability of a randomly fluctuating load profile or an intermittent renewable energy system, by accommodating a maximum expected up- and down-ramp rate (usually in MW/minute) and for a given duration of the ramp (potentially hours in length). V1G or V2G providing load following may change its output frequently and in response to the balance between supply and load in order to maintain system frequency within the specified range. Storage can accommodate the daily changes in load, upward or downward, by respectively discharging or charging. (Reference 1)
- Load Serving Entity: Secures energy and Transmission Service (and related Interconnected Operations Services) to serve the electrical demand and energy requirements of its end-use customers. (Reference 9)
- Local Distribution Area (LDA): Consists of all the distribution facilities and connected DERs and customers below a single transmission-distribution (T-D) interface on the transmission grid. Each LDA is not normally electrically connected to the facilities below another T-D interface except through the transmission grid. However, to improve reliability, open ties between substations at the distribution level exist. (Reference 3)
- Markets: As referred to generically in this report, include any of three types of energy markets: 1) wholesale power supply (including demand response), 2) distribution services, and 3) retail customer energy services. Markets for sourcing non-wires alternatives for distribution may employ one of three general structures: 1) prices (e.g., spot market prices based on bid-based auctions, or tariffs with time-differentiated prices including dynamic prices); 2) programs (e.g., for energy efficiency and demand response); or 3) procurements (e.g., request for proposals/offers, bilateral contracts such as power purchase agreements). (Reference 3)
- Market Service Provider (MSP): The interface with the PEV driver, similar to the role that the CSP provides for traditional retail electricity service. The MSP provides rate and service options for PEV drivers to choose from as well as the payment mechanisms, such as payment cards or RFID tags that customers use to pay for charging. The MSP contracts with a CSO to provide PEV charging services and contracts for the purchase and delivery of electricity to the PEV charging stations. (Reference 8)
- Maximizing Customer Use of Renewable Generation: Minimizing export of electricity generated by behind-the-meter photovoltaic (PV) systems to maximize the financial benefit of solar PV in areas with utility rate structures that are unfavorable to distributed energy resources.

- Meter Data Management System (MDMS): A software platform that receives meter data from one or multiple smart meter technologies, verifies and stores the data, and delivers data subsets to the utility operations' applications such as billing and outage management. (Reference 3)
- Meter Service Agreement (MSA): a California Independent System Operator form/contract available at:  
[http://www.caiso.com/Documents/AppendixB\\_ProFormaAgreements\\_Jul1\\_2014.pdf](http://www.caiso.com/Documents/AppendixB_ProFormaAgreements_Jul1_2014.pdf)
- Microgrid: A group of interconnected loads and DERs within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island modes. (Reference 3)
- Monetizing GHG and Air Pollution Reduction Benefits: Primarily means capturing the value of Low Carbon Fuel Standard (LCFS) credits in a non-residential charging location by measuring (kWh metering) groups of EVs charging or single EVs charging in some cases.
- Net-Energy Metering (NEM): An electricity-tariff billing mechanism designed to facilitate the installation of onsite renewable generation. Under NEM tariffs, participating customers receive a bill credit for excess generation that is exported to the electric grid during times when it is not serving onsite load.
- Net Load: The load measured at a point on the electric system resulting from gross energy consumption and production (i.e., energy generation and storage discharge). Net load is often measured at a T-D interface and at customer connections. (Reference 3)
- Non-Generation Resource: Resources that operate as either generation or load and that can be dispatched to any operating level within their entire capacity range but are also constrained by a MWh limit to: 1) generate energy, 2) curtail the consumption of energy in the case of demand response, or 3) consume energy.
- Non-Participating Ratepayer: Utility customers that do not have EVs.
- Non-Reliability Services: Services on which the electric system, or an end-use customer, does not depend for reliable operation and delivery of electricity. As with reliability services, this distinction does not depend on how the service was procured. (Reference 12)
- Operational Efficiency: A type of benefit where the cost of operating the generation, transmission or distribution system is reduced.
- Outage Management System (OMS): A computer-aided system used by operators of electric utilities to better manage their response to power outages. (Reference 3)
- Participating Load Agreement: a California Independent System Operator agreement with an entity that provides load on the grid available at:  
[http://www.caiso.com/Documents/Blackline-ParticipatingLoadAgreement\\_17-Nov-99.pdf](http://www.caiso.com/Documents/Blackline-ParticipatingLoadAgreement_17-Nov-99.pdf)

- Participating Generator Agreement: is a California Independent System Operator agreement with an entity that provides electricity generation or supply to the grid available at: [http://www.aiso.com/Documents/ParticipatingGeneratorAgreement\\_16-Aug-04.pdf](http://www.aiso.com/Documents/ParticipatingGeneratorAgreement_16-Aug-04.pdf)
- Peak Demand: 1) The highest hourly integrated Net Energy for Load within a Balancing Authority Area occurring within a given period (e.g., day, month, season, or year). 2) The highest instantaneous demand within the Balancing Authority Area. (Reference 9)
- Peak Shaving or Peak Shedding: The reduction in magnitude of peak demand. Strategies such as load reduction or load shifting are often used to achieve peak shaving. (Reference 2)
- Peak Shifting: The shifting of load from one moment in time to another moment in time. (Reference 2)
- Permanent Load Shift: Routine shifting from one time period to another during the course of a day to help meet peak loads during periods when energy use is typically high and improve grid operations in doing so (economics, efficiency, and/or reliability). (Reference 6)
- Power Inverter: A device used to transform direct current (DC) to alternating current (AC). (Reference 2)
- Power Quality: V1G or V2G can protect customer end-use loads downstream from the EV from poor power quality, which may take forms including variations in voltage, variations in frequency, low power factor, harmonics, and service interruptions. In this case, the EV system monitors power quality and discharges to smooth the power quality disturbance for durations of seconds to minutes. (Reference 1)
- Power Reliability: V1G or V2G may provide electricity service during times of a utility system outage, either planned or unplanned. If the storage device is permanently interconnected with the grid, this would entail islanding the storage device and customer loads from the utility system, and resynchronizing with the system upon power restoration. PEV storage systems could be designed to serve select loads that can be separated from the customer's electrical infrastructure that is utility-connected, during emergency situations. (Reference 1)
- Preferred Resource: A prescribed resource loading order by the state of California to meet energy needs. Energy efficiency and demand response are first, followed by renewable sources and clean distributed generation. Definition can also include energy storage.
- Proxy Demand Response (PDR): A resource product developed by CAISO to allow increased demand response participation and facilitate the participation of existing retail demand programs in CAISO markets. A load or aggregation of loads that has the characteristics of a PDR set forth in Section 4.13.5, satisfies all other requirements applicable to a PDR set forth in the CAISO Tariff, and is capable of measurably and verifiably providing Demand Response Services pursuant to the Demand Response Provider Agreement, including but not limited to Sections 4.1 and 4.2 of the Demand Response Provider Agreement and excluding Section 4.3 of the Demand Response Provider Agreement. (Reference 12)

- Qualifying Capacity. The maximum Resource Adequacy Capacity that a Resource Adequacy Resource may be eligible to provide. The criteria and methodology for calculating the Qualifying Capacity of resources may be established by the CPUC or other applicable Local Regulatory Authority and provided to the CAISO. A resource's eligibility to provide Resource Adequacy Capacity may be reduced below its Qualifying Capacity through the CAISO's assessment of Net Qualifying Capacity. (Reference 12)
- Ramp: Part of the Duck Curve. See Duck Curve.
- Real-Time Pricing: Electricity price signals that are sent to the customer and take place immediately after being published. Real-Time Pricing is synonymous with "dynamic pricing" and connotes that rates can be changed at any time to reflect grid or wholesale market changes.
- Real-Time Energy Markets: Wholesale market whereby energy is procured on a spot market for short duration (typically between five minutes and one hour). The markets for energy resources available to an ISO for balancing load and generation supply in real time, as it varies from the final hourly schedules. This includes resources that provide regulation services, ancillary services, and/or supplemental energy bids into the market.
- Regulation Services: The service provided by generating units certified by the ISO capable of responding to the ISO's direct digital control (AGC) signals, or by system resources that have been ISO certified as capable of delivering in an upward and downward direction on a real-time basis matching demand and resources consistent with North American Electric Reliability Corporation (NERC) and Western Electricity Coordinating Council (WECC) reliability standards, including any Nuclear Regulatory Commission requirements. Regulation is used to control the power output of electric generators within a prescribed area in response to a change in system frequency, tie line loading, or the relation of these to each other so as to maintain the target system frequency and the established interchange with other balancing authority areas within the predetermined regulation limits. Regulation includes both the increase of output by a generating unit or system resource (regulation up) and the decrease in output by a generating unit or system resource (regulation down). Regulation up and regulation down are distinct capacity products, with separately stated requirements and ancillary service marginal prices in each settlement period. (2) Regulation involves managing interchange power flows with other control areas to match scheduled interchange flows and momentary variations in demand within the control area. Regulation is used to moderate changes in grid frequency, which are caused by fluctuations in generation and demand, to maintain them within a range set by the NERC reliability standards. Generation output is increased (or load is curtailed) to provide up regulation when electricity demand exceeds supply. Conversely, generation output is reduced (or load is increased) to provide down regulation when electricity supply exceeds demand. The



ability of storage with fast ramp rates to accurately follow an automatic generation control (AGC) has the potential to reduce the wear and tear on other generation. (Reference 1)

- Regulation Energy Management. A market feature for resources located within the CAISO Balancing Authority Area that require Energy from the Real-Time Market to offer their full capacity as Regulation. (Reference 12)
- Regulated Transmission and Distribution Utilities: Electricity is delivered through two layers of regulated monopoly electric utilities. Electricity is first delivered through high voltage transmission systems managed by the Transmission System Operator (TSO). Distribution Services Operators (DSO) receive and distribute electricity to retail customers. Regulators oversee transmission and distribution utilities, approving the network charges and the return on investment that utilities may earn to be fair and reasonable. (Reference 8)
- Regulator: The entity responsible for oversight of the essential functions of the electric utility, including funding authorizations for power procurements, investments and operational expenses. This oversight extends to rate design, planning, scope of services and competitive market interaction. Regulator in the most general sense, means state public utility commissions, governing boards for publicly owned utilities and rural electric cooperatives, and the Federal Energy Regulatory Commission (FERC). (Reference 3)
- Reliability Services. Reliability services are services on which the electric system (transmission or distribution) depend for reliable operation. For example, in the transmission domain reliability services include contingency reserves and any services that are specified for a device that is procured to avoid or defer a transmission infrastructure upgrade. In contrast, wholesale energy would be a wholesale market service. Note that this distinction does not depend on how the service was procured; i.e., contingency reserves are procured through the wholesale market. What matters is whether the service is critical for the reliable operation of the system. (Reference 12)
- Reliability (Back-Tie) Services: Load modifying or supply service capable of improving local distribution reliability and/or resiliency. Specifically, this service provides a fast reconnection and availability of excess reserves to reduce demand when restoring customers during abnormal configurations. These Reliability back-tie services can be provided by a single DER resource and/or an aggregated set of DER resources that are able to reduce the net loading on specific distribution infrastructure coincident with the identified operational need in response to a control signal from the utility. Examples of traditional “Wires” equipment that currently support providing this type of service include, but are not limited to are, circuit breakers and relays, reclosers and recloser controllers, switches, sectionalizers, fault interrupters, Supervisory Control and Data Acquisition (SCADA), and Fault Location, Isolation and Service Restoration (FLISR).

- Renewable energy generation sources (eligible): the list of eligible renewable energy generation is available at: <http://www.energy.ca.gov/2015publications/CEC-300-2015-001/CEC-300-2015-001-ED8-CMF.pdf>
- Resiliency (Microgrid): Load modifying or supply service capable of improving local distribution reliability and/or resiliency. Specifically, this service provides a fast reconnection and availability of excess reserves to reduce demand when restoring customers during abnormal configurations. In addition, this service will also provide power to islanded end use customers when central power is not supplied and reduce duration of outages. These resiliency services can be provided by a single DER resource and/or an aggregated set of DER resources that are able to reduce the net loading on specific distribution infrastructure coincident with the identified operational need in response to a control signal from the utility. In a microgrid application it is necessary for a system to match generation to load while maintaining voltage, frequency, power factor and power quality within appropriate limits. This requires an isochronous supply resource. Examples of traditional “Wires” equipment that currently support providing this type of service include, but are not limited to are, circuit breakers and relays, reclosers and recloser controllers, switches, sectionalizers, fault interrupters, SCADA, FLISR, and Distributed Energy Resource Management Systems (DERMS). (Reference 12)
- Resource Adequacy: Instead of investing in new natural gas combustion turbines to meet generation requirements during peak electricity-consumption hours, grid operators and utilities can pay for other assets, including energy storage, to incrementally defer or reduce the need for new generation capacity and minimize the risk of overinvestment in that area. (Reference 7)
- Retail Choice: With liberalization, the function of selling electricity to retail customers has been unbundled from the regulated monopoly utilities in order to introduce competition and retail choice. Competitive Retail Service Providers (CSPs) provide a variety of rate and service options that retail customers may choose from for electricity service. CSPs purchase electricity from the competitive wholesale markets and pay transmission and distribution regulatory approved network charges to deliver energy to the retail customer. (Reference 8)
- Retail Energy Time Shift / TOU Bill Management: The shifting of load from one moment in time to another moment in time. (1) By minimizing electricity purchases during peak electricity-consumption hours when time-of-use (TOU) rates are highest and shifting these purchase to periods of lower rates, behind-the-meter customers can use energy storage systems to reduce their bill. (Reference 7)
- Ride-Through Event Operations: A capability of a system to continue operating under abnormal conditions (e.g., voltage or frequency fluctuations) until the conditions resolve or reach a point at which the systems are required to do something (e.g., trip-off).

- Same vs. Different Capacity: Provisions governing MUA must distinguish between a resource as a whole and a specific unit or portion of that resource's capacity. In some cases where a resource may not provide two services with the same capacity, it may be possible for the resource to partition its capacity to provide the two services from different dedicated portions of its total capacity. (Reference 12)
- Scheduling Coordinator/Entity: A certified entity that schedules wholesale energy and transmission services on behalf of an eligible customer, load-serving entity, generator, aggregator or other wholesale market participant. This role is necessary to provide coordination between energy suppliers, load-serving entities and the transmission and wholesale market systems. This entity may also be a wholesale market participant. (Reference 3)
- Self-Generation Incentive Program (SGIP): Provides incentives to support existing, new, and emerging DERs. SGIP provides rebates for qualifying distributed energy systems installed on the customer's side of the utility meter. Qualifying technologies include wind turbines, waste heat to power technologies, pressure reduction turbines, internal combustion engines, microturbines, gas turbines, fuel cells, and advanced energy storage systems.
- Self-Schedule: The bid component that indicates the quantities in MWhs with no specification of a price that the Scheduling Coordinator is submitting to the CAISO, which indicates that the scheduling coordinator is a price taker, regulatory must-run generation or regulatory must-take generation, which includes ETC and TOR Self-Schedules, Self-Schedules for converted rights, and variable-energy resource Self-Schedules. (Reference 12)
- Settlement Interval: The five-minute time period during which the CAISO settles cost compensation amounts or deviations in generation and demand in the RTM. (Reference 12)
- Spinning, Non-Spinning and Supplemental Reserve: Reserve capacity is available to be dispatched when normal supply resources are unexpectedly unavailable. Spinning Reserves are synchronized and online, but unloaded, and can respond within 10 minutes to compensate for generation or transmission outages. "Frequency-responsive" spinning reserve can respond within 10 seconds to maintain frequency. Non-Spinning Reserves are not synchronized. Non-spinning generation capacity or curtailable/interruptible loads may be offline but must be able to respond in 10 minutes. Supplemental Reserves can be respond within an hour and provide a back-up for spinning and non-spinning reserves. Generation resources providing reserve capacity must be online and operating at part load. Unlike generation, in most circumstances storage used for reserves does not discharge; it must remain available for discharge as needed. (1) Spinning reserve is the generation capacity that is online and able to serve load immediately in response to an unexpected contingency event, such as an unplanned generation outage. Nonspinning reserve is generation capacity that can respond to contingency events within a short period, typically less than ten minutes, but is not instantaneously available. (Reference 7)

- Structures: An architectural structure created by configuration of functional partition in relation to actors, institutions and/or components and their relationships. Related structures include industry, market, operations, electric system, control, coordination and communications. (Reference 3)
- Sub-Meter: A meter dedicated to measuring loads independently from the overall facility or house load. In the VGI context it means a meter dedicated to measuring EV loads, but may include many types of meters: not just a traditional utility meter. (adapted from Reference 2)
- Summer Season: Typically, June, July, August, September.
- Supervisory Control and Data Acquisition (SCADA) Systems: Operate with coded signals over communications channels to provide control of remote equipment of assets. (Reference 3)
- Transactive Energy: Defined by techniques for managing the generation, consumption or flow of electric power within an electric power system through the use of economic or market-based constructs while considering grid reliability constraints. Transactive energy refers to the use of a combination of economic and control techniques to manage grid reliability and efficiency. (Reference 3)
- Transmission-Distribution Interface (T-D Interface): The physical point at which the transmission system and distribution system interconnect. This point is often the demarcation between federal and state regulatory jurisdiction. It is also a reference point for electric system planning, scheduling of power and, in ISO and RTO markets, the reference point for determining Locational Marginal Prices (LMP) of wholesale energy. (Reference 3)
- Transmission Deferral: Delaying, reducing the size of, or entirely avoiding utility investments in transmission system upgrades necessary to meet projected load growth on specific regions of the grid. (Reference 7)
- Transmission Congestion Relief: ISOs charge utilities to use congested transmission corridors during certain times of the day. Assets including energy storage can be deployed downstream of congested transmission corridors to discharge during congested periods and minimize congestion in the transmission system. (Reference 7)
- Transmission System Operator (TSO): An entity responsible for the safe and reliable operation of a transmission system. For example, a TSO may be an ISO or RTO or a functional division within a vertically integrated utility, or a federal entity such as the Bonneville Power Administration or Tennessee Valley Authority. (3) Uninstructed Imbalance Energy (UIE). The portion of Imbalance Energy that is not RTD Instructed Imbalance Energy. (Reference 12)
- Transmission System Utilization: How the transmission system, as a whole, is used in day-to-day operations to facilitate electricity flows.

- Uninterrupted Power Supply (UPS): Backup power for homes, businesses or individual pieces of equipment.
- Utility Residential Customers: Utility customers who live in single-family attached homes, single-family detached homes including mobile homes, and multi-family homes that do not use common areas for charging.
- Utility Commercial Customers: Business, industrial, institutional, governmental and agricultural customers including common areas for multi-family homes. Includes AC charging and DC fast charging away from home, fleet charging and multi-unit dwelling charging in common areas.
- Var: The standard abbreviation for volt-ampere-reactive, written “var,” which results when electric power is delivered to an inductive load such as a motor. (Reference 3)
- Volt: The standard unit of potential difference and electromotive force in the International System of Units (SI) formally defined to be the difference of electric potential between two points of a conductor carrying a constant current of one ampere, when the power dissipated between these points is equal to one watt.
- Volt Watt Mode: An autonomous function whereby a DER system monitors the local (or feeder) voltage and modifies real power output in order to damp voltage deviations.
- Voltage and/or Reactive Power Support: V1G or V2G may be used to regulate system voltage and so that it is maintained within the specified tolerances for the end-user. Utilities regulate voltage by adjusting tap changers at substations or by switching capacitors to follow load changes to prevent voltage excursions that may be caused by distributed generators or large power loads at the end of radial distribution systems. In this case a V1G or V2G system can discharge real power to provide voltage support. (1) Voltage regulation ensures reliable and continuous electricity flow across the power grid. Voltage on the transmission and distribution system must be maintained within an acceptable range to ensure that both real and reactive power production are matched with demand. (Reference 7)
- Voltage Support Services: Substation and/or feeder level dynamic voltage management services provided by an individual resource and/or aggregated resources capable of dynamically correcting excursions outside voltage limits as well as supporting conservation voltage reduction strategies in coordination with utility voltage/reactive power control systems. DERs providing these services will be delivering or absorbing real or reactive power (VAR) or a combination thereof to ensure the voltage is within Rule 23 limits. Examples of traditional “wires” equipment that currently support providing this type of service include, but not limited to, fixed or switchable capacitors, fixed or switchable variable voltage regulators, overhead and underground line conductors, substation load tap changers, and reactors. (Reference 12)

- Virtual Power Plant (VPP): Aggregator product resulting from combining smaller resources.
- Wholesale Distribution Access Tariff (WDAT): Defines the rates, terms and conditions associated with small and large generator interconnections to the grid. These tariffs are regulated by the Federal Energy Regulatory Commission. (Reference 2)
- Watt: The standard unit of power in the International System of Units (SI), equivalent to one joule per second and equal to the power in a circuit in which a current of one ampere flows across a potential difference of one volt.
- Winter Season: Typically October through May.
- Zero Net Energy (ZNE): A site which generates as much energy as it consumes over the course of a defined period, typically a year. Site boundary and energy accounting metrics vary.

### **General and Technical Terms in the EV and Charging Station Industries (alphabetical)**

- AC Fast Charging: Charging 20 kW or higher with alternating current.
- Automaker (aka Original Equipment Manufacturer or OEM): The company that makes EVs.
- Away-from-Home Charging: Includes public-access charging as well as workplace charging, but excludes fleet charging.
- Building Energy Management System (BEMS): Controls electricity loads for a facility or residence and can control EV charging as a group.
- Battery Electric Vehicle (BEV): A plug-in electric vehicle that solely runs on batteries and electric motors.
- Bollard: One of a series of short posts for excluding or diverting motor vehicles from a road, lawn, charging stations or the like.
- BYD Connector: A connector specified by BYD to connect EVSEs to BYD EVs. Only recognized by Chinese SDOs.
- Chargeport: Usually means the location on the EV where the connector attaches to the vehicle. Not to be confused with port or connector.
- Charge Point Operator: See Charging Station Operator.
- Charge Spot Operator: See Charging Station Operator.
- Charge Sequencing: A system on a multi-port charging station where charging through the multiple ports is sequenced on a first-come-first-serve basis or need basis.
- Charge Sharing: A system on a multi-port charging station where charging through the multiple ports is reduced as more EVs connect to the station on a first-come-first-serve basis or need basis.
- Charger: Off-board the EV inverter (typically DC) or the on-board the EV inverter (AC). 2) Incorrect slang for the charging station or EVSE. 3) The charger can either be on-board the vehicle or off-board. On-board chargers require AC energy transfer to the vehicle (either 120 or 240V single phase) and Off-board chargers are within the EVSE and require DC energy transfer to the vehicle. (Reference 19)

- Charging Access Interoperability: The ability to use a single credential (e.g., RFID card) at any charging station requiring authorization (aka Open Access).
- CHAdeMO Connector: A connector and communication protocol for vehicle DC charging initially developed in Japan during 2005-2009. It was first adopted into international standards IEC 61851-23/24 and IEC 62196-3 in 2014 and then into USA standard IEEE 2030.1.1 in 2015. Further updates to the protocol are managed by the CHAdeMO Association. It is most commonly used on Asian EVs (e.g., Nissan, Mitsubishi, etc.). CHAdeMO” is an abbreviation of “CHARge de MOve”, equivalent to “charge for moving”, and is a pun for “O cha demo ikaga desuka” in Japanese, meaning “Let’s have a tea while charging” in English.
- Charging Gateway or Controller: See gateway. See controller
- Charging Infrastructure: Includes the make-ready and the utility-side-of the meter infrastructure, but does not include the charging station.
- Charging Infrastructure Provider: The company (or companies) that provides the electrical and civil work associated with the make-ready and utility-side infrastructure for the charging station.
- Charging Kiosk: An interactive, free-standing terminal separate from the charging station that is used for payment and other services.
- Charging Plaza or Center: A large collection of public-access charging stations.
- Charging Rate: The kW per hour speed that electricity is supplied by the charging station or sometimes the miles-per-hour of charge that an EV receives from a charging station (also called useful charge rate).
- Charging Station / Device: The off-board-the-EV unit that contains a charging connector that connects to the EV. This is a broad term that includes the AC EVSE, the DC station and charger and may be inductive (e.g. wireless) or conductive charging and may even be capable of V2G (bi-directional) charging.
- Charging Station Installer: The company that provides installation service and may only provide that service.
- Charging Station Manufacturer: The company that manufactures the charging station.
- Charging Station Maintainer: The company that provides repair and maintenance service to the charging station and may only provide that service.
- Charging Station Services Provider: The company that provides services to the owner of the charging station, but the number of services may depend on the package selected or vary between different companies in the market.
- Charging Network Operator: See Charging Station Operator.
- Charging Service Operator (CSO): Secondary actor responsible for the installation and operation of a charging infrastructure (including charging sites), and manages electricity sourcing to provide the requested energy transfer services. (Source: ISO/CD 15118-1 Ed2)

- Charging Station Operator (CSO): Operates the EVSE to facilitate a reliable charging experience for PEV owners. (aka Charge Spot Operator or Charge Point Operator or Charging Network Operator). (8) The CSO is not necessarily the site host or the installer or the maintainer of the charging station.
- Clearinghouse: 1) ISO 15118 defines two roles as clearinghouses, EMOCH and DCH. E-Mobility Operator Clearing House (EMOCH), sometimes also named Contract Clearing House (CCH) Entity mediating between two clearinghouse partners to provide validation services for roaming regarding contracts of different E-Mobility Operators for the purpose of collecting all necessary contract information like contract ID, E-Mobility Operator, communication path to E-Mobility Operator, roaming fees, begin and end date of contract, etc., providing SECC with confirmation that an E-Mobility Operator will pay for a given contract ID (authorization of valid contract), transferring a Service Detail Record (SDR) after each energy transfer interval to correct E-Mobility Operator and Electricity Provider of the identified contract. Note 1 to entry: E-Mobility Operator Clearing House, E-Mobility Operator and meter operator may exchange information with each other as well as other actors. And 2) Demand Clearing House (DCH) Entity for grid negotiation that provides information on the load of the grid. Note 1 to entry: The demand clearing house mediates between two clearing partners: a SECC and the part of the power grid connected to this SECC. Most likely this function will be served by a system operator. Note 2 to entry: Demand clearing house and meter operator may exchange information with each other as well as with other actors.
- SAE Combined Charging System (or Combo/CCS) Connector: A connector that supports both AC J1772 and DC Charging and created by SAE a standards development organization (SDO).
- Connector: The part of the charging station that connects to the EV no matter the level of charging or whether it is AC or DC.
- Cord Set or Charging Cord Set: Portable charging equipment that typically comes with the car. Usually Level 1, but can be level 2.
- Corridor DC Charging or Intercity DC Charging: Charging stations and charging plazas with DC fast charging located between metropolitan areas, but not within them.
- DC Fast Charging: Charging 20 kW or higher with direct current.
- DC Slow Charging: Charging below 20kW using direct current.
- Depot Charging: Same as fleet charging, but term is used in the bus industry only.
- Destination Center Charging: Charging stations located at sites that attract longer distance trips including, but not limited to, hotels, resorts, theme parks, major malls, parks, beaches, theaters, sports centers, concert halls, casinos.
- “Dumb” Charging Station: No communication controls in the station, but the control function may be upstream in the EVEMS or BEMS.
- EV: Electric vehicle includes battery electric and plug-in hybrid electric vehicles and plug-in fuel cell vehicles.



- Electric Vehicle Service Provider (EVSP): A legal term that means an entity that is responsible for the reselling of the electricity to serve the EV. In many cases this can be the site host (commercial or residential) and not the provider of charging services or charging station manufacturer who may not own the charging station.
- EV Supply Equipment (EVSE): 1) The equipment that connects the AC electricity grid at a site to the EV. Can be level 1 or level 2 charging. Incorrectly called the charger. 2) Sometimes used more broadly to mean charging station whether AC or DC, but does not include the make-ready infrastructure or other charging infrastructure. Also see Charging Station / Device. May include multiple connectors (called multi-port) to charge several EVs or to serve EVs with different types of connectors (e.g. SAE Combo and CHAdeMO). Also called the Energy Connection system (ECS).
- Fleet Charging: Charging stations for a business's own commercial EVs.
- Fuel Cell Battery EV: Combination of battery EV and fuel cell.
- Fuel Cell PHEV: PHEV with a fuel cell and battery propulsion system and may include an internal-combustion engine.
- Home Charging: Includes charging at single family homes, mobile homes and multi-unit dwellings but excludes commercial fleets. Implies being able to charge off-street in a driveway, carport, garage or similar location by the home.
- Home DC Charging with Solar PV: Charging an EV at a residence without a need to convert to AC power (typically at slower charging rate than used in DC fast charging).
- Home Energy Management System (HEMS): Any product or service that monitors, controls, or analyzes energy in the home.
- Inductive Paddle Charging: A type of wireless charging installed 15-20 years ago.
- Interoperability: The ability of systems or software to exchange and make use of information. See Interoperate, Charging Access Interoperability, Site Host Station Interoperability, Front-end EVSE network interoperability, and Roaming.
- Interoperate: Ability of two or more systems to operate together.
- Level 1 Charging: Charging at 120V AC typically 1.4 kW but sometimes other levels (e.g. 1.9 kW, 0.7 kW).
- Level 2 Charging: AC Charging at 240V or 208 V over 2 kW and less than 19.3 kW.
- List: Verb describing the process for being approved by a Nationally Recognized Testing Laboratory.
- Long-Dwell Charging Locations: Where vehicles are typically parked for more than four hours and can charge. Examples includes homes, workplaces, fleets, destination centers and mixed-use locations.
- Long-Range BEV: A BEV with more than 220 miles of all electric range.
- Long-Range PHEV: A PHEV with more than 50 miles of battery electric range or equivalent electric range when fully charged, and receives additional range from a fuel cell or internal combustion engine.

- Make-Ready: The behind-the-utility meter infrastructure up-to stub, but not including the charging station or the utility-side equipment. It typically does not include the utility meter or charging station, but may include hardware (panel, trenching, and wiring) and civil work (trenching, planning, and installation).
- Medium-Range BEV: A BEV with 121 to 220 Miles of all-electric range.
- Medium-Range PHEV: A PHEV with 25 to 50 miles of all-electric range or equivalent electric when fully charged, and receives additional range from a fuel cell or internal combustion engine.
- Mixed-Use Charging: Charging where multiple types of users typically charge. For example, city parking structures used by residents of MUDs, workplaces, city fleet vehicles and visitors to regional destination centers.
- Multi-Port: Adjective for a charging station that has more than one port.
- Multi-Unit Dwelling (MUD) Charging: Refers to charging stations in common areas of condos and apartments (usually a commercial account for a utility) and excludes single-family attached buildings (duplexes, triplexes, townhomes) that do not have common area parking.
- Multi-Use Charging: 1) Away-from-home, fleet, or multi-unit dwelling charging where more than one EV is charged each day at the same charging station at those locations. 2) Charging stations which support multiple vehicle types, typically differentiating by class of vehicle. For example, a depot charging unit which could charge a bus or a passenger vehicle using the same standard that light duty passenger vehicles use for DC fast charging.
- NEC: National Electrical Code is defined by National Fire Protection Association document NFPA 70 and has become the most widely adopted electrical installation code in the United States.
- Network Services Provider (NSP): A broader term than the Power Flow Entity (PFE) mainly because the NSP can also provide billing, maintenance and other non-grid information, and is a more commonly used term. 2) The controlling entity that sends the grid commands or messages to the EV or EVSE. The NSP may send non-grid commands (e.g., reservations, billing, maintenance checks). The NSP may receive one or more conflicting grid commands from other entities. The NSP may be the POU, IOU, ISO, Aggregator, Open Vehicle Grid Integration Platform, Clearing House, or Charging Station Operator.
- Off-Board Charger: See Off-Board Inverter.
- Off-Board Inverter: Apparatus that converts direct current (DC) into alternating current (AC), not built into the EV; typically included as part of EVSE.
- Off-Peak: Those hours or other periods defined by North American Energy Standards Board (NAESB) business practices, contract, agreements, or guides as periods of lower electrical demand. (Reference 9)
- On-Board Charger: See On-Board Inverter.

- On-Board Inverter: Apparatus that converts direct current (DC) into alternating current (AC), built into EV.
- On-Peak: Those hours or other periods defined by NAESB business practices, contract, agreements, or guides as periods of higher electrical demand. (Reference 9)
- Open Access: See Charging Access Interoperability.
- Open Vehicle-Grid Integration Platform (OVGIP): A software application that connects various nodes involved in providing and managing energy to Plug-in Electric Vehicles (PEVs). It enables PEV and charging infrastructure management in a grid-friendly manner, and also provides benefits to PEV owners by allowing them to take advantage of utility incentives, while also enabling ratepayer benefits through improved grid capacity utilization. This Platform has been a joint utility industry and automotive industry initiative that has been led by the Electric Power Research Institute (EPRI) since its inception in late 2012, and is in its second phase of implementation.
- Open Systems Interconnection (OSI): A conceptual model that was developed by the International Standards Organization (ISO) to divide a communications system into seven layers which are not dependent on each other.
- Opportunity Charging: 1) See Short-Dwell Charging. 2) Charging at any location in order to add charge to the EV's battery or potentially to provide grid services.
- Parking Lot Electric Vehicle Energy Management System (EVEMS): Can control EV charging as a group through a gateway – but generally not other loads such as lighting.
- Plug-In Hybrid EV (PHEV): Commonly an EV that uses either the battery and electric motor or an internal combustion engine or both for motive power, and uses an external source of electricity for recharging the battery. Can also include a battery EV with a fuel cell instead of an internal-combustion engine. Can also include combinations with three sources of motive power as long as there is an external source of electricity that can be used to power the vehicle. Includes extended-range EVs which are a type of PHEV with a long-range battery.
- Port: See Connector. Not to be confused with Chargeport.
- Public Access Charging: Includes level 1, level 2 and DC charging at locations other than private access locations such fleets, workplaces, and residences with exceptions for visitor parking at workplaces and multi-unit dwellings and mixed-use charging. It includes away-from home-base DC charging open to members or the public as well as charging at restaurants, retail and service businesses, or destination centers, public streets, public or pay parking lots, mixed use locations and rest-stops.
- Ramp Up and Ramp-Down: Refers to increasing or decreasing the charge rate in a single charging station or group of charging stations.
- Restaurant, Retail, and Rest-Stop Charging: Can be level 1, 2 or DC and includes small clusters of charging at those locations but excludes large-scale charging plazas.
- SAE Combo Connector: See Combo Connector.

- Short-Dwell Charging Locations: Locations where a vehicle is parked for a few minutes or few hours and can charge. An EV may or may not need a charge at these locations. Examples include charging at restaurants, retail locations, rest-stops, gas stations, doctors, dentists, and similar service providers.
- Short-Range BEV: A BEV with less than 120 miles of all-electric range.
- Short-Range PHEV: A PHEV with less than 24.9 miles of battery electric range or equivalent electric range when fully charged.
- Single-Family Home Charging: Charging stations in driveways, carports or garages in residences designed for individuals or a family. Includes both attached and detached homes, but excludes large apartment and condo complexes without individual garages or carports near the home.
- Single-Family Home Attached: Examples include duplexes, triplexes, townhomes, and rowhouses with carports, garages, and/or driveways near the home.
- Single-Family Home Detached: Residential home that stands alone and is not attached to another home (includes mobile homes).
- Site Host: Is either the owner or tenant responsible for the parking lot or structure where charging stations are located. Could be a residential or commercial utility account. Although some EVSE is owned and managed by a network, many charging stations are operated by a site host who contracts with a network services provider for services, such as access control, payment processing, and driver communications. In many cases, a site host also works with the network to set pricing and access requirements. For a fee, site hosts receive benefits from EVSE networks, including charging station visibility and availability for drivers, energy monitoring, station usage analysis, automated payments, automated diagnostics, access control, and customer support. Site hosts may set pricing policies based on their business needs (e.g., employees consume electricity for free and visitors pay a fee).
- Site Host Station Interoperability: Ability of a site host to link different networks at the site or easily upgrade the EVSE of a bankrupt charging station manufacturer or network operator.
- Smart Charging Station: Controls and networking functions are in the charging station.
- State of Charge (SOC): Term used to describe how full a battery is, usually in percent.
- Street or Curbside Charging: Charging stations (AC or DC) on a curb, or road or street without curbs.
- Stub Out or Stub: The apparatus or equipment that an upright charging station attaches to.
- Super-Off-Peak Charging: A rate made available through TOU tariffs, which has reduced fees for energy used during specific times and is less expensive than off-peak charging.
- Supercharger: 120 kW DC chargers used by Tesla EVs. A Supercharger may also be a 72kW DC charger when used in urban settings, such as with Tesla's Urban Supercharger.
- Tesla Connector: A connector specified by Tesla to connect Tesla EVSEs to Tesla EVs.

- Traditional Utility Distribution Service Equipment or Utility Side-of-the-Meter Infrastructure: Includes the utility distribution system and transformers, and electrical service on the customer property (overhead or underground) up to and including the utility meter.
- Urban DC Fast Charging Plazas: Concentrations of DC fast charge stations at a single site within a metropolitan area or city that may or may not be open to the general public (e.g., membership or rideshare model) and may be co-located with other fueling facilities and could be on a travel corridor or away-from-them. Tesla refers to their Supercharger plazas or centers as Supercharger Stations, with each Supercharger Station having six or more charging station units/the ability to charge six or more vehicles at one time. For purposes of this Glossary and consistency, Tesla’s concentrations of DC fast chargers will be referred to as plazas or centers.
- Very Short-Range BEV: A BEV with less than 70 miles of all-electric range.
- Visitor Charging: Charging stations for visitors at a workplace or in a condo or apartment complex.
- Wireless Charging: Generally means the new inductive charging systems that do not require plugging in a connector, but instead use a pad under the EV or similar system to charge the light duty EV. In the case of buses and trucks the wireless charging system can connect on top of the vehicle.
- Wall-Box: Slang for wall mounted EVSE.
  - Workplace Charging: Charging stations for employees, staff, students, teachers, and professors at their place of work or on a campus.

### Standards Descriptions

- **ISO 15118:** ISO 15118 specifies the communication between Electric Vehicles (EVs), including Battery Electric Vehicles and Plug-In Hybrid Electric Vehicles, and the Electric Vehicle Supply Equipment (EVSE). Includes support for EV authentication/authorization (Plug and Charge), metering and pricing messages. Protocol utilized for SAE J2847 DC messaging.
- **IEEE 2030.5 (Formerly Smart Energy Profile 2.0 or SEP2.0):** Application layer protocol that defines messages between any client/server. Includes support for demand response, distributed energy resource (DER), metering, pricing, client authentication/authorization and other related applications. Default protocol for California Rule 21 DER communications. Protocol utilized for SAE J2847 AC messaging between EVSE and EV.
- **SEP 2.0:** see IEEE 2030.5
- **Open ADR 2.0:** OpenADR 2.0 defines application layer messages for providing demand response, pricing and measurement information.
- **Open Smart Charging Protocol:** The protocol can be used to communicate a 24-hour prediction of the local available capacity to the Charge Spot Operator. The Service Provider will fit the charging profiles of the electrical vehicles within the boundaries of the available

capacity. It is a protocol between charge point management system and energy management system of the site owner or the DSO system. Therefore, it is both applicable for site owners and DSO's. Source: Open Charge Alliance.

- **Open Charge Point Interface:** The Open Charge Point Interface (OCPI) allows for a scalable, automated roaming setup between Charge Point Operators and e-Mobility Service Providers. It supports authorization, charge point information exchange (including transaction events), charge detail record exchange and finally, the exchange of smart-charging commands between parties. (Source: <https://github.com/ocpi>) Also see <http://en.nknederland.nl/projects/our-current-projects/open-charge-point-interface-ocpi/>
- **Open Clearing House Protocol (OCHP):** OCHP is developed and operated by Smartlab Innovationsgesellschaft mbH (<https://www.smartlabgmbh.de/>) and Stichting ElaadNL (<https://www.elaad.nl/>, a foundation,) and others. OCHP is used by a European roaming platform called e-clearing.net (<https://e-clearing.net/>) with about 20 partners with about 9,700 charge points and a connection to roaming platform, eViolin, operating in The Netherlands (more than 40,000 charge stations and 23 charge point operators and mobility service providers). Source: <http://www.ochp.eu/> The Open Clearing House Protocol enables boundless electric vehicle charging across charging station networks. Using OCHP, service providers for EV charging can connect to infrastructure providers in order to provide access to their network. Open Clearing House Protocol (OCHP) has the purpose to connect market actors in the field of electric mobility charging infrastructure. This protocol enables parties to communicate between their own back-end system (like a CMS) and a clearing house system, in a simple way. OCHP is an open source protocol. It offers a uniform, SOAP based, interface solution. Everyone is free to implement and to actively participate in the development of the protocol. The current protocol version is 1.4.
- **Open InterCharge Protocol:** Defined by HUBJECT GmbH (<https://www.hubject.com/en/>), a German e-mobility contract e-roaming platform with more than 280 partners in 24 countries on 3 continents with more than 55,000 charge points. Source: <https://www.hubject.com/en/solutions/intercharge-direct/> and Specification download <https://www.hubject.com/en/downloads/oicp/> The goal of the "Hubject B2B Service Platform (HBS)" is to enable the electric mobility market in Europe by providing an information and transactional gateway for businesses such as charging infrastructure providers, mobility service providers and vehicle manufacturers. The enabler functions of the platform include:
  - 1) Ensuring the interoperability of the public and semi-public infrastructure through promotion of accepted standards within the network and open business user interfaces to the platform
  - 2) Simplification of authentication and authorization procedures through a trustworthy instance as well as safekeeping of sensitive data through the uncoupling of personal

data and anonymous user data.

- 3) Automation of contract-based business relationships between power suppliers, car manufacturers, infrastructure service providers as well as further mobility business parties.
  - 4) business-to-business information services for the realization of advanced services within the areas of energy management, traffic management, vehicle reservations, intelligent charging, car sharing and intermodal mobility.
- **Open Charge Point Protocol (OCPP):** An application layer protocol for communication between EV charging stations and a central management system, also known as a charging station network, similar to cell phones and cell phone networks. The protocol is an initiative of the E-Laad foundation in the Netherlands, and the Open Charge Alliance, but has not been approved by a Standards Development Organization. The latest completed version is 1.6. Version 2.0 scheduled to be released late 2017
  - **Open ADR 2.0:** A standardized protocol used for automated demand response signaling from a utility, Independent System Operator (ISO), Regional Transmission Operator (RTO) or other appropriate entity to provide automated connectivity to customer end-use control systems or devices.
  - **Open Charge Alliance (OCA):** The OCA is a global consortium of public and private electric vehicle (EV) infrastructure leaders that are developers and maintainers of the Open Charge Point Protocol and the Open Smart Charging Protocol. The OCA is not a Standards Development Organization.
  - **NIST Handbook 44 Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices:** Federal standard that includes measurement and other requirements related to EV charging when remuneration is required.
  - **NIST Handbook 130 Uniform Laws and Regulations in the Areas of Legal Metrology and Engine Fuel Quality:** Federal standard that includes labeling and other requirements related to EV charging when remuneration is required.
  - **SAE J2836/1 Surface Vehicle Information Report: Use Cases for Communication Between Plug-in Vehicles and the Utility Grid.** Established use cases for communication between a PEV and the electric power grid, for energy transfer and other applications. Its purpose is to document the set of use cases which must be supported by SAE J2847/1. This report does not define detailed use cases for PEV engaging with the EVSE as a distributed energy resource (DER) or for pure reverse power flow which are covered by J2836/3. J2836/1 covers V1G operations and J2836/3 covers V2G operations.
  - **SAE J2836/2 Surface Vehicle Information Report: Use Cases for Communication between Plug-in Vehicles and Off-Board DC Charger.** Establishes use cases and general information for communication between plug-in electric vehicles and a DC Off-board charger which must be supported by the detailed communications defined by SAE J2847/2. This only

covers conductive DC fast charging. Pure DC reverse power flow to an EVSE and bidirectional DC power flow with an EVSE as a DER are described in J2836/3.

- **SAE J2836/3 Surface Vehicle Information Report: Use Cases for Plug-in Vehicle Communication as a Distributed Energy Resource.** Establishes use cases for a Plug-in Electric Vehicle (PEV) communicating with an Energy Management System (EMS) as a Distributed Energy Resource (DER) which must be supported by SAE J2847/3. This mode of reverse power flow is designated as SAE V2G-AC. This document also provides guidance for updates to SAE J2847/2 to allow an inverter in an EVSE to use the PEV battery when operating together as a DER. This mode of reverse power flow is designated as SAE V2G-DC. Beyond these two specific communication objectives, this document is also intended to serve as a broad guide to the topic of reverse power flow.
- **SAE J2847/1 Surface Vehicle Recommended Practice: Communication for Smart Charging of Plug-in Electric Vehicles using Smart Energy Profile 2.0.** Describes the use of the IEEE 2030.5 Smart Energy Profile 2.0 Communication Protocol (SEP2) to implement the functionality described in the SAE J2836/1™ use cases. The primary purpose is specifying the communications needed for grid-optimized energy transfer for plugin electric vehicles (PEV) – that is, ensuring that vehicle operators have sufficient energy for driving while enabling the delivery of that energy to vehicles in ways that minimize stress upon the grid or reduce customer costs. This can be accomplished, for example, by vehicle owners' voluntary participation in a utility controlled-charging program in return for incentives, and the specification therefore supports information flows that enable such mechanisms.
- **SAE J2847/2 Surface Vehicle Recommended Practice: Communication Between Plug-In Vehicles and Off-Board DC Chargers.** Establishes requirements and specifications for communication between Plug-in Electric Vehicle (PEV) and the DC Off-board charger. This document applies to the off-board DC charger for conductive charging, which supplies DC current to the PEV battery the electric vehicle through a SAE J1772™ coupler. Communications will be on the SAE J1772 Pilot line for PLC communication A future version of this document is intended to provide messages to support bidirectional flow with an inverter located in the EVSE (V2G-DC). The messages are intended to be harmonized with ISO/IEC 15118 for DC conductive transfer.
- **SAE J2847/3 Surface Vehicle Recommended Practice: Communication for Plug-in Vehicles as a Distributed Energy Resource.** This applies to a Plug-in Electric Vehicle (PEV) which is equipped with an onboard inverter (SAE V2G-AC) and communicates using the IEEE 2030.5 Smart Energy Profile 2.0 Application Protocol (SEP2). It is a supplement to the SEP2 Standard, which supports the U6 and U7 use cases defined by J2836/3™. It provides guidance for the use of the SEP2 Distributed Energy Resource Function Set with a PEV. It also provides guidance for the use of the SEP2 Flow Reservation Function Set, when used for discharging. It is not intended to be a comprehensive guide to the use of SEP2 in a PEV.



- **SAE J3072 Surface Vehicle Standard: Interconnection Requirements for Onboard, Utility-Interactive Inverter Systems.** This SAE Standard J3072 establishes interconnection requirements for a utility-interactive inverter system which is integrated into a plug-in electric vehicle (PEV) and connects in parallel with an electric power system (EPS) by way of conductively-coupled, electric vehicle supply equipment (EVSE) – SAE type V2G-AC. This standard also defines the communication between the PEV and the EVSE required for the PEV onboard inverter to be configured and authorized by the EVSE for discharging at a site.
- **SAE J3068: Level 3 Charging:** Covers the general physical, electrical, functional, testing, and performance requirements for conductive power transfer to an electric vehicle using a coupler capable of, but not limited to, transferring three-phase AC power. It defines a conductive power transfer method including the digital communication system. It also covers the functional and dimensional requirements for the vehicle inlet, supply equipment outlet, and mating housings and contacts (From SAE).
- **SAE J2954:** The SAE Recommended Practice J2954 establishes an industry-wide specification that defines acceptable criteria for interoperability, electromagnetic compatibility, EMF, minimum performance, safety and testing for wireless charging of light duty electric and plug-in electric vehicles. (From SAE).
- **UL 2900:** A set of standards, including UL 2900-1, UL 2900-2-1, UL 2900-2-2, UL 2900-3, that applies to network-connectable products and which details evaluation and testing of those products for vulnerabilities, software weaknesses, and malware.  
(<https://industries.ul.com/cybersecurity/ul-2900-standards-process>)
- **Cybersecurity Standards:** Techniques generally set forth in published materials that attempt to protect the cyber environment of a user or organization. This environment includes users themselves, networks, devices, all software, processes, information in storage or transit, applications, services, and systems that can be connected directly or indirectly to networks. The principal objective is to reduce the risks, including prevention or mitigation of cyber-attacks. These published materials consist of collections of tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies. (Wikipedia) Some relevant standards include: applicable UL 2900-series standards, applicable ISO/IEC 27000-series standards.
- **IEEE 2030.1.1:** North American standard covering the CHAdeMO connector.
- **IEC 61851-23/24 standard covering the DC EVSE functions for CHAdeMO and SAE Combo connectors**
  - IEC 61851 part 23 - <https://webstore.iec.ch/publication/6032>. IEC 61851-23:2014, gives the requirements for DC electric vehicle (EV) charging stations, herein also referred to as "DC charger", for conductive connection to the vehicle, with an AC or DC. input voltage up to 1,000 V AC. and up to 1,500 V DC. according to IEC 60038. It

provides the general requirements for the control communication between a DC EV charging station and an EV. The requirements for digital communication between DC EV charging station and electric vehicle for control of DC charging are defined in IEC 61851-24.

- IEC 61851 part 24 - <https://webstore.iec.ch/publication/6033>. IEC 61851-24:2014, together with IEC 61851-23, applies to digital communication between a DC. EV charging station and an electric road vehicle (EV) for control of DC charging, with an AC or DC input voltage up to 1,000 V AC and up to 1,500 V DC for the conductive charging procedure. The EV charging mode is mode 4, according to IEC 61851-23. Annexes A, B, and C give descriptions of digital communications for control of DC charging specific to DC EV charging systems A, B and C as defined in Part 23.

### **Acronyms**

AC: Alternating Current

ACR: Assigned Commissioner's Ruling

ADMS: Advanced Distribution Management System

ADR: Automated Demand Response

AGC: Automatic Generation Control

AHJ: Authority Having Jurisdiction

ALJ: Administrative Law Judge

AMI: Advanced Metering Infrastructure

A/S: Ancillary Services

BA: Balancing Authority

BAA: Balancing Authority Area

BEMS: Building Energy Management System (sometimes called BMS)

BEV: Battery Electric Vehicle

BPM: Business Practice Manual

BTM: Behind-the-Meter

CAISO: California Independent System Operator

CBM: Capacity Benefit Margin

CCA: Community Choice Aggregator

CEC: California Energy Commission

CHAdEMO: Abbreviation of "CHARge de MOve

CHP: Combined Heat and Power

CIS: Customer Information System

COR: Customer of Record

CPUC or Commission: California Public Utilities Commission

CRM: Customer Relationship Management

CSO: Charging Station Operator  
CSP: Competitive Retail Service Provider  
CVR: Conservation Voltage Reduction  
DC: Direct Current  
DER: Distributed Energy Resource  
DERMS: Distributed Energy Resource Management Systems  
DG: Distributed Generation  
DLC: Direct Load Control  
DMS: Distribution Management System  
DNO: Distribution Network Operator  
DO: Distribution Owner  
DPAG: Distribution Planning Advisory Group  
DPP: Distribution Planning Process  
DR: Demand Response  
DRAM: Demand Response Auction Mechanism  
DRAMP: Demand Response Aggregator Managed Portfolio  
DRP: Distribution Resources Plan  
ECS: Energy Connection System  
ED: Energy Division  
EE: Energy Efficiency  
EM: Electricity Meter  
ERCOT: Electric Reliability Council of Texas  
ERRA: Energy Resource Recovery Account  
EV: Electric Vehicle  
EVBS: Electric Vehicle Battery System  
EVCC: Electric Vehicle Communication Controller  
EVEMS: Electric Vehicle Energy Management System  
EVSE: Electric Vehicle Supply Equipment  
FERC: Federal Energy Regulatory Commission  
FLISR: Fault Location, Isolation, and Service Restoration  
GHG: Greenhouse Gas  
GIS: Geographic Information System  
GRC: General Rate Case  
HEMS: Home Energy Management System  
Hz: Hertz  
ICA: Integration Capacity Analysis  
IDER: Integrated Distributed Energy Resources  
IE: Independent Evaluator

IEC: International Electrotechnical Commission  
IEEE: Institute of Electrical and Electronics Engineers  
IETF: Internet Engineering Task Force  
IFOM: In-Front-of-Meter  
IOT: Internet of Things  
IOU: Investor-Owned Utility; E.g., Pacific Gas and Electric Company, San Diego Gas & Electric Company, Southern California Edison Company, and Southern California Gas Company  
IPE: Independent Professional Engineer  
IPS: Internet Protocol Suite  
IROL: Interconnection Reliability Operating Limit  
IRP: Integrated Resources Plan  
ISB: International Standards Body  
ISO: Independent System Operator  
kV: kilovolt  
kW: Kilowatt  
kWh: Kilowatt Hour  
LCBF: Least Cost, Best Fit  
LCFS: Low Carbon Fuel Standard  
LCR: Local Capacity Requirements  
LDA: Local Distribution Area  
LGP: Local Government Partnership  
LMP: Locational Marginal Price  
LMR DR: Load Modifying Resource Demand Response  
LNBA: Locational Net Benefit Analysis  
LSE: Load-Serving Entity  
LTPP: Long-Term Procurement Plan  
MDMS: Meter Data Management System  
MP: Market Participant  
M&V: Measurement and Valuation  
MSA: Meter Service Agreement  
MSP: Market Service Provider  
MUA: Multi-Use Applications  
MVA: Mega Volt Amp  
MW: Megawatt  
MWh: Megawatt Hour  
NAESB: North American Energy Standards Board  
NDA: Non-Disclosure Agreement  
NEC: National Electrical Code

NEM: Net Energy Metering  
NEMA: National Electrical Manufacturers Association  
NERC: North American Electric Reliability Corporation  
NIST: National Institute of Standards and Technology  
NMV: Net Market Value  
NPV: Net Present Value  
NQC: Net Qualifying Capacity  
NRTL: Nationally Recognized Testing Laboratory  
NSB: National Standards Body  
NSP: Network Service Provider  
OCA: Open Charge Alliance  
OCHP: Open Clearing House Protocol  
OCPI: Open Charge Point Interface  
OCPP: Open Charge Point Protocol  
OEM: Original Equipment Manufacturer  
OMS: Outage Management System  
ORA: Office of Ratepayer Advocates  
OSI: Open Systems Interconnection  
OVGIP: Open Vehicle Grid Integration Platform  
PDR: Proxy Demand Response  
PEV: Plug-In Electric Vehicle  
PHEV: Plug-In Hybrid Electric Vehicle  
PFE: Power-Flow Entity  
PG&E: Pacific Gas and Electric Company  
POU: Publicly-Owned Utility; E.g., Sacramento Municipal Utility District, Los Angeles  
Department of Water and Power  
PRG: Procurement Review Group  
PRP: Preferred Resources Pilot  
PUC: Public Utilities Commission  
PV: Photovoltaic  
RA: Resource Adequacy  
REC: Renewable Energy Credit  
RECC: Real Economic Carrying Charge  
RICA: Renewable Integration Cost Adder  
RFO: Request for Offers  
RPS: Renewables Portfolio Standard  
RTD: Real Time Dispatch Market  
RTM: Real Time Market

RTO: Regional Transmission Organization  
SAE: Society of Automotive Engineers  
SCADA: Supervisory Control and Data Acquisition  
SCE: Southern California Edison Company  
SDG&E: San Diego Gas & Electric Company  
SDO: Standards Development Organizations  
SECC: Supply Equipment Communication Controller  
SGIP: Self Generation Incentive Program  
SI: International System of Units  
SOC: State of Charge  
SSO: Standards Setting Organization  
T&D, T-D: Transmission and Distribution  
TOU: Time of Use  
TPA: Third Party Aggregators  
TPP: Transmission Planning Process  
TSO: Transmission System Operator  
UIE: Unstructured Imbalance Energy  
VAR: Volt-Ampere Reactive  
V1G: Managed or controlled charging  
V2B: Vehicle to Building  
V2G: Vehicle to Grid  
V2H: Vehicle to Home  
VGI: Vehicle-Grid Integration  
VPP: Virtual Power Plant  
WDAT: Wholesale Distribution Access Tariff  
WSCC: Western Systems Coordinating Council  
ZNE: Zero Net Energy

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