Demand Flexibility Common Communication Protocol Project

Project Overview January 2023

Abstract

The purpose of the project is to develop a technical guidance template on the use of OpenADR 2.0 communication for Demand Flexibility in collaboration with the electricity industry.

PROJECT OVERVIEW

The project is a collaborative partnership between industry (represented by the Electricity Engineers' Association of New Zealand (EEA) and the Energy Efficiency and Conservation Authority (EECA).

The project will be evaluating the processes that need to be in place to apply the OpenADR 2.0 (2.0a and or 2.0b) communication protocol to achieve active managed charging of electric vehicles (EVs), enabling flexibility services to be utilised in the electricity sector in New Zealand.

The project directly involves three electricity distribution businesses (EDB's), two flexibility suppliers and end. They will be applying OpenADR 2.0 communication protocols for demand flexibility (DF) of EVs.

The outcome of the project will be the development of an (EEA technical guide developed by the electricity supply industry for industry standardisation. The development of this technical guide will provide direction for the electricity industry on the use of OpenADR 2.0 and allow regulators to support the industry-defined protocols through regulations if required.

Background

Aotearoa New Zealand has an aspirational decarbonisation goal of supplying all electricity generation from renewable resources by 2030, and all energy utilisation being carbon neutral by 2050. Most renewable generation connected going forward will be intermittent in nature, providing challenges to the grid owner, networks, and the system operator to manage supply and demand, and power quality.

With increasing levels of electrification, demand-side flexibility can help to facilitate greater amounts of intermittent renewable electricity generation entering the electricity market than could otherwise be tolerated. Sources of flexibility currently include, thermal storage, for example hot water cylinders, batteries, discretionary industrial heating, EV chargers, and potentially in the future, large scale hydrogen electrolysers. The potential demand from EV charging and lack of clarity on where EV chargers will be located is a challenge for network owners.

Analysis from a recent EV charging report published by Concept Consulting in October 2021 revealed that, "EVs offer flexibility potential that far exceeds all other appliances put together, with hot water cylinder control offering the next biggest source of flexibility. Together, we think EVs, and hot water will provide almost 90% of the potential for flexibility from consumer appliances. What's more, this significantly exceeds the need for flexible response to manage network peaks".

To achieve the benefits reported by Concept Consulting, EV smart chargers are needed that can respond to external conditions (such as carbon intensity or cost), communicated to the charger either from the Transmission System Operator (TSO), Distribution System Operator (DSO) or via flexibility suppliers. However, there are no national agreed standards or protocols for flexibility management. Unmanaged EV charging is estimated to cost an average household $220 per year through increased peak demand. Based on present EV uptake rates and the projected households, in 2050 this equates to $1.7b of additional spending on networks to manage peak loading across New Zealand.

There are technical challenges to achieve the reported benefits based on experience from overseas trials that have been reported. To overcome the challenges that have arisen from overseas implementation, industry agreement on the following requirements would support the coordination of EV smart charging:

a. **A common communication protocol** between flexibility suppliers and those procuring the service system so that a party seeking flexibility services (e.g. a network company, retailer, or grid owner) can easily procure and call-upon such services, irrespective of which control system individual consumers' appliances may be connected to.

b. **Identifying the appropriate level of regulatory prescription.** Some aspects of active EV smart charging may require regulatory prescription by different regulators. For example, government has the right to regulate EV chargers as these are defined as an appliance. Therefore, gaining industry confirmation of the aspects where regulation may be required could lead to consistent functionality for EV service equipment as an outcome.

c. **Electricity industry collaboration** to work through the technical issues and challenges. To provide industry guidance on flexibility services, there is a need to share technical experience within the New Zealand context as well as information across the electricity sector to agree on an acceptable common protocol.

This project seeks to demonstrate a common communication protocol for the coordination of EV smart charging, to identify any resulting issues, and develop a New Zealand technical guide that supports the integration of EV smart chargers into a flexibility management system.

For the purpose of this project, OpenADR 2.0 standard (2.0a and or 2.0b) may be installed on a Transpower-provided platform (as a Flexibility Management System or FMS) to prove the benefits and establish the application logic of the protocol in the New Zealand market. While the project focuses on the application of OpenADR 2.0 standard (referred to simply as OpenADR from this point forward), we acknowledge there are multiple communication protocols. For the purpose of this trial we are utilising OpenADR as a strawman.[1]

[1] The focus of this project is about EV charging and using OpenADR as the mechanism of choice to prove the benefits and establish the application logic of the protocol in the New Zealand market. While our initial work focuses on OpenADR, it does not preclude the use of other protocols that are found to have benefit throughout the project.

Project Vision

To maximise participation in flexibility services through the adoption of a common communication protocol that is accepted by the New Zealand industry, and enables parties seeking or providing flexibility services to easily procure, dispatch, and monitor such services.

Strategic Goals

Demonstrate active managed EV smart charging through the implementation of a common communication protocol.

Illustrate that this common communication protocol can be extended more generally to manage different loads and distributed generation across any platform or system (facilitating flexibility and interoperability).

Assess the suitability of OpenADR in the New Zealand context to facilitate these services.

Work with the electricity industry to create a guide that achieves consistency in New Zealand and is adopted by the whole industry.

Achieving user acceptance, demonstrated by customers using and investing in smart infrastructure.

Enabling intermittent renewable generation to be integrated into the electricity industry, to assist in enabling New Zealand's renewable generation targets.

OpenADR

OpenADR 2.0 is an open, highly secure, two-way information exchange model and global Smart Grid standard. OpenADR 2.0 standardises the message format used for DR and DER management so that signals can be exchanged in a uniform and interoperable fashion among network providers, flexibility suppliers, home energy management systems, and smart devices.

The OpenADR Alliance was created by industry[2] to help organisations around the world standardise DR/DF and DER communications, automate processes, simplify customer energy management, and eliminate stranded assets.

Adoption of OpenADR is occurring throughout many parts of North America including California, Nevada, Texas, Florida, Arizona and Hawaii as well as in Europe, China, Japan and Korea[3]. In New Zealand Transpower and Cortexo are also members.

[2] Honeywell, Edison, Daiken, Fujitsu, JuiceNet, Siemens, Shell, Transpower and Toshiba are among industry members.
[3] NZ are members of the international OpenADR alliance. The OpenADR website https://www.openadr.org/overview provides country case studies.

Project Summary

The project will incorporate EDBs, flexibility suppliers, and technology and EV charger manufacturers. Engagement and involvement of all stakeholders is critical to the outcomes of the project to identify issues with interoperability and develop guidance that will apply to all parts of the industry for active managed EV charging.

There are 5 key questions for the project to research and answer;

1. What are the advantages of OpenADR and where do other standard protocols fit in?
2. What are the flexibility message types for the New Zealand context?
3. What are the learnings for EDBs and flexibility suppliers when implementing OpenADR to communicate with DER?
4. What do EDB's and flexibility suppliers need to do to provide active managed EV charging?
5. What is the consumer's experience?

The project will demonstrate a range of services and technical information such as: avoiding peaks in network loads; providing ancillary services, charger status and ability to take load; customer reaction to experience of active managed charging; and interoperability of systems. These services could be applied to a number of DR assets that are within the home such as EVs, battery storage, hot water storage, and solar arrays.

Interoperability enables freedom of choice for customers by providing the ability to switch products, companies, or operators while ensuring that a charging system/strategy would function as intended[7]. For example, a customer is not limited to purchasing certain types of charging stations because of the car brand or service from a particular flexibility supplier. An objective of the project is to demonstrate and provide approaches to enable interoperability for customer choice.

The final deliverable of the project is the development of a New Zealand technical guide. EDB's and flexibility suppliers need examples of typical flexibility programmes so that they can be used as models for their own flexibility programme implementations. Equipment manufacturers need to understand typical flexibility programme usage models so they can validate interoperability as part of the development process. The intent of the technical guide is to accomplish the needs of all parties involved in DR as follows:

- Define a small set of standard flexibility programme templates modelled after the common characteristics of the most popular flexibility programmes implemented to date;
- Define a small set of deployment scenarios modelled after real world deployments, with actors and roles clearly identified; and,
- Define best practices recommendations for OpenADR characteristics specific to each of the flexibility programme templates.

Project Objectives

Determine the use cases for flexibility services to be communicated and create process maps for these.

Assess the advantages and limitations of OpenADR within the New Zealand context, including a high-level comparison against other communication protocols.

Demonstrate interoperability of communication protocols between EDBs, flexibility suppliers and consumers.

Assist industry participants in understanding the systems investment involved with utilising flexibility services.

Project Deliverables

The purpose of the project is to collaboratively develop active, managed charging using OpenADR 2.0 communication protocols (2.0a and or 2.0b of the standard), with participants in the electricity industry, to develop an industry technical guide applicable to the New Zealand context.

Key deliverables of the project are:

1. A functional specification document that provides direction for the electricity industry on the application of the OpenADR 2.0 communication protocol in New Zealand for actively managing EV charging. The specification document will:
   - Provide guidance for EDB's and flexibility suppliers on how to apply OpenADR 2.0 to achieve active managed EV charging.
   - Define a set of standard flexibility programme templates modelled after the common characteristics of the most popular flexibility programmes implemented to date.
   - Define a set of deployment scenarios modelled after real world deployments, with actors and roles clearly identified.
   - Define best practice recommendations for the implementation of OpenADR by identifying what businesses need to do and the process to go through.
2. A supporting technical guide that:
   - Provides a summary of project learnings for EDB's and flexibility suppliers when implementing OpenADR to achieve active managed charging of EVs.
   - Provides clarity about desirability, viability, and feasibility (DVF) for OpenADR.
   - Provides a summary of project learnings and key insights drawing on international research.
   - Provides recommendations that allow the regulators to support the industry defined protocols through regulation if required.

Defines the role of other communication protocols such as IEEE2030.5 in the New Zealand market.

Project Scope

The project scope covers resources for active managed charging of EVs, charging impacts on EDBs, flexibility suppliers, energy retailers, EV charger suppliers and customers.

Included in the scope is:

- Trialling the implementation of OpenADR (both a & b standards)
- Integration with a Virtual Top Node (VTN), on the Transpower-provided FlexPoint™ platform, or develop and deploy an OpenADR-certified VTN on a platform of the EDB's choice
- Development and deployment of an OpenADR-certified Virtual End Node (VEN)
- Connection and integration into EDB and Flexibility Suppliers IT systems
- Monitoring charger status and ability to respond to events
- Monitoring EV charger response and status
- Exploring the implications of communication security
- Assessing the customer reaction to, and experience of active charging
- Exploring whether OpenADR is appropriate in the New Zealand context
- Assessing the connection to other control protocols, (E.g. IEEE 2030.5 and OCPP)
- Deploying customer surveys to gain an understanding of demand response incentives required to trigger a change in customer behaviour
- Actors:
    - Three EDBs
    - Two flexibility suppliers
    - Access to end customers through the flexibility supplier partners (smart charger ready)
    - OpenADR 2.0 Service Provider. For the purposes of the trial we will be using the FlexPointTM platform
- Devices:
    - Commercial EV smart chargers / EV management systems
    - Residential EV smart chargers

– Excluded from the project scope:

- Financial market issues
- Customer incentives
- Distribution System Operator (DSO)-operating models or systems
- Commercial agreements for demand response incentives
- Load shifting trials and analysis
- Communication link e.g. broadband, cell,
- Electrical infrastructure

Project scope – Trial Configuration

The diagrams below illustrate the scope and configuration for the project.

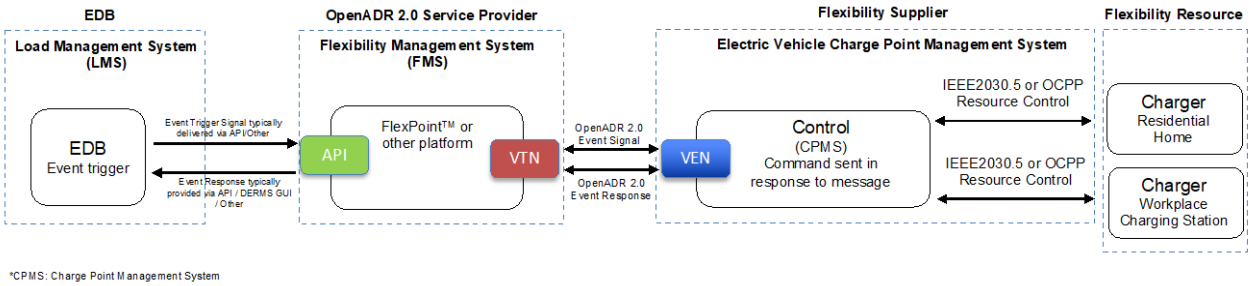


Figure 1. Trial Configuration Option 01

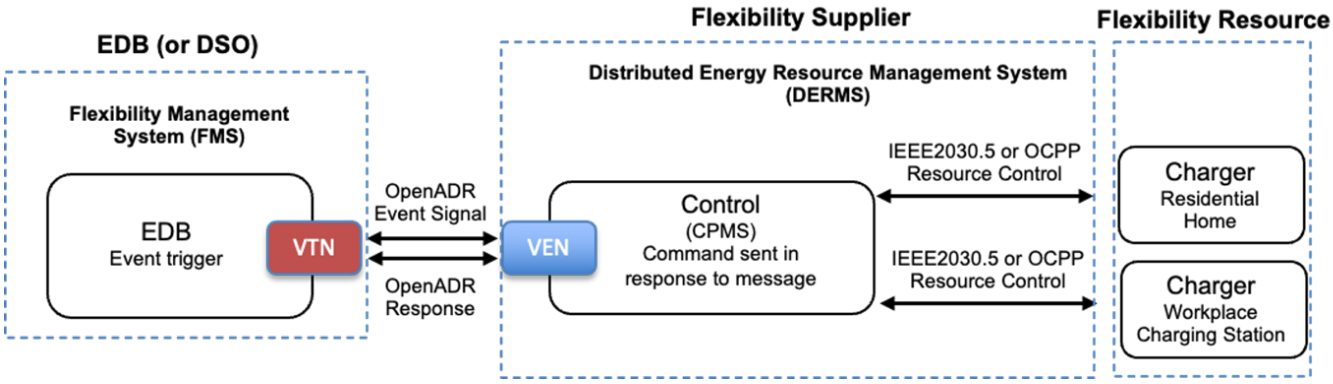


Figure 2. Trial Configuration Option 02

Project Scope – Possible End State

While the future state is still relatively unknown the below diagram is designed to illustrate what a possible end state might look like.

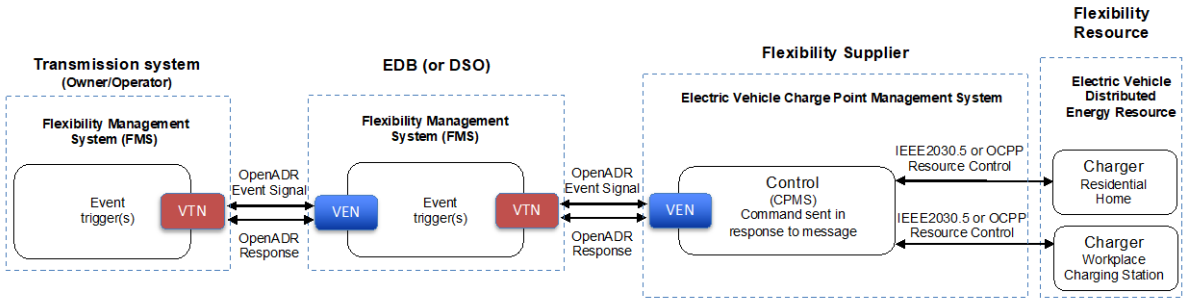
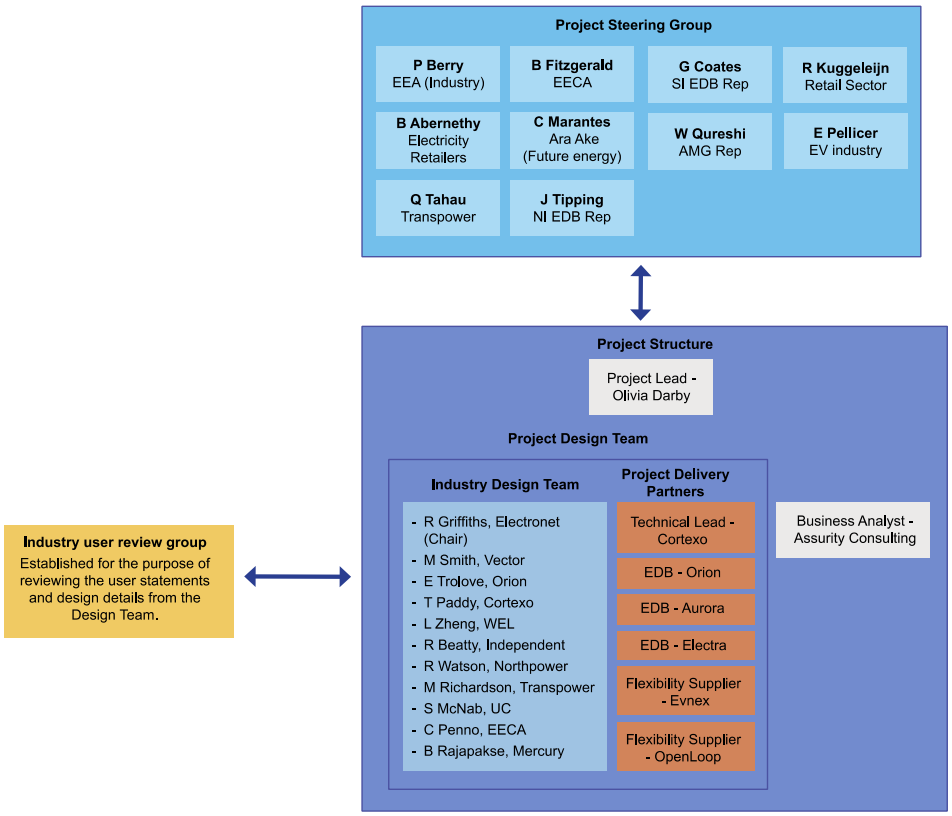


Figure 2. Possible End State

Project Team

The project is a pan-electricity industry project aimed to provide all EEA members and the electricity industry with guidance to apply OpenADR communication protocols for fast and fully automated demand response services. As a pan-industry project, multiple stakeholders have been included in the governance of the project. The roles and responsibilities of those involved in the project are detailed below.



Roles and Responsibilities

ROLES	RESPONSIBILITIES
Project Steering Group (PSG)	The Project Steering Group sponsor the project and the approving authority acting in a Governance role to ensure the project achieves the agreed outcomes. The Project Steering Group is focused on the deliverables, timing, and cost of the project, along with stakeholder management and engagement. They are not looking at technical information. Any change to scope, budget, and timeline are approved and reported to the PSG.
Industry Design Team (IDT)	The IDT are the lead technical team that have developed the scope. They bring technical expertise in the technology and application to distribution networks and EV charge companies. They provide review, advice, and support to the Project Delivery Partners to achieve the deliverables of the project.
Project Design Team (PDT)	The PDT is a collaborative team made up from many organisations and skill sets. They are on the team with a view on what is best for the industry. They will set the technical requirements and develop the user requirements, VTN and VEN implementation. They also undertake the implementation and testing of OpenADR. The PDT sign off of all technical details and approaches and make the final technical decisions on the best approach for the implementation of the OpenADR protocol.
Project Delivery Partners	The Project Delivery partners will include representation from each of the selected EDBs, and flexibility suppliers. They contribute to the overall goal of the project and project design team.
Industry User Review Group	The Industry User Review Group will be responsible for reviewing the user requirements and outputs from the Project Design Team. The group will review and provide recommendations back to the project design team on the end user requirements.
Project Lead	The Project Lead will co-ordinate all the different working groups from the organisations that are involved. The Project Lead reports regularly to the PSG and ensures the project is on track and within timeframes and budget. The Project Lead is accountable for the timeframe, the budget and managing the risks.
Business Analysis (BA)	Reporting to the Project Lead the BA is responsible for developing end user requirements, process mapping and supporting with developing the outputs from the trial.
EDB (Í3)	The selected EDB will be responsible for co-ordinating the integration with any Flexibility Management System (FMS), utilising a VTN, network management in support of the project, and the dispatching of distributed energy resources.
Flexibility Supplier (Í2)	The selected Flexibility Suppliers are responsible for establishing relationships with DER owners, establishing the VEN connection within their EV Management Platform and control of the DER assets.
Technical Lead	The Technical Lead will act as a facilitator, supporting EDB and Flexibility Supplier partners to come together via the OpenADR mechanism.

Project Approach

The project is designed in 7 phases, and within each phase there are approval gates for the EEA Executive and Project Steering Group. We are currently at Phase 4. Select Delivery Partners.

PHASE	DESCRIPTION	TIMINGS	STAGE GATE
1) Industry Engagement	Engagement with the electricity supply industry and regulators to gain support and funding for the project.	April '22 Ongoing	Gate 1 Gate 2
2) Establishment Part A	Establish industry design team, steering group and develop the terms of reference for participants. Development of an industry survey, partner selection criteria, project plan and role briefs.	July '22 Complete	Gate 3 Gate 4
3) Establishment Part B	Commission an international review of DERMs communications protocols and how they might apply in New Zealand. Industry commitment to the project and funding received.	September '22 In progress	Gate 5 Gate 6
4) Select delivery partners	Conduct RFP process to select EDB and Flexibility Supplier partners. Develop user briefs and agreements for all project partners.	October '22 In progress	Gate 7
5) Protocol implementation	Each flexibility programme design tends to be unique, fitting the structural and regulatory requirements of the geographic region it is deployed in. For each flexibility programme there are numerous possible deployment scenarios involving a variety of partners. The implementation stage will use the agile project management approach where the project team will develop a series of scenarios and user requirements then develop code and deploy / test for different stages. There will be two implementation phases, phase one to achieve the OpenADR 2.0 - part A standard, phase two, OpenADR 2.0 part B. Approach to development - Develop scenarios - Develop end user requirements - Develop expected code outcomes - Develop code - Deploy and test - Define best recommendation for scenario / template - Repeat for next scenario or make changes		

PHASE	DESCRIPTION	TIMINGS	STAGE GATE
Phase 01 - Part A	Designed to support the simplest devices installed in commercial and residential environments to enable broad-based and completely automated participation in DR events. One way communication from the EDB to Flexibility Supplier.	November '22 – April '23	Gate 8
Phase 02 - Part B	More sophisticated services for DR services and markets. Including flexible reporting capabilities for past, current and future data report. Two way communication from the EDB to Flexibility Supplier.	May '23 – October '23	
1) Template development	Using the data and approach taken in the implementation phase, a template is developed that provides industry with the approach and guidance. Industry consultation will be undertaken using the EEA process.	November '23 – January '24	Gate 9
2) Roll out	A series of webinars and training opportunities will be developed for the industry.	February '24	

Glossary of Terms

Active Managed Charging	This form of managed charging, also known as direct load control, supersedes customer charging behaviour and imposes utility preferences on charger functionality. Charging is controlled by communication signals sent from a utility or aggregator to a vehicle or charger. Active managed charging can be event based, where load is controlled during a limited number of events in a given time period. Active managed charging can also be continuous, which enables more constant control that is responsive to grid conditions on a more granular scale.
Charge Point Management System (CPMS)	A Charge Point Management System is a software system that manages the charge point infrastructure and can manage either the technical and economic aspects of the charging infrastructure.
Demand Response (DR)	Demand response is a load management method that is used during periods of peak demand to relieve grid stress. As part of a demand response effort that occurs during a charging session, the charger could be throttled to reduce energy consumption temporarily and return to full charging capacity once grid stress is relieved.
Distributed Energy Resources (DER)	Technologies used to generate, store, or manage energy are referred to as distributed energy resources (DER). DER are smaller–scale devices that can either use, generate, or store electricity and form a part of the local distribution system, which primarily serve homes and businesses. DER can include renewable generation, energy storage, electric vehicles (EVs), and technology to flexibly manage loads (such as water heaters or pool pumps) at the premises. Generation or storage DER operate for the purpose of supplying all or a portion of the customer's electrical load and may also be capable of supplying power into the system or alternatively providing a load management service for customers. DER can also include front-of-meter small generation or storage located in lower-voltage parts of the network
Distributed Energy Resource Management System (DERMS)	The software and digital information flows that enable DERM by controlling DER.

Demand Flexibility (DF)	Demand flexibility is the capacity of demand-side loads to change their consumption patterns hourly or on another timescale. Demand flexibility can help make electricity more affordable by helping customers use less power when prices are high.
Distribution Systems Operator (DSO)	A Distribution System Operator (DSO) has a role to monitor, control and actively manage the power flows on the distribution system to maintain a safe, secure, and reliable electricity supply. As a neutral facilitator of an open and accessible market for network services, a DSO will enable competitive access to markets and the optimal use of DER on distribution networks to deliver security, sustainability, and affordability in the support of whole system optimisation. A DSO enables customers to be producers, consumers and storers of energy, enabling customer access to networks and markets, customer choice and great customer service.
Electrical Vehicle Supply Equipment (EVSE)	The equipment that interconnects the AC electricity grid at a site to the EV. It can be Level 1, Level 2, or Direct Current Fast Chargers (DCFC) charging. Also known as a charger.
Flexibility Supplier	An entity providing flexibility to perform a service for an electricity participant.
Flexibility Resource	Typically distributed generation, storage or demand response, are connected to the electricity network, and are flexible in how they operate and impact the network
Flexibility Services	The offer of modifying generation and/or consumption patterns in reaction to an external signal (such as a change in price) to provide a service within the energy system.
Load Management System (LMS)	A control system that can be used to monitor and manage the power draw of an appliance or aggregation of appliances.
Virtual end node (VEN)	This is the OpenADR Virtual End Node that is used to interact with the VTN.
Virtual top node (VTN)	This is the OpenADR Virtual Top Node that is used to interact with the Resources enrolled in the DR Programs.
Transmission Owner (TO)	The Transmission Owner, is used to describe the entity that continues to own, maintain, and expand the transmission system when necessary.

Transmission System Operator (TSO)	The Transmission System Operator (TSO) is responsible for the stability of the electricity system.

Abbreviations

EDB: Electricity Distribution Business

EEA: Electricity Engineers' Association

EECA: Energy Efficiency and Conservation Authority

EV: Electric Vehicle