# Smart Charging, smart grid

Building a Charge Station Management System for SENDLab's V2X Testbed

Joost van Dam Contact information: ja.vandam3@student.avans.nl Date: 02 June 2025

## Introduction

### What is V2X?

V2X (Vehicle-to-Everything) refers to bidirectional energy flows between an electric vehicle and its environment, whether the grid (V2G), a building (V2B) or a home (V2H). By intelligently controlling when and how EV batteries charge or discharge, V2X enables vehicles to act as flexible storage, smoothing out peaks and supporting a more stable, sustainable energy system.

### **Energy transition**

Approach

### **Proof-of-Concept**

Validate that a Python OCPP backend can control the ABB charger and EV-battery emulator.

### **Iterative Refinement**

Weekly demos and stakeholder feedbacksessions

Renewable energy is booming, but generation rarely matches demand

### **EV batteries as flexible storage**

Electric vehicles can support the grid (V2X) by charging and discharging at the right moment, if we control them smartly..

### Missing link at SENDLab

The lab had bidirectional chargers and battery emulators, but lacked a centralized control system.

### **Final Design**

Deliver a robust, maintainable Charge Station Management System with real-time updates, web interface, and support for 100+ bidirectional chargers.





### Results

A minimal Python CSMS with RPC/WebSocket API and OCPP 1.6/2.0.1 support, plus a simple web interface, enabling researchers to plug in, test, and iterate V2X charging algorithms in SENDLab within minutes.



**OCPP Gateway / CSMS** 

### Connected charge-points

MNEXT

Alias	ID OCPP version		Active	Config	
OCPP Simulator	1241	1.6		open	

#### Backend events (all charge-points)

П	PAUSE	*	EXPORT	Pretty	Dracula	Filter
		-			Bradoana	

"event": "StartTransaction", "charge\_point\_id": "1241", "ocpp\_version": "1.6", "payload": { "connector\_id": 1, "id\_tag": "9bcaece2", "meter\_start": 395664, "timestamp": "2025-05-24T12:14:03.1150189+02:00"

"event": "StatusNotification",
"charge\_point\_id": "1241",
"ocpp\_version": "1.6",
"payload": {
 "connector id": 1.

Event	Value / Info
StartTransaction	txId=?
StatusNotification	Charging
MeterValues	{"connector_id":1,"transaction_id":1,"meter_value":[{"timestamp":"2025-05-24T12:14:05.1323002+02:00","sampled_value": [{"value":"395664","context":"Sample.Periodic","measurand":"Energy.Active.Import.Register","location":"Outlet","unit":"Wh"}, {"value":"230","context":"Sample.Periodic","measurand":"Voltage","location":"Outlet","unit":"V"}, {"value":"121.6","context":"Sample.Periodic","measurand":"Current.Import","location":"Outlet","unit":"A"}, {"value":"27974","context":"Sample.Periodic","measurand":"Power.Active.Import","location":"Outlet","unit":"W"}, {"value":"27974","context":"Sample.Periodic","measurand":"SoC","location":"Outlet","unit":"Percent"}]}]}

#### Last MeterValues (live)

Latest events

Measurand	Phase	Value	Unit	Context	Timestamp	Tx-ID
Current.Import		121.6	A	Sample.Periodic	2025-05-24T12:14:05.1323002+02:00	1
Energy.Active.Import.Register		395664	Wh	Sample.Periodic	2025-05-24T12:14:05.1323002+02:00	1
Power.Active.Import		27974	W	Sample.Periodic	2025-05-24T12:14:05.1323002+02:00	1
SoC		49.97	Percent	Sample.Periodic	2025-05-24T12:14:05.1323002+02:00	1
Voltage		230	V	Sample.Periodic	2025-05-24T12:14:05.1323002+02:00	1







### CENTRE OF EXPERTISE