



# Introduction to V2G Technology Solutions

NUVVE.COM



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# COMPANY OVERVIEW



# Nuvve | *Company Overview*

Vehicle-to-Grid Technology Pioneer  
with 25+ years of V2G R&D

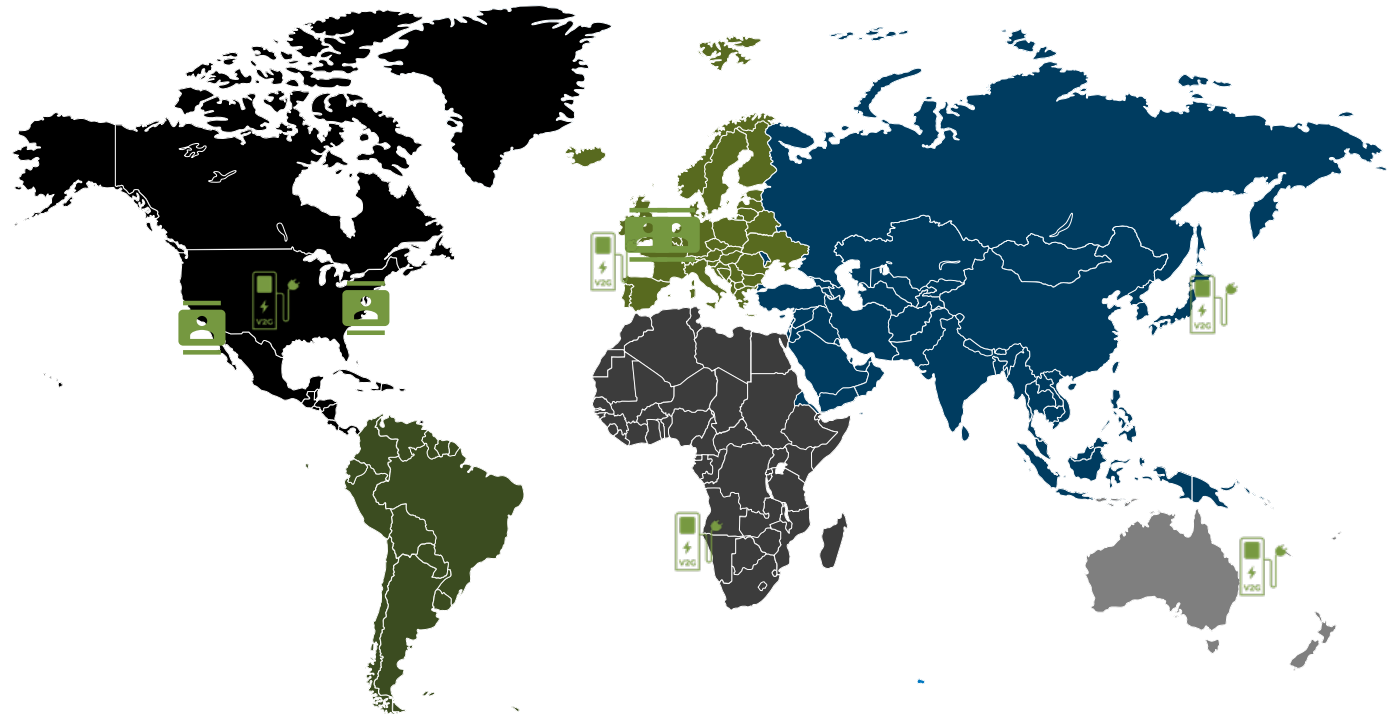
~8 years of continuous commercial  
V2G operations beginning in Europe

500+ EVSEs deployed | Experience  
managing 26+ MW across five  
continents

Headquartered in San Diego, CA  
Nasdaq CM: NVVE

Offices in Newark (Delaware),  
Copenhagen (Denmark), and Tokyo  
(Japan)

Sourcewell & CES supplier



Sourcewell 

Awarded Contract

Contract # 042221-NUV



# Nuvve | GIVe™ Platform Overview

Nuvve's GIVe™\* platform harnesses latent power stored in EV batteries and **sells it to the power grid** on behalf of its customers

*\*GIVe™=Grid Integrated Vehicle*

Nuvve thereby creates long-term **recurring revenues** from grid services

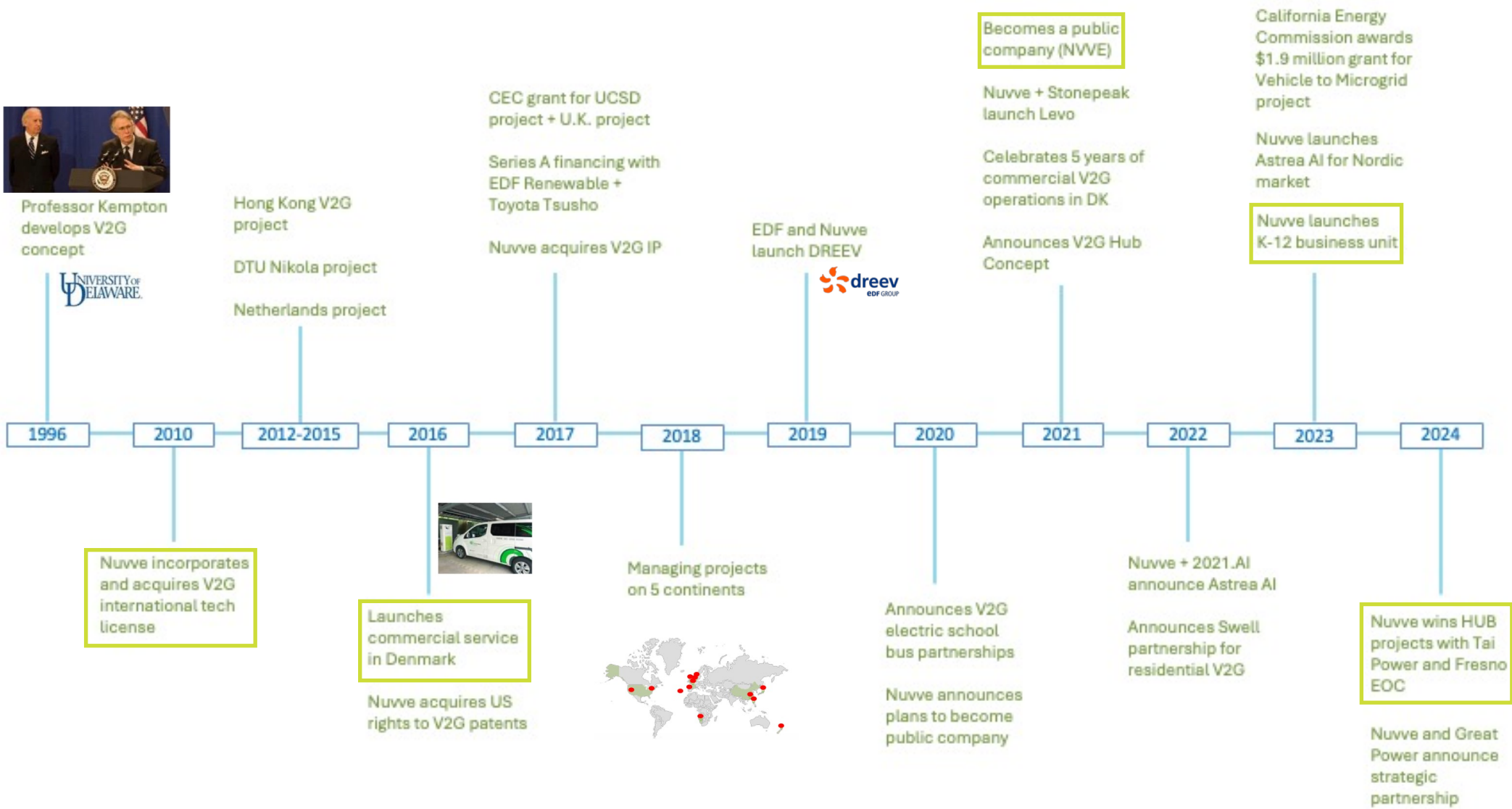
Nuvve's solution dramatically **reduces the total cost of EV ownership (TCO)**

Nuvve's **AI solution** makes highly accurate forecasts of EV charging activity

Nuvve's technology can potentially transform the entire energy industry by linking latent energy stored in millions of EV batteries together to **support the tremendous demands** for power placed on the electric grid



# Backed by Decades of Technology Development and Innovation



# Nuvve Sits at the Intersection of Transportation and Energy

Nuvve enables a new model for electrification through its intelligent energy platform by:

- increasing the utilization of electric vehicles (EVs); and,
- turning EVs into valuable earning assets, thereby reducing their total cost of ownership (TCO).

This helps the grid become more resilient while accelerating the world's transition to clean energy.



# WHAT IS V2G TECHNOLOGY?



# Vehicle-to-Grid (V2G) | *What it is...and Why it matters...*

## What is Vehicle-to-Grid (V2G)?

V2G is critical in achieving energy independence by utilizing electric vehicle fleets to add resilience and stability to the grid

Unlike traditional unidirectional charging, V2G allows for a vehicle's battery to also discharge energy back to the grid when the grid needs it

Multiple EVs can provide enough "smart load" energy to sell back to the market, providing a new recurring revenue stream for fleet owners

V2G technology bridges the gap between renewable energy sources and EVs, and also helps regulate energy on the grid



Power Generators



Transmission Systems



Distribution Systems



End Customers

✓ Bi-Directional

✓ Stabilization of renewables

✓ Access to energy markets



✓ Demand/Supply matching

✓ Virtualization of assets

✓ Smart battery management



## Why is it Critical?

Designed +150 years ago, the grid needs significant overhaul and investment to manage an increasingly distributed energy ecosystem

Increased power demand from EV adoption will add further strain on grid infrastructure and V2G helps solve these issues

EVs will represent a huge energy storage resource, but without investments in V2G, full benefits will not be realized

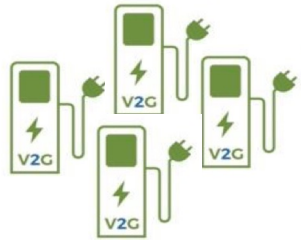


# Vehicle-to-Grid (V2G) | *The Basics*

## How V2G Works



Bi-directional Capable  
Electric Vehicles



Bi-directional Capable  
Charging Stations



Nuvve's GIVE™  
Platform

### What's Required for V2G

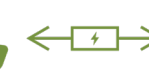
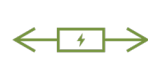
**1 PLUG IN YOUR CAR**  
to any charger



**2 CHARGE BATTERY**  
safely and efficiently in V2G Mode



**3 MAKE MONEY**  
by providing power capacity  
and sending energy back  
and forth to regulate the Grid



**OR SAVE COSTS**  
by using stored energy from  
EV batteries to reduce building  
energy peak consumption

**4 YOU'RE READY TO DRIVE**  
with the charge you set for the day  
with advance trip planning using a  
mobile fleet management app

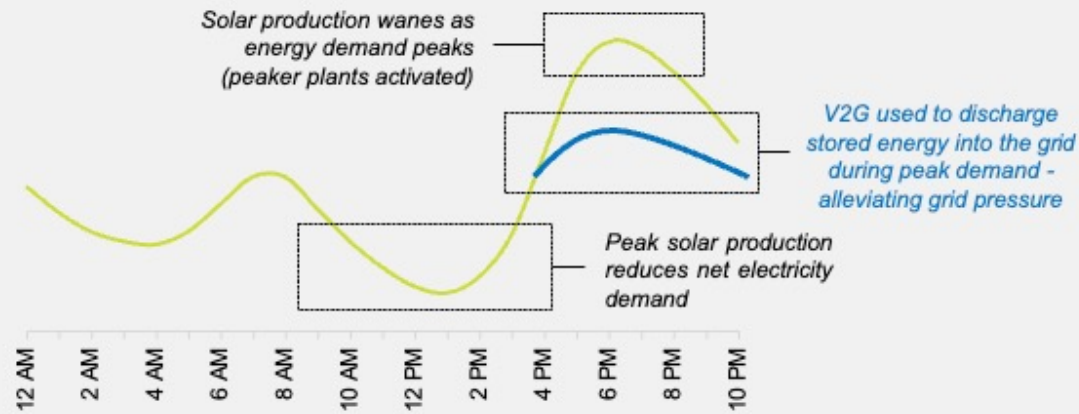


# Vehicle-to-Grid (V2G) | Critical Enabler for the Energy Transition

## V2G As A Solution to the Duck Curve

- ▶ The grid has traditionally been forced to draw highly expensive power from carbon-intensive peaker plants when energy demand is highest
- ▶ As EV adoption accelerates, the ability to discharge stored energy in EV batteries will become a critical resource in responding to peak demand

### The "Duck" Curve – Net Electricity Demand (MW)



## V2G Hubs: Turning EVs into Power Plants

- ▶ Nuve's V2G technology aggregates energy and power capacity across commercial fleets to form virtual power plants (VPP)
- ▶ Given the value V2G can create for utilities, fleet owners will be incentivized to incorporate bidirectional charging capabilities to new EV fleets

### V2G Hubs | The Power of Aggregated Distributed Energy Resources

200 buses connected with V2G capability at 125kW would equate to **25MW of capacity**

25MW would be capable of reducing peak consumption of **10k homes by 50%**



# Intelligently Electrify Your Fleet With Nuvve's V2G Solutions



Save costs  
on your  
fleet charging



Remotely  
monitor and  
control charging  
performance



Give energy  
back to the  
grid when it's  
needed most



Integrate  
renewable  
energy more  
reliably



# THE NUVVE V2G PROMISE



Drivers always have enough energy to drive



Customers enjoy cost savings and revenue generation opportunities



We work within OEM battery warranty limits



## Nuvve’s all-inclusive, turn-key solution includes:

- Grant facilitation
- Collaboration with utilities
- Charging station procurement, delivery and installation
- Testing and qualifying of vehicles to the charging infrastructure
- Energy as a Solution (EaaS) that includes both fleet and V2G management
- Electric vehicle procurement and delivery
- 100% finance options for all vehicles and charging stations
- Purchase and removal of current fleet as EVs come online is also an option



### INFRASTRUCTURE

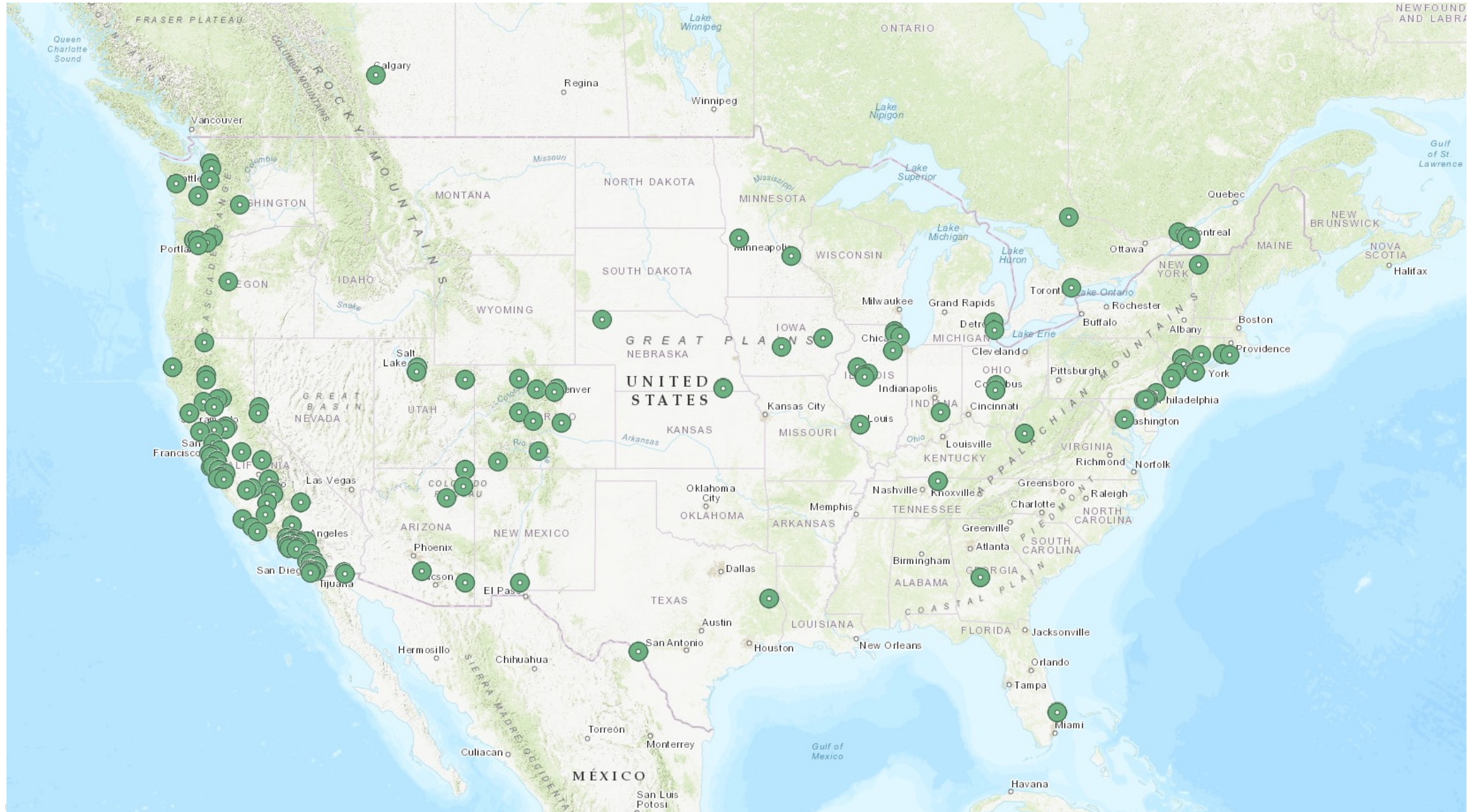
## New Mexico Gov. Orders Agencies to Go Electric by 2035

All state government agencies in New Mexico will need to transition to a fully electric vehicle fleet within the next 12 years under a newly issued executive order from Gov. Michelle Lujan Grisham.

October 17, 2023 • Daniel J. Chacón, The Santa Fe New Mexican



# Nuvve | North American Charging Deployments



# Nuvve | *First Mover Advantage in the V2G Space*

<b><u>First Mover Advantage</u></b>	<b><u>Nuvve Today</u></b>	<b><u>Entry Barrier for Competitors</u></b>
Intellectual Property (IP)	Nuvve owns key patents	Difficult for competitors to perform V2G functions without violating Nuvve's IP
Qualification by Transmission System Operator (TSO)	Nuvve is already qualified by multiple TSOs which makes Nuvve easier to expand in other areas	It is a long path for distributed resources and aggregators to be qualified by TSO : 12-36 months
Experience (market participation & stake-holders)	Nuvve has 10 years experience of market participation and stake-holder interaction including with car OEMs	Optimization of market participation and customer's value proposition is a key element for competitiveness.
Data Collection	A huge amount of data has been accumulated inside Nuvve	Data is a key element for rapid and accurate future development

# **NUVVE'S COMMERCIAL V2G DEPLOYMENTS IN ACTION**





# Nuvve | *World's First Commercial V2G Operation (Denmark)*

***Start of operation September 6, 2016***



- **10 Nissan e-NV200 V2G EVs** light duty fleet
- **100 Hours** of V2G commercial operation per EV per week
- **42,400 Hours** of V2G commercial operation since September 6, 2016 per EV
- **424,000 Hours** of V2G commercial operation for 10 EVs
- **~\$2,000 to \$5,000** per car per year



# Nuvve | Track Record of Global Commercial V2G Deployments



Barcelona, Spain



Bornholm, Denmark



Culver City, CA



London



UCSD, San Diego



Nice, France



Corsica, France



Torrance, CA



El Cajon, San Diego



CDG Airport, Paris



Windhoek, Namibia



Nagoya, Japan



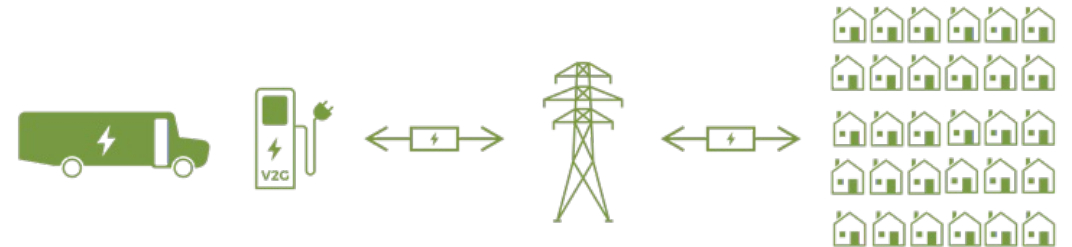
Frederiksberg, Denmark

Through its V2G solutions, starting with light duty fleets in Denmark and the U.S. school bus market, Nuvve has established a first-mover advantage for not only charge and energy management of commercial EVs, but also aggregated grid-level vehicle energy assets under management.

# The Power of V2G

Average U.S. home uses 30kWh of energy per day

An electric bus battery of 150kWh can store enough electricity to power 30 homes for 4 hours



*“As a co-op, we have an obligation to lower costs for our ratepayers and Nuve’s V2G solution is helping us do this. We also have aggressive decarbonization goals, and electrifying school buses in Durango helps us achieve those. It’s a win for our ratepayers and students...”*  
– Dominic May, Energy Resource Program Architect at LPEA.



Based on avg. U.S. home energy use. Source: [U.S. Energy Information Administration](#)



# Electric School Buses are the Ideal Use Case for V2G

- Largest fleet in the U.S.
- Consistent route-based transport with known energy needs
- Parked and unused most of the time
- 95%+ are diesel today – bad for student, driver, and community health
- Reduction of ~88mm tons of carbon emissions with the electrification of the entire U.S. school bus fleet – equivalent to planting ~108 million acres of trees

Source: EPA. (1) Assumes 12-year asset life.

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# Nuvve's Dedicated K-12 Business Unit

- Launched in May, 2023
- Trusted advisor when selecting buses & testing/qualifying them with our chargers
- Experience driven with over a 100 school districts and 500+ charging stations connected to Nuvve's GIVe™ platform
- Standard V2G school buses are available with CCS plugs
- OEM integrations with Nuvve solutions
- Nuvve offers a complete V2G fleet solution:
  - Grant facilitation
  - Project management
  - Chargers
  - Installation
  - Negotiation w/Utilities
  - Financing



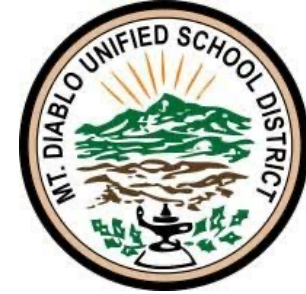
# Nuvve's Charge Management Benefits

- Vehicle Readiness
  - Ontime charge
  - Infrastructure operation and maintenance
  - Vehicle behavior monitoring
- Energy Management
  - Charging at the best cost
  - Clean energy option
  - Micro-grid integration & management
- Battery Life Optimization
  - Battery warranty extension



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# Nuvve's Extensive Electric School Bus Experience



**SIERRA SANDS**  
Unified School District  
— Engaging All Learners —



**Franklin-McKinley**  
School District  
PREPARING ALL CHILDREN AS GLOBAL LEARNERS



**BOULDER VALLEY**  
SCHOOL DISTRICT



# **CALIFORNIA EXAMPLE ELRP Program Results**

**10 Event Snapshot  
Between 17 August and 09 September 2022**





# September 2022 California Heat Wave

**“The heat wave of September 2022 was one of the most challenging events in the history of the ISO grid.”**

*-Elliot Mainzer, CAISO President and CEO*

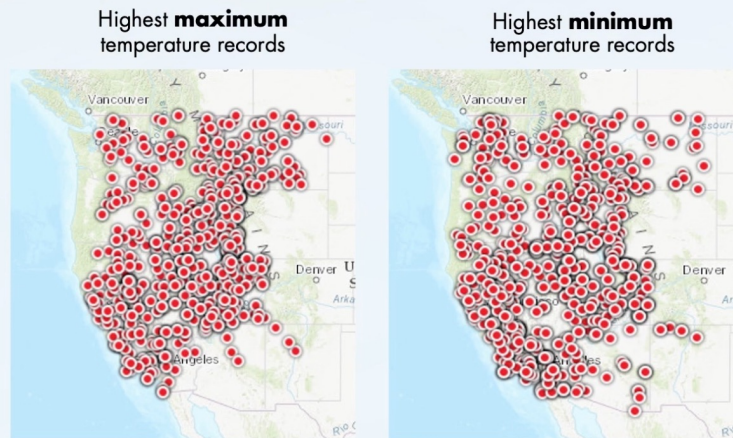
## HEAT RECORDS – SEPTEMBER 1-10

28 California cities broke or tied all-time records for maximum temperatures.

- Sacramento – 116
- San Jose – 109
- Livermore – 116

Across the West:

- 2,864 daily highest maximum temperature records tied or broken
- 2,074 daily high minimum records tied or broken

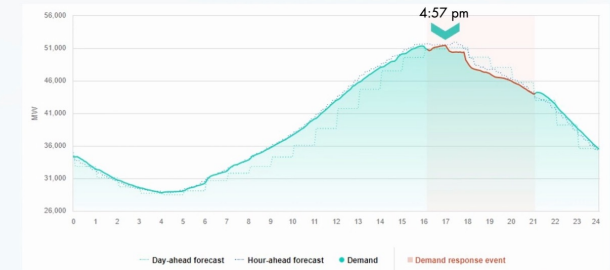


## DEMAND RECORDS FOR SEPTEMBER 6, 2022

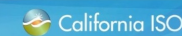
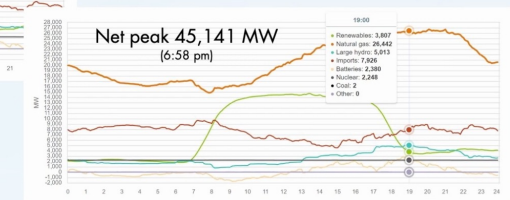
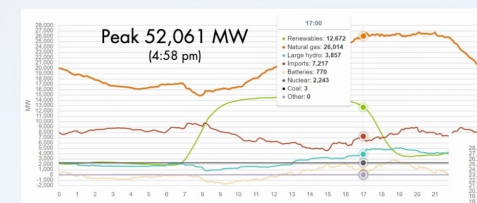
ISO all-time record  
**52,061 MW**

Western Interconnection record  
**167,500 MW**

RC West record  
**130,920 MW**



## SEPT 6 PEAK AND NET PEAK RESOURCE STACK



# Customer Host Site: Cajon Valley USD

CAJON VALLEY UNION SCHOOL DISTRICT

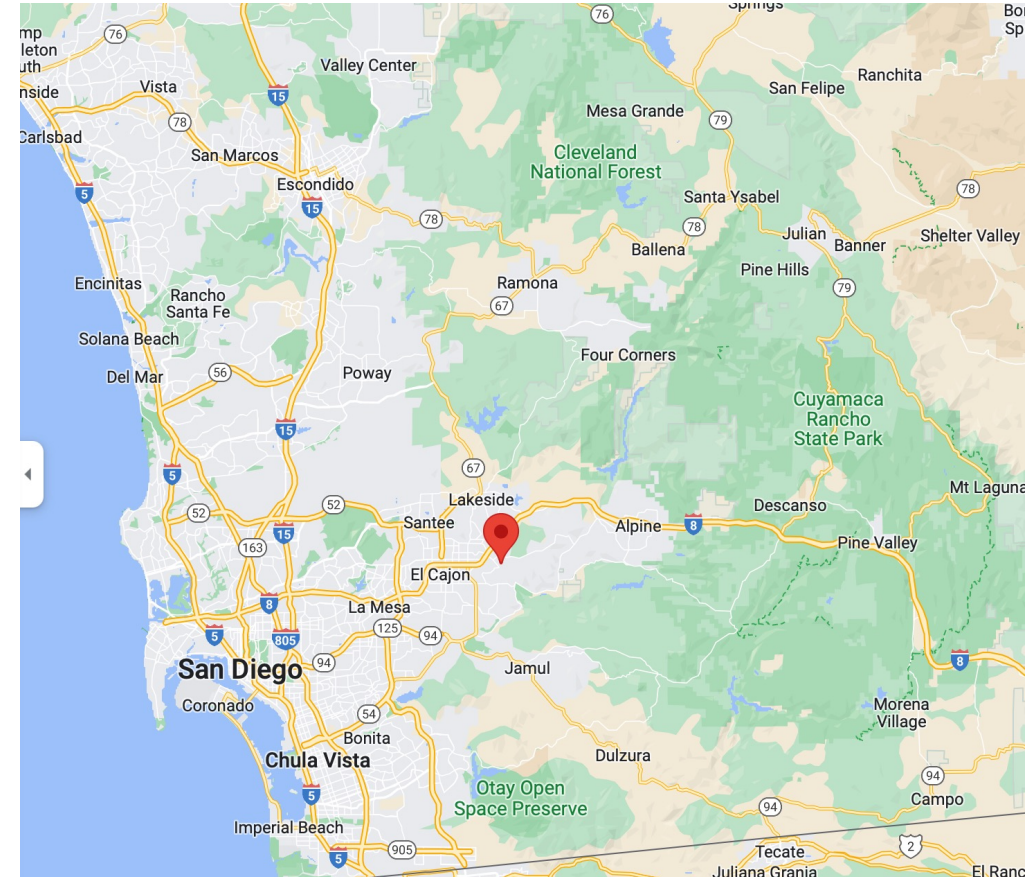
OUR SCHOOLS I WOULD LIKE TO...

About Us Leadership Departments School Information Enrollment Employment Contact Us

2022 CELEBRATION VIDEO

WATCH HERE

SCROLL DOWN



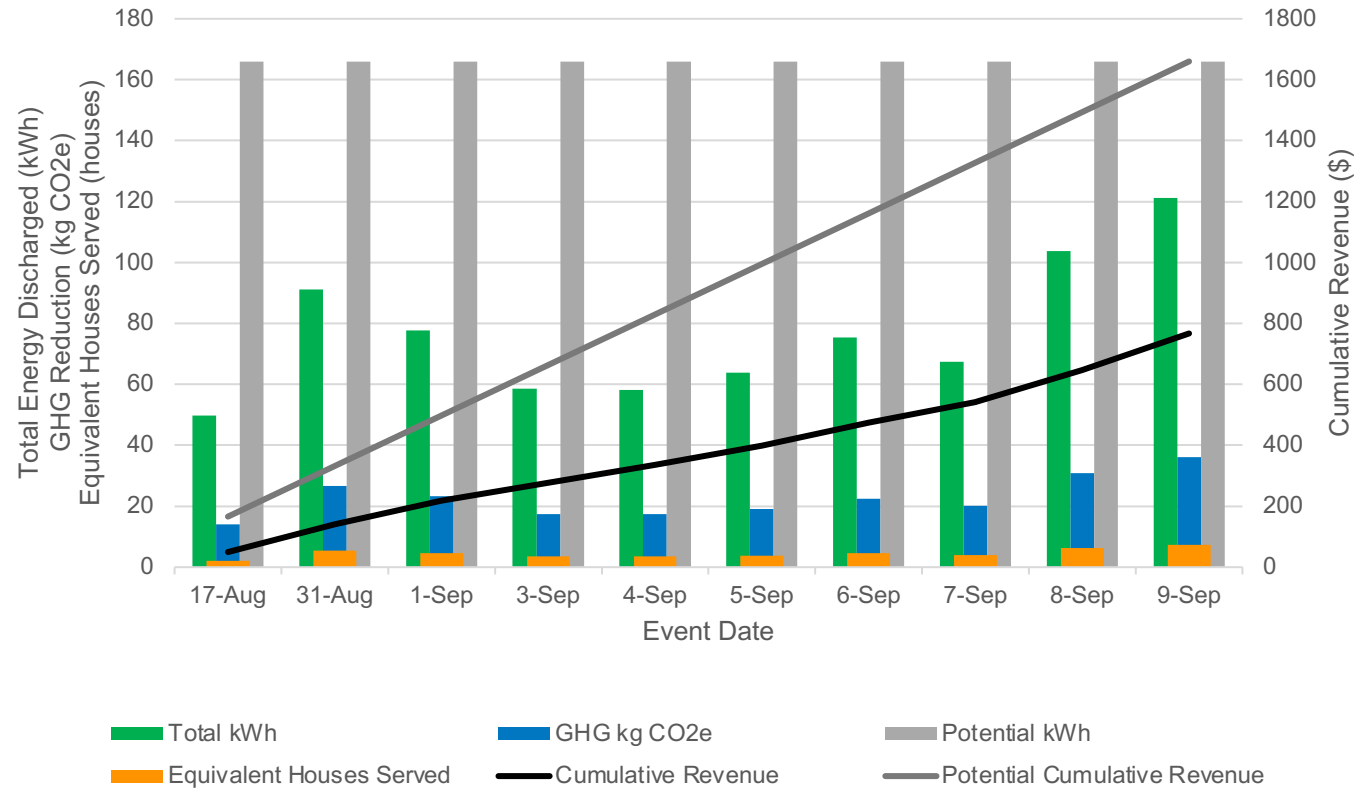
# Cajon Valley USD



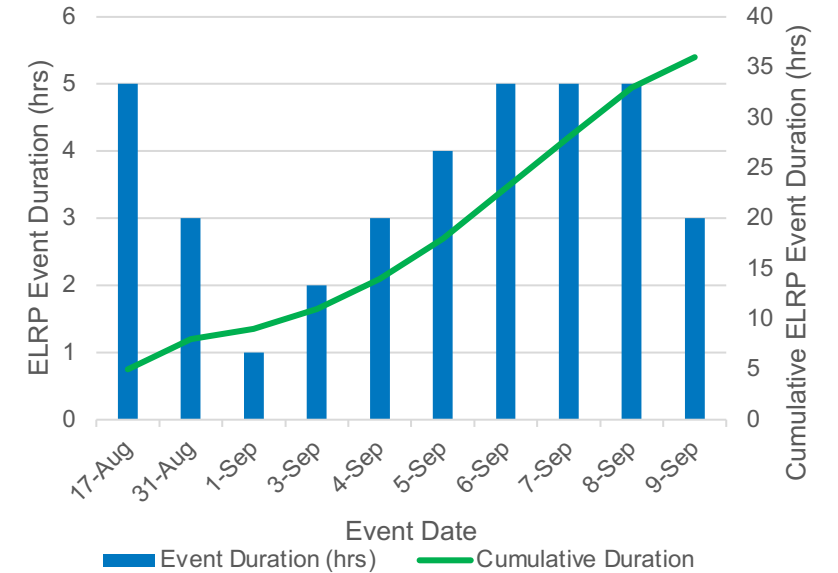
# ELRP Program Results

## 10 Events between 17 August and 09 September 2022

Total kWh Discharged per Event and Cumulative kWh



ELRP Event Duration per Event Date



# Cumulative Data

Power Discharged | 767 kWh

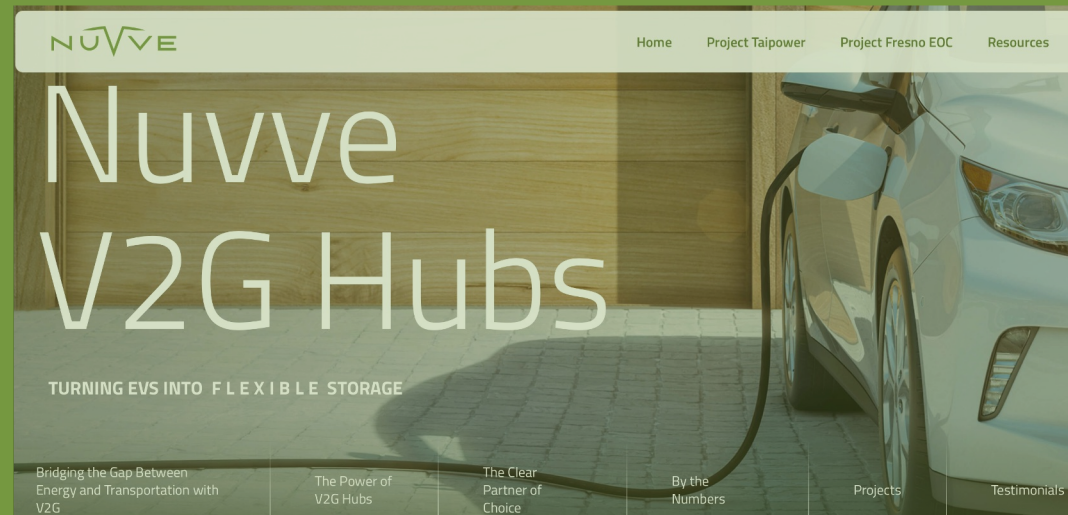
GHG Reduction | 228 kg CO<sub>2</sub>e

EQ Houses Served | 452



# V2G HUBS

[www.nuvvev2ghubs.com](http://www.nuvvev2ghubs.com)



# V2G HUB | PROJECT FRESNO EOC



## Electrifying Fresno EOC Transit Systems' 50-Shuttle Fleet

In January 2024, Nuvve won a \$16M contract with the Fresno Economic Opportunities Commission to support Fresno's vision of a greener future and enhance the overall reliability and effectiveness of its transportation services.

## At A Glance

50

Electric Class A shuttles being deployed at a rate of 10 per year over five years

2.5MW

On-site solar generation and battery energy storage system being installed

## State of the Art Micro-Grid

Fully offsets 12MW/1MWH combined vehicle and kitchen energy usage

## About Fresno EOC

Fresno EOC oversees more than 35 human services programs to help underserved populations in California's Fresno County become more self-sufficient. It uses its bus fleet to transport community members to and from work, school and medical appointments, deliver meals, and fill other transportation needs to support its mission.



# Nuvve's reach & V2G interest continues to grow!

- New Mexico
- California
- New York
- New Hampshire
- Massachusetts
- New Jersey
- Nevada
- Texas
- Colorado
- Arizona
- And many, many more...



*Strong engagement and interest with Schools, Utilities and Government in New Mexico*



Nuvve's 1<sup>st</sup> NM Electric School Bus Deployment

- School Districts
- Utilities
- Government

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# KEY TAKE-AWAYS

1. V2G is a Critical Technology in the Energy Transition
2. Nuve is the V2G Pioneer in Scaling Mode Worldwide
3. Nuve is Engaged in New Mexico
  - ✓ In-State Deployments
  - ✓ Growing Customer Base
  - ✓ Meeting with Key Stakeholders



# NEXT STEPS

- Webinars
- 1-on-1 Consultations
- Virtual Platform Demo
- Onsite Demonstrations
- Provide Customer References



**THANK YOU**



[NUVVE.COM](http://NUVVE.COM)

# APPENDIX



### Revenue Streams

#### 1. PRODUCT + SUBSCRIPTION

1. Customer buys a charger from Nuvve
2. Customer buys installation from a 3<sup>rd</sup> party

#### 2. ENERGY AS A SERVICE

Customer leases a charger from Nuvve and procures installation from a 3<sup>rd</sup> party, managed by Nuvve

#### 3. ENERGY MANAGEMENT

1. Management software included
2. Energy to drive included
3. Charger lifetime (7 years) warranty and maintenance included
4. Company retains 100% from grid services in the future
5. Discount on overall package
6. Individually priced (cost per mile)



#### Charging Station & GIVe™ Subscription Revenue

•White labeled from EVSE partners integrated with Nuvve software



#### Grid Services Revenue

•Agreements with customers and/or directly with utilities for % share of revenue earned through grid services



#### Energy-as-a-Service Revenue

•All-in-one electrification solution for a flat monthly fee

### Products & Services

# Total Cost of Ownership | Illustrative Economics

## Illustrative Cost of Ownership for One School Bus



	Diesel	V2G Electric	
Vehicle	\$125,000	\$375,000	
EVSE (charging stations)	-	\$50,000	
EVSE installation	-	\$10,000	
<b>Total Capex</b>	<b>\$125,000</b>	<b>\$435,000</b>	Higher up-front cost for electric, driven by higher bus price and infrastructure.
Maintenance	\$10,000	\$2,000	
Fuel Cost	\$8,125	\$2,074	
<b>Total Annual OpEx</b>	<b>\$18,125</b>	<b>\$4,074</b>	Lower operating expenses, resulting from reduced fuel and maintenance costs
Lifetime OpEx	\$217,500	\$48,882	
Annual V2G Value	-	\$23,802	
Net Annual V2G Value	-	\$16,661	Revenues from V2G services lower the TCO over the vehicle's lifetime
Lifetime V2G Value <sup>(1)</sup>	-	\$199,237	
<b>Net Lifetime Total Cost</b>	<b>\$342,500</b>	<b>\$283,945</b>	
<b>Operating Cost per mile</b>	<b>\$2.20</b>	<b>\$1.82</b>	Lower operating cost/mile resulting from benefits of V2G revenues and low OpEx

(1) Assumes 12-year vehicle life

# Nuvve's North American Charging Options

## AC Charging: Nuvve PowerPort

Level 2 EVSE

80 amps for 19.2kW max power

UL certified

Energy Star certified

Dual-mount pedestal available

Input voltage: 240V/1Ø

Smart charging



EVSE-B-P1-H1

## DC Charging: Nuvve V2G Fast Charger

V2G capable with specific EV models

CCS1 connector

60kW or 125kW charge and discharge power levels

UL1741-SA certified for California (Rule 21) interconnection

Input voltage: 480V/3Ø



RES-HD60-V2G

# Nuvve's Fleet Management Tools

---

Monitor and control your electric vehicle fleet

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Check charge levels for each vehicle

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Schedule trips

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Trigger emergency charges

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View and generate reports on your fleet's charging history\*

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Customize your dashboard for your monitoring needs\*

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Available for desktop and as a mobile app

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*“We’re excited to be working with Nuvve because they were an early advocate for school bus electrification and worked hard to find solutions to problems that no one had addressed before.”*  
– Tysen Brodwolf, Director of Transportation, Cajon Valley Union School District

\*Only available in desktop application



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# Programs & Resources



## Grant Writing

Dedicated Nuvve team member supports grant/funding applications



## Project Management

Manager assigned to each DCFC deployment customer



## Sourcewell

Satisfy the RFP process  
Free to become a member

Sourcewell 

Awarded Contract

Contract #042221-NUV





# We Go the Extra Mile

*Nuvve's Grants and Fundraising Team is your team*

## Pre-Application Phase

- Analysis of custom fundraising needs
- Research and development
- Monitoring of funding options and policy throughout North America
- Grant training workshops for your team

## Application Phase

- Grant project management
- Application writing
- Budget preparation
- Application submission

## Post-Application Phase

- Stewardship of relationships
- Monitoring of award announcements

# Nuvve Project Management Services

From establishing project scope to supporting day-to-day operations, the Nuvve Project Management Team is your expert guide in electrifying your fleet.

Identifies current client needs while anticipating future growth capacity



Directs and manages EVSE installation and commissioning



Coordinates utility work and implements available incentive programs

Ensures necessary maintenance and employs data collection for grid service revenue generation

# Installation and Commissioning

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Monitor construction and coordinate scope changes as necessary

---

Manage routine communications with all necessary stakeholders

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Partner with nationwide EPC firms and provide active management

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Configure installed chargers to client specific needs

---

Provide remote operational training and documentation

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# Nuvve Customer Testimonials



*"The support and the communication between working with yourself, Rawah, and then all your support staff have been really great. Anytime I've had any questions, not really issues, just questions, it was, "here you go, here's this, here's this."*

*"Who do we go with? Go with Nuvve. They're there for you."*

**Keith Kimbrough**  
Nuvve Customer, Martinsville



*"The Nuvve people took me around, showed me different hands-on, real-life situations, not pamphlets, not a sales pitch, but real-life, the product out in the world, working and operating the way it should. That made a world of difference for the direction we decided to take."*

*"Ever since I've connected with Nuvve through their sales department on down to customer service after it's just complete follow through. I can't imagine. I mean, I feel like Nuvve has just set the bar so high for the other companies that I don't know how they're going to compete."*

**Ken Martinez**  
Nuvve Customer, Salt Lake City



*"Actually, I don't really think about the V2G technology. When my workday starts, the car battery is charged to around 80 percent which is a perfect level for me."*

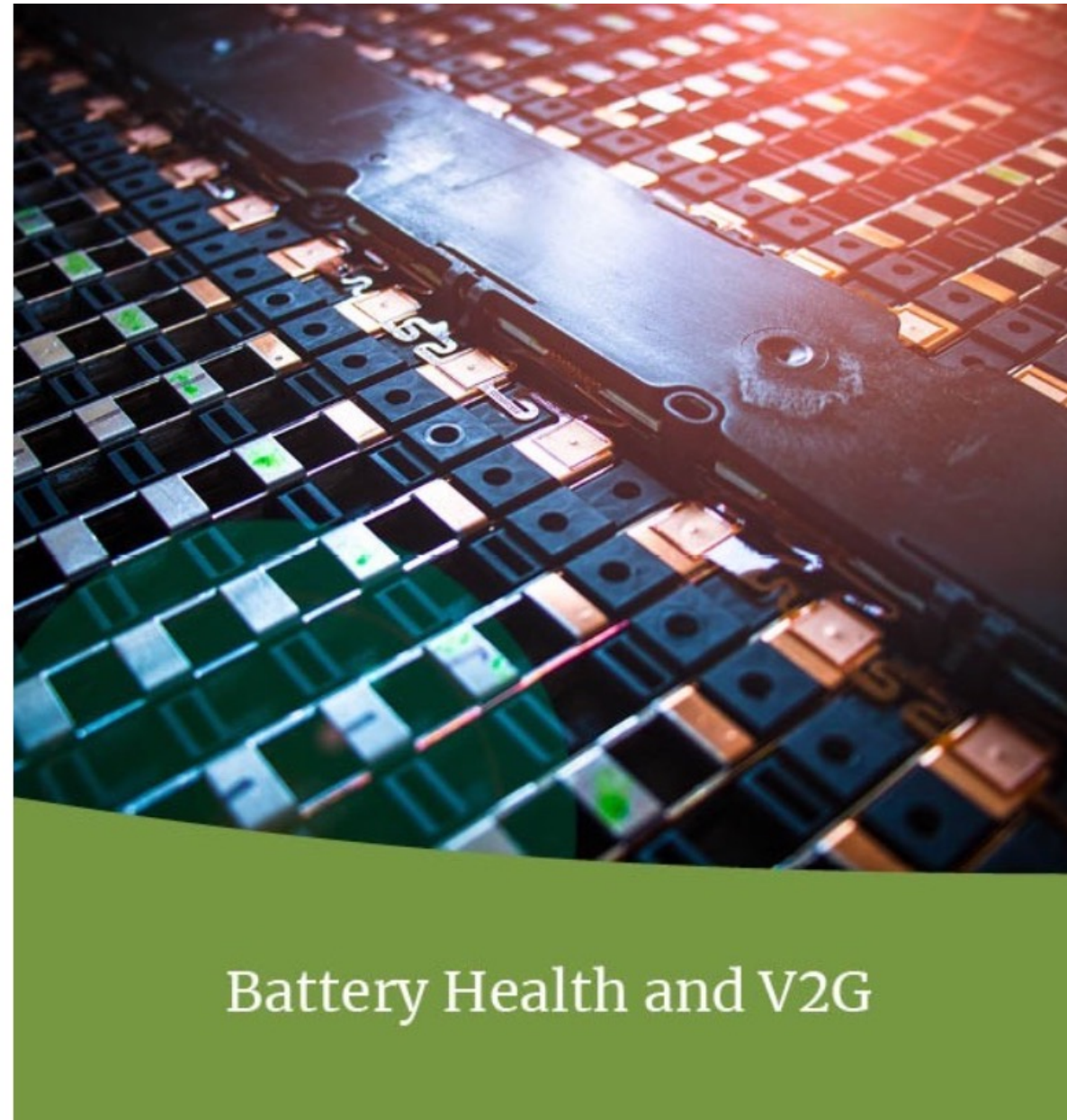
*"I have never experienced running out of electricity and it gives me a great sense of security that I can always give Nuvve a call."*

**Thomas Wester-Andersen**  
Nuvve Customer, Copenhagen

[Nuvve Customer Testimonials - https://nuvve.com/customer-stories/](https://nuvve.com/customer-stories/)  
[Nuvve HUB Customer Feedback - https://www.nuvvev2ghubs.com/#testimonials](https://www.nuvvev2ghubs.com/#testimonials)

# BATTERY HEALTH PAPER

- Learn about the factors that affect EV battery health and how intelligent energy management can help improve it
- Download the paper at [nuve.com/battery-health](https://nuve.com/battery-health)



Battery Health and V2G

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# V2G & Battery Health

## V2G has minimal impact on the battery

- Main factors that impact capacity are driving and age (calendar life)
- Studies show small percentage impact from V2G

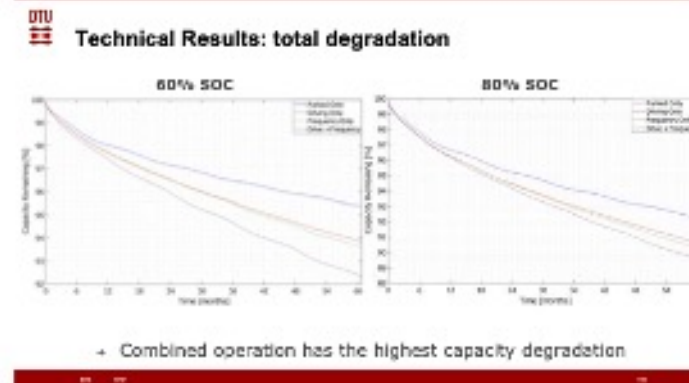
2% impact over 8 years



"Deployment of Vehicle-to-Grid Technology and Related Issues" 2016  
SAE Research Paper: Satoru Shinzaki, Hakaru Sadano, and Yutaka Maruyama, Honda R&D Co., Ltd

<https://www.sae.org/publications/technical-papers/content/2015-01-0306/>

1-2% impact over 5 years



"Techno-economic characterization of EV battery considering degradation" 2019 Lisa Calearo, PhD Student, Center for Electric Power and Energy DTU Risø Campus

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