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SUSTAINABLE FLEET TECHNOLOGY

WEBINAR SERIES 2022

Session #6: The Economic Value Propositions for Bi-Directional Charging

July 21, 2022

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Format

- Q&A at the end
- Submit questions and comments to “Panelists”
- Scheduled for 2:00p-3:00p
- Handout
- Recording

The Economic Value Propositions for Bi-Directional Charging July 21, 2022

2:00-2:05 **Rick Sapienza, NCCETC**--Introduction and Welcome

2:05-2:16 **Joachim Lohse, Ampcontrol**—V2G/V2X Overview

2:16-2:27 **Katherine Stainken, The Electrification Coalition**—Use Cases and Catalysts for Success

2:27-2:38 **Colin Steers, Fermata Energy**—Unlocking Value Streams in Battery Electric Vehicles: Product Updates and Results

2:38-2:49 **Erwin Osterroth, City of Medicine Hat, AB Canada**—Bi-directional Electric Vehicles Municipal Perspective

2:49-? **Q&A**

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Rick Sapienza
resapienza@ncsu.edu
919-515-2788

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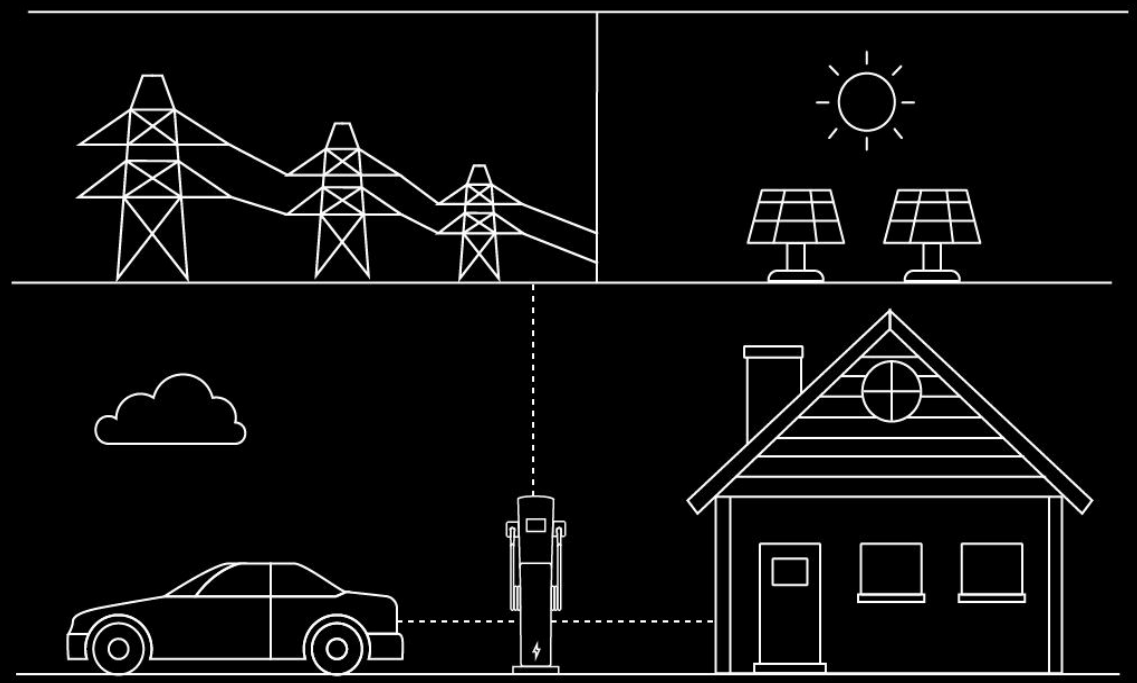
Joachim Lohse

CEO & Founder of Ampcontrol

Before Ampcontrol, Joachim was an energy consultant at PwC and worked with energy companies and utilities on energy transition strategies. Joachim also worked for global companies such as Siemens and Mercedes-Benz.

Bi-directional charging: V2G and V2X

Joachim Lohse, CEO of Ampcontrol.io
contact@ampcontrol.io



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The Problem

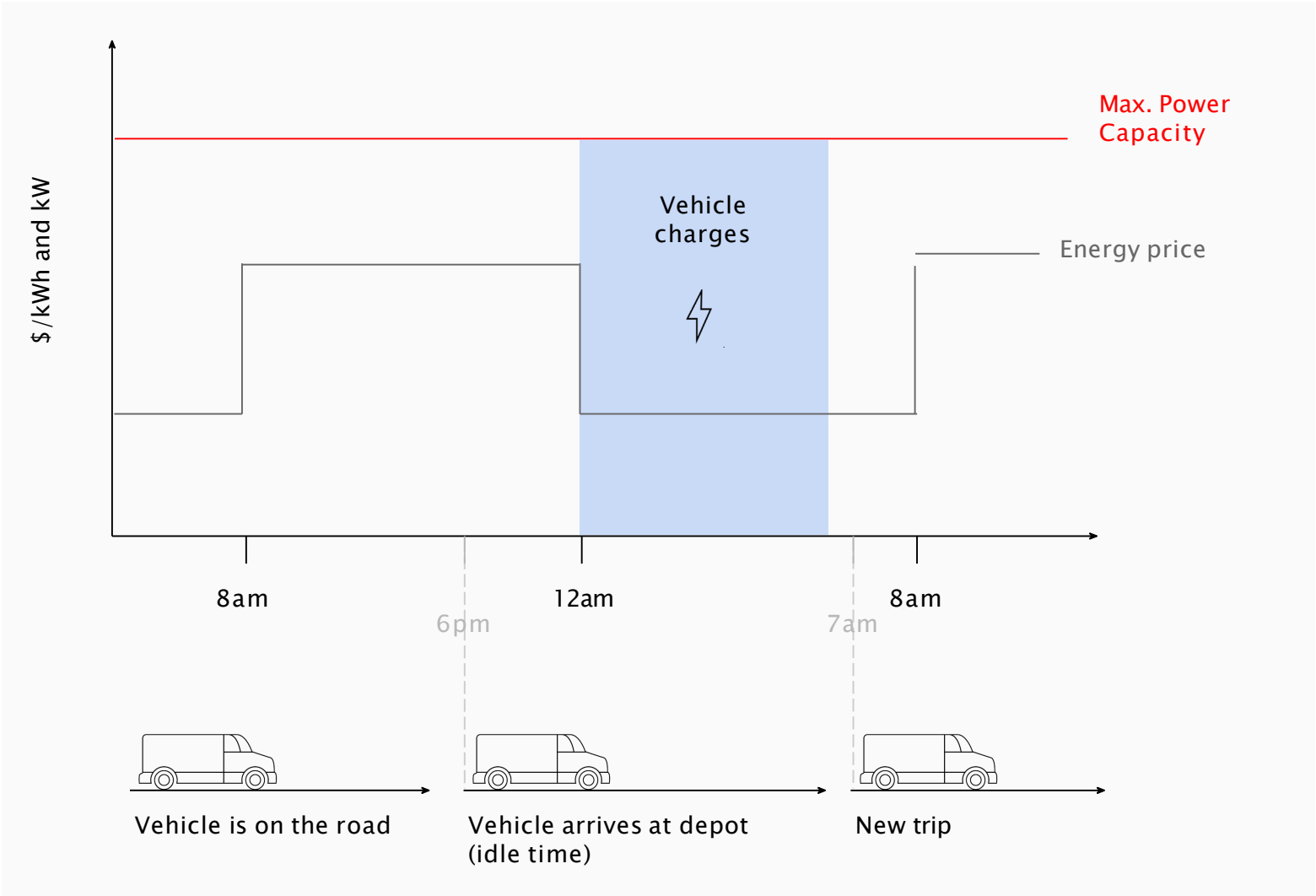
Electrification of fleets is expensive and unreliable when done wrong.

Power Demands

High energy costs

High charger downtime

What is Smart Charging or V1G



Simplified Use Case

1. The vehicle arrives at 6 pm at the depot center, with a planned departure of 7 am.
2. Instead of charging immediately, the vehicle starts charging at midnight, when energy prices drop.
3. By 6.30 am, the vehicle is fully charged and ready for departure.

Objectives

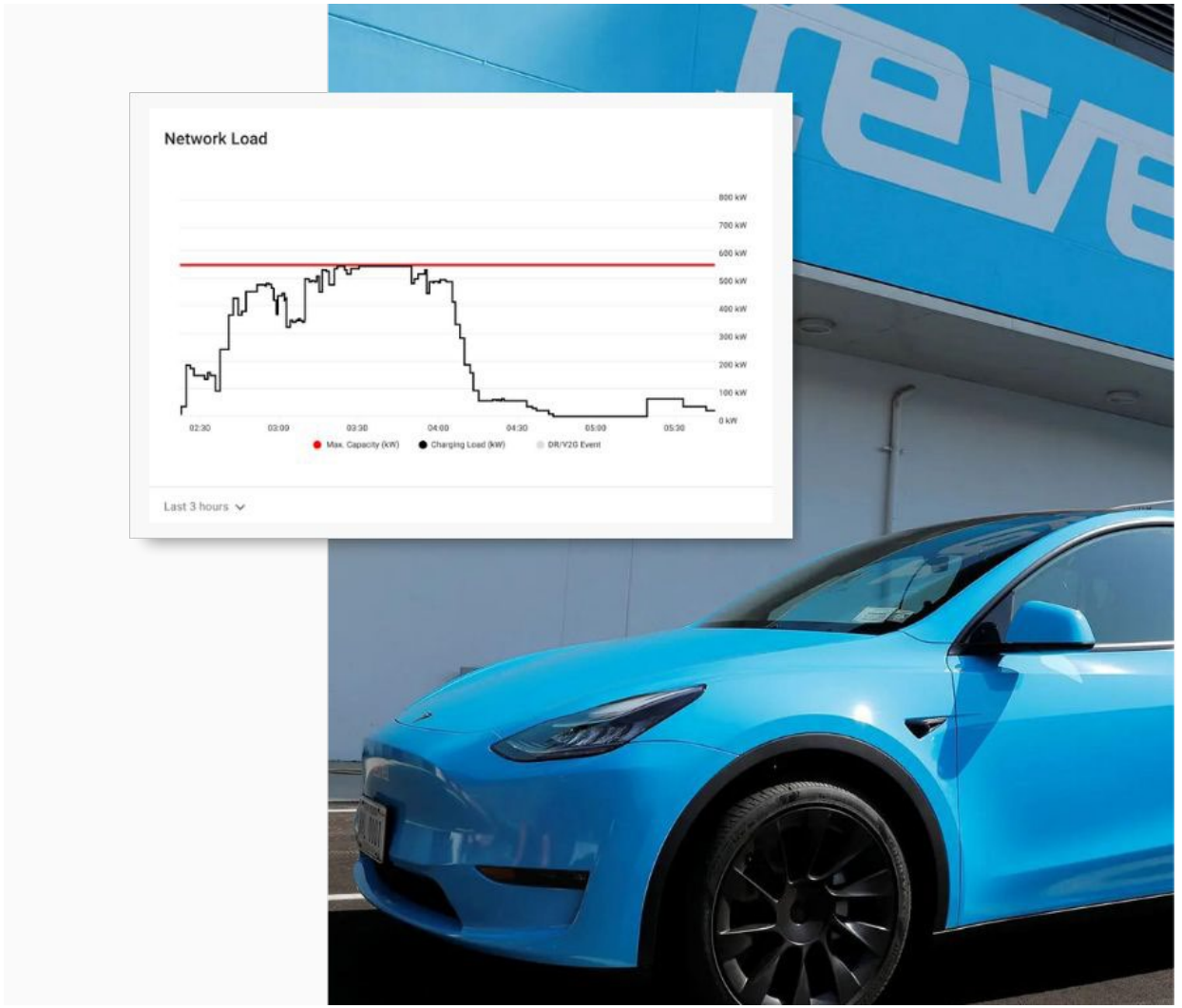
1. Avoid peak load at depot
2. On-time departure of vehicle
3. Reduce energy costs

Benefits of Smart Charging

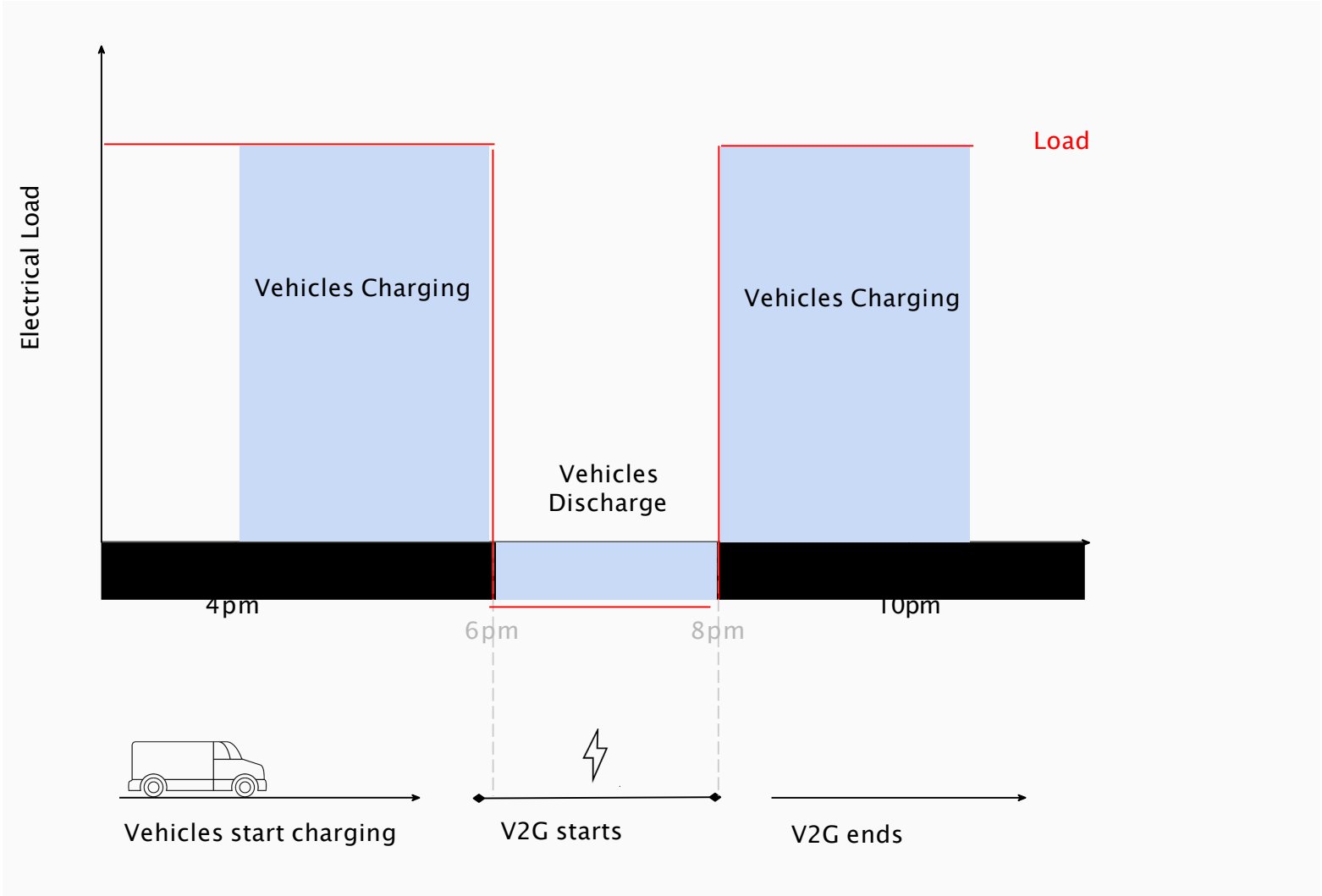
Identify hardware or system errors

Reduce peak power and high energy prices

Ensure on-time departure



What is V2G



Use Case

1. A V2G signal is received
2. The signal informs the site how much load to discharge, during what times
3. Once the event is over, charging resumes to normal

Objectives

1. Respond to V2G Events
2. Signal + Reaction is automatic
3. Ensures fleet operations before considering any V2G

Benefits of V2G

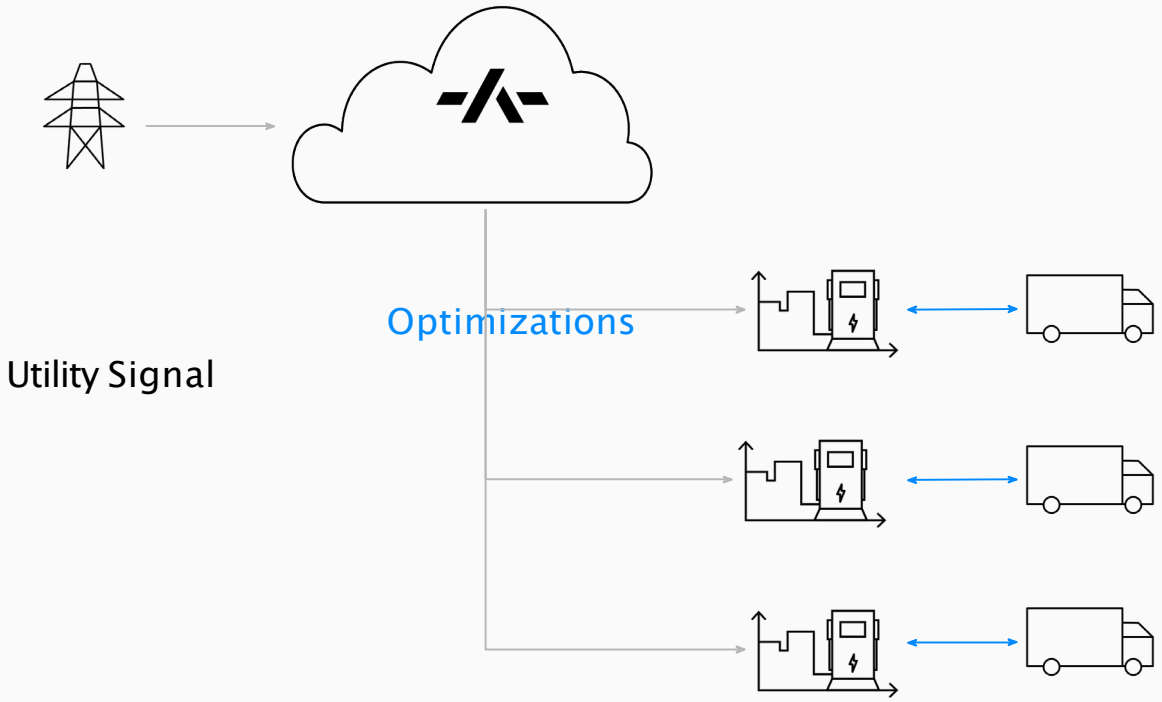
Respond to utility event

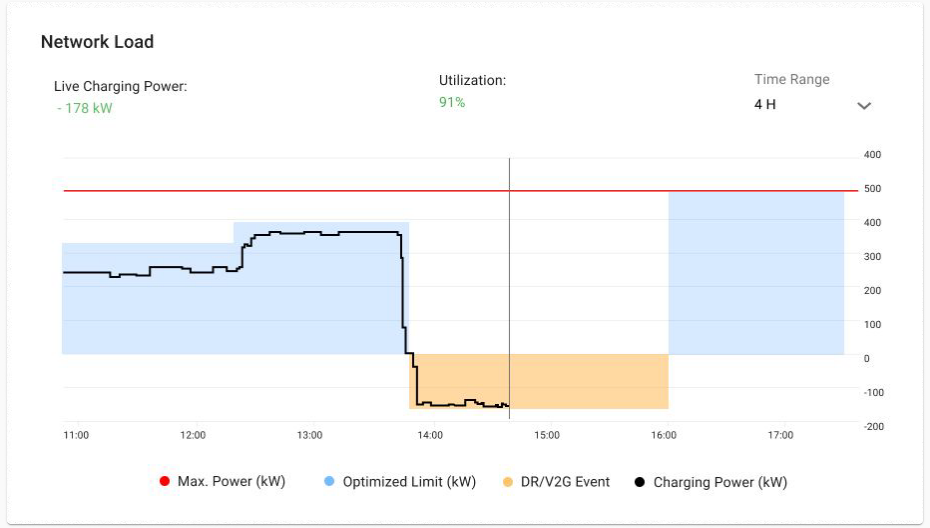
Generate additional revenue

Use vehicle as energy storage

The Solution

EV fleet operators control their EV chargers by making automatic charging and discharging decisions (V2G). The software will ensure uptime, on-time departure and reduce total costs of ownership (TCO)





Financial Benefits of V2G

"If you use a 15 kW charger, you could receive approximately $2,520 per year by providing V2G capability."

Potential annual revenue

School bus: $17,384

Transit bus: $6,170

Sources: NREL, Department of Defense

Challenges in V2G projects

Limited availability V2G capable chargers and vehicles

Utility programs only implemented in pilots

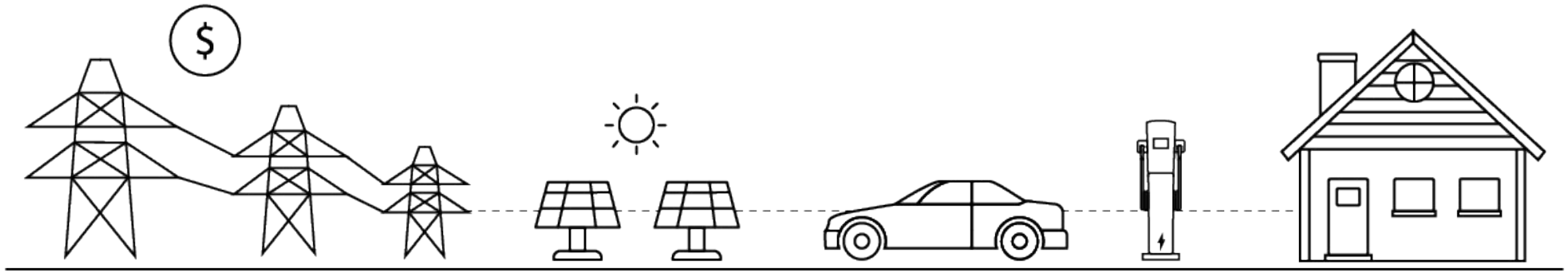
Urgent fleet charging problems are uptime and cost reduction

Key Takeaways

V2G helps utilities to optimize the grid

V2G generates additional revenue for owners

Owners can use vehicle as energy storage



Myth: V2G destroys my EV battery

Charging and discharging vehicles impact the lifetime of batteries, but as long as V2G events happen only a few times per month, the impact in minimal. Fast charging on highways are harming batteries much more.

www.ampcontrol.io

Contact us: contact@ampcontrol.io

Electrification Coalition

Katherine Stainken
kstainken@electrificationcoalition.org
908-229-7837

- Vice President of Policy at the Electrification Coalition
- Leads and manages the policy team at the EC, which is focused on transitioning our transportation sector to be electric
- Previous positions as Policy Director at Plug-In America, Director of Government Affairs at the Solar Energy Industries Association
- Masters degree from American University in Global Environmental Policy and Bachelors degree in Chemistry and German from Boston College
- Fulbright and ThinkSwiss Scholar

The Economic Value Propositions to Make the Business Case for Bi-Directional Charging: Use Cases and Catalysts for Success

July 21, 2022

Electrification Coalition

Katherine Stainken
VP, Policy

EV Adoption Programs Around the U.S.

The **Electrification Coalition** is a nonpartisan, not-for-profit group committed to promoting policies and actions that facilitate the deployment of electric vehicles on a mass scale.

Technical Lead
Climate Mayors EV Purchasing Collaborative

State EV Policy Accelerator
NV, MI, PA, VA, NC, GA, FL, IL and more

Electrification Advisor
Bloomberg American Cities Climate Challenge

Lead Electrification Partner
Smart Columbus

Project Lead
Drive Electric Northern Colorado
Drive Electric Orlando

Pilot Program Leader
Freight and Goods Delivery Electrification

Electrification Coalition

ECBC Partners

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AMPLY
FLEET CHARGING SIMPLIFIED

ARRIVAL

COX AUTOMOTIVE

EVgo

FedEx

Ford

gm

KIA

PROTERRA

PARSONS

Rhombus
Energy Solutions

RIVIAN

ROUSH
CLEANTECH

Sourcewell

Uber

VOLVO
VOLVO GROUP

Electrification
Coalition

To cover in 10 mins…

1. VGI vs. V2G
2. Use Cases
3. V2G Case Studies
4. Policies Needed for Success

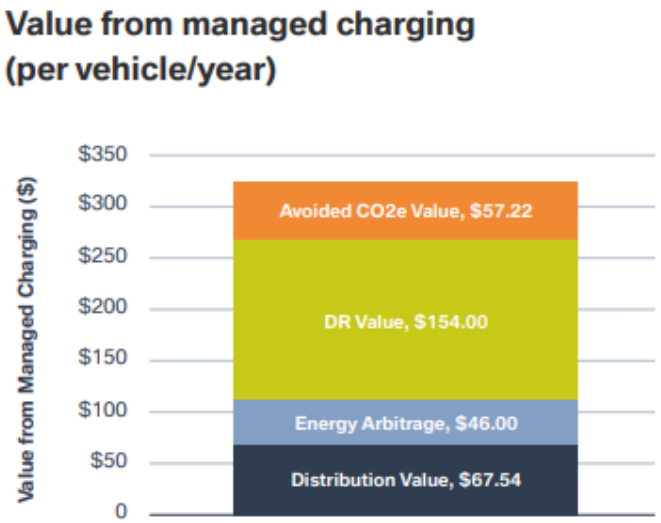
VGI vs. V2G

- Vehicle Grid Integration (VGI) vs. Vehicle-to-Grid (V2G)

***VGI definition**: Any method of altering the time, charging level, or location at which grid-connected EVs charge or discharge, in a manner that optimizes plug-in EV interaction with the electrical grid and provides net benefits to ratepayers by doing any of the following:*

  - *(a) increasing electrical grid asset utilization;*
  - *(b) avoiding otherwise necessary distribution infrastructure upgrades;*
  - *(c) integrating renewable energy resources;*
  - *(d) reducing the cost of electricity supply; and*
  - *(e) offering reliability services.*

***V2G definition**: Two-way, or bidirectional, charging and discharging between EVs and the grid. This enables "vehicles to discharge stored power back onto the grid or into a building or local power system," particularly in times of need, such as a natural disaster or other grid outage situation.*



Source: BMW Charge Forward, https://bmwmovement.org/wp-content/uploads/2020/07/BMW-ChargeForward-Report-R4-070620-ONLINE.pdf

- BMW i3 and PG&E 2017 demand response "ChargeForward" pilot: $325 in grid savings/ vehicle, annually
- California VGI Working group
  - 320 use cases across MHD, light-duty, single-family home, Multi-unit dwelling, commercial, rideshare

Use Cases

- **V2G use cases**:
  - Disaster response: mobile power units to homes, buildings, shelters
  - Grid Services:
    - Support load management for utilities – planned events
    - Support other grid services for utilities – unplanned events, i.e. peak shaving
  - Vehicle to vehicle
  - Climate resiliency, emergency response: back-up for outages
- Legislation: Delaware law defines EVs with V2G as “Grid integrated vehicles”, EVs with V2G receive $ back at the rate they’re charging, interconnection process
- Utility Commissions and ongoing regulatory discussions: California, Michigan, Minnesota, New York, North Carolina, South Carolina, and Virginia.

V2G Case Studies

1. **NC**: Roanoke Electric Cooperative and Fermata Energy - V2G pilot in North Carolina with a Nissan LEAF vehicle and Fermata Energy's bidirectional charger = $2,600 annually
2. **MA**: Highland Electric school bus, built by Thomas and powered by a Proterra battery system -deployed by National Grid for a V2G pilot in Beverly, Massachusetts to help reduce peak demand = over 50 hours provided 3 MWh back (could power 100 homes)
3. **CO**: La Plata Energy Association, Blue Bird and Nuvve - V2G electric school bus projects to help reduce peak demand and reduce overall total cost of ownership for the Durango School District.

Photo credit: Fermata Energy

Photo credit: Proterra

Policies Needed for Success

- SAFE-EC report released June 2022
- Barriers:
  - Insufficient awareness
  - Lack of coordination among key stakeholders
  - Upfront cost for V2G capabilities on top of EVSE costs and unsure of ROI for grid services
  - Absence of uniform national technical standards
  - Concerns on charging and discharging EV batteries for grid services degrading the batteries
  - Concerns on overall impacts of EVs on the grid
  - Treatment of and compensation for services provided by mobile energy storage units
  - Lack of a larger body of data and pilot project results
  - Policy and regulatory challenges similar to those encountered with stationary energy storage

Federal Policies Needed for Success

1. Congress: Extend and expand the Section 30C Alt. Fuel Refueling Property tax credit to include V2G capabilities.
2. Agencies: Incorporate V2G capabilities into FEMA procedures for emergency planning, preparedness, and response efforts for resilience purposes.
3. Agencies: Develop a national V2G Roadmap.
4. National labs, agencies: Facilitate the development and implementation of uniform national V2G-related technical standards.
5. National labs: Conduct research and testing to ascertain the potential impacts of bidirectional charging on battery degradation and warranties.

Photo credit: Nuuve

State & Local, RTO Policies Needed for Success

State & Local

1. Incentivize V2G deployment in EVSE rebate programs.
2. Streamline interconnection standards.
3. Design or apply appropriate utility rate structures to compensate V2G capabilities.
4. Conduct demonstrations, share lessons learned and best practices, and scale V2G technology.

Regional Transmission Organizations (RTOs)

1. Develop or implement roadmaps that fully incorporate EV and V2G capabilities.
2. Develop or revise RTO requirements to include V2G for grid services in wholesale markets.
3. Conduct V2G grid impact studies and disseminate results broadly.

Thank you!

Katherine Stainken
VP, Policy
kstainken@electrificationcoalition.org

ElectrificationCoalition.org

Electrification Coalition

1111 19TH STREET NW
SUITE 406
WASHINGTON, DC 20036

TEL: 202-461-2360
FAX: 202-318-8934
ELECTRIFICATIONCOALITION.ORG

Colin Steers
colin@fermataenergy.com
434-825-2384

- Director of Customer Experience at Fermata Energy
- Joined Fermata in 2016
- Develops revenue streams for V2X applications, works with and onboards V2X customers and partners, and manages active projects and real-time operations
- Activities contribute to Fermata’s goal of accelerating the adoption of EVs and accelerating the transition to a renewable energy future
- Master's in Systems Engineering from University of Virginia

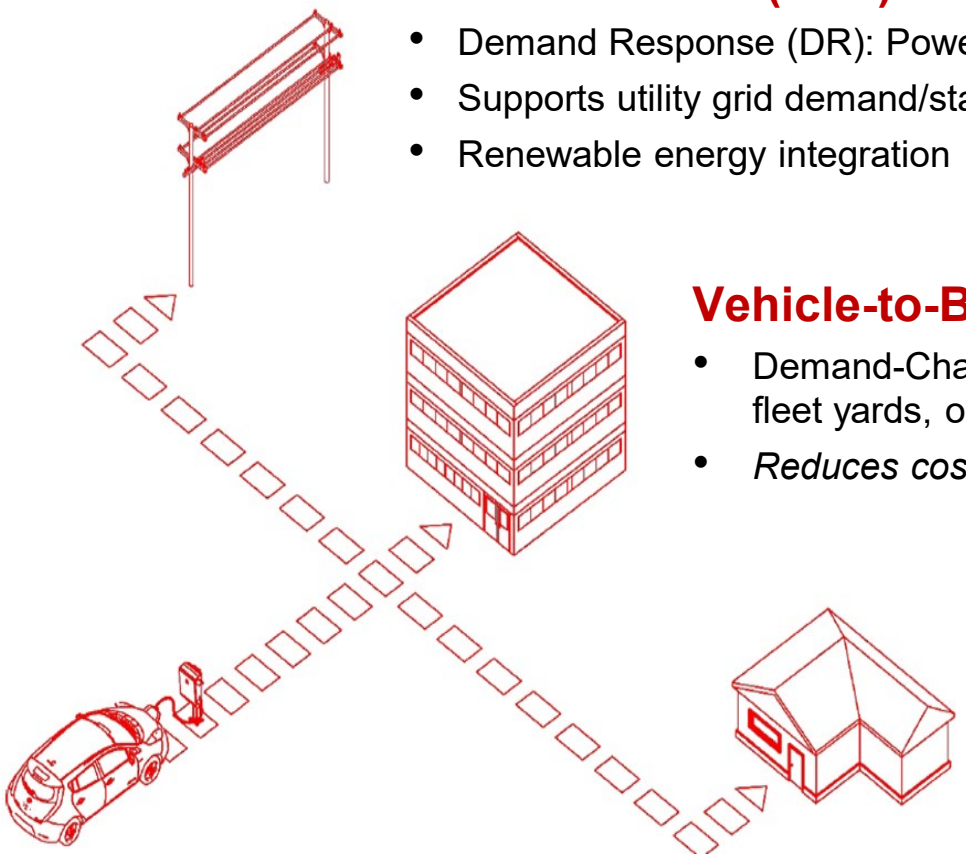
FERMATA ENERGY

Unlocking Value Streams in Battery Electric Vehicles: Projects and Performance Updates

Fermata Energy's Vehicle-to-Everything (V2X) Bidirectional Charging Technology

V2X Technology Overview

V2X bidirectional charging leverages energy from a parked EV to power offboard loads.



Vehicle-to-Grid (V2G)

- Demand Response (DR): Power exported to grid (“in front of meter”)
- Supports utility grid demand/stability, generates revenue for EV owner *Reduces EV TCO*
- Renewable energy integration

Vehicle-to-Building (V2B)

- Demand-Charge Management (DCM): Targets peak loads in buildings, EV fleet yards, or industrial operations (“behind-the-meter”)
- *Reduces costly “demand charges” and supports grid stability*

Vehicle-to-Home (V2H)

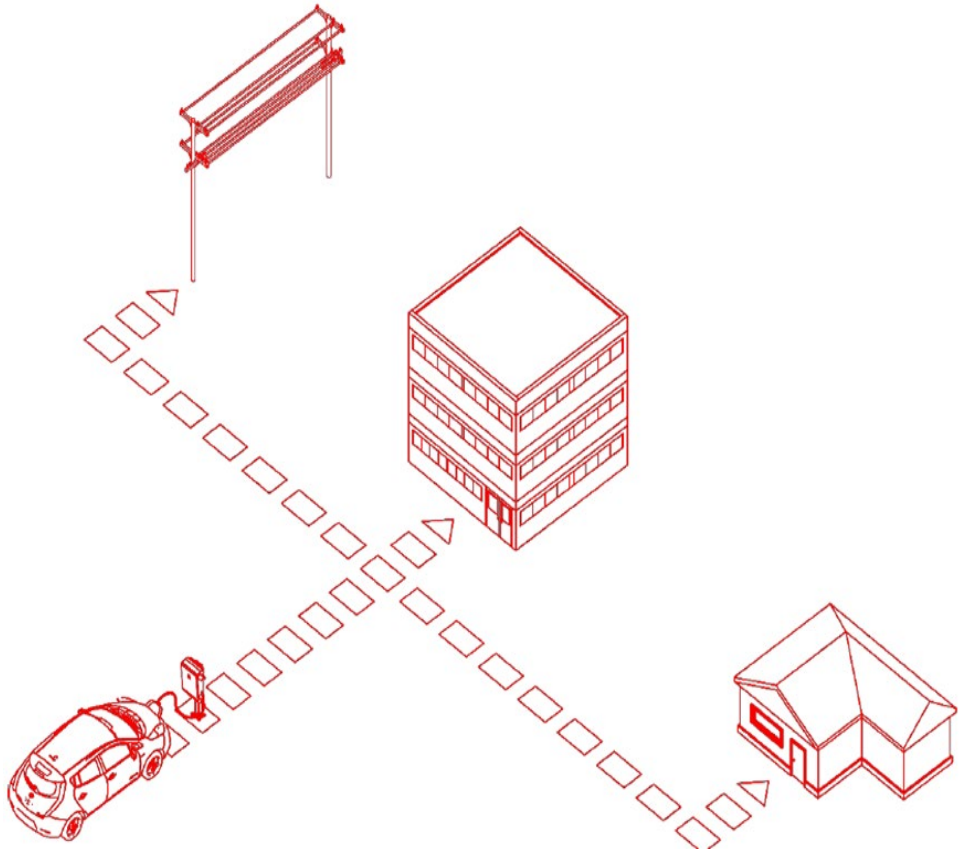
- Residential emergency backup power
- Renewable energy integration
- Supports grid demand and stability

Fermata Energy is operating **commercial V2B and V2G** at multiple customer sites across the U.S.

Fermata Energy will be releasing a **grid-tied V2H solution.**

V2X Technology Overview

What's needed to make V2X happen: 3 Key Pieces



1. Bidirectional Software

FERMATA ENERGY

2. Bidirectional Charger

FERMATA ENERGY

+

Others (L/M/H Duty)

3. Bidirectionally Capable EV

Fermata Energy's V2X Commercial Deployments

- Verified commercial V2X operations at multiple sites across the U.S.
  - Utilities
  - Municipalities
  - Private Deployments
  - OEMs

- Initial light-duty EV focus, but also working with multiple medium- and heavy-duty OEMs

Fermata Energy V2X Projects Sites Across The U.S.

V2G + V2B Deployment (Rhode Island)

Nissan LEAF earns $4,500+ in Fermata Energy V2X pilot

"The electric vehicle and charger delivered power for 57 peak hours this summer when demand was at its highest," said John Isberg, Vice President of Customer Sales and Solutions at ***National Grid****.*

"These results help to give us confidence that ***electric vehicles can be a reliable partner in providing a clean and resilient electricity grid*** *for the future."*

<u>Results achieved with</u>

<u>One</u> Nissan LEAF (62 kWh) + <u>One</u> FE-15 15kW bidirectional charger

Controlled by Fermata Energy's proprietary V2X software

Note: Savings are scalable with greater energy and power.

Note: Total = $4,547.05 (4-month DR = $4,325 + DCM = $222.05)
Source https://twitter.com/FermataEnergy/status/1521849756468850690?cxt=HHwWhMC5_cqS2Z4qAAAA

V2B Deployment (Boulder, CO)

V2B Technology Saves Over $4,000 With Nissan LEAF

*In 17 months of successful usage, [the City of] Boulder has **saved $4,462.15, an average savings of almost $270 per month** — or, approximately **equal to the monthly payment for many popular EVs**, such as the **Nissan LEAF**.*

<u>Results achieved with</u>

<u>One</u> Nissan LEAF (62 kWh) + <u>One</u> FE-15 15kW bidirectional charger

Controlled by Fermata Energy's proprietary V2X software

Note: Savings are scalable with greater energy and power.

Original source: https://www.fermataenergy.com/news-press/fermata-energys-vehicle-to-everything-v2x-technology-lowers-energy-costs-and-increases-renewable-energy-use-for-the-city-of-boulder-colorado

FERMATA ENERGY

Thank you.

For more information, please visit

www.fermataenergy.com

or contact

Colin Steers
Director of Customer Experience
Fermata Energy
colin@fermataenergy.com

Erwin Osterroth
osterwin@gmail.com
(403) 999-6565

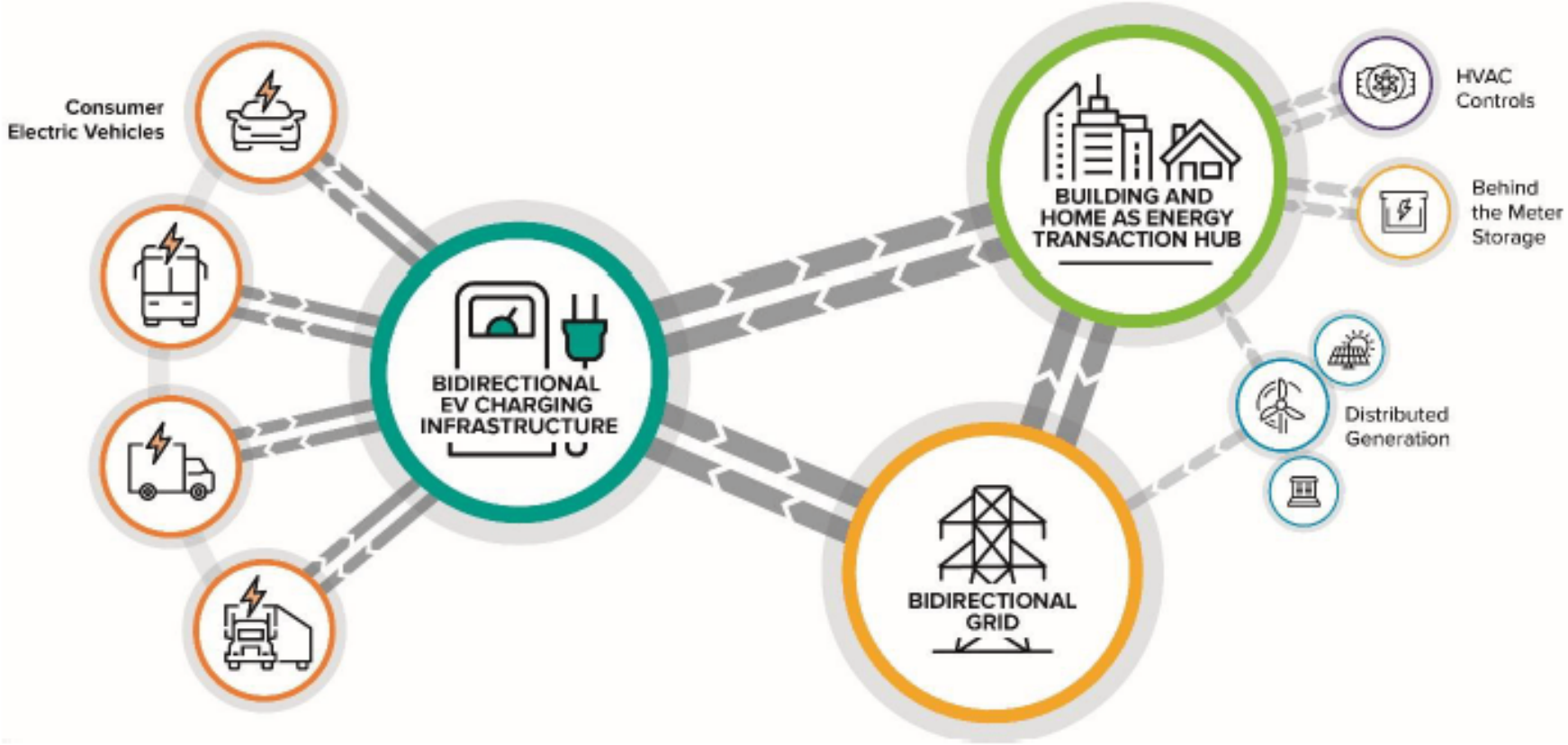
- Asset System Manager with the City of Medicine Hat in Alberta Canada
- Lead integrator on the City's Asset Management portfolio within the Corporate Asset Management and Corporate Services division
- Prior experience as a Royal Canadian Electrical and Mechanical Engineer Officer with the Canadian Armed Forces and private industry experience as a mechanical design engineer in the United Kingdom and Montreal
- Active in American and Canadian professional associations with professional designations as Certified Public Fleet Professional (CPFP), Certified Automotive Fleet Professional (CAFM), Certified IT Asset Manager (CITAM), Supply Chain Management Professional (SCMP), Professional Logistician (P.Log), and Project Management Professional
- B.Sc in Mechanical Engineering, an M.Sc. in Engineering Management, and a Master's in Business Administration

BUILDING THE BUSINESS CASE FOR BIDIRECTIONAL ELECTRIC VEHICLES

Bidirectional Electric Vehicles (BEVs) Vision

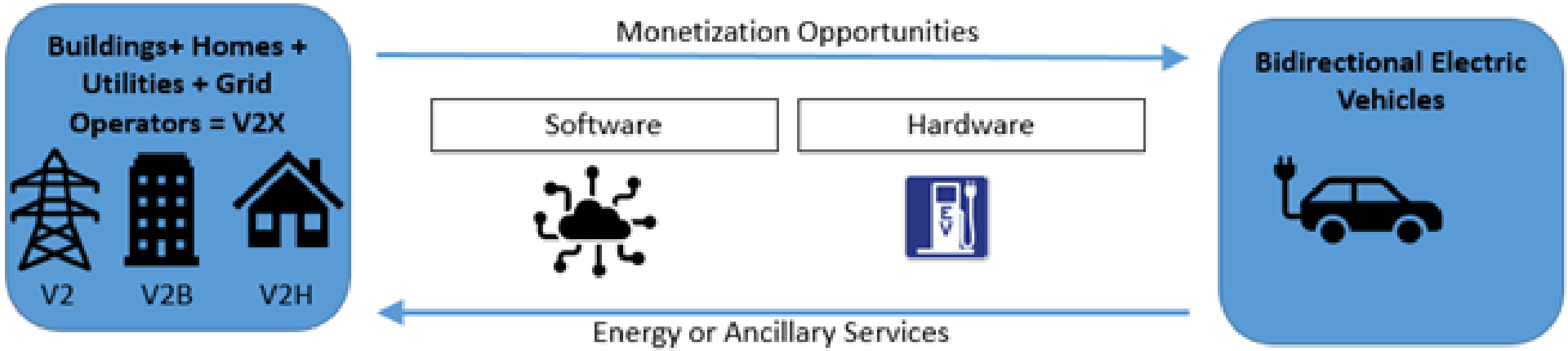
Assumptions

- BEVs will deliver transport and energy storage services.
- BEVs will address battery supply and grid resilience issues
- BEVs mitigate the challenges associated with integrating intermittent renewable energy generation



Bidirectional EV Assumptions (Continued)

- If EVs are bidirectional, then under the right conditions they could serve as both mobility and energy storage assets.
- That means along with sending power back to the grid, they could deliver new monetization opportunities as well.

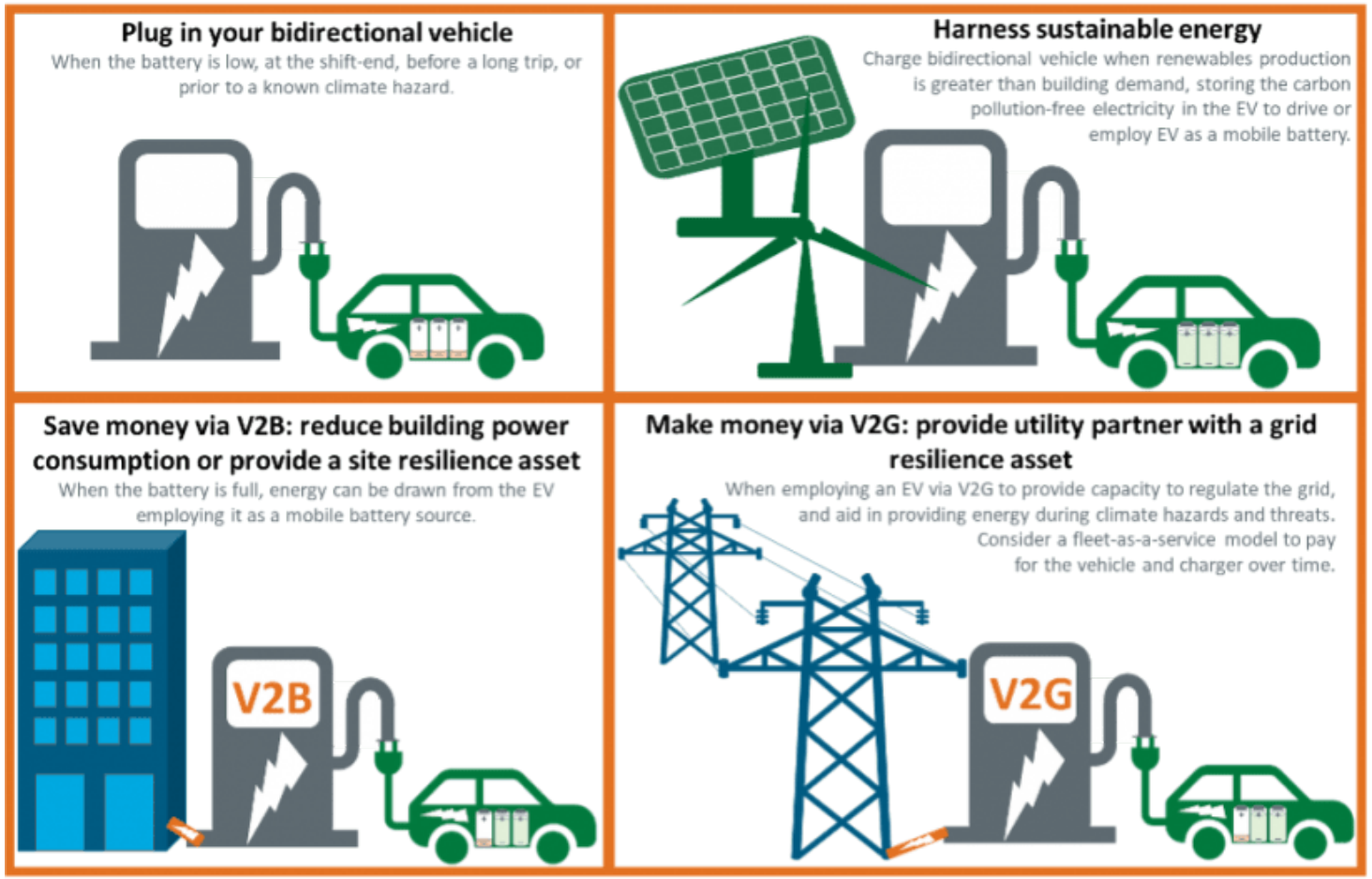


BEVs Realities

- Battery Storage Capacity/ Range / Additional Power output
- Battery degradation through additional charging/discharging cycles
- Supply Chain for semiconductors, Rare Sands, and Other battery materials
- Integration complexity with the micro - and - main grid
- Technology upgrade costs
- Mobile Assets Lifecycles
- Warranty costs of any subsequent failed batteries (OEM manufacturers)
- Additional maintenance costs
- Additional upfront cost in comparison to diesel/gasoline vehicles
- Facilities and infrastructure upgrades to install sub panels and transfer switches

BEVs Realities

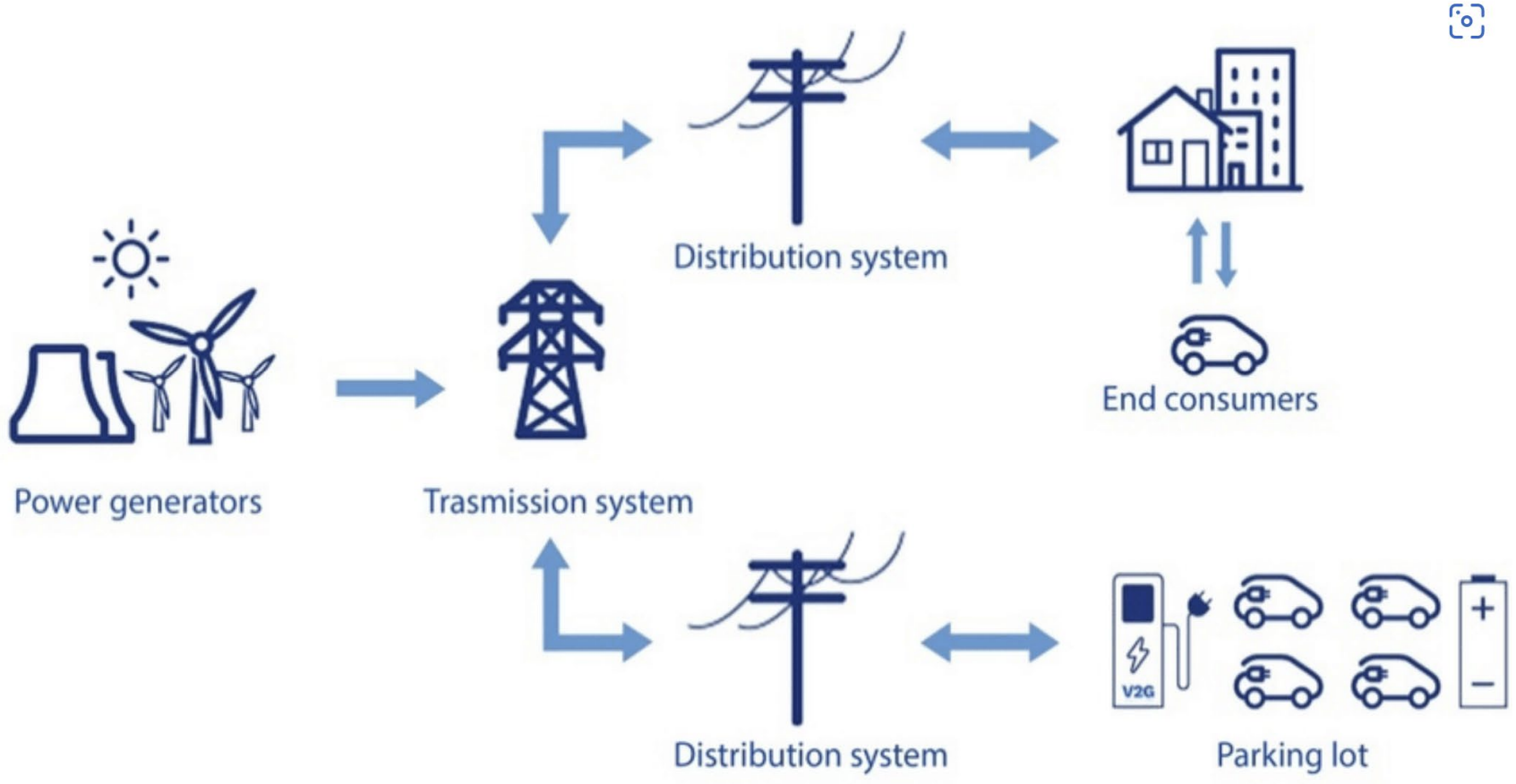
- V2H / V2W only works if the vehicle is at the charging/discharging location (stationary)
- BEVs add complexity and cost for relatively little actual benefit



BEVs in Municipal Operations

- Light Duty Service Truck BEVs are ideal for smaller applications (i.e. replace or supplement emergency diesel generators)
- Larger BEV fleets can be employed for larger applications
- BEVs can provided the necessary power for some tools and equipment needed in remote areas
- BEVs may be subject to State or Federal Grants, and other OEM incentives
- BEVs Lifecycle and Total Cost of Ownership (TCO) typically is assumed at 15 years of operation @ 12,000 miles per year and $014/mile more expensive than an ICE (Argonne National laboratory, 2020)
- Some Utilities companies limit the use of BEVs (lack of innovation, market design, regulatory requirements)
- BEVs charging infrastructure with energy storage or microgrids are used for responding to emergencies and for restarting the grid
- Establishing who pays for the BEVs charging infrastructure: end-users, rate-payers or market participants
- Who should pay for which component of a BEV project (i.e. operations, maintenance, other)

Questions?


Distribution system
End consumers
Power generators
Trasmission system
Distribution system
V2G
Parking lot

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