NARUC Electric Vehicles State Working Group

VEHICLE TO GRID (V2G)

OCTOBER 29, 2024, 3:00 - 4:30 PM ET

Welcome

EV SWG Chair

Commissioner Katherine Peretick, Michigan Public Service Commission

EV SWG Vice Chair

Commissioner Milt Doumit, Washington Utilities and Transportation Commission

EV Commission Staff Leads

Ryan Cheney, North Carolina Utilities Commission

Steve Olea, Arizona Corporation Commission

NARUC Staff

Danielle Sass Byrnett and Robert Bennett

Agenda

Feel free to enter questions into chat at any time

3:00 PM	**Welcome and Announcements: Commissioner Peretick** • Agenda review • Announcements- NARUC Annual Meeting
3:05 PM	**Christa Heavey, Energy & Environmental Economics (E3)**
3:20 PM	**Jonathan Levy, Kaluza**
3:35 PM	**Jordan Smith, Southern California Edison (SCE)**
3:50 PM	**Speaker Q&A**
4:05 PM	**Peer Sharing Discussion**
4:30 PM	**Adjourn**

EV Fact of the Week: **Over Half of All BEV and PHEV Sales in 2023 Were SUVs.** For more info and other facts, visit the DOE FOTW webpage.

Announcements- NARUC Annual Meeting

- The International Committee will feature 2 speakers on lessons learned on EVs from abroad on Monday, November 11th at 9 am (PT).
- Two concurrent sessions will include transportation electrification perspectives:
  - A1: Gaining Headroom on the Grid: Leveraging the Demand Side to Accommodate New Loads Now
  - D4: Peering Into the Crystal Ball: Load Forecasting for the Future

Presentations on V2G

Moderator: Commissioner Katherine Peretick, Michigan Public Service Commission

Guest Speaker

- **Christa Heavey, Energy & Environmental Economics (E3)**
  - Addressing Key Gaps to Incorporate VGI Benefits in Utility Planning
- **Jonathan Levy, Kaluza**
  - Lessons learned from successful V2G pilots and programs abroad and in CA
- **Jordan Smith, Southern California Edison (SCE)**
  - V2G considerations for regulators and utilities

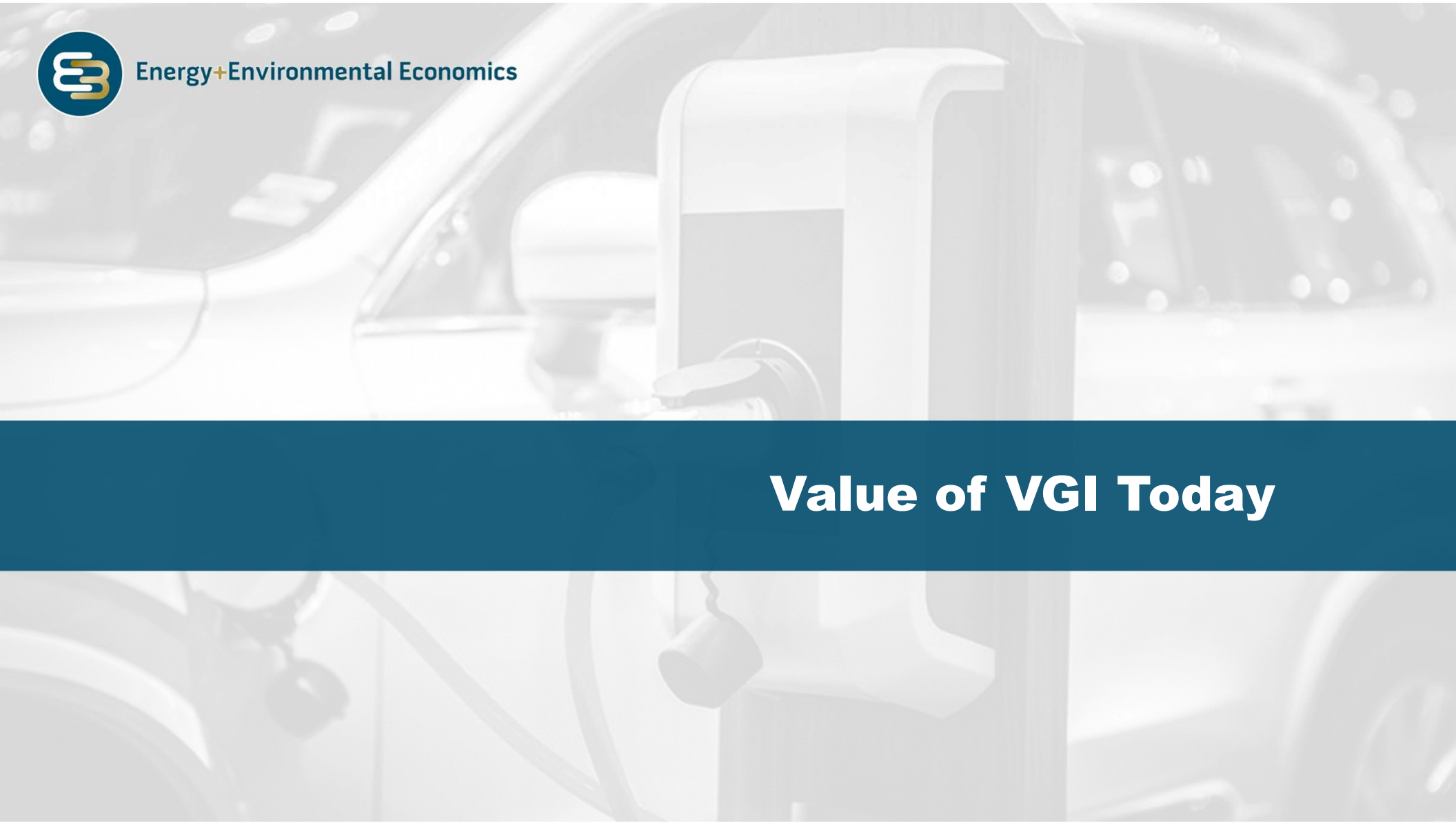
Addressing Key Gaps to Incorporate VGI Benefits in Utility Planning

NARUC EV State Working Group

October 29, 2024

Energy+Environmental Economics

Christa Heavey, Associate Director
Christa.Heavey@ethree.com



Energy+Environmental Economics

Value of VGI Today

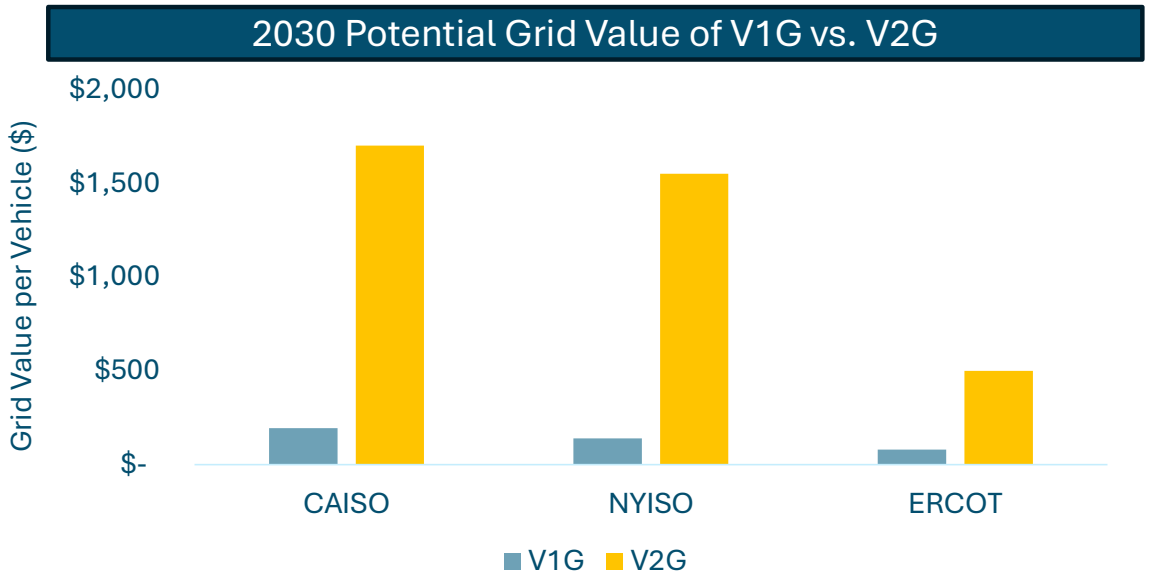
Many studies have quantified the value of V1G and V2G

- Szinai, et. al. (2020) analyzes total system cost savings (**generation, emissions, net imports**) and impact to renewable energy curtailment
- EPRI (2019) study the impacts of V2G using avoided cost methodology (**energy, gen capacity, T&D capacity, CO2, etc.**)
- Wolinetz, et. al. (2018) evaluates how consumer behavior impacts VGI's affect on **wholesale electricity prices**
- Coignard, et. al. (2018) studies the benefit EVs can provide by displacing new stationary grid storage to shave **peak load** and mitigate **generation ramping**
- Noori, et. al. (2016) explores future net revenue from providing **ancillary services** and lifecycle **GHG savings**
- Geng, et. al. (2023) evaluated the **vehicle-side costs and profits** of V2G under current and assumed advancements in battery technology

- ☑ Utility value: avoided energy, capacity, T&D, GHG costs
- ☑ Customer value: bill savings, demand response incentives, etc.

Value of VGI studies are an important to start the conversation

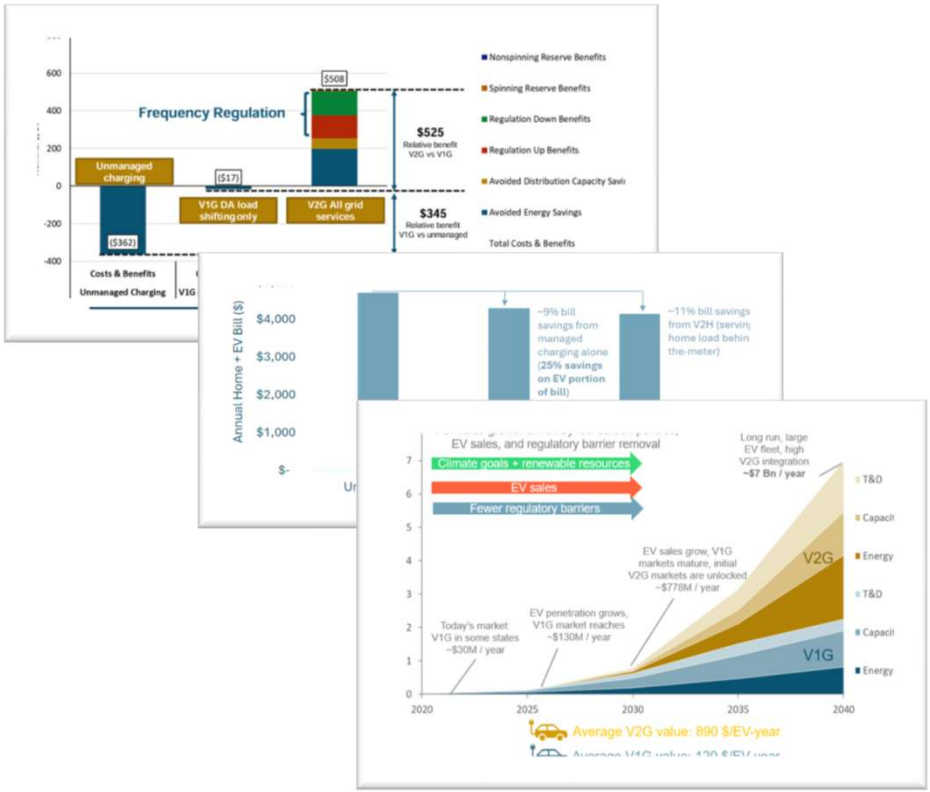
V2G value can provide significant value beyond V1G when optimized for grid value streams



**Example is based on Energy, Capacity, and T&D values only*

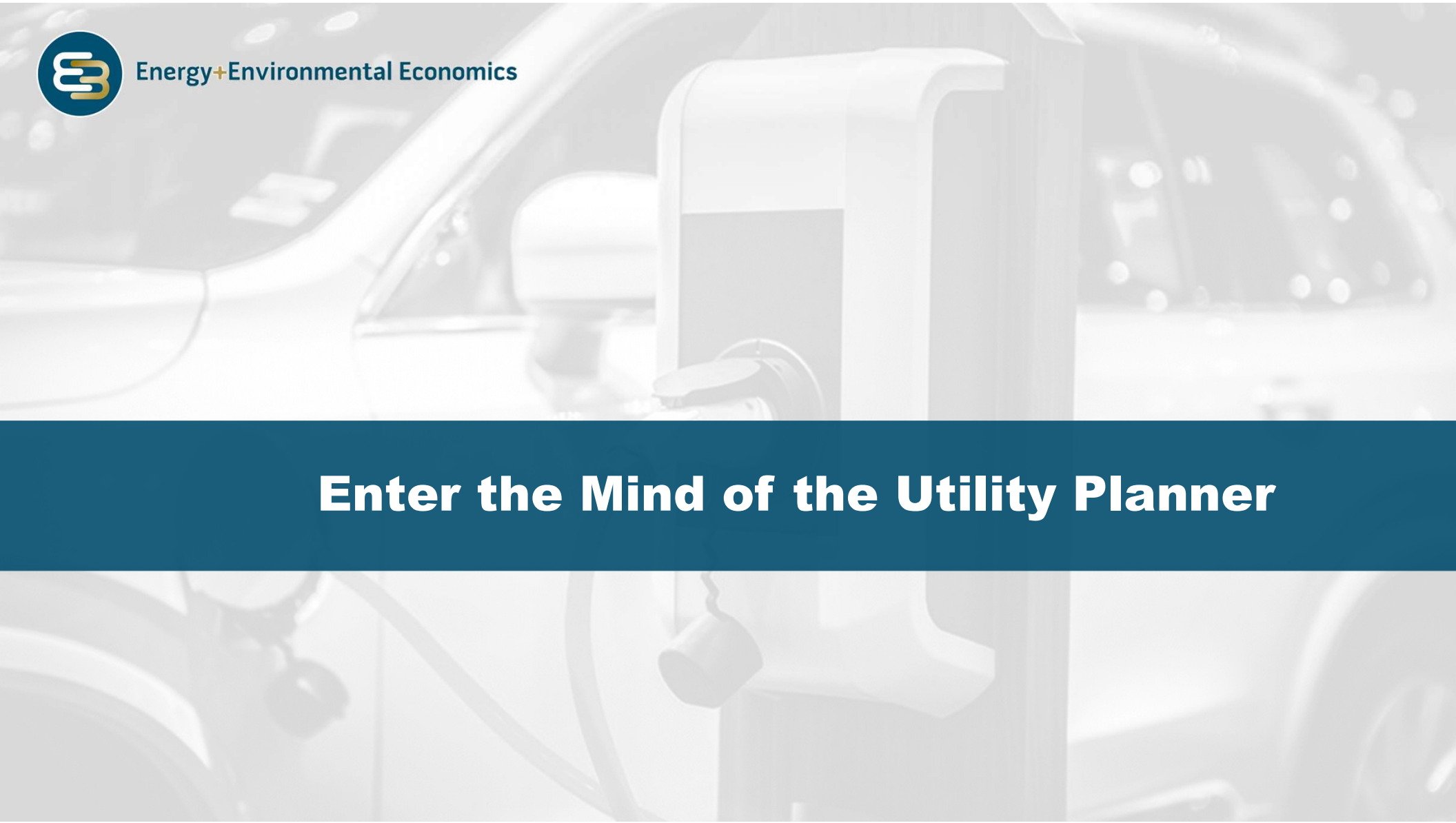
+ **V1G value also depends on the baseline – this example assumes many drivers already respond to TOU rates**
+ **Large values in CAISO and NYISO are driven by high potential T&D deferral value in constrained areas**

Next step is to value VGI as a predictable and reliable resource in utility resource planning models



+ To be compensated as a grid resource, V1G + V2G must be predictable, reliable and visible:

- Right Time
- Right Certainty
- Right Place

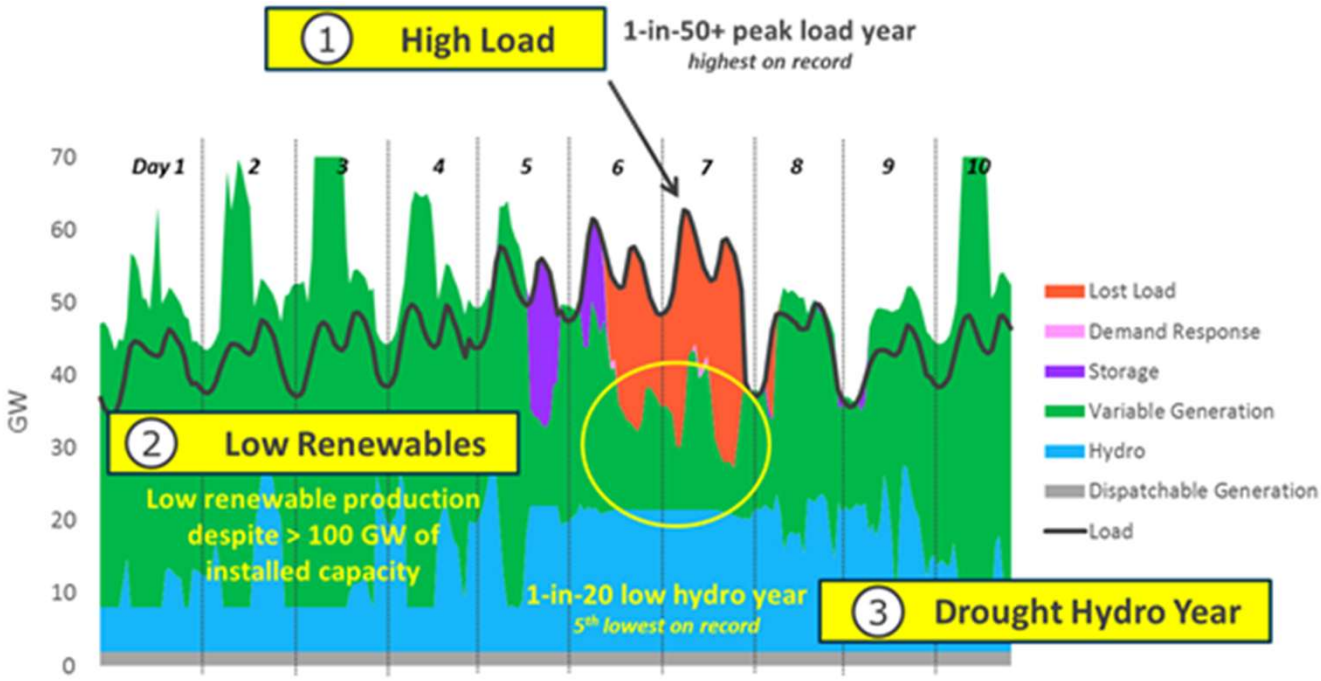


Energy+Environmental Economics

Enter the Mind of the Utility Planner

How will resource perform under extreme conditions

- **LOLP - Loss of Load Probability:** Probability that load will exceed generation in a given hour
- **EUE - Expected Unserved Energy:** amount of load that cannot be served due to insufficient generation
- **ELCC - Effective Load Carrying Capacity:** how effective a specific generation resource is for supporting system reliability



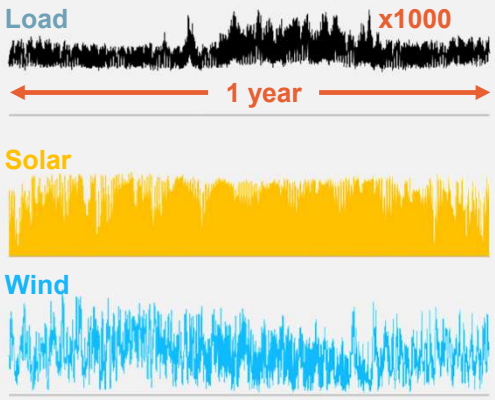
Studies need to define VGI in these terms to show its value

Probabilistic modeling for reliability planning

Part 1: Model + Data

Develop a robust dataset of the loads and resources, typically in a loss of load probability (LOLP) model

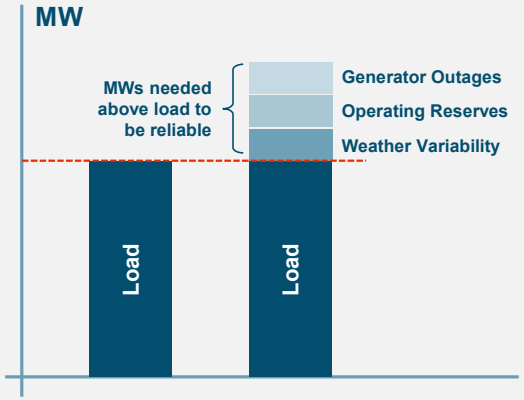
LOLP modeling evaluates resource adequacy across all hours of the year under a broad range of weather conditions



Part 2: Need Determination

Identify the Total Reliability Need to achieve the desired level of reliability

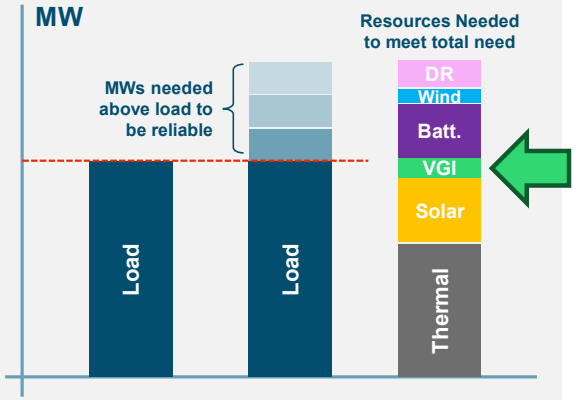
Factors that impact the amount of effective capacity needed include load & weather variability, operating reserve needs



Part 3: Resource Accreditation

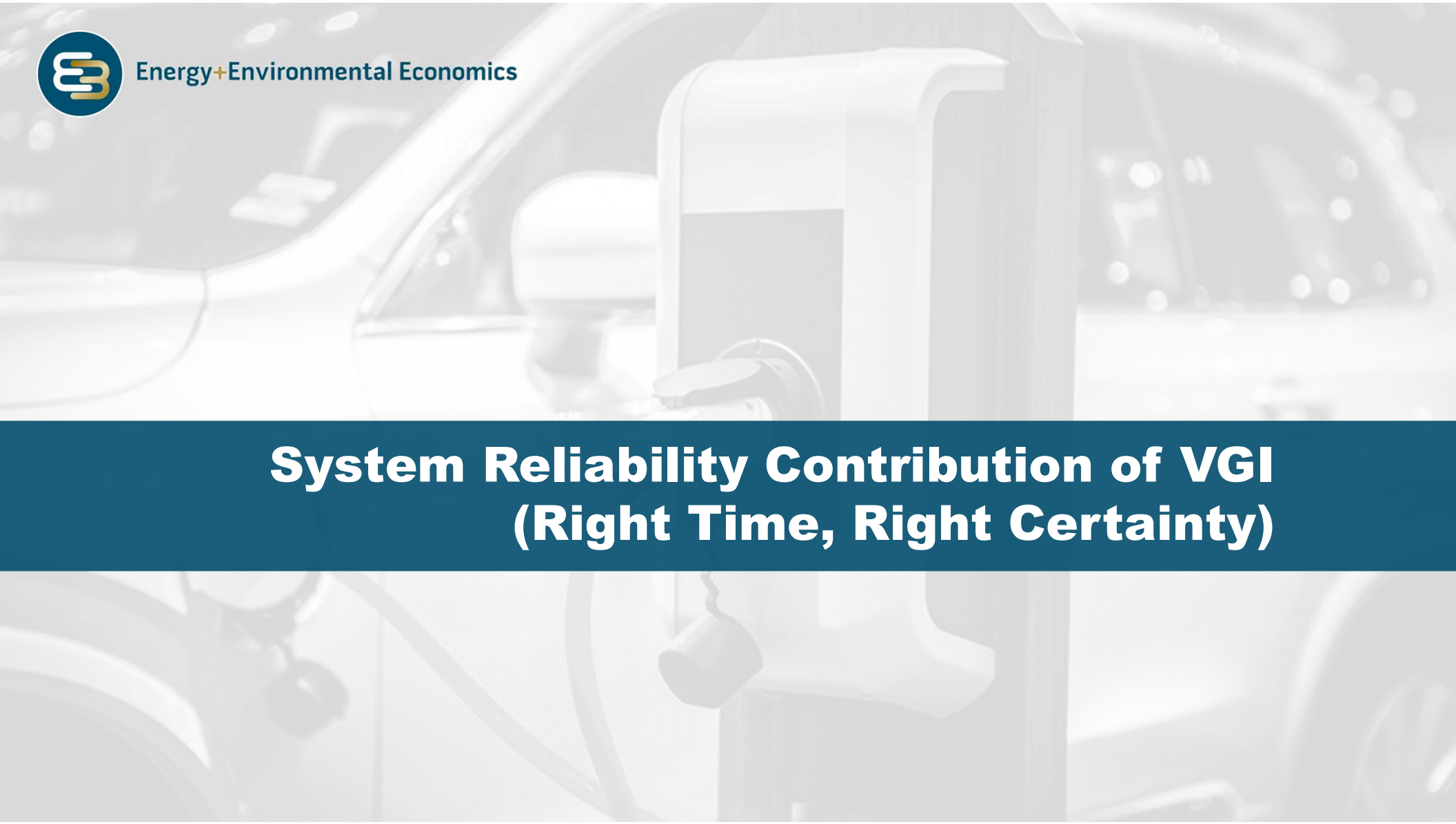
Calculate resource capacity contributions

Measures a resource's contribution to reliability needs relative to target reliability, accounting for performance across all hours



Defining reliability of VGI in terms planners can use

	Fossil Generation	Energy Storage	VGI – Fleet of 1,000 EVs
Max Output: how much power can we expect?	Nameplate Capacity	kW Max Power Capacity	kW capacity of EVSE's that cars parked and plugged in to
Max Duration: how long can we expect max output?	As long as there's fuel	kWh Total Energy Capacity	kWh of battery capacity for cars parked and plugged in
Online: is resource available and online	Available and operational	Available and operational	% of cars parked and plugged in – charging or available to charge/discharge
Fuel: is there sufficient fuel supply	Natural gas supply and delivery	SOC – capacity to charge or discharge	SOC – capacity to charge or discharge
Weather: how season and weather affect performance	Hot - Lower efficiency Cold – equipment freezes	Hot – cooling load, risk of fire Cold – lower output	Different driving patterns? Lower output?
Reliability: Probability of breaking down	Forced outage rate, Correlated fuel supply shortage	Forced outage rate	Will communication and power flow work from utility → aggregator → customer → EVSE → car
Driver			% Enrolled , % Responding, % Opt out

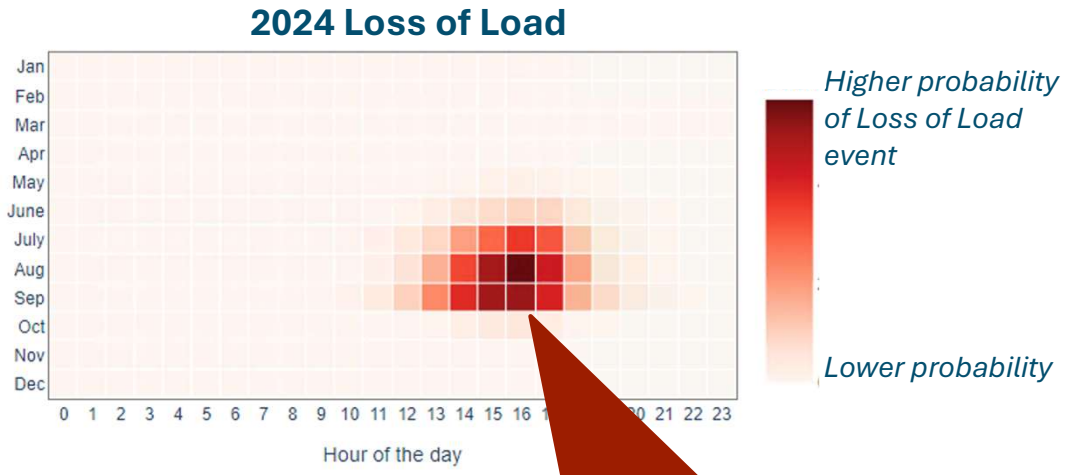


Energy+Environmental Economics

System Reliability Contribution of VGI (Right Time, Right Certainty)

VGI can support critical load hours

- **The *time of day* that load is added is important to reliability**
- **Loss of Load heat maps show when EVs should avoid charging, and when V1G and V2G can provide value**

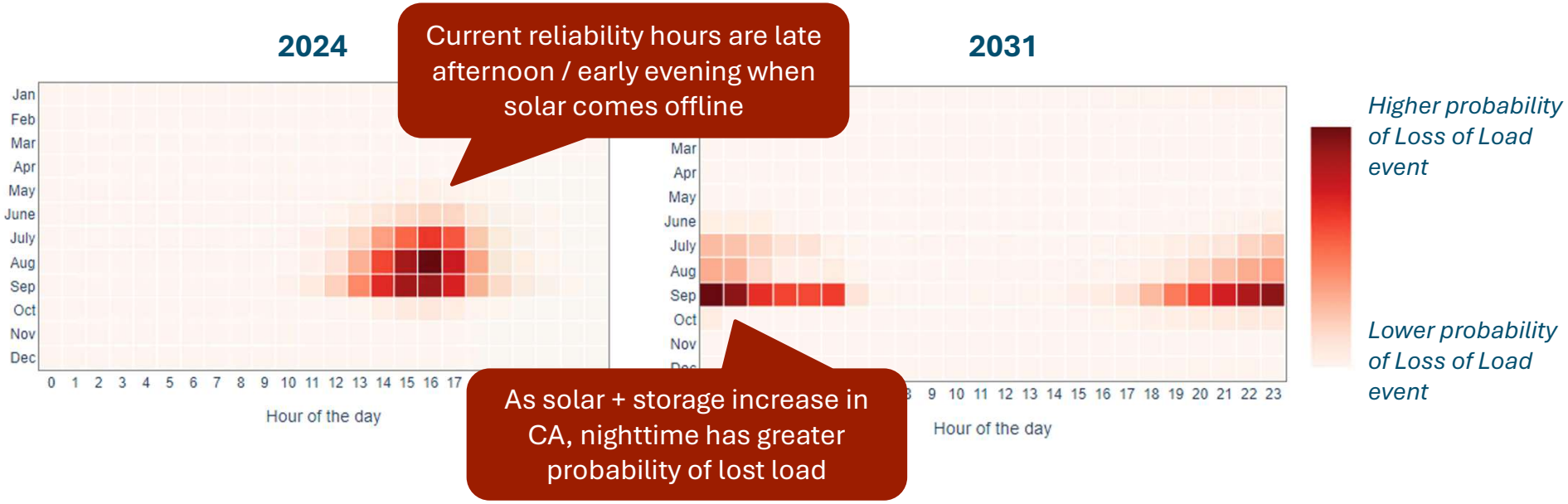


VGI support is most valuable during these critical reliability hours

VGI can provide value throughout the year, but charging and discharging patterns need to be highly responsive to critical hours in order to provide **reliability** value

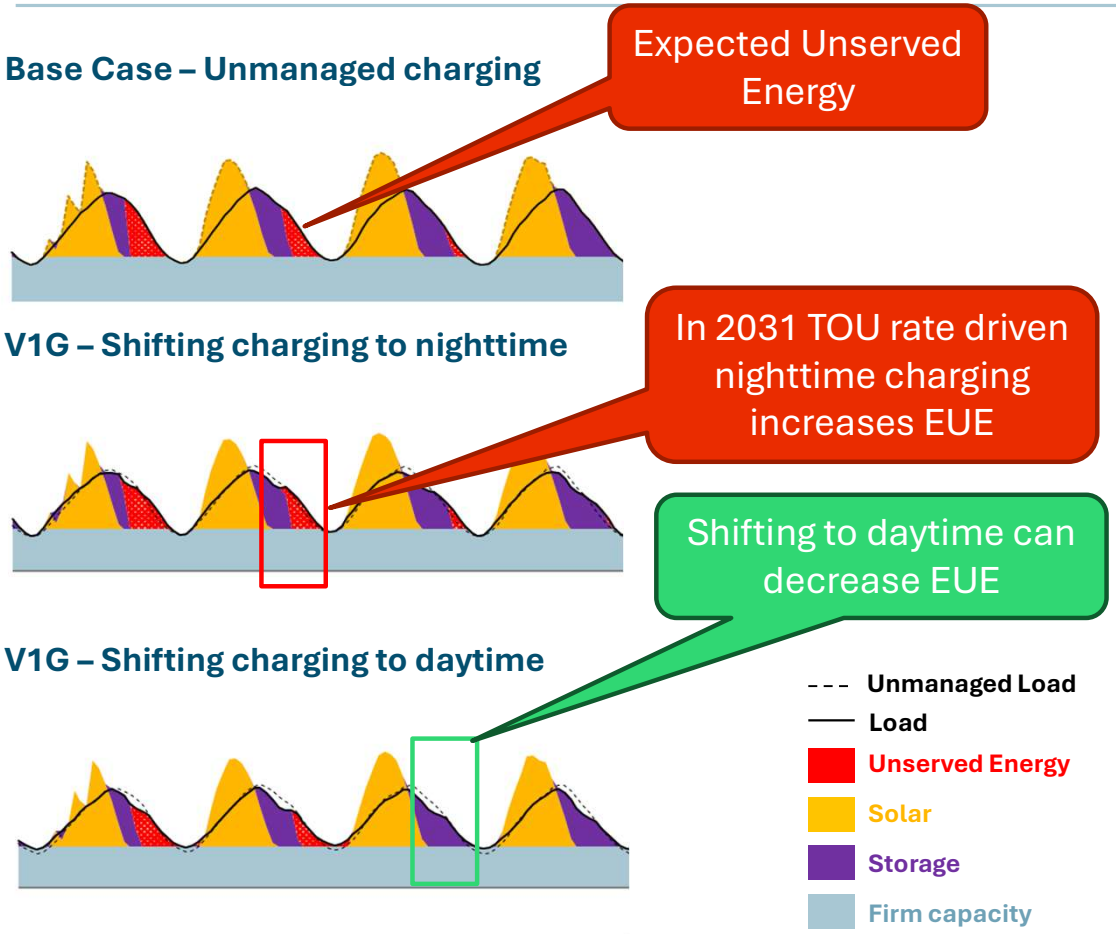
VGI will need to evolve as the grid evolves to continue providing reliability value

+ **In California, as more solar and storage are added to the grid, nighttime hours will eventually become the main reliability hours**



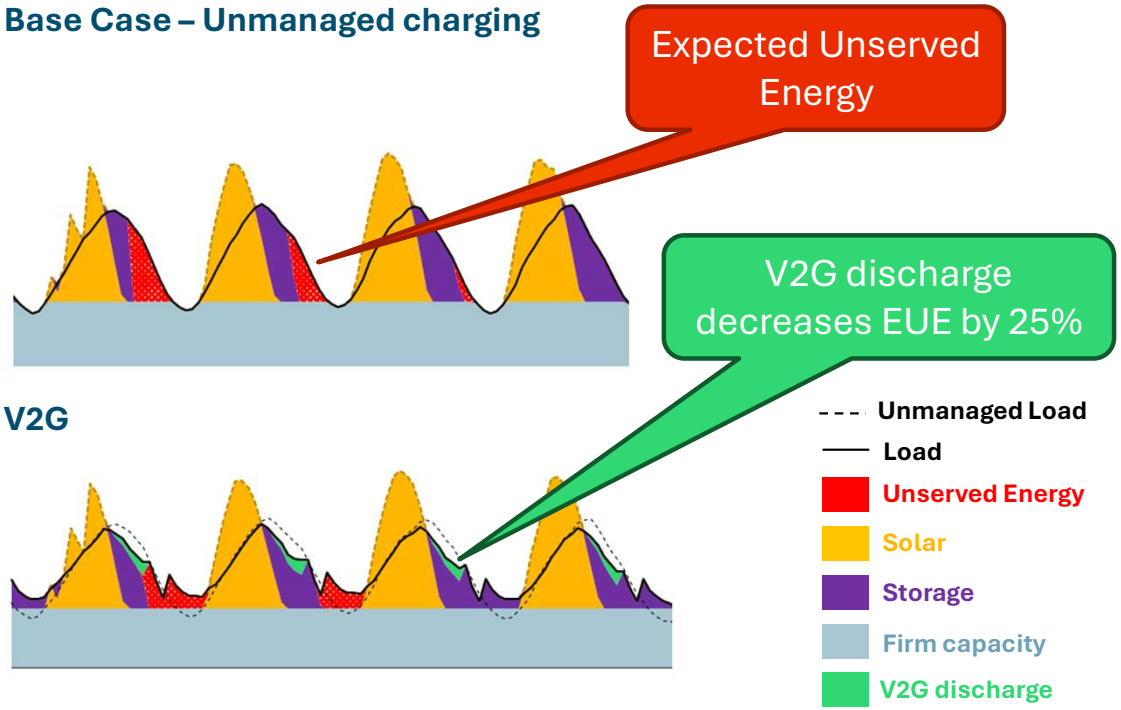
VGI behavior needs to evolve as the grid evolves to ensure charging is not reducing reliability and to ensure V2G is providing maximum reliability support

V1G can support reliability but the time of day for load shifting really matters



- E3 modeled a case study example for 2031 reliability in California
- V1G that shifts charging to nighttime *increases* Expected Unserved Energy (EUE) in 2031 because critical reliability hours are at night
- Shifting charging to the daytime, when solar is generating, decreases EUE and allows for the third Loss of Load event the be resolved

By discharging to the grid during critical hours, V2G can provide even greater reliability support



- **+ V2G during the evening further reduces Expected Unserved Energy**
- **+ V2G improved EUE improved by 25% in this case study**
- **+ Dynamic dispatch of V2G can provide even more reliability improvements**

V1G and V2G can reduce unserved energy while the system meets the same reliability standards, but need to evolve based on the grid's changing critical hours.

Energy+Environmental Economics

Distribution Value of VGI (Right Time, Right Certainty, Right Place)

Policy driven scenario planning for distribution systems

Policy & Regulatory

Clean Energy Plan

Utility IRP

Planning Scenarios

Economy-wide Planning Scenarios

Comprehensive long-term planning scenarios informed by **policy**, **macro-economics and technology drivers**

Total EV Adoption

Spatial Allocation

Utility Data

- IRP / IDP
- AMI & SCADA
- Connectivity Model
- Known Projects

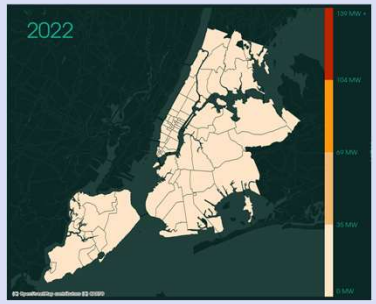
Geospatial Data

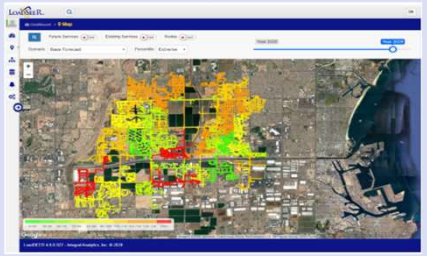
- Parcel / GIS
- Business
- Demographic
- Load Shapes

Model EV adoption propensity and spatial allocation with GIS, machine learning, and heuristic analysis.

When and where charging

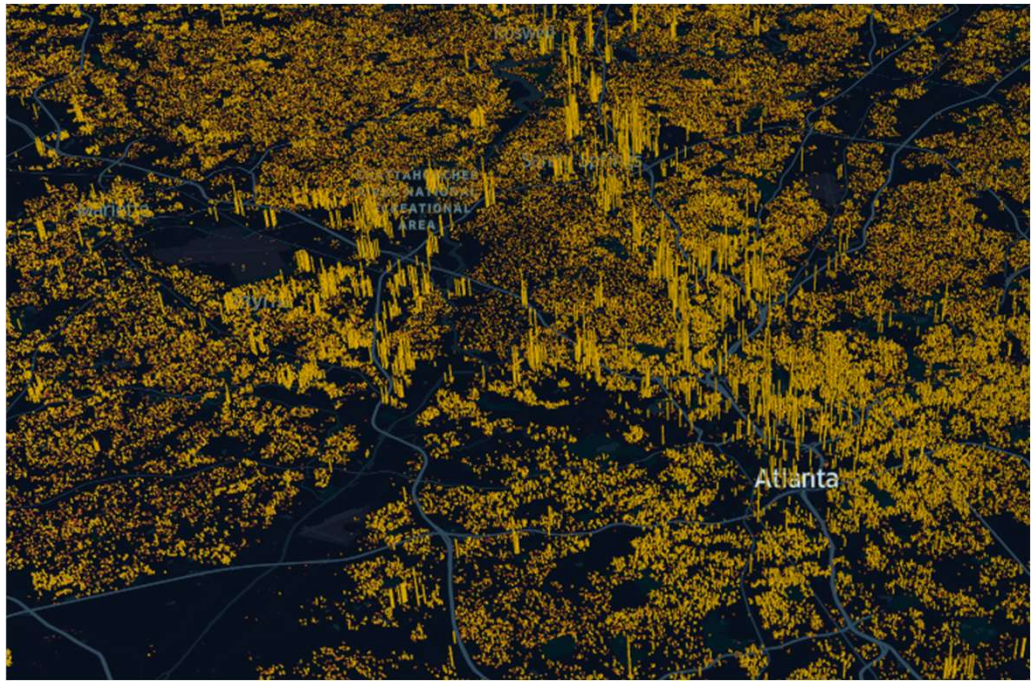
Distribution Planning Software



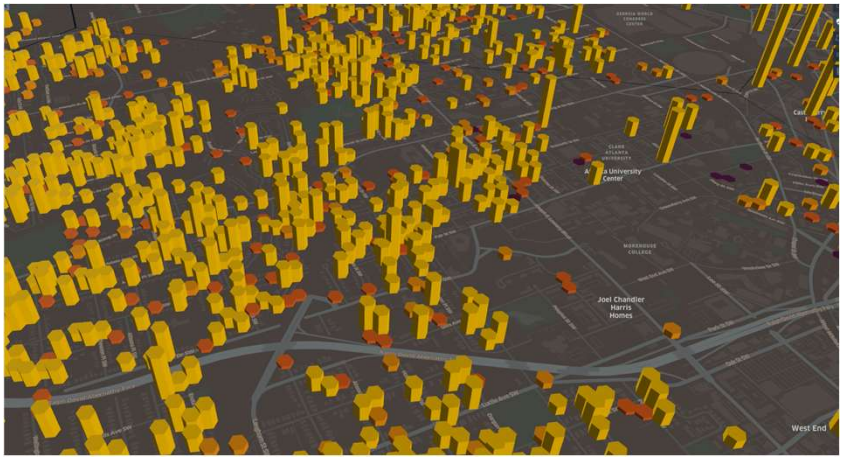


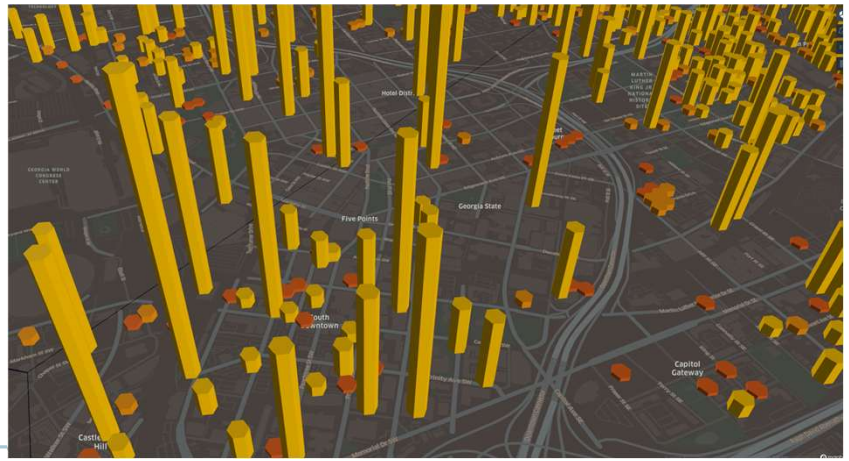
Distribution system impacts with EV adoption and load growth propensity

L2 EV charger adoption in Atlanta



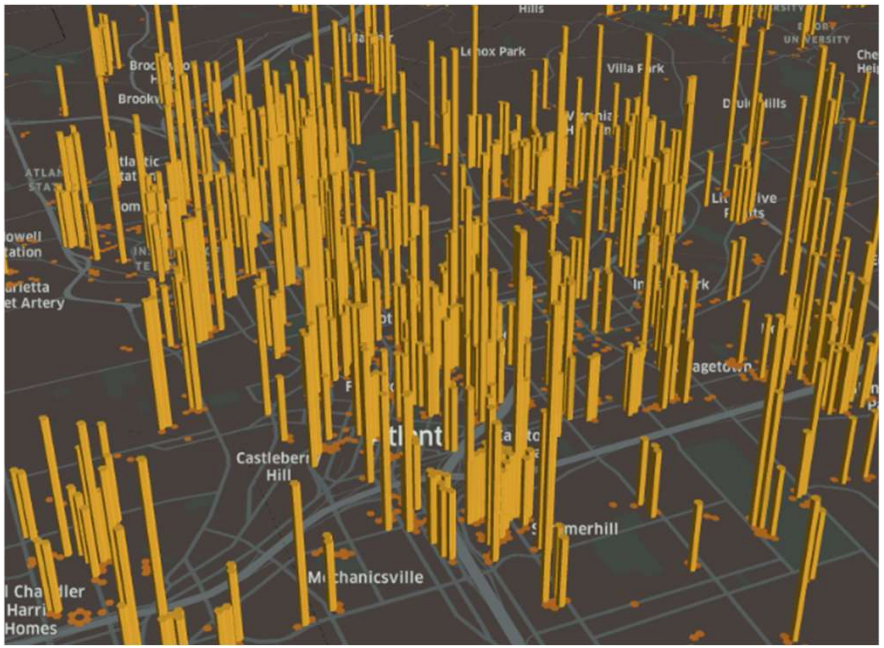
Adoption propensity and spatial allocation

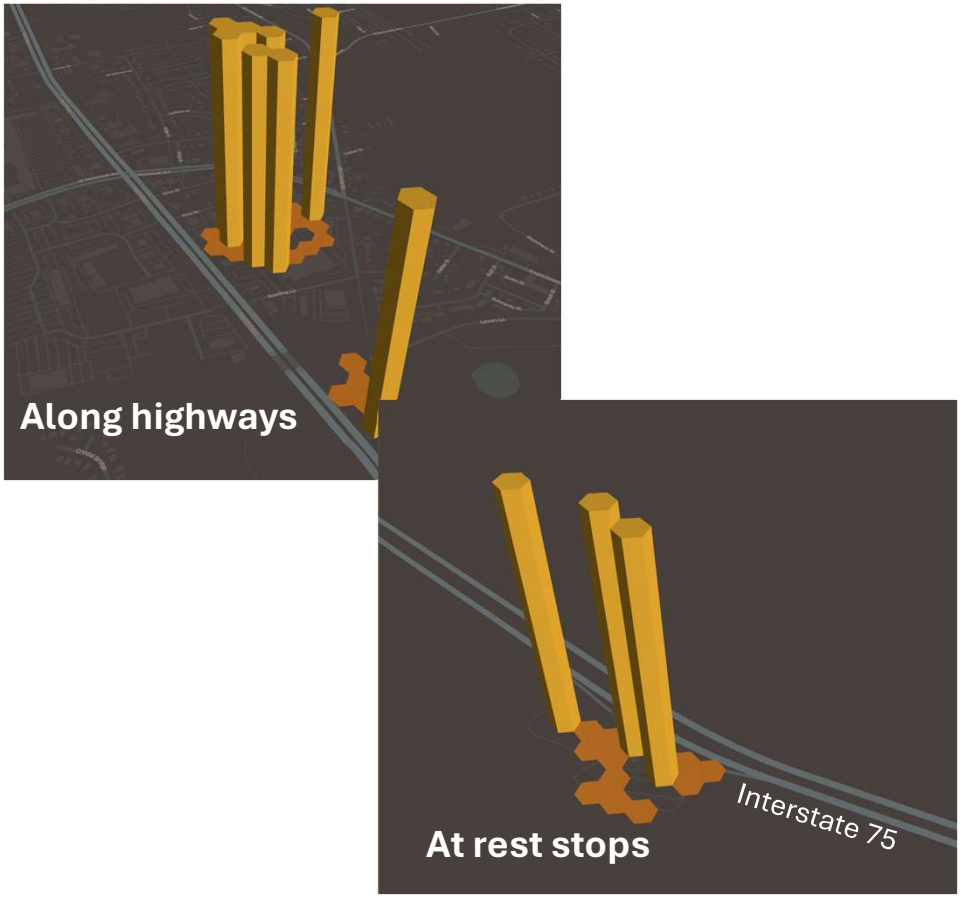




Public DCFC adoption in Atlanta

FORECASTING ANYWHERE





Energy+Environmental Economics

Recommendations

Priorities to unlock VGI value

+ Demonstrate predictable and reliable capacity value of VGI
+ Model reliable capacity in terms that utilities and regulators use and value
  - LOLP - Loss of Load Probability
  - EUE - Expected Unserved Energy
  - ELCC - Effective Load Carrying Capacity
+ Automakers and aggregators to provide data that utilities can use for probabilistic modeling of extreme events
+ Work together on expanded demonstrations with multiple EVSEs and automakers

Thank You

Christa Heavey

Christa.Heavey@Ethree.com

Energy+Environmental Economics

KALUZA

Scaling V2X: The importance of vehicle-to-customer friendly solutions

Jonathan Levy
Managing Director, US and Japan
Kaluza

Who we are

Born out of OVO Energy in 2019

450+ staff across 5 offices internationally

Millions of meters licensed

>26,000 smart devices connected

Products live in 5 countries

Working with leading companies

Proven success

KALUZA

A modern solution for energy transformation

Automating utility operations

through a new
'device-to-cash' approach

Optimizing energy flows

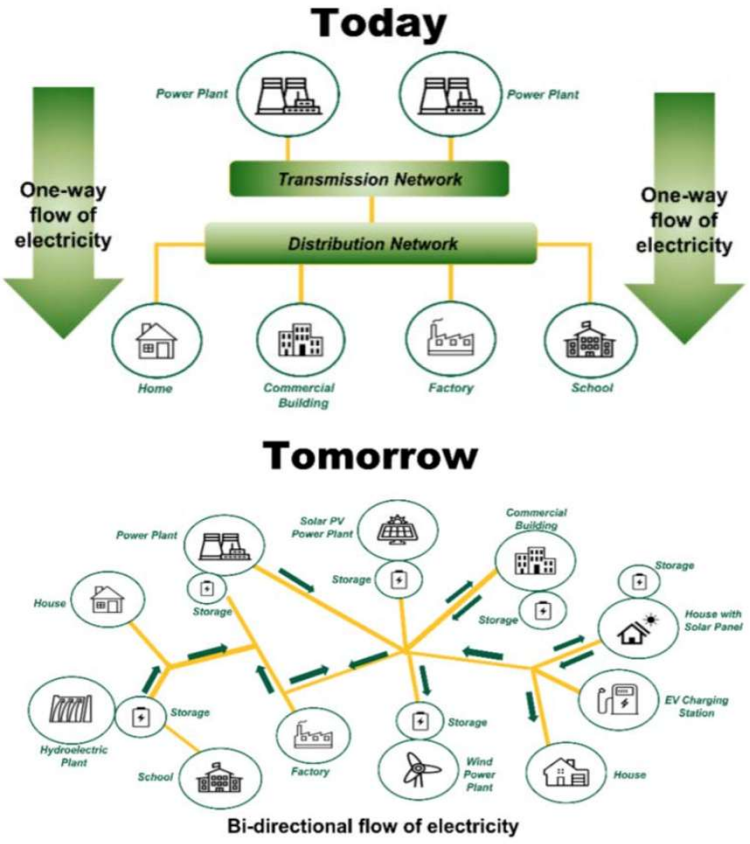
by connecting customer devices
with utility signals

Engaging customers

with integrated, innovative products,
bundles & rates

The Modern Energy System

From unidirectional to multidirectional

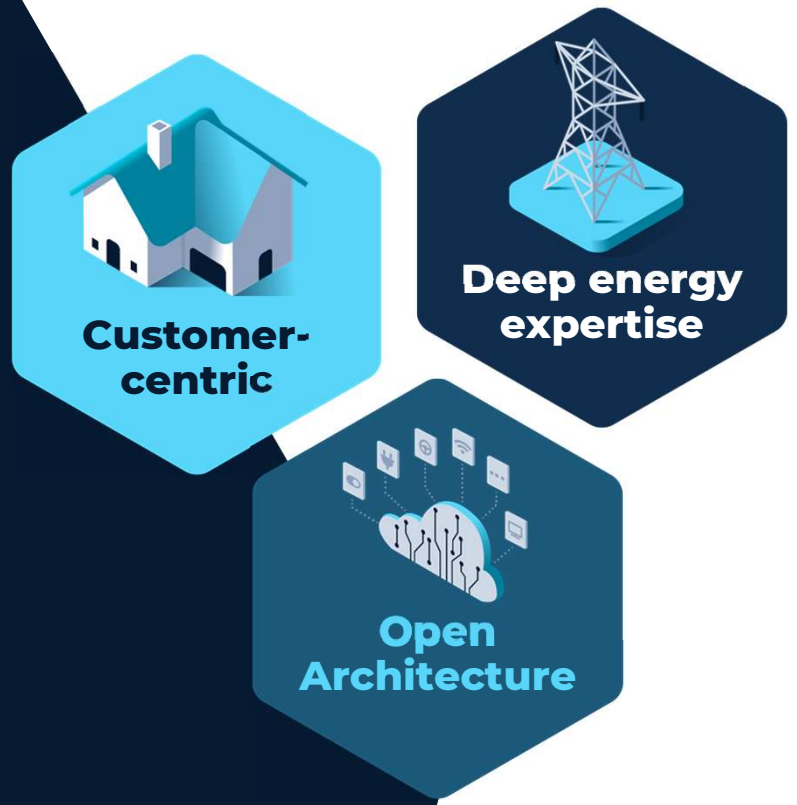


- The world is rapidly changing– residential solar, EVs, whole home electrification all put the customer in the middle of the action
- DER, multidirectional flows, capacity constraints all add **complexity** to an old system
- Innovative hardware and software solutions are required to manage and optimize for end customers, utilities, and the grid overall
- The customer is no longer “just” the end consumer; they are at the CENTER of generation and consumption

The Kaluza difference

> “...stands out from competing CIS and billing systems by enabling retailers to develop **innovative, customer-centric propositions** combined with meter-to-cash for **energy** and connected devices - all underpinned by an **open architecture** that allows clients to adapt to evolving needs.”

FROST & SULLIVAN



CASE STUDY

THE WORLD'S LARGEST RESIDENTIAL V2G PROGRAM

KALUZA · OVO energy · NISSAN · INDRA · cenex · project sciurus

330

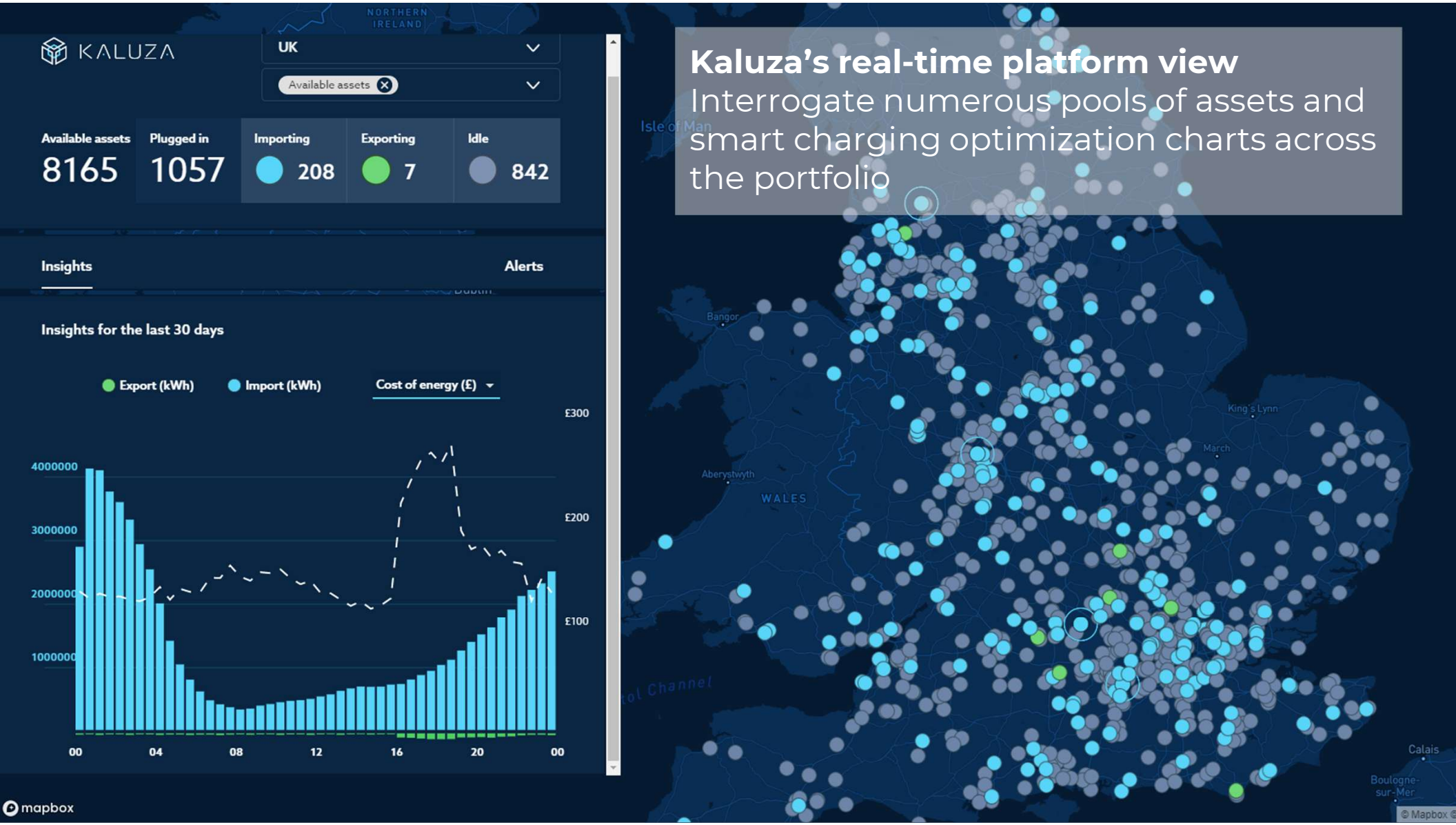
V2G devices installed and Kaluza integrated

Project Background

Part of the UK's Vehicle-to-Grid competition, funded by OLEV and BEIS, in partnership with Innovate UK.

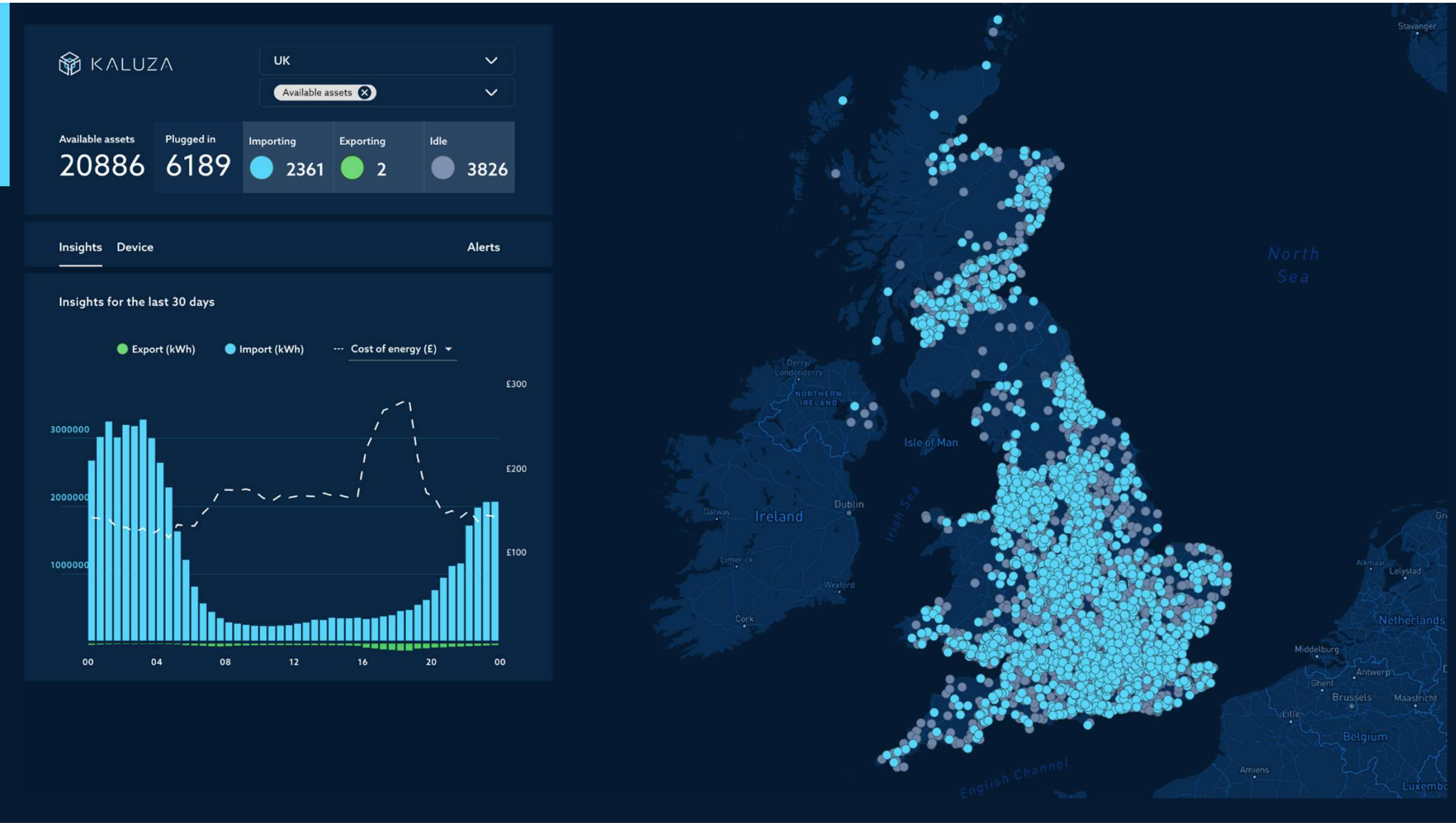
Objective

Validate the technical and commercial potential for a domestic V2G charging solution capable of providing flexibility services to electricity networks and bring added benefits to the device user.



Kaluza's real-time platform view

Interrogate numerous pools of assets and smart charging optimization charts across the portfolio


KALUZA
UK
Available assets
Available assets
20886
Plugged in
6189
Importing
2361
Exporting
2
Idle
3826
Insights
Device
Alerts
Insights for the last 30 days
Export (kWh)
Import (kWh)
Cost of energy (£)
£300
£200
£100
3000000
2000000
1000000
00
04
08
12
16
20
00
North Sea
Isle of Man
Ireland
Dublin
Galway
Limerick
Wexford
Cork
Irish Sea
English Channel
Netherlands
Belgium
Brussels
Antwerp
Ghent
Middelburg
Lille
Amiens
Maastricht
Lelystad
Stavanger

The Potential

World's largest domestic V2G trial

$477/£420
average customer savings per year

93%
customer satisfaction rate

> 3 million
'free' miles driven

2.19 GWh
demand shifted

Potential to
save 10%
in electricity system infrastructure costs

46.8 tonnes
of CO_2 saved

Challenges

Barriers to Scale (V2X)

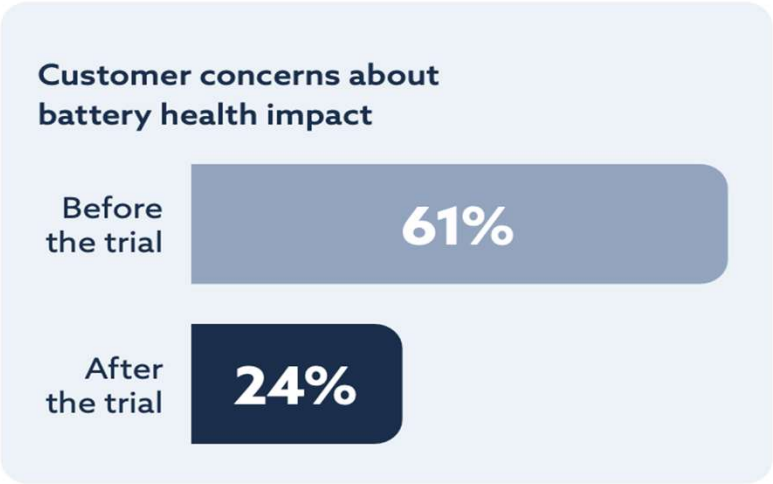
Technology	Policy and Regulation	EV drivers
Cost	Market structures	Tech learning curve
Standardisation	Outdated processes	Battery health
Accessibility	Adaptability	Customer centricity vs complexity

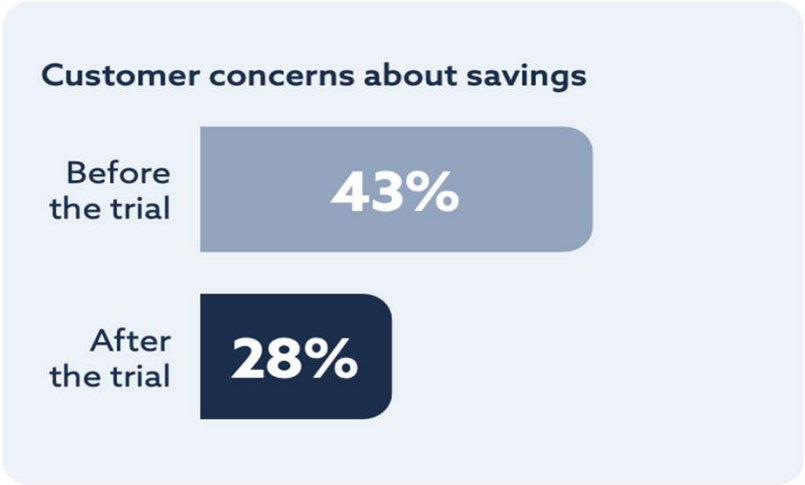
Challenges

Barriers to Scale (V2X)

Technology	Policy and Regulation	EV drivers
Cost	Market structures	Tech learning curve
Standardisation	Outdated processes	Battery health
Accessibility	Adaptability	Customer centricity vs complexity

Customer Experience Busts Myths





INFLEXION objectives

Develop a sustainable and equitable route to market for V2X charging technology

Validate 15118-20 V2X charging hardware

Assess flex value generation

Gather customer insights

Identify a sustainable business model

KALUZA

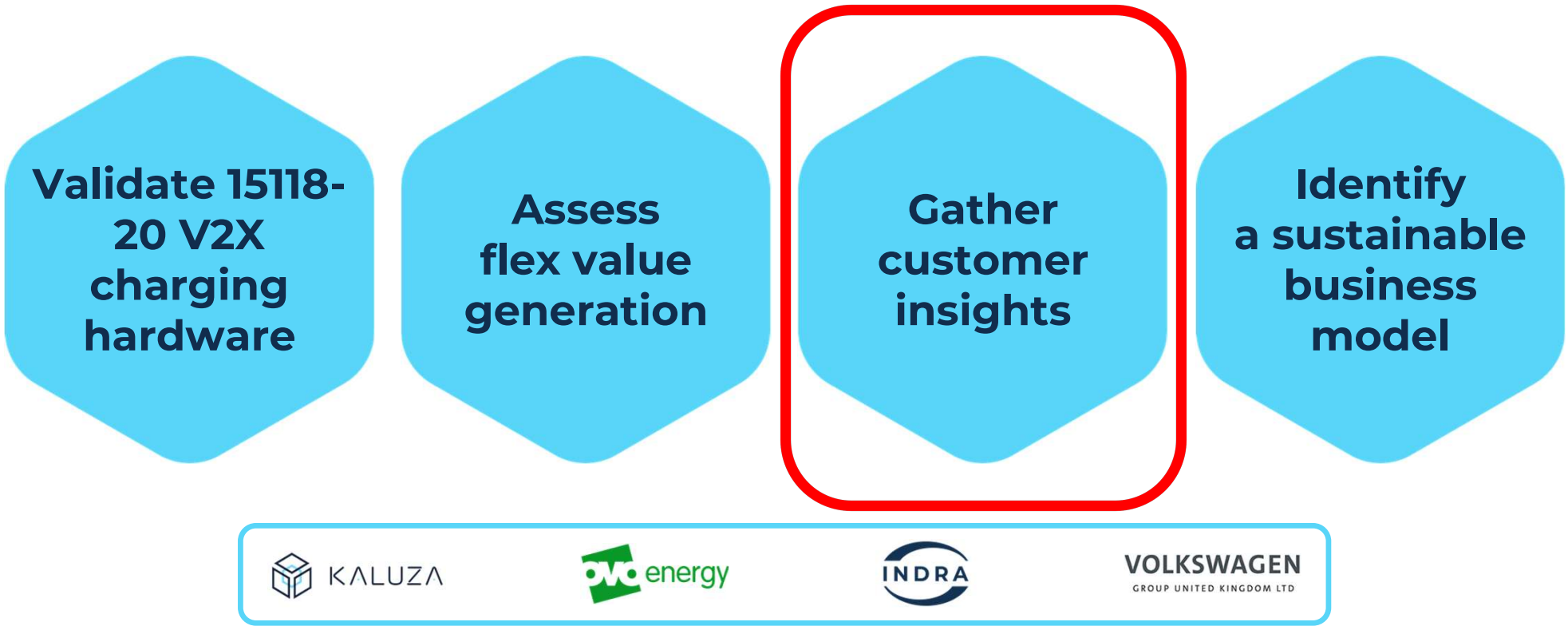
ovo energy

INDRA

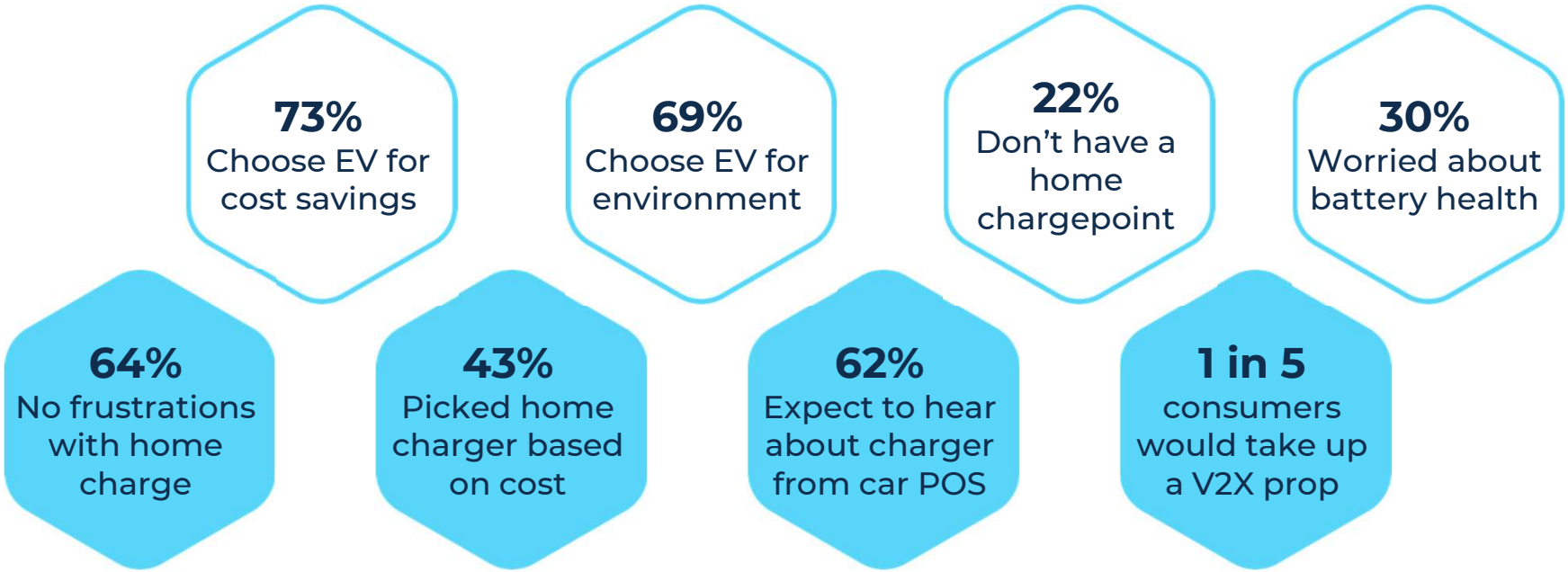
VOLKSWAGEN
GROUP UNITED KINGDOM LTD

INFLEXION objectives

Develop a sustainable and equitable route to market for V2X charging technology



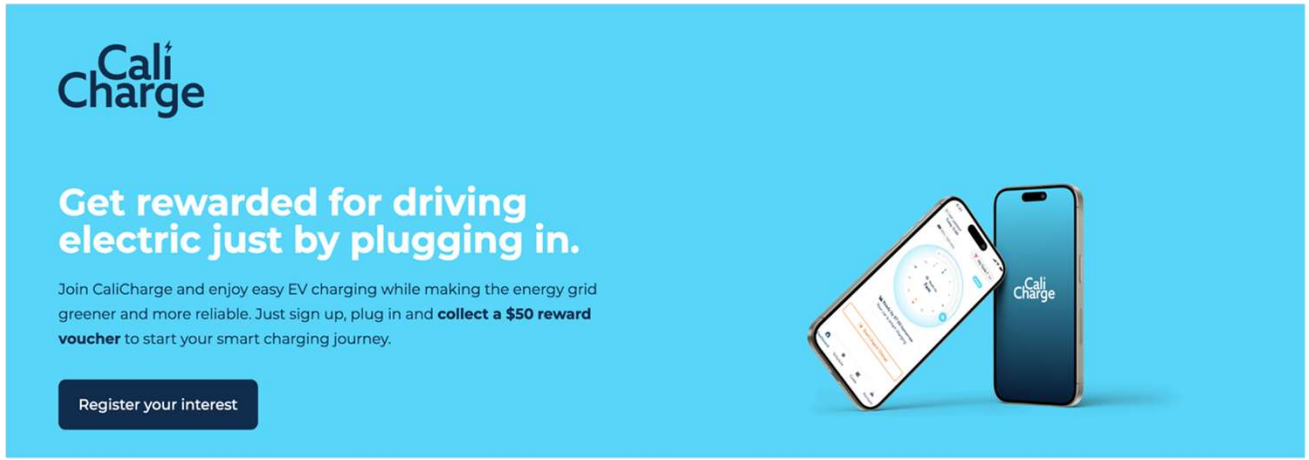
World’s first V2X survey



Nationally representative survey of 2,003 EV Drivers (493) and EV Considers (1,510)

So What's Next?

Smart charging by Kaluza in California



PG&E

wallbox

valley CAN "clean air now"

Join other EV drivers earning rewards with CaliCharge's smart charging technology. Just plug in, set it and forget it.

50% low-income/DAC

Lower barriers to participation by customers in low-income / disadvantaged communities.

Partnerships to Enable EV Adoption

Automakers are critical at point of sale – and beyond

Software partner of choice to deliver smart charging across all brands

Japan's first D2V smart charging service

A commercial V2X solution with Volvo in UK

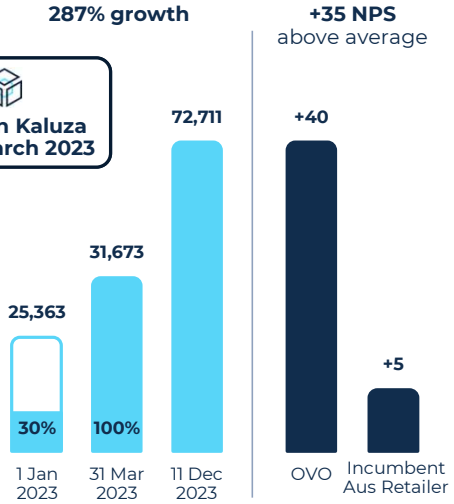
Case Study: Rapid Innovation in Australia

Since completing the migration, OVO Energy Australia has doubled in size, is operating with high performance levels in a digital-first experience and is able to rapidly innovate

2023 in numbers

OVO Energy successfully migrated 100% of its customer base to the kaluza platform in March 2023, and has since scaled it to more than 100k accounts.

100% on Kaluza by 31 March 2023



Rapid innovation

The platform has enabled rapid innovation, with OVO launching 4 new and differentiated energy plans with an average time from inception to launch of just 16 calendar days.

The EV Plan 19 days

Offering electric vehicle owners a charging rate of $0.08/kWh between midnight and 6am.

The Free 3 Plan 23 days

Customers are encouraged to load shift by using free energy between 11am and 2pm every day.

The Solar Plan 13 days

Tiered Solar FiT. First 4,000 kWh per annum at $0.14/kWh and the rest at $0.07/kWh.

The Business Plan 9 days

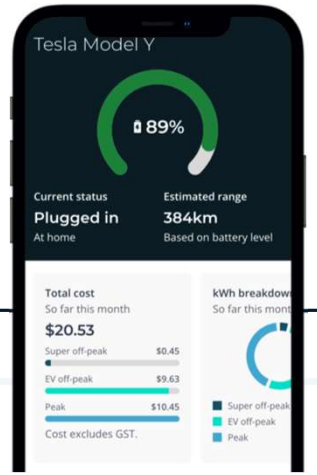
Competitive pisces on smart meters operating with core hours between 8am and 6pm.

Digital-first experience

In 2023 OVO also launch a smartphone app and integrated Kaluza's EV smart charging insights, both online and in-app for Tesla owners.

Android + iOS app 3 months

Designed and implemented by a team of 7, incorporating live balance and Kaluza consumer products.



Thank You!

Jonathan Levy
jonathan.levy@kaluza.com

Questions and Answers

Moderator: Commissioner Katherine Peretick, Michigan Public Service Commission

Guest Speaker

- **Christa Heavey, Energy & Environmental Economics (E3)**
- **Jonathan Levy, Kaluza**
- **Jordan Smith, Southern California Edison (SCE)**

Member EV Roundtable

Please share the situation from your perspective:

- Have utilities mentioned V2G pilots/programs in any filings, plans, or conversations in your state?
- What are your concerns or perceived barriers to help prepare the distribution grid and utilities for V2G?
- Are you aware of other V2G pilots/programs that provide examples or lessons learned to enable grid or customer benefits?

Upcoming 2024 EVSWG Topic

Date (Last Tues. of the month)	Future 2024 EV SWG Topics
December 10, 2024*	Innovative Charging Solutions

* This is the last meeting of 2024. Please let us know what topics you are interested in hearing about in 2025!

Next EV SWG Meeting: **December 10**, 3:00-4:30 pm ET via Zoom

WWW.NARUC.ORG/CORE-SECTORS/ENERGY-RESOURCES-AND-THE-ENVIRONMENT/ELECTRIC-VEHICLES/