Emerging Era of EV Vehicle-to-Home Discharging

Connected Communities

U.S. DEPARTMENT OF ENERGY

Kate Forrest, Ph.D.
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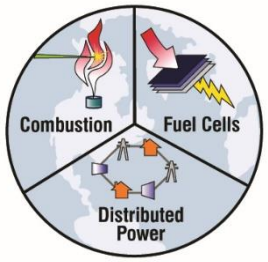
Mobilize SUMMIT DRIVING CHANGE

Connected Communities Project Partners

kb HOME

SUNPOWER®



Advanced Power and Energy Program

UCIrvine | University of California

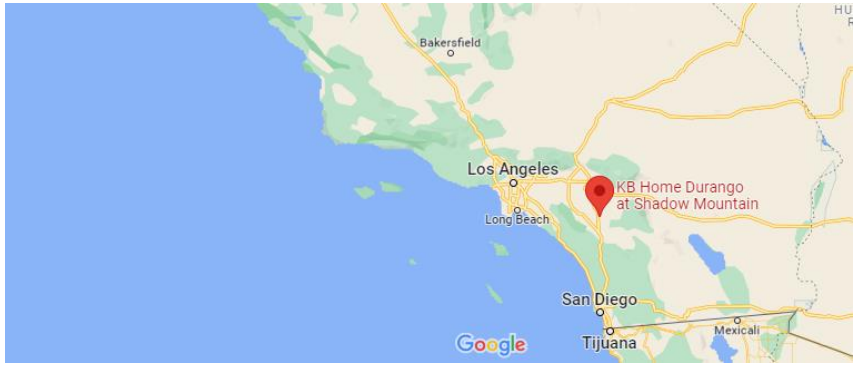
Schneider Electric

SOUTHERN CALIFORNIA EDISON®

KIA

wallbox™

SunPower/KB Home Energy Smart Connected Communities



Durango and Oak Shade at Shadow Mountain

Menifee, CA

Two communities of 219 new homes will host connected microgrids for resiliency and load flexibility

All-Electric homes with 4.9-6 kW solar and 6.4kW/13kWh battery storage

~1MW/2MWh Community Battery

Community VPP option

All Electric Energy-Smart Homes

Schneider Electric™
Square D™ Energy
Center Smart Panel

SunPower® Equinox®
Home Solar System

SunPower® SunVault™
Storage System

10 homes to test Vehicle-to-Home

Electric Vehicle
(EV) Charger

Vehicle-to-Home Lab Testing and Demonstration

Ghazal Razeghi, Ph.D.
Manager, Microgrid and Smart Grid Technologies
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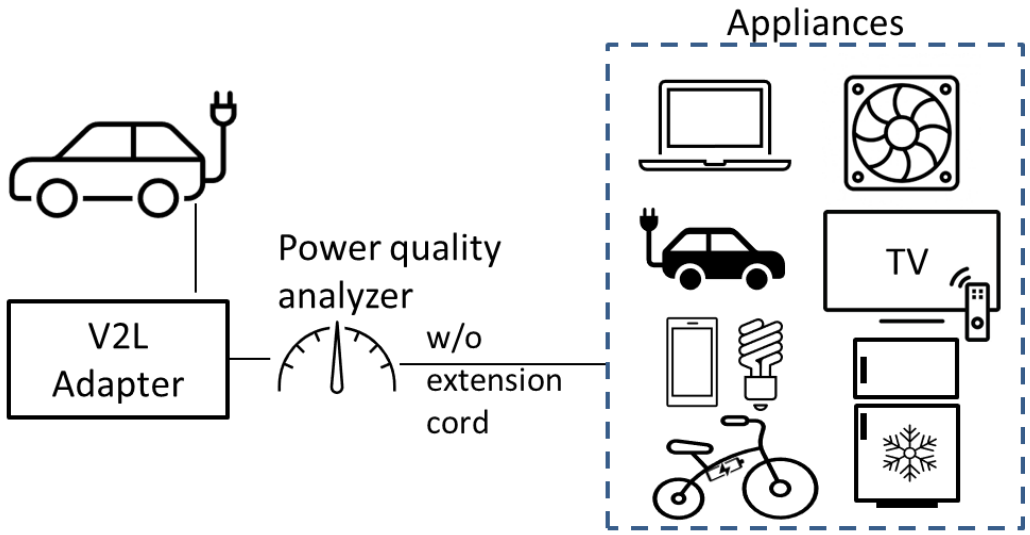
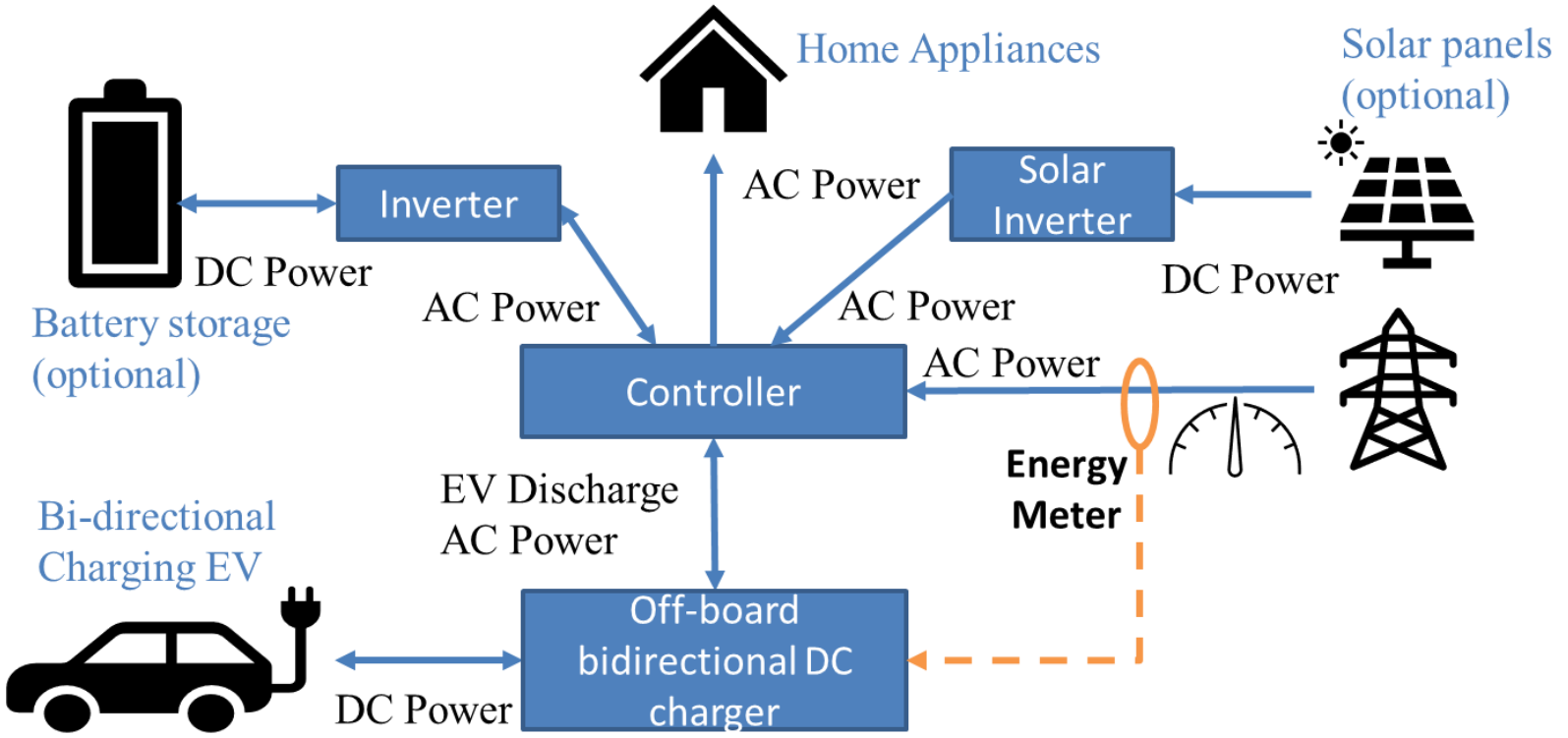
Vehicle/Grid Integration

- **Vehicle-to-Load**



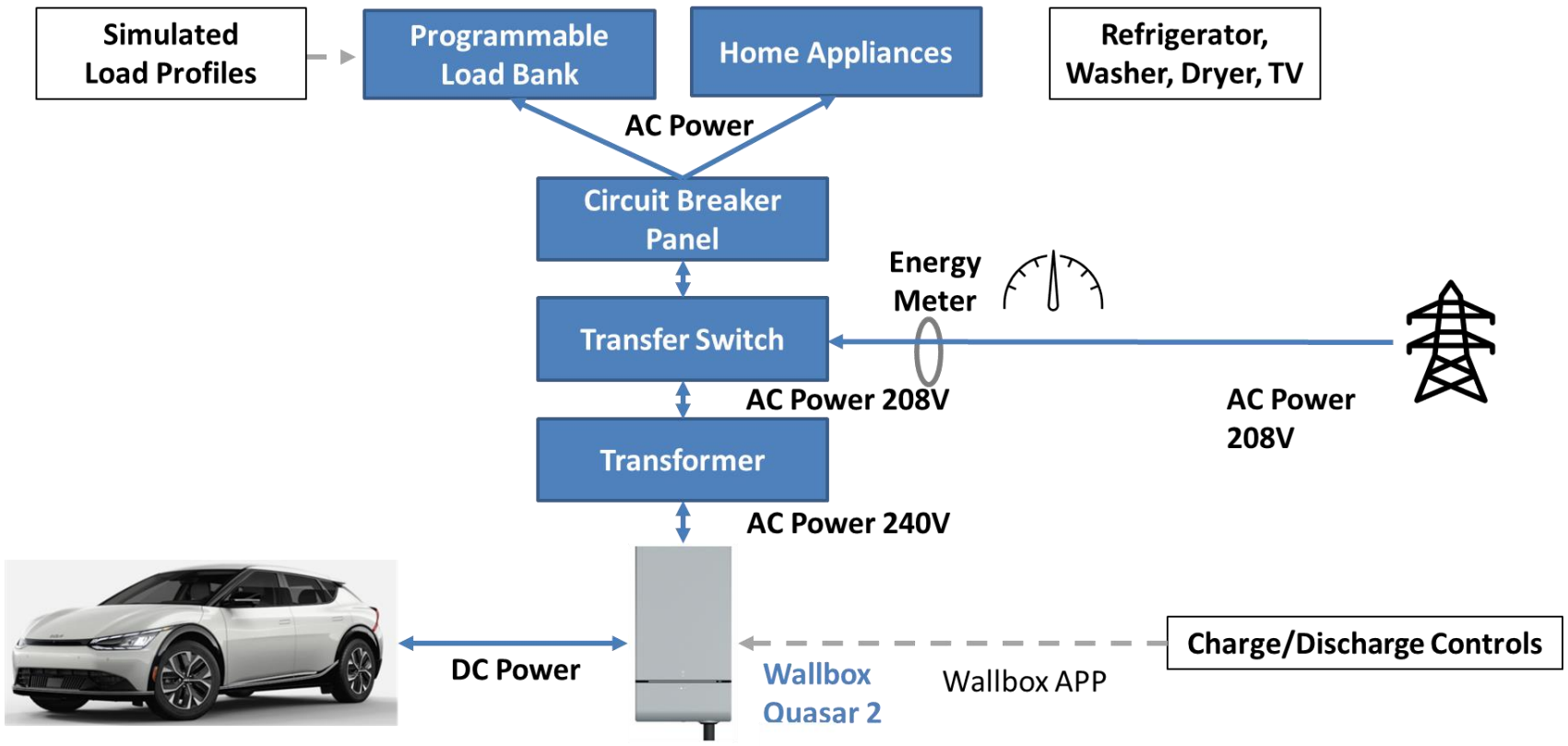
Vehicle/Grid Integration

- **Vehicle-to-Load**
- **Vehicle-to-Home**



Vehicle/Grid Integration

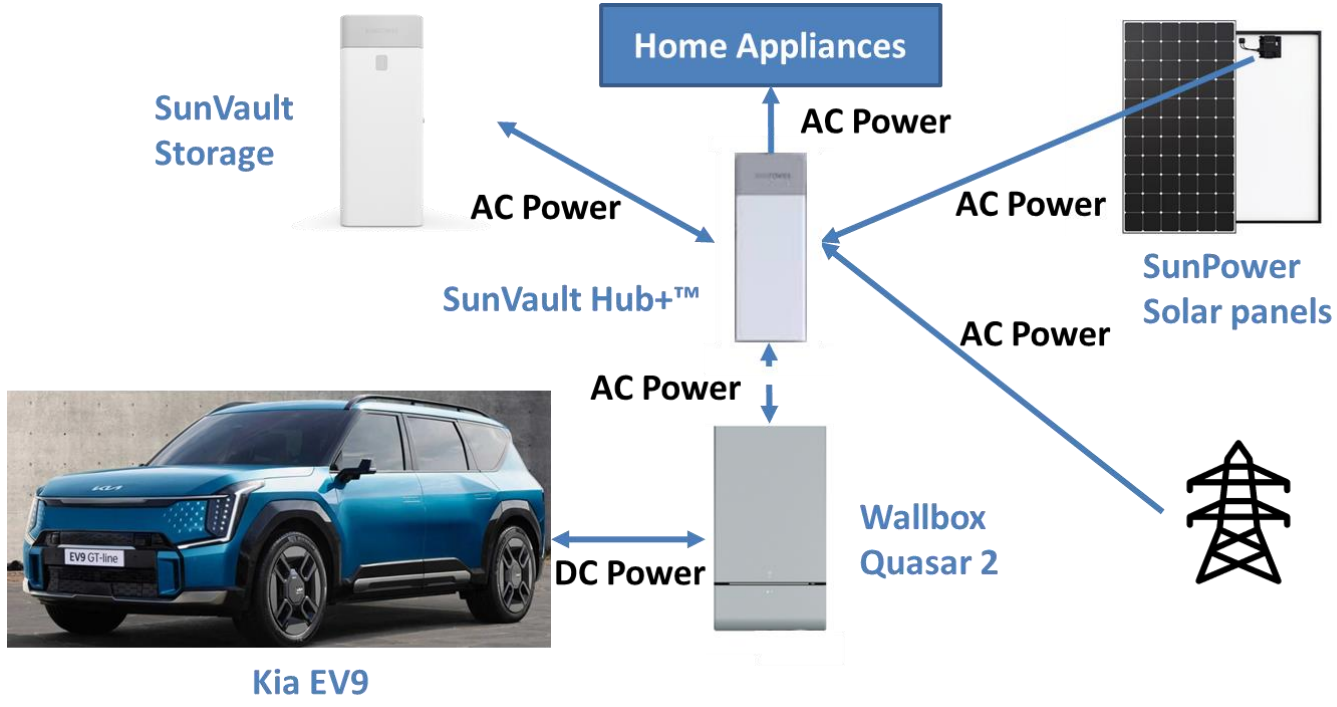
- **Vehicle-to-Load**
- **Vehicle-to-Home**
  - **Laboratory Setup**



Vehicle-to-Home Demonstration

- **Ten homes (out of 219) will be selected**

- **Use Cases:**
  - **Grid-Connected**
    - **Use as a flexible load**
    - **Reduce costs/utility import**
  - **Islanded Microgrid**
    - **Community microgrid is formed**
    - **Home connected to community microgrid**
    - **Vehicle can be used to prolong islanded duration and serve loads**

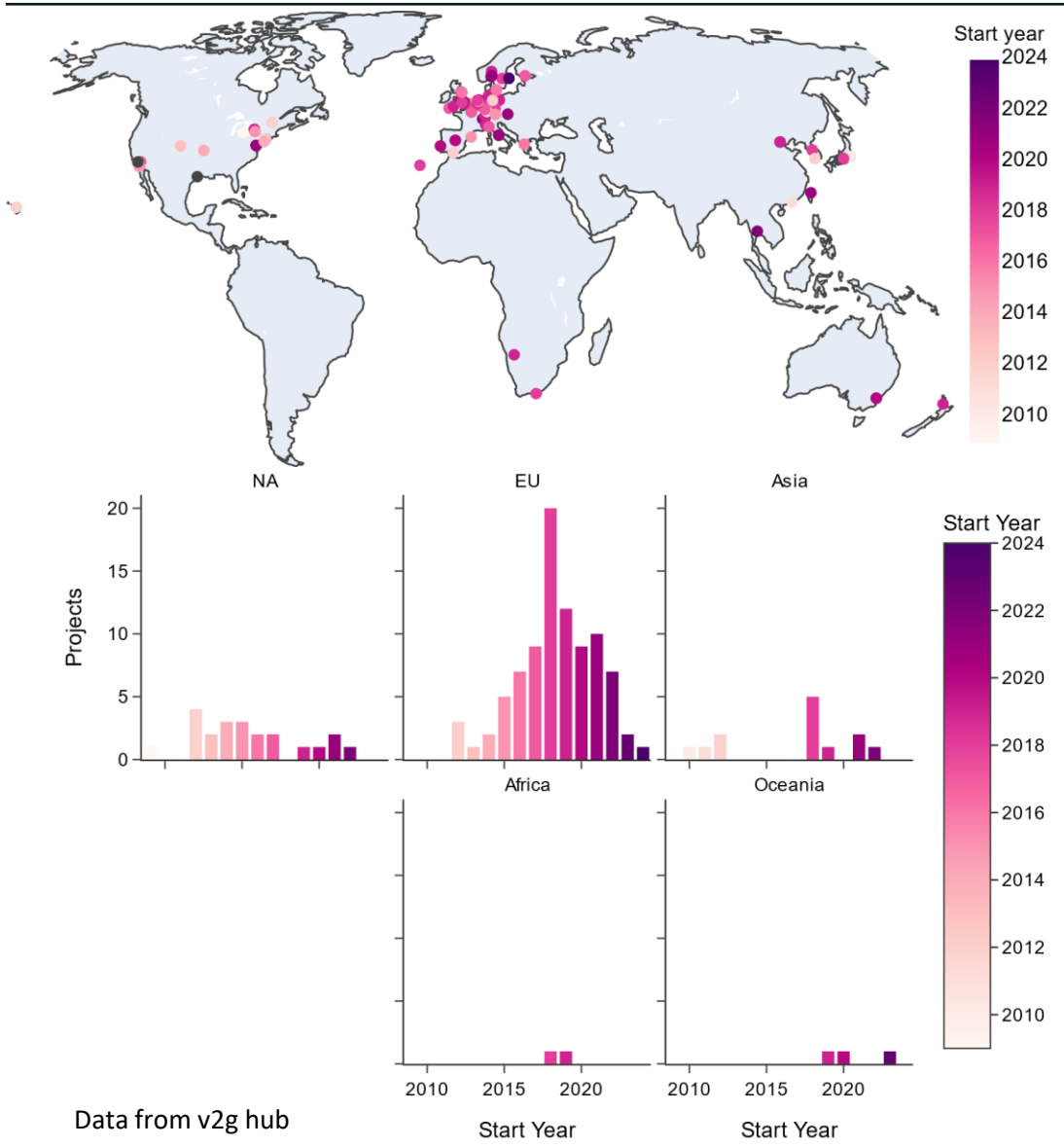


Vehicle 2 Home: Opportunity is Here

EV9: Kia's first bi-directional capable vehicle

- EV9 goes on sale in Nov (vehicle reservations started Oct 16)
  - Mass-market three-row EV SUV
- In '24, V2H feature expected to release to customers
  - 10kW output DC
  - Operate with Wallbox Quasar 2

On again, off again, now is the time for bi-directional charging in NA



Data from v2g hub

1910s

1997

Development and Evaluation of a Plug-in HEV with Vehicle-to-Grid Power Flow

2001

Principal Investigator:
Thomas B. Gage

CARB Grant Number ICAT 01-2

2011

20162020

Now

ELECTRIC VEHICLES AS A NEW POWER SOURCE FOR ELECTRIC UTILITIES

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Photos: Northwestern Library; NY Times; Nissan; KIA
Sources: Everoze 2018, IEEE Spectrum 2023

Challenges to Electrification: A tale of 2 markets

Unidirectional home charger install can range from $0 for simple plug & play installation, to over $5,000 for more complicated installation due to required electric panel upgrades

Recently built house : $400

Item	Cost	Comment
Permit	$100-$250	Cost subject to local jurisdiction
Electric materials	$200-$5,000	Conduit, outlet, wiring, circuit breaker, panel Cost varies depending on charger location (distance from panel), age of panel, etc.
Electrical labor	$200-$1,500	Depends on local market, and time required
TOTAL	**$0-$8,750**	**$0: plug into existing garage outlet** **$8,750: requires new panel, complex upgrades**

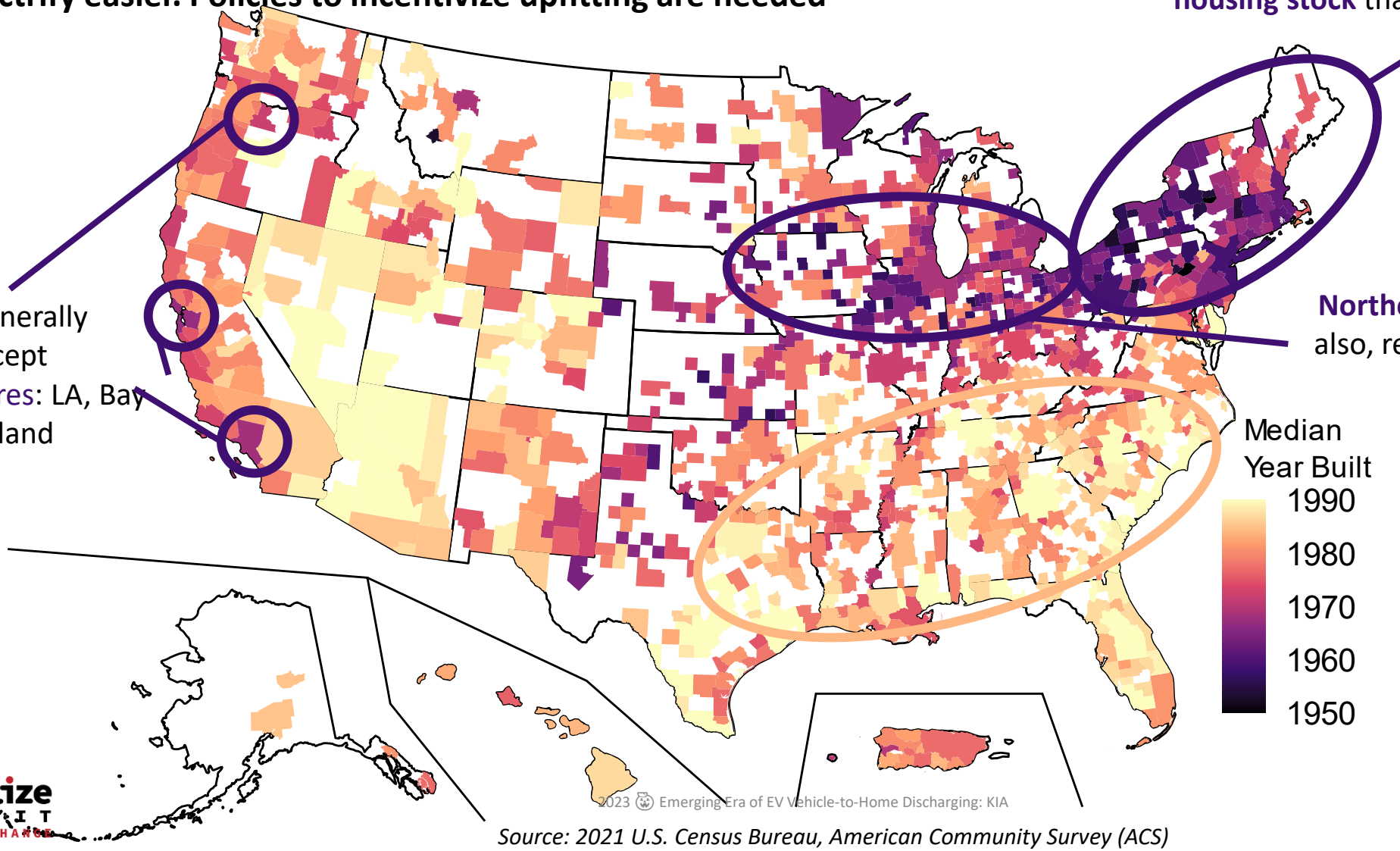
80-year old house: $2,500-$5,000+

- Variables:
  - Type : Single Family Residence, condominium, townhouse
  - **Age of house (older is more costly)**
  - 2/3 of housing units overall with garage/carport
  - Electrical panel capacity (100 amp, etc.) Charger either in garage or outside, proximity to electrical panel
    - In newer homes, sometimes a sub panel (beyond the main) is located in the garage with 100A service

https://homeguide.com/costs/electric-car-charging-stations-cost
https://www.cars.com/articles/what-it-cost-to-outfit-six-homes-with-ev-chargers-447239/

Challenges to Electrification: A tale of 2 markets

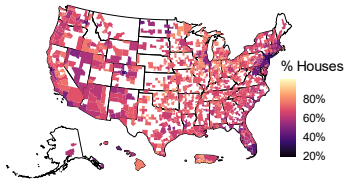
Nationally, separation of older homes and newer homes dictates who can electrify easier. Policies to incentivize upfitting are needed



Source: 2021 U.S. Census Bureau, American Community Survey (ACS)

Challenges to Electrification: A tale of 2 markets

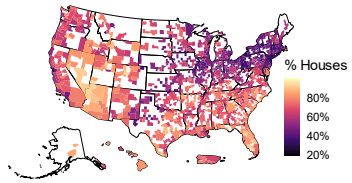
1 unit detached homes, 2021



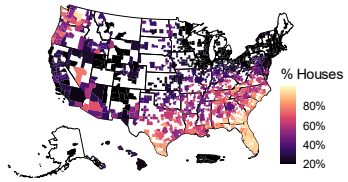
Typically, homes built in 80's+ after have 100A+ panels for centralized heating/cooling

- Northwest, South, and Desert Southwest are strong candidate areas for V2H
- Overall, 17% of US Homes could be strong candidates

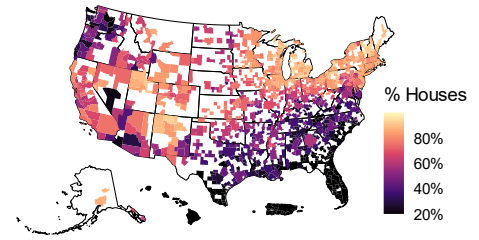
Housing likely with 100A+ panels, 2021



Housing with electric heating , 2021



Housing with combustive heating , 2021



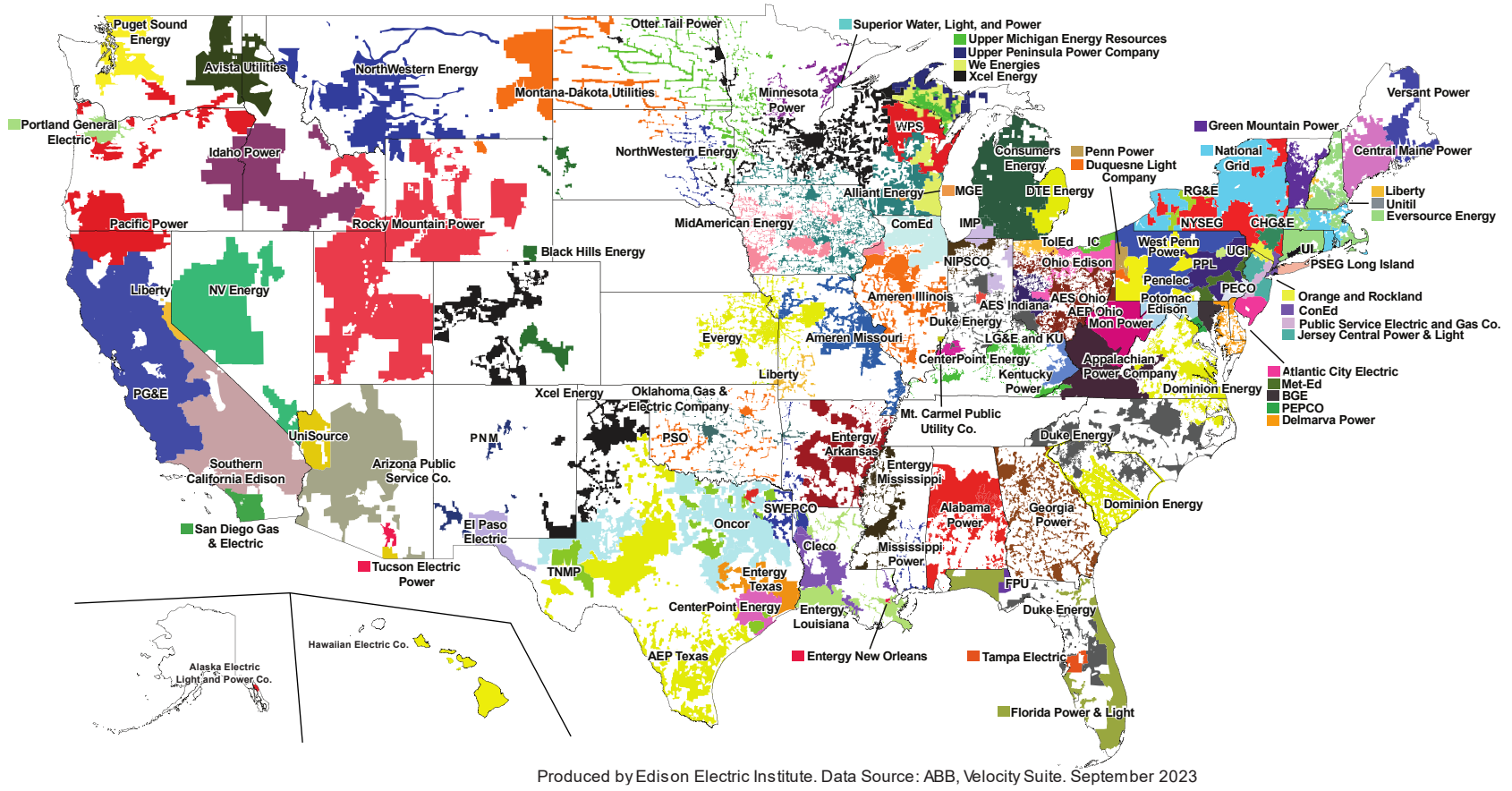
What to Watch:

Northeast has traditionally relied on heating oil furnaces, but with rise of state funded heat pump incentives, this could change (state funded panel upgrades)

Source: 2021 U.S. Census Bureau, American Community Survey (ACS)

Future Questions

- NACS – Bi-directional capability in roadmap, TBD timing
- Tighter Utility Connection to speed interconnection
- Increase Volume of V2H installations, decreased costs (product + installation)
- Vehicle 2 Building
- Opportunities for MUDs?



Produced by Edison Electric Institute. Data Source: ABB, Velocity Suite. September 2023

Quasar 2

North America

First CCS bidirectional charger

Brett Graessle | Mobilize Summit
VP of Global Partnerships and Business Development

wallbox™

WALLBOX AT A GLANCE

We design, develop and distribute charging & energy management solutions for e-mobility

500+k
UNITS SOLD[1]

117
COUNTRIES WITH COMMERCIAL ACTIVITY

20
OFFICES ACROSS 4 CONTINENTS

2
MANUFACTURING FACILITIES

1+mm
IN-HOUSE PRODUCTION CAPACITY[2]

~617k
CHARGING STATIONS CONNECTED[3]

4.3bn
ELECTRIC KM DRIVEN[4]

~564k
TONS OF CO_2 AVOIDED[4]

AWARD-WINNING PRODUCT PORTFOLIO WITH PATENT-PENDING TECHNOLOGY

- Reddot Product Award 2022
- Tom's Guide CES Award 2022
- iF Design Product Award 2022
- GOOD DESIGN Winner 2021
- Engadget Best of CES 2020
- Edison Silver Winner, 2020
- Newsweek Best of CES 2020
- Fast Company World Changing Ideas Finalist, 2020
- Electrek Best of CES 2020

Source: Wallbox data - until June 30st, 2023 | [1] From start of operations | [2]At the end of 2022 & excluding Chinese manufacturing operations | [3]Connected through myWallbox & Electromaps | [4]Based on 406 GWh charged by connected Wallbox chargers

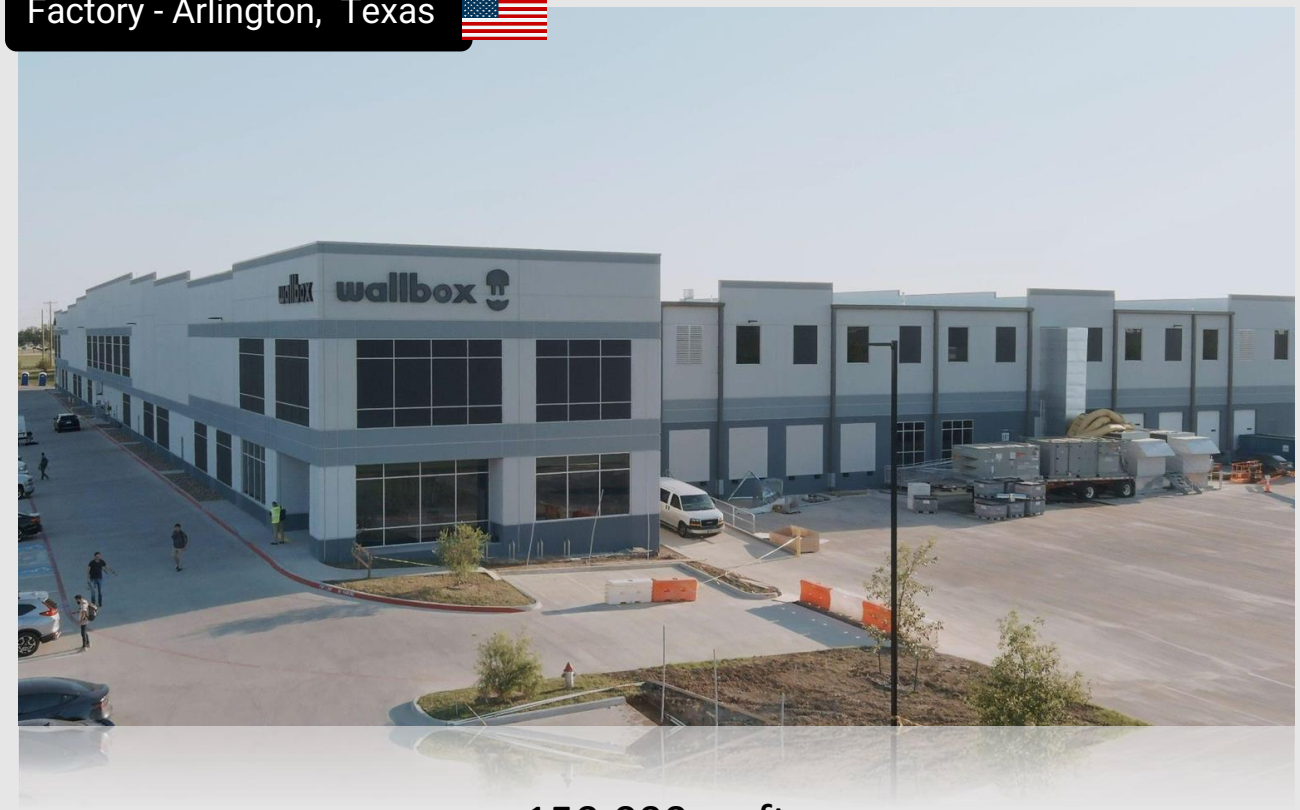
wallbox

Wallbox Factories - Ready to Scale

Factory - D26 Barcelona

120,000 sq ft

Factory - Arlington, Texas



150,000 sq ft

SOLUTIONS OVERVIEW

Wallbox portfolio

Compact

Highest power output per size on the market.

About the size of a Hand

Connected

Via Wi-Fi and bluetooth

*business line with Ethernet & 4G

Smart

Dynamic load balancing and Eco-Smart (Updates every 2 months

Easy-to-use

Personalized and secure user interface.

With iOS and Android APP

Embedded Software

Free APP myWallbox and OCPP 1.6

Durability

Waterproof IP54/IP55 and IK8/IK10 with 3 years warranty (AC products)

Quasar 2

The newest bi-directional DC charger from Wallbox, especially design for the US, that enables the car to power the home, even during a power outage.

More Powerful
12kW for faster EV charging and discharging

Blackout Mode
Use your EV to power your home, daily *or* during a power outage for more than 3 days.

CCS Connector
CCS connector type for compatibility with all next generation, bi-directional enabled vehicles

Updated Design
An updated lightweight design for easy installation that fits your life

Quasar 2 NA

Value Proposition

Value Prop for End-Customer

1 Energy Savings that fit the way you live

V2X
Charge when energy is cheaper, then use that energy to power your Home when expensive or Grid when needed.

Eco-Smart
Obtain breakthrough economics by storing Solar energy surpluses in your EV to self-consume later on.

2 Intuitive, Automatic & Unattended Solution

Hands-free
Set up the Charge/Discharge schedules and let Quasar 2 do the Job.

Intuitive Interface
Easy to use, designed for everyone.

Reports & Statistics
Full control from the palm of your hands. Real-Time 24/7 overview of your energy consumption.

3 Stay Safe at Home

Power Boost & Safety Discharge
Supplement your home's allotted energy while avoiding panel upgrades and your breaker from tripping.

Power Recovery Mode
Use your EV energy to remain disconnected from the Grid around 4 days (no solar considered).

Quasar 2 NA + PRU

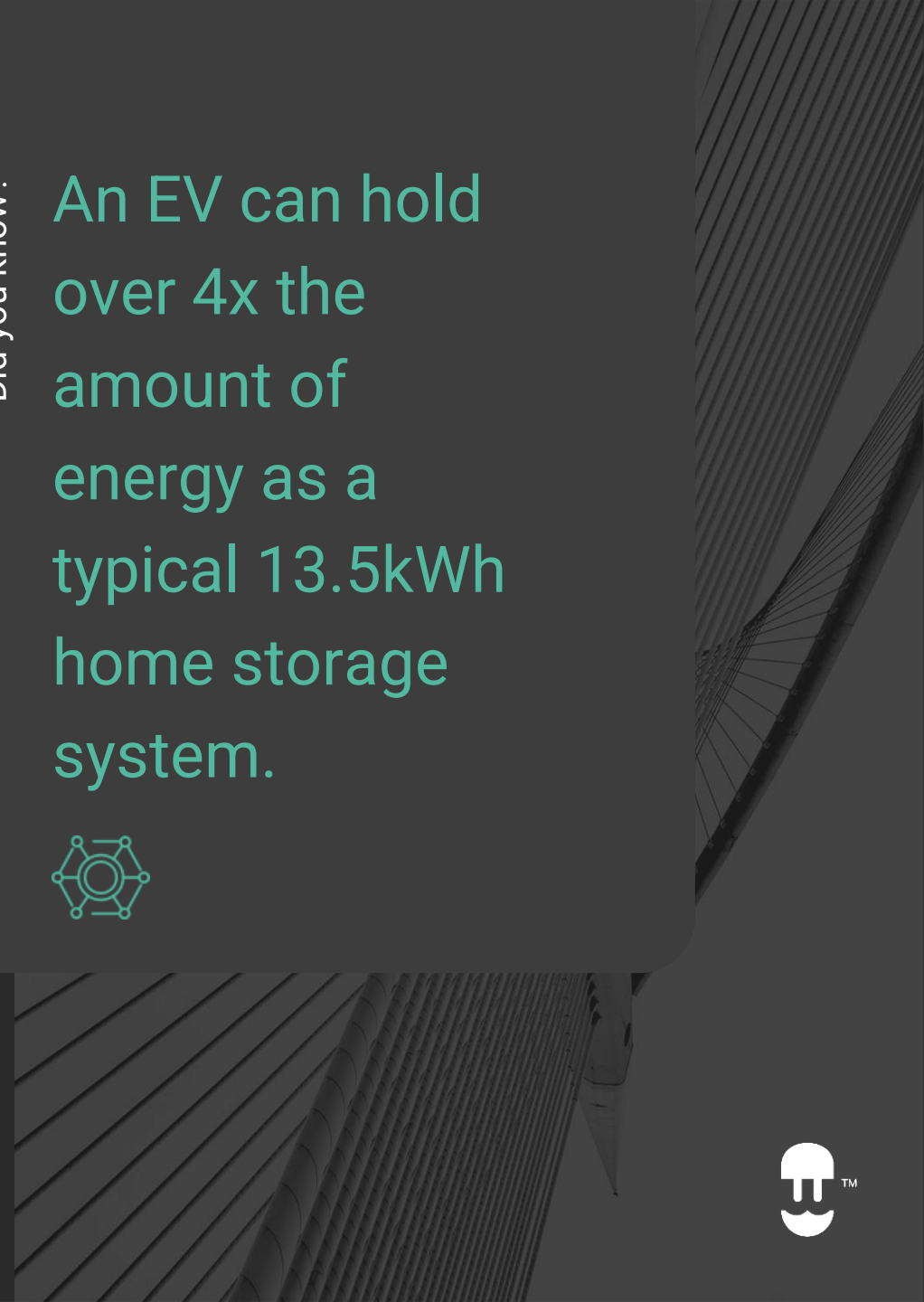
Island Mode + V2H

What is the benefit?

- Supply energy to the home for up to 4 days
- Save up to 500-1300 $/year by reducing dependency on the grid and avoiding high energy costs*
- No need for expensive home energy storage systems (average 5.000 - 10.000$)
- Avoid blackouts with safety discharge
- Store and access solar energy generated from a home PV system**

Did you know?

An EV can hold over 4x the amount of energy as a typical 13.5kWh home storage system.



*Varies based on country, vehicle, energy usage, etc.
**Solar energy compatibility coming soon

Quasar 2 NA

Vehicle-To-Grid (V2G)

What is the benefit?

- Network operators optimize their infrastructure investments and stabilize the grid
- Reduce total cost of EV and fleets ownership
- Helps enabling the mass adoption of EVs
- Provide consumers with savings opportunities
- Integrate renewable energy into existing infrastructure by injecting solar energy to the grid

Source: Bloomberg New Energy Finance, March 2021

Did you know?

By 2030, the energy storage capacity in electric vehicles and buses will reach more than 8.500GWh globally–10x the forecast for installed stationary storage.

Quasar 2 NA

Vehicle-To-Building (V2B)

What is the benefit?

- ✓ Save up to 1000 $/year per fleet vehicle by reducing dependency on the grid and avoiding high energy costs*
- ✓ Save upfront costs by using an existing fleet in place of industrial-grade storage batteries.
- ✓ Avoid grid limitations by expanding your infrastructure
- ✓ Maximize your renewable energy use by storing surplus solar energy in the fleet and then using it to power the building*

*Solar energy compatibility coming soon

Did you know?

The energy storage capacity of a small fleet of just 8 EVs (60kWh/EV) is nearly equivalent to a 500 kWh flow BESS worth in $200,000.

Questions?

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