



Highland

Charging Dispenser



Bi-Directional V2G

Highland

How Electric School Buses Can Do
Triple-Duty: Transportation,
Resiliency, and V2G Resources

Agenda

- Highland – Who we are, what we do, and how we do it
- Our V2G Experience
- A Case Study - Beverly Public Schools



The Highland story



Founded in 2019



Active in 30+ states
& Canada



~\$60 million in grants &
incentives secured for
our partners



Largest electric school
bus project in North
America



600+ electric school
buses under contract



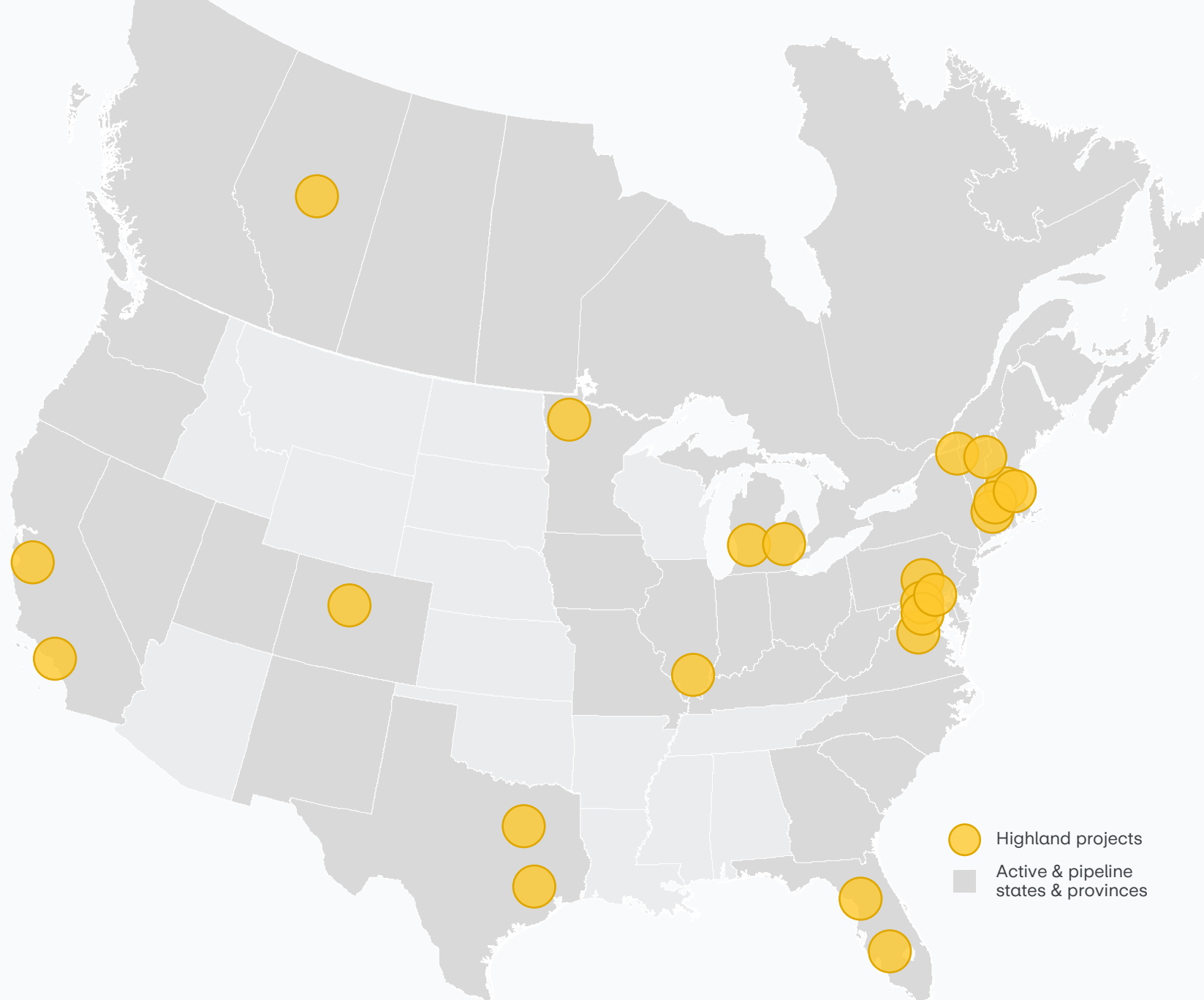
Broad fleet electrification experience

1MM+ ELECTRIC MILES DRIVEN

600+ ELECTRIC SCHOOL BUSES UNDER CONTRACT

20+ SCHOOL DISTRICT PARTNERS

5+ PROJECTS IN RURAL OR UNDERSERVED COMMUNITIES



A partner in fleet electrification



Savings

Avoid peak rates and lower your electric bill by 40-60% with managed charging.



Simplicity

Just plug in your buses and let Highland handle when they charge.



Reliability

Know your buses are charged and ready to go, every day.

Fleet

Our all-inclusive electric bus fleet solution, Highland Fleet includes all the equipment and finances you need to transition your fleet to electric - planned & implemented together at your pace.

- ✓ School Buses
- ✓ Maintenance Cost
- ✓ Chargers
- ✓ Fleet & Charge Management
- ✓ Training

Depot

For districts with existing electric vehicles, Highland Depot upgrades your infrastructure - providing reliable chargers, affordable fueling, coverage of unexpected repairs, and software to manage your fleet.

- ⊖ School Buses
- ✓ Maintenance Cost
- ✓ Chargers
- ✓ Fleet & Charge Management
- ✓ Training



Why Lead with the School Bus?

School buses are the perfect electric vehicle use case – predictable routes, single charging location, equitable benefits.



Predictable

Defined routes, limited range & uniform depots



Versatile

Large & underutilized bidirectional battery



Available

4+ EV models with fierce OEM competition

V2G with Highland



Vehicle-to-grid (V2G) with Highland

# OF BUSES	ENERGY CAPACITY	IMPACT TO COMMUNITY
25	5 MWh	116 Local Homes for 1 Day
275	58 MWh	1,400 Local Homes for 1 Day
1,100	231 MWh	5,500 Local Homes for 1 Day



Electric school buses are essentially batteries on wheels. They're ideally suited to provide capacity, stability, and emergency power to the grid.



500k electrified buses add 60GWh of storage capacity.



Highland uses V2G participation to offset the upfront cost of electric buses and make your fleet more affordable.

Real Results

In the summers of 2021 - 2023, Highland participated in commercial V2G programs with National Grid and Green Mountain Power that sent **29.3 MWh** back to the grid over **368 hours**.

V2G Conceptual Diagram

Provide up to nine hours of 60kW output with a three-bus bidirectional charging system:



600 kWh of mobile dual-use EDSI assets¹

Three interconnected 60 kW bidirectional chargers²

Single 60 kW bidirectional inverter for charge / discharge³

Backflow energy to anywhere with a bidirectional charger: installation distribution grid, microgrid, or critical infrastructure⁴

A single 3-bus system (pictured) services a peak electric power output of 60 kW for 9 hours

40 systems (4,000-amps) will support 2.4 MW of power output for 9 hours (or 60 kW for 360 hours)



1. Based on 200kWh of usable battery capacity on Thomas Built Jouley (2022 vintage); actual capacity varies by OEM model
 2. Sequential discharge format requires cycling between ports; simultaneous discharge capabilities expected in 2023
 3. System capable of continuous backflow of 60 kW until bus batteries are depleted; DC-to-AC conversion results in approximately 5% line losses in Highland operating projects
 4. Additional electrical panels and controls required for interconnection; dependent on localized project dynamics

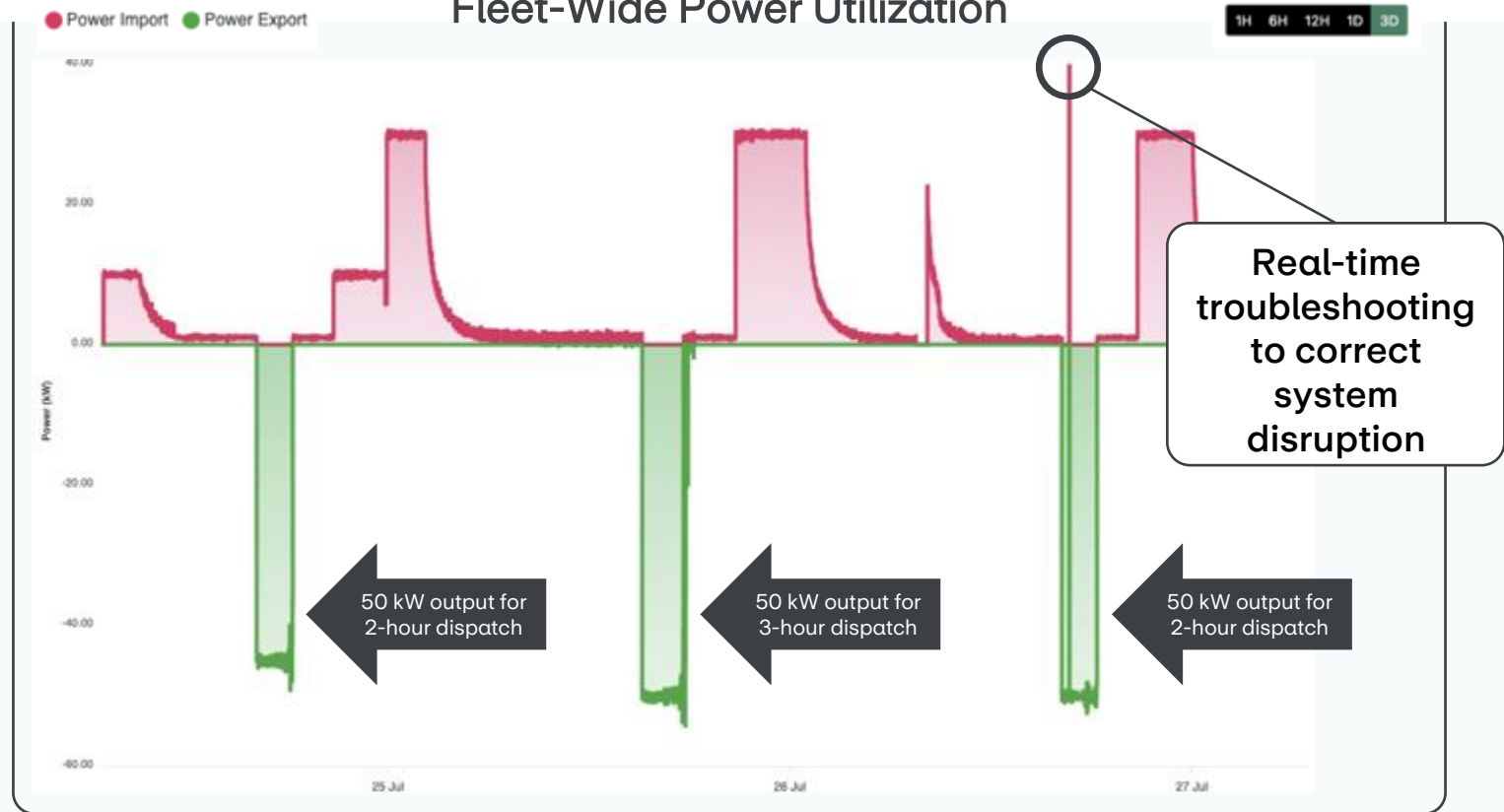
V2G Operating Experience

Highland has two operating Vehicle-to-Grid projects for peak shaving



Single Bus V2G Performance Summer 2022 – Massachusetts¹

Fleet-Wide Power Utilization



1. Snapshot from Highland's energy management software system, developed in coordination with partner Synop. Output not a guarantee of future performance.

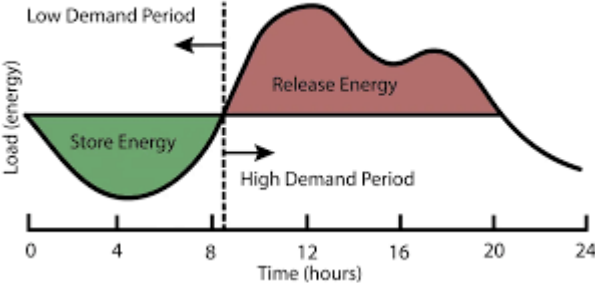
Development of V2G Market Mechanisms

V2G is possible in active demand response programs today

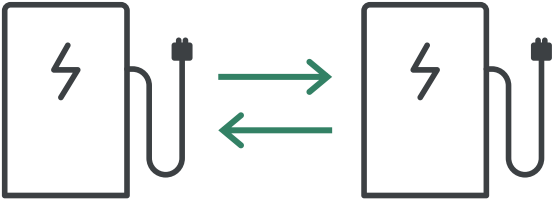


nationalgrid

Program administrators identify peak periods when stored electricity can help



School buses respond to performance-based incentive payments



Get Paid to Discharge at Peak!

Where to next?



Many utilities,
state agencies,
and regulators
are exploring
V2G
opportunities
today

Primary program mechanisms
under discussion include:

- Bi-directional equipment
incentive programs
- Peak demand reduction
incentives
- Wholesale market
participation
- Time of use/Time varying
rates
- Preferential/expedited
interconnection

CASE STUDY

Beverly, MA



The Team

Planning/ Budgeting

We partnered with Beverly's Transportation Director, Dana Cruikshank, and his team to implement a 2-bus pilot that's now expanding to 30 buses.



Beverly's Electric Fleet

Training

We trained Beverly's drivers and mechanics on how to use and maintain the electric vehicles.



The Fleet

Beverly's Electric Fleet

Fleet Build

Beverly selected Thomas Built Saf-T-Liner® C2 Jouley® for their fleet, designed to their specifications.

Fleet Charging

We installed high power, bi-directional charging stations to fully charge buses in 3 hours.



The Depot

Beverly's Electric Fleet

Depot Build

We future-proofed Beverly's depot by installing infrastructure for 24 buses.

Depot Charging

We powered the site in partnership with National Grid, enabling vehicle-to-grid connectivity.



Thank you



Amy McGuire
amy@highlandfleets.com

Appendix



ELECTRIC FLEET

Community benefits



Community Health

Emissions-free vehicles eliminate toxic diesel fumes.



Environmental Justice

Improve air quality for traditionally underserved communities.



School Budgets

Restore balance to your transportation budget with predictable pricing.



Driver Satisfaction

Recruit and retain drivers with clean, quiet, and easy-to-drive vehicles.



Climate

Reduce pollution & greenhouse gas emissions.



Academic Success

Improve academic performance & increase attendance with cleaner air.



Emergency Resilience

Electric school buses can power your community in an emergency.



Grid Modernization

With vehicle-to-grid technology (V2G), electric school buses are helping build a stronger grid.



**1.3 million
additional
days of
student
attendance**

Replacing all US pre-2000 model year diesel school buses would result in >1.3 million additional student days of attendance each year*

**Randomized design evidence of the attendance benefits of the EPA School Bus Rebate Program (Peddle, et al. 2023)*



The smartest way to upgrade to electric

With a Highland partnership:

- 1 Plan** We design & implement the entire project.
- 2 Budget** We apply for grants & create a budget that encompasses all aspects of your electric fleet.
- 3 Build** We procure school buses & infrastructure & manage the construction of depot upgrades.
- 4 Train** We train your drivers & mechanics to operate & maintain your new fleet.
- 5 Charge** We charge the school buses during off-peak hours and ensure you're ready for all routes.
- 6 Maintain** We cover charger repairs & reimburse for school bus repair costs, including parts and labor.

Performance Promise: We guarantee charger uptime and provide ongoing service & support for bus operations

Real Results



1,000,000+
electric miles driven



97%
charger uptime across all
active projects

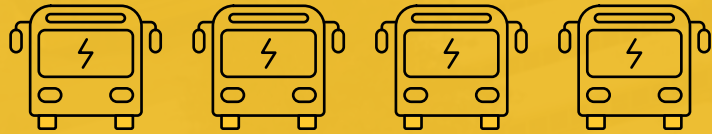


~15-minute
response time to support
requests



Grant dollars for your transportation budget

Highland has helped districts secure ~\$200 million in grants & incentives



More buses, for less \$

Grants & incentives make your existing transportation budget go further



Federal Programs

EPA Clean School Bus Program, IRA, ZETF, DOE



Local Programs

HVIP, NYTVIP, MOREV
MassCEC ACTBus

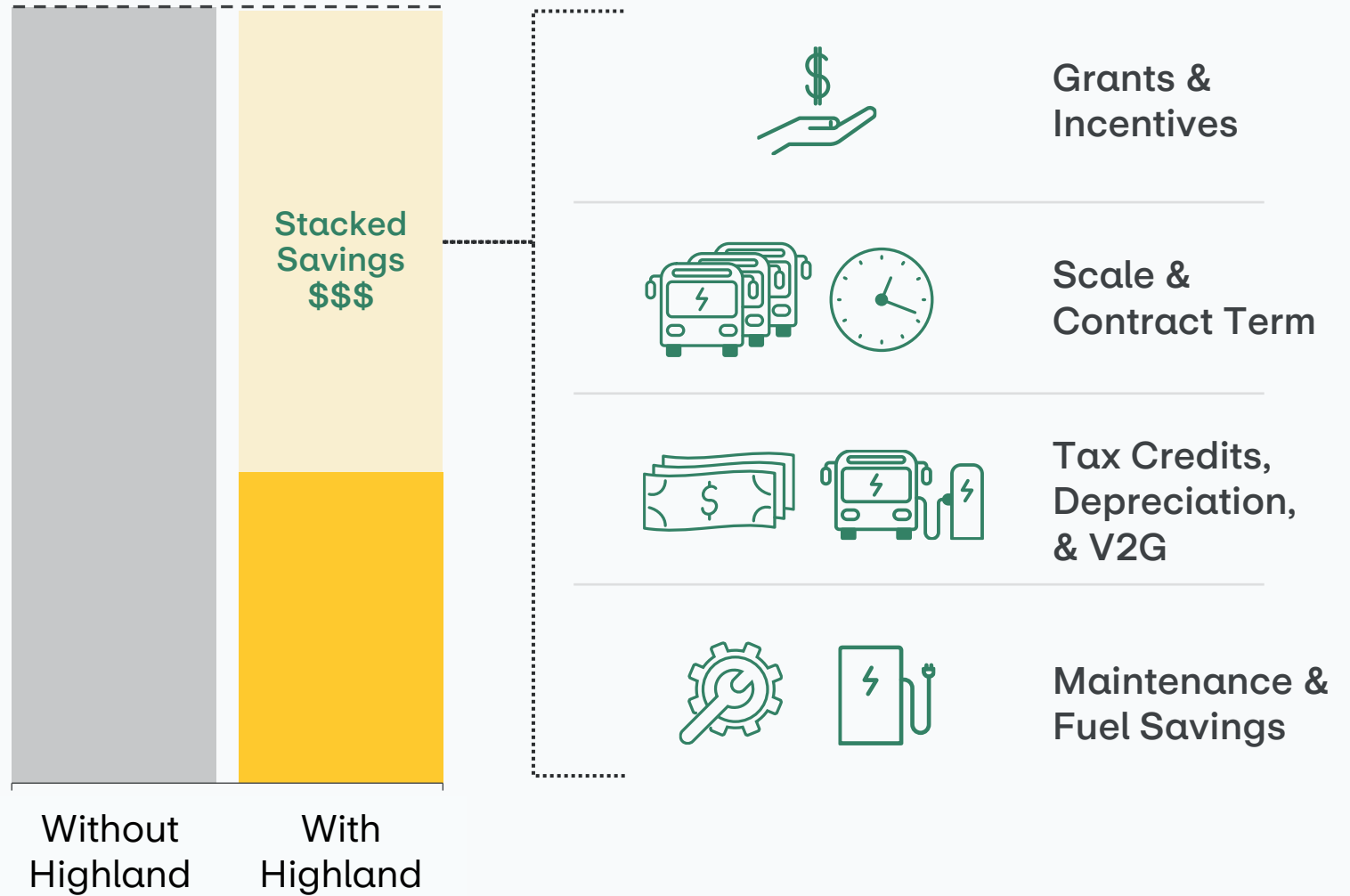


Utility Programs

EVSE Rebates, Demand Response, V2G

Highland makes electric fleets affordable

Total Project Cost



V2G events with Highland

Dashboard: Highland's charge & fleet management software

