Sustainable Transportation

Vehicle & Charging Recommendations Approaching 2025

Kate Della Pietra, Jake Duffy, Claire Briglio, Michelle Drandell, Ernest Robertson, Clio Dakolias, Justas Pakašius
Introductions: Our Team

Claire Briglio  Clio Dakolias  Michelle Drandell  Jake Duffy

Justas Pakašius  Kate Della Pietra  Ernie Robertson
Overview of Presentation

Project Overview
Global Initiatives, Plan 2030, Project Methodology

Fleet Breakdown
Short Description, Vehicle Recommendations

General Recommendations
Areas of improvement, 2025 onwards

Data Analysis
Emissions Model, Fleet Findings

Charging Plan
Campus map with proposed EV charging location
Climate change is global and particles emitted today will persist in the atmosphere for a long time. Emissions here today will affect humans for generations.

Certain communities and societies have a higher responsibility due to higher historic emissions. Columbia has an opportunity to lead not only through its research, but also through action.

Urgent and bold steps are needed to mitigate the worst outcomes of the climate emergency. Columbia’s ambitious climate plans require action on behalf of its community.
Columbia’s Plan 2030’s Road to Zero Emissions

- 21% by 2025
- 42% by 2030
- 63% by 2035
Project Description

Align Columbia with its vehicle emissions reductions targets for 2025 by proposing a detailed electrification and charging plan.
<table>
<thead>
<tr>
<th>Our Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background Research</strong></td>
</tr>
<tr>
<td>Literature Review of EV space and Sustainable Transportation</td>
</tr>
<tr>
<td><strong>10+ Informational Chats</strong></td>
</tr>
<tr>
<td>Consultation with fleet managers to understand operations</td>
</tr>
<tr>
<td><strong>Data Synthesis</strong></td>
</tr>
<tr>
<td>Collection of fleet vehicle usage to create emissions model</td>
</tr>
<tr>
<td><strong>Vehicle Analysis</strong></td>
</tr>
<tr>
<td>Propose EV replacement for highest emitting vehicles in each fleet</td>
</tr>
<tr>
<td><strong>Charging Layout</strong></td>
</tr>
<tr>
<td>Consult ConEd, charging companies &amp; Columbia community</td>
</tr>
</tbody>
</table>
Data Overview
### Overview of Model

<table>
<thead>
<tr>
<th>Department</th>
<th>Emissions(Metric Tonnes of CO₂)</th>
<th>Fuel Used(GA)</th>
<th>Diesel Usage</th>
<th>Electric Usage</th>
<th>Gas Usage</th>
<th>% of Total Emissions</th>
<th>% of Diesel Usage</th>
<th>% of Gas Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arbor Shuttle</td>
<td>228.30</td>
<td>25689.64</td>
<td>0.00</td>
<td>0.00</td>
<td>25689.64</td>
<td>22.74%</td>
<td>0.00%</td>
<td>35.05%</td>
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<tr>
<td>Baker Shuttle Emissions (x2)</td>
<td>193.30</td>
<td>18988.12</td>
<td>18988.12</td>
<td>0.00</td>
<td>0.00</td>
<td>19.25%</td>
<td>54.80%</td>
<td>0.00%</td>
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<tr>
<td>Mail</td>
<td>15.88</td>
<td>1716.24</td>
<td>482.84</td>
<td>0.00</td>
<td>1233.40</td>
<td>1.58%</td>
<td>1.39%</td>
<td>1.68%</td>
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<tr>
<td>Intercampus MV Loop</td>
<td>27.12</td>
<td>2664.00</td>
<td>2664.00</td>
<td>0.00</td>
<td>0.00</td>
<td>2.70%</td>
<td>7.69%</td>
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<tr>
<td>Facilities</td>
<td>102.33</td>
<td>11267.52</td>
<td>1725.64</td>
<td>5.00</td>
<td>9536.87</td>
<td>10.19%</td>
<td>4.98%</td>
<td>13.01%</td>
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<tr>
<td>CUIMC</td>
<td>0.27</td>
<td>30.00</td>
<td>0.00</td>
<td>0.00</td>
<td>30.00</td>
<td>0.03%</td>
<td>0.00%</td>
<td>0.04%</td>
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<tr>
<td>Intra Vans</td>
<td>93.51</td>
<td>9945.72</td>
<td>3963.72</td>
<td>0.00</td>
<td>5982.00</td>
<td>9.31%</td>
<td>11.44%</td>
<td>8.16%</td>
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<tr>
<td>Overflow(x2)</td>
<td>55.87</td>
<td>5493.20</td>
<td>5493.20</td>
<td>0.00</td>
<td>0.00</td>
<td>5.56%</td>
<td>15.85%</td>
<td>0.00%</td>
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<tr>
<td>Via</td>
<td>76.95</td>
<td>8659.00</td>
<td>0.00</td>
<td>0.00</td>
<td>8659.00</td>
<td>7.66%</td>
<td>0.00%</td>
<td>11.81%</td>
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<td>Public Safety</td>
<td>178.65</td>
<td>19908.65</td>
<td>1331.53</td>
<td>0.00</td>
<td>18577.11</td>
<td>17.79%</td>
<td>3.84%</td>
<td>25.35%</td>
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<tr>
<td>Lamont</td>
<td>28.81</td>
<td>3242.26</td>
<td>0.00</td>
<td>0.00</td>
<td>3242.26</td>
<td>2.87%</td>
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<td>4.42%</td>
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<td>Libraries</td>
<td>3.08</td>
<td>346.39</td>
<td>0.00</td>
<td>0.00</td>
<td>346.39</td>
<td>0.31%</td>
<td>0.00%</td>
<td>0.47%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>1004.06</strong></td>
<td><strong>107950.73</strong></td>
<td><strong>34649.05</strong></td>
<td><strong>5.00</strong></td>
<td><strong>73296.68</strong></td>
<td><strong>100.00%</strong></td>
<td><strong>100.00%</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>

**Diesel Calculations:**
10,180 grams of CO₂/gallon of diesel = 10.180 × 10⁻³ metric tons CO₂/gallon of diesel

**Gasoline Calculations:**
8,887 grams of CO₂/gallon of gasoline = 8.887 × 10⁻³ metric tons CO₂/gallon of gasoline

Source:
https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references
2021 Fleet Emissions Breakdown

- Lamont: 2.9%
- Public Safety: 17.8%
- Arbor Shuttle: 22.7%
- Via: 7.7%
- Baker Shuttle: 19.3%
- Overflow(x2): 5.6%
- Mail: 1.6%
- Intra Vans: 9.3%
- Intercampus MV: 2.7%
- Facilities: 10.2%
Fleet Recommendations for 2025
Criteria for Vehicle Recommendations

1. Provide the same physical capacity
2. Maintain the department services and operations
3. Stay around the average market price cost
4. Ensure the switch is achievable by 2025
Arbor Shuttle

OVERVIEW
2 VEHICLES

2021 Total Emissions
22.74%

Ford Goshen
11.46%
Ford Glaval
11.28%

RECOMMENDATIONS:

Plan A
1. Reduce Shuttle Trips
2. Store Vehicles near Columbia or The Arbor
3. Purchase Two EV Shuttles
   a. Ford E-450 Cutaway/Chassis

22% DECREASE IN TOTAL EMISSIONS

Plan B
1. Retrofit Vehicles using XL Fleet or similar company (Flux Hybrid, Make Mine Electric, etc.)

~4.55% DECREASE IN TOTAL EMISSIONS
Baker Shuttle

OVERVIEW
Low Sulfur Diesel Buses

2021 Total Emissions
19.25%

RECOMMENDATION

Diesel Bus Replacement
Van Hool CX45E (x4)

19% Decrease in total Emissions

Reduction per Bus
Bus 1:
- 30% of fleet
- 6% of total
Bus 2:
- 27% of fleet;
- 5.4% of total
Bus 3:
- 15% of fleet;
- 3% of total
Bus 4:
- 15% of fleet
- 3% of total
Proposed Electric Bus Route for the Baker Shuttle

Proposed Baker Loop Using Lot D

*Blue buses are charging
Public Safety

OVERVIEW
27 VEHICLES
20.73%

RECOMMENDATION

Vehicles to Replace
- 2015 Nissan Pathfinder
- 2014 Nissan Pathfinder
- 2015 Ford Fusion (3x)
- 2016 Ford Fusion

Replacements
- Primary Recommendation: 2022 Hyundai Ioniq 5 SE Standard Range
- Secondary Recommendation: 2023 Hyundai Kona Electric SEL

11% DECREASE IN TOTAL EMISSIONS
Facilities

**OVERVIEW**
15 VEHICLES (Morningside)

2021 Total Emissions 10.2%

**RECOMMENDATION**

8% DECREASE IN TOTAL EMISSIONS

**Vehicles to Replace**
- 2010 Jeep Wrangler
- 2016 Dodge Grand Caravan
- 2017 Ram 3500 Promaster
- 2018 Chevy Colorado

**Replacements**
- Jeep Wrangler 4XE Hybrid
- Chevy Bolt EUV
- Ford E-Transit Cargo Van
- Ford F-150 Pro Lightning

**Future replacement of trash trucks:**
- XLE Electric Curbtender
- eQuantum
Intramural Vans

OVERVIEW
12 VEHICLES
9.3%
2021 Total Emissions

Ford E-350
Chevy Express
Mercedes Sprinter Van

RECOMMENDATION

Plan A:
Future Market Availability
12-15 person capacity
300 mile range
Reliable off-site charging infrastructure

Plan B:
Implement a plan to phase out the three oldest vans in the fleet (Vans 00, 01, and 22) for the 2023 Ford E transit Passenger van to be used for day trips only and be charged in the Grove.

NO DECREASE IN TOTAL EMISSIONS
OVERVIEW

16 VEHICLES

8.93%

All vehicles are uniform Mercedes Metris

RECOMMENDATION

Plan A:
Via has no zero emissions plan unlike Lyft: urge Via to develop one or switch to Lyft.

Wait until 2025 for more affordable and varied 7-passenger vehicles to emerge.

Plan B:
Encourage a switch to Mercedes-Benz EQV or retrofitted Ford minivans, the only existing alternatives.

NO DECREASE IN TOTAL EMISSIONS
OVERVIEW
8 VEHICLES
1.58%

Toyota Scion, Tesla, Mercedes 11P Sprinter, Mercedes 15P Sprinter, Chevy Tahoe, Subaru Crosstrek, Chevy Bolt, Ford E350 15P

RECOMMENDATION

1. Toyota Scion
2. Chevy Tahoe
3. Blue Tech 9P Mercedes Sprinter
4. Mercedes 14P Sprinter

1. Chevy Bolt 5 Door Hatchback
2. Rivian R1S SUV
3. 2023 Ford E-Tourneo Custom
4. Do not replace

1.03% DECREASE IN TOTAL EMISSIONS
MV Loop

OVERVIEW
1 VEHICLE
New Flyer Low Floor XE45

2021 Total Emissions
2.7%

RECOMMENDATION
VMC

15 hr/day

NO DECREASE IN TOTAL EMISSIONS
OVERVIEW

1 VEHICLE

2009 Ford Econoline

0.36%

2021 Total Emissions

RECOMMENDATION

Ford Econoline ➔ Ford E-Transit Low Roof Cargo Van

0.36% DECREASE IN TOTAL EMISSIONS
Lamont Operations

OVERVIEW
11 VEHICLES
Ford F250 Super-Duty
Ford F350 Super-Duty
Chevy Express
Ford Escape

2021 Total Emissions
2.9%

RECOMMENDATION
Await an EV alternative that has the dependability and torque/towing capacity of the current Ford F250 and F350 Super Duty Models to hit the market.

NO DECREASE IN TOTAL EMISSIONS
OVERVIEW

3 VEHICLES

0.03%

RECOMMENDATION

After 2025, consider the purchase of Ford F-150 Lightning or a similar class of vehicles able to perform the same role.

NO DECREASE IN TOTAL EMISSIONS
Charging
### Charging 101

<table>
<thead>
<tr>
<th><strong>Volt</strong></th>
<th>A unit of electromotive force, the “pressure” that pushes electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amp</strong></td>
<td>The maximum amount of electrical current that can be delivered to the vehicle</td>
</tr>
<tr>
<td><strong>kWh</strong></td>
<td>Quantity of electricity delivered to vehicle per hour ( (V \times A / 1000) )</td>
</tr>
<tr>
<td><strong>kW</strong></td>
<td>Rate of energy flow ( (V \times A) = \text{Charging Rate} )</td>
</tr>
</tbody>
</table>

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#### Opportunity Charging vs. Depot Charging

- **Level One**: 120V Electrical source from a regular home outlet. Charge Time: 2.5 miles of range per 1 hour of charging.
- **Level Two**: 220V Electrical source from a regular home dryer outlet, home hardwire, or public station. Charge Time: 10-20 miles of range per 1 hour of charging.
- **DC Fast Charge**: 208 or 480V 3-Phase AC Electrical source from a public station. Charge Time: 60-80 miles of range per 20 minutes of charging.

Source: [https://marylandev.org/charging/](https://marylandev.org/charging/)
ChargePoint: Recommended Chargers

- **CPF50**
  - Level 2

- **CT4000**
  - Level 2

- **Smart DC Fast Charging**
  - Express 250
    - Level 3

- **Express Plus**
  - Power Block
    - Level 3
# Charger Recommendation Per Vehicle

<table>
<thead>
<tr>
<th>Fleet</th>
<th>Vehicle Info</th>
<th>Battery (kWh)</th>
<th>Charger Needed</th>
<th>Charging Times (0-100%)</th>
<th>Charger Recommendation</th>
<th>Charging Time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Safety</td>
<td>2022 Hyundai Ioniq 5 SE Standard Range (SUV)</td>
<td>58</td>
<td>Level 2</td>
<td>300 min</td>
<td></td>
<td>4.833333333</td>
</tr>
<tr>
<td>Public Safety</td>
<td>2022 Hyundai Ioniq 5 SE Standard Range (SUV)</td>
<td>58</td>
<td>Level 2</td>
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<td></td>
<td>4.833333333</td>
</tr>
<tr>
<td>Public Safety</td>
<td>2022 Hyundai Ioniq 5 SE Standard Range (SUV)</td>
<td>58</td>
<td>Level 2</td>
<td>300 min</td>
<td></td>
<td>4.833333333</td>
</tr>
<tr>
<td>Public Safety</td>
<td>2022 Hyundai Kona Electrical SEL (SUV)</td>
<td>64</td>
<td>Level 2</td>
<td>360 min</td>
<td></td>
<td>5.333333333</td>
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<tr>
<td>Arbor</td>
<td>Ford E-450 Cutaway (Lightning eMotors)</td>
<td>125</td>
<td>Level 2 AC or DC</td>
<td>7.5-8hr (AC) or 2-2.5 hr (DC)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Arbor</td>
<td>Ford E-450 Cutaway (Lightning eMotors)</td>
<td>125</td>
<td>Level 2 AC or DC</td>
<td>7.5-8hr (AC) or 2-2.5 hr (DC)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Facilities</td>
<td>Chevy Bolt EUV</td>
<td>65</td>
<td>Level 1, 2 or 3</td>
<td>Level 1: 12 hours, 2: 10 hours, 3: 200 miles per hour</td>
<td>5.416666667</td>
<td></td>
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<tr>
<td>Facilities</td>
<td>Ford E-Transit Cargo Van</td>
<td>68</td>
<td>Level 2 or 3</td>
<td>Level 2: 12 hours, Level 3: 180 miles per hour</td>
<td>1.088</td>
<td></td>
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<tr>
<td>Facilities</td>
<td>Ford Lightning Pro Pickup Truck</td>
<td>89</td>
<td>Level 2 or 3</td>
<td>Level 2: 8-10 hours, Level 3: 9 hours</td>
<td>1.424</td>
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<tr>
<td>Libraries</td>
<td>Ford E-Transit Cargo Van Low Roof</td>
<td>68</td>
<td>Level 2 or DC</td>
<td>Level 2: 11 hours (15 miles per hour), DC: 5.2 minutes</td>
<td>5.666666667</td>
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<tr>
<td>Mail</td>
<td>Chevy Bolt 5 Door Hatchback</td>
<td>66</td>
<td>L2 or DC</td>
<td>L2: 6.5 hours, DC: 1hr 15mins</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>Mail</td>
<td>Rivian R15 SUV</td>
<td>128.9</td>
<td>L1, 2, DC</td>
<td>L1: 16 hours (16 mph), L2: 10hr 24mins, DC: 40 mins</td>
<td>2.0624</td>
<td></td>
</tr>
<tr>
<td>Mail</td>
<td>2023 Ford E-Transit Passenger</td>
<td>74</td>
<td></td>
<td></td>
<td></td>
<td>1.184</td>
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<tr>
<td>Lamont</td>
<td>Ford Lightning Pro Pickup Truck</td>
<td>98</td>
<td>Level 2 or 3</td>
<td>Level 2: 8-10 hours, Level 3: 2 hours</td>
<td>1.568</td>
<td></td>
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<tr>
<td>Lamont</td>
<td>Ford Lightning Pro Pickup Truck</td>
<td>98</td>
<td>Level 2 or 3</td>
<td>Level 2: 8-10 hours, Level 3: 2 hours</td>
<td>1.568</td>
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<tr>
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<td>1.568</td>
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<td>Lamont</td>
<td>Ford Lightning Pro Pickup Truck</td>
<td>98</td>
<td>Level 2 or 3</td>
<td>Level 2: 8-10 hours, Level 3: 2 hours</td>
<td>1.568</td>
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<td>Athletic Vans</td>
<td>2023 Ford E-Transit Passenger</td>
<td>74</td>
<td></td>
<td></td>
<td></td>
<td>1.184</td>
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<tr>
<td>MV Loop</td>
<td>N/A, cannot replace until 2027</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Baker</td>
<td>ABC Van Hoil CX45E</td>
<td>676</td>
<td>DC Fast Charge</td>
<td>DC: 5 hours (from 5 to 95%, w/ 125 kW charger)</td>
<td>3.38</td>
<td></td>
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<tr>
<td>Baker</td>
<td>ABC Van Hoil CX45E</td>
<td>676</td>
<td>DC Fast Charge</td>
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<td>3.38</td>
<td></td>
</tr>
</tbody>
</table>

## Charges Details

- **CT4000**: Level 2, Two Ports, $11,000-$16,000, Commercial Use
- **CPF50**: Level 2, Two Ports, $3,500-$8,000, Fleet Manager Use
- **Smart DC Fast Charging Express 250**: Level 3, One Port, $65,000-$75,000
- **Express Plus Power Block**: Level 3, Two Ports, Intended for Bus Charging
How to get started

- Go to Con Ed’s website and select to start a new service
- Input location information
- Set up a consultation with Con Ed to view your location and figure out where to put charging infrastructure
- Utility service and utility transformer come from Con Ed
- Con Ed is committed to provide clean energy and reaching net 0 emissions for customer energy
Operational Requirements

All charging stations must be operational for at least 5 years and undergo quarterly reporting.

There must be public site accessibility.

DC fast charging plugs must be operational 95% of the time annually and DCFC stations for 99% of the time.

Cost Incentives

Publicly accessible sites can receive up to 90% of costs covered by program, non-public would be 50%

90% covers up to $7,200 per Level 2 charger and $427 per kW for DC fast charge.

Eligibility Requirements

Participant Application submission

Hire an approved contractor and network of your choosing or from the list of participating contractors.

CU will have to partner with DOT or the city to get permission to build on curbs.

ConEd Incentive Program (Light-Duty Vehicles)
ConEd Incentive Program (Medium/Heavy-Duty Vehicles)

**Pilot Incentive Structure**

Each participant is eligible for:

<table>
<thead>
<tr>
<th>Incentive Tier</th>
<th>Participant Cap</th>
<th>Annual Pilot Budget Cap</th>
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<tbody>
<tr>
<td>Up to 85% of utility-side costs</td>
<td>Capped at $1.2M per participant (duration of pilot)</td>
<td>Capped at $3M annually (first come, first serve)</td>
</tr>
</tbody>
</table>

Incentive is applied towards utility-side EDF costs and is not sent as a check.

**Pilot Program Basics**

Only available for DCFC. Vehicles must be over 10,000 lbs. gross. Pilot funds can only be applied to utility-side costs customer is responsible for. Must receive, plan to receive service from ConEd grid.

**Overview of Utility-Side Costs**

If a site’s service is ruled inadequate, there may be costs associated with upgrading the utility-side infrastructure.

- **New Business Costs** are utility costs that are part of the minimum design costs as part of Con Edison’s obligation to serve load. Examples include:
  - Upgrading existing service
  - Adding meter

- **Excess Distribution Facilities (EDF)** are utility costs that go above and beyond Con Edison’s obligation to serve load. Examples include:
  - Adding new service
  - Moving Point of Entry

**New Business Costs** are paid for by the utility and do not factor into your costs. **EDF** costs are paid for by the you/the customer and a portion of it can be covered by the MDHD Make Ready pilot pending eligibility and funding availability.

**MDHD Make-Ready Pilot Process Overview**

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**ConEd Team**

**Participant**

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*Note: Service adequate ratings and ratings with no customer cost are not eligible.*
Interactive Map Of Columbia Charging

LEGEND
1. Blue Parking icon indicates large parking spaces.
2. Purple Car icon shows single charging stations.
3. Green color denotes proposed charging locations.
4. Red color shows charging which will be removed.
General Recommendations
Looking Forward to Success

1. Collect Ridership Data
2. Strengthen Cross Team Collaboration
3. Create an Organized Database
4. Optimize Fairway Lot
5. Stay in Touch with OES
6. Bold early action

TOTAL EMISSIONS DECREASE: 39.3%
Thank You
Appendix
Additional Methods for Funding

- **NYSERDA Drive Clean Rebate** for Plug in Electric Cars: Estimate varies
- **NYC Clean Trucks Program**: $12k-185k
- **Con Edison Smartcharge NY**: $150 + device to track charging/driving data
- **University Transportation Center Program**: Application Past Due, but program directly for Universities; perhaps see if there is more funding available
- **Climate Smart Communities Grant Program**: 50/50 match
  - For the greater community—great way to engage with community & install charging infrastructure
- **FTA Buses and Bus Facilities Program**: 80% of project cost
- **VW Funding for Diesel Replacement and EVSE Projects**
Addressing EV Concerns

1. Range anxiety
   a. Benefit of being in NYC—low risk because of minimal mileage & ease of finding charging stations nearby if needed

2. Does winter weather affect the battery?
   a. Yes, the range decreases by around 20%

3. Electrocution?
   a. This is very rare, only a concern if car becomes damaged

4. Lithium-ion battery fires?
   a. Hybrid vehicles fire risk is higher, electric vehicle fire risk is lower

5. What happens if the battery dies?
   a. Just like an engine, batteries eventually need to be replaced, but here are tips for maximizing usage
Costs per Fleet

- **Mail**
  - Chevy Bolt 5 Door Hatchback: $25,600
  - Rivian R1S SUV: $78,000
  - 2023 Ford E-Tourneo Custom: N/A

- **MV Loop**
  - VMC: 2 x $550,000 = $1.1M

- **Libraries**
  - Ford E-Transit Cargo Van Low Roof = $50,185

- **Arbor**
  - Lightning eMotors: 2 x Ford E-450 Cutaway = ~$330,000

- **Facilities**
  - Chevy Bolt EUV: $33,500
  - Ford E-transit cargo van: $55,000
  - Ford Lightning Pro: $51,974
  - Jeep Wrangler 4XE Hybrid: $54,735

- **Baker**
  - 4 x Van Hool CX45E @ ~ $900,000 – $1,000,000 each

- **Public Safety**
  - 6 x 2022 Hyundai Ioniq 5 SE Standard Range: $39,950 x 6 = $239,700
  - OR
  - 6 x 2023 Hyundai Kona Electric SEL: $37,300 x 6 = $223,800

- **Lamont**
  - 4 x Ford F150 Lightning Pro = $51,974 each
1. Background research on charging, other Ivies, Plan 2030, City/State/Federal programs, & general EV technology

2. 10 fleet manager meetings to properly understand the ins and outs of each fleet and its operations
   a. On the ground visits to fleet locations

3. Standardization of fleet inventories and fuel consumption into a spreadsheet
   a. Creation of an emissions model outlining fleet and individual vehicles (if applicable) contributions to total CU transportation emissions by percentage.

4. Survey of current fleet routes and charging infrastructure throughout Columbia’s 4 campuses

5. Research of electric/alternatives fuel vehicles for each fleet, if applicable
   a. Identification of high-emitting vehicles with corresponding EV replacement options that could be feasibly replaced by 2025

6. Meetings with ConEd and ChargePoint to create a detailed charging plan for the MS/MV campuses

7. Crowdsourcing from Columbia’s executive level leadership to gather more information (e.g., Peter Pilling and Michael Gerrard)
Looking Ahead: 2030 & 2037

- In-Depth Recommendations for all Vehicles in all Fleets (to be distributed to Fleet Managers)
  - Determined based on Fleet Criteria, Fleet Necessities, Range, Cost, Current Vehicle Age
- Work Serves as a Template for Future Projects
- Deliverables as a Resource for Future Emissions Reductions and Infrastructure Options
  - Emissions Model (Input Fleet Information to Understand Emissions Impact)
  - Interactive Charging Maps
  - Proposed Vehicle Lot Storage/Charging Sites
What are other universities doing?

<table>
<thead>
<tr>
<th>University</th>
<th>Harvard</th>
<th>Yale</th>
<th>Dartmouth</th>
<th>Princeton</th>
<th>Brown</th>
<th>Cornell</th>
<th>Penn</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrification</strong></td>
<td>Shift to Biodiesel since 2004</td>
<td>X</td>
<td>Plan to eventually introduce electric and hybrid vehicles into the shuttle fleet and will use the study of traffic patterns to inform the evolution of this field</td>
<td>X</td>
<td>Committed to improving its transportation infrastructure and encouraging community to replace gas miles with electric</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Commuter Focus</strong></td>
<td>X</td>
<td>⅓ of employees commute via walk, bike, or shuttle</td>
<td>X</td>
<td>The institution also has a TDM program that since 2008 to shift behavior of former SOV drivers toward alternative modes</td>
<td>Emphasize the usage of the Brown University Shuttle as well as the RIPTA U-Pass Program which allows for all members of the Brown community to ride public transit anywhere in Rhode Island for free.</td>
<td>Focused on the commuter through an emphasis on walking, biking, rideshare, and free shuttle buses</td>
<td>They currently have an initiative to increase the number of staff and faculty choosing sustainable commuting options.</td>
</tr>
<tr>
<td><strong>Holistic</strong></td>
<td>Encouraged officers to reduce idling. For their students, they encourage biking and walking</td>
<td>Partnered with the city and other local employers to encourage the use of expanding infrastructure</td>
<td>They have plans to manage traffic, bolster public transportation and parking, as well as improving pedestrian and bike access</td>
<td>Go Electric Plan that focuses mostly on individual riders and commuters</td>
<td>introduced over 100 spin scooters around campus for Brown students.</td>
<td>FLX Carpool which is rideshare for students and also Campus 2 Campus which is a bus service from NYC to Ithaca.</td>
<td>Penn Transportation and Parking look to improve the energy efficiency of parking facilities and works to minimize the environmental impacts of Penn's Transit fleet.</td>
</tr>
</tbody>
</table>
EV Battery (for size/reference)