

ELECTRIC VEHICLE READINESS ROADMAP



October 2018

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City Council

Wade Troxell, Mayor
Gerry Horak, Mayor Pro Tem, District 6
Bob Overbeck, District 1
Ray Martinez, District 2
Ken Summers, District 3
Kristin Stephens, District 4
Ross Cunniff, District 5

Steering Committee

Cassie Archuleta (Environmental Services)
Pablo Bauleo (Utilities)
Noah Beals (Planning and Zoning)
Melina Dempsey (TransFort)
Lindsay Ex (Environmental Services)
Michelle Finchum (Sustainability)
Nick Heimann (FC Moves)
Rick Johnson (TransFort)
Seth Lorson (TransFort)
Caitlin May (Streets)
Kenyon Neal (FC Moves)
Tracy Ochsner (Fleet Services)
Paul Sizemore (FC Moves)
Diane Tjalkens (Social Sustainability)
Sonu Upadhyay (Utilities)
Heidi Wagner (Utilities)
Erica Benti, Colorado State University
Daniel Daneshka, City of Loveland
Joel Danforth, Platte River Power Authority
Ryan Dusil, North Front Range Metropolitan Planning Organization
Aaron Fodge, Colorado State University
Annie Freyschlag, Electrification Coalition & Drive Electric Northern Colorado
Alex Gordon, North Front Range Metropolitan Planning Organization
Mark Houdashelt, Northern Colorado EV Enthusiasts
Becky Karasko, North Front Range Metropolitan Planning Organization
Todd Parker, Brinkman Construction
Addison Philips, Electrification Coalition & Drive Electric Northern Colorado
Christine Schraeder, City of Loveland

Project Management Team

Carrie Frickman (Environmental Services)
Aaron Iverson (FC Moves)
Amanda Mansfield (FC Moves)

Consultant Team - ICF

Stacy Noblet, Project Manager
Abby Brown
Louise Huttinger
Wendy Jaglom-Kurtz
Carrie Ryder

KEY ACRONYMS

AFDC: Alternative Fuels Data Center
BEV: Battery electric vehicle
CAP: Climate Action Plan
CDOT: Colorado Department of Transportation
CEO: Colorado Energy Office
CSU: Colorado State University
DENC: Drive Electric Northern Colorado
DOE: U.S. Department of Energy
DOT: U.S. Department of Transportation
EV: Plug-in electric vehicle
EVSE: Electric vehicle supply equipment
FHWA: Federal Highway Administration
GHG: Greenhouse gas
HEV: Hybrid electric vehicle
ICE: Internal combustion engine
LEV: Low-emission vehicle
NFRMPO: North Front Range Metropolitan Planning Organization
NREL: National Renewable Energy Laboratory
PHEV: Plug-in hybrid electric vehicle
PRPA: Platte River Power Authority
VMT: Vehicle miles traveled
ZEV: Zero-emission vehicle
REV West: Regional Electric Vehicle West



FORT COLLINS ELECTRIC VEHICLE READINESS Strategies



Outreach & Education

- Target education and outreach to key audiences
- Maintain a comprehensive electric vehicle (EV) website

City Planning & Regional Coordination

- Incorporate EV readiness in local and regional planning
- Coordinate and advocate regionally

Emerging Technologies

- Track emerging technologies and market developments

SHORT-TERM (within 1-2 years)

Policies

- Clarify City policy related to EV charging
- Allow right-of-way locations for EV charging station installations
- Establish and enforce EV parking rules

Incentives

- Support public charging station installation
- Recognize local businesses with workplace charging

Leading by Example

- Pursue electrification opportunities within the City's light-duty and transit fleet

MEDIUM-TERM (within 3-5 years)

Policies

- Revise building codes to require EV-ready developments

Incentives

- Incentivize consumer EV purchases

Utilities

- Support smart grid operations for EVs
- Increase renewable electricity for EV charging
- Assess and adjust utility rate structures for EV drivers

Leading by Example

- Install EV charging for the City fleet
- Encourage EV adoption by City employees

LONG-TERM (within 10 years)

City Planning & Regional Coordination

- Encourage EV ride-hailing and car sharing

Utilities

- Upgrade electricity distribution infrastructure

Emerging Technologies

- Pursue living laboratory projects



Illustration by Carrie Frickman

EXECUTIVE SUMMARY /

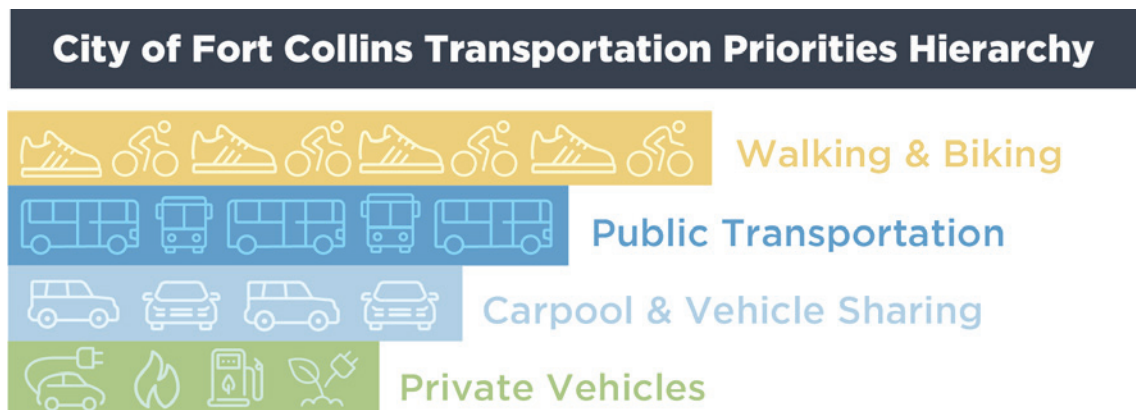
Purpose of the Electric Vehicle Readiness Roadmap

This Electric Vehicle Readiness Roadmap (Roadmap) is a strategic plan to guide the City of Fort Collins (City) in preparing for and implementing actions that support increased use of plug-in electric vehicles (EVs) throughout Fort Collins and the Northern Colorado region.

EV readiness is a community effort that requires supportive planning, partnerships, policies, infrastructure development, and education and outreach. This Roadmap is a tool for the municipal government of Fort Collins to investigate the actions that it can take to support EV adoption in the community. While publicly available, it is an internal planning document. Although partnerships with community members and other stakeholders will be vital to any success, the strategies in the Roadmap are designed to be primarily within the control of, and led by, City departments. The City aims to be a regional, state, and national leader in EV readiness, and this Roadmap outlines how to achieve that goal. It builds upon the City's past and ongoing EV-related efforts and was developed in coordination with internal and external stakeholders. The Roadmap includes a vision, goals, and clearly defined roles for City departments, public and private partners, and the Fort Collins community.

Electric Vehicle Vision and Goals

This Roadmap is just one piece of a larger strategy to make transport more convenient, accessible, and cleaner in Fort Collins. That transportation strategy includes efforts to shift land use patterns to shorten trips and reduce the need to drive, as well as initiatives to increase the adoption of multimodal transport, including public transit, cycling, and walking. To the extent that people continue to use personal and fleet vehicles in Fort Collins, the City wants to support the use of EVs. The scope of this Roadmap is focused on supporting current and future adoption of EVs, including on-road personal and fleet vehicles. Policies and direction on electric assist bicycles, e-scooters, and similar equipment, while outside the scope of this Roadmap, are being developed as part of the ongoing [Transportation Master Plan](#) and through other focused efforts.



EVs reduce greenhouse gas (GHG) emissions and criteria pollutants, as well as other impacts of personal vehicle use in Fort Collins. Increased EV use will be necessary for the City to reach its air quality, climate, and sustainability goals, including those identified in the [2015 Climate Action Plan \(CAP\)](#) and [CAP Framework](#).¹

In addition to Fort Collins' goals, the state of Colorado has identified low, medium, and high growth EV adoption scenarios. To achieve the goals set in the state's [2018 EV Plan](#), all municipalities will need to take measures to support EV adoption. This Roadmap provides Fort Collins with the tools and strategies to lead the way.

With that context, the City's vision and goals for EV adoption in the Fort Collins community and the Northern Colorado region are identified below. The Roadmap and resulting implementation actions taken by the City aim to achieve this vision and these goals.

Vision

Fort Collins will be a leader and innovator in supporting the use of EVs within the community's sustainable transportation system. Residents, businesses, and visitors to Fort Collins will choose EVs over conventional fuel vehicles.²

Goals

Community-Wide



Increase the use of EVs over conventional fuel vehicles in Fort Collins and the region.



Improve awareness of EV purchase, operation, and life-time costs and benefits among residents, businesses, and visitors to Fort Collins.



Make EVs and charging infrastructure accessible to a broad range of users in an equitable way by making it easier to purchase, charge, operate, and ride in an EV.



Integrate EVs with a renewably-powered electric grid to minimize GHG and criteria air pollutant emissions, maximize energy system resilience, and reduce costs to Fort Collins residents, businesses, and government.

Government-Focused



Increase EVs in the City fleet by making 100% of light-duty³ vehicle purchases plug-in electric by 2025 and incorporating battery electric transit buses, subject to the availability of suitable technology.



Increase awareness and use of personal EVs among City employees.



Invest in the charging infrastructure needed to support EVs in the City fleet and provide adequate workplace charging for municipal employees.

¹ And any subsequent amendments to the CAP or CAP Framework.

² For the purpose of this Roadmap, "conventional fuel" refers to gasoline and diesel.








³ For the purpose of this Roadmap, "light-duty" refers to passenger cars and trucks intended for on-road use.

Summary of Readiness Strategies

Strategies to achieve the City's goals are organized into seven categories, as follows:

- Outreach and Education
- City Planning and Regional Coordination
- Policies
- Incentives
- Utilities
- Leading by Example
- Emerging Technologies

The following table lists the readiness strategies and illustrates how each is linked to the goals outlined above.

	<p>A large bold X indicates the primary impact of each strategy, while the small <i>x</i> (in italics) indicates secondary impacts.</p>						
	INCREASE EV USE 	IMPROVE AWARENESS 	MAKE ACCESSIBLE 	INTEGRATE WITH RENEWABLES 	INCREASE EVS IN CITY FLEET 	INCREASE EMPLOYEE AWARENESS 	INVEST IN MUNICIPAL CHARGING 
Outreach and Education							
1a. Target education and outreach to key audiences	x	X				x	
1b. Maintain a comprehensive EV website	x	X				x	
City Planning and Regional Coordination							
2a. Encourage EV ride-hailing and car sharing	X	x	X				
2b. Incorporate EV readiness in local and regional planning	X	x	x				
2c. Coordinate and advocate regionally	X	x	x				



Policies							
3a. Clarify City policy related to EV charging	X	X	X				
3b. Allow right-of-way locations for EV charging station installations	X	X	X				
3c. Revise multi-family and commercial building codes to require EV-ready developments	X	X	X				
3d. Establish and enforce EV parking rules	X	X	X				
Incentives							
4a. Incentivize consumer EV purchases	X		X				
4b. Support public charging station installation	X	X	X				
4c. Recognize local businesses with workplace charging through the ClimateWise program	X	X	X				
Utilities							
5a. Support smart grid operations for EVs	X			X			
5b. Increase renewable electricity for EV charging	X			X			
5c. Upgrade electricity distribution infrastructure	X		X	X			
5d. Assess and adjust utility rate structures for EV drivers	X		X	X			



Leading by Example							
6a. Pursue electrification opportunities within the City's light-duty fleet	X	X			X	X	X
6b. Pursue electrification opportunities within the City's transit fleet	X	X	X		X	X	X
6c. Install EV charging for the City fleet	X	X			X	X	X
6d. Encourage EV adoption by City employees	X	X			X	X	X
Emerging Technologies							
7a. Pursue living laboratory projects	X	X		X	X		
7b. Track emerging technologies and market developments	X	X		X	X		

Summary

With its strong sustainability goals and history of supporting the use of EVs in the community and region, Fort Collins is well positioned to leverage its lessons learned and commitment to emissions reductions to become a leader in EV adoption. As external funding becomes more available for charging infrastructure, entities that have incorporated EV readiness into regional planning, formed strong stakeholder partnerships, and identified charging infrastructure needs and gaps will have the advantage when pursuing grant opportunities.

Fort Collins will need to dedicate both financial and staff resources to pursue EV readiness strategies if the City intends to contribute to Colorado's aggressive growth scenarios. Further, the City will need to dedicate significant resources to achieve the 2015 CAP Framework EV adoption goal of 50% of new vehicle sales being electric by 2030.

To effectively pursue the readiness strategies, the City must first determine departmental ownership of overarching City EV efforts, identify and engage key partners, and commit to implementing, revisiting and revising the Roadmap. An organized and purposeful City effort will allow Fort Collins to be efficient, effective, and grant-ready, and is critical to the success of the Roadmap and its strategies.

ROADMAP ORGANIZATION

This Roadmap is intended to be a strategic plan, primarily for internal use by the City of Fort Collins, to increase EV use throughout the community. It was developed in coordination with internal and external stakeholders. The Roadmap is comprised of the following sections:

- The **Vision and Goals** provide the foundation for this Roadmap and the means by which successful implementation will be measured.
- The **Introduction** provides background information on EVs and charging infrastructure, funding sources, and federal and state initiatives. It also summarizes the City's plans, targets, and EV-related efforts to date. This section can be used to provide City staff, partners, and community members with a basic awareness about these topics.
- The **Readiness Strategies** are the primary focus of this Roadmap and present recommended strategies as well as corresponding implementation actions. Each readiness strategy corresponds with at least one Roadmap goal and includes a lead department, key partners, and other important considerations. This section includes information on methodology used to develop the strategies.
- The **Education and Outreach Toolkit** identifies target audiences, objectives, sample messages, channels, tactics, and resources that will be important to ensure successful implementation of the Roadmap. This section demonstrates the City's intention to play a facilitation role and empower other entities (non-profits, businesses, citizen groups, etc.) to take the lead on implementing many of the strategies.
- The **Appendices** provide additional details, including a summary of the community questionnaire and charging infrastructure demand analysis.



VISION AND GOALS

This Roadmap is **just one piece of a larger transportation strategy** to make transport more convenient, accessible, and cleaner in Fort Collins. That larger strategy includes efforts to shift land use patterns to shorten trips and reduce the need to drive, as well as initiatives to increase the adoption of multimodal transport, including public transit, cycling, and walking. The City prioritizes reducing the number of miles traveled in personal vehicles, particularly those in single-occupancy vehicles. Other initiatives are focused on this need.

To the extent that people continue to use personal and fleet vehicles in Fort Collins, the City wants to support the use of EVs, which provide air quality, climate action, total ownership cost, and other benefits. As a result, the scope of this Roadmap is focused on supporting current and future adoption of EVs, including on-road personal and fleet vehicles. Policies and direction on electric assist bicycles, e-scooters, and similar equipment, while outside the scope of the Roadmap, are being developed as part of the ongoing [Transportation Master Plan](#) and through other focused efforts.

With that context, the City's vision and goals for EV adoption in its community and region are identified below. The Roadmap and resulting implementation actions taken by the City aim to achieve this vision and these goals.

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INTRODUCTION /

Electric Vehicle and Charging Overview

This section provides an introduction to EVs, including the different types of vehicles, how they charge, their benefits, and other considerations such as costs, operations, and national and state level incentives.

Electric Vehicles

The term EV encompasses several different types of vehicles (see Table 1). Specifically, all EVs can be plugged-in and powered solely by electricity; however, some are also powered using an engine and gasoline or conventional vehicle fuels. EVs are available for use in applications other than passenger vehicles, such as transit buses. EVs suitable for medium-duty and other heavy-duty applications (e.g., long-haul trucking, refuse) are also under development.

Currently, the up-front purchase cost of an EV is typically more expensive than a comparative conventional fuel vehicle due to the high cost of the large battery. However, as the technology advances and battery manufacturing capacity increases, the vehicle cost is likely to decrease. Bloomberg New Energy Finance, for example, projects that by 2029, most EVs will have reached price parity with comparable conventional vehicles on a global scale.⁴ There are also various incentives available to reduce the purchase cost of EVs, including those mentioned later in this section. In addition, EVs are typically less expensive to operate due to lower fuel and maintenance costs.

Vehicle Type	Description	Example
Plug-in Hybrid Electric Vehicle (PHEV)	PHEVs are powered by an internal combustion engine (ICE) and an electric motor that uses energy stored in a battery. The vehicle can be plugged in to an electric power source to charge the battery. PHEVs can travel on either electricity or gasoline. The all-electric range of a PHEV can be from 10 to over 50 miles, depending on the model.	Chevrolet Volt
Battery Electric Vehicle (BEV)	BEVs use a battery to store the electric energy that powers the motor. A BEV does not have an ICE. BEV batteries are charged by plugging the vehicle in to an electric power source. The range of a BEV on a full charge can be over 300 miles, depending on the model.	Nissan Leaf

Table 1: EV Characteristics

⁴ Bloomberg New Energy Finance, EV Outlook 2017. Available online: https://data.bloomberglp.com/bnef/sites/14/2017/07/BNEF_EVO_2017_ExecutiveSummary.pdf

Electric Vehicle Charging

Charging equipment for EVs, also called electric vehicle supply equipment (EVSE), is available in different levels based on the rate that the battery is charged. The time needed to fully charge an EV will vary based on the size of the battery, how depleted the battery is, and the electric current of the EV charging equipment.

Light-Duty Vehicle Charging

EV drivers have the flexibility to charge at a variety of locations, including home (single-family and multi-family), work, and other destinations such as shopping centers, restaurants, and fleet parking facilities. Table 2 provides an overview of EV charging levels, including the amount of range each level provides an EV, the connector types used, and typical applications.

	Electric Current	Charging Rate	Connector(s)	Primary Use
Level 1	Alternating current (AC) 120 volt (V), 20 amp (A)	2 to 5 miles of range per hour of charging	J1772	Residential Workplace Fleet
Level 2	AC 208/240V, 30A	10 to 20 miles of range per hour of charging	J1772	Residential Workplace Fleet Public
DC Fast	Direct current (DC) 208/480V, 80-200A (and higher)	60 to 80 miles of range per 20 minutes of charging	J1772 Combo (CCS) CHAdeMO Tesla	Fleet Public

Table 2: EV Charging Characteristics ⁵

Most EV charging occurs at home. However, there are some challenges with charging infrastructure development at multi-family developments, including access to reliable parking, billing, sufficient power supply, and ownership concerns. Workplace charging is another opportunity for Fort Collins' employers, as workplace charging helps increase the convenience of driving electric for employees and increases charging during off-peak hours. Similarly, access to public charging is a key factor in decreasing range anxiety and increasing the convenience of driving EVs in the region. For all charging applications, dwell time (or the amount of time a vehicle is typically parked) should be considered when determining what charging level to install. For more information on charging infrastructure and demand analysis, see Appendix C.

The cost of EV charging infrastructure varies based on

⁵ DC fast charging rate is for 50 kilowatt (kW) chargers. Higher-powered chargers (up to 350 kW) are being developed and will allow for more rapid charging rates.



charging level, the number of connectors, type of mounting (wall, pedestal), and additional features such as networking and communication capabilities. Typically, before incentives and installation costs, the price of Level 1 charging equipment can range from \$300-\$1,500, Level 2 equipment can range from \$400-\$6,500, and DC fast infrastructure can range from \$10,000-\$40,000.⁶ Installation costs can also vary greatly depending on the number of EV chargers installed, indoor versus outdoor installation, and any electrical upgrades required. Installation costs alone can range from \$0-\$51,000 per unit.⁷

Charging station costs vary widely, mostly depending on where the infrastructure is installed. Stations in parking garages are relatively straightforward and the bulk of installation costs are for electrician labor. Charging stations in parking lots may require trenching and boring, which can drastically increase costs. DC fast charging stations often need electrical upgrades to provide the site with enough power. Figure 1 provides the typical breakdown of charging station costs by installation type. While every installation is different, and the figures shown are somewhat dated, the graphic illustrates how the specific costs elements relate to the full cost of the installation.

Typical Installation Cost Elements

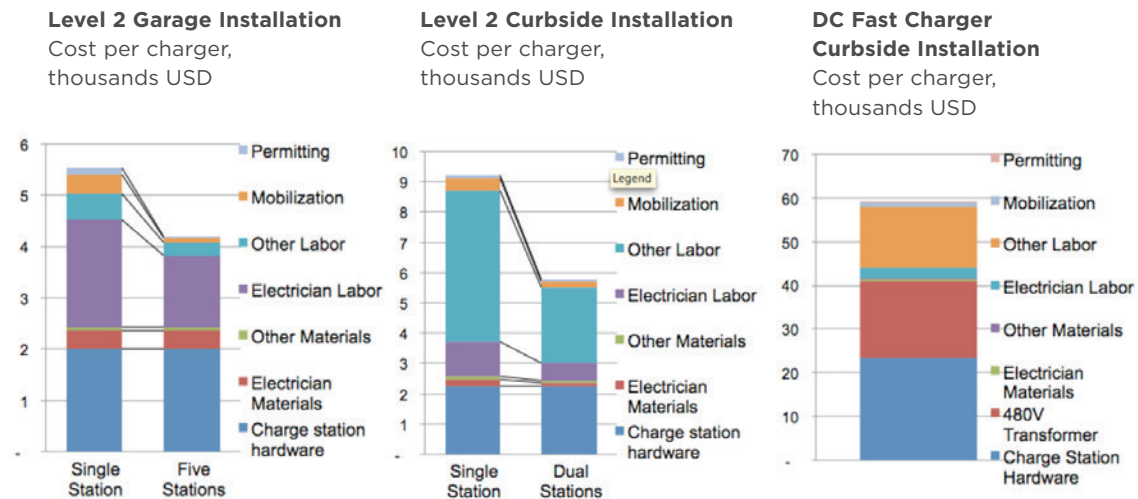


Figure 1: Charging station project costs by element. Mobilization refers to the time electricians and others need to prepare the site. Source: Rocky Mountain Institute. Available online: <https://rmi.org/pulling-back-veil-ev-charging-station-costs/>

Other factors impacting total station development costs are the cost of electricity, which will depend on the type of EV charger installed, and the frequency and time of day the charger is used. For example, if an EV charger is used during times of peak electricity demand, the rate per kilowatt-hour may be higher. For DC fast chargers, in particular, station hosts may incur additional demand charges assessed by the utility based on the highest electricity rate drawn during a set (15- to 30-minute) period.

⁶ U.S. Department of Energy. Costs Associated with Non-Residential EVSE. Available online: https://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf

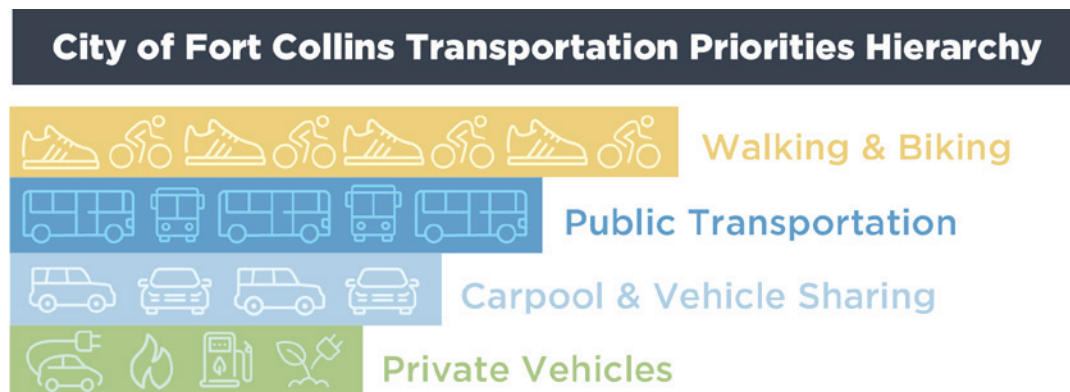
⁷ ibid

Heavy-Duty Vehicle Charging

While charging for heavy-duty trucks is still being developed, electric transit bus technology has been widely implemented. Battery electric buses can charge through wireless (or inductive) charging, on-route overhead DC fast charging, and in-depot plug-in charging. Plug-in charging is the slowest of charging methods and is typically used for overnight refueling at the bus depot. While plug-in charging is the least expensive of the three methods, a 2018 report by the Transportation Research Board found that half of surveyed agencies use on-route overhead conductive chargers. Although limited information is available, plug-in charging has been reported to cost \$50,000 and overhead DC fast charging has been reported to cost \$665,000.⁸ Wireless charging is largely experimental at this time. For more information about battery electric buses, see Appendix A.

Benefits of EVs

The City of Fort Collins supports the use of different transportation options for City employees, residents, and visitors—including biking, walking, public transportation, and carpooling or vehicle sharing. That said, a private vehicle is often most convenient to get around the community. EVs align with the City’s air quality, climate, transportation, and sustainability goals.



The benefits of EVs include:

- EVs have little or no tailpipe emissions (depending on the type of vehicle), meaning they support the City’s goals to reduce local air pollution and improve public health.
- Depending on the electricity generation mix, EVs have much lower GHG emissions than conventional vehicles. Even in areas that primarily use coal as an electricity source, such as Colorado, EVs offer life-cycle GHG emissions reductions.⁹
- EVs have the capability to use cleaner sources of electricity, such as solar, to charge. The City can use EVs as a reason to justify the diversification of electricity sources to include renewable fuels,¹⁰ in the effort to increase emissions benefits of EVs.

⁸ National Renewable Energy Laboratory. Foothill Transit Battery Electric Bus Demonstration Results. Available online: https://www.afdc.energy.gov/uploads/publication/foothill_transit_beb_demo_results_2nd_rpt.pdf

⁹ U.S. DOE. Emissions from Hybrid and EVs. Available online: https://www.afdc.energy.gov/vehicles/electric_emissions.php

¹⁰ For the purpose of this Roadmap, renewable electricity includes non-fossil fuel sources, including electricity derived from wind, solar, hydroelectricity, geothermal sources, and other means that may become available that do not add GHG emissions to the atmosphere.

- The cost to charge an EV is much cheaper than the cost to fuel a conventional vehicle with gasoline, by about 50%. The U.S. Department of Energy's (DOE) [eGallon](#) tool provides an up to date cost comparison.
- EVs, particularly BEVs, which do not have an ICE, require very little maintenance. Because of these lower maintenance and fuel costs, EVs have a lower lifetime cost of ownership than conventional vehicles.¹¹

Additional Considerations

Operations

Driving an EV in Colorado, with its cold weather and mountainous terrain, poses unique operational considerations. With proper knowledge of how these conditions might affect EV operation, drivers can prepare and plan accordingly.

Cold Temperatures

With extremely cold outside temperatures, EV driving range can be reduced. This is mainly due to the extra energy needed to heat the inside of the vehicle. While the average low temperature in Fort Collins during the winter months is around 25 degrees Fahrenheit, temperatures can get much colder in surrounding mountainous areas.

Charging an EV in cold temperatures can mean increased charging times. Recent [research](#) from Idaho National Laboratory found that cold temperatures impact the electrochemical reactions within the battery, and therefore onboard battery management systems reduce the charging rate to avoid battery damage. When comparing charging in 70 degree and 30 degree weather, research showed that the charge was 36% less after the same amount of time in colder weather.

Mountainous Terrain

Because BEVs do not have an ICE, and therefore do not require oxygen to operate, going up mountain passes where oxygen is sparse is much easier than in a conventional gasoline vehicle. Driving uphill for an extended period of time does, however, use more battery than driving on flat terrain.

EVs use regenerative braking. When easing off the accelerator while going downhill in an EV, the wheels of the vehicle turn the motor that generates electricity, which is then stored in the battery.

Market Disruption

As with any new technology, EVs will have an impact on existing markets and business models. The extent to which these impacts are positive or negative may change over time.

Vehicle Servicing

According to the National Automobile Dealers Association, service and parts operations accounted for 46% of total dealership gross profit and 14.5% of total dealership net profit in 2017.¹² BEVs do not have a conventional engine; their battery, motor, and associated electronics do not generally require regular maintenance and there are far fewer fluids, such as engine oil, to change.

¹¹ Rausted. EV Life Cycle Cost Analysis. Available online: <http://fsec.ucf.edu/en/publications/pdf/fsec-cr-2053-17.pdf>

¹²National Automobile Dealers Association. 2017 Annual Financial Profile of America's Franchised New-Car Dealerships. Available online: <https://www.nada.org/2017NADAdata/>

Although lower maintenance costs are generally considered a benefit to the EV owner, this could have an impact on dealership profit models, and has been cited by some dealerships as a deterrent from actively marketing and selling EVs.

Fueling

While there is not yet consensus on what, if any, vehicle charging model will become the industry standard, EVs have more fueling options than conventional vehicles. EV drivers can charge at home, at work, and at destinations such as grocery stores and shopping malls. The current gasoline station business model may be less relevant with widespread EV adoption, which is already giving some oil companies reason to co-locate EV chargers in Europe and elsewhere.

Manufacturing Impacts

Battery Production

While rare metal mining does have local environmental impacts, the energy and GHG benefits of EVs mean lower life-cycle energy requirements and lower GHG emissions than conventional vehicles.¹³ Researchers are working to decrease the impacts of battery manufacturing and, at the end of their useful life, EV [batteries](#) can be recycled or repurposed.¹⁴ See Appendix A for more resources on EV battery recycling.

National and State Electric Vehicle Efforts

This section describes current EV-related funding sources at both the national and state levels, as well as information on various EV initiatives taking place across the country and the state of Colorado.

Current Funding Sources

There are a number of existing incentives and funding sources related to EVs both at the national and state levels. Colorado is one of the leading states in the country for availability of EV-related incentives, offering a tax credit of up to \$7,000 for a light-duty EV, as well as \$9,000 in grants for Level 2 charging stations and \$30,000 in grants for DC fast charging infrastructure. While funding for EVs and EV infrastructures is available in 2018, all programs listed here are subject to change due to a variety of reasons, including market conditions and the political environment. See Table 3 for an overview of incentives available as of October 2018, including a description and funding amounts.

¹³ Argonne National Laboratory. The significance of Li-ion batteries in electric vehicle life-cycle energy and emissions and recycling's role in its reduction. Available online: <https://greet.es.anl.gov/publication-lion-ev>

¹⁴ U.S. DOE. Vehicle Technology Office Batteries website. Available online: <https://www.energy.gov/eere/vehicles/batteries>



	Funding Source	Funding Amount	Description
Federal	Qualified EV Tax Credit	Up to \$7,500 per vehicle	<p>A tax credit is available for the purchase of a new* qualified EV, with the amount based on each vehicle's battery capacity and the gross vehicle weight rating. The credit will begin to be phased out for each manufacturer in the second quarter following the calendar quarter in which a minimum of 200,000 qualified EVs have been sold by that manufacturer for use in the United States since January 2010.</p> <p><i>*Note that the credit can be passed down to a leasee by the car dealership in the form of a deduction off monthly payments.</i></p>
	Federal Transit Administration Low or No Emission Vehicle Program	Varies; up to a total of \$84.45 million available annually	State and local governments are eligible to receive program funds to purchase or lease zero-emission and low-emission transit buses and supporting fueling facilities.
	Public Transportation Innovation Program	Varies	Funding is available to a variety of eligible recipients to develop research, demonstration, and deployment projects and assist transit agencies in meeting the needs of their customers.



	Funding Source	Funding Amount	Description
Colorado	EV Tax Credit	Light-duty: \$5,000-\$7,000 Medium-duty: \$10,000 Heavy-duty: \$20,000	Qualified light-, medium-, and heavy-duty EVs titled and registered in Colorado are eligible for a tax credit. A purchaser can assign the tax credit generated through the purchase, lease, or conversion of the vehicle to the financing entity, allowing the purchaser to realize the value of the tax credit at the time of the purchase, lease, or conversion.
	EV & EV Charging Station Grants	EVs: \$8,260 Level 2: \$9,000 DC Fast: \$30,000	The Colorado Energy Office (CEO) and the Regional Air Quality Council (RAQC) provide grants through the Charge Ahead Colorado program to support EV adoption by individual drivers and fleets. CEO and RAQC will fund 80% of the cost of EV charging, up to specified amounts. RAQC will fund 80% of the incremental cost difference between a qualified EV and a comparable gasoline vehicle, up to the specified amount.
	Energy Impact Assistance Fund Grant	Varies	The Colorado Department of Local Affairs (DOLA) provides funding for the incremental cost of EVs for public fleets. DOLA funding can cover the matching funds required by the RAQC grant program.

Table 3: EV and EV Charging Infrastructure Funding Sources

National Initiatives

There are several notable EV initiatives underway at the national level. The U.S. Department of Transportation (DOT) Federal Highway Administration (FHWA) is establishing a [national network](#) of alternative fueling and charging infrastructure along national highway system corridors. There are several designated corridors in Colorado, including I-25 (which passes through Fort Collins), I-70, and I-76. While this designation does not guarantee funding for projects, it may give I-25 and other Alternative Fuel Corridors priority for future funding.

Another national effort is the result of a \$14.7 billion [settlement](#) between Volkswagen (VW) and the U.S. Environmental Protection Agency (EPA). This funding includes \$2.7 billion to be spent in support of programs and actions that reduce nitrogen oxide (NOx) emissions (also called the Environmental Mitigation Trust), and \$2 billion in support of programs and actions that increase the use of zero-emission vehicle (ZEV) technology (also called the ZEV Investment Commitment). Out of the ZEV Investment Commitment, [Electrify America](#) was formed to invest the \$2 billion over the next 10 years in ZEV infrastructure, education, and outreach. As a result, Electrify America is building a nationwide network of workplace, community, and highway charging stations, some of which will be in Colorado.

Multi-State Initiatives

In 2017, Colorado joined Arizona, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming (Signatory States) in signing the Regional Electric Vehicle (REV) West [Memorandum of Understanding](#) (MOU). The Signatory States pledged to create an Intermountain EV Corridor that will make it possible to seamlessly drive an EV across the Signatory States' major transportation corridors. Commitments include creating best practices and procedures that will enhance EV adoption, creating minimum standards for EV charging, identifying and developing opportunities to incorporate EV charging infrastructure into planning and development processes, encouraging EV manufacturers to offer vehicles in the Signatory States, and collaborating on funding opportunities to support the plan.

State Initiatives

The [Colorado EV Plan](#) was released in January 2018, developed in partnership by CEO, RAQC, the Colorado Department of Public Health and Environment (CDPHE), and the Colorado Department of Transportation (CDOT). The plan calls for the state to be a leader in the EV market and accelerate the adoption of EVs through a series of actions to support EV infrastructure along Colorado's corridors. The plan, which will be updated annually, outlines a number of activities including creating strategies and partnerships to create EV fast-charging corridors; coordinating with REV West states; developing strategic partnerships with utilities, local governments, and other stakeholders; updating signage and wayfinding requirements to include EV fast-charging; and ensuring economic and tourism benefits of EV charging.

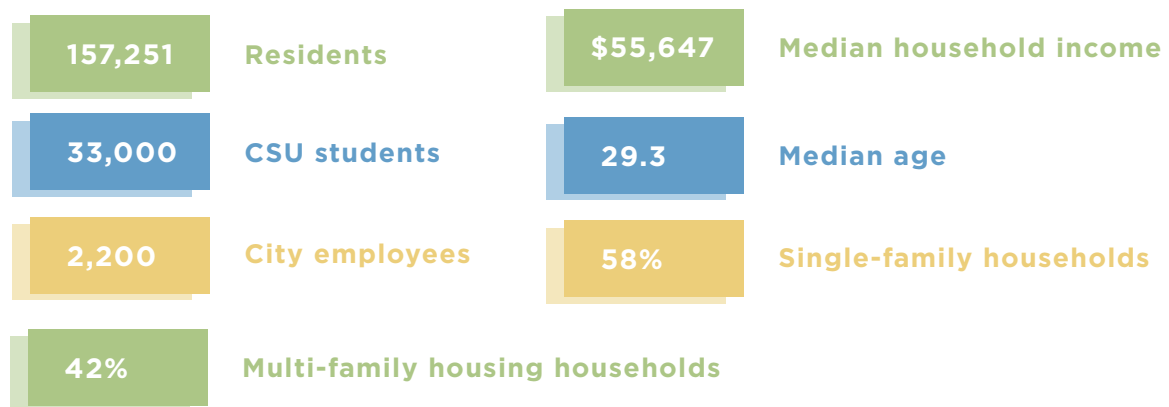
The [Colorado Wired Workplaces](#) program, administered by CEO, recognizes Colorado employers that are committed to the growth of the state's EV market and install workplace charging for their employees. Colorado State University (CSU) has been recognized by the Wired Workplaces program.

In June 2018, Governor Hickenlooper signed an [executive order](#) that commits Colorado to adopting low-emission vehicle (LEV) standards. The order directs CDPHE to develop a rule to establish a Colorado LEV program. A [draft rule](#) was proposed in August 2018 and will potentially be adopted by the end of 2018. The City, in coordination with Colorado Communities for Climate Action (CC4CA), supported state executive action in favor of cleaner vehicle standards.

Colorado will receive \$68.7 million in [funding](#) from the VW settlement discussed above, specifically from the Environmental Mitigation Trust. CDPHE will oversee how the money is distributed and spent in the state. CDPHE coordinated with CDOT, CEO, RAQC, and other agencies to draft the [Beneficiary Mitigation Plan](#), which details how the state intends to spend the funds. Specifically, Colorado plans to:

- Allocate the maximum allowable amount of trust funds to EV charging infrastructure and align funds with the Colorado EV Plan
- Complement any investments made by VW in Colorado through Electrify America efforts, including EV infrastructure, access, and education
- Use trust funds to increase the adoption of EVs and alternative fuel vehicles

Fort Collins by the Numbers



Fort Collins Overview

Fort Collins is located in Northern Colorado at the base of the Rocky Mountains, approximately 70 miles from the capital city of Denver. The city sits at 5,000 feet above sea level and is a short distance from mountainous terrain. Fort Collins is home to CSU. It receives a steady stream of tourists and saw 1.73 million visitor days in 2017, with 14% of those visitors coming from other parts of Colorado. This provides an opportunity to decrease transportation emissions across the state by encouraging those traveling to and around Fort Collins to do so in an EV.

Electricity in Fort Collins is currently generated primarily by coal, with 32% of electricity coming from renewable sources in 2017.¹⁵ The City's goal is to diversify electricity sources with more renewables, specifically solar, with a goal of 22% of existing homes and 50% of existing businesses having installed solar by 2030. In October 2018, the Fort Collins City Council adopted the goal of 100% renewable energy by 2030.¹⁶

The use of coal in the current electricity mix is a significant consideration when evaluating the environmental impacts of current and future EV charging in Fort Collins. EVs running only on electricity have zero tailpipe emissions, but emissions

¹⁵ Platte River Power Authority (PRPA). Carbon-free resources as of 2017. Available online: <https://www.prpa.org/generation/carbon-free-resources/>

¹⁶ City Council Resolution 2018-094. Available online: http://citydocs.fcgov.com/?cmd=convert&vid=72&docid=3254662&dt=AGENDA+ITEM&doc_download_date=OCT-02-2018

may be produced by the source of electricity. Areas that use low carbon or renewable sources for electricity typically have a strong overall emissions benefit compared to conventionally fueled vehicles, whereas in regions such as Fort Collins that depend on carbon-heavy fuels for electricity, EVs may not have a strong overall emissions benefit. According to the U.S. DOE's Alternative Fuels Data Center (AFDC), with Colorado's current electric grid, EVs will emit about 6,300 pounds of carbon dioxide (CO₂) from charging annually, compared to 11,500 pounds from comparable gasoline vehicles.¹⁷ Electricity used in Fort Collins uses slightly more coal than the Colorado average (65% as opposed to 53.8%), and annual EV emissions in Fort Collins are higher as well (about 6,600 pounds of CO₂ annually).¹⁸ However, this is still significantly lower than gasoline vehicle CO₂ emissions.

Plans and Goals

In 2015, the City Council unanimously adopted the [CAP](#) in response to [City Council Resolution 2014-028](#). The CAP calls for a 20% GHG emission reduction by 2020 below 2005 levels; 80% reduction by 2030; and carbon neutrality by 2050.

The [CAP Framework](#) outlines a series of high-level strategies to achieve the GHG emissions reduction goals. In addition to GHG emissions reductions from reducing vehicle miles traveled (VMT) by increased walking, biking, and transit use, the framework estimates that 2% of 2020 emissions savings, 2% of 2030 emissions savings, and 6% of 2050 emissions savings will be the result of accelerated adoption of fuel efficient and electric vehicles. To reach these savings, the framework sets a goal of 50% of new passenger vehicles purchased in 2030 being electric (BEVs or PHEVs).

Published in 2011, [City Plan](#) and the Transportation Master Plan call out several goals loosely related to EVs, including a vision for a long-term multimodal transportation system, a reduction in VMT per capita, and support of the use of and investment in alternative fueling infrastructure to reduce transportation emissions.

Electric Vehicle Support

The City has taken multiple actions related to EVs. The City adopted EVs into the City fleet starting in 2012. As of February 2018, the fleet contained 15 BEVs, one PHEV, and 18 hybrid electric vehicles (HEVs), with plans to add more EVs in the future.¹⁹ The City also partnered with [Drive Electric Northern Colorado](#) (DENC), the Electrification Coalition (EC), the City of Loveland, and CSU to install EV charging stations. DENC was established in 2013 as a living laboratory for the development and testing of strategies to accelerate the adoption of EVs. In 2014 and 2015, 13 public, City-owned stations were installed

Key City EV Actions to Date

- **City Fleet:** 15 BEVs, 1 PHEV, and 18 HEVs
- **EV Charging:** 13 public, city-owned stations
- **ClimateWise:** Transportation badge
- **City Municipal Planning:** Municipal and building codes

¹⁷ U.S. DOE AFDC. Emissions from Hybrid and EVs as of August 13, 2018. Available online: <https://www.energy.gov/maps/egallon>

¹⁸ Correspondence with PRPA. September 2018.

¹⁹ Interview with Tracy Ochsner, Operation Services, February 22, 2018.

in high traffic areas such as downtown and retail shopping centers, as well as municipally-owned facilities. Municipally-owned station installations were limited to City-owned property. The highest utilized public station is one of two chargers at the Civic Center parking garage, with 450 charging sessions in 2017. In contrast, the remaining stations averaged less than 100 sessions per year, with one station used only seven times in 2017.

A 2011 City EV capacity study sought to determine capacity of the existing electric distribution system for charging EVs. In 2015, in partnership with DENC, the City joined the U.S. DOE Workplace Charging Challenge. As a result of challenge participation, the City and DENC hosted EV ride-and-drives for 193 employees, held eight EV promotion events, and offered free EV charging for City employees through 2016 in the Civic Center parking garage. DENC also coordinated a Nissan LEAF group buy for a discounted price. The City's ClimateWise program is a free, voluntary program that offers solutions for Fort Collins businesses to reduce their environmental impact, save money, and gain recognition for their climate-related achievements. ClimateWise partners are recognized with badges for their accomplishments, and can receive a transportation badge for work done to reduce emissions through reduced VMT and accelerated adoption of fuel-efficient vehicles and EVs. At this time, the ClimateWise transportation badge does not require specific EV adoption actions, such as installing workplace charging or converting a fleet to EVs.

The City has established EV-ready building codes for single-family homes. [Residential Code](#) section E3401.5 states that new single-family dwellings with an attached garage must have an empty conduit installed from the dwelling's electrical panel board to a junction box in an accessible location in the garage capable of supporting a 30A, 240V outlet to enable the installation of a Level 2 EV charging station. Additionally, [Municipal Code](#) section 26-476 sets public EV charging station service user fees (Level 2: \$1 per hour, DC fast: \$3 per session).

In addition to the City's actions, the Fort Collins community has also supported EV adoption. As of October 2018, there are 35 locations in Fort Collins with charging stations installed by entities other than the City, including car dealerships, local breweries, apartment buildings, businesses, workplaces, and CSU. 15 non-municipal employers participated in DENC's Northern Colorado EV Workplace Charging Challenge and encouraged their employees to drive EVs. In particular, CSU has seen greater demand for EV charging for both employees and students; since 2015, CSU received over 100 EV parking permit requests, and as of October 2018 there are 26 charging ports on campus. Lastly, the Northern Colorado EV Enthusiasts group meets month to month to discuss and promote EVs locally.

Electric Vehicle Population and Projections

As of January 2018, there were 624 EVs registered in Fort Collins, including both BEVs and PHEVs. The EV portion of the region's light-duty vehicle market share is currently higher than the Colorado state average (0.40% vs. 0.25%).²⁰ In 2017, EVs made up 1.21% of the national light-duty market share.²¹ For planning purposes,

²⁰ ICF analysis of IHS Markit vehicle registration data.

²¹ Auto Alliance. Advanced Technology Vehicle Sales Dashboard. Available online: <https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/>

it is important for the City to both gain an understanding of how the market may develop over the next 10-12 years and track progress towards such projections and goals.

The U.S. Energy Information Administration (EIA) estimates that 6.2% of the national light-duty car market share will be EVs by 2030.²² The Colorado EV Plan includes three statewide EV growth scenarios with projections from 2014 to 2030. Based on the state's [EV Market Implementation Study](#):

Measuring EV Adoption

EV adoption can be tracked with three metrics:

- **Sales** (annual, percentage, or absolute)
- **Stock** – number of vehicles on the road (absolute)
- **Light-duty market share** (percentage)

- The low growth scenario assumes that 1.85% of all vehicle *sales* will be EVs by 2030.
- The medium growth scenario assumes that 5.00% of all vehicle *stock* will be EVs by 2030.
- The high growth scenario assumes that 15.50% of all vehicle *stock* will be EVs by 2030.

To align with these state-level projections, the Roadmap project team scaled the Colorado growth scenarios to the Fort Collins area using population forecasts from DOLA.²³ These scaled EV growth projections, along with the Fort Collins CAP framework goal of having 50% of new vehicle sales be EV by 2030, are shown in the figure below.

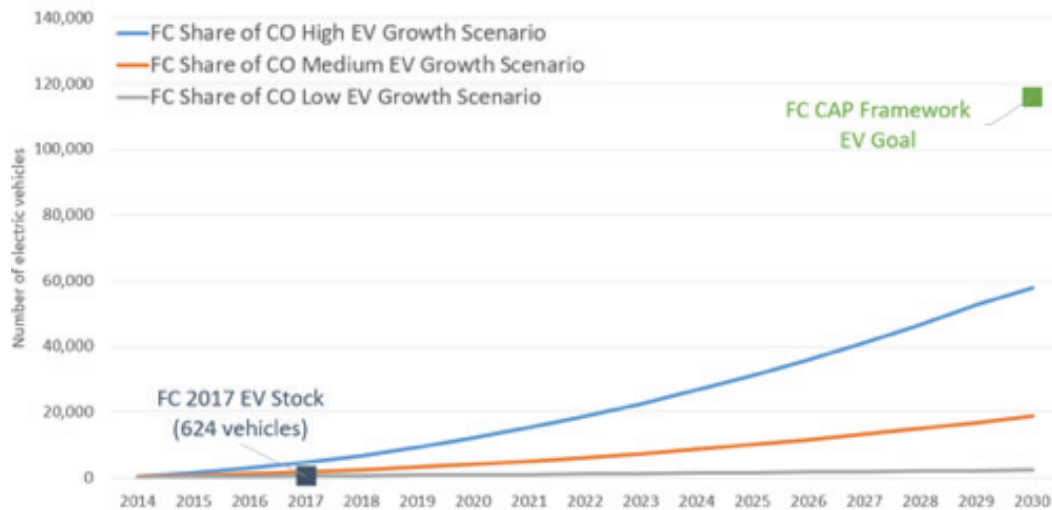


Figure 2: The Fort Collins share of Colorado EV growth scenarios. Based on Fort Collins' percentage of total state population, accounting for Colorado and Fort Collins-specific population forecasts by DOLA. The Fort Collins CAP Framework goal of 50% of new light-duty vehicle sales being electric is shown here as stock rather than sales to provide an easy comparison; as the high growth scenario in 2030 is equivalent to roughly 25% of new sales being electric, the Fort Collins CAP Framework goal results in approximately twice as many vehicles as the high growth scenario (about 116,000 vehicles).

²² EIA. Annual Energy Outlook 2018. Table 40: Light-Duty Vehicle Stock by Technology Type. Available online: https://www.eia.gov/outlooks/aeo/tables_ref.ph

²³ Colorado State Demography Office. Population Forecasts - 1-year increments, 2000 - 2050. Available online: <https://demography.dola.colorado.gov/population/population-totals-colorado-substate/#population-totals-for-colorado-and-sub-state-regions>

As the graph shows, Fort Collins is currently slightly behind the medium growth scenario. To achieve EV adoption predicted in the high growth scenario and move toward the goal of 50% of new vehicle sales being electric by 2030, Fort Collins will need to dedicate significant funding and staff resources to aggressively pursue EV readiness strategies.

Charging Infrastructure Projections

Electric Vehicle Infrastructure Projection (EVI-Pro) Lite, developed by the National Renewable Energy Laboratory (NREL), projects consumer demand for EV charging infrastructure. Infrastructure projections are based on the number of EVs in the area (entered by the user), and the tool differentiates workplace charging, public Level 2 charging, and public DC fast charging needs. For more information, see the [EVI-Pro Lite](#) tool.

	EV Growth Scenarios			
	CO Low Growth	CO Medium Growth	CO High Growth*	CAP Framework Goal*
Workplace Charging Connectors	248	1,182	3,546	7,092
Public Level 2 Connectors	195	1,156	3,468	6,936
DC Fast Connectors	30	155	465	2,790

Assumptions:

- Vehicle Mix: Uses the EVI-Pro Lite default assumptions of 35% BEVs with a 250+ mile range, 35% PHEVs with an electric range of 50+ miles, 15% BEVs with a 100+ mile range, and 15% PHEVs with an electric range of 20+ miles.
- PHEV support: Fully supports PHEV charging to encourage a maximum amount of electric VMT (eVMT).
- Residential charging: Assumes that the 58% of Fort Collins residents with single-family homes have access to residential charging. Assumes that 25% of the 42% of Fort Collins residents in multi-family housing have access to residential charging.

**CO High Growth and CAP Framework Goal projections: EV-Pro Lite can only calculate demand if the projected number of EVs is less than 10% of the current light-duty vehicle stock. Both the high growth scenario and the CAP Framework goal have EV adoption projections above this threshold, and infrastructure requirement projections are extrapolated proportionally from the low and medium growth scenarios.*



READINESS STRATEGIES / Methodology

This Roadmap is the City's strategic plan to support increased EV adoption throughout the Fort Collins community and the Northern Colorado region. It provides specific readiness strategies the City should implement, either independently or in coordination with partners, to make progress toward climate, environmental, and transportation goals.

To inform readiness strategy development, the project team collected information about existing conditions through a review of public resources and interviews, distributed a community questionnaire, conducted an EV charging demand analysis, and engaged a Steering Committee for input and feedback throughout the process.

Discovery Phase

To begin the discovery phase, the project team reviewed existing information relevant to EVs and charging infrastructure, including building codes, traffic codes, department plans (e.g., Transportation Master Plan, Environmental Services Strategic Plan), municipal plans (e.g., CAP), and websites.

The project team conducted interviews with City staff from multiple departments, including Building Services, FCMoves, Operation Services (Fleet Maintenance), Parking Services, Sustainability Services (Environmental Services, Social Sustainability), Streets, Transfort, Utilities, and Zoning Services. Each interview offered unique insights to EV adoption in Fort Collins and each department was supportive of the Roadmap's vision.

The project team also conducted interviews with representatives of CEO, CSU, DENCO, local businesses, local developers, Northern Colorado Clean Cities, Northern Colorado EV Enthusiasts, Platte River Power Authority (PRPA), and the Southwest Energy Efficiency Project (SWEET). External partners provided both their technical input and local experience. Interviewees were eager to collaborate and increase EV adoption in Fort Collins.

Community Questionnaire

The project team compiled a community questionnaire to understand the driving habits of Fort Collins residents, learn the level of community interaction with EVs, and gauge the community's knowledge and opinions of EVs. The questionnaire was distributed through City channels (e.g., CAP newsletter, ClimateWise partners, Facebook pages) and external channels (e.g., Northern Colorado EV Enthusiasts group, Fort Collins Sustainability Group). The questionnaire received 457 responses between March 21, 2018, and April 9, 2018.

The results of the questionnaire suggest the current generation of EVs can meet the travel needs of most respondents. While questionnaire respondents were generally comfortable with EVs and have had some degree of interaction with the technology, there was a low awareness of federal and state incentives for EVs, and respondents were concerned with the range of vehicles and lack of public infrastructure. For a full summary of the questionnaire, see Appendix B.

Charging Demand Analysis

The project team conducted a demand analysis to determine where there is likely to be demand for different types of charging, including residential (at home), workplace (at work), and public (other destinations). The analysis used census demographic data and vehicle registration data to produce three residential cases: a map showing areas where individuals likely to own EVs live (see Figure 3), a map illustrating where individuals who dwell in multi-family housing and are likely to own EVs live, and a map showing where low-income individuals live.

The likely-adopter residential map can be used to understand the potential grid impacts of residential charging; these neighborhoods are most likely to have EVs and if enough of the homes install charging stations, there could be a need for local distribution infrastructure upgrades. The multi-family residential map shows where residents who are likely to adopt EVs and live in multi-family housing are located; these residents typically do not have access to home charging. These areas are key for City outreach to building managers and developers to provide education on the benefits of providing multi-family housing charging and are also key areas that public infrastructure could offer more charging options for residents. The low-income residential map shows areas where low-income residents live. These are not areas of predicted high EV adoption. They are, however, key areas for education efforts about federal and state incentives and local group-buy initiatives, and the map shows where efforts to expand EV access to all residents, such as through offering EV car sharing programs or expanding and electrifying public transit routes, can be focused.

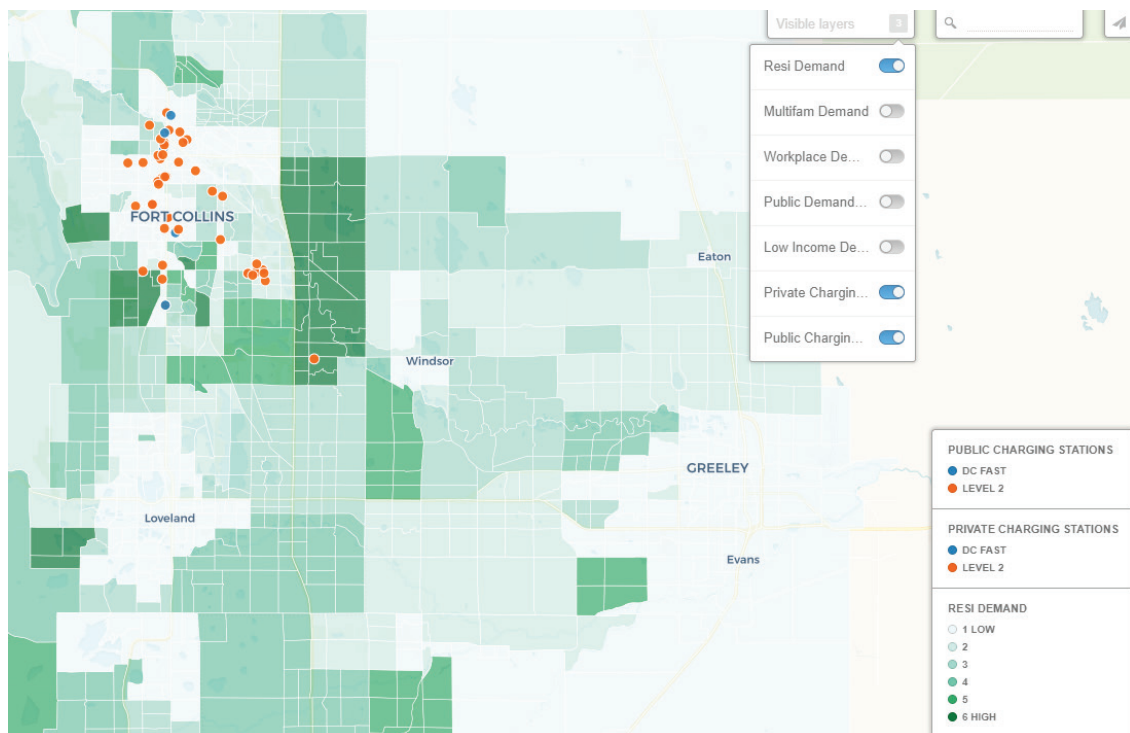


Figure 3: The demand analysis results highlight areas likely to have relatively high demand for residential (shown here), multi-family, low-income, public, and workplace charging. The first five layers of the map illustrate the results of the different cases, while the last two layers show existing public and private charging stations. The five case layers are not cumulative and should be viewed individually.

Combining the likely-adopters residential case with trip data from the North Front Range Metropolitan Planning Organization's (NFRMPO) regional travel demand model, the project team developed workplace and public charging maps that show where people likely to own EVs travel for work and non-work trips, respectively. These maps identify key areas for the City to conduct outreach to employers about workplace charging, as well as areas that may be good candidates for public charging that will be highly utilized.

For more information about the demand analysis methodology, as well as maps illustrating the results, see Appendix C.

Steering Committee Input

The Steering Committee, comprised of City departments, regional partners, and community stakeholders, provided critical input at various stages of the Roadmap development. The Steering Committee worked together to define the Roadmap vision and goals, provided feedback on the infrastructure demand analysis, and collaborated to prioritize and refine Roadmap strategies. For Steering Committee meeting notes, see the [EV Readiness Roadmap](#) website.

Summary of Findings

While there have been many initiatives to support EV adoption in and around Fort Collins, and City departments and stakeholders are supportive of EVs and understand the emissions benefits of EVs are crucial to the City's environmental goals, there has been no cohesive strategy about how to increase EV adoption. City departments have not had the authority, resources, or overarching policy to comprehensively address barriers to EV adoption, and much of the institutional knowledge gained during previous efforts has been lost as a result of staff turnover and organizational changes.

There is a strong public interest in EVs, though there are some common misconceptions about EVs in the community. The City is uniquely positioned to provide EV-related education, answer questions, and help increase community familiarity with EVs. With a municipal utility, environmentally conscious energy provider, and university involved in EV and transportation research, Fort Collins has the ability to be an innovative leader in a rapidly changing sector, and the City can bring together partners and stakeholders to help achieve its CAP goals.

Implementing the Roadmap

To effectively pursue the recommended readiness strategies that follow, the City must first establish ownership of overarching EV efforts, identify and engage key partners, and commit to implementing, revisiting and revising the Roadmap. An organized and purposeful City effort will allow Fort Collins to be efficient, effective, and grant-ready, and is critical to the success of the Roadmap and its readiness strategies.

Departmental Ownership

Many City departments have worked to support EV adoption, including Utilities, Environmental Services, and FC Moves. While there has been some collaboration on EV matters, one department must take a leadership role in coordinating efforts and directing the implementation of the Roadmap.

Although a wide variety of departments will need to lead individual strategies and pursue actions to implement the Roadmap, ***FC Moves is best suited to lead overall Roadmap efforts.*** FC Moves is uniquely positioned to be able to view EV adoption through the lens of the transportation hierarchy and has experience collaborating with Environmental Services, Streets, and Planning. To ensure a successful program, EV work needs to be supported by departmental leadership and FC Moves will coordinate with other departmental partners as much as possible. In order for EV support to be successful and ongoing, efforts must be sustained past staff tenure or short-term projects, and EV adoption must be a stated component of the department's mission.

To support ongoing coordination, FC Moves should ***convene an interdepartmental EV-focused working group*** at least twice each fiscal year. The working group should be a natural evolution of the Roadmap's Steering Committee but limited to City departments that "touch" or have a vested interest in EVs, including but not limited to Environmental Services, Utilities, Streets, Planning, Operation Services, and Parking. As needed, the working group can consult with local partners, including CSU, DENC, PRPA, Northern Colorado Clean Cities, and NFRMPO. The working group meetings will be an opportunity to report on progress, coordinate activities, and plan for future initiatives. In addition to the working group, there may be value in forming a CAP team focused on EV planning, potentially a sub-group of the current CAP Multimodal Planning and Development team.

Infrastructure Development

The City should support the installation of EV charging infrastructure through policy, education, and incentives, but ***refrain from owning, operating, and maintaining charging stations.*** Because its charging station installation opportunities are limited to City property, the City is unable to site stations in areas where they are most likely to be used. The City's existing stations have seen very low utilization. Additionally, it can be very difficult to recover costs from charging station installation; most businesses that install stations benefit financially through increased dwell time rather than direct revenue from the charging station. While CEO and others offer grants for charging station installation, grant data reporting requirements demand staff time and grant management can result in other resource needs. The private sector has more flexibility, so the City is in a position to play a supporting role in infrastructure installation, providing the public sector with information, assisting with coordination, and offering financial incentives.

Key External Partnerships

To achieve the Roadmap goals, the City will need to ***partner with local, regional, and state stakeholders.***



Research from the International Council on Clean Transportation (ICCT) and others concludes that EV market growth requires numerous actions by multiple players.²⁴ Partners provide a range of expertise and value, and communication with a wide range of entities will allow the implementation of Roadmap strategies to be comprehensive, inclusive, and innovative. See Table 4 for a (non-exhaustive) list of potential stakeholders and the valuable insights they bring.

	Scope	Strengths
CSU	Local, Regional	Technical expertise, community feedback, communication
Northern Colorado Clean Cities	Regional	Community feedback, communication and outreach
Northern Colorado EV Enthusiasts	Local	Community feedback, communication and outreach
PRPA	Regional	Technical expertise
CEO	State	Technical expertise, legislative advocacy
Chamber of Commerce	Local	Community feedback, communication and outreach
NFRMPO	Regional	Technical expertise (trip modeling)

Table 4: Roadmap Implementation Stakeholders

Ongoing Tracking and Revisions

FC Moves, together with the working group, must **continually revisit the Roadmap to determine both progress and challenges**. As technology continues to improve, Roadmap goals and strategies will need to evolve and adjust to the new electrified landscape; for example, as more EV models become available, the City fleet should incorporate EVs in more fleet applications.

On an annual basis, Fort Collins should assess progress on Roadmap readiness strategies and goals, regional EV sales/stock, and regional charging station availability.

Fort Collins should work with NFRMPO to update the demand analysis every four to seven years. Updated analyses will provide better information about where likely EV owners live and travel, particularly as the EV market, neighborhood demographics, and land uses change.

²⁴ ICCT. July 2018. The Continued Transition to Electric Vehicles in U.S. Cities. Available online: https://www.theicct.org/sites/default/files/publications/Transition_EV_US_Cities_20180724.pdf



Strategies

Strategies to achieve the Roadmap goals are outlined in this section and organized into seven categories, as follows:

- Outreach and Education
- Leading by Example
- City Planning and Regional Coordination
- Policies
- Incentives
- Utilities
- Emerging Technologies

Each readiness strategy description in this section includes:

- **Actions:** A series of actions to advance the strategy
- **Lead Department:** Lead department(s) responsible for initiating and owning the strategy.
- **Partners:** Key partners that will need to be consulted to move forward with related actions.
- **Timeline:** Suggested timelines for when a strategy should be implemented. While start and end dates are not listed, timelines indicate when a strategy should actively be pursued. Most strategies will require follow-up after they are completed to ensure continued success (e.g., electrifying the City fleet will need to be constantly revisited), and some will be ongoing (e.g., outreach and education).
- **Budget:** Funding, other than staff time, needed from the City to complete the strategy. Budget is noted using a low, medium, and high indicator, and budget level is relative among the strategies. “Low budget” items may be accomplished with existing resources.
- **Level of Effort:** Staff time and work needed to complete the strategy. Level of effort is noted using a low, medium, and high indicator. As with budget, level of effort is relative among the strategies, and “low” level of effort is meant to indicate that a strategy could be accomplished with existing resources.
- **Potential Impact:** A gauge of the extent to which the completion or achievement of a strategy will affect the Roadmap goals (i.e., increased EV adoption and readiness). Potential impact is noted using a low, medium, and high indicator. Because there are many factors that determine success, the Roadmap does not identify impact in terms of emissions reduction or other quantifiable metrics. For example, it is difficult to estimate the environmental impact that results from behavior change due to outreach and education events. Many assumptions would need to be made to accurately quantify the impact of strategies. Further, any concrete numbers would be largely subjective. Instead, impact is considered in the context of how well the execution of a strategy will achieve the vision and goals of the Roadmap.








Together, budget and level of effort indicate the resource needs for readiness strategy implementation. Both should be considered scalable, meaning if there are limited resources (funding, staff time) available, the readiness strategy can still be implemented in some way. Potential impact can also be considered scalable, since it will depend on how actively a readiness strategy is pursued and the extent to which resources are dedicated to actions. For example, the “support

public charging installation” strategy may have a low to medium impact if the City provides basic information to local businesses about existing incentives. However, the strategy could have a very high impact if the City allocates resources and provides funding to local businesses to install chargers. By acknowledging that impacts can be scalable and are a result of level of effort and available funding, the Roadmap is intended to reflect the reality of the City budget process.

All of the readiness strategies are important to the vision of the Roadmap. Strategies designated as relatively low impact may also be low effort and should be considered “easy wins.” However, high impact strategies, which may be more difficult to execute, also need to be pursued if Fort Collins intends to meet its aggressive Roadmap and CAP goals. Fort Collins should use the budget, level of effort, potential impact, and timeline information to determine the priority of each readiness strategy (and their respective actions).

The following table lists the readiness strategies and illustrates how each is linked to the goals outlined at the outset of this Roadmap.

A large bold **X** indicates the primary impact of each strategy, while the small *x* (in italics) indicates secondary impacts.

INCREASE EV USE	IMPROVE AWARENESS	MAKE ACCESSIBLE	INTEGRATE WITH RENEWABLES	INCREASE EVS IN CITY FLEET	INCREASE EMPLOYEE AWARENESS	INVEST IN MUNICIPAL CHARGING
						

Outreach and Education							
1a. Target education and outreach to key audiences	x	X				x	
1b. Maintain a comprehensive EV website	x	X				x	
City Planning and Regional Coordination							
2a. Encourage EV ride-hailing and car sharing	X	x	X				
2b. Incorporate EV readiness in local and regional planning	X	x	x				
2c. Coordinate and advocate regionally	X	x	x				



Policies							
3a. Clarify City policy related to EV charging	X	X	X				
3b. Allow right-of-way locations for EV charging station installations	X	X	X				
3c. Revise multi-family and commercial building codes to require EV-ready developments	X	X	X				
3d. Establish and enforce EV parking rules	X	X	X				
Incentives							
4a. Incentivize consumer EV purchases	X		X				
4b. Support public charging station installation	X	X	X				
4c. Recognize local businesses with workplace charging through the ClimateWise program	X	X	X				
Utilities							
5a. Support smart grid operations for EVs	X			X			
5b. Increase renewable electricity for EV charging	X			X			
5c. Upgrade electricity distribution infrastructure	X		X	X			
5d. Assess and adjust utility rate structures for EV drivers	X		X	X			



Leading by Example							
6a. Pursue electrification opportunities within the City's light-duty fleet	X	X			X	X	X
6b. Pursue electrification opportunities within the City's transit fleet	X	X	X		X	X	X
6c. Install EV charging for the City fleet	X	X			X	X	X
6d. Encourage EV adoption by City employees	X	X			X	X	X
Emerging Technologies							
7a. Pursue living laboratory projects	X	X		X	X		
7b. Track emerging technologies and market developments	X	X		X	X		

1. Outreach and Education

Outreach and education strategies are key to improving understanding of EV-related costs, benefits, and considerations, as well as raising general awareness of EVs. As the Community Questionnaire found, residents of Fort Collins have a low level of awareness about financial incentives for EVs and charging infrastructure, and there were conflicting ideas about EVs that indicate a lack of factual knowledge. Outreach and education strategies should be pursued with specific audiences in mind and should build on existing efforts by City partners, particularly non-profit organizations, such as Northern Colorado Clean Cities and DENC. Outreach and education strategies will need to be ongoing and reevaluated for efficacy and should be well coordinated with the implementation of other strategies to increase public awareness of EV Roadmap efforts. EV readiness education and outreach should be coordinated with City transportation demand management (TDM) education and outreach to streamline messaging and reduce confusion about the City's commitment to both reducing VMT and electrifying VMT.

For more information and guidance related to education and outreach strategies, including a list of key target audiences, key objectives, sample messages, channels, tactics, and resources see the Outreach and Education toolkit (Appendix A).

1a. Target education and outreach to key audiences

Education and outreach should be targeted to specific audiences, including (but not limited to) local businesses, low-income communities, multi-family housing tenants and landlords, building developers, and employers.

Actions

- Engage and partner with key stakeholders to conduct targeted outreach to:
 - Developers, multi-family housing building managers and governing boards – highlight the benefits of installing conduit/wiring and charging stations; refer to key guidance on ownership models, installation options, and applicable funding or incentive programs
 - Employers – summarize the benefits of workplace charging for both employers and employees; refer to applicable funding or incentive programs; encourage employee education about EVs
 - Businesses (destinations) – summarize the potential business case for public charging and opportunities to partner with neighboring businesses; refer to applicable funding or incentive programs
 - Private fleets – encourage organizations to lead by example with EV use and charger installation; assist with making connections between fleets for peer-to-peer information exchange
- Leverage the charging demand analysis to identify specific geographic areas that are likely to have higher demand for multi-family, workplace, and public charging to target outreach efforts. Use the low-income and multi-family layers of the demand analysis (Appendix C) to ensure that efforts are equitable and serving all community members.

Key Resources

The U.S. DOE's AFDC has a number of resources for various audiences:

- [EV Handbook for Workplace Charging Hosts](#)
- [EV Handbook for Public Charging Station Hosts](#)
- [EV Handbook for Fleet Managers](#)

See Appendix A for more resources.

Lead Department	FC Moves
Partners	Key stakeholders, including local businesses, developers, property managers, employers, non-profits, and universities, and Economic Health
Timeline	Ongoing
Budget	Low
Level of Effort	Low to medium
Potential Impact	Medium

1b. Maintain a comprehensive EV website

The City can provide residents, businesses, and visitors with specific, relevant, and factual information about EVs and charging via a website. The website should include information about Fort Collins EV parking and charging stations, residential and public charging permitting, EV building codes, and local initiatives, incentives, and considerations. The site can link to external sources for more information about state and national EV efforts, as well as general EV information. The City should coordinate with stakeholder agencies and organizations with existing EV-focused websites to coordinate and to share best practices, avoiding duplication.

Actions

- Catalog and review all EV-related information currently presented on the Fort Collins website and on other agency and organization websites to identify outdated information and update accordingly.
- Establish a central website maintained by FC Moves, consolidate existing content, and establish links to DENC, the AFDC, and other resources that provide relevant and current information.

Lead Department	FC Moves
Partners	Environmental Services
Timeline	Ongoing
Budget	Low
Level of Effort	Low
Potential Impact	Medium

Website Best Practices

Municipal websites should include basic information about relevant codes, policies, and incentives, and should be tailored to the community.

Some examples include:

- Braintree Drives Electric
- Go Electric Oregon
- Tahoe Alternative Fuels



Case Study: BlueLA

BlueLA is an EV car sharing program in low-income communities of Los Angeles. It is a partnership of BlueLA Carsharing and the Los Angeles Department of Transportation, and provides EVs (and charging stations) in self-service kiosks in Los Angeles. Members pay a monthly fee as well as a fee per minute of use of an EV; low-income qualified members receive a discount. For more information, see the [BlueLA website](#).

2. City Planning and Regional Coordination

As a major regional destination with a high number of commuters in and out of the community, Fort Collins must coordinate EV efforts both internally and externally. In order to be a leader in EV adoption, it is important that the City collaborate at the regional, state, and national scale and advocate for policies, such as clean vehicle standards, that support its goals.

2a. Encourage EV ride-hailing and car sharing

By collaborating with car sharing and ride-hailing (e.g., Uber, Lyft) companies to incorporate EVs into the fleet, Fort Collins can expand access to EVs for community members that do not own cars or cannot afford to purchase or lease an EV.

Actions

- Incorporate EV car sharing and ride-hailing services into the City Plan and Transportation Master Plan update
- Explore opportunities, in coordination with the Chamber of Commerce, to incentivize EV car sharing programs that cater to small businesses

Lead Department	FC Moves
Partners	Car/ride sharing service providers, Chamber of Commerce, Economic Health
Timeline	Within 10 years
Budget	Low
Level of Effort	Low
Potential Impact	Medium

2b. Incorporate EV readiness in local and regional planning

The City should be explicit in its inclusion of EVs, and actions to support EV adoption, in City department and regional plans.

Actions

- Include EV readiness as a priority in the City Plan Transportation Master Plan update
- Include EV readiness as a priority in the Energy Policy
- Coordinate with NFRMPO to include EV strategies in the Regional Transportation Plan

Lead Department	FC Moves
Partners	All City departments, NFRMPO
Timeline	Ongoing
Budget	Low
Level of Effort	Low
Potential Impact	Medium

Regional Hub

According to the City Plan *Trends and Forces Report*, NFRMPO's regional travel demand model projects a 140% increase in trips between Fort Collins and the central I-25 subregion, a 68% increase between Fort Collins and Loveland, and an average increase of 88% between Fort Collins and all other subregions. Fort Collins' role as a hub in Northern Colorado necessitates the City's coordination with its neighbors to ensure that EVs will be supported in all regional plans.



2c. Coordinate and advocate regionally

Fort Collins should engage in state, regional, and national advocacy efforts to support EVs, aligning with CEO, other leading cities, NFRMPO, and complementary regional initiatives.

Leading Together

With adopting the [Colorado EV Plan](#) and signing the [REV West MOU](#), Colorado is playing a leading role in EV adoption. Fort Collins should communicate and collaborate with the CEO to build upon and learn from existing EV efforts.

Actions

- Continue to engage with CC4CA on EV-related issues, including clean vehicle standards
- Incorporate EVs and charging infrastructure in the Fort Collins Legislative Policy Agenda
- Actively participate in the [Colorado Electric Vehicle Coalition](#)
- Coordinate with CEO to ensure that DC fast charging installations in Fort Collins align with FHWA priority corridors

Lead Department	FC Moves
Partners	Environmental Services, external organizations
Timeline	Ongoing
Budget	Low
Level of Effort	Low
Potential Impact	Medium

3. Policies

Fort Collins should amend and clarify City policies to allow greater access to EV charging. By clarifying existing station installation procedures, the City can help reduce the burden for and increase education among charging station owners and site hosts. Allowing charging infrastructure in right-of-way locations vastly increases the places that charging stations can be installed, allowing station owners to strategically place stations for maximum utilization. Incentivizing and eventually requiring charging stations in new commercial and multi-family buildings increases access to charging for residents that do not own single-family homes, allowing more people access to EVs. The City should engage stakeholders and solicit community feedback during the process of developing or modifying policies.

Signage Best Practices

The FHWA's *Alternative Fuel Corridors* program is working to develop national signage and branding for EV charging stations. As part of the *Colorado EV Plan*, the state is updating CDOT DC fast charging signage criteria, as well as establishing a process for signing new publicly-accessible stations. Fort Collins should build on these efforts and ensure that local signage guidance is compatible with federal and state guidance.

3a. Clarify City policy related to EV charging

The City should document, streamline, and provide guidance for existing residential and commercial EV charging station installation procedures.

Actions

- Clearly summarize the basic steps residents, businesses, and developers must follow to install EV charging infrastructure
- Establish a residential EV charging permitting process notification mechanism for Utilities
- Establish wayfinding and signage guidance, coordinating with regional and state efforts

Lead Department	Planning
Partners	Utilities
Timeline	Within one year
Budget	Low
Level of Effort	Low
Potential Impact	Low

3b. Allow right-of-way locations for EV charging station installations

By allowing charging stations to be installed in right-of-way locations, Fort Collins will increase the viable sites for charging and ensure that chargers can be placed in optimal areas.

Actions

- Convene a working group that includes local businesses and developers to evaluate concerns and identify solutions for right-of-way charging
- Amend the Streets code to allow right-of-way charging

Lead Department	Planning
Partners	Utilities, Streets, Economic Health, local businesses
Timeline	Within 2 years
Budget	Low
Level of Effort	Medium
Potential Impact	High

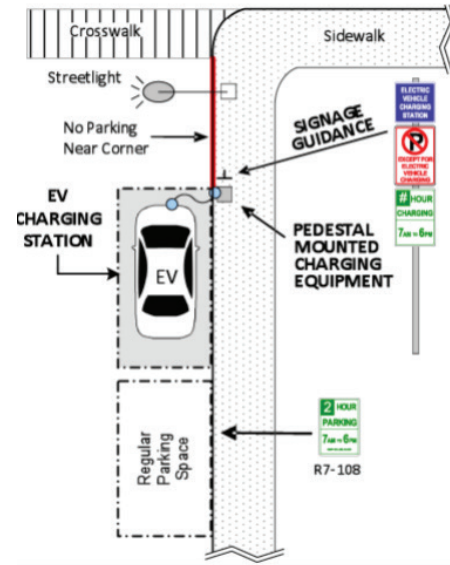


Figure 4: Sample right-of-way charging configuration. Source: Washington State Energy Office. EVs for Washington's Public Fleets & Facilities. Available online: <http://www.commerce.wa.gov/wp-content/uploads/2015/11/Energy-Electric-Vehicles-EV-EVSE-Guide-Oct-2014.pdf>

Case Study: Seattle's EV Charging in the Public Right-of-Way (EVCROW)

Seattle's EVCROW Pilot Program allows EV charging stations at curbside locations. EVCROW is meant to provide more charging options to meet the needs of more potential EV drivers, including people who drive EVs for ride share companies, people without access to a private garage, and people who may not have access to reliable home or work charging options. For more information, see the [EVCROW](#) website.



3c. Revise multi-family and commercial building codes to require EV-ready developments

New policies incentivizing and code changes mandating charging stations in multi-family and commercial new construction will increase resident and visitor access to convenient charging stations.

Actions

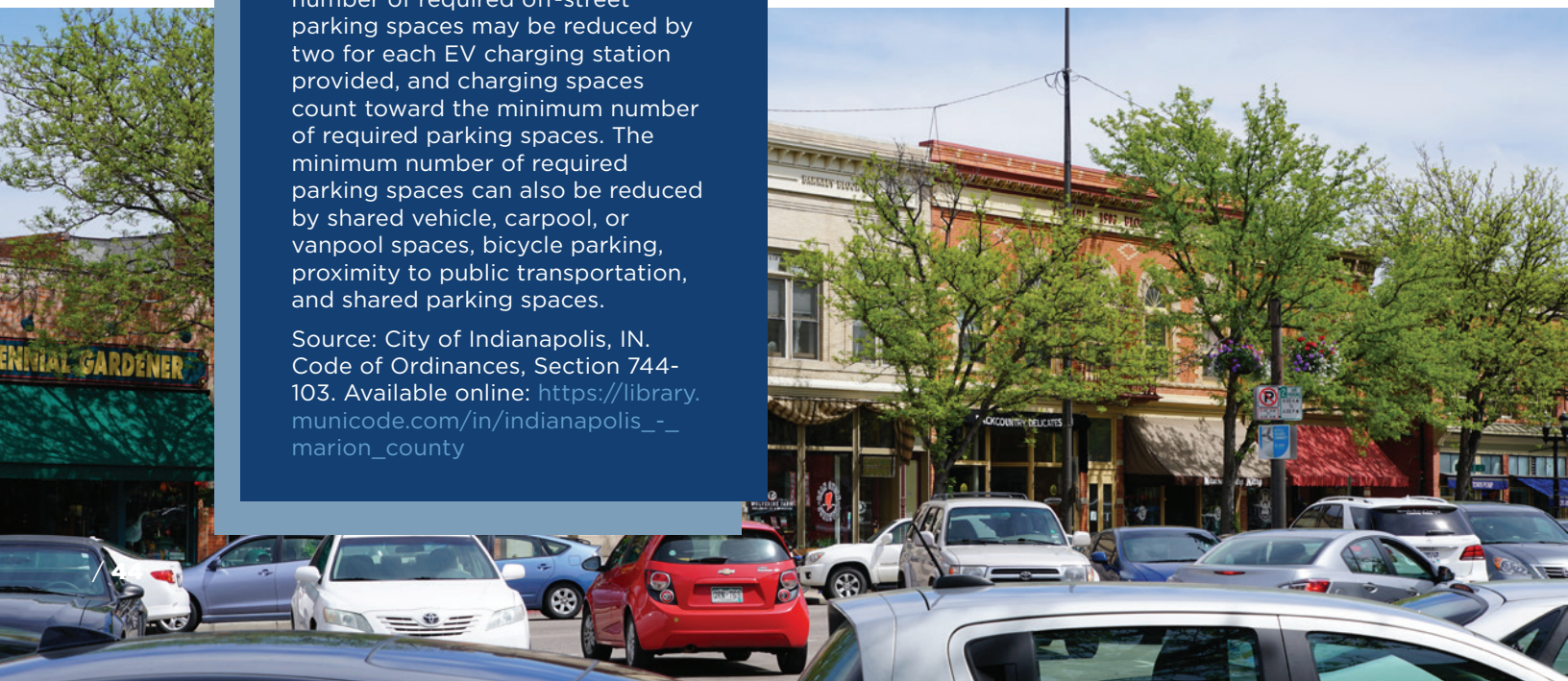
- Update building and land use codes to require that the infrastructure necessary for EV charging stations (conduit, etc.) be installed as part of all new multi-family and commercial developments
- Provide incentives for charging station installation in new commercial and multi-family buildings
- Phase out incentives and implement charging station mandates in new commercial and multi-family buildings through the building code

Lead Department	Planning
Partners	Local developers, Environmental Services (Green Building Program), Utilities, Building and Development Review
Timeline	Within 3 years
Budget	Low
Level of Effort	Medium
Potential Impact	High

Case Study: Indianapolis

In Indianapolis, the minimum number of required off-street parking spaces may be reduced by two for each EV charging station provided, and charging spaces count toward the minimum number of required parking spaces. The minimum number of required parking spaces can also be reduced by shared vehicle, carpool, or vanpool spaces, bicycle parking, proximity to public transportation, and shared parking spaces.

Source: City of Indianapolis, IN. Code of Ordinances, Section 744-103. Available online: https://library.municode.com/in/indianapolis_-_marion_county





3d. Establish and enforce EV parking rules

While the City has parking spaces designated as EV-only, there are no regulations that allow enforcement of these restrictions.

Actions

- Update the traffic code to allow enforcement of EV-only parking spaces
- Allocate fines associated with the enforcement of EV-only parking spaces to funding for EV charging stations or EV projects
- Conduct outreach to educate the public about EV parking space policies

Leveraging Existing Resources

As part of the 2015 Workplace Charging Challenge, Environmental Services drafted proposed changes to the Traffic Code to give parking staff the authority to ticket non-EVs when they park in EV spaces. The suggested revisions were not voted on by the Council. Appendix A of the original memorandum to City Council includes draft code updates. The City should revisit these suggested codes and leverage the existing work to amend the traffic code.

Lead Department	Parking Services
Partners	None
Timeline	Within one year
Budget	Low
Level of Effort	Medium
Potential Impact	High

4. Incentives

Providing incentives toward the purchase of EVs and the installation of EV charging stations decreases the barrier to entry and allows more community members access to EVs. ICCT highlights the importance of consumer incentives to market growth, even as EV costs continue to decline.²⁵ The City can educate others about available incentives, provide direct financial incentives, encourage local businesses and organizations to provide incentives, coordinate and provide access to external financial resources, and provide recognition to community leaders. Charging stations, with the exception of municipal fleet and municipal workplace charging stations, should be encouraged and supported by the City but installed, owned, and operated by the private sector.

²⁵ ICCT. July 2018. The Continued Transition to Electric Vehicles in U.S. Cities. Available online: https://www.theicct.org/sites/default/files/publications/Transition_EV_US_Cities_20180724.pdf

Benefits of Group Buys

In 2016, SWEEP published an evaluation of Colorado EV group purchase programs. It reports that the DENC group buy resulted in selling six times more EVs than during an average month, and notes that, according to a survey of program participants in a 2015 group buy in Boulder County, Adams County, and County and City of Denver, only 28% of EV purchasers in the group buy were already intending to buy an EV prior to the program. For more information, see the SWEEP report.





Innovative Financing
 Clean Energy Credit Union, based in Denver, offers low rates for clean energy vehicle loans, which includes EVs, HEVs or highly fuel-efficient vehicles, and fuel cell and alternative fuel vehicles.

4a. Incentivize consumer EV purchases

By decreasing the cost of EVs, Fort Collins can help make EVs more affordable for a larger portion of the community.

Actions

- Coordinate group buys with local dealerships; clarify the City’s purchasing rules to allow for this
- Work with local financial institutions and organizations serving these populations to offer attractive EV leases or interest rates to qualifying low-income residents
- Exempt EVs from City sales tax or allocate sales tax on EVs to fund EV charging projects

Lead Department	FC Moves
Partners	Local EV dealerships, Sales Tax Department, Purchasing, Economic Health
Timeline	Within 5 years
Budget	Medium
Level of Effort	High
Potential Impact	High

4b. Support public charging station installation

Fort Collins should encourage and provide funding for public charging station installations, including those that enable EV travel to and from the community.

Actions

Provide grants to private sector entities for the installation of public, workplace, and multi-family housing charging stations

- Stay up to date on funding opportunities and notify local partners when funding is available for station installation
- Support the installation of solar-powered charging stations when possible and where feasible

Lead Department	FC Moves
Partners	Private businesses, CSU, commercial and multi-family building developers, Economic Health
Timeline	Within two years
Budget	Medium
Level of Effort	High
Potential Impact	High

Charging Installation Best Practices

- Futureproof charging sites by wiring them for additional charging stations to drastically lower future installation costs
- Locate charging stations as close as possible to the electric service to reduce installation costs
- Place public charging stations, particularly Level 2, in areas where drivers are parking for a prolonged period of time, such as shopping centers, movie theaters, or parking garages



4c. Recognize local businesses with workplace charging through the ClimateWise program

Providing recognition to local employers is a way the City can support workplace charging and increase access to charging infrastructure for Fort Collins residents.

Actions

- Coordinate with ClimateWise to create a new recognition badge for providing workplace charging
- Create resources to help local businesses implement workplace charging programs
- Facilitate a peer-to-peer information exchange between local employers about workplace charging
- Conduct outreach to local businesses to raise awareness of the new ClimateWise recognition program and the Colorado Wired Workplaces program

Benefits of Workplace Charging

According to a 2016 U.S. DOE survey of employers that offer workplace charging:

- 91% reported receiving positive feedback from staff about their workplace charging programs
- Employees with access to workplace charging were six times more likely to drive an EV than the average worker
- 50% of employers helped other companies in their area with workplace charging efforts

Lead Department	FC Utilities – ClimateWise Program
Partners	Local employers, Economic Health
Timeline	Within two years
Budget	Low
Level of Effort	Low
Potential Impact	Medium

5. Utilities

It is important that Fort Collins Utilities continues to coordinate with PRPA to seamlessly incorporate additional EVs into the grid. While PRPA is actively working to increase the share of renewable energy in its electricity mix, the City should encourage EV drivers to choose green energy and decrease the environmental impact of EVs.²⁶ Fort Collins also needs to ensure that EV drivers have affordable electricity rates. Lower fuel costs mean EVs have a lower lifetime cost than comparable conventional vehicles. As a municipal utility, the City has more flexibility than a regulated entity needing approval from the state Public Utilities Commission.

²⁶ “Green energy” refers to electricity generated from renewable sources, such as solar, wind, or geothermal.

5a. Support smart grid operations for EVs

Fort Collins must work to ensure that EVs will act as an asset to the grid and will be fully supported.

Actions

- Support PRPA pilot studies of EV impacts on the grid
- Review and update utility standards for EV charging stations
- Investigate the implications of vehicle-to-grid technology
- Explore opportunities to provide incentives for charging infrastructure capable of capturing usage data for Utilities and PRPA

Lead Department	Utilities
Partners	PRPA
Timeline	Within 3 years
Budget	Medium
Level of Effort	High
Potential Impact	Medium

Case Study – GridSavvy

Sonoma Clean Power’s (SCP) GridSavvy Community offers residents a \$5 credit per monthly bill if they install smart, internet-connected Level 2 charging stations and allow SCP to remotely control the charging stations to balance the grid when it is under stress. By balancing the grid, GridSavvy allows more renewable energy to come online. For more information, see the [GridSavvy](#) website





5b. Increase renewable electricity for EV charging

Although EVs already offer tailpipe and well-to-wheel (life-cycle) emissions benefits, they depend on a clean grid. By supporting renewable energy, Fort Collins can help make EVs an even stronger environmental choice.

Building Momentum

In 2017, 32% of energy delivered by PRPA came from carbon-free resources. In addition to its existing renewable projects, it will be purchasing the energy from a proposed 150 megawatt wind farm (scheduled to be built in 2020) and has requested proposals to purchase an additional 20 megawatts of solar generating capacity. For more information about PRPA's renewables portfolio, see its [Carbon-Free Resources website](#).

Actions

- Investigate the feasibility of providing EV owners with 100% renewable energy at no cost through the Green Energy program
- Work with local banks to bundle solar and residential EV charging stations with mortgages

Lead Department	Utilities
Partners	PRPA, local financial institutions
Timeline	Within 5 years
Budget	Medium
Level of Effort	High
Potential Impact	High

5c. Upgrade electricity distribution infrastructure

Fort Collins should ensure that existing distribution infrastructure is adequate for future EV needs and upgrade as necessary.

Actions

- Coordinate Utilities and Planning communication to ensure that Utilities is consulted before large charging installations
- Use the results of the charging demand analysis to determine areas that may need future upgrades (see Appendix C)

Lead Department	Utilities, Planning Services
Partners	PRPA
Timeline	Within 10 years
Budget	Medium
Level of Effort	High
Potential Impact	Medium

Innovative Approach: Battery Storage

Batteries can play a role in stabilizing the grid and reduce the need for infrastructure upgrades. On-site battery storage at DC fast charging stations could help smooth load profiles and reduce demand charges, storing electricity when demand is low and drawing electricity from the battery rather than the grid when demand is high.

For more information, see the McKinsey report, [How Battery Storage can Help Charge the EV Market](#)





5d. Assess and adjust utility rate structures for EV drivers

Working with PRPA, Fort Collins can incentivize EVs by providing EV drivers with favorable charging rates.

Time-of-Use Rates

Time-of-use rates incentivize EV drivers to charge their vehicles during periods of low demand, balancing the grid. As an added benefit, time-of-use rates provide utilities with information about where EVs are charging residentially, which may not be otherwise reported if the vehicles use Level 1 charging.

Actions

- Evaluate the need for and implement a time-of-use discount rate pilot program for EVs
- Evaluate the need for and impact of demand charges for DC fast charging in Fort Collins; determine if formally exempting DC fast charging from future demand charges is feasible

Lead Department	Utilities
Partners	PRPA
Timeline	Within 5 years
Budget	Medium
Level of Effort	High
Potential Impact	High

6. Leading By Example

In addition to encouraging community members to adopt EVs, the City must lead by example. Incorporating EVs into the municipal fleet (including transit) and installing the charging infrastructure necessary to support the fleet are key steps in reducing overall municipal emissions. Supporting employees' choice to drive electric is an opportunity for Fort Collins to provide a strong example to local employers.

6a. Pursue electrification opportunities within the City's light-duty fleet

To reduce municipal fleet emissions, the City should incorporate EVs into its light-duty vehicle fleet.

Actions

- Record, and update on an annual basis, whether there is a feasible electric option for every vehicle in the City inventory, focusing on light-duty in the near-term
- Update procurement guidance to require justification for the purchase of non-electric vehicles
- Establish guidance for employees about driving EVs, including how to maximize PHEV electric miles
- Track fleet eVMT and seek opportunities to benchmark against other municipalities in the region

National Leader

The Fort Collins fleet has routinely received national recognition for its outstanding sustainability leadership.

- **Green Fleet:** The Green Fleet Awards recognizes fleets that, among other criteria, have a high number of alternative fuel vehicles, low fuel consumption and emissions, and forward-thinking policy and planning. Fort Collins has been ranked in the top 20 for the Green Fleet Awards since 2015 and was ranked third in 2018.
- **Government Fleet and the American Public Works Association:** Fort Collins' Fleet Services division was named a Top 10 Leading Fleet in 2018. The award recognizes public-sector fleets for their leadership, efficiency, and vision.

Lead Department	Operation Services
Partners	FC Moves
Timeline	Within 2 years
Budget	High (if procuring vehicles)
Level of Effort	Medium
Potential Impact	High

6b. Pursue electrification opportunities within the City's transit fleet

To reduce municipal fleet emissions, the transit fleet should include battery electric buses, building upon successful implementation of the City's electric bus pilot.

Actions

- Pursue funding opportunities for battery electric buses
- Investigate the feasibility of using the battery electric buses on routes in underserved communities
- Track data and compile lessons learned about electric bus routes, charging, and operations

Lead Department	Transfort
Partners	Operation Services, FC Moves
Timeline	Within 2 years
Budget	High
Level of Effort	Medium
Potential Impact	High

Battery Electric Bus Benefits

As of 2018, there are at least 13 battery electric bus models available and more than 70 transit agencies in the United States using them. Benefits include:

- Energy efficiencies of four times greater than compressed natural gas (CNG) and diesel buses
- Zero tailpipe emissions and life cycle GHG emissions that are 75% lower than CNG and diesel buses

For more information, see the Transportation Research Board's [Battery Electric Buses - State of the Practice report](#).





VW Mitigation Trust Funding

In its VW Beneficiary Mitigation Plan, Colorado pledges to provide funding for projects involving public and private fleets, with greater incentives for fleets owned by government agencies. Colorado has allocated \$18 million (26% of its initial allocation of trust funds) to replace medium- and heavy-duty trucks with alternative fuel or electric vehicles; if mitigation trust funds are awarded for a new EV, charging equipment associated with the vehicle may also receive trust funds. For more information, see the [Colorado Volkswagen Diesel Emissions Settlement website](#).

6c. Install EV charging for the City fleet

To support the City’s EV fleet adoption goals, Fort Collins must install adequate charging infrastructure to allow EVs to be as effective as conventional vehicles. The City must ensure that adequate transit charging infrastructure is installed to meet the needs of battery electric buses.

Actions

- Pursue EV charger funding via CEO, VW, and other sources
- Pursue funding opportunities for battery electric bus charging infrastructure, assessing the feasibility of both depot charging and options along the route
- Assess utilization of existing light-duty charging infrastructure to determine optimal siting; consider relocating charging stations if they are underused

Lead Department	Operation Services, Transfort
Partners	FC Moves
Timeline	Within 3 years
Budget	High
Level of Effort	High
Potential Impact	High

6d. Encourage EV adoption by City employees

Fort Collins should encourage municipal employees to drive EVs as personal vehicles.

Actions

- Survey City employees about current and future EV ownership and commuting habits
- Install workplace charging stations at municipal buildings to meet employee demand
- Identify opportunities to incorporate EVs into existing City programs (e.g., an eligible purchase in the HomeWise program)

Building on Previous Efforts

In 2015, Fort Collins participated in the EV Workplace Charging Challenge. As a result of these efforts:

- 10% of City employees drove an EV through outreach events
- 19 City leaders participated in extended test drives of EVs, for up to five business days
- City employees reported a higher awareness and understanding of EVs

Lead Department	Operation Services, Human Resources
Partners	Environmental Services (Municipal Sustainability)
Timeline	Within 3 years
Budget	Medium
Level of Effort	High
Potential Impact	Medium

7. Emerging Technologies

The transportation sector is rapidly changing, and EV and EV charging technology is continually advancing. In order to meet future needs, Fort Collins will need to be aware of these trends and support innovative, advanced technology projects. The City can partner with stakeholders involved in EV and transportation research and will need to track the progress of emerging technologies, including connected and autonomous vehicles, extreme fast charging stations, and inductive/wireless charging.

7a. Pursue living laboratory projects

The City should support innovative projects that test emerging technology in real world applications. Examples include smart grid projects, testing new transportation technology (e.g., wireless/inductive charging) on city streets, examining the potential impact of autonomous vehicles, and supporting EV battery recycling.

Actions

- Convene an innovation group twice a year to discuss potential living laboratory projects
- Provide support for at least three living laboratory projects by 2030
- Coordinate with Innovate Fort Collins to support an EV Challenge
- Create an “Electric Avenue” to showcase EV charging stations

Lead Department	FC Moves
Partners	CSU, PRPA, Environmental Services
Timeline	Within 10 years
Budget	High
Level of Effort	High
Potential Impact	High

Steering Committee Living Laboratory Ideas

In developing the Roadmap, the Steering Committee brainstormed ideas for living laboratory projects, including:

- Test wireless charging on Fort Collins roads, potentially along a MAX route
- Create an EV charger demonstration area, similar to Portland’s [Electric Avenue](#)
- Partner with ride-hailing services to create electrified mobility hubs



Photo by Pat Corkery, NREL 54321

7b. Track emerging technologies and market developments

Fort Collins needs to stay up to date on new and innovative technologies, including (but not limited to) connected and autonomous vehicles, extreme fast charging, inductive charging, and battery recycling.

Actions

- Communicate with CSU on an least a biannual basis about ongoing research projects and new technology
- Attend at least one emerging technology webinar a quarter (e.g., through CEO, NREL, or other national research groups)
- Track changes in the EV market, including new model availability, federal tax credit availability, and any issues that may arise as EVs age

Lead Department	FC Moves
Partners	CSU, Environmental Services, Utilities, PRPA
Timeline	Ongoing
Budget	Medium
Level of Effort	Low
Potential Impact	Low

Key Resources & Best Practices

Transportation as a system is rapidly changing, and many experts are predicting a future of automated, connected, electric, and/or shared (ACES) vehicles. [Studies](#) have found that this disruption could result in a 60% decrease in energy use (due to vehicle right-sizing and efficiencies) or a 200% increase in energy consumption (due to increased accessibility and ease of travel). Correctly supporting and encouraging ACES vehicles is crucial to a sustainable future, and Fort Collins should stay up to date on connected and autonomous technology developments.

For more information, see the U.S. DOE's [Energy Efficient Mobility Systems](#) website.

APPENDIX A:

EDUCATION AND OUTREACH TOOLKIT

Education and outreach is an essential element to successful implementation of the Fort Collins Electric Vehicle Readiness Roadmap (Roadmap). In addition to the strategies focused specifically on education and outreach, there will likely be education and outreach components to every readiness strategy within the Roadmap. Efforts should be tailored to each situation, including who you are trying to reach and what you are trying to achieve. The messages, channels, tactics, and messengers used should be driven largely by the target audience and objective. This toolkit identifies a list of key target audiences, key objectives, sample messages, and channels and tactics likely important for implementation of the Roadmap. It also outlines some key considerations for communicating with low-income and/or under-represented communities. Finally, it provides a list of resources to support plug-in electric vehicle (EV) readiness-related education and outreach efforts.

Target Audiences

There are a wide variety of audiences that may be relevant to Roadmap-related education and outreach efforts. Priority audiences should be identified, and different strategies should be developed for different target audiences. Keep in mind that you may also have different objectives for different audiences within a given readiness strategy, as well as different objectives associated with different strategies for a given audience. For example, an audience may be a partner for one readiness strategy and a user for another.

Below are some key audiences that should be considered when pursuing education and outreach related to the Roadmap:

- Residents – renters and/or homeowners
- Multi-family housing stakeholders
 - Building owners/managers
 - Residents
- Businesses
 - Employers
 - Fleet managers
 - City leadership
 - City departments
 - City employees
 - Developers
 - Dealerships
 - Visitors
 - First responders
 - Colorado State University (CSU)
- Northern Colorado EV Enthusiasts group
- Poudre School District
 - Fleet managers
 - Educators
 - Students

- Platte River Power Authority (PRPA)
- Low-income/under-represented communities
- Regional, state, and national organizations
 - Drive Electric Northern Colorado (DENC)
 - North Front Range Metropolitan Planning Organization (NFRMPO)
 - Colorado Energy Office (CEO)
 - Regional Air Quality Council (RAQC)
 - Colorado Department of Transportation (CDOT)
 - Neighboring cities and counties
 - Regional utilities (e.g., Xcel Energy, Loveland Water and Power)
 - State and national legislatures
 - Clean Cities
 - National Renewable Energy Laboratory (NREL)
 - Electrification Coalition
 - Colorado EV Coalition
 - Southwest Energy Efficiency Project (SWEET)

Objectives

Key objectives should be articulated for each specific education and outreach effort. However, objectives for Roadmap-related communications are likely to fall into one of the following four categories:

- Work together to advance EV-related initiatives, including the strategies outlined in the Roadmap.
- Raise awareness of EV technologies, processes, and policies.
- Educate potential EV owners, operators, and users to break down barriers related to purchasing, charging, operating, and riding in an EV.
- Motivate EV-related action and behavior change, including EV purchase, EV charger installation, and EV ridership.

Key Messages

Messages should be developed, tailored, and framed for each target audience and objective. Be sure to frame messages based on the audience's needs, interests, and motivations. Speak the audience's language, not yours. Sample messages include:

- EVs are greener and cleaner than gasoline vehicles when looking at full life-cycle impacts.
- There are a wide range of EV models available, representing a variety of price points, styles, and sizes.
- While EVs may be more expensive up front, EV lifetime costs are lower given lower fuel and maintenance costs.
- State tax credits can provide up to \$7,000 for the purchase of a qualified light-duty vehicle, with up to \$7,500 in tax credits available at the federal level. Grants are also available for the installation of EV charging infrastructure.
- EV batteries typically have a warranty of 8-10 years, meaning they should not need to be replaced during the vehicle's typical lifetime. When a battery does need to be replaced, it may only be necessary to replace a few cells of the battery and the old battery can be recycled or reused.
- With all-electric ranges and public charging infrastructure increasing, battery electric vehicles (BEVs) can be used by people who drive longer distances.

Plug-in hybrid electric vehicles (PHEVs) are another great option for those that need to travel longer distances since you can use the gasoline engine when the battery runs out.

- EVs work in all types of weather and all types of terrain. Battery range may be affected by extreme heat, cold, and inclines, but these impacts can be managed.
- Most EV drivers take care the majority, if not all, of their charging needs at home and overnight, meaning fueling an EV is even easier than fueling a gasoline-powered vehicle.
- You don't have to own an EV to benefit from EV adoption. First, there are ways to ride an EV other than owning one (e.g., through ride sharing, car sharing, or public transit). Second, the air quality improvement and noise reduction benefits apply to everyone in the community.
- There are significant benefits to EV use for low-income populations since the air quality benefits are particularly important for disadvantaged individuals with higher health risks.

As with any new technology, information about EVs and EV charging infrastructure changes quickly. The City should be an objective source of information for the public and stakeholders. City representatives discussing EVs must stay current on the key benefits and considerations of EVs and charging infrastructure. For a sample list of EV-related misconceptions that the City may encounter, see the Tahoe Regional Planning Agency's [EVs: Myths vs Facts](#) brochure.

Channels and Tactics

A wide variety of channels and tactics exist to promote EV readiness education and outreach, such as:

- Websites, including City websites, Northern Colorado Clean Cities, Alternative Fuels Data Center (AFDC), etc.
- Social media
- Direct training and technical assistance
- Webinars
- Education and outreach materials
 - Fact sheets
 - Case studies
 - Checklists
 - Frequently Asked Questions (FAQs)
- Direct engagement, including at existing meetings (e.g., community meetings, board meetings)
- Physical showcases, including:
 - Permanent/semi-permanent installations (e.g., Electric Avenue, at dealerships)
 - Temporary showcases (e.g., booths at existing events)
- Recognition programs
- EV ride and drives

EV readiness education and outreach should be coordinated with City transportation demand management (TDM) education and outreach to streamline messaging and reduce confusion about the City's commitment to both reducing vehicle miles traveled (VMT) and electrifying VMT.

In addition, citizens should be empowered to become community leaders and advocates on behalf of EV readiness efforts. The City should identify and leverage these community members to extend the reach and impact of outreach and education efforts beyond what would be possible with only the City's limited resources. Several organizations, such as [ChangeLab Solutions](#), exist to help citizens participate effectively in local planning processes and provide [tools and resources](#) to help citizens, neighborhoods, and cities make their community a healthier place to live, work, and play.

Key Considerations for Low-Income and Under-Represented Audiences

There are special considerations for communicating with low-income and under-represented audiences. For example, consider the following steps to promote good communications:

- Translate materials into multiple languages, understanding that English is not everyone's first language. Engage with dealerships to translate sales materials.
- Plan outreach at locations where these groups already meet; providing transportation, food, and childcare where appropriate.
- Educate the audience on why and how the conversation is relevant to them.
- Frame messages in ways that are relevant to your audience and highlight the benefits to them. (This is important for all audiences!) See the last couple of messages above for examples.
- Highlight less expensive ways to own, operate, or ride an EV, such as:
 - Purchasing a used EV
 - Using car sharing or ride-hailing services
 - Riding electric buses

Resources

Education and outreach efforts must be grounded in accurate and up-to-date information from reputable sources. The following list covers a range of topics, including those that may be considered sensitive or controversial, such as battery production and emissions from electricity generation.

General

- U.S. Department of Energy's (DOE) [AFDC](#)
 - [Electricity](#)
 - [Hybrid and Plug-In Electric Vehicles](#)
 - [Station Locations](#)
 - [Vehicle Search](#)
- [DENC](#)
- [CEO](#)
- [Alternative Fuel Toolkit](#)
- Incentives:
 - [AFDC Laws & Incentives](#)
 - [Grants.gov](#)
 - U.S. DOE Office of Energy Efficiency and Renewable Energy [Financial Opportunities](#)
 - U.S. Environmental Protection Agency's (EPA) [Grants](#)

Public Charging

- [AFDC Charging EVs in Public](#)
- [U.S. DOE EV Handbook for Public Charging Station Hosts](#)
- [U.S. DOE Costs Associated with Non-Residential Electric Vehicle Supply Equipment](#)
- [Right-of-way charging guidance: Washington State Energy Office EVs for Washington's Public Fleets & Facilities](#)

Multi-Family Housing Charging

- [AFDC EV Charging for Multi-Unit Dwellings](#)
- [Veloz, EV Charging Guide for Property Owners, Managers and Homeowner Associations of Multi-Unit Dwellings](#)
- [Veloz, Plug-In Electric Vehicle Charging Guide for Residents of Multi-Unit Dwellings](#)

Workplace Charging

- [AFDC Workplace Charging for EVs](#)
- [U.S. DOE EV Handbook for Workplace Charging Station Hosts](#)

Fleet Charging

- [U.S. DOE EV Handbook for Fleet Managers](#)

Battery Electric Buses

- [NREL Foothill Transit Agency Battery Electric Bus Progress Report](#)
- [NREL Foothill Transit Battery Electric Bus Demonstration Results: Second Report](#)
- [Transportation Research Board Battery Electric Buses – State of the Practice](#)
- [U.S. Department of Transportation and NREL King County Metro Battery Electric Bus Demonstration](#)

Deployment

- [AFDC EV Deployment Policy Tools: Zoning, Codes, and Parking Ordinances](#)
- [U.S. DOE EV Readiness Projects](#)
- [Transportation & Climate Initiative of the Northeast and Mid-Atlantic States, Creating EV-Ready Towns and Cities: A Guide to Planning and Policy Tools](#)
- [Electric Vehicle Infrastructure Projection Tool \(EVI-Pro Lite\)](#)

Batteries and Recycling

- [FDC Batteries for Hybrid and EVs](#)
- [Argonne National Laboratory \(ANL\) Lithium-Ion Battery Recycling and Life Cycle Analysis](#)
 - [ANL Closing the Lithium-ion Battery Life Cycle](#)
 - [ANL Energy and Materials Issues That Affect EV Batteries](#)

Energy and Emissions

- [U.S. DOE AFDC State & Local Energy Data](#)
- [AFDC Emissions from Hybrid and EVs](#)

APPENDIX B: **ELECTRIC VEHICLE**

COMMUNITY QUESTIONNAIRE SUMMARY

Key Takeaways:

- Based on survey responses, the current generation of plug-in electric vehicles (EVs) could meet the travel needs of most respondents.
- Survey respondents were generally comfortable with EVs and have had some degree of interaction with them, but there was a low awareness of federal and state incentives for EVs.
- There was a split in opinion about EVs; for each respondent that associated the words “zippy” or “fast” with EVs, there were respondents that considered EVs “slow” and “low-power.”
- Respondents were primarily concerned about the range of vehicles and lack of public charging infrastructure.
- A notable number of respondents (28) were worried about the environmental impact of EVs, including the impact of battery manufacturing and the emissions from the electric grid.
- Many respondents associated EVs with “the future;” whether this indicates that they believe the technology is futuristic and modern or that they think that EVs are not yet practical but will be useful in the future is not clear.

Responses

457 responses between March 21, 2018, and April 9, 2018.

Respondent Driving Habits

- 91% drive a vehicle, with 64% driving 0-20 miles a day.
- In the next 12 months, the average driver (mean) will make 17 trips over 100 miles long. The median number of trips over 100 miles is 2.5.
- 52% are likely to buy their next vehicle more than 2 years from now, and 30% expect to buy a new vehicle. 40% expect to buy a mini or compact sport utility vehicle (SUV), and 24% expect to buy a mid- or full-size car.

Familiarity with EVs

- Respondents were familiar with EVs.
 - 77.68% of respondents were familiar with plug-in hybrid electric vehicles (PHEVs), and 78.5% were familiar with battery electric vehicles (BEVs).
 - Of respondents with a household income under \$25,000, 55% were familiar with PHEVs and 55% were familiar with BEVs.
- Respondents have interacted with EVs.
 - 20% own/lease an EV, and 56% know someone who owns/leases an EV. 42% have driven an EV, and 10% have not interacted with an EV at all.
 - 30% of respondents with a household income under \$25,000 have not interacted with an EV.
- Respondents are not familiar with federal and state financial incentives.
 - 67% were not at all or a little familiar with federal financial incentives.
 - 70% were not at all or a little familiar with Colorado financial incentives.
- Respondents were split on whether they would consider buying an EV.

- 32% are definitely or likely to buy an EV as their next vehicle, while 23% could be convinced and 36% are unlikely or definitely won't.
- 64% of respondents that do not live in single family homes reported that they are unlikely or definitely won't buy an EV.
- 40% prefer to buy a gasoline vehicle. 33% prefer to buy an EV, and 44% would consider buying an EV. 20% prefer to buy a hybrid electric vehicle (HEV), and 66% would consider buying one. 19% would not consider buying an EV.
 - For respondents with a household income of under \$50,000, 22% prefer to buy an EV and 37% would consider it.
 - For respondents with a household income of under \$30,000, 27% would prefer to buy an EV and 41% would consider it.

Perception of EVs

Statement	% of Respondents that Agree
EVs are very quiet.	93%
I could use an EV to drive to most places I regularly drive.	77%
EVs save money on fuel.	77%
Sales of EVs in Colorado will continue to increase.	76%
I am familiar with EVs.	73%
EVs are the most fuel efficient option available.	69%
I like EVs.	68%
EVs are the most environmentally friendly vehicles out there.	66%
EVs are safe.	65%
EVs look good.	54%
EVs have great performance.	50%
EVs are an affordable option for me.	42%
In the next three years, I expect to own or lease an EV.	31%

- Motivators and Barriers: Not all respondents agreed on what was a motivator or a barrier. For example, the fifth most popular barrier (of 16 considerations) was considered a motivator by nearly the same number of respondents.

Top 5 Motivators

- Environmental impact (76% motivator, 7% barrier)
- Government incentives for purchasing (71% motivator, 4% barrier)
- Ability to charge at home (62% motivator, 22% barrier)
 - 31% of residents that do not live in a single-family home found this to be a barrier
- Cost of fuel/charging (61% motivator, 16% barrier)
- Ability to charge at work (53% motivator, 25% barrier)

Top 5 Barriers

- Purchase price (52% barrier, 25% motivator)
- Number of public charging stations available (51% barrier, 26% motivator)

- Vehicle range (49% barrier, 38% motivator)
- Performance in snow and on dirt roads (35% barrier, 34% motivator)
- Battery health over the life of the vehicle (34% barrier, 35% motivator)

- Words that come to mind when thinking about EVs: Respondents were asked to list words that they associate with EVs. A full list of answers is available in the questionnaire summary sheet. The top ten topics mentioned were:
 1. Environment (118)
 2. Range Anxiety (110)
 3. Efficient (53)
 4. Expensive (47)
 5. Quiet (44)
 6. Poor Performance (34)
 7. Inadequate Charging Infrastructure (30)
 8. The Future (30)
 9. Fuel Cost Saving (26)
 10. Small (26)

Demographics

The race and ethnic demographics of survey respondents are similar to those of Fort Collins as a whole; however household income and level of education are significantly higher for respondents than for Fort Collins generally. That being said, respondents answered most questions similarly across income levels. Significant differences in answers among income levels are noted above.

- 27% of respondents do not live in Fort Collins but 87% work in Fort Collins.
- 56% of respondents are male.
- 82% live in a single-family home, 79% own their residence, and 73% have a private garage.
- 84% are white.
 - According to the 2010 census, Fort Collins residents are 82% white.
- 78% are non-Hispanic/latinx.
 - According to the 2010 census, 10.79% of Fort Collins residents identify as Hispanic/latinx.
- 63% have a household income of over \$75,000 (and 44% have a household income of over \$100,000).
 - The median household income of Fort Collins is \$55,647.
- 78% have a bachelor's degree or higher.
 - 52% of Fort Collins residents have a bachelor's degree or higher.

APPENDIX C: CHARGING INFRASTRUCTURE DEMAND ANALYSIS

As part of the Fort Collins Electric Vehicle Readiness Roadmap (Roadmap), ICF conducted a charging infrastructure demand analysis to assess the areas in Fort Collins that are most likely to experience increased demand for plug-in electric vehicle (EV) charging. The following document provides information on how to use and access the map, along with a description of the methodology and data sources used for the analysis.

Introduction

The purpose of the analysis is to employ a flexible methodology that can be updated and used to understand where EV drivers will likely live, work, and visit within Fort Collins. It is best to consider the results of the analysis as a useful guide to coordinate and prioritize investments in charging infrastructure at a high level for engaged stakeholders.

The demand analysis is an analytical exercise that looks at key EV ownership indicators and regional travel patterns to identify areas where there will likely be demand for charging infrastructure in the near to mid-term (approximately 5-15 years). The results can be used to identify areas where the deployment of chargers is predicted to be most cost effective, as chargers located in an area where EV drivers are most likely to travel will be utilized more. Research by Idaho National Laboratory (INL), for instance, demonstrated that charging equipment deployed in areas that fell within a planning process experienced nearly 90% greater utilization (as measured by charging events per week) compared to charging equipment deployed in unplanned locations.²⁷ It is important to note that the results of the demand analysis are useful in planning for infrastructure, but they should not be the only determining factor when deciding on the location and quantity of charging stations to install.

Accessing and Interpreting the Map

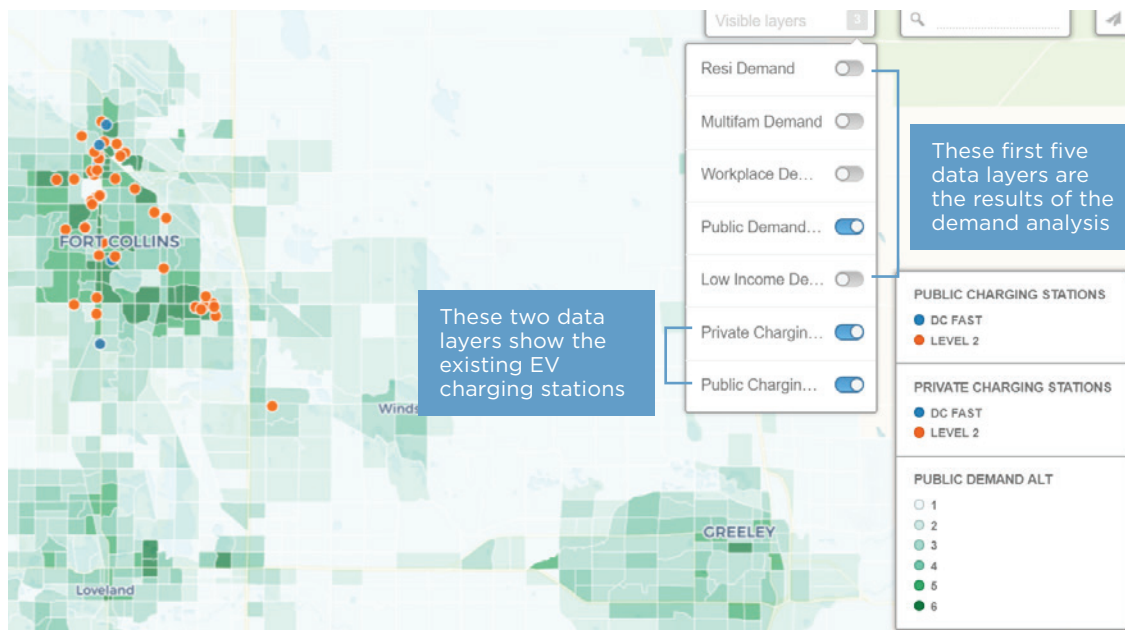
ICF mapped the demand analysis results online for Fort Collins stakeholders to access via the hyperlink below.

- Link: https://icfinternational.carto.com/u/icf-pnw-geo/viz/be5a8b42-ee6a-4ba2-b761-d5bebecfa176/embed_map
- Password: Energy
- *Note that the map works best in Chrome and is not all features are available when viewing in Internet Explorer. Also note that the map will only be available online for the duration of the project, through 2018.*

On the next page is a screenshot of the map. To change which set of data is presented, click on the visible layers dropdown in the top right corner and select the data you would like to view via the toggle button.

²⁷ INL. April 2015. How Does Utilization of Non-Residential Electric Vehicle Supply Equipment Compare Between those Installed in Oregon in Planned versus Unplanned Locations? Available online: <http://avt.inl.gov/pdf/EVProj/UtilizationOfNonResEVSEInstallationVsPlan.pdf>

- The **first five data layers** show the results of the charging demand analysis. A description of what these first five data layers represent is provided below, after the map figure. Please note that the first five data layers are not additive, meaning you should only view one at a time.
- The **last two data layers** are the locations of existing charging infrastructure, referred to as EV charging stations. Turning on the “Public Charging” layer will show all charging stations that are generally open to the public for use. Turning on the “Private Charging” layer will show the stations that are not open to the general public for use (e.g., workplace, fleet, or dealership chargers). The location of charging stations that include direct current (DC) fast chargers are indicated by blue dots on the map, Level 2 chargers are indicated by orange dots.



The five layers showing demand analysis results include:

- **Residential (Resi) Demand** – highlights areas in Fort Collins that will likely experience high demand for residential charging. Because residential charging takes place at home, these are locations in areas where likely EV adopters live.
- **Multi-family (Multifam) Demand** – highlights the areas that will experience high demand for multi-family residential charging. These are the areas where likely EV adopters live in multi-family housing.
- **Low-income Demand** – highlights the areas where low-income residents with reduced access to residential charging live. These are locations where more charging infrastructure would benefit low-income residents and help make EVs more accessible across income groups.
- **Workplace Demand**– highlights areas that will likely experience high demand for workplace charging—areas where likely EV owners work and where vehicles are parked for several hours during the day.
- **Public Demand** – highlights areas that will likely experience high demand for public access charging—areas where likely EV owners shop, dine, and visit.

The data is broken out by Traffic Analysis Zones (TAZs). The demand analysis ranks each TAZ on a scale from 1 to 6, with 1 being the lowest likely demand and 6 being the highest likely demand. Because TAZs vary in size, data is weighted by TAZ area. While this favors density (e.g., small TAZs located downtown over large TAZs in rural areas), it generally reflects where there is the most demand. It is important to note that charging stations will need to be deployed in areas with low demand (and low density) to provide adequate coverage, but this analysis highlights the areas where charging stations are most likely to be in demand and most likely to be used.

Methodology and Data Sources

Residential and Multi-family Charging

ICF initiated the analysis by identifying where EV owners are most likely to live, which required identifying the most likely EV adopters. Based on research and experience, ICF identified key indicators for EV ownership. The team then used these key indicators to develop a scoring methodology that estimates the likelihood of EV adoption in a given TAZ. The following parameters were selected for further consideration, with corresponding weighting factors highlighted below:

- **Income:** Research suggests that households with higher incomes are more likely to purchase an EV. Because EVs tend to have higher upfront costs, income can also be a limiting factor. In other words, individuals with lower household income might not be able to afford an EV.
- **Hybrid Electric Vehicle (HEV) Ownership:** In addition to correlating with income, HEV ownership correlates well with influencing factors such as environmental stewardship and price sensitivity to gasoline, both of which have proven to play a significant role in the level of interest in EVs.
- **Home Ownership:** Households who own their property are more likely to adopt an EV than those who rent. Home ownership reduces both financial and non-financial barriers to charging infrastructure deployment. The influence of home ownership will likely change considerably over time; however, in the near future, it will be a significant driver. There is already some correlation between home ownership and income, so the weighting for this parameter is designed to distinguish between census block groups that are already likely to include EV adopters based on the income profile. ICF only provided positive weighting to TAZs that had both an income greater than median income for the region and home ownership greater than the median level of home ownership for the region.
- **Dwelling Type:** Dwelling type (e.g., single-family detached, single-family attached, or multi-family) is an important parameter because drivers are expected to charge their vehicles at home. ICF assumes that consumers with a single-family detached home generally have fewer barriers to EV adoption. Only TAZs that were above the median income and above the median percentage of single-family residences were considered for the residential analysis.

ICF weighted these EV ownership indicators to develop the three residential scenarios seen on the map. See Table 1 for more information about how the model uses the EV ownership indicators to evaluate EV adoption.

Table 1. Key EV Adoption Indicator Weighting Factors

	Residential Charging	Multi-family Residential Charging	Low-income Residential Charging
Income	60% weight Favors high income	50% weight Favors high income	50% weight Favors low income
HEV Ownership	30% weight Favors high HEV adoption	20% weight Favors high HEV adoption	20% weight Favors high HEV adoption
Home Ownership	5% weight Favors high home ownership	5% weight Favors low home ownership	5% weight Favors low home ownership
Dwelling Type	5% weight Favors single family dwellings	25% weight Favors multi-family dwellings	25% weight Favors multi-family dwellings

ICF obtained statistics about the EV ownership indicators from census data from the American Community Survey (ACS), an ongoing statistical survey that samples a percentage of the population every year. For the purposes of this exercise, ICF determined that the most complete datasets for census block groups were the five-year estimates; ICF used data for years 2011-2016. ICF extracted demographic data on income, home ownership, and dwelling type by census block group in Larimer and Weld Counties. ICF analyzed vehicle registration data from IHS Markit from January 2018 to establish HEV ownership rates by census block group. The team then mapped census block groups to their corresponding TAZs to generate EV indicator data at the TAZ level.

Workplace Charging

Workplace charging is, as the language suggests, charging infrastructure provided by an employer for employee use while at work.

To identify likely areas for workplace charging, ICF used data from the North Front Range Metropolitan Planning Organization (NFRMPO) travel model, [the 2040 Regional Travel Demand Model \(RTDM\)](#) to identify the origin-destination pairs for home-based work trips made between various TAZs.

Similar to the residential charging analysis, ICF used ACS demographics on income, home ownership and dwelling type, as well as hybrid ownership rates, to weight the trips on EV likelihood.

Public Charging

Public charging covers a wide range of situations where an EV driver could potentially charge when away from home or work. Unlike residential and workplace charging, where vehicles are parked for long enough that they achieve a significant charge even with Level 1 charging, public access charging will take place at locations where drivers are parked for varying times; therefore, the level of charging bears much greater consideration when siting public charging. Table 2. Recommended Charging Level for Different Venues shows the preferred charging method based on the available charging time at different venues.

Table 2. Recommended Charging Level for Different Venues

Typical Venue	Available Charging Time	Charging Level (Primary/Secondary)
Shopping Centers	0.5–2 hours	Level 2/DC Fast
Other	< 1 hour	Level 2/DC Fast
Street/Meters	1–2 hours	Level 1/Level 2
Parking Garages	2–10 hours	Level 2/Level 1
Hotels/Recreation Sites	8–72 hours	Level 2/Level 1

To identify likely areas for public charging, ICF used data from RTDM to identify the origin-destination pairs for non-work related trips, such as home to shopping and home to social or recreational activity.

Using the areas that have the most likely EV adopters, ICF weighted trips based on the likelihood that it would be completed with an EV.

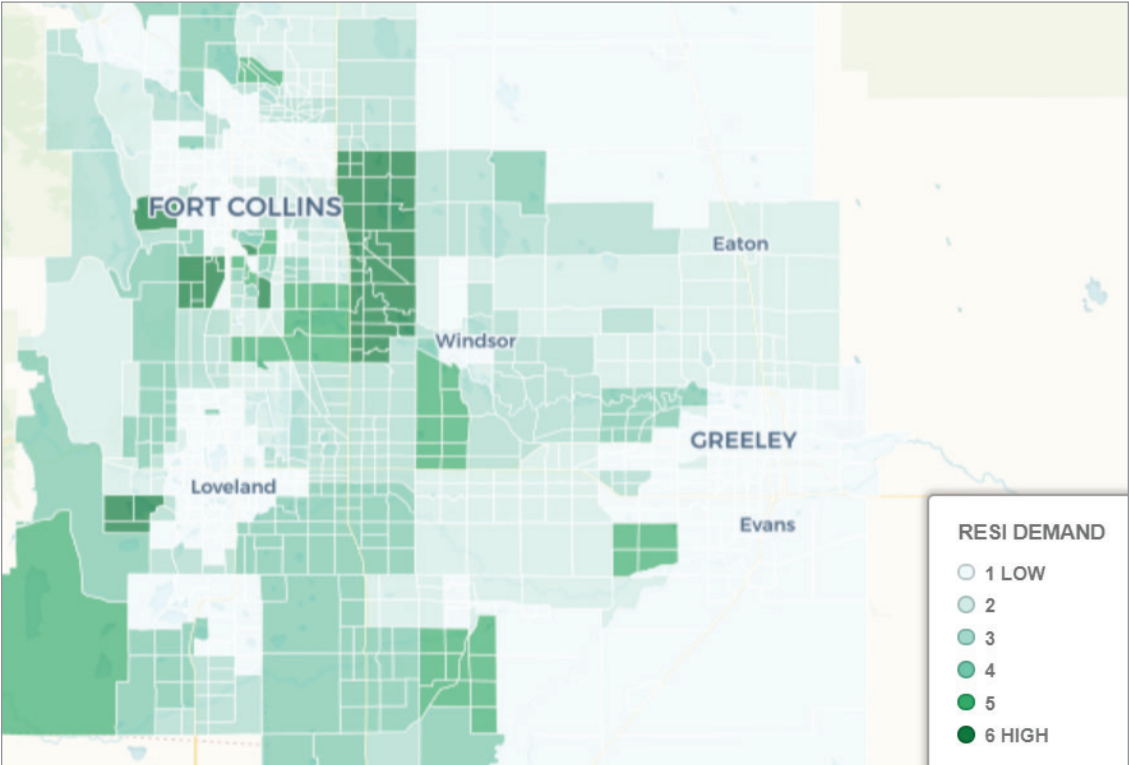
Equity

ICF analyzed workplace and public charging locations for low-income residents and residents that live in multi-family dwellings. ICF did not find a significant difference between the workplace and public destinations of low-income, multi-family dwelling, and likely EV adopting residents. This indicates that charging stations located in the demand areas identified for public and workplace charging will serve all members of the Fort Collins community.

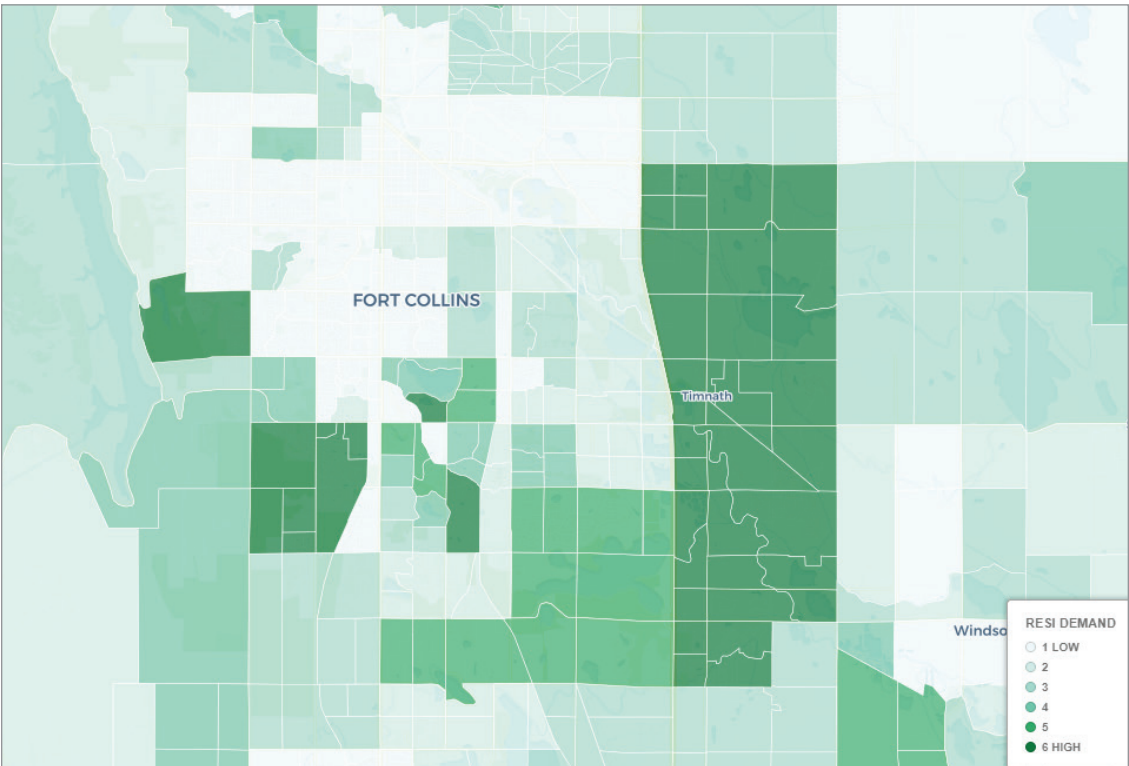
ICF also examined if the high number of college students in Fort Collins affects the low-income residential distribution map. While college students are recorded as low-income, they may have different needs and support systems than other low-income communities. ICF found that there was no significant change to low-income residential distribution when college students were categorized separately, and kept college students in the analysis of Fort Collins residents.

Results

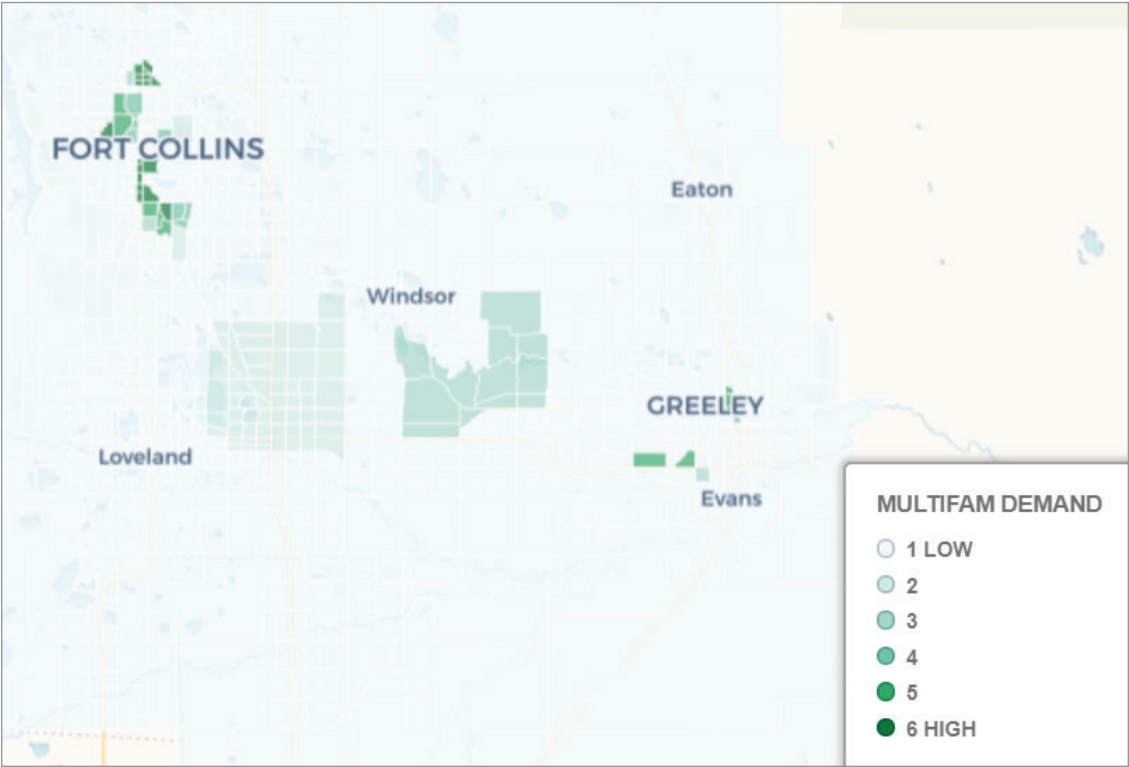
Residential Demand: Region



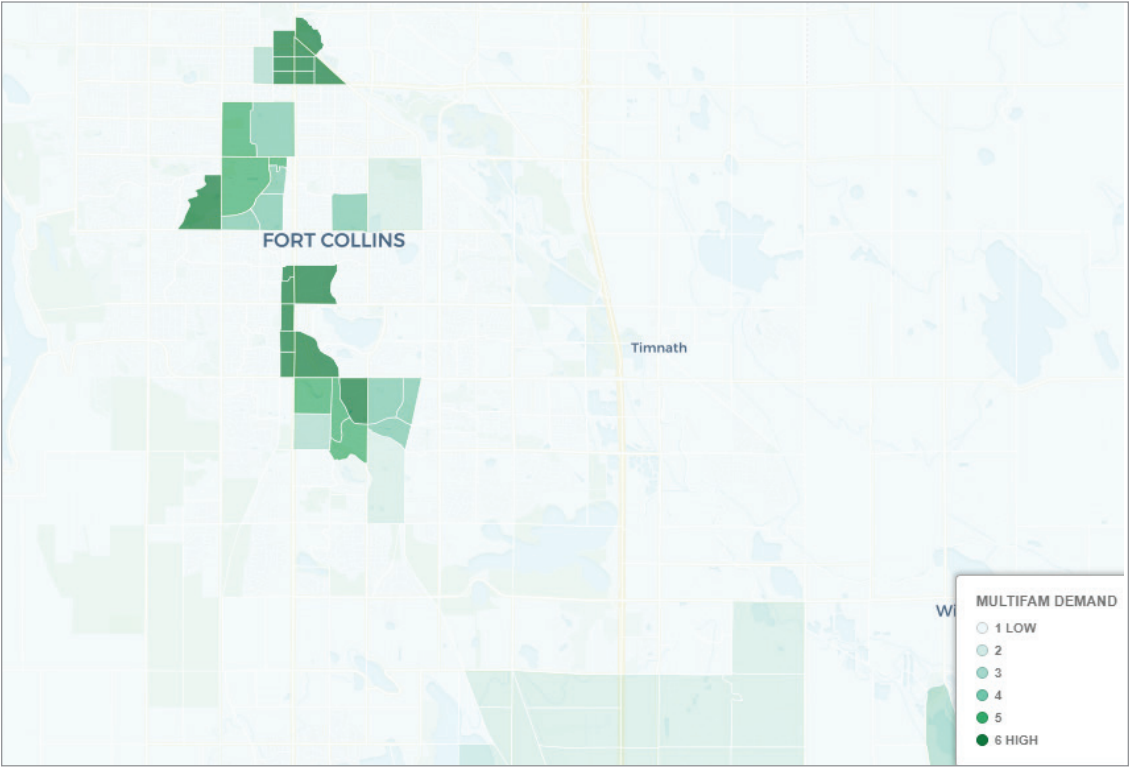
Residential Demand: Fort Collins



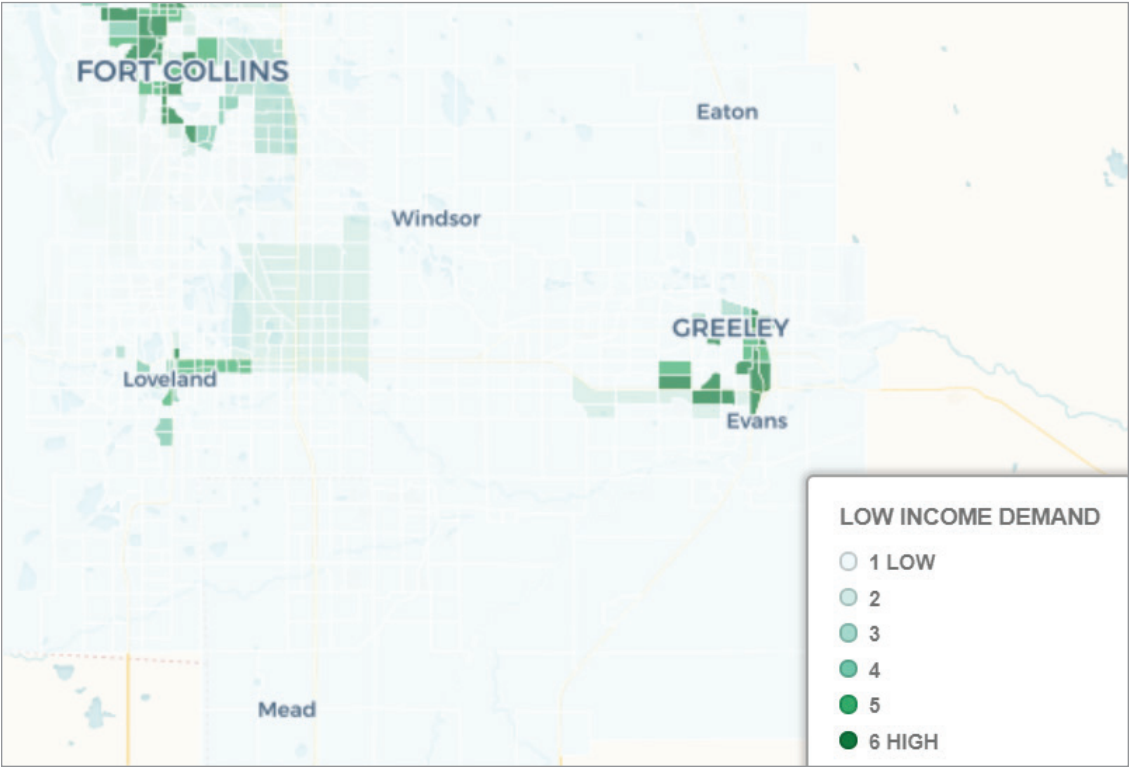
Multi-family Demand: Region



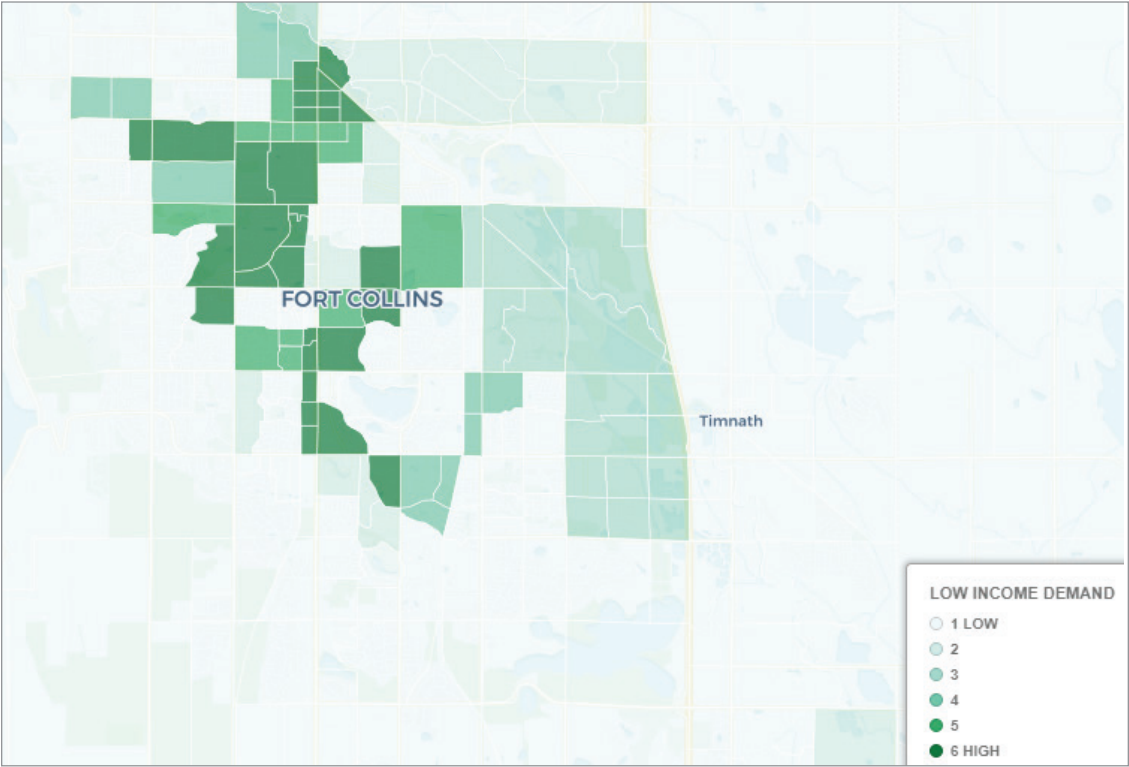
Multi-family Demand: Fort Collins



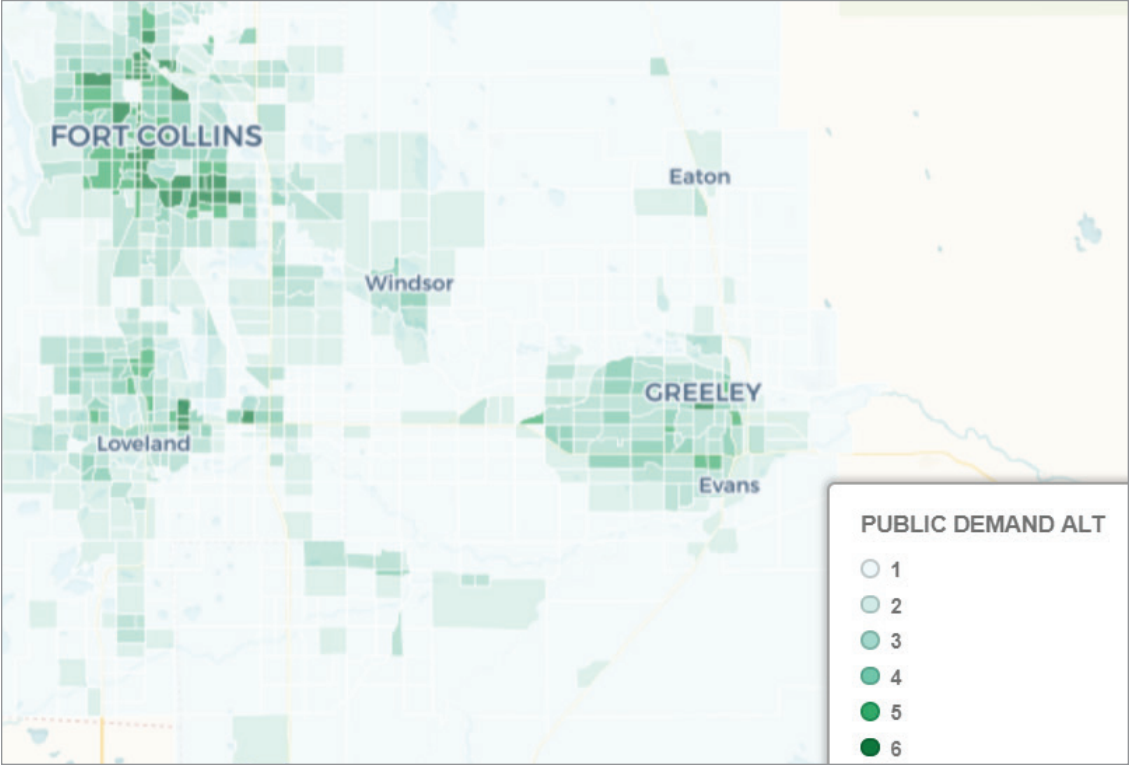
Low-income Demand: Region



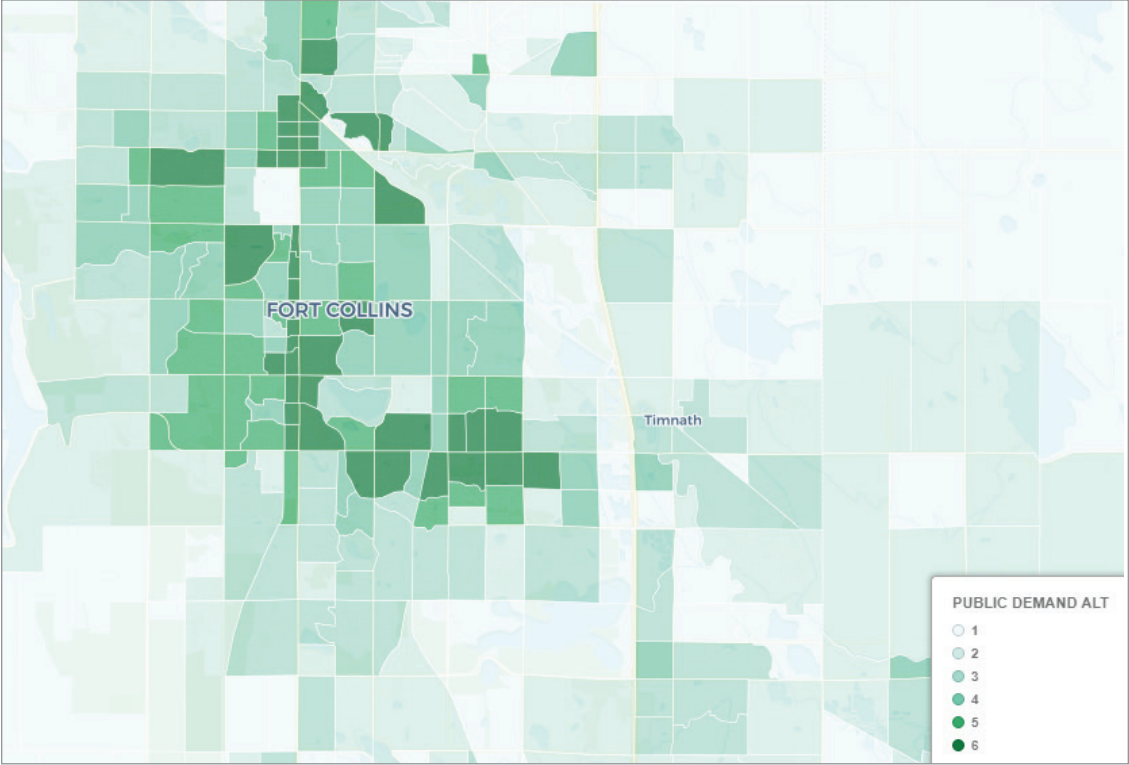
Low-income Demand: Fort Collins



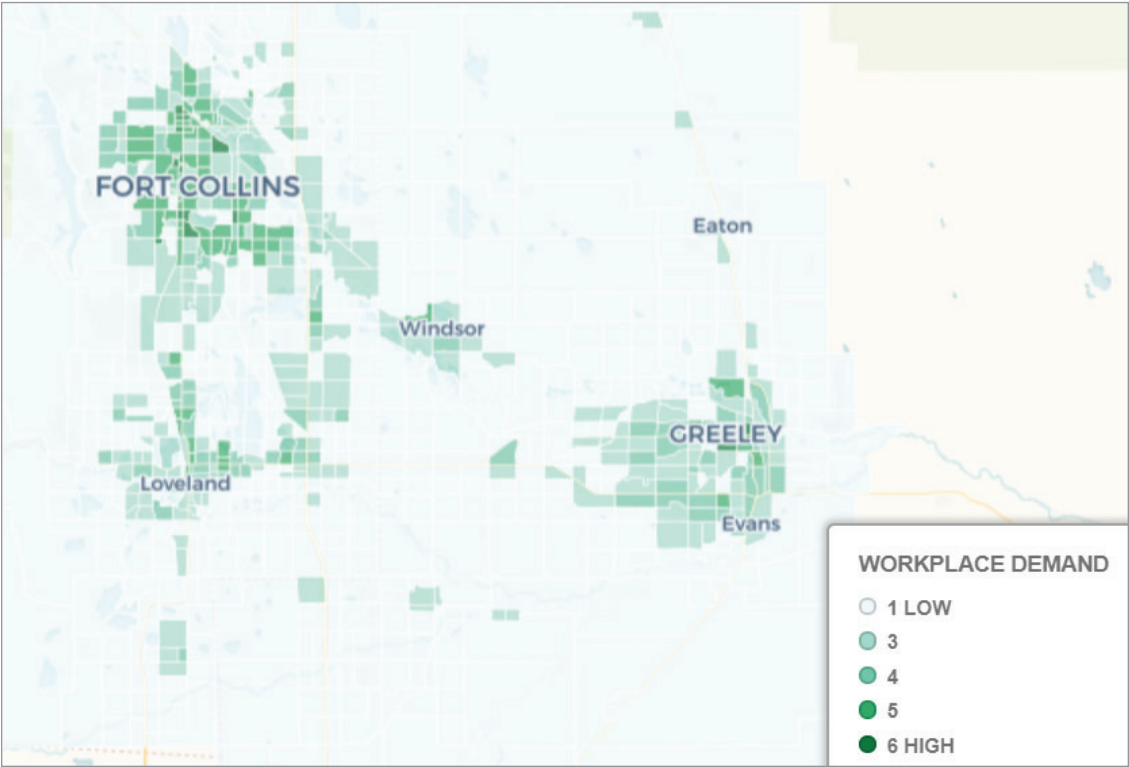
Public Demand: Region



Public Demand: Fort Collins



Workplace Demand: Region



Workplace Demand: Fort Collins

