Rocky Mountain Power
Exhibit RMP___(JAC-4)
Docket No. 20-035-34
Witness: James A. Campbell

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF UTAH

ROCKY MOUNTAIN POWER

Exhibit Accompanying Direct Testimony of James A. Campbell

UDOT

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UDOT
Keeping Utah Moving
Utah Statewide
EV Charging Plan

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Executive Summary

During Utah's 2020 legislative session, Representative Robert Spendlove and Senator David Buxton sponsored House Bill 259 (Link) directing the Utah Department of Transportation (UDOT) to develop a Statewide Electric Vehicle (EV) Charging Network Plan (Plan). The Plan's objective is twofold: to ensure access to DC Fast Charge (DCFC) electric vehicle chargers at least every 50 miles along Utah's interstate highways, and along other key highways, and to prepare for the EV charging capacity needs in Utah's urban and rural areas. This document is intended to fulfill the directives of HB 259, include contributions from stakeholder engagements, and provide guidance for EV charging station developers regarding implementation of Electric Vehicle Service Equipment (EVSE) on a statewide level.

Over the past year there has been a significant acceleration of efforts to convert the light duty surface transportation sector to alternative fuel vehicles. Most notably, the largest vehicle manufacturers (GM, VW, Ford, Volvo, Honda, etc.) have set ambitious targets for converting to a largely electrified fleet offering of light duty vehicles within 10-15 years. In some cases, manufacturers are planning a complete replacement of their internal combustion engine vehicle offerings as early as 2035 (GM, VW) and 2040 (Honda).

The aggressive efforts by the auto industry, coupled with initiatives at federal and state levels, offer the possibility of a once in a lifetime evolution of the transportation industry. The cost and range of battery electric vehicles (BEV) have improved to the point they are nearly on cost parity with internal combustion engine (ICE) vehicles. A major component to successfully incentivizing the adoption of electric vehicles is to eliminate the perception of not having enough charging infrastructure ("range anxiety") by providing an effective, efficient, and convenient charging infrastructure system.

The State of Utah and Rocky Mountain Power have installed EVSE at many state agency facilities and along key corridors. This charging infrastructure has received positive feedback by EV drivers via PlugShare.com, and available data indicate post pandemic utilization continues to increase.

The feasibility of installation and operation of DCFC infrastructure by the private sector has proven to be costly and difficult to monetize during the early phases of EV adoption. This is because of the low utilization rates, as there are relatively few EVs as a percentage of total vehicles on Utah's highways; although EV registrations in Utah are increasing 50-100% year over year since 2015. As the path to privatization of charging infrastructure continues to unfold, it appears beneficial for the public sector to invest early in the process by providing the core infrastructure necessary to support the early phases of adoption. This may be accomplished by direct EVSE installations, tax incentives, public-private

partnerships, building codes requirements and other mechanisms that encourage EVSE infrastructure build out.

Utah is a large open space state, making it essential to consider non-interstate routes that also carry a significant amount of commerce, tourism, and regional travel. Routes outside of the main interstate system often become a necessary and invaluable detour during extreme events such as crashes, floods, mud/landslides, wildfires, snowstorms, etc. We identified corridors based on their contribution to the following:

- Connectivity
- Traffic Volumes
- Tourism
- Local and Interstate Commerce
- Transportation Resilience and Public Safety
- Facilitate fleet and personal EV adoption

This plan contemplates two priorities for implementation and analysis:

1. **Priority I - EV Charging Accessibility** – filling EV charging gaps within key corridors to mitigate range anxiety and ensure charging infrastructure is located within reasonable distance from the previous and next EV chargers. This priority intends to provide a safety net for EV drivers, and may not adequately accommodate high-volume travel periods. (see 4.1)

2. **Priority II – Corridor Capacity / Urban DCFC** – adding additional EV chargers over time to accommodate increasing EV user base and EV adoption rates. We expect this next priority to be fulfilled by both private sector and strategic government investments as EV ownership increases demand for increased EVSE charging capacity. (see 4.2 & 4.3)

1.0 Introduction

In 2020, Representative Spendlove and Senator Buxton sponsored HB0259: Electric Vehicle Charging Network Plan, which was passed by the Utah Legislature. This bill directs UDOT in Utah Code (UC) 72-1-216 to develop a statewide electric vehicle charging network plan that includes the following:

- Consult with relevant entities in the private sector. The following entities were consulted in producing this Plan:
    - Rocky Mountain Power
    - Utah Association of Municipal Power Systems (UAMPS)
    - Utah Municipal Power Agency (UMPA)
    - Utah Rural Electric Cooperatives Association (URECA)
    - Former Senate President Wayne Neiderhauser
    - Utah Clean Cities (UCC)
    - Western Resource Advocates
    - Leaders for Clean Air
    - UCAIR
    - Southwest Energy Efficiency Project (SWEEP)
    - Plug In America
- Consult with other political subdivisions and other relevant state agencies, specifically the Department of Environmental Quality, the Division of Facilities and Construction Management, the Office of Energy Development, and the Department of Natural Resources. Each of these agencies were consulted in producing this Plan.
- Provide implementation strategies to ensure that EV charging stations are available at strategic locations, at incremental distances no greater than 50 miles along the state's interstate system by December 21, 2025, and along other major state highways within the state as UDOT finds appropriate.

This Statewide Electric Vehicle Charging Network Plan (Plan) fulfills the objectives of this legislation and guides its implementation.

2.0 Implementation

This Plan comprises two phases. Each phase of the Plan expands upon existing EVSE infrastructure. Cost of implementation and challenge of install increases with each phase. The goal is that by the completion of the first phase of the plan on December 31, 2025, the State EV charging network will be realized in rural communities and provide complete connectivity

(defined as *access* to EV charging infrastructure at least every 50 miles) for electrified light vehicle transportation throughout the state. Throughout the planning process, the state EV mapping platform, state park visitation data, and site-specific analyses will be evaluated to determine the most economic development strategies.

Phase 1 – EV Charging Accessibility

- This phase of the plan prioritizes filling EV charging gaps within key corridors to mitigate range anxiety and ensure charging infrastructure is located within reasonable distance from the previous and next EV chargers. The objective of this phase is to provide a safety net for EV drivers, with strategically sited capacity to accommodate high-volume travel periods. The Plan will prioritize EVSE in rural communities that would provide high benefit and are considered necessary to state-wide EV travel.

- Outlined in HB0259:
  - Strategic locations determined by the department [Utah Department of Transportation] by June 30, 2021 (this Plan)
  - Incremental distances no greater than every 50 miles along the state's interstate highway system by December 31, 2025
  - Along other major highways within the state as the department [Utah Department of Transportation] finds appropriate
  - Level 3 DC Fast Charger installations

Phase 2 – EV Charging Capacity/Densification

- Adding additional EV chargers over time to accommodate increasing EV user base and EV adoption rates. We expect this phase of the plan to be ongoing and dynamic, fulfilled by both private sector and strategic government investments as EV ownership increases demand for increased EVSE charging capacity.

3.0 Modeling Scenarios

3.1 EV Charging Accessibility Analysis (Gap)

A gap analysis examines EV charger spacing on a corridor, connectivity to cities/regions, connectivity to national and state parks, potential to continue priority corridors vital for interstate commerce, and overall contribution to the statewide network. The objective is to identify strategic locations that best connect long stretches of highway and provide EVSE access to important destinations and other EVSE corridors.

This analysis is primarily seeking to optimize connectivity and 50-mile spacing within the prioritized corridors and the network at large to ensure that connectivity goals are met and that corridors support each other in a meaningful way.

Dual DCFC chargers are recommended at key locations where three-phase 480-volt power is accessible, and Utah's commitment to implement REV-West voluntary minimum standards can be reasonably achieved. Having a minimum of two DCFC chargers at each location provides redundancy and a modicum of additional capacity to promote a positive user experience. In situations when the cost of utility upgrade to three phase power may not be economical, we recommend that alternative solutions be considered (solar and battery-based charging solutions).

3.2 EV Charging Capacity

A needs-based analysis of increasing capacity or densification of charging ports along key corridors. Increasing the number of chargers reduces wait times as more EVs use the network. Detailed models are being developed to determine the ideal number of Fast Chargers based on EV adoption rates. The Plan methodology prioritizes corridors based on AADT, tourism, economic potential, and adjacent corridor connectivity. However, improved models will look at the mix of truck (freight) and light-duty vehicles in the next year. Additionally, peak volumes, seasonal variations and other factors will also be integrated.

The Plan will seek to include data analytics from other EVSE providers to determine unique trends, issues with wait times at existing chargers and other data sets to help develop and increase capacity along heavily traveled corridors.

3.3 Corridor Capacity Prioritization Ranking

A prioritization scoring sheet is provided in the next section to help group corridors based on their traffic, connectivity, and other factors. It should not be interpreted as a definitive and chronological list to be developed, but groupings to be evaluated for the most cost effective and beneficial implementation based on available funding. Evaluation criteria include:

- Annual Average Daily Traffic (AADT) Score:
  - Score = 1: Lower AADT, Under 10000
  - Score = 2: AADT 10,001 to 20,000
  - Score = 3: AADT 20,001 and above
- Tourism Benefit:
  - Score = 1: No specific tourism destination
  - Score = 2: No specific tourism destination, but meaningfully supports connectivity
  - Score = 3: Direct connection to National Parks and high-volume tourism destinations
- Rural Economic Development:
  - Score = 1: Corridor contains locations for EVSE, but minimal economic impact.
  - Score = 2: Corridor contains locations for EVSE where EV owners may eat or shop or recreate.

    - Score = 3: Corridor contains multiple locations for EVSE where EV owners may eat and shop and recreate. These corridors also impact multiple rural communities.
- Adjoining Corridor Connectivity:
    - Score = 1: Alternative routes/transportation resilience/public safety
    - Score = 2: Key state highways that connect to high-volume destinations
    - Score = 3: Interstate Corridor

3.4 Urban EVSE Analysis

We limited urban area analysis was limited to five (5) key urban areas, and the tool may estimate needs elsewhere, and under various scenarios. Identifying specific locations in urban areas requires a more intense analysis looking at the spatial distribution of vehicle ownership, existing EVSE, government and private fleet facilities, among other potential sites.

For this planning document, we used the EVI-Pro default light-duty vehicle data from 2016 for a baseline estimate. We evaluated various rates of adoption to help show potential trend lines. It is possible that the rate of EV adoption may increase at greater speeds and the need for additional EVSE will accelerate. Future iterations of this plan will include a more comprehensive evaluation of urban EVSE strategies and potential EVSE target locations.

4.0 Analysis

The Statewide EV Charging Network Plan is to be a living document requiring frequent updates as interested parties fill gaps and install additional capacity, and to reflect ongoing stakeholder engagement, funding opportunities, and EV adoption trends. We will further refine specific EVSE location areas to fill gaps and provide connectivity to meaningful destinations and ensure effective connections to other EVSE corridors.

One of the key benefits of the Statewide EV Charging plan is to bring together interested and affected parties to help refine models by gathering valuable input. As the group coalesces around a unified plan, projects can be efficiently planned and implemented, funding sources can be leveraged, and a well-connected network will evolve. Currently, there is not enough funding to address the projected EVSE needs, and the goal of this Plan is to provide a path of steady and targeted planning to guide development and provide confidence in and comfort with advancing ongoing funding to support this transformational opportunity. A unified plan will ensure a methodical approach to developing the statewide EV network, coordinate funding and maximize the contributions of stakeholders.

4.1 GAP Analysis Results

Gap filling in non-urban areas of the EV mobility network is the initial focus priority of this Plan. There is a benefit to having EVSE in all Utah cities and towns, and this analysis attempts to bring a more practical focus to the alternative fuel corridors and regional connectivity. We will address other corridors as the identified primary corridors are completed and as funding becomes available.

When further refining gap locations it is important assess the adjoining corridors and how their EVSE locations are impacted. As an example, placing charging stations in Duchesne will help with both US-191 and US-40. Another example would be strategically placing EVSE in Morgan (I-84) to eliminate the need to backtrack on I-80 to Coalville for those traveling to or from Ogden and Evanston, Wyoming.

The table below is a summary of the Gap analysis that was performed on the GIS datasets. Multiple sites will undergo further vetting with the communities, ESPs and potential site hosts. Having multiple sites will allow for a best value contracting based on funding. For example, there may be 11 pre-screened sites and funding to accomplish 9 or 10 sites. Contractors may be able to package the 10 sites and provide better contract value.

Table 1: Gap Analysis Summary

Utah Statewide EV Charging Plan Gap Analysis Summary

EVSE Corridor Segments							Number of DCFC Sites Needed
Route	From	To	Begin Mile Post	End Mile Post	Length	(AADT) Avg Annual Daily Traffic	
I-15	Arizona Border	I-70	0	132	132	29,000	0
	I-70	US-6 (Spanish Fork)	132	258	126	20,000	0
	US-6 (Spanish Fork)	US-89 (Brigham)	258	362	104	264,000	0
	US-89 (Brigham City)	Idaho Boarder	362	400	38	180,000	0
I-215	Entire Route	Entire Route	0	28	28	100,000	0
I-70	I-15	Salina	0	57	57	8,000	1
	Salina	Green River	57	161	104	5,100	3
	Green River	Colorado Border	160	231	71	10,000	2
I-80	Nevada Border	I-15	0	119	119	8,800	4
	I-15	US-40	122	146	24	29,000	0
	US-40	Wyoming Border	146	196	50	58,000	0
I-84	Idaho Border	Tremonton (I-15)	0	41	41	10,000	0
	I-15	I-80, Echo Jct	81	119	38	15,000	0
SR-12	US-89	SR-24	0	160	160	2,000	3
SR-24	I-15	I-70	0	122	122	2,500	4
US-191	Arizona Border	I-70	0	157	157	8,700	1
	US-6	US-40	251	295	44	2,200	1
	US-40	Wyoming Border	352	404	52	1,300	1
US-40	I-80	Colorado Border	0	174	174	6,100	5
US-6	Nevada Border	I-15, Santaquin	0	111	111	1,000	3
	I-15	I-70	173	299	126	9,400	3
US-89	Arizona Border	I-70, Sevier	0	191	191	2,000	4
	I-70/Salina	US-6/Thistle	225	312	87	3,000	2
					DCFC Site Totals		37

4.2 Rural Capacity Analysis Results

The capacity analysis is a preliminary screening of corridors to provide guidance for increasing EVSE density to accommodate more users. Due to the complexities of site development for larger EVSE installations, the Statewide EV Charging Plan only provides limited initial guidance. Larger projects have the potential for more extensive site development with multiple chargers, and we expected this type of project to require significantly more detailed planning effort to develop meaningfully.

Besides increasing the allocation of existing parking area for EV parking, the Plan makes additional considerations for energy storage (or storage ready) to help mitigate potentially large electricity power demands and mitigate potentially unfeasible power line extensions to remote locations. Another consideration would integrate onsite renewable energy components to help create resilience if a power outage occurs (as happened in the recent Texas winter freeze). Finally, the heavy truck industry is nearing 300 miles range with full battery electric. Larger commercial sites may consider accommodating future EV-Semi trucks which will have even larger energy draw needs.

The Statewide EV Charging Plan team will continue to engage with stakeholders who wish to develop large-scale projects that exceed a simple retrofit of existing parking areas. Capacity is not currently an issue in Utah but will likely need to be addressed in the next two to five years.

Table 2: Capacity Analysis

Utah Statewide EV Charging Plan Priority (Capacity)							Average Annual Daily Traffic	Capacity Scoring				Route Score Totals	Capacity Priority	*Average Annual Daily Traffic (**AADT**) data does not differentiate between passangeer cars and heavy trucks. AADT varies along corridors, a blended average was used. Future detailed analysis will also consider peak hour traffic, % trucks and other relevant traffic data.* ***Urban Fast DC**: Areas that have more potential for private development.* ***COMPLETE**: Areas that have reasonably met the 50-mile spacing goals*
		Segments				Segment Length	2019	Average Annual Daily Traffic (AADT)	Tourism	Rural Economic	Corridor Connectivity			SEGMENT NOTES
	Route	From	To	Begin Mile Post	End Mile Post									
Interstate Routes	I-15	Arizona Border	I-70	0	132	132	29,000	3	3	3	2	11	1	Interstate Travel, Mighty 5, I-70, Vegas, LA
		I-70	US-6 (Spanish Fork)	132	258	126	20,000	3	3	3	3	12	1	Interstate Travel, Mighty 5, I-70, Vegas, LA, I-70,
		US-6 (Spanish Fork)	US-89 (Brigham)	258	362	104	264,000	3	3	1	1	8	2	Urban Area Development/Workplace/Home/Fleet
		US-89 (Brigham City)	Idaho Boarder	362	400	38	180,000	3	3	1	1	8	2	Urban Area Development/Workplace/Home/Fleet
	I-215	Entire Route	Entire Route	0	28	28	100,000	3	1	1	1	6	3	Urban Area Development/Workplace/Home/Fleet
	I-70	I-15	Salina	0	57	57	8,000	1	1	3	3	8	2	Rural, Connect Mighty 5
		Salina	Greenriver	57	161	104	5,100	1	2	3	3	9	1	Large Gap, Rural, Connect Mighty 5
		Greenriver	Colorado Border	160	231	71	10,000	1	3	3	3	10	1	Interstate Travel
	I-80	Nevada Border	I-15	0	119	119	8,800	1	2	1	3	7	2	Interstate Travel, Nevada Interstate
		I-15	US-40	122	146	24	29,000	3	1	1	1	6	3	Urban Area Development/Workplace/Home/Fleet
		US-40	Wyoming Border	146	196	50	58,000	3	3	1	1	8	2	Ski, tourism, interstate
	I-84	Idaho Border	Tremonton (I-15)	0	41	41	10,000	2	1	2	3	8	2	Interstate, Idaho,
		I-15	I-80, Echo Jct	81	119	38	15,000	2	2	2	3	9	1	Interstate, I-15/I-80 Connector
US Routes	US-6	Nevada Border	I-15, Santaquin	0	111	111	1,000	1	1	1	1	4	3	Connect to Nevada, Low volume.
		I-15	I-70	173	299	126	9,400	1	3	3	3	10	1	Interstate connections
	US-191	Arizona Border	I-70	0	157	157	8,700	1	3	3	2	9	1	arizona and colorado
		US-6	US-40	251	295	44	2,200	1	1	1	2	5	3	Indian Canyon, Camping.
		US-40	Wyoming Border	352	404	52	1,300	1	2	1	1	5	3	Flaming Gorge, Wyoming
	US-40	I-80	Colorado Border	0	174	174	6,100	1	2	1	1	5	3	strawberry Res, Heavy Truck Traffic, Heber
	US-89	Arizona Border	I-70, Sevier	0	191	191	2,000	1	3	3	2	9	1	Mighty 5, Rural, Lake Powell, Grand Canyon, AZ, I-15 Alternate
		I-70/Salina	US-6/Thistle	225	312	87	3,000	1	2	3	2	8	2	Central Utah Corridor, Alternate to I-15
State Routes	SR-24	I-15	I-70	0	122	122	2,500	1	3	3	1	8	1	Mighty 5, Rural, Interstate Connector
	SR-12	US-89	SR-24	0	160	160	2,000	1	3	3	1	8	1	Mighty 5, Rural, Corridor Connector.

4.3 Urban DCFC Analysis Results

The following table includes the result of using the EVI-Pro tool and a variety of EV ratios expressed as a percentage of the baseline 2016 light duty vehicle counts for the five urban areas available in the application. The summary is intended to provide an approximation of the EVSE needs. This can be useful for estimating, planning, and budgeting installations that meet the future need. Future spatial analysis will use GIS data to identify target zones based upon population/vehicle density, public buildings, and other datasets to help city planners start to determine specific locations. Individual charts can be found in Appedix C.

Additional resources and case studies are available at the Alternate Fuels Data Center (https://afdc.energy.gov/fuels/electricity.html).

Table 3: Urban Capacity Analysis

Urban Capacity

Assumptions

10% of alt fuel vehicles are Plug In Hybrid, 50-mile electric range
10% of alt fuel vehicles are All electric, 100 mile range
80% of alt fuel vehicles are All Electric, 250 mile range
Partial support of plug-in hybrids
Percent with home charging available: 80%

Vehicle Mix	2016 Light Duty	2%	5%	10%
Logan	80,400	1,608	4,020	8,040
Ogden-Layton	542,600	10,852	27,130	54,260
Provo-Orem	398,700	7,974	19,935	39,870
Salt Lake - West Valley	924,000	18,480	46,200	92,400
St. George	123,000	2,460	6,150	12,300
Workplace Level II Needs				
Logan		8	21	41
Ogden-Layton		55	133	263
Provo-Orem		39	97	188
Salt Lake - West Valley		85	201	397
St. George		12	31	61
Public Level II Needs				
Logan		7	17	32
Ogden-Layton		43	89	168
Provo-Orem		32	73	121
Salt Lake - West Valley		55	161	240
St. George		10	25	44
Public DCFC				
Logan		6	14	25
Ogden-Layton		34	58	88
Provo-Orem		26	55	73
Salt Lake - West Valley		33	66	110
St. George		9	20	32

5.0 Potential Action Items

There are many resources available on-line to help EVSE planners and designers during the planning and development process. This document identifies several of those resources within the body and in the appendix. If funding were to become available, the following is a proposed list of action items that merit consideration to help implement the Plan and improve coordination and policy.

5.1 EVSE Steering Committee

It is advisable that UDOT form a steering committee with the intent of meeting quarterly to discuss topics and strategies related to the implementation of the Statewide EV Charging Network Plan. Committee members may be asked to take ownership of certain topics to present to the group at each meeting. This will help ensure the latest trends and innovations are brought to the group and integrated into future Plan releases. Potential topics for quarterly discussion include:

- Building Codes, Government Policy, and Legislation.
- Trends and future needs for commerce and long-haul trucking.
- The state of EV Adoption and areas for improvement.
- Funding and innovative partnerships. These could be private, public or a combination.
- Grants and other research opportunities.
- Energy Storage, ESP rate schedules and general utility impacts.
- State Fleet conversion efforts and needs.
- Public awareness and tourism.

5.2 Remote site monitoring

Adding monitoring cameras at remote EVSE locations may provide additional security. UDOT currently contracts with a remote monitoring company that provides roadway cameras in remote areas to view road conditions (snow season). One such area for consideration is Ivie Creek Rest Area on I-70.

5.3 Improve datasets and modeling

EVSE station developers could partner with EVSE manufacturers to get analytical data from their charging infrastructure, such as unique user IDs using EVSE, home state, trips and other useful data that can help project future needs while also protecting user privacy. EVSE managers

can provide data analytics on EVSE usage, wait times, and other key data to help improve modeling and find targeted areas for improvements and capacity increases.

5.4 State fleet EV modeling

The State's Fleet could benefit from an additional review of the 2019 Sawatch Labs report titled "Electric Vehicle Suitability Assessment: State of Utah". The original report targeted vehicles that traveled under a limited mileage and returned to the same location for fleet charging each night. Additionally, all fleet vehicles that meet criteria should be equipped with data gathering technology that facilitates the identification of fleet vehicles that may be ideal for conversion to zero or low emission/Tier 3 fuel. The number of electric vehicle product offerings, the driving ranges of EVs, and the availability of DCFC chargers have increased significantly since the Sawatch Labs report was published. We recommend that State Fleet vehicle makeup should be evaluated anew to identify potential benefits from the rapidly developing EVSE network.

A comprehensive review of fleet vehicles will also help identify locations for new or additional EVSE at government office locations.

5.5 Fee collection at State-owned EVSE

Obtaining legislative authority to collect fees at state owned EVSE is a key element of the Plan's successful implementation, given the need to provide a level playing field for all station developers and achieve the ultimate goal of eventually privatizing or granting a concession to a private vendor to operate and maintain state owned EVSE as feasible. Currently, state-owned EV chargers are free to the public. This may be acceptable in the near term, as it helps to support accelerated EV adoption and economic development in rural Utah. However, ongoing free EV charging will eventually have a detrimental impact on the feasibility for the private sector to manage state EVSE or install privately funded EVSE (it is difficult to convince people to pay for electricity when it is offered for free nearby). Government created EVSE block out zones inhibit the market from operating efficiently and discourage private investment in increasing EVSE capacity (Priority 2). It is also prudent and fiscally responsible to enable the State to perform cost recovery to offset the costs of electricity, maintenance, and eventual equipment replacement.

5.6 Building code updates

Planning for a future that includes significant increases in electric vehicles is benefited by prescribing EV infrastructure design into new construction. This "everything starting now forward" approach will help avoid costly retrofits of relatively new construction. Currently, Salt Lake City addresses multi-tenant EVSE in its Off Street Parking, Mobility, and Loading

document (Link). Another useful summary of EV Infrastructure building codes is the Southwest Energy Efficiency Project (link).

5.7 Public/Employee relations

A well-executed Public Relations campaign could promote the EV mobility network and help educate the public on this evolving alternative fuel transportation option. A parallel campaign could focus on government employees and the paradigm shift towards how best to effectuate the public's business in an EV.

5.8 Consider providing flexibility for EVSE target spacing

Allowing some exceptions to the 50-mile target spacing would allow for more practical and cost-effective use of funds in the early stages of deployment. In some instances, the space between logical installation locations is either of minimal value (see 55-mile gap below), or not currently cost effective. Many stretches of Interstate 70 lack any electrical infrastructure and in one instance, no developed areas to install. These sites would require pavement, bathroom facilities, lighting and solar power. UDOT recommends that although these sites would not be developed initially, but be evaluated for alternative solutions, such as lower powered level II "safety net" solutions.

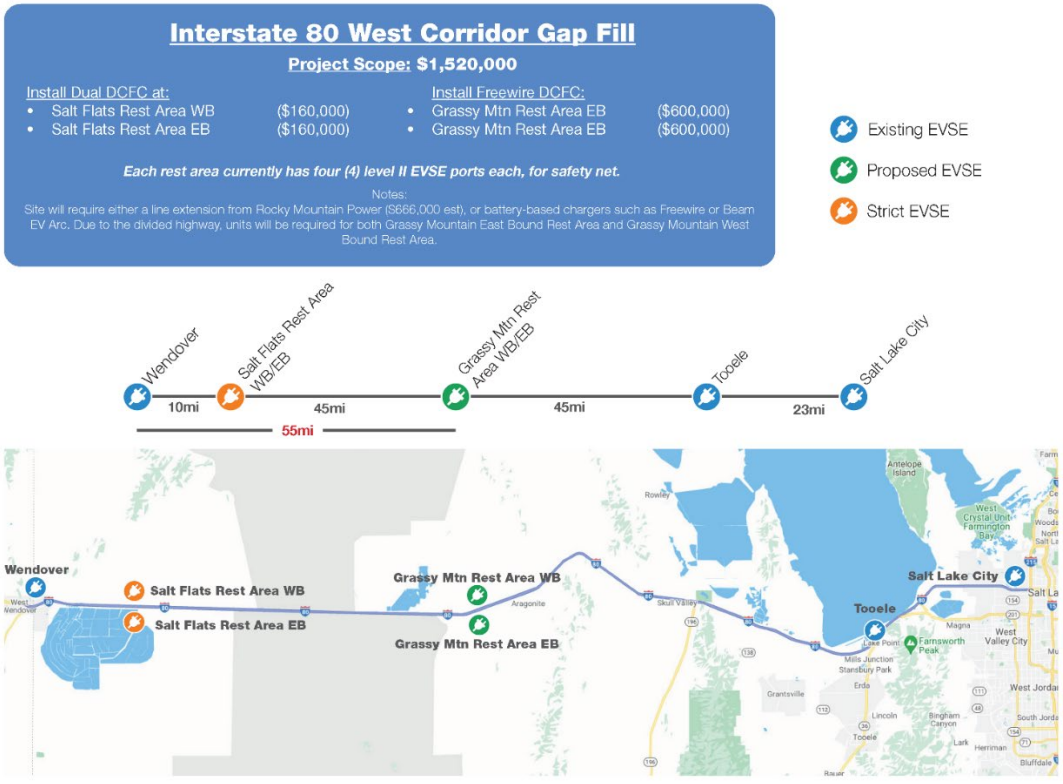


Figure 1: EVSE Gap map, showing minimal benefit in some instances (Salt Flats)

5.9 Port standardization/agnostic EVSE installation

We recommend any EVSE installed with government funding be open source and non-proprietary. Tesla vehicles use a proprietary network and port connector that is not available to other EVs, but Teslas are equipped to use non-Tesla EVSE by use of an adapter. New and upstart EV manufacturers may be inclined to follow the Tesla business model by offering exclusive infrastructure (imagine Ford owned gas stations that only sell gas to Ford owners). The exclusivity approach has the potential to compete with public chargers for real estate and grid capacity. The public is benefitted when all EVs may use all EVSE.

The European Union has adopted the CCS Combo 2 charge port as their standard. Because of this, and for other reasons, Tesla is now manufacturing its cars with the CCS Combo 2. This Plan recommends that all publicly funded installations should be port agnostic (CCS/CHAdeMO/J1772) and provide charging ports that all EVs can use.

5.10 Issue a Request for Information (RFI)

UDOT could issue a Request for Information (RFI), targeting EVSE manufacturers/integrators and EV manufacturers. The RFI process is a non-contractual request for information. The steering committee would help craft the question bank and resulting information will be shared. Because the EVSE and EV industry as a whole are quickly evolving and innovating, it is important to stay informed about opportunities and unique products. Some possible question groups in the RFI include:

- Responder's experience with Public-Private Partnerships for EVSE
- Responder's solution to lack of adequate power source on site
- Responder's recommendations for ideal EVSE site host criteria
- Responder's experience with integrated energy storage and possible ROI calculations.
- Responder's experience with modeling calculations for urban EVSE siting

6.0: Gap Funding Needs (50 mile spacing):

The following table is a summary of the proposed EVSE and an estimated cost for Gap filling along key corridors. Costs were based on the previous EVSE project that UDOT implemented under the Volkswagen Mitigation Trust grant that was administered by the Utah Department of Air Quality. Solar and battery storage types (Freewire) were estimated using recent bids from surrounding states. The estimates are a general estimate and sites will vary in cost based on a variety of factors including, necessary utility upgrades, site improvements and/or any private-public partnership opportunities developed during the planning an implementation process.

UDOT is also proposing an alternative flexible option where some of the sites are temporarily removed from the list such that other more cost-effective sites can be developed. Suggested sites to delay include locations with no existing electrical and/or civil infrastructure, remote sites that will need a solar (or generator) solution, and sites that fill minimal gap spacing (i.e. filling a 55 mile gap to hit an ideal spacing of 50 miles).

Until more cost-effective solutions are available, UDOT recommends using the savings to provide additional capacity along major corridors to help mitigate high usage times as more EVs are adopted. Sites that are delayed will continued to be evaluated based upon EV adoption rates, travel patterns, grant opportunities, possible combination with roadway projects in the area and other factors.

(TABLE ON NEXT PAGE)

TABLE 4: FUNDING OPTIONS (50-MILE VS. FLEX):

EVSE Investment Options: Strict 50 Mile vs. Flex Option					
Route	**Location**	**Scope**	**50 Mile Option**	**Flex Option**	**NOTES**
I-70	Cove Fort	4 DCFC	$ 265,000	$ 265,000	
$2,795,000	Ivie Creek	4 DCFC	$ 265,000	$ 265,000	Not including RMP upgrade power ($160,000)
	Crescent Jct	4 DCFC	$ 265,000	$ 265,000	(May Consider Thompson, some backtracking)
	Ghost Rocks R/A EB	Solar Power DCFC	$ 500,000		BLM Approval Needed
	Ghost Rocks R/A WB	Solar Power DCFC	$ 500,000		BLM Approval Needed
	Ranch Exit	Solar Power DCFC	$ 1,000,000		Civil Site development (New pavement, drainage, evironmental)
I-80	Grassy R/A EB	2 Freewire DCFC / RMP	$ 600,000	$ 600,000	Site has 4 level 2 for security net
$1,520,000	Grassy R/A WB	2 Freewire DCFC / RMP	$ 600,000	$ 600,000	Site has 4 level 2 for security net
	Salt Flats R/A EB	2 DCFC	$ 160,000		fills minimal gap filling between Grassy and Wendover
	Salt Flats R/A WB	2DCFC	$ 160,000		fills minimal gap filling between Grassy and Wendover
US-40, US-191	Heber	4 DCFC	$ 265,000	$ 265,000	
$1,855,000	Duchesne	4 DCFC	$ 265,000	$ 265,000	Needed to complete US-191 Central
	Vernal	4 DCFC	$ 265,000	$ 265,000	
	Fruitland	4 DCFC	$ 265,000	$ 265,000	Possibly use Pinion Ridge Rest Area
	Myton	4 DCFC	$ 265,000	$ 265,000	
	Dutch John	4 DCFC	$ 265,000	$ 265,000	
	Helper	4 DCFC	$ 265,000	$ 265,000	Needed to complete US-191 Central
US-50/6	Delta	4 DCFC	$ 265,000	$ 265,000	
$925,000	Eureka	2 DCFC	$ 160,000	$ 160,000	Possibly sited at Eureka Maintenance Station
	Skull Rock M/S	Solar Power DCFC	$ 500,000		Security, BLM, Environmental, Modify Maintenance Yard
US-6	Tie Fork R/A	2 Freewire DCFC	$ 600,000	$ 600,000	Site already has 4 level 2 for security net
$1,100,000	Horse Canyon	Solar Power DCFC	$ 500,000		Civil Site development (New pavement, drainage, evironmental)
	Huntington	4 DCFC	$ 265,000	$ 265,000	Provide alternate route to SR-6 (see wildfire closure)
US-191 South	Kane Springs R/A	2 Freewire DCFC	$ 600,000		minimal gap filling between Monticello and Moab
$600,000					
US-89 North	Fairview	4 DCFC	$ 265,000	$ 265,000	Connects SR31 to SR10 and Price as alternate route to US6
$530,000	Ephraim	4 DCFC	$ 265,000	$ 265,000	
US-89 South	Panguich	4 DCFC	$ 265,000	$ 265,000	
$1,060,000	Junction	4 DCFC	$ 265,000	$ 265,000	
	Orderville	4 DCFC	$ 265,000	$ 265,000	
	Paria River Ranch	4 DCFC	$ 265,000	$ 265,000	3 phase power access
SR-12	Bryce City	4 DCFC	$ 265,000	$ 265,000	
$795,000	Escalante	4 DCFC	$ 265,000	$ 265,000	
	Boulder	4 DCFC	$ 265,000	$ 265,000	
SR-24	Torrey	4 DCFC	$ 265,000	$ 265,000	
$1,295,000	Hanksville	4 DCFC	$ 265,000	$ 265,000	
	Loa	4 DCFC	$ 265,000	$ 265,000	
	Goblin Valley S/P	Solar Power DCFC	$ 500,000	$ 500,000	BLM, Environmental
		Project Totals	**$12,740,000**	**$ 8,820,000**	
		Site Count	**37**	**29**	

7.0 Conclusion

With the rapid paced, global shift to electrified transportation underway, some are wondering what the role of government should be. Auto manufacturers across the board are making "no going back" commitments to electrification and investing billions of dollars to bring about a once in a century modernization of surface transportation. Many nations and several states are setting zero transportation emission goals to address energy independence, climate, and air pollution.

With increasing urgency, federal, state, and local governments are grappling with the many new and unique challenges that must be addressed to help with a quickly approaching market shift to electrified transportation. A few challenges include:

- What is the role of government and investment needed, to support EV adoption to ensure minimal inconvenience and maximum benefits to their constituents and the economy?
- How and when will privatization of EVSE take place?
- How to continue funding roadway maintenance and construction?
- What impact will electrification have on the electrical grid (reliability/resilience)?
- How will private and government fleets make the transition?
- What building code updates are necessary to bring EVSE to multi-tenant building residents?
- How to support, and bring opportunities to low-income households and underserved communities?

This report was commissioned to establish a plan to develop the core EVSE mobility network on key Utah highways. The Plan presents a foundational 50-mile spacing EVSE network that supports tourism, rural communities, and regional connectivity.

Development of the statewide EVSE mobility network will help ensure Utah's businesses, citizens and visitors have much improved access to vehicle charging options. Although this initial gap filling process will help improve EV adoption and boost consumer confidence, there is also a growing need to build out more EVSE capacity along key corridors and in urban areas. EVSE installations, both urban and rural, should trend along with EV adoption and utilization. Prudent and thoughtful planning are critical for providing the foundational framework that can expand as demand grows.

Mass adoption of electric vehicles will require significant and ongoing planning and coordination among stakeholders and planners to meet the growing EVSE infrastructure needs. Along with early baseline investment needs identified in this document, the other main takeaway is the need to promote strategic coordination among stakeholders.

It is recommended that a Utah EV technical working group be established to help evaluate core issues and make pragmatic and timely recommendations to policy makers and leaders. This working group can provide direction on areas of planning needs, public outreach, growth studies, building codes, utility engagement, equity, privatization, and other pertinent topics. The working group would develop strategic objectives and recommendations to help policy makers make informed decisions that help navigate the many electrification challenges that are rapidly approaching.

Finally, UDOT has identified a base budget needed to fulfill the objectives of completing a statewide EVSE charging network as mandated in HB259. It has also provided a second "Flex Funding" option that provides some flexibility by allowing development of more cost effective and useful sites initially and continuing to monitor EVSE utilization, EV adoption and funding opportunities that may raise the need to provide more costly infrastructure upgrades. It is also recommended that efforts be made to leverage any state funding towards grants, public-private-partnerships, innovative contracting, and other opportunities to maximize the value of the investments being made.

Appendix A: EVSE Modeling and Datasets

A.1 Identifying Key Corridors for Development

Key corridors were evaluated by UDOT and included based on their destination, traffic flow and connectivity to the overall EVSE network.

A.2 Corridor Pending (Electric)

This is a corridor that has been identified as being desirable and useful for the development of alternative fuel infrastructure. A corridor or corridor segment will remain pending until a minimum 50-mile spacing of DCFC infrastructure is met.

A.3 Corridor Ready (Electric)

Corridor ready identifies corridors that meet the required 50-mile spacing of EVSE. These corridors are eligible for mainline signage to identify fueling opportunities for Alternative Fuel Vehicles using electricity as fuel.

The alternative fuel corridors are a primary foundation of Utah's Statewide EV Charging Plan. Although some corridors have yet to be designated by the FHWA, UDOT is planning to continue to nominate them as future rounds are announced. The routes evaluated in this plan are a complete list of current and future nominated routes.

Given the spatial nature of the EV network, UDOT determined it would be best to perform its analysis using the ESRI Geographic Information System (GIS) as the primary modeling and analysis tool. This allows multiple datasets to be included and analyzed with respect to location and other spatial features.

Some of the data sets used in the GIS tool include:

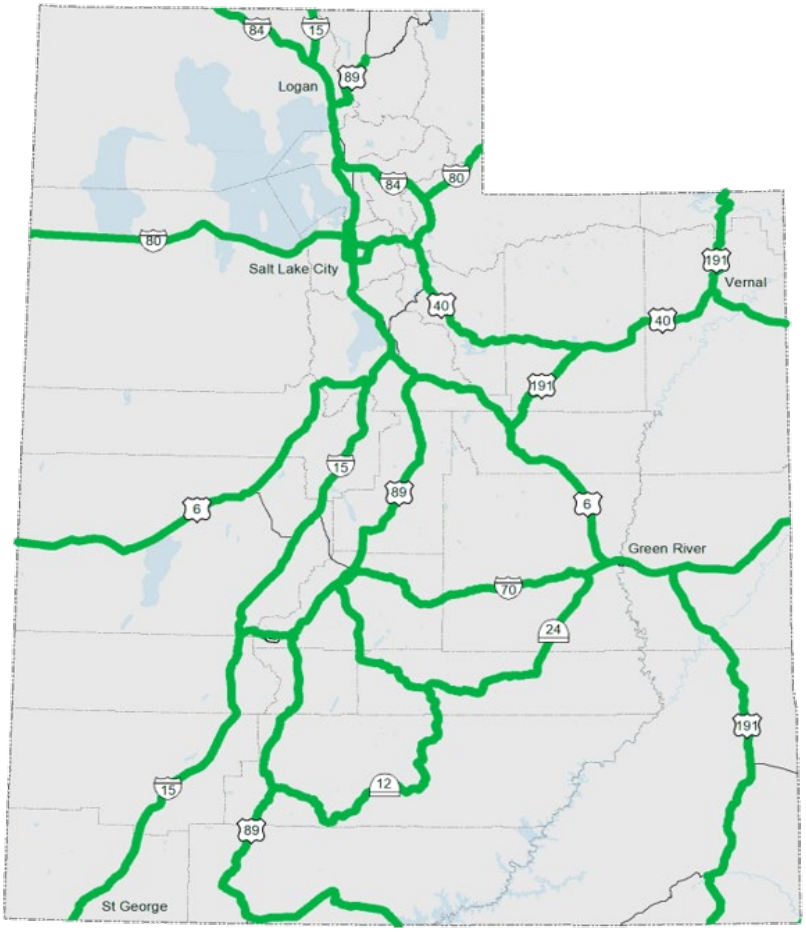
- Alternative Fuel Corridors
- Average Annual Daily Traffic (AADT)
- Energy Service Provider territories
- National Parks/Monuments/Recreation areas/Forests.
- State Parks
- Points of Interest (Lakes, museums, golf courses, etc.)

Additional Datasets will be included during the Phase IV - EV Charging Capacity analysis to help model holidays, weekends, and other considerations. Further, UDOT will seek to obtain analytics from EVSE vendors to help determine peak usage, possible queuing issues and other operational data points that would inform future prioritized EVSE installations.

A.4 Urban DCFC

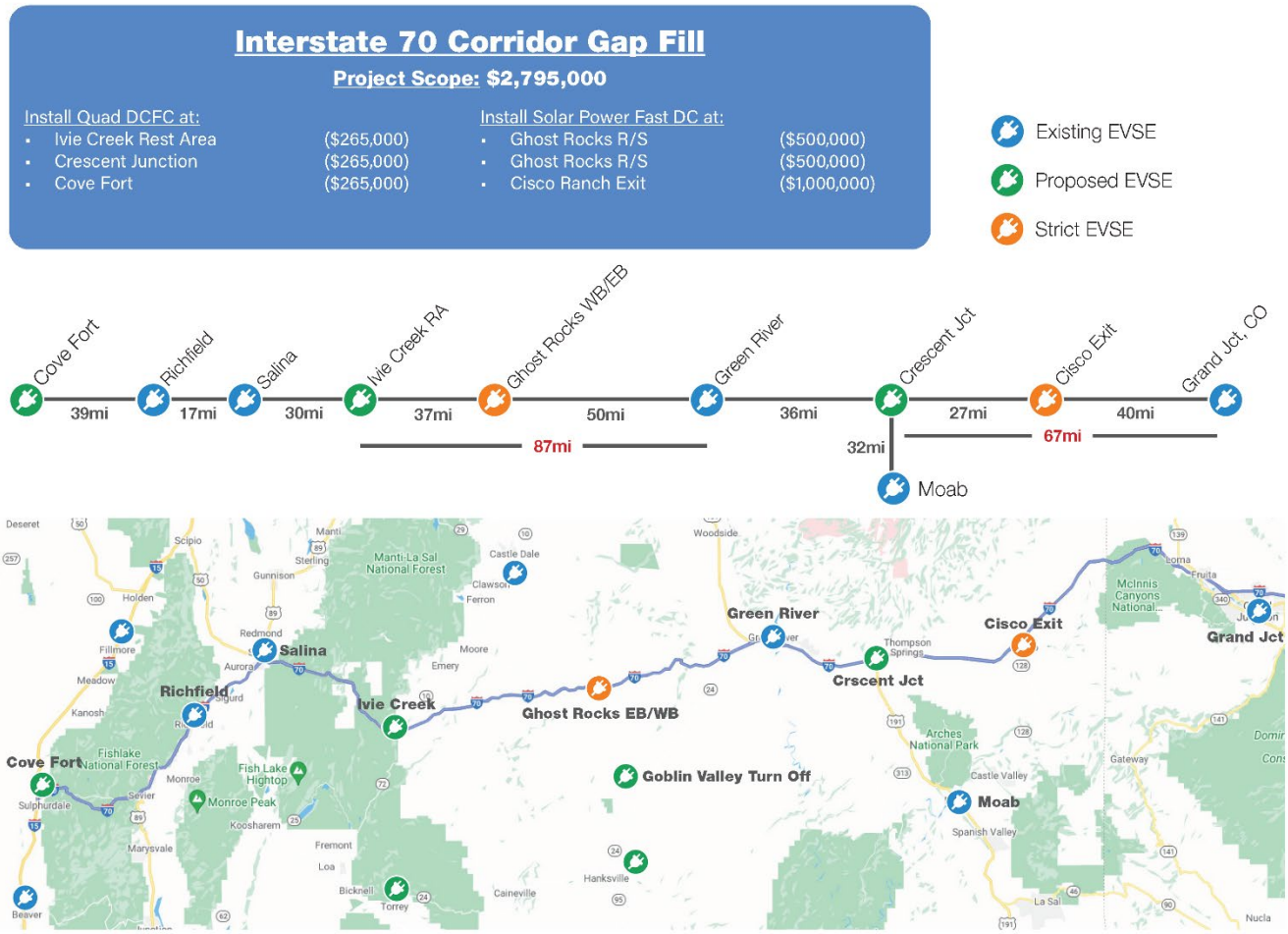
Urban EVSE needs were analyzed using the U.S. Department of Energy's EVI-Pro Tool that is available through the Alternative Fuels Data Center (https://afdc.energy.gov/evi-pro-lite).

This analysis tool looks at light duty vehicle mix based on 2016 total light duty count data. Light duty vehicles are considered passenger and cargo vehicles with a GVWR of less than 10,000 pounds. The urban areas analyzed include Logan, Ogden-Layton, Salt Lake City-West Valley City, Provo-Orem, and St. George. Results can be used to extrapolate EVSE needs in other cities around the state. For the purposes of this analysis, it was assumed that 80% of EV owners would have access to at home charging. Actual high density and multi-tenant values will impact this ratio. The model is limited to 10% electric vehicle ownership.



Utah's Nominated Alternative Fuel Corridors (Electric)

Appendix B: Corridor Maps



Interstate 80 West Corridor Gap Fill

Project Scope: $1,520,000

Install Dual DCFC at:		Install Freewire DCFC:	
• Salt Flats Rest Area WB	($160,000)	• Grassy Mtn Rest Area EB	($600,000)
• Salt Flats Rest Area EB	($160,000)	• Grassy Mtn Rest Area EB	($600,000)

Each rest area currently has four (4) level II EVSE ports each, for safety net.

Notes:
Site will require either a line extension from Rocky Mountain Power ($666,000 est), or battery-based chargers such as Freewire or Beam EV Arc. Due to the divided highway, units will be required for both Grassy Mountain East Bound Rest Area and Grassy Mountain West Bound Rest Area.

Existing EVSE
Proposed EVSE
Strict EVSE

SR 12 Corridor Gap Fill

Project Scope: $795,000

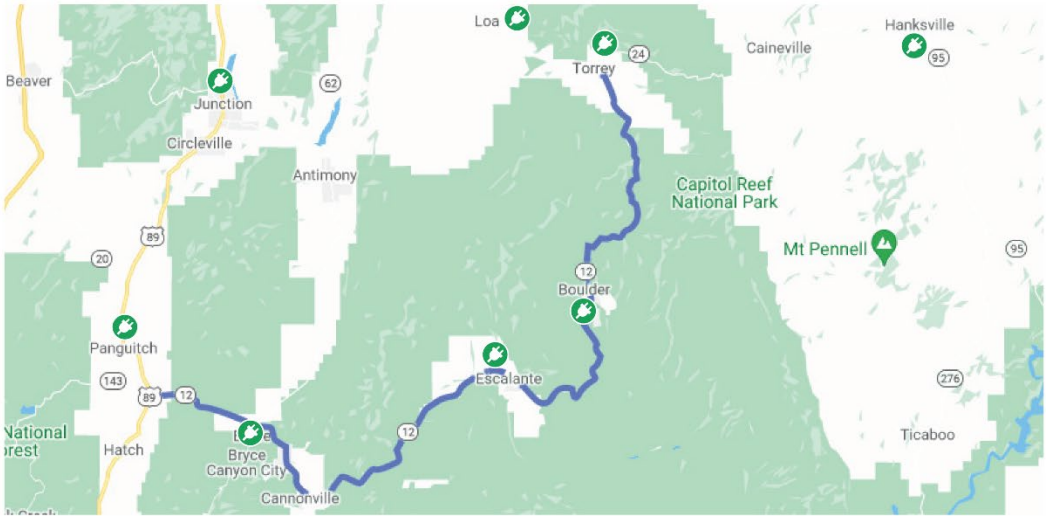
Install Quad DCFC at:

- Bryce City ($265,000)
- Escalante ($265,000)
- Boulder ($265,000)

Notes: Torrey also covers SR24. Panguich, Junction, and Hanksville needed on other corridors

Existing EVSE

Proposed EVSE



SR 24 Corridor Gap Fill

Project Scope: $1,295,000

Install Dual DCFC at:

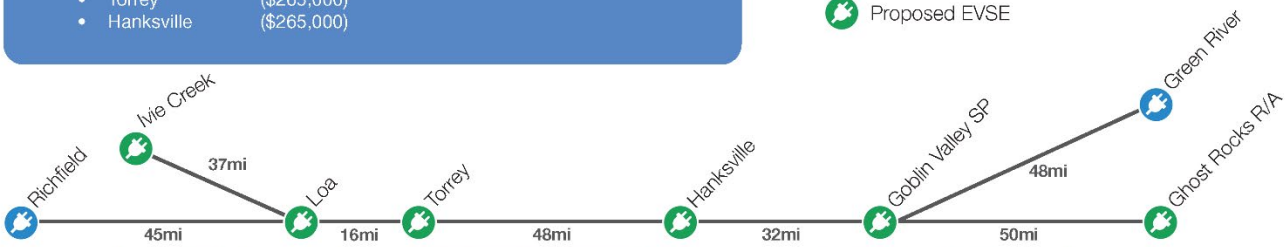
- Loa ($265,000)
- Torrey ($265,000)
- Hanksville ($265,000)

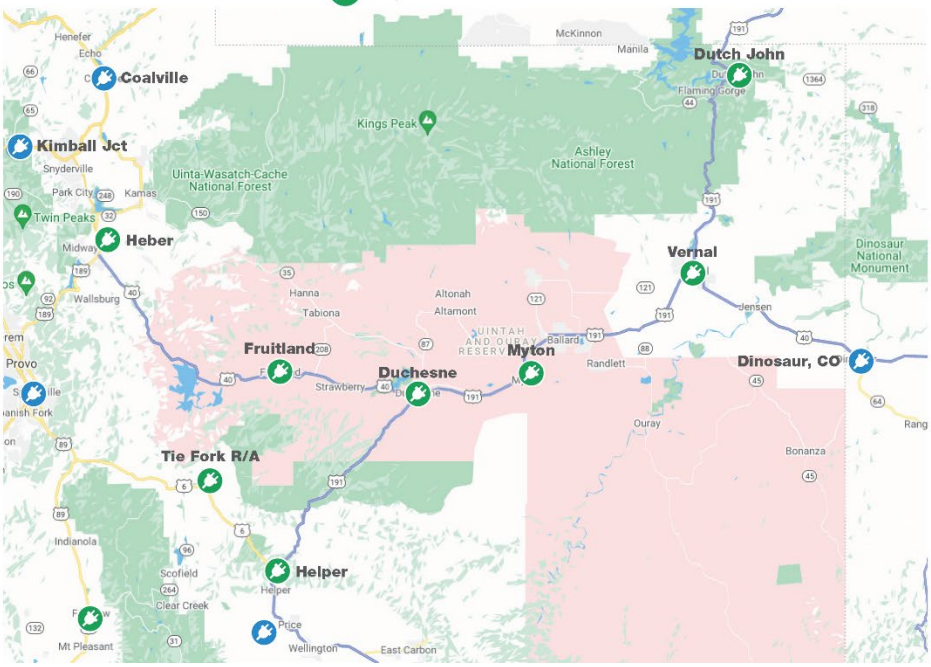
Install Solar DCFC at:

- Goblin Valley ($500,000)

Existing EVSE

Proposed EVSE





US-40 & US-191 North Corridor Gap Fill

Project Scope: $1,855,000

Install Quad DCFC at:

- Heber ($265,000)
- Myton ($265,000)
- Fruitland ($265,000)
- Vernal ($265,000)
- Duchesne ($265,000)
- Dutch John ($265,000)
- Helper ($265,000)

Existing EVSE

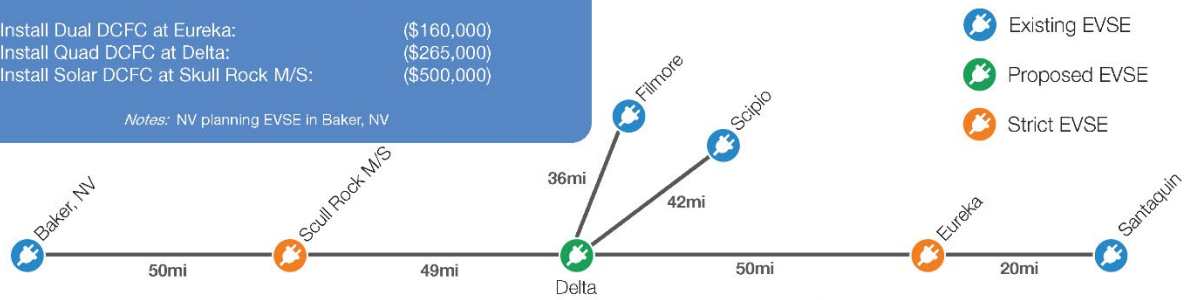
Proposed EVSE

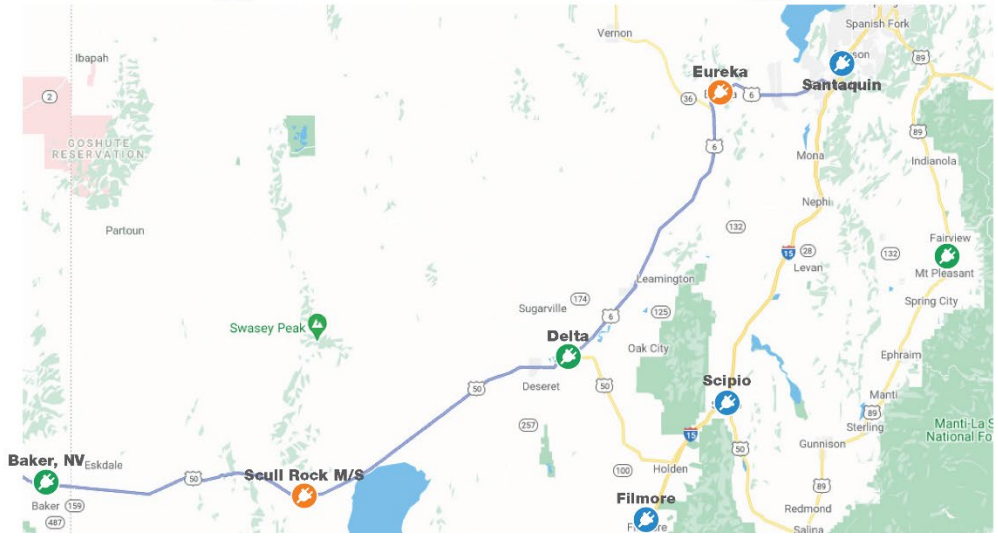
US-6/US-50 West Corridor Gap Fill

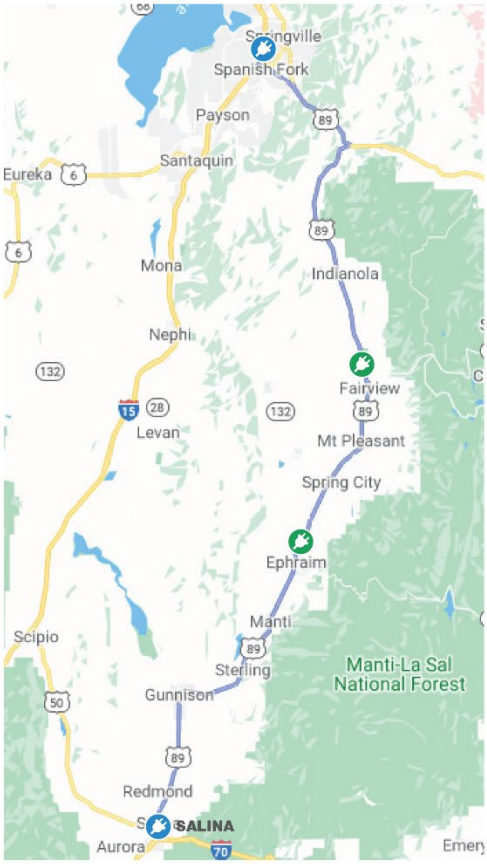
Project Scope: $925,000

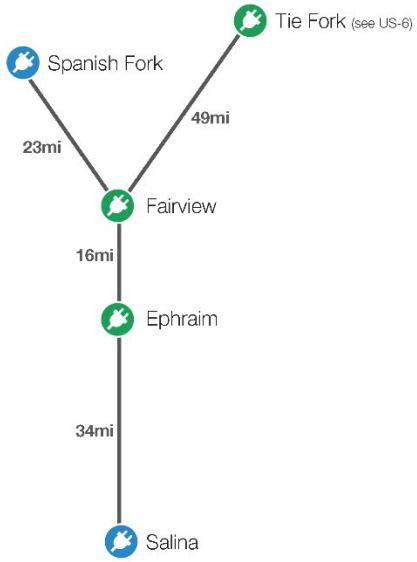
Install Dual DCFC at Eureka:	($160,000)
Install Quad DCFC at Delta:	($265,000)
Install Solar DCFC at Skull Rock M/S:	($500,000)

Notes: NV planning EVSE in Baker, NV









Existing EVSE

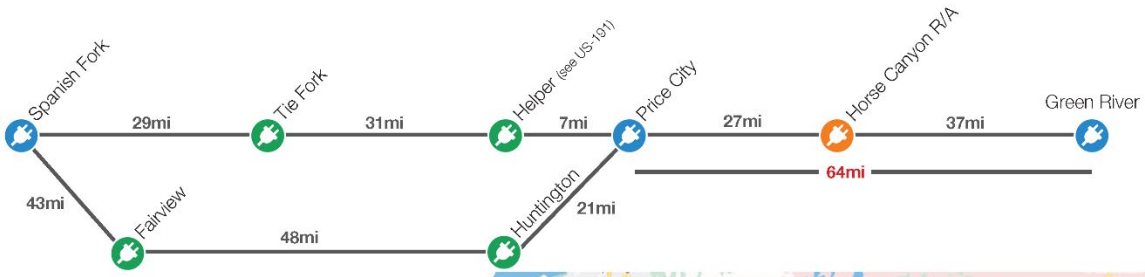
Proposed EVSE

US-89 Central Gap Fill

Project Scope: $530,000

Install Quad DCFC at:

Fairview	($265,000)
Ephraim	($265,000)



Existing EVSE

Proposed EVSE

Strict EVSE

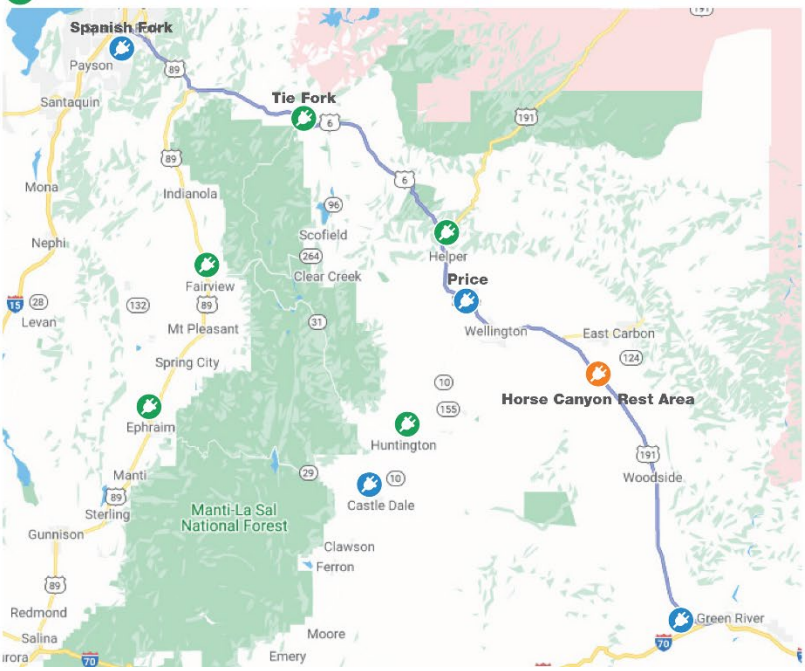
US-6 Central Corridor Gap Fill

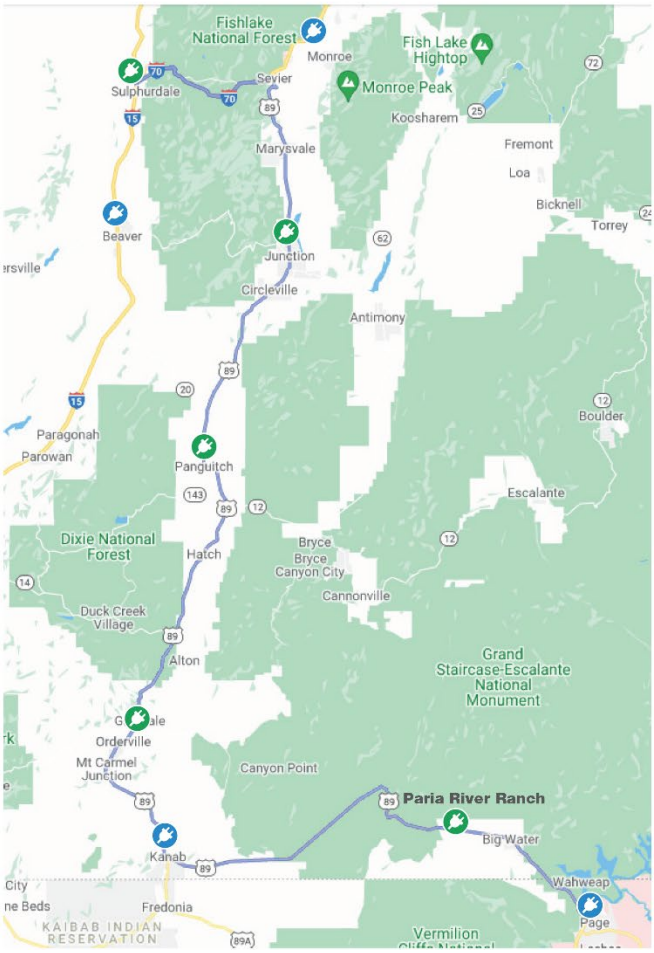
Project Scope: $1,100,000

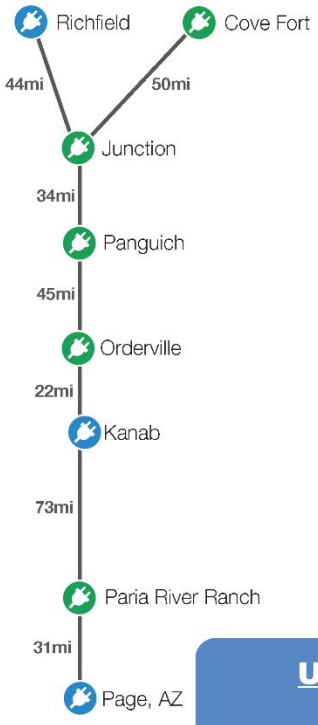
Install Freewire DCFC at
- Tie Fork Rest Area: ($600,000)

Install Solar DCFC at
- Horse Canyon Rest Area: ($500,000)

Install Quad DCFC at
- Huntington (alt route): ($265,000)







Existing EVSE

Proposed EVSE

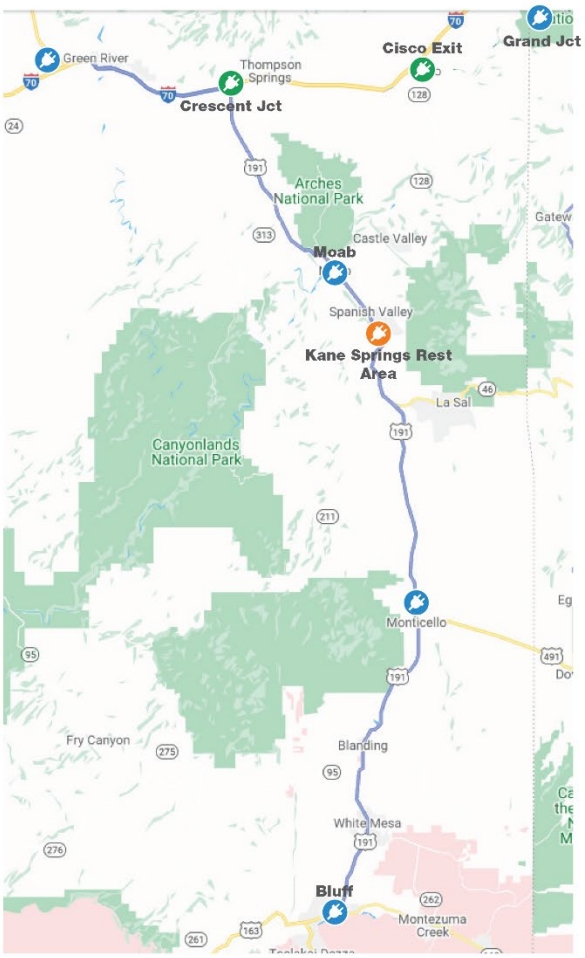
US-89 South Gap Fill

Project Scope: $1,060,000

Install Quad DCFC at:

- Orderville ($265,000)
- Panguich ($265,000)
- Junction ($265,000)
- Paria River Ranch ($265,000)

Notes: SR-153 is seasonal



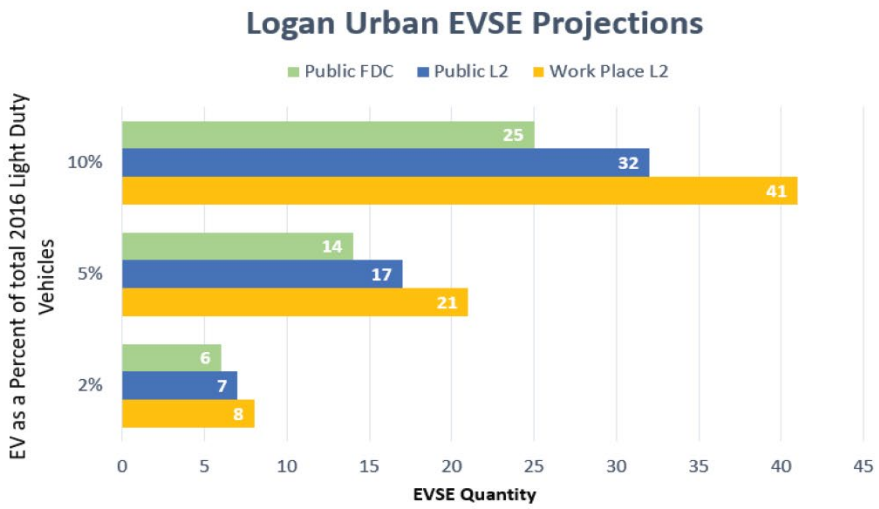
Existing EVSE
Proposed EVSE
Strict EVSE

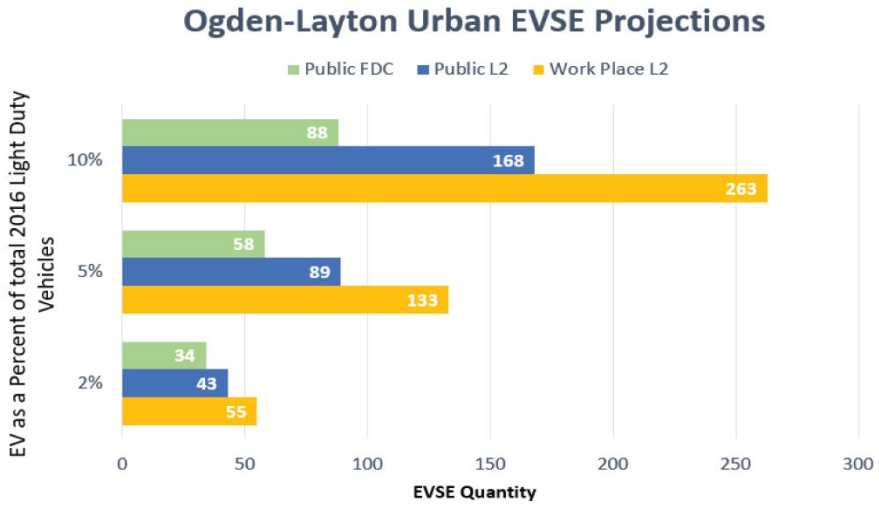
US-191 Corridor Gap Fill

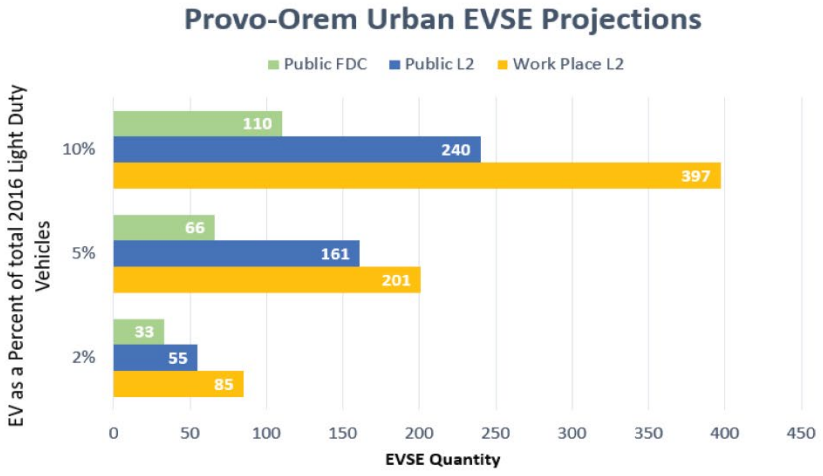
Project Scope: $600,000

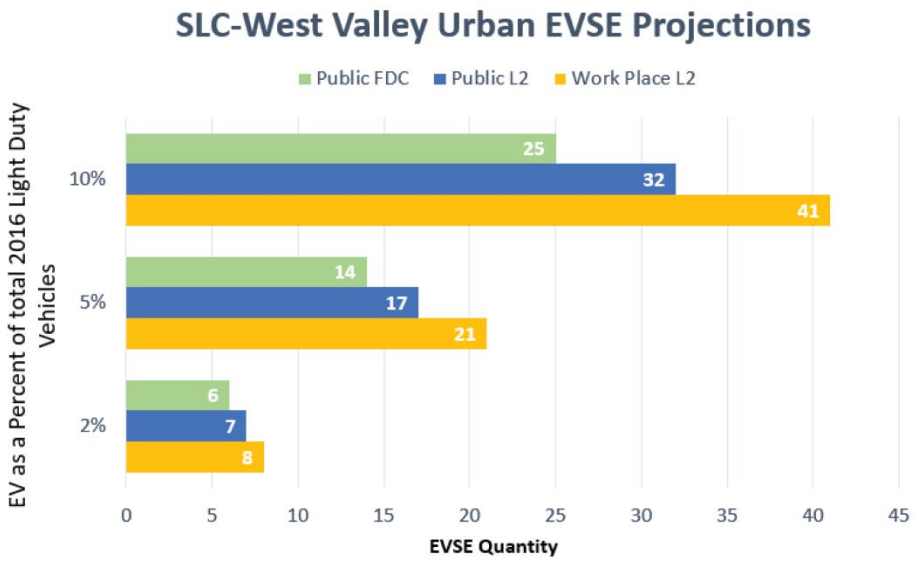
Install Freewire DCFC at:
Kane Springs Rest Area ($600,000)

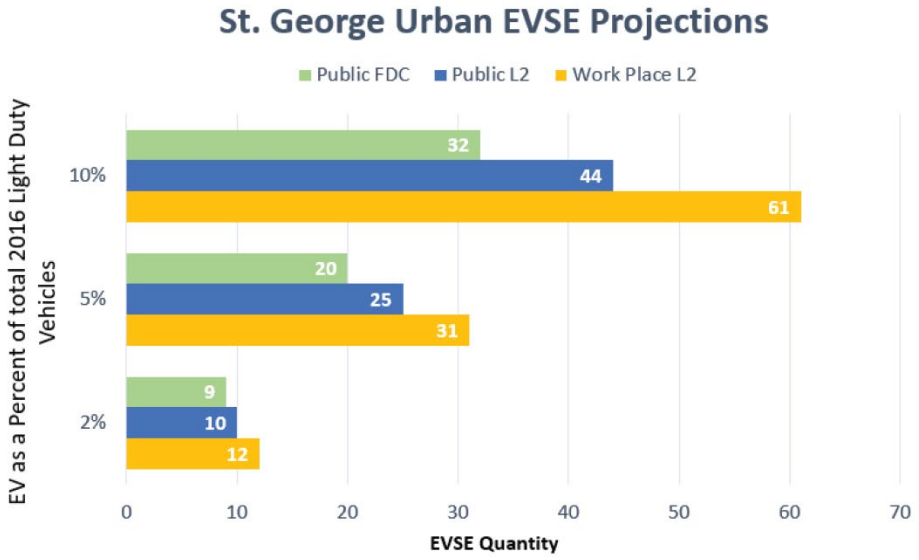
Appendix C: Urban EVSE Needs








SLC-West Valley Urban EVSE Projections
Public FDC
Public L2
Work Place L2
EV as a Percent of total 2016 Light Duty Vehicles
10%
5%
2%
25
32
41
14
17
21
6
7
8
0
5
10
15
20
25
30
35
40
45
EVSE Quantity


St. George Urban EVSE Projections
Public FDC
Public L2
Work Place L2
EV as a Percent of total 2016 Light Duty Vehicles
10%
5%
2%
32
44
61
20
25
31
9
10
12
0
10
20
30
40
50
60
70
EVSE Quantity

Appendix D: Plan Benefits

D.1 Fill Gaps, Complete Corridors, Create Connection and Enhancement within the Region

In 2019, Governor Gary Herbert joined the governors of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, and Wyoming to sign an updated Memorandum of Understanding (MOU) for Regional Electrical Vehicle Plan for the West (REV West) with a goal to enable drivers to "seamlessly drive an electric vehicle across the Signatory States' major transportation corridors." The new MOU builds on lessons learned by the REV West states as they work together to encourage public and private sector investment in electric vehicle charging stations to help grow EV adoption in the region. The REV West partnership also released Voluntary Minimum Standards for Direct-Current Fast Charging (DCFC) stations, covering administration, interoperability, operations, and management. This information can serve as guidance for station developers, public entities, and businesses looking to build EV charging stations (link).

D.2 Improved EV Travel Experience

Utah continues to add more EVs onto its roads, and the continued build out of electric infrastructure is greatly needed for Utah commuters and businesses. Additionally, Utah continues to be a popular travel destination especially for those seeking outdoor recreation.

As Utah continues to be a popular location for travel, especially for those wanting to experience the great outdoors, the increased ease of EV travel through improved infrastructure will facilitate access to Utah's range of visitor destinations, from popular sites such as The Mighty 5® national parks of Southern Utah to all the national monuments, recreation areas, forests, state parks, open spaces, and cultural offerings along the way. By targeting priority locations at gateway and base camp towns with opportunities to dine or explore nearby cultural attractions while charging, improved EV infrastructure can further support economic growth in Utah's rural communities.

D.3 Improved Air Quality

Every action in this plan supports Utah's ongoing goal to decrease emissions through vehicle transportation as an effort to improve air quality and quality of life for Utah. Motor vehicles are the largest source of emissions in the state. Electrifying transportation will assist with reducing emissions that contribute to both ozone and particulate matter 2.5 ($PM_{2.5}$). Vehicle emissions from both urban and local areas also play a role in contributing to visibility impairment (known

as regional haze) in our national parks and other scenic areas. Vehicle electrification can help improve our experience when we visit these treasured natural areas by improving visibility as well as reducing noise impacts and vehicle congestion.

D.4 Building Fuel Resilience

The State of Utah encourages building resilience across transportation operations. Through diversified transportation options, the State of Utah can enhance fleet operations and be better prepared to withstand fuel disruptions. Electric Vehicle Supply Equipment (EVSE) can also be made more resilient to grid disruptions with onsite energy generation and storage.

Appendix E: EVSE Types

E.1 Charger Types

There are multiple configurations of EVSE power output, power source and charge port connector types.

- **Level I:**
  - 120 Volt, 1.3kW to 2.4kW output.
  - 3-5 miles of range per hour charged.
  - J-1772 Connector Port
  - Home or emergency charger

- **Level II:**
  - 208-240 Volt, 3kW to 19kW output.
  - 18-28 miles of range per hour charged.
  - J-1772 Connector Port

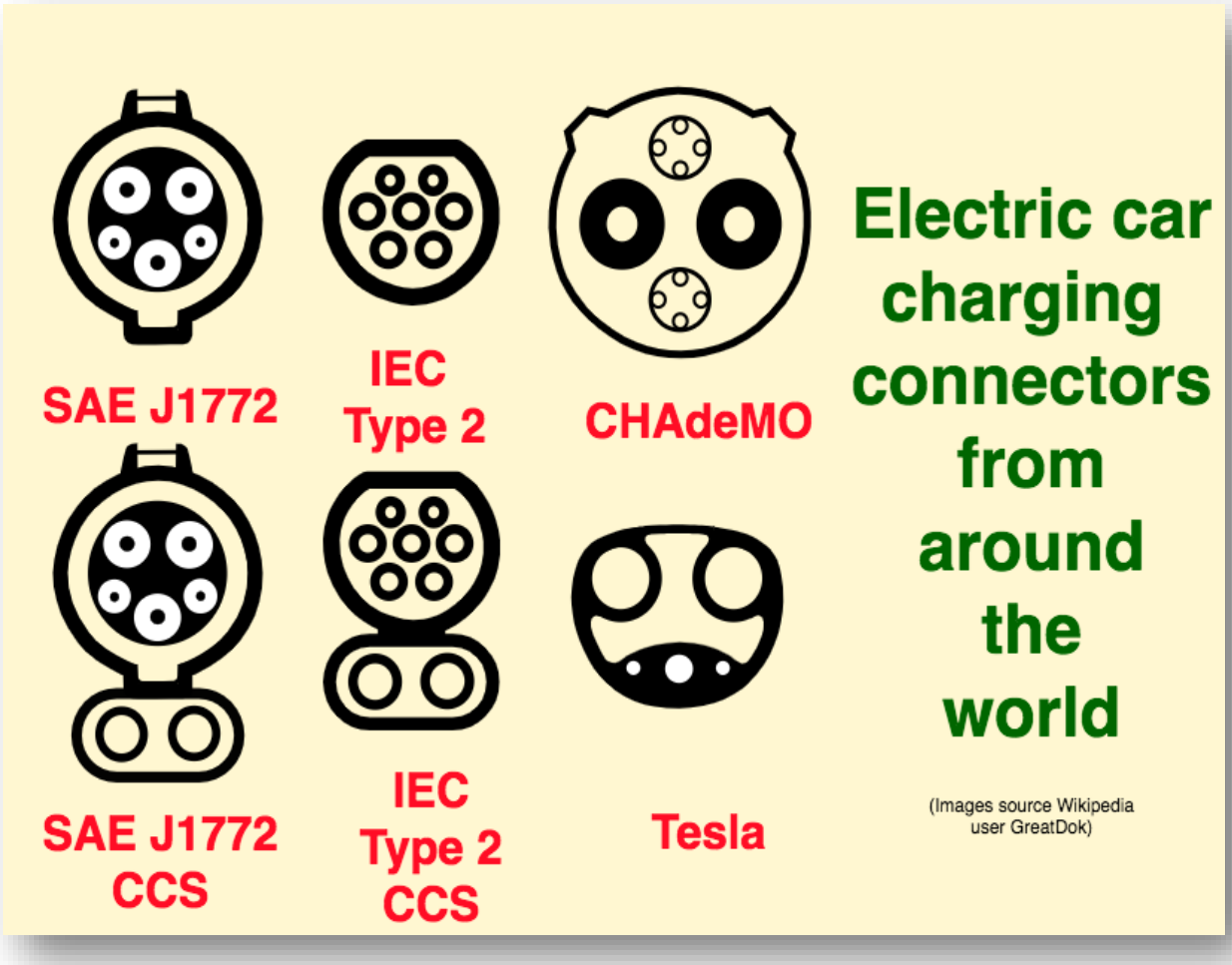
- **Level III (Direct Current Fast Charger DCFC)**
  - 480 Volt/3-ph power, or battery-based system.
  - Output up 50kW to 350kW
  - 100+ miles of range per 15-minute period.
  - Power tappers after 80% battery state of charge
  - CCS-Combo, Tesla, CHAdeMO connectors.

One of the key features that separate Level I/II from DCFC is how the charge is being sent to the battery pack. Level I/II chargers use the vehicles onboard charger to covert the utility grid's Alternating Current (AC) source to Direct Current at the vehicle pack voltage. DCFC chargers do the conversion from AC to DC internally (off-board charger). Thus, DC power is flowing from the charger to the vehicle battery pack. DCFC chargers generally have a broad range of DC voltage output to work with vehicles up to 900 volts DC.

E.2 EVSE Connector / Plug Types.

There are three main connector types currently being installed by manufacturers. Each has limitations on the amperage (power) that can be sent through the cable and plugs.

J-1772 plug is the base plug that accommodates Level I and Level II charger CHAdeMO is a charger plug configuration common with Nissan, Hyundai, Mitsubishi. The standard was largely adopted by several Asian manufactures. Tesla also offers a CHAdeMO adapter for use at non-tesla EVSE.CCS- (Combined Charging System) is a EV Charger port protocol. It has been adopted by most vehicle manufacturers (BMW, Ford, Jaguar, GM, etc.). It should also be noted that since 2014, the European Union has required the provision of Type 2 (CCS-Combo 2) within its EVSE network. Tesla has historically used a proprietary connector; however, the European Union standardization has let Tesla to integrate the CCS2 charge port into vehicles sold there.



Appendix F: EV Charging Location Categories

F.1 Home/Work/Fleet/Extended Stay:

The US Department of Energy estimates that over 80% of EVs are currently being charged at home or place of business (work). This is largely because of the convenience and cost of charging at these locations. Other locations such as public buildings, shopping centers and airports also bolster the opportunity for charging EVs.

Although most EV charging happens at home or work, a large area of opportunity for improvement is multi-tenant housing. Higher density residential new construction is rapidly growing in response to Utah's population growth, housing availability, and socioeconomic dynamics.

As a first step, changes in building codes can help ensure future construction is "EV Ready" by requiring the appropriate sizing of electrical equipment and installing electrical conduit necessary to provide power for future dedicated parking spaces. Additionally, continuing grant opportunities to help retrofit existing locations help provide EVSE to multi-tenant housing locations and improve the likelihood of EV adoption for their residents.

F.2 Urban DCFC:

These stations are located within urban areas. Initially, some are likely to be at government buildings, existing gas stations, shopping centers and other high-traffic areas that will see increased utilization early in the EV adoption process. These locations are important for individuals without access to workplace or home charging.

F.3 EV Mobility Network DCFC:

These stations are intended to reduce range anxiety for current and potential EV owners. DCFC stations also support fleet conversions (government and private). A well-planned EV mobility DCFC network will encourage ecotourism from out-of-state EV owners/visitors.

This document and planning effort are focused on this group primarily out of the need to coordinate their development in a methodical and pragmatic way. Many of the urban areas have opportunities for EVSE implementation by private entities and government places of business.

EVSE implementations outside of the major urban areas provide functional travel opportunities for EV owners (individuals and fleets). Non-urban DCFC is least likely to privatize initially, and the state of Utah intends to pursue innovative public-private partnerships during each round of EVSE funding. The State's strategic goal is to support accelerated EV adoption by providing access to EVSE on Utah's key corridors via public investments and public-private partnerships until the private sector enters the market to continue building out the Plan.

Appendix G: Energy Service Providers

G.1 Energy Service Providers (ESP) and Utility Infrastructure

While selecting sites for EV installation, ESP service territories will need to be considered. Early and continuous engagement with ESPs is critical in planning EVSE locations. EVSE, particularly DCFC, may strain the utility grid and mitigation efforts should be considered. ESPs are a critical partner in the development of a statewide DCFC network.

ESPs are also an important partner to help address expensive and ongoing operating costs, particularly the demand component of the utility bill. EVSE implementers are encouraged to work with ESPs to help determine the most balanced rate schedules as the need for an economic and fair solution continues to grow. Energy storage solutions may be deployed to help mitigate operational costs, grid loading, or when line extensions to bring 3-phase/480Volt electricity to the site are not feasible.

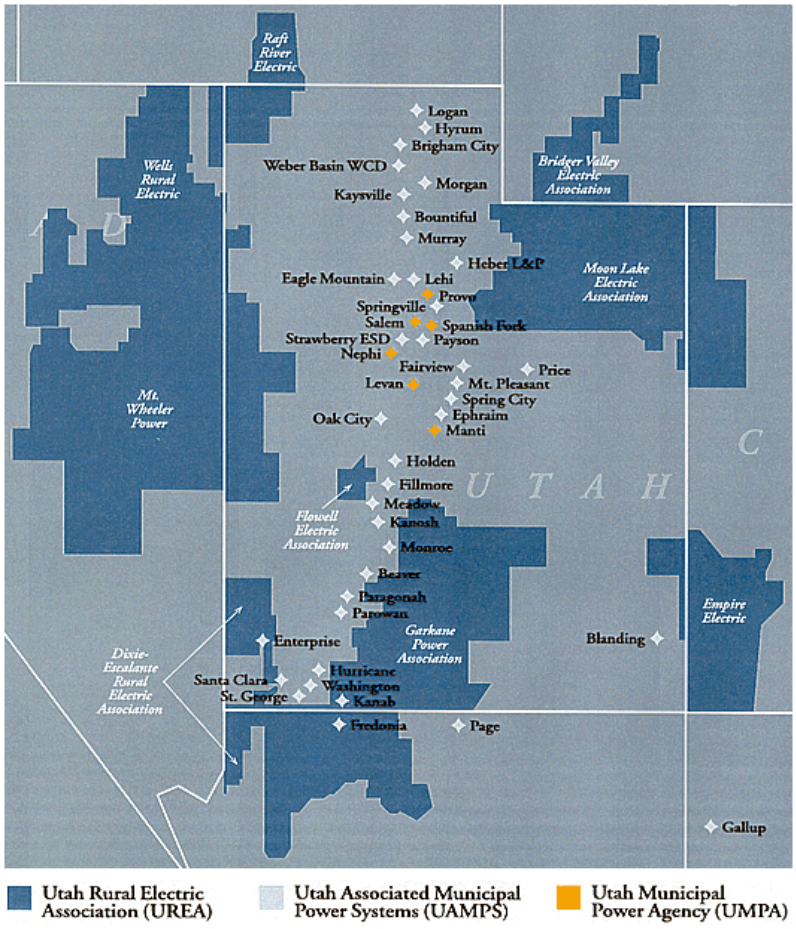


Figure 3: https://dpu.utah.gov/map.html

G.1.1 Rocky Mountain Power (RMP)

Rocky Mountain Power is Utah's largest electrical energy supplier. Besides its direct customers, RMP also provides energy to other ESPs around the western US.

"Rocky Mountain Power, a division of PacifiCorp, is an energy company based in Salt Lake City, Utah. The business efficiently delivers reliable, affordable, safe and environmentally responsible energy to more than 1.1 million customers in Utah, Wyoming and Idaho. The company supplies customers with electricity from a diverse portfolio of generating plants including hydroelectric, natural gas, coal, wind, geothermal and solar resources."

In the interest of interstate connectivity, and the potential to create EVSE partnerships outside the State of Utah that benefit the citizens of Utah, the service map of Rocky Mountain Power to all surrounding areas is provided.

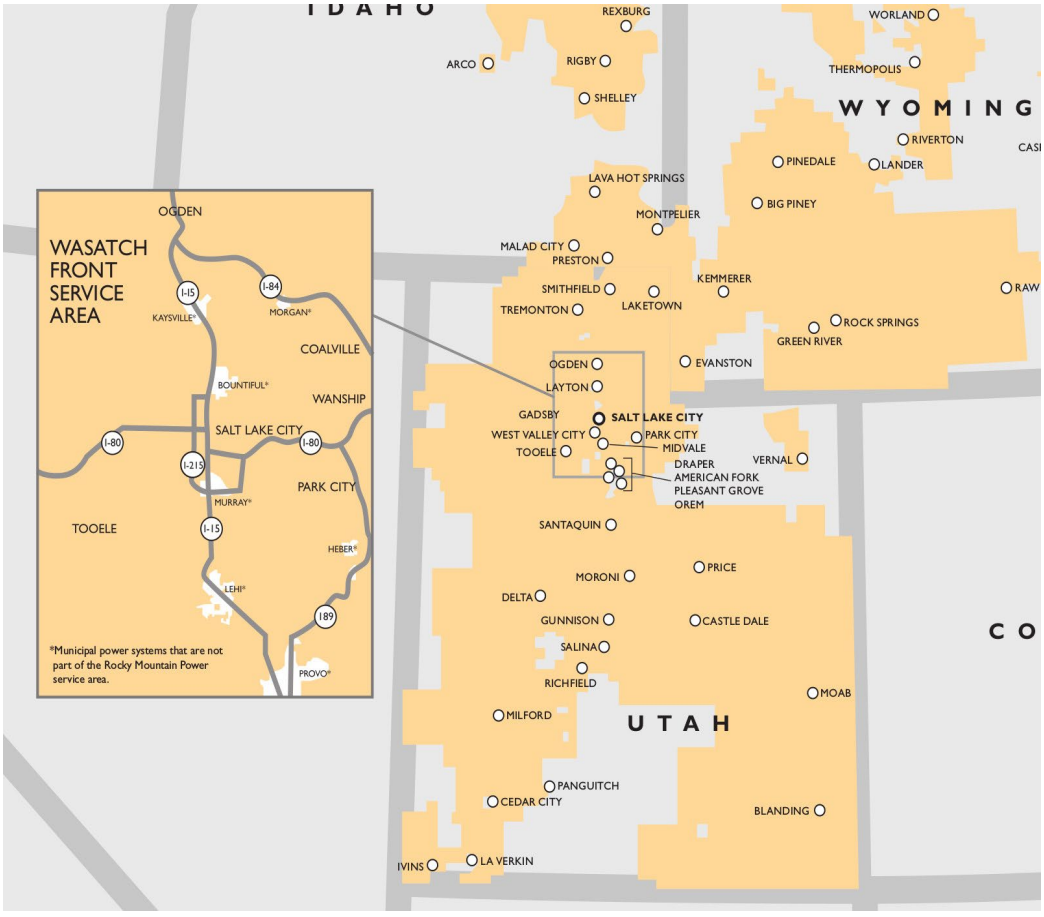


Figure 4: Rocky Mountain Service Area Map. Source: "Service Area Map." Glossary of Electrical Terms, www.rockymountainpower.net/about/cf/sam.html.

G.1.2 Utah Associated Municipal Power Systems (UAMPS):

UAMPS is an organization that represents multiple municipal entities and utility service districts in the intermountain west. According to its website:

"*Utah Associated Municipal Power Systems (UAMPS) is a political subdivision of the State of Utah that provides comprehensive wholesale electric-energy, transmission, and other energy services, on a nonprofit basis, to community-owned power systems throughout the Intermountain West. UAMPS members are located in Utah, California, Idaho, Nevada, New Mexico and Wyoming.*"

G.1.3 Utah Rural Electric Cooperative Association (URECA):

URECA includes eleven (11) electric cooperatives that operate and provide power around the state of Utah and adjoining states. Some members include Wells Rural Electric Coop, Garkane Energy, Empire Electric, etc. According to its website:

"URECA exists to provide leadership, advocacy and support to unify and empower Utah's consumer-owned electric co-ops."

G.1.4 Utah Municipal Power Agency (UMPA):

UMPA is an organization that represents the electrical services of the municipalities of Levan, Manti, Nephi, Provo, Salem, and Spanish Fork. According to its website:

"To develop a reliable and economical power supply program to meet the electric power and energy needs as required by the members and their customers."

Appendix H: Report Terminology/Definitions

H.1: Transportation and Traffic

Mile Post (MP):

Mile Posts are a roadside marker indicating the linear location along a given corridor. Highway mile posts start with zero (0) at the southern or western state border and increase heading north or east respectively. Mile Posts are also used to identify highway exits and other signage along corridors.

Annual Average Daily Traffic (AADT):

AADT is a measure used primarily in transportation planning and transportation engineering. Traditionally, it is the total volume of vehicle traffic of highway or road for a year divided by 365 days. AADT is a simple, but useful, measurement of how busy the road is.

Vehicle Miles Traveled (VMT):

A measure of the amount of travel for all vehicles in a geographic region over a given period of time, typically a one-year period. It is calculated as the sum of the number of miles traveled by each vehicle. VMT provides a measure of total travel, how travel changes over time, and differences in travel among regions and states. It can be used as a measure of personal and commercial vehicle demand. While not the sole measure of travel demand, VMT can help identify the regions that are traveled more frequently and contribute to producing more traffic congestion.

Peak Hour Volume:

The volume of traffic that uses the approach, lane, or group of lanes in question, during the hour of the day that observes the highest traffic volumes. This may be a useful measure in helping estimate EVSE demand during peak travel periods.

Queue:

Queue is the number of vehicles being delayed due to demand exceeding capacity of a design feature. This could be at stop lights, on-ramps, or in this case of this report, waiting for access to EVSE.

H.2: Vehicle Terminology

Light Duty Vehicle (LDV):

Light Duty Vehicles are defined by the US-EPA as vehicles with a maximum gross vehicle weight rating (GVWR) of less than 8,500 lbs. This accounts for most typical passenger vehicles/cars.

Vehicle Drive Systems:

- ***Internal Combustion Engine (ICE)***, a vehicle that burns fuel to drive a piston or rotary type engine.
- ***Hybrid Electric Vehicle (HEV)***, a vehicle that is powered by an internal combustion engine in combination with one or more electric motors that use energy stored in batteries.
- ***Plug-In Hybrid Electric Vehicle (PHEV)***, a hybrid electric vehicle that has the additional ability to charge the battery through charging equipment (EVSE).
- ***Electric Vehicle (EV)***, a vehicle that uses a battery pack to store electrical energy that powers an electric motor. EVs are charged using charging equipment (EVSE).
- ***Fuel Cell Electric Vehicle (FCEV)***, a vehicle that use stored hydrogen to generate electricity, via a fuel cell, to drive one or more electric motors.
- ***Alternative Fuel Vehicle (AFV),*** a vehicle that operates on substances other than traditional/conventional petroleum gas and diesel.
- ***Zero-Emissions Vehicle (ZEV)***, a vehicle that never emits exhaust gas from the onboard source of power.

EV Charging Equipment:

- ***AC and DC Power***, Alternating Current (AC) is a type of electrical current in which the direction of the flow of electrons switches back and forth at regular intervals or cycles. Direct Current (DC) is electrical current in which electrons only flow one way. Energy storage is DC power and is measured in Kilowatt-Hours (kWh).
- ***Electric Vehicle Supply Equipment (EVSE)***, electric vehicle supply equipment also called, electric vehicle charging station, EV charging station, electric recharging point, charging point, charge point, electronic charging station (ECS), is an element in an infrastructure that supplies electric energy for the recharging of plug-in electric vehicles—including electric cars, neighborhood electric vehicles and plug-in hybrids. EVSE is the electrical and EV trade terminology for EV chargers. EVSE is defined in Article 625 of the National Electric Code (NEC).
- ***Level I Charging***, low powered EVSE that operates on 120 Volt Alternating Current. Level I chargers use the vehicles onboard charger to convert the AC to DC power stored by the battery.
- ***Level II Charging***, mid-tier EVSE that is typically found at work, fleet, home or other long term parking locations. Level II chargers operate on either 240V (typically residential) or 208V (typically businesses, offices) power sources. The vehicles onboard charger converts the AC to DC power stored by the battery.
- ***Level III, Direct Current Fast Charger (DCFC)***, EVSE that is powered by high voltage sources that convert AC power to DC power in the unit and send energy directly to the vehicle battery.

  - *Fast DC* chargers typically have a power output range of up to 150kW.
  - Ultra Fast DC chargers have power output of over 150kW and currently up to 350kw.
  - The vehicle battery chemistry is the limiting factor.
  - Batteries are typically designed to accept their full design charging power up to approximately 80% state of charge, then taper the charging power for the final 20%.
  - Often, EV owners will fast charge to 80% at public chargers to speed mobility and then provide a full charge at home or work Level II chargers.
- ***Battery Exchange Station****,* a fully automated facility that will enable an electric vehicle with a swappable battery to enter a drive lane and exchange the depleted battery with a fully charged battery through a fully automated process.

- ***EVSE Connector Types:***
  - ***Combined Charge System (CCS1)***, One of two current United States plug standards for fast DC.
  - ***CHAdeMO***, an EVSE plug type, typically found on some Asian brands of vehicles such as older Nissan Leaf, Mitsubishi, etc. The industry is moving away from this standard and towards the CCS1 plugs. (Note: European Union has standardized on the CCS2 since 2017, as a result, new Tesla vehicles sold in Europe are designed with the CCS2).
  - ***J-1772****,* also known as a J-Plug, is a type of connector that is present on all models of EVs. This connector is the standard for level I/II charging.
- ***Grid-to-vehicle (G2V),*** Grid-to-vehicle-technology enables vehicles to charge at varying capacities, depending on energy availability. Electric vehicle batteries can be charged in a smart way to prevent peak loads on the grid. This can be based on energy demand and available capacity on a local level. The vehicle to grid technology determines when, and at which capacity, the vehicle will be charged.
- ***Vehicle-to-grid (V2G),*** Vehicle-to-grid-technology enables vehicles to feed electricity back into the grid. The battery in the vehicle can be used as a buffer to store energy in times of high (sustainable) energy production, but also to act as an energy supplier in times of low (sustainable) energy production. Vehicle-to-grid technology contributes to optimizing sustainable energy usage.

H.3: Miscellaneous:

- ***Public Private Partnership (PPP)***, Public-Private Partnerships involve collaboration between a government agency and a private-sector company that can be used to finance, construct, and operate projects, such as public transportation projects and services.
- ***Request for Information (RFI)***, a common business process whose purpose is to collect written information about the capabilities of various suppliers. Normally RFIs are structured to allow for side-by-side comparisons to help evaluate offerings. RFIs are a useful tool to

gather an overview of the current state of practice in each field or service. This information is often tabulated, evaluated, and used as a reference when developing any subsequent Request for Proposal(s).

- ***Request for Proposals (RFP)***, is a business document that announces a project, describes it, and solicits bids from qualified contractors to complete it.

Appendix J: Useful Links

In addition to resources found in the State of Utah EV Master Plan V2.0, the below links are some of the current links used as references during the development of this report. It is important to recognize that the EV and EVSE industries are continually evolving, and additional web searches should be used to identify the latest information available.

Utah Links:

Utah EV Master Plan, V2.0:

- https://das.utah.gov/wp-content/uploads/State-of-Utah-EV-Master-Plan_Version2_FINAL-1.pdf

Utah HB 259 (2020)/Utah Code 72-1-216S

- https://le.utah.gov/xcode/Title72/Chapter1/72-1-S216.html?v=C72-1-S216_2021050520210701

Utah HB 396 (2020)/Utah Code 54-4-41

- https://le.utah.gov/xcode/Title54/Chapter4/54-4-S41.html?v=C54-4-S41_2021050520210701

Utah DAQ Workplace Grant

- https://deq.utah.gov/air-quality/workplace-electric-vehicle-charging-funding-assistance-program

Rocky Mountain Power EVSE Grant

- https://www.rockymountainpower.net/savings-energy-choices/electric-vehicles/utah-incentives.html

REV-West

- https://www.naseo.org/issues/transportation/rev-west

EVSE Codes Resources:

Southwest Energy Efficiency Project

- https://www.swenergy.org/transportation/electric-vehicles/building-codes

Salt Lake City Off Street Parking

- https://www.slc.gov/planning/wp-content/uploads/sites/13/2019/05/Parking-Chapter-Final-Draft.pdf

EV and EVSE Links:

Plug Share (Crowd sourced EVSE locator)

- https://www.plugshare.com/

US Department of Energy, Alternative Fuels Data Center

- https://afdc.energy.gov/

Advanced Clean Technology-News

- https://www.act-news.com/