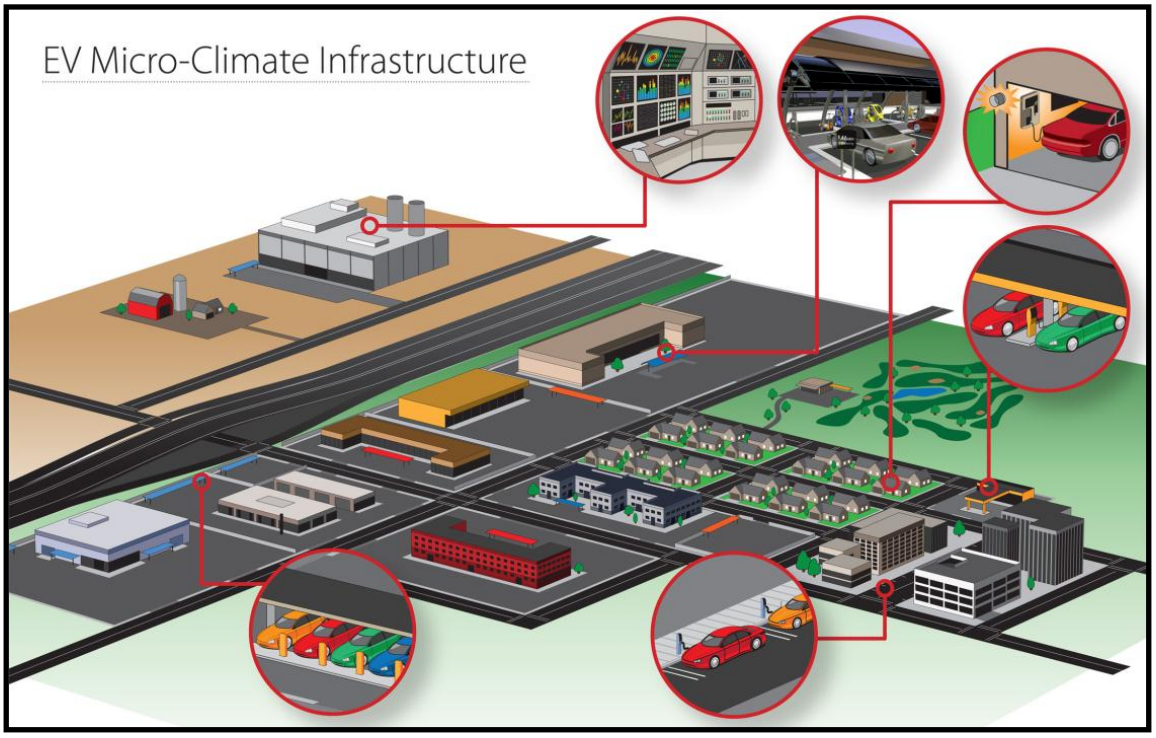
EV Micro-Climate™ Plan

for

Arizona



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NORTH AMERICA

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Acronym List

AC	Alternating Current
ADA	Americans with Disabilities Act
APS	Arizona Public Service
ASU	Arizona State University
DC	Direct Current
DCFC	Direct Current Fast Charger
DOT	Department of Transportation
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
HEV	Hybrid Electric Vehicle
INL	Idaho National Laboratory
MAG	Maricopa Association of Governments
MSA	Metropolitan Statistical Area
NHTS	National Household Travel Survey
OEM	Original Equipment Manufacturer
PAG	Pinal Association of Governments
PEV	Plug-in Electric Vehicle
SRP	Salt River Project
TEP	Tucson Electric Power
UA	University of Arizona
U.S.	United States

1 Introduction

The purpose of this Electric Vehicle (EV) Micro-Climate document is to record the process used by The EV Project for distributing, locating, and selecting electric vehicle supply equipment (EVSE) sites. The input to this document is the work of the Arizona Electric Vehicle Long Range Plan. An important output of this document is a series of maps to identify geographic locations for the publicly available alternating current (AC) Level 2 EVSE and direct current (DC) Fast Charge equipment. This output will be used to find specific EVSE hosts leading to contracts and EVSE installations.

Input was solicited from the Phoenix and Tucson advisory groups and the general public for ideas on EVSE locations. Early adopters and innovator demographics will also guide the process.

This document also provides a deliverable as required by the Department of Energy (DOE) contract for the EV Project and is a standard offering as part of ECOtality North America's (ECOtality) Micro-Climate planning process. In addition, the purpose of the Micro-Climate Plan is to detail the process for and outline the continued importance of stakeholder engagement in the design and development process of The EV Project, the largest deployment of electric vehicles and electric vehicle infrastructure in the history of the United States of America (U.S.).

The State of Arizona is one of seven states to experience the electrification of the transportation industry through the DOE Vehicle Demonstration and Vehicle Infrastructure Evaluation (DE-FOA-0000028). Through a highly collaborative and interactive approach including policy makers, utilities, local and state government, grass roots organizations, the DOE, major employers, charge operators and leaders of industry, ECOtality implements the EV Micro-Climate in The EV Project to successfully deploy EV infrastructure for the purpose of creating a Lessons Learned report about EVs and EV charging infrastructure.

The ECOtality EV Micro-Climate™ is a process by which custom electric vehicle infrastructure results from the implementation of a standard process: a truly rich, highly functional and scalable EV charging infrastructure and growth strategy. This process involves a series of documents created together with a key stakeholder group that together comprise the framework from which the infrastructure develops. Continued stakeholder engagement ensures that the projects goals and objectives are met and provides opportunity to discuss the advantages and challenges of using electricity as a fuel for our vehicles.

The EV Micro-Climate™ program is an integrated turn-key program that advances select areas for the adoption of electric transportation. Beginning with extensive feasibility and infrastructure planning studies, the program provides a blueprint for a comprehensive EV infrastructure system and provides detailed action plans for its successful execution and continued maintenance.

1.1 Deployment Guidelines

The Electric Vehicle Infrastructure Deployment Guidelines document was prepared by ECOtality for review and comment by the local advisory committee and published in May 2010. This document provides the foundation for the installation of publicly available EVSE. It developed a common language in discussing topics related to EVs and provided the platform for discussions on several important local decision points. Some of these topics included accessibility for disabled persons, permitting, signage, codes and standards, utility concerns and so forth. These topics are required to have a wide dissemination in order to smooth the processes for EVSE location decisions and to streamline the installation process. The Phoenix and Tucson EV Infrastructure Deployment Guidelines have become a public document to which any additional stakeholders and enthusiasts can refer to understand the local deployment of electric vehicles and charging stations.

1.2 Long Range Plan

The next step in the planning process was the development of the long range plan for infrastructure deployment. The Long Range EV Infrastructure Plan for Arizona was completed in October 2010. While some EVSE suppliers are simply trying to “sell” EVSEs to local retailers, they are doing so without looking at the total need and local requirements to determine if that location truly makes sense as part of a complete system. ECOtality prepared a draft of this long range plan for distribution to the local stakeholders for review and consideration. This draft considers local demographics, traffic patterns, likely initial EV buyers, etc. to provide context for the project.

The long range plan reviews the projected EV adoption rates, as well as the necessary quantities and locations of charging systems to provide a “rich” infrastructure environment. For plug-in electric vehicles (PEVs) to succeed, the infrastructure provided must give consumers a sense of comfort, convenience and reliability. Unless a rich charge infrastructure is in place prior to vehicle launch, PEV owners will not be able to travel comfortably without experiencing "range anxiety", that they will run out of energy before being able to charge. To avoid this anxiety, a charge infrastructure must be established that allows EV owners to charge where they live, where they work, where they shop and where they are entertained. This infrastructure must be sufficiently dense to ensure that EV owners can charge conveniently. In areas where the automotive suppliers provide DC Fast-Charge (DCFC) inlets on their vehicles, this infrastructure must also include fast-charge stations, which can recharge about half the EV’s battery in approximately 30 minutes, to make recharging at commercial locations simple and efficient. Such a rich charge infrastructure is critical to successful market penetration of EVs.

In essence, the Long Range Plan develops EVSE infrastructure density maps, which should predict the expected deployment that would be viewed from the year 2020. This Micro-Climate Plan is intended to develop the first two to three years of this Long Range Plan.

2 Two-Year Planning Horizon

Planning the deployment of public EVSE starts with the projection of the need for infrastructure based upon the projections of adoption of PEVs in general. The nationwide penetrations of EVs and EVSE assist in providing projections of EVs and EVSE deployment in Arizona. The early market launch of EVs into Arizona will create an informed public and enhance the public awareness of EVs. The infrastructure provided by The EV Project will also create more public awareness and interest. Local promotional materials, incentives, and press releases encouraged by the original equipment manufacturers (OEMs) and The EV Project also will increase vehicle penetration.

National figures are used as the basis for Arizona, with local population behavior taken into consideration. The factor is increased based upon increased enthusiasm and awareness resulting from OEM and The EV Project marketing. These figures are identified later in this section.

2.1 EV Sales Projections

The Phoenix and Tucson areas are one of the initial market areas for major production EVs in 2011. The Nissan Leaf is being introduced into this market. Other OEMs will follow as well. The political will and public enthusiasm are driving the interest and motivation to draw the EVs into public acceptance. This will place the Arizona area on a faster path to EV adoption. The projections of EV deployment were identified in the Long Range Plan.

These factors can be applied to EV sales projections in Arizona to show the following projections by metropolitan statistical area (MSA).

Table 2-1 Annual EV Sales Projections for Arizona

Annual Sales	Phoenix MSA	Tucson MSA	Flagstaff MSA	Prescott MSA	Total
2011	1,880	440	0	0	2,320
2012	1,860	430	60	100	2,450
2013	2,340	540	70	120	3,070
2014	3,770	870	120	190	4,950

Table 2-1 Annual EV Sales Projections for Arizona (Continued)

Annual Sales	Phoenix MSA	Tucson MSA	Flagstaff MSA	Prescott MSA	Total
2015	6,340	1,470	190	320	8,320
2016	9,200	2,130	280	470	12,080
2017	13,310	3,080	410	680	17,480
2018	17,880	4,140	540	910	23,470
2019	23,800	5,510	730	1,210	31,250
2020	30,260	7,000	920	1,540	39,720

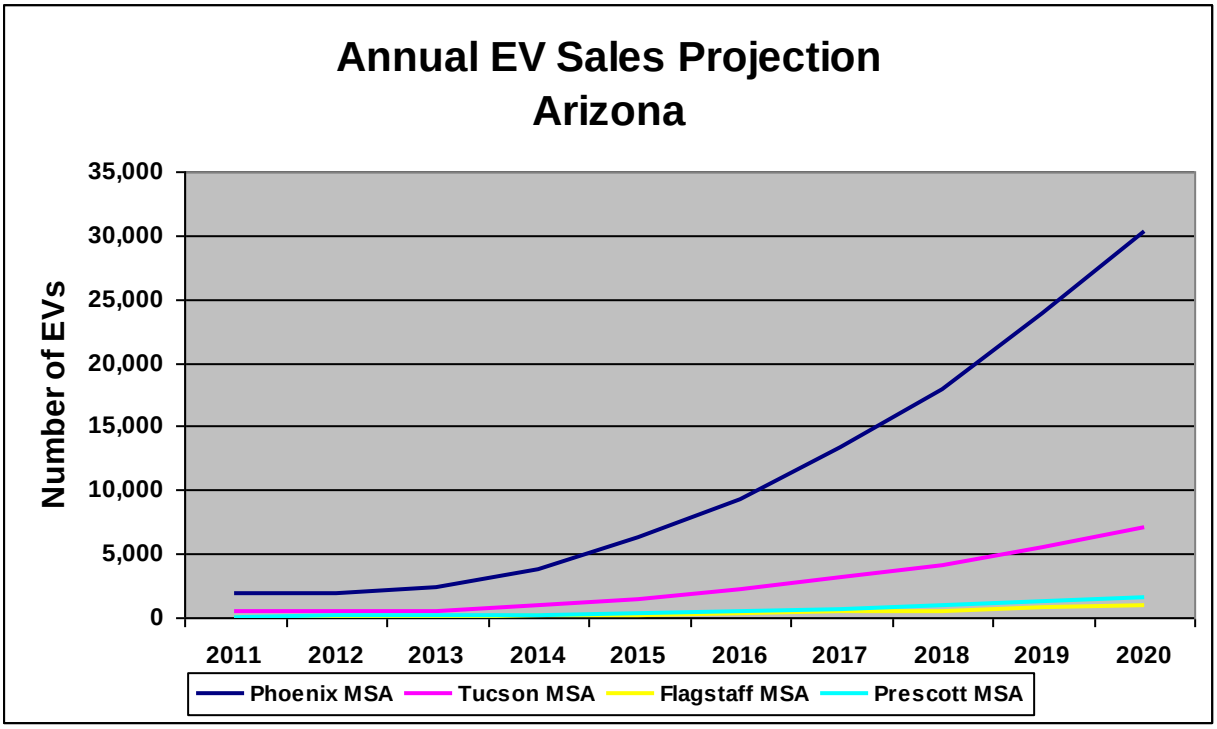


Figure 2-1 Annual EV Sales Projections for Arizona

Table 2-2 Cumulative EV Sales Projections for Arizona

Cum. Sales	Phoenix MSA	Tucson MSA	Flagstaff MSA	Prescott MSA	Total
2011	1,870	440	0	0	2,310
2012	3,730	870	60	100	4,760
2013	6,070	1,410	130	210	7,820
2014	9,840	2,280	240	400	12,760
2015	16,180	3,750	440	730	21,100
2016	25,370	5,880	720	1,200	33,170
2017	38,690	8,960	1,120	1,870	50,640
2018	56,570	13,100	1,670	2,780	74,120
2019	80,380	18,610	2,390	3,990	105,370
2020	110,630	25,610	3,320	5,530	145,090

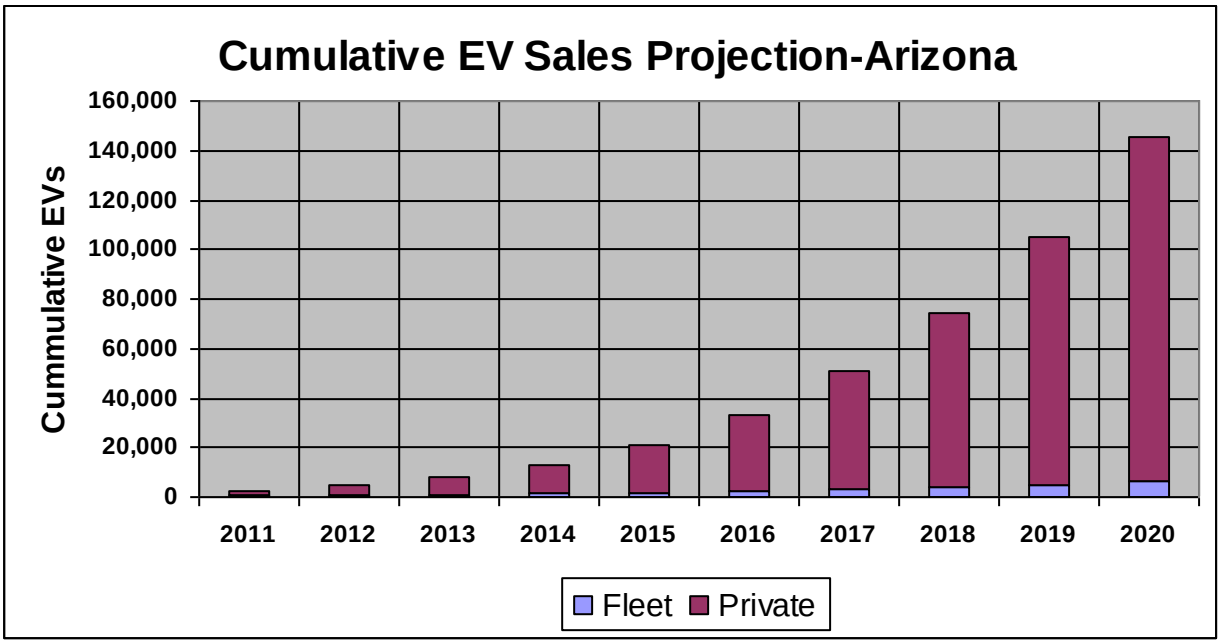


Figure 2-2 Cumulative EV Sales Projections for Arizona

2.2 EVSE Sales Projection

EVSE deployment precedes EV deployment to provide the rich infrastructure desired. The number of EVSE is calculated, as before, to provide the following tables.

Table 2-3 Annual EVSE Projections for Arizona

Annual Sales	Phoenix MSA	Tucson MSA	Flagstaff MSA	Prescott MSA	Total
2011	5,610	1,320	0	0	6,930
2012	5,300	1,230	160	270	6,960
2013	6,010	1,390	180	310	7,890
2014	8,460	1,960	260	430	11,110

Table 2-3 Annual EVSE Projections for Arizona (Continued)

Annual Sales	Phoenix MSA	Tucson MSA	Flagstaff MSA	Prescott MSA	Total
2015	12,920	2,990	390	660	16,960
2016	16,780	3,880	510	850	22,020
2017	22,680	5,250	690	1,150	29,770
2018	28,500	6,600	870	1,450	37,420
2019	36,330	8,410	1,110	1,850	47,770
2020	45,110	10,440	1,380	2,300	59,230

Table 2-4 Cumulative EVSE Projections for Arizona

Cum. Sales	Phoenix MSA	Tucson MSA	Flagstaff MSA	Prescott MSA	Total
2011	5,610	1,320	0	0	6,930
2012	10,910	2,540	160	270	13,880
2013	16,920	3,940	340	580	21,780
2014	25,380	5,890	600	1,010	32,880
2015	38,300	8,880	1,000	1,660	49,840
2016	55,080	12,770	1,510	2,520	71,880

Table 2-4 Cumulative EVSE Projections for Arizona (Continued)

Cum. Sales	Phoenix MSA	Tucson MSA	Flagstaff MSA	Prescott MSA	Total
2017	77,760	18,010	2,200	3,670	101,640
2018	106,260	24,610	3,070	5,120	139,060
2019	142,590	33,020	4,180	6,970	186,760
2020	187,700	43,450	5,550	9,260	245,960

For each of the metropolitan areas, the individual categories of Level 2 EVSE are as follows:

Table 2-5 Phoenix MSA Projections

Year	Fleet	Residential	Publicly Available	Total Year
2011	250	1,200	4,160	5,610
2012	140	1,270	3,890	5,300
2013	110	1,710	4,290	6,010
2014	160	2,470	5,830	8,460
2015	240	4,010	8,670	12,920
2016	280	5,530	10,970	16,780
2017	380	7,640	14,650	22,670

Table 2-5 Phoenix MSA Projections (Continued)

Year	Fleet	Residential	Publicly Available	Total Year
2018	450	9,810	18,240	28,500
2019	610	12,360	23,360	36,330
2020	700	14,610	29,800	45,110

Table 2-6 Tucson MSA Projections

Year	Fleet	Residential	Publicly Available	Total Year
2011	60	280	980	1,320
2012	30	300	900	1,230
2013	20	370	990	1,380
2014	40	570	1,350	1,960
2015	60	930	2,010	3,000
2016	70	1,280	2,540	3,890
2017	90	1,770	3,390	5,250
2018	100	2,270	4,220	6,590
2019	140	2,860	5,400	8,400
2020	160	3,380	6,900	10,440

3 EV Micro-Climate Plan

With the Long Range Plan as a guide, the planning for the first two to three years of that plan commences.

As before, this planning phase encourages a very interactive relationship with all stakeholders. The Advisory groups previously established in Phoenix and Tucson were once again called upon to assist in the crafting of this EV Micro-Climate plan. These groups have assured that there is maximum information sharing and exchange to their various public and private sector organizations, the various project documents, research material, and project presentations. Their schedules are made available to the group for maximum stakeholder input. The result of the EV Micro Climate Process is a truly rich, highly functional and customized electric vehicle charging infrastructure.

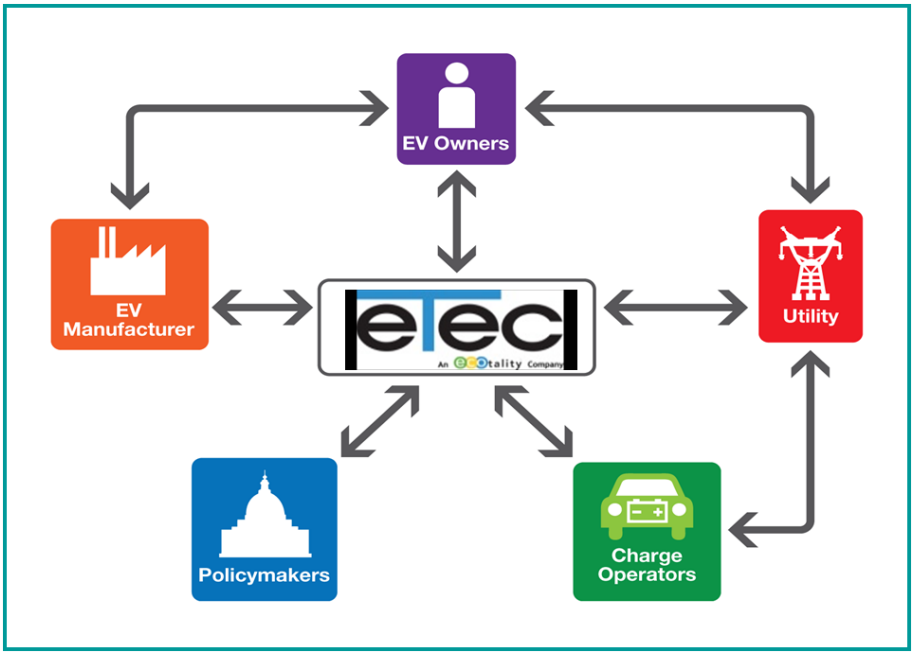


Figure 3-1 EV Micro-Climate Stakeholder Involvement

The Phoenix and Tucson Advisory teams included:

a. Local, county, and state government representatives
b. Electric utilities representative
c. Building code permitting and inspections personnel from key cities
d. EV clubs and organizations
e. Homebuilders
f. Building, Condominium Owners
g. Electrical Contractors / Building Engineering Firms
h. Local planners
i. Retail owners
j. Parking lot owners and developers
k. Fleet manager
l. Colleges and Universities
m. Automotive dealers
n. Owners of first generation EVSE

3.1 Micro-Climate Plan Elements

3.1.1 Stakeholder Organization

The Advisory Teams were also instrumental in the gathering of potential EVSE host sites, as well as orchestrating invitations to speak at public events, individual groups and as panel members. These groups were involved in various areas, such as alternative fuels, sustainable transportation, the private sector and those interested in EVs and EV charging. In addition, Public Forums were held in Phoenix and Tucson to educate the public about The EV Project, as well as to inquire about EVSE host sites.

An additional function of the Advisory Teams is to actively engage in The EV Project for the purposes of understanding the impacts of wide spread EV adoption. These members individually, and as member organizations, work together to coordinate events of The EV Project, work through challenges that arise, and to collaboratively create a custom EV charging infrastructure for the specific needs of the local area.

3.1.2 Permitting, Inspection and Standards

The installation of an EVSE requires permitting and inspection from the local permitting and inspection office. The Area Manager, along with Field Services visited with each City and Town in the Phoenix and Tucson EV Project areas to discuss permitting, inspection, and standards with the goal of creating a streamlined permitting and inspection process for The EV Project. The Cities of Phoenix and Tucson, as well as the other EV Project municipalities, were instrumental in working to use their best practices for wide spread EV deployment and keep current on EV charging equipment and installation standards. These Cities and Towns have a strong interest in understanding how to ensure that the permitting and inspection processes can provide for a standardized and streamlined process.

In addition, Stakeholder Services and Field Services met with representatives from each City and Town to discuss important issues such as signage, lighting and shelter, Americans with Disabilities Act (ADA) accessibility and safety issues.

3.1.3 Utility Considerations

The use of electricity as a fuel requires the understanding and analysis of generation and electric grid impacts. Arizona Public Service (APS), SRP (Salt River Project), and Tucson Electric Power (TEP) will jointly work toward collecting the relevant industry, technology and policy developments for the utility considerations and provide for the methodology for information dissemination to the utilities involved within the Arizona market. They will also keep the utility industry abreast of developments in The EV Project and in the EV and EVSE industry.

3.1.4 Siting

The Phoenix and Tucson Advisory, as well as other stakeholder groups, were instrumental in the suggested siting of the EV charging stations. The goal was to establish diversity in charging locations by understanding driver expected interest in recharge venues for their EV using AC Level 2 Charging Stations. The metro Phoenix and Tucson areas are expected to have a significant number of Level 2 Charging Stations and the following destinations will be targeted within The EV Project.

Table 3-1 Siting Locations

Airports
Community Center/Parks
Convention Centers
Schools/Universities
Educational
Grocers
Golf Courses
Libraries
Malls
Medical/Hospital
Parking/Park & Rides
Sports Venues
Restaurants
Retail
Theaters/Museums/Arts

These targets will be satisfied through the combined efforts of ECOtality National Accounts and the local efforts of stakeholders, Stakeholder Services Area Manager, and Sales Specialists. Within the 25 mile radius from city center boundaries for the blanketing of EV charging infrastructure, 10 mile radii are drawn where a diversity of choice by charging location will be sought. Offering a choice as to location at which an EV owner will be able to charge, will provide important information for the planning and development of the growth of the EV infrastructure.

3.1.5 Media and Educational Outreach

Many fine organizations in the Phoenix and Tucson metro areas have assisted in educating the stakeholders and spreading the word about The EV Project. These organizations include Maricopa Association of Governments (MAG), Pima Association of Governments (PAG), Phoenix and Tucson Clean Cities, and the Departments of Economic Development for each EV Project area city and town. In addition, organizations like APS, SRP and TEP, as well as Valley Forward, Arizona State University (ASU) Global Institute of Sustainability, University of Arizona (UA) Parking and Transit, Building Owners and Managers Association International, etc. have been instrumental in hosting meetings, presentations and workshops for The EV Project.

Ribbon cuttings and grand openings will occur at each city and town location for the first EVSE to be installed.

The draft of the local plan was prepared by the Arizona Area Manager. It relied as much as possible on EV OEM sales plans, local demographics, local geographic features, local attractions, etc. It identified charger densities in terms of number of chargers per square mile, but does not identify specific retail locations. Implementation of the Micro-Climate Plan will solicit the charging site hosts to install the EVSE. The draft plan was delivered to the Advisory Group for refinement by the local stakeholders. By intimate knowledge of the local area, the local stakeholders refined the plan by identifying or moving EVSE concentrations.

Contributions by the Stakeholder Services team included:

a. Potential EV penetration rates by major region and anticipated vehicle rollout schedules through 2020;
b. EVSE penetration rates to support the rich *EV Micro-Climate* concept;
c. Initial input of local population demographics to determine the general market conditions;
d. Projections on residential adoption of Level 2 EVSEs;
e. Projections on fleet adoption of Level 2 and DC Fast Charging EVSEs;
f. Initial review of local destination or “purposeful trip” locations as input to the infrastructure plan;
g. Geographic coverage of the market and municipal areas for Level 2 and DCFC EVSEs;
h. Cost estimates for implementation of infrastructure plans.

This plan engages all the municipalities in the region so that they may be included in the initial deployment plan. This will give all stakeholders the opportunity to participate in the planning and provide their feedback on the infrastructure planning. It also gives the local stakeholders a plan by which the initial infrastructure can be increased through additional funding resources or additional commercial EVSE purchases. It also assists those retail companies who are installing EVSEs as part of The EV Project to see how their investment in additional equipment could be beneficial.

The local stakeholders provided specific information to the draft provided. Areas of input included:

a. Refined demographics of plug-in vehicle owners;
b. Likely driving habits, including daily traffic patterns, parking for work, shopping, other;
c. Percentage of homes with garage parking, street parking or other as input to the plan;
d. Inventory of existing or previous generation public charge stations throughout the area;
e. Possible sources of grant funding for EVSE infrastructure deployment;
f. Sources of grants for existing EV conversion car owners to obtain J1772 inlets;
g. Utility and analyst determination of the status of electrical supply grid capabilities;
h. Draft legislation to encourage EV ownership, including new home circuit requirements, etc.

3.2 Data and Analysis for Micro-Climate Planning

3.2.1 Zoning

The cities of Phoenix and Tucson metro areas are the core project cities. In determining the area of coverage for EV charging infrastructure, the Advisory Teams considered: the zip codes of those eligible for The EV Project vehicle participation, the anticipated demographics of EV purchasers, major employer locations, topography, population, commuting patterns, and Nissan LEAF Hand Raiser data.

3.2.2 Employment Data

Major employment centers are of interest because they represent a significant destination for EV drivers. They may be an important location for employer or workplace EVSE but being a destination, EV drivers will likely stop at other destinations between these work centers and their homes. The greatest densities of businesses are in the three zip codes below. The State of Arizona Department of Economic and Community Development, as well as each city/town, supplied information on the location of the top 100 employers statewide. These entities affect traffic patterns and commuter behavior. Their location was considered for the deployment of charging infrastructure in the understanding about where potential EV owners might travel.

The population density, topography, local and statewide traffic patterns are evaluated for the proper placement of infrastructure. The Arizona Department of Transportation (DOT) along with the Maricopa and Pima Counties Transportation Departments, MAG, and PAG, has been integral in this ongoing data layer review.

Table 3-2 Major Business Densities

Zip Code	City	Density Businesses/Sq Mi
85003	Phoenix Center South	961
85012	Phoenix Center North	728
85701	Tucson Center South	865

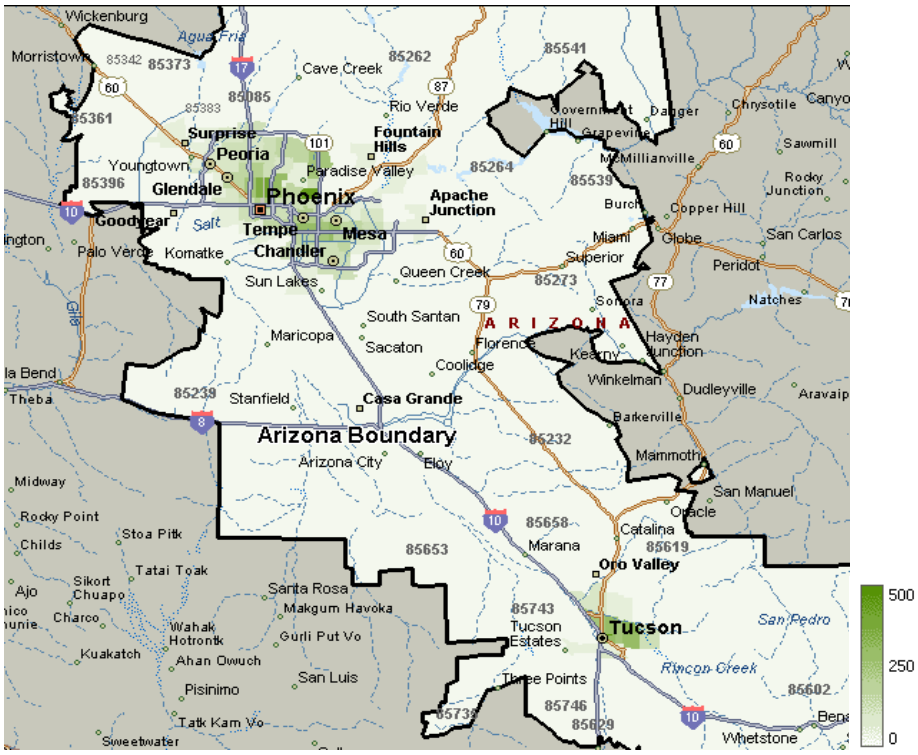


Figure 3-2 Businesses per Square Mile by Zip Code[1]

The metropolitan business density areas of Phoenix and Tucson are shown in Figures 3-3 and 3-4.

[1] ibid

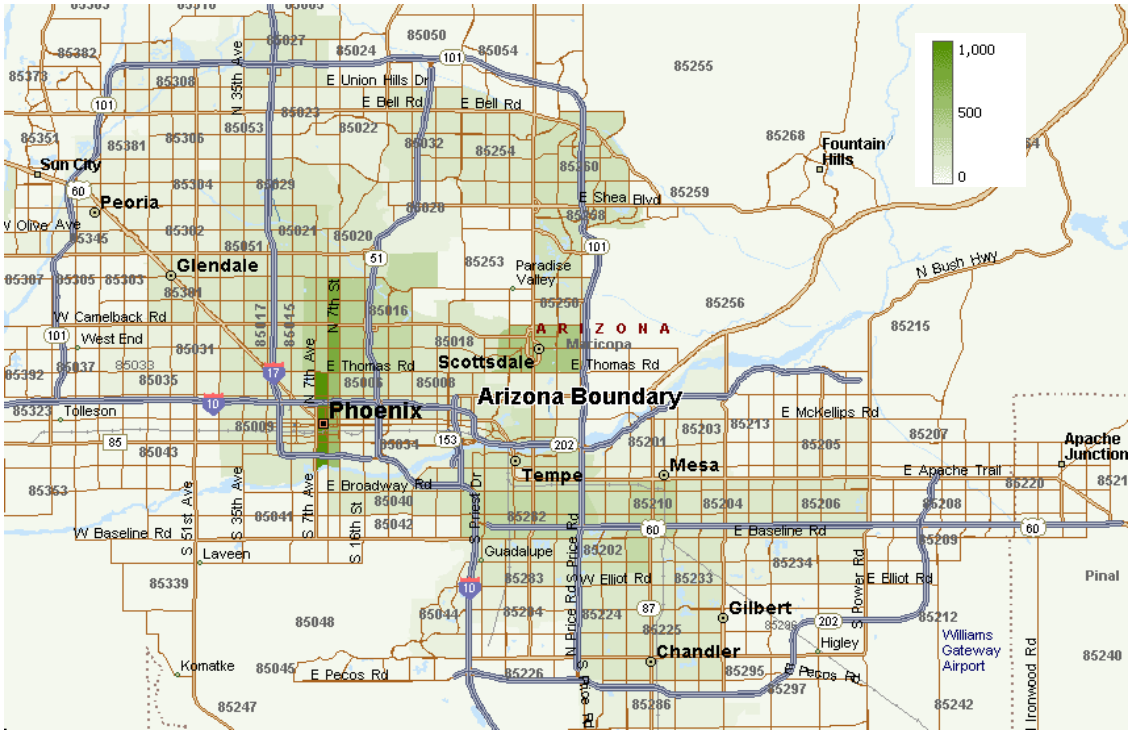


Figure 3-3 Phoenix Major Business Densities

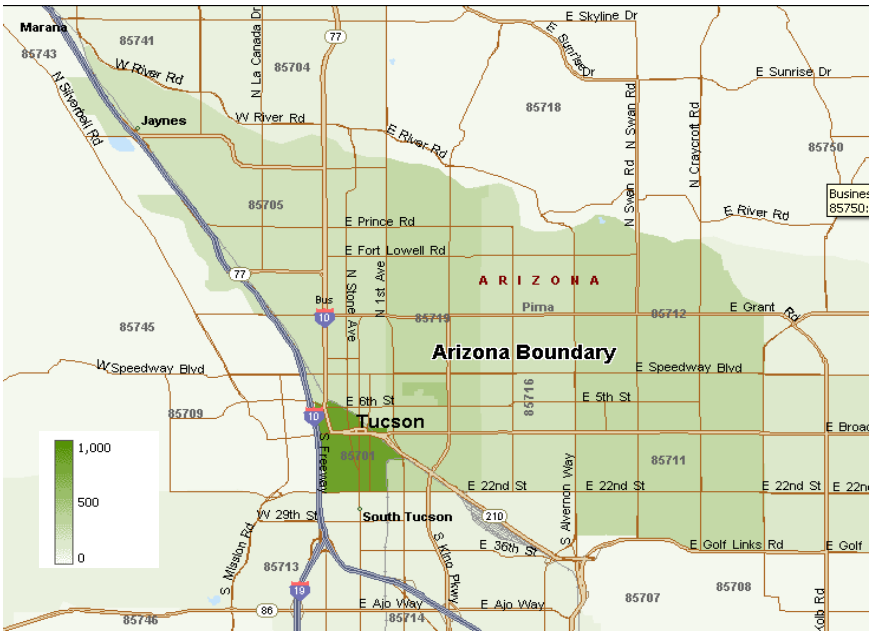


Figure 3-4 Tucson Major Business Densities

3.2.3 Travel Patterns

Figure 3-5 and Tables 3-3 and 3-4, below, shows the average weekday traffic study results. Data was collected in 2002 and 2003. Traffic volumes were derived from MAG, city, county and state traffic recording devices. Most volumes were collected on a typical weekday, such as Tuesday, Wednesday and Thursday. Interestingly, the data collected reflected an increased volume of traffic due to population growth but there was only a slight variation in the busiest intersections and streets from the previous study in 2000.

Figure 3-5 Phoenix's Busiest Intersections and Streets

Table 3-3 Phoenix's Busiest Streets

On-Map	Street	Section of Street	Avg. Daily Traffic	Max Daily Traffic
1- 2	Loop 202 - E/W	SR-51 to I-17	234,000	291,000
3 - 4	I-10 - N/S	Warner Rd. to SR-51	219,000	257,000
5-6	I-10 - E/W	Litchfield Rd. to 7th Ave.	180,000	239,000
7 - 8	Loop 202 - E/W	Loop 101 to SR-51	172,000	179,000
9 - 10	SR-51 - N/S	Cactus to Loop 202	167,000	178,000
11 - 12	Rt. 60 – E/W	Higley to I-10	164,000	210,000
13 - 14	Loop 101 – N/S	Frank Lloyd Wright to McDowell	158,000	184,000
15 - 16	Loop 101- E/W	SR-51 to 75th Ave.	132,000	182,000
17 – 18	Loop 101 – N/S	Beardsley to I-10	128,000	146,000
19 – 20	Loop 202 – E/W	Cooper to I-10	88,000	100,000

Source: MAG

Table 3-4 Phoenix's Busiest Intersections

On Map	Intersection	Date Collected	Average Daily Traffic*
1	Baseline Rd. and I-10	2006	58,000
1	Indian School Rd. and I-17	2006	58,000
2	27th Ave. and Indian School Rd.	2006	55,000
3	Scottsdale Rd. and Shea	2006	54,000
3	24th St. and Baseline Rd.	2006	54,000
4	Olive and 17th Ave.	2006	53,000
5	Scottsdale Rd. and Cactus	2006	50,000
5	Cactus and 35th Ave.	2006	50,000
6	24th St. and Camelback	2006	48,000
7	Indian School Rd. and 24th St.	2006	46,000
8	Camelback and 32nd St.	2006	45,000
9	Priest and Warner	2006	44,000

* Vehicles Entering Intersections
Source: MAG

Figure 3-6 and Tables 3-5 and 3-6, below, shows the 2004 Average Weekday traffic study results. Data was collected in 2002 and 2003. Traffic volumes were derived from PAG, Clean Cities, and city, county and state traffic recording devices. Most volumes were collected on a typical weekday, such as Tuesday, Wednesday and Thursday. Interestingly, the data collected reflected an increased volume of traffic due to population growth, but there was only a slight variation in the busiest intersections and streets from the previous study in 2000.

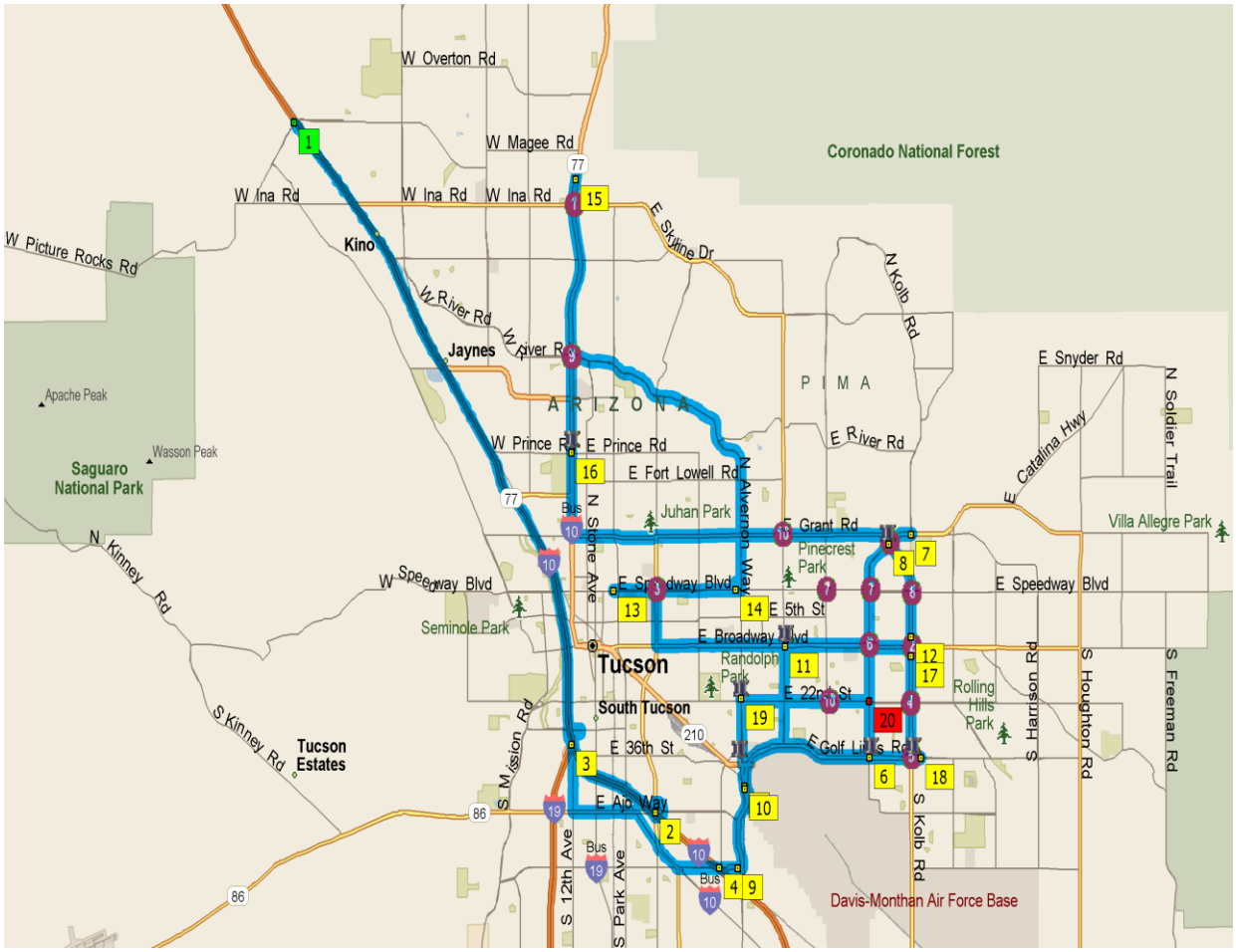


Figure 3-6 Tucson's Busiest Intersections and Streets

Table 3-5 Tucson's Busiest Streets

On-Map	Street	Section of Street	Avg. Daily Traffic	Max Daily Traffic
1 - 2	I-10	Ajo Way to Cortaro Rd.	130,000	169,000
3 - 4	I-19	I-10 to Irvington Rd.	83,000	96,000
5 - 6	Golf Links Rd.	Wilmot Rd. to Alvernon	61,000	75,000
7 - 8	Tanque Verde Rd.	Grant Rd. to Camino Pioneer	56,000	60,000
9 - 10	Alvernon Rd.	Golf Links Rd. to Irvington	55,000	63,000
11 - 12	Broadway Blvd.	Swan Rd. to Kolb Rd.	55,000	55,000
13 - 14	Speedway Blvd.	1st Ave. to Alvernon Way	53,000	56,000
15 - 16	Oracle	Prince Rd. to 1st Ave.	52,000	59,000
17 - 18	Kolb Rd.	Broadway Blvd. to Golf Links	52,000	54,000
19 - 20	22nd St.	Alvernon Way to Wilmot Rd.	52,000	52,000

Source: PAG

Table 3-6 Tucson's Busiest Intersections

On Map	Intersection	Date Collected	Average Daily Traffic*
1	Oracle and Ina	2006	150,000
2	Broadway and Kolb	2006	100,000
3	Speedway and Campbell	2006	98,000
4	22nd and Kolb	2006	96,000
4	Grant/Kolb and Tanque Verde	2006	96,000
5	Golf Links and Kolb	2006	94,000
6	Broadway and Wilmot	2006	92,000
7	Speedway and Craycroft	2006	91,000
7	Speedway and Wilmot	2006	91,000
8	Speedway and Kolb	2006	88,000
9	Oracle and River	2006	87,000
10	22nd and Craycroft	2006	86,000
10	Grant and Swan	2006	86,000

* Vehicles Entering Intersections
Source: PAG

3.2.4 Points of Interest

It was shown in the Long Range Plan that a significant number of trips for personal reasons to various destinations occur every day of the week. These trips can be of substantial length, as well.

A quick review of the major Phoenix metropolitan area (approximate 30 mile radius from Phoenix center) revealed the following destinations, as shown in Table 3-7.

Table 3-7 Phoenix Destinations – 30 Mile Radius

Airports (Major)	1	Airports (Minor)	8	Amusement parks	9
ATMs	1404	Auto services	2230	Banks	828
Bus Stations	8	Campgrounds	67	Casinos	6
Cinemas	30	Community Centers	16	Convention Centers	8
Galleries	96	Gas Stations	761	Golf Courses	216
Grocery Stores	443	Hospitals	60	Libraries	46
Marinas	2	Museums	58	Nightclubs	649
Park & Rides	41	Parking lots	109	Pharmacies	361
Police Stations	35	Post Offices	40	Schools	1035
Shopping	67	Stadiums and arenas	34	Theaters	29
Wineries	1	Restaurants	5277		

There are a total of 13,975 destinations shown above and all are areas where the driver will likely stay for a substantial amount of time. If just two thirds of these destinations installed an EVSE and there were just two EVSEs at these locations by 2020, the total number of ports would be about 18,600. (Note that the Phoenix Level 2 EVSE population shown in Table 2-3 reaches this point in 2018.) Many of these locations will be able to support many more than two EVSEs and the demand will again increase the quantity of EVSEs. These would represent ideal locations for possible Level 2 EVSEs.

A similar review of the major Tucson metropolitan area shows 3,825 destinations. Again, if just two thirds these destinations included two EVSEs at these locations by 2020, the total number of ports would be about 5,100 in Tucson. Here again, the projections show that these penetrations of EVSEs should occur between 2018 and 2019.

3.2.5 Population

The boundary area population in 2007 was 5,469,675 compared to Arizona State population of 6,248,612.[2] Figure 3-7 shows the population by zip codes within the boundary area.

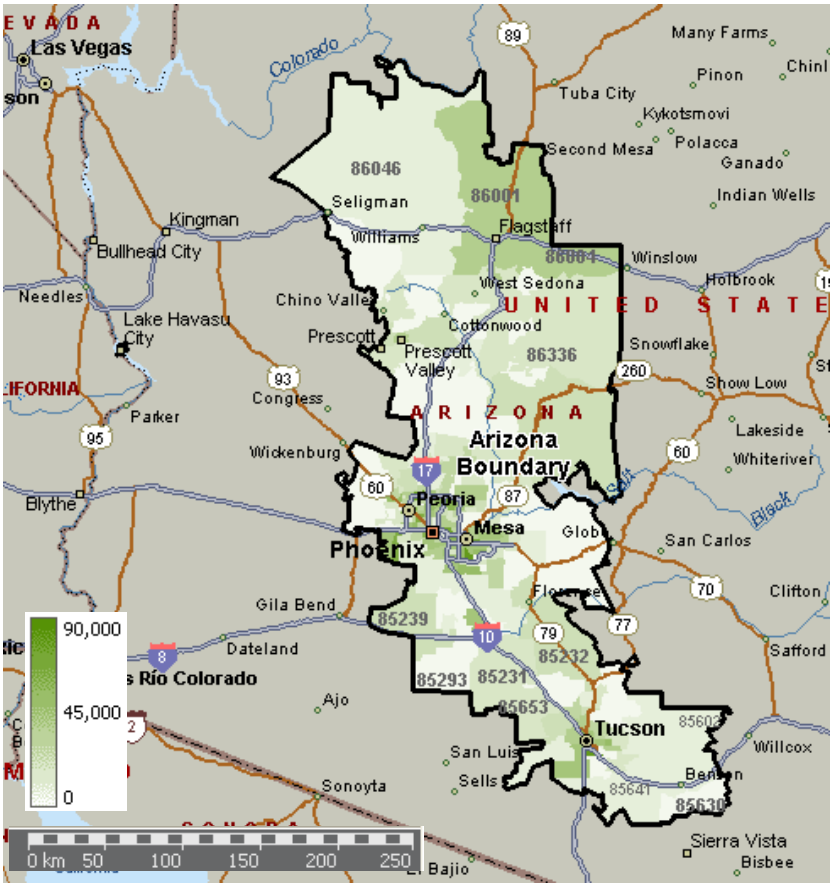


Figure 3-7 Total Persons Population (2007) by Zip Code[3]

[2] Microsoft MapPoint 2010 United States
[3] ibid

This boundary includes most of the major cities of Arizona, as shown in Table 3-8, below. The U.S. Office of Management and Budget combines population centers into Metropolitan Statistical Areas (MSA), where there is at least one urban core of at least 50,000 people. When there are adjacent territories that have a high degree of integration with the core, those areas are included. In Arizona, there are six MSAs.

Table 3-8 Major Population Centers Arizona 2008[4]

City Area	Population
Phoenix Metropolitan Statistical Area	**4,179,427**
Tucson Metropolitan Statistical Area	**967,089**
Flagstaff Metropolitan Statistical Area	**127,450**
Prescott Metropolitan Statistical Area	**212,635**
Kingman/Lake Havasu Metropolitan Statistical Area	**194,944**
Yuma Metropolitan Statistical Area	**196,972**

3.2.6 Distribution of Nissan Registrants

Through the Nissan Customer Journey (http://www.nissanusa.com), those interested in getting additional information were registered as a hand raiser from April 20, 2010 until the end of May 2010. At that time, they could reserve a LEAF with $99. The anonymous geographic locations of those that registered through this process were reviewed on a periodic basis. The demographics of hybrid electric vehicle (HEV) owners to date were another layer of data reviewed. Together, these two data layers demonstrated where early adopters would be located.

[4] http://www.citypopulation.de/USA-Arizona.html

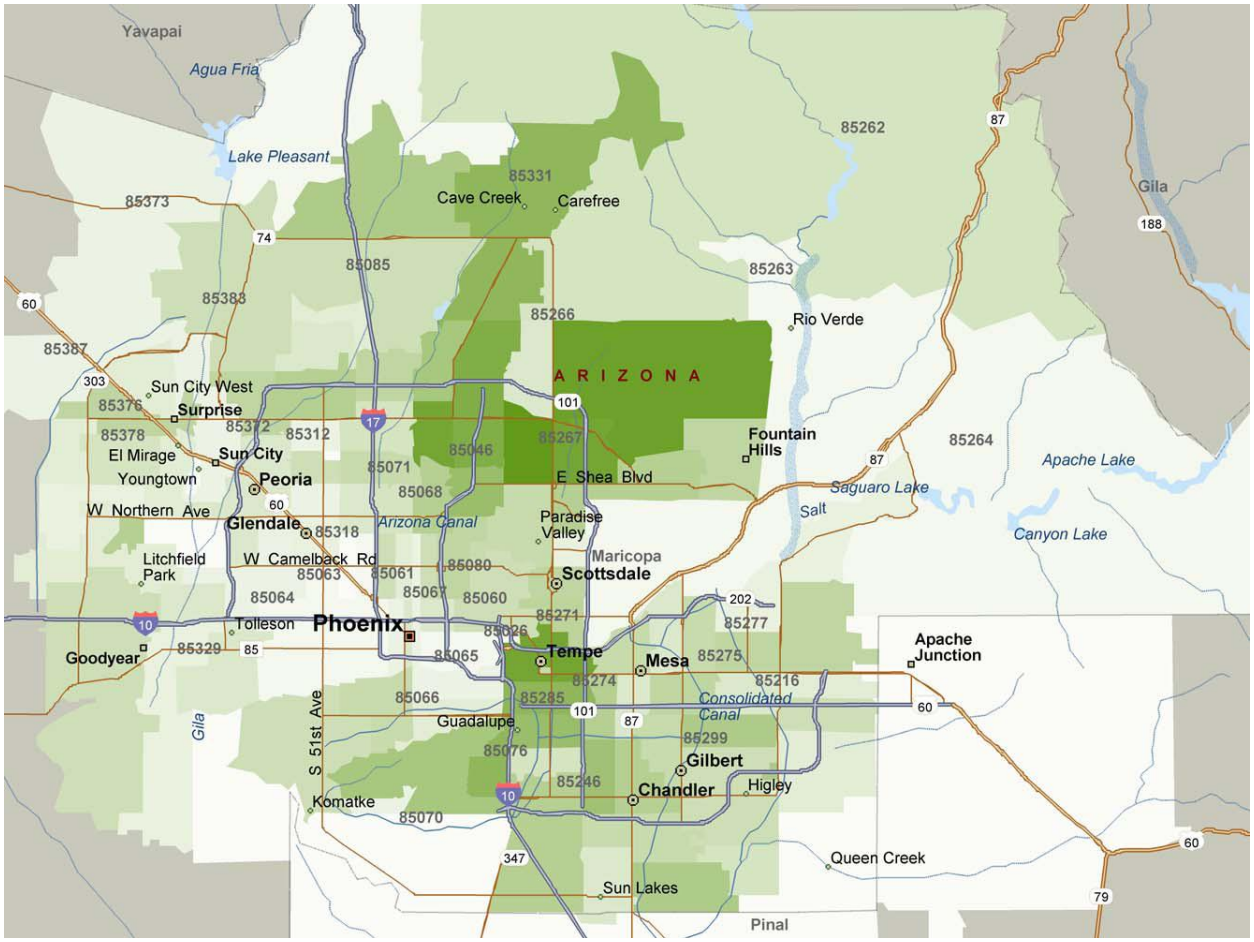


Figure 3-8 Phoenix Nissan Hand Raiser by Zip Code

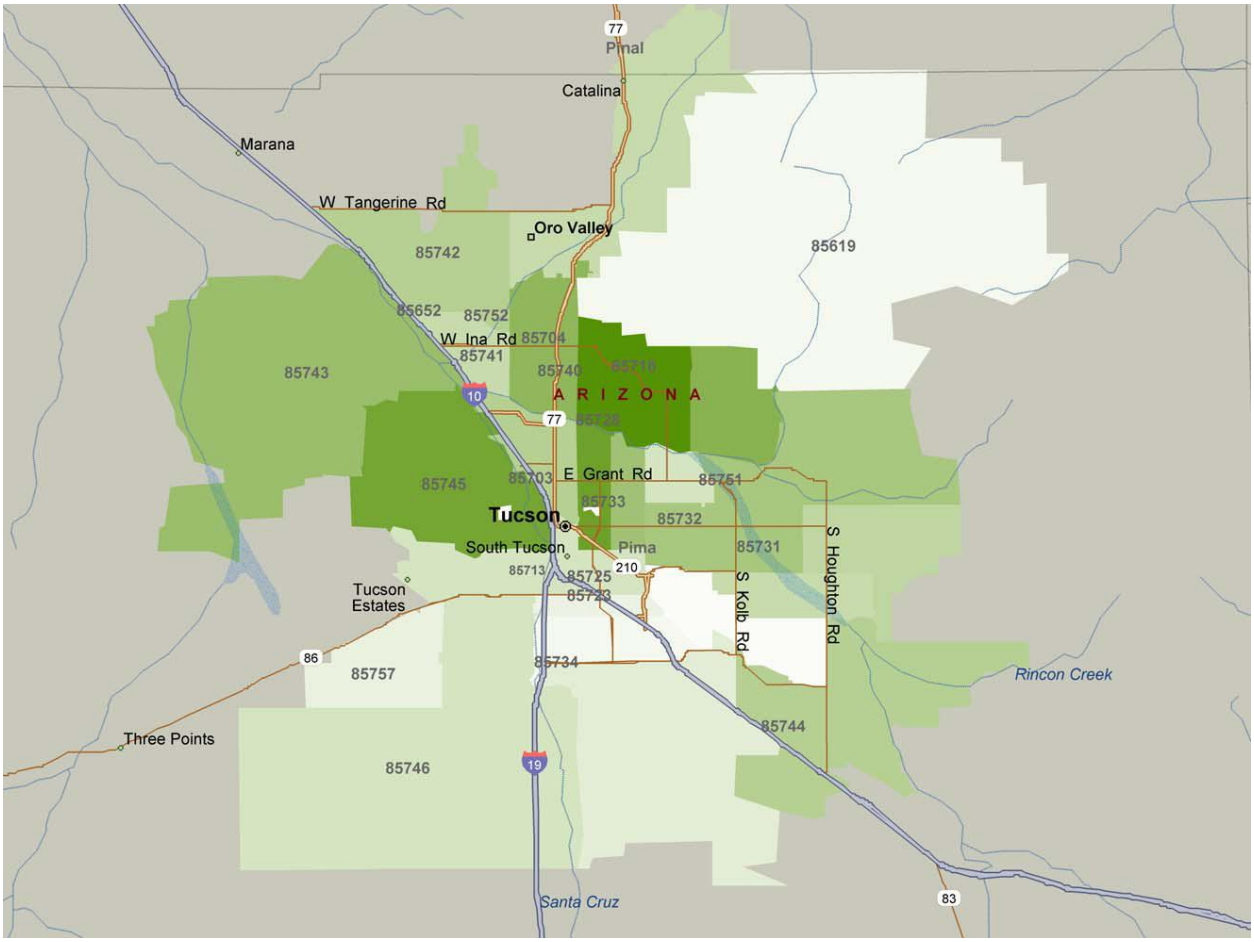


Figure 3-9 Tucson Nissan Hand Raiser by Zip Code

3.3 Placement Objectives for Public EVSE

3.3.1 Methods

The EV Project provides the resources in order to develop an infrastructure, study the infrastructure deployment and driver behavior, to learn lessons from this study and refine the deployment methodology. The installed infrastructure must support these project objectives. To do that, the following areas must be considered:

Data Collection

1. Matching Data: Data collection is vital to the success of The EV Project. Data from an EVSE is matched. as much as possible. to the participant's vehicle data by Idaho National Laboratories (INL) to study EV driver behavior. Data from The EV Project EVSE that does not match a participant vehicle will be evaluated, but nothing is known about the vehicle. Likewise, data from a participant's vehicle that does not match an EV Project EVSE doesn't provide data on the public use. The EV Project EVSE should be placed where it is likely to be used by the Participant's vehicle. Participant demographics must be considered in this placement. These demographics include where the likely buyer will live, work or frequent as a destination. It is expected that the participants (early adopters) will be of higher than average income, college and above educated, slightly older than the average driver (i.e. 45 years and above). It is also expected that the demographics will closely match HEV owners. They will own their own home or condo and will own two or more vehicles.
2. High Use: Site selection should favor those areas where the use of the EVSE will be frequent throughout the day and evening; weekday and weekend.
3. Special Project: Some of the EVSEs will be placed specifically to support special projects and data collection of The EV Project. Those will be identified specifically. Workplace or employer EVSEs and condo EVSEs are examples and will be evaluated individually.

Long Range Plan

1. Local Stakeholders have provided input into the Long Range Plan. Where possible, that input should be followed.
2. The placement of The EV Project EVSEs should support locations identified in the area's Long Range Plan.
3. Demographic data analyzed in the Long Range Plan (i.e. traffic patterns) should also support the location of The EV Project EVSEs.

Utility Concerns

1. Placement of the publicly available EVSEs will be of interest to the electric utility – especially in the case of DC Fast Charging. Electric utilities should be given an opportunity to review the placement with respect to their local grid capabilities.
2. Clustering of residential EVSEs is another concern to the electric utility. While there is no control over who will obtain an EV, the electric utility should be provide as much information about residential EVSE installations as soon as possible within the privacy guidelines.

Budget

1. The budgeted cost for installation of the Level 2 and DCFCs are fairly rigid in The EV Project. Simple installations for residential and commercial EVSEs will be the norm. Additional costs for service upgrades, etc. cannot be borne by The EV Project.
2. Expenditures in the placement and installation of the EVSEs must be directly tied to The EV Project objectives.
3. Vendors and sub-recipients must abide by the DOE contract requirements.

Visibility

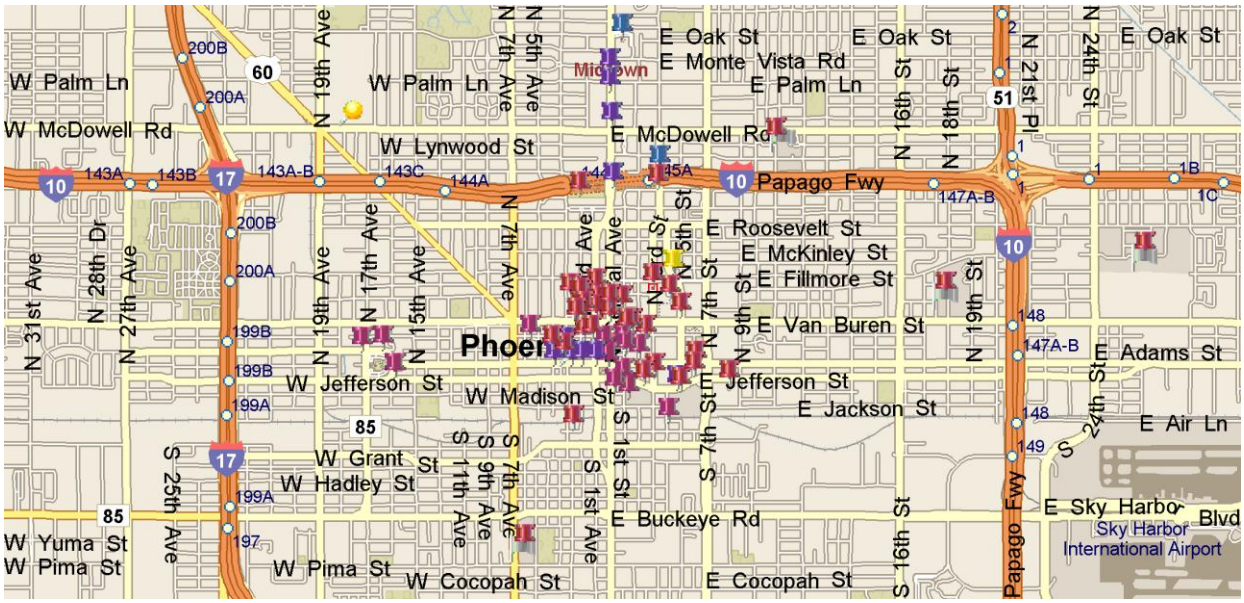
A strong effort should be made to locate the EVSEs in a highly visible location. While perhaps not the prized location with respect to the business entrance, the EVSEs should be in a location easily noticed by others entering the business.

There are two major factors then in siting Level 2 charging stations: 1) suitability for charging purposes; and 2) suitability of the electric grid capability. Studies have found that the inclusion of a rich charging infrastructure at familiar locations has a significant effect on drivers in relieving "range anxiety". With the knowledge that there is a facility nearby that can deliver a significant charge in a time period of time, while they are shopping, dining out, attending an event, etc., the driver is more comfortable using the full range of the vehicle. In particular, the following criteria will be utilized to site AC Level 2 Charging stations in Phoenix and Tucson:

- Projections on residential adoption of Level 2 EVSEs;
- Projections on fleet adoption of Level 2 and DCFC EVSEs;
- Initial review of local destination or "purposeful trip" locations as input to the infrastructure plan;
- Geographic coverage of the market and municipal area for Level 2 and DCFC EVSEs.

3.3.2 Density Map

The projected density maps for Phoenix and Tucson, separated by destinations are listed below each map:

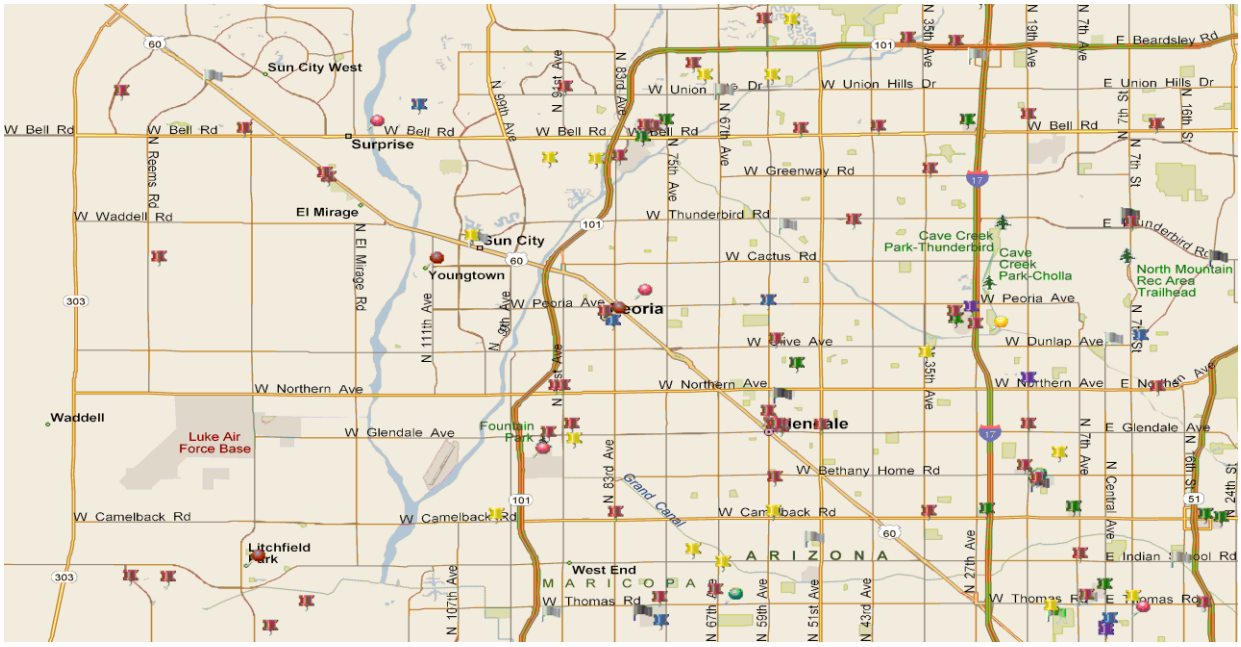


Key to Density Maps:

- Museums, Theaters & Libraries - Shopping Malls, Restaurant and Amusement Parks

- Parking Garages - Movie Theaters and Golf Courses - City Halls - Hospitals

Figure 3-10 Central Phoenix Level 2 - Long-Range Plan Densities

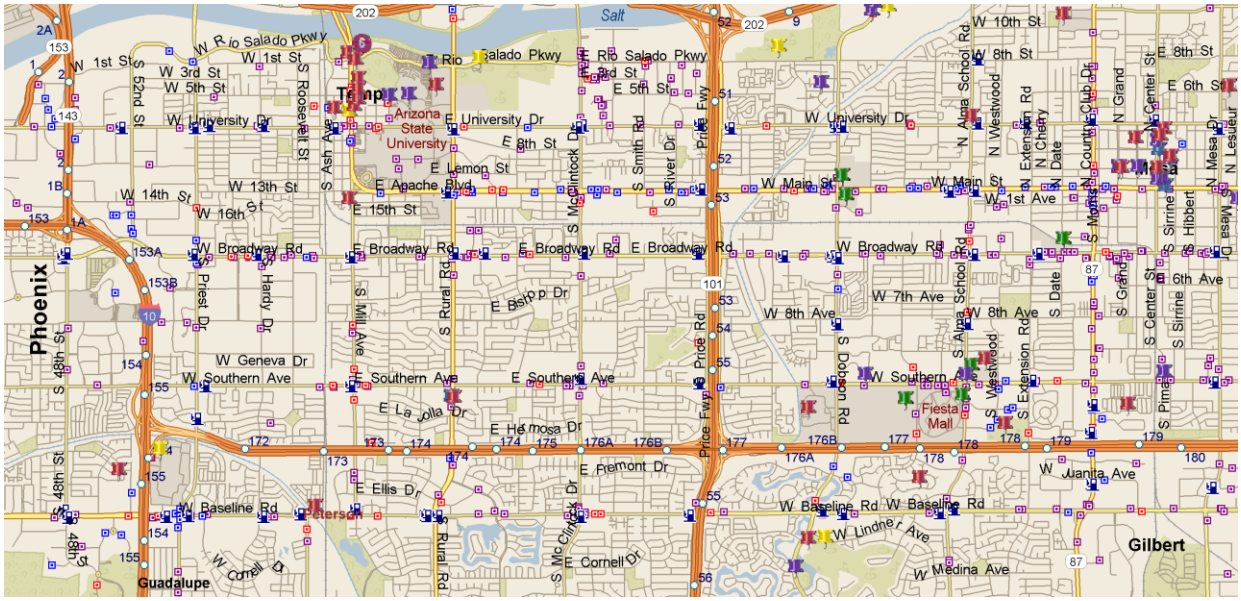


Key to Density Maps:

- Museums, Theaters & Libraries - Shopping Malls, Restaurant and Amusement Parks

- Parking Garages - Movie Theaters and Golf Courses - City Halls - Hospitals

Figure 3-11 West Phoenix - Level 2 Long-Range Plan Densities

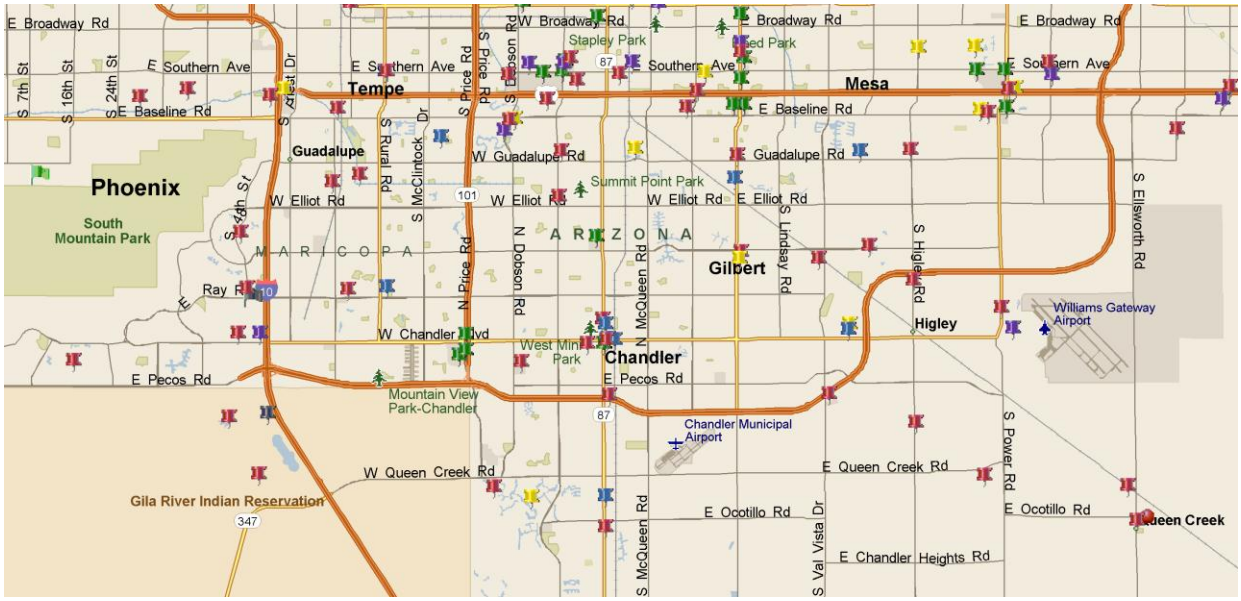


Key to Density Maps:

- Museums, Theaters & Libraries - Shopping Malls, Restaurant and Amusement Parks

- Parking Garages - Movie Theaters and Golf Courses - City Halls - Hospitals

Figure 3-12 Tempe/Mesa - Level 2 Long-Range Plan Densities

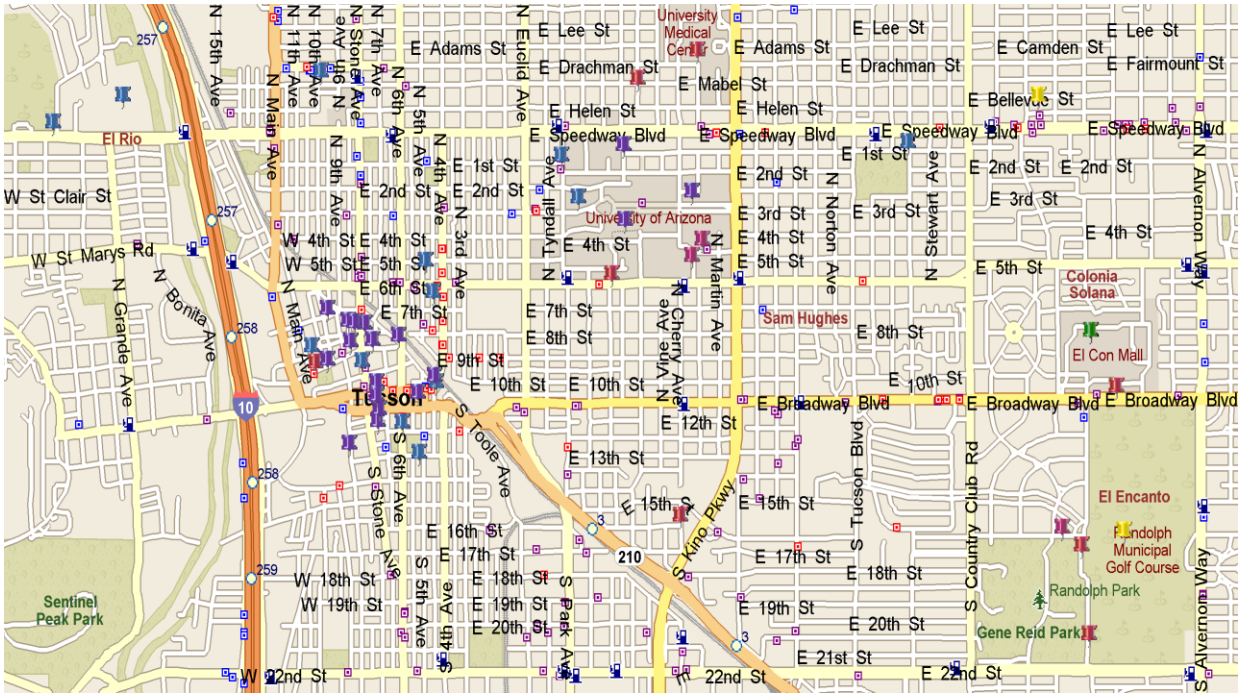


Key to Density Maps:

- Museums, Theaters & Libraries - Shopping Malls, Restaurant and Amusement Parks

- Parking Garages - Movie Theaters and Golf Courses - City Halls - Hospitals

Figure 3-13 SE Phoenix Metro Area - Level 2 Long-Range Plan Densities



Key to Density Maps:

- Museums, Theaters & Libraries - Shopping Malls, Restaurant and Amusement Parks

- Parking Garages - Movie Theaters and Golf Courses - City Halls - Hospitals

Figure 3-14 Central Tucson - Level 2 EVSE Long-Range Plan Densities

Key to Density Maps:

- Museums, Theaters & Libraries - Shopping Malls, Restaurant and Amusement Parks

- Parking Garages - Movie Theaters and Golf Courses - City Halls - Hospitals

Figure 3-15 North Tucson - Level 2 EVSE Long-Range Plan Densities

3.4 Level 2 EVSE Plan

Figure 3-16 Level 2 Wall Mount EVSE

Figure 3-17 Level 2 Pedestal EVSE

3.4.1 Methods

ECOtality's methodology for projecting Level 2 EVSE sales over the next few years focuses on four major factors: 1) geographic coverage, 2) destination planning, 3) refueling stations and 4) rich infrastructure.

Geographic Coverage

Because the cost of owning and operating, EVs will become increasingly competitive and by 2020, will appeal to a wide demographic. This will require the available infrastructure to expand to cover an entire metropolitan area. Outlying communities can expect to have some local infrastructure. While the highest demand will be at destination venues, additional EVSEs will be required in the regions away from the city center, much in the way that gas stations are located. The geographic coverage is likely to be provided by zones that define the appropriate density of EVSE.

Varying zones of increasing EVSE density are projected, with the city center or specific destination complex having the highest density of EVSEs. Total projected EVSEs required providing this geographic coverage is considered the minimum needed to provide EV drivers assurance that they will not be stranded by a depleted battery anywhere in the metropolitan area.

Destination Planning

It was shown in the National Household Travel Survey that a significant number of trips for personal reasons to various destinations occur every day of the week. For destination planning, the metropolitan area is canvassed to determine the number of potential destinations and the number of EVSEs that would be installed at each venue. The number EVSEs installed at each destination grows with the demand created by the introduction of EVs.

Refueling Stations

Deloitte research indicates that there is a comfort level in the public with the availability of gas stations. Their study shows that the convenience of publicly available EVSEs should, at a minimum, match the convenience of gas stations.

Rich Infrastructure

Analysts generally agree that the acceptance of EVs by the general public will require a readily available EVSE infrastructure. The EV owner will be comfortable with densely-populated Level 2 equipment. Indeed, the visibility of this equipment will encourage others to consider purchasing an EV when they next choose a new car. In the early years of vehicle deployment, the ratio of publicly-available EVSEs to the number of deployed EVs likely will be much higher than it might be in a mature market.

Previously, Table 2-4 provided the cumulative calculated number of EVSE installations to be deployed in residential, fleet, and public/commercial locations based upon the ECOtality methodology. This infrastructure is then identified as a percentage of total EVs.

- Projections on residential adoption of AC Level 2 EVSEs
- Projections on fleet adoption of AC Level 2 and DCFC EVSEs

Paramount to the planning of AC Level 2 EVSE locations is the initial review of local destinations or "purposeful trip" locations as input to the infrastructure plan.

As part of Maricopa Association of Governments' (MAG) 2001 Maricopa Regional Household Travel Survey, the 4,018 participating households reported data for 78,511 places visited and 58,484 trips. In Phoenix, the study indicates that the most frequent trip purpose throughout the week is shopping, followed by trips to work, going to school, and getting a meal as shown in Figure 3-18, below.. This coincides with the National Household Travel Survey (NHTS) study that states most drivers make several stops per day. Driving to and from work also generally involves a side trip and stops along the way. Errands may also include a stop for school. Destinations for stops become important in the evaluation of charge infrastructure developed later. Intuition might suggest that charging infrastructure at home and work would be sufficient, but this data indicates otherwise.

Driving to eat a meal was almost 8% of trips, which would be another reason to locate EVSEs at locations where shopping and dining occur.

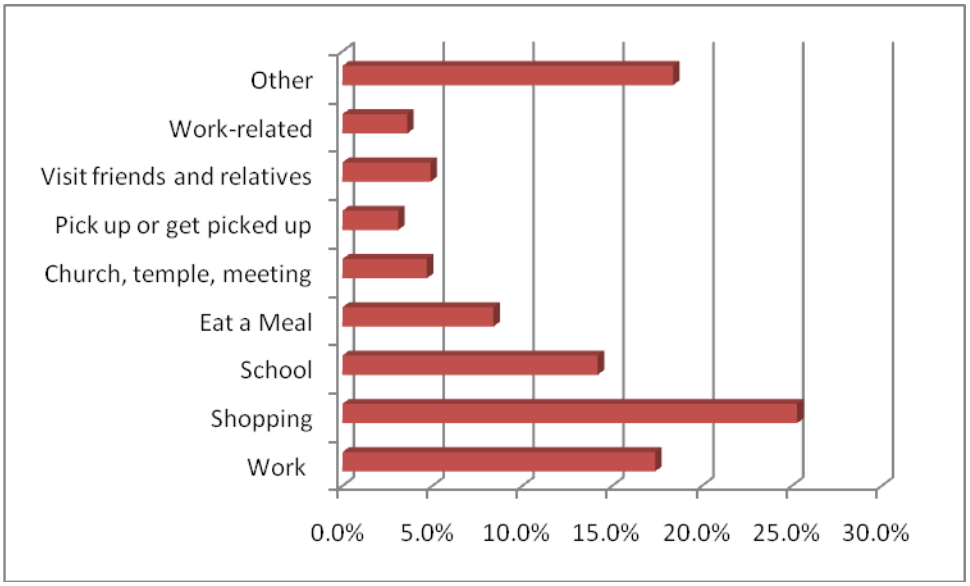


Figure 3-18 Distribution of Phoenix Trip Purposes - All Days

In Phoenix and Tucson, commuters stop for a variety of reasons, such as to drop children at school, stop at the grocery store on the way home from work and attend to other personal business. As in the NHTS survey, examples show that trip chaining is often a response to the pressures of work and home. But, the data also show that some of the growth in trip chaining has been to grab a meal, snack or coffee, activities that historically were done at home and did not generate a trip. This again supports the suggestion that workplace charging may not be as important as had been expected. In addition to this trend, a number of workers stop to shop, including getting coffee or a meal, during the commute.

The overall growth in travel for shopping, family errands, and social and recreational purposes reflects the busy lives and rising affluence of the traveling public in the Phoenix and Tucson metro areas.

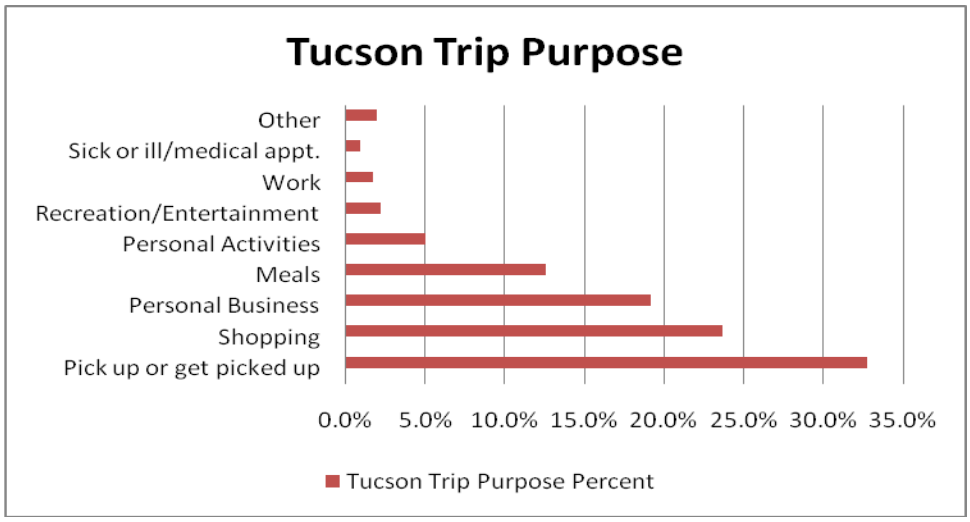


Figure 3-19 Distribution of Tucson Trip Purposes – All Days

3.4.2 Level 2 EVSE Plan Map

Figure 3-20 North Phoenix Level 2 Density

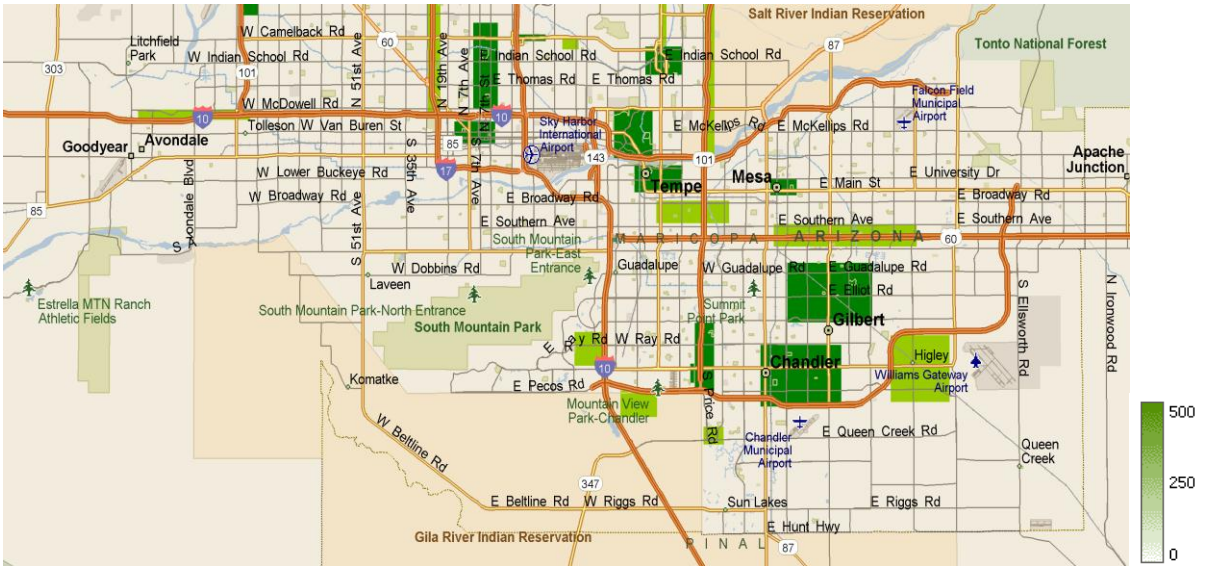


Figure 3-21 South Phoenix Level 2 Density

Figure 3-22 North Tucson Level 2 Density

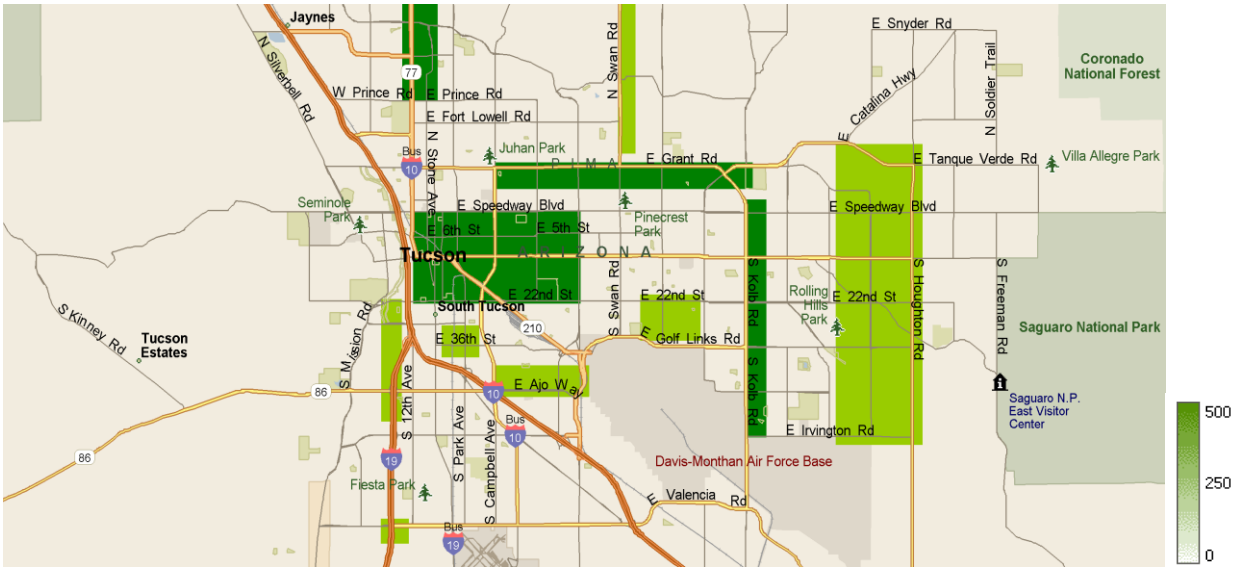


Figure 3-23 South Tucson Level 2 Density

3.5 DC Fast Charge Plan

DC Fast Charging provides a DC charge directly to the vehicle battery where an EV owner can receive a boost in their state of charge in 5-15 minutes or receive up to 80% state of charge in less than 30 minutes. Not all vehicles can receive a DC charge and the connector has not been standardized by the Society of Automotive Engineers to date. The EV Project will use the connector that is standardized in Japan and that the Nissan LEAF has as an option:

Figure 3-24 DC Fast Charger Connector

Studies have found that the inclusion of DC Fast Charging has a significant effect on drivers in relieving "range anxiety". With the knowledge that there is a facility nearby that can deliver a significant charge in a short period of time, the driver is more comfortable using the full range of the vehicle. Without this safety net, the driver is more concerned about maintaining the vehicle battery at a higher state of charge. Thus the availability of DC Fast Charging will go a long way in the promotion of EVs. There is some question, however, whether the availability of the DC Fast Charging actually causes a higher usage of the equipment. A safety net is only needed in extreme conditions. Consequently, it may be that once established, a network of DC Fast Chargers may be sufficient for a substantial time into the long-range plan. This section explores the design and location process for DC Fast Charging.

3.5.1 Stakeholder Involvement

Local Stakeholders have provided input to where the DC Fast Charging stations will be located. All are agreed that rapid recharge capabilities of DC Fast Charging make it ideal for locations where the consumer will stop for a relatively short period of time (10 to 30 minutes). The local stakeholders understand that DC Fast Charging will not generally be used for completing the charge in a vehicle, but rather to provide a substantial recharge quickly. While DC Fast Charge stations may be a destination in themselves, they will likely be placed in existing locations where customers are likely to linger for this amount of time such as coffee shops, convenience stores and central downtown areas, serve as some examples.

Methods

There are three major factors then in siting the DC Fast Chargers: suitability for charging purposes, suitability for augmenting the Level 2 publicly available charge infrastructure, and suitability of the electric grid capability. Studies have found that the inclusion of DC Fast Charging has a significant effect on drivers in relieving “range anxiety”. With the knowledge that there is a facility nearby that can deliver a significant charge in a short period of time, the driver is more comfortable using the full range of the vehicle. Without this safety net, the driver is more concerned about maintaining the vehicle battery at a higher state of charge. Thus the availability of DC Fast Charging will go a long way in the promotion of EVs.

In particular the following criteria will be used to site DC Fast Chargers in Phoenix and Tucson

A majority of the DC Fast Chargers will be placed along the busiest transportation corridors – right at and not more than ¼ mile from Interstates and State Routes

- The remaining will be placed along main or prime arterials with high ADT
- DC Fast chargers will be deployed beyond the boundary of the EV Project to create trip extension possibilities
- Specifically DC Fast chargers will be placed into Pima County along Interstate 10 to connect with Tucson. They will be placed in South Phoenix/Chandler area, Casa Grande, Picacho Peak and Marana. These locations are approximately 30 miles apart, which is well within the comfort level of EV owners.
- DC Fast Chargers will be placed along Interstates 10 and 17, entering Phoenix from the West and along the Loop 101 Loop 202, Routes 60 and 51.
- Utility demand charges for DC Fast chargers will be a very important element to contract negotiations with any host site, as small hosts may be on an A rate in Phoenix and their demand charge may be very minimal – adding a single DC Fast Charger is likely to put them on a TOU rate and drastically affect their utility.
- Projections on residential adoption of Level 2 EVSE.
- Projections on fleet adoption of Level 2 and DC Fast Charging EVSE.
- Initial review of local destination or “purposeful trip” locations as input to the infrastructure plan.
- Geographic coverage of the market and municipal area for Level 2 and DC Fast charging EVSE.

3.5.2 Metropolitan Area

Corridor planning should involve the major freeways in the Arizona area, as well as the major state highways connecting population centers. The DC Fast Charge stations become range extenders for the EVs. Thus, they should also extend from the major highways into the major residential areas.

3.5.2.1 Corridor

Transportation Corridors

DC Fast Charging is particularly important for transportation between major metropolitan areas. The metropolitan areas will contain the local EVSE infrastructure to support EVs in the area but the corridors will allow BEVs in particular the ability to traverse the long corridors between. DC Fast charging is more suited here than Level 2 because customer satisfaction will require the shortest recharge time available in order to minimize travel delays. In fact as batteries gain in power densities and vehicle ranges are extended, it can be expected that the power levels of DC Fast Chargers will also be increased.

Corridor Spacing

Research provided in the Long Range Plan, from a convenience standpoint, EV charging stations should be as plentiful as current gasoline stations. This holds true for corridor travel. A review of gasoline stations along Interstate 10 from Phoenix to Tucson shows 8 exit locations where gasoline stations can be found

The longest stretch in this trip between stations is about 35 miles. This is about 30% of the range of an EV. In general for corridor travel, minimum planning should allow DC Fast Charging locations at no more than 30 mile intervals. The number of charge ports at these locations will initially be few but more stations or more ports at existing stations can be added as demand grows. Figure 3.23 DC Fast Charge Plan Map illustrates the plan to place charging stations in Casa Grande, Florence Road Exit, which is 34 miles from the Riggs Road/I10 interchange where the placement of a charging station is planned at the southern end of the Phoenix Metro area.

Another suggestion was received for a DC Fast Charging Stations in Picacho Peak, which is 34 miles from Casa Grande and on Cortaro Road in Marana, which is 33 miles from Picacho Peak.

While the average distance between these stations in some cases is less than 30 miles, the stations were sited at intersections of state and federal highways as well as leading to major residential population concentrations.

3.5.3 DC Fast Charge Plan Map

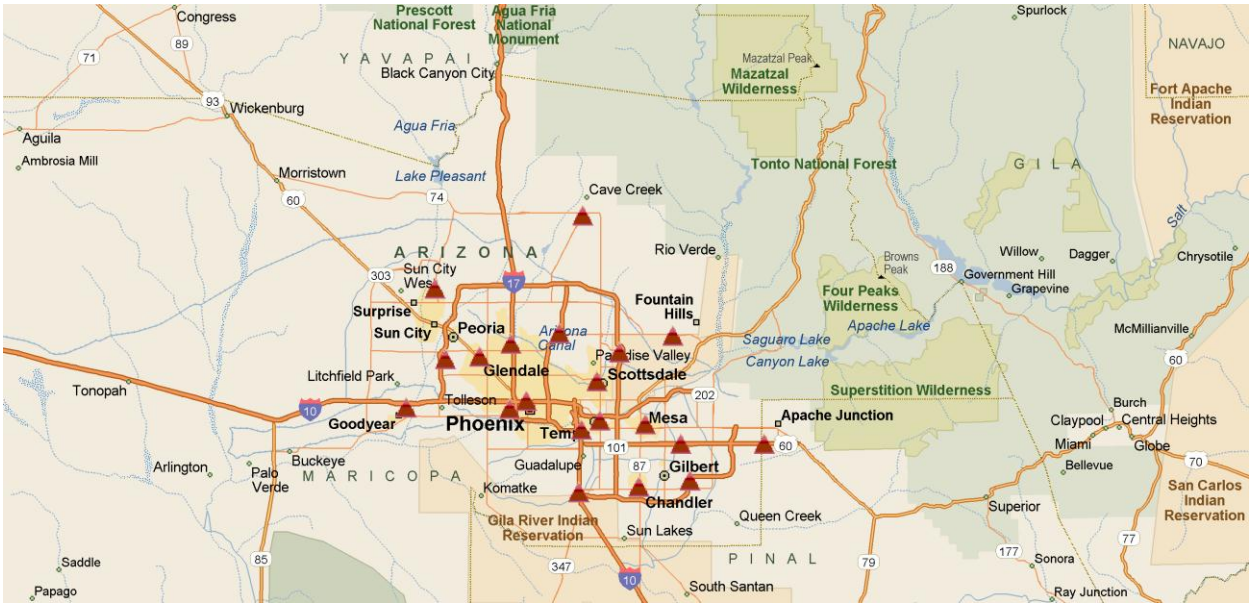


Figure 3-25 DC Fast Charging Stations Phoenix

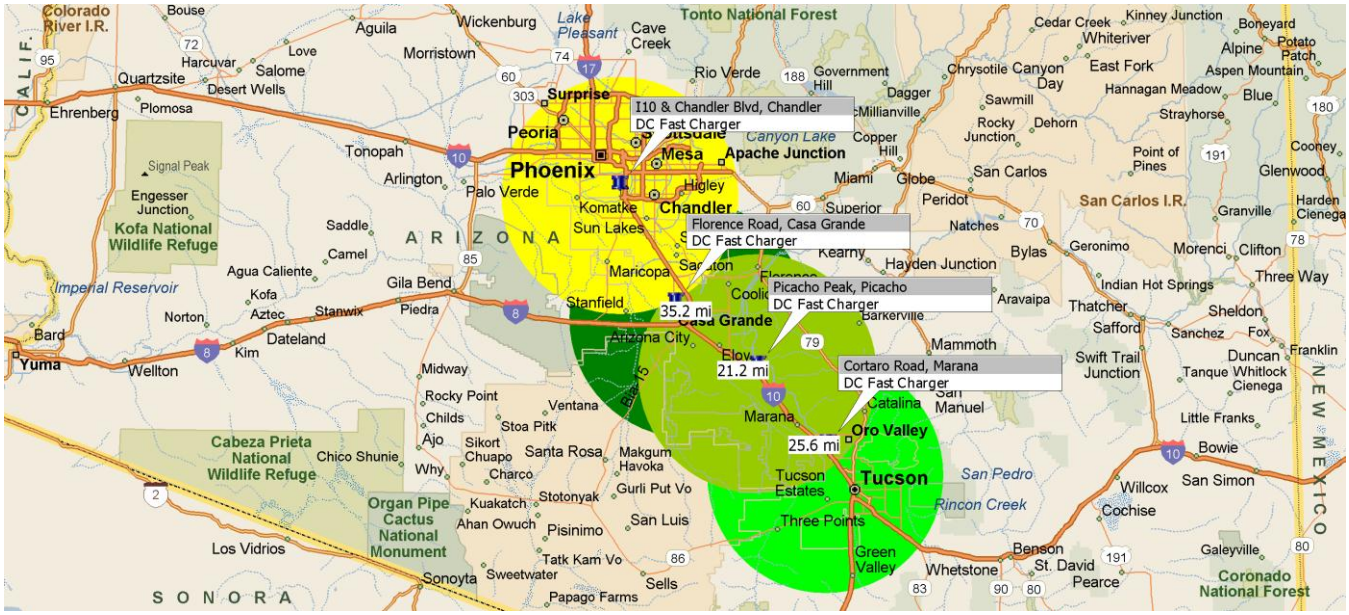


Figure 3-26 DC Fast Charging Stations Phoenix to Tucson Corridor

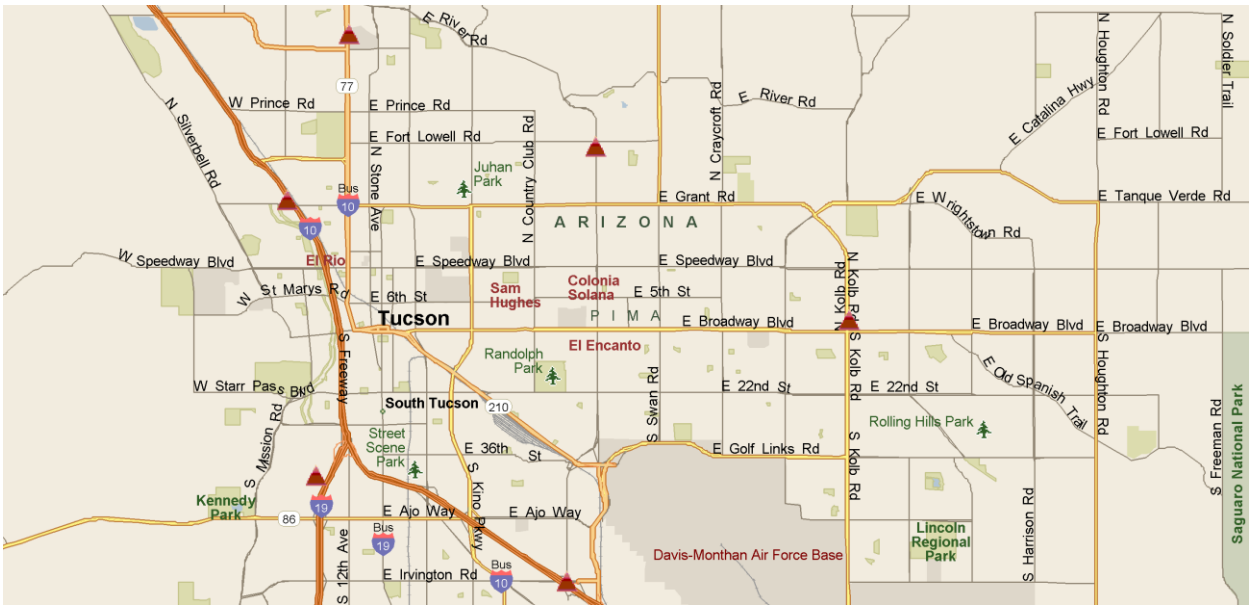


Figure 3-27 DC Fast Charging Stations in Tucson