



SIEMENS

Electric Vehicle (EV) Feasibility Study

Prepared for

California Department of Transportation &
Quechan Indian Tribe of the Fort Yuma
Indian Reservation

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Glossary

Caltrans	California Department of Transportation
DCFC	Direct Current Fast Charger
EDA	Economic Development Administration
EV	Electric Vehicle
ICE	Internal Combustion Engine
IID	Imperial Irrigation District
L1	Level 1
L2	Level 2
L3	Level 3
MSRP	Manufacturer's Suggested Retail Prices
QPD	Quechan Police Department
VIN	Vehicle Identification Number

1. Goals and Objectives

In an effort to address climate change, the Quechan Indian Tribe was determined to develop an electric vehicle (EV) charging feasibility study. Quechan has a longstanding commitment to environmental stewardship and recognized that investing in vehicle electrification opportunities for both fleet and personal vehicles could be a tangible step in reducing greenhouse gas emissions (GHG). This effort was led, in tandem, by the Quechan Tribal Council, the Tribe's Economic Development Administration (EDA), and the California Department of Transportation (Caltrans).

The study was funded by Caltrans and assessed the costs, logistics, and infrastructure impact of electrifying the Tribe's fleet vehicles. This included constructing a development model for several shared charging hubs at distinct locations where Tribal vehicles will commute to and charge when required. The study also explored charging opportunities for Tribal members or visitors with personal electric vehicles, highlighted funding opportunities, public outreach opportunities, and reviewed other considerations that would support the transition.

Siemens PTI was the primary consultant that conducted the study. The Feasibility Study, as outlined in the following sections, includes an evaluation of the existing Quechan fleet, an assessment of future EV opportunities and costs, a vehicle replacement schedule, an infrastructure plan, a GHG reduction forecast, and a cost-benefit analysis.

2. Executive Summary

The Quechan Indian Tribe engaged Siemens PTI to develop a feasibility study to assess the impact of transitioning 100% of its fleet vehicles to electric alternatives. The study includes, but is not limited to, a comprehensive evaluation of the existing Quechan fleet, an analysis of the potential future EV ecosystem, the subsequent infrastructure and cost impacts, a vehicle replacement schedule, a maintenance and fuels savings assessment, and a GHG reduction forecast.

Key Findings and Recommendations:

1. Expected total cost of transition by 2030 is approximately \$9.85 Million (2025\$)

Siemens PTI estimates the total cost of transitioning to electric vehicles at \$9.851 million. Approximately \$8.07 million of this expense includes the purchase of 127 vehicles, while the remaining \$1.7 million covers infrastructure, including 50 chargers. The cost to replace the aging fleet with new gas vehicles was determined to be \$5.04 million, meaning the Tribe will pay a net incremental premium of \$3.03 million for electric vehicles. Vehicle costs are based on Manufacturer's Suggested Retail Prices (MSRP), which are anticipated to be higher than what the Tribe will ultimately pay, as discounts, manufacturer incentives, and lease agreements may apply. Detailed incentives are discussed later in the report, and further discussions amongst Tribal members are recommended to explore additional cost-reduction strategies. Infrastructure costs include the "make ready" electric infrastructure costs and associated chargers but exclude any upgrades to the Imperial Irrigation District's (IID) grid infrastructure, as these are not anticipated based on initial feedback from IID.

2. Potential for a partial fleet replacement has been discussed as a viable option for the Tribe

Discussions with stakeholders offered the potential of a partial fleet replacement, where only some fleet vehicles are replaced with EVs. As the Tribe may not mandate all fleet operators and Tribal programs to transition, some programs may be allowed to opt out of the replacement entirely. In doing so, fewer than 127 vehicles will be replaced, and fewer chargers will be required with a lower cost impact. However, the resulting environmental benefit will be less as well. Quechan is prepared to have future conversations with the Tribal programs and determine the extent of the fleet replacement. Opportunities to replace specific vehicle types were discussed, such as focusing on the light-duty segment and avoiding the larger, more expensive vehicles such as trucks or buses.

3. Expected tailpipe emissions reductions from the modeled fleet replacement amount to 698.9 metric tons CO2 annually

EVs offer substantial potential to reduce greenhouse gas emissions, as they replace traditional internal combustion engine vehicles that depend on fossil fuels. With zero tailpipe emissions, EVs can significantly decrease air pollution and the transportation sector's overall carbon footprint. Siemens PTI determined that the fleet currently emits approximately 698.9

metric tons of tailpipe CO₂e per year, equivalent to approximately 1,600 barrels of oil. This calculation applied emission factors from FuelEconomy.gov and considered the annual driven mileage of each vehicle, reflecting the specific make and model being replaced. This calculation only considers tailpipe emissions and does not include emissions from grid generation for charging.

4. Possible savings of \$159,000 annually in fuel and maintenance savings

Electric vehicles typically cost less to operate and maintain compared to traditional internal combustion engine (ICE) vehicles. Potential operational savings exist for the Quechan fleet after transitioning to electric vehicles. On average, the Tribe can save an estimated \$709 annually in fuel costs per vehicle and an additional \$547 in maintenance costs. When extrapolated to the entire fleet, this amounts to a total savings of ~\$159,000. The Tribe must decide the value of these cost savings and if they influence the decision-making process surrounding the final transition.

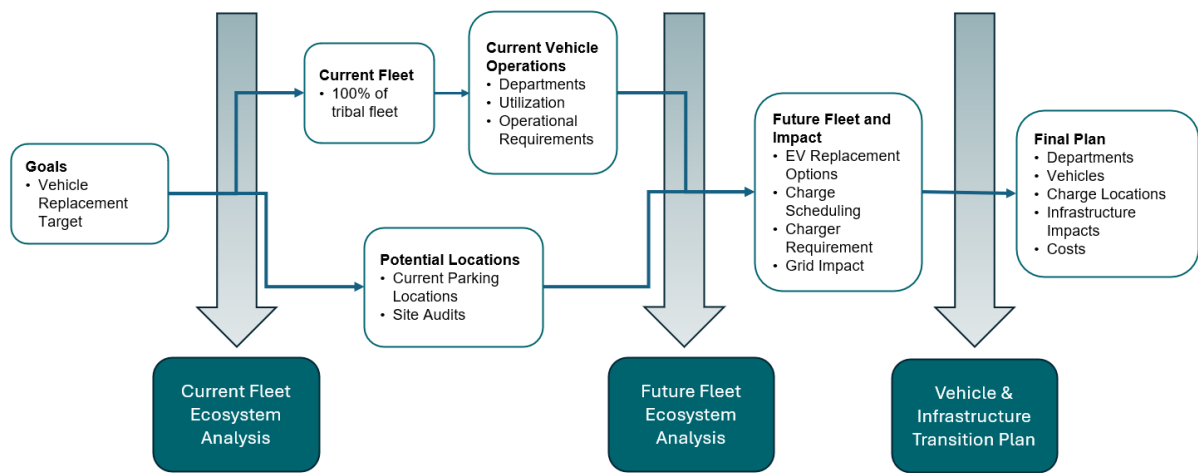
5. Tribe is exploring opportunities to offer public-facing charging for visitors and Tribal members

This study focuses primarily on fleet charging, with four additional charging stations modeled at the Quechan Casino Resort and Paradise Casino. However, the Tribe has expressed interest in developing public-facing EV chargers beyond those outlined in the study. Quechan would serve as a Charge Point Operator, responsible for ongoing maintenance and management of the stations. Siemens PTI provided insight into potential monthly gross margins for public charging stations outlined in Section 7.3. The Tribe will need to determine the appropriate charge rate for the stations to ensure appropriate cost-recovery for the charger investments and consider additional costs (maintenance, station cell service, etc.). Assuming there is ample utilization, the stations would provide the tribe with additional revenue, economic development, and employment opportunities.

3. Overall Methodology

Siemens PTI utilized a multi-step approach when conducting the feasibility study. The initial step required defining the goals for the Tribe. Quechan expressed interest in exploring a full 100% replacement of its fleet. As there was no stringent mandate for when the transition needed to be completed, Siemens PTI relied on infrastructure development considerations, vehicle age, and discussions with Quechan to guide the study’s phasing.

Figure 3-1: Analytical Fleet Electrification Methodology



After solidifying goals for the transition, Siemens PTI analyzed the current Tribal fleet and existing infrastructure. The analysis involved an examination of each fleet vehicle, its parking location, operating patterns, and utilization, fuel consumption, and the identification of relevant stakeholders, such as the individual Tribal programs operating the vehicles

Once a comprehensive understanding of the fleet and infrastructure was developed, Siemens PTI identified and assessed the options for the future electrified fleet. This included identifying optimal charging locations, potential EV replacement options, considerations like charging patterns and needed capacity, and the required number and size of chargers. Further insight was gained through discussions with the Imperial Irrigation District (IID), the local electric utility, to assess potential site and distribution grid upgrades required to accommodate new charging loads.

Additionally, Siemens worked with Quechan to engage members of the community with the project. This included two workshops and a webinar, led by external consultants, for Tribal community and the establishment of a Quechan EV Advisory Committee. The Advisory Committee consisted of Tribal, utility, Imperial County, Caltrans and Siemens PTI stakeholders, and contributed to the decision process for the final recommendation. A discussion of the committee and public outreach activities can be found in Appendices B and C.

3.1 Assumptions

Several assumptions were developed to support this analysis. The Tribe approved each assumption, providing the foundation for the analysis and final recommendation.

All vehicles within the Tribal fleet were considered for the study. All information regarding the existing fleet was provided by the Tribe and updated accordingly through discussions with Tribal program representatives if possible. Some programs, such as the Quechan Police Department (QPD), offered limited information regarding their vehicle operations, so Siemens PTI applied prior experience and the studied operations of the rest of the fleet to estimate accordingly.

All prospective charging locations were suggested by Quechan and presented to members of the Advisory Committee to ensure alignment.

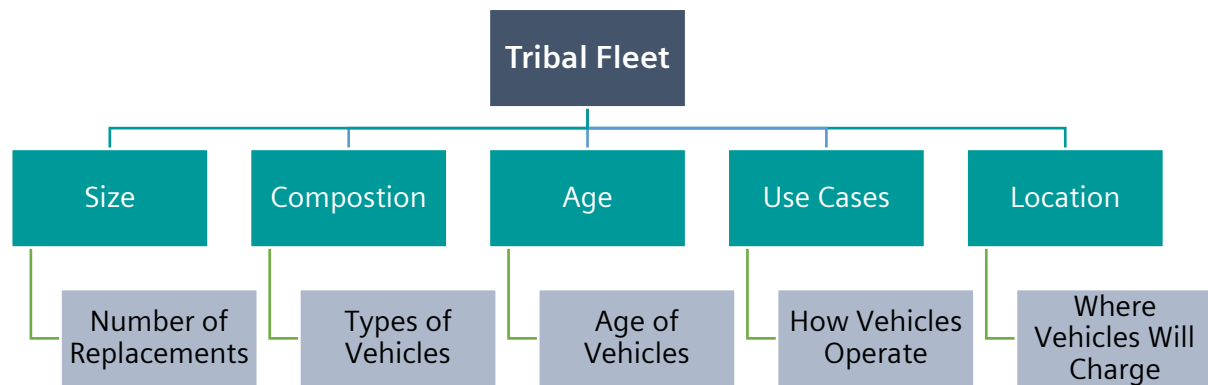
Infrastructure costs were determined using RSMMeans¹ and Siemens PTI experience to estimate installed costs for each charging location. These include the costs of the equipment, make ready infrastructure (conduit, transformers, etc.), installation, and all other necessary equipment. All costs for the analysis are represented in real 2025 dollars.

¹ RSMMeans is a web-based service that provides accurate cost information updated quarterly. Analysis assumes 2025 costs as the final analysis was conducted in December 2025.

4. Current EV Ecosystem

Understanding the Quechan EV ecosystem required a comprehensive examination of the fleet's composition, operations, and current parking locations. This analysis was essential in ensuring the final recommendation would not hinder Tribal operations. All fleet data was provided by Quechan. Additional information was gained through conversations with the Tribal stakeholders and fleet operators.

Figure 4-1: Current Fleet Analysis Contributions



4.1 Fleet Size, Composition, and Age

At the time of the analysis, the Quechan Tribe operated a fleet of 127 vehicles mostly comprised of light-duty class 1-2b trucks. In line with the 100% replacement target, Siemens PTI assessed the impact of replacing the entirety of the fleet with appropriate replacements.

Figure 4-2 highlights the current Tribal fleet split out by vehicle type. The Tribal fleet contains a variety of vehicles of differing sizes with a strong emphasis on light pickups. For simplicity, Siemens PTI considers the term “pickup” to be synonymous with pickup trucks of class 2b and below. Across vehicle types, the fleet is made up of 13 unique vehicle manufacturers.

Figure 4-2: Number of Fleet Vehicles by Vehicle Type

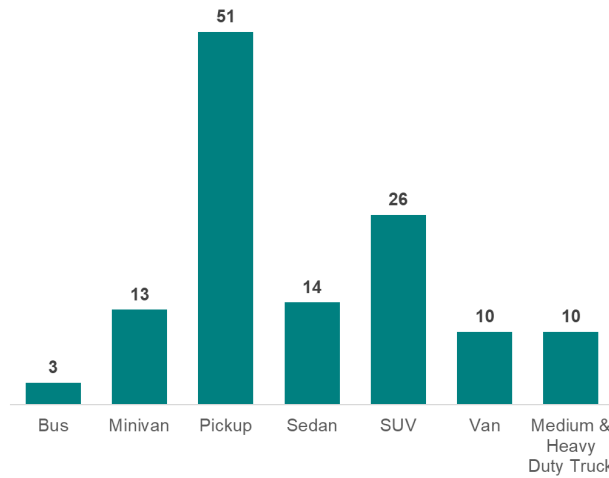


Table 4-1 segments the fleet by purchase date. At the time of the analysis, 61 Vehicles had been purchased in the past 5 years. With approximately half of the fleet being replaced relatively recently, Siemens PTI and Quechan took note to prioritize older vehicles first when planning the transition and delay the replacement of the newer vehicles to later in the schedule.

Table 4-1: Fleet Vehicles by Purchase Date

Purchase Date	Vehicle Count
2015 and Prior	41
2016	5
2017	11
2018	2
2019	7
2020	24
2021	8
2022	4
2023	6
2024	19
Total	127

4.2 Fleet Utilization

In addition to vehicle type and age, Siemens PTI also assessed which Tribal programs operated the vehicles and their needs, identifying over 40 programs. Quechan reached out to each of these programs to confirm the existence of each vehicle and understand their operations.

One year of mileage data was provided by Quechan. This came in the form of vehicle mileage logs, which were filled out by the fleet operators themselves, documenting each individual trip a vehicle took during the year, and the starting and ending odometer

readings for each trip. There was a considerable number of vehicles (~70%) without data available. For most of these, utilization was estimated based on others in the fleet of a similar size and operational profile. However, for programs with more intensive or unique operations, such as the police fleet, Siemens PTI assumed higher annual mileage.

Table 4-2: Fleet Vehicle Mileage Metrics

Metric	Value (Miles)
Average Annual Mileage	7,701
Maximum Annual Mileage	31,357
Minimum Annual Mileage	300

Table 4-2 summarizes the annual mileage of the vehicles provided by Quechan. On average, the fleet is utilized sparingly; however, some vehicles are used much more than others. Having an appropriate understanding of how the fleet is utilized helps identify how frequently vehicles will require charging, and thus how many chargers and plugs are needed. Seeing that the fleet’s utilization was relatively low, Siemens PTI predicted that this would result in fewer charging sessions on average and thus fewer total chargers overall to support the transition.

4.3 Parking Locations

As part of the data request, Siemens PTI obtained the parking location of each vehicle. The available data revealed three distinct clusters. As depicted by the heat map in Figure 4-3, most of the fleet is located north of Yuma, with one cluster located by the Tribe’s Paradise Casino and the other by the Quechan Community Center. The smaller remainder of vehicles is located to the West, south of the Quechan Casino Resort.

Figure 4-3: Fleet Parking Locations



It was assumed that each program’s headquarters location was the primary home for each vehicle. These parking locations were a crucial factor in the EV infrastructure assessment, as

charger locations should reflect locations that were currently utilized for fleet operations. This ensures that no large operational interruptions occur due to the transition to electric vehicles and that fleet operators are not required to travel long distances when vehicles require a charge, a sentiment heavily supported by Quechan stakeholders.

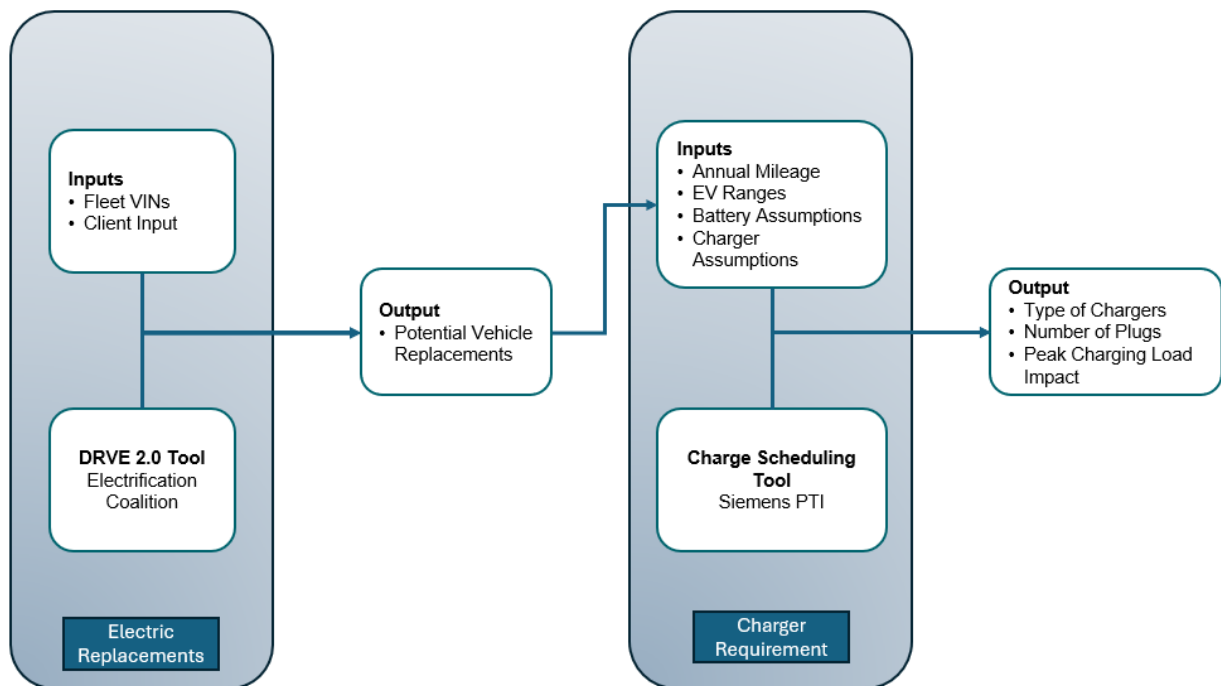
4.4 IID Power Supply

Siemens PTI established contact with the Imperial Irrigation District (IID) prior to conducting the future fleet analysis. This relationship was important later in the process to understand the future impact the proposed plan would have on the utility's infrastructure. IID representatives also served on the EV Advisory Committee, providing crucial insight throughout as analysis was being conducted.

5. Future EV Ecosystem

After establishing an understanding of the current fleet, Siemens PTI developed a concept for the future EV ecosystem, including vehicles and charging infrastructure. The initial step involved identifying electric replacements for the fleet vehicles. Once those were decided, the team determined how and where the fleet would charge, how many chargers/plugs would be required at each location, and the electrical impacts.

Figure 5-1: Future EV Ecosystem Methodology



5.1 EV Replacements

Siemens PTI utilized the Excel-based DRVE 2.0 tool developed by the Electrification Coalition and Atlas Public Policy to identify appropriate electric vehicle replacements. Using the vehicle roster and uploading each vehicle’s identification number, the tool identifies the current vehicle make, model, and any specific characteristics. The tool then selects suitable electric vehicle replacements based on the specifications of the current vehicles. Atlas Public Policy maintains a database of prospective replacement options, updated on a rolling basis using manufacturers’ websites and FuelEconomy.gov, which the tool utilizes. Further refinements were made based on consultation with the Tribe to ensure each replacement was suitable for each use case.

Table 5-1 highlights the unique vehicle replacements selected for the analysis. It should be noted that these serve as a proxy to determine costs and size of charging infrastructure. When it is time to purchase vehicles, new vehicle options may be available, and different EVs may

be more appropriate for the Tribe's needs. Images of each proxy replacement vehicle can be found in Appendix D: Modeled Electric Vehicle Replacements.

Table 5-1: Unique Replacement Vehicles²

EV Replacement Vehicle	MSRP	Range (miles) ³
2024 NISSAN LEAF BEV	\$28,140	149
2024 TESLA MODEL 3 RWD BEV	\$42,990	272
2023 CHEVROLET BOLT EV BEV	\$26,500	259
2023 FORD TRANSIT VAN CARGO BEV	\$51,000	126
2023 FORD TRANSIT VAN CUTAWAY BEV	\$46,000	126
2023 FORD MUSTANG MACH-E RWD LFP BEV	\$39,895	250
2024 KIA EV9 STANDARD RANGE RWD BEV	\$54,900	230
2025 CHEVROLET EQUINOX EV FWD BEV	\$33,600	319
2025 RAM RAMCHARGER PHEV	\$60,000	145
2023 VOLKSWAGEN ID BUZZ	\$38,995	234
2023 FORD F-150 LIGHTNING 4WD BEV	\$49,995	240
2024 RIZON E18L BEV	\$148,000	132
2023 ROUSH FORD F-650 BEV	\$266,000	138
2026 Chevy Blazer Police	\$60,459	286
2025 FREIGHTLINER EM2 CHASSIS BEV	\$415,000	180
2024 IC CORPORATION CE SCHOOL BUS BEV	\$391,000	200

5.2 Charging Model

The current fleet is scattered across several unique locations. Upon consultation with the Tribe, Siemens PTI explored opportunities to consolidate charging to fewer locations or hubs. Two primary charging/ infrastructure strategies were considered:

Distributed charging involves installing charging stations at various locations throughout the fleet's operational area, allowing vehicles to charge where they are parked.

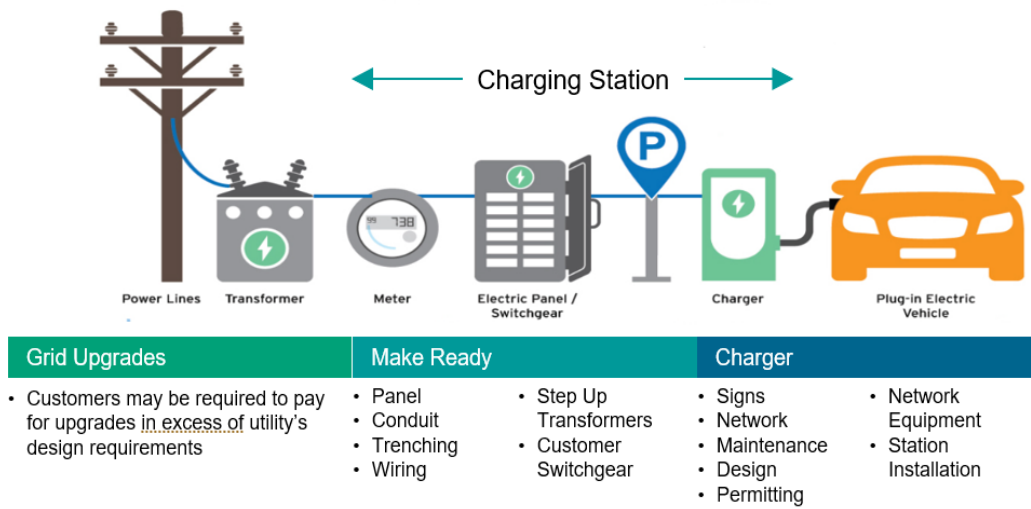
Depot/Hub charging involves consolidating vehicles at specific operational hubs, central locations designated for charging. Under this strategy, fleet vehicles may park where desired and approved as they do today, but they must return to designated depot locations for charging.

Siemens PTI identified depot charging can significantly reduce infrastructure costs by taking advantage of the economies of scale associated with make ready infrastructure.

² These replacement options are a sufficient proxy for the vehicles considered in this study

³ Per manufacturer specifications, unadjusted

Figure 5-2: Charging Infrastructure Components



Make ready infrastructure is required for any unique location with vehicle charging. Putting more chargers at a single location can be considerably less expensive (upwards of 75%) than installing those chargers elsewhere and putting new make ready infrastructure in place.

Depot charging also allows for centralized management and control of charging operations, maintenance, and fleet logistics from a single location. It also ensures there are adequate plugs present to support the fleet in the event a charger and/or plug are inoperable.

The depot model was an option the Tribe expressed interest in exploring early in the project. Quechan identified five potential locations to serve as charging hubs, which aligned well with the current location distribution of the fleet. These locations are outlined in Table 5-2 below.

Table 5-2: Proposed Charging Hubs by Vehicle Count

Proposed Charging Location	Vehicle Count
Tribal Admin Building	21
Paradise Casino	33
Paradise Casino LE	30
Quechan Community Center	39
Quechan Casino Resort	4

Each of the vehicles was assigned to each hub location through consultation with the tribe and an assessment of current fleet vehicle locations. The vehicles located by the Community Center were easily assigned there as well as the vehicles located south of the Quechan Casino Resort. However, since the Paradise Casino and Tribal Administration Building are located close to each other, Siemens PTI relied on Quechan to determine where the remaining vehicles should be assigned. It should be noted that one location, Paradise Casino Law Enforcement (LE), has not been constructed yet. This location will serve as the primary headquarters for the Tribe’s security and police programs, as well as Fish & Game and Animal Control, and is expected to be completed after 2027.

Figure 5-3: Proposed Charging Hub Locations



As part of the study, the Tribe expressed interest in providing public charging opportunities at some of the charging locations as well. These public chargers would be separate from those assigned to the fleet and be available for visitors and Tribal members with personal electric vehicles. Through discussions, it was identified that the Quechan Casino Resort and the Paradise Casino would be the two locations chosen for public charging as they support the greatest number of visitors.

The Tribe also highlighted its current solar development initiative, which will construct solar power generation at the Paradise Casino and the Quechan Casino Resort. This initiative would allow fleet vehicles to be charged with 100% renewable power generated by Tribal assets. As a result, Siemens PTI also met with the necessary stakeholders to ensure that the plan wouldn't interfere with the initiative.

5.3 Charger Requirement Analysis

The Tribe noted that there would be ample time for most of the fleet vehicles to charge during non-operating hours, indicating that a 12-hour evening window would be available. Siemens PTI also chose appropriately sized chargers to ensure that each vehicle would be fully charged by the following morning. However, Siemens PTI noted from prior experience that the police and security vehicles may operate differently (with unique shift and operational requirements). As a result, the chargers specified for those vehicles are larger, offering a faster charge in a shorter time window.

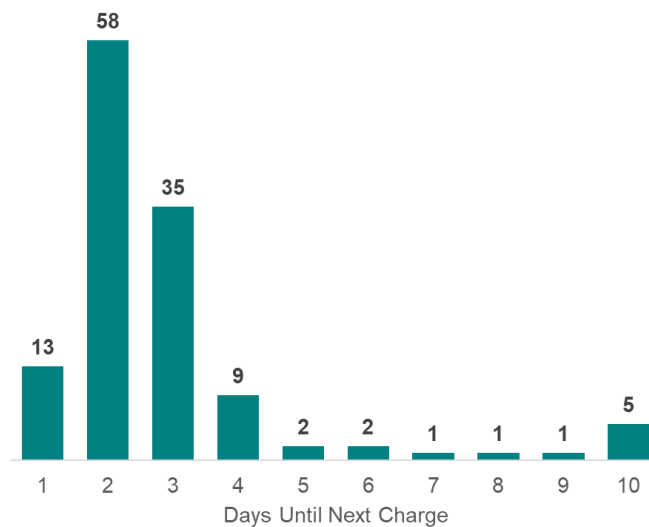
These decisions were made using the manufacturer's specifications for the EV replacements; however, adjustments were made to account for the state of charge (SOC) of the battery. It's recommended that electric vehicles do not operate below a 20% state of charge, as this could impact the warranty of the vehicle. The result is a vehicle that utilizes only 80% of its listed battery capacity. The fleet operating analysis indicated that each fleet vehicle could be charged using an L2 AC charger; however, as indicated above, some would require greater capacity to accelerate charging.

An additional adjustment was made to account for local temperature impacts. It's commonly seen that in temperate climates, cold temperatures put extra strain on batteries to heat the

batteries and the vehicle itself. However, the same strain can occur with hot temperatures, such as those seen in Yuma. The result is a reduced battery capacity and vehicle range. A 26% reduction in vehicle range was applied to each vehicle to account for this.

Siemens PTI applied a statistical and stochastic approach to identify the expected usage patterns of the fleet vehicles. Based on the usage patterns and the technical limitations of the replacement vehicles, we identified how often each vehicle should be charged to ensure its availability with a confidence of 95%. This analysis identified the minimum number of chargers needed to satisfy the charging demand. Figure 5-4 shows the number of vehicles that are going to be charged every given interval (days).

Figure 5-4: Distribution of EV Charging Vehicles



Siemens PTI then applied its Charge Scheduling Tool to simulate vehicle operations for the fleet. Using the expected charge frequencies for the fleet, the tool organized schedules for vehicle charging, highlighting when each vehicle would need to charge throughout the year. It was assumed that all vehicles would operate on a weekday schedule (260 days in a year) except for QPD and security vehicles, which would operate a full 365 days per year. These schedules reflect differences in vehicle usage (some vehicles require fewer charge sessions per week, and vice versa). Additionally, a unique schedule was created for each distinct charging location, reflecting different mixes of vehicles. Based on the schedule, the tool identified which day had the largest number of vehicles charging. This “peak” day was used to determine the number of chargers needed. By planning for the most extreme case, Siemens PTI ensures that fleet charging is sized appropriately to not impact fleet operations.

Table 5-3 below outlines an example charging schedule for a hub that serves five vehicles. Vehicles are grouped by their required charger type, and the day each vehicle is scheduled to charge is noted. Here, only a single work week is highlighted; however, Siemens PTI’s tool conducts this analysis for the entire year. For this example, 2 plugs of each charger type are required to support peak operations. Considering operations may change, additional chargers can be added to account for redundancy or station malfunctions.

Table 5-3: Example Hub Charging Schedule

Vehicle	Required Charger Type	Monday	Tuesday	Wednesday	Thursday	Friday
Vehicle 1	L2 50a (2 plug 25a)	x	x	x	x	x
Vehicle 2	L2 50a (2 plug 25a)		x		x	
Vehicle 3	L2 50a (2 plug 25a)			x		
Vehicle 4	L2 50a (1 plug 50a)	x	x	x	x	x
Vehicle 5	L2 50a (1 plug 50a)		x		x	
Total Plugs Needed						
	L2 50a (2 plug 25a)	1	2	2	2	1
	L2 50a (1 plug 50a)	1	2	1	2	1

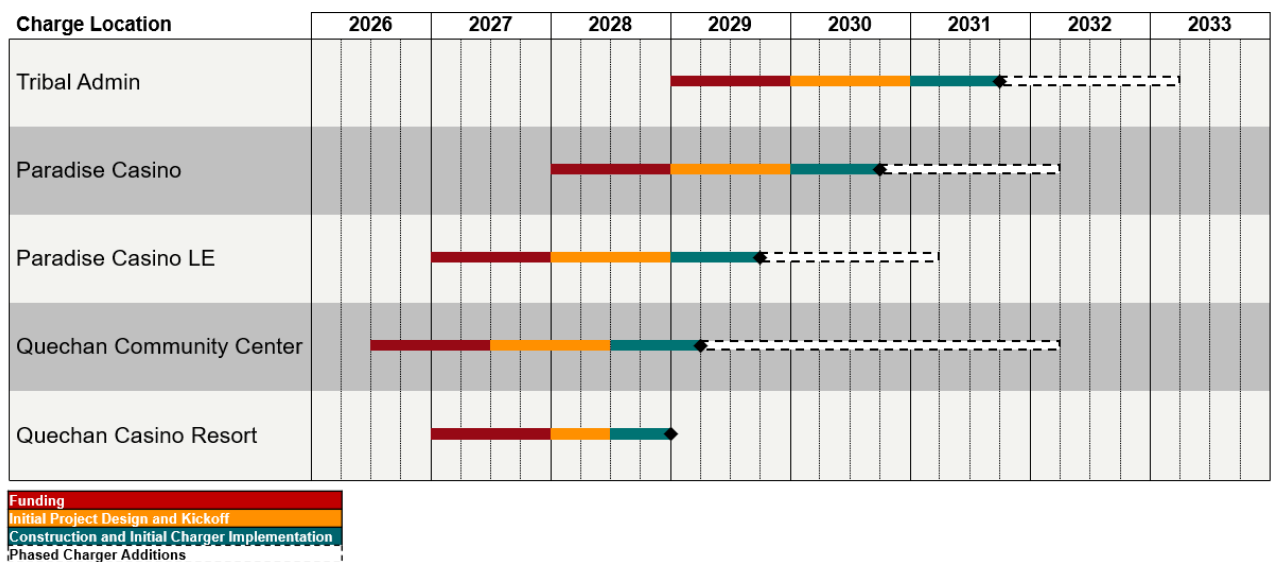
6. Results

With the electrified ecosystem defined and the methodology established, Siemens PTI determined the timeline and calculated the cost of the transition. As there was no strict mandate defining transition timing, Siemens PTI developed a phased plan that assumes all fleet vehicles will be replaced and that charging infrastructure will be operational prior to their purchase.

6.1 Transition Timeline

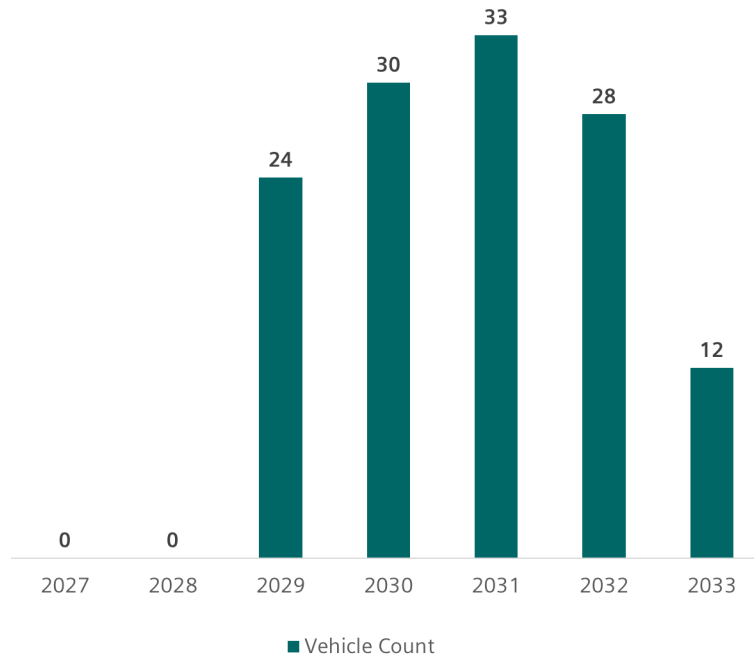
Siemens PTI constructed a development timeline for each prospective charging location. The schedule outlined below in Figure 6-1 reflects discussions with Quechan stakeholders and ensures that all the required charging infrastructure is in place and operational prior to electric vehicle operations. Ample time was afforded for the encumbrance of funds, site design, and pre-purchase of long lead equipment to minimize the risk of delays.

Figure 6-1: Charging Location Development Schedule⁴



Vehicle age and site construction logistics served as the main drivers influencing the prioritization of the locations. Vehicle age helped determine the timing of needed vehicle replacements. From that basis, efforts were made to phase vehicle procurements as evenly as possible year-to-year to minimize budget disruptions, creating the schedule outlined in Figure 6-2.

⁴ **Funding:** time required to gather funding for each location.
Initial Project Design and Kickoff: time required to develop a project team and order long-lead equipment
Construction and Initial Charger Implementation: time required to implement make ready infrastructure and place the initial batch of chargers
Phased Charger Additions: time required to install additional chargers as vehicles are purchased.

Figure 6-2: Vehicle Procurement Schedule

The Community Center was chosen as the first location in the timeline as it houses many older vehicles. Conversely, the Paradise Casino was scheduled late as it will house vehicles purchased more recently. Paradise Casino LE was scheduled to begin planning and development after 2027 to align with the Tribe’s expected timeline for the construction of that facility.

For those locations with more vehicles, Siemens PTI planned phased charger installations to keep pace with EV procurements and delay cost impacts. Quechan Casino Resort, which will serve only four vehicles, requires considerably less development time.

6.2 Charger Requirement

Siemens PTI’s charger requirement analysis revealed that each vehicle in the Tribal fleet can be supported by level 2 chargers, assuming ample dwell time is provided in the evening hours to charge. With a 12-hour assumed charging window for most of the fleet, level 3 fast charging is not required, which reduces potential load impacts and infrastructure costs.

Table 6-1 summarizes the charger counts at each proposed charging hub. On average, each fleet charger will support approximately 2.7 vehicles. The fleet charger sum (46 total) includes additional chargers at each of the larger four sites for redundancy. Redundant chargers were specified to account for changes in day-to-day operations (peak days where more vehicles require charging than expected) or in the event of a charger malfunction. A more detailed breakdown of the charger distribution at each location can be found in Appendix A: Further Site Details.

Table 6-1: Proposed Charging Hubs by Charger Count

Location	Vehicle Count	Fleet Charger Count	Public Charger Count
Tribal Admin	21	9	0
Paradise Casino	33	10	2
Paradise Casino LE	30	14	0
Quechan Community Center	39	12	0
Quechan Casino Resort	4	1	2
Total	127	46	4

6.3 Costs

Siemens PTI calculated that the expected gross cost of the transition will be **approximately \$9.85 million dollars**. Approximately \$8 million of this cost is vehicle costs. It should be noted that vehicle costs reflect MSRP pricing, which is expected to be a higher price than the Tribe will eventually pay. Prices may change by the time purchases are made. Discounts from manufacturers or dealers are expected to be available, as well as EV incentives and lease agreements. Relevant incentives are outlined later in the report. Further discussions should be had amongst Tribal representatives to identify further opportunities to reduce vehicle costs.

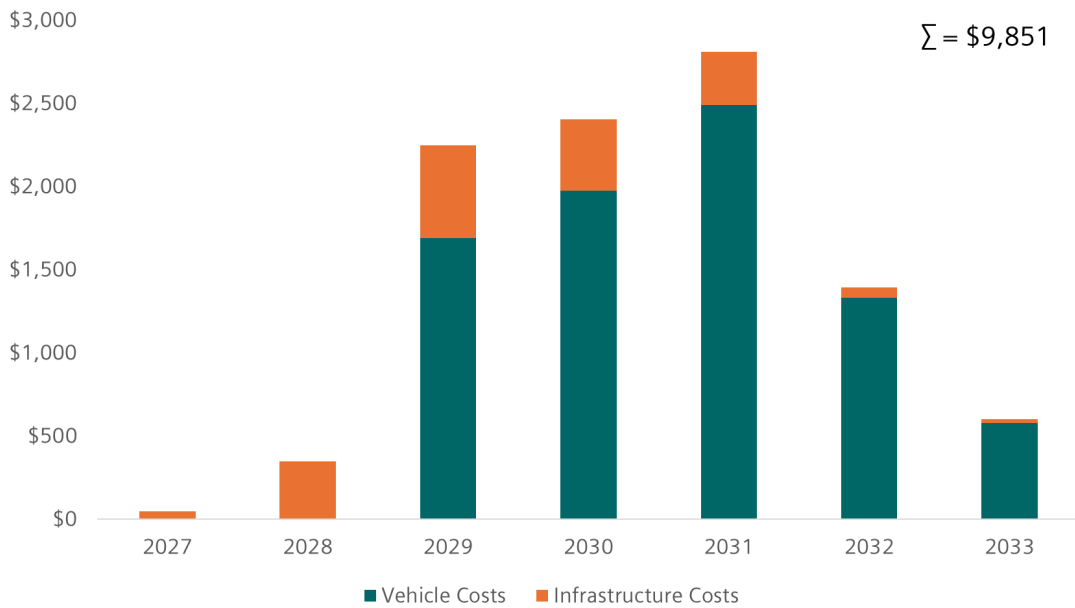
Table 6-2: EV Transition Budget (2025\$)

Cost Category	Cost
Vehicles (127)	\$8,067,456
Infrastructure (50 Chargers)	\$1,783,169
Total	\$9,850,625

Infrastructure costs include the total investment needed to support vehicle charging. This includes the cost of the chargers, make ready infrastructure, construction and labor costs, and other markups (such as cable management system, mounting pad, warranty, etc.). These costs do not include any upgrades to IID's grid infrastructure, as initial analysis from IID does not deem upgrades necessary.

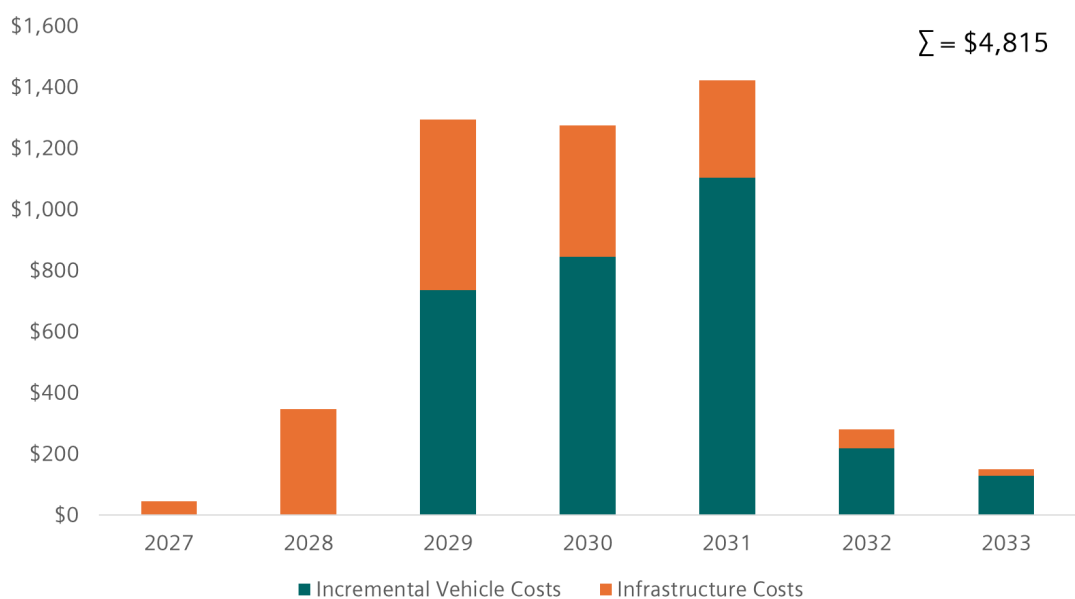
Generally, infrastructure costs precede vehicle costs, as outlined in Figure 6-3. This ensures that appropriate charging infrastructure is purchased and built prior to vehicle purchases. All charging infrastructure is expected to be installed by 2033 since the final vehicle purchases are expected to occur at the end of 2033. Vehicle purchases will begin occurring in 2029 upon the completion of the Community Center and Quechan Casino Resort locations.

Figure 6-3: EV Transition Budget by Year (2025 \$000)



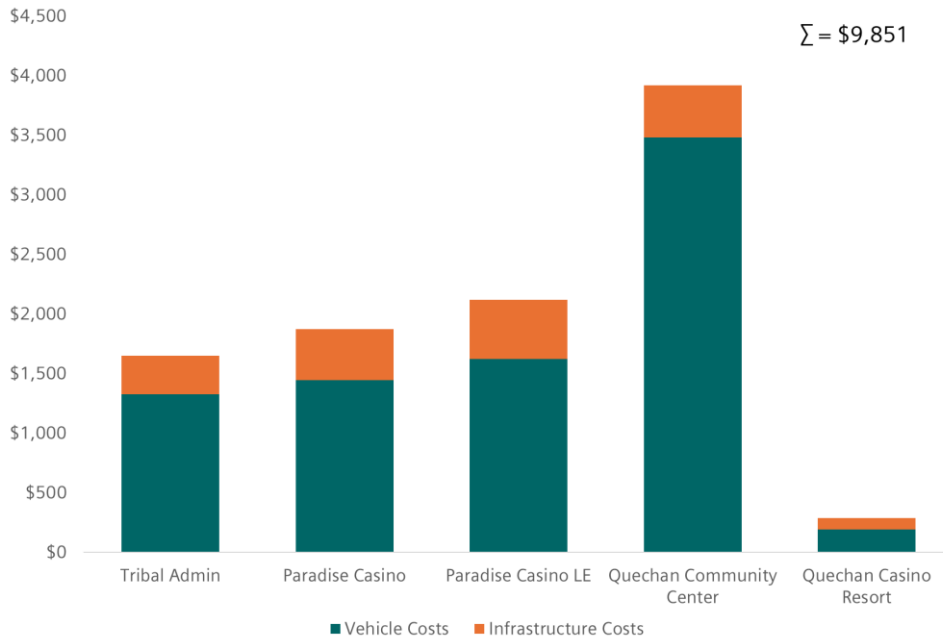
Siemens PTI recognized that the Tribe would need to replace its aging existing fleet regardless as vehicles reach the end of their useful life. We assume the replacement of the existing fleet with traditional vehicles is already budgeted and thus a key question for the Tribe is what the incremental cost of EVs and the associated infrastructure is. Figure 6-4 highlights the annual incremental EV and EV charging infrastructure costs, highlighting the premium that the Tribe will need to pay for EVs compared to gas vehicles. Based on the current fleet roster, replacing the fleet with new gas vehicles will cost approximately \$5.04 million, indicating that the **incremental EV vehicle cost is approximately \$3.03 million over the years 2027 to 2033.**

Figure 6-4: EV Transition Budget with Incremental EV Costs by Year (2025 \$000)



Infrastructure costs are a function of vehicle utilization and the number of chargers. Given that each of the four larger locations has a similar charger and number of vehicles, they have comparable infrastructure costs. Vehicle mix (types of vehicles) is the primary driver of the differing vehicle MSRP costs seen in Figure 6-5. The Community Center has the highest vehicle costs because it will support larger vehicles (larger trucks and buses). These vehicles require EV replacements that are more expensive.

Figure 6-5: EV Transition Budget by Location (2025 \$000)



6.4 Grid Impact

The expected number of chargers and load at each site was provided to IID. IID is the utility serving each of the sites. Connected KVA calculations assume a power factor of 0.9.

Table 6-3: Charging Hub Connected Loads

Location	Charger Count	Base Connected kW	Connected kVA
Tribal Admin	12	188.3	209.2
Paradise Casino	9	141.2	156.9
Paradise Casino LE	14	219.7	244.1
Quechan Casino Resort	3	47.1	52.3
Quechan Community Center	12	207.1	230.2

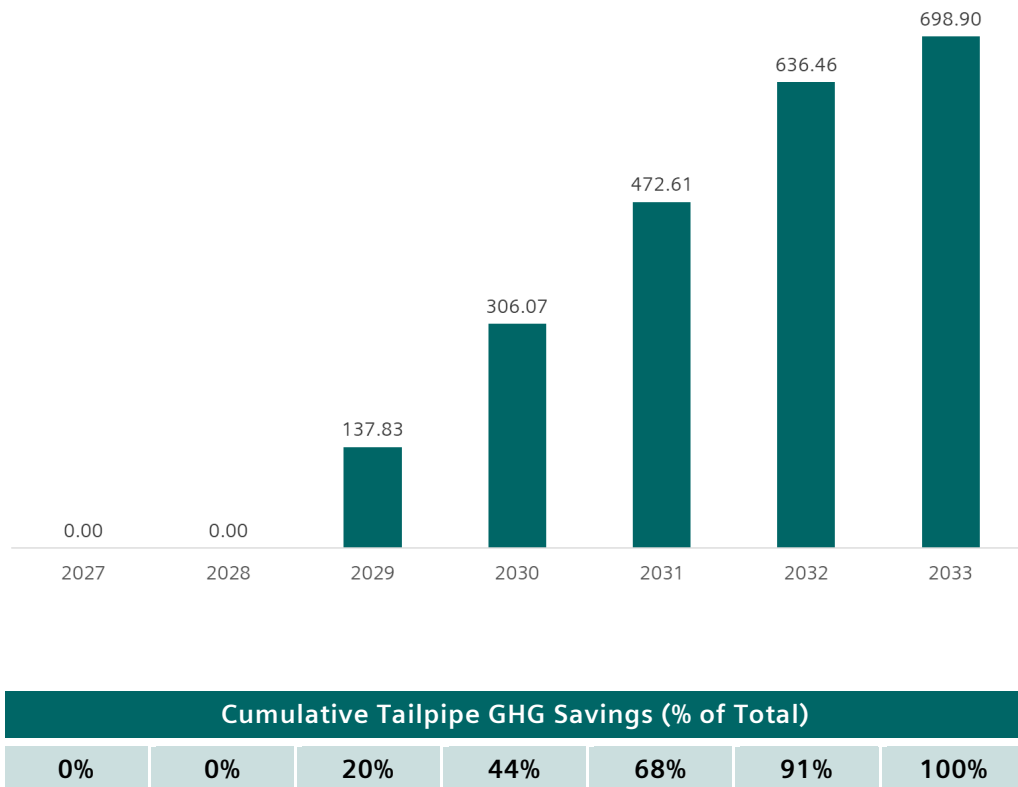
Table 6-3 was provided to IID in addition to an annualized version, which summarized the cumulative load additions by year, matching the development timeline in Figure 6-1. It should be noted that at the time of this report’s publication, IID’s planning department was in the process of completing its final circuit analysis. IID did not have any immediate concerns about the additional load at these locations; however, a more extensive analysis may be

required. The additional costs of this analysis or the added infrastructure impact required to support the charging load are not included in these results. If IID identifies any additional costs, they will be appended to this study.

6.5 Emissions Savings

Siemens PTI estimated the Quechan fleet emits approximately 698.9 metric tons of CO2 equivalent annually, comparable to 1,618 barrels of oil.⁵ This was calculated by applying emission factors from FuelEconomy.gov and comparing them with each vehicle’s annual mileage. Emissions factors reflect the specific make and model of the vehicle being replaced. Figure 6-6 highlights the cumulative reductions in the fleet’s tailpipe emissions. It should be noted that these reductions do not factor in emissions from grid-provided generation.

Figure 6-6: Cumulative Tailpipe Emission Reductions (Metric Tons)

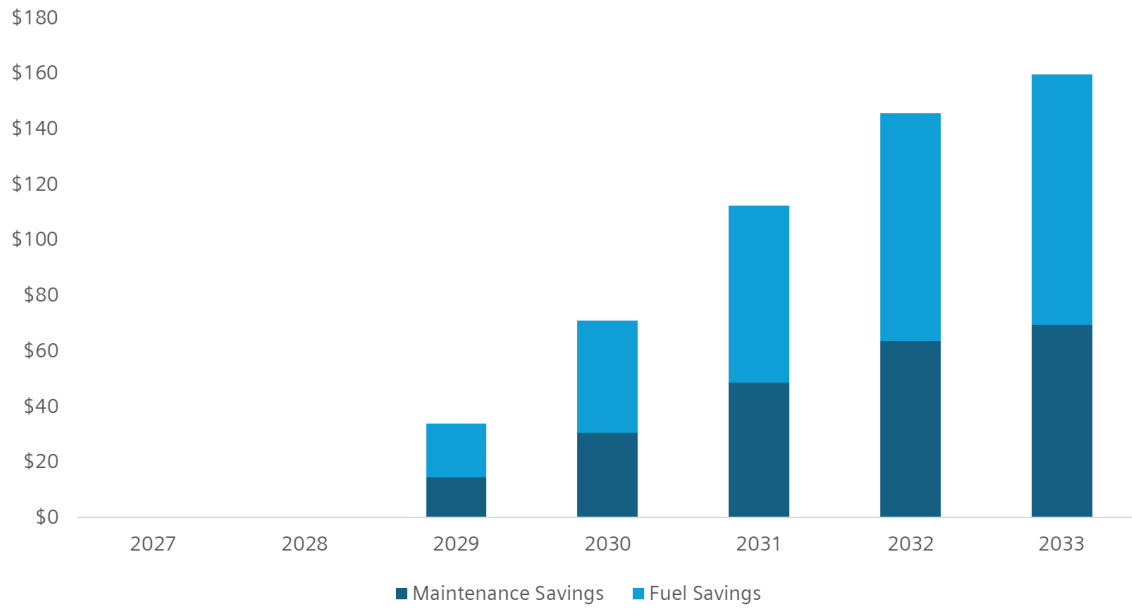


6.6 Operational Savings

Siemens PTI determined that with a full transition of the fleet, maintenance and fuel savings can amount to approximately **\$159,000 annually**. This was calculated by using the annual mileage of the fleet vehicles, estimating the costs of fuel and maintenance for the vehicle if it remained a gas vehicle, then comparing that to the respective costs of EV replacement. Figure 6-7 outlines the cumulative savings for each category by year. On average, the Tribe will save ~\$709 in fuel costs and ~\$546 in maintenance costs per vehicle each year.

⁵ Per EPA

Figure 6-7: Cumulative Maintenance and Fuel Savings (\$000)



7. Further Opportunities

7.1 Partial Fleet Replacement

The results outlined above represent the possibility of a 100% fleet replacement, setting an upper limit on the potential costs and impacts. However, as discussed early in the project between Quechan and Siemens PTI, when the time comes to replace vehicles and prepare to build charging infrastructure, some Tribal programs that own vehicles may choose to withdraw from consideration. Quechan has expressed that the transition may not be mandatory and will leave the decision in the hands of the fleet vehicle operators. The Tribe will take these individual decisions into account and develop an appropriate plan for the portion of the fleet that chooses to opt in. Fewer than 127 vehicles replaced will result in lower costs across the board and require fewer chargers; however, the climate benefit will be less.

Table 7-1: Quechan Fleet by Vehicle Type

Vehicle Type	Count	EV MSRP	% of Total Cost	% of Total Fleet Tailpipe Emissions
Sedan	14	\$605,300	8%	9%
SUV	26	\$1,264,431	16%	22%
Minivan	13	\$506,935	6%	8%
Van	10	\$490,000	6%	8%
Pickup	51	\$2,639,790	33%	37%
Medium & Heavy-Duty Truck	10	\$1,364,000	17%	15%
Bus	3	\$1,197,000	15%	2%

Table 7-1 above segments the Quechan fleet by vehicle type. The larger vehicle types (Medium/Heavy-Duty trucks and buses), despite only totaling 13 vehicles, contribute nearly 32% of the total MSRP costs for the fleet because their replacements are significantly more expensive. On a per-vehicle basis, these vehicles have higher emissions factors given their size; however, Siemens PTI identified that their annual mileage is the lowest across the fleet, thus lowering their share of the fleet's total emissions. Additionally, due to their size, these vehicles will require larger L2 chargers and have the greatest load impact when charging. Despite there being replacement options available for these types of vehicles, the required investment may not be justified.

Most of the fleet consists of smaller pickup trucks (class 2b and below). Per this analysis, this segment of the fleet contributes to approximately a third of the total MSRP costs for the transition and ~37% of total emissions. These vehicles are also among the most widely used on an annual mileage basis compared to others in the fleet. In years past, there have been several available options on the market for fully electric alternatives for light-duty pickups. However, at the time of this report's publication, many auto manufacturers have expressed

interest in moving away from fully electric pickup trucks and instead focusing on plug-in hybrids (PHEV). This is mainly due to declining sales and fewer incentives available (further explained in the following section). Even though replacing these vehicles with PHEVs won't result in a complete reduction in tailpipe emissions, they still emit less than ICE vehicles and may offer greater operational flexibility given the presence of a gas engine onboard. Additionally, the Tribe may choose to downsize vehicles if deemed reasonable. Some services and programs may be able to function with vehicles of a different type or class. For example, if a program currently operates a pickup but its operations can be conducted with an SUV or even a low-speed electric vehicle (LSEV), Quechan could opt for the smaller electric alternative, which will result in emissions savings but be significantly less expensive.

Sedans, SUVs, and minivans encompass approximately the same percentage of the fleet as the light-duty pickups, with similar cost and emissions contributions. Fully electric alternatives for these types of vehicles are plentiful in the market currently, and it's expected that this will remain the case in the coming years. If the tribe is interested in replacing a portion of the fleet and is worried about potential options, these vehicles may be more ideal candidates.

Once again, the Tribe will need to assess all options and have discussions with fleet operators to determine the best direction forward.

7.2 Fleet Funding Opportunities

As this study was conducted, the legislative landscape for EV incentives changed significantly. Due to a change in the federal administration, many of the programs driving the EV transition in the United States have been revoked. This includes 30D federal tax credit (New Clean Vehicle credit), which was reinforced by the Inflation Reduction Act (IRA) under the Biden Administration and offered up to \$7,500 for the purchase of new plug-in electric vehicles. Once the One Big Beautiful Bill (OBBBA) was enacted in July of 2025, this incentive was designated to sunset in September of 2025, seven years earlier than originally planned. Under the current Trump Administration, it's not expected that the 30D tax credit will be reinstated in the near future. Beyond 30D, many of the federal rebate programs for EV charging infrastructure have also been revoked. Despite the limited incentive landscape, a future change in administration, one that's more favorable to the EV transition, could offer more opportunities.

In response to fewer federal funding opportunities, some states have stepped in to fill the federal funding gap. For example, California has an ambitious 100% clean electricity goal by 2045, which includes increased investment in EV charging infrastructure. Siemens PTI has compiled a list of potential programs that could provide financial assistance to the Tribe in transitioning to an electric fleet. These programs are targeted mainly for larger vehicles. It's expected that more state-specific opportunities will be available in the coming months.

Table 7-2: Potential Quechan Tribe Funding Opportunities

Funding Opportunity	Amount and Award Type	Deadline	Source
California Air Resources Board (CARB) Bus Replacement Grant	Grant: Up to \$400,000 per vehicle	First-come, first-served	https://ww2.arb.ca.gov/our-work/programs/volkswagen-environmental-mitigation-trust-california
California Clean Truck and Bus Voucher Incentive Project (HVIP)	Voucher: Can be >\$100,000 per vehicle depending on class	First-come, first-served	https://californiahvip.org/?utm_source=chatgpt.com
CALeVIP Inland Counties Incentive Project	Rebate: Up to \$6,000 per level 2 connector	First-come, first-served	https://calevip.org/incentive-project/inland-counties?utm_source=chatgpt.com

To gain further insight into funding opportunities, Siemens PTI asked the Advisory Committee members from IID and Caltrans for any non-federal EV incentive programs that may be available. IID noted that there were no specific incentives offered by the utility for fleet charging infrastructure or workforce assistance.

7.3 Public Charging Opportunities

Outside of the fleet charging, Quechan has expressed interest in offering more public charging opportunities, beyond those noted in this feasibility study. Caltrans highlighted its Medium and Heavy-Duty ZEV Parking project. This program is designed to offer public charging opportunities for zero-emission trucks traveling along major corridors in California. Potential locations for this development include the Quechan Casino Resort as well as a proposed travel center located nearby.

In addition to this program, the National Electric Vehicle Infrastructure (NEVI) program has yet to be discontinued by the current administration. This program was introduced under the Biden administration and allocates funding for states to maintain a Level 3 charging network along key interstate corridors. Each state involved in the NEVI program has created plans outlining potential locations for these stations. If the Tribe wants to focus on public charging, aligning with the California or Arizona NEVI plans may offer funding support and economic development opportunities.

Quechan agreed that this study primarily explores the potential of a 100% electric vehicle transition for Tribal vehicles, with some additional opportunities for public charging provided. To demonstrate the potential economic benefits of offering public L2 charging, Siemens PTI analyzed an example charging configuration similar to that outlined in the plan for the Quechan Casino Resort and Paradise Casino.

Figure 7-1 below represents the potential monthly gross margin that could be achieved from operating two L2 chargers with two plugs each. Typically, public charging stations average between 25%-50% utilization across an entire day. For a four-plug setup, this would equate

to one or two cars charging on average at any given hour. Charging utilization would typically be lower in the early morning hours or on weekends, and greater during typical business hours. Plug utilization is the key driver of potential revenue and gross margin. Overbuilding and providing more plugs than the market requires will result in underutilized assets and high cost relative to revenues.

Figure 7-1: Potential Monthly Gross Margin by Charge Rate

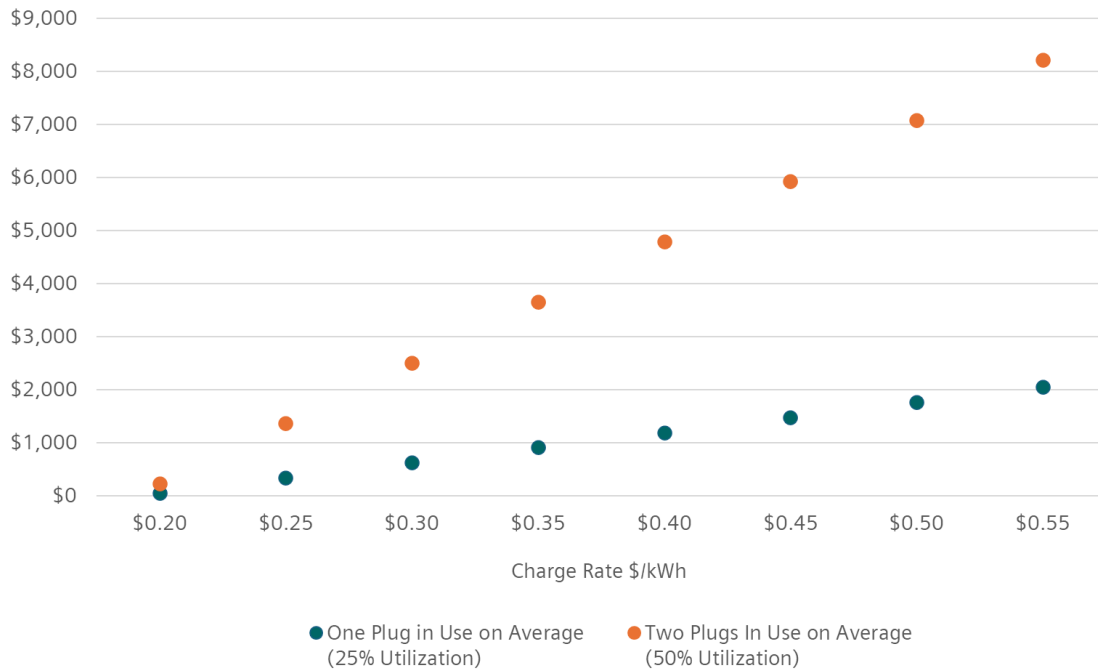


Figure 7-1 includes the costs to purchase power from IID, assuming a rate of \$0.19 per kWh, but it does not consider additional costs to own or operate the chargers themselves, including maintenance, station cell service, warranty, or CAPEX recovery for the added chargers and incremental required make ready infrastructure. For this analysis, Siemens PTI considered L2 charging because adding L2 charging at an existing fleet charging location would add minimal make ready costs. Adding L3 DCFC charging would require not only more expensive chargers, but substantially more robust make ready infrastructure, and could result in additional costs resulting from required IID upgrades. L2 charging, while slower than L3 DCFC charging, aligns well with EV drivers taking time to appreciate the amenities at the Paradise Casino or Quechan Casino Resort, and in doing so, could charge their EV at a lower cost using an L2 charger.

When considering the potential of public charging, Quechan must decide if public demand supports the development. If utilization can be maintained at a suitable level, the make ready costs are considered (or supported already by fleet charging development), and other operational costs are planned for, public charging may play a role in providing the Tribe with additional revenue.

7.4 Workforce Assessment

Siemens PTI analyzed the workforce requirements for the Tribe to carry out the transition outlined in the study by leveraging the JOBS EVSE (Jobs and Economic Impacts of Electric

Vehicle Station Equipment) tool. The tool was developed by the Argonne National Laboratory with funding from the U.S. Department of Energy’s Clean Cities Program. Based on user inputs, it helps estimate the economic impacts of charger development and the necessary employment requirements. The tool is also geographically granular in terms of its analysis, allowing the user to assess impacts on a state-by-state level (in this case, Arizona was selected). Siemens PTI uploaded the expected annual charger deployment into the model based on the development timeline outlined in Section 6.1.

Figure 7-2: Employment Requirement (Number of Workers)

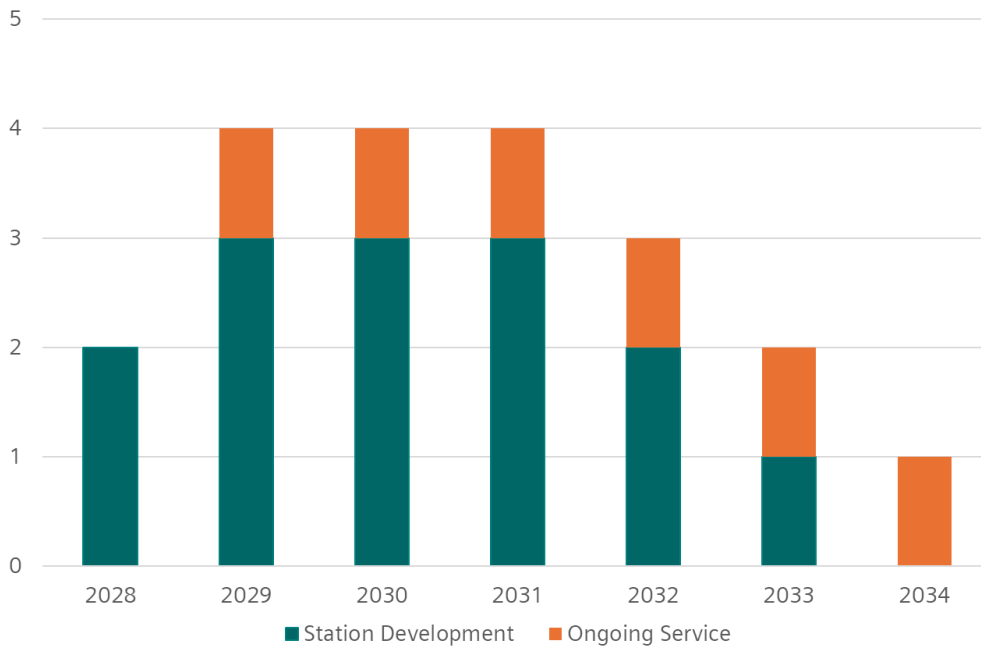


Figure 7-2 highlights the annual incremental employment requirements to support the development and maintenance of EV chargers. The incremental jobs shown focus on the physical construction, installation, and maintenance of the charging assets. During the peak years of the transition, Quechan can expect to employ at least 3 workers for station development (make ready, charger installation, etc.). Once chargers are installed, and the years following, at least 1 worker is required to service and manage the assets. Quechan can use this analysis as a starting point; however, more in-depth conversations are needed to understand the Tribe’s employment capabilities. Outside of the charging stations, the Tribe must train its existing vehicle operation and maintenance workforce on EV technologies to support the ongoing maintenance of the vehicles themselves (not included in the JOBS analysis above). Given that EVs have fewer maintenance requirements, a considerable amount of the service may come from the vehicle dealer.

7.4.1 Considerations and Resources

One of the major concerns for EV adoption is the availability of a skilled workforce that can meet the needs of this emerging market. A holistic workforce development strategy lays out the foundation for a thriving EV market. These types of technologies will continue to struggle to become mainstream if there is not a larger ecosystem of trained, skilled professionals that can provide services to keep EVs operational and safe. The development of said workforce can entail standardized education, training, certifications, and apprenticeships.

EV workforce development policies and programs must understand and be responsive to labor market dynamics to prepare enough skilled professionals for jobs that currently exist or will soon. Key factors to consider are the following:

- **Occupations needed:** Which occupations are needed to build and sustain EVs in a local, regional, and national market? Are there existing occupations that could expand into this space (with additional training), or are entirely new jobs and skill sets needed?
- **Anticipated growth rate for jobs:** How many jobs will be needed to support EV deployment and when? How can one ensure that labor supply and demand match? How will job growth change as the industry expands?
- **Current challenges:** How difficult is it for firms to find qualified labor? What skill sets do firms need?
- **Size of local job markets and regional distribution of jobs:** How can one discourage the training of workers into non-existent or declining job markets? What kind of firms hire for specific types of roles in the EV market? Where are they located?
- **Typical wages:** What are employers willing to pay for services? What kind of wages can workers expect in this industry? How do these wages compare with the cost of education required to perform in these jobs?
- **Equity concerns:** How can the representation of women and other minorities in EV workforce development be increased?

There are different types of professionals needed for this market, and for very different job occupations, such as engineers, technicians, electricians, installers, construction workers, project managers, etc.

Some examples of current programs and resources are the following:

- **Siemens Foundation’s Everyone Charging Forward:** Includes State and local collaborations to support an inclusive workforce for the EV charging sector. The NLC and NGA will provide resources, guidance, and best practices for states and cities to align policies and funding priorities and develop accessible, industry-recognized pathways to family-sustaining careers in the sector.
- **Federal Energy Management Program (FEMP):** provides live and on-demand training to foster and maintain a high-performance workforce that constructs, operates, and maintains energy-efficient and cost-effective federal facilities.
- **SAE International Electric Vehicle Supply Equipment (EVSE) Technician Certification:** a certification program to establish and verify the skills and knowledge of technicians who maintain, repair, and operate electric vehicle charging stations.
- **Alternative Fuel Data Center (AFDC) Resources:** AFDC provides overviews of maintenance and safety considerations for EVs. Additionally, it provides an extensive list of educational resources specific to the EV space.
- **Electric Vehicle Infrastructure Training Program (EVITP):** EVITP provides training and certifications for electricians installing EV supply equipment. It’s a brand-neutral, volunteer-based, nonprofit organization that trains electricians in the EV infrastructure

space. Training includes site assessment, load calculations, National Electric Code, jobsite safety, personal protection equipment, and other installation and maintenance best practices.

- **Future48 Workforce Accelerators:** a series of Arizona-based facilities designed to train workers for in-demand industries. Future48 offers customized training resources to support workforce development in many sectors, including the power and battery industries.

8. Appendix A: Further Site Details

Table 8-1: Charging Hub Charger Counts

Location	L2 50 amp (Dual Plug)	L2 50 amp (Single Plug)	L2 80 Amp	Total
Tribal Admin	0	3	6	9
Paradise Casino	0	0	12	12
Paradise Casino LE	0	12	2	14
Quechan Casino Resort	0	3	7	12
Quechan Community Center	2	0	3	3
Total	2	18	20	50

Figure 8-1: Proposed Charging Hub Location (Tribal Admin Building)



Figure 8-2: Proposed Charging Hub Location (Paradise Casino)

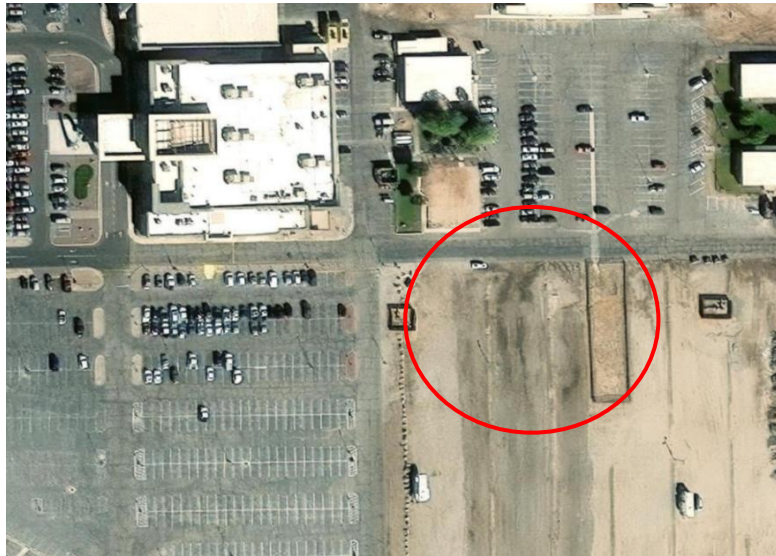


Figure 8-3: Proposed Charging Hub Location (Paradise Casino LE)



Figure 8-4: Proposed Charging Hub Location (Quechan Community Center)

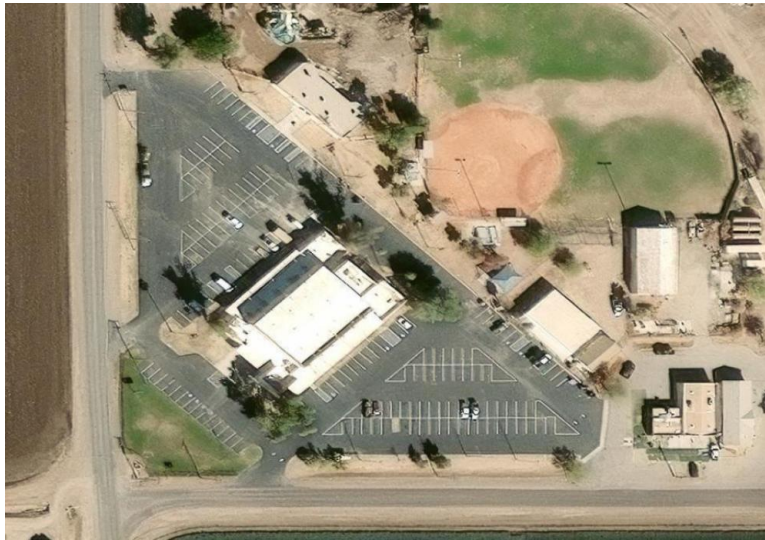
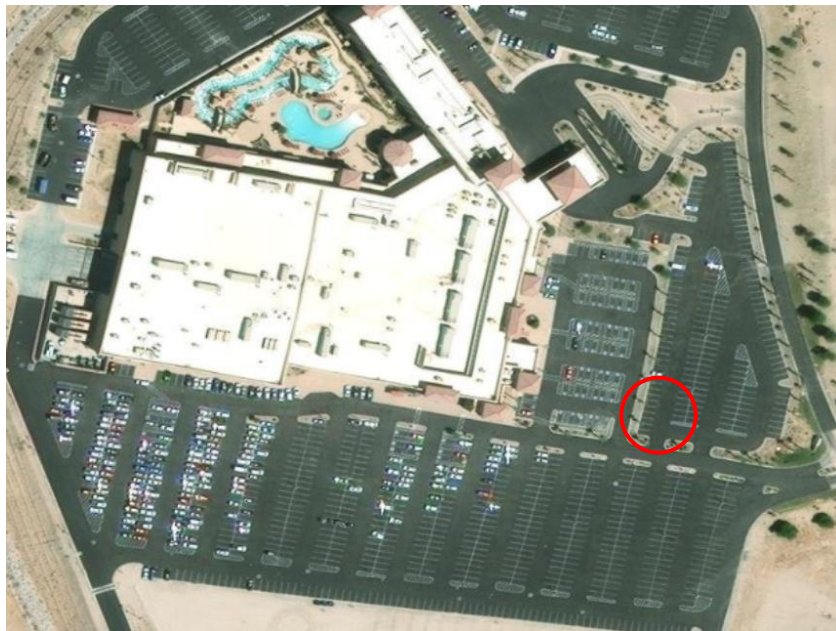


Figure 8-5: Proposed Charging Hub Location (Quechan Casino Resort)



9. Appendix B: Public Outreach

As part of the scope of work, Siemens PTI worked with Quechan to engage the Tribal community with the project. This came in the form of two in-person workshops held on Tribal grounds and conducted by local contractors at key points during the project timeline. The workshops were intended to provide status updates and gather feedback regarding the study's analysis and assumptions. Those in attendance were from Tribal programs that operate fleet vehicles. The first was held in May 2025 and the second in October 2025. An additional webinar was conducted in February 2026, serving as a precursor to the study's final delivery.

9.1 Workshop 1

The first workshop was held on May 21, 2025, at the Ironwood Community Center. This workshop served as the first formal introduction of the study to the Tribal community. Conducted early in the timeline of the study's analysis, the workshop primarily centered around the current fleet ecosystem while also gauging the interest of community members in owning electric vehicles of their own.

Stephine Poston and Darlene Lee of Poston & Associates conducted the workshop. Poston & Associates is a local communications firm based on the Pueblo of Sandia Reservation in New Mexico. The firm specializes in communication services and public outreach campaigns for Tribal communities. Siemens PTI provided Poston & Associates with the necessary presentation materials and worked with them to create promotional materials that were posted to the Tribe's website and at various locations on Tribal grounds. Representatives from five Tribal programs attended the workshop, including the ICWA (Indian Child Welfare Act), Senior Center, Office of Emergency Management, Fish and Game, and the Sleepy Hollow RV Park. The following day, Poston & Associates was ready to present the key takeaways from the workshop in a session with the Quechan Tribal Council, but the session was postponed to the following week. Tribal staff provided the Tribal Council with a recap of the workshop.

9.2 Workshop 2 and Final Webinar

The second workshop was held on October 15, 2025, at the Ironwood Community Center. This workshop was conducted after much of the study's future fleet analysis was completed. Finalized charger counts and locations were presented, and additional emphasis was placed on ensuring that these locations were feasible.

April Tinhorn and Zoie Thomas of Tinhorn CX conducted the workshop. Tinhorn CX is a local consulting group based out of Phoenix, Arizona, specializing in community outreach efforts for indigenous communities. As with the first workshop, Siemens PTI provided Tinhorn CX with the necessary presentation materials and collaborated to create promotional materials. Community members from three Tribal programs attended the workshop, including Records Retention, Fish and Game, and Water Management. As with the first workshop, Tinhorn CX presented the key takeaways from the workshop in a session with the Quechan Tribal Council the following day.

Tinhorn CX also conducted the virtual webinar held in February 2026. This webinar served as the final public outreach session, presenting much of the finalized analysis that was incorporated into this final feasibility study.

9.3 Key Takeaways

The workshops served as a means for Quechan and Siemens PTI to engage the Tribal community with the project and gain key insights that could guide the study's decision-making. There was no resistance from those in attendance regarding the proposed charging hub locations, giving Siemens PTI and Quechan further support to continue their analysis. Some attendees expressed hesitation about operating electric vehicles, citing concerns with battery range, terrain, and safety. Others emphasized grid stability and the need to deliberate with IID to ensure the impact is mitigated. The general sentiment of personal EV adoption was mixed; however, members of the community expressed support for a fleet transition if opportunities for further EV education were provided and the potential of on-site solar generation was explored. Overall, the community and Tribal council expressed interest in exploring how a fleet transition could align with the Tribe's greater sustainability, environmental, and economic goals. It was made clear that continued community participation, engagement, and education would be essential if a transition were to be conducted.

10. Appendix C: EV Advisory Committee

To further guide the study's decision-making, Quechan and Siemens PTI established the Quechan EV Advisory Committee, consisting of stakeholders pertinent to the project. Siemens PTI worked with Quechan to identify the best potential members. These included:

- **Quechan Economic Development Administration:** Brian Golding (Director)
- **Caltrans:** Virginia Mendoza (Associate Transportation Planner) and Omar Flores (Sustainable Transportation Planning Lead for District 11)
- **Imperial Irrigation District:** Gabriel Ramirez (Project Development Planner) and Alejandro Barraza (Engineering Tech)
- **Imperial County Planning & Development Services:** Michael Abraham (Assistant Planning & Development Services Director)
- **Imperial County Transportation Commission:** David Aguirre (Executive Director) and Gustavo Gomez (Senior Transportation Planner/Regional Mobility Coordinator)
- **Paradise Casino:** Frank Comet (Manager, Facilities)
- **Tinhorn CX:** April Tinhorn (Community Engagement Consultant)

Six meetings were held virtually from August 2025 through January 2026. The purpose of the meetings was to engage the committee with many of the key assumptions surrounding Siemens PTI's analysis and present results. The meeting consisted of

1. The first meeting (August 6, 2025) introduced the study to the group, mainly focused on the current fleet ecosystem analysis and gauging the feasibility of the potential charging hub locations.
2. The second meeting (August 27, 2025) introduced the preliminary future fleet analysis, describing the methodology Siemens PTI utilized to determine the charger requirement for the fleet.
3. The third meeting (September 23, 2025) presented finalized charger counts for each location and introduced the methodology for determining the phasing of the transition.
4. The fourth meeting (October 28, 2025) discussed the takeaways from the second community workshop conducted by Tinhorn CX and introduced the assumptions that would be used to determine the costs of the transition.

5. The fifth meeting (December 2, 2025) introduced the key results of the final analysis, namely the transition development timeline, program costs by year and by location, and potential emissions savings.
6. The final meeting (January 28, 2026) discussed the initial draft of the study with the goal of incorporating feedback into the final deliverable

The Advisory Committee was designed to support the study's analysis. Each member of the committee provided key considerations that guided Siemens PTI's assumptions, ensuring the validity of the final product. The committee may also serve as a precursor to future collaborations, which will help guide the Tribe's transition planning.

11. Appendix D: Modeled Electric Vehicle Replacements



2024 Nissan Leaf BEV



Tesla Model 3 RWD BEV



2023 Chevrolet Bolt EV BEV



2023 Ford Transit Van Cargo BEV



2023 Ford Transit Van Cutaway BEV



2023 Ford Mustang Mach-e RWD LFP BEV



2024 Kia EV9 Standard Range RWD BEV



2025 Chevrolet Equinox EV FWD BEV



2025 Ramcharger PHEV



2023 Volkswagen ID Buzz



2023 Ford F-150 Lightning 4WD BEV



2024 Rizon E18L BEV



2023 Roush Ford F-650 BEV



2026 Chevy Blazer Police



2025 Freightliner EM2 Chassis BEV



2024 IC Corporation CE School Bus BEV

12. Appendix E: Implementation Best Practices

In the EV ecosystem, there are established best practices and recommendations to help ensure smooth operations. The California Energy Commission (CEC) provides various guides and resources for charging station hosts, installers, and communities to navigate the process of permitting, purchasing, installing, and operating charging stations. These include general guides for site owners and developers, as well as best practices for workplace charging and Level 2 EV chargers. These resources help different stakeholders plan, install, and manage EV charging stations in their respective contexts.

The National Renewable Energy Laboratory (NREL) is another leading organization in the EV ecosystem, offering valuable insights and recommendations. A key recommendation is to involve a technical expert and electrical engineer from the start of each project to ensure the successful and timely installation of charging stations. It is also advised to have a dedicated project manager oversee the entire installation or fleet transition process, creating a timeline and facilitating regular meetings with all relevant parties.

When selecting sites, choosing locations with easy access to existing electricity is essential to minimize installation costs. Ensuring sufficient electricity capacity to accommodate future charging needs is also crucial. Renewable energy sources can be considered as a power option. Cellular service availability should also be taken into account, as it may impact the required infrastructure.

Partnering with other organizations to share the costs of charging infrastructure is recommended whenever possible. Additionally, analyzing the conditions of the surrounding area is advised, as it can help determine the level of maintenance required, especially considering seasonal variations. An example of this could be geography and terrain. Uneven terrain or areas prone to flooding may require special installation considerations, such as elevated platforms or water-resistant enclosures for outdoor chargers. Largely, these conditions refer to any factor that can impact the performance, maintenance, and long-term sustainability of the charging stations.

Lastly, a feasibility analysis should be one of the first steps, confirming the need, demand, and potential utilization of the charging infrastructure before proceeding with the project.

All of this can be summarized into a general checklist, typically in the order listed below, though some items are done in parallel:

- **Confirm Project Feasibility:** Assess demand, scope, timeline, budget, and approvals.
- **Identify Key Partners:** Collaborate with utilities, agencies, and manufacturers.
- **Determine Equipment Needs:** Decide on charging equipment, types, and costs for various applications.
- **Networking and Payment:** Decide if chargers will be networked and include payment capabilities.

- **Site Selection:** Choose an ideal location considering power infrastructure and future demand.
- **Utility Coordination:** Inform the utility about load and assess impacts.
- **Installation Planning:** Identify necessary electrical upgrades and obtain permits.
- **Compliance and Installation:** Complete installation and ensure regulatory compliance.
- **Maintenance and Operations:** Define responsibilities for ongoing maintenance and operation.
- **Public Awareness:** Promote the charger via websites, social media, and signage.

13. Appendix F: Load Management Best Practices

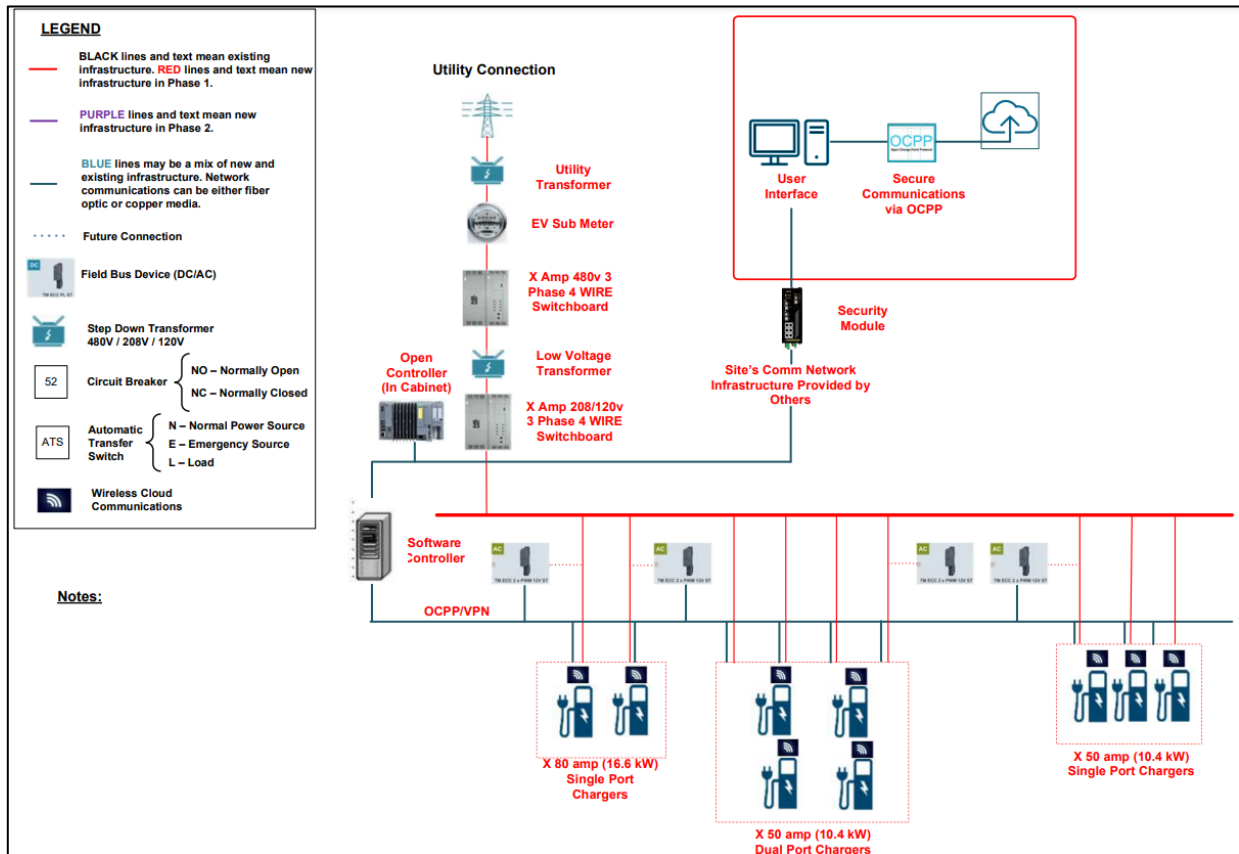
Load management systems have become essential in the EV market and are widely used where there are clusters of EV charging at locations. Also known as load shifting, load control, load curtailment, and load restricting, load management controls the maximum total power made available to a group of EV chargers. Load management often includes a demand response capability, which connects to the electric utility and other third-party software platforms, controlling how the available power is shared across a group of EV chargers.

EV charging load management provides two key benefits. In the first, load management allows owners to connect multiple charging stations to a single circuit, which helps avoid or minimize expensive installation costs or upgrades. Without load management, installations may require increased electric supply, in turn increasing equipment capacity and cost. In the second, the costs of electric supply to charging stations can be minimized by scheduling charging to times when electric costs are lower. By scheduling charging, to the degree possible, in off-peak times, often overnight and on weekends, electric rates will be lower. Load management benefits include:

- **Optimize Power Distribution**
 - Efficiently manage distribution across charging stations throughout the site.
 - Safely operate more stations than the electrical circuit would normally support.
 - Dynamically changes the load in real time in response to the charging demand.
- **Control Energy Costs**
 - Remove the need for costly electrical panel upgrades.
 - Reduce energy consumption during peak times.
 - Ensure that existing circuit capacity can charge multiple vehicles.
 - There are many advantages of EV charging load management.
- **Eliminate the Risk of Overloading**
 - Reduce the required load during times of high usage.
 - Monitor real-time use to manage capacity.
 - Ensure that set power limits are not exceeded.

A simplified installation concept for a site with only L2 charging is provided in Figure 13-1 below.

Figure 13-1: Generic EV Charging Concept, L2 Charging Only



Hardwired and Wireless Load Management

Load management systems can either be hardwired or wireless. At the heart of the systems is a Power Control System (PCS), which can generally control up to 50 EV chargers simultaneously, which can cost from \$4,000-\$5,000, not including installation. PCS systems are generally controlled by a local interface that may require an enclosure, which can add between \$250 and \$500 per charger, depending on the distance from the PCS.

Conversely, wireless systems use a cellular network to communicate with the EV chargers and do not require a PCS, and everything is controlled online through the cloud, typically through a vendor website. Equipment and installation costs tend to be lower for wireless systems, and there are no limits to the number of EV chargers controlled by a single system. However, there is a wireless network access fee, generally ranging from \$200 to \$350, which can be negotiated for larger installations. Since the systems are wireless, reliability is dependent on the quality of the available internet connection, which can be degraded in the lower levels of parking garages.

14. Appendix G: Support Models

14.1 Support Models

When most entities first consider the need for EV charging, they generally expect to follow a traditional business model in which they build, own, and operate the charging infrastructure. However, there is a spectrum of alternatives available. Selection may hinge on tradeoffs between profits, risk, and competition for scarce capital, and similar questions arise regarding insourcing and outsourcing operations and maintenance. Generally, these alternatives can be grouped into four models: Host Owned Equipment Purchase, Hybrid Owned Revenue Shared, Energy as a Service Monthly Subscription, or Partner Owned Turnkey Solution. Key elements of these models are presented in Figure 14-1 below.

Figure 14-1: EV Charging Roles and Responsibilities for Typical Ownership Models

	Host Owned Equipment Purchase Model		Hybrid Owned Revenue Shared Model		Energy as a Service Monthly Subscription		Partner Owned Turnkey Solution	
	Host	Partner	Host	Partner	Host	Partner	Host	Partner
Site Preparation (i.e., Make Ready)	●		●		●			●
Equipment Cost	●			●		●		●
Charger Installation	●			●		●		●
Electricity	●			●	●			●
Make Ready Maintenance	●		●		●			●
Charger Maintenance	●			●		●		●
Network Connectivity Fee	●		Negotiated		Included		Negotiated	
Subscription Fee					●			
Indicative Charging Revenue Share	100%	0%	40%	60%	100%	0%	5%	95%

15. Appendix H: Other Charging Considerations

15.1 Charging Levels, Chargers, and Plugs









Charger levels denote charging speed, with Level 1 (L1) the slowest, Level 2 (L2) in the middle, and Level 3 (L3), also known as Direct Current Fast Charge (DCFC), the fastest. Charger designs vary by manufacturer, so the speed of L2 and L3 chargers will differ depending upon manufacturer and charger model. L1 chargers plug into a typical 120-volt outlet, like those in your home. L2 chargers plug into a 208-volt plug like that used for your dryer or oven. L3 chargers must be connected to a 480-volt plug common in larger commercial or industrial settings.

Chargers may have as few as one or as many as perhaps four ports or plugs for each charger, which is the end of the cable that plugs into the vehicle and delivers the electricity from the charger to the vehicle. Some chargers are designed to deliver the same charging speed regardless of how many vehicles are plugged into the charger, while the speed of others will be reduced as more vehicles are plugged into the same charger. For example, one model of L2 charger with two plugs, sometimes termed a dual port charger, can deliver the same electricity to each of the two plugs, while another can only deliver half the electricity to each plug at the same time.

At this time, there are several types of connectors in the market. These connectors are at the end of the plug and make the physical connection between the plug and the vehicle.

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Table 15-1: Charging Level Definitions

Parameter	Level 1	Level 2	Level 3/ DC Fast
Graphical Representation			
Voltage	120 volt 1-phase Alternating Current (AC)	208 volt 1-Phase AC	480 volt 3-phase
Amperage	12 – 16 amps	12 – 80 amps (32 amps typical)	< 125 amps (60 amps typical)
Connector Type	Compatible with: • J1772 connector 	Compatible with: • J1772 connector 	Compatible with: • Combined Charging System (CCS) Connector  • CHAdeMO Connector  • Tesla Connector 
Typical Power Output	1.4 – 1.9 kW	2.5 – 19.2 kW (Typical 7 kW)	50 -350 kW
Range	2 to 5 miles of range per 1 hour of charging	10 to 30 miles of range per 1 hour of charging	150 to 350+ miles of range per 1 hour of charging

15.2 Electric Vehicle Benefits over Internal Combustion Engine Vehicles (ICEV)

The transition from ICEV to EV has various benefits, ranging from cost of ownership to air quality and environmental benefits.

When comparing the benefits (cost and environmental) between an electric vehicle and an internal combustion engine, there are various items to consider. All items will vary based on model, but when comparing electric vehicles to internal combustion engine vehicles of a similar model:

- **Purchase Price:** Historically, EV’s have been higher, though this gap has been narrowing due to advances in battery technology, increased market supply, and government incentives.
- **Fuel Cost:** Typically, much cheaper for EV compared to ICEV due to the efficiency of electricity compared to gasoline. The average electricity cost ranges from \$0.10-\$0.20 per kWh, with an average range of 3-4 miles/kWh, the average fuel cost for an electric vehicle is around \$.03-\$.06 per mile. While gasoline prices vary depending on season and external factors, a typical range is around \$3-\$5 per gallon, and assuming a fuel efficiency of 20-30 miles per gallon, an ICEV fuel price is roughly \$0.10-\$0.20 per mile.
- **O&M:** Electric vehicles generally require less maintenance than internal combustion engine vehicles. This is because EVs have fewer moving parts compared to ICEVs such as no transmission, no exhaust system, no oil changes, etc.).

- **Return on Investment (ROI):** Over a typical lifespan (assuming 100k-150k miles), an EV can achieve \$6,000-\$10,000 in fuel savings compared to an ICEV, along with additional savings from O&M. It is expected that an EV will often offer a positive ROI, especially if it is utilized for a long time.
- **Environmental Benefits:** EVs produce no tailpipe emissions (CO₂, NO_x, or particulate matter), which leads to improved air quality in some regions. However, the total emissions benefit can vary based on the energy mix used to charge the EV. In regions reliant on coal or natural gas for power generation, secondhand emissions may be associated with an electric vehicle. The mining of raw materials for electric vehicle batteries does have an environmental impact but is decreasing as recycling improves and battery technologies evolve.

While EV's may currently have a higher purchase price, the overall cost, ROI, and environmental benefits exceed those of their internal combustion engine counterparts. It is expected with battery technology improvements, the growing shift towards clean energy, and the required infrastructure to reliably utilize electric vehicles, EV's are increasingly seen as the more suitable and cost-effective option long term.

15.3 EV Safety Considerations

Electric-based mobility introduces new safety concerns, not only relating to the operation of the devices but also as it pertains to charging infrastructure standards. Lithium-ion batteries are the primary battery type used for micromobility. Physical damage, electrical damage, extreme temperatures, product defects, and overcharging have led to chemical fires, which release heat, smoke, and toxic gases. The diverse range of developers for these devices increases the odds of equipment malfunctions, as there are no uniform performance or safety standards in effect. Moreover, for applications that are in remote areas, fires from equipment failures could lead to wildfires.

15.4 ADA Requirements

The U.S. Access Board, an independent federal agency that issues accessibility guidelines under the Americans with Disabilities Act (ADA), Architectural Barriers Act (ABA), Rehabilitation Act of 1973, and other laws, provided a technical assistance document to assist in the design and construction of electric vehicle (EV) charging stations that are accessible to and usable by people with disabilities. The document is titled "Design Recommendations for Accessible Electric Vehicle Charging Stations", it was last updated on July 17, 2023 and is publicly at <https://www.access-board.gov/tad/ev/>. States such as California have built these requirements into new building codes.

The Access Board offers guidance for EV charging stations including:

- State or local government offices
- Public parks
- Municipal building parking lots
- Street parking and the public right-of-way
- Residential housing facilities provided by a state or local government
- Public EV charging stations provided by a private entity

- Fleet charging stations used by the federal government
- Commercial fleet charging stations available to corporate clients
- Rest stops along the Interstate Highway System

EV charging requires drivers with disabilities to exit their vehicle, traverse to the charger, and carry the connector back to their vehicle charging inlet (which may be on the opposite side of where they enter/exit their EV). Since EVs do not have a standard location for the vehicle charging inlet, maneuverability around the entire EV is needed. Also, as L3 cables get heavier and shorter to achieve faster charging, EVs need to be parked in a way that aligns the vehicle charging inlet with the charger, which could conflict with the orientation needed for a driver with a disability to use the access aisle.

It is generally agreed that an EV station should include a reasonable number of EV chargers with physical access for people who use mobility devices, such as wheelchairs, scooters, walkers, and canes. Accessible mobility features primarily concern the size of the vehicle charging space, providing access aisles, how and where the chargers are installed, and the physical operability of the charger.

It is also understood that all EV chargers should have accessible communication features and operable parts. This enables EV chargers to be used by people who are deaf or hard of hearing, little people, and other people with disabilities who do not need accessible mobility features (like access aisles) to use an EV charger. All EV chargers containing ICT that are developed, procured, maintained, or used by the federal government must comply with the Section 508 Standards and have accessible ICT, including accessible hardware, software, and operable parts.

EV chargers designed to serve people who use mobility devices must be located on an accessible route and should provide:

- A vehicle charging space at least 11 feet wide and 20 feet long
- Adjoining access aisle at least 5 feet wide
- Clear floor or ground space at the same level as the vehicle charging space and positioned for an unobstructed side reach accessible operable parts, including on the charger and connector.

These mobility features allow sufficient space for a person who uses a mobility device to exit and maneuver around the vehicle, retrieve the EV connector, and plug the connector into the electric vehicle charging inlet. Since EVs do not have a uniform vehicle charging inlet location, a larger vehicle charging space is needed to maneuver around all sides of the electric vehicle.

Figure 15-1 below depicts the access and space issues a person using mobility devices might face at an EV charging station.

Figure 15-1: Sample ADA Accessibility Issue



(Image source: The U.S. Access Board)

Designing EV charging stations is made challenging in part by the fact OEMs place EV charging inlets in different locations, and this issue is compounded when including accessible mobility features. Since the vehicle charging inlet needs to align closely to the charger, a person with a disability will often need to access the aisle positioned on the driver's side. Figure 74 above depicts the issue and space requirements.

It is important to note that the ADA and ABA Guidelines do not specifically address how many chargers must be accessible at an EV charging station. Under the ADA Standards, when a facility or element does not have specific scoping requirements, access to a "reasonable number" is required under the general prohibitions against discrimination in the Department of Justice (DOJ) regulations for Title II and Title III entities. However, the Access Board provides guidance that aligns with the 2021 International Building Code (IBC), which requires 5%, resulting in the suggestion in Table 15-2 below.

Table 15-2: Access Board Accessible Parking Recommendation

Table 208.2 Parking Spaces

Total Number of Parking Spaces Provided in Parking Facility	Minimum Number of Required accessible Parking Spaces
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1000	2 percent of total
1001 and over	20, plus 1 for each 100, or fraction thereof, over 1000

As specifically regards fleets, the Access Board under §203.9 of the ADA Standards, entities subject to Title II or Title III of the ADA may be eligible for an exception for EV charging stations provided at a commercial facility for charging fleet vehicles under the employee work area exception if charging stations are used only by employees for charging company/fleet vehicles. However, it is recommended that at least one EV charger have accessible mobility features to accommodate employees with disabilities because the employer may be required to provide an accessible EV charger if requested by an employee as a reasonable accommodation.

The Access Board further indicates that if charging stations are provided for employees to charge their personal vehicles, the employee work area exception would not apply, and EV charging stations must be accessible. EV chargers provided for specific employees to charge their personal vehicles should provide accessibility as needed.