Guidehouse

FILED
11/13/26
10:28 AM
R2312008

Transportation Electrification Proactive Planning: Corridor Disaggregation Methodology

DRAFT FOR PUBLIC COMMENT

Prepared for:

California Public Utilities Commission

Submitted by:
Guidehouse Inc.
400 Capitol Mall Room #08-102 Sacramento, CA 95814

Reference No.: 225223

July 2026

guidehouse.com

This deliverable was prepared by Guidehouse Inc. for the sole use and benefit of, and pursuant to a client relationship exclusively with the California Public Utilities Commission (CPUC) ("Client"). The work presented in this deliverable represents Guidehouse's professional judgement based on the information available at the time this report was prepared. Guidehouse is not responsible for a third party's use of, or reliance upon, the deliverable, nor any decisions based on the report. Readers of the report are advised that they assume all liabilities incurred by them, or third parties, as a result of their reliance on the report, or the data, information, findings, and opinions contained in the report.

Table of Contents

1. Introduction 7

1.1. Overview of Corridor Disaggregation Methodology 7

1.2. Approach to BEV Load Calculation 7

1.2.1. BEV Charging Load 7

1.3. Scope of Analysis 9

1.4. Data and Inputs 10

1.5. Document Contents 13

2. CDM Implementation 14

2.1. Corridor Segmentation and Characteristic Assignment 16

2.2. Corridor Energy Requirement Calculation 19

2.3. Integration of Trip Data and Cumulative BEV Energy Requirement 20

2.4. BEV Load Calculation through Integration of Charging Behavior 21

2.4.1. Where Charging is Likely to Occur 21

2.4.2. When Charging is Likely to Occur 22

2.5. CDM Outputs 23

2.5.1. BEV Load (MW) 23

2.6. Potential Integration with California Energy Commission (CEC) Load Bus Allocation 24

3. Potential Future Refinements 26

3.1. Integration of Additional Road Networks 26

3.2. Integration of Light Duty Residential and Workplace Charging 26

3.3. Integration of Additional Vehicle Types (e.g., Off-road) 26

3.4. Data Updates and Refinements 26

4. Key Considerations 28

4.1. Corridor Definition 28

4.2. Fleet Depot Data 28

4.3. Charging Behavior Assumptions for Medium- and Heavy-Duty BEVs 29

4.4. Charging Behavior Assumptions for Public Charging 29

Appendix A. BEV Energy Requirement Formulas 30

Appendix B. Route Likelihood Calculation Example 31

Appendix C. Cumulative BEV Energy Requirement Calculation Example 36

Appendix D. BEV Load (MW) Formula 41

Appendix E. Corridor Segmentation Example 42

Appendix F. Probabilistic Modeling of BEV Charging 46

F.1 Probabilistic Modeling Overview 46

F.2 Probabilistic Modeling Methodology 47

Appendix G. Expansion of Geotab Data 49

Appendix H. Roads Included in CDM 51

Appendix I. CDM Outputs 53

List of Tables

Table 1-1. Parameters Associated with Charging Behavior 8

Table 1-2. Geospatial Data for CDM 10

Table 1-3. BEV Characteristics for CDM 12

Table 1-4. Charging Behavior for CDM 13

Table 2-1. Corridor Segment Characteristics 17

Table 2-2. Inputs for Corridor Segment BEV Load Calculation 19

Table 2-3. Assumptions on Where a BEV Will Charge 22

Table F-1. Probabilistic Modeling of BEV Charging Example 48

Table H-1. Roads Included in the CDM 51

Table I-1. CDM Outputs 53

List of Figures

Figure 2-1. CDM Output Calculation Process 14

Figure 2-2. CDM Logic Model 15

Figure 2-3. California Highways in CDM 16

Figure 2-4. Route Likelihood Calculation 20

Figure 2-5. Cumulative BEV Energy Requirement Calculation 21

Figure 2-6. Calculation of BEV Load (MW) 24

Figure B-1. Route Likelihood Step 1 Example: Number of Trips 31

Figure B-2. Route Likelihood Step 2 Example: Identify Routes 32

Figure B-3. Route Likelihood Step 3 Example: Calculate AADT 33
Figure B-4. Route Likelihood Step 4 Example: Determine Route Weight 34
Figure B-5. Route Likelihood Step 5 Example: Determine Number of Trips per Route 35
Figure C-1. Cumulative Energy Step 1 Example: Number of Trips 36
Figure C-2. Cumulative Energy Step 2 Example: Identify Destination Corridor Segments 37
Figure C-3. Cumulative Energy Step 3 Example: Determine Length of Trip 38
Figure C-4. Cumulative Energy Step 4 Example: Determine Trip BEV Energy Requirement 39
Figure C-5. Cumulative Energy Step 5 Example: Determine Cumulative BEV Energy Value 40
Figure E-0-1. Interstate Highway in FAF 5 to be Included in CDM 42
Figure E-0-2. Segments of US 395 from FAF 5 based on Traffic Volume 43
Figure 0-3. Segments of US 395 with SCE and LADWP Boundary 44
Figure F-1. CDM Output vs Charger Location Driven Approach 46

List of Acronyms

- **AADT:** Average annual daily traffic derived from the Federal Highway Administration's Freight Analysis Framework, Version 5, and trip data. Average annual daily traffic is the number of vehicles that travel across a corridor segment on an average day.
- **AATE:** Additional Achievable Transportation Electrification; load modifier used in the California Energy Commissions Integrated Energy Policy Report
- **AFDC:** Alternative Fuels Data Center, information and data on alternative and renewable fuels, advanced vehicles, fuel-saving strategies, and emerging transportation technologies, provided by the Department of Energy
- **BEV:** Battery Electric Vehicle
- **Charger:** Electric vehicle supply equipment used to charge electric vehicle batteries, which may consist of one or many ports.
- **CEC:** California Energy Commission
- **Corridor Disaggregation Methodology:** The methodology by which public DC charging load for LD and MDHD EVs is allocated to specific corridor segments throughout major corridors in California.
- **Corridor Segment:** A section of a major arterial and collector road, interstate highway, collector/distributor lane or controlled-access highway no longer than 3 miles in length that varies in traffic volume from adjacent sections of the same major arterial and collector road, interstate highway, collector/distributor lane or controlled-access highway and exists in a single utility territory.
- **CPUC:** California Public Utilities Commission
- **CTC:** California Transportation Commission
- **DAC:** Disadvantaged Community, based on geographic, socioeconomic, public health, and environmental hazard criteria. As designated by CalEPA for the purposes of SB 535, disadvantaged communities include census tracts receiving the highest 25 percent of overall scores in CalEnviroScreen 4.0, census tracts with CalEnviroScreen 4.0 data gaps but which received the highest five percent of CalEnviroScreen 4.0 cumulative pollution burden scores, census tracts identified in the 2017 DAC designation as disadvantaged, and lands under the control of federally recognized Tribes.
- **DCFC:** Direct current fast charging infrastructure for electric vehicles
- **EV:** Electric Vehicle
- **FAF 5:** Federal Highway Administration's Freight Analysis Framework, Version 5, providing estimates of US freight flows
- **I&A:** CPUC's Transportation Electrification Proactive Planning Modeling Inputs and Assumptions
- **IEPR:** Integrated Energy Policy Report

- **IOU:** Investor-Owned Utility
- **kWh:** Kilowatt hour
- **L2:** Level 2 charging infrastructure for electric vehicles, operating at anywhere from 3 kW to 19 kW of AC power
- **LD:** Light-Duty [vehicle]
- **MDHD:** Medium and Heavy Duty [vehicle]
- **MW:** Megawatt
- **NLR:** National Laboratory of the Rockies, formerly known as National Renewable Energy Laboratory
- **Non-Attainment Area (NAA):** [Ozone] Nonattainment areas, Environmental Protection Agency terminology for areas that do not meet the national primary or secondary ambient air quality for a national ambient air quality standard (NAAQS)
- **O/D:** Origin/destination, for the purposes of the CDM, used in reference to vehicle trip data that provides insights into where a vehicle began its trip and where a vehicle completed its trip
- **Port:** The component of a charger that is physically connected to an electric vehicle to provide energy to the vehicle.
- **POU:** Publicly- owned utilities
- **SOC:** State of Charge, representing an electric vehicle battery's energy level as a percentage; analogous to the fuel gauge of a gasoline-powered vehicle
- **TE:** Transportation Electrification
- **TEPP:** Transportation Electrification Proactive Planning
- **TEPP Modeling I&A :** : Transportation Electrification Proactive Planning Modeling Input and Assumptions; set of inputs and assumptions used to inform transportation electrification modeling
- **TOU:** Time of use, used in reference to electric rates that have different costs of electricity based on the time of day the energy is consumed.
- **VGI:** Vehicle-grid-integration; any method of altering the time, charging level, or location at which grid-connected electric vehicles charge or discharge in a manner that optimizes interaction with the electric grid
- **VMT:** Vehicle Miles Traveled
- **ZEV:** Zero-Emission Vehicle

1. Introduction

The adoption of battery electric vehicle (BEV) technology in the California market is rapidly extending beyond light-duty (LD) vehicles. Meeting the energy demand and transportation needs of medium- and heavy-duty (MDHD) electric vehicles will require public charging infrastructure. Transportation electrification (TE) infrastructure planning must account for increased load impacts to California's electric system from the emerging MDHD BEV population as the market develops.

To support this infrastructure planning, the California Public Utility Commission (CPUC) engaged Guidehouse Inc. to develop a **Corridor Disaggregation Methodology (CDM)**. The **purpose** of this methodology is to inform targeted grid planning by estimating public charging demand for LD and MDHD BEVs within one mile of 150 major California corridors at a granular level. The **objective** of this document is to outline the **CDM** which leverages the Transportation Electrification Proactive Planning Modeling Input and Assumptions (TEPP Modeling I&A). The CDM brings together TEPP Modeling I&A, including charging assumptions and geospatial input data for various corridors within the state of California to identify demand for charging on a corridor segment basis.

1.1. Overview of Corridor Disaggregation Methodology

The CDM intends to identify expected TE load associated with public LD and MDHD BEV charging along 150 California highway corridors, leveraging the TEPP Modeling I&A. The output of the CDM is a disaggregation of TE charging demand **through 2045 for each corridor segment** (see Sections 1.2, Section 2.1 through 2.5).

The CDM will leverage the TEPP Modeling I&A for data inputs and assumptions. This includes integrating trip data and charging behavior insights to accurately model how much energy will be required to support BEVs, where BEV charging is likely to take place, and when BEV charging load can be expected for all hours of an average day and for the highest hour of every month of the year across California's highway corridors.

The CDM will identify load associated with 150 major arterial and collector roads, interstate highways, collector/distributor lanes and controlled-access highways in California split into corridor segments. Each **corridor segment** will be defined as a section of a major arterial and collector road, interstate highway, collector/distributor lane or controlled-access highway that varies in traffic volume from adjacent sections of the same major arterial and collector road, interstate highway, collector/distributor lane or controlled-access highway and exists in a single utility territory.

1.2. Approach to BEV Load Calculation

This section describes the approach to calculating BEV charging load used in the CDM:

1.2.1. BEV Charging Load

BEV charging load is the hourly load, in megawatts (MW), that BEVs are expected to use for charging. The first step in determining BEV charging load will be to calculate the cumulative energy required for BEVs to traverse all corridor segments associated with a trip. The cumulative BEV energy requirement is the sum of the BEV energy requirements (see Appendix A) associated with

each corridor segment a vehicle passes through while driving from an "Origin A" to a "Destination B." This cumulative energy requirement will be determined by integrating trip data from the TEPP Modeling I&A to establish corridors on which BEVs will travel. See Appendices A through C for more details on the cumulative energy requirement calculation.

After the cumulative energy requirement is calculated, charging behavior will be integrated to model *where* charging is occurring along highway corridors and *when* it is likely to occur at hourly intervals. Charging behavior assumptions will be informed by the TEPP Modeling I&A.

To establish *where* charging is likely to occur, the CDM identifies the BEV energy requirement associated with each corridor segment, which will be the cumulative energy requirement used by a BEV while traveling from its origin to the corridor segment where it will charge. To establish *when* during the day charging will happen, the CDM will determine the hourly load for a given corridor segment by allocating the corridor's daily BEV energy requirement to each hour of the day based on a normalized load shape.

Table 1-1 provides parameters used to define charging behavior in the CDM.

Table 1-1. Parameters Associated with Charging Behavior

Charging Behavior Parameter	Associated Assumption	Description
Starting Vehicle State-of-Charge (SOC)	Charging Location	BEV minimum SOC when beginning trip
En-Route Vehicle SOC	Charging Location	BEV minimum SOC integrated with calculated SOC along trip that identifies where vehicles will need to charge
Presence of Rest Stops	Charging Location	Rest stops as potential locations of future BEV public charging infrastructure signifying convenient and known stopping locations
Presence of Truck Stops	Charging Location	Truck stops as potential locations of MDHD BEV public charging infrastructure signifying convenient and known stopping locations
Presence of Existing / Planned Infrastructure	Charging Location	Existing infrastructure identifying where BEV charging behavior may occur through convenience
Proximity to Fleet Depots*	Charging Location	Depots in close proximity to corridor segments, which may indicate a reduced need for public charging infrastructure
Local BEV Traffic Volume	Charging Location	Areas of high BEV traffic volume, which may indicate ideal locations for charging infrastructure rollout

Charging Behavior Parameter	Associated Assumption	Description
Trip Destinations	Charging Location	Corridor segment a trip concludes, which may align with where a vehicle charges based on fleet owners' preference towards charging vehicles at the end of trips as opposed to en route
Home Charging Access*	Charging Location	Home charging access represents how prevalent the option to charge at a BEV owner's residence is, and limited access to home charging will lead to increased charging at other locations, e.g., public charging
Price Signals*	Charging Time	Economic incentives, such as off-peak electricity costs, to shift the time of BEV charging
Load Management*	Charging Time	May include active and passive managed charging, as implemented through Vehicle-Grid-Integration (VGI)

*Proximity to fleet depots, home charging access, price signals and load management are not included as charging behavior parameters in the current version of the CDM. These parameters can be considered in future updates of the CDM.

1.3. Scope of Analysis

The CDM will focus analysis on 150 major arterial and collector roads, interstate highways, collector/distributor lanes and controlled access highways across California, broken into corridor segments.

The 150 roads and highways represent all major arterial and collector roads, interstate highways, collector/distributor lanes and controlled-access highways across California identified in the Federal Highway Administration's Freight Analysis Framework, Version 5 (FAF 5) data. The roads and highways are either 50 miles or more[1] in length, are included as part of the 34 priority corridors defined by California Transportation Commission's (CTC) Senate Bill (SB) 671 Clean Freight Corridor Assessment, or are included in the March 2024 National Zero-Emission Freight Corridor Strategy. Corridors meeting any of these criteria will be included in the scope. A complete list of corridors to be included in the scope is available in Appendix H.

Corridor segments were determined based on the existing segmentation of roads in the FAF 5. Further segmentation was conducted to reduce any segment to no greater than three miles in length and to split any segment that overlapped utility service territories into territory-unique segments. For example, if a segment in the FAF 5 data was five miles in length, the CDM would split that segment into two segments of 2.5 miles in length. If a segment crossed from PG&E's service territory into SCE's service territory, the CDM would split that segment into two segments, with one exclusively in PG&E's service territory and one exclusively in SCE's service territory.

[1]50-mile minimum length specified in California Transportation Commission's Senate Bill 671 Clean Freight Corridor Assessment.

1.4. Data and Inputs

The CDM will incorporate several data sets as inputs, which are provided through the TEPP Modeling I&A. The data and inputs can be grouped into three categories that support certain aspects of the CDM:

- **Geospatial data**, used to associate characteristics to corridor segments
- **Electric vehicle and EVSE characteristics**, used to determine where BEVs are traveling and the energy associated with those trips
- **Charging behavior**, used to determine where BEVs are likely to charge along California's major highway corridors and when BEVs are likely to charge during an average day and for the highest hour of every month of the year

Data granularity is a critical feature for both BEV characteristics and charging behavior. The CDM breaks out electric vehicle data by vehicle use case, duty, ownership, year, and census tract. Charging behavior data and load shapes are broken out by charging use case, vehicle use case, duty, ownership and charging technology.

Table 1-2, Table 1-3, and Table 1-4 outline the data that are used to inform the CDM. The TEPP Modeling I&A Report provides more details about the data and its assumptions in Table 1-2.

Table 1-2. Geospatial Data for CDM

Data / Input	Description
California Counties	Geographic information system (GIS) shapefiles for county borders; this will allow for the targeting of corridor segments within a certain county and understand vehicle trips, charging infrastructure, and grid impacts associated with that geographical area.
Freight Analysis Framework (FAF) 5 Model Highway Network (California's Highway Corridors)	FAF 5 geodatabase that includes all roads in the National Highway System and the National Highway Freight Network, showing traffic flows by corridor segment at five-mile increments; this will allow for identification of a comprehensive road network in California and the travel patterns of MDHD BEVs along those roads.
Investor Owned Utility (IOU) / Publicly Owned Utility (POU) Service Areas	GIS shapefiles for IOU and POU service areas; this will allow for identification of corridor segments associated with specific IOUs and POUs.

Data / Input	Description
Disadvantaged Communities (DAC)	GIS shapefiles from California Office of Environmental Health Hazard Assessment's (OEHAA)[2] identifying DACs and Tribal Communities using CalEPA's designation of disadvantaged communities for the purposes of SB 535, specifically: 1. Census tracts receiving the highest 25 percent of overall scores in CalEnviroScreen 4.0 2. Census tracts lacking overall scores in CalEnviroScreen 4.0 due to data gaps, but receiving the highest 5 percent of CalEnviroScreen 4.0 cumulative pollution burden scores 3. Census tracts identified in the 2017 DAC designation as disadvantaged, regardless of their scores in CalEnviroScreen 4.0 4. Lands under the control of federally recognized Tribes This shapefile will allow for the identification of corridor segments located in or in close proximity to DACs.
CalEnviroScreen 4.0 Top Quartiles	GIS shapefile of the census tracts receiving the highest 25 percent of overall scores in CalEnviroScreen 4.0
AB 1550 Low Income Designation	GIS shapefile from California Climate Investment Priority Population Mapping Tool 4.0[3] that identifies low-income communities for the purposes of California Climate Investments
PM2.5 and Ozone Non-Attainment Areas (NAA)	NAA geographic layers that will be used to associate corridor segments with non-attainment areas, or any areas that do not meet (or that contribute to ambient air quality in nearby areas that do not meet) the national primary or secondary ambient air quality standards for National Ambient Air Quality (NAAQ).
Land Use / Zoning	SDG&E: GIS shapefile from San Diego Association of Governments (SANDAG)[4] describing land use based on SANDAG's Regional Demographic, Economic and Land Use Models PG&E and SCE shall be required to file a Tier 1 Advice Letter proposing a land use / zoning layer that can be used for their territories.

[2] SB 535 Disadvantaged Communities - OEHHA

[3] **California Air Resources Board (CARB).** *California Climate Investments Priority Populations Mapping Tool (Version 4.0).* https://gis.carb.arb.ca.gov/portal/apps/experiencebuilder/experience/?id=5dc1218631fa46bc8d340b8e82548a6a&page=Priority-Populations-4_0

[4] **San Diego Association of Governments (SANDAG),** *GeoPortal Item: [interactive GIS dataset].* https://geo.sandag.org/portal/home/item.html?id=e9321d784a6b4ef5b89af2e0679fb8c8

Data / Input	Description
Planned & Existing Public Charging Infrastructure	AFDC-provided geographic spatial layers that identifies where planned and currently existing public charging infrastructures will be or is located; this includes the number of ports, associated charging power, and accessibility (public/private), and will be used to current nodes in the charging network and identification of gaps for optimal charging locations.
Truck Stops	Geographic layer from Find my fuels that identifies the location of major California truck stops; this will be used to provide insights into where electric semis may recharge at public stations along transportation corridors.
Rest Stops	Geographic layer from Caltrans that will be used to identify locations of California rest stops, and that has the potential to offer insights into where passenger BEVs may recharge at public stations along transportation corridors.
Fleet Depots	Geographic layer currently only available through private sector vendors that identifies the location of major California fleet depots. This offers improved accuracy in fleet domicile locations and offers better precision in determining where public charging infrastructure should be located to facilitate fleet routes.

Table 1-3. BEV Characteristics for CDM

Data / Input	Description
BEV Population	Used to determine what percent of traffic associated with a corridor segment is attributable to BEVs
Origin / Destination Data	Used to determine where BEV trips are beginning and ending
Trip Route Data	Used to determine what corridors are used for BEV trips
Segment-level Annual Average Daily Trips	Used to both verify accuracy of trip route data and develop weights for route likelihood
BEV Battery Capacity	Used to establish BEV range and BEV state-of-charge along trips
BEV Efficiency	Used to determine energy required to traverse corridor segments and impact on BEV state-of-charge
Public Charging %	Used to determine what percent of BEV load will be charged using public charging infrastructure

Table 1-4. Charging Behavior for CDM

Data / Input	Description
Vehicle Start SOC	Used to determine the SOC of a BEV as it begins its trip
Likelihood to Charge by SOC	Used to determine the probability that a BEV charges given its current SOC
Likelihood to Charge by Trip Details	Used to determine the probability that a BEV charges given where a trip ends or a trips length
Public Charging %	Used to determine what percent of BEV load will be charged using public charging infrastructure
BEV Charging Load Shape	Used to determine at what hours during an average day and and for the highest hour of every month of the yearBEVs are charging (BEV hourly load)

1.5. Document Contents

The remainder of this document is organized as follows:

- **Section 2: CDM Implementation** describes the components and functionality of the CDM.
- **Section 3: Potential Future Refinements** outlines the suggested future enhancements to the CDM as it continues to evolve over time.
- **Section 4: Key Considerations** outlines some of the limitations with the currently best available data.

2. CDM Implementation

Corridor Disaggregation Methodology Implementation

The purpose of the CDM is to estimate public charging demand for LD and MDHD BEVs within one mile of 150 major California corridors at a granular level. The CDM builds on work conducted by the CTC, which was mandated by SB 671 to conduct a Clean Freight Corridor Efficiency Assessment to identify road networks and major arterial corridors that will require charging infrastructure to support zero-emission (ZEV) MDHD vehicles.

This section provides a detailed description of the CDM. This process begins by segmenting California's highway corridors and assigning characteristics to each corridor segment. This will determine the energy requirement associated with BEVs traversing each corridor segment.

Once the corridor segments and associated energy requirements for BEVs traversing the segment have been established, trip data will help determine the most likely routes of travel and the cumulative BEV energy requirement for trips passing along each route. Charging behavior data will then help identify where along the routes and corridors charging is most likely to occur, and when charging will occur during an average day and for the highest hour of every month of the year. Where charging is likely to occur establishes the amount of energy BEVs need to charge at each corridor segment. When charging is likely to occur, represented by load shapes, establishes the hourly BEV load.

Figure 2-1. CDM Output Calculation Process

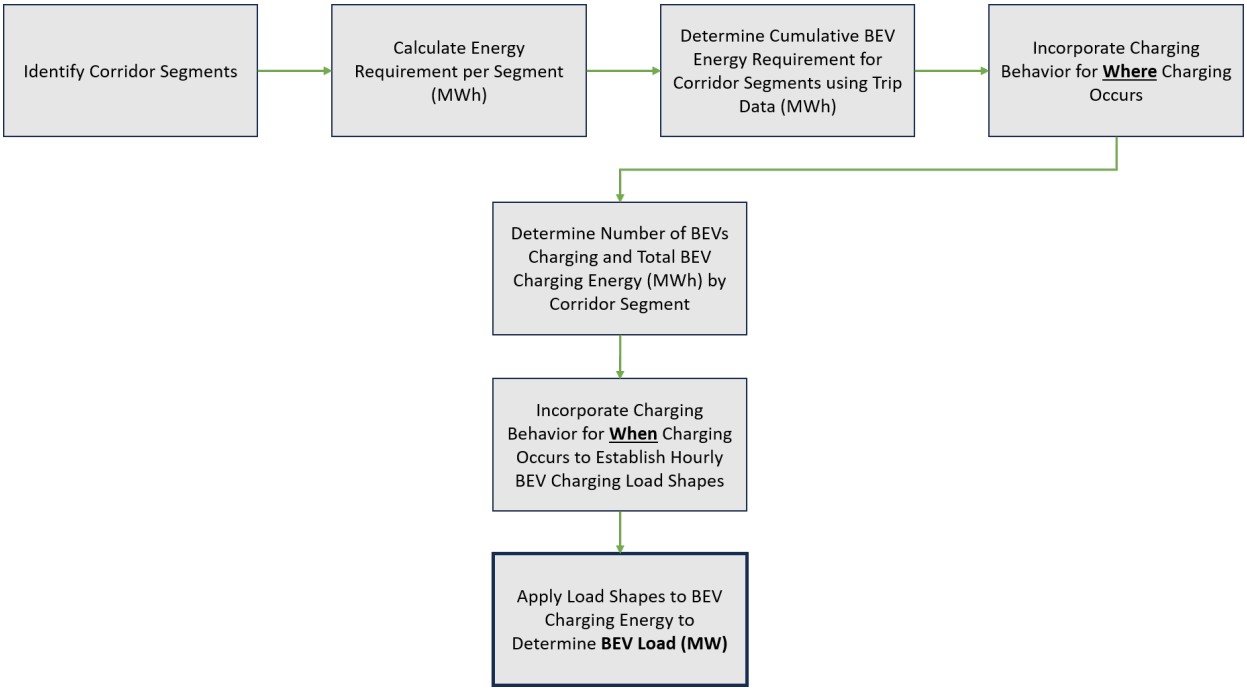
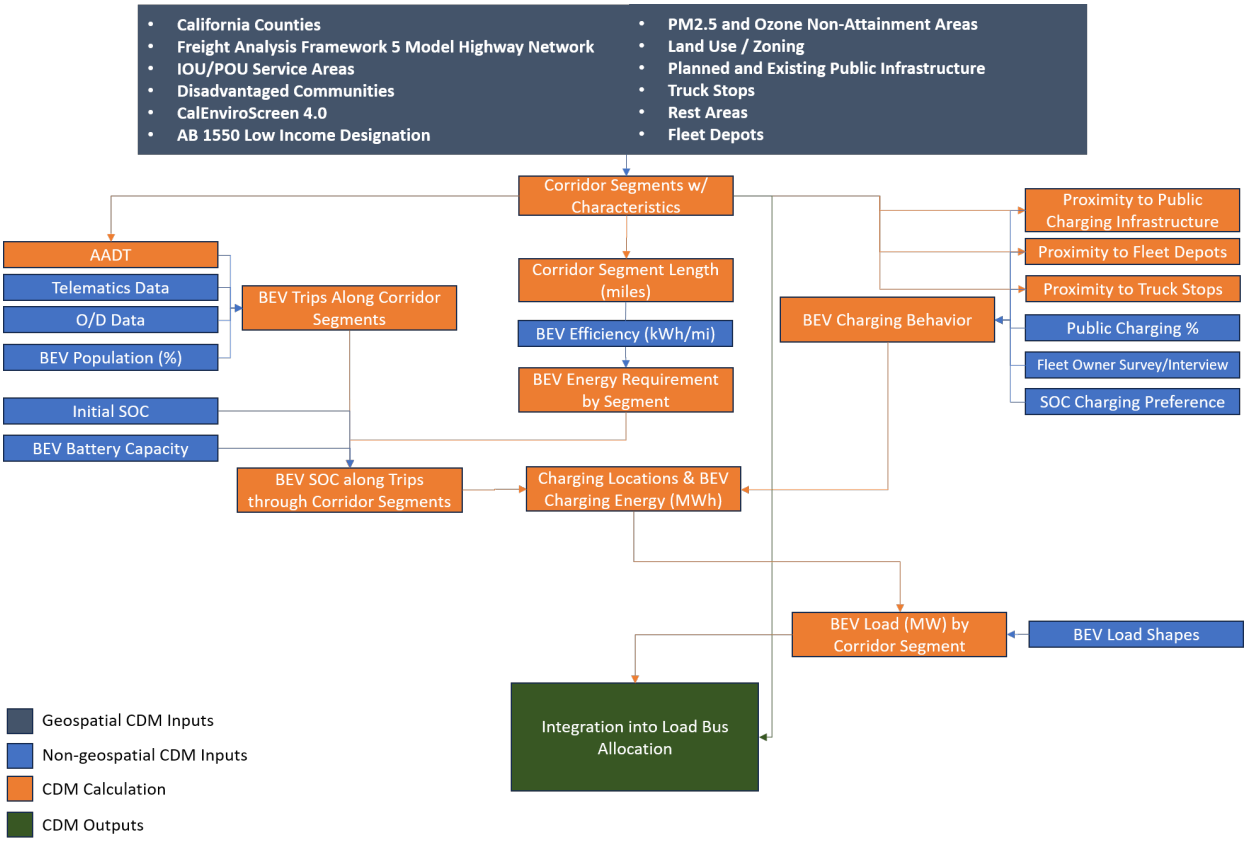


Figure 2-2 provides a **logic model** of the CDM inputs, calculations, and outputs, which include a BEV load disaggregation through 2045.

Figure 2-2. CDM Logic Model



2.1. Corridor Segmentation and Characteristic Assignment

The road network used for the CDM consists of 150 major arterial and collector roads, interstate highways, collector/distributor lanes and controlled-access highways in California that are at least 50 miles in length, have been identified as one of the 34 priority corridors by CTC's SB 671 Clean Freight Corridor Assessment or are included in the National Zero-Emission Freight Corridor Strategy. Any corridor meeting at least one of these criteria is included in the scope. Figure 2-3 is a map of all highways considered as part of the CDM. A full list of the 150 roads included in the CDM is captured in Appendix H.

Figure 2-3. California Highways in CDM



These 150 highways are split into smaller segments based on changes in traffic volume as reported

by FAF 5. The corridor segments defined in the CDM will further split the highway segments based on utility territory boundaries so that no single segment exists within two utility territories. The results will be unique segments of the 150 highways that vary in traffic volume from adjacent sections of the same highway and exist within a single utility's territory. Appendix E provides an illustration of this process.

Each corridor segment will be assigned characteristics. Table 2-1 describes the list of characteristics that are assigned to corridor segments.

Table 2-1. Corridor Segment Characteristics

Corridor Segment Characteristic	Description	Purpose
BEV Load (MW)	The annual load associated with a corridor segment	BEV load will provide insights into the load capacity needed to support BEV charging
Minimum Corridor Segment Length (Miles)	Minimum threshold for corridor segment length	Allows for targeting of corridor segments above a specific length
Minimum Vehicle Volume (Average Annual Daily Trips)	Minimum threshold for average annual daily trips, as proxy for vehicle volume, associated with corridor segment	Allows for targeting of corridor segments with high total vehicle traffic
Minimum BEV Vehicle Volume (Average Annual Daily Trips)	Minimum threshold for average BEV annual daily trips, as proxy for BEV volume, associated with corridor segment	Allows for targeting of corridor segments with high BEV traffic
IOU/POU	IOU or POU service territory through which the corridor segment passes	Allows for targeting of corridor segments within a specific IOU or POU service territory
County	County through which the corridor segment passes	Allows for targeting of corridor segments within a specific California county
DAC Status	Whether a corridor segment falls within a DAC area	Allows for targeting of corridor segments within disadvantaged communities
CalEnviroScreen 4.0 Top Quartile	Whether a corridor segment falls into a region that is scored in the top 25% of CalEnviroScreen 4.0	Allows for targeting of corridor segments in the top quartile of CalEnviroScreen 4.0
AB 1550 Low Income Designation	Whether a corridor segment falls within a low-income community	Allows for targeting corridor segments in low-income communities
Tribal Community Status	Whether a corridor segment falls within a Tribal Community	Allows for targeting corridor segments within Tribal Communities
NAA	Whether a corridor segment falls in a Non-Attainment Area for PM2.5 and NOx	Allows for targeting corridor segments in non-attainment areas

Corridor Segment Characteristic	Description	Purpose
Land Use / Zoning	For SDG&E: The designated land use, specified using Standard Industry Classification (SIC) codes PG&E and SCE shall be required to file a Tier 1 Advice Letter proposing a land use / zoning layer that can be used for their territories.	Allows for identifying commercial and industrial zones suitable for charging station development
Road Class Description	Classification of corridor segment	Allows for specifying the types of roads to be included, e.g., highway, freeway
Road Name	Name of corridor segment	Allows for specifying the roads to be included, e.g., highway, freeway
Existing and Planned BEV Charging Infrastructure	Corridor segments that have existing and planned BEV charging infrastructure within a 1-mile width	BEV charging infrastructure may provide insights on both where charging is likely to happen if there is a high density of infrastructure or where gaps in charging networks exist
Truck Stops	Corridor segments that have truck stops within a 1-mile width	Truck stops may provide insights into where public charging may occur, as truck stops may be natural locations for public MDHD charging
Rest Stops	Corridor segments that have rest stops within a 1-mile width	Rest stops may provide insights into where public charging may occur, as rest stops may be natural locations for public LD charging
Fleet Depots	Corridor segments that have fleet depots within a 1-mile width	Fleet depots may provide insights into where private MDHD charging may occur

For the corridor segment characteristics that are not outputs of the CDM, underlying data will be provided through the TEPP Modeling I&A and associated with corridor segments using geoprocessing such as joins and intersections in ArcGIS. For those characteristics that are based on outputs of the CDM, such as BEV load, they will be determined and assigned to corridor segments through the methodology described in Sections 2.2 through 2.5.

Most corridor segment characteristics can be determined based on whether the corridor segment intersects with the characteristic. For example, IOU/POU is determined based on whether the corridor segment is in a certain IOU/POU's service territory. Other characteristics, such as existing/planned infrastructure and fleet depots, may not fall directly on a corridor segment. For characteristics that may not fall directly on a corridor segment, the CDM will determine the associated segment by identifying whether the characteristic, such as the existing and planned infrastructure, and truck stops, are within a 1-mile width[5] of the corridor.

[5] The one-mile width refers to an aerial buffer measured one-mile adjacent to the corridor with the intent to include existing and planned charging infrastructure. This is not meant to be measured as a distance driven on roads.

2.2. Corridor Energy Requirement Calculation

The BEV energy requirement associated with each corridor segment is calculated once the corridor segmentation is completed (see Appendix A). The BEV energy requirement for each segment represents the kilowatt hours (kWh) of energy a BEV needs to traverse a given corridor segment. For each corridor segment, this metric will be determined for both an individual BEV trip and for all BEV trips in a given year. Table 2-2 identifies the required inputs for calculating a corridor segment's BEV load.

Table 2-2. Inputs for Corridor Segment BEV Load Calculation

Input	Description
Corridor Segment Length	Each corridor segment's length in miles
Trips along Corridor	The number of trips taken along each corridor segment
BEV Population	The percent of trips along each corridor segment attributable to BEVs, broken out by year and vehicle use case
BEV Efficiency	The efficiency of the BEVs (kWh/mi), broken out by year and vehicle use case

The per trip BEV energy requirement for a given corridor segment will be calculated by multiplying the corridor segment's length by the BEV efficiency. The BEV efficiency will be broken out by vehicle duty, vehicle use case, and vehicle year. Each corridor segment will have multiple per trip BEV energy requirements that vary across these three fields (see Appendix A for equation).

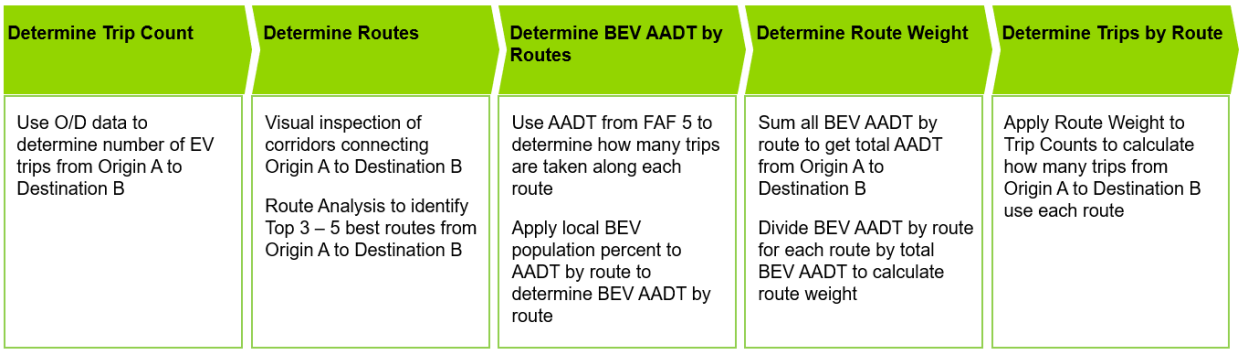
The annual BEV energy requirement for a given corridor segment will be calculated by scaling up the per trip BEV energy requirement for each vehicle use case/duty combination for each year by the number of annual trips taken for each vehicle use case/duty combination for each year (see Appendix A for equation).

2.3. Integration of Trip Data and Cumulative BEV Energy Requirement

Trip data will be integrated into the CDM to determine the number of daily trips taken along corridor segments, broken out by various BEV duties and vehicle use cases (e.g., long-haul truck, short-haul truck, delivery truck, passenger cars). This process begins with identifying a trip's origin and destination and then determining which corridors the BEVs are using to reach their destination.

Depending on the available data, this analysis may be as simple as integrating route analysis information from the Origin and Destination (O/D) data itself. If route analysis data is not available, weights will be established instead for the likelihood of a BEV using a specific corridor segment given a trip starting at Origin A and ending at Destination B. These weights will be determined by combining route analysis to determine the best route from location A to location B and average annual daily traffic data (AADT) along applicable corridors. The best route can be defined as either the fastest route in terms of travel time or the shortest route in terms of miles. Figure 2-4 outlines this approach, and an example calculation is provided in Appendix B.

Figure 2-4. Route Likelihood Calculation



Once trip routes and the number of trips along a corridor by vehicle use case have been established, the annual BEV energy requirement associated with a corridor will be calculated, as described in Section 2.2. Additionally, having determined trip routes, the CDM will determine the cumulative BEV energy requirement for a given BEV trip at a given corridor segment.

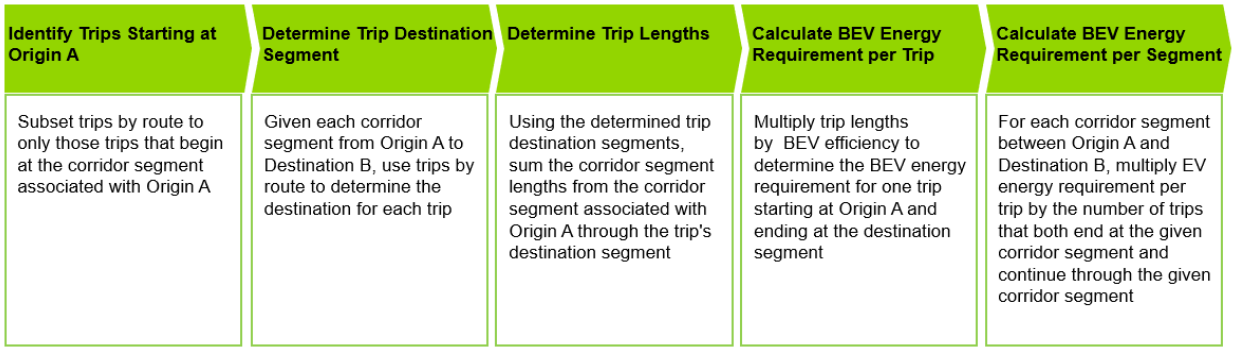
The cumulative BEV energy requirement for a trip is a central datapoint for estimating BEV load at corridors segments. As a BEV traverses a corridor segment, it will expend some amount of energy, which is calculated as the per trip BEV energy requirement for a corridor segment in Section 2.2. A BEV trip from Origin A to Destination B will consist of traversing a number of corridor segments, expending energy as it travels through each corridor segment. A trip's cumulative BEV energy requirement is the sum of the per trip BEV energy requirement for a corridor segment for each corridor segment the vehicle traverses while traveling from Origin A to Destination B.

Scaling up the cumulative BEV energy requirement for a single trip through a corridor segment to all trips will determine the cumulative BEV energy requirement for a corridor segment. This value represents the total energy expended by all BEVs as they drive from their origin to the given corridor segment. For the CDM, the cumulative BEV energy requirement for a corridor segment represents the total amount of energy BEVs would need to recharge their batteries assuming they have not

recharged since leaving their origin.

Figure 2-5 outlines the approach for calculating the cumulative BEV energy requirement for a trip and for a corridor segment, and an example calculation is provided in Appendix C.

Figure 2-5. Cumulative BEV Energy Requirement Calculation



2.4. BEV Load Calculation through Integration of Charging Behavior

The work described in Sections 2.2 and 2.3 establish how much energy BEVs are using for public charging and along which corridor segments. The integration of charging behavior serves to establish both where charging is likely to occur and when during an average day and for the highest hour of every month of the year charging is likely to happen. By determining where charging is likely to occur, the CDM can identify which corridor segments will have high levels of BEV charging. By determining when charging is likely to occur, the CDM can calculate the hourly load associated with BEV charging at a given corridor segment. See Appendix D for formulas summarizing the BEV load calculation.

2.4.1. Where Charging is Likely to Occur

Section 2.3 describes the process of determining the amount of energy BEVs need to recharge their battery at a given corridor segment, defined as the cumulative BEV energy requirement for a corridor segment. The cumulative BEV energy requirement for a corridor segment only represents the potential amount of BEV charging at that corridor segment – not all the energy BEVs need at a corridor segment will be recaptured through charging at that corridor segment. The CDM will integrate assumptions from the TEPP Modeling I&A on where charging is likely to occur to determine the energy associated with BEV charging (MWh) at each corridor segment.

The CDM will determine where charging is likely to occur using a probabilistic model that uses the cumulative BEV energy requirement for corridor segments to calculate vehicle state of charge (SOC) along trips and integrate the likelihood of charging at any given SOC. The output of the probabilistic model will establish weights that are applied to the cumulative BEV energy requirement for corridor segments that determine the energy associated with BEV charging at a given corridor segment. The CDM will provide a perspective on where BEV charging will be the heaviest, assuming charging infrastructure can be rolled out at any given corridor segment. See

Appendix F for further details on how the CDM uses probabilistic modeling to determine where charging is likely to occur.

The probability curve associated with the likelihood of charging at any given SOC will be based on the TEPP Modeling I&A, which will include surveys and interviews with MDHD fleet owners and operators to address unique uncertainties associated with MDHD BEV charging. These assumptions vary based on vehicle use cases, duties and ownership models and will capture the nuances across vehicle charging use cases and duty cycles. The TEPP Modeling I&A will be used to establish more targeted scenarios that do not assume charging infrastructure is available at all corridor segments (e.g., scenarios where charging only occurs at a specific SOC).

In addition to vehicle SOC, the location of existing or planned BEV charging infrastructure may indicate where charging is likely to happen. The CDM will integrate geospatial inputs from the TEPP Modeling I&A based on existing and planned EVSE to establish where infrastructure will be deployed. Truck stop and rest stop location data will also be integrated into the CDM, as these locations may serve as suitable locations for future BEV infrastructure rollout out.

Table 2-3 outlines BEV charging assumptions the CDM will incorporate from the TEPP Modeling I&A.

Table 2-3. Assumptions on Where a BEV Will Charge

Assumptions on Where a BEV Will Charge	Applicable Vehicle Duty and Ownership	Description
Minimum SOC before Charging	All Duties	The target lowest state of charge a BEV should reach before drivers are recommended to recharge their battery
Minimum Allowed SOC	All Duties	The minimum SOC a vehicle can reach and still be recommended to **not** charge
Minimum SOC at Trip Start	All Duties	The lowest state of charge a BEV can have when beginning a trip
End of Trip vs On Route Charging	All Fleet-owned Duties	Whether MDHD BEVs target charging at the end of their trip, or charge on route
Use of Public Infrastructure	All Duties	Whether BEVs use public infrastructure to charge or rely solely on depot/home charging

Lastly, the CDM will identify infrastructure locations derived from network optimization analysis, which determines the mathematically optimal sites where BEV charging infrastructure can be deployed using AADT, vehicle miles traveled (VMT) and BEV population over time to define BEV charging demand for a given objective function (such as maximize network coverage). The analysis identifies point locations that capture BEV charging demand, which is ideal for estimating future charging sites, charging gaps, and network adequacy.

2.4.2. When Charging is Likely to Occur

The previous sections described the process for determining how much BEV charging will occur at each corridor segment. To convert that into BEV load through 2045, the CDM will distribute the energy associated with BEV charging at each corridor for an average weekday and weekend to each hour of the day and for the highest hour of every month of the year using normalized load shapes.

The energy associated with BEV charging at each corridor segment is broken out by vehicle use case and duty. Using assumptions from the TEPP Modeling I&A, each vehicle use case and duty's energy associated with BEV charging will be allocated to applicable charger technologies (e.g., L2 and DCFC charging stations). The normalized load shapes will also account for this level of granularity in energy associated with BEV charging, and each hourly load will be calculated for each vehicle use case/duty/charging technology combination. These load shapes will then be combined to create a final hourly BEV load profile for each corridor segment.

The baseline load shapes used in the CDM will be provided through the TEPP Modeling I&A. The load shapes will be aligned with the 2026 Integrated Energy Policy Report (IEPR) 8760 load shapes, aggregated to the average weekday and weekend for each month and cross-walked to TEPP Modeling I&A charging use cases. Hub load shapes will be sourced from National Laboratory of the Rockies (NRL) data.

2.5. CDM Outputs

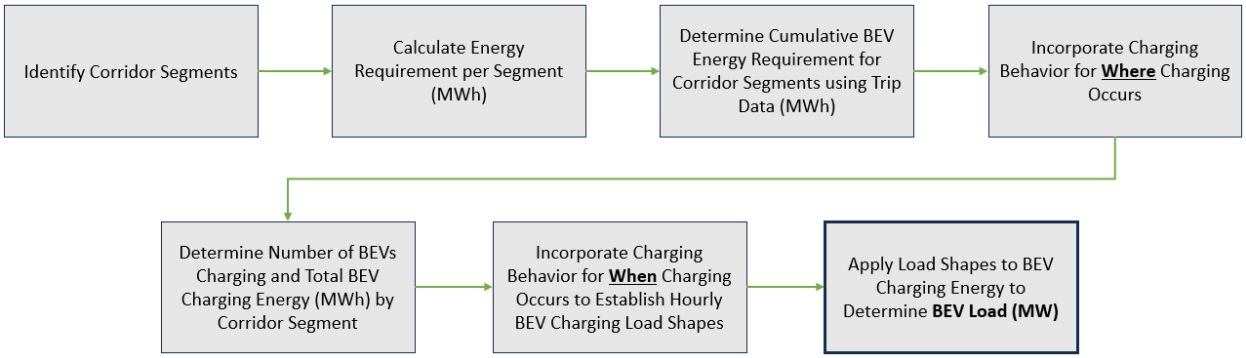
Section 2 describes the key metrics the CDM will determine for each corridor segment. These metrics are intended to provide a comprehensive perspective on all details associated with BEV charging at each corridor segment, with the key metric being BEV load (MW) through 2045 included as an output to the CDM. A full list of CDM outputs, including the corridor characteristics described in Table 2-1, can be found in Appendix I.

2.5.1. BEV Load (MW)

BEV load (MW) is the hourly load associated with BEV charging at a specific charging segment for an average day and for the highest hour of every month of the year. BEV load establishes how much electric load for each hour of an average day and for the highest hour of every month of the year will be needed to support BEV charging at a given corridor segment and can be used to identify the peak BEV charging load.

This metric will be derived from determining the cumulative BEV charging requirement at each corridor segment to support public LD and MDHD BEV charging, then establishing when segments charging will occur based on charging behavior assumptions described in Sections 2.1 through 2.4. Once the CDM calculates the cumulative BEV charging requirement for the corridor segments where charging will occur, charging behavior associated with when charging will occur, based on BEV load shapes, will determine what the hourly BEV charging load is at each corridor segment, as described in Section 2.4.2. This metric represents the key output for BEV Load.

Figure 2-6. Calculation of BEV Load (MW)



The CDM reports BEV load in two forms:

- **Hourly BEV load for an average day in a given year**
- **Monthly peak BEV load for each month of a given year**

To generate the hourly BEV load for an average day, the CDM normalizes the load shapes from the TEPP Modeling I&A to a single day, 24-hour load shape and applies this 24-hour load shape to the average daily charging energy determined at the corridor segment.

To generate the monthly peak BEV load, the CDM expands the load shapes from the TEPP Modeling I&A to a full year, 8760 load shape and normalizes the load shape against all hours of the year. As the TEPP Modeling I&A provides load shapes for each month, capturing their seasonal variation, the expansion and normalization of these load shapes to 8760s also captures the seasonal variation needed to identify monthly peaks.

2.6. Potential Integration with California Energy Commission (CEC) Load Bus Allocation

To support the Transmission Planning Process, the California Energy Commission (CEC) disaggregates load modifiers from the IEPR forecast, including the Additional Achievable Transportation Electrification (AATE) load modifier, to bus bars. The TEPP CDM outputs could be used to refine the CEC's current process of allocating public DC charging load to load buses. Since the CDM provides a bottom-up source for pending loads, the CEC could replace the public DC charging load in the disaggregated IEPR load forecast with the CDM outputs. This process would require the CEC to isolate public DC charging load from the overall EV charging load in the load bus allocation. A key consideration in integrating the CDM with the CEC's load bus allocation is to ensure that total EV charging load matches the IEPR disaggregated bus bar forecast to avoid any double counting.

Potential Steps to Integrate TEPP into the CEC Load Bus Allocation:

1. CEC isolates public DC charging load forecast from overall EV charging load.

2. The IOUs provide CDM outputs as a pending load source at a given substation

3. CEC allocates additional TE load associated with the AATE modifier to the substation, according to its current process.

4. The load bus allocation incorporates both CDM and AATE loads.

3. Potential Future Refinements

This section outlines refinements that could be made to the CDM in the future.

3.1. Integration of Additional Road Networks

The CDM will identify load associated with 150 major arterial and collector roads, interstate highways, collector/distributor lanes, and controlled-access highways in California, identified by whether they are at least 50 miles in length or included in the 34 priority corridors identified by SB 671 or include in the National Zero-Emission Freight Corridor Strategy. The CDM outputs are intended to highlight corridor segments along these highways where high-volume BEV charging is most likely to occur.

California's comprehensive road network consists of many additional roads, including common roads, evacuation routes, and scenic byways, which are not captured in the scope for the initial CDM. These roads are not expected to contain the same levels of traffic as the corridors incorporated into the CDM, but BEV charging may still occur on these roads and contribute to the overall BEV load in California.

Future versions of the CDM could look to integrate additional roads to capture a more comprehensive perspective on BEV load on California's corridors.

3.2. Integration of Light Duty Residential and Workplace Charging

The CDM as described in Section 2 will model public charging for LD and MDHD BEVs along California's highways. Future versions of the CDM could expand beyond the major highway systems to also include residential and workplace charging, providing a more comprehensive picture of BEV charging. This would incorporate private versus public charging assumptions from the TEPP Modeling I&A and charging behavior assumptions associated with the private charging use case and vehicle use cases.

3.3. Integration of Additional Vehicle Types (e.g., Off-road)

The CDM estimates BEV load on California's highways for on-road vehicles. Off-road vehicles such as agricultural equipment, airport ground support equipment, port cargo handling equipment, and forklifts could be incorporated into future versions of the CDM.

3.4. Data Updates and Refinements

CDM will leverage inputs and assumptions from the TEPP Modeling I&A. As the BEV market is still early in its maturity curve, particularly for MDHD BEVs, these inputs and assumptions could be updated over time, with input from stakeholders, including as part of the CEC's IEPR process.

Examples of inputs that could be updated over time include:

- Updates to the vehicle adoption forecast, including forecasts based on various policy scenarios
- Additions to vehicle use cases to capture nuances in duty-cycle, efficiency and charging behavior
- Updates to trip data
- Refinements to charging behavior as MDHD BEV fleet owners develop an improved understanding of how they will use BEVs
- Updates to load shapes, including load shapes for scenarios that emphasize managed charging

4. Key Considerations

The following section highlights key considerations around the underlying data, and assumptions for the CDM).

4.1. Corridor Definition

Geospatially, a corridor is defined as a linear stretch of road associated with major arterial and collector roads, interstate highways, collector/distributor lanes, and controlled-access highways. Any characteristic assigned to the corridor segments contain or intersect the corridor segment. For example, the IOU/POU associated with a corridor segment is determined by where the linear stretch of road is located.

Certain characteristics the CDM will assign to corridor segments may fall outside of the linear segment. For example, existing and planned charging infrastructure or fleet depots may not fall precisely on a road segment defining the corridor. The CDM will associate such infrastructure or fleet depots with a specific corridor to provide insights on charging behavior.

To fully characterize corridor segments, existing and planned charging infrastructure will be identified, including truck stops that fall within a 1-mile width of the corridor. Finally, all other characteristics of a corridor segment that may not contain or intersect a specific corridor segment will be assigned to the nearest corridor segment within a 1-mile width.

Once completed, the CDM outputs will be transmitted to the IOUs, who will map corridor segments to distribution substations using their knowledge of the substation's electrical footprint. The IOUs will then aggregate loads from distribution substations to transmission substations.

4.2. Fleet Depot Data

The use of fleet depot data in the CDM will provide insights into charging behavior and BEV load for any corridor segment containing the depot within its footprint. Clusters of fleet depots along certain corridor segments may indicate a high BEV load associated with charging at depots but also limited demand for public charging infrastructure, as charging would likely occur at the depot.

A key challenge with the integration of fleet depot data is establishing depot-level granularity for associated BEV load. Knowing where depots are located only supports the functionality to identify corridor segments with fleet depots but does not provide insights into which BEVs are domiciled at each depot.

Additional assumptions and heuristics still need to be developed to accurately allocate a percentage of BEV load to specific depots themselves, and alignment on the validity of these assumptions will be required.

While this challenge is significant, it is important to include fleet depot data to provide a more complete perspective on BEV charging along California's highway corridors. Any limitation will be caveated, and refinements can be made in future versions of the CDM.

4.3. Charging Behavior Assumptions for Medium- and Heavy-Duty BEVs

While surveys, interviews, and market research are key inputs into charging behavior assumptions, the MDHD BEV market is still in its nascency. Insights from fleet owners and operators will be based on preliminary expectations on BEV duty-cycles and have a high likelihood of changing as MDHD BEV adoption continues to mature. Assumptions on charging behavior applied to the CDM will be limited by this overall uncertainty.

While charging behavior assumptions integrated into the CDM provide guidance on where charging will likely take place, they need to be caveated with the degree of uncertainty associated with the MDHD BEV segment.

4.4. Charging Behavior Assumptions for Public Charging

Load shapes used in the CDM are not explicitly designed to capture shifts in charging behavior associated with price signals, load management, and flexible load. The load shapes are aligned with the 2026 IEPR or are based on NLR data and are intended to reflect charging behavior based on charging convenience. Alternative perspectives on when charging is likely to occur when influenced by load management does affect the broader BEV charging ecosystem, especially in the private charging domain, but are not currently included in the CDM as they have limited impacts on public charging.

Since the CDM focuses primarily on public charging along California's main corridors, managed charging through price signals or VGI are unlikely to have significant impacts on the time and manner of charging.

Appendix A. BEV Energy Requirement Formulas

The spreadsheet below outlines the calculation used to determine whether individual vehicle classes would be suitable for charging using L2 ports or if they would require DC charging.

CDM per trip BEV energy requirement across a given corridor segment:

Equation 1. CDM BEV energy for individual trip

$$L_c * e_{v,y}$$

where:

- L_c the corridor segment length in miles
- $e_{v,y}$ the BEV efficiency in kWh/mile for vehicle use case v in year y

CDM annual BEV energy requirement associated with a corridor segment:

Equation 2. CDM annual BEV energy for corridor segment

$$\sum_{v}(AADT_C * L_C \quad * e_{v,y} * 365)P_{v,C}$$

where:

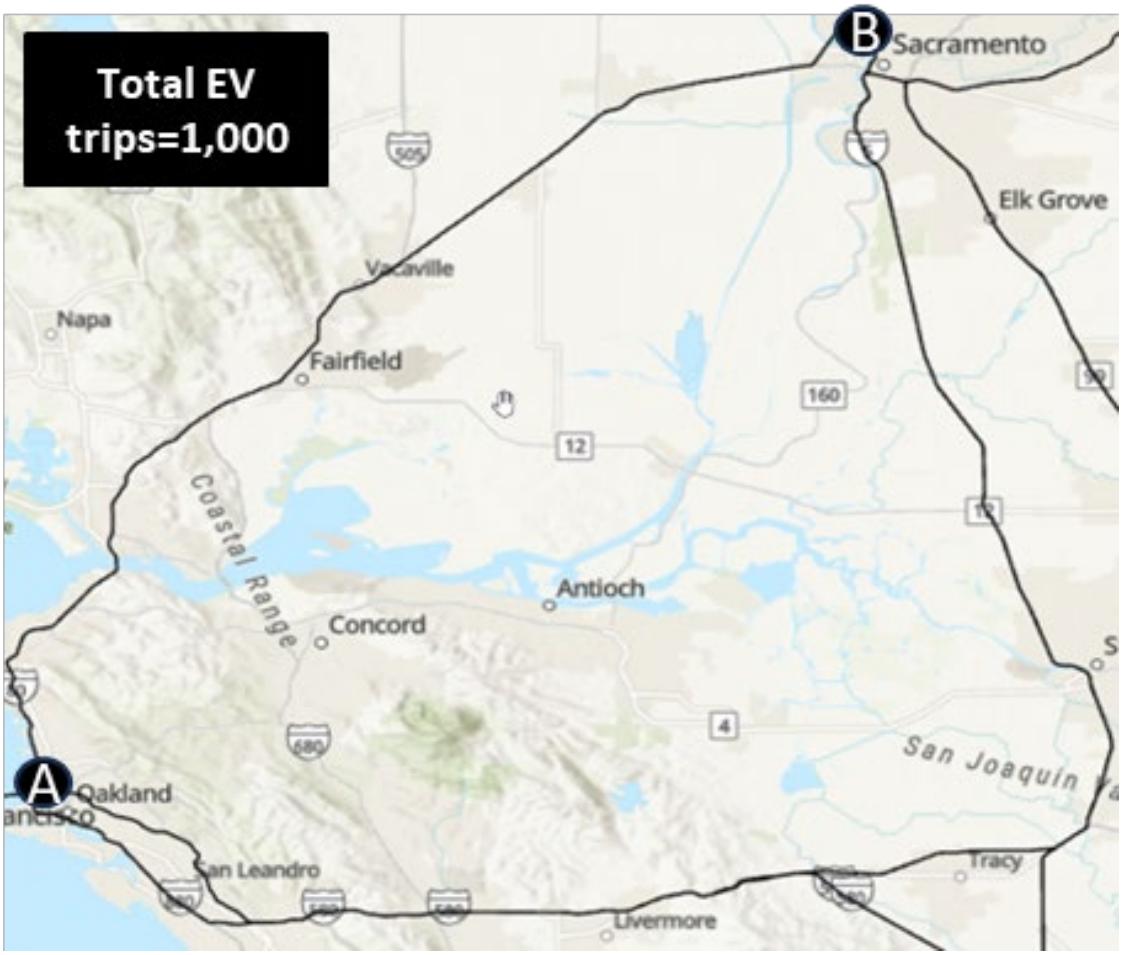
- $AADT_c$ the annual average daily traffic along a corridor segment C
- L_c the corridor segment C length in miles
- $e_{v,y}$ the BEV efficiency in kWh/mile for vehicle use case v in year y
- $P_{v,C}$ the percent of AADT taken by BEVs of use case v on corridor segment C

Appendix B. Route Likelihood Calculation Example

The following is an example of how route likelihood weights will be calculated, as described in Section 2.3. Values in this example are for demonstrative purposes only and are not actuals.

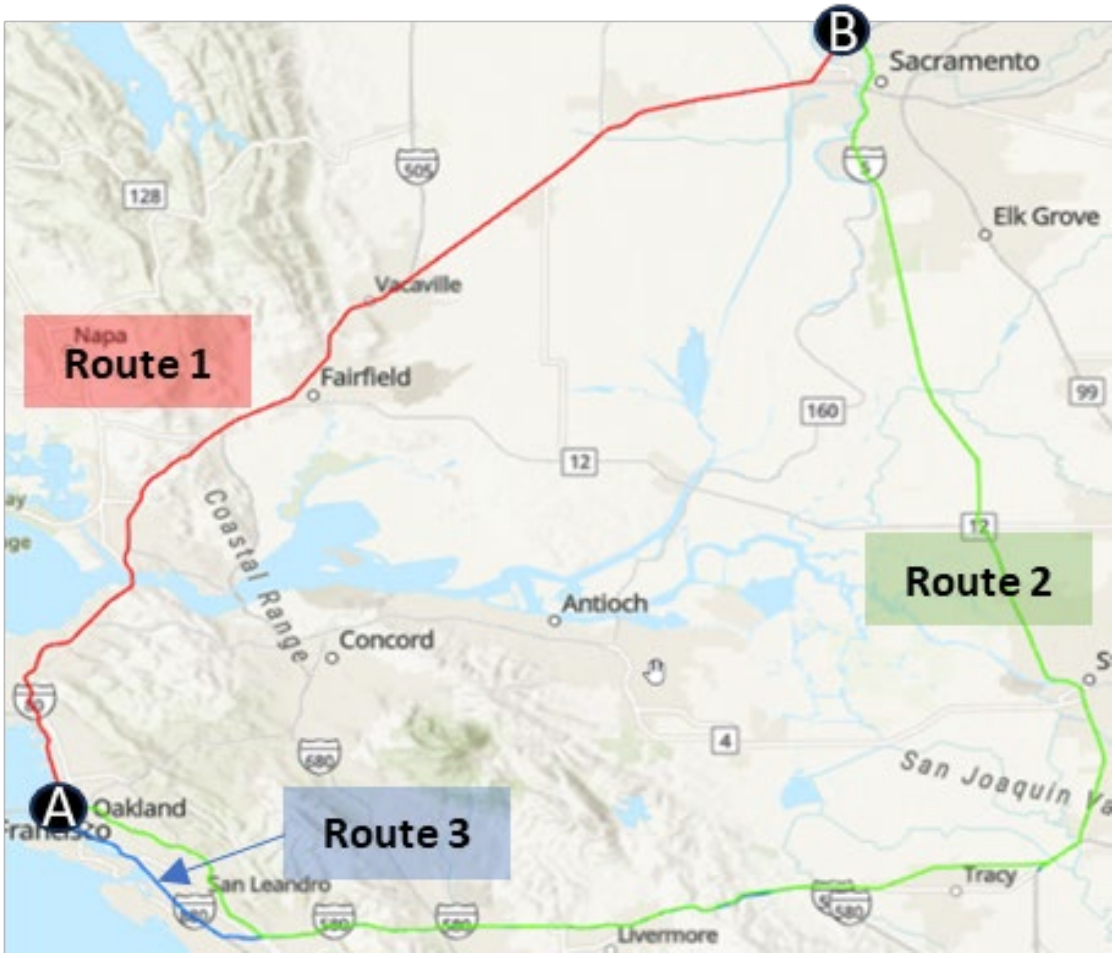
Step 1: Determine the number of BEV trips from Oakland (Origin A) to Sacramento (Destination B) using O/D data provided by the TEPP Modeling I&A.

Figure B-1. Route Likelihood Step 1 Example: Number of Trips



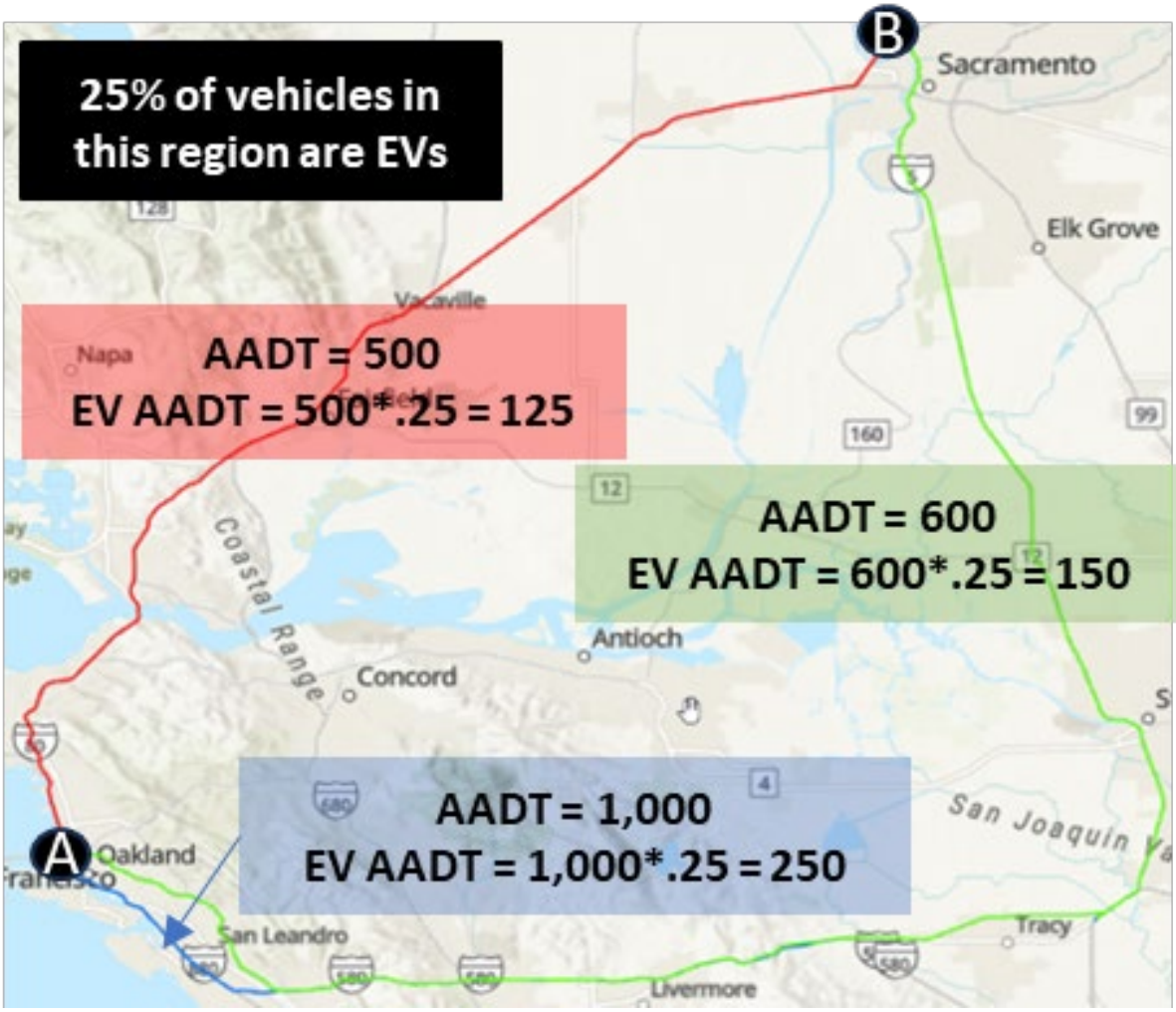
Step 2: Identify the routes from Oakland (Origin A) to Sacramento (Destination B) via visual inspection and/or route analysis.

Figure B-2. Route Likelihood Step 2 Example: Identify Routes



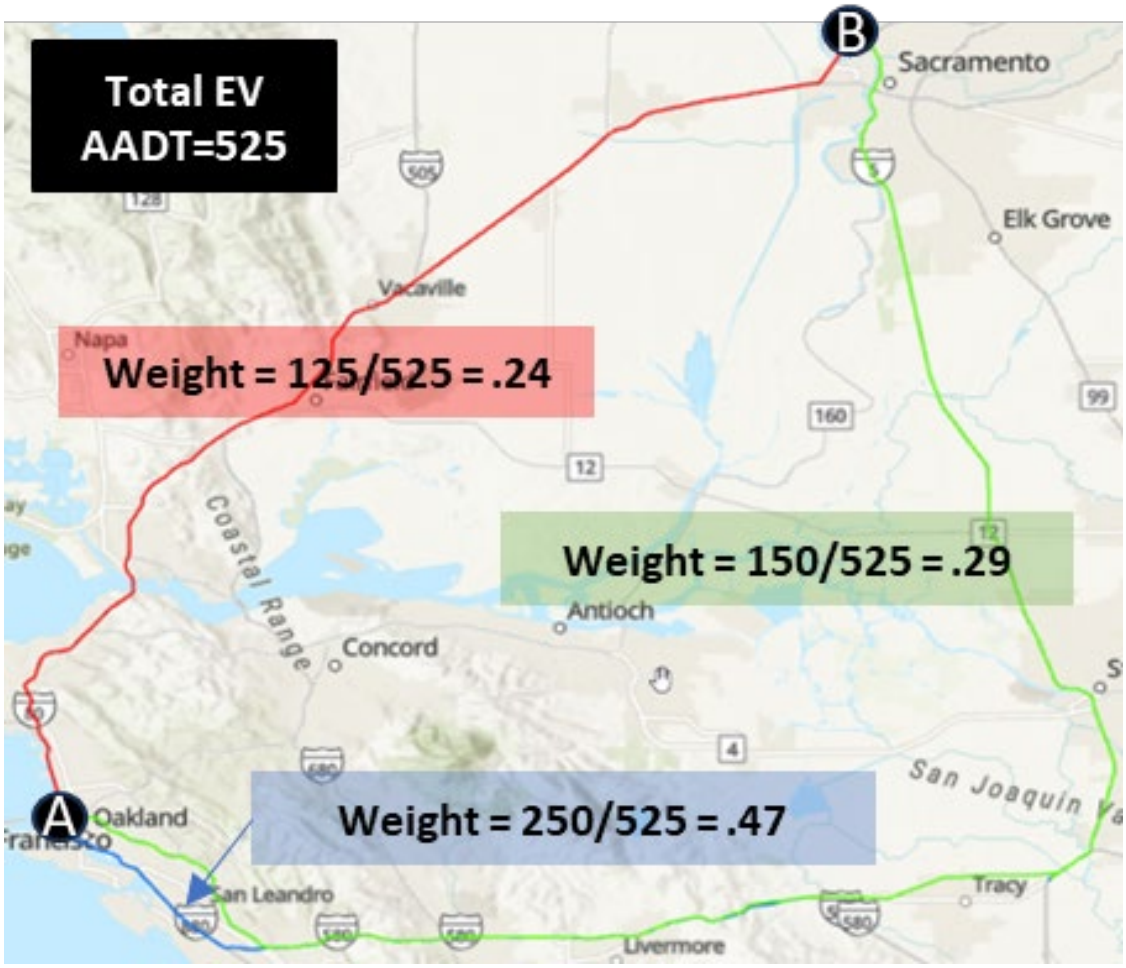
Step 3: Using AADT data associated with each route and BEV population data provided by the TEPP Modeling I&A, calculate the AADT associated with BEVs for each route.

Figure B-3. Route Likelihood Step 3 Example: Calculate AADT



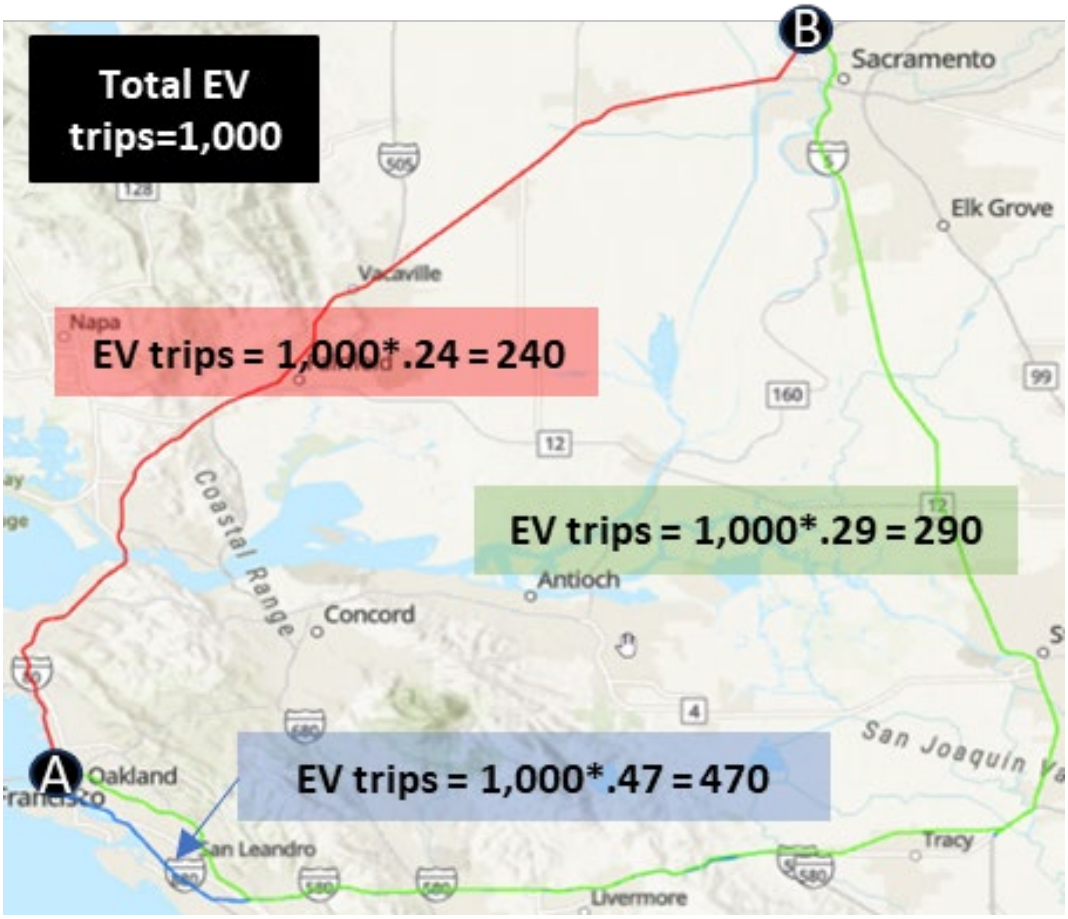
Step 4: Divide each route's BEV AADT by the total number of BEV AADT associated with all routes to determine each route's weight.

Figure B-4. Route Likelihood Step 4 Example: Determine Route Weight



Step 5: Multiply the number of BEV trips from Oakland (Origin A) to Sacramento (Destination B) by each route's weight to determine the number of BEV trips associated with each route.

Figure B-5. Route Likelihood Step 5 Example: Determine Number of Trips per Route



Appendix C. Cumulative BEV Energy Requirement Calculation Example

The following is an example of how the cumulative BEV energy requirement will be calculated, described in Section 2.3. Values in this example are for demonstrative purposes only and are not actuals.

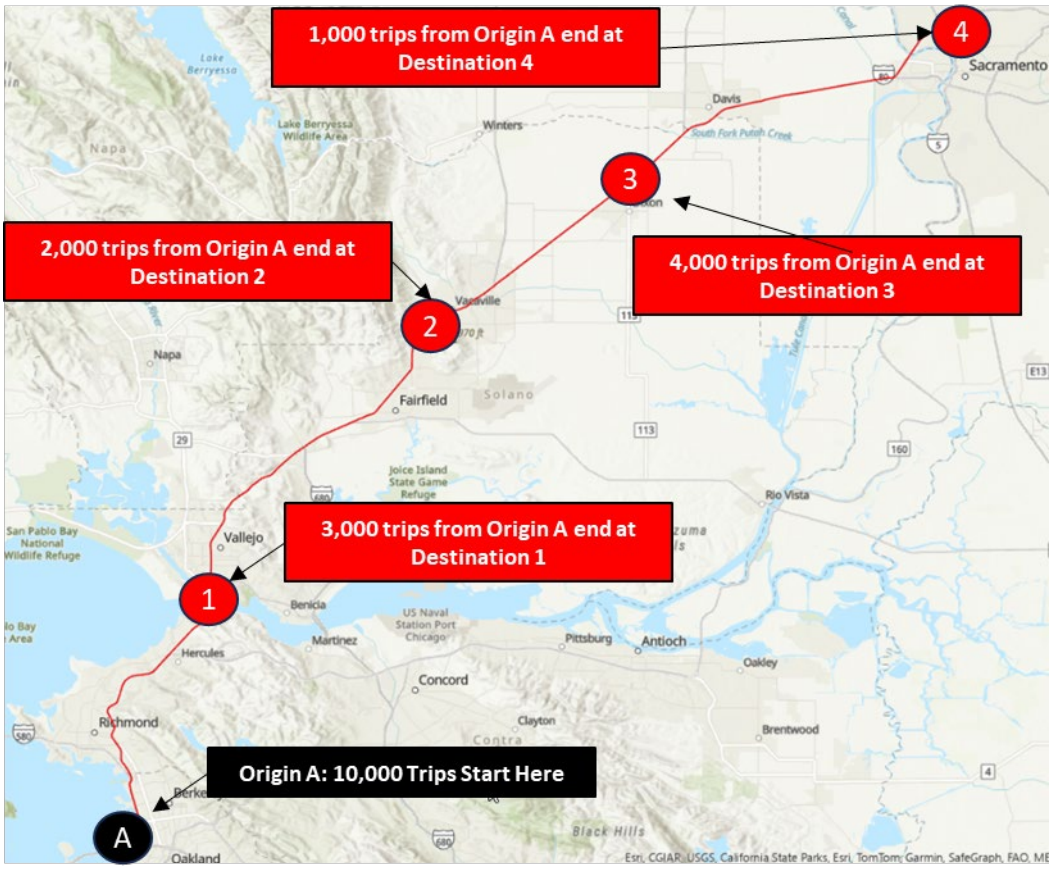
Step 1: Using O/D data provided through the TEPP Modeling I&A, determine the number of trips that start at Oakland (Origin A).

Figure C-1. Cumulative Energy Step 1 Example: Number of Trips



Step 2: Using O/D data provided through the TEPP Modeling I&A, for those trips that start at Oakland (Origin A), determine at what corridor segment those trips end.

Figure C-2. Cumulative Energy Step 2 Example: Identify Destination Corridor Segments



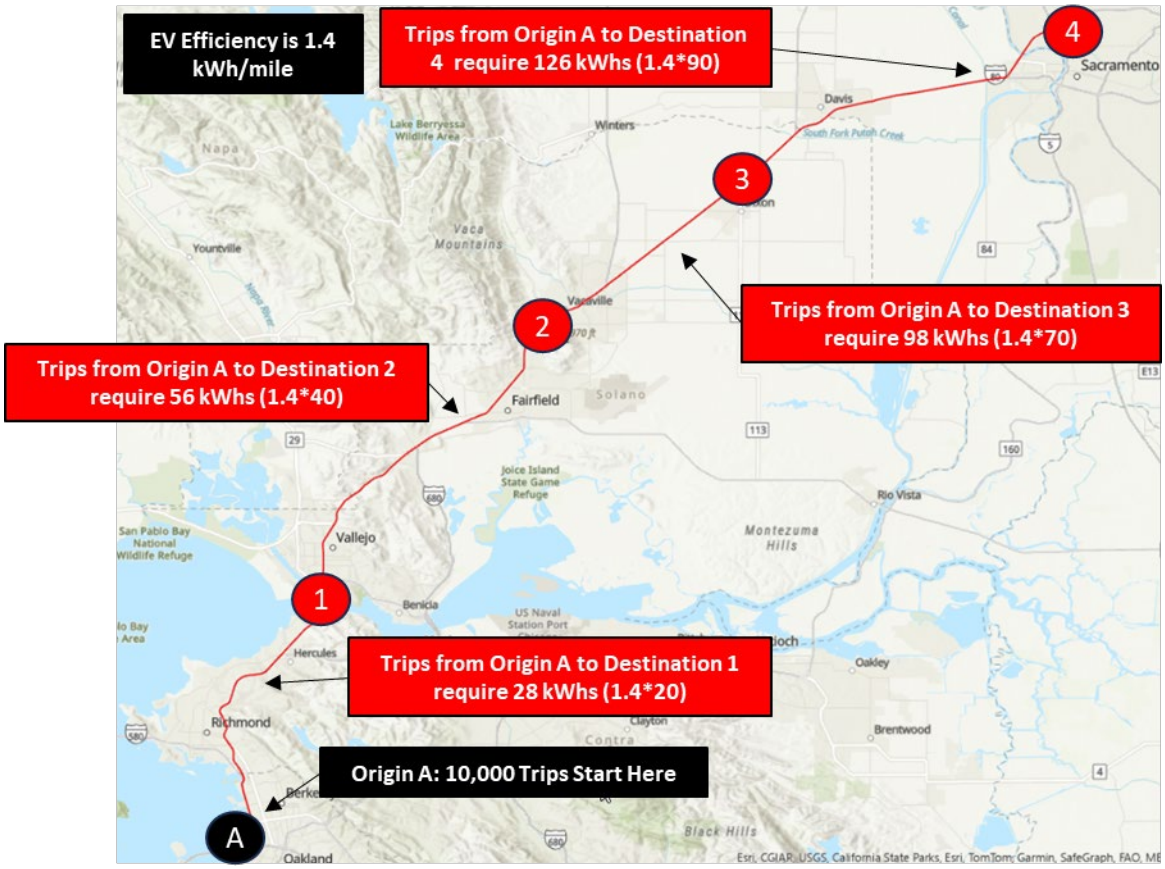
Step 3: Determine the length of each trip that passes through each corridor segment using data on California's highways provided through the TEPP Modeling I&A.

Figure C-3. Cumulative Energy Step 3 Example: Determine Length of Trip



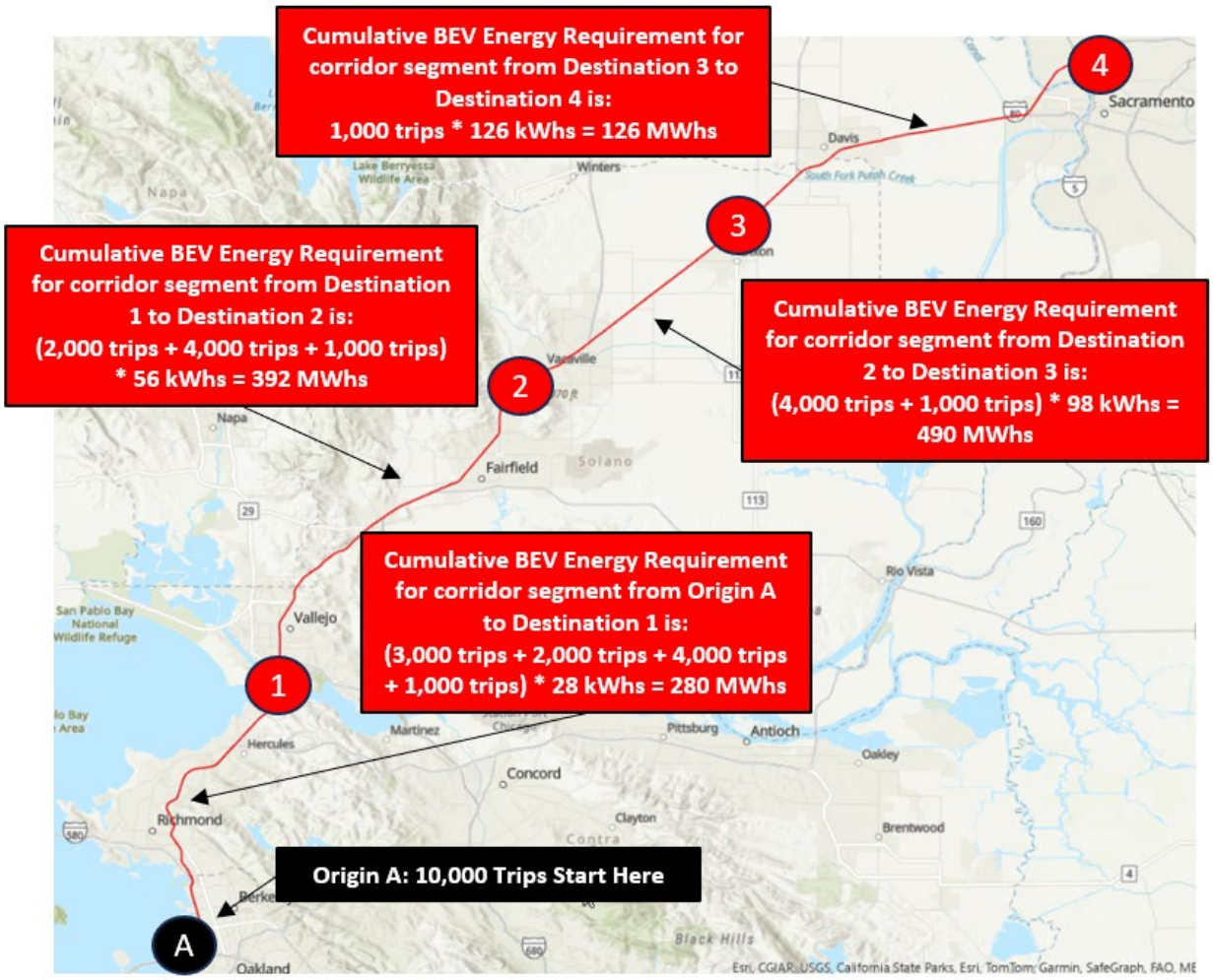
Step 4: Determine the per trip BEV energy requirement associated with each trip identified in Step 3 by multiplying each trip's length by BEV efficiency, provided through the TEPP Modeling I&A.

Figure C-4. Cumulative Energy Step 4 Example: Determine Trip BEV Energy Requirement



Step 5: For each corridor segment, sum the per trip BEV energy requirement for each trip that either passes through the corridor segment or concludes at the corridor segment. The resulting value is the cumulative BEV energy requirement for a corridor segment and represents the amount of energy BEVs would need to charge at that corridor segment to return to the SOC at the beginning of their trip (at Oakland, Origin A).

Figure C-5. Cumulative Energy Step 5 Example: Determine Cumulative BEV Energy Value



Appendix D. BEV Load (MW) Formula

The CDM BEV hourly load for a given corridor segment at a given hour:

Equation 3. CDM BEV load for corridor segment

$$\sum_{u} E_u * P_{u,h}$$

where:

- E_u the average daily energy associated with charging for vehicle use case u at a given corridor segment
- $P_{u,h}$ the percent of charging of vehicle use case u that occurs at hour h

Appendix E. Corridor Segmentation Example

The following is an example of how the CDM will segment the FAF 5 corridors for inclusion in the CDM, as described in Section 2.1.

Step 1: Identify the 150 major arterial and collector roads, interstate highways, collector/distributor lanes and controlled-access highways across California from the Federal Highway Administration's Freight Analysis Framework, Version 5 (FAF 5) data that are either 50 miles or more[6] in length or included as part of the 34 priority corridors defined by CTC's SB 671 Clean Freight Corridor Assessment.

Figure E-0-1. Interstate Highway in FAF 5 to be Included in CDM



[6] 50-mile minimum length specified in CTC's SB 671 Clean Freight Corridor Assessment

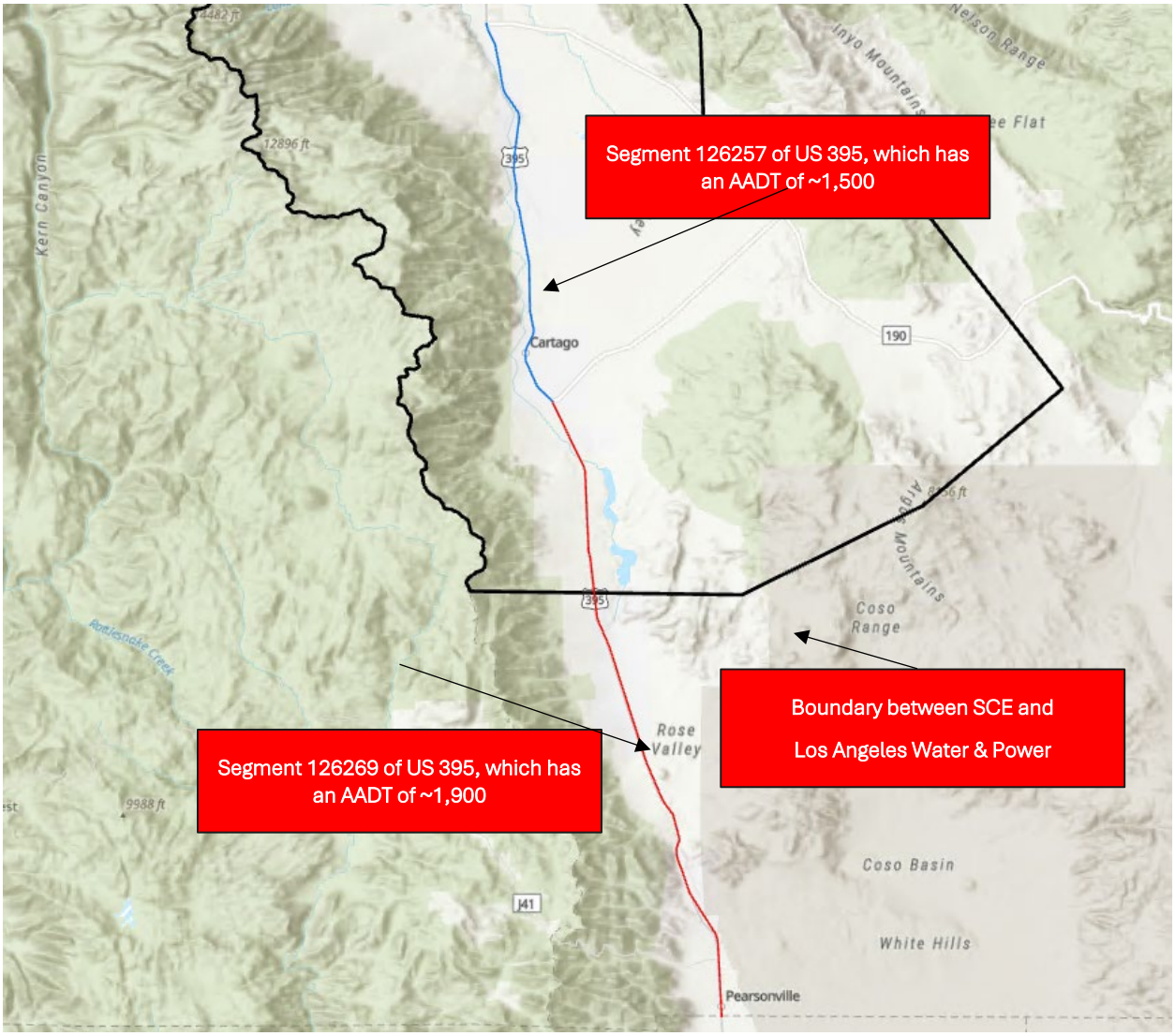
Step 2: Identify FAF 5's existing segmentation of roads based on variation in traffic volume.

Figure E-0-2. Segments of US 395 from FAF 5 based on Traffic Volume



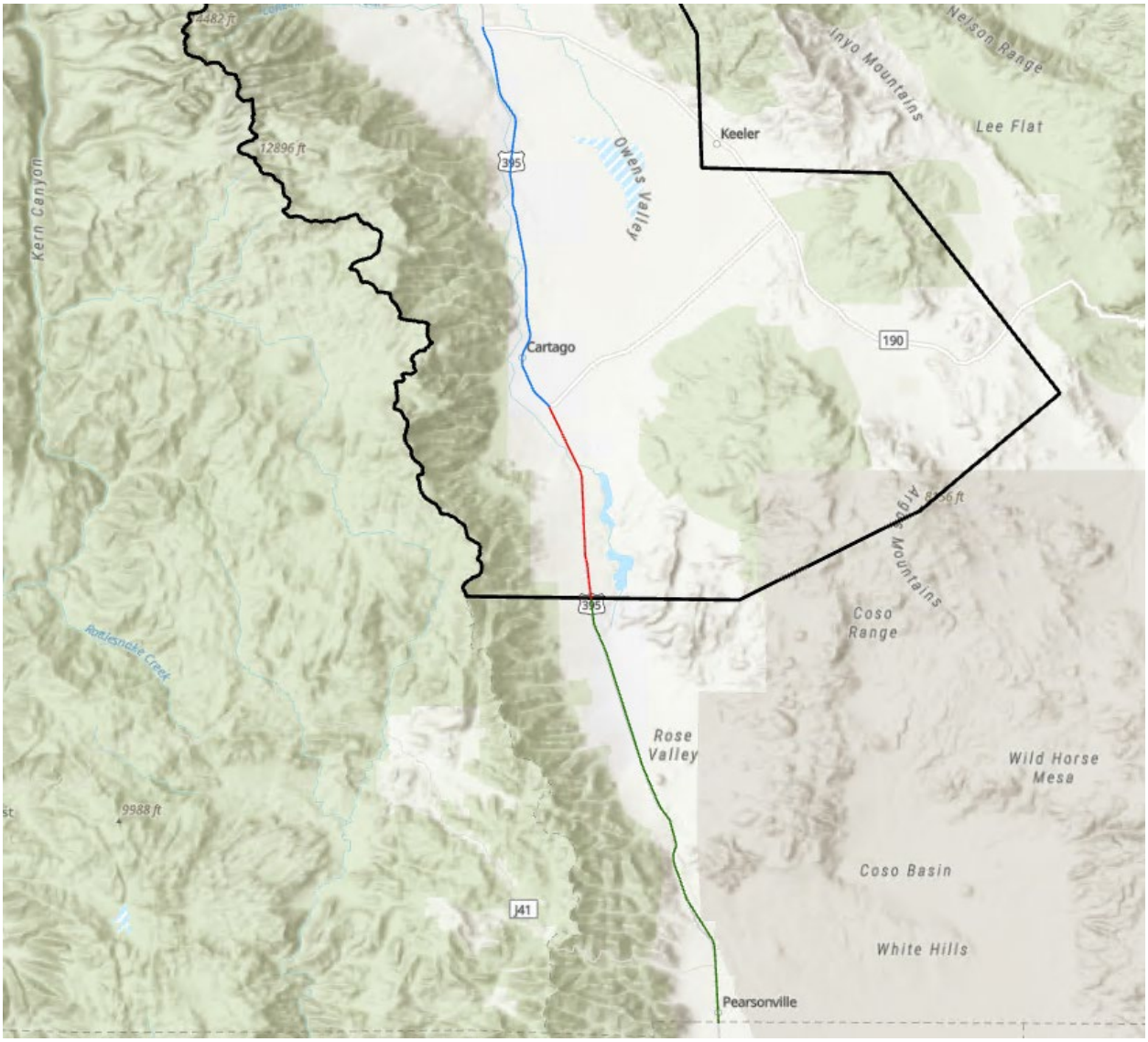
Step 3: Incorporate IOU/POU service territory boundaries.

Figure 0-3. Segments of US 395 with SCE and LADWP Boundary



Step 4: Split Segment 126269 based on IOU/POU service territory boundaries.

Figure E-1. Segments of US 395 split based on Traffic Volume and IOU/POU Service Territory

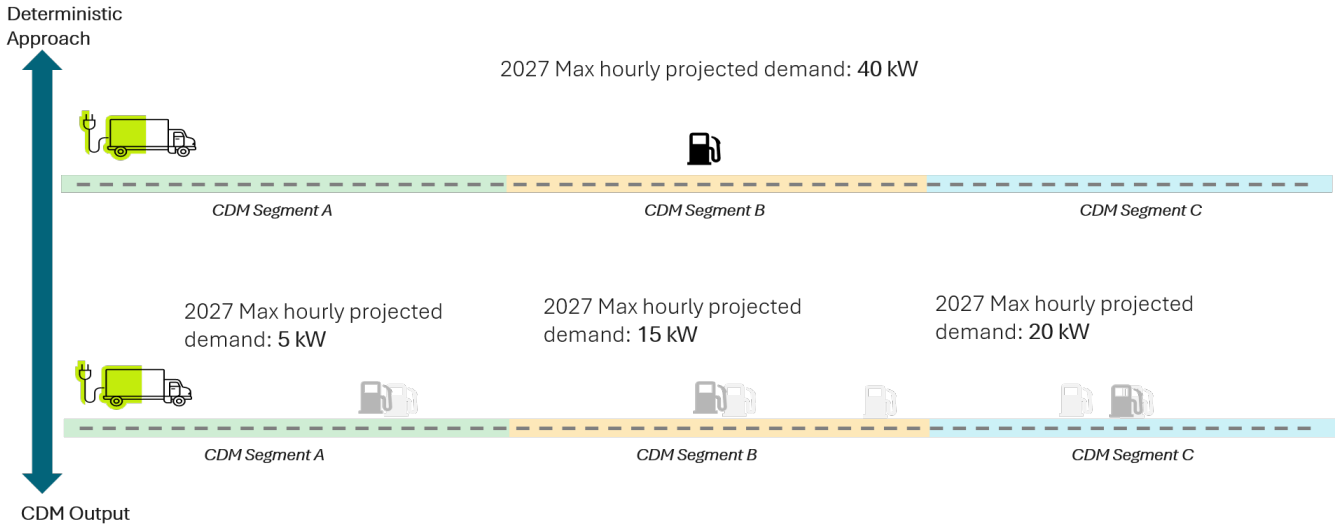


Appendix F. Probabilistic Modeling of BEV Charging

F.1 Probabilistic Modeling Overview

The CDM uses a probabilistic modeling approach to project where charging is likely to occur along highway corridors. This enables the model to estimate BEV charging load for every corridor segment included in the CDM, rather than only those associated with existing or future charging stations. Figure F-1 provides an example of how the CDM's probabilistic approach with a charger location-based deterministic approach.

Figure F-1. CDM Output vs Charger Location Driven Approach



The bottom of Figure F-1 illustrates the CDM output for hypothetical corridor segments A, B, and C and their respective maximum hourly projected demand as estimated probabilistically by the model. The top of Figure F-1 shows a charger location-based deterministic approach, where Segment B contains a charging station. In this approach, the charging demand from Segments A, B, and C is concentrated at Segment B, resulting in maximum hourly demand equal to the combined maximum hourly load of the three segments.

The charger location-based approach depicted in Figure F-1 more closely reflects how BEV charging is likely to occur at discrete locations along highway corridors rather than continuously along the entire corridor. However, a deterministic approach assumes a level of certainty about the long-term deployment of charging infrastructure that may not be warranted, creating a risk of false precision. In contrast, the CDM's probabilistic approach addresses this limitation by identifying where BEV charging load is most likely to occur without requiring assumptions about charging station locations in 2045.

F.2 Probabilistic Modeling Methodology

The CDM accounts for vehicle state of charge (SOC) when estimating the likelihood of charging at each corridor segment. Equation 4 describes the probabilistic methodology for used to estimate BEV charging load for a given vehicle class at a specific corridor segment.

Equation 4. CDM BEV Charging Load at Segment

$$\sum_{O} V_O * \mathrm{P}(C|SoC_O) * E_O$$

where:

- V_O the number of vehicles of a specific class at a given corridor segment having started their journey at origin O
- SoC_O the state of charge of a vehicle of a specific class at the corridor segment given origin O
- $\mathrm{P}(C|SoC_O)$ the probability of a vehicle of a specific class charging given their SOC
- E_O the energy required for a vehicle of a specific class to reach 80% SOC having reached a given corridor segment from origin O

As described in Section 2.4.1, the TEPP Modeling I&A provides the probability curve associated with the likelihood of charging at any given SOC. The research team surveyed and interviewed with MDHD fleet owners and operators to address unique uncertainties associated with MDHD BEV charging to support developing the likelihood of charging at any given SOC.

For additional context, Table F-1 provides an example of how the probabilistic modeling of BEV charging will be calculated for a given corridor segment, described in Section 2.4.1. Values in this example are for demonstrative purposes only and are not actual values. The Number of Vehicles Charging at Corridor Segment (4) in the table are calculated by multiplying the Number of Vehicles at Corridor Segment (1) by the Probability of Vehicle Class Charging given SOC (2). The BEV Charging Load (kWh) at Corridor Segment (6) is determined by multiplying the Number of Vehicles Charging at Corridor Segment (4) by the BEV Charging Load (kWh) needed to Reach 80% SOC (5).

Table F-1. Probabilistic Modeling of BEV Charging Example

Origin of Vehicles at Corridor Segment	Vehicle Class	Number of Vehicles at Corridor Segment (1)	SOC of Vehicles at Corridor Segment (2)	Probability of Vehicle Class Charging Given SOC (3)	Number of Vehicles Charging at Corridor Segment (4)	BEV Charging Load (kWh) Needed to Reach 80% SOC (5)	BEV Charging Load (kWh) at Corridor Segment (6)
Origin A	LD Passenger Car	20	40%	25%	5	20	100
	Long-Haul Truck	10	30%	24%	3	80	240
Origin B	LD Passenger Car	30	75%	2%	6	5	30
Origin C	MD Delivery Truck	15	20%	18%	3	60	180

Appendix G. Expansion of Geotab Data

There is a well-known mismatch between vehicle registration location and domicile location, especially for fleet vehicles. The structure of interstate trucking operations suggests that such mismatches are considerably more common for MDHD fleets than for LDVs. Federal Motor Carrier Safety Administration data indicates that roughly one-third of motor carriers operate interstate,[7] while International Registration Plan rules allow carriers to register vehicles through a single base jurisdiction even when vehicles operate from multiple terminals and service areas.[8] Consequently, vehicle registration data often does not accurately represent the geographic location of MDHD vehicle operations or charging demand. Therefore, the TE Modeling I&A uses telematics to determine where fleet vehicles are domiciled. This will provide a more accurate estimate of trip origination, corridors used for vehicle travel, and where infrastructure should be located to meet vehicle charging needs. This data will be used to disaggregate fleet vehicles from the IEPR forecast to more geographically granular locations based on their actual activity.

The telematics dataset represents a sample of the overall vehicle fleet. To align these data with the IEPR vehicle forecasts, Guidehouse cross walked between vehicle class and vocation information available in the Geotab dataset and the corresponding IEPR class. This mapping enabled each vehicle record to be associated with an IEPR vehicle class. Guidehouse then calculated expansion factors for each Geotab vehicle class–vocation combination to scale the sample data to match IEPR vehicle stock projections.

Geotab data also provided expansion factors for scaling the dataset to state-level vehicle counts; however, the resulting vehicle totals did not always align with IEPR forecasts. To address these discrepancies, the project team calculated an additional adjustment factor for each vehicle class to reconcile the expanded Geotab fleet with IEPR vehicle counts. Finally, the reconciled vehicle records were mapped from IEPR vehicle classes to TEPP vehicle classes and use cases. This final crosswalk enabled the travel and charging behavior observed in the Geotab data to be associated with the appropriate TEPP vehicle segments for subsequent analysis.

The model applies these expansion and adjustment factors to all Geotab vehicles such that the total number of domiciled fleet vehicles match IEPR state-level forecasts. While this telemetry data does provide confidence in domicile location and trips, there is a drawback in sample size. future fleet vehicle populations.

A recognized risk associated with any sample-based expansion methodology is the potential for geographic concentration when a limited number of observed vehicles are scaled to represent a larger forecasted population. Guidehouse evaluated this risk during methodology development and determined that the benefits of preserving observed fleet activity patterns outweigh the limitations associated with reliance on registration locations. The methodology therefore prioritizes observed operating behavior while applying expansion factors across thousands of telematics observations statewide, reducing reliance on any individual vehicle or location.

---

[7] Federal Motor Carrier Safety Administration (FMCSA). 2026. *A&I Online: Registration Statistics*. U.S. Department of Transportation. https://ai.fmcsa.dot.gov/RegistrationStatistics/

[8] International Registration Plan, Inc. (IRP, Inc.). 2026. *About IRP*. https://www.irponline.org/page/about

To further mitigate potential over-concentration of expanded vehicle populations, vehicle domicile locations are used as one input to the broader corridor demand modeling framework rather than as the sole determinant of charging demand. Vehicle trips are distributed throughout the transportation network based on observed origin-destination activity, route assignment procedures, and corridor traffic characteristics. As a result, charging demand is informed by both where vehicles are based and where they actually travel, reducing sensitivity to any individual domicile location. This approach better reflects the distributed nature of fleet charging demand across California's transportation system.

Appendix H. Roads Included in CDM

Table H-1. Roads Included in the CDM

Road Names				
Death Valley Rd	SR 1	SR 16	SR 3	SR 76
I 10	SR 101 P	SR 160	SR 32	SR 78
I 105	SR 103	SR 162	SR 33	SR 79
I 110	SR 104	SR 165	SR 35	SR 84
I 15	SR 108	SR 166	SR 36	SR 85
I 170	SR 11	SR 168	SR 37	SR 86
I 205	SR 110	SR 17	SR 38	SR 88
I 210	SR 111	SR 170	SR 4	SR 89
I 215	SR 113	SR 175	SR 41	SR 905
I 238	SR 116	SR 178	SR 43	SR 91
I 280	SR 118	SR 18	SR 44	SR 92
I 380	SR 119	SR 180	SR 45	SR 94
I 40	SR 12	SR 190	SR 46	SR 96
I 405	SR 120	SR 198	SR 47	SR 98
I 5	SR 125	SR 2	SR 49	SR 99
I 505	SR 126	SR 20	SR 52	US 101
I 580	SR 127	SR 201	SR 55	US 199
I 605	SR 128	SR 210	SR 57	US 395
I 680	SR 132	SR 22	SR 58	US 50
I 710	SR 134	SR 223	SR 60	US 6
I 780	SR 138	SR 23	SR 62	US 95

Road Names				
I 8	SR 139	SR 241	SR 63	US 97
I 80	SR 14	SR 245	SR 65	Old Bakersfield Highway- San Bernadino County
I 805	SR 140	SR 246	SR 67	Pomerado Road- San Diego County
I 880	SR 145	SR 247	SR 7	Laurel Street- San Diego County
I 980	SR 15	SR 25	SR 70	Grape Street- San Diego County
Jolon Rd	SR 150	SR 26	SR 71	Hawthorne Street- San Diego County
National Trails Hwy	SR 152	SR 269	SR 710	Cesar Chavez Street- San Francisco County
North Hwy	SR 154	SR 29	SR 73	Roth Road- San Joaquin County
Sierra Hwy	SR 155	SR 299	SR 74	Las Posas Road- Ventura County

Appendix I. CDM Outputs

Table I-1. CDM Outputs

Output Field	Definition	Example Output
Year	Year associated with the analysis (2027-2045)	2027
Corridor Name	Name of the road segment according to its highway system	I 5
Segment ID	Unique Identifier of each road segment and the name of the associated IOU/POU electricity serving entity.	I 5_San_Diego_Gas_&_Electric_1
Segment Length	The length of the road segment (miles)	1.21838408330839
Utility	Investor-Owned Utility/Publicly Owned Utility territory currently servicing the associated with the corridor segment. 'Unknown Utility' indicates the segment falls outside of any utility's service territory, e.g., on a bridge	San_Diego_Gas_&_Electric
Census Tract	Census tract that contains the road segment	6073018700
County	Geographic California County boundary associated with each road segment	SAN DIEGO
State	Geographic boundary; State of California	CA
Land Use / Zoning	For SDG&E: The designated land use, specified using Standard Industry Classification (SIC) codes. PG&E and SCE outputs will be determined based on the source proposed in the Tier 1 Advice Letter filing.	Open Space Park or Preserve
DAC	Disadvantaged Community; Road Segment is located within a DAC identified using CalEPA's designation of disadvantaged community for the purposes of SB 535 based on CalEnviroScreen. 1 indicates segment is in a DAC, 0 indicates segment is not in a DAC.	1
CalEnviroScreen 4.0	Road Segment is in an area that received a score in the top 25% of CalEnviroScreen 4.0	1
AB 1550 Low Income Community	Road Segments in a low-income community based on California Climate Investments Priority Populations Mapping Tool 4.0	0

Output Field	Definition	Example Output
Tribal Community	Tribal Community; Road Segment is located within a designated Tribal Area based on CalEPS's designation of a Tribal Community for the purposes of SB 535. 1 indicates segment is in a Tribal community, 0 indicates segment is not in a Tribal community.	0
NAA	Non-attainment Area; Road Segment that is located within an ozone non-attainment area boundary. 1 indicates segment is in an NAA area, 0 indicates segment is not in an NAA area.	1
Existing Charging Infrastructure	Indicates whether Road Segment is located close to an existing DC Fast Charging (DCFC) charger or not. 'Close to' is defined as a segment that is within one mile of an EVSE. 1 indicates road segment falls within a 1 mile radius of a currently operating DCFC charger, 0 indicates road segment does not fall within a 1 mile radius of a currently operating DCFC charger.	0
SB 671 Corridor Designation	Associated with the 34 Priority Freight Corridors or Top 6 High Priority Corridors identified within CTC's SB 671 Clean Freight Corridor Assessment. Corridors segments are designated as High Priority, Priority or N/A.	High Priority
Average Daily Peak Public Load (kW)	Peak hourly load (kW) for the average day coincident to all electric vehicles charging at public DC infrastructure (not coincident with system peaks)	7.9871755861171
Monthly Peak Public Load (kW) - Jan through Dec (12 columns)[9]	Peak hourly load (kW) for January through December (12 columns), capturing seasonal variation, coincident to all electric vehicles charging at public DC infrastructure (not coincident with system peaks)	15.18284957377
Monthly Peak End Hour – Jan through Dec (12 columns)[10]	Peak end hour associated with the January through December peak (12 columns) public load	14
EV Percent of Total Journeys	Percent of BEV journeys traveling along a given corridor segment for an average day for all duties	0.0425083514888262

[9] The CDM output for Monthly Peak Public Load (kW) will consist of 12 separate columns representing the peak hourly load for each month of the year

[10] The CDM output for Monthly Peak End Hour will consist of 12 separate columns representing the peak end hour for each month of the year

Output Field	Definition	Example Output
MDHD EV Journeys	Count of medium- and heavy-duty BEV journeys traversing a given corridor segment for an average day (regardless of whether they originated at depot or other)	191
MDHD EV Percent of Total Journeys	Percent of MDHD BEV journeys traveling along a given corridor segment for an average day for all MDHD vehicles	0.0332934596342291
MDHD EVs Charging at Segment	Count of medium- and heavy-duty BEVs charging at charging stations at a given corridor segment for an average day	1
MDHD Annual kWh	Annual BEV charging energy (kWh) for medium- and heavy-duty vehicles along a given corridor segment for a calendar year	25657.271421434
MDHD Daily kWh	Daily BEV charging energy (kWh) for medium- and heavy-duty vehicles along a given corridor segment for a calendar year	70.2938943052986
MDHD Hour End 1 (kW)	Average daily load associated with MDHD charging at hour 1	0.03627256328216
MDHD Hour End 2 (kW)	Average daily load associated with MDHD charging at hour 2	0.133848010024605
MDHD Hour End 3 (kW)	Average daily load associated with MDHD charging at hour 3	0.163386488526212
MDHD Hour End 4 (kW)	Average daily load associated with MDHD charging at hour 4	0.14897877077382
MDHD Hour End 5 (kW)	Average daily load associated with MDHD charging at hour 5	0.22507605869907
MDHD Hour End 6 (kW)	Average daily load associated with MDHD charging at hour 6	0.410408511909079
MDHD Hour End 7 (kW)	Average daily load associated with MDHD charging at hour 7	0.770096534676065
MDHD Hour End 8 (kW)	Average daily load associated with MDHD charging at hour 8	1.45638643915673
MDHD Hour End 9 (kW)	Average daily load associated with MDHD charging at hour 9	2.78857987525948

Output Field	Definition	Example Output
MDHD Hour End 10 (kW)	Average daily load associated with MDHD charging at hour 10	4.02826626528089
MDHD Hour End 11 (kW)	Average daily load associated with MDHD charging at hour 11	5.05703174839337
MDHD Hour End 12 (kW)	Average daily load associated with MDHD charging at hour 12	6.48539510482193
MDHD Hour End 13 (kW)	Average daily load associated with MDHD charging at hour 13	7.16972233347971
MDHD Hour End 14 (kW)	Average daily load associated with MDHD charging at hour 14	7.55378638085662
MDHD Hour End 15 (kW)	Average daily load associated with MDHD charging at hour 15	7.35695806417193
MDHD Hour End 16 (kW)	Average daily load associated with MDHD charging at hour 16	6.34636404479462
MDHD Hour End 17 (kW)	Average daily load associated with MDHD charging at hour 17	5.29548600046884
MDHD Hour End 18 (kW)	Average daily load associated with MDHD charging at hour 18	4.65607888997066
MDHD Hour End 19 (kW)	Average daily load associated with MDHD charging at hour 19	4.20321813794325
MDHD Hour End 20 (kW)	Average daily load associated with MDHD charging at hour 20	2.94090491657781
MDHD Hour End 21 (kW)	Average daily load associated with MDHD charging at hour 21	1.59248856349002
MDHD Hour End 22 (kW)	Average daily load associated with MDHD charging at hour 22	0.851611373035424
MDHD Hour End 23 (kW)	Average daily load associated with MDHD charging at hour 23	0.534727481621658
MDHD Hour End 24 (kW)	Average daily load associated with MDHD charging at hour 24	0.0888218886723949
LD EV Journeys	Count of light-duty BEV journeys traversing a given corridor segment for an average day	424

Output Field	Definition	Example Output
LD EV Percent of Total Journeys	Percent of LD BEV journeys traveling along a given corridor segment for an average day for all LD vehicles	0.0485619579696864
LD EVs Charging at Segment	Count of light-duty BEVs charging at a given corridor segment for an average day	1
LD Annual kWh	Annual BEV charging energy (kWh) for light-duty vehicles along a given corridor segment for a calendar year	2100.204
LD Daily kWh	Daily BEV charging energy (kWh) for light-duty vehicles along a given corridor segment for a calendar year	5.75398368422827
LD Hour End 1 (kW)	Average daily load associated with LD charging at hour 1	0.0213578380285474
LD Hour End 2 (kW)	Average daily load associated with LD charging at hour 2	0.0179563245417464
LD Hour End 3 (kW)	Average daily load associated with LD charging at hour 3	0.0136877374995853
LD Hour End 4 (kW)	Average daily load associated with LD charging at hour 4	0.0122084803581092
LD Hour End 5 (kW)	Average daily load associated with LD charging at hour 5	0.0173976012180405
LD Hour End 6 (kW)	Average daily load associated with LD charging at hour 6	0.0553378333181981
LD Hour End 7 (kW)	Average daily load associated with LD charging at hour 7	0.124705075687151
LD Hour End 8 (kW)	Average daily load associated with LD charging at hour 8	0.307785317043959
LD Hour End 9 (kW)	Average daily load associated with LD charging at hour 9	0.497661139719481
LD Hour End 10 (kW)	Average daily load associated with LD charging at hour 10	0.556821263843341
LD Hour End 11 (kW)	Average daily load associated with LD charging at hour 11	0.570102902436444
LD Hour End 12 (kW)	Average daily load associated with LD charging at hour 12	0.528361076609938
LD Hour End 13 (kW)	Average daily load associated with LD charging at hour 13	0.483554753874999
LD Hour End 14 (kW)	Average daily load associated with LD charging at hour 14	0.433389205260472

Output Field	Definition	Example Output
LD Hour End 15 (kW)	Average daily load associated with LD charging at hour 15	0.412946837544053
LD Hour End 16 (kW)	Average daily load associated with LD charging at hour 16	0.372655596758323
LD Hour End 17 (kW)	Average daily load associated with LD charging at hour 17	0.324026338771551
LD Hour End 18 (kW)	Average daily load associated with LD charging at hour 18	0.286209328231991
LD Hour End 19 (kW)	Average daily load associated with LD charging at hour 19	0.256036582834651
LD Hour End 20 (kW)	Average daily load associated with LD charging at hour 20	0.191581913361798
LD Hour End 21 (kW)	Average daily load associated with LD charging at hour 21	0.117335085685207
LD Hour End 22 (kW)	Average daily load associated with LD charging at hour 22	0.0741336238015876
LD Hour End 23 (kW)	Average daily load associated with LD charging at hour 23	0.0459548178783107
LD Hour End 24 (kW)	Average daily load associated with LD charging at hour 24	0.0327770041668053
Geometry	Geospatial data to locate the corridor segment.	MULTILINESTRING Z((-13082328 3941717 0,-13082323 3941713 0,-13080549 3940184 0))

(END Appendix B)