Examining Electrical Vehicle Charging Accessibility in the United States

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VW expects half of U.S. sales to be electric vehicles by 2030

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THE WHITE HOUSE

President Biden's American Jobs Plan includes a transformational $15 billion investment to fund this vision and build a national network of 500,000 charging stations. Through a combination of grant and incentive programs for state and local governments and the private sector, it will support a transformational acceleration in deployment of a mix of chargers in apartment buildings, in public parking, throughout communities, and as a robust fast charging along our nation's roadways.

AEP, Dominion Energy, Duke Energy, Entergy, Southern Company and TVA Plan to Add Electric Vehicle Fast Chargers to Connect Gulf Coast, Midwest and Atlantic State Destinations

RICHMOND, Va., March 2, 2021 /PRNewswire/ – Six major utilities today announced a plan to ensure that electric vehicle (EV) drivers have access to a seamless network of charging stations connecting major highway systems from the Atlantic Coast, through the Midwest and South, and into the Gulf and Central Plains regions.

The Electric Highway Coalition – made up of American Electric Power, Dominion Energy, Duke Energy, Entergy Corporation, Southern Co., and the Tennessee Valley Authority – announced a plan to enable EV drivers seamless travel across major regions of the country through a network of DC fast chargers for EVs. The companies are each taking steps to provide EV charging solutions within their service territories. This represents an unprecedented effort to offer convenient EV charging options across different company territories and allow EV travel without interruption.

Overview

- Research Objectives
- Past Research
- Justification: EV Ownership Rates
- Justification: GHG Emissions
- Defining Accessibility
- Background: Electrical Charger Types
- CAPCOG Population Demographics
- CAPCOG: Income and Charging Station Demographics
- Timeline
- Research Approach
- Examples of Aggregation Tools and Workflows
- Preliminary Results of Network Analysis on a Sample Area
- Limitations
- References

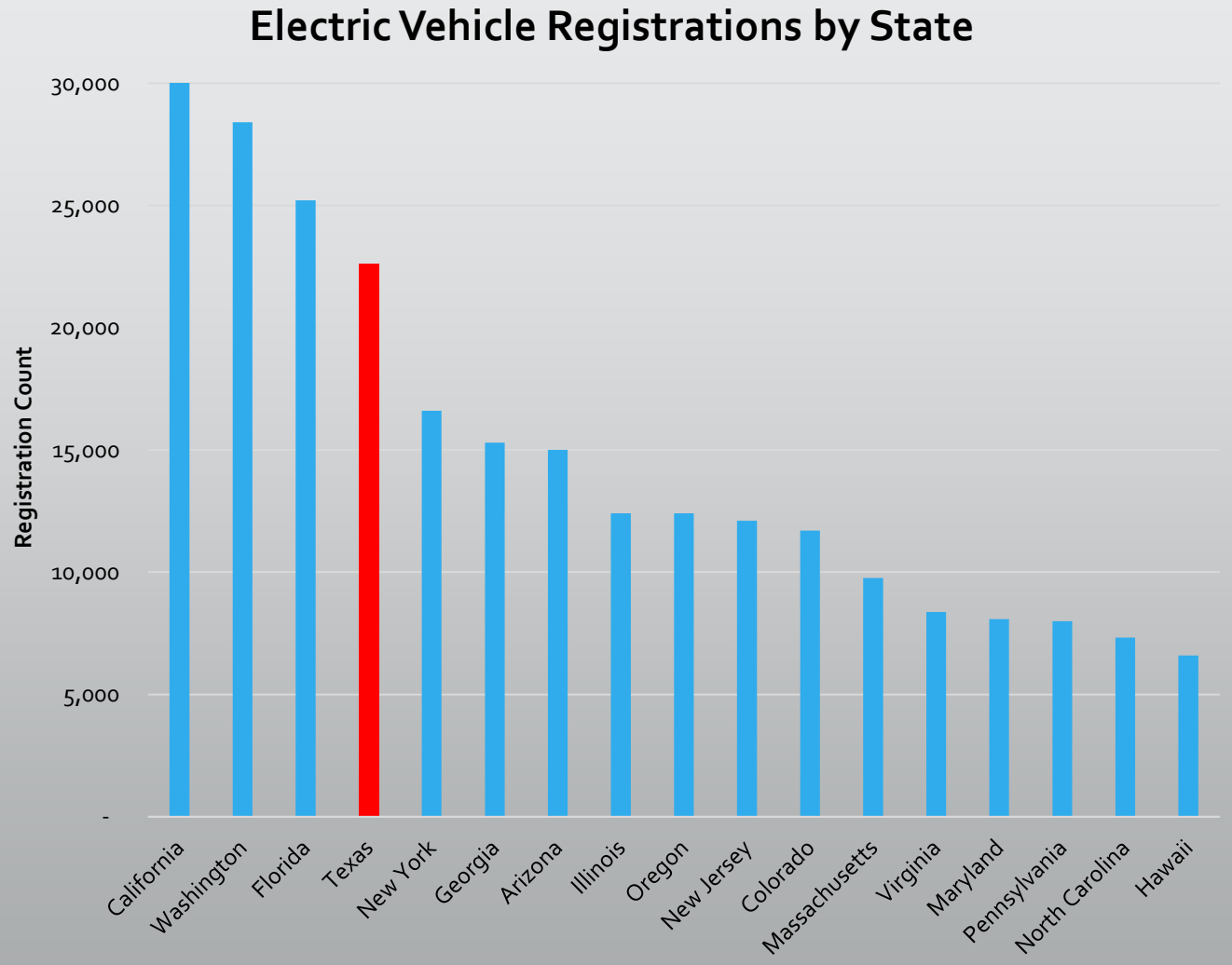
Research Objectives

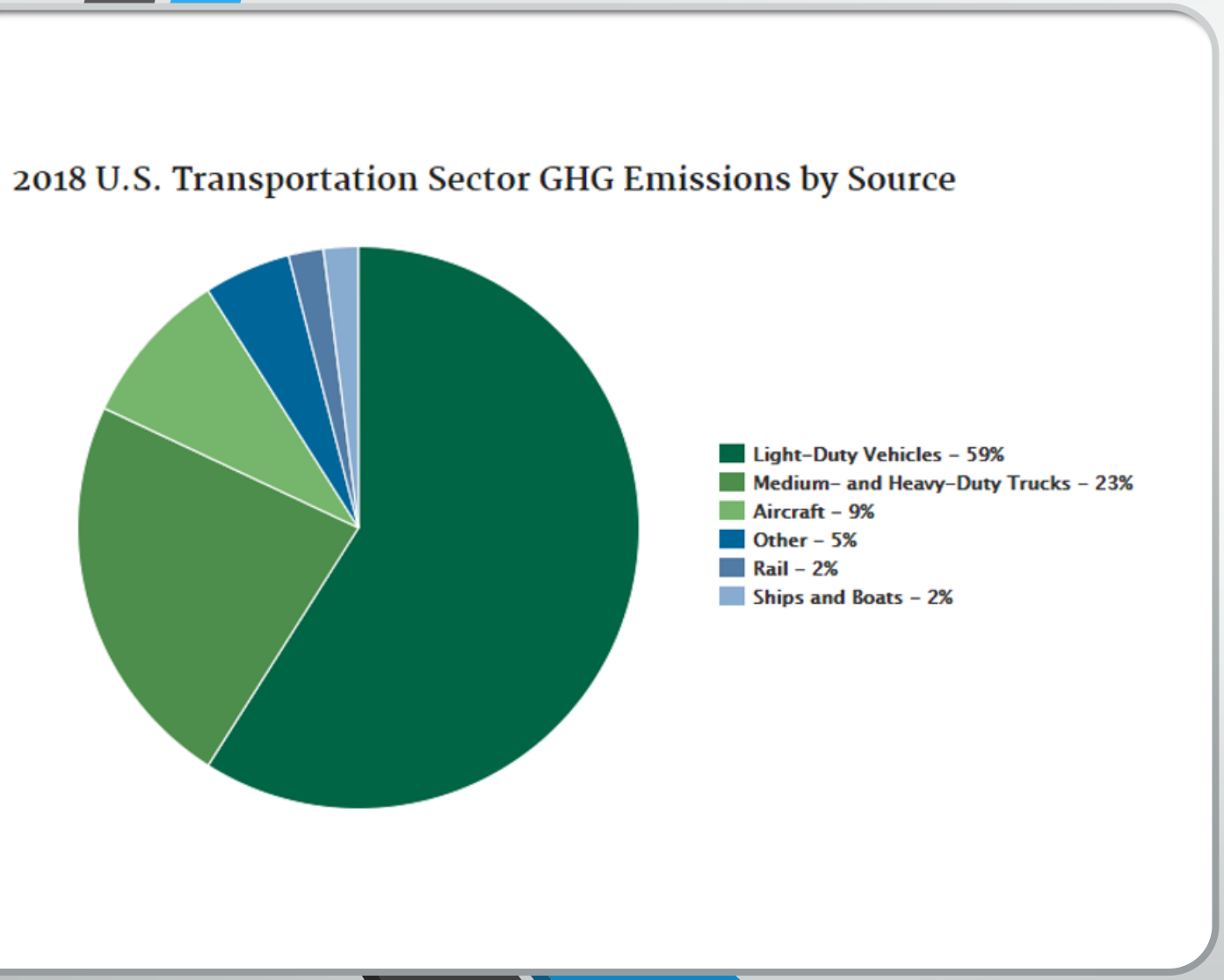
- Analysis of Electrical Vehicle Charging Infrastructure in the **Capital Area Council of Governments of Texas (CAPCOG)**
- This research will focus on the locational relationship between electrical vehicle charging stations infrastructure and accessibility to job areas, retail, entertainment, and parks.
- This study will also examine local socio-economic demographics of census blocks in proximity to charging station locations

Past Research on the Electrical Charging Station Network

- *California public electric vehicle charging stations' accessibility to amenities: A GIS network analysis approach (Chen, 2017)*
- *Charging Electric Vehicles in Smart Cities: An EVI-Pro Analysis of Columbus, Ohio* (NREL, 2018)
- *Measuring the impacts of new public transit services on space-time accessibility: An analysis of transit system redesign and new bus rapid transit in Columbus, Ohio (Lee & Miller, 2018)*

Justification: Electrical Vehicle Ownership Rates





Justification: Green House Gas Emissions

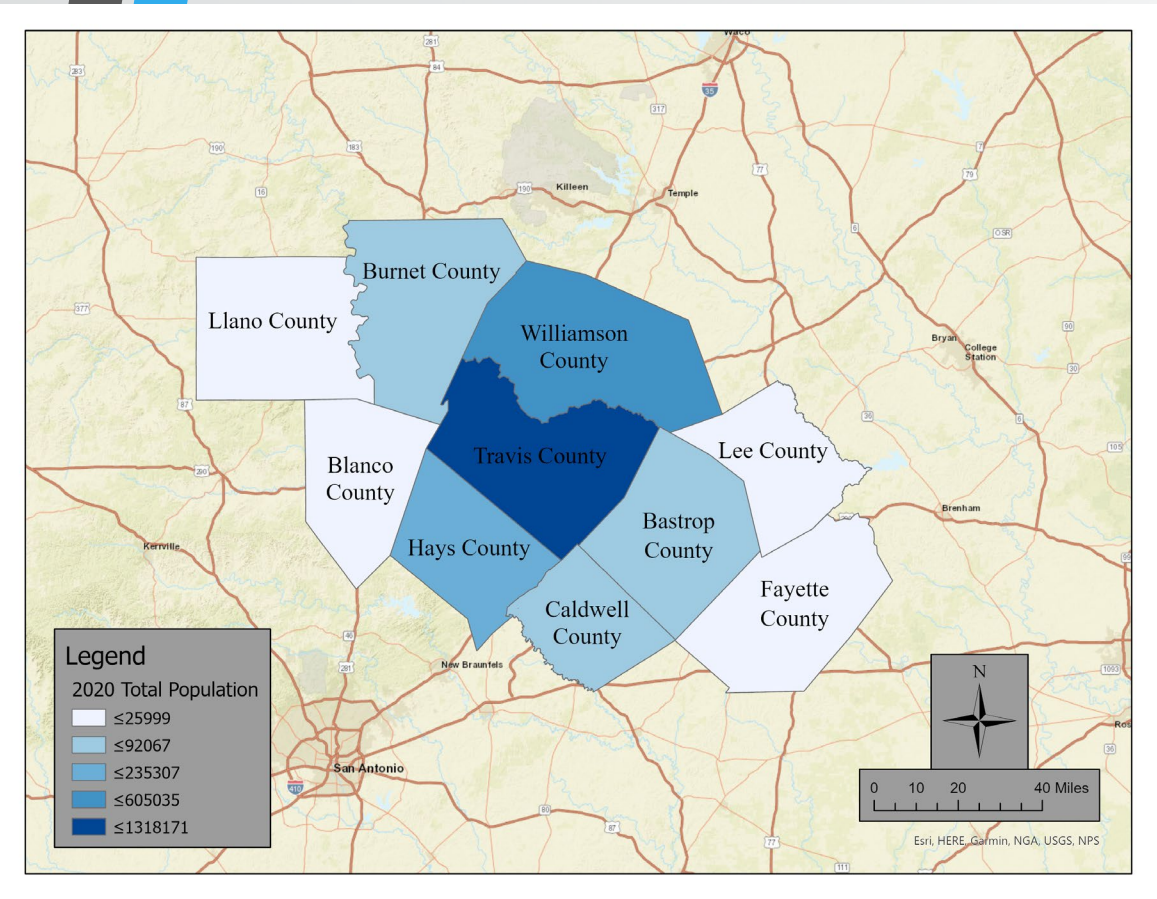
Defining Accessibility

- **Travel Cost:**
  - Time and Distance
- **Attractiveness of Destination:**
  - Shopping centers, workplaces, and recreational centers (parks, etc.)
- **Unit of Measurement:**
  - Time: retail, workplaces, and recreational centers within 10 minutes of an electrical charging station
  - Distance: retail, workplaces, and recreational centers within .25 of an electrical charging station
- Limitation: Distance Decay

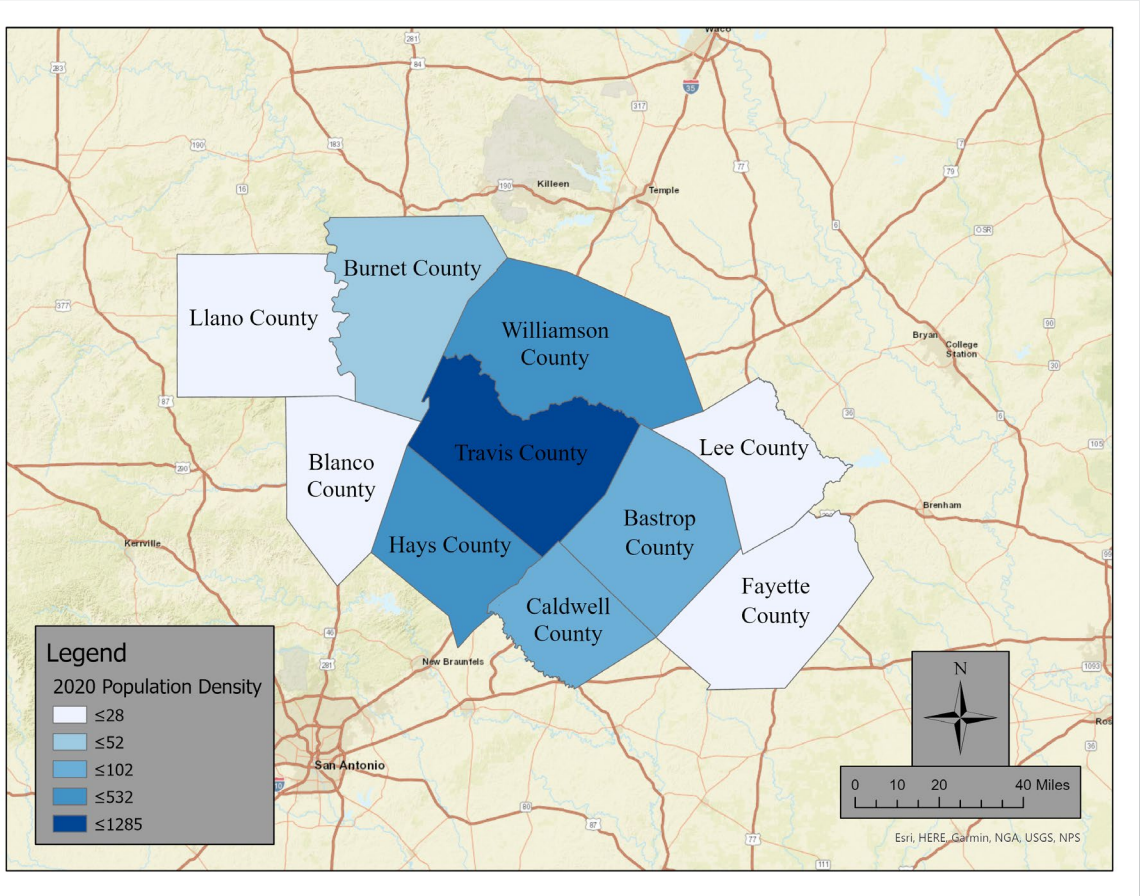
Background:
Electrical Vehicle Charger Types

- Level 1
- Level 2
- Direct Current Fast Charge

CAPCOG: Population Demographics

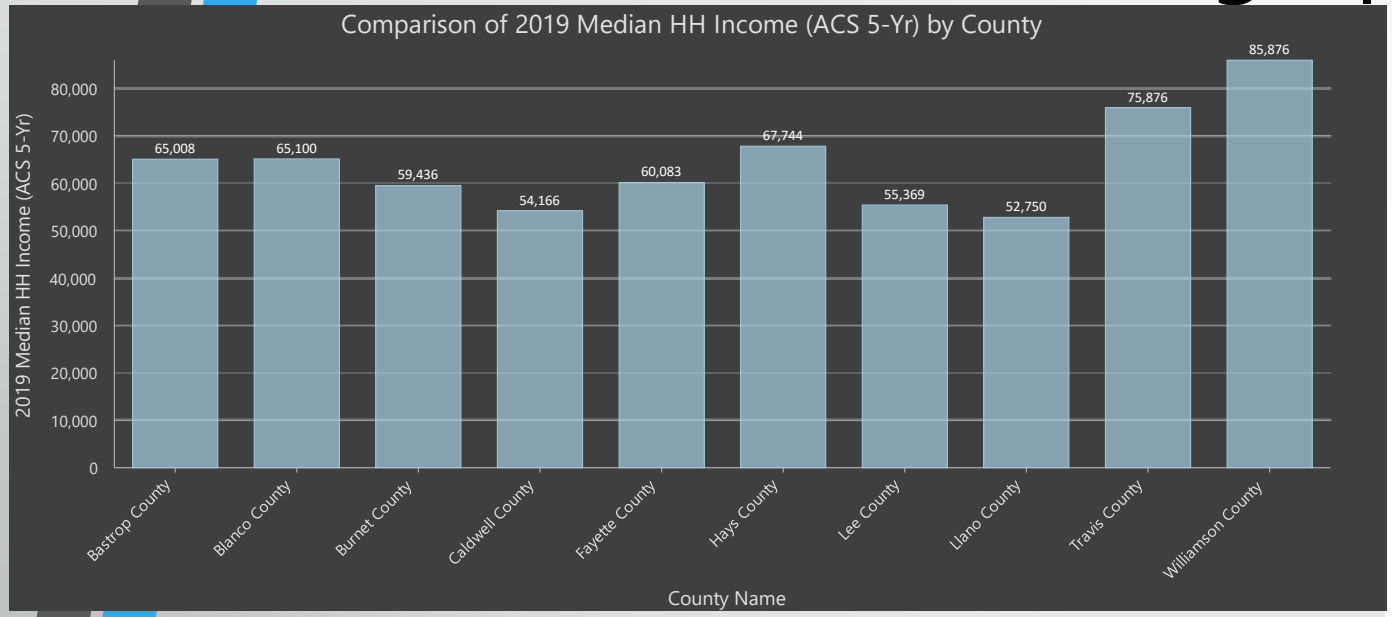


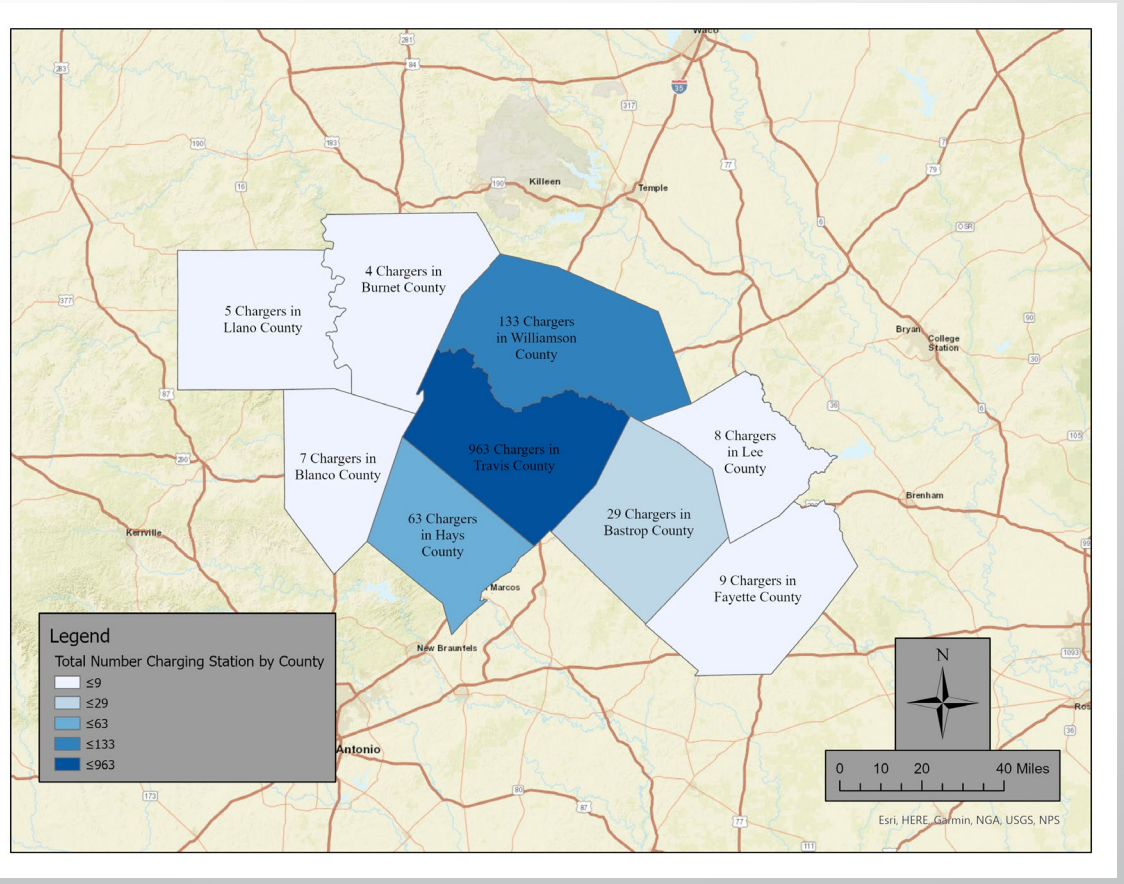
Mean: 242, 914| Minimum: 11,757 | Maximum: 1,318,171



Mean: 250.13| Minimum: 16.50| Maximum: 1,285.80

CAPCOG: Income and Charging Station Demographics





Timeline


Develop/finalize Capstone Proposal
Create scripting tools and aggregate datasets
Gather further data
Conduct final analysis on datasets
Begin writing final paper
Select and develop demonstration for Capstone Presentation
May–June 2021
July–Aug. 2021
Sep.–Oct. 2021
Nov.–Dec. 2021
Conduct preliminary analysis
Evaluate results and refine methodology/datasets
Start draft of final paper
Present Capstone Presentation

Research Approach

Gather

- Datasets
- Past research results & methods
- Speak with government officials and researchers

Build

- "Service Areas" and produce isochrone maps detailing accessibility per charging station location
- Workflows to aggregate electrical charging station locations, electrical vehicle registration, and building address points
- Automatize scripting tools
- Template layouts and reports
- Standardized accessibility weight measurement

Analyze

- Relationships between electrical charging station locations, electrical vehicle registrations, socioeconomic demographics, and available destination types
- Public policy initiatives
- Charging station network through overlay, buffer, and network analysis

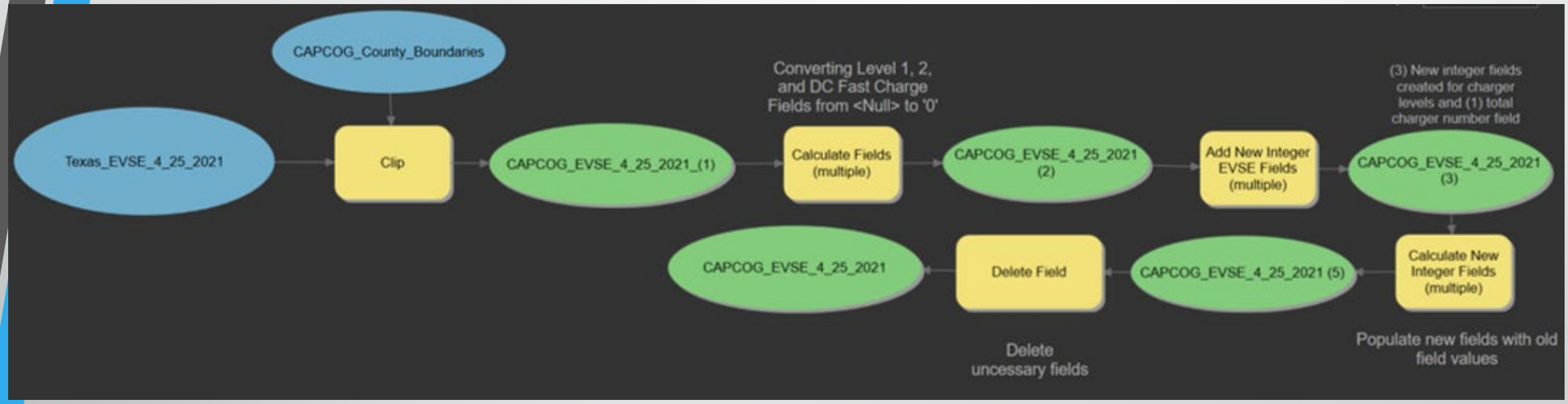
Report

- Results of network analysis on the CAPCOG region by county
- On the overall accessibility of electrical charging stations in CAPCOG region

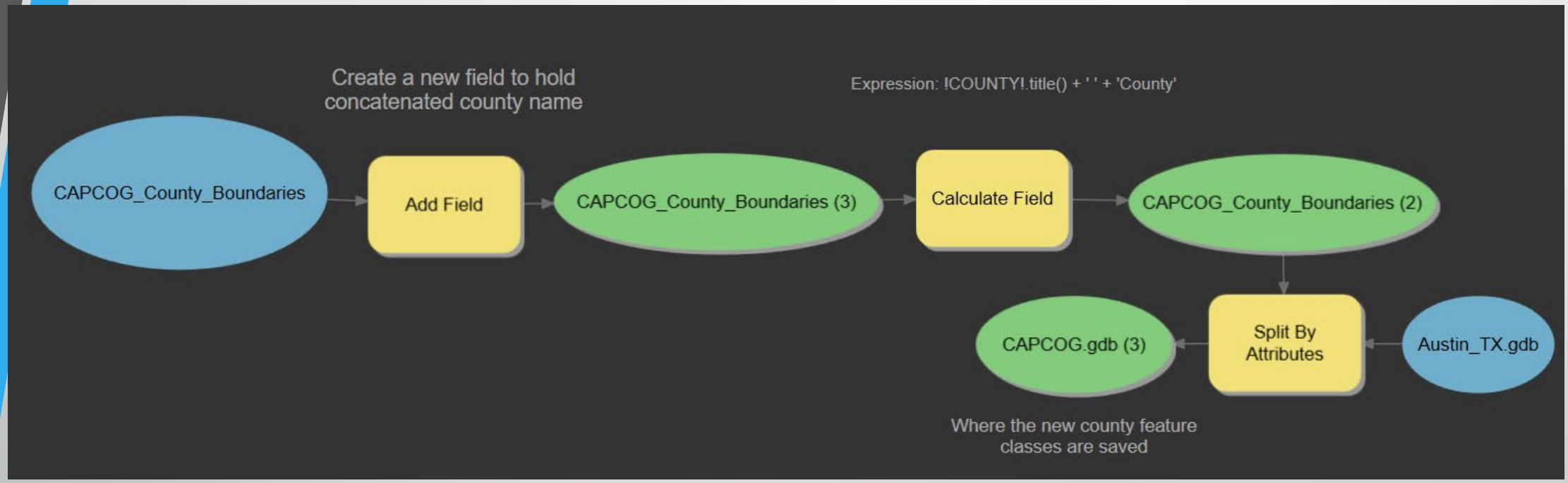
Data Types

Layer Name	Source	Update Date	Data Type	Description of Dataset
Electrical Charging Station Locations	Alternative Fuels Data Center (AFDC)	04-11-2021	Point	This dataset contains the geographic location of electrical vehicle charging stations in Texas
County Boundaries	Capitol Area Council of Governments (CAPCOG)	04-17-2020	Polygon	This dataset defines the geographic boundaries of CAPCOG and associated counties
Road Network Center Lines	Capitol Area Council of Governments (CAPCOG)	04-12-2021 (Monthly)	Polyline	This dataset defines the local road network in the CAPCOG region and is classified by road type
Address Points of Locations	Capitol Area Council of Governments (CAPCOG)	04-12-2021 (Monthly)	Point	This dataset defines all address points within the CAPCOG region and is classified by building type
City Limits of CAPCOG Region	Capitol Area Council of Governments (CAPCOG)	04-12-2021	Polygon	This dataset defines the geographic boundaries of all towns/cities in the CAPCOG region
2020 Census Tracts/Blocks/Block Groups of CAPCOG Region	United States Census Bureau		Polygon	This dataset defines the geographic boundaries and their associated socio-economic demographics
Electrical Vehicle Registrations by Zip code	Dallas-Fort Worth Clean Cities Coalition	04-06-2021 (Monthly)	(.csv file) Longitude and Latitude Coordinates	This dataset defines the geographic location and month of registration of electrical vehicles in Texas

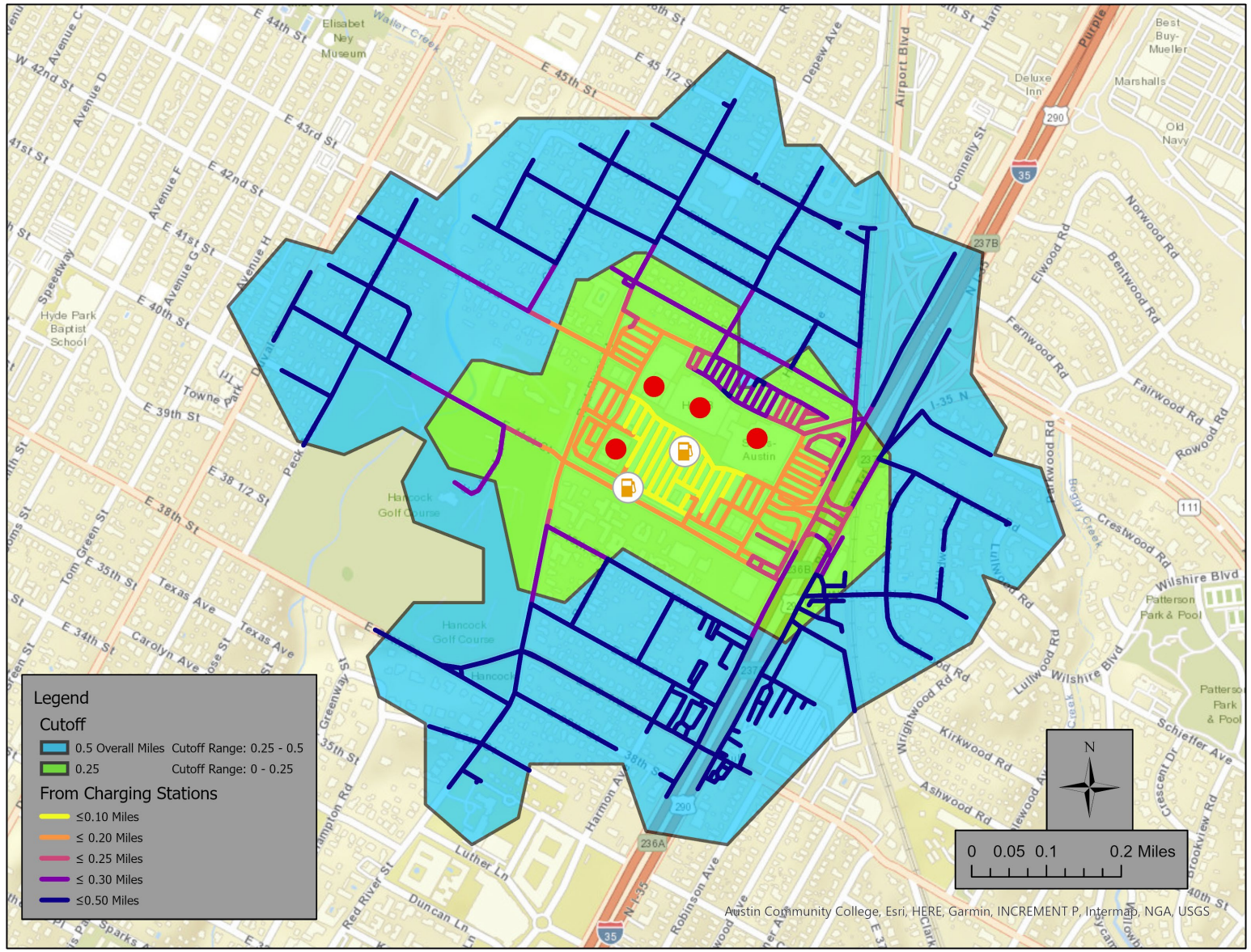
Charging Station Dataset Aggregation/Filtering Tool



CAPCOG County, City/Town, and Census Block Creation Tool



Preliminary Results of Network Analysis on a Sample Area



Data and Infrastructure Limitations

- Modifiable Areal Unit Problem (MAUP)
  - Shape or zonation effect
  - Aggregation effect
- EVSE Charger Levels and Connector Types
- BEV Car Manufacture, Model, Series, and Year Produced
- Defining Accessibility

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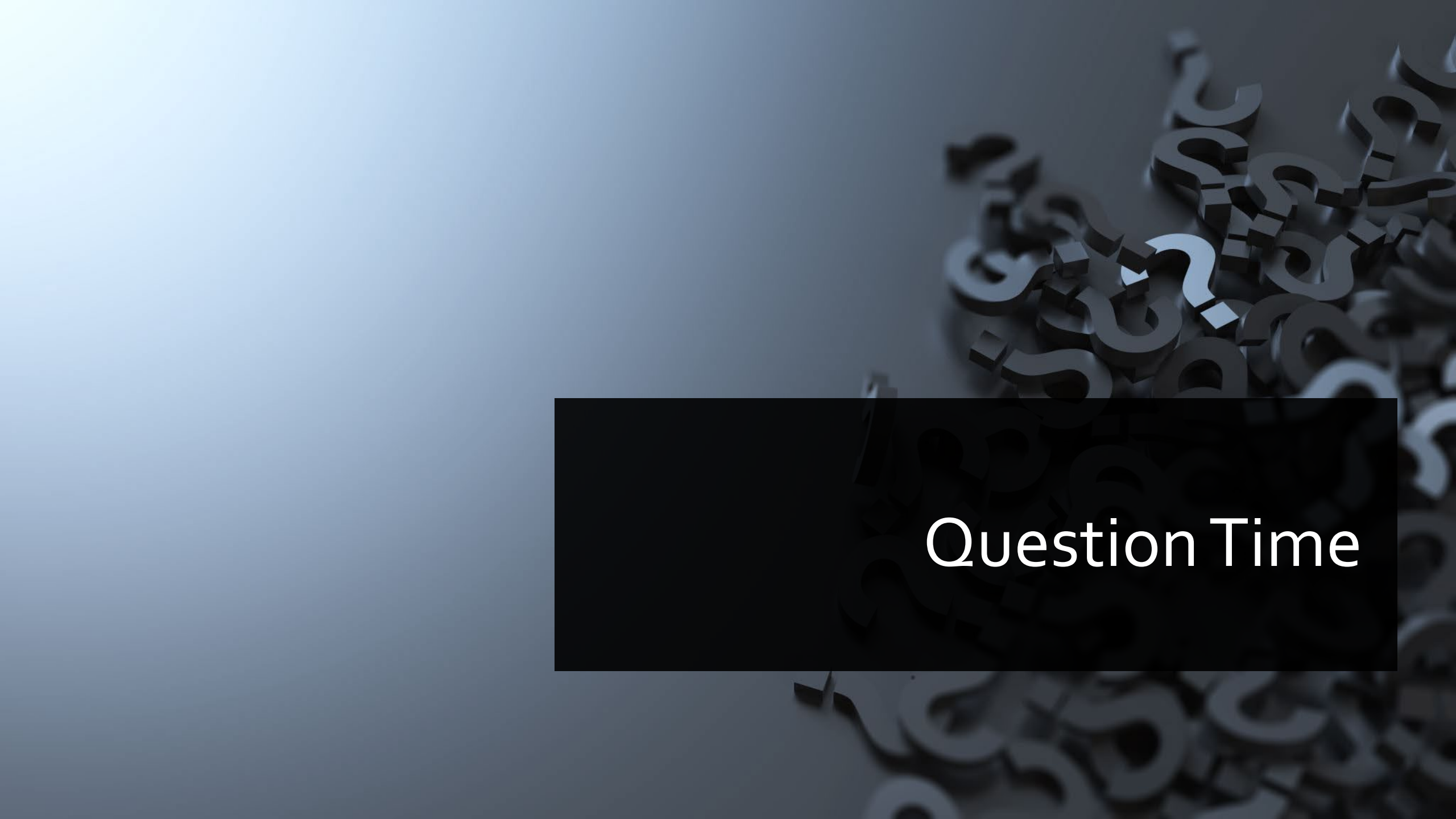
Question Time

Possibly remove or use as prompt for questions

Terminology

Acronyms	Definition
CAPCOG	Capital Area Council of Governments of Texas
BEV	Battery Electric Vehicle
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
L1	Level 1 Charging Station
L2	Level 2 Charging Station
DCFC	Direct Current (DC) Fast Charging Station
MUD	Multi-Unit Dwelling
SUD	Single-Unit Dwelling