Analysis Report

December 30, 2024

1. Introduction

The adoption of electric vehicles (EVs) has been widely promoted as a means to mitigate urban air pollution. This report examines the relationship between the growth of EV adoption in King County, Washington—particularly in Seattle—and its influence on air quality from 2016 to 2024.

2. Data Sources

2.1 Electric Vehicle Population Size History By County (WA State)

- **Metadata URL:** EV Population
- **Data URL:** Download EV Population
- **Data Type:** CSV
- **Description:** This dataset details the monthly vehicle registrations recorded by the Washington State Department of Licensing (DOL), which combines the data from the National Highway Traffic Safety Administration (NHTSA) and the Environmental Protection Agency (EPA) fuel efficiency ratings with its own titling and registration records.
- **Data Structure and Quality:** Data includes historical Electric Vehicle population counts from January 2017 through October 2024. It categorizes the data by county of Washington State, distinguishing between passenger vehicles and trucks.
- **License and Obligations:** Open Database License. It is stated in the Metadata. To comply with the obligation, appropriate credit to the Washington State Open Data Portal will be given and the link to the License will be provided.

2.2 Air Quality System (AQS) Data

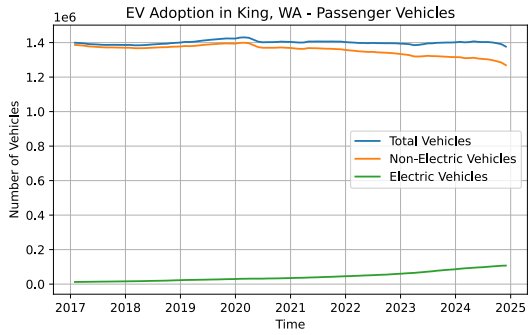
- **Metadata URL:** Air Data Description
- **Data URL:** For each year and each substance a different zip file has to be downloaded from Air Data
- **Data Type:** zip folder containing CSV file.
- **Description:** The Air Quality System (AQS) contains ambient air pollution data collected by the Environmental Protection Agency (EPA), state, local, and tribal air pollution control agencies from over thousands of monitors.

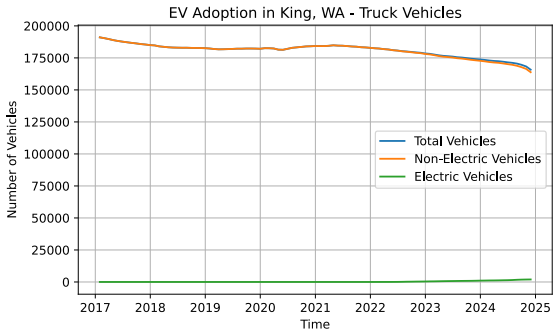
- **Data Structure and Quality:** For our study Daily Summary Files will be used. CSV files that aggregate the measurements by day. There are up to 29 different variables or columns, many of which might be redundant for our use, like the different ways to express the location of the monitor. We will use 4 substances: Carbon Monoxide (CO), Nitrogen Dioxide (NO2), PM2.5 Speciation and PM10 Speciation
- **License and Obligations:** Public Domain License. The License statement can be found here. To comply with the obligation, citations will be included as mentioned here.
- **Domain Specific Value Types:**
  - **Site Num.**: Each unique geographic location that contains monitors is called a site. In this analysis, two sites will be used:
    * Seattle - 10th & Weller referred by number **30**
    * Seattle - Beacon Hill referred by number **80**

3. Analysis

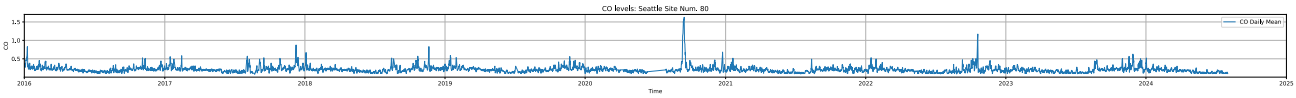
For passenger vehicles, the total population remained relatively stable at approximately 1.4 million over the years, while EV adoption showed a steady, monotonic increase, reaching 7.8% of the total by December 2024.

At the beginning of 2017 there were 191 048 registered truck vehicles, which decreased by December 2024 to 165 803, of which only 1.2 % are electric vehicles. That is a decrease of 13.2 % in total population.

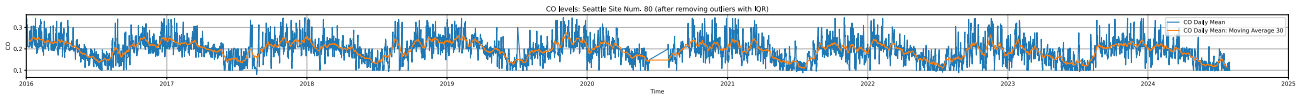




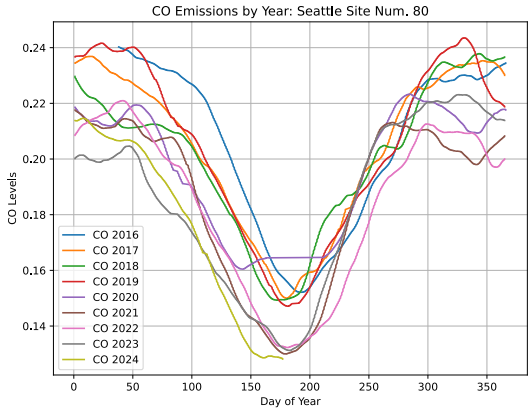
The AQI data is less straightforward. Plotting the CO daily average dataset reveals high volatility with few outliers:

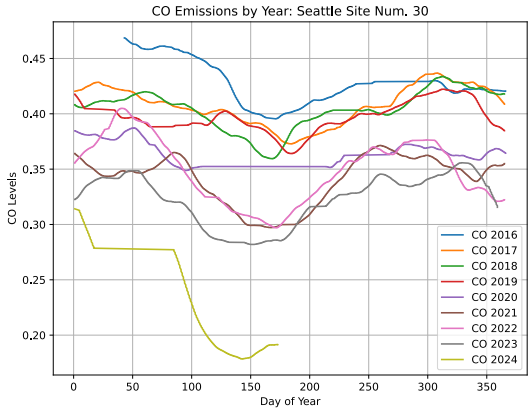


After using the IQR method and setting all the outliers to the mean, the data still shows heavy fluctuations. To help smooth out those fluctuations and highlight longer-term trends, 30-day centered moving average is applied and the result reveals a yearly pattern: the CO emission is seasonal.



To compare one year with the next, a moving average of 120 days followed by another one of 30 days was performed to smooth the trend even further, iteratively, and then each year was plotted on top of each other. The flat lines in site 30 are periods of missing data. The table below shows the yearly average computed directly from the daily mean without moving averages. The 2024 has been excluded from the table since it is incomplete. Both data representations are showing that Seattle is getting less CO emissions by each year.





Year	CO: Yearly Mean (80)	% Decrease (80)	CO Yearly Mean (30)	% Decrease (30)
2016	0.2082	0.00%	0.4315	0.00%
2017	0.2043	-1.85%	0.4063	-5.83%
2018	0.2006	-3.63%	0.4037	-6.45%
2019	0.2067	-0.70%	0.4002	-7.25%
2020	0.1987	-4.55%	0.3642	-15.61%
2021	0.1858	-10.75%	0.3399	-21.23%
2022	0.1841	-11.55%	0.3484	-19.27%
2023	0.1855	-10.88%	0.3283	-23.91%

For NO2 we also see a yearly decrease on site number 30, however, for site number 80 there are some fluctuations, with 2020 having the lowest average.

Year	NO2: Yearly Mean (80)	% Decrease (80)	NO2: Yearly Mean (30)	% Decrease (30)
2016	11.1525	0.00%	20.3328	0.00%
2017	11.0991	-0.48%	19.3251	-4.96%
2018	10.1951	-8.59%	19.1513	-5.81%
2019	10.3392	-7.30%	17.8398	-12.27%
2020	8.4683	-24.06%	15.5562	-23.50%
2021	9.1620	-17.85%	15.7019	-22.77%
2022	9.9837	-10.47%	16.0346	-21.16%
2023	9.3035	-16.57%	14.9959	-26.24%

The PM10 Speciation dataset presents even more volatility and the mean is mostly linear over the years. The PM2.5 Speciation dataset has the same problem and additionally it contains up to 43 different measurement methods. Therefore these two parameters are omitted from this study.

4. Conclusions

An analysis of the EV dataset indicates that it is still too early to address the posed question definitively. As of December 2024, EVs account for only 7.8% of passenger vehicles and 1.2% of truck registrations in King County. However, it would be interesting to repeat the analysis in a few years, since the State of Washington is setting new standards for the newly registered vehicles.

According to U.S. Environmental Protection Agency (EPA) and World Health Organization (WHO), vehicle emissions are the greatest source of carbon monoxide (CO) and Nitrogen dioxide (NO2) pollution, however it is not clear the distribution of the impact between passenger cars and other vehicles. And even among passenger cars, it depends on the year of production, the emission filter, the quality of fuel burned, etc.

This analysis confirms that from 2016 to 2024, Seattle has seen a gradual decline in carbon monoxide (CO) and nitrogen dioxide (NO2) emissions. How they achieved it and whether the adoption of electric vehicles had a significant contribution to it requires a much more detailed and technical analysis, better quality data and higher percentage of EVs.

References

- Washington State Open Data Portal: Electric Vehicle Population Size History by County.
- U.S. Environmental Protection Agency: Air Quality System (AQS) Data.