



Data Visualization Project

Electric Vehicles (EVs)

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EVs Project Description

In this project, our primary focus revolves around addressing a series of analytical questions related to the use of electric vehicles (EVs) over the past five years. We have at our disposal two main datasets: the first one provides us with a comprehensive EV census spanning from 2018 to 2022 in the United States, while the second dataset offers an in-depth insight into the technical specifications and pricing information of the most popular EV models.

Our primary goal is to put into practice the skills acquired in our classroom through the creation of insightful visualizations and present our findings as the solutions to these analytical inquiries. This project aims to not only enhance our understanding of the EV landscape but also contribute valuable insights to this dynamic and evolving sector.

Original Data Sets

The original datasets can be found at the following links.

- Dataset No. 1: “*Electric_Vehicle_Population_Data.csv*”:
<https://catalog.data.gov/dataset/electric-vehicle-population-data>
- Dataset No. 2: “*ElectricCarData_Clean_Me.csv*”:
<https://www.kaggle.com/datasets/divyanshugupta95/cars-dataset-with-battery-pack-capacity>
- Dataset No. 3: “*euro-daily-hist_1999_2022.csv*”:
<https://www.kaggle.com/datasets/lsind18/euro-exchange-daily-rates-19992020/data>

Data Dictionary

1. **EV_Type:** define if the car model is a Battery Electric Vehicle (BEV) or Plug-in Hybrid Electric Vehicle (PHEV).
2. **Brand:** name of the manufacturer of the vehicle.
3. **Model:** model name.
4. **Accel_Sec:** acceleration as 0-100 km/h.
5. **Top_Speed:** is the top speed in km/h.
6. **Range_Km:** is the range in km.
7. **Efficiency_WhKm:** amount of electrical energy consumed to travel 1 Km.
8. **Rapid_Charge:** indicate whether the EVs have rapid charge.
9. **Fast Charge:** charge km/h.
10. **Power_Train:** front, rear, or all-wheel drive.
11. **Plug_Type:** plug type.
12. **Body_Style:** basic size or style.
13. **Battery_Pack_Kwh:** Refers to the total amount of electrical energy a battery pack can store. It's measured in units like kilowatt-hours (kWh).
14. **Seats:** number of seats.
15. **Price:** average price in euros for the last 5 years.

Analysis Questions

1. Are people using more EVs in recent years?
2. Which states had more EVs?
3. Which county held the highest number of EVs?
4. Which manufacturer had the majority of EVs?
5. Which style of EVs do people tend to gravitate towards?
6. Which manufacturer had the highest battery pack capacity?
7. Which manufacturer had the highest efficiency?
8. Which manufacturer had the lowest acceleration?
9. Which manufacturer had the highest top speed?
10. Are specific features of EVs linked to their pricing?

Part A

Data transformation in Power BI Cleaning

Dataset No. 1: "Electric_Vehicle_Population_Data.csv"

Initial screenshot

The screenshot shows the Power BI desktop interface with the 'Electric_Vehicle_Population_Data' query selected in the 'Queries' list. The 'Transform' tab is active. The 'Properties' pane on the right shows the query name and applied steps ('Promoted Headers' and 'Changed Type'). The table preview displays 28 rows of data with columns: VIN (1-10), County, City, State, Postal Code, Model Year, and Make.

VIN (1-10)	County	City	State	Postal Code	Model Year	Make
KMBK33AGXL	King	Seattle	WA	98103	2020	HYUNDAI
1CARV1B61N	King	Bothell	WA	98011	2022	JEEP
1CARV1D61P	Yakima	Yakima	WA	98908	2023	JEEP
SY3E1EA7J	King	Kirkland	WA	98034	2018	TESLA
WBYY7ZBCXU	Thurston	Olympia	WA	98501	2018	BMW
SY3E1EA8L	Snohomish	Marysville	WA	98271	2020	TESLA
ZC4RC1N7H	King	Kent	WA	98042	2017	CHRYSLER
SY3YGD0E3L	King	Woodinville	WA	98072	2020	TESLA
SY3E1EA8J	Island	Coupeville	WA	98239	2018	TESLA
75AYG0EF0P	King	Bellevue	WA	98004	2023	TESLA
SY3E1EA7J	King	Kirkland	WA	98033	2018	TESLA
3FA6P0S09G	Kitsap	Port Orchard	WA	98367	2016	FORD
JDTKARFP9H	Kitsap	Port Orchard	WA	98366	2017	TOYOTA
SY3E1EB8K	Snohomish	Mukilteo	WA	98275	2019	TESLA
SY3E1EA8K	King	Redmond	WA	98052	2019	TESLA
3FA6P0S0J0	Thurston	Rochester	WA	98579	2013	FORD
WA1VAB0E4K	King	Seattle	WA	98112	2015	AUDI
1N4A20CP6F	King	Seattle	WA	98125	2015	NISSAN
KN0CC3LD7K	Kitsap	Bremerton	WA	98311	2019	KIA
1N4A20CP1E	Kitsap	Poulsbo	WA	98370	2014	NISSAN
21 SUKXT0C1J	King	Kent	WA	98042	2018	BMW
SY5SA1E2ZJ	Snohomish	Marysville	WA	98271	2018	TESLA
1G1RB6E46D	Kitsap	Bremerton	WA	98312	2013	CHEVROLET
2T3YLADV5E	King	Seattle	WA	98108	2014	TOYOTA
JDTKARFP5H	Snohomish	Lake Stevens	WA	98258	2017	TOYOTA
SY3E1EB8L	Kitsap	Silverdale	WA	98383	2020	TESLA
SY3E1EB8J	King	Kirkland	WA	98033	2018	TESLA

→ Renamed the query to: Electric_Vehicle_Census.

→ Removed the following columns:

- 'VIN (1-10)',
- 'Clean Alternative Fuel Vehicle (CAFV) Eligibility',
- 'Base MSRP',
- 'Legislative District',
- 'DOL Vehicle ID',
- '2020 Census Tract'

'Electric Utility'

- Split longitude and latitude from the 'Vehicle Location' column.
- Renamed columns:
 - 'Postal Code': 'Postal_Code',
 - 'Model Year': 'Model_Year',
 - 'Make': 'Brand',
 - 'Electric Vehicle Type': 'EV_Type',
 - 'Electric Range': 'Range_Km'
- Removed blank rows.
- Based on the column "Model_Year", created a new "column for example" called Sales_Year.
- Reorder Columns:

Brand,
 Model,
 Model_Year,
 Sales_Year,
 EV_Type,
 Range_Km,
 County,
 City,
 Postal_Code,
 State,
 Longitude,
 Latitude.

- Changed data types.
- Filtered Sales_Year only from 2018 to 2022.

Final screenshot

The screenshot shows the Microsoft Power BI Data Editor interface. The main area displays a table titled "Electric_Vehicle_Census" with the following data:

	Brand	Model	Model_Year	Sales_Year	EV_Type
1	HYUNDAI	KONA	2020	2020	Battery Electric Vehicle (BEV)
2	JEEP	GRAND CHEROKEE	2022	2022	Plug-in Hybrid Electric Vehicle (PHEV)
3	TESLA	MODEL S	2018	2018	Battery Electric Vehicle (BEV)
4	BMW	i3	2018	2018	Plug-in Hybrid Electric Vehicle (PHEV)
5	TESLA	MODEL 3	2020	2020	Battery Electric Vehicle (BEV)
6	TESLA	MODEL Y	2020	2020	Battery Electric Vehicle (BEV)
7	TESLA	MODEL 3	2018	2018	Battery Electric Vehicle (BEV)
8	TESLA	MODEL 3	2018	2018	Battery Electric Vehicle (BEV)
9	TESLA	MODEL 3	2019	2019	Battery Electric Vehicle (BEV)
10	TESLA	MODEL 3	2019	2019	Battery Electric Vehicle (BEV)
11	AUDI	E-TRON	2019	2019	Battery Electric Vehicle (BEV)
12	KIA	NIRO	2019	2019	Plug-in Hybrid Electric Vehicle (PHEV)
13	BMW	x5	2018	2018	Plug-in Hybrid Electric Vehicle (PHEV)
14	TESLA	MODEL S	2018	2018	Battery Electric Vehicle (BEV)
15	TESLA	MODEL 3	2020	2020	Battery Electric Vehicle (BEV)
16	TESLA	MODEL 3	2018	2018	Battery Electric Vehicle (BEV)
17	VOLKSWAGEN	E-GOLF	2019	2019	Battery Electric Vehicle (BEV)
18	TESLA	MODEL S	2020	2020	Battery Electric Vehicle (BEV)
19	AUDI	E-TRON	2021	2021	Battery Electric Vehicle (BEV)
20	KIA	NIRO	2019	2019	Battery Electric Vehicle (BEV)
21	CHEVROLET	BOLT EV	2020	2020	Battery Electric Vehicle (BEV)
22	CHEVROLET	BOLT EV	2022	2022	Battery Electric Vehicle (BEV)
23	NISSAN	LEAF	2019	2019	Battery Electric Vehicle (BEV)
24	TESLA	MODEL 3	2019	2019	Battery Electric Vehicle (BEV)

The sidebar on the right shows the "APPLIED STEPS" pane with the following steps listed:

- Promoted Headers
- Changed Type
- Removed Columns
- Split Column by Delimiter
- Changed Type1
- Split Column by Position
- Changed Type2
- Split Column by Position1
- Changed Type3
- Removed Columns1
- Renamed Columns
- Reordered Columns
- Duplicated Column
- Reordered Columns1
- Filtered Rows
- Changed Type4
- Removed Blank Rows
- Filtered Rows1

Dataset No. 2: "ElectricCarData_Clean_Me.csv"

Initial screenshot

15 COLUMNS, 103 ROWS Column profiling based on top 1000 rows

PREVIEW DOWNLOADED AT 6:11 PM

Column1	Column2	Column3	Column4	Column5	Column6	Column7
1	Brand	Model	AccelSec	TopSpeed_KmH	Range_Km	Battery_Pack_Kwh
2	Tesla	Model 3 Long Range Dual Motor	4.6	233	460	161
3	Volkswagen	ID.3 Pure	10	160	270	45
4	Polestar	2	4.7	210	400	75
5	BMW	iX3	6.8	180	360	74
6	Honda	e	9.5	145	170	28.5
7	Lucid	Air	2.8	250	610	110
8	Volkswagen	e-Golf	9.6	150	190	35.8
9	Peugeot	e-208	8.1	150	275	45
10	Tesla	Model 3 Standard Range Plus	5.6	225	310	50
11	Audi	Q4 e-tron	6.3	180	400	77
12	Mercedes	EQC 400 4MATIC	5.1	180	370	80
13	Nissan	Leaf	7.9	144	220	36
14	Hyundai	Kona Electric 64 kWh	7.9	167	400	64
15	BMW	i4	4	200	450	80
16	Hyundai	IONIQ Electric	9.7	165	250	38.3
17	Volkswagen	ID.3 Pro S	7.9	160	440	77
18	Porsche	Taycan Turbo S	2.8	260	375	83.7
19	Volkswagen	e-Up!	11.9	130	195	36.8
20	MG	ZS EV	8.2	140	220	42.5
21	Mini	Cooper SE	7.3	150	185	28.9
22	Opel	Corsa-e	8.1	150	275	45
23	Tesla	Model Y Long Range Dual Motor	5.1	217	425	72.5
24	Skoda	Enyaq IV 50	10	160	290	52
25	Audi	e-tron GT	3.5	240	425	85
26	Tesla	Model 3 Long Range Performance	3.4	261	435	70
27	Volkswagen	ID.4	7.5	160	420	77
28						183

- Renamed the query to: ElectricCarData_Prices.
- Removed the column "Segment".
- Renamed columns:

'AccelSec': 'Accel_Sec',
 'TopSpeed_KmH': 'Top_Speed_KmH',
 'Battery_Pack_Kwh': 'Battery_Pack_Kwh',
 'FastCharge_KmH': 'Fast_Charge_KmH',
 'RapidCharge': 'Rapid_Charge',
 'PowerTrain': 'Power_Train',
 'PlugType': 'Plug_Type',
 'BodyStyle': 'Body_Style',
 'PriceEuro': 'Price_Euro'

- Changed data types.

Final screenshot

14 COLUMNS, 102 ROWS Column profiling based on top 1000 rows

PREVIEW DOWNLOADED AT 6:24 PM

Brand	Model	Accel_Sec	Top_Speed_KmH	Range_Km	Battery_Pack_Kwh	Efficiency_Wh
1	TESLA	MODEL 3 LONG RANGE DUAL MO...	4.6	233	460	161
2	VOLKSWAGEN	ID.3 PURE	10	160	270	45
3	POLESTAR	2	4.7	210	400	75
4	BMW	iX3	6.8	180	360	74
5	HONDA	e	9.5	145	170	28.5
6	LUCID	AIR	2.8	250	610	110
7	VOLKSWAGEN	E-GOLF	9.6	150	190	35.8
8	PEUGEOT	e-208	8.1	150	275	45
9	TESLA	MODEL 3 STANDARD RANGE PLUS	5.6	225	310	50
10	AUDI	Q4 E-TRON	6.3	180	400	77
11	MERCEDES	EQC 400 4MATIC	5.1	180	370	80
12	NISSAN	LEAF	7.9	144	220	36
13	HYUNDAI	KONA ELECTRIC 64 kWh	7.9	167	400	64
14	BMW	i4	4	200	450	80
15	HYUNDAI	IONIQ ELECTRIC	9.7	165	250	38.3
16	VOLKSWAGEN	ID.3 PRO S	7.9	160	440	77
17	PORSCHE	TAYCAN TURBO S	2.8	260	375	83.7
18	VOLKSWAGEN	e-Up!	11.9	130	195	36.8
19	MG	ZS EV	8.2	140	220	42.5
20	MINI	COOPER SE	7.3	150	185	26.9
21	OPEL	CORSA-E	8.1	150	275	45
22	TESLA	MODEL Y LONG RANGE DUAL MO...	5.1	217	425	72.5
23	SKODA	ENYAQ IV 50	10	160	290	52
24	AUDI	e-TRON GT	3.5	240	425	85
25	TESLA	MODEL 3 LONG RANGE PERFORMANCE	3.4	261	435	70
26	VOLKSWAGEN	ID.4	7.5	160	420	77
27	VOLKSWAGEN	ID.3 PRO	9	160	350	58
28						

Dataset No. 3: "euro-daily-hist_1999_2022.csv"

Initial screenshot

41 COLUMNS, 999+ ROWS Column profiling based on top 1000 rows

PREVIEW DOWNLOADED AT 6:34 PM

- Renamed the query to: Currency.
- Remove all column except from “Period\Unit:”, and “[US dollar]”.
- Renamed columns:
 - 'Period\Unit:': 'Date',
 - 'US dollar': 'US_dollar',
- Extracted the year from the “Date” column. Created a new “custom column” → Used Power Query M formula: Date.Year([Date]).
- Changed data types.
- Removed errors.
- Filtered Year only from 2022.

Final screenshot

3 COLUMNS, 257 ROWS Column profiling based on entire data set

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New Table: Calendar

→ Table view → Home → New table → DAX: Calendar = CALENDARAUTO()

The screenshot shows the Power BI Table view interface. The table is named "Calendar" and contains a single column labeled "Date". The data consists of 365 rows, each representing a specific date from January 1, 2022, to December 31, 2022, at 12:00:00 AM. The table tools ribbon at the top has "Calendars" selected. The Data pane on the right shows the table's relationship to other datasets: "Currency", "Electric_Vehicle_Census", and "ElectricCarData_Prices".

Date
1/1/2022 12:00:00 AM
1/2/2022 12:00:00 AM
1/3/2022 12:00:00 AM
1/4/2022 12:00:00 AM
1/5/2022 12:00:00 AM
1/6/2022 12:00:00 AM
1/7/2022 12:00:00 AM
1/8/2022 12:00:00 AM
1/9/2022 12:00:00 AM
1/10/2022 12:00:00 AM
1/11/2022 12:00:00 AM
1/12/2022 12:00:00 AM
1/13/2022 12:00:00 AM
1/14/2022 12:00:00 AM
1/15/2022 12:00:00 AM
1/16/2022 12:00:00 AM
1/17/2022 12:00:00 AM
1/18/2022 12:00:00 AM
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1/22/2022 12:00:00 AM
1/23/2022 12:00:00 AM
1/24/2022 12:00:00 AM
1/25/2022 12:00:00 AM
1/26/2022 12:00:00 AM
1/27/2022 12:00:00 AM
1/28/2022 12:00:00 AM
1/29/2022 12:00:00 AM
1/30/2022 12:00:00 AM
1/31/2022 12:00:00 AM

Relation Model

To figure out which types of EVs people are into, we used two datasets: "ElectricCarData_Prices", which tells us about the car's style by brand and model, and "Electric_Vehicle_Census", which counts the number of these cars by brand and model. **Quick note:** To keep things manageable, we only looked at a handful of brands – Tesla, Nissan, KIA, Ford, Volkswagen, BMW, Audi, and Volvo. This way, we can get a clearer picture of what styles people are going for in their EVs.

→ In the "ElectricCarData_Prices" query, we modified the 'Model' column to match the 'Model' Column of the "Electric_Vehicle_Census" query. This modification is held in the 'Model_ID' Column.

Example: "*Electric_Vehicle_Census*" query

The screenshot shows the Power BI Table view interface. The table is named "Electric_Vehicle_Census" and contains three columns: "Brand", "Model", and "Model_ID". The data shows 8 rows, all of which are for the brand "TESLA" and the model "MODEL 3". The "Model_ID" column is highlighted with a yellow background. The first row is also highlighted with a red border.

A ^B _C Brand	A ^B _C Model	A ^B _C Model_ID
1 TESLA	MODEL 3	MODEL 3
2 TESLA	MODEL 3	MODEL 3
3 TESLA	MODEL S	MODEL S
4 TESLA	MODEL 3	MODEL 3
5 TESLA	MODEL 3	MODEL 3
6 TESLA	MODEL 3	MODEL 3
7 TESLA	MODEL 3	MODEL 3
8 TESLA	MODEL 3	MODEL 3

"ElectricCarData_Prices" query

A ^B _C Brand	A ^B _C Model	A ^B _C Model_ID
1 TESLA	MODEL 3 LONG RANGE DUAL MO...	MODEL 3

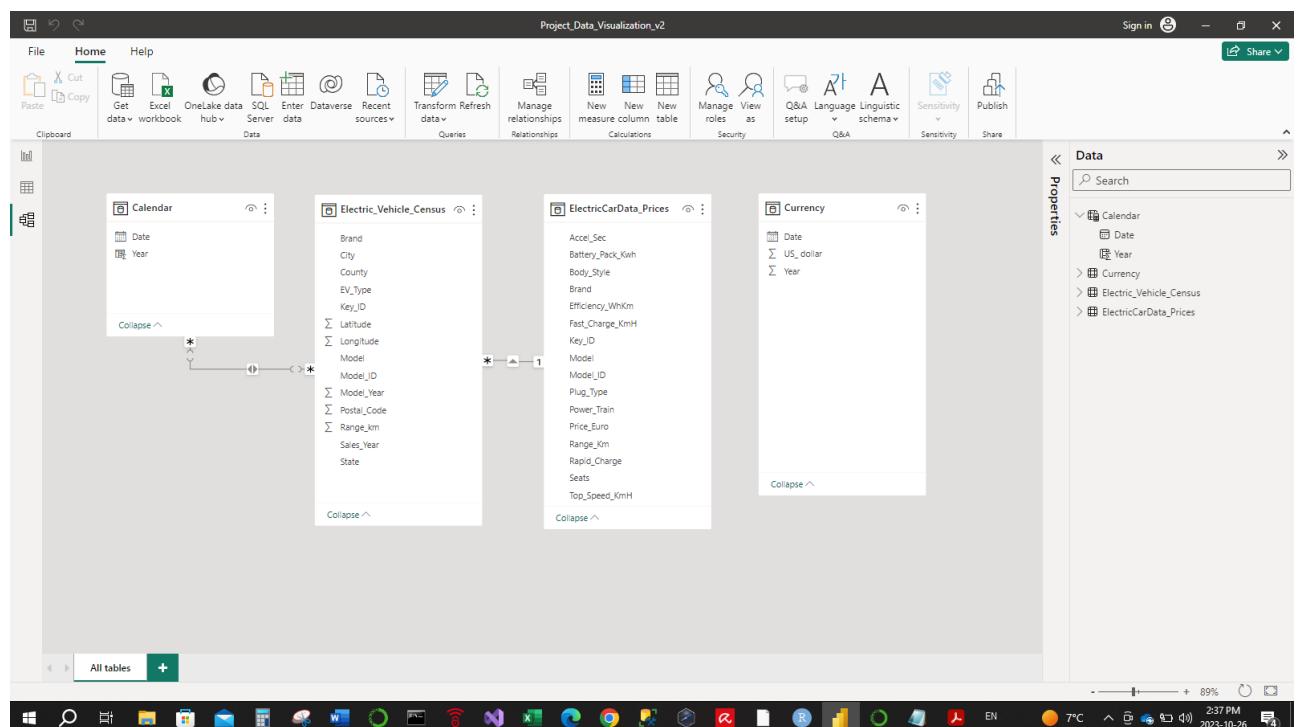
- Now that we standardized the 'Model' car in both queries, we created a primary KEY in both called 'Key_ID' which concatenates 'Brand' and 'Model_ID' columns.

"Electric_Vehicle_Census" query

A ^B _C Key_ID	A ^B _C Brand	A ^B _C Model	A ^B _C Model_ID
1 TESLA_MODEL 3	TESLA	MODEL 3	MODEL 3

"ElectricCarData_Prices" query

A ^B _C Key_ID	A ^B _C Brand	A ^B _C Model	A ^B _C Model_ID
1 TESLA_MODEL 3	TESLA	MODEL 3 LONG RANGE DUAL MO...	MODEL 3



Measures

→ **CurrencyAverage_USD** : We calculated the average currency exchange rate of USD against the Euro (EUR).

The screenshot shows the Power BI Data Visualization interface. On the left, there are three tables: 'Calendar', 'Electric_Vehicle_Census', and 'ElectricCarData_Prices'. The 'ElectricCarData_Prices' table is selected. In the center, the 'Properties' pane shows a new measure named 'CurrencyAverage_USD' with the formula `AVERAGE('Currency'[US_dollar])`. The 'Data' pane on the right lists the table 'Currency' and its measures, including 'CurrencyAverage_USD'. The bottom status bar shows the date as 2023-10-26 and the time as 2:45 PM.

DAX

→ In the table review, we added the equivalent US dollar price next to the 'Price_Euro' column → **'Price_USD' = 'Price_Euro' * CurrencyAverage_USD** measure.

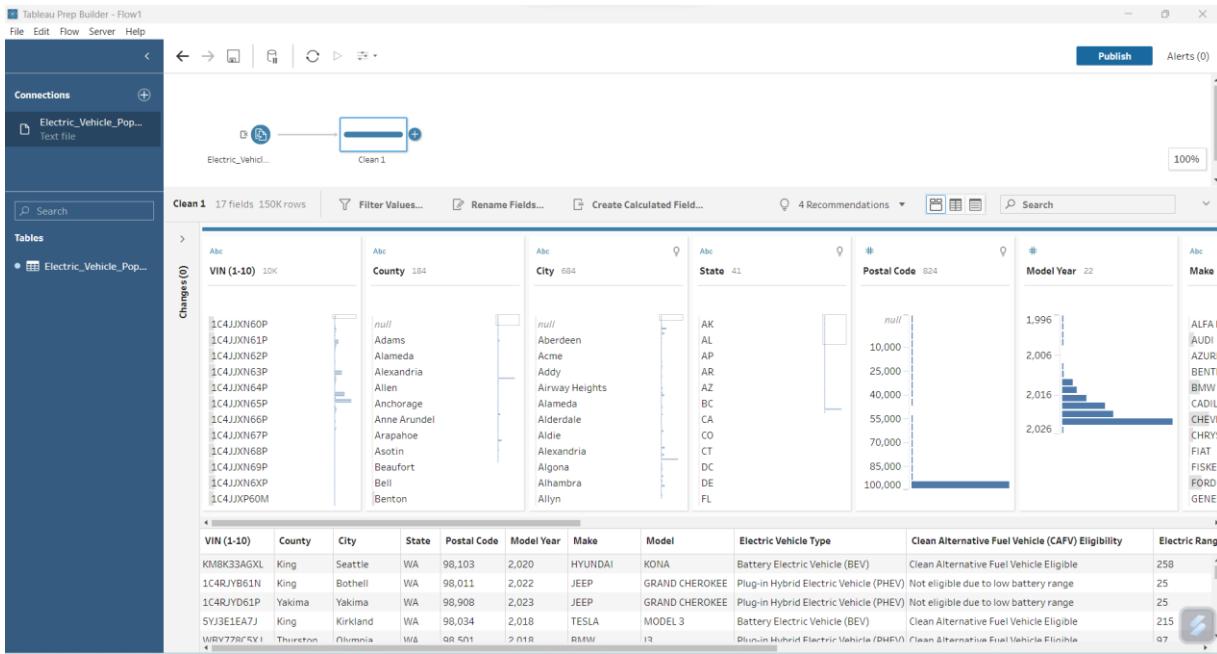
The screenshot shows the Power BI Data Visualization interface with the 'ElectricCarData_Prices' table selected. A new column 'Price_USD' has been added, calculated as 'Price_Euro' multiplied by the 'CurrencyAverage_USD' measure. The table contains 102 rows of data. The bottom status bar shows the date as 2023-10-26 and the time as 2:52 PM.

Part B

Data transformation in Tableau Cleaning

Dataset No. 1: "Electric_Vehicle_Population_Data.csv"

Initial screenshot



- Renamed the file to: Electric_Vehicle_Census.
- Removed the following columns:
 - 'VIN (1-10)',
 - 'Clean Alternative Fuel Vehicle (CAFV) Eligibility',
 - 'Base MSRP',
 - 'Legislative District',
 - 'DOL Vehicle ID',
 - '2020 Census Tract'
 - 'Electric Utility'
- Split longitude and latitude from the 'Vehicle Location' column.
- Renamed columns:
 - 'Postal Code': 'Postal_Code',
 - 'Model Year': 'Model_Year',
 - 'Make': 'Brand',
 - 'Electric Vehicle Type': 'EV_Type',
 - 'Electric Range': 'Range_Km'
- Removed blank rows.
- Based on the column "Model_Year", created a new "column for example" called Sales_Year.
- Reorder Columns:
 - Brand,
 - Model,

Model_Year,
 Sales_Year,
 EV_Type,
 Range_Km,
 County,
 City,
 Postal_Code,
 State,
 Longitude,
 Latitude.

- Changed data types.
- Filtered Sales_Year only from 2018 to 2022.

Final screenshot

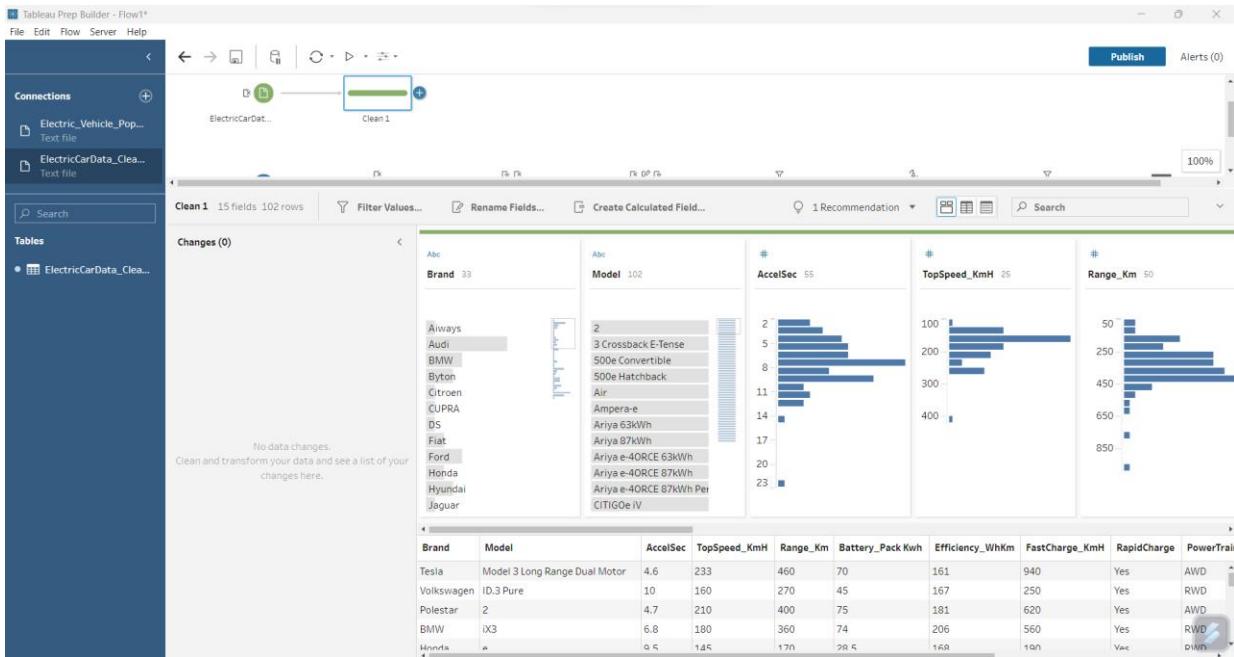
The screenshot shows the Tableau Prep Builder interface with the following details:

- Connections:** Electric_Vehicle_Pop... (Text file)
- Flow:**
 - Electric_Vehicle... → Remove Columns
 - Remove Columns → Split Vehicle Lo...
 - Split Vehicle Lo... → Renamed and o...
 - Renamed and o... → Remove blank r...
 - Remove blank r... → Change data ty...
 - Change data ty... → Filter years
- Changes (1):** Filter years (12 fields, 83K rows)
 - Filter: Selected Values** (Sales_Year) - Keep only: 5 values
- Preview:** Shows five columns: Brand, Model, Model_Year, Sales_Year, and EV_Type. The Sales_Year column has five distinct values: 2018, 2019, 2020, 2021, and 2022. The EV_Type column shows two categories: Battery Electric Vehicle (BEV) and Plug-in Hybrid Electric Vehicle.
- Data Table:**

Brand	Model	Model_Year	Sales_Year	EV_Type	Range_Km	County	City	Postal_Code	State	Longitude	Latitude
TESLA	MODEL 3	2018	2018	Battery Electric Vehicle (BEV)	215	King	Seattle	98112	WA	-122.306935	47.62441
TESLA	MODEL 3	2018	2018	Battery Electric Vehicle (BEV)	215	King	Seattle	98112	WA	-122.306935	47.62441
TESLA	MODEL 3	2018	2018	Battery Electric Vehicle (BEV)	215	King	Seattle	98112	WA	-122.306935	47.62441
TESLA	MODEL 3	2018	2018	Battery Electric Vehicle (BEV)	215	King	Seattle	98112	WA	-122.306935	47.62441
TESLA	MODEL 3	2018	2018	Battery Electric Vehicle (BEV)	215	King	Seattle	98112	WA	-122.306935	47.62441

Dataset No. 2: "ElectricCarData_Clean_Me.csv"

Initial screenshot



→ Renamed the file to: ElectricCarData_Prices.

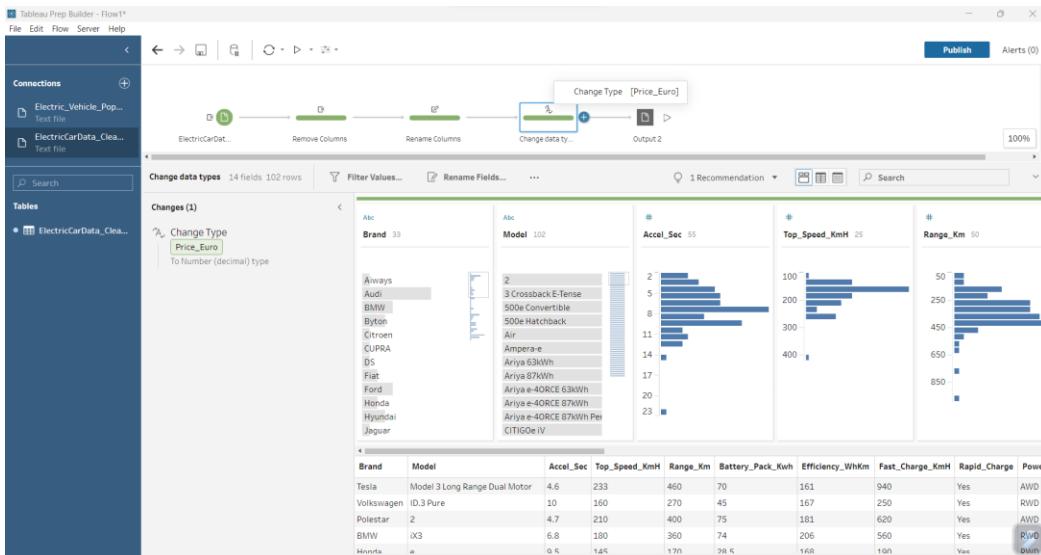
→ Removed the column "Segment".

→ Renamed columns:

- 'AccelSec': 'Accel_Sec',
- 'TopSpeed_Kmh': 'Top_Speed_Kmh',
- 'Battery_Pack_Kwh': 'Battery_Pack_Kwh',
- 'FastCharge_Kmh': 'Fast_Charge_Kmh',
- 'RapidCharge': 'Rapid_Charge',
- 'PowerTrain': 'Power_Train',
- 'PlugType': 'Plug_Type',
- 'BodyStyle': 'Body_Style',
- 'PriceEuro': 'Price_Euro'

→ Changed data types.

Final screenshot



Dataset No. 3: "euro-daily-hist_1999_2022.csv"

Initial screenshot

The screenshot shows the Tableau Prep Builder interface with a data flow and a preview pane.

Data Flow:

- Starts with a "Currency" connection.
- An arrow points to a "Remove Columns" step, which has a red box around it.
- From "Remove Columns", an arrow points to an "Extract year" step.
- From "Extract year", an arrow points to a "Change data type..." step.
- From "Change data type...", an arrow points to a "Remove nulls" step.
- From "Remove nulls", an arrow points to a "Filter year" step.

Changes (5) in the preview pane:

- Remove Field (Australian dollar)
- Remove Field (Bulgarian lev)
- Remove Fields (Brazilian real)
- Remove Fields (Iceland krona)
- Remove Fields (Slovenian tolar)

Preview Data:

Period\Unit:	(US dollar)
05/26/2023	1.0751
05/25/2023	1.0735
05/24/2023	1.0785
05/23/2023	1.0779
05/22/2023	1.0822
05/19/2023	1.0808
05/18/2023	1.0813
05/17/2023	1.0829
05/16/2023	1.0881
05/15/2023	1.0876
05/12/2023	1.0892
05/11/2023	1.093
05/10/2023	1.095
05/09/2023	1.0959
05/08/2023	1.1037
05/05/2023	1.1014
05/04/2023	1.1074
05/03/2023	1.1043
05/02/2023	1.0965

- Renamed the file to: Currency.
- Remove all column except from “Period\Unit:”, and “[US dollar]”.
- Renamed columns:
 - 'Period\Unit': 'Date',
 - 'US dollar ': 'US_dollar',
- Extracted the year from the “Date” column. Created a new “*custom column*” → Used Power Query M formula: Date.Year([Date]).
- Changed data types.
- Removed errors.
- Filtered Year only from 2022.

Final screenshot

The screenshot shows the Tableau Prep Builder interface with a data flow and a preview pane.

Data Flow:

- Starts with a "Currency" connection.
- An arrow points to a "Remove Columns" step.
- From "Remove Columns", an arrow points to an "Extract year" step.
- From "Extract year", an arrow points to a "Change data type..." step.
- From "Change data type...", an arrow points to a "Remove nulls" step.
- From "Remove nulls", an arrow points to a "Filter year" step, which has a red box around it.

Changes (1) in the preview pane:

- Filter: Selected Values
Year
Keep only: "2022"

Preview Data:

Data	Year	US_dollar
12/30/2022	2022	1.0666
12/29/2022	2022	1.0649
12/28/2022	2022	1.064
12/27/2022	2022	1.0624
12/23/2022	2022	1.0622
12/22/2022	2022	1.0633
12/21/2022	2022	1.0636
12/20/2022	2022	1.0599
12/19/2022	2022	1.0598
12/16/2022	2022	1.0619
12/15/2022	2022	1.0621
12/14/2022	2022	1.0649
12/13/2022	2022	1.0545
12/12/2022	2022	1.0562
12/09/2022	2022	1.0559
12/08/2022	2022	1.0519
12/07/2022	2022	1.0529
12/06/2022	2022	1.0516
12/05/2022	2022	1.0587

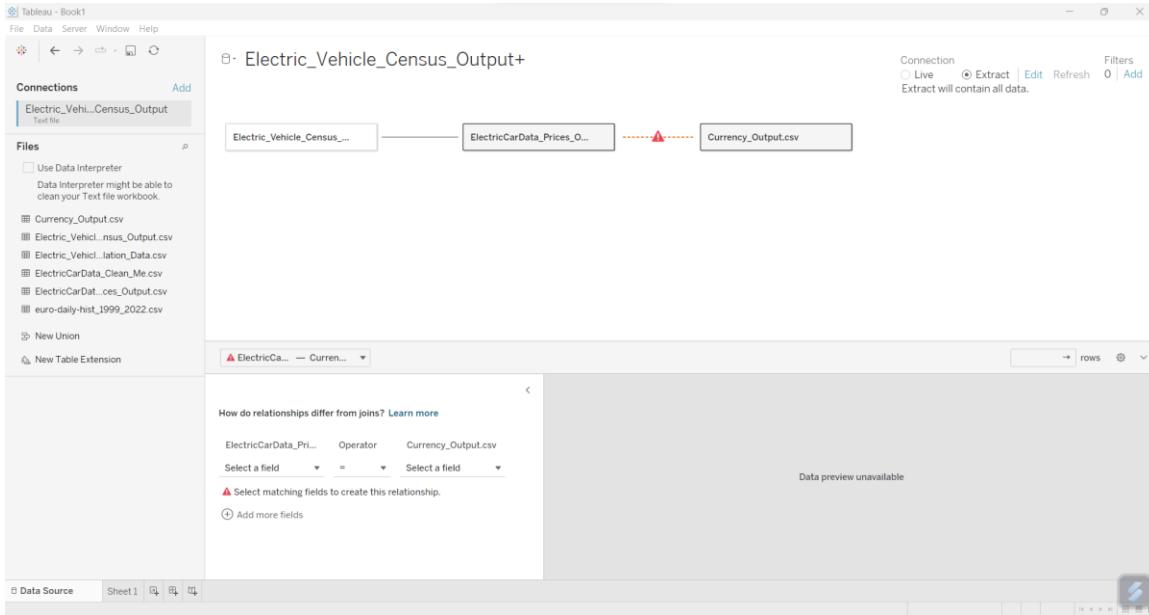
- In the “ElectricCarData_Prices” file, we modified the ‘Model’ column to match the ‘Model’ Column of the “Electric_Vehicle_Census query”. This modification is held in the ‘Model_ID’ Column.
- Now that we standardized the ‘Model’ car in both files, we created a primary KEY in both called ‘Key_ID’ which concatenates ‘Brand’ and ‘Model_ID’ columns.

Key_ID	Brand	Model	Model_ID	Accel_Sec	To
TESLA_MODEL_3	TESLA	MODEL 3 LONG RANGE DUAL MOTOR	MODEL 3	4.6	3
VOLKSWAGEN_ID.3 PURE	VOLKSWAGEN	ID.3 PURE	ID.3 PURE	10	3
POLESTAR_2	POLESTAR	2	2	4.7	3
BMW_X	BMW	X3	X	6.8	3
HONDA_E	HONDA	E	E	9.5	3
LUCID_AIR	LUCID	AIR	AIR	2.8	3
VOLKSWAGEN_E-GOLF	VOLKSWAGEN	E-GOLF	E-GOLF	9.6	3
PEUGEOT_E-208	PEUGEOT	E-208	E-208	8.1	3
TESLA_MODEL 3 STANDARD RÁ TESLA	TESLA	MODEL 3 STANDARD RANGE PLUS	MODEL 3 STANDARD RANGE PLUS	5.6	3
AUDI_Q4 E-TRON	AUDI	Q4 E-TRON	Q4 E-TRON	6.3	3
MERCEDES_EQC 400 4MATIC	MERCEDES	EQC 400 4MATIC	EQC 400 4MATIC	5.1	3
NISSAN_LEAF	NISSAN	LEAF	LEAF	7.9	3
HYUNDAI_KONA ELECTRIC 64 K	HYUNDAI	KONA ELECTRIC 64 KWH	KONA ELECTRIC 64 KWH	7.9	3
BMW_I4	BMW	I4	I4	4	3
HYUNDAIIONIQ ELECTRIC	HYUNDAI	IONIQ ELECTRIC	IONIQ ELECTRIC	9.7	3
VOLKSWAGEN_ID.3 PRO S	VOLKSWAGEN	ID.3 PRO S	ID.3 PRO S	7.9	3
PORSCHE_TAYCAN TURBO S	PORSCHE	TAYCAN TURBO S	TAYCAN TURBO S	2.8	3
VOLKSWAGEN_E-UP!	VOLKSWAGEN	E-UP!	E-UP!	11.9	3
MG_ZS EV	MG	ZS EV	ZS EV	8.2	3

Connecting the data

Relation Model

Once we've cleaned and transformed our dataset using Tableau Prep, we proceed to connect the data to Tableau to initiate the visualization process. The 'ElectricCarData_Prices_Output' file is linked to the 'Electric_Vehicle_Census_Output' through the shared Key_ID present in both tables.



Measures

→ **CurrencyAverage_USD** : We calculated the average currency exchange rate of USD against the Euro (EUR).

The screenshot shows the Tableau interface with a project titled 'EV_Project'. A calculated field named 'CurrencyAverage_USD' is being created in the 'Marks' shelf. The formula is 'AVG([US dollar])'. A tooltip says 'The calculation is valid.' Buttons for 'Apply' and 'OK' are visible.

→ Price_USD : We converted Euro (EUR) into USD.

The screenshot shows the Tableau interface with the following details:

- Project:** Tableau - EV_Project
- Table:** Electric_Vehicle_Census
- Calculated Field:** Price_USD
- Formula:** [Currency_Output].[CurrencyAverage_USD] * sum([Price_Euro])
- Note:** "The calculation is valid."
- Buttons:** Apply, OK

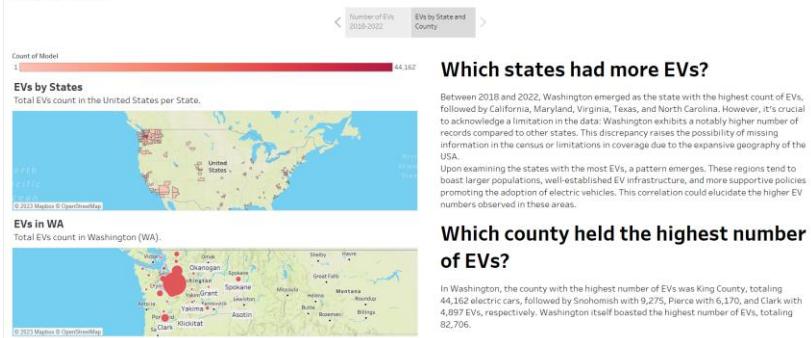
Stories

We decided to create 5 stories, 2 of them are for introductions and conclusions, and the other three are divided into 3 categories: EVs use, User preferences, and EVs performance. We classified our analysis questions within these categories and answered them accordingly.

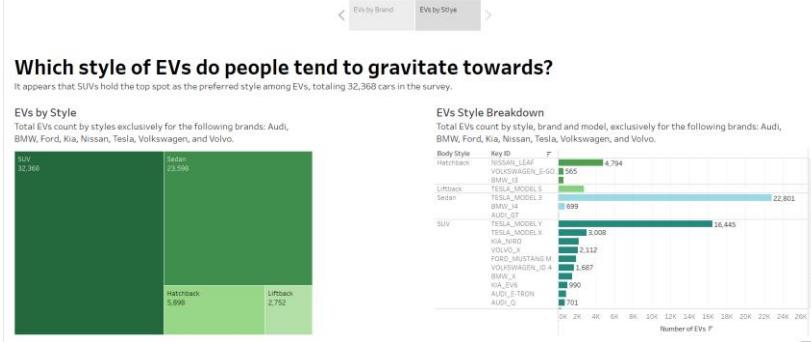
Story 1: Introduction



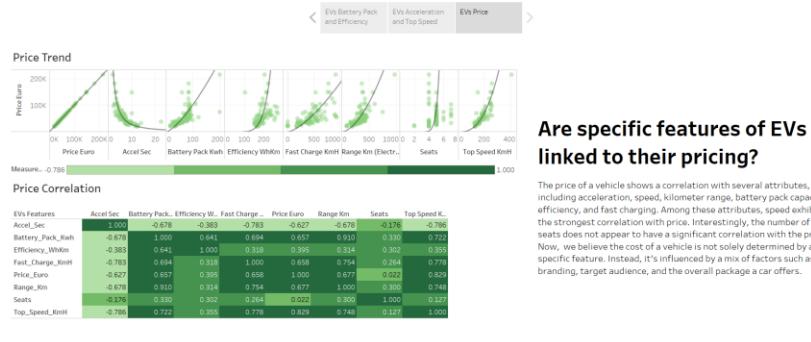
Story 2: EVs Use



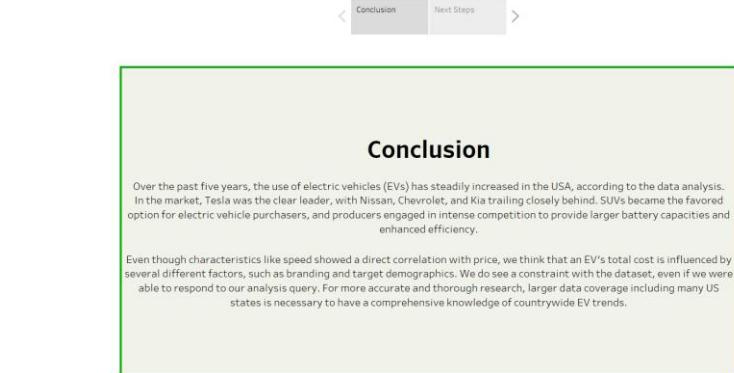
Story 3: User Preferences



Story 4: EVs Performance



Story 5: Conclusion

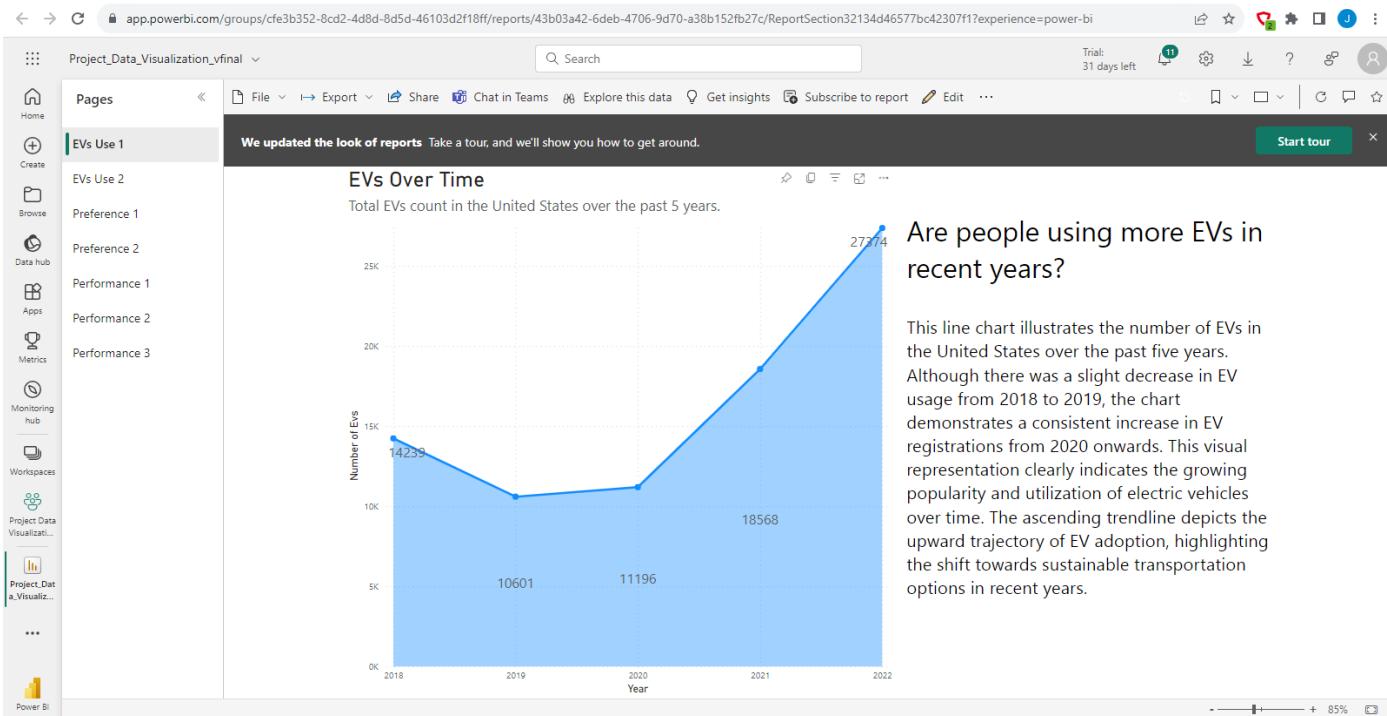


Workspace and Dashboard in PowerBI

After developing all the reports in PowerBI Desktop, we decided, to publish them in a Workspace, and then to create a Dashboard in Power BI App. Following the link to access the App (access have been granted in advance only to the professor and group members):

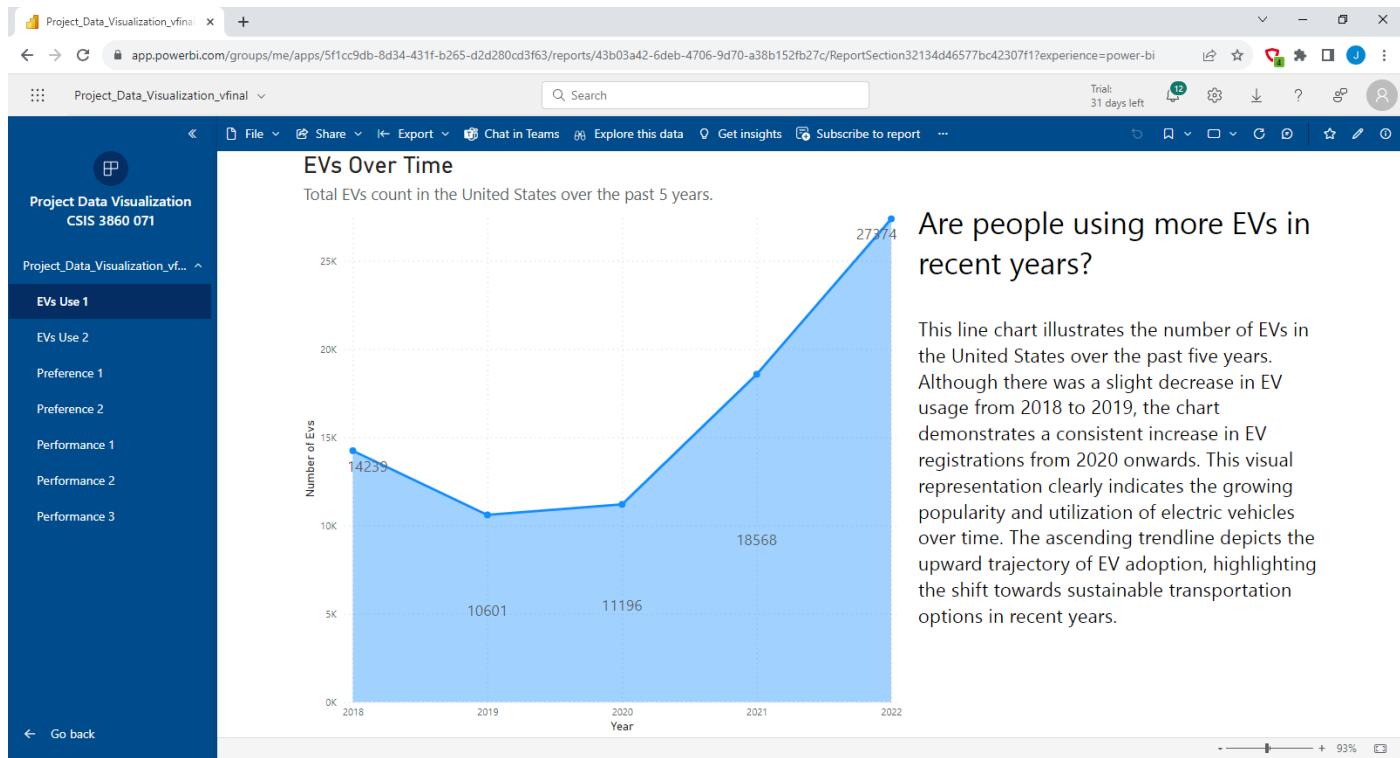
Link of the Workspace “Project Data Visualization CSIS 3860 071”:

https://app.powerbi.com/links/AsR2gfTF9s?ctid=3af48838-cd53-4507-9e7f-fc6dac355e33&pbi_source=linkShare



Link of App “Project Data Visualization CSIS 3860 071”:

<https://app.powerbi.com/Redirect?action=OpenApp&appId=5f1cc9db-8d34-431f-b265-d2d280cd3f63&ctid=3af48838-cd53-4507-9e7f-fc6dac355e33>

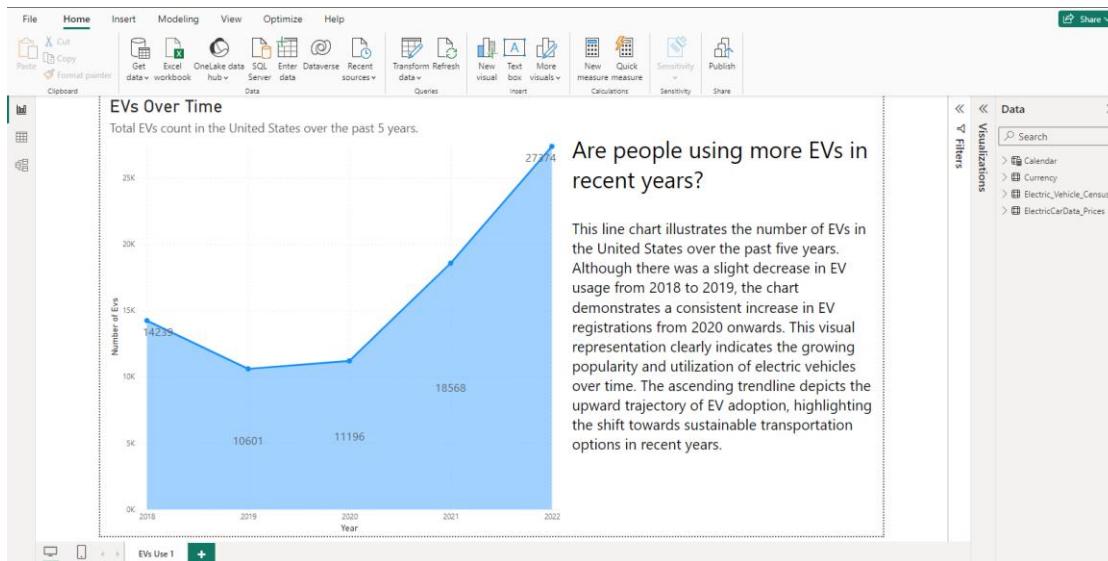


Answers to analysis questions

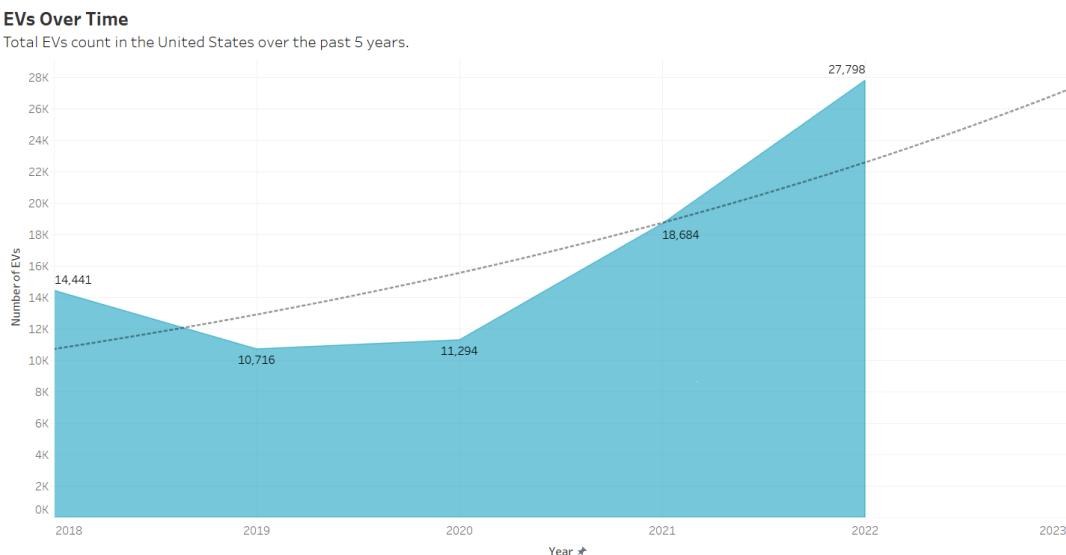
1. Are people using more EVs in recent years?

This line chart illustrates the number of EVs in the United States over the past five years. Although there was a slight decrease in EV usage from 2018 to 2019, the chart demonstrates a consistent increase in EV registrations from 2020 onwards. This visual representation indicates the growing popularity and utilization of electric vehicles over time. The ascending trendline depicts the upward trajectory of EV adoption, highlighting the shift towards sustainable transportation options in recent years.

Screenshot Power BI:



Screenshot Tableau:

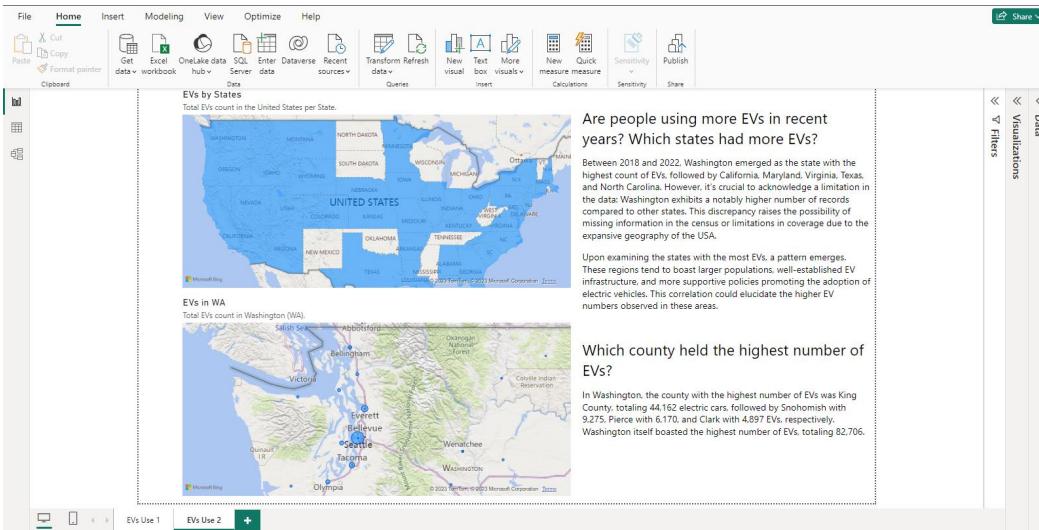


2. Which state had more EVs?

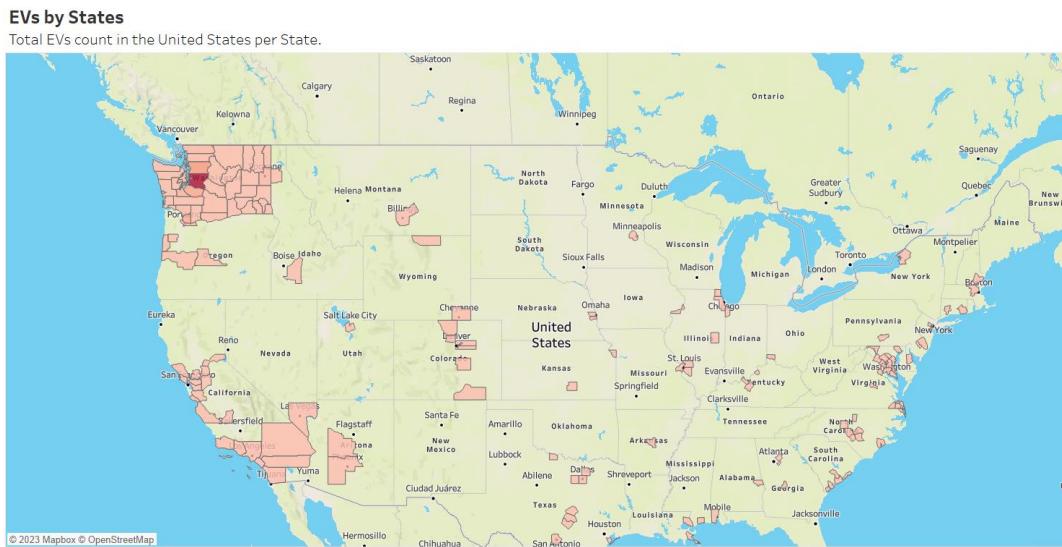
Between 2018 and 2022, Washington emerged as the state with the highest count of EVs, followed by California, Maryland, Virginia, Texas, and North Carolina. However, it's crucial to acknowledge a limitation in the data: Washington exhibits a notably higher number of records compared to other states. This discrepancy raises the possibility of missing information in the census or limitations in coverage due to the expansive geography of the USA.

Upon examining the states with the most EVs, a pattern emerges. These regions tend to boast larger populations, well-established EV infrastructure, and more supportive policies promoting the adoption of electric vehicles. This correlation could elucidate the higher EV numbers observed in these areas.

Screenshot Power BI:



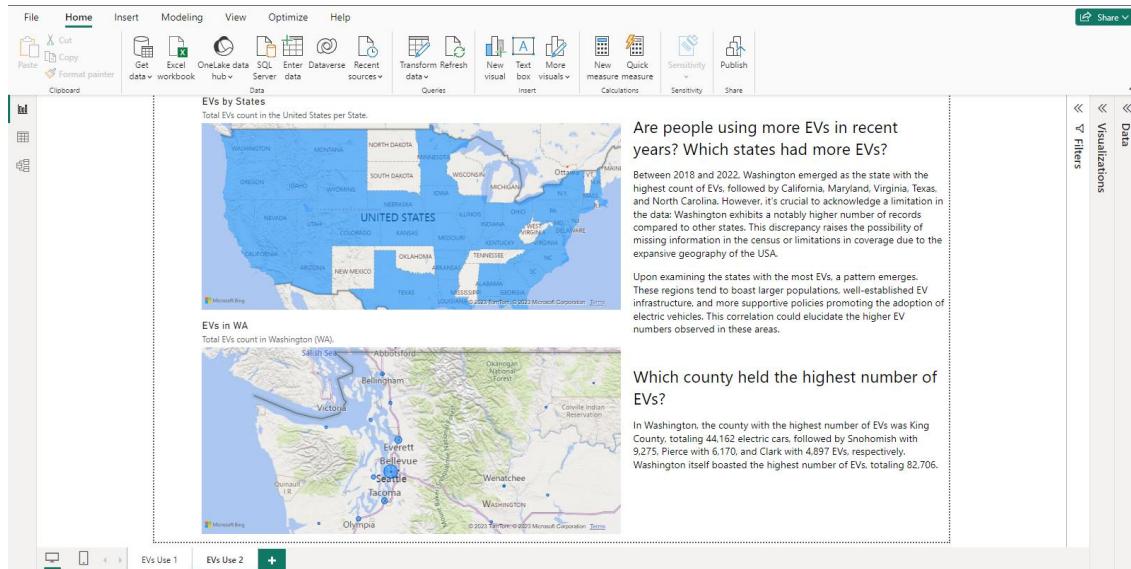
Screenshot Tableau:



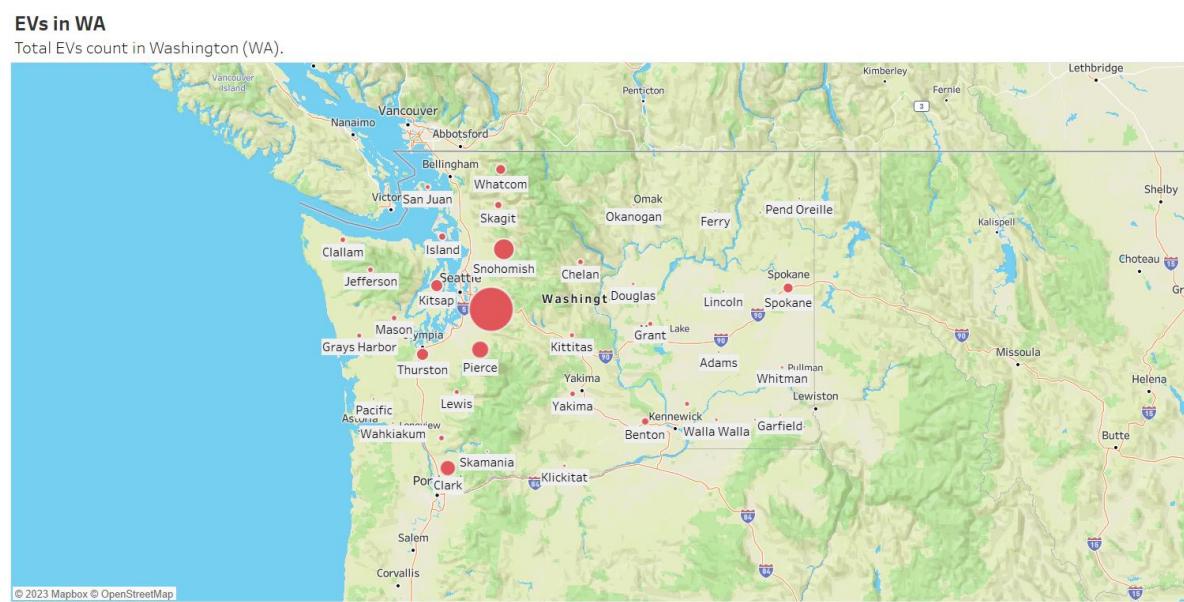
3. Which county held the highest number of EVs?

In Washington, the county with the highest number of EVs was King County, totaling 44,162 electric cars, followed by Snohomish with 9,275, Pierce with 6,170, and Clark with 4,897 EVs, respectively. Washington itself boasted the highest number of EVs, totaling 82,706.

Screenshot Power BI:



Screenshot Tableau:



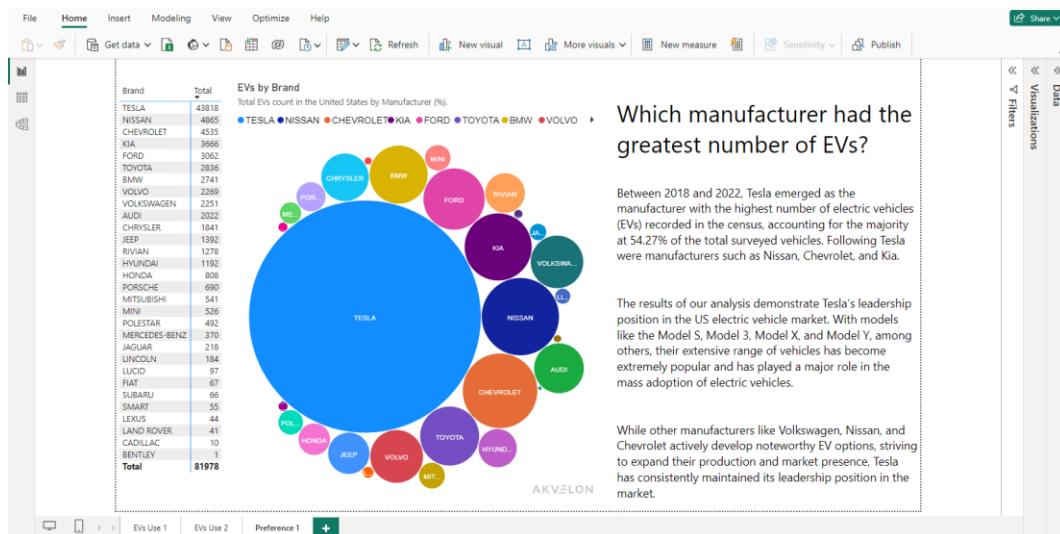
4. Which manufacturer had the majority of EVs?

Between 2018 and 2022, Tesla emerged as the manufacturer with the highest number of electric vehicles (EVs) recorded in the census, accounting for the majority at 54.27% of the total surveyed vehicles. Following Tesla were manufacturers such as Nissan, Chevrolet, and Kia.

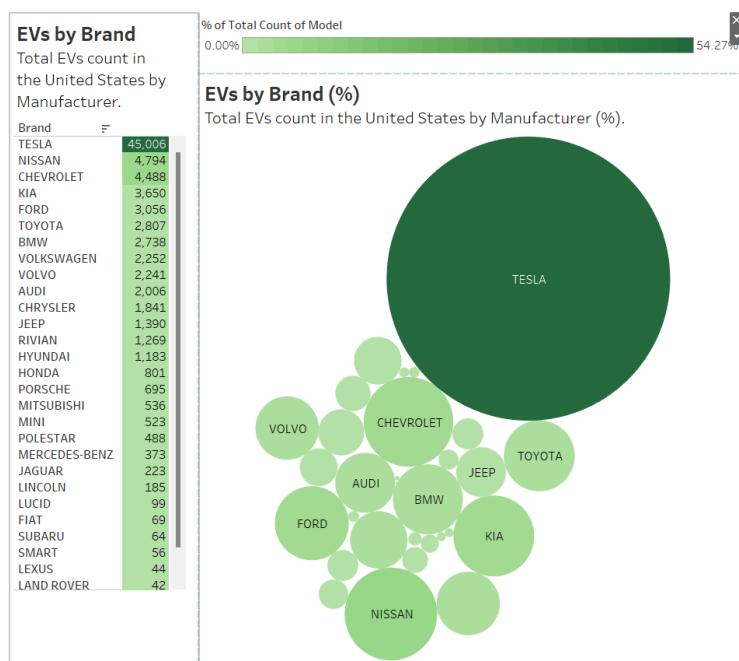
The results of our analysis demonstrate Tesla's leadership position in the US electric vehicle market. With models like the Model S, Model 3, Model X, and Model Y, among others, their extensive range of vehicles has become extremely popular and has played a major role in the mass adoption of EVs.

While other manufacturers like Volkswagen, Nissan, and Chevrolet actively develop noteworthy EV options, striving to expand their production and market presence, Tesla has consistently maintained its leadership position in the market.

Screenshot Power BI:



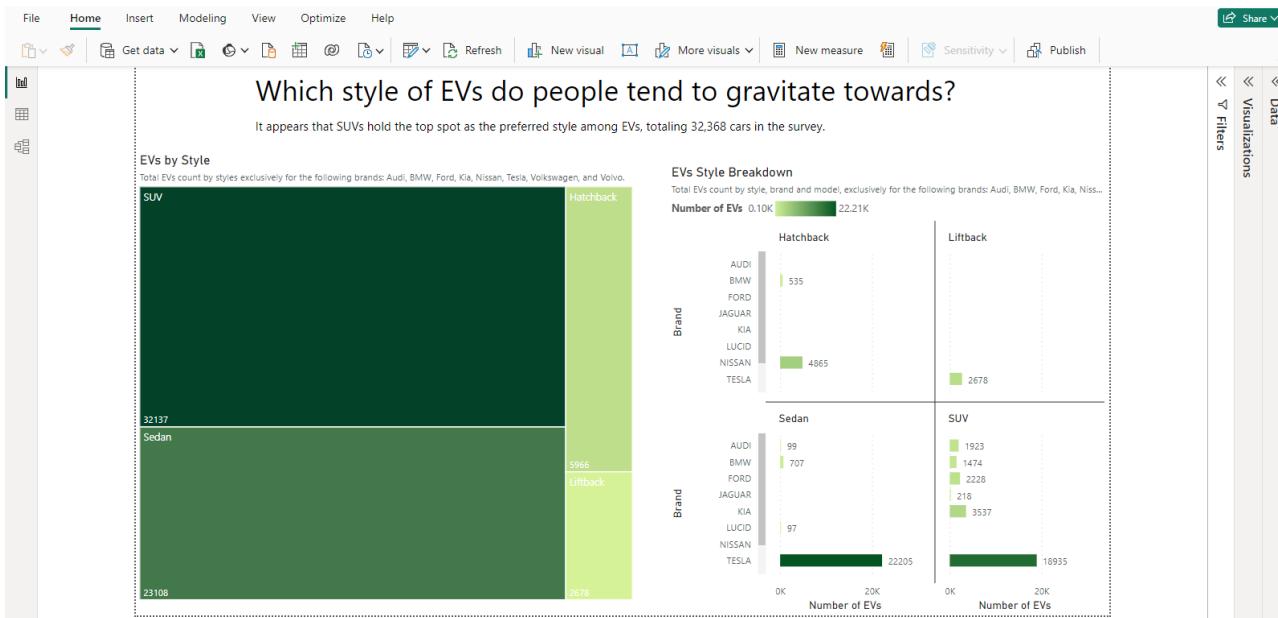
Screenshot Tableau:



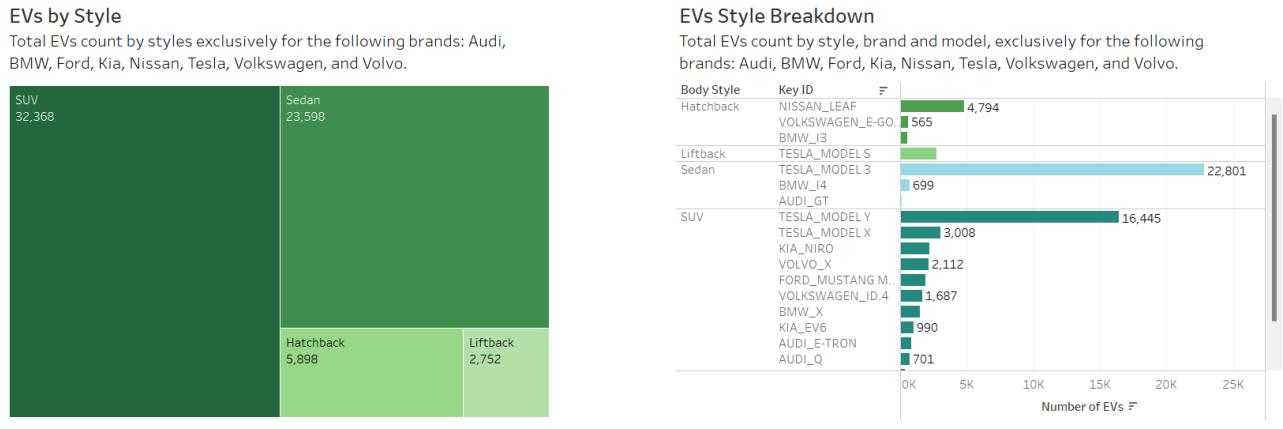
5. Which style of EVs do people tend to gravitate towards?

It appears that SUVs hold the top spot as the preferred style among EVs, totaling 32,368 cars in the survey.

Screenshot Power BI:



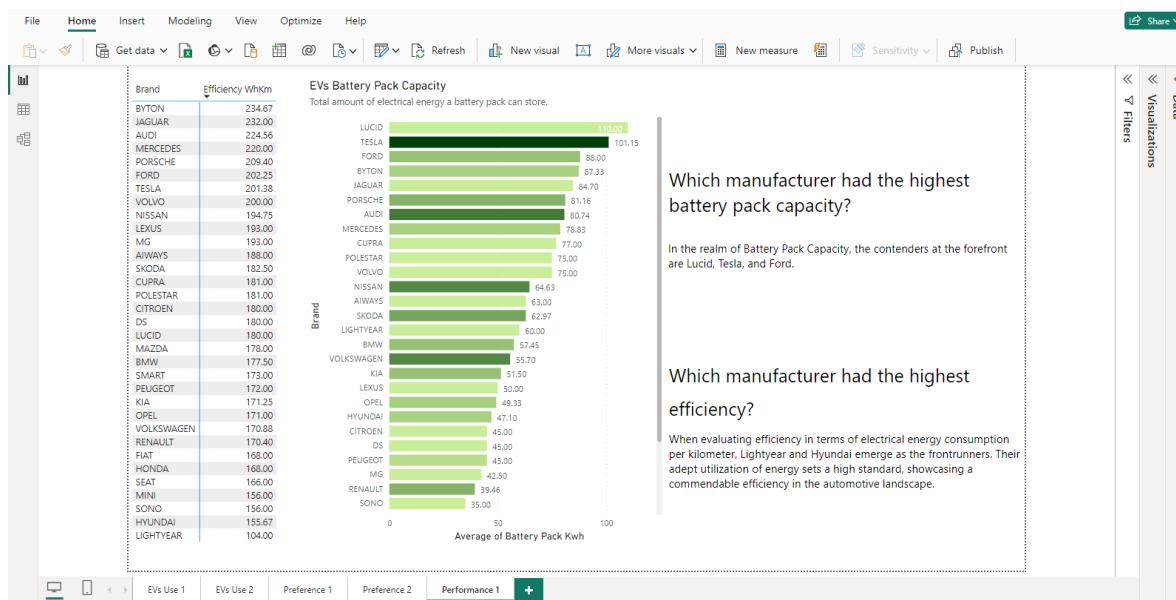
Screenshot Tableau:



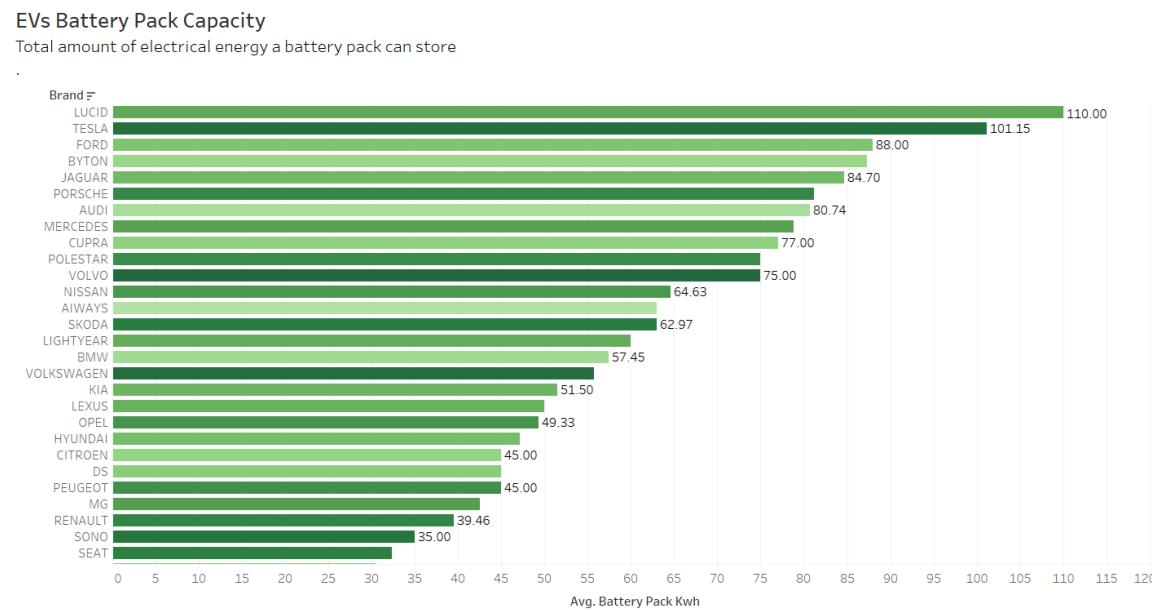
6. Which manufacturer had the highest battery pack capacity?

Regarding battery Pack Capacity, the contenders at the forefront are Lucid, Tesla, and Ford.

Screenshot Power BI:



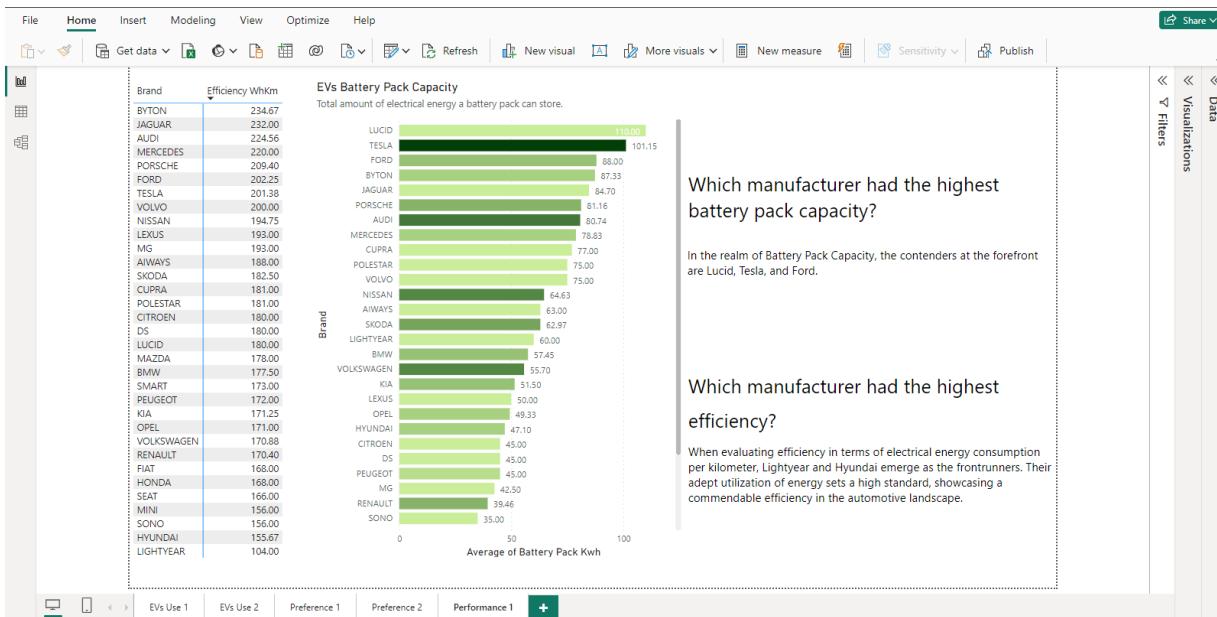
Screenshot Tableau:



7. Which manufacturer had the highest efficiency?

When evaluating efficiency in terms of electrical energy consumption per kilometer, Lightyear and Hyundai emerge as the frontrunners. Their adept energy utilization sets a high standard, showcasing commendable efficiency in the automotive landscape.

Screenshot Power BI:



Screenshot Tableau:

EVs Efficiency

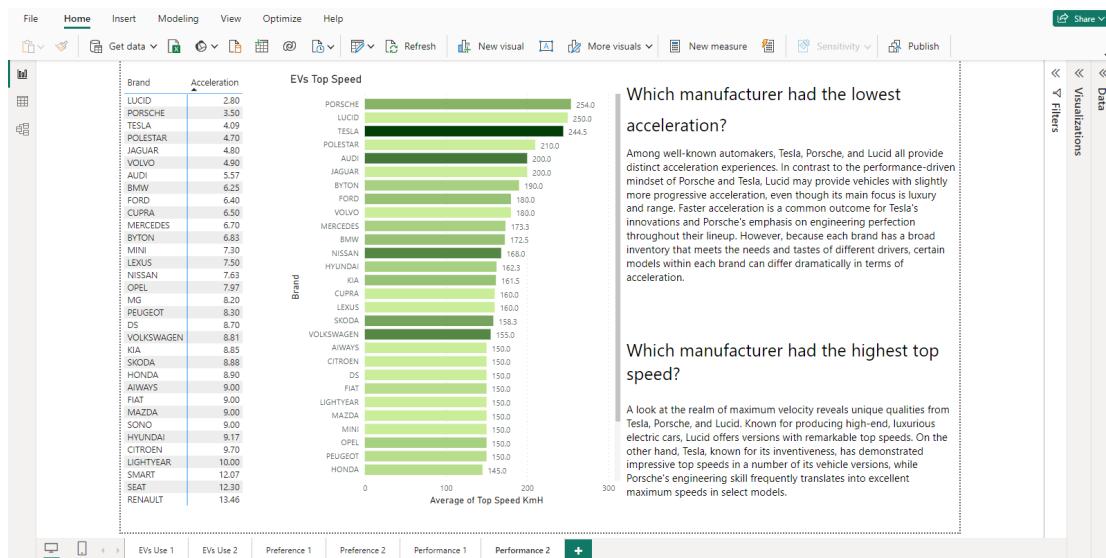
Amount of electrical energy consumed to travel 1 Km.

Brand	Efficiency
LIGHTYEAR	104.0
HYUNDAI	155.7
MINI	156.0
SONO	156.0
SEAT	166.0
FIAT	168.0
HONDA	168.0
RENAULT	170.4
VOLKSWAGEN	170.9
OPEL	171.0
KIA	171.3
PEUGEOT	172.0
SMART	173.0
BMW	177.5
MAZDA	178.0
CITROEN	180.0
DS	180.0
LUCID	180.0
CUPRA	181.0
POLESTAR	181.0
SKODA	182.5
AIWAYS	188.0
LEXUS	193.0
MG	193.0
NISSAN	194.8
VOLVO	200.0
TESLA	201.4
FORD	202.3
PORSCHE	209.4
MERCEDES	220.0
AUDI	224.6

8. Which manufacturer had the lowest acceleration?

Among well-known automakers, Tesla, Porsche, and Lucid all provide distinct acceleration experiences. In contrast to the performance-driven mindset of Porsche and Tesla, Lucid may provide vehicles with slightly more progressive acceleration, even though its focus is luxury and range. Faster acceleration is a common outcome of Tesla's innovations and Porsche's emphasis on engineering perfection throughout their lineup. However, because each brand has a broad inventory that meets the needs and tastes of different drivers, certain models within each brand can differ dramatically in terms of acceleration.

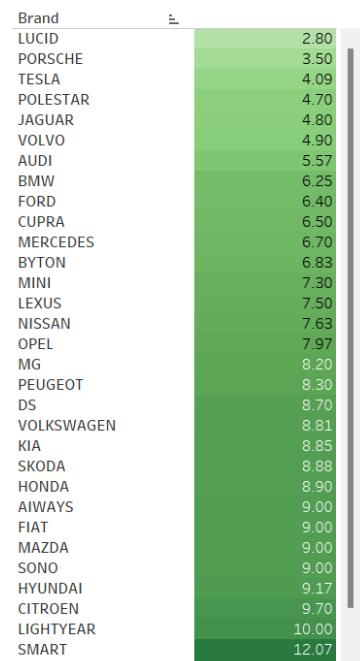
Screenshot Power BI:



Screenshot Tableau:

EVs Acceleration

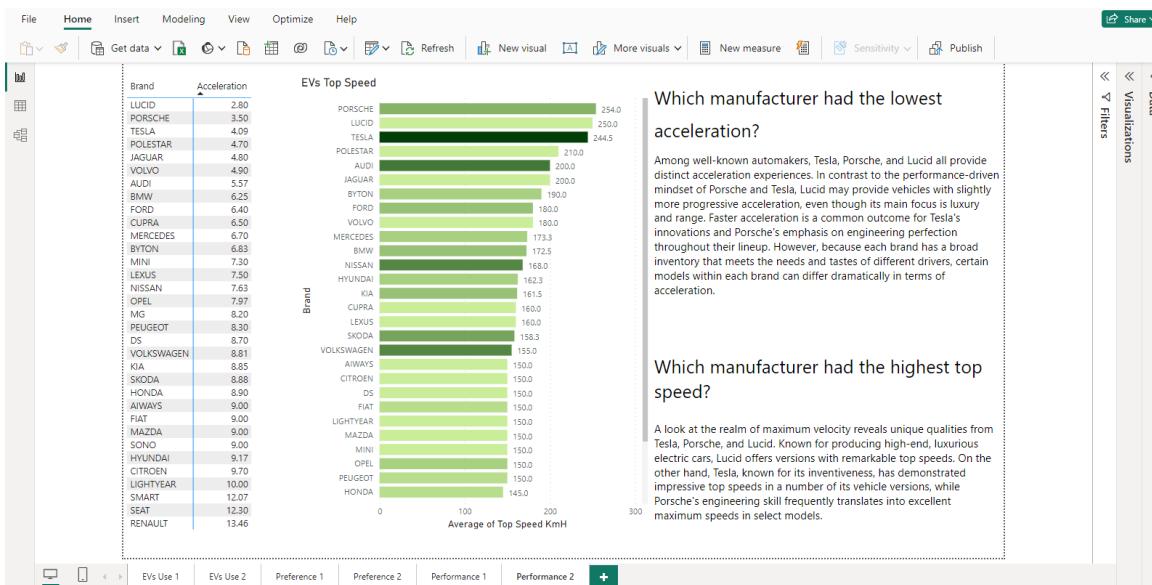
Acceleration as 0-100 km/h.



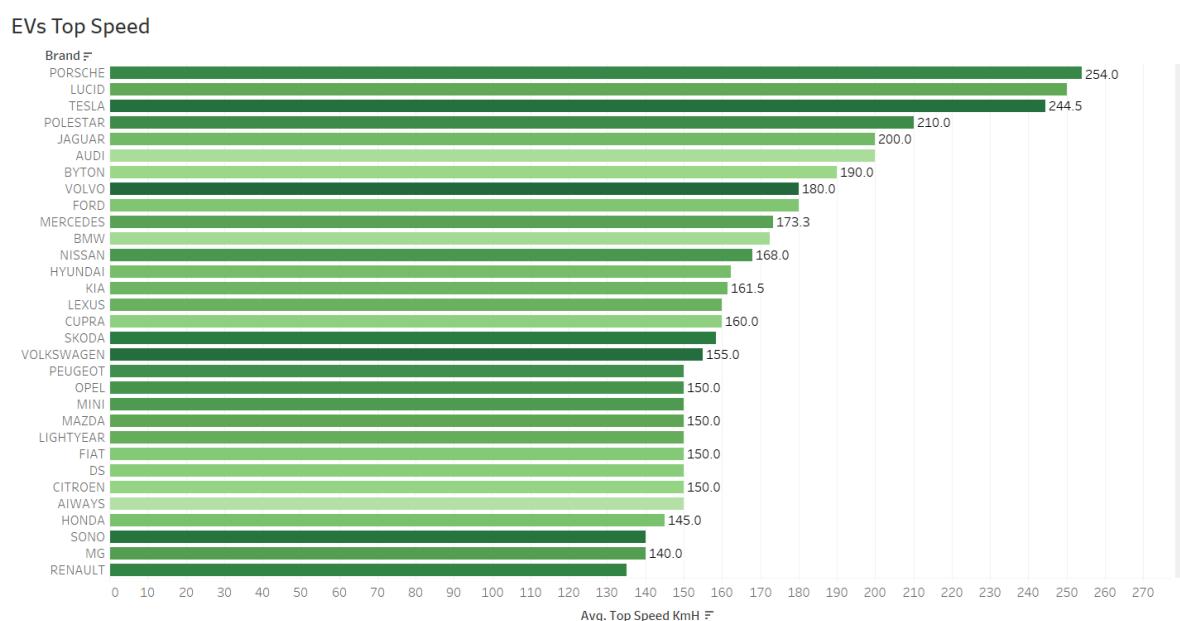
9. Which manufacturer had the highest top speed?

A look at the realm of maximum velocity reveals unique qualities from Tesla, Porsche, and Lucid. Known for producing high-end, luxurious electric cars, Lucid offers versions with remarkable top speeds. On the other hand, Tesla, known for its inventiveness, has demonstrated impressive top speeds in some of its vehicle versions, while Porsche's engineering skill frequently translates into excellent maximum speeds in select models.

Screenshot Power BI:



Screenshot Tableau:

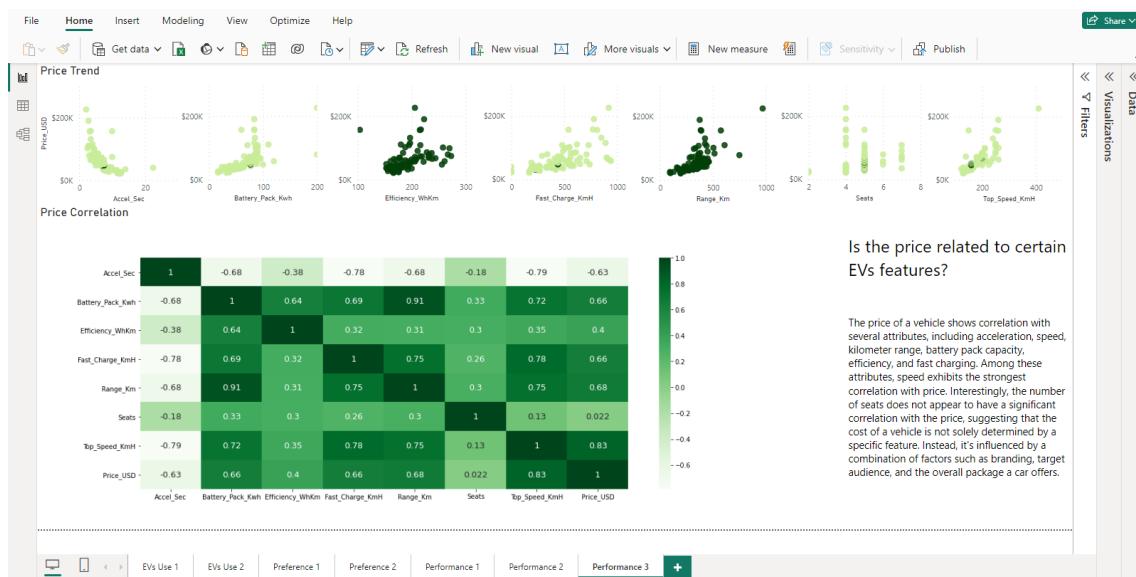


10. Are specific features of EVs linked to their pricing?

The price of a vehicle shows a correlation with several attributes, including acceleration, speed, kilometer range, battery pack capacity, efficiency, and fast charging. Among these attributes, speed exhibits the strongest correlation with price. Interestingly, the number of seats does not appear to have a significant correlation with the price.

Now, we believe the cost of a vehicle is not solely determined by a specific feature. Instead, it's influenced by a mix of factors such as branding, target audience, and the overall package a car offers.

Screenshot Power BI:



Screenshot Tableau:



Price Correlation

EVs Features	Accel_Sec	Battery_Pack_Kwh	Efficiency_WhKm	Fast_Charge_Kmh	Price_Euro	Range_Km	Seats	Top_Speed_Kmh
Accel_Sec	1.000	-0.678	-0.383	-0.783	-0.627	-0.678	-0.176	-0.786
Battery_Pack_Kwh	-0.678	1.000	0.641	0.694	0.657	0.910	0.330	0.722
Efficiency_WhKm	-0.383	0.641	1.000	0.318	0.395	0.314	0.302	0.355
Fast_Charge_Kmh	-0.783	0.694	0.318	1.000	0.658	0.754	0.264	0.778
Price_Euro	-0.627	0.657	0.395	0.658	1.000	0.677	0.022	0.829
Range_Km	-0.678	0.910	0.314	0.754	0.677	1.000	0.300	0.748
Seats	-0.176	0.330	0.302	0.264	0.022	0.300	1.000	0.127
Top_Speed_Kmh	-0.786	0.722	0.355	0.778	0.829	0.748	0.127	1.000

In order to answer this question in Power BI, it was required to create a custom visual (heatmap of correlation) using Python Visual. Following you can see the coding details.

	Accel_Sec	Battery_Pack_Ah	Efficiency_WhKm	Fast_Charge_KmH	Range_Km	Seats	Top_Speed_KmH	Price_USD
Accel_Sec	1	-0.68	-0.38	0.78	0.68	-0.18	-0.79	-0.63
Battery_Pack_Ah	-0.68	1	0.64	0.68	0.91	-0.31	0.72	0.66
Efficiency_WhKm	-0.38	0.64	1	0.38	0.33	0.3	0.95	0.4
Fast_Charge_KmH	0.78	0.68	0.38	1	0.75	0.28	0.78	0.68
Range_Km	0.68	0.91	0.31	0.75	1	0.2	0.75	0.68
Seats	-0.18	0.33	0.3	0.38	0.3	1	0.33	-0.023
Top_Speed_KmH	-0.79	-0.72	0.35	0.76	0.75	0.13	1	0.63
Price_USD	-0.63	0.66	0.4	0.68	0.68	0.023	0.87	1

The price of a vehicle shows correlation with several attributes, including acceleration, speed, battery capacity, efficiency, and fast charging. Among these attributes, speed exhibits the strongest correlation with price. Interestingly, the number of seats does not appear to have a significant correlation with the price, suggesting that the cost of a vehicle is not solely determined by a specific feature, instead, it's influenced by a combination of factors such as branding, target audience, and the overall package a car offers.

Conclusion

Over the past five years, the use of electric vehicles (EVs) has steadily increased in the USA, according to the data analysis. In the market, Tesla was the clear leader, with Nissan, Chevrolet, and Kia trailing closely behind. SUVs became the favored option for electric vehicle purchasers, and producers engaged in intense competition to provide larger battery capacities and enhanced efficiency.

Even though characteristics like speed showed a direct correlation with price, we think that an EV's total cost is influenced by several different factors, such as branding and target demographics.

We do see a constraint with the dataset, even if we were able to respond to our analysis query. For more accurate and thorough research, larger data coverage including many US states is necessary to have a comprehensive knowledge of countrywide EV trends.

Next steps

Electric vehicles (EVs) hold significant importance due to their contributions to mitigating environmental impact by reducing greenhouse gas emissions and enhancing air quality, crucial steps in combating climate change. Consequently, we advocate for the continuation and expansion of comprehensive census efforts to cover diverse geographical regions. Collecting more data periodically is necessary as it enables states to track evolving consumer trends. This information equips cities and regions with insights necessary to develop and adapt infrastructure, ensuring it adequately supports the growing demand for EVs and comprehensive analysis.

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(<https://www.packtpub.com/product/learning-tableau-2022-fifth-edition/9781801072328>)
- Microsoft Power BI Quick Start Guide – Preferably 3rd edition- Devin Knight, Mitchell Pearson, Bradley Schacht,, et al – ISBN 9781804613498 – Packt Publishing – eBook available from publisher's website (<https://www.packtpub.com/product/microsoft-power-bi-quick-start-guide-second-edition/9781804613498>)
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