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Analysis of Electric Vehicles using SQL and Python

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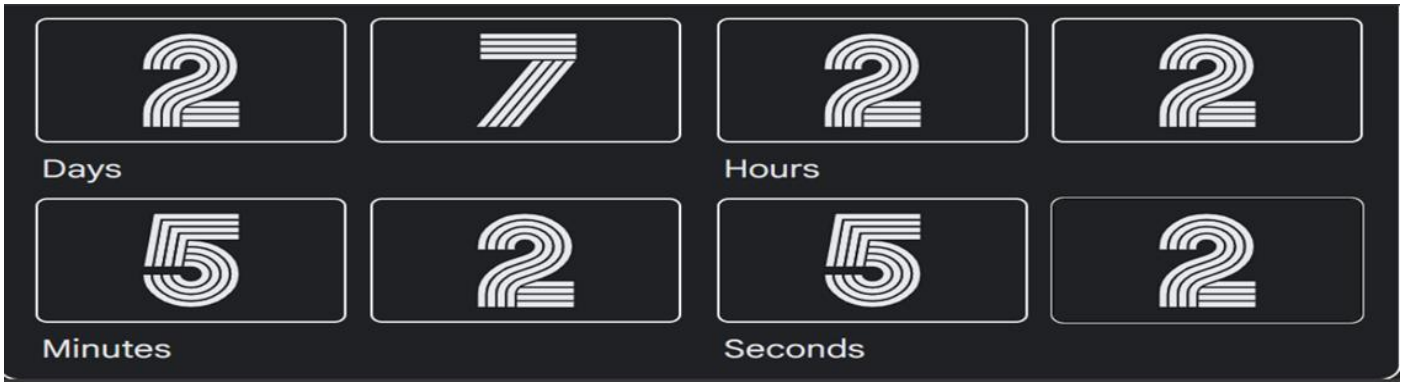

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About Dataset

Electric vehicles are vehicles that run on electricity stored in a battery rather than on fossil fuels like gasoline or diesel. EVs are becoming increasingly popular as more and more people become aware of the environmental and financial benefits of owning one. In addition, governments around the world are offering incentives to encourage people to switch to EVs, such as tax breaks and subsidies.

Advantages of electric vehicles include:

Reduced emissions: EVs produce zero tailpipe emissions, which means they can help reduce air pollution and greenhouse gas emissions.

Lower operating costs: EVs can be cheaper to operate than traditional gasoline vehicles since electricity is generally cheaper than gasoline or diesel fuel. They

also require less maintenance since they have fewer moving parts than traditional vehicles.

Quieter operation: EVs are much quieter than traditional vehicles, which can help reduce noise pollution in urban areas.

Improved energy efficiency: Electric motors are much more efficient than internal combustion engines, which means that EVs can travel further on the same amount of energy.

Disadvantages of electric vehicles include:

Limited driving range: Many EVs have a limited driving range, which means that they may not be suitable for long-distance travel or for people who have long commutes.

Higher upfront cost: EVs can be more expensive to purchase than traditional vehicles, although the cost is coming down as battery technology improves.

Limited charging infrastructure: While there are more and more charging stations being installed, the charging infrastructure for EVs is still not as extensive as the traditional gasoline refueling network.

Battery recycling: The production and disposal of batteries used in EVs can have environmental impacts.

Overall, Electric vehicles have the potential to significantly reduce greenhouse gas emissions and air pollution, which are major contributors to climate change and public health problems. Additionally, electric vehicles can help reduce our dependence on fossil fuels, which are finite resources and subject to price volatility. As battery technology continues to improve, electric vehicles will become more practical and affordable for a wider range of consumers, and we can expect to see their use become even more widespread in the future.

Source:https://www.kaggle.com/datasets/geoffnel/evs-one-electric-vehicle-dataset

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Section I: Data Overview

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[1]: What are the top 10 rows of the Dataset for the Analysis

```
SELECT Top 10 *
FROM Electric_Vehicles;
```

100 %

Results | Messages

	Brand	Model	AccelSec	TopSpeed_KmH	Range_Km	Efficiency_WhKm	FastCharge_KmH	RapidCharge	PowerTrain	PlugType	BodyStyle	Segment	Seats	PriceEuro
1	Tesla	Model 3 Long Range Dual Motor	5	233	450	161	940	1	AWD	Type 2 CCS	Sedan	D	5	55480
2	Volkswagen	ID.3 Pure	10	160	270	167	250	1	RWD	Type 2 CCS	Hatchback	C	5	30000
3	Polestar	2	5	210	400	181	620	1	AWD	Type 2 CCS	Liftback	D	5	56440
4	BMW	iX3	7	180	360	206	560	1	RWD	Type 2 CCS	SUV	D	5	68040
5	Honda	e	10	145	170	168	190	1	RWD	Type 2 CCS	Hatchback	B	4	32997
6	Lucid	Air	3	250	610	180	620	1	AWD	Type 2 CCS	Sedan	F	5	105000
7	Volkswagen	e-Golf	10	150	190	168	220	1	FWD	Type 2 CCS	Hatchback	C	5	31900
8	Peugeot	e-208	8	150	275	164	420	1	FWD	Type 2 CCS	Hatchback	B	5	29682
9	Tesla	Model 3 Standard Range Plus	6	225	310	153	650	1	RWD	Type 2 CCS	Sedan	D	5	46380
10	Audi	Q4 e-tron	6	180	400	193	540	1	AWD	Type 2 CCS	SUV	D	5	55000

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[2]: How many rows, unique Brands, Models, Power Train, Body Styles, and Segment are in the dataset?

```
SELECT 'Basic information about the Dataset' AS [.]

SELECT
    (SELECT COUNT(*) FROM Electric_Vehicles) AS [Number of Observations]

SELECT
    COUNT(DISTINCT Brand) AS [Number of Unique Brand],
    COUNT(DISTINCT Model) AS [Number of Unique Model],
    COUNT(DISTINCT BodyStyle) AS [Number of Unique Body Style],
    COUNT(DISTINCT Segment) AS [Number of Unique Segment],
    COUNT(DISTINCT PlugType) AS [Number of Unique Plug Type],
    COUNT(DISTINCT PowerTrain) AS [Number of Unique Power Train],
    COUNT(DISTINCT RapidCharge) AS [Number of Unique RapidCharge]
FROM Electric_Vehicles;
```

100 %

Results | Messages

	.
1	Basic information about the Dataset

	Number of Observations
1	103

	Number of Unique Brand	Number of Unique Model	Number of Unique Body Style	Number of Unique Segment	Number of Unique Plug Type	Number of Unique Power Train	Number of Unique RapidCharge
1	33	102	9	8	4	3	2

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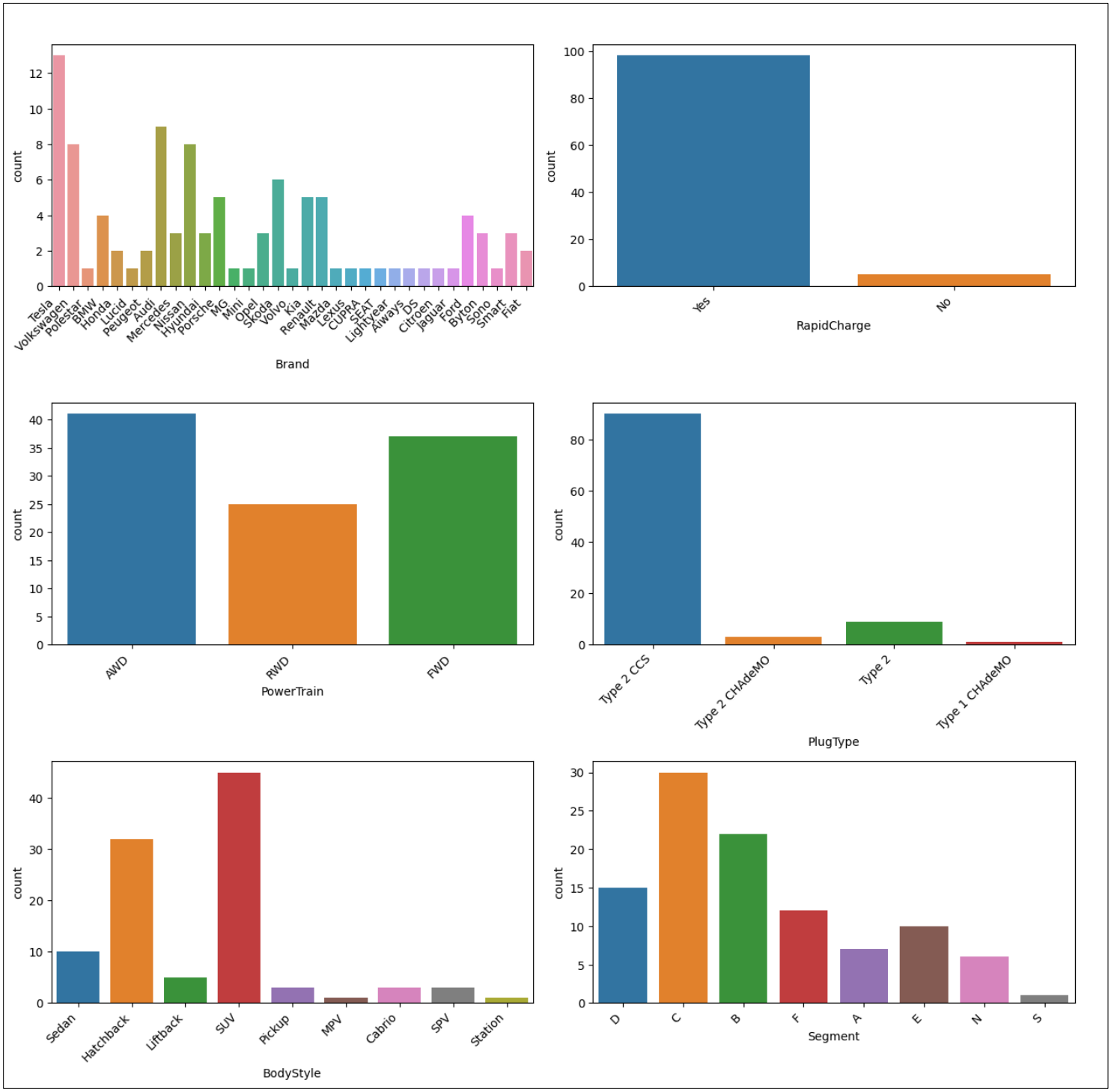
[2b]:What are the general features of the electric vehicles currently available?



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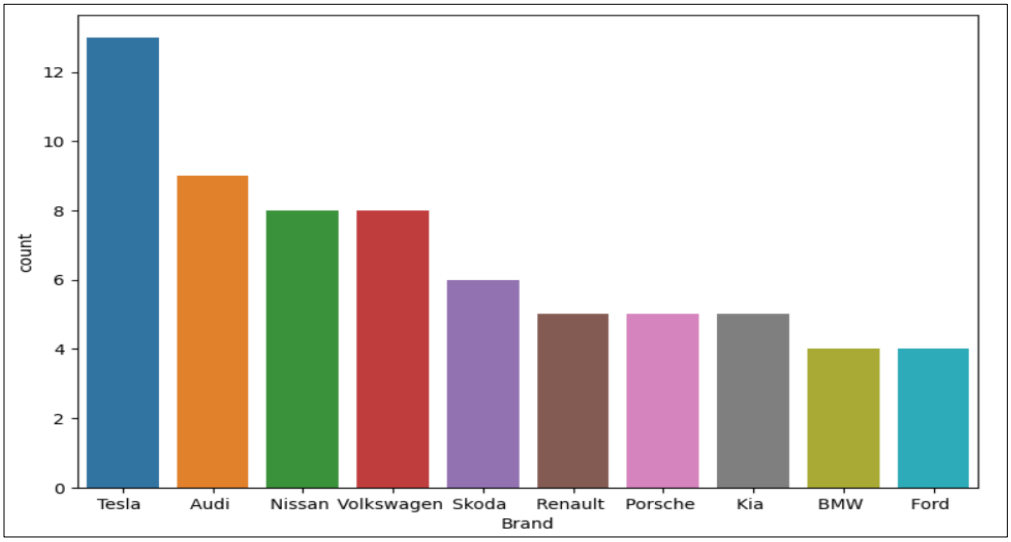
[3]: Which Electric Vehicle Brands are currently available on the market, rank, and the top 10?

```
SELECT Top 10 Brand,
       COUNT(*) AS [No. of Vehicles],
RANK() OVER (ORDER BY COUNT(*) DESC) AS Rank
FROM Electric_Vehicles
GROUP BY Brand
ORDER BY RANK;
```

100 %

Results | Messages

	Brand	No. of Vehicles	Rank
1	Tesla	13	1
2	Audi	9	2
3	Volkswagen	8	3
4	Nissan	8	3
5	Skoda	6	5
6	Porsche	5	6
7	Renault	5	6
8	Kia	5	6
9	BMW	4	9
10	Ford	4	9



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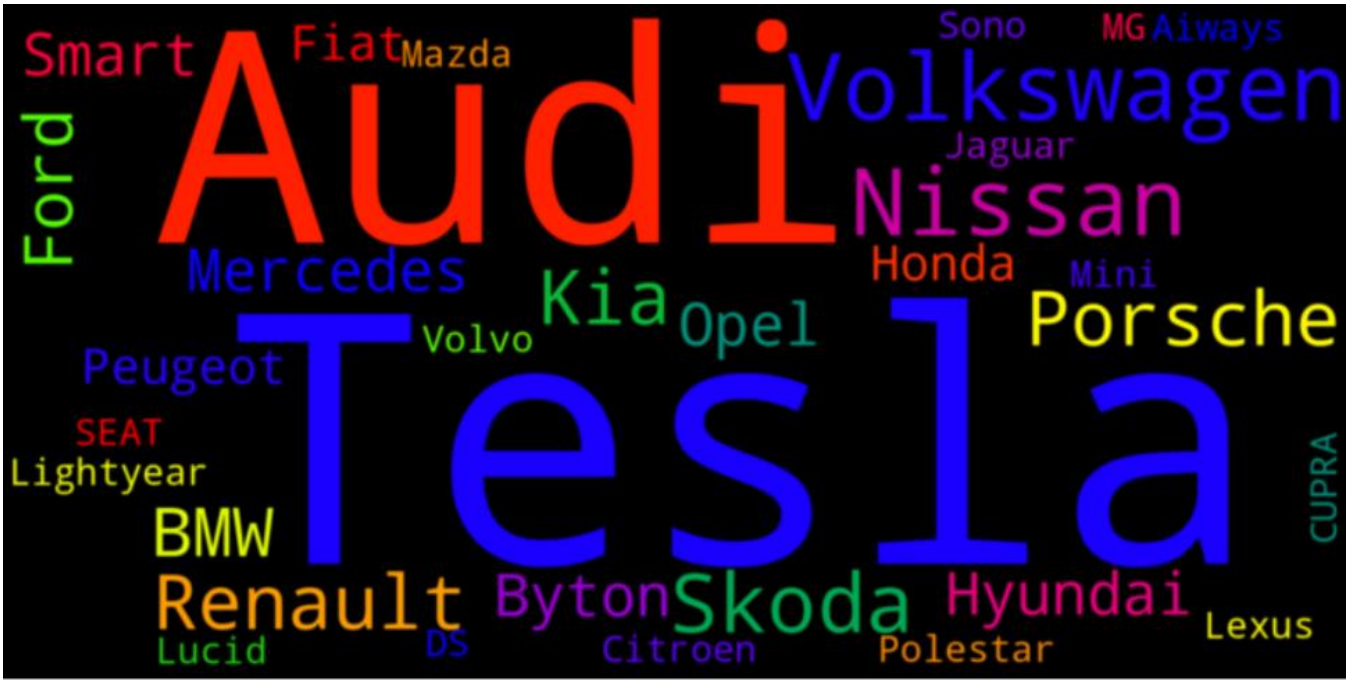
[3a]: Display the list of all the EV Brands in a "WordCloud"?



[See the Python code at the bottom]

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[3c]: Display the list of all the EV Models in a “WordCloud”?

[See the Python code at the bottom]

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[4]:What are the main features of the following EV models if you buy one?

1.Lucid Air 2. Porsche Taycan Turbo S 3.Audi e-tron GT
4.Tesla Roadster 5. Porcsche Taycan 4s Plus 6.Tesla Model X Performance

```
SELECT *
FROM Electric_Vehicles
WHERE Model in('Roadster','Taycan Turbo S','e-tron GT','Taycan 4S Plus','Air','Model X Performance');
```

100 %

Results | Messages

	Brand	Model	AccelSec	TopSpeed_KmH	Range_Km	Efficiency_WhKm	FastCharge_KmH	RapidCharge	PowerTrain	PlugType	BodyStyle	Segment	Seats	PriceEuro
1	Lucid	Air	3	250	610	180	620	1	AWD	Type 2 CCS	Sedan	F	5	105000
2	Porsche	Taycan Turbo S	3	260	375	223	780	1	AWD	Type 2 CCS	Sedan	F	4	180781
3	Audi	e-tron GT	4	240	425	197	850	1	AWD	Type 2 CCS	Sedan	F	4	125000
4	Tesla	Roadster	2	410	970	206	920	1	AWD	Type 2 CCS	Cabrio	S	4	215000
5	Porsche	Taycan 4S Plus	4	250	425	197	890	1	AWD	Type 2 CCS	Sedan	F	4	109302
6	Tesla	Model X Performance	3	250	440	216	480	1	AWD	Type 2	SUV	F	7	102990

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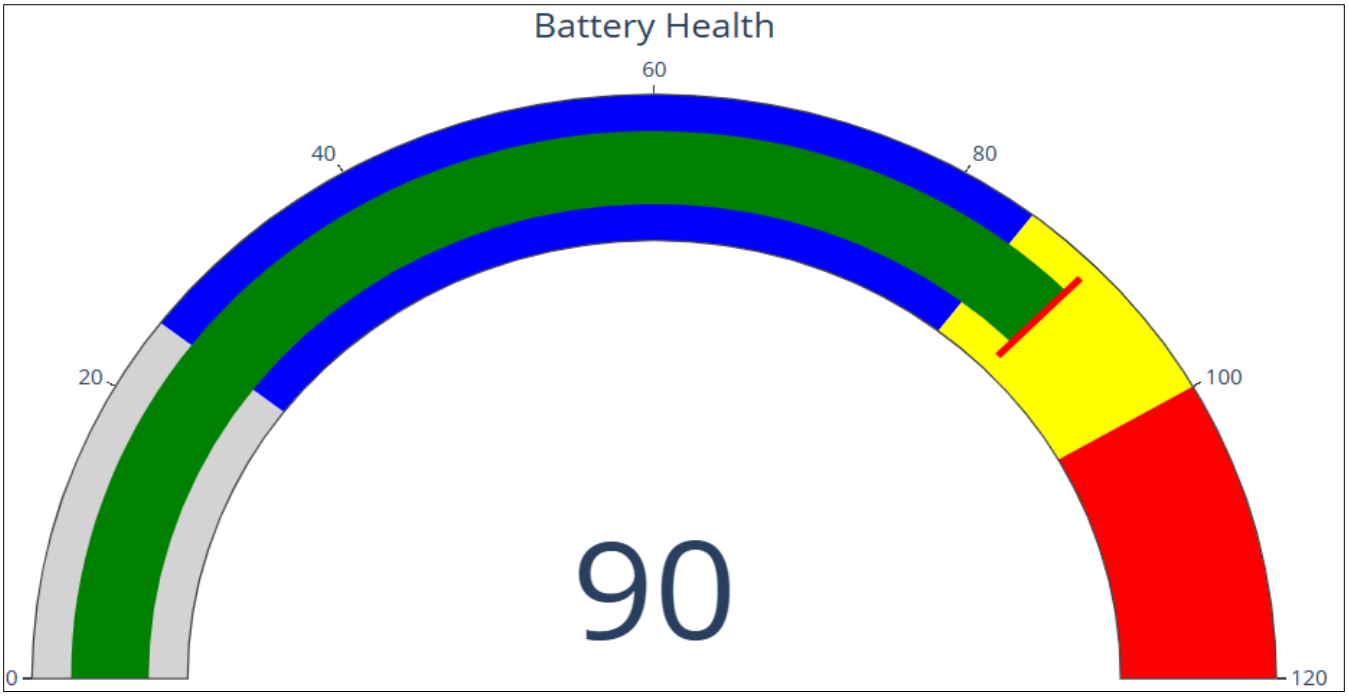
[5]: What speed range_KmH is ideal for maintaining good battery health in electric vehicles?



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[6]: Which EV models are currently available at the lowest and highest prices in the market?

```
SELECT
	MIN(PriceEuro) AS [Least EV Price(€)],
	MAX(PriceEuro) AS [Highest EV Price (€)]
From Electric_Vehicles

SELECT *
FROM Electric_Vehicles
WHERE PriceEuro in (20129,215000);
```

100 %

Results | Messages

	Least EV Price(€)	Highest EV Price (€)
1	20129	215000

	Brand	Model	AccelSec	TopSpeed_KmH	Range_Km	Efficiency_WhKm	FastCharge_KmH	RapidCharge	PowerTrain	PlugType	BodyStyle	Segment	Seats	PriceEuro
1	SEAT	Mii Electric	12	130	195	166	170	1	FWD	Type 2 CCS	Hatchback	A	4	20129
2	Tesla	Roadster	2	410	970	206	920	1	AWD	Type 2 CCS	Cabrio	S	4	215000

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[7]:What is the average price of an EV, and which are the top 10 models that are currently priced below this average?

```
SELECT
	AVG(PriceEuro) AS [Average EV Price(€)]
From Electric_Vehicles

SELECT Top 10*
FROM Electric_Vehicles
WHERE PriceEuro < 55811
ORDER BY PriceEuro ASC;
```

100 %

Results | Messages

	Average EV Price(€)
1	55811

	Brand	Model	AccelSec	TopSpeed_KmH	Range_Km	Efficiency_WhKm	FastCharge_KmH	RapidCharge	PowerTrain	PlugType	BodyStyle	Segment	Seats	PriceEuro
1	SEAT	Mii Electric	12	130	195	166	170	1	FWD	Type 2 CCS	Hatchback	A	4	20129
2	Smart	EQ fortwo coupe	12	130	100	167	0	0	RWD	Type 2	Hatchback	A	2	21387
3	Volkswagen	e-Up!	12	130	195	166	170	1	FWD	Type 2 CCS	Hatchback	A	4	21421
4	Smart	EQ forfour	13	130	95	176	0	0	RWD	Type 2	Hatchback	A	4	22030
5	Skoda	CITIGOe iV	12	130	195	166	170	1	FWD	Type 2 CCS	Hatchback	A	4	24534
6	Smart	EQ fortwo cabrio	12	130	95	176	0	0	RWD	Type 2	Cabrio	A	2	24565
7	Renault	Twingo ZE	13	135	130	164	0	0	RWD	Type 2	Hatchback	A	4	24790
8	Sono	Sion	9	140	225	156	270	1	FWD	Type 2 CCS	Hatchback	C	5	25500
9	Opel	Corsa-e	8	150	275	164	420	1	FWD	Type 2 CCS	Hatchback	B	5	29146
10	Nissan	Leaf	8	144	220	164	230	1	FWD	Type 2 C...	Hatchback	C	5	29234

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[8]: What is the average price of an EV, and which are the top 10 models that are currently priced above this average?

```
SELECT
	AVG(PriceEuro) AS [Average EV Price(€)]
From Electric_Vehicles

SELECT Top 10*
FROM Electric_Vehicles
WHERE PriceEuro > 55811
ORDER BY PriceEuro DESC;
```

100 %

Results | Messages

	Average EV Price(€)
1	55811

	Brand	Model	AccelSec	TopSpeed_KmH	Range_Km	Efficiency_WhKm	FastCharge_KmH	RapidCharge	PowerTrain	PlugType	BodyStyle	Segment	Seats	PriceEuro
1	Tesla	Roadster	2	410	970	206	920	1	AWD	Type 2 CCS	Cabrio	S	4	215000
2	Porsche	Taycan Turbo S	3	260	375	223	780	1	AWD	Type 2 CCS	Sedan	F	4	180781
3	Porsche	Taycan Cross Turismo	4	250	385	217	770	1	AWD	Type 2 CCS	Station	F	4	150000
4	Lightyear	One	10	150	575	104	540	1	AWD	Type 2 CCS	Liftback	F	5	149000
5	Porsche	Taycan Turbo	3	260	390	215	810	1	AWD	Type 2 CCS	Sedan	F	4	148301
6	Audi	e-tron GT	4	240	425	197	850	1	AWD	Type 2 CCS	Sedan	F	4	125000
7	Porsche	Taycan 4S Plus	4	250	425	197	890	1	AWD	Type 2 CCS	Sedan	F	4	109302
8	Lucid	Air	3	250	610	180	620	1	AWD	Type 2 CCS	Sedan	F	5	105000
9	Tesla	Model X Performance	3	250	440	216	480	1	AWD	Type 2	SUV	F	7	102990
10	Porsche	Taycan 4S	4	250	365	195	730	1	AWD	Type 2 CCS	Sedan	F	4	102945

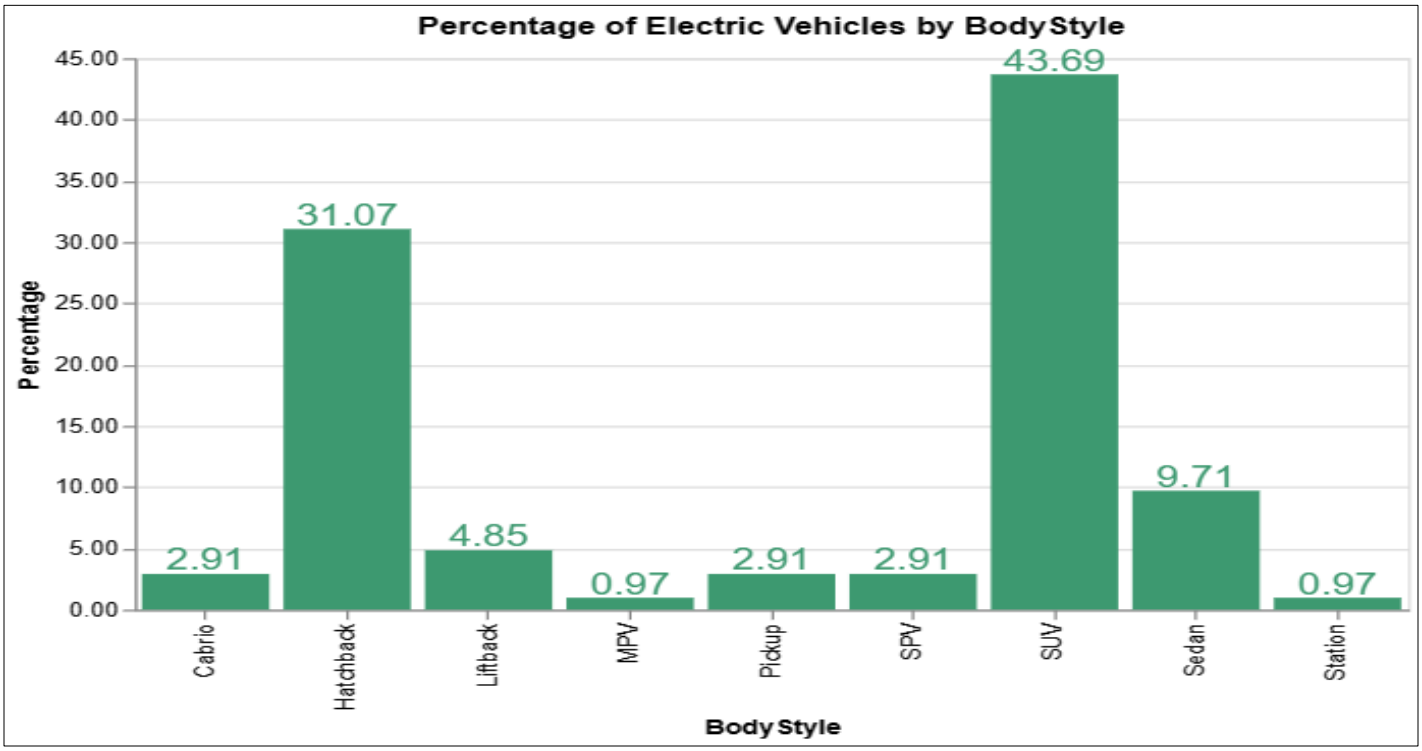
[9]: What types of EV body styles are currently available on the market?

```
SELECT
       BodyStyle, COUNT(*) as [No. of Vehicles],
RANK() OVER (ORDER BY COUNT(*) DESC) AS Rank
FROM Electric_Vehicles
GROUP BY BodyStyle
ORDER BY RANK;
```

100 %

Results | Messages

	BodyStyle	No. of Vehicles	Rank
1	SUV	45	1
2	Hatchback	32	2
3	Sedan	10	3
4	Liftback	5	4
5	Cabrio	3	5
6	Pickup	3	5
7	SPV	3	5
8	Station	1	8
9	MPV	1	8



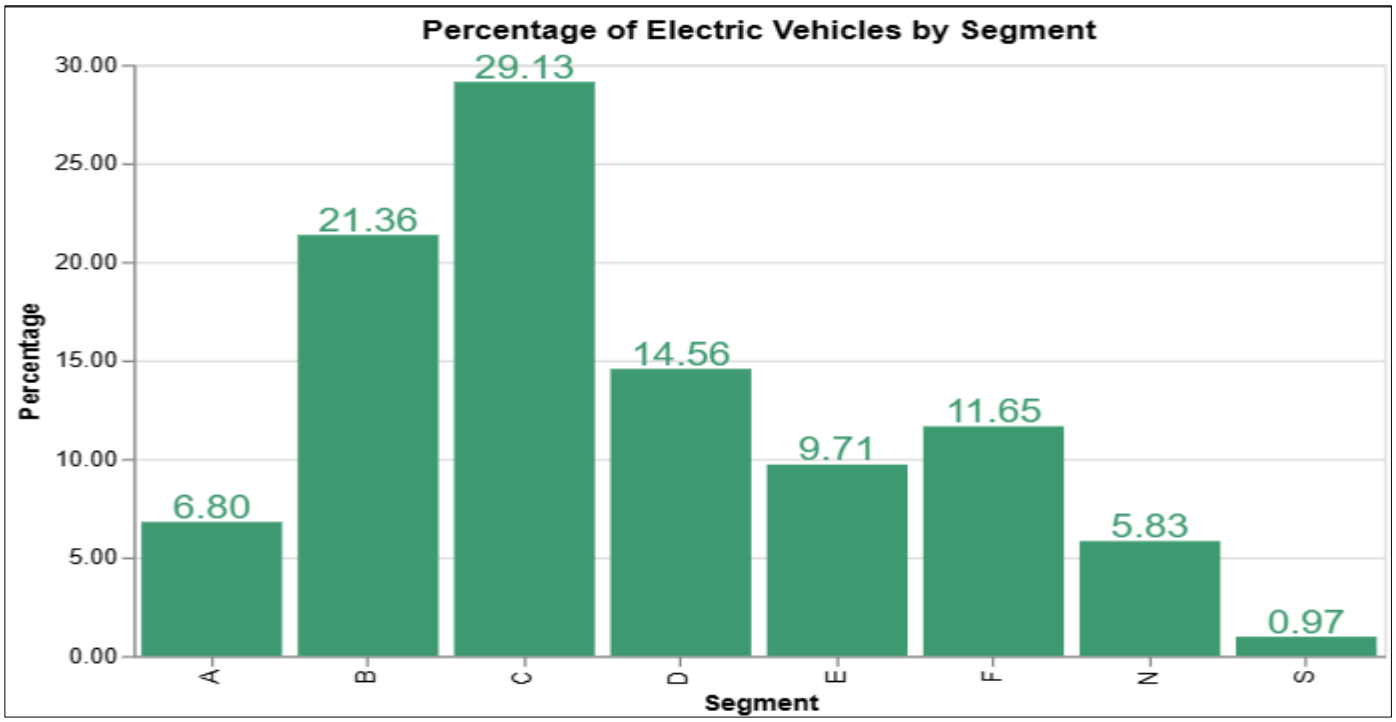
[10]: What are the current EV segments available on the market?

```
SELECT Segment, COUNT(*) AS [No. of Vehicles],
RANK() OVER (ORDER BY COUNT(*) DESC) AS Rank
FROM Electric_Vehicles
GROUP BY Segment
ORDER BY RANK;
```

100 %

Results | Messages

	Segment	No. of Vehicles	Rank
1	C	30	1
2	B	22	2
3	D	15	3
4	F	12	4
5	E	10	5
6	A	7	6
7	N	6	7
8	S	1	8



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[11]: Which electric vehicle models have the highest acceleration and efficiency specifications?

```
SELECT
  Brand,
  Model,
  AccelSec,
  Efficiency_WhKm,
  PriceEuro,
  SQRT(Range_Km) AS Range,
  CASE
    WHEN AccelSec < 8 THEN 'Fast'
    WHEN AccelSec < 10 THEN 'Medium'
    ELSE 'Slow'
  END AS AccelType
FROM Electric_Vehicles
WHERE AccelSec IS NOT NULL AND Efficiency_WhKm IS NOT NULL
ORDER BY Brand, Model;
```

100 %

Results | Messages

	Brand	Model	AccelSec	Efficiency_WhKm	PriceEuro	Range	AccelType
1	Aiways	U5	9	188	36057	18.3030052177231	Medium
2	Audi	Q4 Sportback e-tron	6	188	57500	20.2484567313166	Fast
3	Audi	Q4 e-tron	6	193	55000	20	Fast
4	Audi	e-tron Sportback 55 quattro	6	228	81639	19.4935886896179	Fast
5	Audi	e-tron Sportback 50 quattro	7	219	69551	17.1755640373177	Fast
6	Audi	e-tron S Sportback 55 quattro	5	258	96050	18.3030052177231	Fast
7	Audi	e-tron S 55 quattro	5	270	93800	17.8885438199983	Fast
8	Audi	e-tron GT	4	197	125000	20.6155281280883	Fast
9	Audi	e-tron 55 quattro	6	237	79445	19.1049731745428	Fast
10	Audi	e-tron 50 quattro	7	231	67358	16.7332005306815	Fast
11	BMW	iX3	7	206	68040	18.9736659610103	Fast
12	BMW	i4	4	178	65000	21.2132034355964	Fast
13	BMW	i3s 120 Ah	7	165	41526	15.1657508881031	Fast
14	BMW	i3 120 Ah	7	161	38017	15.3297097167559	Fast
15	Byton	M-Byte 95 kWh 4WD	6	244	64000	19.7484176581315	Fast
16	Byton	M-Byte 95 kWh 2WD	8	238	62000	20	Medium
17	Byton	M-Byte 72 kWh 2WD	8	222	53500	18.0277563773199	Medium
18	Citroen	e-C4	10	180	40000	15.8113883008419	Slow
19	CUPRA	el-Born	7	181	45000	20.6155281280883	Fast

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[12]: What are the average values for speed range, efficiency, top speed, fast charging capability, acceleration time, seating capacity, and price among the top 10 electric vehicles (EV) brands?

```
SELECT Top 10 Brand, Model,BodyStyle,
       AVG(Range_Km) AS [Avg Range_Km],
       AVG(Efficiency_WhKm) AS [Avg.Efficiency_WhKm],
       AVG(TOpSpeed_KmH) AS [Avg. Top Speed],
       AVG(FastCharge_KmH) AS [Avg. Fast Charge],
       AVG(AccelSec) AS [Avg. Accel Sec],
       AVG(Seats) AS [Avg. Seats],
       AVG(PriceEuro) AS [Avg. PriceEuro],
RANK() OVER (ORDER BY AVG(PriceEuro) DESC) AS Rank
FROM Electric_Vehicles
GROUP BY Brand,Model,BodyStyle
ORDER BY Rank;
```

100 % — Results | Messages

	Brand	Model	BodyStyle	Avg Range_Km	Avg.Efficiency_WhKm	Avg. Top Speed	Avg. Fast Charge	Avg. Accel Sec	Avg. Seats	Avg. PriceEuro	Rank
1	Tesla	Roadster	Cabrio	970	206	410	920	2	4	215000	1
2	Porsche	Taycan Turbo S	Sedan	375	223	260	780	3	4	180781	2
3	Porsche	Taycan Cross Turismo	Station	385	217	250	770	4	4	150000	3
4	Lightyear	One	Liftback	575	104	150	540	10	5	149000	4
5	Porsche	Taycan Turbo	Sedan	390	215	260	810	3	4	148301	5
6	Audi	e-tron GT	Sedan	425	197	240	850	4	4	125000	6
7	Porsche	Taycan 4S Plus	Sedan	425	197	250	890	4	4	109302	7
8	Lucid	Air	Sedan	610	180	250	620	3	5	105000	8
9	Tesla	Model X Performance	SUV	440	216	250	480	3	7	102990	9
10	Porsche	Taycan 4S	Sedan	365	195	250	730	4	4	102945	10

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[13]: What are the minimum values for speed range, efficiency, top speed, fast charging capability, acceleration time, seating capacity, and price among the top 10 electric vehicles (EV) brands?

```
SELECT Top 10 Brand,Model,BodyStyle,
       MIN(Range_Km) AS [Min Range_Km],
       MIN(Efficiency_WhKm) AS [Min Efficiency_WhKm],
       MIN(TOpSpeed_KmH) AS [Min  Top Speed],
       MIN(FastCharge_KmH) AS [Min Fast Charge],
       MIN(AccelSec) AS [Min Accel Sec],
       MIN(Seats) AS [Min Seats],
       MIN(PriceEuro) AS [Min PriceEuro],
RANK() OVER (ORDER BY MIN(PriceEuro) DESC) AS Rank
FROM Electric_Vehicles
GROUP BY Brand,Model,BodyStyle
ORDER BY Rank;
```

100 % — Results | Messages

	Brand	Model	BodyStyle	Min Range_Km	Min Efficiency_WhKm	Min Top Speed	Min Fast Charge	Min Accel Sec	Min Seats	Min PriceEuro	Rank
1	Tesla	Roadster	Cabrio	970	206	410	920	2	4	215000	1
2	Porsche	Taycan Turbo S	Sedan	375	223	260	780	3	4	180781	2
3	Porsche	Taycan Cross Turismo	Station	385	217	250	770	4	4	150000	3
4	Lightyear	One	Liftback	575	104	150	540	10	5	149000	4
5	Porsche	Taycan Turbo	Sedan	390	215	260	810	3	4	148301	5
6	Audi	e-tron GT	Sedan	425	197	240	850	4	4	125000	6
7	Porsche	Taycan 4S Plus	Sedan	425	197	250	890	4	4	109302	7
8	Lucid	Air	Sedan	610	180	250	620	3	5	105000	8
9	Tesla	Model X Performance	SUV	440	216	250	480	3	7	102990	9
10	Porsche	Taycan 4S	Sedan	365	195	250	730	4	4	102945	10

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[14]: What are the maximum values for speed range, efficiency, top speed, fast charging capability, acceleration time, seating capacity, and price among the top 10 electric vehicles (EV) brands?

```
SELECT Top 10 Brand,Model,BodyStyle,
       MAX(Range_Km) AS [Max Range_Km],
       MAX(Efficiency_WhKm) AS [Max Efficiency_WhKm],
       MAX(TOpSpeed_KmH) AS [Max Top Speed],
       MAX(FastCharge_KmH) AS [Max Fast Charge],
       MAX(AccelSec) AS [Max Accel Sec],
       MAX(Seats) AS [Max Seats],
       MAX(PriceEuro) AS [Max PriceEuro],
RANK() OVER (ORDER BY MAX(PriceEuro) DESC) AS Rank
FROM Electric_Vehicles
GROUP BY Brand,Model,BodyStyle
ORDER BY Rank;
```

100 % — Results | Messages

	Brand	Model	BodyStyle	Max Range_Km	Max Efficiency_WhKm	Max Top Speed	Max Fast Charge	Max Accel Sec	Max Seats	Max PriceEuro	Rank
1	Tesla	Roadster	Cabrio	970	206	410	920	2	4	215000	1
2	Porsche	Taycan Turbo S	Sedan	375	223	260	780	3	4	180781	2
3	Porsche	Taycan Cross Turismo	Station	385	217	250	770	4	4	150000	3
4	Lightyear	One	Liftback	575	104	150	540	10	5	149000	4
5	Porsche	Taycan Turbo	Sedan	390	215	260	810	3	4	148301	5
6	Audi	e-tron GT	Sedan	425	197	240	850	4	4	125000	6
7	Porsche	Taycan 4S Plus	Sedan	425	197	250	890	4	4	109302	7
8	Lucid	Air	Sedan	610	180	250	620	3	5	105000	8
9	Tesla	Model X Performance	SUV	440	216	250	480	3	7	102990	9
10	Porsche	Taycan 4S	Sedan	365	195	250	730	4	4	102945	10

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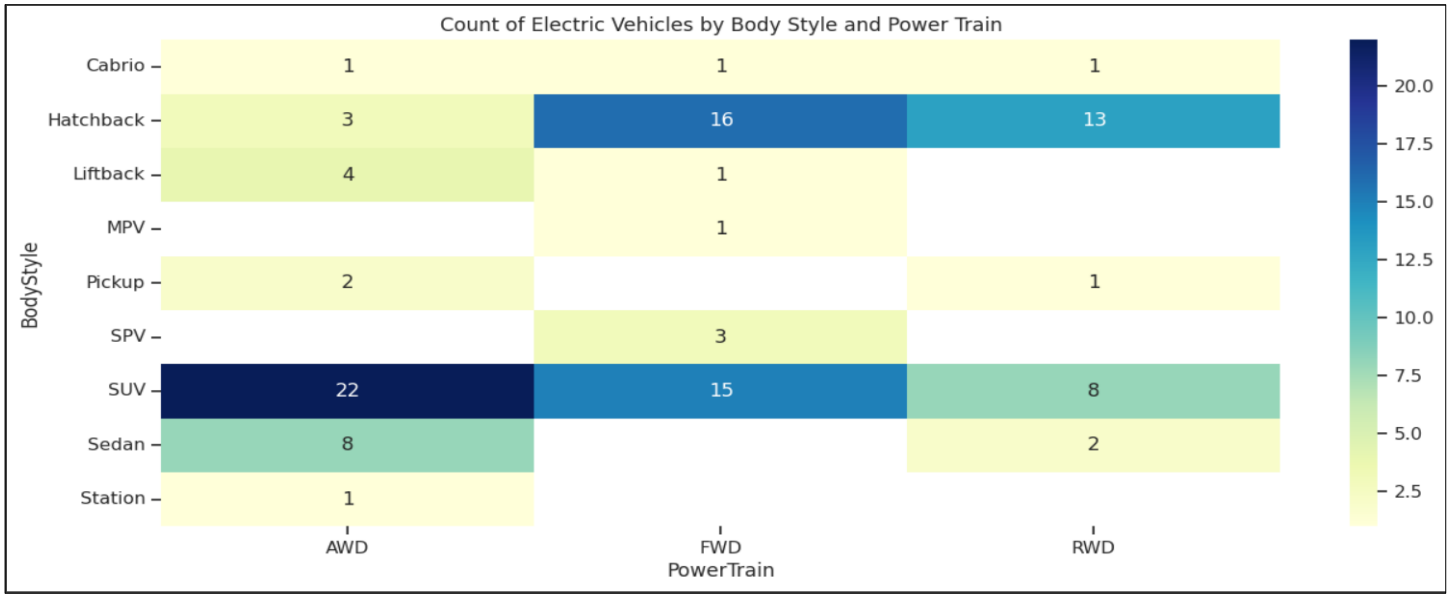
[15]: What are the Power Trains for the top 5 EV Body Styles currently available on the market?

```
SELECT
       PowerTrain, BodyStyle, COUNT(*) AS VehicleCount
FROM Electric_Vehicles
GROUP BY PowerTrain, BodyStyle
ORDER BY VehicleCount DESC;
```

100 % — Results | Messages

	PowerTrain	BodyStyle	No. of BodyStyle	Rank
1	AWD	SUV	22	1
2	FWD	Hatchback	16	2
3	FWD	SUV	15	3
4	RWD	Hatchback	13	4
5	AWD	Sedan	8	5
6	RWD	SUV	8	5
7	AWD	Liftback	4	7
8	AWD	Hatchback	3	8
9	FWD	SPV	3	8
10	RWD	Sedan	2	10
11	AWD	Pickup	2	10
12	AWD	Cabrio	1	12
13	AWD	Station	1	12
14	FWD	Cabrio	1	12
15	RWD	Pickup	1	12
16	RWD	Cabrio	1	12
17	FWD	Liftback	1	12
18	FWD	MPV	1	12



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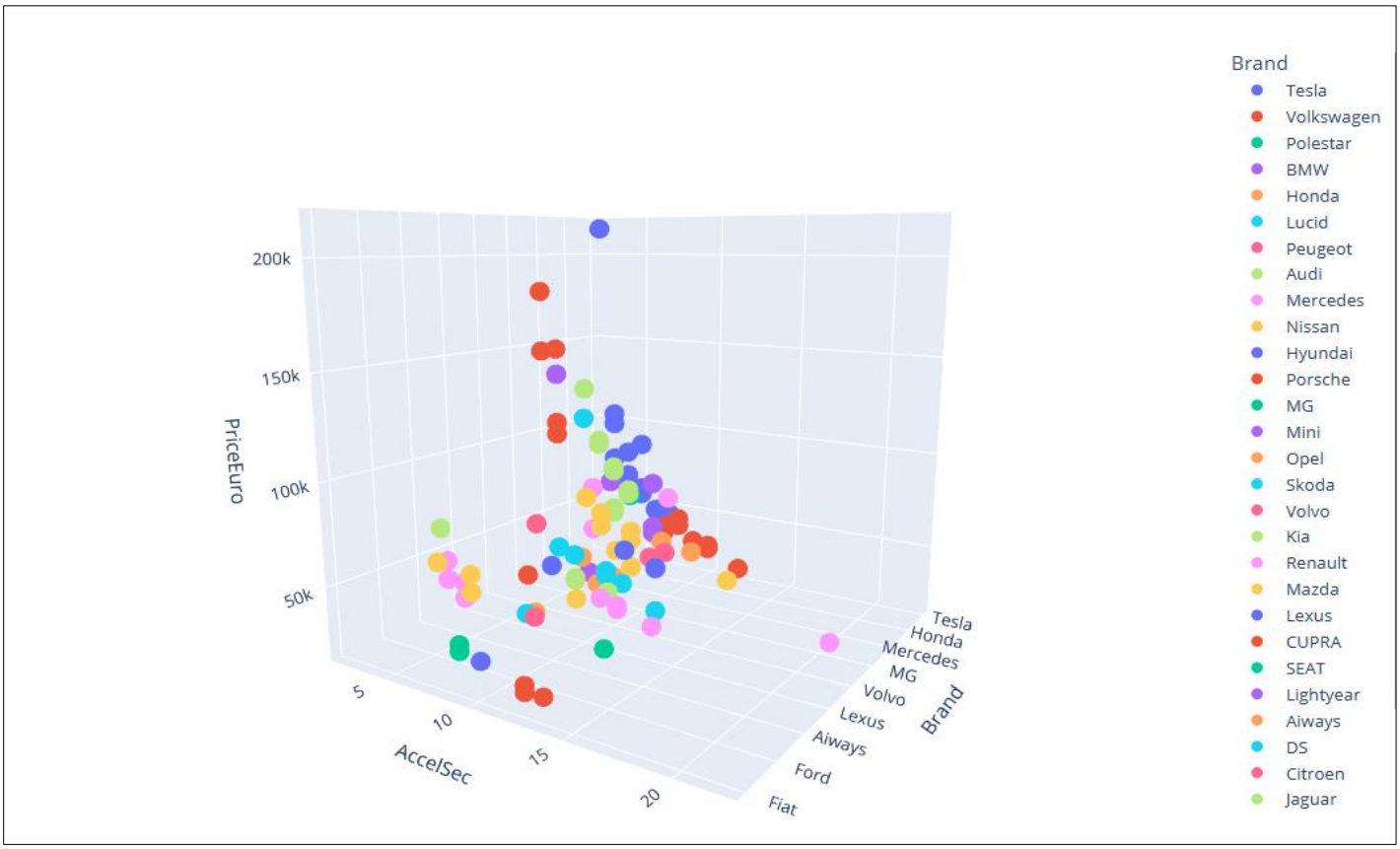
[16]:How does the Acceleration impact the price of electric vehicles by Brand?



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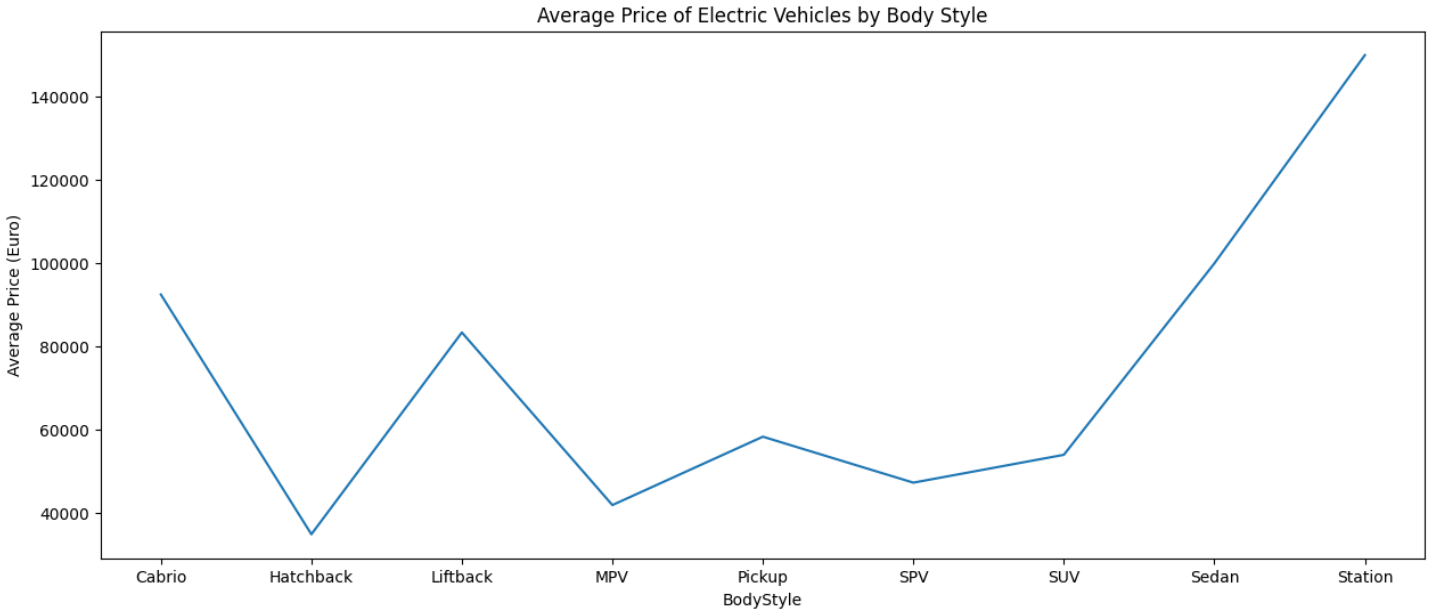
[17]:What is the average price of electric vehicles that have either a Hatchback or Cabrio Body Style?



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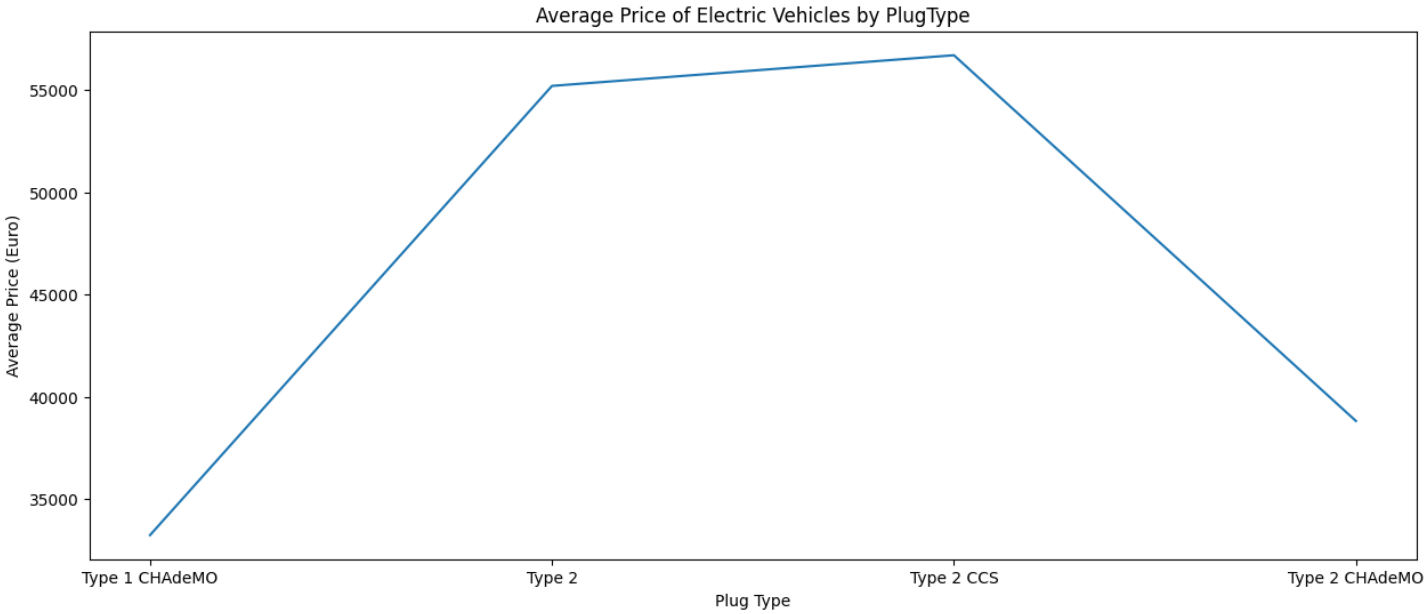
[17b]: What is the average price of electric vehicles that have either Type 2 CCS or Type 2 CHAdeMO plug types?



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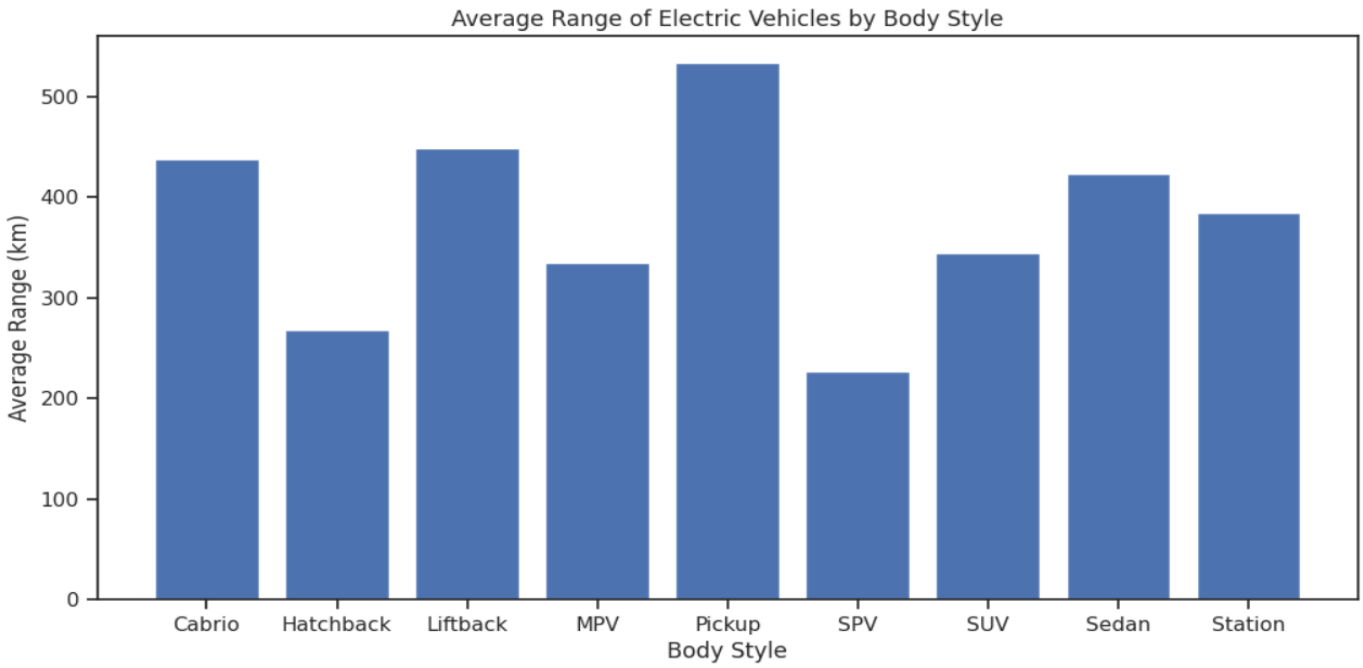
[17c]: What is the average price of an electric vehicle by Body Style?



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Section II: Technical Analysis of the Features of EVs

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[18]: How much of the variation in the price of electric vehicles can be explained by their acceleration, top speed, range, efficiency, and fast charge capabilities?

[18b]:Based on a 95% confidence interval, which independent variable(s) have a significant impact on the price of electric vehicles and can be used to explain its variation?

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.852815134
R Square	0.727293653
Adjusted R Square	0.713236625
Standard Error	18279.21286
Observations	103

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	86437314721	17287462944	51.73879168	7.08351E-26
Residual	97	32410573407	334129622.8		
Total	102	1.18848E+11			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-52261.82815	16104.75978	-3.245116901	0.001611587	-84225.31829	-20298.33801	-84225.31829	-20298.33801
TopSpeed_KmH	510.8984747	75.13096768	6.800105076	8.57601E-10	361.7843012	660.0126482	361.7843012	660.0126482
Range_Km	49.70691037	24.29442457	2.046021309	0.04346067	1.48920263	97.92461811	1.48920263	97.92461811
Efficiency_WhKm	178.5905441	68.15654328	2.620299322	0.010198164	43.3186724	313.8624159	43.3186724	313.8624159
FastCharge_KmH	1.147615981	14.54739088	0.078888097	0.937284146	-27.72492799	30.02015996	-27.72492799	30.02015996
Seats	-7084.775225	2532.700679	-2.79732038	0.006214776	-12111.48499	-2058.065464	-12111.48499	-2058.065464

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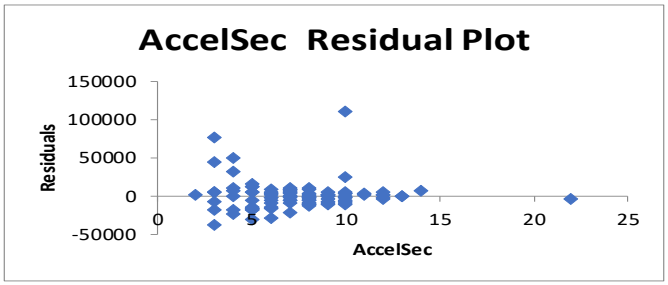
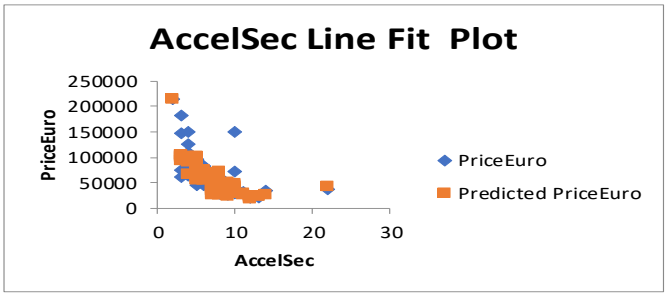
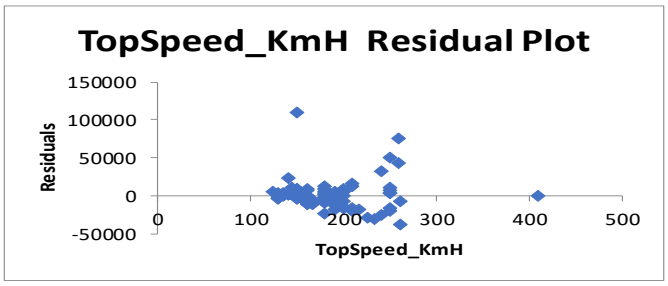
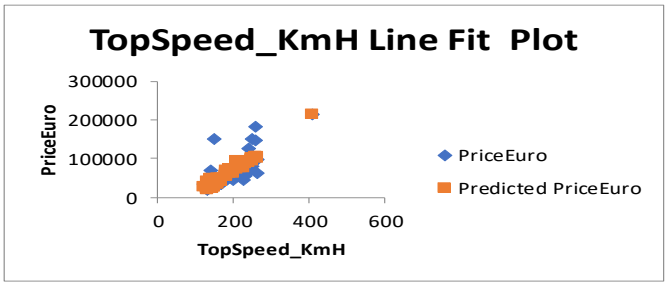
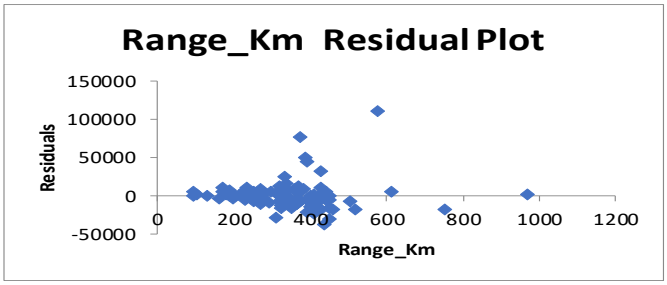
[18c]: How can the correlation between EV technical features be demonstrated through residual and line fit plots?

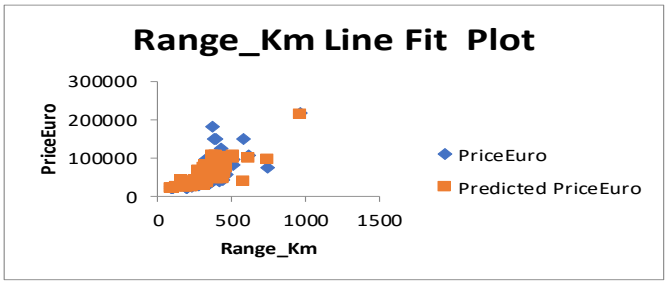


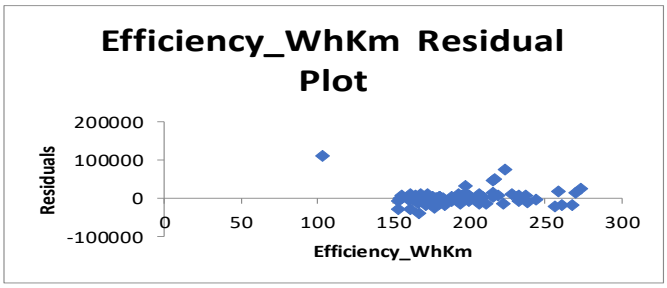


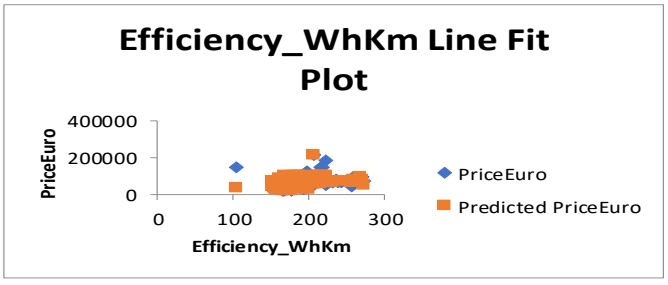


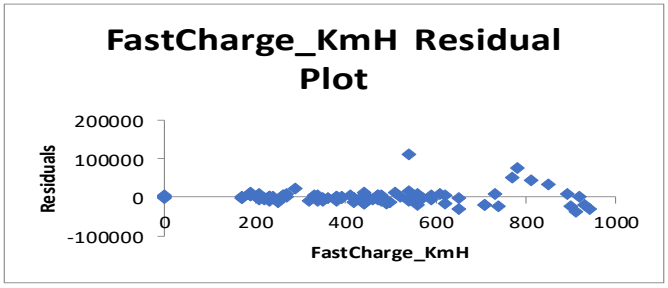


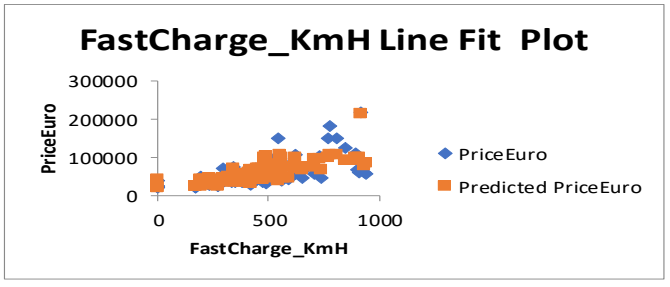












==========

[19]: What are the summary statistics for all-electric vehicle (EV) specifications or features?

	count	mean	std	min	25%	50%	75%	max
AccelSec	103.000000	7.504854	2.976621	2.000000	5.000000	7.000000	9.000000	22.000000
TopSpeed_KmH	103.000000	179.194175	43.573030	123.000000	150.000000	160.000000	200.000000	410.000000
Range_Km	103.000000	338.786408	126.014444	95.000000	250.000000	340.000000	400.000000	970.000000
Efficiency_WhKm	103.000000	189.165049	29.566839	104.000000	168.000000	180.000000	203.000000	273.000000
FastCharge_KmH	103.000000	434.563107	219.660061	0.000000	260.000000	440.000000	555.000000	940.000000
Seats	103.000000	4.883495	0.795834	2.000000	5.000000	5.000000	5.000000	7.000000
PriceEuro	103.000000	55811.563107	34134.665280	20129.000000	34429.500000	45000.000000	65000.000000	215000.000000

==========

[19b]: What are the quantile statistics for the specifications or features of electric vehicles?

index	0.250000	0.500000	0.600000	0.750000	0.900000	0.950000	0.990000
AccelSec	5.000000	7.000000	8.000000	9.000000	10.800000	12.000000	13.980000
TopSpeed_KmH	150.000000	160.000000	180.000000	200.000000	250.000000	250.000000	261.000000
Range_Km	250.000000	340.000000	366.000000	400.000000	448.000000	500.500000	747.200000
Efficiency_WhKm	168.000000	180.000000	191.400000	203.000000	231.800000	254.800000	269.940000
FastCharge_KmH	260.000000	440.000000	470.000000	555.000000	738.000000	886.000000	929.800000
Seats	5.000000	5.000000	5.000000	5.000000	5.000000	6.900000	7.000000
PriceEuro	34429.500000	45000.000000	53600.000000	65000.000000	96802.000000	123430.200000	180165.380000

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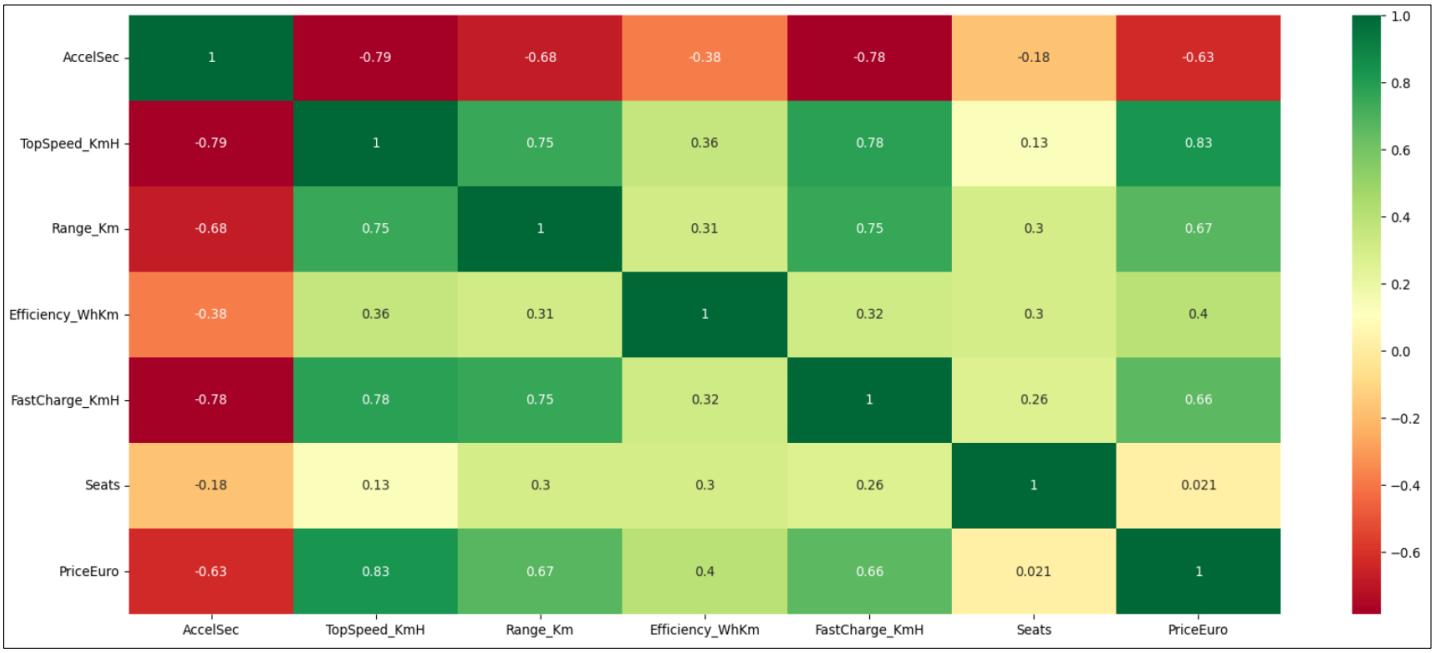
[20]: What are the correlation coefficients for the technical features of electric vehicles?



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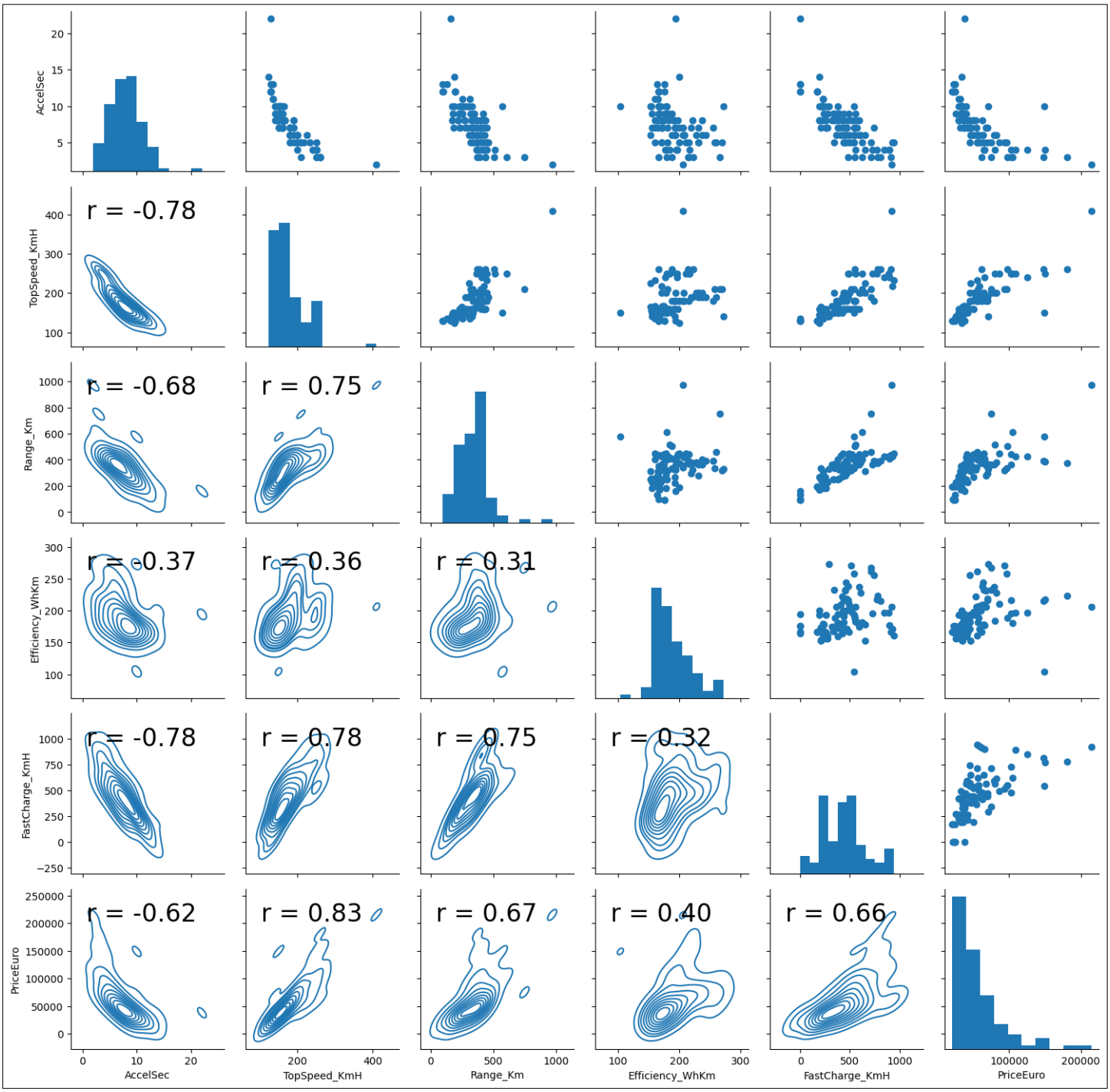
[21]: Correlation matrix showing the relationship between technical features of EVs



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[22]: What is the general distribution of electric vehicle specifications?

[22a] Treemap showing the distribution of Electric Vehicles by Segment

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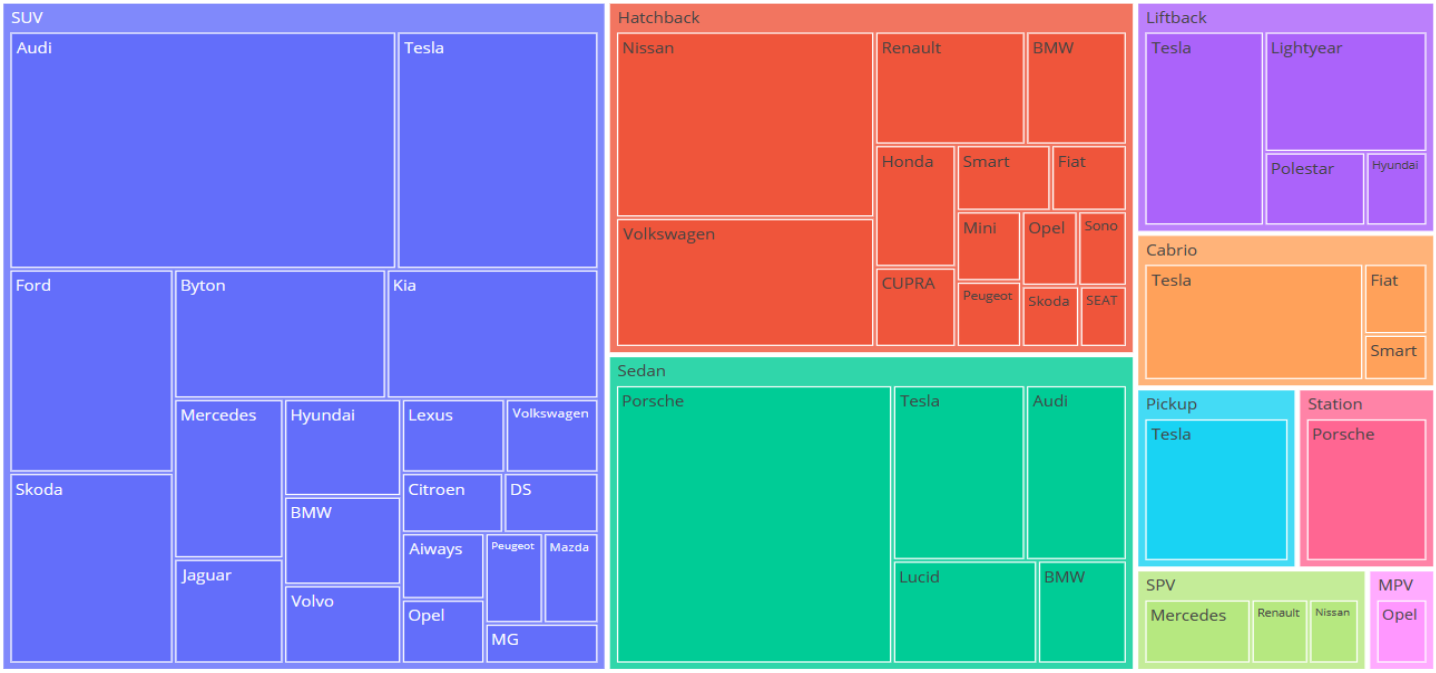
[23]: Treemap showing the distribution of Electric Vehicles by Body Style



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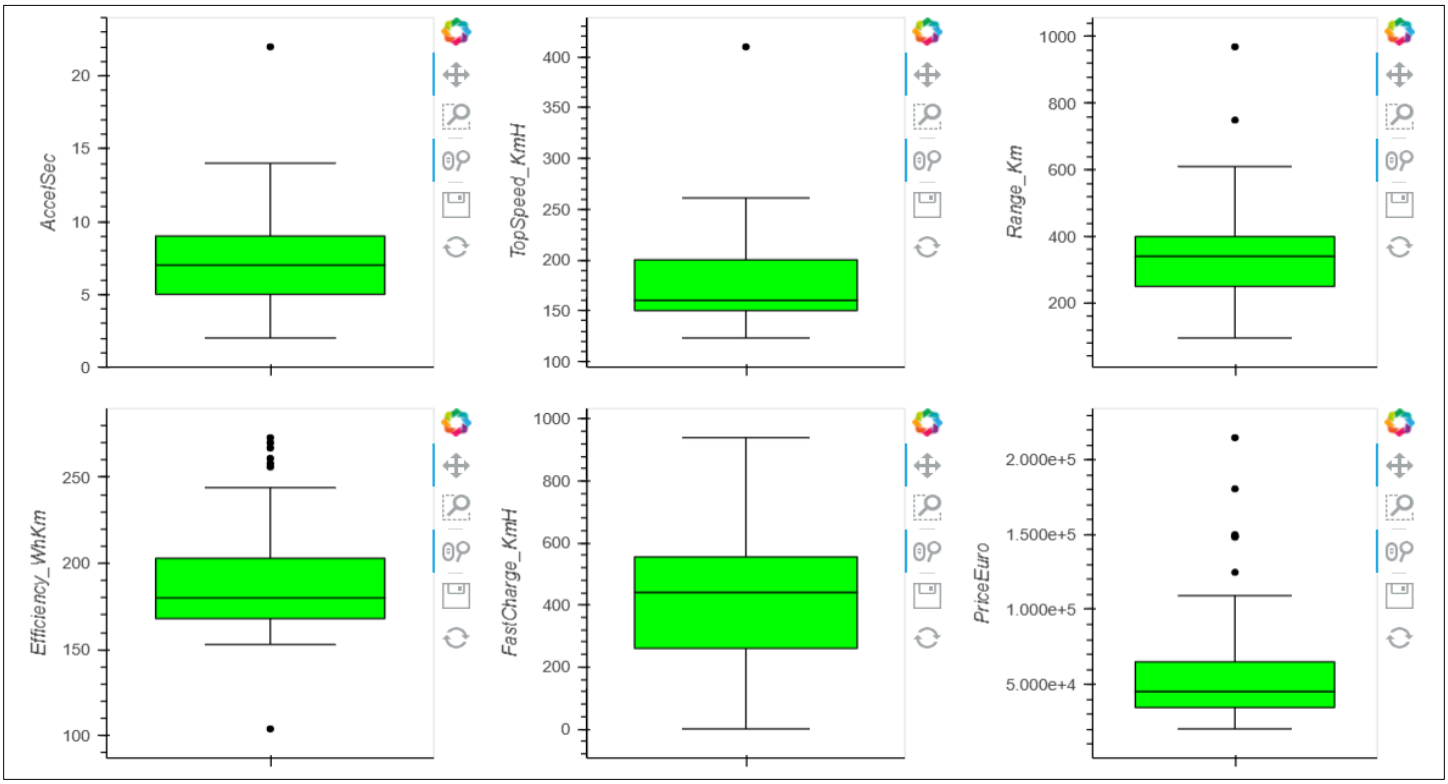
[24]: Box plots showing the distribution of electric vehicle technical features



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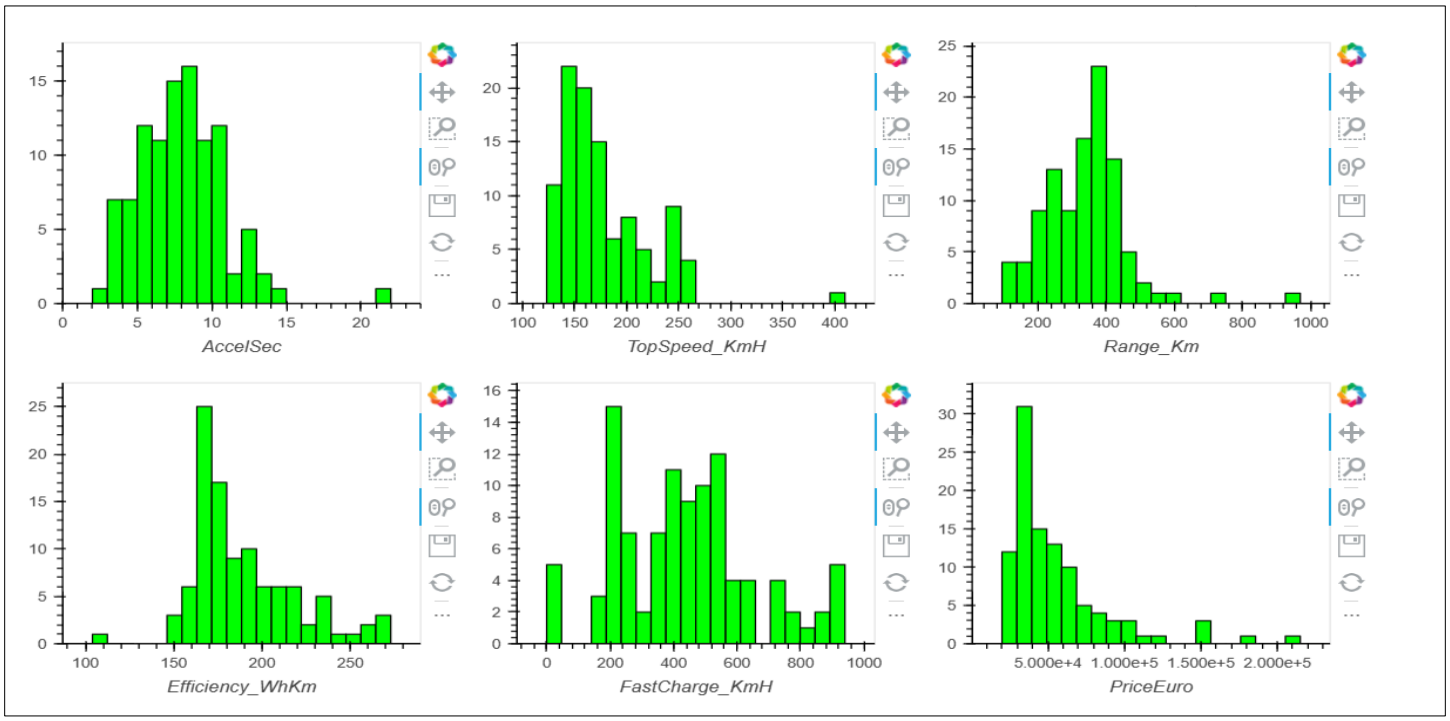
[25]: Histogram plots showing the distribution of technical features of electric vehicle



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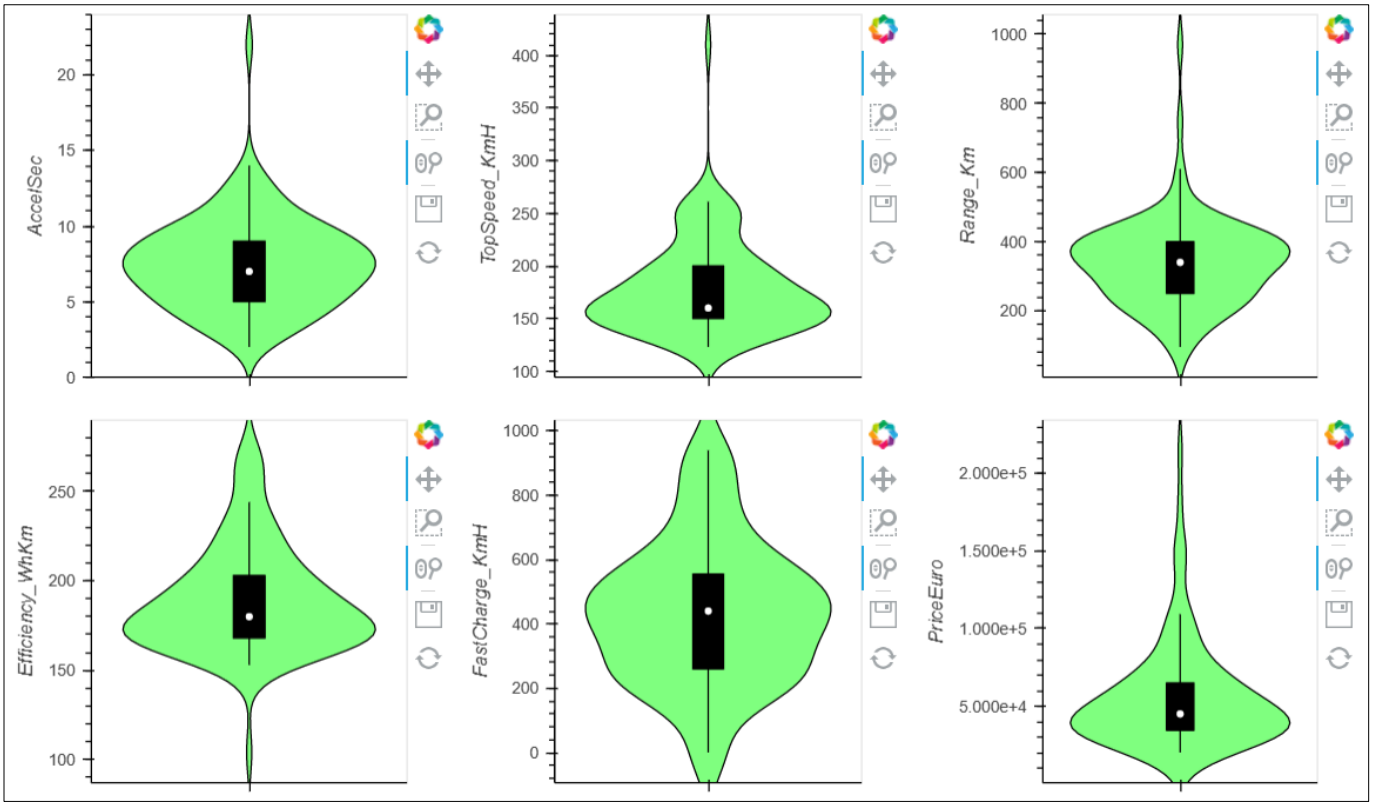
[26]: Violin plots showing the distribution of technical features of electric vehicles



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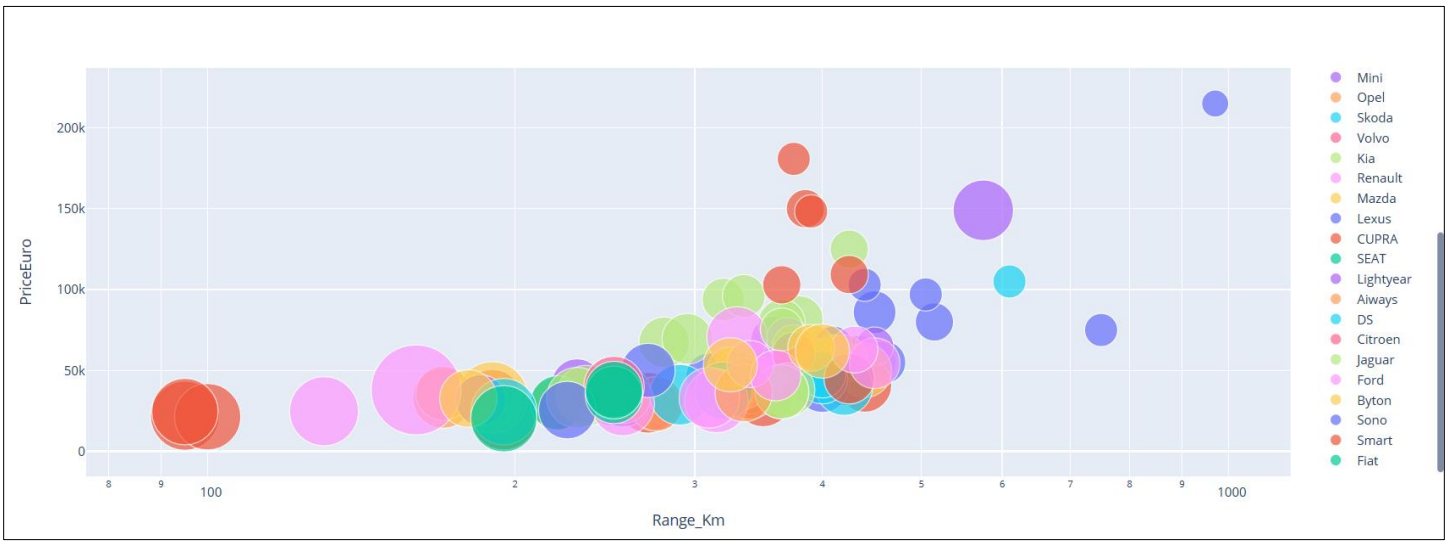
[27]: Scatter plot showing the correlation between EV Price and Speed Range by Brand.



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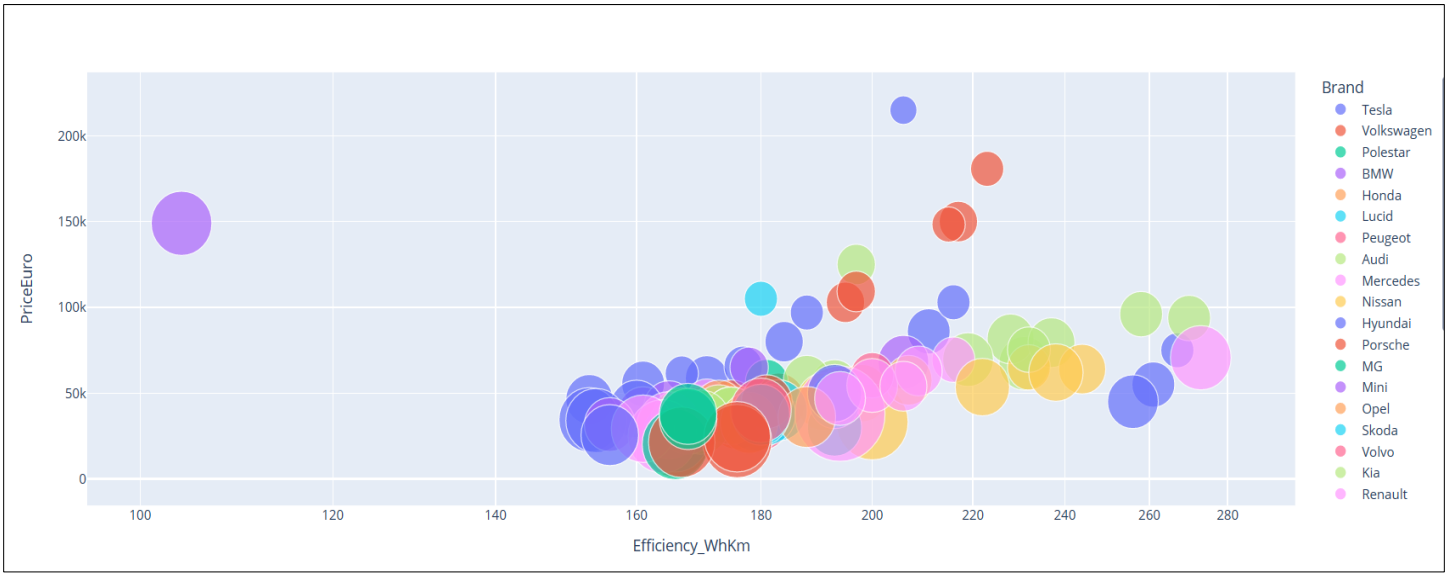
[28]: Scatter plot showing the correlation between Price and Efficiency by Brand.



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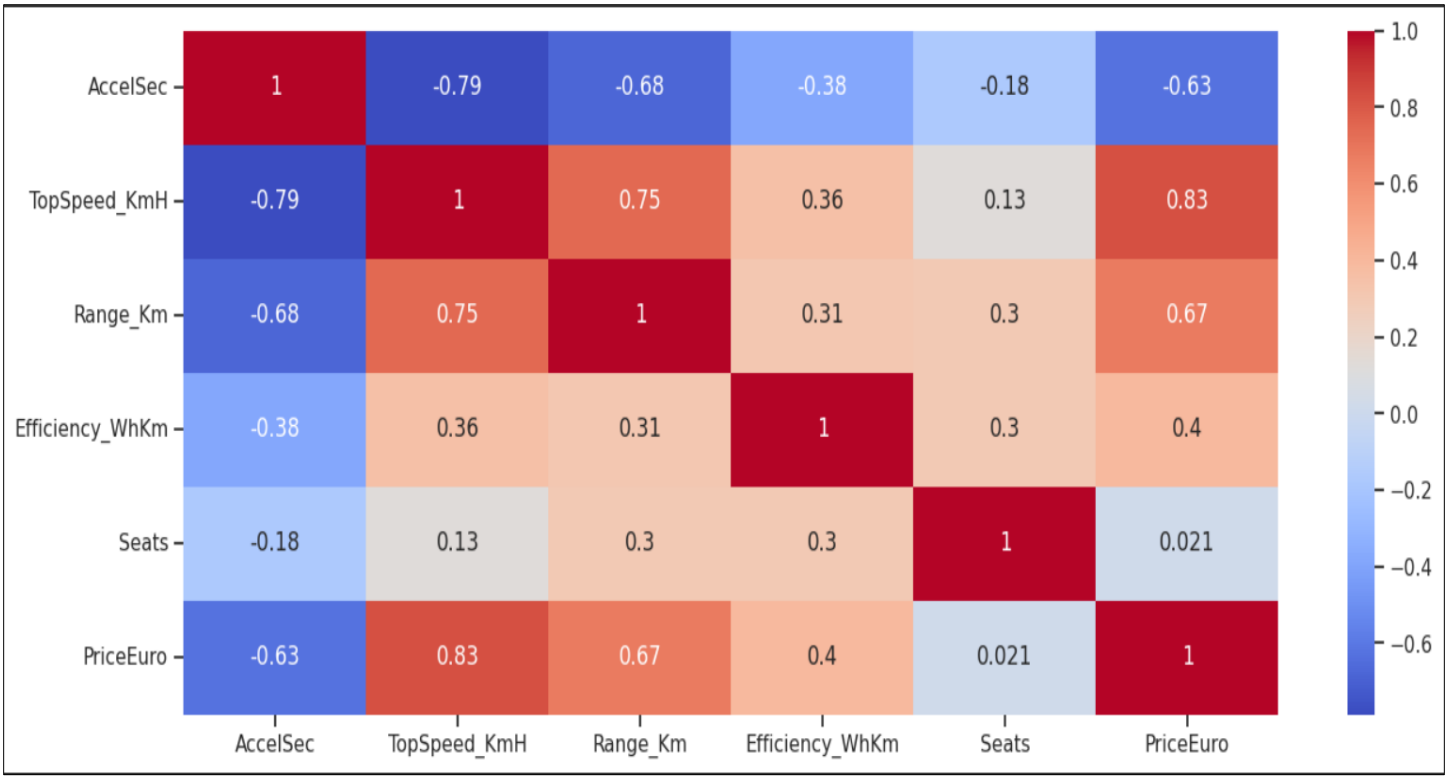
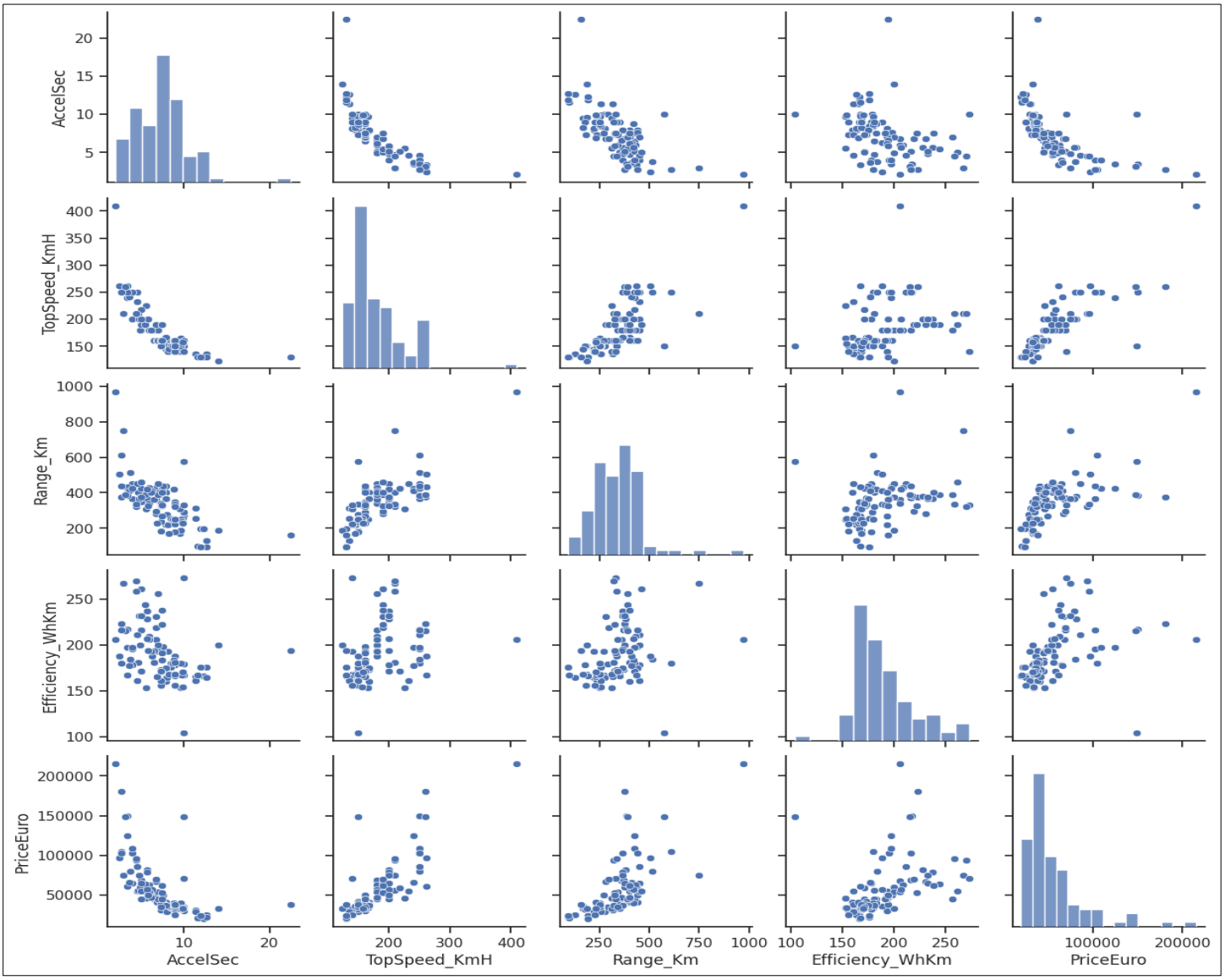
[29]: A pivot table showing the correlation between the technical features of electric vehicles



[30]: Scatter plot showing the correlation between EV technical feature



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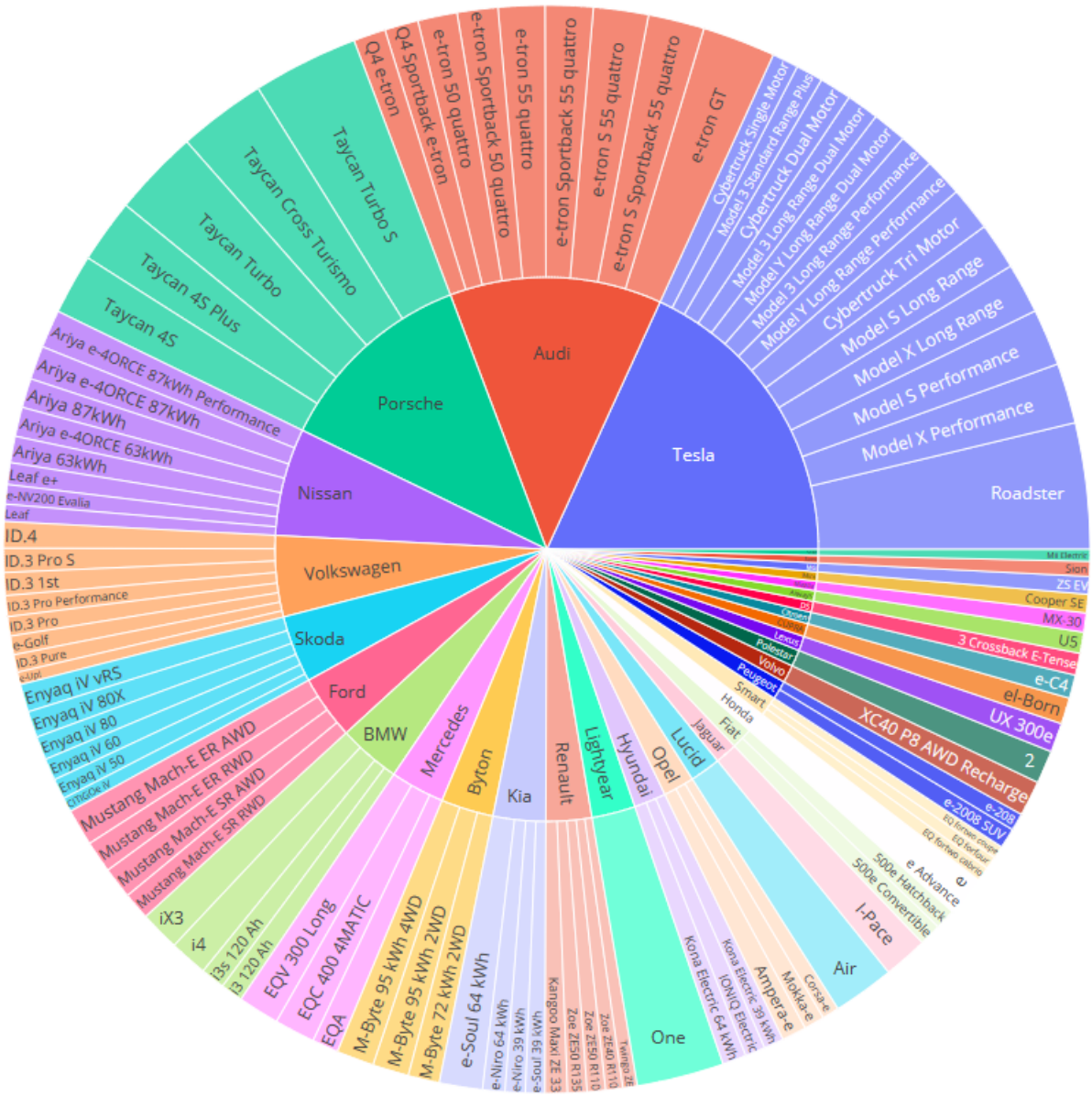
[31]: Sunburst Chart showing the distribution of the general features of electric vehicles by Brand and Model.



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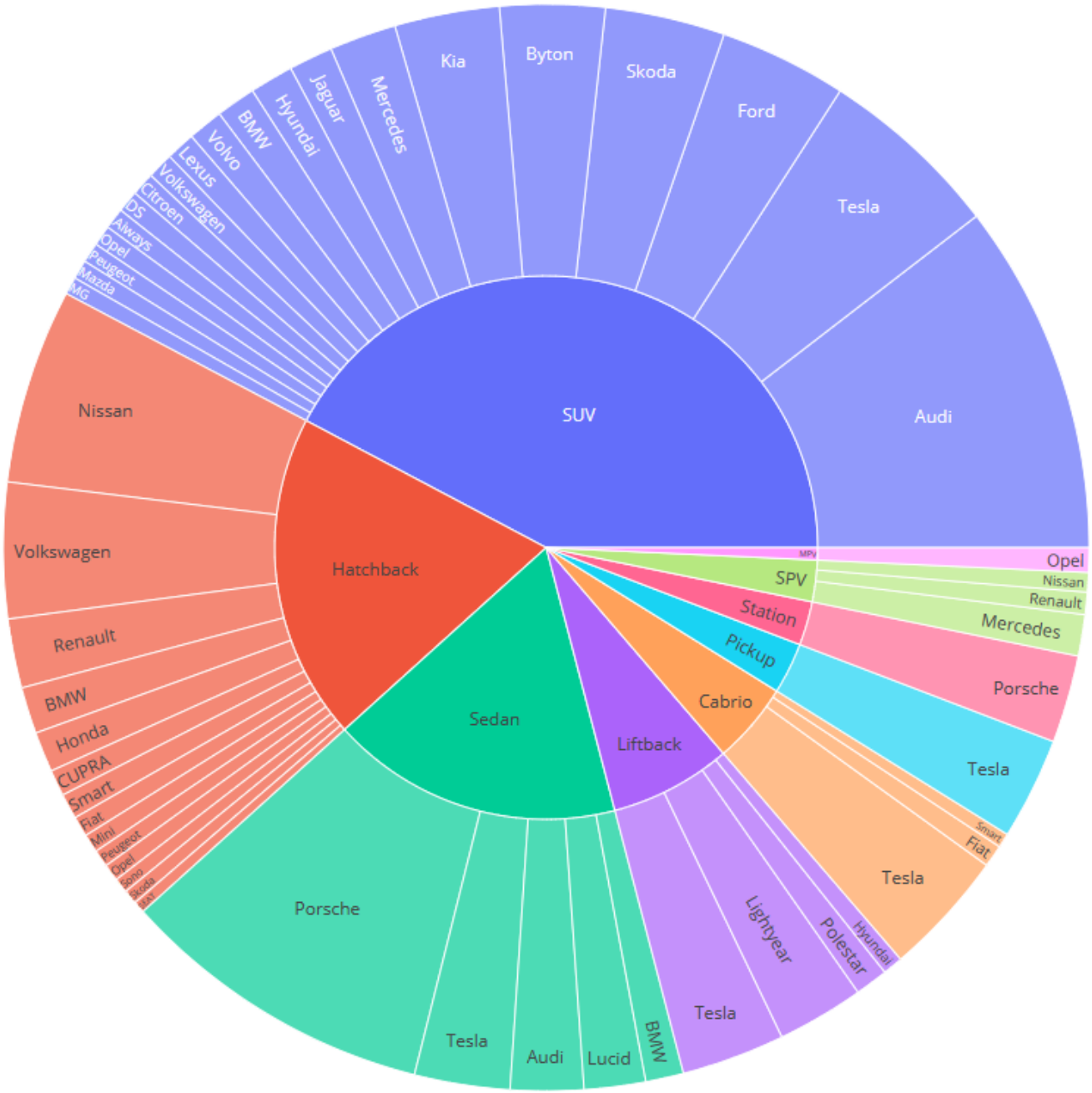
[32]: Sunburst Chart showing the distribution of the general features of electric vehicles by Body Style and Brand.



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To access the full Python notebook with detailed comments for each chart and table in the analysis, click on the link here: ***[Hayford GitHub Data Science Certification Projects]***

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Appendix I: Other Fancy SQL Queries

==========

```sql
WITH cte AS (
  SELECT
    PowerTrain,
    Segment,
    PlugType,
    COUNT(*) AS Count
  FROM Electric_Vehicles
  GROUP BY PowerTrain, Segment, PlugType
)
SELECT
  PowerTrain,
  Segment,
  PlugType,
  Count,
  ROUND(Count / SUM(Count) OVER (), 2) AS PctTotal
FROM (
  SELECT
    PowerTrain,
    Segment,
    PlugType,
    Count,
    ROW_NUMBER() OVER (PARTITION BY PowerTrain ORDER BY Count DESC) AS RN
  FROM cte
) AS t
WHERE RN <= 5
ORDER BY PowerTrain, Count DESC
```

==========

```sql
SELECT
  PowerTrain,
  Segment,
  SUM(CASE WHEN FastCharge_KmH < 50 THEN 1 ELSE 0 END) AS FastCount,
  SUM(CASE WHEN FastCharge_KmH >= 50 AND FastCharge_KmH < 100 THEN 1 ELSE 0 END) AS MedCount,
  SUM(CASE WHEN FastCharge_KmH >= 100 THEN 1 ELSE 0 END) AS SlowCount
FROM Electric_Vehicles
WHERE FastCharge_KmH IS NOT NULL
GROUP BY PowerTrain, Segment
ORDER BY PowerTrain, Segment
```

==========

```sql
SELECT
  Segment,
  PlugType,
  Range_Km,
  Efficiency_WhKm,
  PriceEuro
FROM Electric_Vehicles
WHERE Range_Km IS NOT NULL AND Efficiency_WhKm IS NOT NULL
ORDER BY Segment, PlugType, Range_Km
```

```sql
SELECT Segment,
       SUM(CASE WHEN Range_Km IS NOT NULL THEN Range_Km ELSE 0 END) AS Total_Range_Km,
       SUM(CASE WHEN Efficiency_WhKm IS NOT NULL THEN Efficiency_WhKm ELSE 0 END) AS
Total_Efficiency_WhKm
FROM Electric_Vehicles
GROUP BY Segment
ORDER BY Total_Range_Km DESC;
```

```sql
SELECT Brand,
       SUM(Range_Km) AS Total_Range_Km,
       SUM(Efficiency_WhKm) AS Total_Efficiency_WhKm
FROM Electric_Vehicles
GROUP BY Brand
ORDER BY Total_Range_Km DESC;
```

```sql
SELECT Brand, Segment, AVG(Range_Km) AS Avg_Range_Km, AVG(Efficiency_WhKm) AS Avg_Efficiency_WhKm
FROM Electric_Vehicles
GROUP BY Brand, Segment
ORDER BY Avg_Range_Km DESC, Avg_Efficiency_WhKm DESC;
```

```sql
SELECT Brand,
       AVG(Range_Km) AS Avg_Range_Km,
       AVG(Efficiency_WhKm) AS Avg_Efficiency_WhKm,
       SUM(PriceEuro) AS Total_PriceEuro
FROM Electric_Vehicles
GROUP BY Brand
ORDER BY Total_PriceEuro DESC;
```

```sql
SELECT Brand,
       COUNT(*) as num_vehicles,
       AVG(TopSpeed_KmH) as avg_top_speed,
       AVG(Range_Km) as avg_range
FROM Electric_Vehicles
GROUP BY Brand
HAVING num_vehicles > 10
ORDER BY avg_top_speed DESC, avg_range DESC;
```

```sql
SELECT BodyStyle,
       Segment,
       COUNT(*) as num_vehicles
FROM Electric_Vehicles
GROUP BY BodyStyle, Segment;
```

```sql
SELECT AccelSec, Efficiency_WhKm, PowerTrain
FROM Electric_Vehicles
WHERE PowerTrain IN ('Battery Electric Vehicle', 'Hybrid', 'Plug-in Hybrid Electric Vehicle')
ORDER BY PowerTrain;
```

```sql
SELECT COUNT(*) as num_vehicles
FROM Electric_Vehicles
WHERE Range_Km >= 400;
```

```sql
SELECT Segment,
       COUNT(*) AS num_vehicles,
       SUM(COUNT(*)) OVER (ORDER BY Segment) AS cumulative_sum
FROM Electric_Vehicles
GROUP BY Segment
ORDER BY Segment;
```

```sql
SELECT BodyStyle,
       COUNT(*) as num_vehicles
FROM Electric_Vehicles
GROUP BY BodyStyle
ORDER BY num_vehicles DESC;
```

Appendix II: Some interesting facts about electric vehicles

- 20+ Facts and Stats About Electric Cars in 2023 - Review42. https://review42.com/uk/resources/facts-about-electric-cars/.
- Pros and Cons of Electric Cars: Everything You Need to Know. https://www.caranddriver.com/features/a41001087/pros-and-cons-electric-cars/.
- Electric Vehicle Myths | US EPA. https://www.epa.gov/greenvehicles/electric-vehicle-myths.
- Car and Driver Answers 20 Questions about EVs. https://www.caranddriver.com/features/a36876962/20-questions-about-evs/.
- Electric Car Statistics and Facts 2021 | Policy Advice. https://policyadvice.net/insurance/insights/electric-car-statistics/.
- 41 Fascinating Electric Car Facts | FactRetriever.com. https://www.factretriever.com/electric-car-facts.
- EVs explained: everything you need to know about electric vehicles. https://www.techradar.com/news/evs-explained.
- 10 Common Electric Car Myths Busted - MYEV.com. https://www.myev.com/research/ev-101/10-common-electric-car-myths-busted.
- Top 10 Facts About Electric Cars You Might Not Know. https://www.compare.com/other-products/vehicle/electric-cars/guides/electric-car-facts.
- 10 Facts about electric cars - Bankrate. https://www.bankrate.com/insurance/car/facts-about-electric-cars/.
- Everything Explained About Electric Cars: Basics Of An EV. https://fossbytes.com/everything-explained-about-electric-cars/.
- Interesting Facts About Electric Vehicles. https://bilitielectric.com/blog/electric-vehicles-facts-and-myths/.