VISUALIZATION TOOL FOR ELECTRIC VEHICLE CHARGE AND RANGE ANALYSIS

A vehicle that can be powered by an electric motor that draws electric from a battery and is capable of being charged form an external source and have an electric motor instead of an internal combustion engine.

The electric vehicle (EV)is not new, but it has been receiving significantly more attention recent years. Advance in both EV analytics and battery technologies have led to increased automotive market share. However, this growth is not attributed to hardware alone. The modern mechatronic vehicle marries electrical storge and propulsion system with electronic sensors, controls, and actuators, integrated closely with software, secure data transfer, and data analysis, to form a comprehensive transportation solution. Advances in all these areas have contributed to the overall rise of EV's, but the common thread that runs through all these elements is data analytics.

The new EV's are combined Electrical storage and propulsion systems with electronic sensors, controls, and actuators, integrated closely with software, secure

INTRODUCTION:

data transfer to from a comprehensive transportation solution.

In this study, EV energy consumption estimation is the main focus and it is performed based on vehicle modelling using MATLAB/Simulink software. The BMW i3 is selected as the case-study here to demonstrate the proposed concept. The authors believe that same technique can be applied to other types of EV and the general outcomes of this study do not

depend on the vehicle type used here. As an important part of this study, the proposed vehicle model is validated against experimental data obtained from the literature.

Two main approaches are used for EV modelling[3]: (a) Forward approach also called “dynamic approach” or cause-effect method, and (b) Backward approach also called “quasi-static approach” or effect-cause method. The forward approach is based on equations of the powertrain components behaviour and the dynamic interaction between the components. This approach requires a driver controller to set the start of the calculations. Therefore, the driver behaviour can be studied using this approach. The controller is implemented to model the driver that has to press/release either the accelerator or the brake pedal in order to reduce the error between the actual speed and the speed from a drive cycle.[4] The driver model provides the torque demand to match the drive cycle speed profile. Thereafter, from the driver set-point, the energy required to overcome the opposing forces acting on the vehicle is compute.

1.1 OVERVIEW:

As the various players in the electric vehicle smart charging solutions space continuously look for new ways to optimize performance, the key to improvement lies in monitoring data to make improvements. TekMindz is committed to providing advanced analytics and data visualization capabilities to businesses in the electric vehicle Charging space to help them gain deeper insights into the health of

their systems and to in turn provide seamless experiences to their end users.

Massive amounts of data generated by devices, vehicles, buildings, the power grid, and many other connected things combined with increased rates of data transmission pose major data challenges. Data generated by electric vehicles comes from various sources ranging from sensors to trip logs. By monitoring vast amounts of data and analyzing it by using big data techniques, we help to create smart charging algorithms, address energy efficiency issues and optimize power distribution systems to handle extra charging loads for better vehicle-to-grid operations.

1.2 PURPOSE:

Data visualization strengthens the impact of messaging for your audiences and presents the data analysis results in the most persuasive manner. It unifies the messaging systems across all the groups and fields within the organization. Visualization lets you comprehend vast amounts of data at a glance and in a better way. It helps to understand the data better to measure its impact on the business and communicates the insight visually to internal and external audiences.

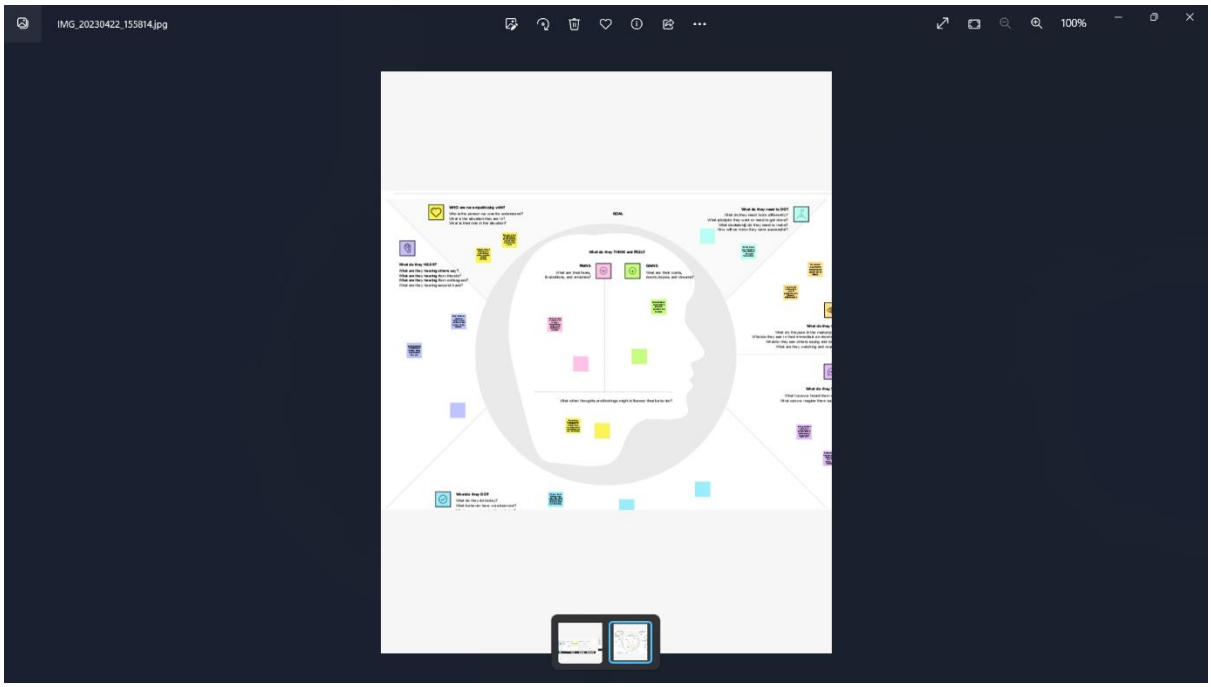
Decisions can't be made in a vacuum. Available data and insights enable decision-makers to aid decision analysis. Unbiased data without inaccuracies allows access to the right kind of information and visualization to represent that information and keep it relevant.

Data visualization has the potential to solve many business issues. All businesses must incorporate data visualization

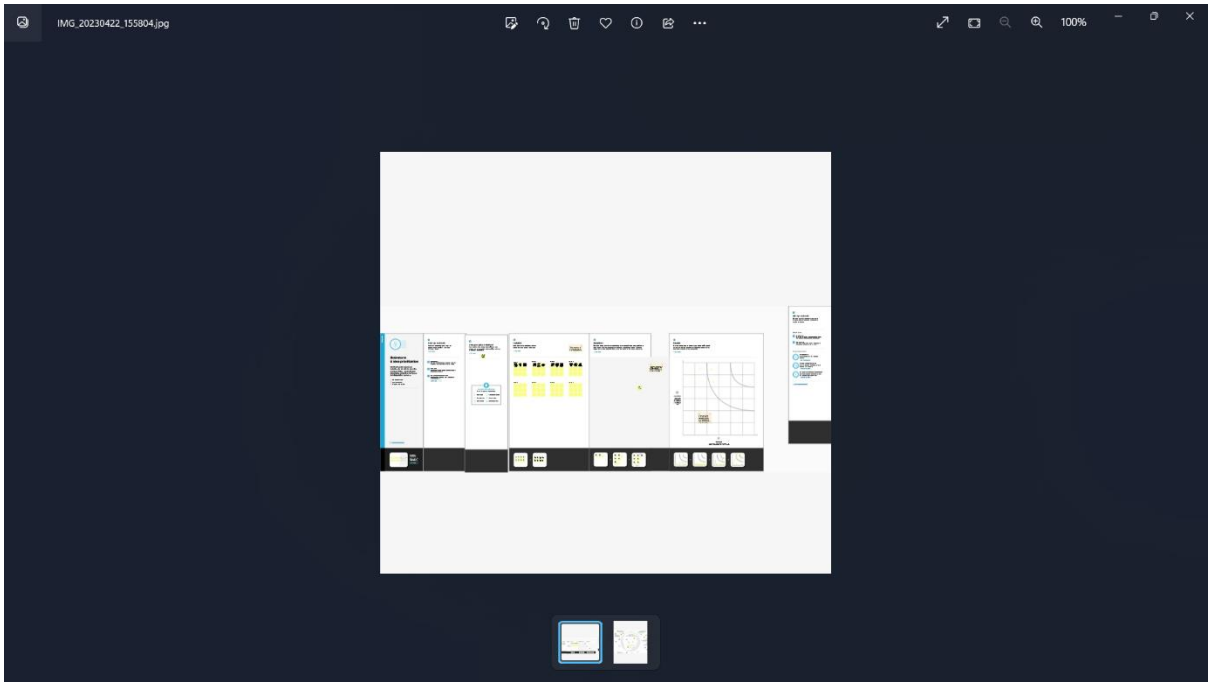
tools and reap transformative benefits in their critical areas of operations.

2. PROBLEM DEFINITIONS & DESIGN THINKING

2.1 EMPATHY MAP



2.2 IDEATION & BRAINSTORMING MAP



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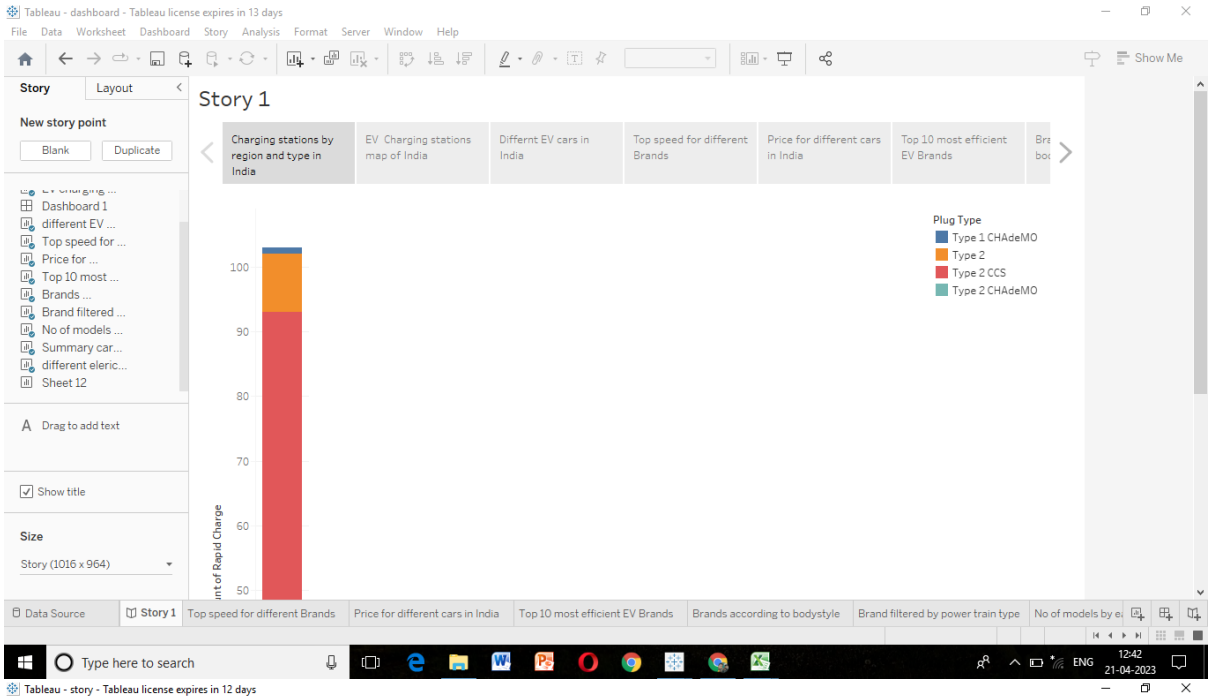
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Top 10 most efficient EV Brands
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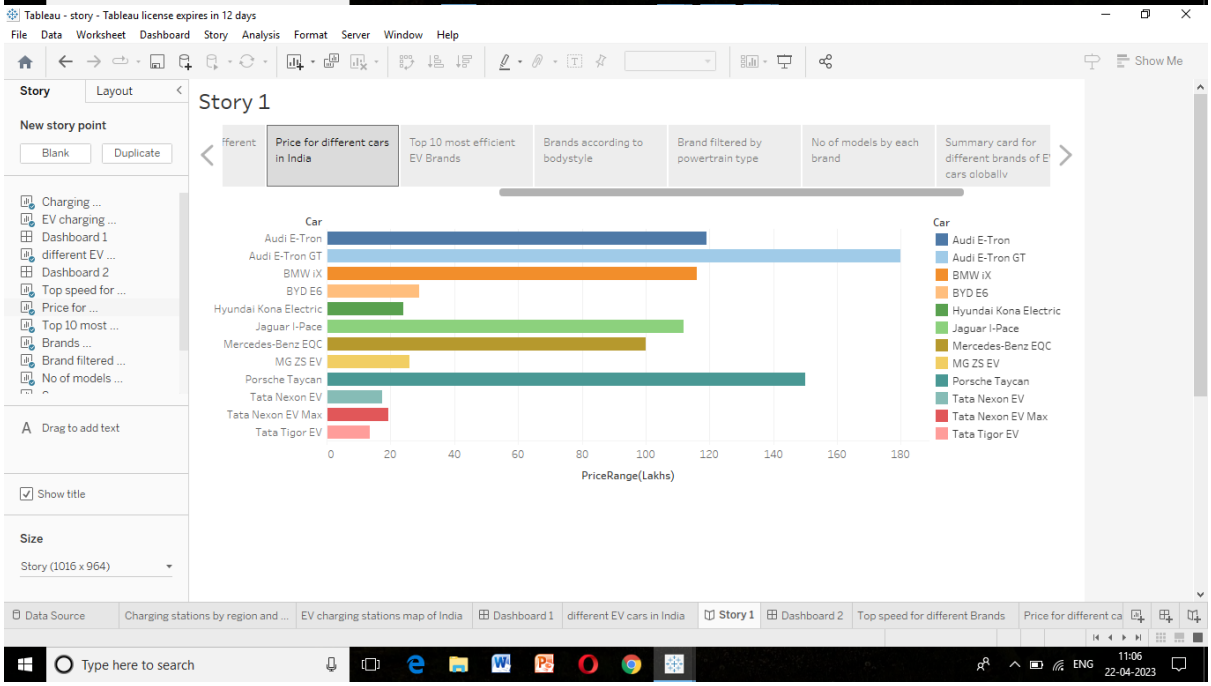
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BMW iX
BYD E6
Hyundai Kona Electric
Jaguar I-Pace
Mercedes-Benz EQC
MG ZS EV
Porsche Taycan
Tata Nexon EV
Tata Nexon EV Max
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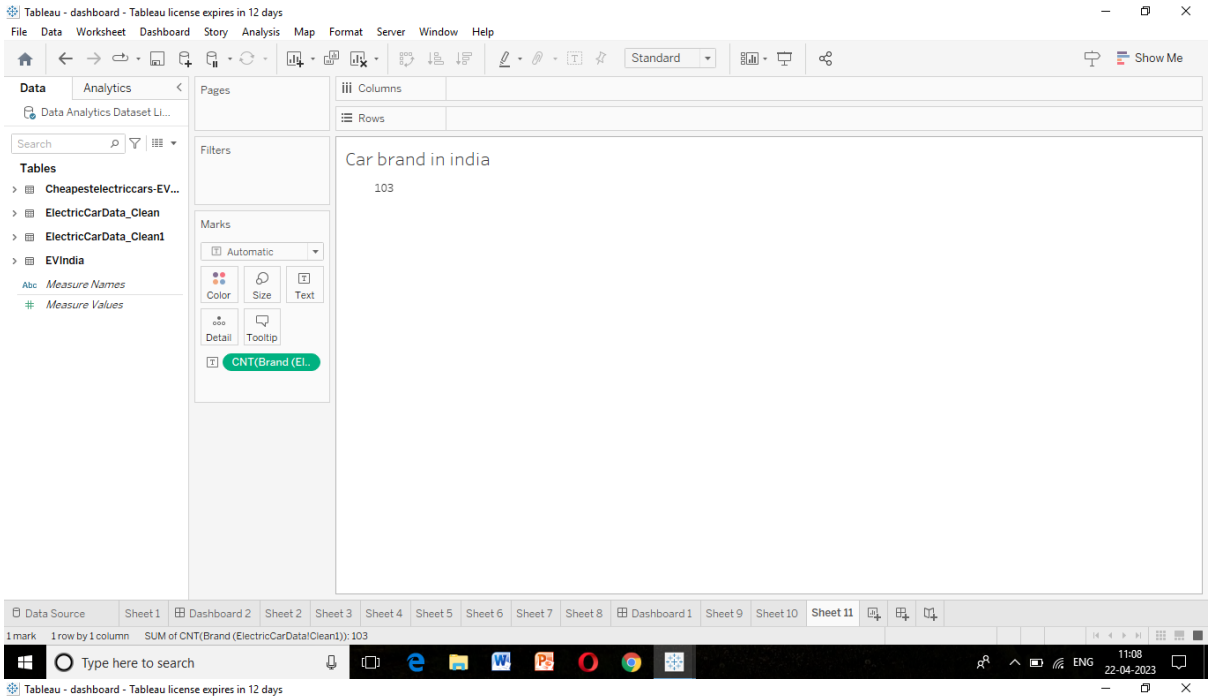
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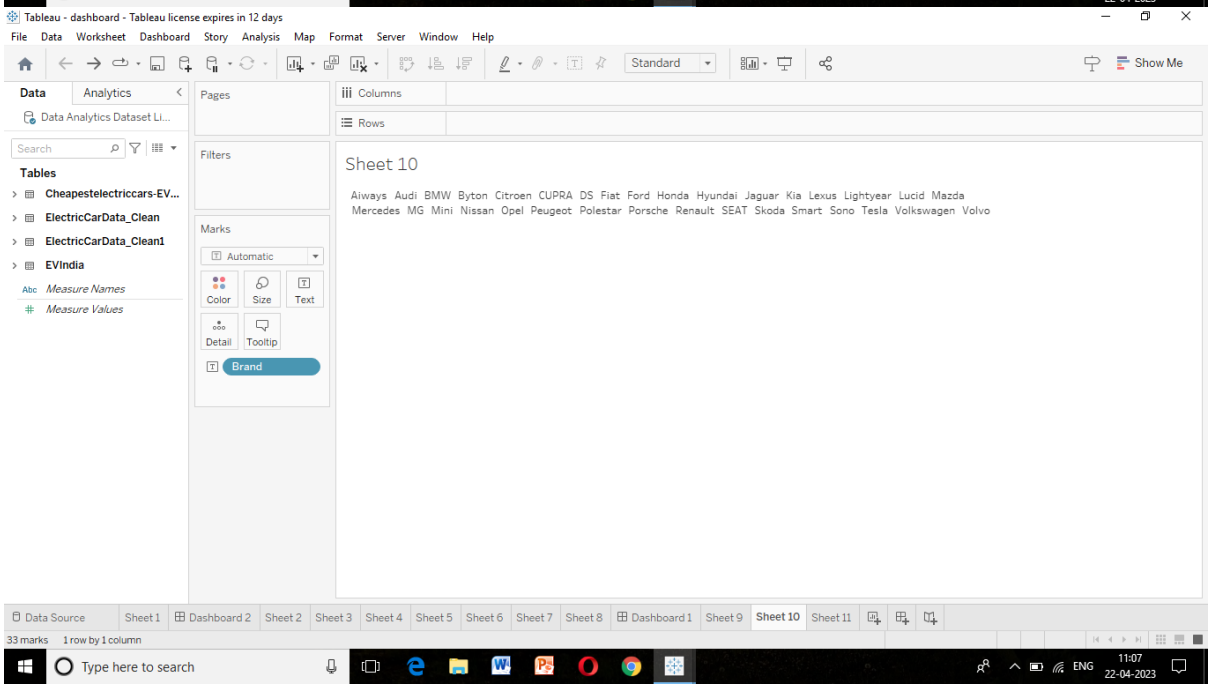
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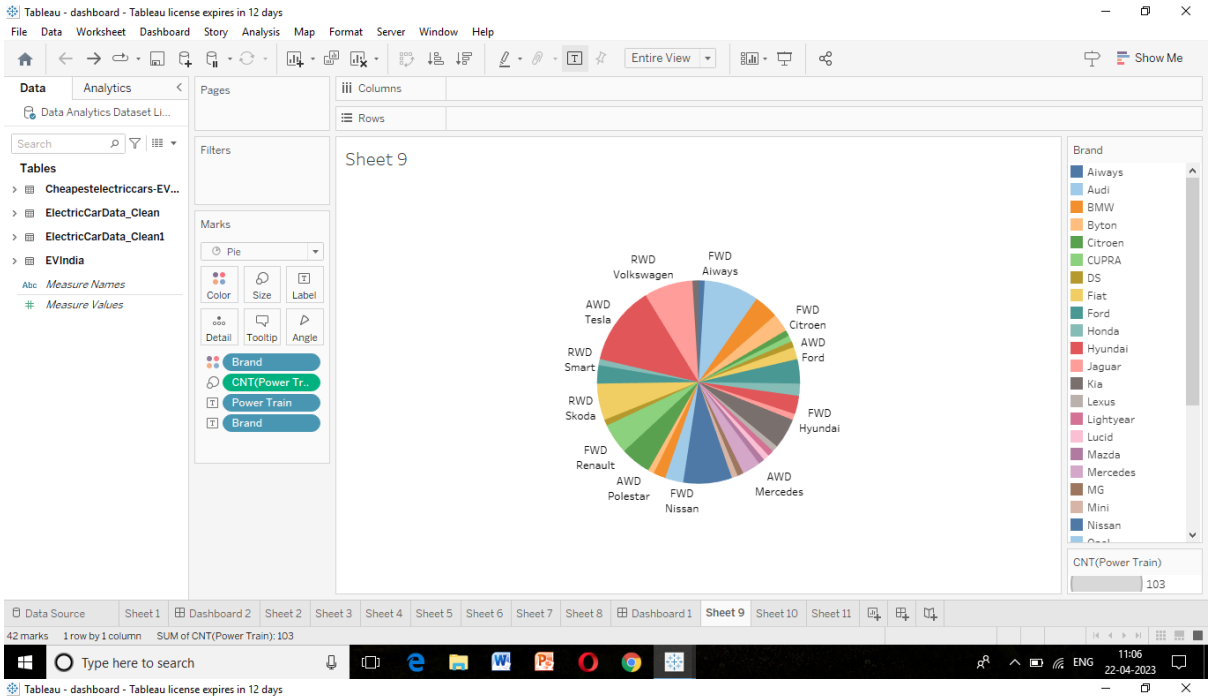
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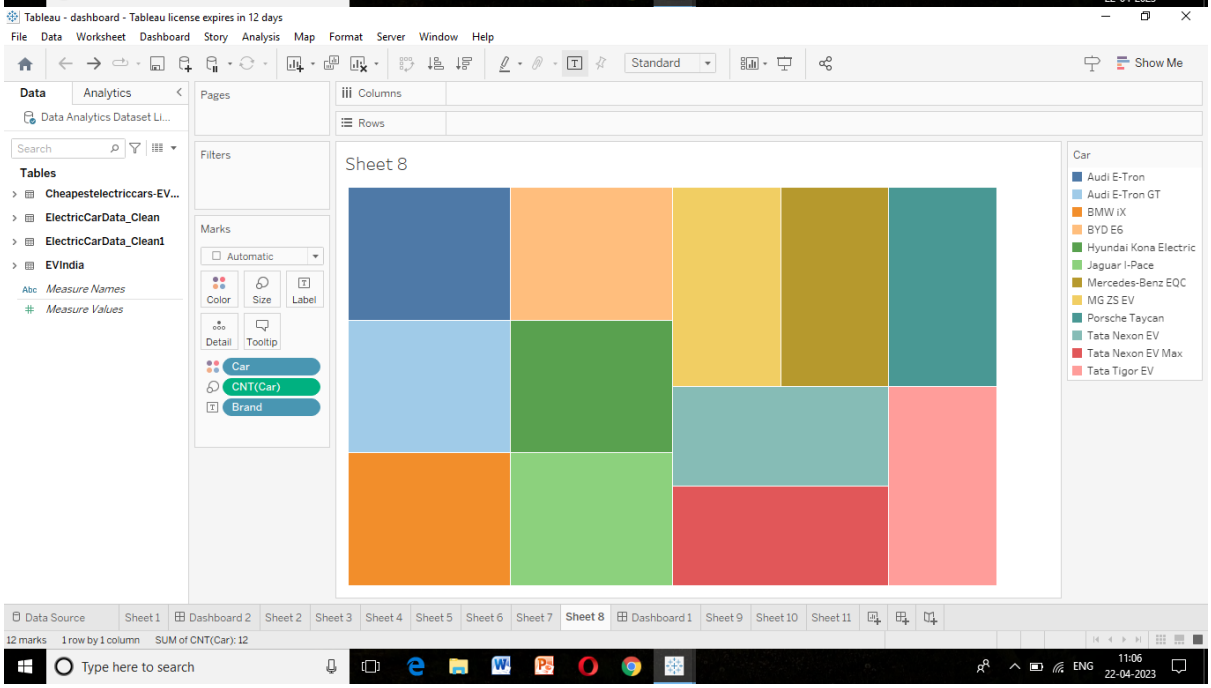
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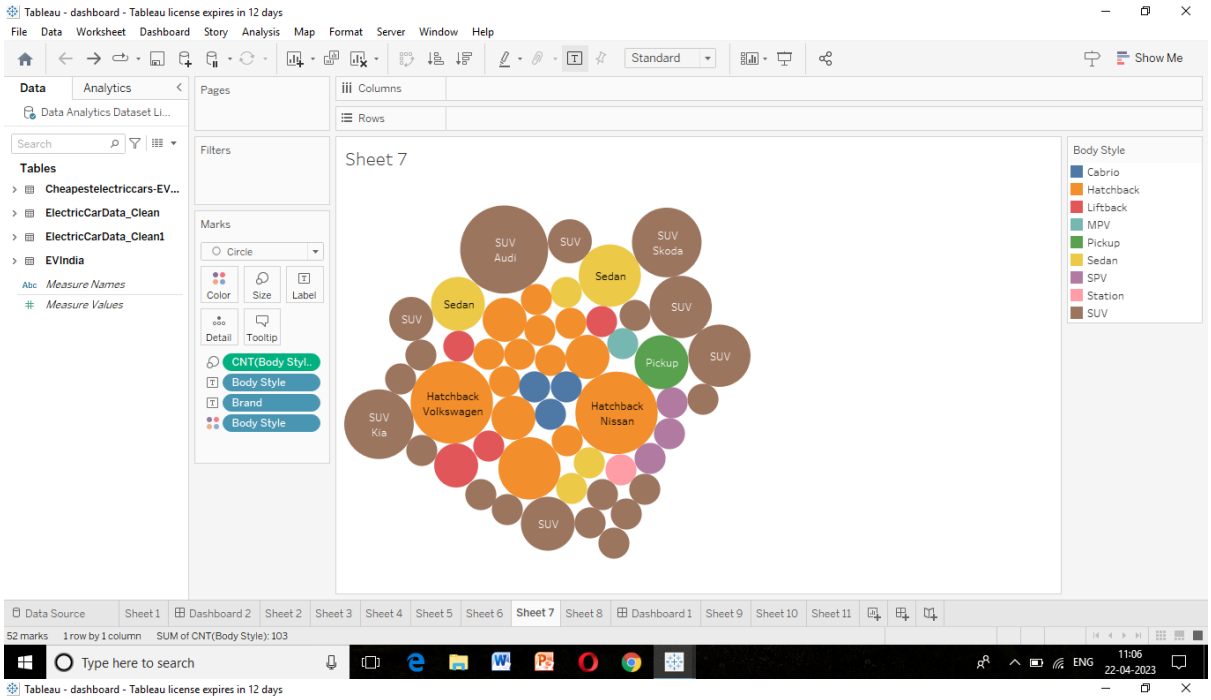
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SUV
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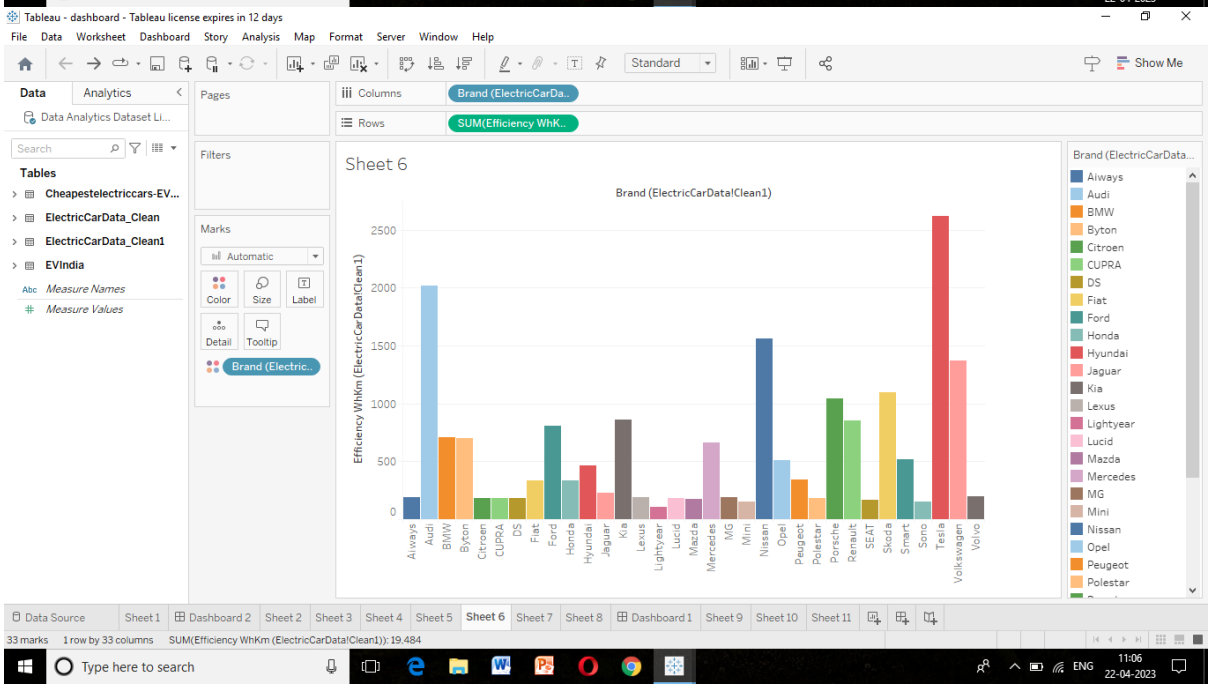
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Sheet 1
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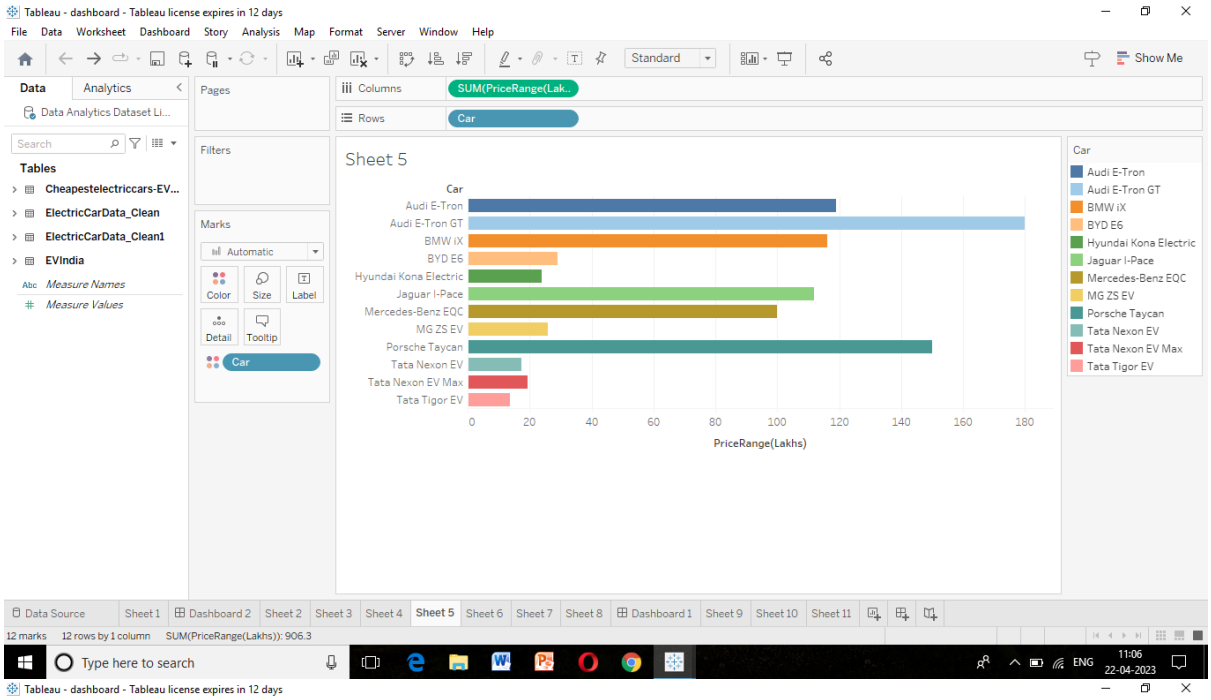
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BMW iX
BYD E6
Hyundai Kona Electric
Jaguar I-Pace
Mercedes-Benz EQC
MG ZS EV
Porsche Taycan
Tata Nexon EV
Tata Nexon EV Max
Tata Tigor EV
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Audi E-Tron GT
BMW iX
BYD E6
Hyundai Kona Electric
Jaguar I-Pace
Mercedes-Benz EQC
MG ZS EV
Porsche Taycan
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Tata Tigor EV
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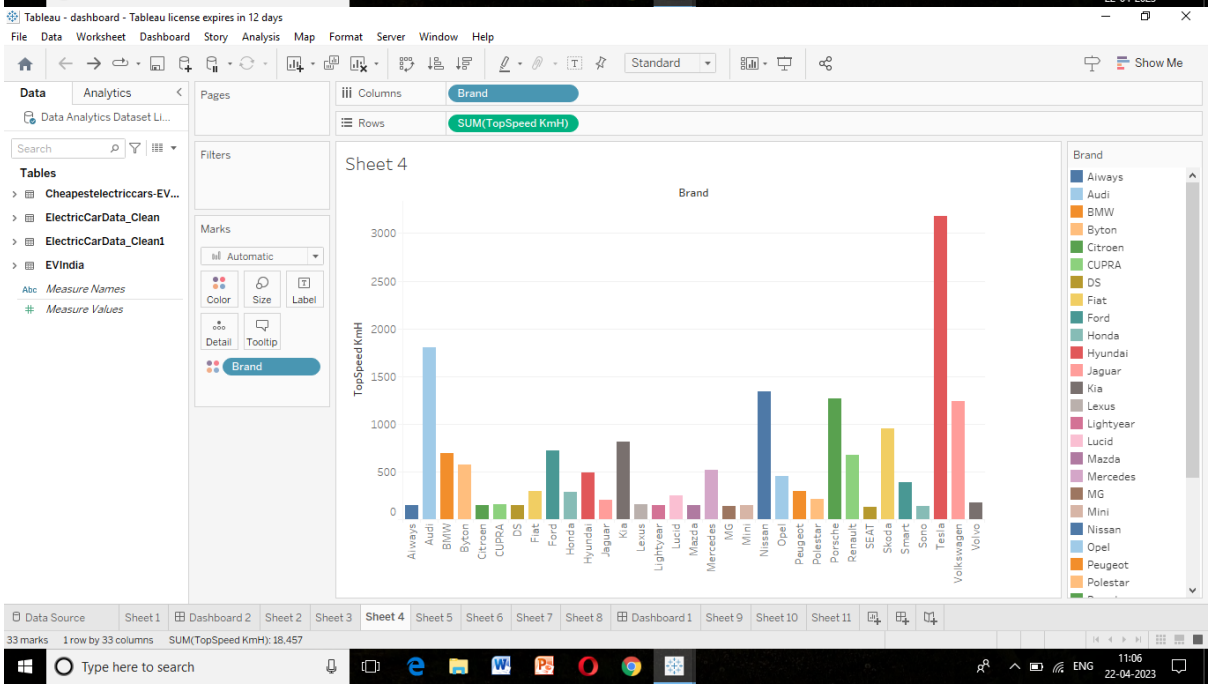
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Aiways Audi BMW Byton Citroen CUPRA DS Fiat Ford Honda Hyundai Jaguar Kia Lexus Lightyear Lucid Mazda Mercedes MG Mini Nissan Opel Peugeot Polestar Porsche Renault SEAT Skoda Smart Sono Tesla Volkswagen Volvo
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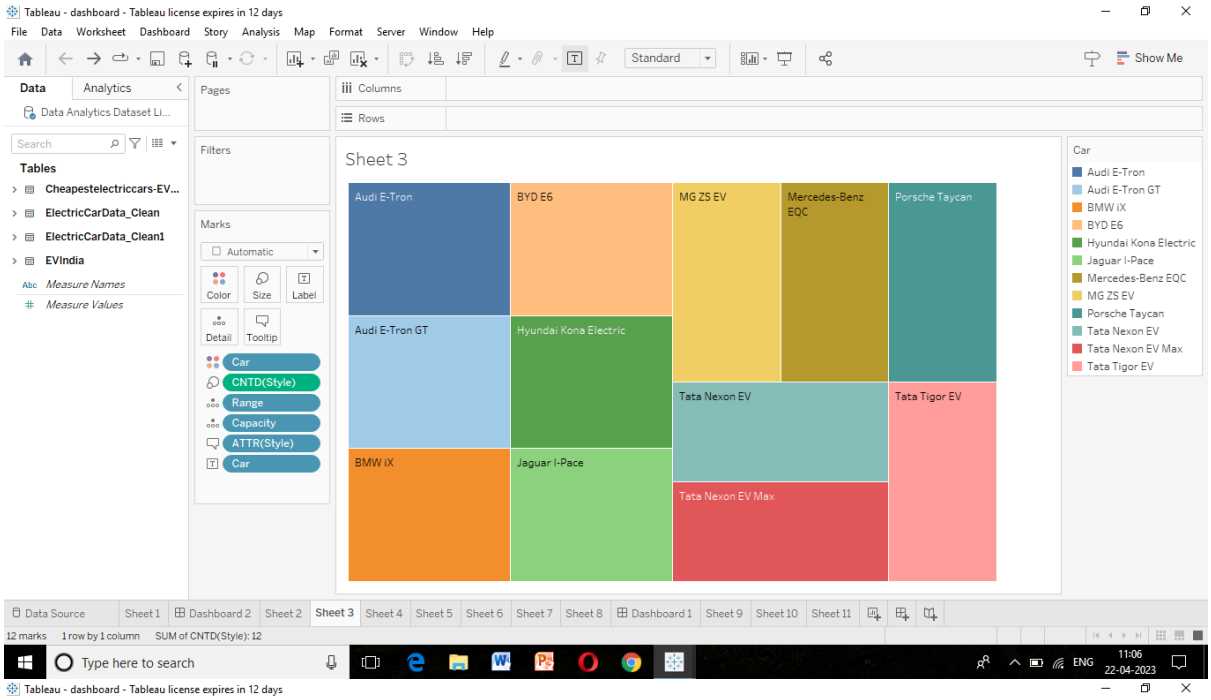
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Hyundai Kona Electric
Tata Nexon EV
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BMW iX
Jaguar I-Pace
Tata Nexon EV Max
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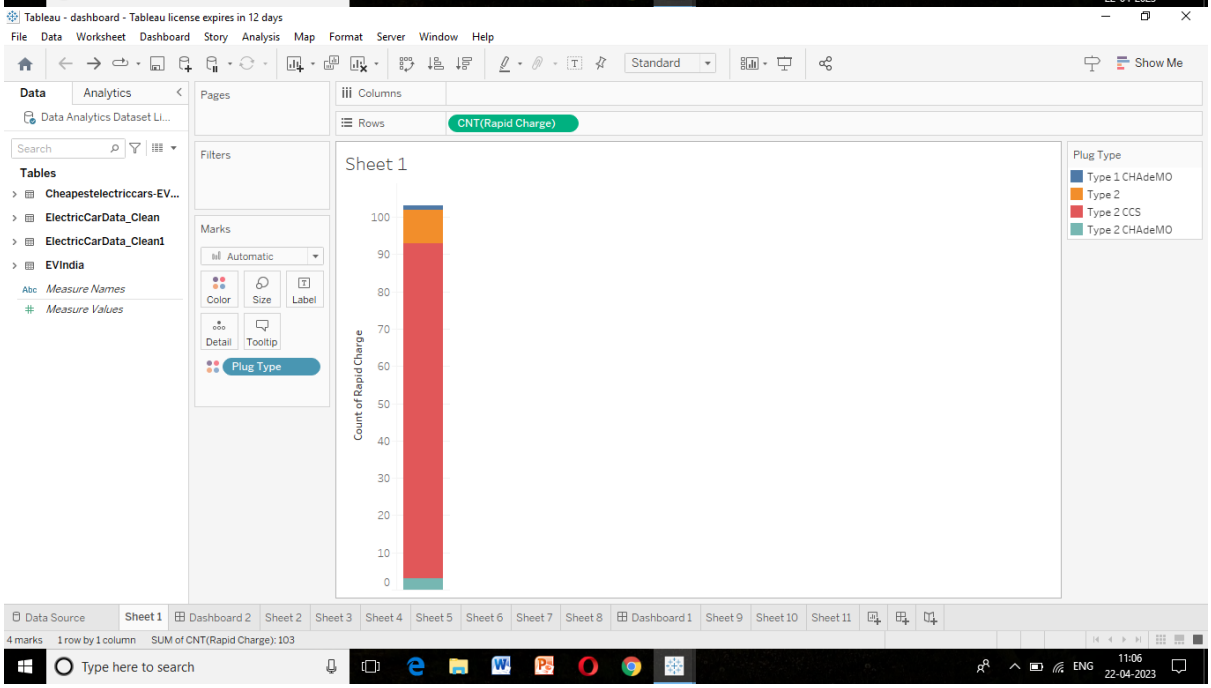
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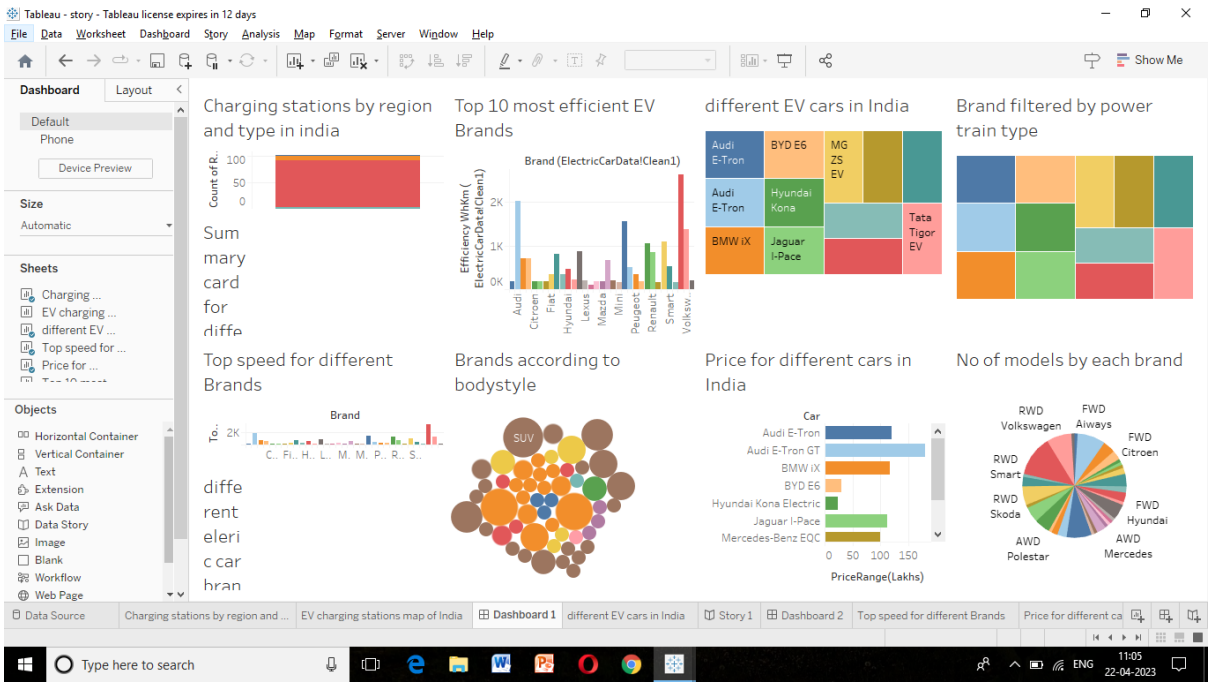


4. ADVANTAGES & DISADVANTAGES

- Avoid fully charging each time: Most of the time, city-driving conditions will allow you to recover some electricity using regenerative braking. Avoid fully charging the EV unless you're leaving for a long road trip where you'll need all the range you can get.
- Don't exclusively use fast charging: Fast charging may be more convenient, but it deteriorates your EV battery's ability to hold its charge over the long term. It's advisable to charge at a slower speed using a wall box whenever viable.
- Be careful with long-term storage: If you're planning to store the EV for a few months, don't leave it parked unplugged or plugged-in and fully charged. Instead, you can set your home wallbox to keep the charge between 25 percent and 75 percent to ensure long-term battery health.

In conclusion, charging an EV takes some getting used to, but adopting good charging etiquette can go a long way to reduce range anxiety. Besides, carmakers are always striving to make charging their EVs more convenient for end-users with quicker charging times and longer range figures. Electric cars are here for the long haul, and plugging into a charger is the new way to "brim-up the tank".

Disadvantages of Electric Vehicles

High initial cost: Electric vehicles continue to be quite expensive, and many buyers believe they are not as inexpensive as traditional automobiles.

Charging station limitations: People who need to travel long distances are concerned about finding adequate charging stations in the middle of their journey, which are not always accessible.

Recharging takes time: Unlike conventional automobiles, which require only a few minutes to replenish their gas tanks, charging an electric vehicle takes many hours.

Limited options: Currently, there aren't many electric car models to pick from in terms of appearance, style, or customized variations.

Less driving range: When compared to conventional automobiles, electric vehicles have a shorter driving range. Electric cars can be convenient for short-distance travel but are inconvenient for long-distance travel.

5. APPLICATIONS

- Avoid fully charging each time: Most of the time, city-driving conditions will allow you to recover some electricity using regenerative braking. Avoid fully charging the EV unless you're leaving for a long road trip where you'll need all the range you can get.
- Don't exclusively use fast charging: Fast charging may be more convenient, but it deteriorates your EV battery's

ability to hold its charge over the long term. It’s advisable to charge at a slower speed using a wall box whenever viable.

- Be careful with long-term storage: If you’re planning to store the EV for a few months, don’t leave it parked unplugged or plugged-in and fully charged. Instead, you can set your home wallbox to keep the charge between 25 percent and 75 percent to ensure long-term battery health.
- Start the day with adequate charge: Plug in your EV whenever you return home – you can manage the charging using connected car features present in most modern EVs to protect the battery’s health.
- Planned stops for longer journeys: Before you set out on a road trip, find out where you can charge your car on the way. It’s also important to know what type of public chargers may be available on the way (AC or DC) and what power outputs they offer.
- Don’t overestimate your car’s range: The real-world range of an EV depends on many factors, and it may be lower than the company-claimed figures. Anticipate how far you can drive before you need a charging stop, and remember that extreme temperatures, traffic jams, and high-speed driving can significantly reduce the car’s range.
- Electric vehicles (EVs) have several advantages in India – government subsidies, zero emissions, lower running costs, and a lifelong immunity from rising crude oil prices. But if you’ve ever considered buying an electric car, you might have found the prospect of charging it a bit intimidating, especially given the lack of a widespread network of public chargers.
- EV charging is certainly a new way to refuel your car, so we’ve broken it down to the basics. Here’s everything you need to know about charging an electric vehicle.

6. CONCLUSION

In conclusion, charging an EV takes some getting used to, but adopting good charging etiquette can go a long way to reduce range anxiety. Besides, carmakers are always striving to make charging their EVs more convenient for end-users with quicker charging times and longer range figures. Electric cars are here for the long haul, and plugging into a charger is the new way to “brim-up the tank”.

The progress that the electric vehicle industry has seen in recent years is not only extremely welcomed, but highly necessary in light of the increasing global greenhouse gas levels. As demonstrated within the economic, social, and environmental analysis sections of this webpage, the benefits of electric vehicles far surpass the costs. The biggest obstacle to the widespread adoption of electric-powered transportation is cost related, as gasoline and the vehicles that run on it are readily available, convenient, and less costly. As is demonstrated in our timeline, we hope that over the course of the next decade technological advancements and policy changes will help ease the transition from traditional fuel-powered vehicles. Additionally, the realization and success of this industry relies heavily on the global population, and it is our hope that through mass marketing and environmental education programs people will feel incentivized and empowered to drive an electric-powered vehicle. Each person can make a difference, so go electric and help make a difference!

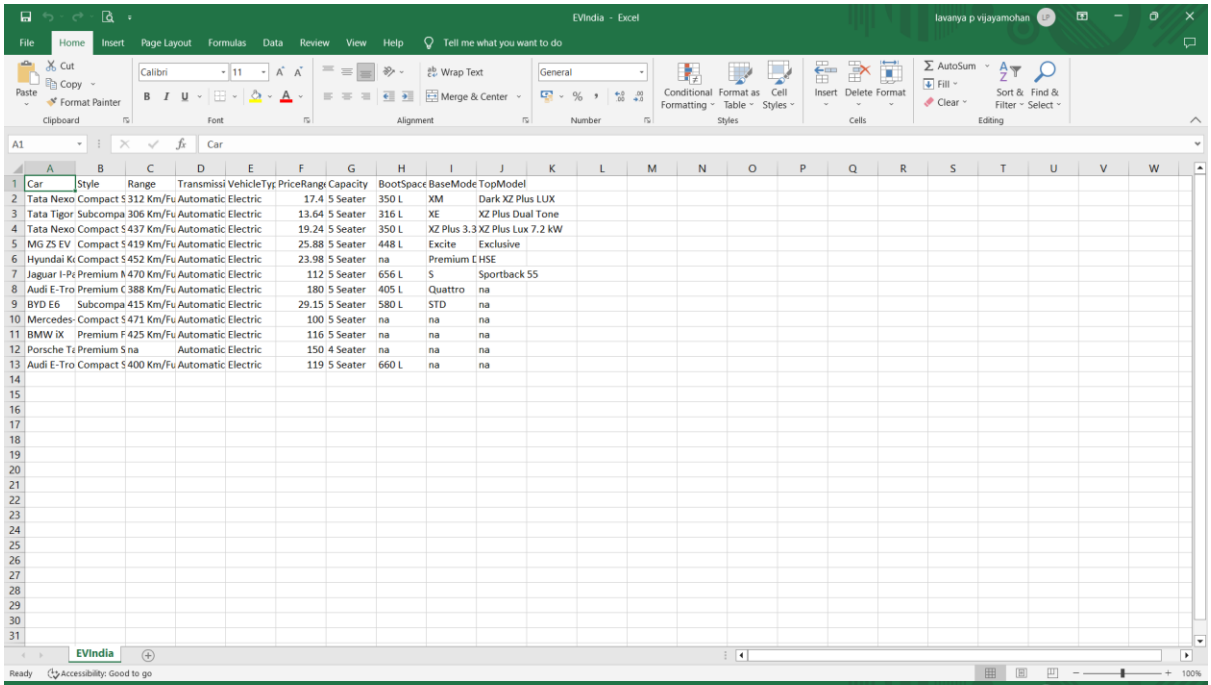
7. FUTURE SCOPE

Electric vehicles (EV) is the future not only of transport but of our planet. Can electric vehicles ever face a more serious form of gridlock however? These vehicles are plugged into a charging station at a low voltage. There are no emissions released from these vehicles.

But what if you have an electric vehicle that gets charged up from home electricity or by solar energy. What if you can use this charge to power your home and your garage. You will no longer need to fear the impact of fuel exporters. This means that electric vehicle drivers will be looking at long trips and camping. A home built electric vehicle will reduce the carbon footprint of the family and it will also lower electricity bills.

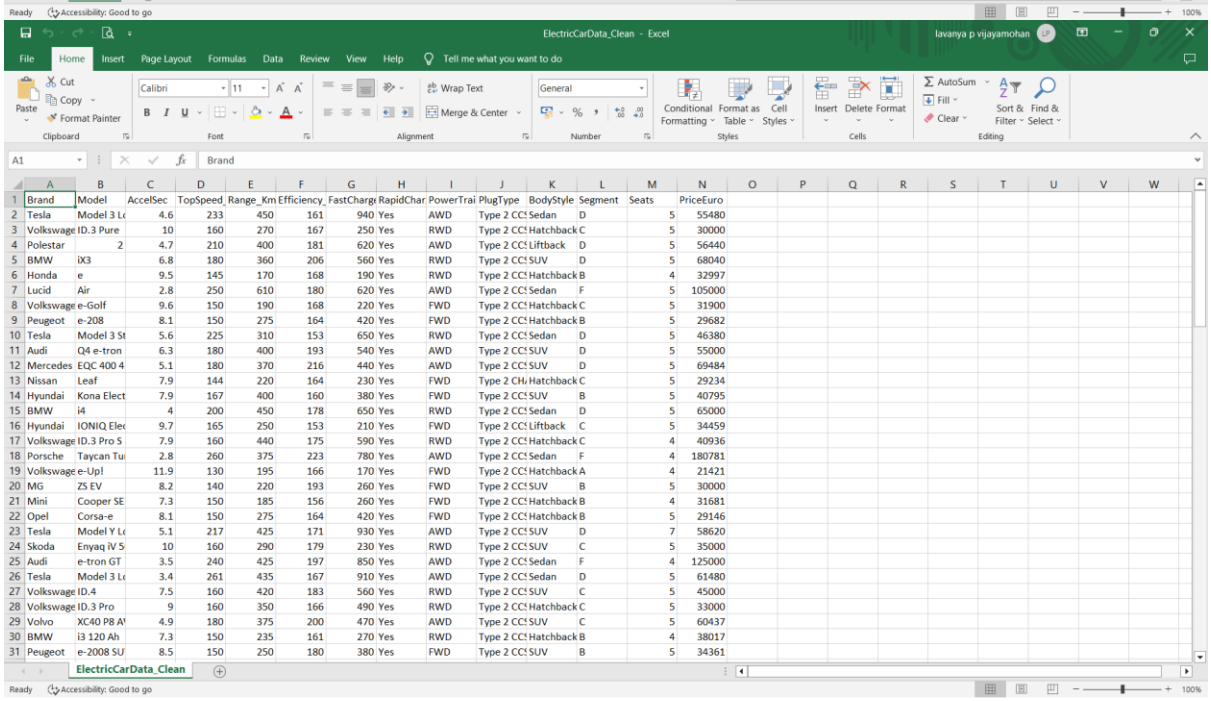
The future potential of electric vehicles is enormous. The obvious starting point for these vehicles is the charging station. This is however only the first step in a potential journey which will see charge Banks and other industrial areas as well as homes and cities. The future scope of electric vehicles is therefore massive.

8.APPENDIX:



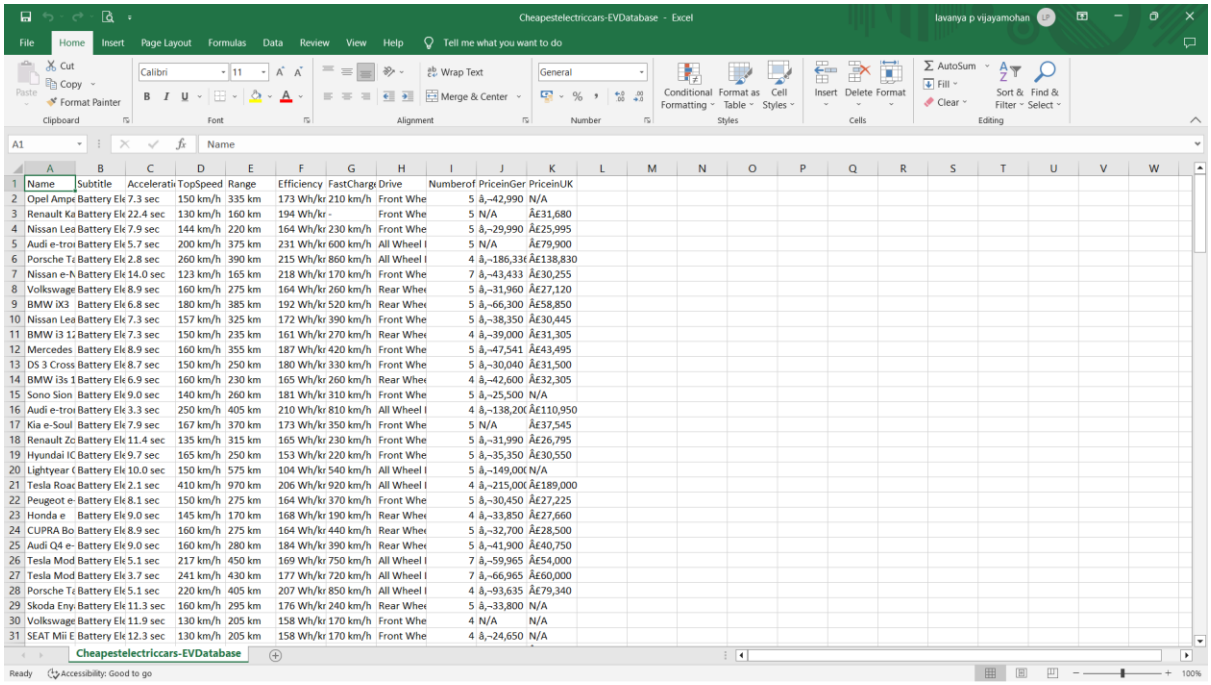
EVIndia - Excel

Car	Style	Range	Transmissi	VehicleTyp	PriceRang	Capacity	BootSpace	BaseMode	TopModel
Tata Nexo	Compact S	312 Km/Fu	Automatic	Electric	17.4	5 Seater	350 L	XM	Dark XZ Plus LUX
Tata Tigor	Subcompa	306 Km/Fu	Automatic	Electric	13.64	5 Seater	316 L	XE	XZ Plus Dual Tone
Tata Nexo	Compact S	437 Km/Fu	Automatic	Electric	19.24	5 Seater	350 L	XZ Plus 3.3	XZ Plus Lux 7.2 kW
MG ZS EV	Compact S	419 Km/Fu	Automatic	Electric	25.88	5 Seater	448 L	Excite	Exclusive
Hyundai K	Compact S	452 Km/Fu	Automatic	Electric	23.98	5 Seater	na	Premium D	HSE
Jaguar I-P	Premium M	470 Km/Fu	Automatic	Electric	112	5 Seater	656 L	S	Sportback 55
Audi E-Tro	Premium C	388 Km/Fu	Automatic	Electric	180	5 Seater	405 L	Quattro	na
BYD E6	Subcompa	415 Km/Fu	Automatic	Electric	29.15	5 Seater	580 L	STD	na
Mercedes-	Compact S	471 Km/Fu	Automatic	Electric	100	5 Seater	na	na	na
BMW iX	Premium F	425 Km/Fu	Automatic	Electric	116	5 Seater	na	na	na
Porsche Ta	Premium S	na	Automatic	Electric	150	4 Seater	na	na	na
Audi E-Tro	Compact S	400 Km/Fu	Automatic	Electric	119	5 Seater	660 L	na	na



ElectricCarData_Clean - Excel

Brand	Model	AccelSec	TopSpeed_	Range_Km	Efficiency_	FastCharg	RapidChar	PowerTrai	PlugType	BodyStyle	Segment	Seats	PriceEuro
Tesla	Model 3 L	4.6	233	450	161	940	Yes	RWD	Type 2 CC	Sedan	D	5	55480
Volkswage	ID.3 Pure	10	160	270	167	250	Yes	RWD	Type 2 CC	Hatchback	C	5	30000
Polestar	2	4.7	210	400	181	620	Yes	AWD	Type 2 CC	Liftback	D	5	56440
BMW	iX3	6.8	180	360	206	560	Yes	RWD	Type 2 CC	SUV	D	5	68040
Honda	e	9.5	145	170	168	190	Yes	RWD	Type 2 CC	Hatchback	B	4	32997
Lucid	Air	2.8	250	610	180	620	Yes	AWD	Type 2 CC	Sedan	F	5	105000
Volkswage	e-Golf	9.6	150	190	168	220	Yes	FWD	Type 2 CC	Hatchback	C	5	31900
Peugeot	e-208	8.1	150	275	164	420	Yes	FWD	Type 2 CC	Hatchback	B	5	29682
Tesla	Model 3 St	5.6	225	310	153	650	Yes	RWD	Type 2 CC	Sedan	D	5	46380
Audi	Q4 e-tron	6.3	180	400	193	540	Yes	AWD	Type 2 CC	SUV	D	5	55000
Mercedes	EQC 400 4	5.1	180	370	216	440	Yes	AWD	Type 2 CC	SUV	D	5	69484
Nissan	Leaf	7.9	144	220	164	230	Yes	FWD	Type 2 CH	Hatchback	C	5	29234
Hyundai	Kona Elect	7.9	167	400	160	380	Yes	FWD	Type 2 CC	SUV	B	5	40795
BMW	i4	4	200	450	178	650	Yes	RWD	Type 2 CC	Sedan	D	5	65000
Hyundai	IONIQ Elec	9.7	165	250	153	210	Yes	FWD	Type 2 CC	Liftback	C	5	34459
Volkswage	ID.3 Pro S	7.9	160	440	175	590	Yes	RWD	Type 2 CC	Hatchback	C	4	40936
Porsche	Taycan Tu	2.8	260	375	223	780	Yes	AWD	Type 2 CC	Sedan	F	4	180781
Volkswage	e-Up!	11.9	130	195	166	170	Yes	FWD	Type 2 CC	Hatchback	A	4	21421
MG	ZS EV	8.2	140	220	193	260	Yes	FWD	Type 2 CC	SUV	B	5	30000
Mini	Cooper SE	7.3	150	185	156	260	Yes	FWD	Type 2 CC	Hatchback	B	4	31681
Opel	Corsa-e	8.1	150	275	164	420	Yes	FWD	Type 2 CC	Hatchback	B	5	29146
Tesla	Model Y L	5.1	217	425	171	930	Yes	AWD	Type 2 CC	SUV	D	7	58620
Skoda	Enyaq iV 5	10	160	290	179	230	Yes	RWD	Type 2 CC	SUV	C	5	35000
Audi	e-tron GT	3.5	240	425	197	850	Yes	AWD	Type 2 CC	Sedan	F	4	125000
Tesla	Model 3 L	3.4	261	435	167	910	Yes	AWD	Type 2 CC	Sedan	D	5	61480
Volkswage	ID.4	7.5	160	420	183	560	Yes	RWD	Type 2 CC	SUV	C	5	45000
Volkswage	ID.3 Pro	9	160	350	166	490	Yes	RWD	Type 2 CC	Hatchback	C	5	33000
Volvo	XC40 P8 A	4.9	180	375	200	470	Yes	AWD	Type 2 CC	SUV	C	5	60437
BMW	i3 120 Ah	7.3	150	235	161	270	Yes	RWD	Type 2 CC	Hatchback	B	4	38017
Peugeot	e-2008 SU	8.5	150	250	180	380	Yes	FWD	Type 2 CC	SUV	B	5	34361



	A	B	C	D	E	F	G	H	I	J	K
1	Name	Subtitle	Acceleratio	TopSpeed	Range	Efficiency	FastCharge	Drive	Numberof	PriceinGer	PriceinUK
2	Opel Ampe	Battery Ele	7.3 sec	150 km/h	335 km	173 Wh/kr	210 km/h	Front Whe	5	â‚¬42,990	N/A
3	Renault Ka	Battery Ele	22.4 sec	130 km/h	160 km	194 Wh/kr	-	Front Whe	5	N/A	Â£31,680
4	Nissan Lea	Battery Ele	7.9 sec	144 km/h	220 km	164 Wh/kr	230 km/h	Front Whe	5	â‚¬29,990	Â£25,995
5	Audi e-tro	Battery Ele	5.7 sec	200 km/h	375 km	231 Wh/kr	600 km/h	All Wheel I	5	N/A	Â£79,900
6	Porsche Ta	Battery Ele	2.8 sec	260 km/h	390 km	215 Wh/kr	860 km/h	All Wheel I	4	â‚¬186,33(	Â£138,830
7	Nissan e-N	Battery Ele	14.0 sec	123 km/h	165 km	218 Wh/kr	170 km/h	Front Whe	7	â‚¬43,433	Â£30,255
8	Volkswage	Battery Ele	8.9 sec	160 km/h	275 km	164 Wh/kr	260 km/h	Rear Whee	5	â‚¬31,960	Â£27,120
9	BMW iX3	Battery Ele	6.8 sec	180 km/h	385 km	192 Wh/kr	520 km/h	Rear Whee	5	â‚¬66,300	Â£58,850
10	Nissan Lea	Battery Ele	7.3 sec	157 km/h	325 km	172 Wh/kr	390 km/h	Front Whe	5	â‚¬38,350	Â£30,445
11	BMW i3 12	Battery Ele	7.3 sec	150 km/h	235 km	161 Wh/kr	270 km/h	Rear Whee	4	â‚¬39,000	Â£31,305
12	Mercedes	Battery Ele	8.9 sec	160 km/h	355 km	187 Wh/kr	420 km/h	Front Whe	5	â‚¬47,541	Â£43,495
13	DS 3 Cross	Battery Ele	8.7 sec	150 km/h	250 km	180 Wh/kr	330 km/h	Front Whe	5	â‚¬30,040	Â£31,500
14	BMW i3s 1	Battery Ele	6.9 sec	160 km/h	230 km	165 Wh/kr	260 km/h	Rear Whee	4	â‚¬42,600	Â£32,305
15	Sono Sion	Battery Ele	9.0 sec	140 km/h	260 km	181 Wh/kr	310 km/h	Front Whe	5	â‚¬25,500	N/A
16	Audi e-tro	Battery Ele	3.3 sec	250 km/h	405 km	210 Wh/kr	810 km/h	All Wheel I	4	â‚¬138,20(	Â£110,950
17	Kia e-Soul	Battery Ele	7.9 sec	167 km/h	370 km	173 Wh/kr	350 km/h	Front Whe	5	N/A	Â£37,545
18	Renault Zo	Battery Ele	11.4 sec	135 km/h	315 km	165 Wh/kr	230 km/h	Front Whe	5	â‚¬31,990	Â£26,795
19	Hyundai IC	Battery Ele	9.7 sec	165 km/h	250 km	153 Wh/kr	220 km/h	Front Whe	5	â‚¬35,350	Â£30,550
20	Lightyear (	Battery Ele	10.0 sec	150 km/h	575 km	104 Wh/kr	540 km/h	All Wheel I	5	â‚¬149,00(	N/A
21	Tesla Roac	Battery Ele	2.1 sec	410 km/h	970 km	206 Wh/kr	920 km/h	All Wheel I	4	â‚¬215,00(	Â£189,000
22	Peugeot e-	Battery Ele	8.1 sec	150 km/h	275 km	164 Wh/kr	370 km/h	Front Whe	5	â‚¬30,450	Â£27,225
23	Honda e	Battery Ele	9.0 sec	145 km/h	170 km	168 Wh/kr	190 km/h	Rear Whee	4	â‚¬33,850	Â£27,660
24	CUPRA Bo	Battery Ele	8.9 sec	160 km/h	275 km	164 Wh/kr	440 km/h	Rear Whee	5	â‚¬32,700	Â£28,500
25	Audi Q4 e-	Battery Ele	9.0 sec	160 km/h	280 km	184 Wh/kr	390 km/h	Rear Whee	5	â‚¬41,900	Â£40,750
26	Tesla Mod	Battery Ele	5.1 sec	217 km/h	450 km	169 Wh/kr	750 km/h	All Wheel I	7	â‚¬59,965	Â£54,000
27	Tesla Mod	Battery Ele	3.7 sec	241 km/h	430 km	177 Wh/kr	720 km/h	All Wheel I	7	â‚¬66,965	Â£60,000
28	Porsche Ta	Battery Ele	5.1 sec	220 km/h	405 km	207 Wh/kr	850 km/h	All Wheel I	4	â‚¬93,635	Â£79,340
29	Skoda Eny	Battery Ele	11.3 sec	160 km/h	295 km	176 Wh/kr	240 km/h	Rear Whee	5	â‚¬33,800	N/A
30	Volkswage	Battery Ele	11.9 sec	130 km/h	205 km	158 Wh/kr	170 km/h	Front Whe	4	N/A	N/A
31	SEAT Mii E	Battery Ele	12.3 sec	130 km/h	205 km	158 Wh/kr	170 km/h	Front Whe	4	â‚¬24,650	N/A