Dayananda Sagar College of Engineering

CHARGING INFRASTRUCTURE BUSINESS MODELS AND POLICIES FOR ELECTRIC VEHICLES IN KARNATAKA

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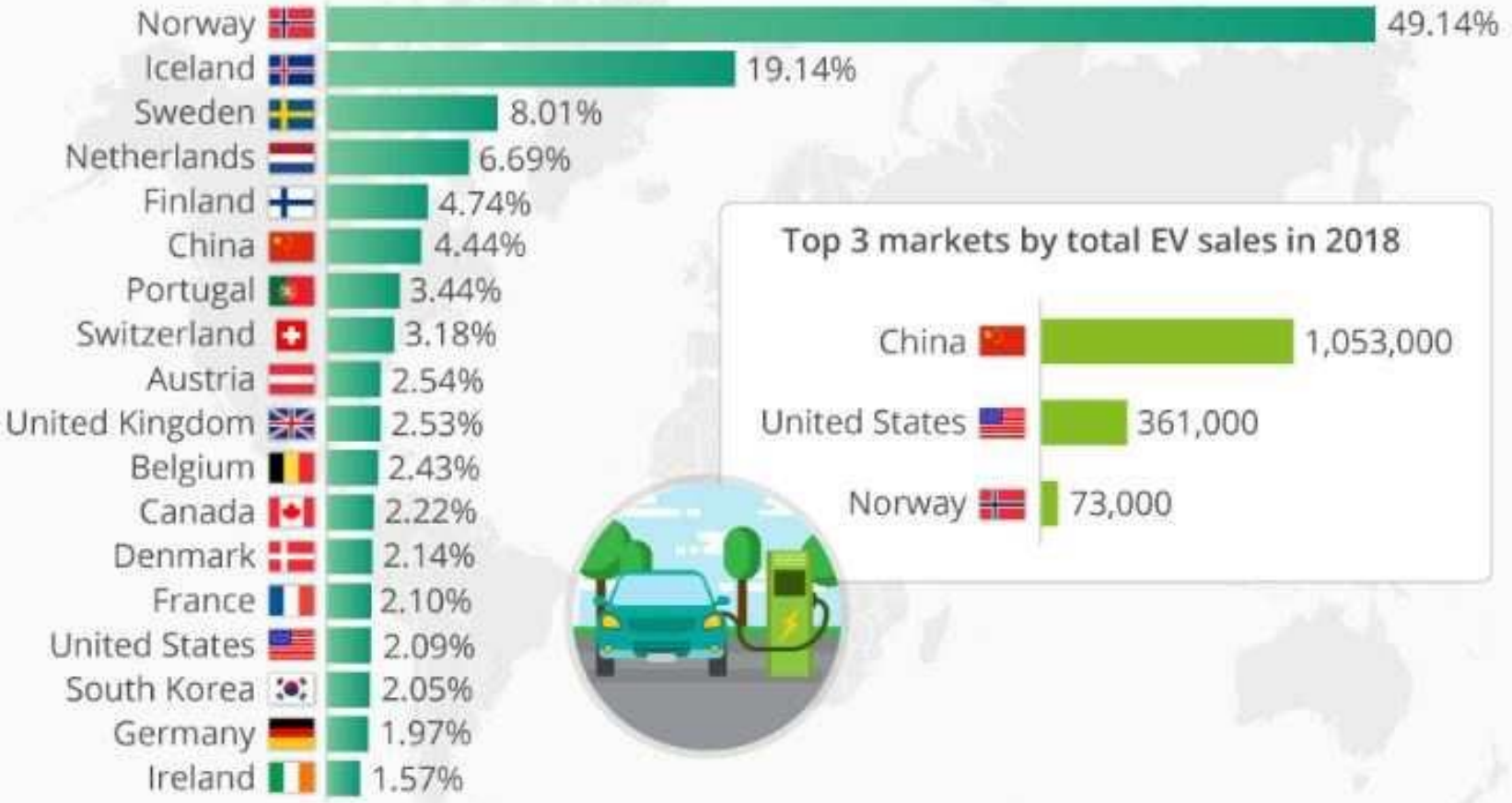
INTRODUCTION

- Electric vehicles are eco friendly from systemic stand point, cheaper fuel cost, lower maintenance expenses etc

- Public charging infrastructure is a key to growing the electric vehicle market. As the global electric vehicle market grows there will be need for much more public charging infrastructure.

Electric Mobility: Norway Races Ahead

Countries with the highest share of plug-in electric vehicles in new passenger car sales in 2018*



* including plug-in hybrids and light vehicles, excluding commercial vehicles

Sources: ACEA, CAAM, InsideEVs, KAIDA

statista

ELECTRIC VEHICLE (EV) CHARGING SYSTEM

- The infrastructure element that provides the crucial link between an Electric Vehicle (EV) with a depleted battery and the electrical source that will recharge those batteries is the Electric Vehicle Supply Equipment or EVSE.
- A EVSE come with added features like authentication, Integrated payment gate ways, software for remote monitoring.

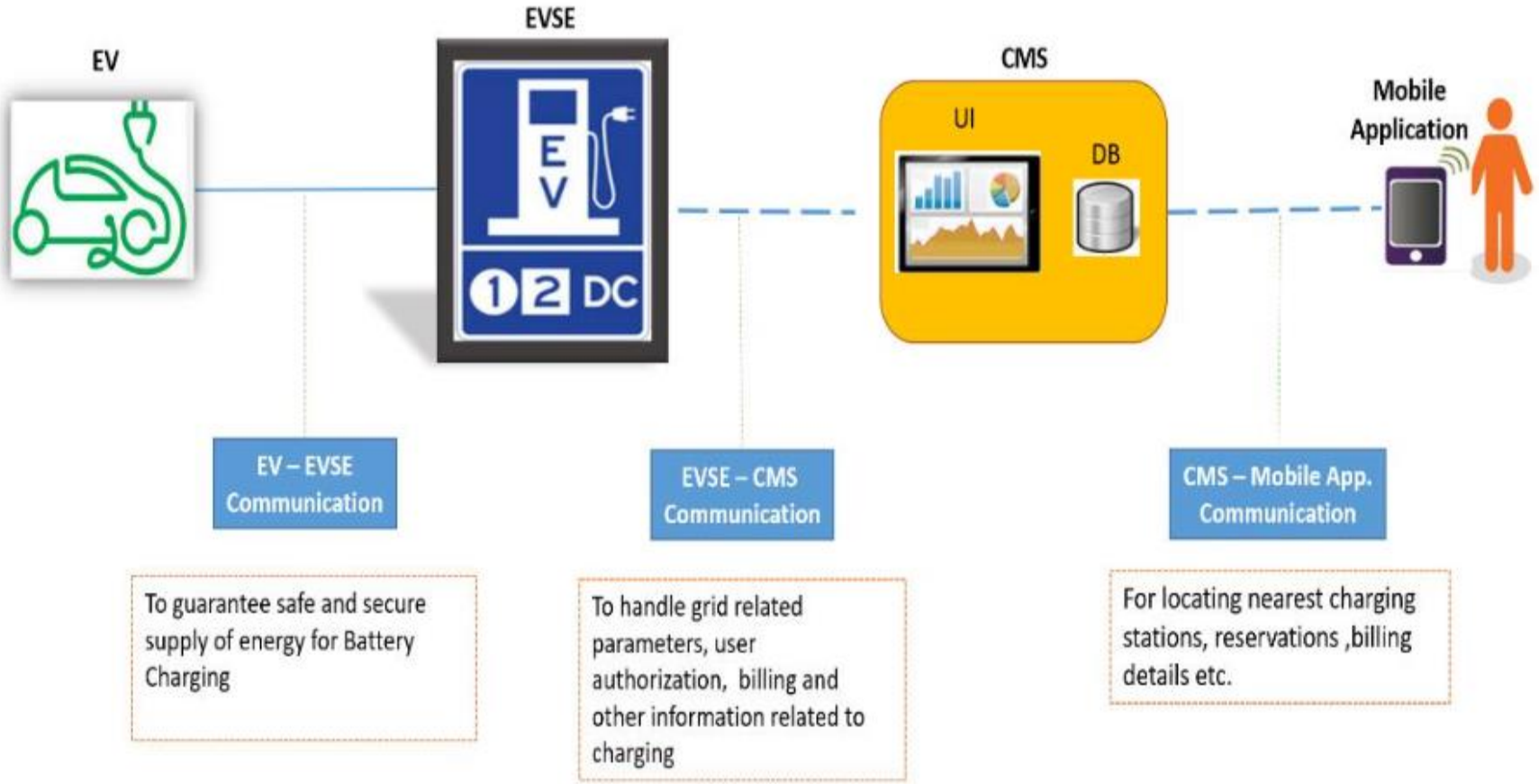


Figure 1: Architecture for EV and Charging Infrastructure

- EVSE units are commonly referred to as charging stations.The basic EVSE components include Electric Vehicle Connector, Electric Vehicle Inlet, and Battery Charger. EVSE is normally classified as Level 1, Level 2 or DC Fast Charge (DCFC).

Classification in use here	Level	Current	Power	Type			
				China	Europe	Japan	North America
	Level 1	AC	≤ 3.7 kW	Devices installed in private households, the primary purpose of which is not recharging electric vehicles			SAE J1772 Type 1
Slow chargers	Level 2	AC	> 3.7 kW and ≤ 22 kW	GB/T 20234 AC	IEC 62196 Type 2	SAE J1772 Type 1	SAE J1772 Type 1
	Level 2	AC	≤ 22 kW	Tesla connector			
Fast chargers	Level 3	AC, triphase	> 22 kW and ≤ 43.5 kW		IEC 62196 Type 2		SAE J3068 (under development)
	Level 3	DC	Currently < 200 kW	GB/T 20234 DC	CCS Combo 2 Connector (IEC 62196 Type 2 & DC)	CHAdeMO	CCS Combo 1 Connector (SAE J1772 Type 1 & DC)
	Level 3	DC	Currently < 150 kW	Tesla and CHAdeMO connectors			

- Electric vehicle charging infrastructure has seen substantial cost declines over the past several years due to new technological innovation and larger production scale, as with electric vehicle production.
- Charging stations with lower power output tend to cost less but are better suited for workplace and residential charging than for situations when drivers are parked for only a few hours

- Many newer charging stations are connected to the internet and can provide live information about their status and any problems, which can be incorporated into online charging station locating services. Finally, more advanced networked stations frequently collect usage data from charging stations; these data can provide helpful lessons for governments and researchers, and may eventually lead to more efficient charging station construction and management practices.

BUSINESS MODEL OF CHARGING INFRASTRUCTURE

- It is currently challenging to construct a profitable business case for publicly available EV charging investments for several reasons.

- To build a business case that will attract capital and convince the private sector to invest in EV charging, total revenues must be greater than the project's total cost, and an acceptable level of profit is necessary.

- One promising opportunity to improve the financial performance of charging station investments is to develop business models that, through private partnerships and joint investment strategies, capture other types of business value in addition to selling electricity.

- A business model is a description of the ways a business makes money by offering a product or service. The key component of a business model is its value proposition the value a customer receives in exchange for payment or value-transfer.
- A business model consists of the target market for a product or service, the cost and revenue streams to demonstrate the concept's viability, guidance on implementing or demonstrating the concept, and methods to test the concept's success or failure.

- The emerging Business Model for EV includes

(1) **Direct Vehicle Sales**

(2) **EV Leasing**

(3) **Battery Leasing and Swap Schemes**

(4) **End-to-End Solution**

Cost Estimates and Revenue Model for a typical EVSE setup

Table-1

Type of Charger	Number of Chargers in the EVSE Station	Power Input	Power Output	Approx Cost including GST @18% (INR)	Number of EVs that can be charged simultaneously	Maximum Power sold to EVs per Day (20 hours/day assumed) kWh
CAPEX (Capital Expenditure)						
Bharat Charger AC 001	01	3 Phase 415 Volt	3 x 3.3 kW	70,000	3	198
Type-2 AC Charger	01		7.2 kW	75,000	1	144
CCS-2	01	3Phase, 415Volt	25 kW*	700,000	1	500
New Electricity Connection (50kW), LT Cabling (100 meters), Panels, Breakers, Energy Meter etc.				200,000		
Civil Works (Flooring, Boards, Painting, Branding, Shed/Cover etc.				75,000		
EVSE Management Software – Integration with Chargers and Payment Gateway				25,000		
CCTV Camera System				25,000		
Total Capex				**11,70,000**		**842**

Table-2

OPEX (Operational Expenditure)			
Technicians (one technician @25k/month considered for first 6 months	150,000		
Server and Storage Fee per Year (on public cloud)	5,000		
EVSE Management Software Fee (considered as 10% of net margin on electricity charges)		Refer Table-3 on Revenue projections	
Payment Gateway Fee (2-3% of total money collected)		Pass through to customer is considered	
Land Rent	Not considered		
Advertising (@5000/month)	60,000		
Total Opex	**215,000 +** EVSE Management Software Fee in First Year **65,000** + EVSE Management Software Fee from second year onwards		

**DCFCs usually comes with 50 kW or higher power outputs. A 50 kWh DCFC cost over Rs 1.5 million. Since present models of EVs sold in India cannot be charged above 1C rate and batteries are 11kWh to 25 kWh capacity, investment in DCFC of over 25 kWh is not considered in this estimation*

Revenue projection from the EVSE business is calculated in the table-3 based on the following assumptions:

- 20 hours of charging operations for 25 days/month (300 days x 20 hrs = 6000 hours maximum capacity)
- Capacity Utilization Factor (CUF) of EVSE setup considered at 10% for Year-1, 20% for Year-2, 35% for Year-3, 55% for Year-4 and 80% for Year-5 (which is very ambitious targets)
- Electricity tariff to the DISCOM is considered as pass through and no minimum monthly charges considered
- A margin of Rs 2 on electricity tariff is considered in Scenario-A and Rs 3 is considered in Scenario-B.
- Payment Gateway charges (2-3%) is considered to be added to the EV customer bill
- Land Rent is not considered
- EVSE Management Software fee considered @10% of net margin on electricity tariff (Rs 0.20 in Scenario-A and Rs 0.30 in Scenario-B)

Table-3

Description	YEAR-1 10% CUF	YEAR-2 20% CUF	YEAR-3 35% CUF	YEAR-4 55% CUF	YEAR-5 80% CUF	Total in 5 Years
Electricity Sold to EVs/Year (kWh): 842 kWh per day maximum x 300 days per year considered as 100 % CUF	25,260	50,520	88,410	138,930	202,080	505200
Estimated Revenue (INR)						
SCEANRIO-A: Margin of Rs 2 on electricity tariff	50,520	101,040	176,820	277,860	404,160	10,10,400
SCENARIO-B: Margin of Rs 3 on electricity tariff in Year 1 & 2; margin of Rs 2.5 in Year 3 &4 and margin of Rs 2 from Year-5 onwards	75,780	151,560	265,230	416,790	606,240	15,15,600
Opex from Table-2	215,000	65,000	65,000	65,000	65,000	475,000
EVSE Management Software Fee (10% of net Revenue): Scenario-A						101,040
Total Opex Scenario-A						576,040
EVSE Management Software Fee (10% of net Revenue): Scenario-B						151,560
Total Opex Scenario-B						626,560
Net Revenue: Scenario-A						434,360
Net Revenue: Scenario-B						889,040

ELECTRIC VEHICLE POLICY

- For a rapidly growing economy like India with an objective to achieve inclusive growth and balanced development the need to find sustainable and eco-friendly transportation / mobility solutions is imperative.
- The Faster Adoption and Manufacturing of Electric Vehicle (FAME) Scheme was introduced and according to the report, eight two wheeler manufacturers and three four wheeler manufacturers have registered and availed benefits under the scheme.

- To explore the available opportunity and to allow EV sector to bloom in Karnataka, a comprehensive and well-designed policy is formulated based broadly on the principles of Karnataka Industrial Policy 2014-19 with a focus on creating enabling environment for investors in EV segment.

NEED FOR ELECTRIC VEHICLE POLICY

- In order to achieve the potential, a well-designed, systemic and collaborative approach is required with a clear long term roadmap to develop a robust, pro-growth landscape for the EV sector to bloom in the State. Today, the convergence of low cost technologies, smart design and integration, innovative business models with supportive policies will establish certain market segments as economically viable.

POLICY MEASURES.

- The various policy measures include Special initiatives for EV manufacturing, Support for Charging Infrastructure, Support for Research & Development, Support for Skill Development, Incentives and concessions
- **Special initiatives for EV manufacturing:** includes

1. EV manufacturing Parks / Zones:
2. Migrating to EV environment:
3. Facilitation to EV, Battery & Charging Equipment Manufacturing

- **Support for Charging Infrastructure:**

1. Availability of charging infrastructure is a prerequisite for electric mobility. Government of Karnataka will develop charging infrastructure as a commercially viable business venture that attracts private investment.

2. Charging infrastructure for personal transport vehicles of Government employees would be made available at Vikasa Soudha Basement/ Multistoried Building parking area and covered parking areas in all Government buildings across the State. Existing apartment associations will be encouraged to provide special dedicated plug/charging station facilitating adoption of EVs by their members.

3. To facilitate EV mobility on highways between prominent cities with heavy density of vehicles such as the Bengaluru -Mysuru highway and others, fast charging station/ battery swapping infrastructure will be provided at every 50 kilometers. BMRCL / BMTC / KSRTC / BBMP will provide charging stations for two wheelers at their parking stations to encourage EVs for last mile commute. ESCOMs will examine permitting use of solar energy / renewable energy at low connection cost and offer zero wheeling charges by EV charging stations.

- **Support for Research & Development:**

Government of Karnataka will constitute working groups for development of necessary technologies from concept to market in the areas of drive technologies; battery technologies; charging infrastructure & network integration; standards and certification; materials and recycling; quality & training etc., Research program in collaboration of EV industry with a focus on battery innovation will be introduced in Engineering College/ Universities.

- **Support for Skill Development:**

An EV skill development center will be set up in collaboration with the industry for up-skilling the work force to augment the manpower required for the EV industry. This center will introduce curriculum and courses suited to the EV industry in professional institutes, polytechnics as well as vocational education institutions, a short term course on electric mobility and also in-plant training is provided by the EV Manufacturers in the State by offering a stipend up to 50% of the cost of training subject to a limit of Rs.10,000/- per month per trainee.

- **Incentives and concessions**

To attract investments in electric vehicle manufacturing, electric vehicle battery manufacturing/assembly and electric vehicle charging/swapping infrastructure equipment manufacturing Enterprises, has offered attractive package of incentives and concessions by the Government. It is also proposed to offer subsidies to EV charging infrastructure providers like charging stations, lithium ion battery switching/swapping stations etc. to popularize use of EVs in the State.

LT-6 (C) Electric Vehicle Charging Stations (Newly Introduced Tariff)

Tariff Approved by the Commission for LT – 6 (C)

	Approved Tariff	
Fixed /Demand charges per KW	LT	HT
	Rs. 50 / KW/Month	Rs. 180 /KVA /month
Energy charges per KWH (for both LT & HT)	485 paise / unit	

CONCLUSION

- With increased production volumes and battery cost reductions over the next 10 years, electric vehicles are projected to approach cost competitiveness with conventional vehicles.
- Public charging infrastructure is a key to growing the electric vehicle market. Using a multivariable regression of 350 metropolitan areas, it is found that both Level 2 and DC fast charging infrastructure are linked with electric vehicle uptake, are consumer purchase incentives.

- The idea of a ratio between electric vehicles and public charge points is attractive to policy makers, as this ratio could inform targets for infrastructure build out to support an electric vehicle market of a given size.
- The benefits of commercialized charging stations include diverting the peak of charging load from the demand peak of the network, Unpredictable mobile load in the form of EVs would be transformed into a stationary load and it would be easier to predict.

- The Government in Karnataka aims to replace around 50 per cent of the petrol and diesel vehicles used by the state government staffers in Bengaluru to eco-friendly electric vehicles (EV) by 2019
- The policy aims to create a conducive environment for the transition to electric vehicle environment from internal combustion engines.

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Thank You