Host Utilities

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ORGANIZER

India Smart Grid Forum

India SMART UTILITY Week 2024

Supporting Ministries

Session: Open Charge Alliance Workshop

United States (U.S) & Automotive OEM Perspectives

Presented By

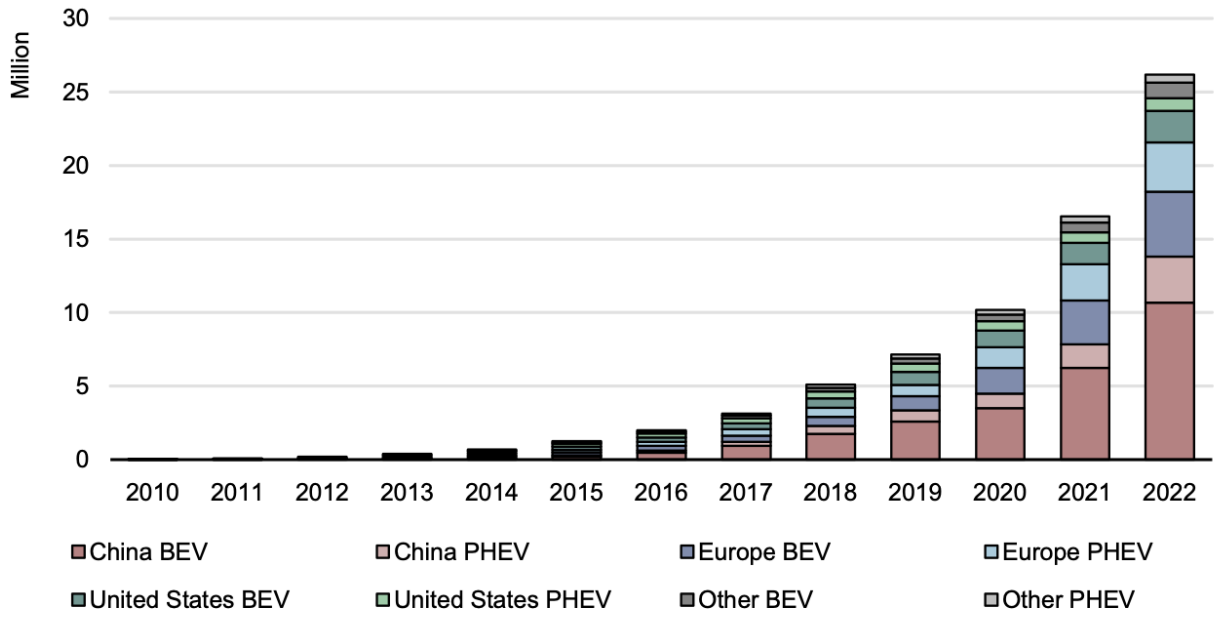
Rish Ghatikar, Advisor to India Smart Grid Forum (ISGF)

ELECTRIC MOBILITY: GLOBAL TRENDS

Electric Transportation over a decade has seen a significant upward trajectory in sales.
Sales exceeded 10 million in 2022.*

Sales driven by advances in policies, technologies, and clean energy climate targets.
A total of 14% of all new cars sold were electric in 2022.*

Major Markets: China, Europe & United States
China has more than 50% of global electric cars.*
In Europe, electric car sales increased by over 15%.*
In the U.S. electric car share of sales share is 8%.*



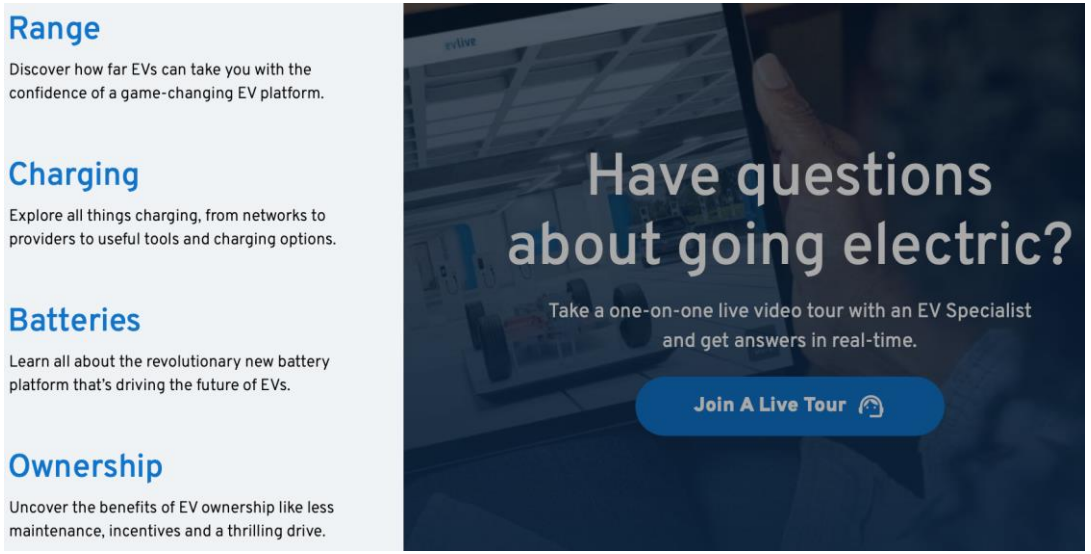
Global electric car stock in selected regions, 2010-2022.*

** Source: International Energy Agency (IEA) Global EV Outlook 2023; Includes PHEVs and BEVs*

ELECTRIC MOBILITY: U.S. TRENDS

Sales driven by automotive industry release of new models, falling battery prices & government incentives.

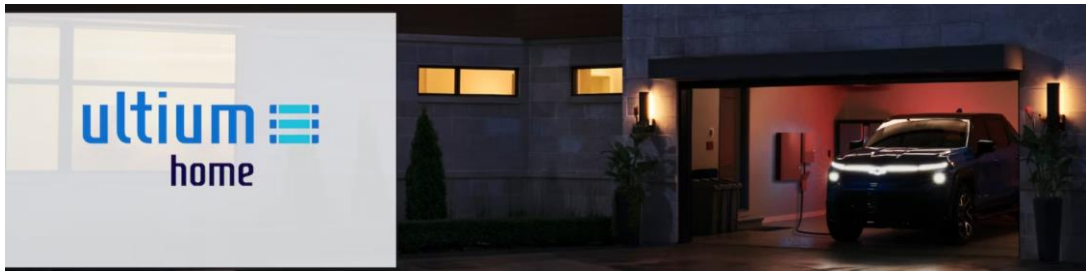
Increase in education and awareness initiatives by the automotive and public-sector industries



https://evlive.gm.com

Public charging infrastructure & availability of home charging is alleviating range & charging anxiety

Electric grid stakeholders & innovative energy management solutions to address grid impacts.

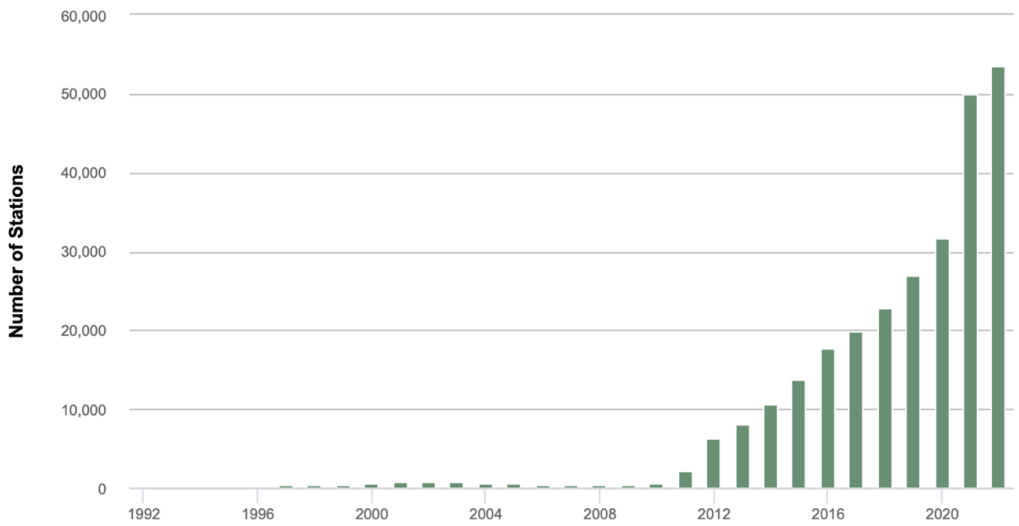


https://gmenergy.gm.com/

CHARGING & INFRASTRUCTURE

Majority charging at home & work, yet publicly accessible charging points are outpacing EV sales.

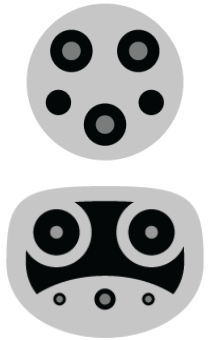
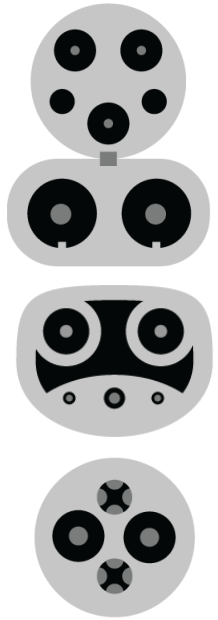
> 85% of EV charging at homes



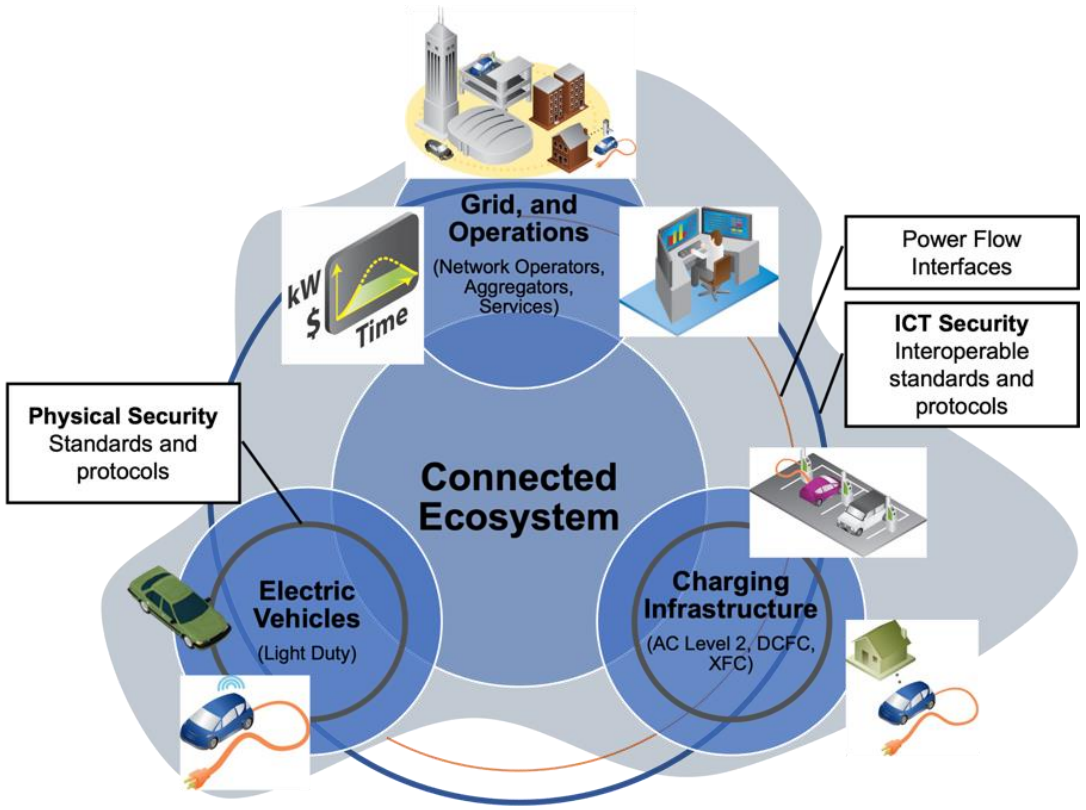
Source: U.S. DOE Alternative Fuels Data Center (AFDC) and Oak Ridge National Laboratory (ORNL) Transportation Energy Data Book, Last Update January 2023, Accessible at https://afdc.energy.gov/stations/states and https://tedb.ornl.gov

Various connectors & communication technologies used for EV charging infrastructure.

> J1772, CCS & NACS dominate charging connectors & inlets.

Level 1 Charging ~7 miles of range per 1 hr. charging*	Level 2 Charging ~30 miles of range per 1 hr. charging**	DC Fast Charging ~200-400+ miles of range per 1 hr. charging‡
		
SAE J1772 connector	**SAE J1772 & NACS (SAE J3400) Connectors**	**SAE CCS, NACS (J3400) & CHAdeMO Connectors**

ELECTRIC MOBILITY & GRID ECOSYSTEMS



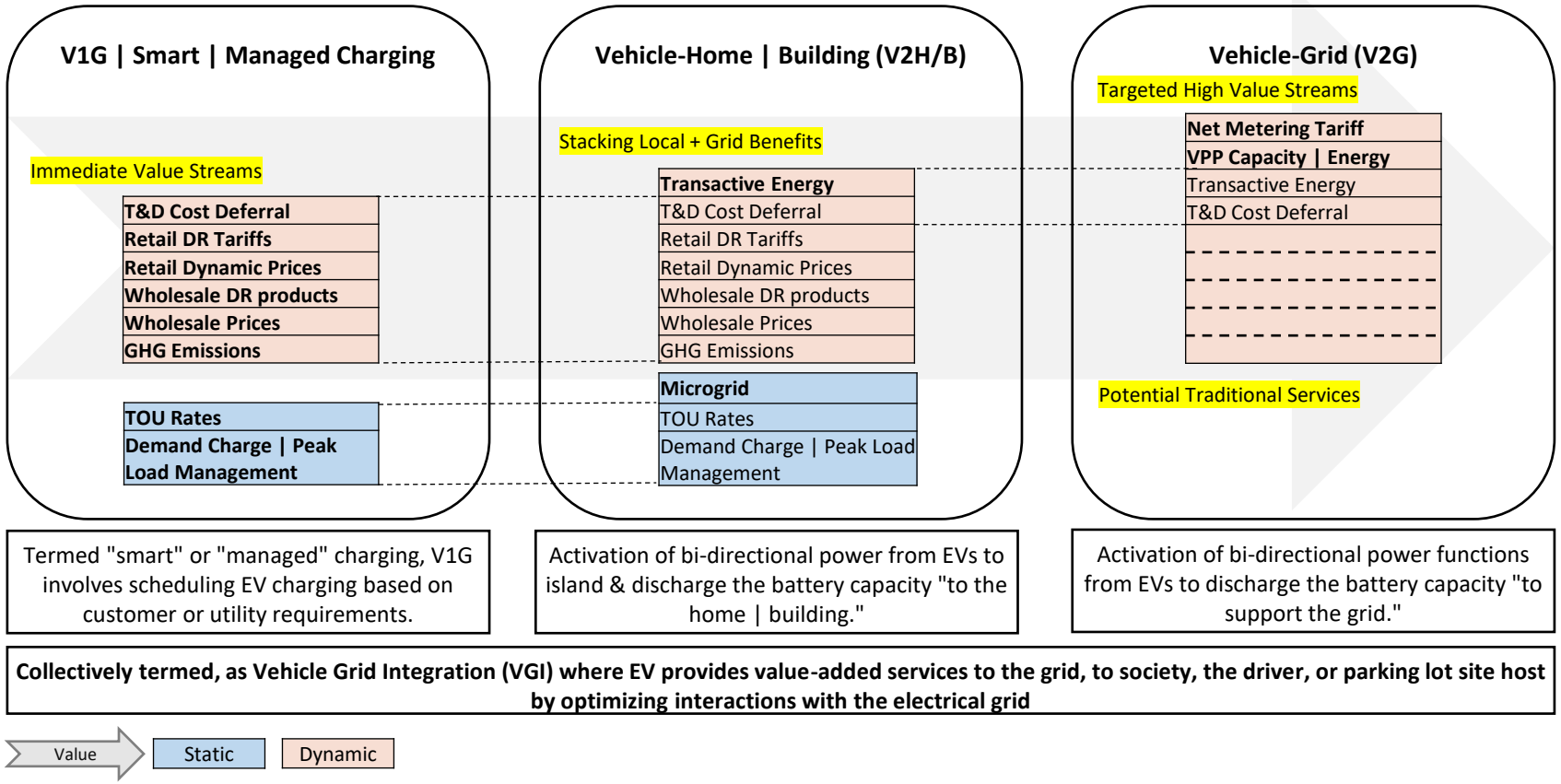
Decarbonization of transportation sector requires a grid-connected ecosystem

> Engagement of multiple sectors and agencies.

Source: Electric Power Research Institute (EPRI) & U.S. Department of Energy (DOE) Project
https://www.osti.gov/servlets/purl/1974448

Image Sources: General Motors (GM) & New York Times

ELECTRIC MOBILITY & GRID INTEGRATION VALUE



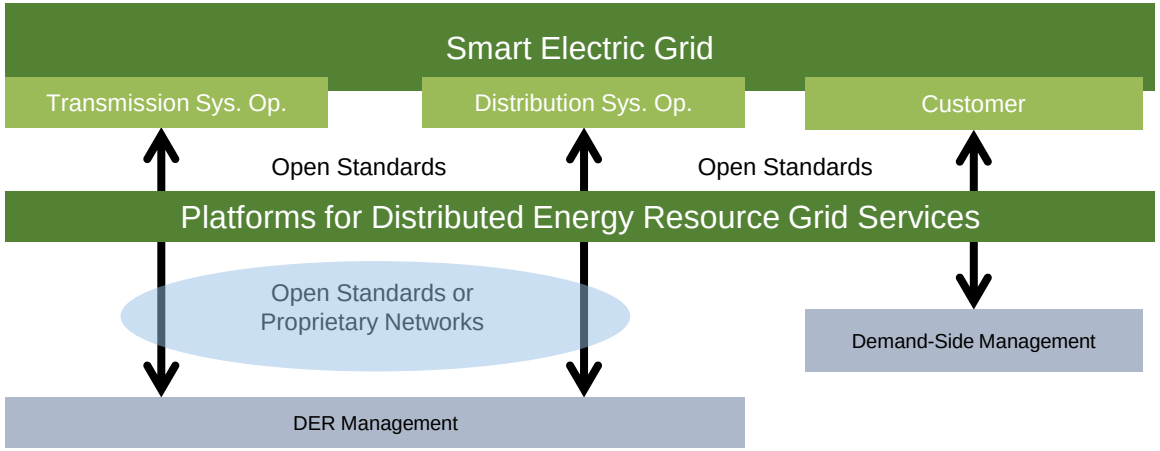
Ghatikar, G., Alam, M.S., Technology, and economics of electric vehicle power transfer: Insights for the automotive industry. Energy Inform 6, 46 (2023). https://doi.org/10.1186/s42162-023-00300-4

ELECTRIC MOBILITY & GRID INTEROPERABILITY

Interoperability: Standardized communication & data interfaces across multivariate systems.
Open Charge Point Protocol (OCPP), IEC 62746-10-1 (OpenADR 2.0.)

Interconnection: Standards-based electrical power components & system interfaces
California Rule 21 for inverter-based distributed energy resources (DER).

Interoperability, interconnection, and their cybersecure applications are critical for electric grid resiliency & reliability.



Future Proofing Grid Operator & Customer Assets

Grid-connected customers, DER platforms, and services at transmission and distribution system domains

Ghatikar G; Decoding Power Systems' Integration for Clean Transportation and Decarbonized Electric Grid, Proceedings of the ISGW, New Delhi. March 2016. DOI 10.13140/RG.2.1.3555.4960

* Ghatikar G., J. Zuber, E. Koch, and R. Bienert, Smart Grid and Customer Transactions: The Unrealized Benefits of Conformance, IEEE Green Energy and Systems Conference,2014.
** Ghatikar G; *Decoding Power Systems' Integration for Clean Transportation and Decarbonized Electric Grid*, The Proceedings of the India Smart Grid Week. March 2016, New Delhi.

OEM CHALLENGE: CHARGING RELIABILITY | UPTIME

Survey of EV drivers in California (n=1290) indicates ”not-so-reliable” charging infrastructure.*

- charging station not functioning (22%)
- payment problems (18%)
- need to contact customer service via cell phone (53%).

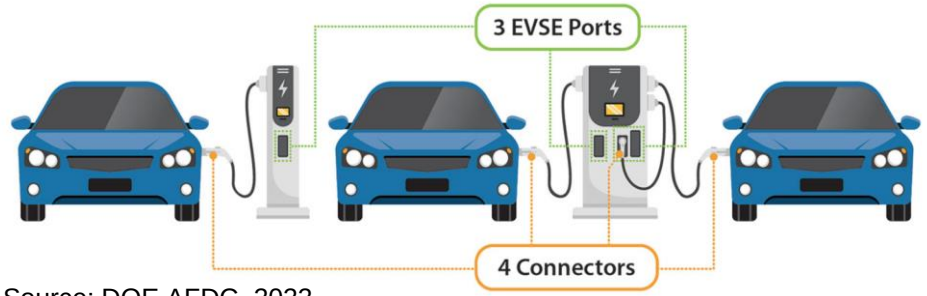
Evaluation of 657 CCS EVSE connectors in 181 open, public DCFC stations in Northern California shows 72.5% were functional*

- EVSEs that were non-functioning were unresponsive or unavailable screens, payment system failures, charge **initiation failures, network failures, or broken connectors (22.7%)**

>> Results contradict 95% to 98% uptime stated by the operators of EV charging stations!

*CARB 2022a. Electric Vehicle Supply Equipment Standards Technology Review. California Air Resources Board. February 2022.
** Reliability of Open Public Electric Vehicle Direct Current Fast Chargers. UC Berkeley. Available at SSRN: https://ssrn.com/abstract=4077554

Regulators taking measures to require >95% uptime of EVSEs for public-funded infrastructure.



Source: DOE AFDC, 2022

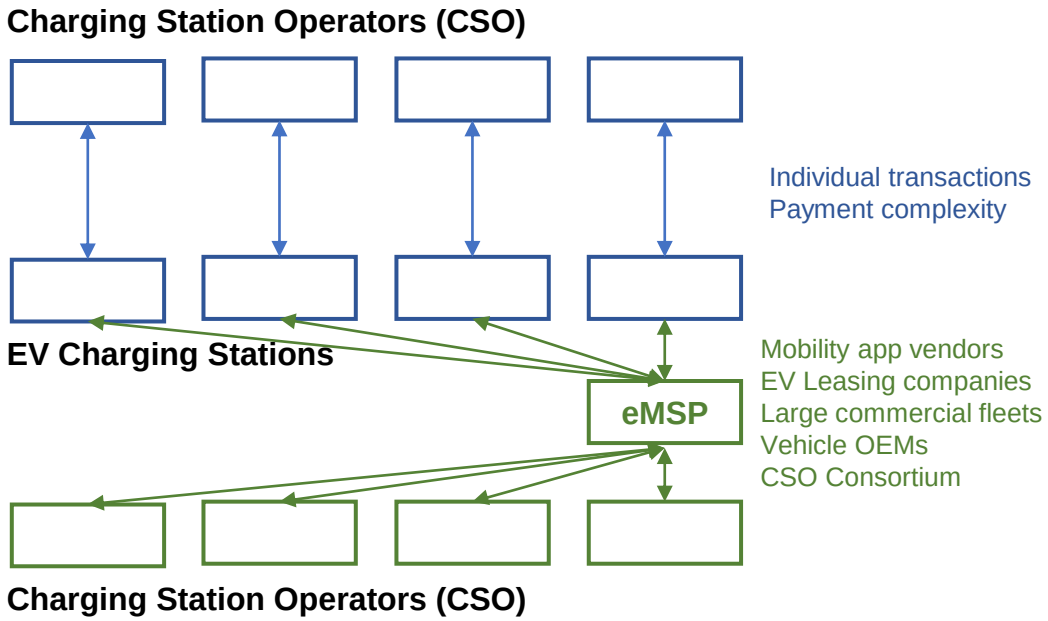
OEM CHALLENGE: CHARGING EXPERIENCE

Seamless Plug-and-Charge (PnC) & Roaming Services Required for Mass-Market Adoption

Plug-and-Charge: Authenticated and seamless EV charging when plugged.
> Authentication enabled through standardized or proprietary EV—EVSE communications.

Roaming: Centralization of authenticated charging and billing over multivariate CSOs (or CPOs).
> Centralization usually through a master eMobility Service Provider (eMSP)

Figure Source: General Motors (GM)

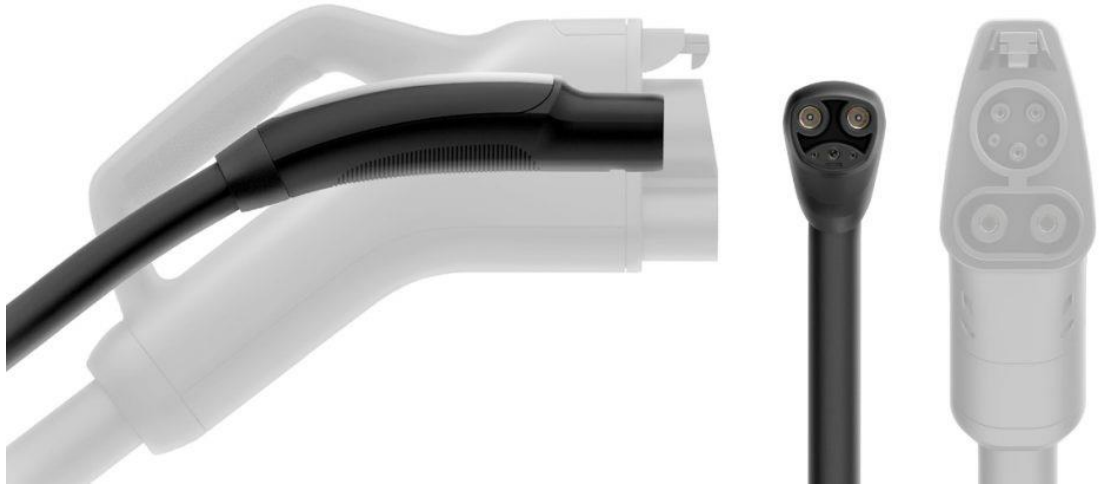


OUTCOME: A TALE OF OEM INDUSTRY DISRUPTIONS

Disruptive Change to Reduce Customer Charging & Range Anxiety

> 27 automotive OEMs committing to adoption of Tesla's NACS for reliable & seamless PnC customer experience.

Acura	Honda	Mercedes	Stellantis
Aptera	Hyundai	Mini	Subaru
BMW	Hyundai	Nissan	Tesla
Fisker	Jaguar	Polestar (Volvo)	Toyota
Ford	Lexus	Porche	Volkswagen
Genesis	Lucid	Rivian	Volvo
General Motors	Mazda	Rolls-Royce	



Source: https://electrek.co/2023/06/08/gm-announces-adopt-tesla-nacs-connector/

Automotive OEMs Transition to Charging Infrastructure Deployment & Operations

> Automotive OEMs need to offer better customer charging experience and address charging reliability issues.

Source: https://news.gm.com/newsroom.detail.html/Pages/news/us/en/2023/dec/1205-pilot.html

Source: General Motors (GM) & IONNA, LLC

STANDARDIZED & SECURE EV ECOSYSTEMS

Data Communication Standards

EVSE-CPO	EVSE- or CSO-Utility	EVSE-EV	EV-OEM-Utility
OCPP 1.6 or 2.x (Operate) OCPI (Roaming)	IEC 62746-10-1 (OpenADR 2.0*) IEEE 2030.5** or 1815(DNP3)** SunSpec-Modbus**	DIN 70121 SAE PLC-CP, PWM-CP ISO 15118-2 or -20 (VGI & PnC)	Telematics IEC 62746-10-1 (OpenADR 2.0*) GreenButton***

* Required by regulators, building codes, etc., in CA and other states for demand response and price signals.
** Required by CA regulators and utilities for DR programs and Rule 21 interconnection tariff for inverter-based DERs
*** Implemented by some distribution utilities to provide secure access to customer metered or energy-usage data

Interconnection (Electrical) Standards

Inverter Interconnection
IEEE 1547, UL 1741, UL 9741

Image Sources: General Motors (GM) & New York Times

KEY TAKEAWAYS

Federal, state policies & industry investments driving EV adoption & standardization
India can contextualize federal (e.g., NEVI) & state (e.g., CA) mandates to increase EV sales & interoperability.

Future-proofing grid operator & customer assets is essential for cost-recovery of multivariate systems
Indian electric & EV industries must coordinate interoperability across various systems & stakeholders.

Communication standards (EV, OEM, CPO, Utility) are relatively mature for EV ecosystem & VGI applications
India has the potential to adopt international standards & best practices

Charging Reliability, PnC & Roaming capabilities improves customer charging experience & foster EV sales.
Indian automotive OEMs & CSOs must recognize the need to increase EV sales & better customer experience.

Automotive OEMs transitioning to deployment and operations of charging infrastructure
India has a working model (e.g., Tata Power and Tata Motors) that can be corroborated to scale EV adoption.

Image Source: Tata Power

AN EPILOGUE

"The levels of interoperability, enabled by standards, **are gateways that integrate electric transportation and grid industries.** Standardized systems that leverage industry standards also **support competition and innovation for relevant stakeholders** any of whom can aspire to be a VGI service provider."

Source: Electric Grid Services Interoperability: Automotive Transition to North American Charging Standard (Yet to be published)

THANK YOU

http://linkedin.com/in/ghatikar/