Enabling a Successful EV Transition in the United States

Charles Fine, David Keith and Jim Womack

MIT Mobility Initiative

EV Charging Working Group

January 2023

Mobility Initiative

Background

- The US has embarked on a historic transition from ICEs to EVs.
- A thirty-year project to achieve a net-zero GHG motor vehicle system.
- The transition must address many challenges:

➢Vehicle and battery design, to provide cost-effective net-zero vehicles for all classes of users.

➢Net-zero production systems and energy supplies.

➢Adequate charging systems to spur EV adoption.

Nature of the Challenges

- Some are traditional engineering problems that can be addressed by individual companies: vehicle structures, battery designs, robust software.

- Some are systems problems - the energy supply system; the charging system – that require collaboration among companies in order to create a system adequate to spur EV adoption. I.e., *Chicken-and-egg problem*.

The Role of the MIT Mobility Initiative

- We believe that the creation of a net-zero mobility system is one of the great challenges for humanity in the next 30 years.
- The MMI should play an enabling role.
- How can we be helpful?
- Others at MIT are tackling the “hard” engineering challenges – materials science, mechanical engineering, computer science.
- We believe our role is to look at the supporting systems needed for the EV transition, beginning with the charging system.

The Complexity of the Charging Challenge

- Charging EVs requires two systems -- public (long distance and destination) with short charge times & private (home and office) with longer charge times.
- Motorists will use the combination that suits their needs, and the mix may change over time. (The split is about 15/85 today.)
- Both systems are complex to create – involving some combination of OEMs, charging system operators, EVSEs, payments processors, IT providers, maintenance providers, utilities, and government funders.
- Both are being developed without a “chief engineer” of the sort that many organizations have for a complex product.

A Unique Element of the Challenge

- Charging systems are being developed with the objective of eliminating an externality – CO2 – and therefore are different in a critical aspect from a service industry that has the narrower objective of maximizing customer utility and provider profitability.
- Success is unusually dependent on collaboration between the participants in system build-out and operation – if one element fails the whole system can fail.

A Role for an MIT-led EV Charging Working Group

- We are proposing a collaborative effort by all of the parties involved in building out and sustaining an adequate EV charging systems – OEMS, charging system operators, EVSEs, payments processers, IT providers, maintenance specialists, and utilities – to:

➢Grasp the state of the current charging system.

➢Identify the root causes of gaps in performance as experienced by system users.

➢Identify countermeasures to close the gaps.

➢Instigate and observe the application of countermeasures.

➢Perform these tasks on a continuing basis as the situation changes through the transition to an all-EV fleet.

➢Report findings to governments and the general public.

Our Topic Identification Process

- We will develop a list of topics for analysis, beginning with public high-speed charging:

➢Coverage, with particular attention to areas not covered by grant programs.

➢Reliability, to address the perceived need for a leap in system reliability.

➢Capacity, in particular for peak periods of motorist demand.

➢Profitability, in the belief that the charging system must be able to support itself while providing adequate service to the public without continuing need for subsidies.

- All of these are important, but we anticipate that reliability will be the first topic as we wait to learn more about the adequacy of coverage created by current grant programs.
- As we begin our work we will also develop of a list of topics for private, low-speed charging, to be pursued as soon as possible.

Our Operational Process

- We will convene periodic meetings of the working group participants (perhaps vitual after the first meeting, but participants who can attend in person will always be welcome) to review topics for analysis.
- During each analytic cycle we will solicit input from all participants and make course corrections as necessary.
- We may also ask participants with knowledge critical to the analysis to share their knowledge, with appropriate safeguards.
- We will make our findings available to the public through various methods after review by the participants.
- We will tackle additional challenges as we make progress on the initial challenges and will solicit the views of the participants on the most fruitful topics to pursue.
- Finally, we will not make comparisons between the performance of individual participants. Our objective is to improve the performance all participants and the total system through continuing collaboration.

Our Team

- Leader:
- Professor Charles Fine, former director of the MIT International Motor Vehicle Program, inaugural CEO/Dean of the Asia School of Business (established in collaboration with MIT), Professor of Operations Management at the MIT Sloan School of Management. Co-author of *Faster, Smarter, Greener: The Future of the Car and Urban Mobility,* MIT Press, 2017 and *Clockspeed*, Perseus Press, 1998.
- Members:
- David Keith, Associate Professor of System Dynamics at the MIT Sloan School, Professor of Energy Systems at the University of Melbourne School of Engineering.
- Jim Womack, former research director of the MIT International Motor Vehicle Program, Founder of the Lean Enterprise Institute, Fellow of the Mobility Initiative. Lead author of *The Machine That Changed the World*.
- Supported by John Moavenzadeh, Executive Director, MIT Mobility Initiative and Bhuvan Atluri, Program Manager, MIT Mobility Initiative.

Our Ask

- We seek the participation of as many of the major participants in the EV charging transition as possible including OEMs, charging system operators, EVSEs, payment system processers, IT providers, maintenance specialists and electric utilities.
- To date we have gained agreements from the following organizations to participate:

➢Toyota

➢General Motors

➢Volvo Car

➢AAA

➢Several more in the pipeline to be announced soon

- We are asking each participant to make a contribution of $50,000 for one year of participation, to be renewed on an annual basis.