The University of Michigan’s Energy Institute and Mcity co-hosted a day long, invitation only workshop on the economic and social impacts of future mobility (see pp. 3 - 4 for the workshop agenda). The topics were wide ranging, but centered on the likely outcomes regarding the penetration of electrified vehicle (EVs) sales, the extent to which ride hailing services will increasingly substitute for personal car ownership, how fast will autonomous car features be adopted on the global highways and cities, and what policy menus are on offer which affect these new mobility trends?

Economic Scenarios for EVs and CAVs for 2035

- Panel experts agreed that the data do not suggest that the transition toward large shares of EV sales, or an onslaught of switching toward CAVs will happen anytime soon.
- One expert noted that it would take until 2035 to see a 26% market share of EV sales (this includes both plug-in and battery electric vehicles).
- Even more distant is the likelihood of significant penetration of connected and automated vehicles. Fewer than one out of every 5 miles driven will be Level 4 -5 automated vehicles (see top box).
- This panel of experts provided a realistic appraisal of the “slope of the curve.” It will take years before we see any meaningful shift away from the internal combustion engine vehicles.
- Adding to this assessment was an expert’s discussion of a study regarding outright urban car bans’ impact on fuel use. One conclusion from this analysis showed that it would take at least 45% closure of city centers worldwide in order to have a significant impact on fuel use.

Consumer and Business Behavior: Economic and Financial Factors

- A heavy dose of policy stimulus can incentivize consumer behavior to buy EVs. In the case of China (see last week’s briefing here), several policies are designed to stimulate EV demand, and it has been successful (see top chart).
By 2025, China will expand its lead on global EV sales, according to the U.S. Energy Information Administration’s (EIA) forecast. Panel experts agreed that the data do not suggest that the transition toward large shares of EV sales, or an onslaught of switching toward CAVs will happen anytime soon.

Consumer and Business Behavior: Economic and Financial Factors

- One panel expert indicated that we may be too pessimistic about China’s growth in EV demand. In 2017, EV sales grew by 70% and the government plan is to achieve leadership in this sector by 2025.
- Regarding AV content, all the experts agreed that getting to near fully autonomous vehicles is many years — and testing miles — away.
- Even so, Level 4-5 vehicle cost per mile could become very competitive as compared to personal car ownership cost. By one expert’s calculations, The cost of private vehicle ownership is $0.67-$3.10/mile in major cities that were studied vs. average $1.54/mile for Uber X (i.e., there is significant variation in $/mile between cities). Based on this data, 4% of households would today find it cheaper to use UberX than their private cars.
- When you take the driver out in a Level 5 vehicle, decreases to an average of $0.91/mile for autonomous ridesharing. By this estimate, 60% of households in dense urban centers, would find it cheaper to use ridesharing than their private cars.
- Beyond this, what are we seeing from companies engaged in new mobility business?
  - And we heard from Mobileye expert that they are pushing ahead with aggressive testing of autonomous technology to enable less human driver activity in the cockpit.
  - Still, one expert rightly pointed out that GPS and autonomous technology has a long way to go before it comes close to replicating the complex human behavior needed for driving a car.

More Out-Takes From Workshop to Come

We will be issuing a Workshop summary and posting on our website soon. With speakers’ permissions, slides and video will also be available. There are so many substantive data sets and insights to share.

What about the future of energy? How does the future of mobility affect the fuel type and magnitude of energy use?

- We have some mixed results. While some experts indicated that ride sharing with multiple riders could lead to improved energy efficiency, if the cost drops significantly (i.e., cost per mile), it could increase mobility access to a larger population and thereby increase the growth of vehicle miles traveled (i.e., more fossil fuel use if they are not EVs).
- There is also a risk of eating into public transit ridership — another trend which needs urgent study.
- One of the very encouraging highlights of the day was the keynote remarks by Dr. Sue Babinec, Commercialization Advisor at the U.S. Department of Energy’s ARPA-E unit. In a review of battery technology, there are several indications that battery costs are coming down to a point where they will be competitive with ICE engine powered vehicles. If this is really happening — and Dr. Babinec indicated it is “when,” not “if,” then the need for policy stimulus lessens and the demand for EVs could portend diminishing demand growth from gasoline and diesel fuels for transportation.
- Finally, one expert indicated that energy savings could be obtained from more, not fewer, fuel economy standards, attention to freight transport technology with electrification, platooning, and more autonomous features.
- The workshop served to lay important groundwork for the October 25-26, 2018 TE3 conference next fall here at the University of Michigan.
The global future of mobility is changing faster than meets the eye. The rising tide of electrified and connected automated vehicles is happening because the economics and technology have combined to make it increasingly affordable, efficient, and safe. Social behaviors have shifted as consumers and businesses leverage the advances in digital platforms, from e-commerce, to capital and labor sharing businesses which allow us to expand our collective horizons.

While most agree that the change is occurring, research on these topics is ambiguous. Some experts believe that the “flipping” toward new modes of mobility will occur by the end of this decade. Others argue that the pathway to CAVs will require more time, more policy adjustments, and lower cost.

This workshop will convene experts on these topics to explore the cutting edge thinking on the economic and social impacts of our mobility future. Timing is everything: The number of vehicles worldwide with advanced driver-assisted vehicle attributes rose by 50% during 2014-2016 – to 140 million units. As these features gather momentum, CAV technology could be the 21st Century “Edison Moment.” We look forward to your participation in the workshop and your ride toward the future thinking of mobility.

AGENDA

8:00 AM  Registration and Continental Breakfast

9:00 AM  Welcome and introduction
Ellen Hughes-Cromwick, Senior Economist, University of Michigan Energy Institute
Carrie Morton, Deputy Director, Mcity

9:15 AM  Economic scenarios for EVs and CAVs: 2025 and 2035
As of 2017, plug-in electric and battery electric vehicle sales rose globally to an estimated 1.2 million units, up 58% as compared to the prior year. Similarly, the number of connected and autonomous attributes of the vehicle fleet is growing. Many companies have targeted 2020 – 2025 as the “take-off” stage for growth of EVs and CAVs. This session will invite three experts to discuss how fast these trends will emerge, and the demand, supply, and policy factors that will be important in determining the growth curve.
Moderator: Catie Hausman, Assistant Professor of Public Policy, Gerald R. Ford School of Public Policy, University of Michigan
Panelists: Nigel Griffiths, Chief Automotive Economist, IHS Markit; Emily Kolinski Morris, Chief Global Economist, Ford Motor Company; Amy Myers Jaffe, David M. Rubenstein Senior Fellow for Energy and the Environment and Director of the Program on Energy Security and Climate Change, Council on Foreign Relations

10:15 AM  Consumer and business behavior: Key economic and financial factors
Technology developments and the automotive cycle will play important roles in the future of mobility. A global economic downturn could diminish cash flow and prospects for funding nascent transportation technologies. Will new joint ventures and partnerships with cash rich entities from Silicon Valley fulfill the need that traditional

automotive manufacturers may have during the downturn? Is the supply chain ready to make the transition to EVs and CAVs? Expanding on the day's first session, experts will talk about the economic and financial aspects of the growth trends in EVs, CAVs, and digital platforms for ride-hailing and ride-sharing services.

**Moderator:** Fred Keller, Executive in Residence, University of Michigan; Founder and Chair, Cascade Engineering

**Panelists:** Dan Galves, Senior VP, Chief Communications Officer, Mobileye (Invited); Rod Lache, Managing Director, Deutsche Bank Securities; Richard Wallace, Vice President, Transportation Systems Analysis, Center for Automotive Research

**11:15 AM**

**How far and how fast: Shared mobility, ride hailing, and digital platforms for sharing**

The rapid growth of Transportation Network Companies (TNCs) has caught many by surprise. Use of TNCs is fast, easy, often economic, and fits with the trend toward the convenience of mobile apps. Even so, they represent a small percentage of total trips in urban areas and have faced potential policy roadblocks as public transit officials and other interest groups confront the impacts on congestion, the drivers-as-gig workers, and the legacy transit systems. This panel will focus on these topics and provide some perspective about the growth and pricing dimensions of these platforms – and whether the energy impacts are sustainable.

**Moderator:** Robert Hampshire, Assistant Research Professor, Human Factors Group, University of Michigan Transportation Research Institute

**Panelists:** Alejandro Henao, Postdoctoral Researcher, National Renewable Energy Lab, U.S. Department of Energy; Alexander Keros, Chief of Smart Cities, Maven, General Motors Urban Mobility

**12:00 PM**

**Luncheon and talk – Future of mobility: A view from Silicon Valley**

Speaker: Sven Beiker, Managing Director, Silicon Valley Mobility

**1:30 PM**

**Keynote armchair: Perspectives on key drivers underpinning electrified vehicle trends**

**Moderator:** Ellen Hughes-Cromwick, Senior Economist, University of Michigan Energy Institute

**Speaker:** Sue Babinec, Senior Commercialization Advisor, ARPA-E, U.S. Department of Energy

**2:00 PM**

**Break**

**2:45 PM**

**Social factors and technology adoption: Generation Z and the Millennial generations**

Generation Z and the Millennials, born between 1995-2012 and 1980-1994, respectively, will be the generations using new transportation technologies; whether they are EVs, fully loaded with Level 4 autonomous content and features, or fully autonomous bots in a geo-fenced city. A panel of experts will address the social factors which influence technology adoption rates and whether the succeeding Generation Alpha, born between 2013-2025, will drive the growth into the future.

**Moderator:** Kaitlin Raimi, Assistant Professor of Public Policy, Gerald R. Ford School of Public Policy, University of Michigan

**Panelists:** Ipek Sener, Associate Research Scientist, Texas A&M Transportation Institute; Alex Stimpson, Mission & Behavior Planning Manager, Autonomous Driving Systems, American Haval Motor Technology, LLC; Adam Waytz, Professor of Psychology, Kellogg School of Business, Northwestern University

**3:45 PM**

**Concluding remarks and adjourn**