

UNIVERSITY of **HOUSTON**

C. T. BAUER COLLEGE of BUSINESS
Gutierrez Energy Management Institute

EV Overview

Evolve Houston

May 16, 2019

Introduction to GEMI

History

- The Global Energy Management Institute was established in 2001 by Dean Arthur Warga to engage the energy industry as an important part of the Houston and global economy.
- In 2016, energy executive and alumnus Joe Gutierrez made a gift to support the institute, which was re-named the Gutierrez Energy Management Institute.

Mission

- The Gutierrez Energy Management Institute (GEMI) is responsible for the energy education and industry outreach programs at Bauer. GEMI partners with the energy industry by developing and placing future leaders with relevant knowledge and experience of the industry, undertaking research in business matters of interest to the industry, and providing opportunities to discuss relevant issues in a neutral setting.

Aspiration

- Our aspiration is for Bauer to be the destination of first choice for energy industry executives and students interested in careers in the energy industry.

Several major technical trends are converging to improve the prospects for rapid penetration of EVs.

- There have been significant advances in LDV electrification in the last few years
 - Lithium ion batteries are at the center of these advances. Since 2010, prices have dropped 80% and battery energy density has improved by 5%-7% per year.
 - Automakers have dramatically increased their commitments to electrification and are launching a large number of new electric vehicles in 2019 and 2020.
- EV infrastructure is emerging in many countries.
 - Automakers are establishing networks (Tesla in US, BMW/Daimler/Ford and Volkswagen in Europe)
 - Utilities and electrical equipment companies are also establishing charging networks in the U.S., Europe and China.
- Competitively-priced renewable electric power generation is helping to realize the full environmental benefits of EVs
 - There have been significant cost reductions in wind and solar power generation due to technology improvements, competitive procurement processes, and development of a large base of active project developers.
- Autonomous vehicle technology is advancing
 - Over 300 established companies and start-ups are currently working on different aspects of the technology

There are also government and social trends accelerating the adoption of EVs

- Pressures to reduce GHG and polluting emissions
 - The transportation sector is a significant source of greenhouse gas emissions, accounting for a quarter of U.S. emissions
 - To meet the Paris climate accord target, accounting for population growth and increasing of living increase in developing countries, global GHG emissions would have to be reduced by 60%-80% versus a business-as-usual scenario.
 - EV penetration will also help reduce polluting emissions, including particulate matter, nitrogen oxides, carbon monoxide and unburned hydrocarbons.
- Need to reduce urban area congestion
 - Congestion costs the U.S. about \$300 billion per year. With about 220 million drivers, this cost is about \$1,400 per driver per year.
 - Urbanization is expected to increase average city density by 30% over the next 15 years, stretching existing systems as demand rises.
 - Autonomous vehicles (with much higher speeds and lower spacing) combined with shared mobility (car sharing, ride hailing and ride sharing), could allow replacement of up to ten private vehicles with a single autonomous taxi
- Rapid increase in interest in shared transportation
 - Renewed interest in urbanism and growing environmental, energy and economic concerns have intensified the need for sustainable alternatives.

EVs with autonomous capabilities powered by renewable power could bring significant benefits - 1

- Lower travel cost
 - While private cars sit idle on average, 95% of the time, self-driving taxis could have utilization rates of more than 75%, significantly lowering capital costs per person per mile
 - EV operating costs are estimated to be about 50% less than comparable internal combustion vehicles
 - Maintenance costs (even including battery replacement) are about 25% less for EVs which have about 40% fewer moving parts
- Safer Travel
 - If 90% of cars on American roads were autonomous, the number of accidents would be projected to fall by 75% and the number of road deaths by 65%
- Better travel experience
 - Smart highways and connected vehicles with traffic optimization will significantly reduce average trip times and lower travel time “costs” by making travel time more productive

EVs with autonomous capabilities powered by renewable power could bring significant benefits -2

- Better access for mobility-challenged populations
 - Autonomous vehicles would significantly improve access to transportation for the growing elderly population (especially those 85 year old and up) and the estimated 20% of the U.S. population that has some form of disability
- Lower road construction spending
 - Higher road utilization leads to less need for new road construction. A 90% penetration of self-driving cars would be equivalent to a doubling of road capacity.
- More efficient land use
 - Parking accounts for as much as a quarter of the area of US cities
 - With autonomous vehicles in nearly constant use, much less parking space would be needed
 - This would conceivably free up substantial amounts of prime real estate for housing, green-space, or commercial uses.

However, rapid EV penetration will require significant progress in many areas - 1.

- Vehicle technology advances
 - Further declines of 30-70% are needed in battery and electric drive system costs and vehicle weights to make the levelized cost of an EV comparable to a similar internal combustion vehicle
 - Most expect EVs to be fully price competitive with comparable ICVs between 2022 and 2024
- Availability of clean electricity and electrical infrastructure
 - New renewable power generating capacity to replace existing coal capacity and meet growing demand from EVs
 - Cost-effective grid-scale electricity storage to manage time of day, seasonal, and weather-induced imbalances.
 - New fast-charging infrastructure, distributed broadly with some at residential and commercial sites and some on highways
 - Investment in existing transmission and distribution infrastructure to manage changes in equipment heating and cooling requirements.
 - New systems to recycle batteries
 - New mechanisms to manage much more complex electricity flows in a more distributed grid

However, rapid EV penetration will require significant progress in many areas - 2.

- Consumer preferences
 - A rapid penetration scenario probably requires rapid growth in self-driving vehicles which will require the demonstration of the safety of autonomous vehicles and their benefits in terms of reduced travel time.
 - Broader acceptance of shared mobility systems and reduced private vehicle ownership beyond the millennial generation will also be required.
- Government Policies for EVs
 - EV penetration so far has been supported by significant government incentives, including mandates (emission targets, vehicle quotas) as well as incentives (purchase subsidies, favorable lane and parking access, free charging, reduced costs for licenses and tolls).
 - Some level of continued government intervention will likely be required to achieve rapid penetration

A significant transition will require government policies to address several categories of indirect consequences

- Reduced vehicle demand will significantly reduce automobile manufacturing and supply chain employment
- EVs' simpler designs will translate into a smaller number of jobs to produce and maintain each vehicle
- Reduced demand for taxis and traditional mass transit will result in stranded assets and lower employment in those sectors.
- Reduced demand for oil and coal will reduce employment and potentially strand assets in those value chains.
- Increased demand for battery and electric motor minerals, many sourced in nations with low environmental and safety standards or political conflict, may prompt calls for increased scrutiny and potentially boycotts
- Lost government gasoline sales tax revenues will need to be replaced.
- The transition period ,when autonomous and human-directed vehicles must share the roads, will require government policies with respect to liability, insurance and cybersecurity