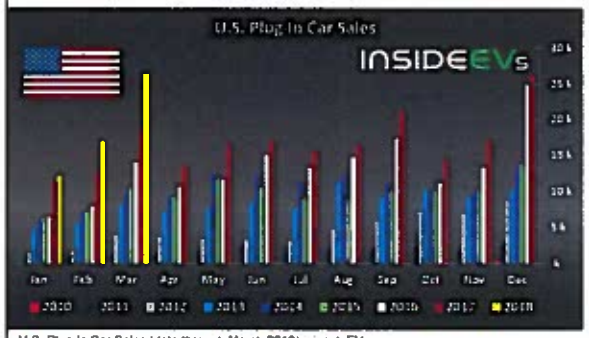
Michigan
House Committee on
Energy Policy

24 April 2018

"Electric Vehicles and Infrastructure needed for the 21st Century"

Britta K. Gross
GM, Director Advanced Vehicle Commercialization Policy

U.S. EV Market



U S Plug-In Car Sales (data through March 2018) – insideEVs.com

- 820,000 PEVs in US
- EV sales have risen YOY for 30 months
- 26% EV sales growth in 2017 over 2016
- 32% EV sales growth so far in 2018 over 2017

Why EVs Matter to Michigan

Why EVs matter to GM
- Global automotive technology leadership
- Flexibility to adapt to market conditions (e.g. cyclical volatility in oil prices)
- Global regulatory pressures from China, Europe (incl. cities), California, other states
- And a keen interest in shaping the mobility outcome

Why EVs matter to Michigan
- Jobs – Orion (Bolt EV/AV), Hamtramck (Volt), Brownstown (batteries), Holland (LG Chem battery cells)
  - New Hires – 30% of our salaried workforce < 4 years with GM (heavy hiring in software, controls,…)
- Electricity sales revenue stays in Michigan
- IF WE DO IT RIGHT and if utilities can help design the solutions, then EVs will benefit the grid by filling in the off-peak "valleys"

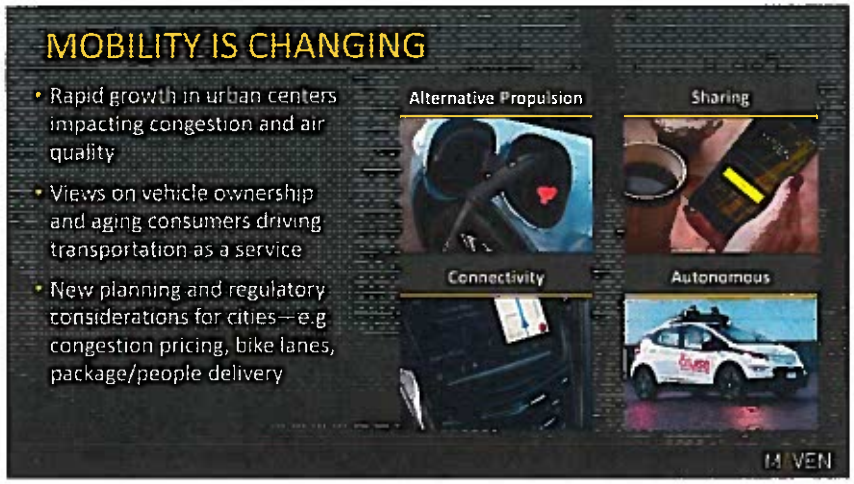
How AVs/Shared Mobility are connected to EVs
- Costly equipment means high-mileage commercial applications and lower cost of electricity improves the business case
- Cities are driving for congestion and zero-emission solutions

GM'S WORLD VIEW

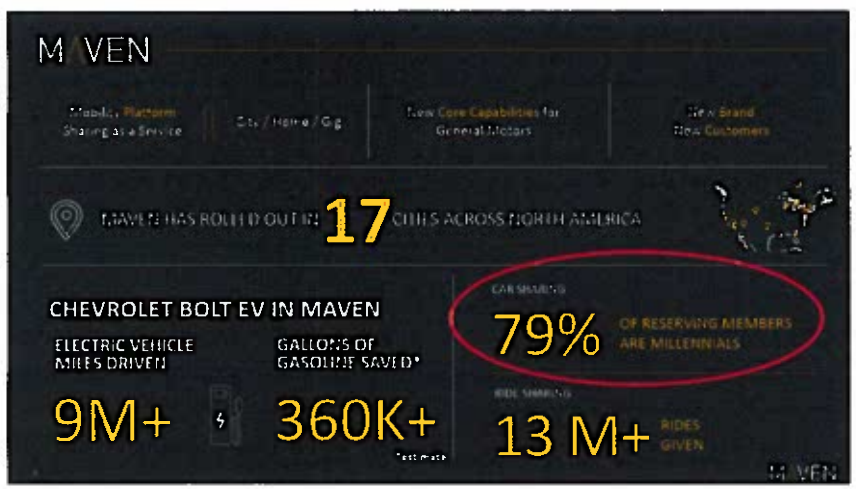
GM is committed to a future of:

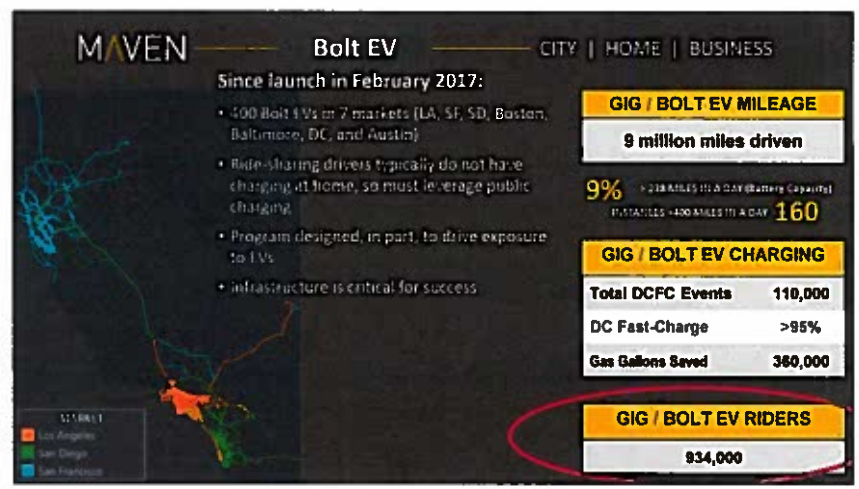
ZERO *CRASHES* | **ZERO** *EMISSIONS* | **ZERO** *CONGESTION*

TECHNOLOGY WILL HELP UNLOCK THIS FUTURE


MOBILITY IS CHANGING
• Rapid growth in urban centers impacting congestion and air quality
• Views on vehicle ownership and aging consumers driving transportation as a service
• New planning and regulatory considerations for cities—e.g congestion pricing, bike lanes, package/people delivery
Alternative Propulsion
Sharing
Connectivity
Autonomous
MAVEN

MAVEN CITY
Round-Trip Car Sharing
NUMBER OF CITIES
13 and counting
AVERAGE TRIPS
~13-14 Hours
~75-80 Miles
FAVORITE CARS
Chevrolet Volt
Chevrolet Tahoe
MAVEN HOME
Exclusive closed-community car-sharing
AVAILABLE IN
Residences in DC, San Francisco + growing. (Multiple non-exclusive properties as well)
AVALIABLE TO
> 8,000 Residents and counting
MAVEN GIG
Solutions for the Gig Economy – Ridesharing, Delivery Services.
Short-term rental includes vehicle, maintenance, insurance.
AVAILABLE IN
9 Cities and Counting
MILES DRIVEN
>175 Million
MAVEN


MAVEN
Mobility Platform Sharing as a Service
City / Home / Gig
New Core Capabilities for General Motors
New Brand New Customers
MAVEN HAS ROLLED OUT IN 17 CITIES ACROSS NORTH AMERICA
CHEVROLET BOLT EV IN MAVEN
ELECTRIC VEHICLE MILES DRIVEN
9M+
GALLONS OF GASOLINE SAVED*
360K+
CAR SHARING
79% OF RESERVING MEMBERS ARE MILLENNIALS
RIDE SHARING
13 M+ RIDES GIVEN
MAVEN


MAVEN
Bolt EV
CITY | HOME | BUSINESS
Since launch in February 2017:
• 400 Bolt EVs in 7 markets (LA, SF, SD, Boston, Baltimore, DC, and Austin)
• Ride-sharing drivers typically do not have charging at home, so must leverage public charging
• Program designed, in part, to drive exposure to EVs
• Infrastructure is critical for success
GIG / BOLT EV MILEAGE
9 million miles driven
9%
160
GIG / BOLT EV CHARGING
Total DCFC Events 110,000
DC Fast-Charge >95%
Gas Gallons Saved 360,000
GIG / BOLT EV RIDERS
934,000

EVS AND AUTONOMOUS

- Fleet of 180 Bolt EV self-driving vehicles being tested today on public streets
- Operating in San Francisco, Scottsdale, AZ, and in the Detroit area

What will it take to Grow the EV Market?

- Address Cost/Affordability
  - OEMs #1 priority is to get cost out of these technologies
    - Mainstream consumers are very sensitive to upfront cost of vehicles (even though they can save through the fuel cost savings)
- Install Charging Infrastructure at a faster pace (incl. role for utilities)
  - Address the "Perception" that there isn't enough infrastructure
    - Public DC Corridors (SAE Industry Standard) and Key Destinations – "story-telling"
  - Home and Work place will provide the majority of all charging
- Build EV Awareness!
  - Drive Consumer Demand through:
    - Promotional Campaigns (that really get to new car buyers)
    - Ride & Drives ("Butts in Seats")

Michigan Infrastructure Needs & Opportunities

- **Total MI EV Sales to Date: 14,863 (through 2017)**
- **323 publicly available charge sites (L1, L2, DC)**
  - **13 SAE Combo DCFC (most in/around Detroit)**

Challenging business case (upfront costs, low station utilization in early market) results in lack of investment.

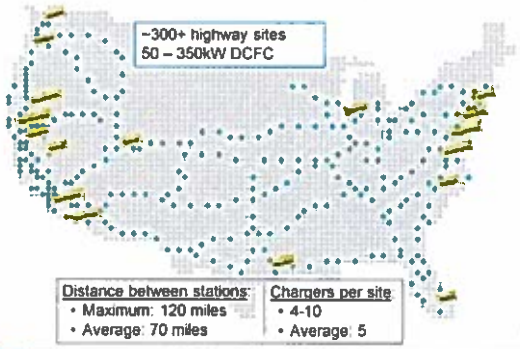
Opportunities:

- **Electrify America – national network of 300+ DC highway corridor stations**
- **50-state "VW Appendix D" funds – 15% can be spent on EV Infrastructure**
- **MI Utility Engagement**

DCFC Network in MI – Major Gaps
(public, nonproprietary chargers)

Infrastructure Opportunities: Electrify America – National Network Plans (2018-2019)

Electrify America's Cycle 1 investment will create a robust charging network linking U.S. highways and major metropolitan areas generating 70% of new EV sales in 2020



- $2Bil Investment
  - EV infrastructure
  - EV awareness
  - Green City "Sacramento"
- Cycle 1 of 4
  - 300 Highway DC sites
    - 1,500 plugs
    - 39 states
  - 17 Metro Areas
    - 785 sites
    - 3,500 L2 and DC plugs

Distance between stations:	Chargers per site
• Maximum: 120 miles	• 4-10
• Average: 70 miles	• Average: 5

Infrastructure Opportunities: VW Appendix D

Current outlook of States funding EV Charging Infrastructure

Allocate up to 15% of Funds for EV Charging

Unknown • No • Unlikely • Likely • Yes

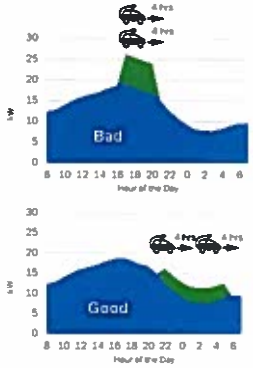
- $2.9B national fund
- Max 15% allowed for EV Infrastructure
- **Michigan will receive $65M**
  - **15% = $10M opportunity**
- To ensure funds are applied effectively, **each state should develop a strategic infrastructure plan** that considers highest-impact EV charging needs (e.g. DC corridors, MDU, workplace, key destinations)

Source: AtlasPolicy.com/EVhub

EVs present a Grid Opportunity

... but only if Utilities plan and engage

- **Will EVs add to peak? Overload circuits? Can EVs smooth and balance load?**
- **Utilities can ensure grid benefits**
  - No impacts at today's low market penetration
  - As EVs scale up, system impacts will depend on charging patterns
    - Charging behavior – where, when, how fast?
    - Clustering – where, when, how many?
    - High-power charging - 150kW and beyond?
    - Impact of shared use applications (rideshare, autonomous, etc.)?



Source of Graphs: Consumers Energy

2030 EV Station and EVSE Estimates: Model Goals & Assumptions

September 2017 NREL Report – National PEV Infrastructure Analysis

NREL Assumptions:

- Assumes every PEV has access to a home charger
- Highway: avg. 70 miles to a DC station
- Community: < 3 miles to a DC station
- **15mil PEVs in 2030**

Goals:

1) **Coverage:** Enable long-distance driving and dispel range anxiety by providing a safety net of DCFC stations
2) **Demand:** 88% home charging supported by workplace and public L2 and DC charging to meet expected demand and maximize eVMT

State	Total PEVs	% BEV	Work L2 Plugs	Public L2 Plugs	Public DCFC Plugs
MD	337,000	42%	8,700	5,400	430
ME	65,000	26%	2,700	2,000	110
MI	258,000	20%	9,700	6,700	290
MN	228,000	43%	6,600	4,500	370
MO	201,000	43%	5,900	4,100	370

(Today: 14,553 PEVs in Michigan)

Utility engagement? Yes...

- There is (almost) no business case today for public EV infrastructure, so investment is lagging.
- Consumers must see more infrastructure or they will not buy EVs.
- The business case will improve over time – and the market will become more competitive.
- But today ... utilities need to:

1. Engage actively in public DC fast-charging, workplace and home charging

- Most charging at home, so this is a way to reach all consumers (including those in multi-dwelling units)
- Workplace charging is key to growing EV awareness and corporate relationships are key to utilities
- A visible strategy of DC fast-chargers tells a big story to consumers and grows EV adoption among fence-sitters

2. Engage actively in PEV outreach and education

- Utilities are trusted 3rd parties and operate at a local level – key for building awareness

Advanced transportation technologies can not be introduced without a thriving EV market foundation

Batteries: Refurbishment, Recycling, and Secondary Use

Battery Refurbishment - The evaluation and re-use of returned battery components in a vehicle application

Battery Recycling - recyclemybattery.com

A battery refurbishment program has been in place for the Volt for some time and has been very successful

Grid Opportunity (especially at scale and lower costs):

Battery Secondary Use - The re-use of a returned battery in a non-automotive application

Current Process:

- Dealer removes battery and ships back to a facility that evaluates the battery for two purposes:
  - To understand what went wrong with it and use this information for continuous improvement
  - To determine if it is a refurbishment candidate – if so, it is retained for refurbishment
- Any materials not suitable for refurbishment are sent to a recycler

Thank You

1st to 2nd Generation EREV Improvements: Chevrolet Volt

1st Gen Volt	Metric	2nd Gen Volt
38	EV Range (miles)	53
382	Total Range (EV+gas miles)	420
37	Fuel Economy (gas mpg)	41
16.5	Battery (kWh)	18.4
4	Passenger Capacity	5
3.4 sec*	0 to 30	2.6 sec
9 sec	0 to 60	8.4 sec
273	Torque (ft-lb)	294
3.3	Charger (kW)	3.6
80%	EV-only Trips	90% (exp)
900	Miles between gas fill-ups	1000 (exp)

Gen 1 Volt

Gen 2 Volt

* Edmunds

1st to 2nd Generation BEV Improvements: Chevrolet Bolt EV

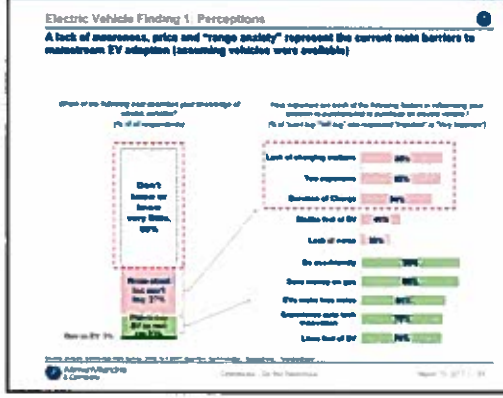
1st Gen EV (Spark EV)	Metric	2nd Gen EV (Bolt EV)
82 miles	EV Range	238 miles
19 kWh	Battery	60 kWh
4	Passenger Capacity	5
86.3 ft³	Passenger Volume	94.4 ft³
3 sec	0 to 30	< 3
7.2 sec	0 to 60	< 7
3.3 kW	Charger	7.2 kW
3 states	Availability	50 states

Chevrolet Spark EV

Chevrolet Bolt EV

EV Awareness – 2 Key Findings

July 2016 Market survey of 2,562 respondents (nationwide)



2 Key Findings:

- **60% know little/nothing about EVs**
- **Of the 27% that know something about EVs, 85% would not consider an EV because <u>there is not enough EV infrastructure</u>**

(Next reasons were expense and time-to-charge)

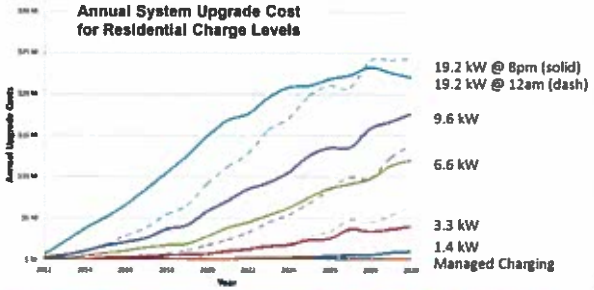
L1/L2 Charging Sites in Michigan (April 2018)

- **Level 1 / Level 2 = 310 stations (696 outlets)**
- **SAE J1772 (industry standard)**

The Grid Impacts of Plug-in Vehicle Charging

... there's a Cost if we ignore the EV Opportunity and don't plan!

Higher charge rates and unmanaged charging drive grid costs → smart charging and/or lower vehicle charge rates drive down grid costs



As the PEV market grows, it becomes increasingly important to apply smart charging

Source: Sacramento Municipal Utility District - Electric Grid Integration Costs for Plug-In Electric Vehicles (April 2013)

EV Infrastructure – Where, What, Why Guidance

GM – BKGross
March 2017

	Home		Work	Public			Commercial	Commuting	Road Trips
	Single Family Home	Multi-Unit Dwelling	Workplace Charging	Short dwell public	Mid dwell public	Long dwell public	Urban high-mileage applications	Urban to-Urban Corridors	Long distance Highway Corridors
Parking/ Charging description ... e.g.	Overnight	Overnight ... condos, apartments	Work shift	1-2 hours ... retail	4-8 hours ... parks, beaches	1-X days ... airports	High-use stations ... "shared", autonomous	(<200 miles)	(>200 miles)
Near-term	L1 or L2 (L2 recom'd)	Neighborhood L2 and DC (50kW)	L1 or L2	L2	L2	L1 or L2	High-speed DC 50-150kW (mega-stations)	High-speed DC 50-150kW	High-speed DC 150kW
Long-term	L1 or L2 (L2 recom'd)	L1 or L2 at Multi-Unit Dwelling	L1 or L2	L2	L2	L1 or L2	150-320kW	150-320kW	150-320kW
Importance to Consumers	Where most charging is done	Need to grow EV market to these consumers	Where many consumers see EVs for the 1st time (EV Showcase) and most used charging after "home"	Nice perk (and retailers benefit from increased in-store dwell time)	Increases practicality of EVs (the number of places an EV can go)	Increases practicality of EVs (especially among early adopters/ professionals)	Enables commercial EV business cases (e.g. Lyft/Uber car-hailing services)	Increases practicality of EVs (especially among early adopters/ professionals)	Increases consumer confidence in EVs (perception of endless EV range)

- Note, Professional installation of L1, L2 and DC is always recommended
- Note, Future 150-350kW SAE fast-chargers will be backward compatible, allowing 50kW EVs to charge

Station redundancy is especially important