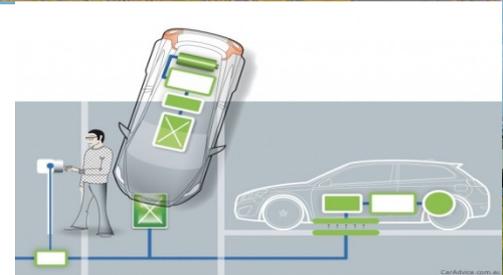
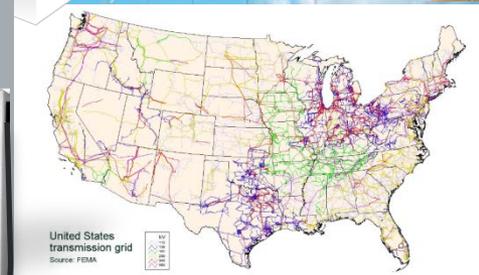


# *EV Everywhere* Grand Challenge

## Charging Infrastructure Enabling Flexible EV Design

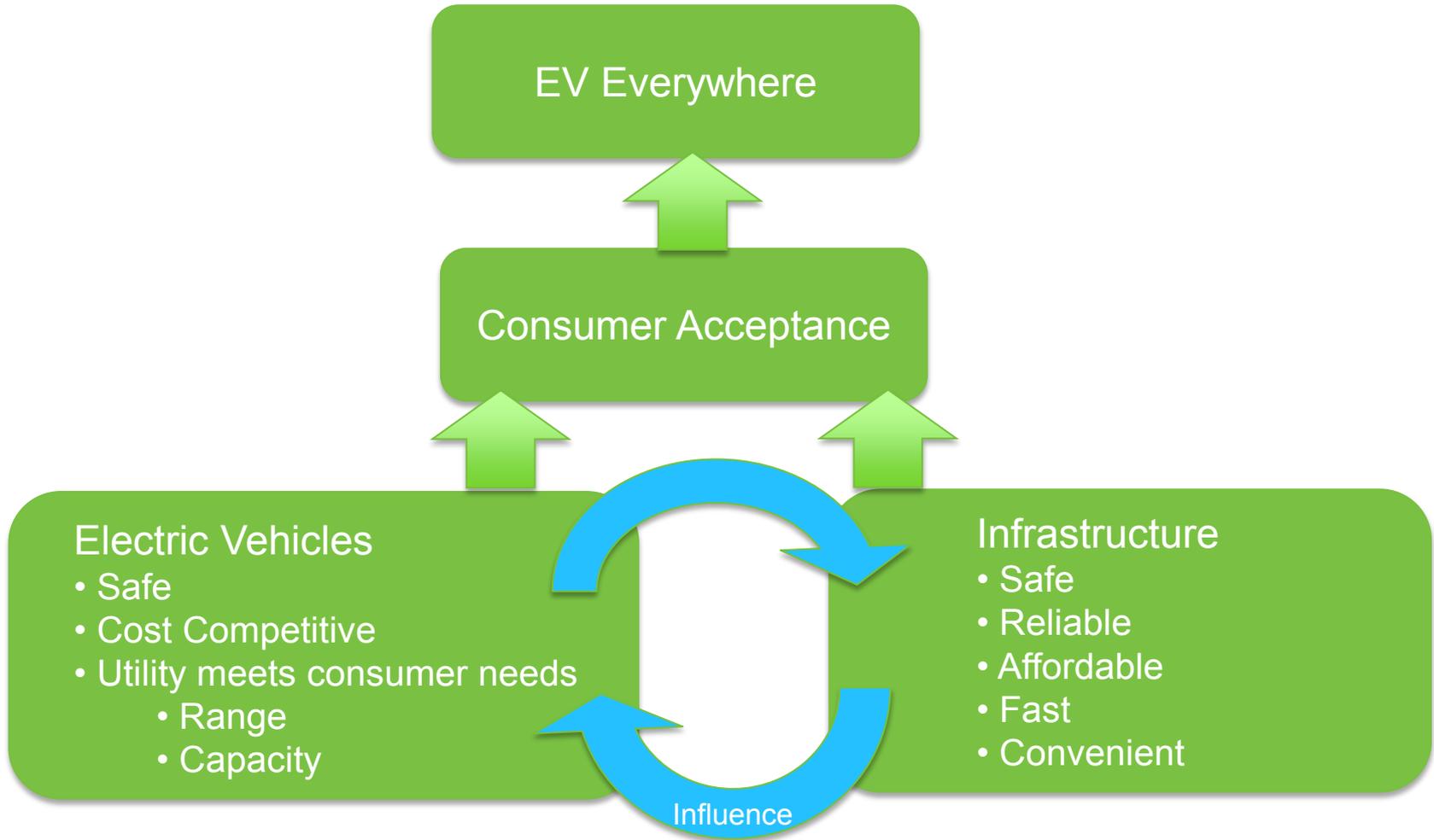


July 30, 2012

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- Purpose
  - Establish Vision for Achieving EV Everywhere
    - Enable Strong Demand for EVs
    - Supply of Vehicles and Infrastructure
    - Current Status of Infrastructure and Vehicles
    - Desired Workshop Outputs
- Approach
  - Design Candidate Infrastructure Strategies for 2022

# Achieving EV Everywhere – Enable Strong Demand for EVs



- Infrastructure
  - Timely deployment linked to EVs
    - Business models that attract private investment
    - Interoperable for nationwide compatibility with grid and EVs
  - Leverage existing grid to minimize costs
    - Maximize use of clean energy
- Electric Vehicles
  - Sell for a profit
  - Standardized components and Interfaces
  - Low cost technologies

# Current Status – Vehicle Operation and Economy



Prius Hybrid



Gasoline Operation



Prius Plug-in Hybrid



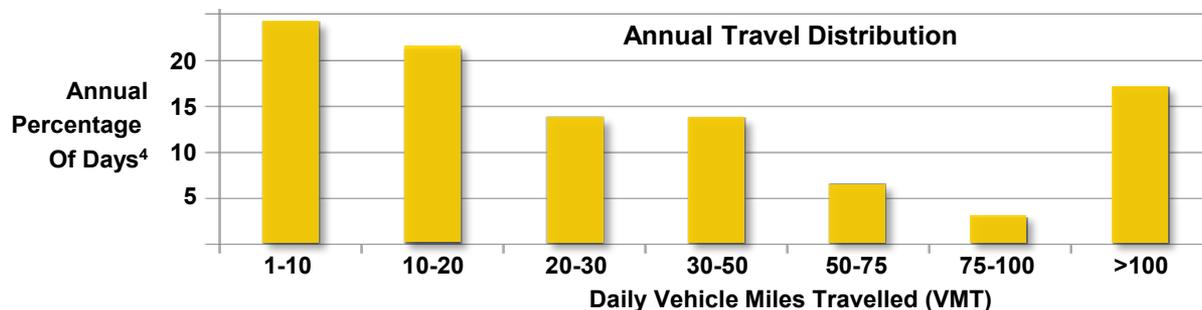
Volt Plug-in Hybrid (aka 'Extended-Range Electric')



Leaf Plug-in Electric



Electric Operation



% Miles  
Travelled  
Electric

Utility Factor

**EV Everywhere :** Do you really need 300 miles of range without charging?  
How much is that capability worth to consumers?  
How does it drive demand?

# Current Status - Charging Standards (U.S.)

 <p><b>Residential AC L1, AC L2</b></p>	<p><b>Charge Method</b> <i>Typical charge rates</i></p>	<p><b>Nominal Voltage/ Branch Circuit Rating</b></p>	<p><b>Charge Coupler (aka plug and receptacle)</b></p>
	<p><b>AC Level 1 RESIDENTIAL</b> 5 mi/hour @ 1.7 kW</p>	<p>120v/20A (15A continuous)</p>	
	<p><b>AC Level 2 RESIDENTIAL</b> 10 mi/hour @ 3.3 kW <b>COMMERCIAL</b> 20 mi/hour @ 6.6 kW</p>	<p>240v/20A (15A continuous) 208v/40A (32A continuous)</p>	
<p><b>Commercial AC L2, DC L2</b></p> 	<p><b>DC Level 2 (Fast Charging)</b> <b>COMMERCIAL</b> 165 mi/hour @ 50 kW</p>	<p><i>Standards in process</i>  480 V AC, 3Ø (supply to EVSE)</p>	

**EV Everywhere : Possible charging requirement is to provide 200-300 miles range in 10 minutes.  
The proposed range of power transfer is 7 -11 X of today's highest charging standard.**

# Current Status – Charge Times\* Versus Method

Plug-in Prius



Volt



Leaf



Residential  
AC L1, AC L2

**AC Level 1  
RESIDENTIAL**  
5 mi/hour @ 1.7 kW

2.6 hrs

10.5 hrs

20 hrs

**AC Level 2  
RESIDENTIAL**  
10 mi/hour @ 3.3 kW  
**COMMERCIAL**  
20 mi/hour @ 6.6 kW

1.3 hrs

4.25 hrs

10 hrs

Commercial  
AC L2, DC L2

**DC Level 2  
(Fast Charging)**

Not applicable

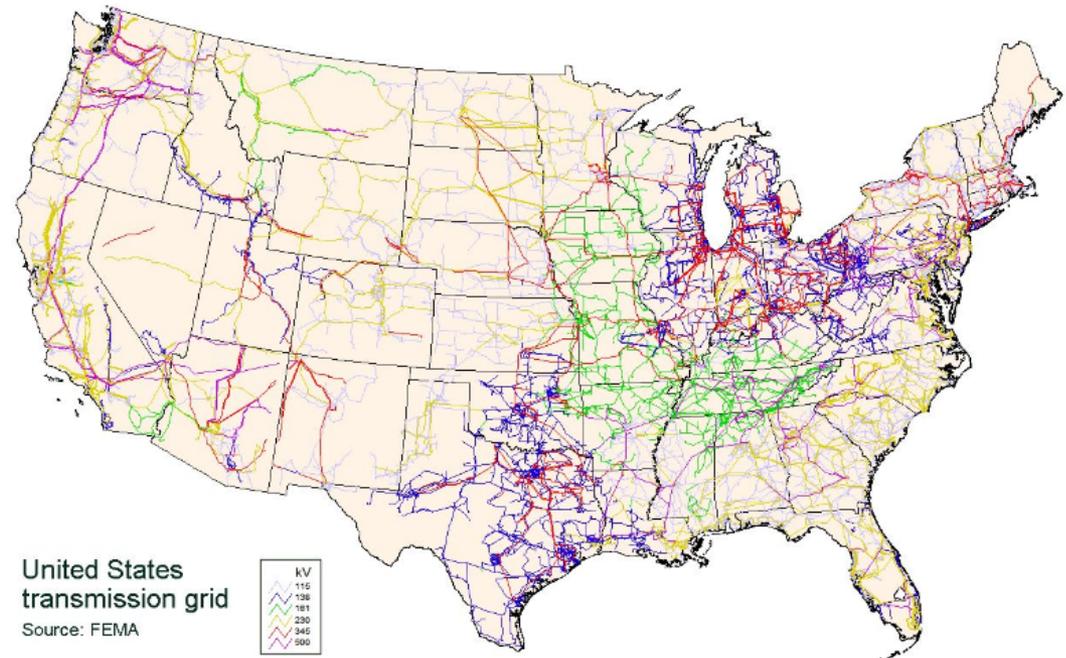
Not applicable

36 min

**COMMERCIAL**  
165 mi/hour @ 50 kW

\* Approximations using the charge rate (mi/hour) and nominal electric range (13, 40 and 100 mi, respectively);  
The AC Level 1 charge time for the Volt (10 hrs) is the GM estimate based on the 120v 1.2 kW charger provided as standard equipment with the vehicle  
10/12/2012

## Plug-in EV's Leverage Pre-Existing Infrastructure *EV Chargers are the last few feet!*



*US Grid is a **pre-existing** Trillion dollar energy transmission network !*

- Best candidate strategies for infrastructure to maximize consumer demand for EVs in 2022
- Characteristics of best candidate strategies
  - Infrastructure and vehicle attributes
  - Technology R&D needs
  - Codes and standards
  - Regulations
  - Players
- Action plans and timelines for implementing the strategies

- Session 1 – Define candidate strategies at a high level, Rank strategies
- Session 2 – Refine selected strategies
  - *What are the key attributes of the charging Infrastructure and vehicles?*
  - *How much infrastructure of each type is needed? Where is the infrastructure located?*
  - *What are the Pros, Cons, Costs, and Barriers?*
- Session 3 – Create action plans and timelines
  - *What are the limitations of the proposed ideas?*
  - *What are the R&D needs?*
  - *What are the Regulatory and Standards needs?*
  - *What are the funding requirements and sources?*
  - *Identify the actions needed.*
  - *Identify the appropriate leaders/participants for each action.*
  - *What are the timelines for the actions?*

- Group A – **Blue Dots** – Consumer Acceptability
  - Meridian Room (this room)
- Group B – **Yellow Dots** – Consumer Acceptability
  - Atlanta Room (ballroom level)
- Group C – **Green Dots** – Consumer Acceptability
  - Boston Room (ballroom level)
- Group D – **Red Dots** – Charging Infrastructure
  - Chicago Room (ballroom level)
- Group E – **Black Dots** – Charging Infrastructure
  - Dallas Room (ballroom level)