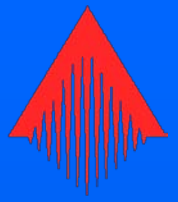
PHEV / EV Pros



1. Reduced foreign oil dependency

2. Lower emissions – even with coal electricity as centralized source is easier to control emissions. Electricity generation expected to become cleaner over time i.e. higher % of renewables, better technology.

3. Tax credit of up to $7,500 available.

4. While 78% of Americans live within 20 miles of their job…

   - Lower cost per mile for fuel ($0.025 vs. $0.20)* – could drive on electricity only for majority of all driving

     * $.10/kWh; 250 Wh/mi; gas 4.00/gal; 20 mi. /gal

   - Convenience: Get gas a few times a year instead of current average 24 to 36/yr.

PHEV / EV Pros

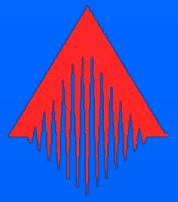
5. Help meet 2016 CAFÉ (Corporate Average Fuel Economy) standards. The average fuel economy for cars must improve from the current 27.5 mpg, where it has been since 1990, to 37.8 mpg by 2016.

6. Potential to help control electricity rates with better utilization of generation resources – IF charged off-peak.

7. Many parts U.S. made.

8. Evolving technology – Battery cost declining ($800 now, $300 by 2015), power density increasing.

PHEV / EV Cons



1. Initial cost: Volt is $41,000 (CR paid $48,700)- $7,500 tax credit = $33,500. Leaf $32,780 - $7,500 = $25,280

2. Cost to install level 2 charger (208-240 volts) in a home garage – $800 to $2,000 plus $1k to $2k for installation.

3. Environmental impact of battery manufacturing/disposal.

4. Battery life: Speed of discharge, depth of discharge, “topping off” to 100% SOC, heat - all affect battery life. For longest battery life charge to 85% to 90%. Tesla 58 kWh battery to last 5 to 10 years. GM says it is confident that everyone will get 10 years from the pack. Car resale value?

PHEV / EV Cons

5. Could stress utility distribution assets requiring substantial upgrade of electricity infrastructure: Current grid capacity could supply about 70% of our vehicles without adding capacity, but assumes 1) vehicle would charge only during off-peak, 2) “perfect” distribution of electricity, 3) No localized affects such as overburdening neighborhood transformers.

6. EV “Range Anxiety”. Are manufacturers range estimates reliable?

7. One million Electric Vehicles by 2015 = $7.5 billion tax credits borne by tax payers

8. Reduced range in cold weather – About 16% greater range at 70°F than 20°F*. Not good for MN owners but may experience longer battery life with cooler MN weather.

*The Impact of Driving Conditions on PHEV Battery Performance 1/1/2011

PHEV / EV Cons

9. Potential to increase electricity rates with sub-optimal utilization of generation resources IF cars are charged on-peak.

10. Consumer Reports review on Volt less than glowing: overall cost, cost per mile, comfort, range, charge time, heater output. “For now it seems that owning a Volt is an expensive way to be green”

11. Longer “fill time” than gas vehicle.

12. Economically competitive with Prius HEV @ $22k and 50 MPG? Volt in gas mode, $0.10/mi.; Prius $0.068/mi.

www.pluginamerica.org/vehicles

Electric cars around since early 1900's so what's different now?...

- Urgency of Energy and Environmental Challenges
- Battery Technology
- CAFE standards post 2016

Yes, there are Cons but they will be resolved with better batteries:

- Lower cost
- Higher power density
- Better thermal management

Build out of Charging Infrastructure

Key Today: Home Charging

- Need to get the cost and installation process right. Currently a significant barrier

Public Charging

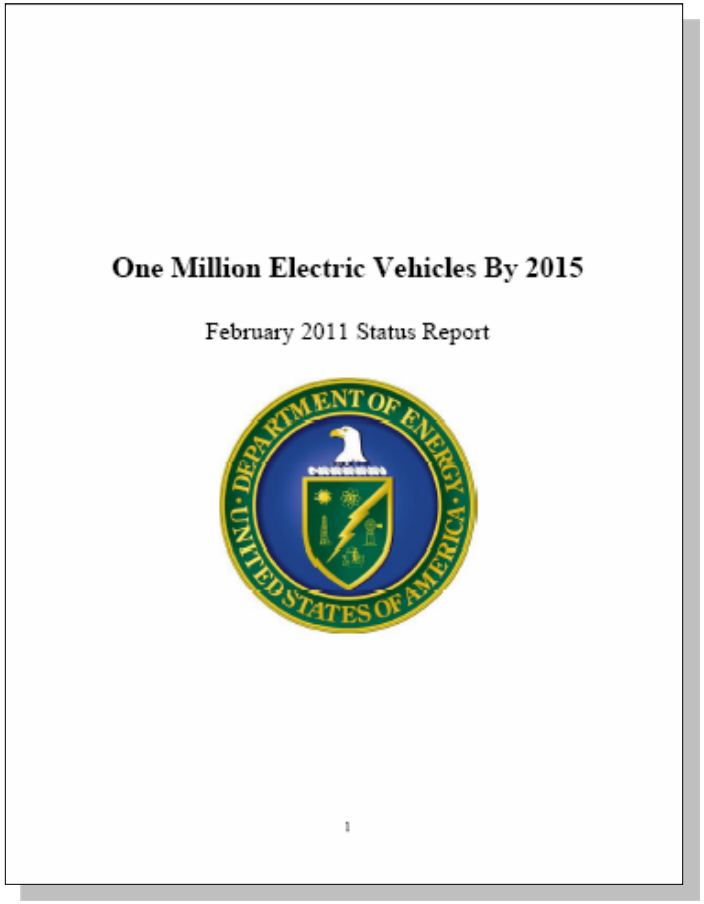
- Expensive if not well utilized
- Expansive to fully cover full driving patterns

Ideally need market pull to determine public infrastructure build out

- PHEV's are key to help initiate market pull for public infrastructure

Goal: 1 Million Electric Vehicles by 2015

- DOE Report on capacity to reach one million vehicles by 2015 released February 8, 2011.
- Key findings
  - Manufacturers already have plans for cumulative U.S. production capacity in the range of 1.2 million electric vehicles by 2015
  - This doesn't include vehicles from at least half a dozen manufacturers who have not announced production capacities
  - Consumer acceptance, existing R&D and policy measures are important to reaching the goal


One Million Electric Vehicles By 2015

February 2011 Status Report

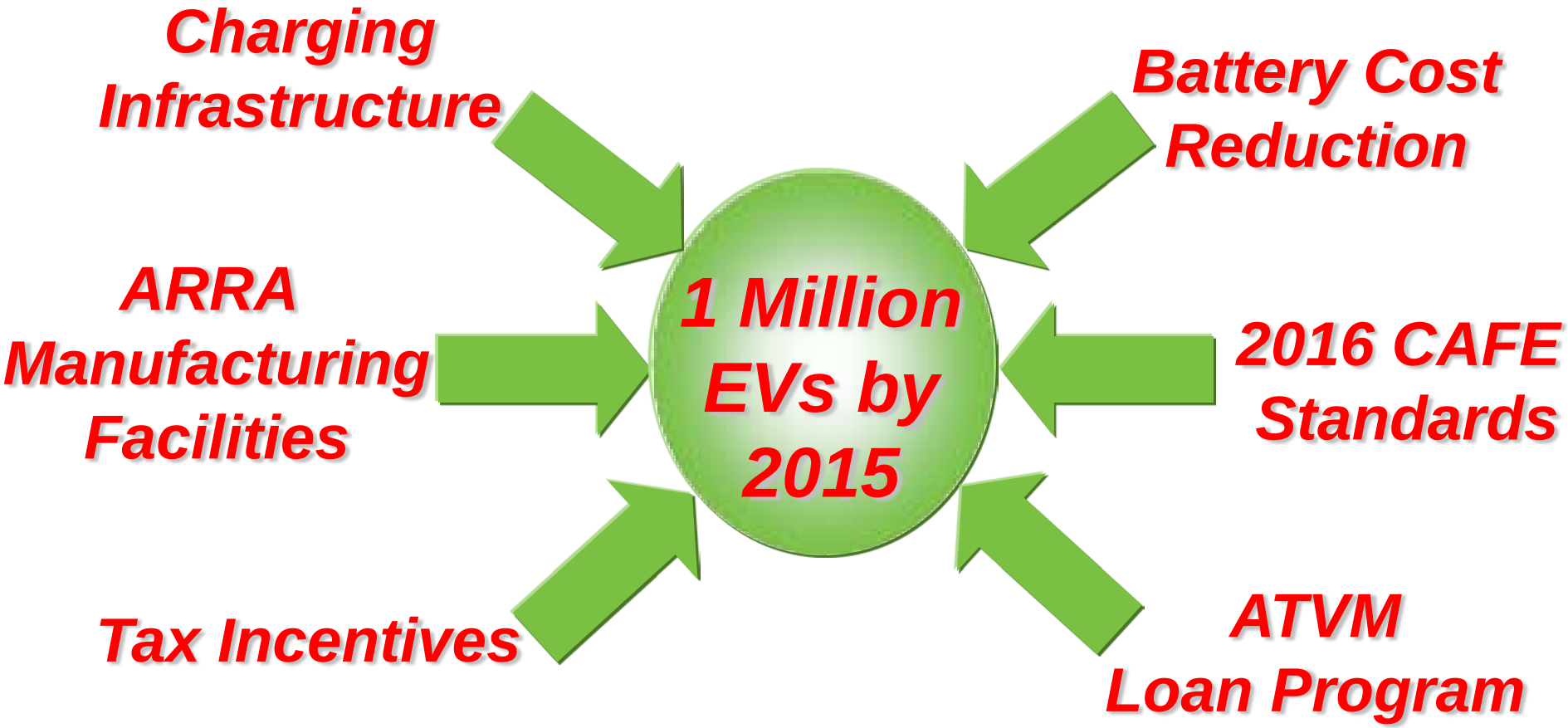
Estimated Cummulative Production Capacity Through 2015

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Estimated U.S. Supply of Electric Vehicles from 2011 through 2015						
Manufacturer and Model	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**
Fisker Karma PHEV	1,000	5,000	10,000	10,000	10,000	36,000
Fisker Nina PHEV		5,000	40,000	75,000	75,000	195,000
Ford Focus EV		10,000	20,000	20,000	20,000	70,000
Ford Transit Connect EV	400	800	1,000	1,000	1,000	4,200
GM Chevrolet Volt	15,000	120,000	120,000	120,000	120,000	505,000
Navistar eStar EV (truck)	200	800	1,000	1,000	1,000	4,000
Nissan LEAF EV	25,000	25,000	50,000	100,000	100,000	300,000
Smith Electric Vehicles Newton EV (truck)	1,000	1,000	1,000	1,000	1,000	5,000
Tesla Motors Model S EV		5,000	10,000	20,000	20,000	55,000
Tesla Motors Roadster EV	1,000					1,000
Think City EV	2,000	5,000	10,000	20,000	20,000	57,000
Cumulative Total						1,222,200

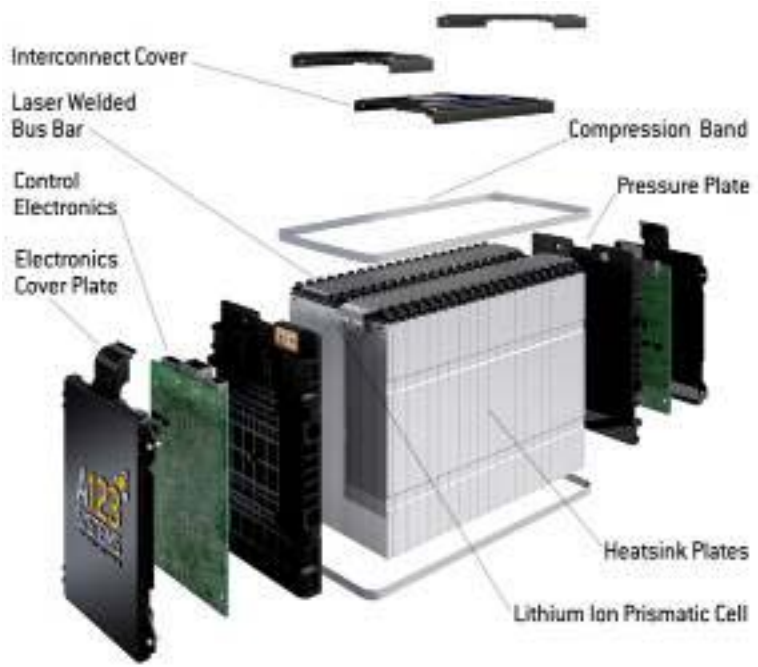
Estimates are from media reports and public statements

Reaching 1 Million EVs by 2015

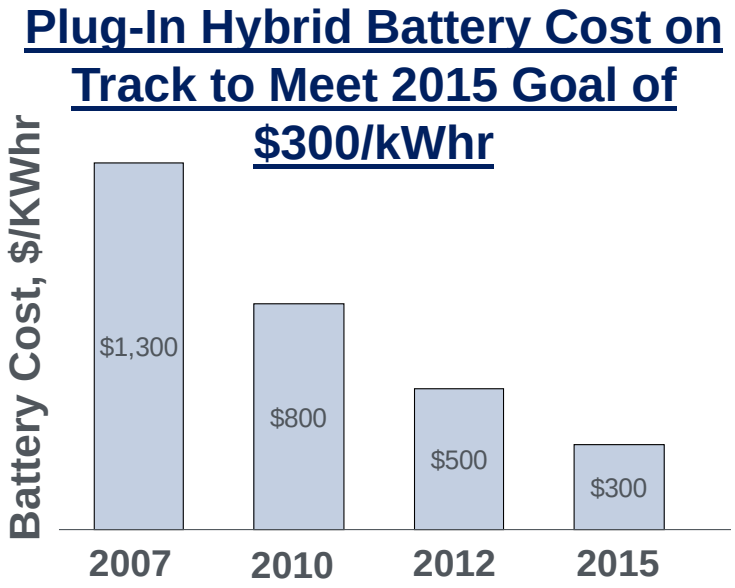


DOE Battery Innovation, Market Acceptance and Cost Reduction

- 1990's → Nickel Metal Hydride (NiMH) batteries enable commercial introduction of HEVs
- 2000 – 2010's → Li-ion batteries enable next generation HEVs, PHEVs and EVs (Volt)
- Future → Next Generation Chemistry with 3x energy density: Li(metal) battery



Battery Module Construction



Outlook for Battery Cost and EV Production Capacity

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

On Track to Meet Administration's Goal of 1 Million EVs by 2015

	Battery Cost ($ per kWh)	Battery Production Capacity (10 kWh packs) ARRA	Battery Production Capacity (10 kWh packs) ATVM	Vehicle Production Capacity (announced,cumulative)
2008 2009	$1,000-$1,200	0	0	0
2010 2011	$700-$950	50,000		45,600
2012	Goal = $500	150,000	144,000	223,200
2013				486,200
2014	Goal = $300			854,200
2015		500,000	488,000	1,222,200

9.88 GWh per year production capacity in 2015

>7.7 GWh per year capacity demand in 2015