

# Electric vehicle charging technology Today & Tomorrow

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## Electric Vehicles Today



Nissan Leaf BEV 2011  
To be built in Smyrna, TN



Smart BEV  
Production 2013



Tesla Roadster BEV  
Supercar 2010



Mitsubishi BEV  
Normal, IL



Chevy Volt EREV  
60,000 Hamtramck



Think City BEV  
Elkhart, IN

**engineexpo2012**  
Novi, Michigan



Ford Electric Focus  
Late 2012



Fisker Karma  
2012



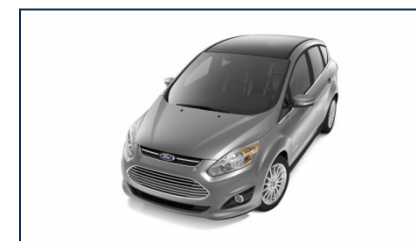
Tesla S  
July 2012



Ford C Max PHEV  
Est 2013



Toyota RAV4 Electric  
Summer 2012



Ford PHEV  
C Max 2013



## Electric & Plug-in Hybrid Large Vehicles



Smith Electric Newton



VIA Motors EREV  
Van, & P/U +4WD



Navistar EStar



PHEV Utility Trucks



Smith Electric School bus



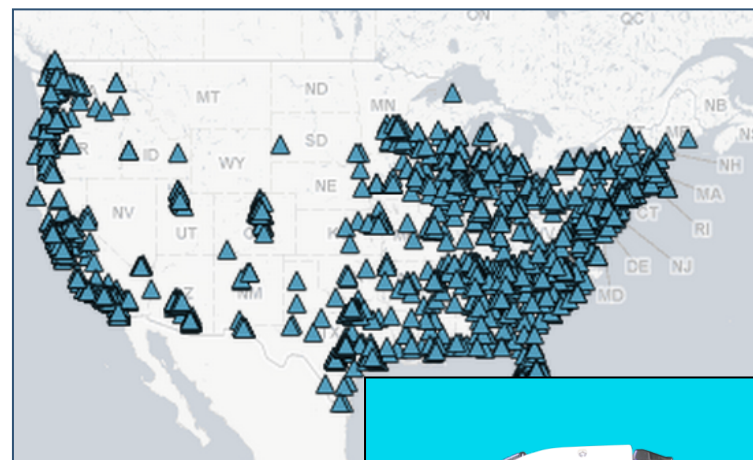
DesignLine Electric Bus  
Built in Charlotte, NC





## EV Charging Infrastructure

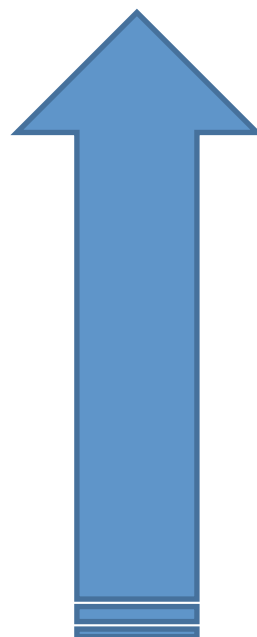
- ✓ Charging Standards are complete
- ✓ Charge station deployment underway
- ✓ Public access friendly – cost, location
- ✓ Costs reducing for EV's and Infrastructure
- ✓ Public education and awareness
- ✓ Next generation charging standards



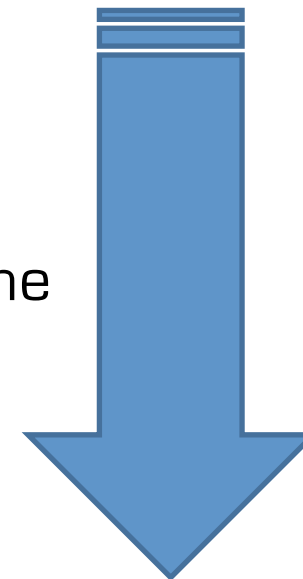


## Key Dynamics Driving Growth Passenger Car Market

- Driving Range
- Vehicle Performance
- Variety – PHEV & EV
- Design for Efficiency
- Consumer acceptance



- Vehicle Cost
- Charging Time
- Energy Cost





## EV Charging Power & Energy Storage

### Vehicle Charging Power Increasing

Cars from 3 to 6 kW per hour

Trucks from 6 to 12 to 20 kW per hr

### Driving Range:

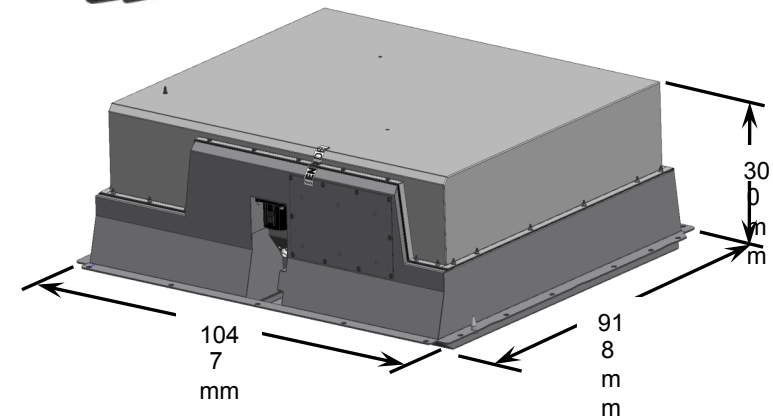
Cars - 5 Mi per kW-Hour

Trucks - 3 Mi per kW-Hour

### Battery Capacity

E- Cars - 20 to 85 kW- Hr

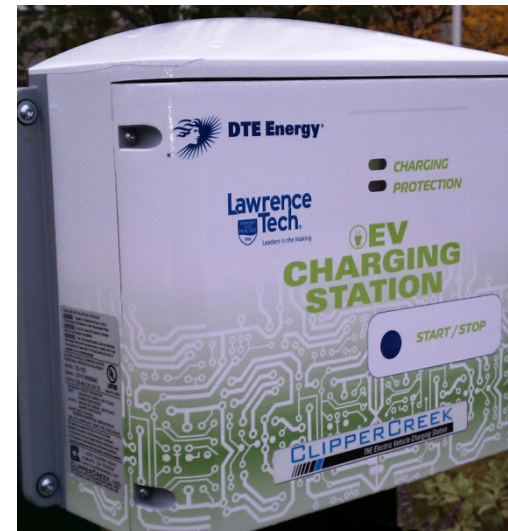
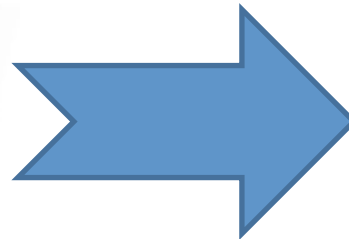
E- Trucks - 24 to 80 to 240 kW-Hr





## Smart Grid Deployment

- Vehicle to grid communication
- Demand side control – load shedding
- Off–peak charging incentives
- Free charging !

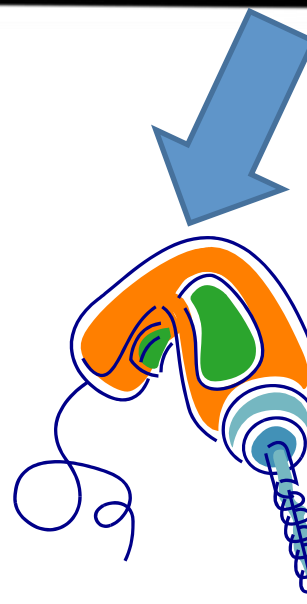






## Now What?

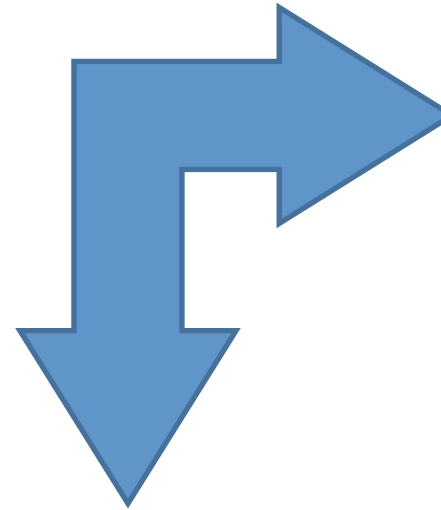
- **Vehicle Export Power**
  - Vehicle to Home
  - Emergency Power
  - Portable Power





## Now What?

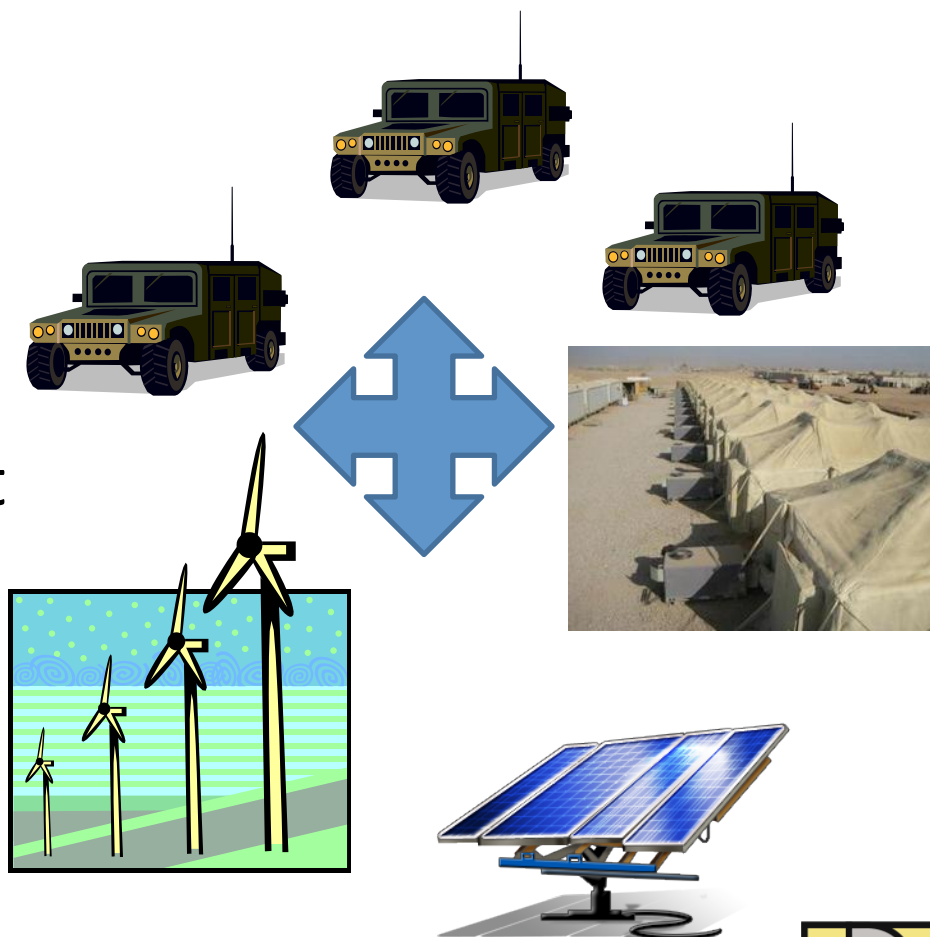
- **Vehicle to Grid (V2G)**
  - Utility grid stabilization
  - Peak power management





## Now What?

- **Micro Grids (V2G)**
  - Military deployment
  - Remote locations
  - Off-the-grid



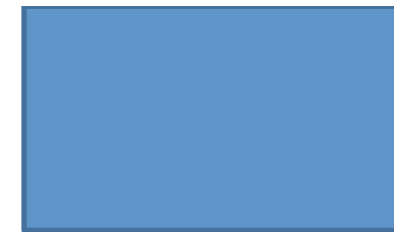
**engineexpo2012**  
Novi, Michigan



# 2012 Fisker Karma PHEV







# Thank You !

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