“E2: Implications for Advanced Vehicle Energy Technologies”

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Energy and Environmental Implications of Automated Transportation
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“Advanced Vehicle Energy Technologies”?

DOE’s Office of Energy Efficiency and Renewable Energy funds Transportation efforts via:

• Vehicle Technologies Office
• Bio-Energy Technologies Office
• Fuel Cell Technologies Office
DOE’s Vehicle Technologies Office’s Advanced Technologies

- Combustion
- Batteries & Elec. Drive Components
- Materials
- Fuels & Lubes
- Deployment
- Vehicle Systems
A Clean Energy Grand Challenge

- Enabling plug-in vehicles to be as affordable and convenient for the American family as conventional gasoline-powered vehicles by 2022
- Bring together America’s best and brightest scientists, engineers, and businesses to produce EVs at lower cost, with improved vehicle range and increased fast-charging ability

EV Everywhere Goal

Enable the U.S. to be the first in the world to produce plug-in electric vehicles that are as affordable and convenient as today’s gasoline-powered vehicles within the next 10 years

For a copy of the Blueprint, visit electricvehicles.energy.gov

President Obama announced EV Everywhere during a visit to Daimler Trucks in North Carolina, March 2012
Workplace Charging Challenge

Workplace Charging Challenge Goal
Increase number of U.S. employers offering workplace charging by tenfold in five years.

- Benefits for the big picture
  - Fill infrastructure gap
  - Grow the PEV market
  - Increase visibility of PEVs
  - Add electric VMT

- Benefits for the employer
  - Employee benefit
  - Corporate sustainability
  - Contribute to LEED certification
  - Keeping up with the Googles

>40 Partners

>10 Ambassadors
DOE’s SuperTruck Program

President Obama Highlights Success, February 2014:
VTO Analysis Portfolio at a Glance

Models and Tools:

- VISION, NEAT
- MA3T, ADOPT, LV Choice, StoCo, ParaChoice, LAVE-Trans, TRUCK
- GREET
- Autonomie, FASTSim, HTEB
- TEDB, xEV data, SRA database

Integrated Analysis

- Macro-econ. Accounting
- Market Penetration
- Emissions and Environmental Modeling
- Vehicle Modeling and Simulation
- Technology and Market Data
Metric of Interest: Emissions

Low, Medium & High GHGs/mile for 2035 Technology, Except Where Indicated

2012 Gasoline
Gasoline
Diesel
Natural Gas
Corn Ethanol (E85)
Cellulosic E85
Cellulosic Gasoline
Gasoline
Cellulosic E85
Cellulosic Gasoline
Gasoline & U.S./Regional Grid
Gasoline & Renewable Electricity
Cellulosic E85 & Renewable Electricity
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Cellulosic Gasoline & Renewable Electricity
BEV100 Grid Mix (U.S./Regional)
BEV100 Renewable Electricity
BEV300 Grid Mix (U.S./Regional)
BEV300 Renewable Electricity
Distributed Natural Gas
Nat. Gas (Central) w/Sequestration
Coal Gasif. (Central) w/ Sequestration
Biomass Gasification (Central)
Wind Electricity (Central)

Conventional Internal Combustion Engine Vehicles

Hybrid Electric Vehicles

Plug-in Hybrid Electric Vehicles (10-mile [16-km] Charge-Depleting Range)

Extended-Range Electric Vehicles (40-mile [64-km] Charge-Depleting Range)

Battery Electric Vehicles (100-mile [160 km] and 300-mile [480-km])

Fuel Cell Electric Vehicles

0 50 100 150 200 250 300 350 400 450 500
Grams CO₂e per mile

430

180
160
165
190
110
100
76
73
66
58
48
44
35
30
120
100
44
170
170
150
170
51
76
66
48
44
35
30
Metric of Interest: Cost

Notes: Average distance driven per car-year derived from USDOT/NHTSA analysis (13,500 Miles / 22,500 km per year), 7% net discount rate for future fuels expenditures, 5-Year Ownership, 2010 Dollars
Opportunities for Connected/Automated Vehicle Models and Tools?

- U.S.-wide transportation energy use?
- Consumer behavior/reaction?
- Emissions effects?
- Significant vehicle and component redesign?
- New vehicle use patterns?

Integrated Understanding?

- Macro-econ. Accounting
- Market Penetration
- Emissions and Environmental Modeling
- Vehicle Modeling and Simulation
- Technology and Market Data
Considerations for today’s discussion:

Technologies:
• Energy Storage
• Traction Drives
• Lightweighting
• Advanced Combustion
• Fuels and Lubricants

Mobility Design:
• Vehicle(s)
• Infrastructure(s)
• System(s)
## Vehicle connectivity and automation (even at varying levels?) could facilitate:

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<td><em>intelligent refueling? fewer stations?</em></td>
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<td><strong>Infrastructure</strong></td>
<td><em>intelligent recharging?</em></td>
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