FHWA EV Feasibility Project

Nature's Call to Action II

Frankfort, Kentucky

April 2014

EV Feasibility Project Basics

- Feasibility and Implications of Electric Vehicle (EV) Deployment and Infrastructure Development
  - Lead Office: FHWA Office of Natural Environment
- Project Team:

CADMUS

RICARDO-AEA

good COMPANY

ERG

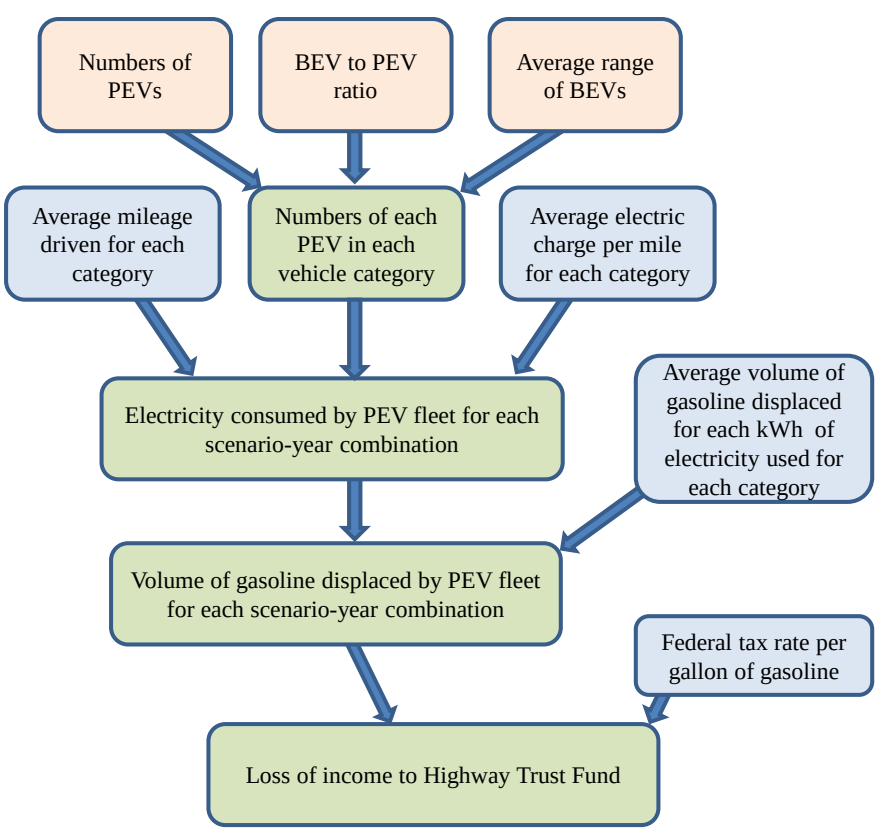
Motivation for Research

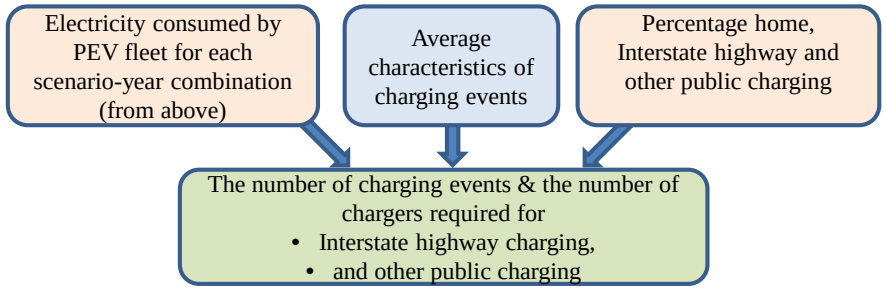
- Existing highway infrastructure and funding is designed around conventionally fueled vehicles.
- Widespread adoption of EV technologies could have major implications on both of these areas.
- FHWA needs to understand whether future changes in the vehicle fleet have implications for its mission and programs.

Progress to Date

- Completed **literature review** to gather information from academic journals and other publically available sources related to EVs and their deployment.
- Undertook **interviews with industry and government experts** that were flagged as key information holders and reviewed suggested internal agency documents.
- Held **EV Forum** with attendance from ~50 practitioners in the energy, highway, and vehicle sectors to solicit expert input to the technical aspects of the project.
- Developed variables and dependent parameters for the **EV deployment scenarios**.
- Undertook scenario **analysis**, investigating the implications of the EV deployment scenarios on FHWA's mission and other potential impacts.
- Developed four **case studies** of EV deployment: California Bay Area and Monterey Bay Area; North Carolina Greater Charlotte Region; Oregon I-5 Metro Areas; Texas Greater Houston Area.
- Developed a draft **Final Report**.
- Undertaking **outreach** to key stakeholders at relevant conferences and events.

General Scenario Analysis Methodology





Key

Data specified in the scenario definitions

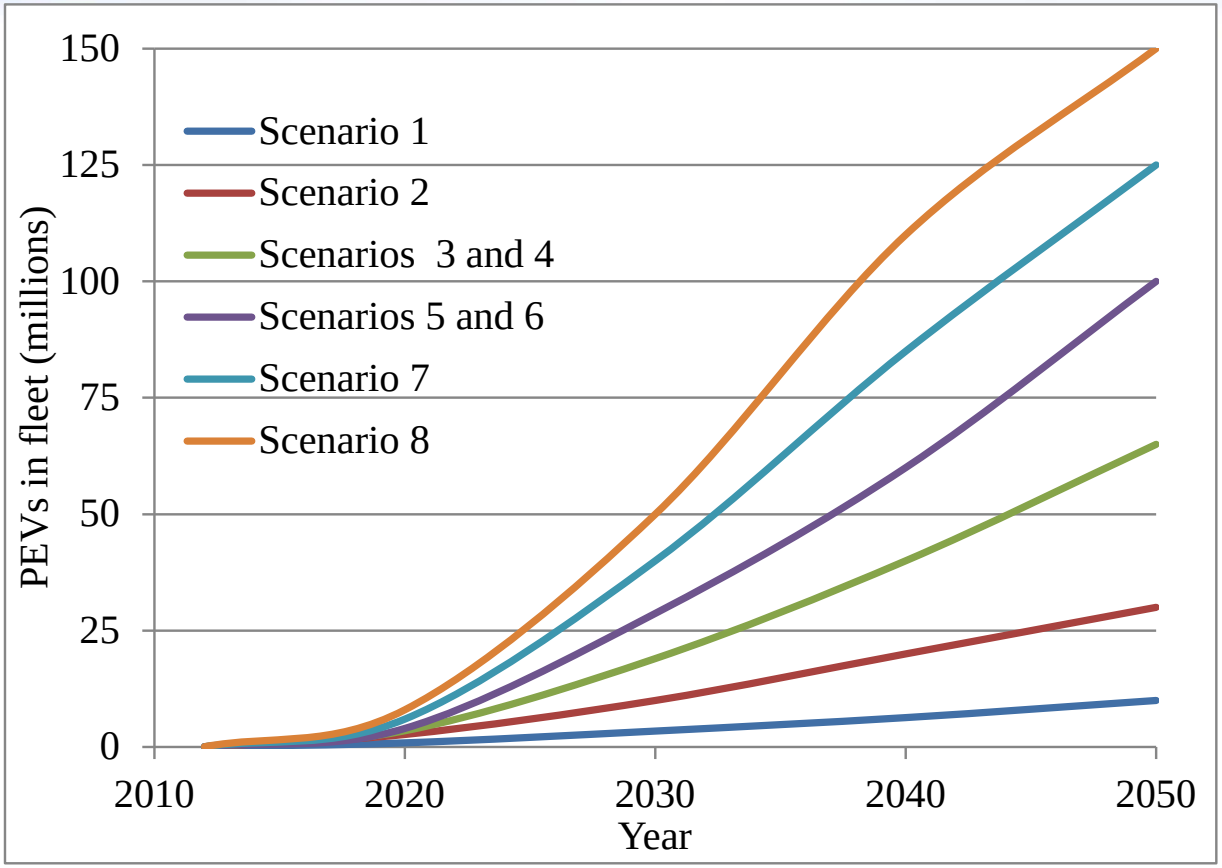
Assumed characteristic

Calculated implications

EV Feasibility Project: Deployment Scenario Assumptions

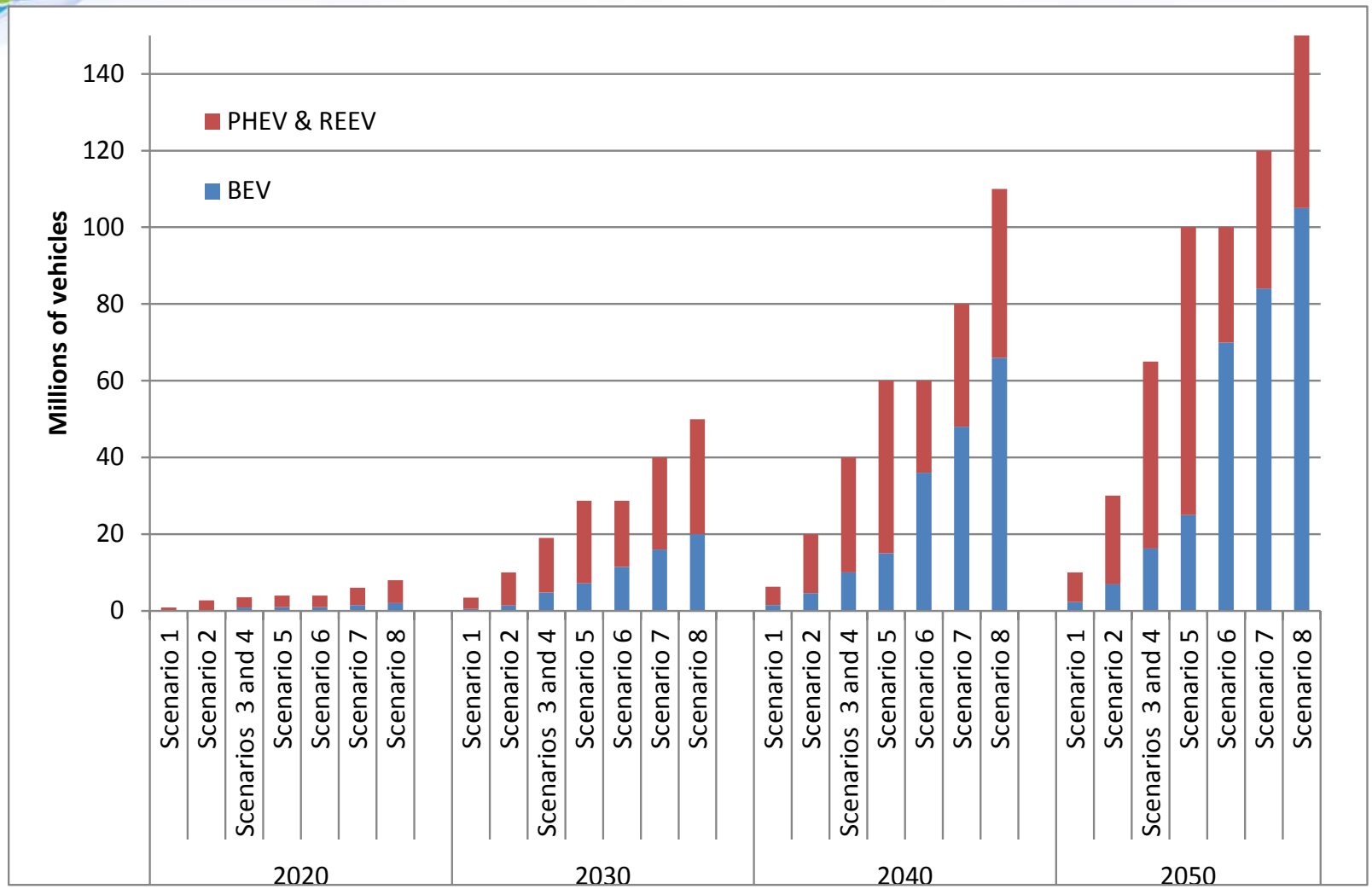
	PEV uptake	BEV/PEV ratio	Average BEV Range	Charging away from home in 2050 (on interstate highways)
Scenario 1	EIA AEO 2013	EIA AEO 2013	EIA AEO 2013 (100 miles)	5.0% (1.0%)
Scenario 2	Value for Scenario 1 multiplied by ~3	EIA AEO 2013	100 miles	5.0% (1.0%)
Scenario 3	Value for Scenario 1 multiplied ~6	Around 25%	150 miles	5.0% (2.0%)
Scenario 4	Scenario 3	Scenario 3	Scenario 3	30.0% (15.0%)
Scenario 5	“Medium” PEV growth	Scenario 3	150 miles	5.0% 2.0%
Scenario 6	“Medium” PEV growth	~60% by 2040	180 miles	20.0% (3.0%)
Scenario 7	“Medium” growth from EPRI + 40%	Scenario 6	180 miles	20.0% (5.0%)
Scenario 8	“High” PEV growth	Scenario 6	220 miles	30.0% (15.0%)

PEV Deployment Scenarios – Vehicle Numbers



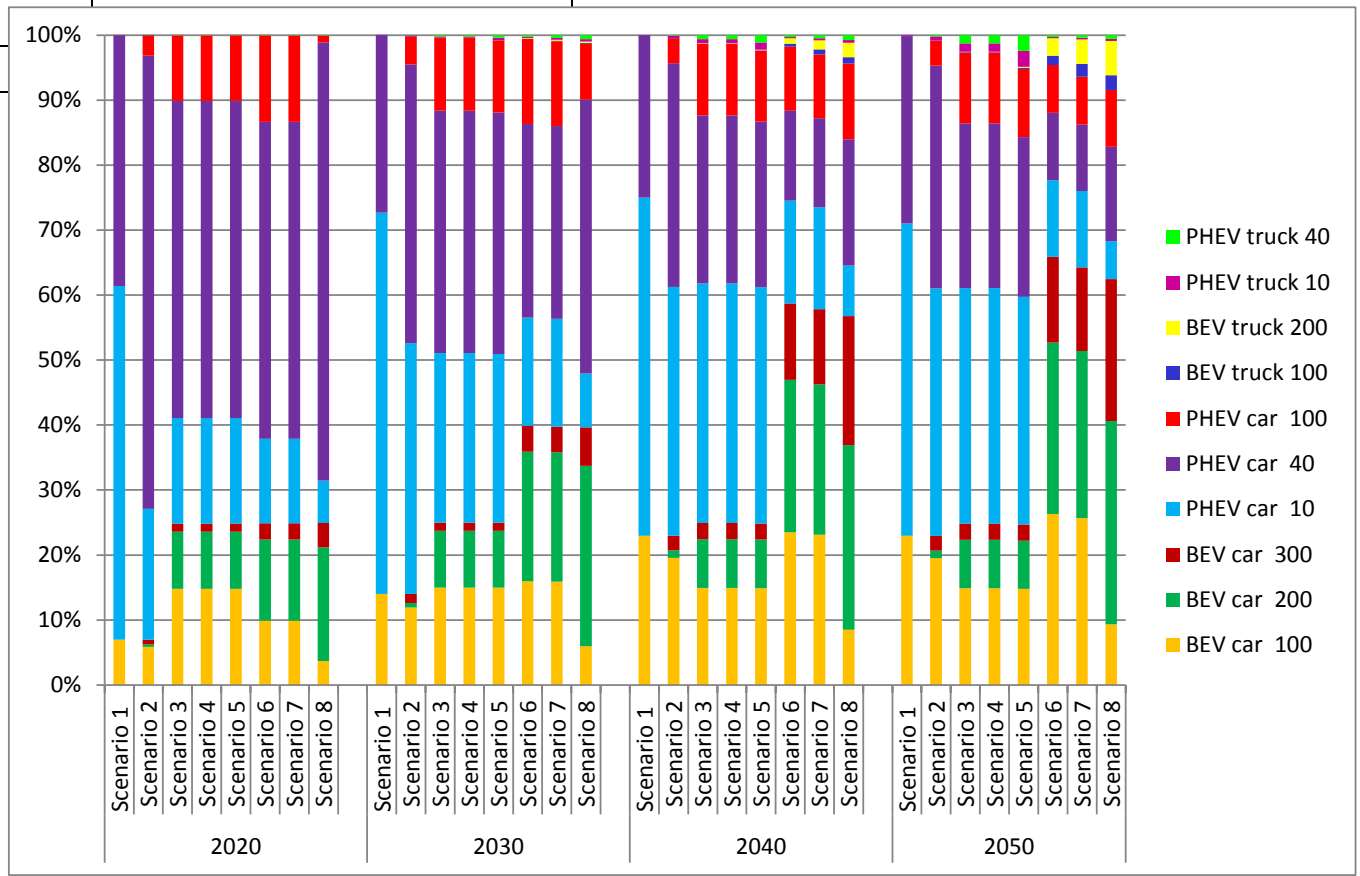
- **Scenario 1** **Based on AEO 2013 reference case**
- **Scenarios 2, 3 (& 4)** **PEV numbers developed for this research between Scenarios 1 and 5**
- **Scenarios 5 (& 6)** **Based on EPRI "Medium" PEV growth projections**
- **Scenario 7** **PEV numbers developed for this research between Scenarios 5 and 8**
- **Scenario 8** **Based on EPRI "High" PEV growth projections**

BEV and PHEV & REEV Counts by Scenario-year Combination



PEV Categorization

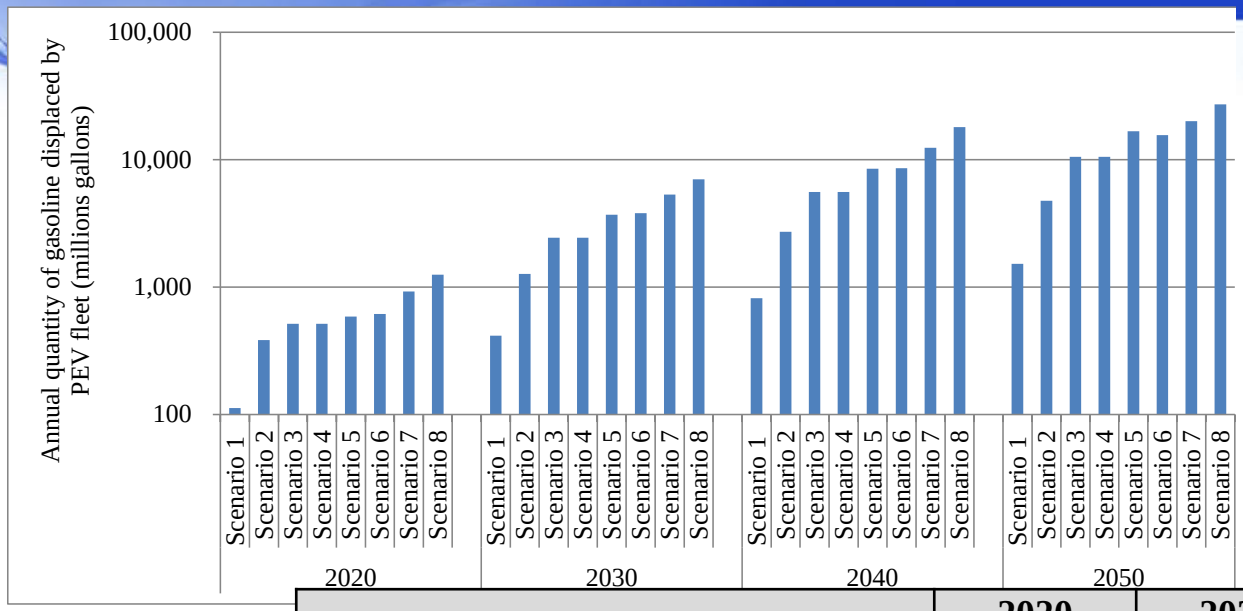
Types of PEV - passenger cars	Types of PEV - light trucks
BEV 100-mile range	BEV 100-mile range
BEV 200-mile range	BEV 200-mile range
BEV 300-mile range	PHEV 10-mile range
PHEV 10-mile range	PHEV 40-mile range
PHEV 40-mile range	
PHEV 100-mile range	



Scenario Analysis

- The eight deployment scenarios analyzed for their potential impacts:
  - Public charging infrastructure needed
    - how many? where?
  - Number of types of charging events
    - Private, public, Interstate; fast vs slow charge
  - Fuel savings/displacement
  - Fuel tax revenues

Decrease in annual vol. of gasoline consumed by the U.S. light vehicle fleet due to PEVs

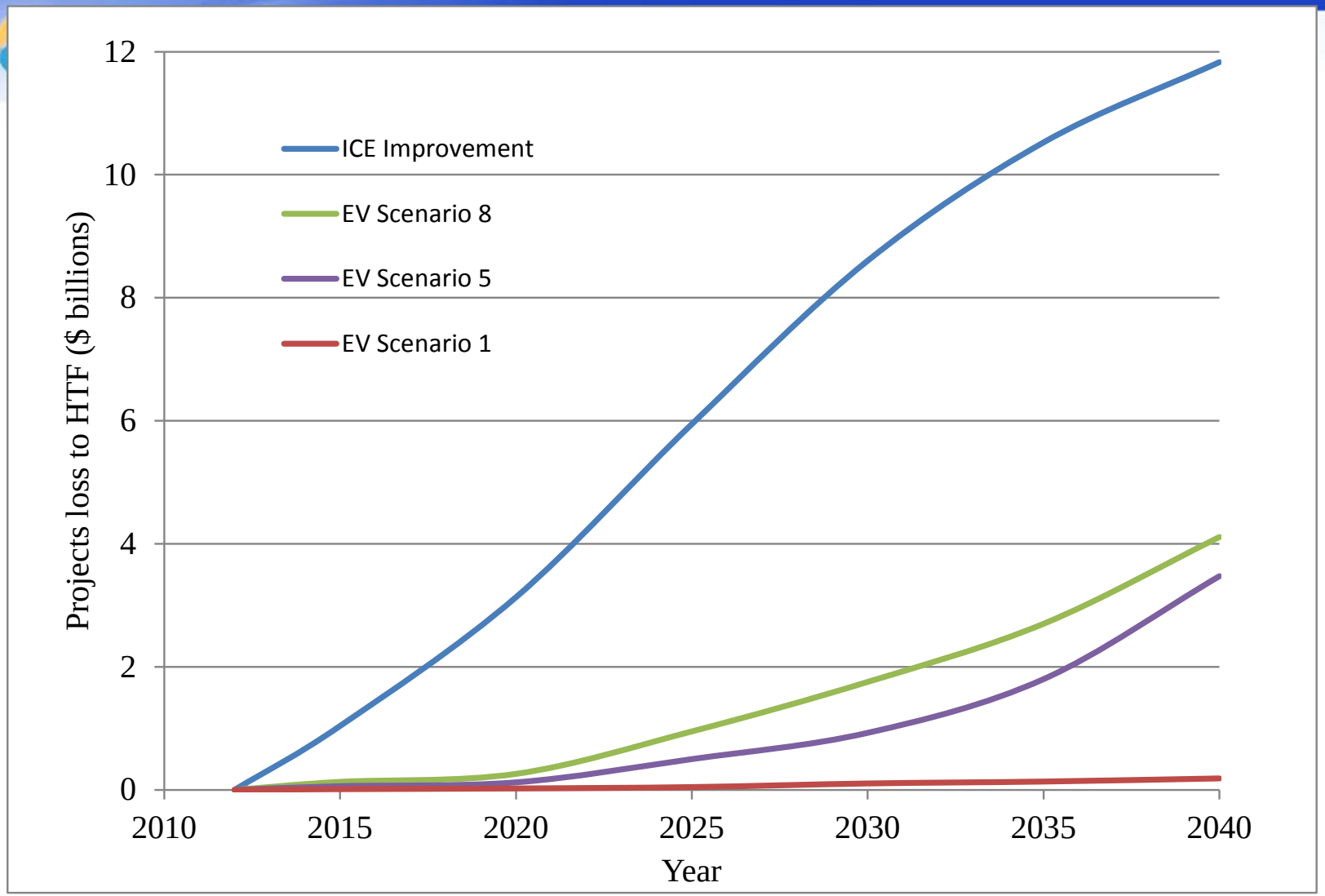


	2020	2030	2040	2050
AEO 2013 predictions for gasoline used in United States (millions gallons)	125,655	111,772	108,777	108,777
Scenario 1 predictions (lower bound) for gasoline displaced by US PEV fleet (millions gallons)	112	414	816	1,524
Scenario 8 predictions (upper bound) for gasoline displaced by US PEV fleet (millions gallons)	1,249	7,007	18,029	27,189
% of US gasoline consumption displaced (see Note 1)	0.09–0.99%	0.37–6.27%	0.75–16.57%	**1.40–25.00%**
PEVs as % light vehicle fleet	0.38–3.34%	1.31–19.05%	2.23–38.78%	**3.31–49.67%**

Reduction in annual federal fuel tax revenue caused by electric PEV travel by scenario (billion dollars)

		2010	2020	2030	2040	2050
Sc 1	Baseline	0.002	0.023	0.104	0.186	0.317
Sc 2	Modest additional growth	0.002	0.079	0.312	0.603	0.966
Sc 3	Larger additional growth	0.002	0.107	0.611	1.269	2.193
Sc 4	Larger growth & Interstate highway charging	0.002	0.107	0.611	1.269	2.193
Sc 5	Based on EPRI medium growth	0.002	0.122	0.927	1.932	3.474
Sc 6	Based on EPRI medium growth and extended range	0.002	0.128	0.951	1.954	3.250
Sc 7	Larger growth than Sc 6	0.002	0.192	1.332	2.820	4.170
Sc 8	Based on EPRI high growth, extended range & highway charging	0.002	0.260	1.755	4.108	5.657

The reduction in revenue relative to a constant 2012 level of ICE fuel efficiency



EV Feasibility Project: Early Conclusions and Implications

- Implications for FHWA & DOTs
  - Policy and Legal
    - HOV lane policy
      - Policies exist (and could be expanded) to encourage uptake of PEVs to use HOV lanes - implications for signage and law enforcement
    - MAP-21 and EV charging infrastructure:
      - Clarifies that infrastructure may not be placed in Interstate Rest Areas
      - Creates opportunities for federal financing at fringe or corridor parking facilities (off of the Interstate ROW) with STP funds or other locations with CMAQ funds
      - Implications for location and type of charging infrastructure
  - Safety, emergency services, and incident response
    - First responder training needed nationally (ongoing NHTSA and DOE work)
    - ADA standards for charging stations need to be considered
    - Vehicle quietness concern for pedestrians (at low speeds only)
    - Debate about likelihood of EV drivers getting stranded on the side of the road
    - (~1.1% of incidents for “out of gas’)

EV Feasibility Project: Early Conclusions and Implications

- Implications for FHWA & DOTs
  - HTF Impacts
    - Will have impact on HTF, but not as much as CAFÉ
    - Replacing lost revenue with charging income
      - Vehicle tax
      - Road user fee
      - Other?
  - Potential Climate Benefits of PEVs
    - Tailpipe emissions – no GHG or criteria air pollutants
    - Depends on how electricity is being generated
      - Coal
      - Natural gas
      - Nuclear
      - Hydro

For More Information

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Final report should be available on FHWA's web site Summer 2014