FHWA EV Feasibility Project

EV Roadmap July 28th, 2015

EV Feasibility Project team

- 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

* Electric Vehicles (EVs) that are powered at least in part by plugging into the electric power grid.

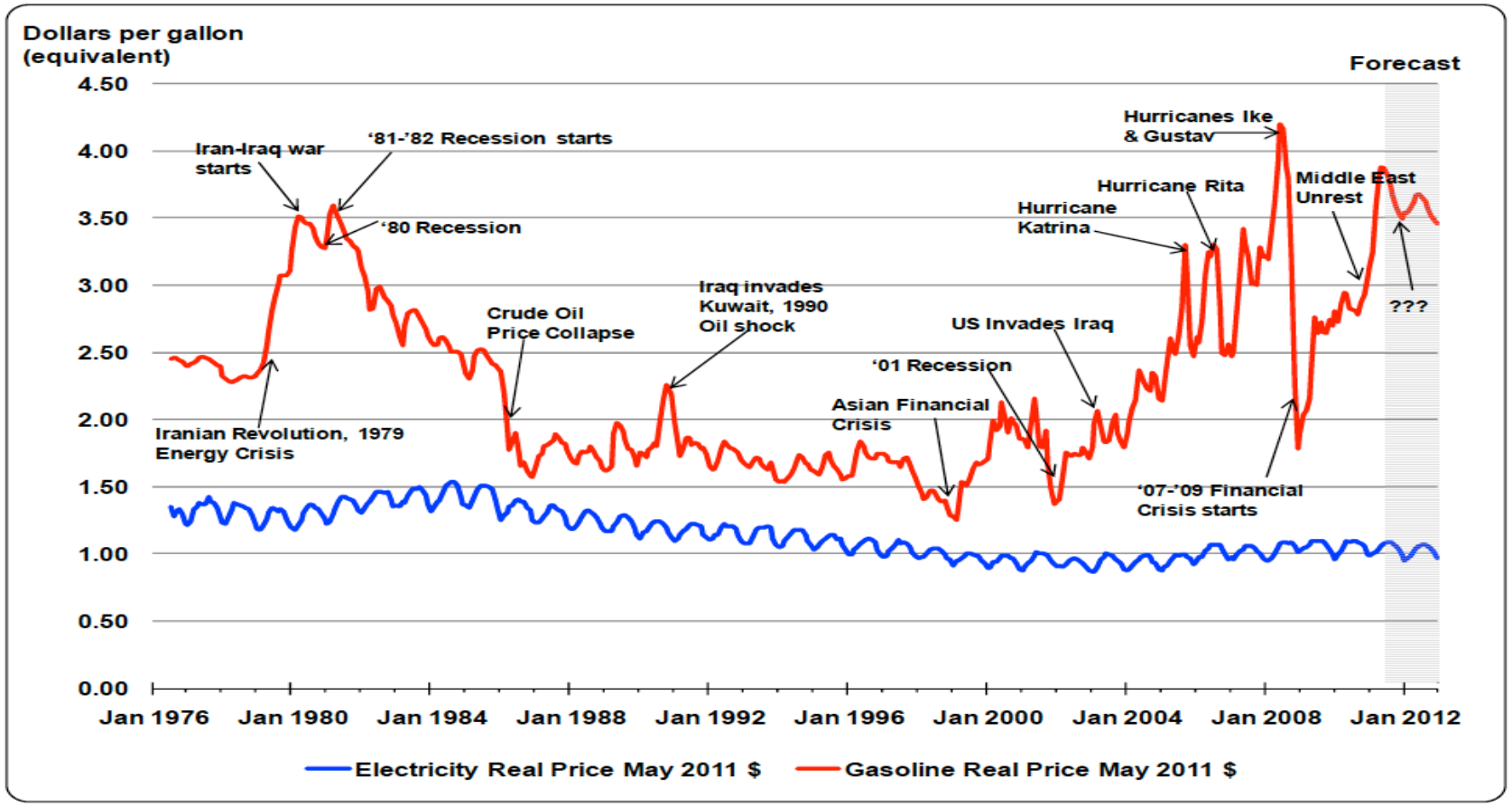
Context

- 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.

How far can alternative fuels get us?

Feedstock Source	Gasoline Equivalent - billion gallons per year			
	U.S.	% of baseline	Califorinia	Oregon
Baseline (2013)	187	n/a	17.6	2.0
Gasoline	134	71.7%	14.9	1.5
Diesel	53	28.3%	2.7	0.5
Total Cellulosic Ethanol	12.9	6.9%	1.348	0.732
Forest Residue	2.2	1.2%	0.075	0.157
Ag. Residue (corn, wheat, barley)	4.7	2.5%	0.075	0.031
Urban Wood Waste and Secondary Mill Residue	1.2	0.6%	0.226	0.025
Primary Mill Residue	2.4	1.3%	0.198	0.414
Mixed Waste Paper	1.5	0.8%	0.4	0.041

Fuel cost vs. electricity cost



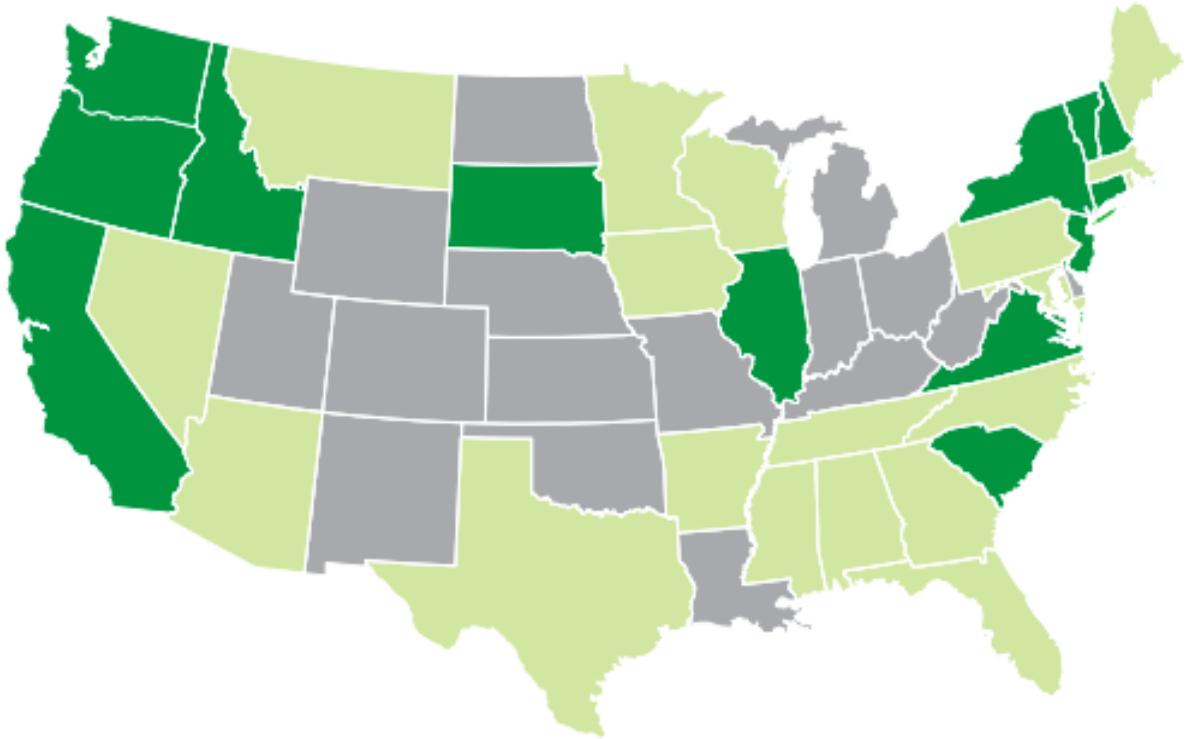
Source: Edison Electric Institute (EEI, 2011)

MPG equivalent - GHG per mile from different electric power sources

Electricity source	Well-To-Wheels EV Miles Per Gallon Equivalent (mpg_{ghg})
Coal	30
Oil	32
Natural Gas	54
Solar	500
Nuclear	2,000
Wind	3,900
Hydro	5,800
Geothermal	7,600

Anair, Don and Amine Mahmassani. “State of Charge.” Union of Concerned Scientists, June, 2012.

Electric LEAF vs. Prius



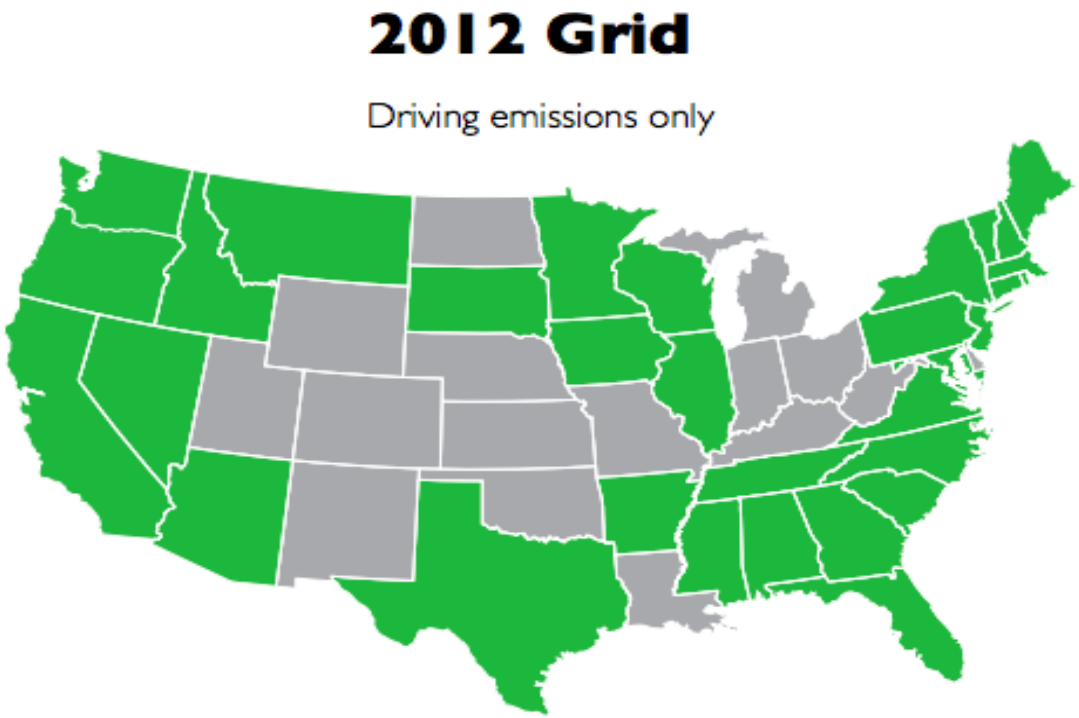
States where Leaf is more climate friendly than Prius based on total lifecycle emissions per mile

States where Prius is more climate friendly than Leaf based on total lifecycle emissions per mile

States where Prius is more climate friendly than Leaf based on lifecycle emissions, but where Leaf would be more climate friendly if manufacturing emissions were not considered

Climate Central

Renewable Portfolio Standards make a difference



States where the Leaf is more climate friendly than the Prius

Climate Central

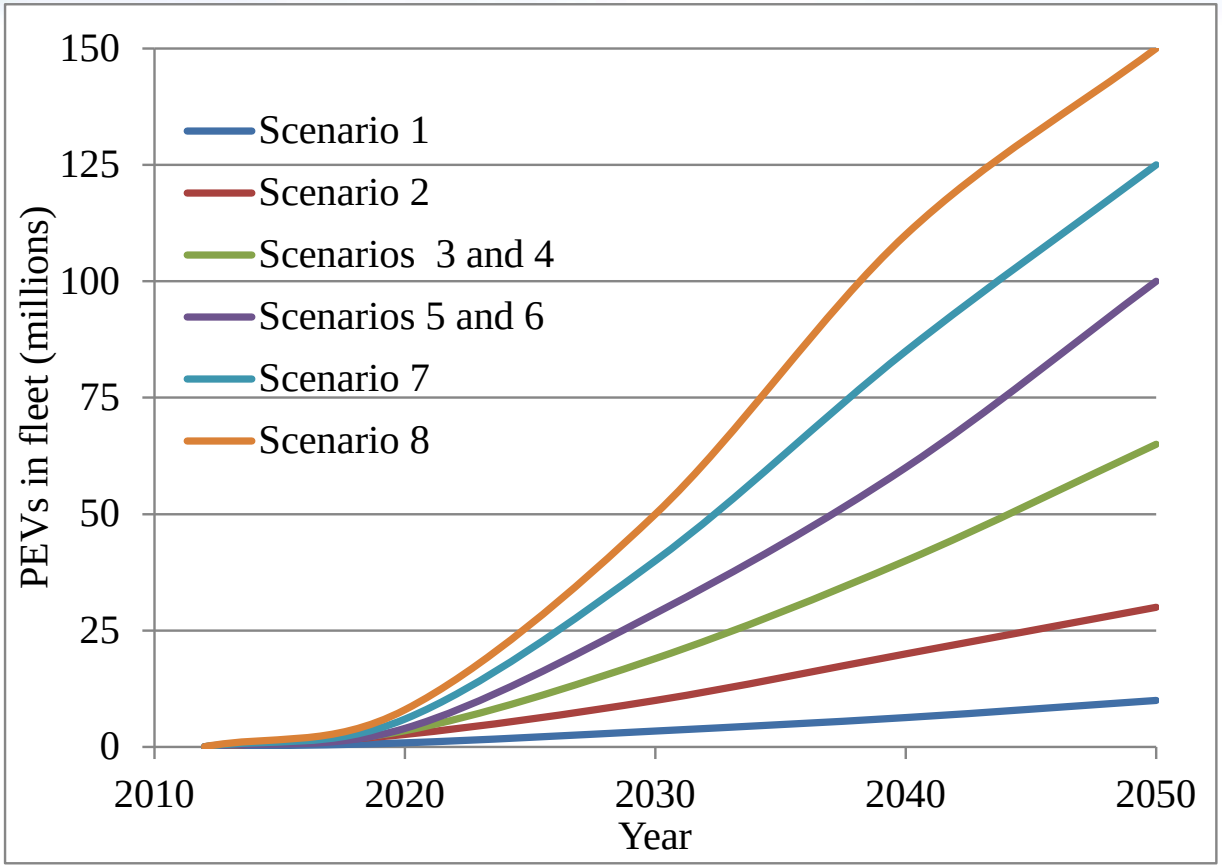
EV Feasibility Project: methodology

- Information on technology costs, performance and potential deployment all uncovered as part of the literature review, expert interviews, and EV Forum.

- We developed **eight** credible EV viability scenarios to help understand future infrastructure requirements and impacts on FHWA's mission.

- Range of assumptions relating to costs, technologies, consumer behaviors, policy interventions and market penetration rates.

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**

Findings and Conclusions
Policy, regulatory, and statutory issues

- Federal, state and local incentives matter
- Title 23, 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
- ZEV Rules, Low Carbon Fuel Standards and CAFE Standards support movement of EVs
- DOE stimulus-era charging network development coming to an end means business model transition for charging stations

Findings and Conclusions
EVSE in different travel markets

- Home and work first
- Market Response – EVSE along ROW, for example, at park and rides, Turnpikes and “grandfathered highways”
- Market Support – PPPs along/near ROW of EV commuter corridors between dense PEV cities (likely at interchanges)
- Market Acceleration – PPPs connecting the corridors that connect the dense PEV cities together

Findings and Conclusions
Highway design standards & infrastructure

- R&D on inductive charging underway; but some skepticism
- Competing fast charging plug standards a consideration for park-and-ride charging installations; CHaDeMO standards adopted by International Electrotechnical Commission in Q1, 2014
- ADA standards for charging stations need to be considered

Findings and Conclusions
Safety, emergency services, and incident response

- First responder training needed nationally (ongoing NHTSA and DOE work)
- National Fire Protection Association program released in 2012
- 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’)

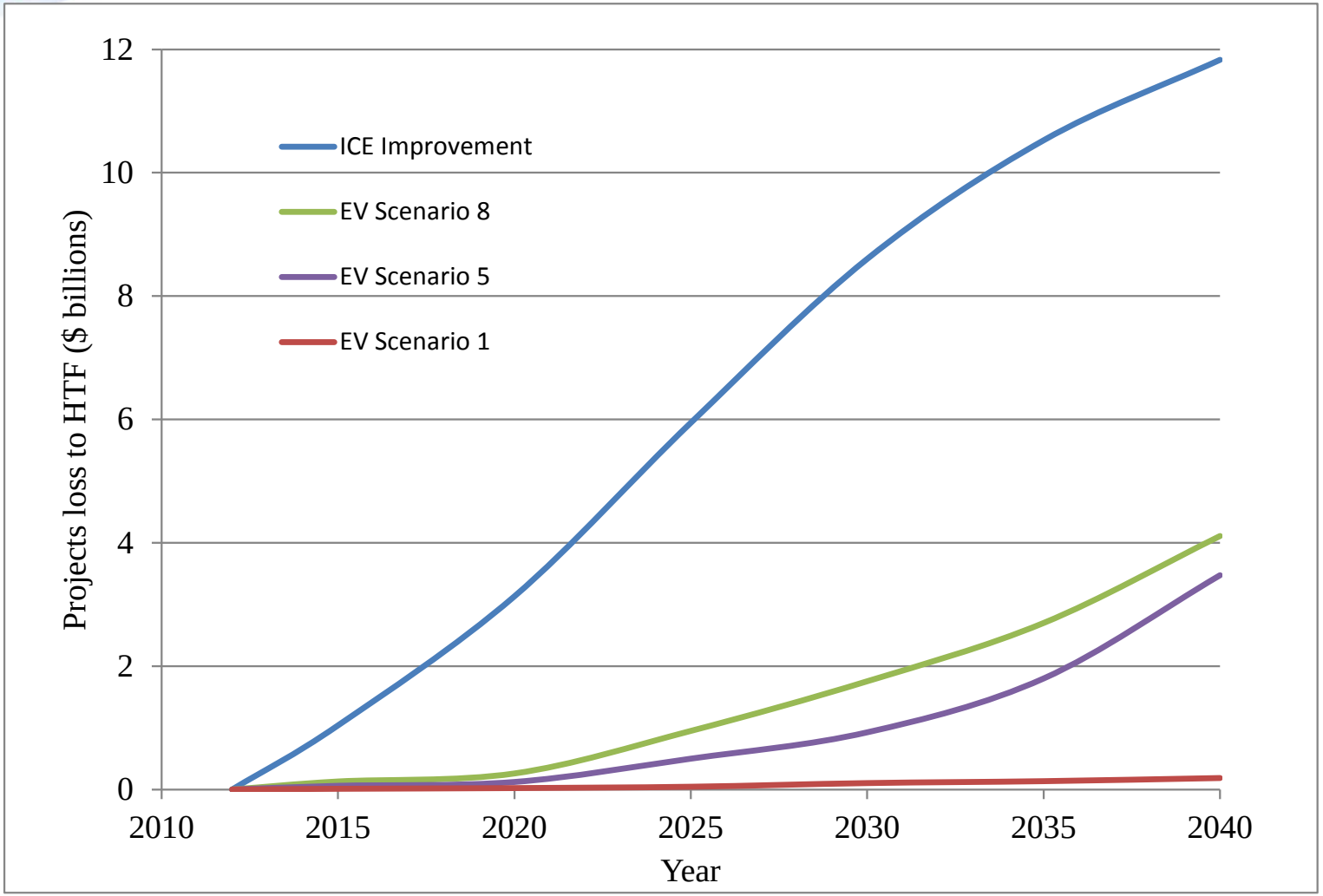
Findings and Conclusions
Signage, information networks, and online mapping

- Wayfinding *all the way* to the station and indicating the type of charge

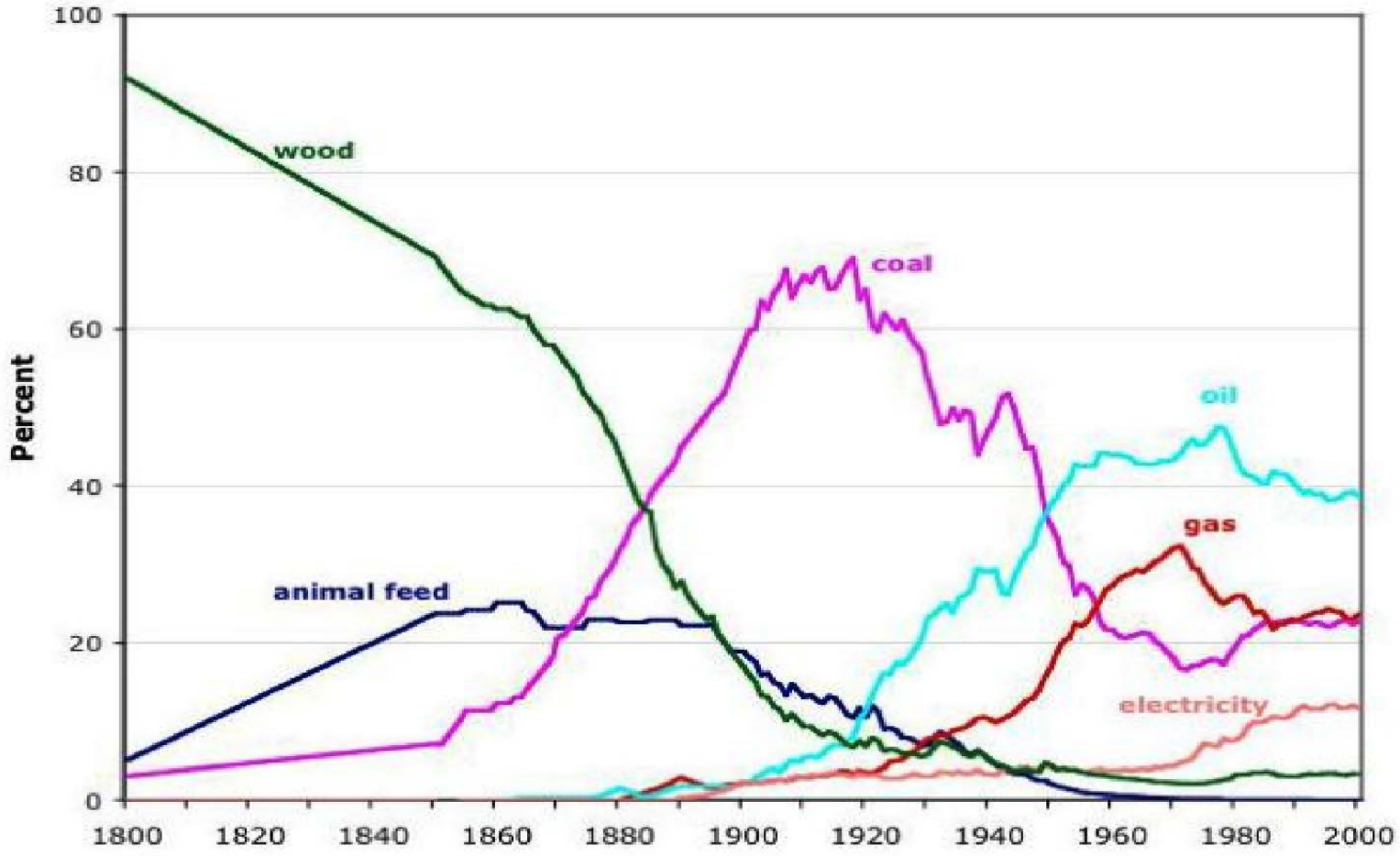
Findings and Conclusions
Revenue impacts and potential costs

- Fast charging station business model profitability uncertain
- Debate about whether fast charging will matter given home charging, though demand for fast charging may increase as the technology develops – especially intercity between dense PEV populations
- Washington State has an EV fee in place
- Road User Fee discussions taking place
  - Pilot studies exist but no widespread implementation

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



US energy mix by percentage from 1800-2000



Source: U.S. Energy Information Administration

For more information

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- **http://www.fhwa.dot.gov/environment/climate_change/mitigation/publications_and_tools/ev_deployment/index.cfm**

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