

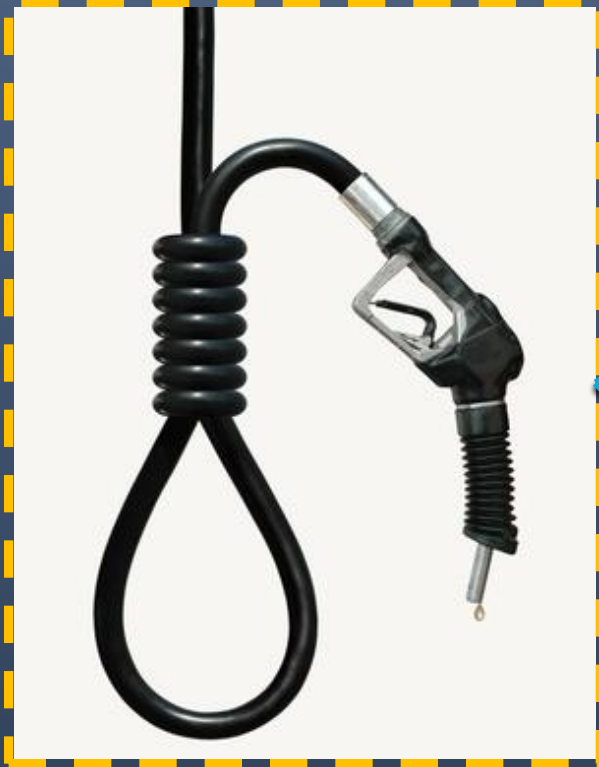
Environmental Assessment of Plug-in Electric Vehicles: Assessing Potential Changes in Rhode Island Emissions

Yoni Dolgin '10

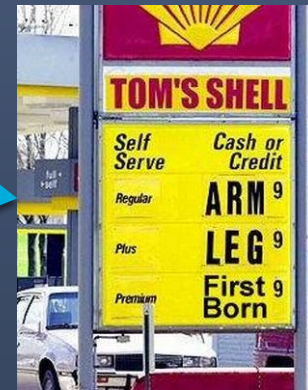
Thesis Presentation

Brown University, Environmental Science

Triple Threat of Oil



GREEN ENERGY
NATIONAL SECURITY



Revenge of the Electric Car



Source: Better Place



Source: www.autobloggreen.com

“Inevitable transition to electricity as the energy for our personal transportation.”
- Energy Secretary Steven Chu



How will electric vehicle adoption
impact individual and statewide GHG
emission profiles?

Focus of Study

- Electric Vehicles
- Greenhouse Gases Emissions Impact
- Local Impact and Implications

Vehicle Spectrum

Conventional Vehicle



Hybrid Vehicle



Plug-in Hybrid
Electric Vehicle



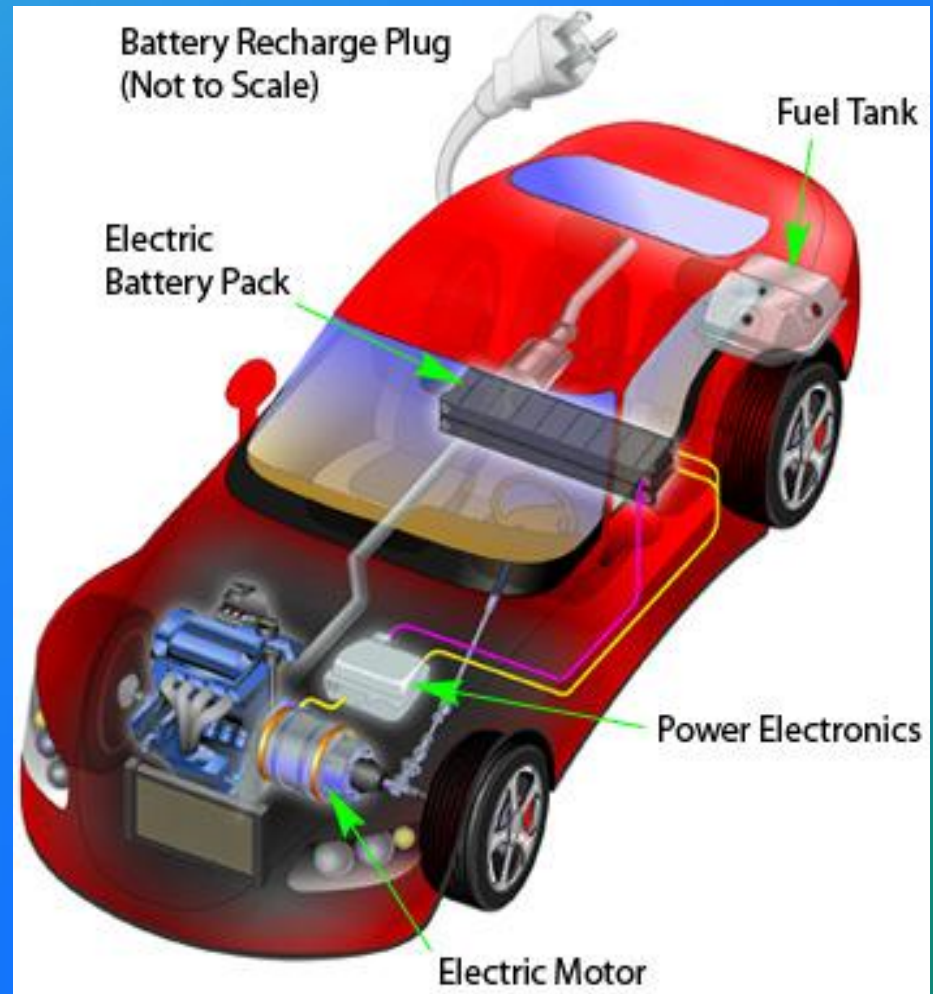
Battery Electric Vehicle



PHEV

- Two Cars in One
- All-Electric Ranges
 - Volt – 40 miles
 - PHEV Prius – 10 miles

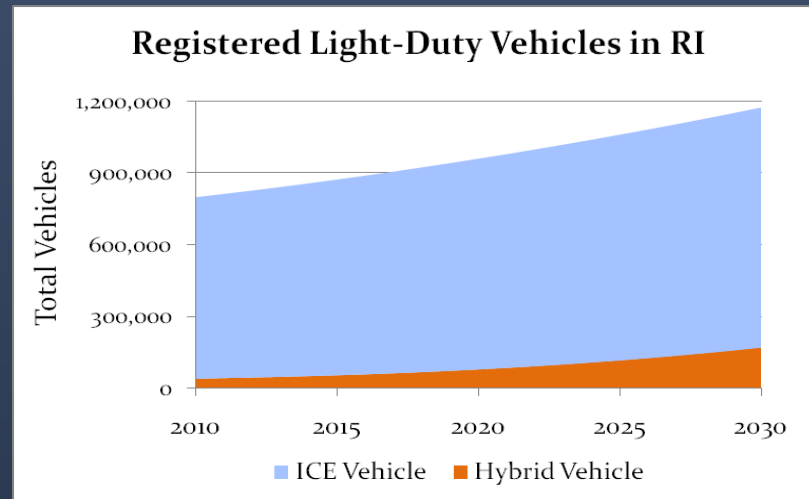
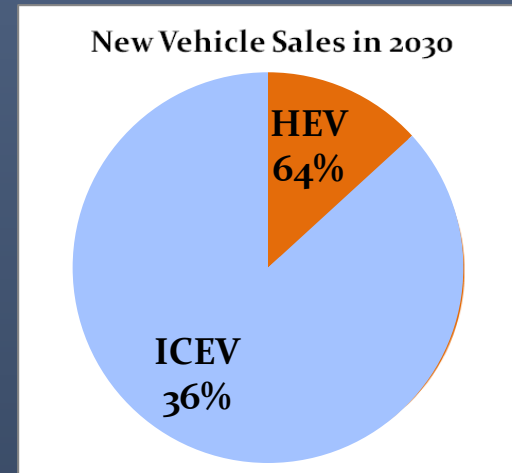
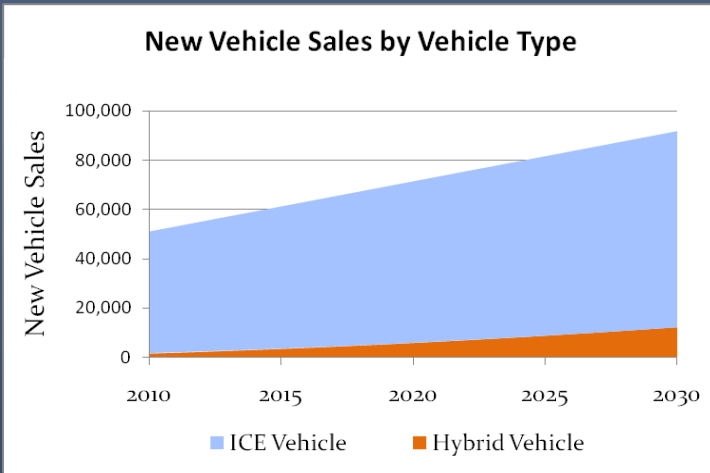
Mobile and Stationary Fuel Sources



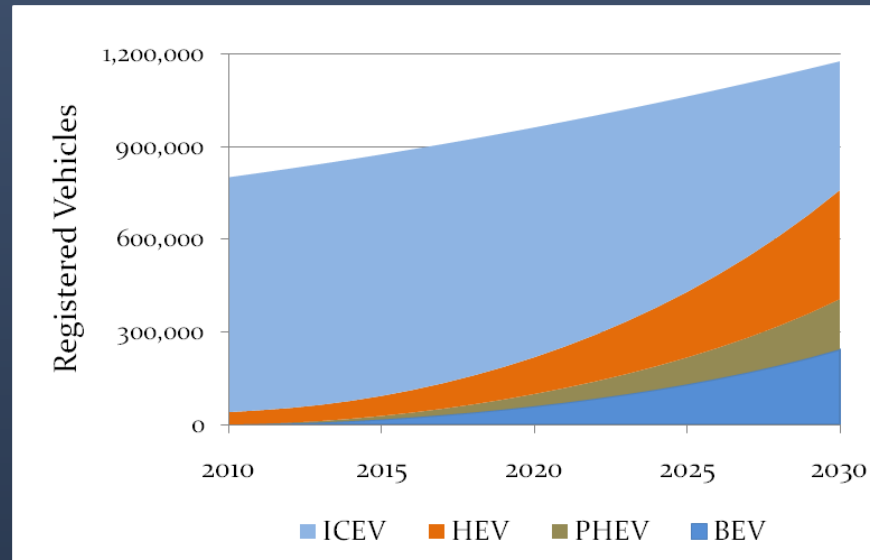
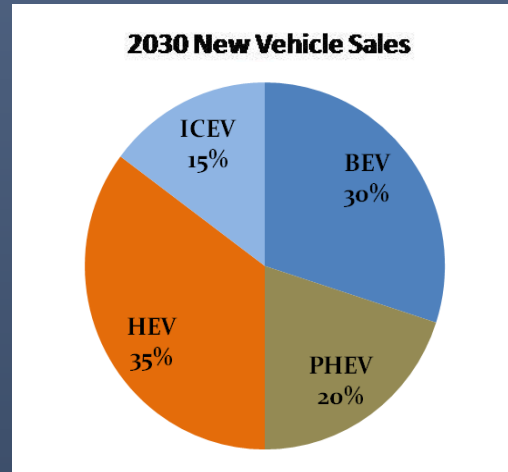
Source: U.S. Department of Energy

Rhode Island's Future Vehicle Fleet: Scenario Analysis

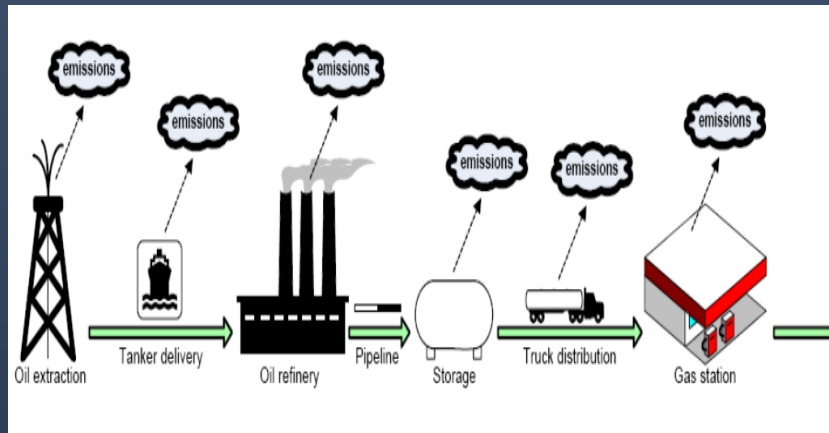
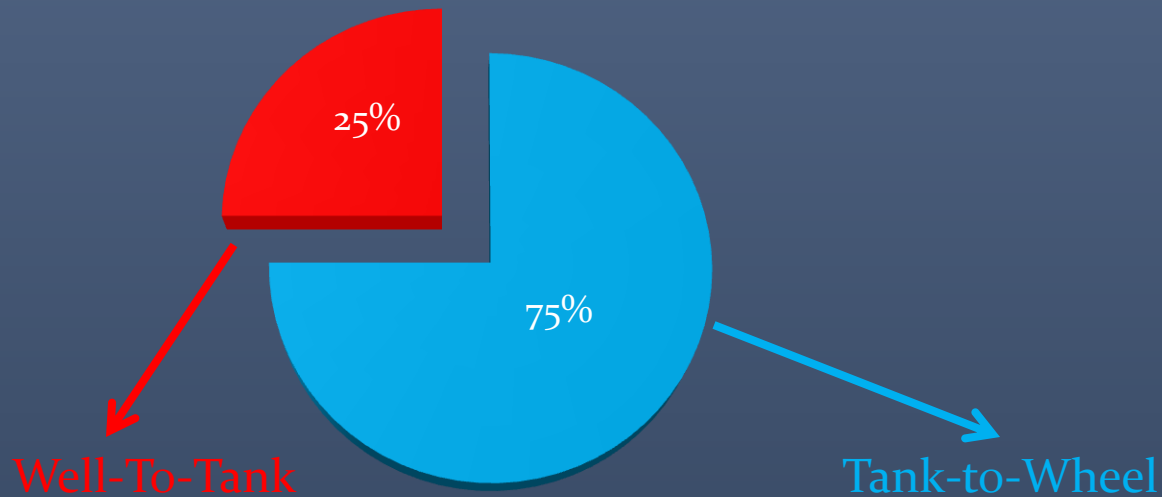
Future Fleet Scenario #1: Business-As-Usual



Future Fleet Scenario #2: 50% PEV Adoption



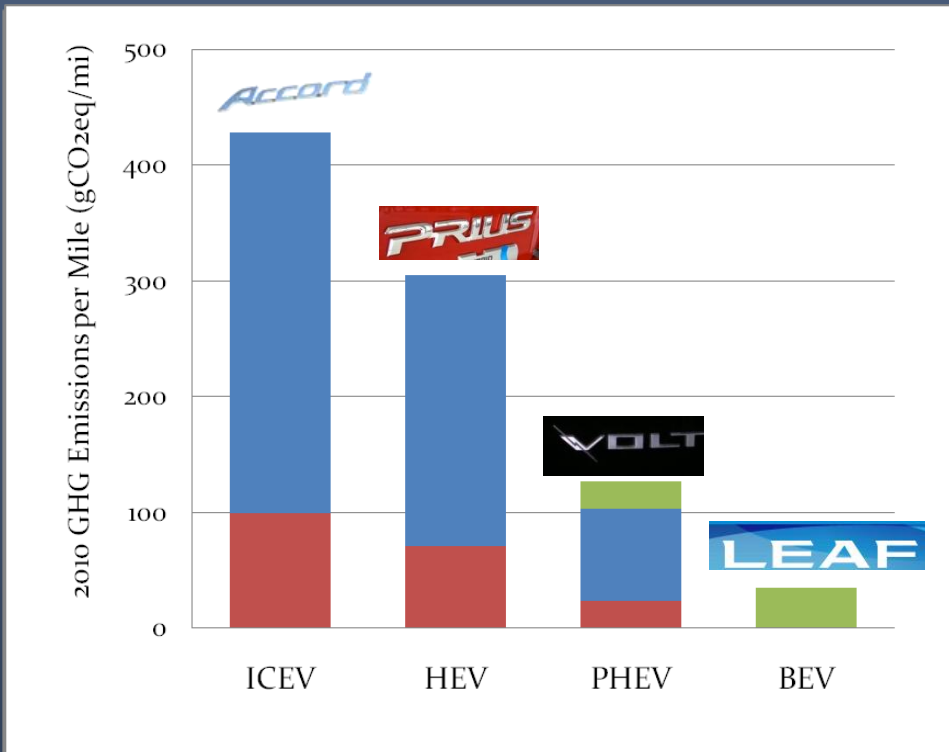
Well-To-Wheels Emissions – Gasoline



Electric Vehicle Emissions



GHG Emissions per mile (2010)



Gasoline Tank-To-Wheels



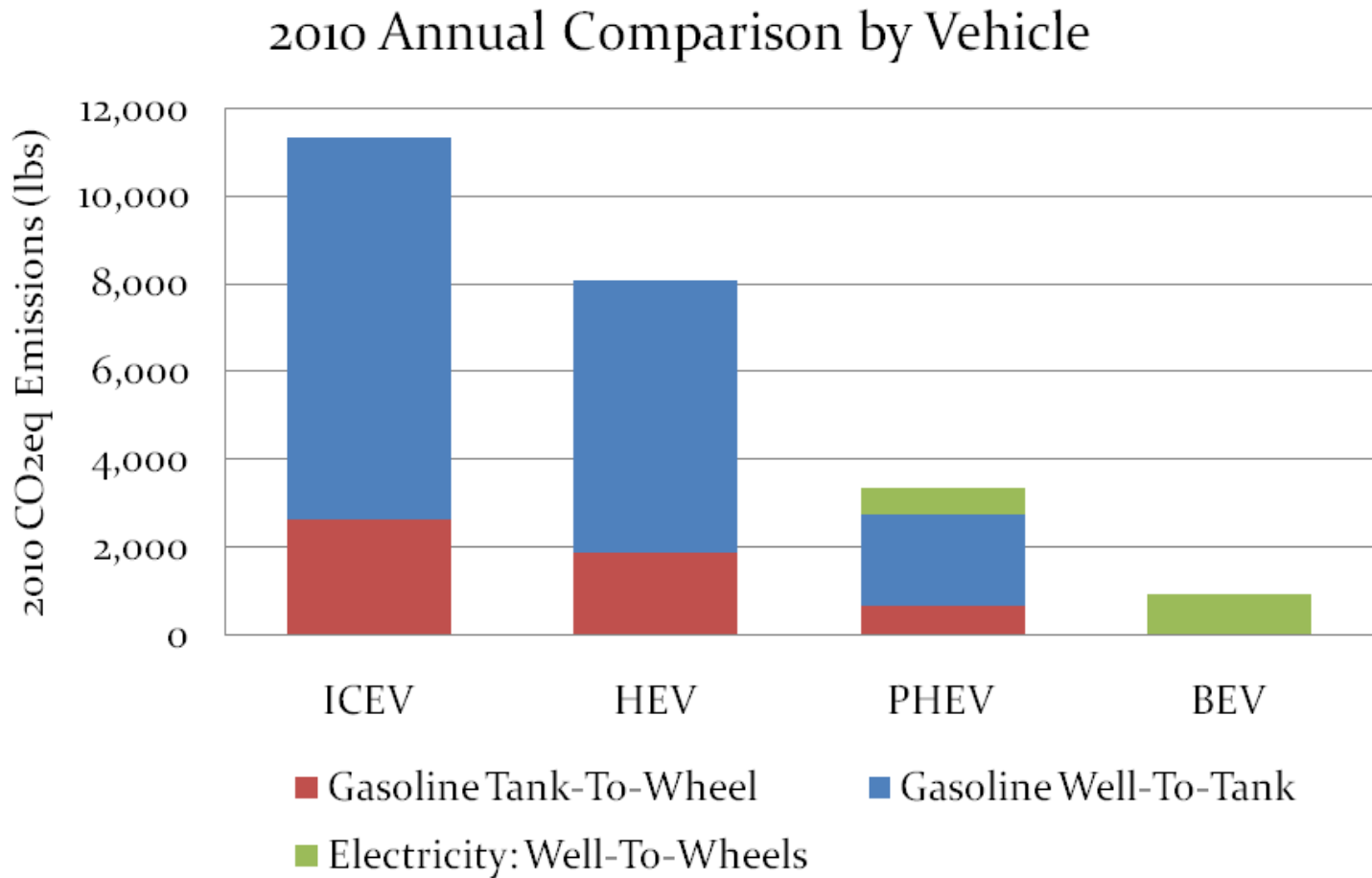
Gasoline Well-To-Tank



Electric Well-To-Wheels



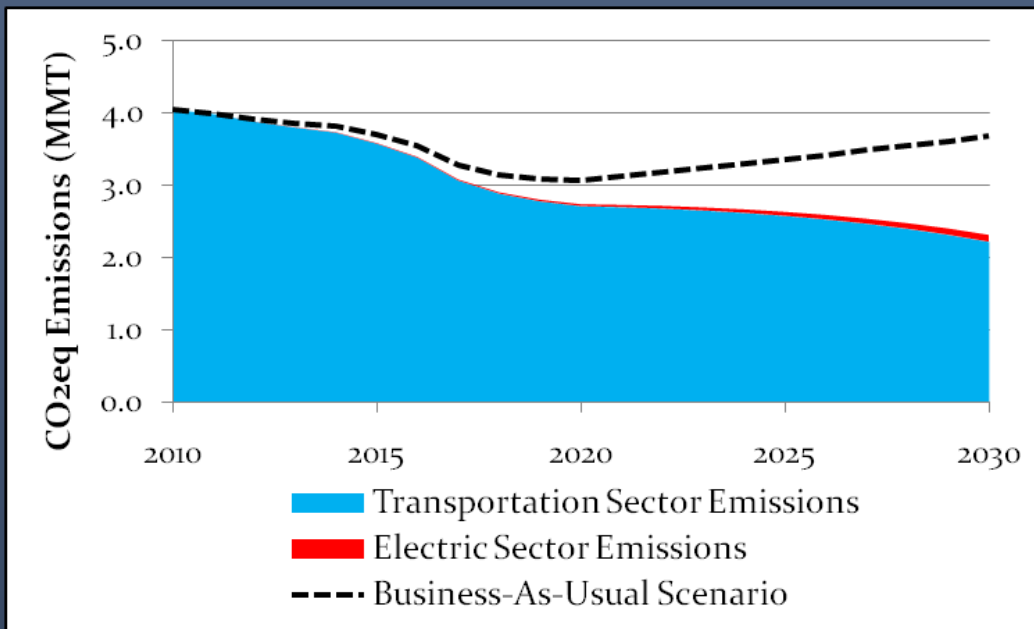
Individual Vehicle Results



Future Fleet Scenarios: Emissions Results

50% EV Adoption Emissions Results

2010-2030



Electric VMT (billion mi.)	4.21
% of Total	30%
Registered Plug-in Electric Vehicles	405,629
% of Total	35%
PEV New Vehicle Sales	45900
% of Total	50%

Cumulative Impact: 2010-2030

	<i>Units</i>	Business- As-Usual	50% PEV Adoption	Difference
Total				
Greenhouse Gas Emissions	<i>MMT</i>	73.3	63.7	9.6
Percent Change	<i>%</i>	-	-	-13%
Transportation Sector				
Gas Consumption	<i>Million Gallons</i>	6,341	5,506	835
Percent Change	<i>%</i>			-13%
Greenhouse Gas Emissions	<i>MMT</i>	73.3	63.0	10.3
Percent Change	<i>%</i>	-	-	-14%
Electric Sector				
Energy Consumption	<i>TWh</i>	-	7.3	-
Electricity Emissions	<i>MMT</i>	-	0.7	-

2030 Results

- Aggregate: 37% emissions reduction (1.4 MMT CO_{2Eq})
- Electricity Consumption:
 - 1.6% electricity consumption increase (1 TWh)
 - 0.4% GHG emissions increase (0.5 MMT CO_{2Eq})
- Transportation Sector:
 - 41% reduction in gas consumption (130 mill. gallons)

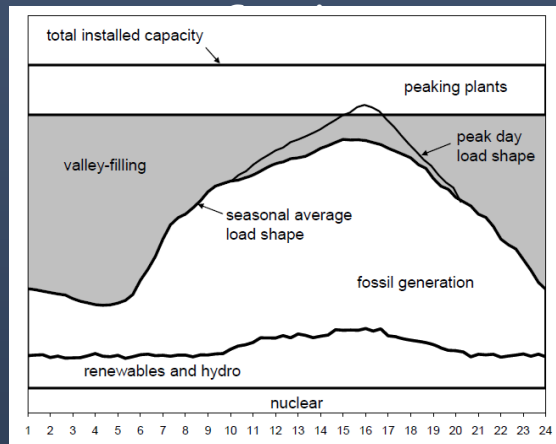


Policy Implications

Will EV Adoption Increase Electricity Production?

- Influence of Rate Structuring on “Valley Filling”
 - Time-of-Use Pricing; On-Peak vs. Off-Peak Pricing
- Regional EV Adoption Influence

Load Shape for Average Day
During Peak (Summer) Season,
Generation Dispatch, and Installed



Source: Kinter-Meyer and Schneider, 2007.

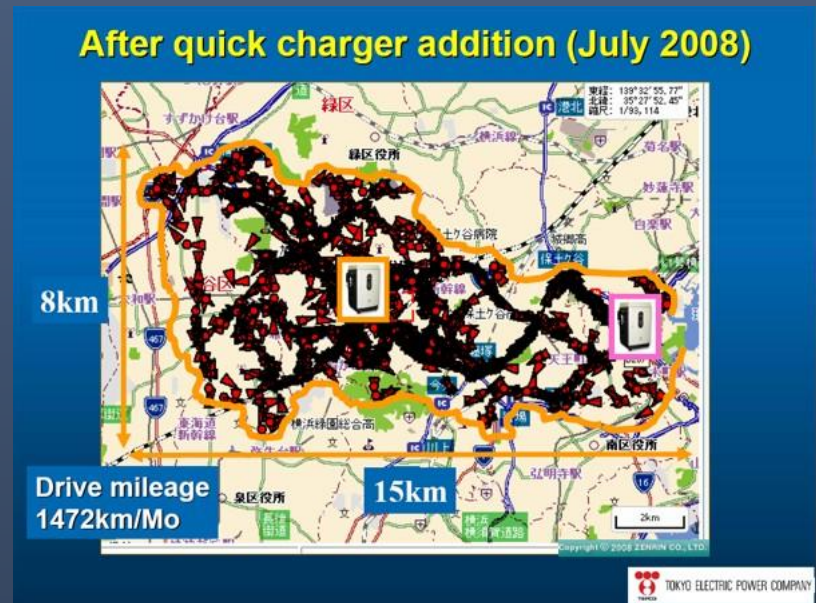
Significance for Low Carbon Fuel Standard

- LCFS to ensure that fuel providers sell mix of fuels not exceed a standard for GHG emissions.
- Comparison to other alternative fuel vehicles
 - No Indirect Land Use Emissions Impacts

Factors influencing mass adoption rates

- Upfront Cost of vehicle
- Policy Mechanisms
 - Tax Rebate on Vehicle Cost (\$7,500 ARRA Funding)
- Range mobility of BEV, AER of PHEV
 - Battery Technology Improvements
- Charge Station accessibility

Impact of Level III Chargers on BEV Range Anxiety



Source: Allcock, "Growing Spectrum of EV Activities in Oregon." slides 45-46

Installation of Quick Charge Station in Tokyo
Increased battery usage (on single charge) from 50% → 80%, and increased total mileage driven.

Project Get Ready Rhode Island

- Goal: 10,000 Evs in Rhode Island by 2015 (= 2% fleet)
- Install 30 public charge spots in Rhode Island by January 2011.
- Strategic Planning



Further Research

- Air Quality Impact Assessment
- Lifecycle Study - Include Vehicle Production and End-of-life Management of Vehicle Components (specifically battery)
- Economics

Acknowledgments

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 - Kurt Teichert, Brown University
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- Project Get Ready Rhode Island