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# Road Charging and Adoption of Electric Vehicles in California

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Agenda Item #10

TAC Meeting #15, September 16, 2016

San Diego, CA



## Policy Question from June 2015 TAC Meeting:

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*“What impact might a Road Charge have on the State of California’s policy initiatives to encourage adoption of Electric Vehicles?”*

As pointed out by TAC, the question could be extended to:

- ◆ Hydrogen Fuel Cell vehicles (FCV)
- ◆ Hybrid-Electric Vehicles like the Toyota Prius
- ◆ Biodiesel vehicles
- ◆ Compressed Natural Gas vehicles

California Air Resources Board’s *Advanced* Clean Cars Program:

- ◆ Focus is on **Zero-Emission Vehicles**
- ◆ Some incentives for Super Ultra-Low Emission Vehicles (such as Chevy Volt)



# Zero Emission Vehicles

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- ◆ Vehicles that are driven only by an electric motor that are powered by advanced technology batteries or a hydrogen fuel cell
- ◆ No tailpipe emissions over their entire lifetime

## Battery Electric Vehicles:



Nissan Leaf



BMW i3



Tesla Model S

## Hydrogen Fuel Cell Vehicles:



Hyundai Tucson FCV



Toyota Mirai FCV



# Plug-in Hybrid Electric Vehicles (PHEVs)

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- ◆ Combine two propulsion modes - an electric motor that is battery powered that can be plugged in and recharged - and a gas engine
- ◆ Super Ultra Low Emissions (actual emissions depend on ratio of gas used)

## Popular PHEVs:



Chevrolet  
Volt



Ford C-MAX  
Energi



Ford Fusion  
Energi

## Other PHEVs:



Porsche Panamera S  
E-Hybrid



BMW i8



McLaren P1

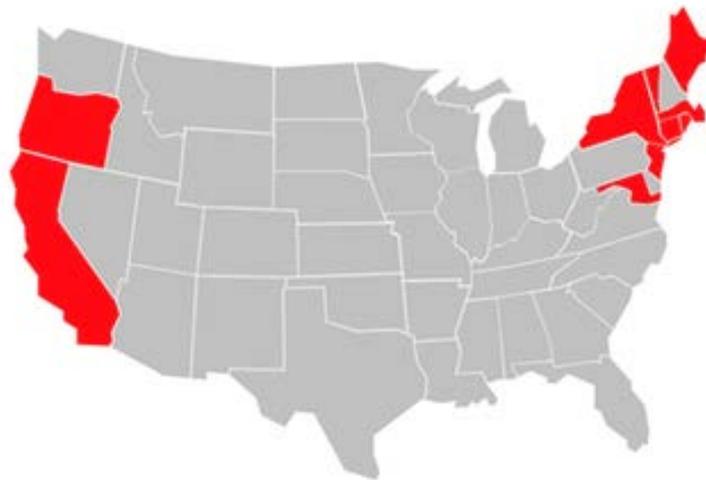


# California's Zero Emission Vehicle (ZEV) mandate

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- ◆ **Rationale:** vehicle emissions reduction (smog, soot and GHG emissions)
- ◆ **Legal basis:** Section 177 of Federal Clean Air Act grandfathered in California's air emissions standards and regulatory scheme -- other states can choose to adopt the federal standards, or California's.

## The Ten ZEV States:



Credit: Alliance of Automobile Manufacturers. [www.ZEVFacts.com](http://www.ZEVFacts.com), 2016

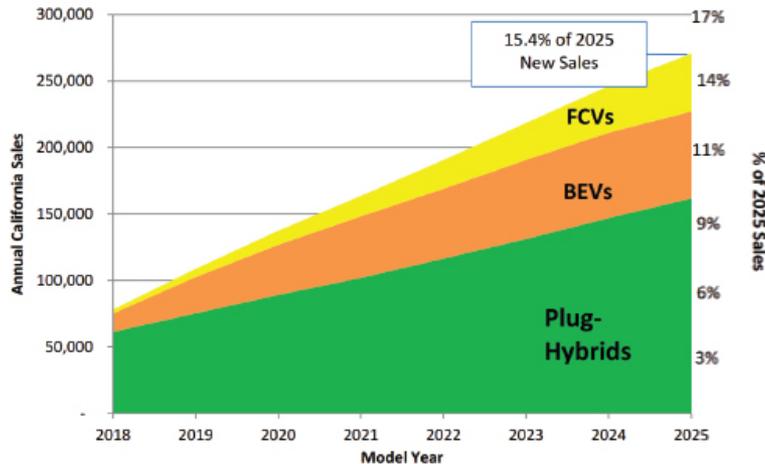


# ZEV Mandate: How it Works

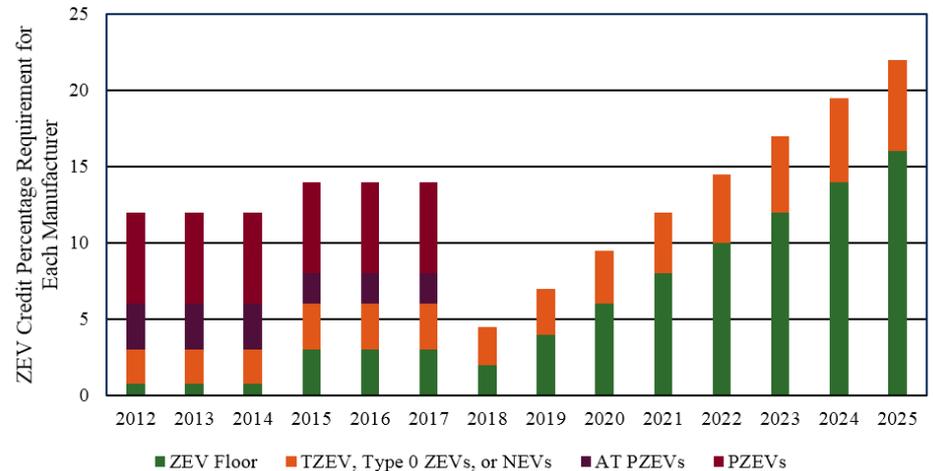
**Mandate:** larger auto manufacturers' new vehicles sales must meet target for Zero-Emission Vehicle sales

- ◆ 2018: 10% goal that can be met with credits starts to taper down
- ◆ 2025: 15% of new sales must be ZEV

**ZEV Mandate: Volume Sales vs. Manufacturer Credits**



Projected Annual Vehicle Sales



Manufacturer Credits by Vehicle Type

# Public Policies to Promote Consumer Adoption of PEVs

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## Purchase Incentives:

- California Clean Vehicle Rebate Program\*: \$1,500 for PHEV, \$2,500 for BEVs, \$5,000 for FCV
- Additional \$1,500\* rebate for low income households

\* Availability subject to legislative appropriations

- Federal income tax credit of up to \$7,500, based on battery capacity of the PEV (\$8,000 for FCV)
- California financing assistance for residential PEV charging installation
- Federal tax credit of up to \$1,000 for purchase of PEV charging equipment

## Use Incentives:

- High Occupancy Vehicle lane exemptions:



**White decals** – unlimited number available for use through 2018 for BEV, FCV and CNG



**Green decals** – max of 85,000 reached for “Transitional ZEVs” (i.e., PHEVs), valid through 2018.

- Utility rate discounts for off-peak charging in select service territories
- Free metered parking in select municipalities
- Public electric vehicle charging stations (including some that are subsidized or no-fee)

# Sales of PEVs in California: Highest in U.S.

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## California PEV sales are now 52% of the U.S. total

- 223,696 PEVs sold through June 2016, tops in U.S.

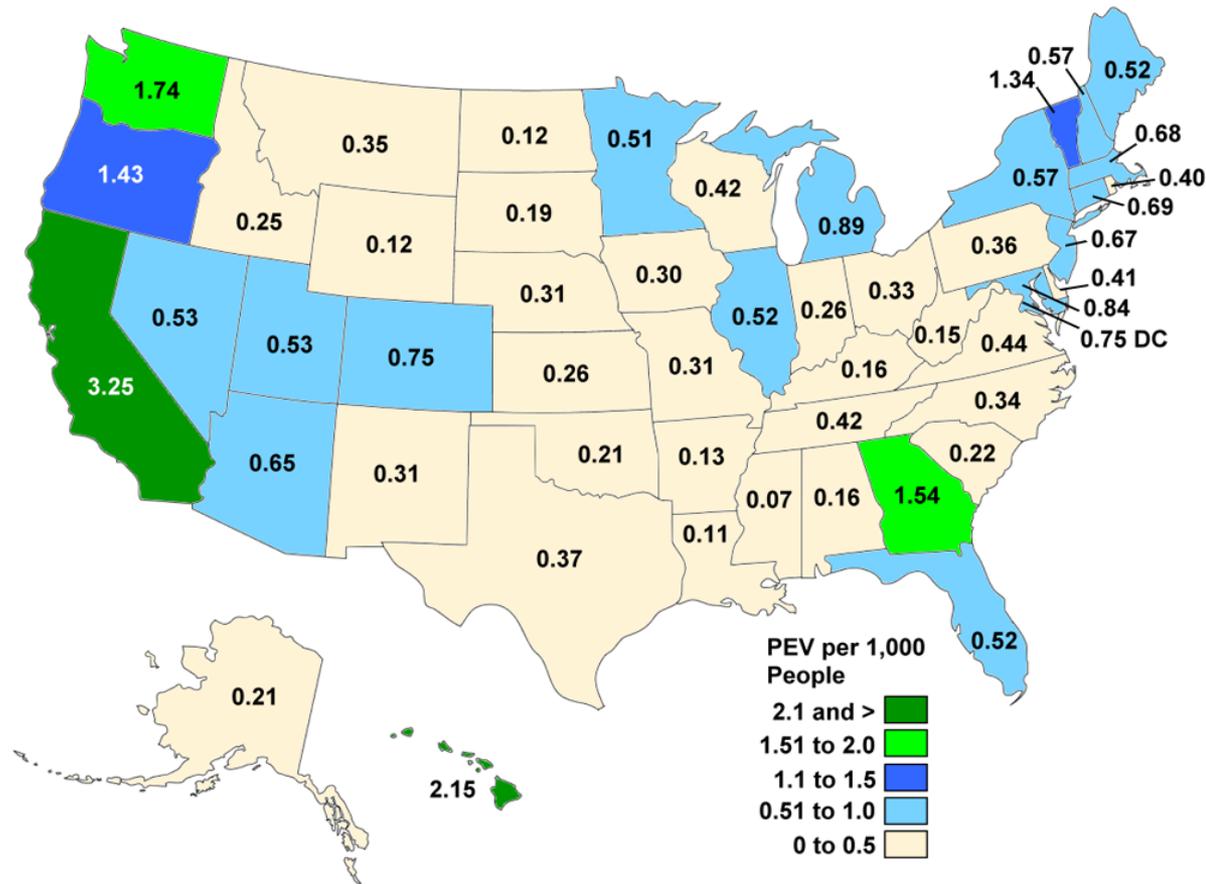


Source: PEV Collaborative



# Sales of PEVs in California: Highest Per Capita Sales

3.25 PEVs sold per 1,000 population (through 2014)



Sources: PEV Collaborative



# Sales of PEVs in California: 15% by 2025

To meet 15% ZEV target by 2025, California must reach sales of approximately 265,000 per year



Source: Alliance of Automobile Manufacturers



# What Effect Will a Road Charge Have on Consumer Adoption of PEVs in California?

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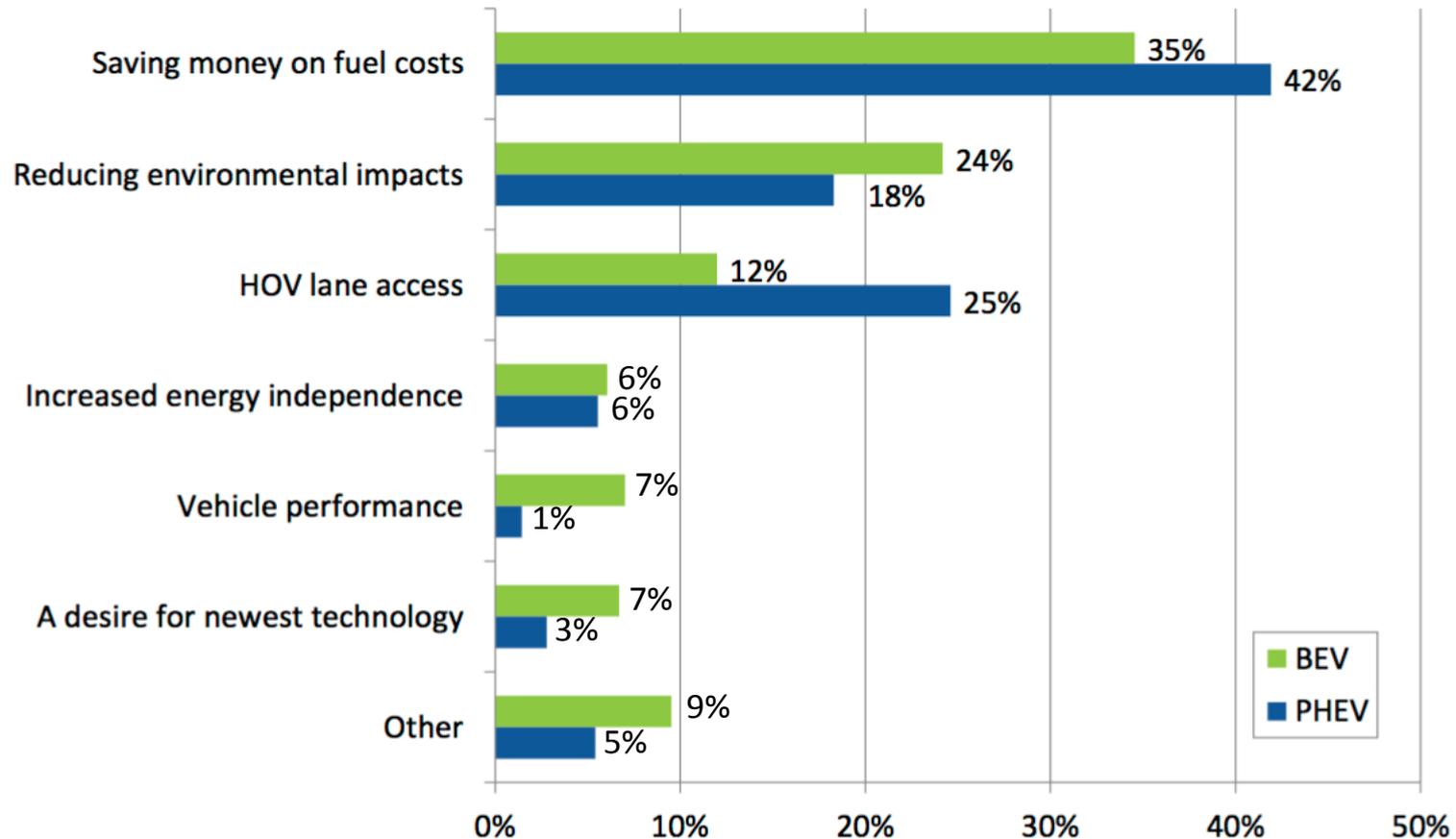
## Commonly Expressed Consumer Motivations for PEV Purchase

- ◆ **Energy independence:** avoid purchasing petroleum products
- ◆ **Reducing environmental impacts:** environmental benefits of low or zero emission vehicles
- ◆ **Early adopters:** desire for most advanced technology vehicles
- ◆ **Vehicle performance:** PEVs drive smoother, quieter, quicker
- ◆ **Driving benefits:** HOV lane access, preferred parking, etc.
- ◆ **Financial benefits:**
  - Capital costs: capture the value of tax credits, rebates and similar purchase incentives offered
  - **Operating costs: lower fuel and maintenance costs**



# Stated Reasons for Purchasing PEVs in California

There are differences based on PEV type:

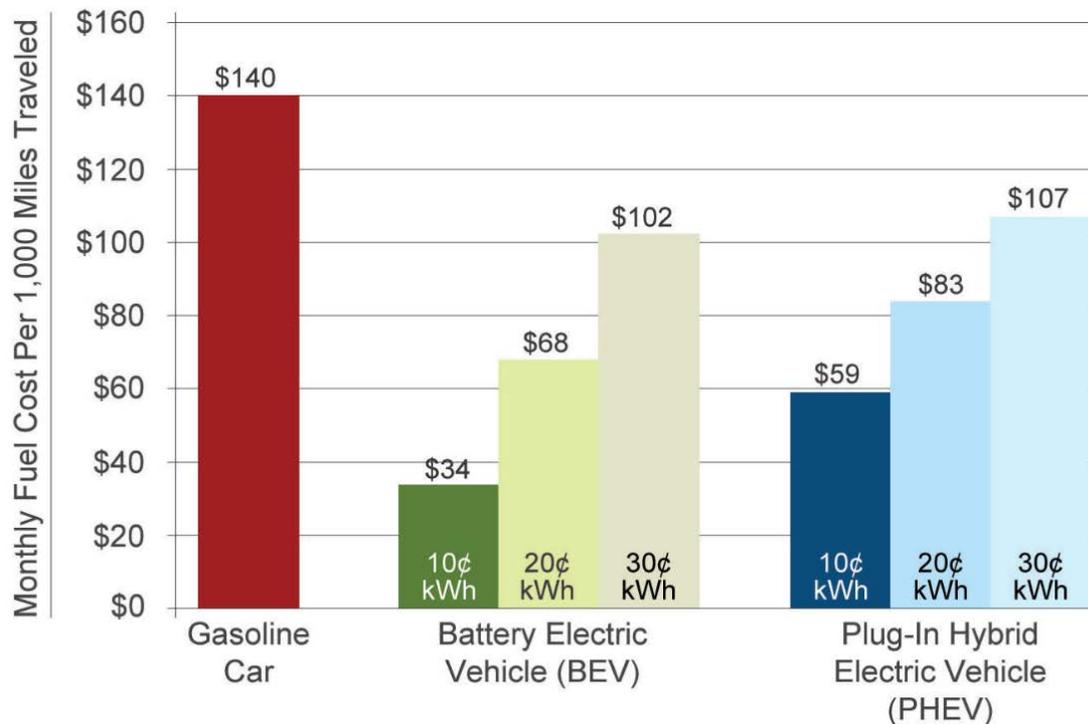


Source: California Clean Vehicle Rebate Project. Credit: Center for Sustainable Energy



# Cost of Fuel: Gasoline Vehicle vs. PEV

Charging PEVs night-time, off-peak can save 76% in fuel costs alone (savings of \$106 per 1,000 miles/month)



## Key assumptions:

- 26 MPG for gas car
- Gas \$3.63 gallon
- BEV similar to Nissan Leaf
- PHEV similar to Chevy Volt
- Three different energy rate assumptions

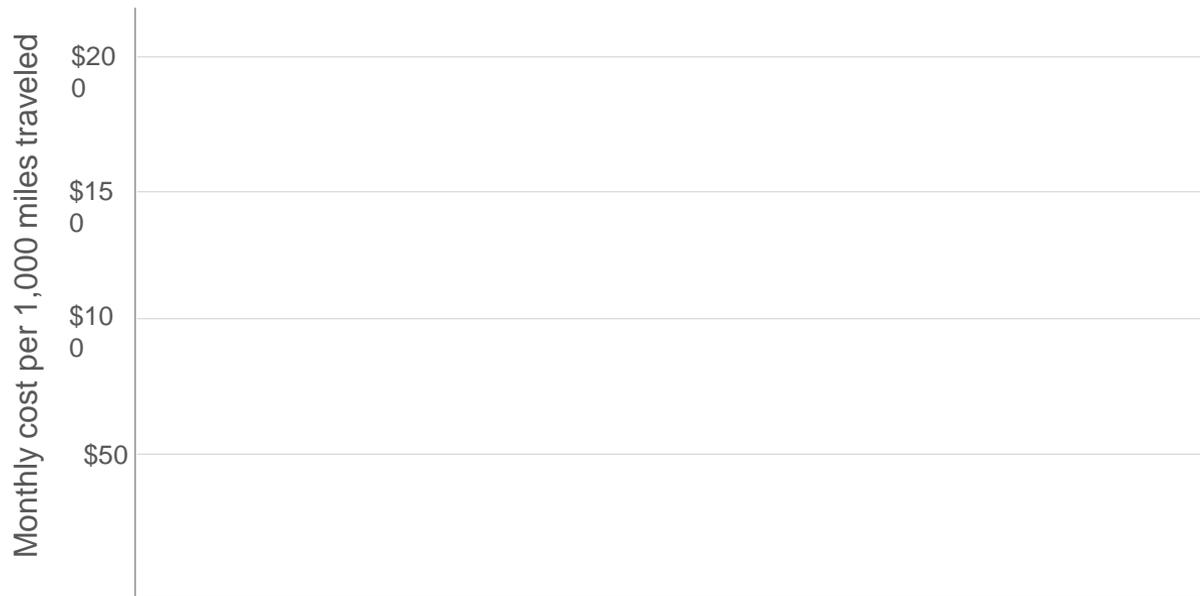
Source: Plug-in Electric Vehicle Resource Center. California Air Resources Board.



# Impact of Road Charge on Vehicle Operating Costs

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PEVs maintain a significant operating cost advantage over gas vehicles, even after paying a Road Charge



2016 Volkswagen Golf R  
(26 MPG)

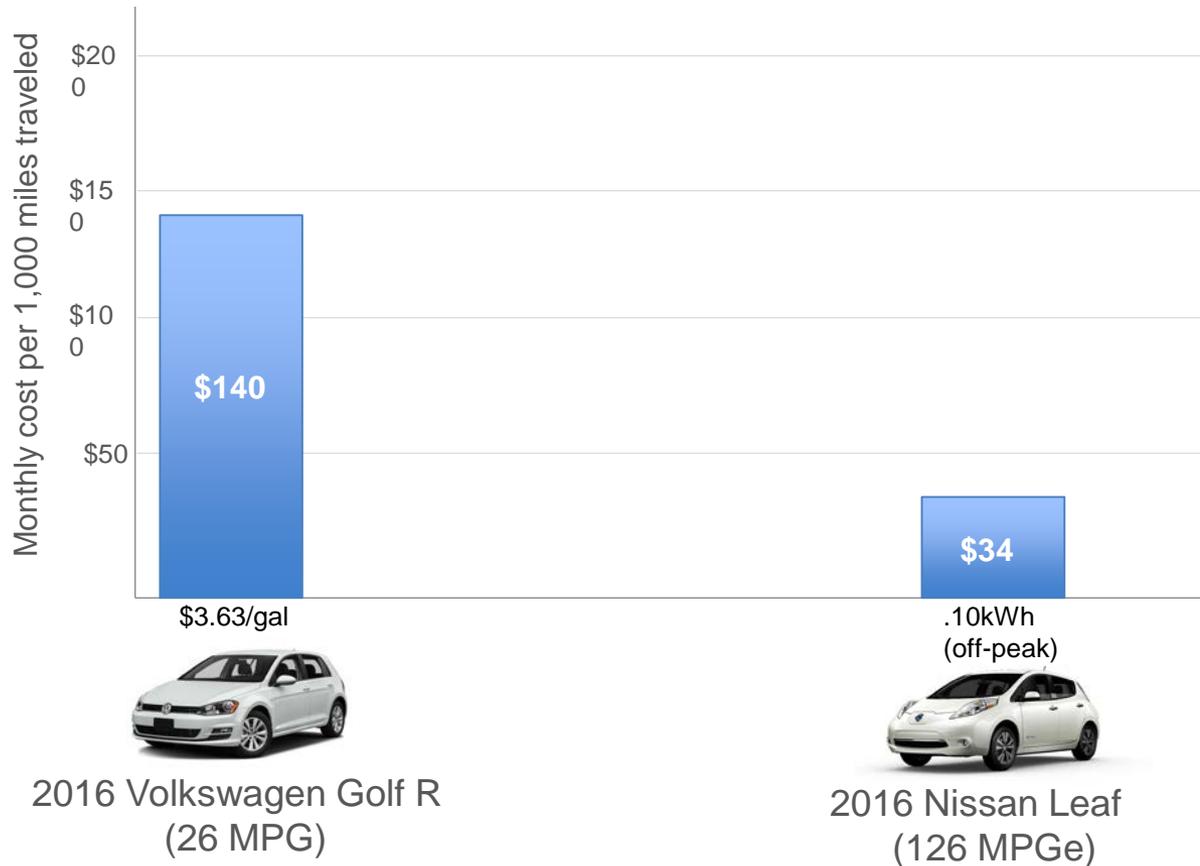


2016 Nissan Leaf  
(126 MPGe)



# Impact of Road Charge on Vehicle Operating Costs

PEVs maintain a significant operating cost advantage over gas vehicles, even after paying a Road Charge



## PEV Operating Cost Savings

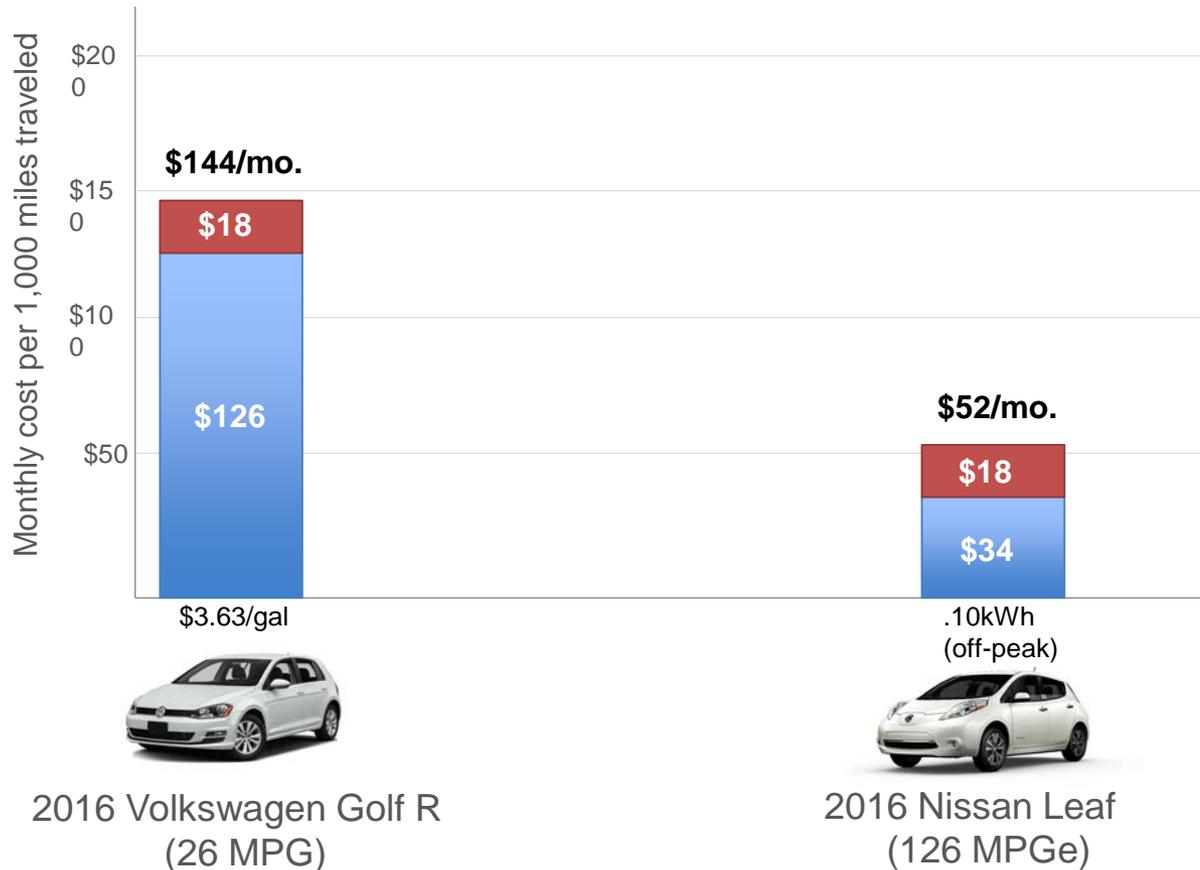
- Fuel Costs:

Save **\$106** per month



# Impact of Road Charge on Vehicle Operating Costs

PEVs maintain a significant operating cost advantage over gas vehicles, even after paying a Road Charge



## PEV Operating Cost Savings

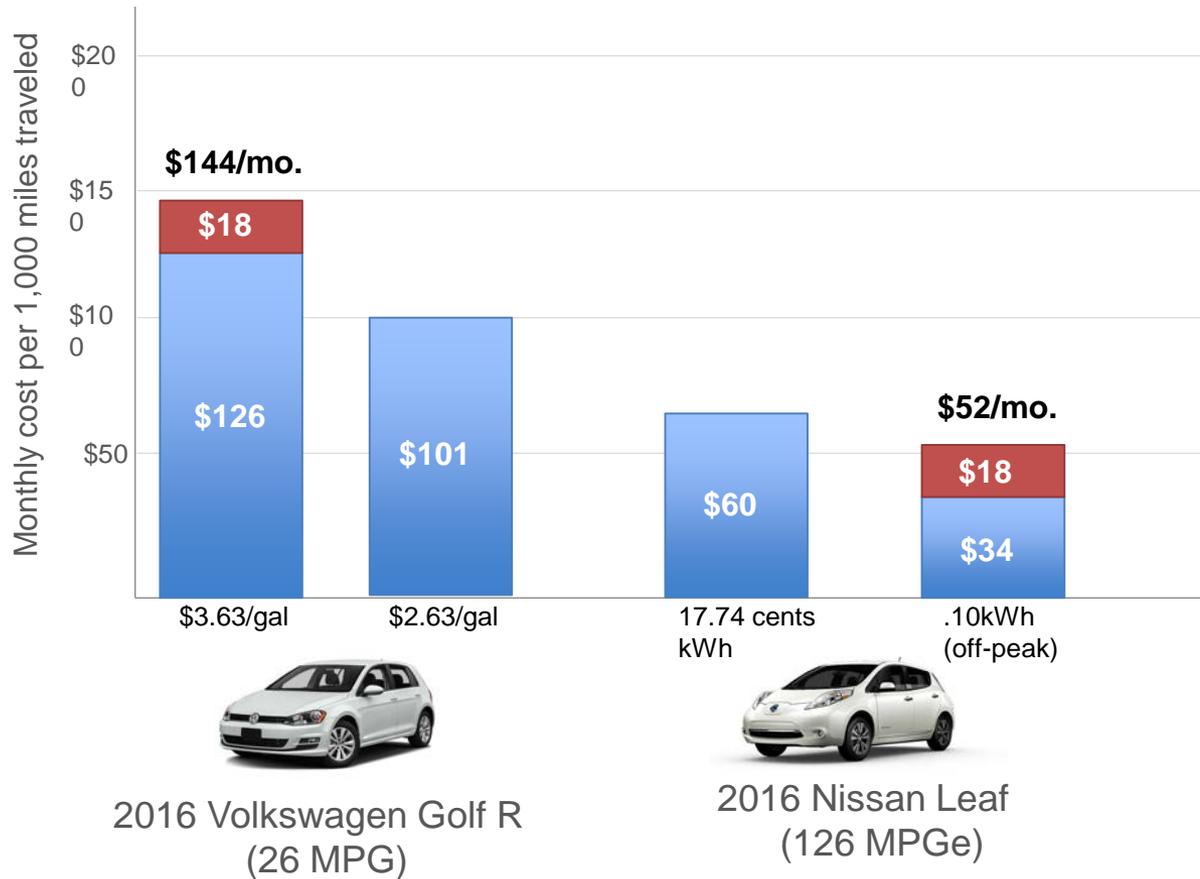
- Fuel Costs
- with Road Charge of 1.8 cents per mile:

Save **\$92** per month



# Impact of Road Charge on Vehicle Operating Costs

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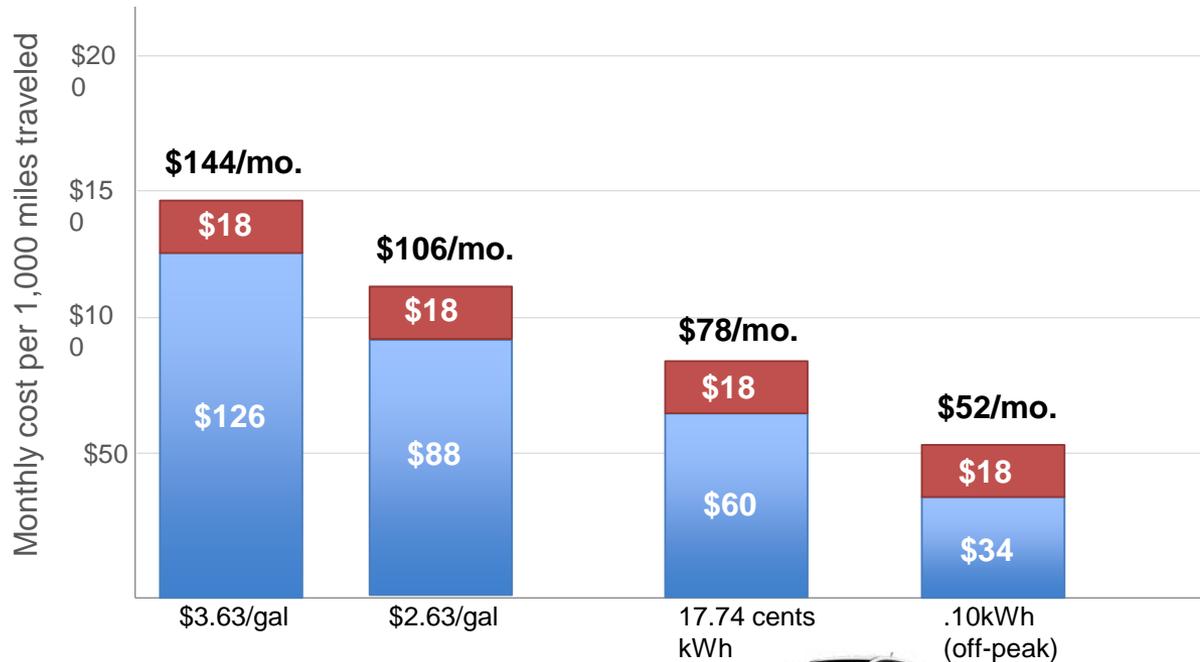
## PEV Operating Cost Savings

- Fuel Costs
- August 22 prices
- Averaged residential electricity rates:

Save **\$41** per month

# Impact of Road Charge on Vehicle Operating Costs

PEVs maintain a significant operating cost advantage over gas vehicles, even after paying a Road Charge



2016 Volkswagen Golf R  
(26 MPG)



2016 Nissan Leaf  
(126 MPGe)

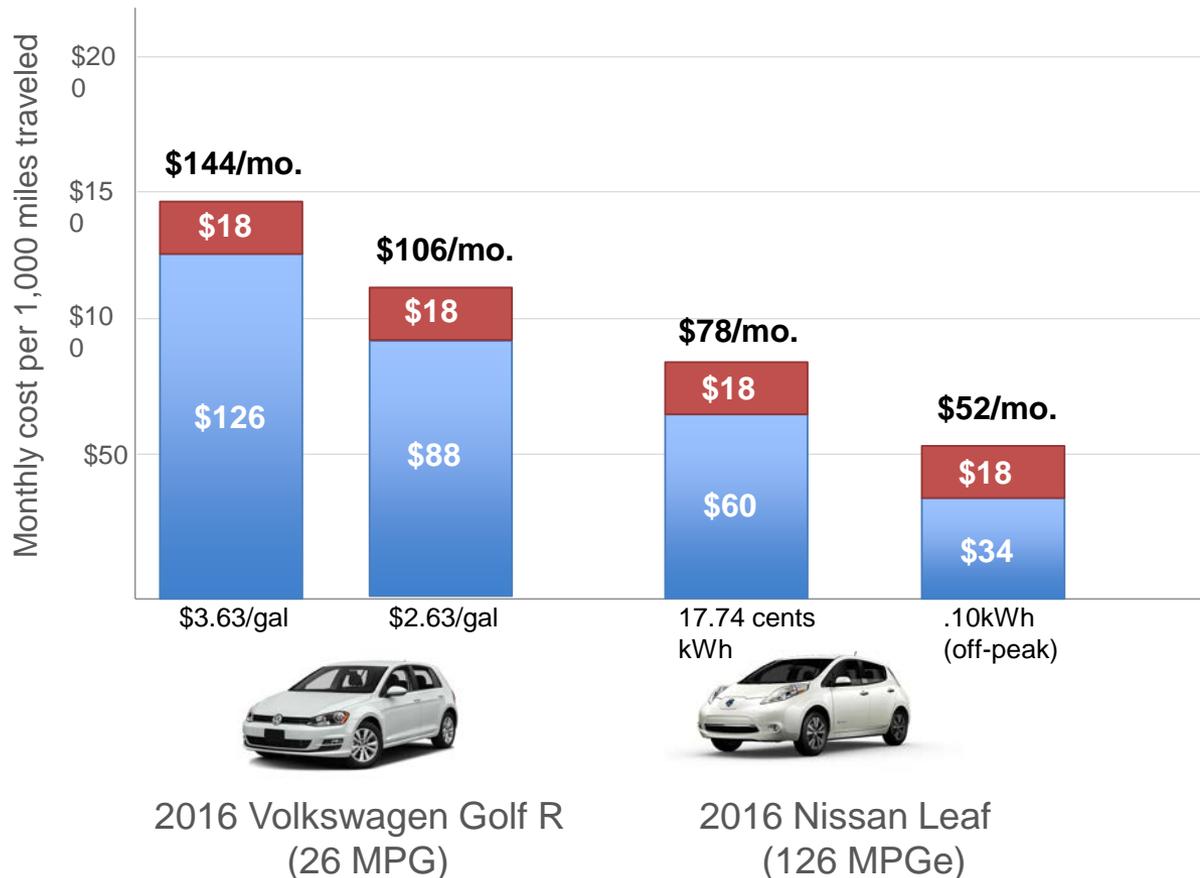
## PEV Operating Cost Savings

- Fuel Costs
- August 22 prices
- with Road Charge of 1.8 cents per mile
- Averaged residential electricity rates:

Save **\$28** per month

# Impact of Road Charge on Vehicle Operating Costs

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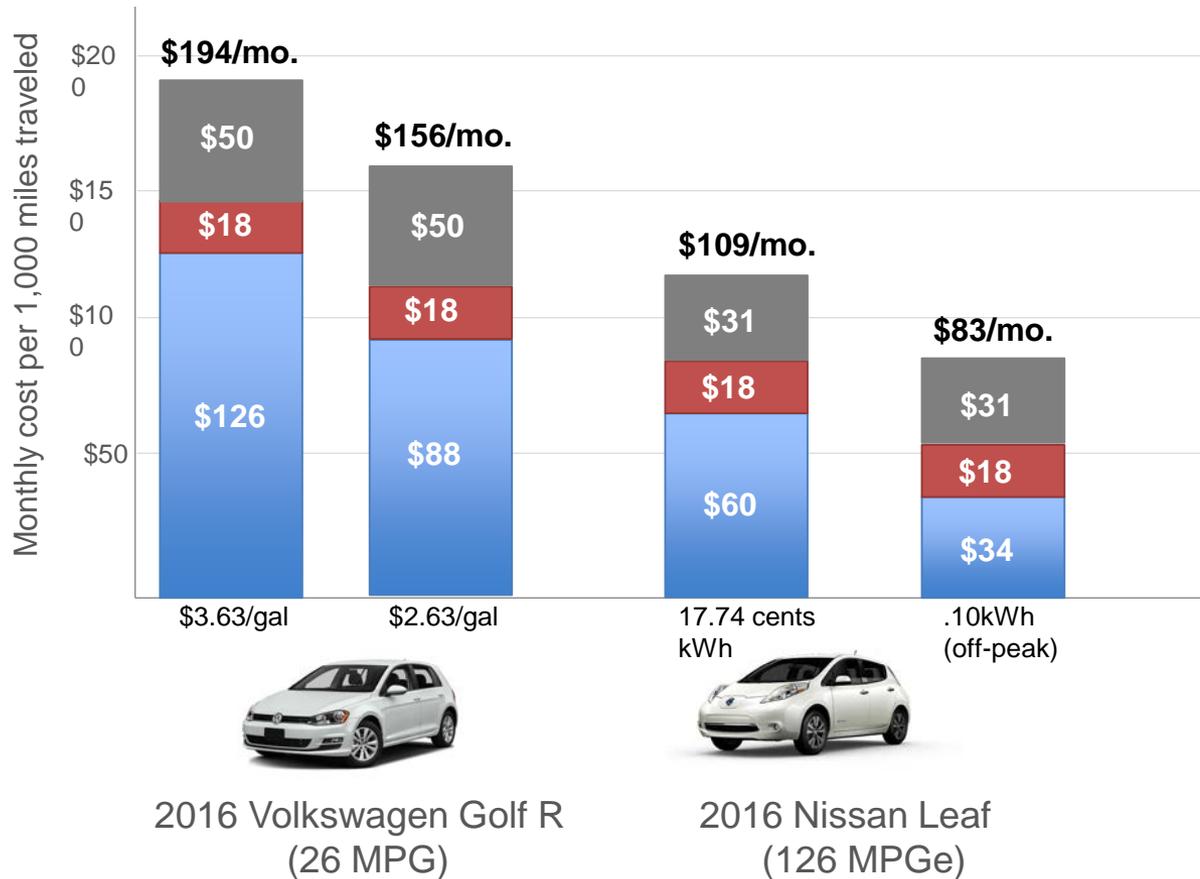
## PEV Operating Cost Savings

- Fuel Costs with Road Charge of 1.8 cents per mile
- Current gas price (\$2.63/gallon)
- Off-peak charging

Save **\$54** per month

# Impact of Road Charge on Vehicle Operating Costs

PEVs maintain a significant operating cost advantage over gas vehicles, even after paying a Road Charge



## PEV Operating Cost Savings

- Fuel Costs with Road Charge of 1.8 cents per mile
- Current gas price (\$2.63/gallon)
- Off-peak charging
- With maintenance costs (amortized)

Save **\$73** per month

# Effect of Operating Cost *Changes* on Consumer Purchases

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- ◆ Shortage of directly relevant information on this topic
- ◆ Limited information available (as shared by automakers or market research firms) shows various reasons cited by consumers for to support their purchase decision (either purchasing, or declining to purchase, a PEV)
- ◆ Research on this topic has been proposed at the federal level and state level

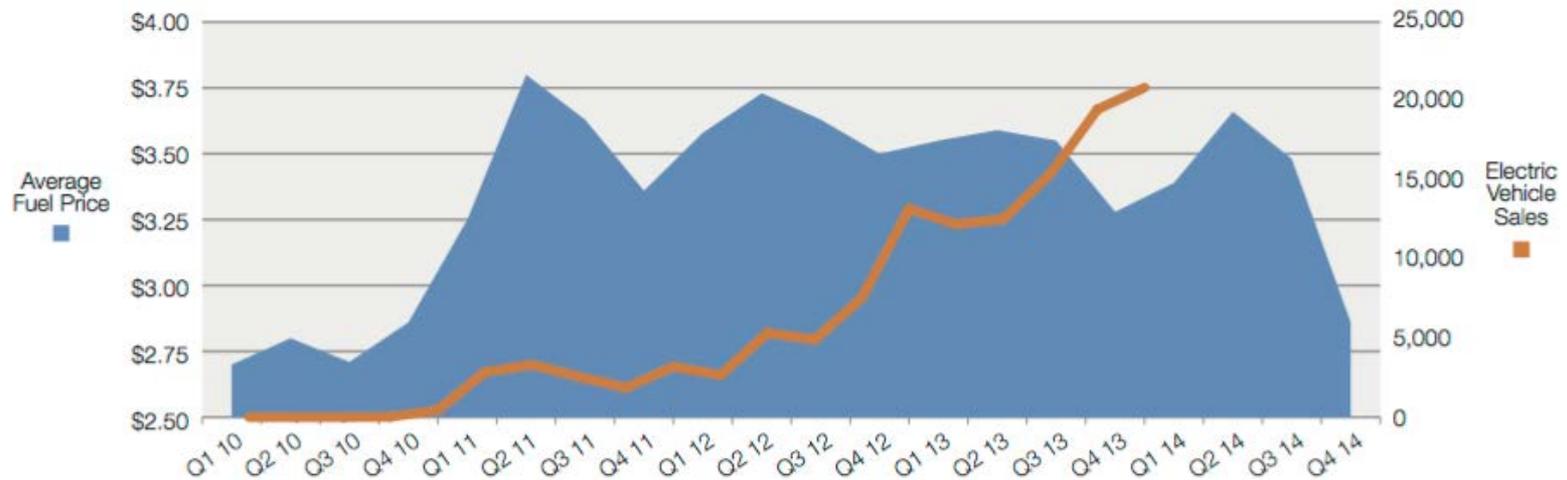
*The best we can do for now is to look at ancillary information and use judgment to draw inferences.*



# Data Point: Gas Prices and Consumer Behavior

Although the California survey shows 38% of PEV drivers cite fuel cost as a primary motivation for PEV purchase, the data does not show strong correlation

PEV Sales vs. Average Fuel Prices, 2010 - 2014



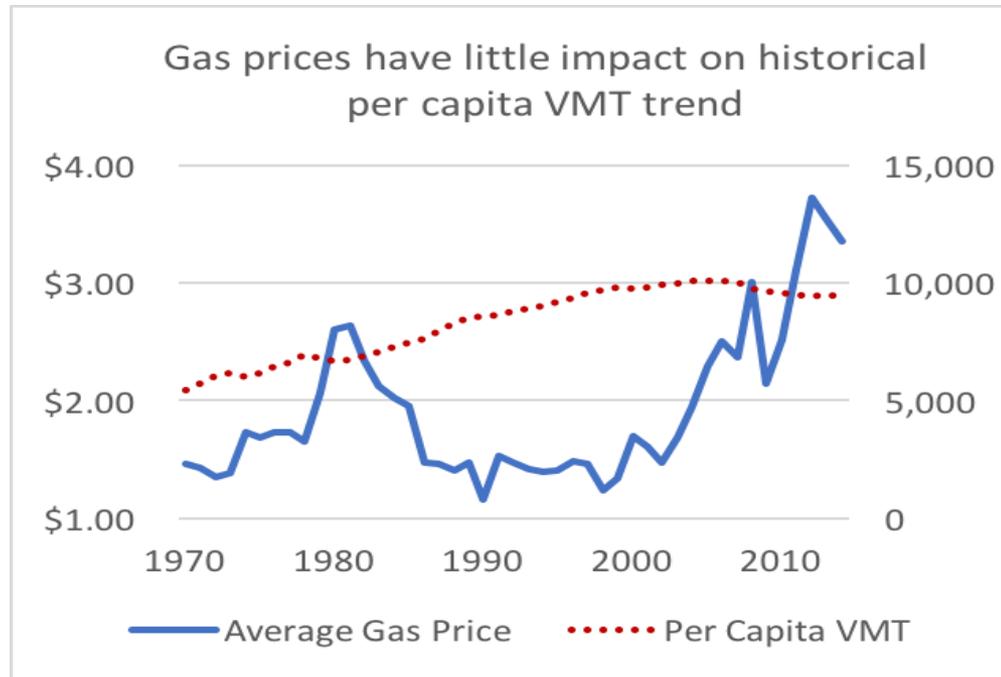
Source: Fuels Institute and WardsAuto.com



# Data Point: Gas Prices and Consumer Behavior, continued

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When measuring how drivers respond to increased gas prices:



A very large increase in operating costs is required for drivers to react by conserving their driving

Source: U.S. Energy Information Administration



# Opportunities to Gain Further Insights

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- Road Charge participant feedback – especially PEV owners
- Pilot tests in other states
- PEV user groups (as distinct from environmental advocacy groups)
- Active Studies: [http://www.arb.ca.gov/research/single-project.php?row\\_id=65197](http://www.arb.ca.gov/research/single-project.php?row_id=65197)



# Main Conclusions

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- ◆ PEV adoption is critical to California's Advanced Clean Cars Program, which requires 15% of new sales to be ZEV by 2025.
- ◆ California already offers both PEV purchase (ex: rebates) and PEV use incentives (ex: HOV lane access).
- ◆ 38% of PEV purchasers in California said operating cost savings (i.e., fuel) was a primary motivation.
- ◆ Although the cost advantage varies based on current gas prices, on average, cost-conscious PEV owners can save \$106 per month by switching from a new gas-powered vehicle to a Nissan Leaf.
- ◆ The operating cost advantage is \$92 per month if a Road Charge is applied to all vehicles, including PEVs.
- ◆ As a market segment, sales of PEVs do not appear to be strongly reactive to gas prices.
- ◆ Whether a 1.8 cent per mile Road Charge (est. \$18/month) would significantly impair PEV sales is an unanswered question.



# Questions?

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