Alternative Fuels, Fuel Efficient Vehicles and Funding our Highways

Committee for a Study of the Future Interstate Highway System

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NREL at a Glance

- Only U.S. National Laboratory dedicated to renewable energy and energy efficiency research
- Established in 1979 as Solar Energy Research Institute
- About 2,400 employees with world-class facilities
- Owned by the Department of Energy, operated by the Alliance for Sustainable Energy
Transportation and Energy Policies are Not Aligned

CAFE is projected to provide economic benefit of between $372 and $507 billion by 2025
Source: NHTSA, 2011

Fuel tax revenues are projected to decrease by $57 billion by 2022 due to CAFE.*
Source: Congressional Budget Office, 2012 (Dinan and Austin)
Transportation Funding is at an Impasse

Transportation fundamentals are changing and current funding paradigms are being challenged

- Infrastructure is deteriorating and current funding mechanisms are largely insufficient; federal government has relied on supplemental payment from general fund since 2008

Alternative fuels introduce increased complexity

- Multiple fuels with varying energy contents, delivery methods, and taxation schemes present challenges towards balancing parity and promotion
- Potential approaches pursued include:

  - Annual Fees
  - Energy-Based Taxation
  - VMT
  - Carbon Tax
States/Provinces Are Implementing New Funding Mechanisms

- **VMT**: Oregon is conducting a pilot that allows for up to 5,000 drivers of certain types of light-duty vehicles to participate in a program that will pay $0.015/mile in lieu of the $0.30/gallon state gasoline tax.

- **%**: Virginia eliminated its $0.175/gallon motor fuels tax in favor of a 3.5% sales tax on gasoline and a 6% sales tax on diesel fuel. The tax is adjusted twice annually.

- **CO₂**: In 2008, British Columbia instituted a carbon tax that is levied in proportion to equivalent tons of carbon dioxide emitted by a given fuel.
Vehicles Are Becoming Increasingly Fuel Efficient

Federal Light-duty Fuel Economy Standards

MILES PER GALLON


Passenger Cars
Light-Duty Trucks

U.S. Department of Energy Alternative Fuels Data Center
The Market for Alternative Fuels Is Increasing

Light-Duty Hybrid and Alternative Fuel Vehicle Models Available to Consumers

Available Light-Duty Hybrid and Alternative Fuel Vehicles by Fuel Type (MY16)

- **Flex Fuel**: 45%
- **CNG**: 8%
- **Plug-In Electric**: 20%
- **Hybrid**: 4%
- **Propane**: 4%
- **Hydrogen**: 2%

U.S. Department of Energy Alternative Fuels Data Center
AFV sales are increasing substantively on a year over year basis, but still make up a small portion of the overall fleet.

Approximate number of gasoline, diesel, hybrid, electric, and alternative fuel light-duty vehicles (Model years 1999-2015)

Source: IHS/Polk 2015
Collecting Motor Fuel Taxes Used to be Simple...

- Single, consistent point of enforcement
- Two major fuels (gasoline and diesel)
- International Fuel Tax Agreement for interstate transactions
New Fuels and Technologies Complicate Things

Plug-in Hybrid Electric Vehicle
Series Hybrid Vehicle
Parallel Hybrid Vehicle
Series/Parallel Hybrid Vehicle
Mild Hybrid
Battery Electric vehicle
Hybrid Electric Vehicle
Fuel Cell Electric Vehicle

Gasoline Vehicle

Diesel Vehicle

Fuel Cell Hybrid Vehicle
Bi-fuel Natural Gas Vehicle
Dedicated Natural Gas Vehicle
Dual-fuel Natural Gas Vehicle
Propane Vehicle
Flexible Fuel Vehicle
Extended Range Electric Vehicle
Neighborhood Electric Vehicle
Fuel Taxes are Traditionally Based on Volume

Current System of Taxation Does Not Accommodate Variation Among Alternative Fuels

Gallons of Fuel Needed to Produce the Energy Equivalent of a Gallon of Gasoline

- **Ethanol (E85)**: 1.36
- **Propane (LPG)**: 1.34
- **Liquid Natural Gas (LNG)**: 1.53
- **Biodiesel (B20)**: 0.90
- **Biodiesel (B100)**: 0.97
- **Diesel #2**: 0.88

Gallons of Fuel Needed to Produce the Energy Equivalent of a Gallon of Diesel

- **Ethanol (E85)**: 1.54
- **Propane (LPG)**: 1.52
- **Liquid Natural Gas (LNG)**: 1.73
- **Biodiesel (B20)**: 1.02
- **Biodiesel (B100)**: 1.11
- **Gasoline (regular)**: 1.14

Please note that these values are averages and are subject to regional and seasonal variation.

Source: U.S. Department of Energy Alternative Fuels Data Center
Energy Content-Based Taxation

Recent Legislation Seeks to Tax Alternative Fuels Based on Energy Content

Consideration of Energy Content Based Fuel Taxes

- Establishing a baseline
- Fuel blending and vehicle conversion
- Introduction of non-traditional “fuels” such as electricity
- Funding impacts
Utilizing Decals and Fees for Alternative Fuels

Decals/annual fees being used in 17 states as a mechanism for compliance, convenience, and incentive

- Recover revenues from non-traditional fueling options (home fueling, behind the fence, etc.)
- Facilitate private fleet use of alternative fuels
- Incentivize the use of alternative fuels, especially for vehicles/fleets with relatively high fuel consumption

Considerations for Implementation/Administration

- Fair and efficient taxation
- Taxation in commercial transactions
- Parity with electric and bi-fuel vehicles
- Enforcement

Photo by Pat Corkery, NREL 18175
Nationally, annual fees are generally being phased out for CNG/LNG/LPG and established for EVs.
Vehicle Fees Across Vehicles Types

- Flat-fee decals effectively provide a subsidy to heavy fuel users and a penalty on light-duty vehicle drivers
- Burden of compliance is often not clear resulting in possible situations of double taxation or no taxation

Average Federal Fuel Tax Revenue for Various Vehicle Classes

[Bar chart showing revenue for different vehicle classes: $96 for Light-Duty Car, $126 for Light Truck, $463 for School Bus, $482 for Delivery Truck, $518 for Taxi, $2,410 for Refuse Truck, $2,547 for Transit Bus, $3,145 for Class 8 Truck]

[1] Average mileage values are derived from Federal Highway Administration Table VM-1 American Public Transit Association's Public Transportation Fact Book Tables 8, 16, and 21
### How Much Revenue Are EVs Displacing?

<table>
<thead>
<tr>
<th>Average New Car</th>
<th>Nissan Leaf</th>
<th>Chevrolet Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.2 MPG</td>
<td>112 MPGe</td>
<td>106/42 MPGe</td>
</tr>
<tr>
<td>$96.42</td>
<td>$26.86</td>
<td>$21.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$17.19</td>
</tr>
</tbody>
</table>

**Estimate of Annual Federal Fuel Taxes Paid by an Average Conventional Vehicle, Nissan Leaf EV, and Chevrolet Volt PHEV if Electricity Were Taxed as a Motor Fuel**

- **Tax assumed to be $0.18 per gallon of gasoline**
- **Average annual vehicle mileage assumed to be 16,349 miles based on average fuel consumption from FHWA**
- **Average new car fuel economy from mpge for Nissan Leaf and Chevrolet Volt from U.S. Environmental protection agency fuel economy guide**
Relevant and Recent Legislation

U.S. Congress (2015)
Legislation was passed to equalize the federal excise tax on LNG with that of diesel and LPG and CNG with that of gasoline (H.R. 3236)

Colorado (2013)
HB1110 phased out decal for CNG/LNG/LPG and phased in energy-content based fuel taxation. Assessed $50 annual fee on EVs - $25 of which goes to transportation infrastructure, $25 of which goes to EV charging infrastructure

Mississippi (2015)
HB1590 defined a diesel gallon equivalent for the purpose of taxation of LNG

New Mexico (2014)
HB30 removed the decal and established an energy equivalent tax for CNG, LNG, and LPG
Thank You

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Learn more at
www.nrel.gov/transportation
Backup Slides and Supporting Information
## Energy Content of Various Alternative Fuels

<table>
<thead>
<tr>
<th>Energy Content (Lower heating value)</th>
<th>Gasoline/E10</th>
<th>Low Sulfur Diesel</th>
<th>Biodiesel</th>
<th>Propane (LPG)</th>
<th>Compressed Natural Gas (CNG)</th>
<th>Liquefied Natural Gas (LNG)</th>
<th>Ethanol/E100</th>
<th>Methanol</th>
<th>Hydrogen</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Content (Higher heating value)</td>
<td>112,114 - 116,090 Btu/gal (g)</td>
<td>128,488 Btu/gal (g)</td>
<td>119,550 Btu/gal for B100 (g)</td>
<td>84,250 Btu/gal</td>
<td>20,160 Btu/lb</td>
<td>21,240 Btu/lb</td>
<td>76,330 Btu/gal for E100 (g)</td>
<td>57,250 Btu/gal (g)</td>
<td>51,585 Btu/lb</td>
<td>61,013 Btu/lb</td>
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See: [http://www.afdc.energy.gov/fuels/fuel_comparison_chart.pdf](http://www.afdc.energy.gov/fuels/fuel_comparison_chart.pdf) for additional details and notes
<table>
<thead>
<tr>
<th>Fuel</th>
<th>Tax Rate Per Gallon (cents)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>18.4</td>
</tr>
<tr>
<td>Ethanol/Methanol</td>
<td>18.4</td>
</tr>
<tr>
<td>Diesel and Kerosene</td>
<td>24.4</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>24.4</td>
</tr>
<tr>
<td>Liquefied Petroleum Gas</td>
<td>18.3</td>
</tr>
<tr>
<td>(Propane, butane, pentane, or mixtures of these gases)</td>
<td></td>
</tr>
<tr>
<td>Liquefied Natural Gas</td>
<td>24.3</td>
</tr>
<tr>
<td>Compressed Natural Gas (including biogas)</td>
<td>18.3</td>
</tr>
<tr>
<td>P-series Fuels</td>
<td>18.4</td>
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<tr>
<td>Liquefied Hydrogen</td>
<td>18.4</td>
</tr>
<tr>
<td>Any liquid fuel derived from coal through the Fischer-Tropsch process</td>
<td>24.4</td>
</tr>
<tr>
<td>Ethanol produced from natural gas</td>
<td>11.4</td>
</tr>
<tr>
<td>Methanol produced from natural gas</td>
<td>9.25</td>
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<tr>
<td>Other Fuels</td>
<td>18.4</td>
</tr>
</tbody>
</table>
The International Fuel Tax Agreement (IFTA) was enacted in 1991 to address some of these disparities and simplify state-level transactions. It currently includes the 48 contiguous states in the United States and 10 Canadian provinces as parties to the agreement. Vehicles that operate in multiple states and meet one of the following conditions qualify for an IFTA license:

- Two axles and a gross vehicle weight (or registered gross weight) exceeding 26,000 pounds
- Three or more axles, regardless of weight
- Used in combination, and the gross vehicle weight of the combination is more than 26,000 pounds.

Carriers in participating jurisdictions are required to obtain an IFTA license; alternately, carriers can in some cases obtain trip permits if interstate travel occurs infrequently. Fuel taxes are reported on a quarterly basis through IFTA and allow for a carrier to report taxable miles, gallons of fuel, and taxes paid in order to reconcile discrepancies across states. It's important to note that while IFTA is a coordinating entity, its functions are purely administrative and do not influence state rates.