The Case for Vehicle Efficiency Regulations: Past, Present, and Future of US Standards

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Outline

– The case for efficiency standards
  • Political case
  • Legal case
  • Petroleum case
  • Efficiency case
  • Consumer case
  • Technical feasibility case
  • Environmental case
  • Automotive industry case
  • Domestic jobs case
  • International competitiveness case

– Summary (and limitations…)
Political Case for Efficiency Standards

– Common ground for energy, environmental, and economic win
  • Auto industry, environmental NGOs, labor unions, states embrace standards
  • May 19, 2009: Agreement on 2012-2016 standards (“35.5 mpg”)
  • July 29, 2011: Agreement for 2017-2025 standards (“54.5 mpg”)

For details, see http://www.epa.gov/otaq/climate/regulations.htm
Legal Case for Efficiency Standards

– Petroleum use reduction
    – US DOT’s NHTSA develops Corporate Average Fuel Economy (CAFE) standards

– Climate change mitigation
  • California’s “Pavley” AB 1493 of 2002; AB 32 of 2006; Mass et al v. EPA, 2007
    – CARB develops greenhouse gas (GHG) standards for 2009-2016; 2017-2025
    – US EPA develops GHG standards for 2012-2016; 2017-2025

National program standard test cycle fuel economy assumes use of air-conditioning credits (11 gCO₂/mi in 2016; 21 gCO₂/mi in 2025) Based US EPA “Trends” Report (http://www.epa.gov/otaq/fetrends.htm), and “SNOI” (http://www.epa.gov/otaq/climate/regulations.htm)
Petroleum Case for Efficiency Standards

- Basic statistics:
  - Autos are ~94% petroleum fueled, consume half of all US petroleum (~9 million bbl/day)
  - US petroleum consumption is ~50% imported (~9 million bbl/day)

- In-development, agreed-upon model year 2017-2025 standards:
  - Test-cycle standards: 28 mpg in 2008 → 34 mpg in 2016 → 48 mpg in 2025
    - Real-world consumer label: 21 mpg → 27 mpg → 39 mpg
  - President Obama: “This agreement on fuel standards represents the single most important step we’ve ever taken to reduce our dependence on foreign oil”
  - US EPA estimate: 4 billion barrels oil use reduction (2017-2025 vehicle lifetime)

Efficiency Case for Efficiency Standards

The modern internal combustion automobile, at about 15-20% efficiency, is riddled with efficiency losses – and available solutions

Consumer Case for Standards

- **Consumers:**
  - 85% concerned about gas prices; 79% concerned about mid-east oil dependence
  - 81% general support of fuel economy standards; 64% support 60 mpg standard

- **Standards help automakers overcome investment risk → require new technology offerings → help overcome consumer loss aversion**
  - Result: Technology cost of $1500-2500/vehicle; Fuel savings of $500-1000/year;
  - Consumer payback in 2-4 years; all scenarios offer benefits >3 times initial costs

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Technology Case</th>
<th>New Vehicle Technology in 2025</th>
<th>Per-vehicle price increase ($/vehicle)</th>
<th>Average payback period (yr)</th>
<th>Net lifetime owner savings ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>51 mpg 173 gCO$_2$/mi 4%/year</td>
<td>Path A</td>
<td>15% Mass Reduction, 65% Gasoline &amp; diesel vehicles, 34% Hybrid, 0% Electric</td>
<td>1,700</td>
<td>2.5</td>
<td>5,900</td>
</tr>
<tr>
<td>Path B</td>
<td>20% Mass Reduction, 82% Gasoline &amp; diesel vehicles, 18% Hybrid, 0% Electric</td>
<td>1,500</td>
<td>2.2</td>
<td>5,700</td>
<td></td>
</tr>
<tr>
<td>Path C</td>
<td>25% Mass Reduction, 97% Gasoline &amp; diesel vehicles, 3% Hybrid, 0% Electric</td>
<td>1,400</td>
<td>1.9</td>
<td>5,500</td>
<td></td>
</tr>
<tr>
<td>Path D</td>
<td>15% Mass Reduction, 55% Gasoline &amp; diesel vehicles, 41% Hybrid, 4% Electric</td>
<td>1,900</td>
<td>2.9</td>
<td>5,300</td>
<td></td>
</tr>
<tr>
<td>56 mpg 158 gCO$_2$/mi 5%/year</td>
<td>Path A</td>
<td>15% Mass Reduction, 35% Gasoline &amp; diesel vehicles, 65% Hybrid, 1% Electric</td>
<td>2,500</td>
<td>3.1</td>
<td>6,500</td>
</tr>
<tr>
<td>Path B</td>
<td>20% Mass Reduction, 56% Gasoline &amp; diesel vehicles, 43% Hybrid, 1% Electric</td>
<td>2,300</td>
<td>2.8</td>
<td>6,300</td>
<td></td>
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<tr>
<td>Path C</td>
<td>25% Mass Reduction, 74% Gasoline &amp; diesel vehicles, 25% Hybrid, 0% Electric</td>
<td>2,100</td>
<td>2.5</td>
<td>7,000</td>
<td></td>
</tr>
<tr>
<td>Path D</td>
<td>15% Mass Reduction, 41% Gasoline &amp; diesel vehicles, 49% Hybrid, 10% Electric</td>
<td>2,600</td>
<td>3.6</td>
<td>5,500</td>
<td></td>
</tr>
</tbody>
</table>

Scenario labels are based on regulatory two-cycle fuel economy and CO$_2$ (various credits, like for air-conditioning technology are available).


Technical Feasibility Case for Standards

- Emerging off-the-shelf technology now; advanced technology later
- Technologies available for -50% GHG reduction (+100% mpg)
  - Example mid-size vehicle class with increasingly advanced technology packages

Emission rates are test-cycle (not adjusted real world);
Environmental Case for Efficiency Standards

- New vehicle GHG emissions by ~25% in 2016, by ~50% in 2025
- Cumulative: ~4 billion tons CO₂ reduction over US vehicle lifetimes
- Automobile fleet on path to deep climate change stabilization goals (?)

Figure is California-only, based on CARB, 2010.  
http://www.arb.ca.gov/msprog/levprog/leviii/meetings/111610/ghg_11_10.pdf
GHG benefits are from US EPA, 2011.  
http://www.epa.gov/otaq/climate/regulations.htm
Auto Industry Case for Efficiency Standards

- Regulatory certainty + lead-time = increased technology investment
- Marchionne (Fiat/Chrysler):
  - “You will see incredible results even out of what I consider to be absolutely plain vanilla technology”
- Technology investments
  - Advanced engine valvetrain
  - Cylinder deactivation
  - Turbocharged engines
  - Direct injection
  - 6-spd, dual-clutch, CVT transmissions
  - Hybrid

Domestic Jobs Case for Standards

- Development, deployment of efficient engines, transmissions, supplier components retain and create automotive jobs
- UAW: 50,000 to 100,000 new jobs by 2020 from standards
- Fiat/Chrysler CEO: “an incredible stimulus for the American car industry”

<table>
<thead>
<tr>
<th>Area</th>
<th>Technology</th>
<th>Example automakers</th>
<th>Example suppliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>Advanced variable valvetrains</td>
<td>All</td>
<td>Bosch, Delphi, Denso, Magna, Siemens, Valeo</td>
</tr>
<tr>
<td></td>
<td>Turbochargers</td>
<td>Nearly all</td>
<td>AISEN, BorgWarner, Delphi, Denso, Honeywell</td>
</tr>
<tr>
<td></td>
<td>Gasoline direct injection systems</td>
<td>Nearly all</td>
<td>Delphi, Denso, Valeo, BorgWarner</td>
</tr>
<tr>
<td></td>
<td>Diesel engines</td>
<td>BMW, Mercedes, VW</td>
<td>BorgWarner</td>
</tr>
<tr>
<td>Transmission</td>
<td>6+ speed, dual-clutch transmission</td>
<td>Nearly all</td>
<td>BorgWarner, Getrag, LuK, Ricardo, ZF</td>
</tr>
<tr>
<td></td>
<td>Continuously Variable</td>
<td>Ford, GM, Honda, Nissan</td>
<td>Bosch, ZF</td>
</tr>
<tr>
<td>Vehicle</td>
<td>Stop-start</td>
<td>All</td>
<td>Bosch, Delphi, Denso, GKN, Siemens, Valeo, Visteon, ZF</td>
</tr>
<tr>
<td></td>
<td>Accessory and auxiliary efficiency</td>
<td>All</td>
<td>Bosch, DANA, Delphi, Siemens, Visteon, Valeo</td>
</tr>
<tr>
<td></td>
<td>Low rolling resistance tires</td>
<td>All</td>
<td>Michelin, Continental</td>
</tr>
<tr>
<td></td>
<td>Low-GHG refrigerant</td>
<td>GM, Aston Martin</td>
<td>DuPont, Honeywell</td>
</tr>
<tr>
<td>Advanced materials</td>
<td>High-strength steel</td>
<td>All</td>
<td>Continental, EDAG, Gestamp, Magna, ThyssenKrupp</td>
</tr>
<tr>
<td></td>
<td>Advanced plastics</td>
<td>All</td>
<td>Dupont, Faurexia, Ticona, Trexel</td>
</tr>
<tr>
<td></td>
<td>Aluminum</td>
<td>Audi, VW</td>
<td>Alcoa, Novelis, Rio Tinto, Hydro</td>
</tr>
<tr>
<td>Hybrid and electric</td>
<td>Motors, electric drivetrain</td>
<td>All</td>
<td>Azure Dynamics, Delphi, Magna, UQM</td>
</tr>
<tr>
<td>vehicles</td>
<td>Batteries</td>
<td>All</td>
<td>A123, AESC, JCI-Saft, LG Chem, Panasonic, Sanyo, Tesla</td>
</tr>
<tr>
<td></td>
<td>Power electronics</td>
<td>All</td>
<td>Delphi, Magna</td>
</tr>
</tbody>
</table>

Nearly every major automaker market has increasing regulatory pressure for automobile efficiency for 2015, 2020

- All nations motivated to have leading manufacturing base, reduced oil imports
- For the US to *not* implement new standards risks becoming a “technology island”

![Graph showing MILES PER GALLON (Adjusted for US CAFE test cycle) for various countries from 2005 to 2025]

[1] Standards as announced July 29, 2011
[2] Standards as announced July 29, 2011, after use of 21 gCO₂e/mile for air conditioning credits.

Summary (and Limitations)

- The case for efficiency standards is strong, multi-faceted
  - Few policies offer such an economic, energy, environmental benefit package
- However, there are many things the standards do not do
  - Don’t as efficiently address vehicle purchasing and vehicle travel decisions (as e.g., increased fuel taxation could)
  - Increasingly efficient vehicles essentially require us to restructure road taxes
  - Can’t guarantee success of advanced technology (e.g., electric, fuel cell)
  - Can’t guarantee lower carbon life-cycle fuels (e.g., electricity, hydrogen)
  - Standards don’t (yet) put us on a path to long-term climate stabilization
  - Vehicle technology only goes so far in addressing transportation issues
    - Separate actions required to address travel demand, congestion, land use effects
Extra: Background slides

- Timeline, milestones for 2016 standards
- Footprint-indexed 2016 car and truck CO$_2$ standards
- Timeline, milestones for CARB/EPA CO$_2$ and NHTSA CAFE 2017-2025 standards
- CARB/EPA/NHTSA technical assessment
U.S. 2016 Vehicle GHG Standards

- Automakers agree to ~250 gCO₂/mile (~34.1 mi/gal) for model year 2016
  - From 2010 baseline of 314 gCO₂/mi → a 20% reduction
  - From 2010 baseline of 28 mi/gal → a 20% increase

Government-industry agreement (May 19, 2009)
Obama administration, automakers, and California agree to national US standards
US 2016 Greenhouse Gas Emission Standards

- 2012-2016 standards are footprint-indexed for cars and light trucks
  - Overall US 2016 new vehicle targets: 250 gCO$_2$/mile, 155 gCO$_2$/km, 34 mile/gallon, 6.9 L/100km
  - Manufacturers have different standards based on their sales composition (car vs truck, footprint)

*Federal 2012-2016 CO$_2$ standards are administered by the US Environmental Protection Agency; Equivalent 2016 “CAFE” fuel economy standards are based on 8887 gCO$_2$/gallon gasoline, 10.6 gCO$_2$/mile air conditioning credit and are administered by the National Highway Traffic Safety Administration; These standards are based the existing 2009-2016 greenhouse gas standards of the California Air Resources Board; percents shown are from model year 2008 baseline*
U.S. automobile 2009-2016 GHG Standards

• The U.S. vehicle standards
  – Based on an 8-year process with technical, regulatory, legal, political elements
  – Final adoption: US standards for new vehicles of model years 2012-2016
Automakers agree to ~163 gCO₂/mile (~48 mi/gal) for model year 2025
- From 2010 baseline of 314 gCO₂/mi → a 48% reduction
- From 2010 baseline of 28 mi/gal → a 71% increase

Government-industry agreement (July 29, 2011)
Obama administration, automakers, and California agree to national US standards
# Regulatory Timeline: 2025 Standards

**California begins work:**
- CARB public workshops on CO₂, NOx, PM, etc.
- Standards through 2025

**Joint US/CA work for 2017-2025:**
- EPA/NHTSA/CARB
- Technical report: “TAR”
- Analyze 143-190 gCO₂/mi by 2025

**Obama Administration:**
May 21: Announce work on 2025 CO₂/FE standards; CARB collaborates

**Work continues:**
- Agencies collaborate
- Technical analysis
- Industry meetings

**US 2017-25 standards:**
- July 2012: Finalize

**US/CA 2017-25 standards:**
- ~Nov. 2011: Propose

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<td>2010</td>
<td>California begins work.</td>
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<tr>
<td>2012</td>
<td>Obama Administration: May 21: Announce work on 2025 CO₂/FE standards; CARB collaborates.</td>
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Technical Assessment Report ("TAR")

Interim Joint Technical Assessment Report:

Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2017-2025

Office of Transportation and Air Quality
U.S. Environmental Protection Agency

Office of International Policy, Fuel Economy, and Consumer Programs
National Highway Traffic Safety Administration
U.S. Department of Transportation

California Air Resources Board
California Environmental Protection Agency

• Report available at –