The Case for Vehicle Efficiency Regulations:

Past, Present, and Future of US Standards

Nic Lutsey
Institute of Transportation Studies
University of California, Davis

Energy Policy and the Transportation – Land Use – Environment Connection
21st Annual UCLA Lake Arrowhead Symposium
October 17, 2011

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”)

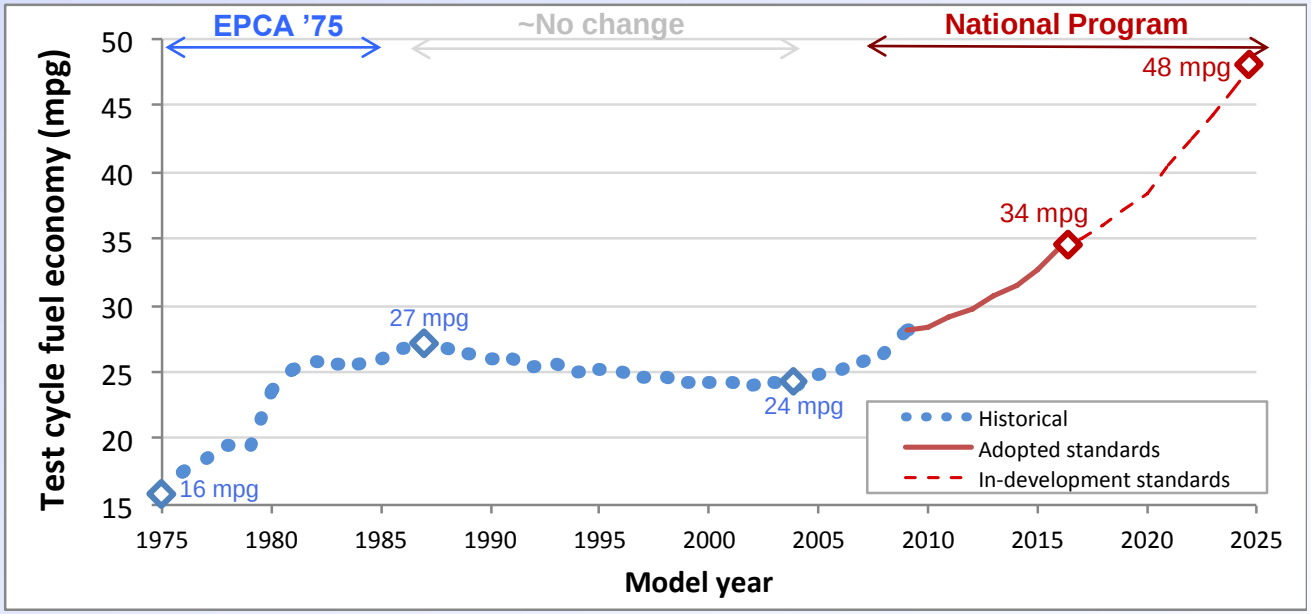
NY Times

Bloomberg

For details, see http://www.epa.gov/otaq/climate/regulations.htm

Legal Case for Efficiency Standards

- Petroleum use reduction
  - Energy Policy Conservation Act of 1975; Energy Independence and Security Act of 2007
    - 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 gCO_2/mi in 2016; 21 gCO_2/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)

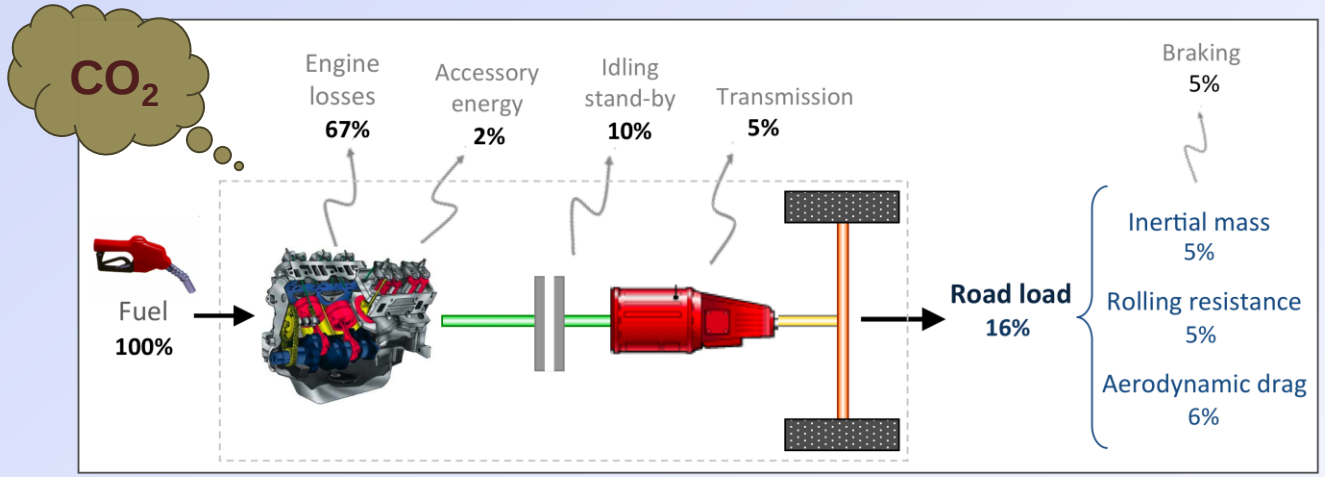
Petroleum Case for Efficiency Standards

- 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)

Sources: ORNL Trans. Energy Data Book; US EIA Annual Energy Outlook 2010; US EPA http://www.epa.gov/otaq/climate/regulations.htm

Efficiency Case for Efficiency Standards

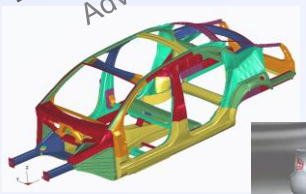
– The modern internal combustion automobile, at about 15-20% efficiency, is riddled with efficiency losses – and available solutions



Variable valve lift
Variable valve timing
Low friction lubrication
Cylinder deactivation
Turbocharging
Direct injection
Cooled exhaust gas recirculation
Lean-burn
Compression ignition
Electric power steering
Efficient air conditioning
Efficient alternator
Integrated starter "Stop-start"
6-8 speed transmission
Dual-clutch transmission
Advanced lightweight materials
Optimized vehicle design
Low drag brakes
Improved aerodynamics
Low rolling resistance tires





Sources: Kromer and Heywood, 2007 and U.S. EPA, 2010 http://www.fueleconomy.gov/feg/atv.shtml

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

Scenario	Technology Case	New Vehicle Technology in 2025				Per-vehicle price increase ($/vehicle)	Average payback period (yr)	Net lifetime owner savings ($)
		Mass Reduction	Gasoline & diesel vehicles	Hybrid	Electric			
51 mpg 173 gCO_2/mi 4%/year	Path A	15%	65%	34%	0%	1,700	2.5	5,900
	Path B	20%	82%	18%	0%	1,500	2.2	6,000
	Path C	25%	97%	3%	0%	1,400	1.9	6,200
	Path D	15%	55%	41%	4%	1,900	2.9	5,300
56 mpg 158 gCO_2/mi 5%/year	Path A	15%	35%	65%	1%	2,500	3.1	6,500
	Path B	20%	56%	43%	1%	2,300	2.8	6,700
	Path C	25%	74%	25%	0%	2,100	2.5	7,000
	Path D	15%	41%	49%	10%	2,600	3.6	5,500

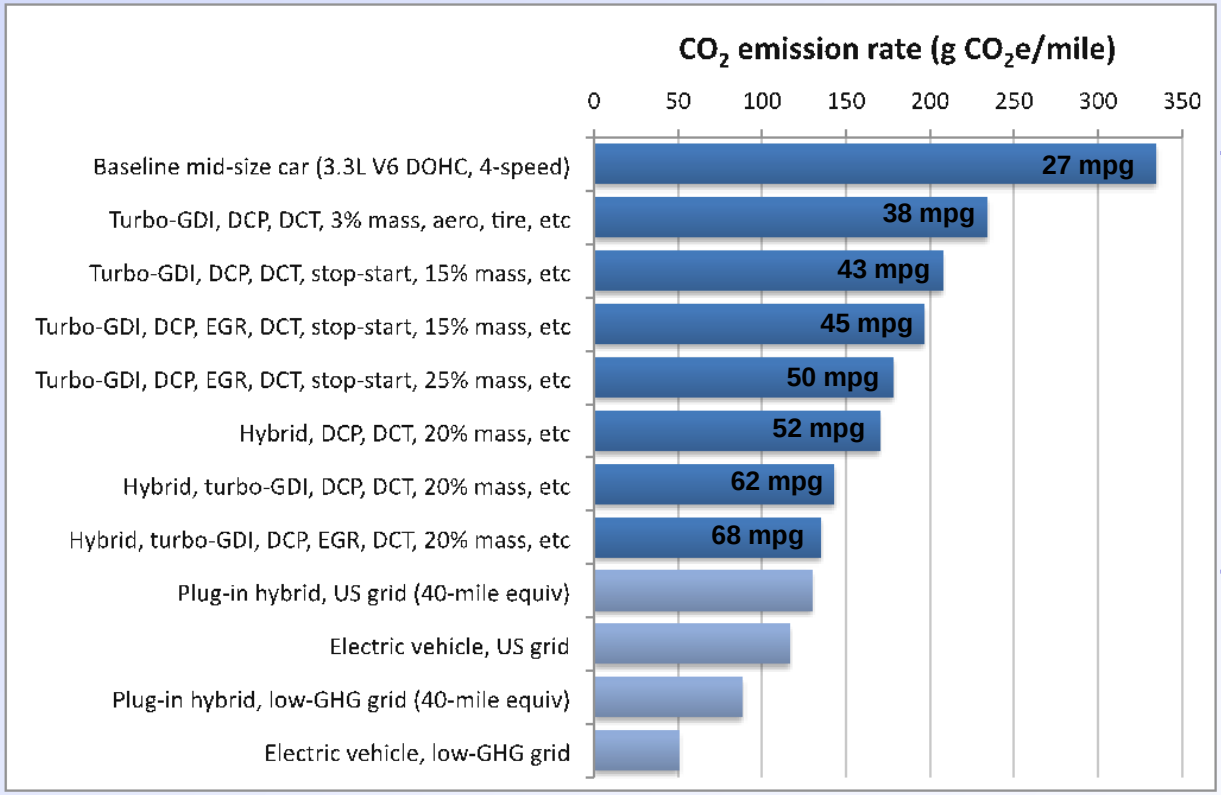
Scenario labels are based on regulatory two-cycle fuel economy and CO_2 (various credits, like for air-conditioning technology are available)

CFA, 2011. Rising Gasoline Prices and Record Household Expenditures. http://www.consumerfed.org/pdfs/CFA-Auto-Standard-Report-May-16-2011.pdf

US EPA/NHTSA/CARB 2010 Interim Technical Assessment Report. http://www.arb.ca.gov/msprog/clean_cars/ldv_ghg_tar.pdf

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);
See CARB, 2010. http://www.arb.ca.gov/msprog/levprog/leviii/meetings/111610/ghg_11_10.pdf

Environmental Case for Efficiency Standards

- New vehicle GHG emissions by ~25% in 2016, by ~50% in 2025
- Cumulative: ~4 billion tons CO_2 reduction over US vehicle lifetimes
- Automobile fleet on path to deep climate change stabilization goals (?)

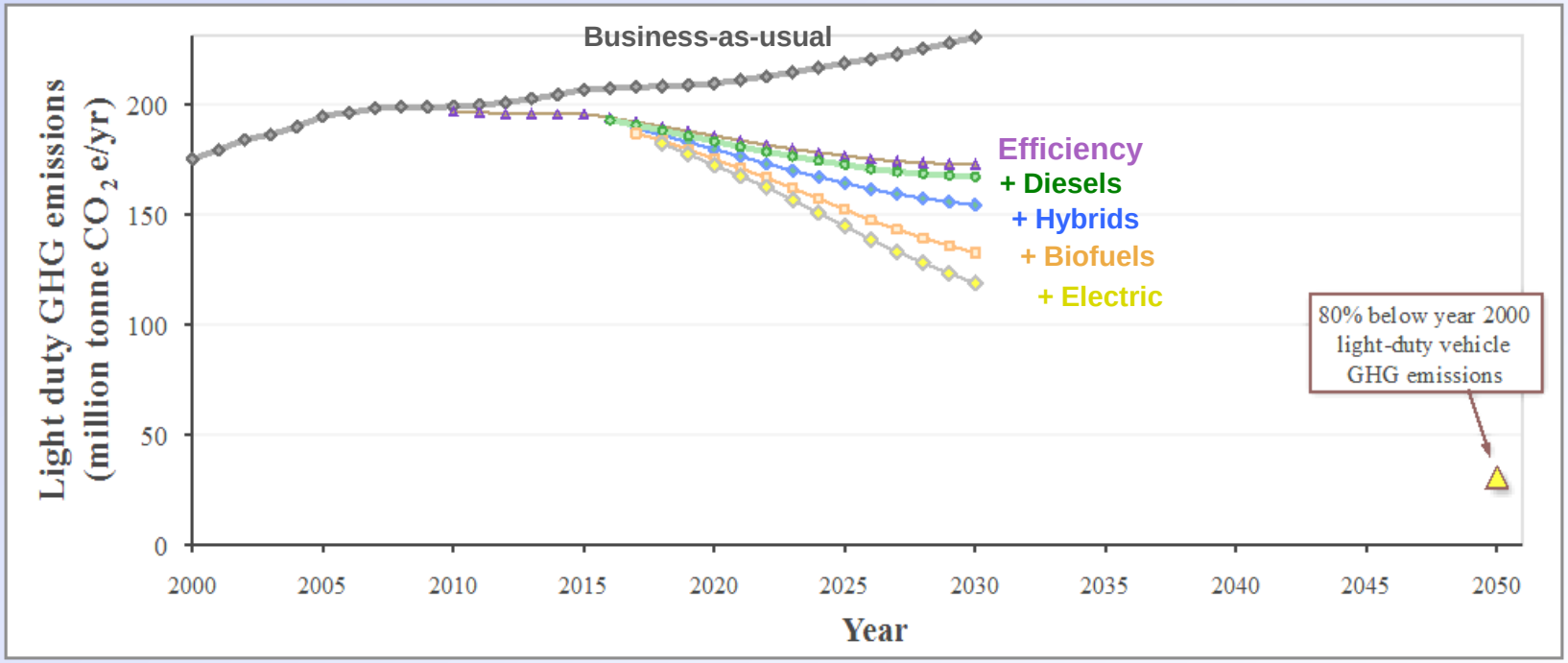
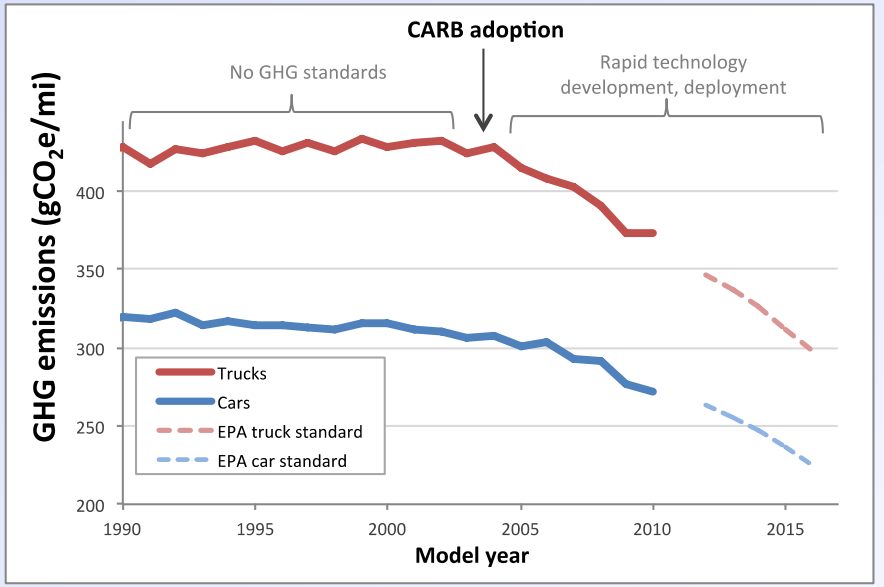
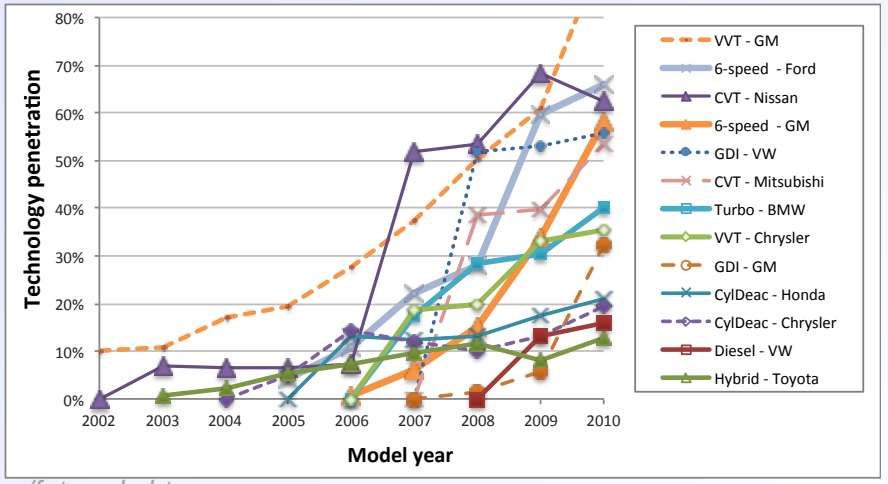


Figure is California-only, based on CARB, 2010. http://www.arb.ca.gov/msprog/levprog/leviii/meetings/111610/ghg_11_10.pdf
GHG benefits are from US EPA, 2011. http://www.epa.gov/otaq/climate/regulations.htm

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





Sources: US EPA, 2010 "Trends". http://www.epa.gov/otaq/fetrends.htm
Autonews, 2011: http://www.autonews.com/article/20110803/VIDEO/308039699/1219

Domestic Jobs Case for Standards

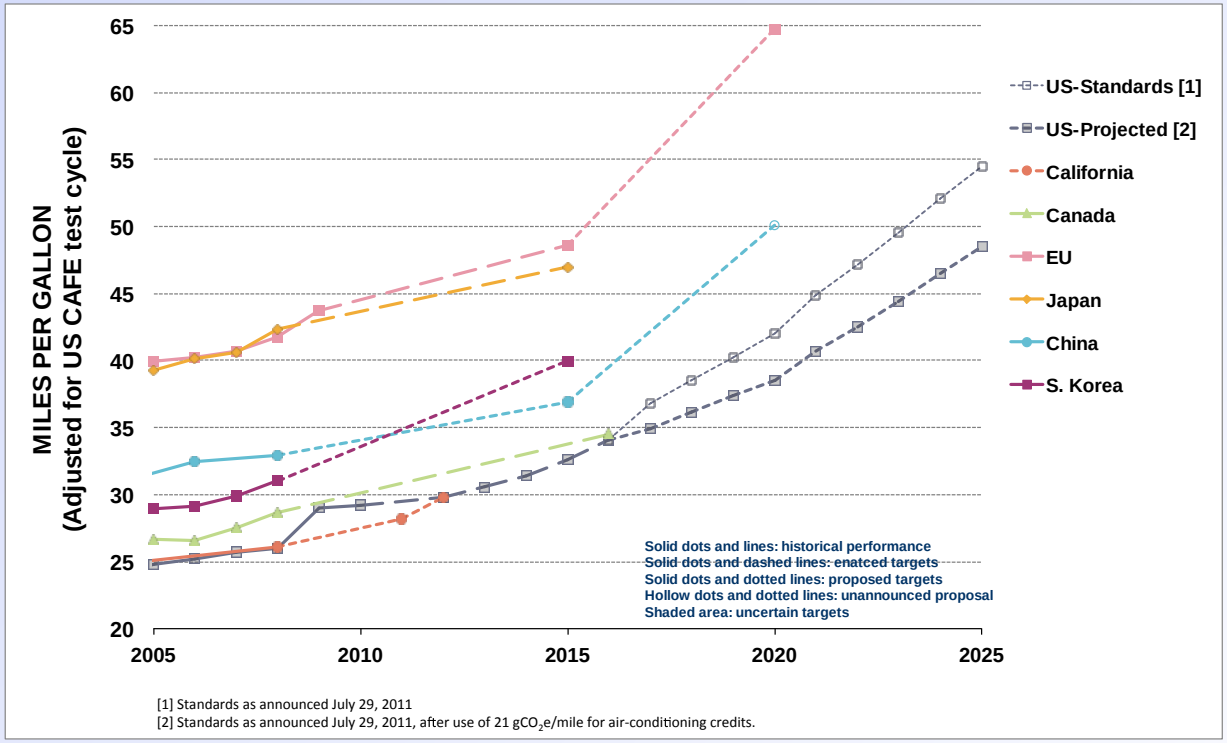
- Development, deployment of efficient engines, transmissions, supplier components retain and create automotive jobs
- UAW: 50,000 to 100,000 *new* jobs by 2020 from standards
- Fiat/Chrysler CEO: “an incredible stimulus for the American car industry”

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

Baum and Lauria, 2010. Driving Growth: How Clean Cars and Climate Policy Can Create Jobs;
Visnic, B., 2011. http://www.autoobserver.com/2011/08/marchionne-warns-on-china-and-evs.html
Boston Consulting Group, 2010. Powering Autos in 2020. www.bcg.com/documents/file80920.pdf

International Competitiveness Case for Standards

- 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"



Based International Council on Clean Transportation (ICCT), 2011. Datasheet on global passenger vehicle FE/GHG regulations. http://www.theicct.org/info/data/Global_PV_Std_Jan2011 Update_datasheet.xlsx. Updated January 2011.

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

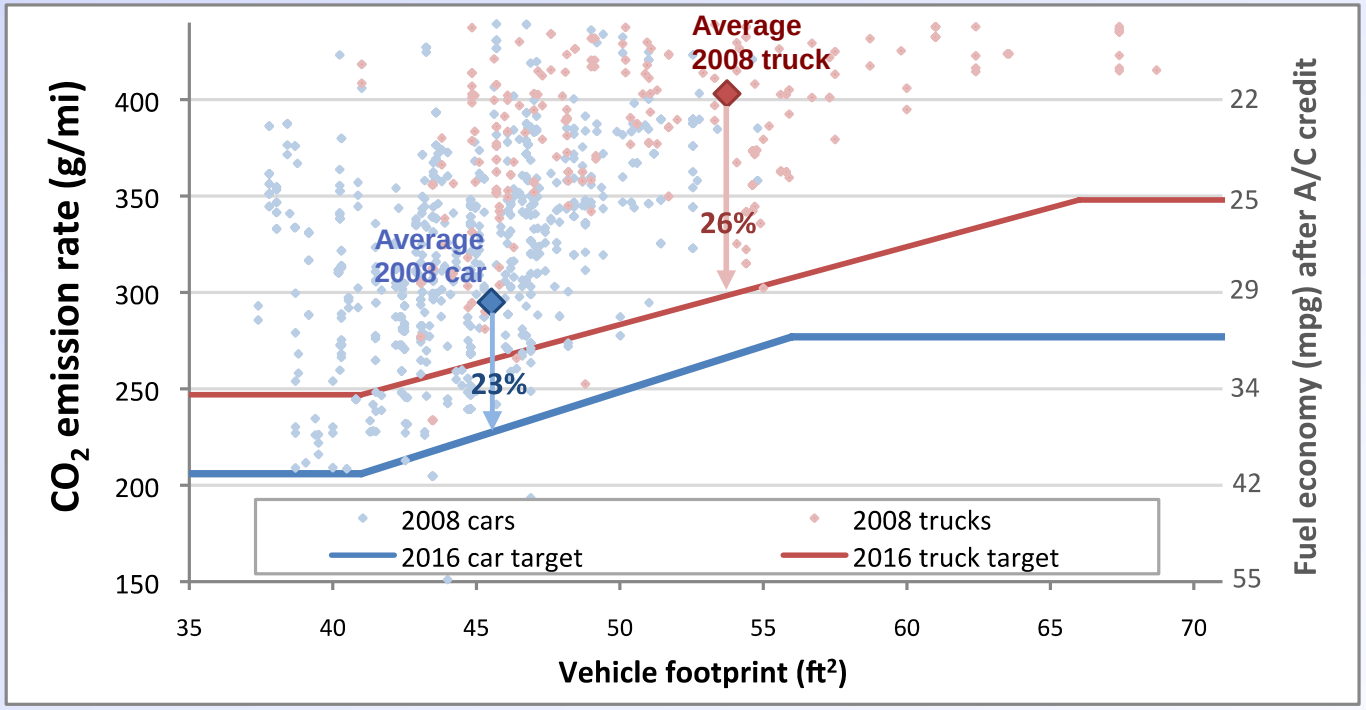
- Automakers agree to ~250 gCO_2/mile (~34.1 mi/gal) for model year 2016
  - From 2010 baseline of 314 gCO_2/mi → a 20% reduction
  - From 2010 baseline of 28 mi/gal → a 20% increase

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
  - California (2002-04) → Litigation (2004-09) → Federal US adoption (2010)
  - Final adoption: US standards for new vehicles of model years 2012-2016

Legislation:
California (Pavley) passes vehicle CO_2 legislation

California regulation:
California Air Resources Board (CARB) sets 2009-16 vehicle GHG standards

Litigation:
- Automaker lawsuits against CARB
- 13 US states adopt CARB rules
- Federal US EPA denies CARB
- US Supreme Court supports CARB

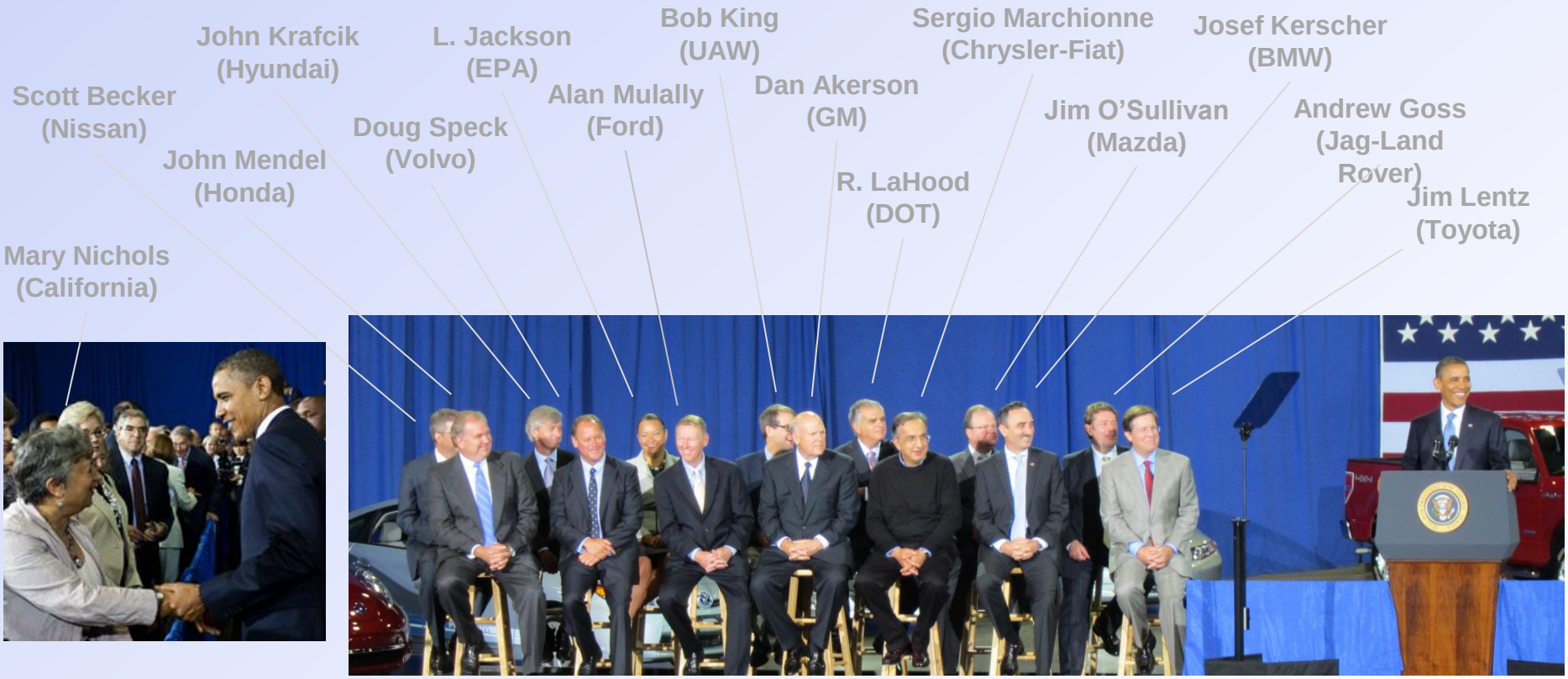
Government-industry agreement:
Obama administration, automakers, and California agree to national US standards

U.S. regulation:
US EPA and NHTSA finalize standards for 2012-2016 vehicles

2002	2003	2004	2005	2006	2007	2008	2009	2010

U.S. 2025 Vehicle GHG Standards

- Automakers agree to ~163 gCO_2/mile (~48 mi/gal) for model year 2025
  - From 2010 baseline of 314 gCO_2/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 CO_2, NOx, PM, etc.
- Standards through 2025

US 2017-25 standards:
- July 2012: Finalize

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

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

Joint US/CA work for 2017-2025:
- EPA/NHTSA/CARB
- Technical report: "**TAR**"
- Analyze 143-190 gCO_2/mi by 2025*

Obama Administration:
May 21: Announce work on 2025 CO_2/FE standards; CARB collaborates

2010	2011	2012

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

EPA

NHTSA
www.nhtsa.gov

California Environmental Protection Agency
Air Resources Board

- Report available at –
  - *http://www.arb.ca.gov/msprog/clean_cars/ldv-ghg-tar.pdf*