Asia-Pacific
Economic Cooperation

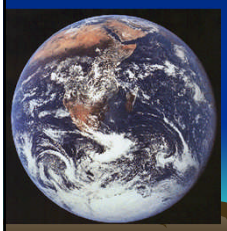
2011/SOM1/EWG/WKSP3/007
Agenda Item: III-C- (a)

Fuel Economy Standards: How Far? How Fast? How Wide? How Best

Submitted by: International Council on Clean Transportation (ICCT)

APEC Cooperative Energy Efficiency Design for Sustainability - Energy Efficient Urban Passenger Transportation
San Francisco, United States
14–16 September 2011

Fuel Economy Standards: How Far? How Fast? How Wide? How Best?



Michael P. Walsh
"Energy Efficient Urban Passenger Transportation"

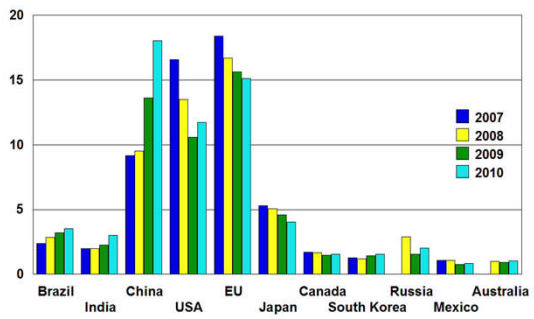
San Francisco
24 September, 2011

International Council on Clean Transportation

Goal of the ICCT is to dramatically reduce conventional pollutant and greenhouse gas emissions from personal, public and goods transportation in order to improve air quality and human health, and mitigate climate change.

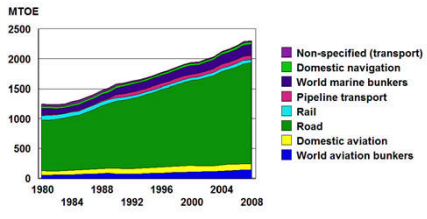
WWW.THEICCT.ORG

The Largest Vehicle Markets



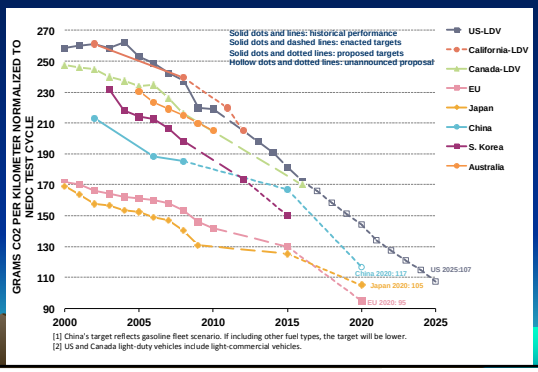
Transportation Fuel Consumption is Growing Rapidly

Global Trends in Transportation Fuel Consumption



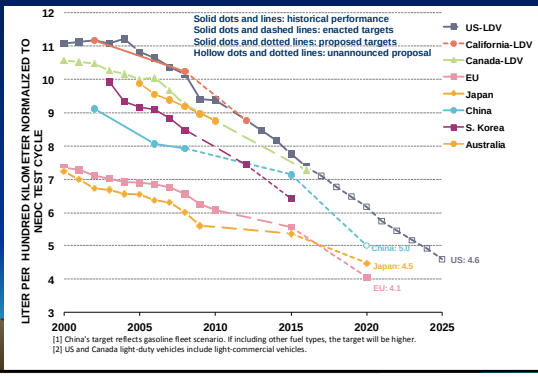
Source
Lew Fulton, IEA

Historical Fleet CO_2 Emissions Performance And Current Or Proposed Standards We Are Starting To Address The Growth



[1] China's target reflects gasoline fleet scenario. If including other fuel types, the target will be lower.
[2] US and Canada light-duty vehicles include light-commercial vehicles.

Historical Fleet Fuel Consumption Performance And Current Or Proposed Standards But We Have A Long Way To Go

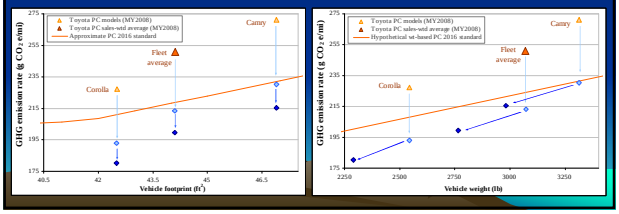


[1] China's target reflects gasoline fleet scenario. If including other fuel types, the target will be higher.
[2] US and Canada light-duty vehicles include light-commercial vehicles.

Standard Design: Mass Reduction Technology Size Based Standards Incentivize Lightweighting

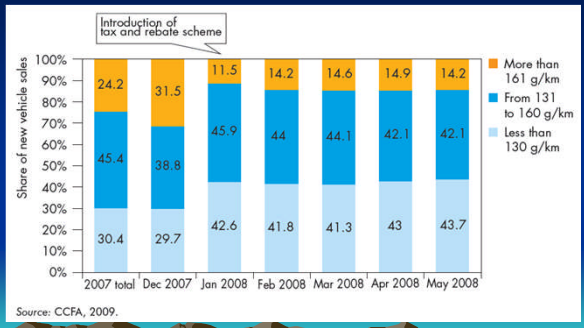
- Take a particular technology package, for example:
  - **Efficiency** (15% GHG reduction) gasoline direct injection, turbocharging, new transmission
  - **Mass reduction** (10% mass reduction → 6% GHG reduction) via lightweight materials
- Size-based approach fully rewards lightweighting; weight-based does not

- Size-based design:
  - Efficiency: 34-41 g CO_2/mi benefit
  - Lightweighting: 13-15 g CO_2/mi *actual* benefit
  - Plus potential for further optimization
- Weight-based design:
  - Efficiency: 34-41 g CO_2/mi benefit
  - Lightweighting: only 4-5 g CO_2/mi *compliance* benefit
  - Lightweighting results in more stringent standard



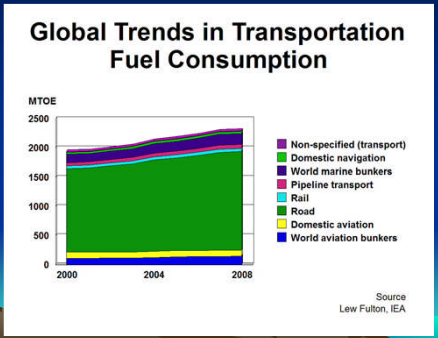
Fiscal Measures Are Also Very Important

Impact Of French Bonus-Malus On Car Market Shift



Source: CCFA, 2009.

Programs Adopted To Date Are Just Starting To Turn The Corner

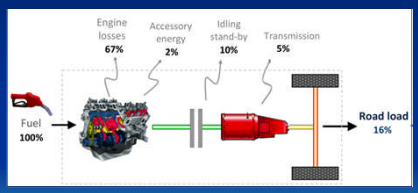


Tremendous Potential Still Exists For Increasing Efficiency, Reducing CO_2

- Technical efficiency low-CO_2 options
  - Petroleum efficiency
    - Gasoline
    - Diesel
    - Hybrid
  - Alternative fuels
    - Compressed natural gas
    - Biofuels
  - Electric-drive
    - Plug-in hybrid electric
    - Electric
    - Fuel cell electric

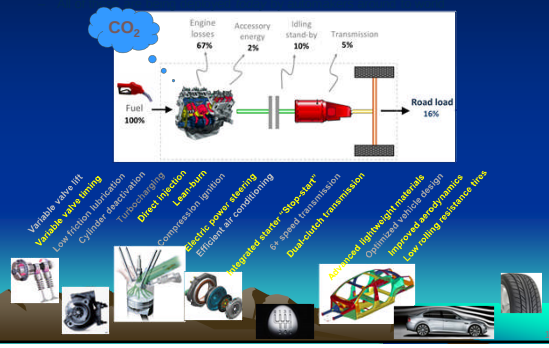
- Petroleum-fueled vehicles will be dominant for many years
  - The most near-term GHG reduction potential, most affordable, lowest consumer payback period, lowest cost-per-ton CO_2 are petroleum efficiency options

All Aspects of the Vehicle Have Potential For Improvement



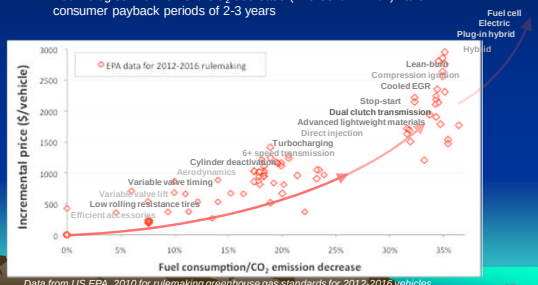
Efficiency and Low-CO_2 Technologies

- What efficiency technologies are available for conventional vehicles?



Increased Efficiency: Near-Term

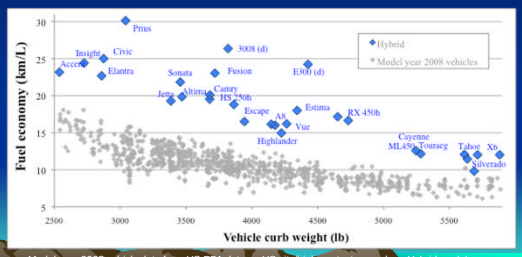
- Major incremental efficiency improvement comes at modest cost
  - engine, transmission, and vehicle load reduction technologies will proliferate for global 2015-2016 standards
  - Technologies with 20-25% CO_2 decrease (+25-33% in km/L) have consumer payback periods of 2-3 years



Data from US EPA, 2010 for rulemaking greenhouse gas standards for 2012-2016 vehicles

Increased Efficiency: Mid-Term

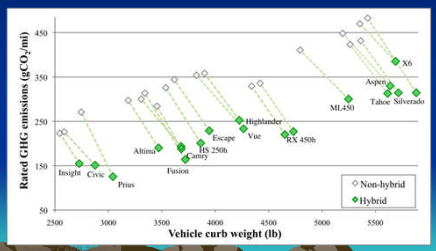
- More exciting hybrid models arrive every year
  - Hybrids now span across compacts, sedans, crossovers, large SUVs, pickups
  - Hybrids have much higher efficiency: 40-100% greater km/L (30-50% lower CO_2)
  - Hybrids are 3% of US market today; but costs decrease with volume, new entries



Model year 2008 vehicle data from US EPA data on US city/highway test procedure; Hybrid models are existing and announced model year 2008-2011 hybrid models

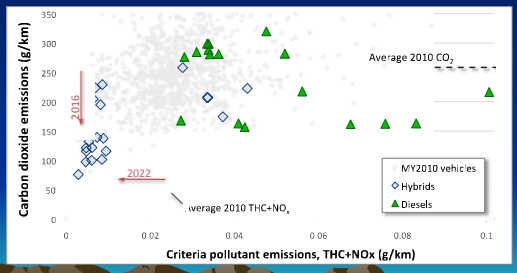
Hybrid Technology: GHG Reduction

- Hybrid vehicle models commercialized in U.S.
  - Span vehicles: compacts, sedans, crossovers, large SUVs, pickups
  - Average 33% CO_2/mi reduction, 50% mpg increase vs. similar non-hybrids



Hybrid Vehicle Technology: Emissions

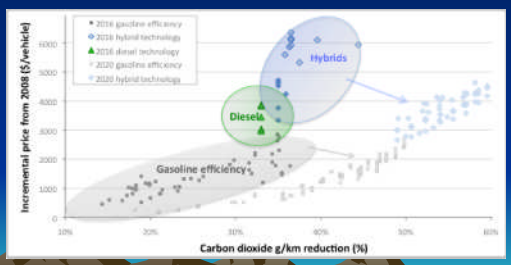
- Hybrids well-positioned for new CO_2 and criteria pollutant standards
  - Current hybrid models tend to offer 25-30% CO2 decrease and lowest NO_x/HC
  - Future standards (e.g., in US, California) will push CO2, as well as NO_x/HC, lower



Notes: data from EPA, 2010. Future year CO_2 reduction based on EPA/NHTSA adopted 2016 standards; Future Total hydrocarbon and oxides of nitrogen (THC+NOx) based on proposed California LEVIII criteria pollutant standards for 2022 for NMOG and NOx

Hybrid Technology Costs

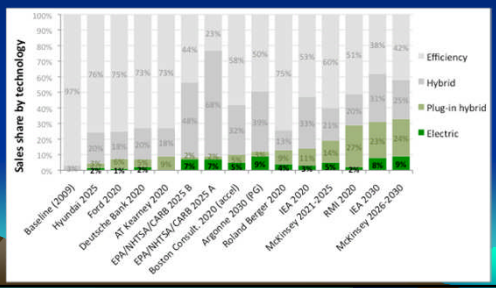
- Hybrid component costs continue to come down
  - This is happening due to innovation, learning, volume, competitive supplier base
  - Hybrids become more cost-competitive over time



Data sources: EPA, 2010; EPA/NHTSA/CARB, 2010

Increased Efficiency: Long-Term

- Gradually over the long-term, electric drive is expected to take off
  - Today's stop-start and hybrids will offer a bridge to plug-in electric vehicles
  - But… according to nearly *every* consulting and technical research study -
    - Of new vehicles in 2020-2025, *over 90% still use petroleum* fuels
    - In optimistic cases, there are *5-10% full electric vehicles* by 2025

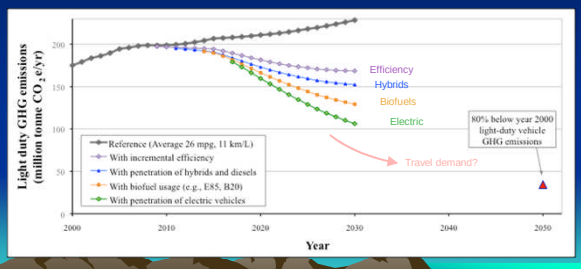


Automobile CO_2 Emissions: Long-Term

How might we achieve deeper, long-term CO_2 cuts by 2050?

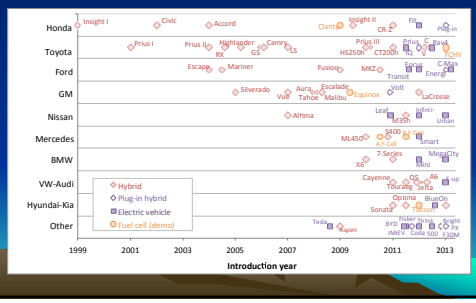
→ *Advanced technology will be required (e.g., efficiency, hybrids, electric, biofuels)*

→ *We will need to change travel behavior, land use patterns, not just technology*



Electrification: New Model Introduction

- In just the next several years…
  - Every major automaker will have several hybrid models
  - Every major automaker will have several plug-in electric vehicles
  - Some major automakers will be running major fuel cell vehicle demonstrations



Conclusions

- Automakers continuously innovate and compete to deliver a full range of efficiency technologies
  - Incremental gasoline and diesel efficiency technologies…
    - Are emerging today and will dominate the 2010-2020 market
    - Reduce CO_2 by about 25-30% (increase km/L by about 33-40%)
    - Have low-cost to consumers, with quick 2-3 year payback periods
  - New advanced technologies are more exciting every year
    - Hybrid, plug-in electric vehicles: new models, more volume, costs decrease
    - Major shift to electric-drive vehicles in the 2020-2030 timeframe
- Need robust policies to promote near- and long-term efficiency
  - Technology-forcing long-term CO_2/efficiency performance standards can push all efficiency technologies with ample lead-time
  - Additional and complimentary policies can also be critical (e.g., feebates, fuel taxes, infrastructure investment, consumer incentives)

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Fuel Economy Standards

- How Far? As far as technologically feasible and cost effective.
- How Fast? As fast as we can and as technology advances.
- How Wide? All major vehicle markets today; everywhere as soon as possible
- How Best? Sized based standards coupled with economic incentives