# Passenger vehicle fuel efficiency standards in Asia: the risks of regulating by weight

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## Overview

- About the ICCT
- Overview of fuel efficiency standards
- Importance of standard basis
- Risks of regulating by vehicle weight
- Options to minimize these risks

# International Council on Clean Transportation

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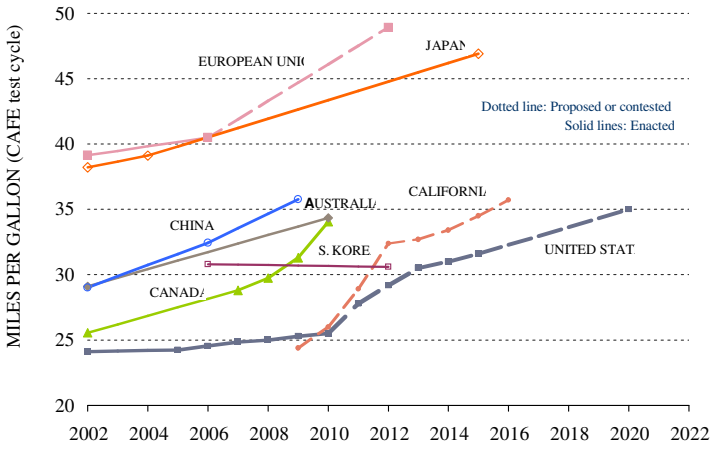
## Many examples of passenger vehicle fuel efficiency/GHG standards worldwide

Actual and Projected Fuel Economy for New Passenger Vehicles by Country/Region, 2002-2022




Source: *Passenger Vehicle Greenhouse Gas and Fuel Economy Standards: A Global Update*, ICCT. 7 August 2008 update.

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## Importance of standard basis

- Key design decision for fuel efficiency standards
- Determines how efficiency targets are assigned to vehicles/manufacturers
- Three basic options
  - Pure corporate average
  - Weight-based: "control" for vehicle weight
  - Footprint-based: "control" for vehicle size
- Advantages/disadvantages:
  - Pure corporate average offers lowest cost compliance, goal certainty, and rewards today's efficient fleets
  - Attribute-based: reduced competitiveness impacts, maximize automaker freedom

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## Some facts about weight-based standards

- First used in Japanese 1998 "top runner" fuel efficiency standard
  - Heterogeneous fleet with large differences between manufacturers
  - Essentially no diesels
  - Viewed by regulators as a technology standard
  - Backed up by fiscal incentives that discourage increases in weight and power
- Weight-based standards favored by automobile industry
  - Treats each vehicle equally, rather than automakers
  - Promotes automaker freedom

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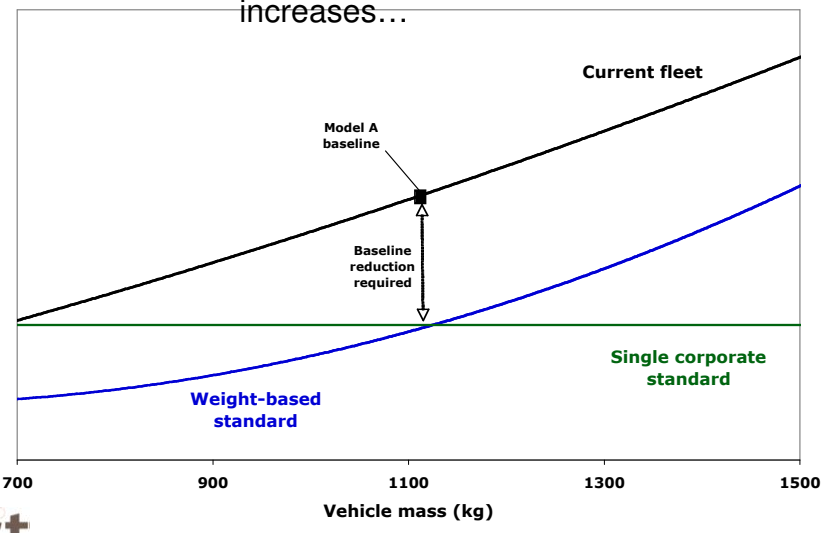
## Some facts about weight-based standards

- High correlation between vehicle weight and efficiency --> limited compliance flexibility

| Standard basis | Compliance possible through | | | | |
|---|---|---|---|---|---|
| | Changing sales mix | Chassis downsizing | Lightweight materials | Engine downsizing | Efficient technologies |
| Single corporate | Ć | Ć | Ć | Ć | Ć |
| Footprint-based | | | Ć | Ć | Ć |
| Weight-based | | | | Partial | Ć |

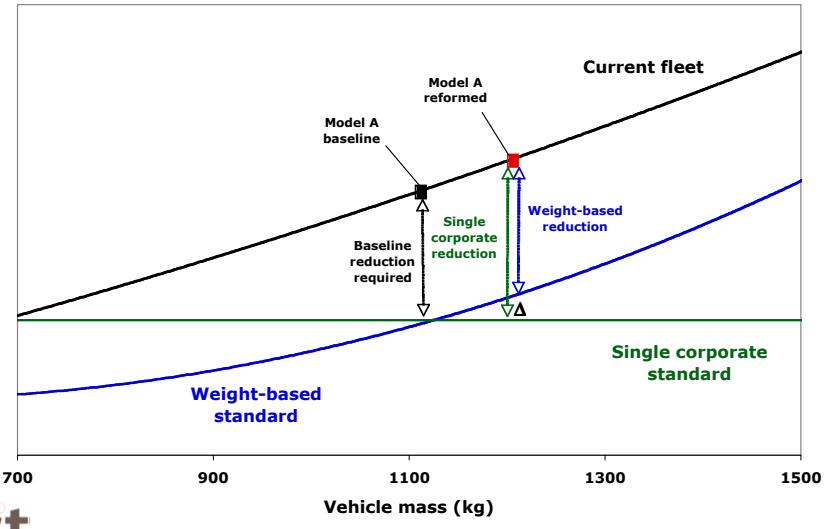
## Risk 1: Goal underperformance

As weight increases…



# Risk 1: Goal underperformance

Fleetwide goal degraded




# Risk 1: Goal underperformance

Under EU-style dieselization…

| Population | Curb Weight (kg) | | | | $CO_2$ Emissions (g/km) | | | |
|---|---|---|---|---|---|---|---|---|
| | Petrol | Diesel | Ave | Δ(kg) | Petrol | Diesel | Total | Δ (%) |
| Matched Pairs only | 1452 | 1500 | 1476 | 48 | 205 | 169 | 186 | -18% |
| All Vehicles | 1203 | 1454 | 1333 | 250 | 166 | 157 | 161 | -5% |

Source: ICCT Analysis.

And as engine size increases…

| Conf. | Pan Area (m) | Fuel | Curb weight (kg) | Engine size (L) | 2006 Emissions (g CO/km) | 2012 EU target (g/km) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Single corporate | Footprint | Weight |
| A | 9.58 | Gasoline | 1805 | 3.0 | 241 | 130 | 181 | 172 |
| B | | | 1895 | 4.0 | 267 | | | 180 |
| C | | | 1910 | 4.8 | 271 | | | 183 |
| D | | Diesel | 2040 | 4.4 | 239 | | | 195 |

Source: BMW data, ICCT Analysis

In general, 50 kg increases $CO_2$ emissions ~3%, or 5 g/km at these weights

Results are preliminary and have not been reviewed by ICCT participants.

# Risk 2: Safety

- Recent research questions the link between vehicle weight and safety
- Safety more linked to:
  - Vehicle size
  - Design
  - Fleet structure: heterogeneous fleets are dangerous
- Problem: Many Asian fleets are homogeneous today, and attribute-based standards could allow shift to more heterogeneous fleets
  - Single corporate average best to constrain vehicle upsizing

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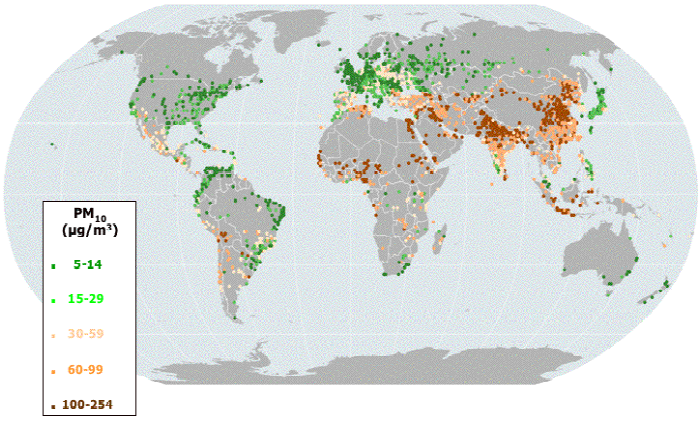
# Risk 3: Air quality

Air quality goals may be compromised by the preferential treatment afforded light-duty diesels under weight-based standards.




Source: Cohen et.al. 2004

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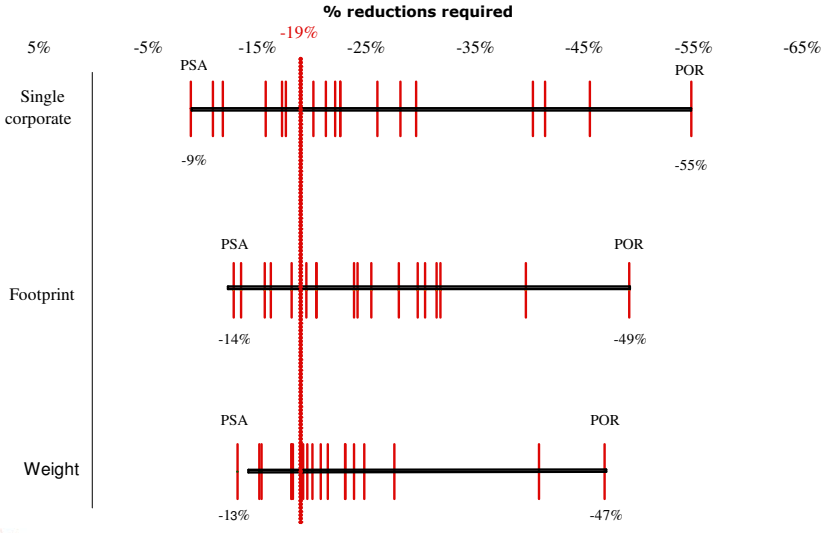
# Ways to avoid risks of weight-based standards

- Use single corporate average
- Failing that, use footprint
- Failing that, moderate slope of weight-based standard

# Footprint-based standards can offer competitiveness benefits of weight-based standards

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## Lightweight materials particularly important in future to improve fuel efficiency

| Manufacturer | Lightweighting Technology | Mass Reduction |
|---|---|---|
| GM | Hollow intake valvestems on Corvette LS3 engine | 13% reduction in valvetrain mass |
| Nissan | VR38 engine uses sprayed plasma cylinder coating rather than iron sleeves | 2.8 kg |
| BMW | New M3 V8 engine includes: aluminum/silicon alloy engine block, aluminum alloy pistons, magnesium/HSS alloy connecting rods, short HHS crankshaft, and small diameter lightweight valve shafts. | 15 kg relative to older *V6* engine |
| Chrysler | Optimized steel allocation through improved body simulation software | Up to 54 kg |
| Supplier | Prototype plastic exhaust system with improved acoustics relative to standard metal systems | 3-4 kg |
| GM | Replace five piece steel/plastic SUV step with one piece plastic counterpart | 50% reduction in step mass |
| Chrysler | Replace door hardware and trim unit with improved plastic module | 10% relative to old parts |
| Chrysler | Replace aluminum throttle control module with plastic | 28% relative to old module |
| Toyota | 1/X concept car with carbon-reinforced fiberglass construction and downsized engine | 830 kg |
| Mitsubishi | D5 features nylon-based plastic fenders | 4 kg |
| Ferrari | New 599GTB engine redesign | 21 kg relative to 575M predecessor |
| Ferrari | New 599GTB aluminum body design | 13% relative to 575M predecessor, despite 8% longer wheelbase |
| Honda | Acura MDX aluminum instrument panel supports | 4.8 kg |
| Honda | Acura MDX aluminum hood | 7 kg |
| Hyundai | Extensive use of plastics in QarmaQ (skin and structural parts, glazing) | 60 kg relative to conventional construction |

Potential: 28% by 2035 at 6~7% fuel reduction for 10% weight reduction (MIT 2007)

## Summary

- Standard basis key design decision of fuel efficiency standards with important tradeoffs
- Weight-based standards pose risks to developing Asia:
  - Goal underperformance
  - Safety
  - Local air pollution
- Disadvantages of weight-based standards can be offset through the use of single corporate average or a footprint basis

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