Vehicle fuel economy standards: A global policy update and implications

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JP Sponsors Webinar

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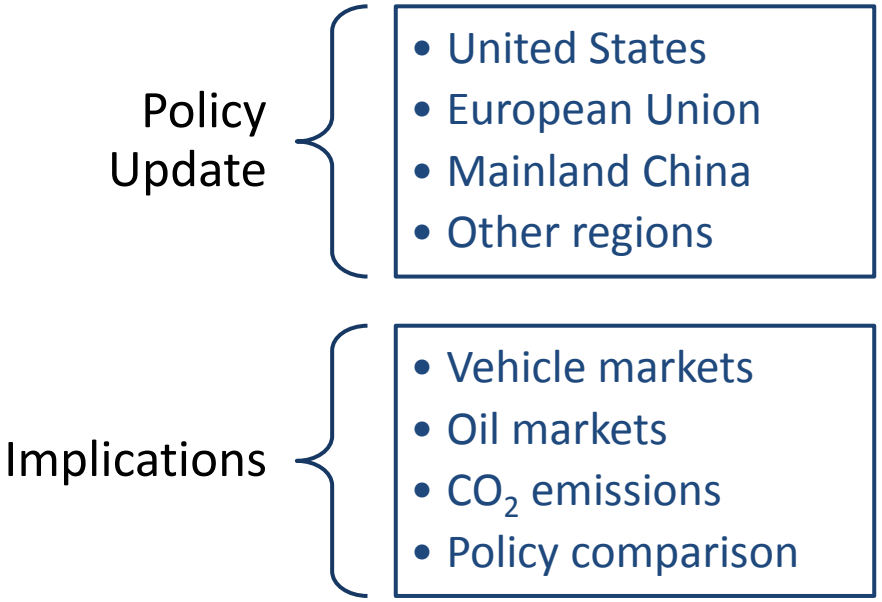
This presentation

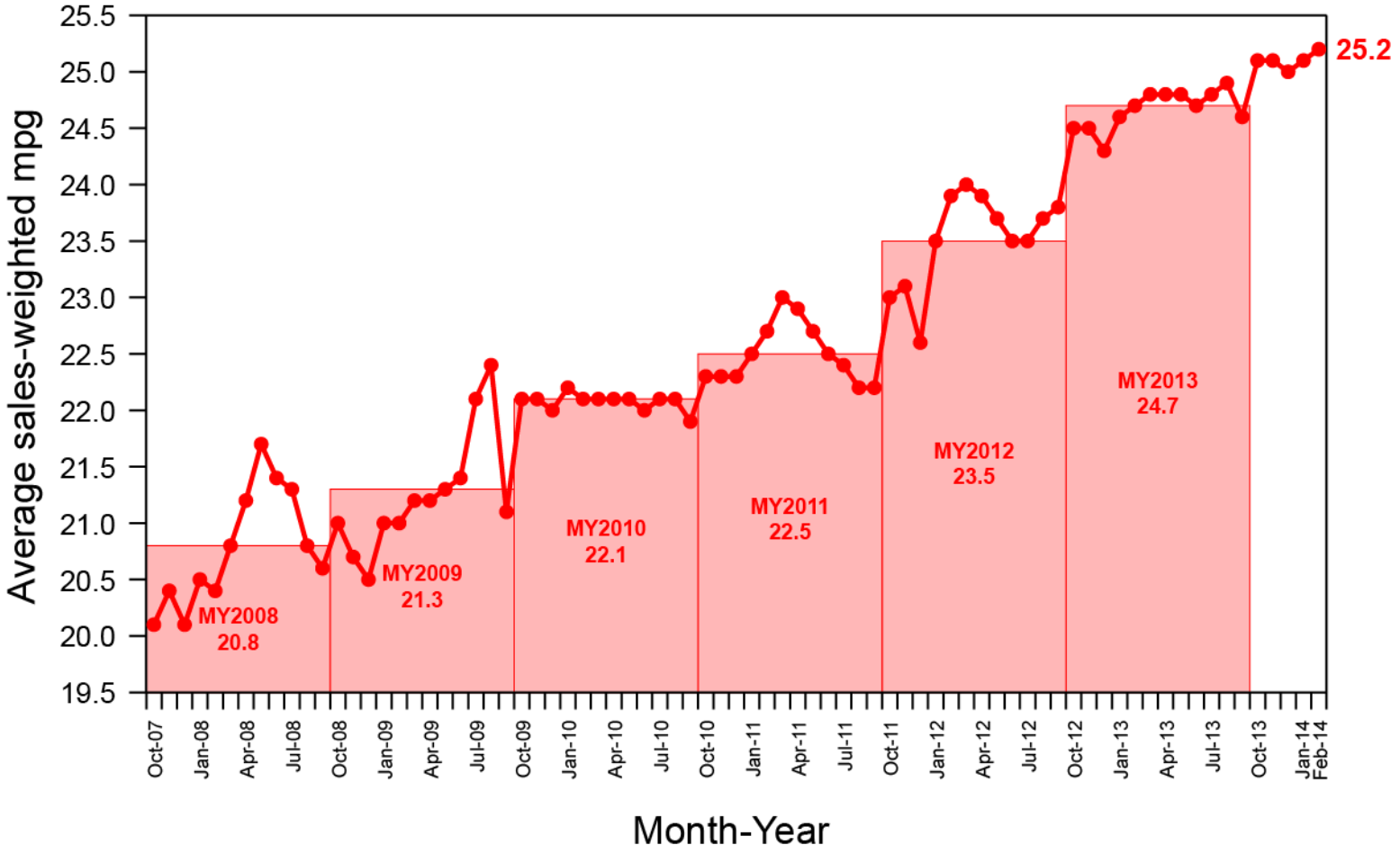


United States: Fuel economy regulations and other measures

- **Light-duty vehicles account for ~17% of CO_2 emissions in the United States (EPA, 2012).**
- **Fuel economy/per-mile emissions standards for cars and light-duty trucks (manufacturer sales-weighted average)**
  - **2012-2016:** 250 g/mile (35.5 mpg)*
  - **2017-2025:** 163 g/mile (54.5 mpg)*
- **Gas Guzzler Tax** – imposed only on cars (not minivans, trucks, or SUVs) with low fuel economy
- **Tax credits for PHEVs, EVs**
  - Evidence suggests that HEVs and short-range PHEVs may offer greatest benefits (Michalek et al., 2011)
- **Medium- and heavy-duty vehicle fuel economy/per-mile emissions regulations** (2011)
- **Zero-emissions Vehicles mandates** (California and 9 other states)
- **Renewable fuel standards**

*If achieved through fuel economy alone.

Fuel economy in the United States has been gradually rising

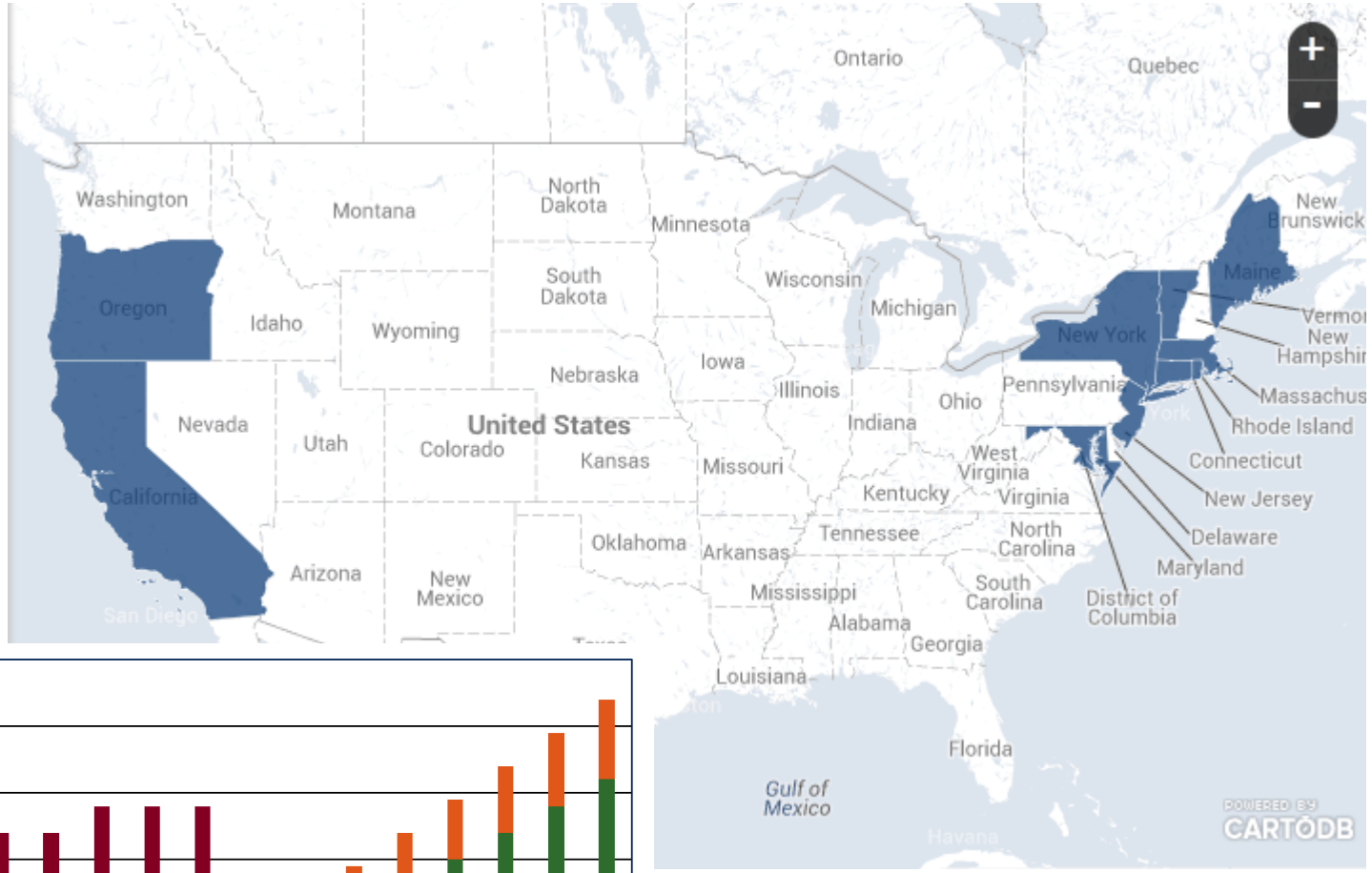


Shows on-road fuel economy*

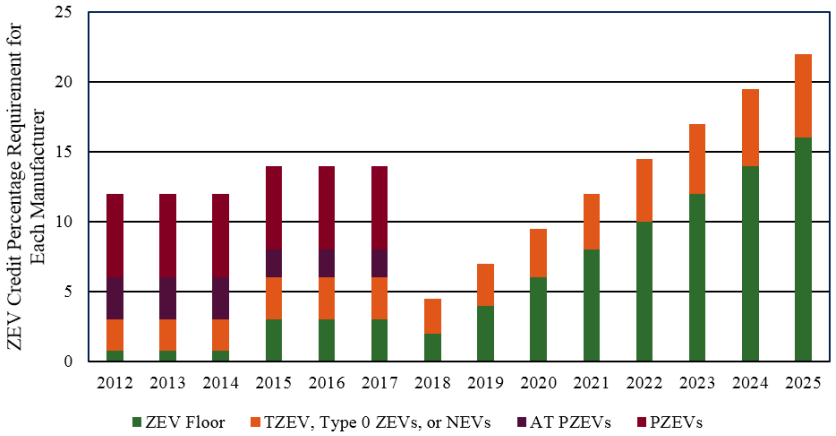
Michael Sivak and Brandon Schoettle
University of Michigan Transportation Research Institute

*Based on “window-sticker” ratings published in the EPA fuel economy guide.

Zero-emissions vehicle mandate is imposed on top of the national fuel economy program



Source: Center for Climate and Energy Solutions, 2014.



Source: California Air Resources Board, 2014

European Union: Passenger vehicle per-mile CO_2 regulation

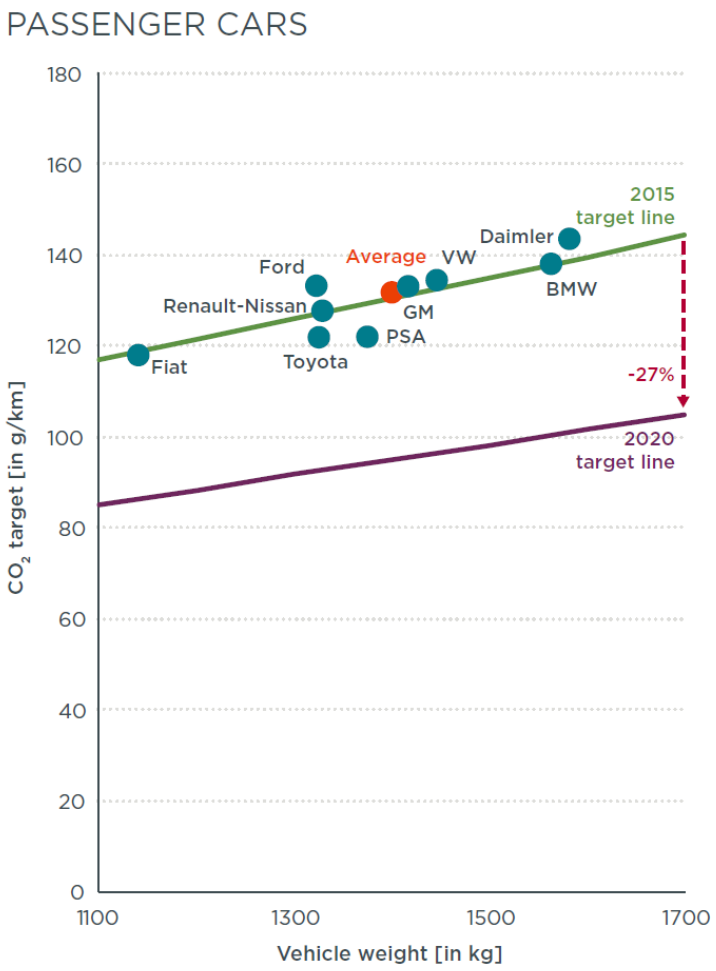
- Passenger cars are responsible for about 12% of CO_2 emissions in the EU.
- Vehicle CO_2 emissions controls introduced in 2009 (DG Clima).
- Latest emissions rules:

Passenger cars:

  - 2015: 147 g CO_2/km for all manufacturers combined (weight adjusted)
  - 2020: 95 g CO_2/km (95% of vehicles)
  - 2021: 95 g CO_2/km (100% of vehicles)

Vans:

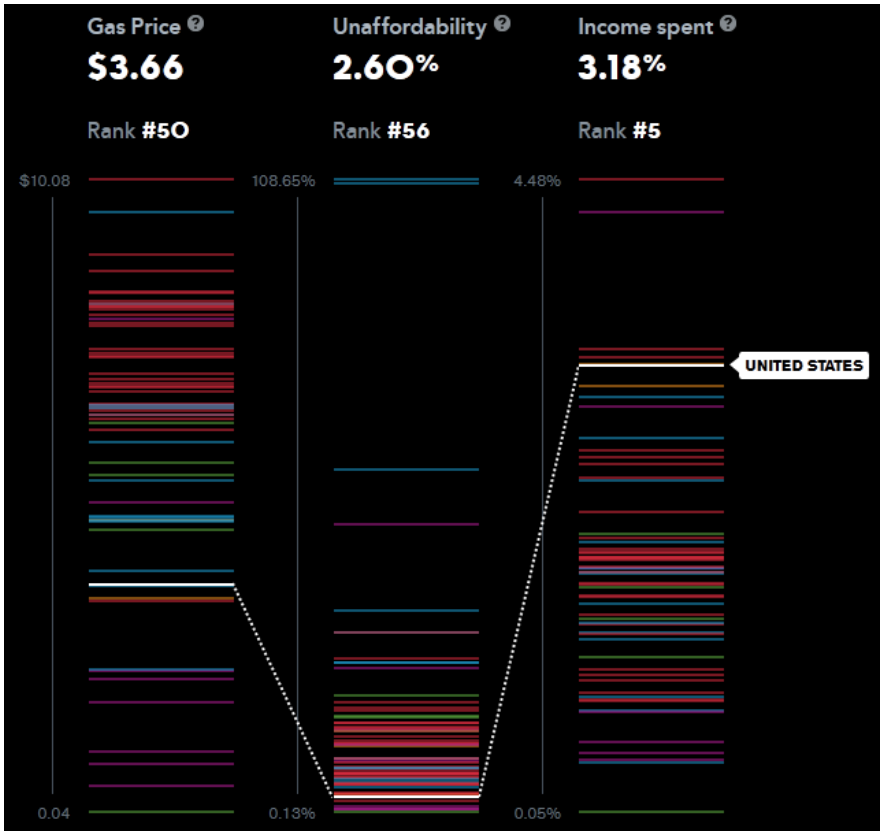
  - 2020: 147 g CO_2/km for all manufacturers combined



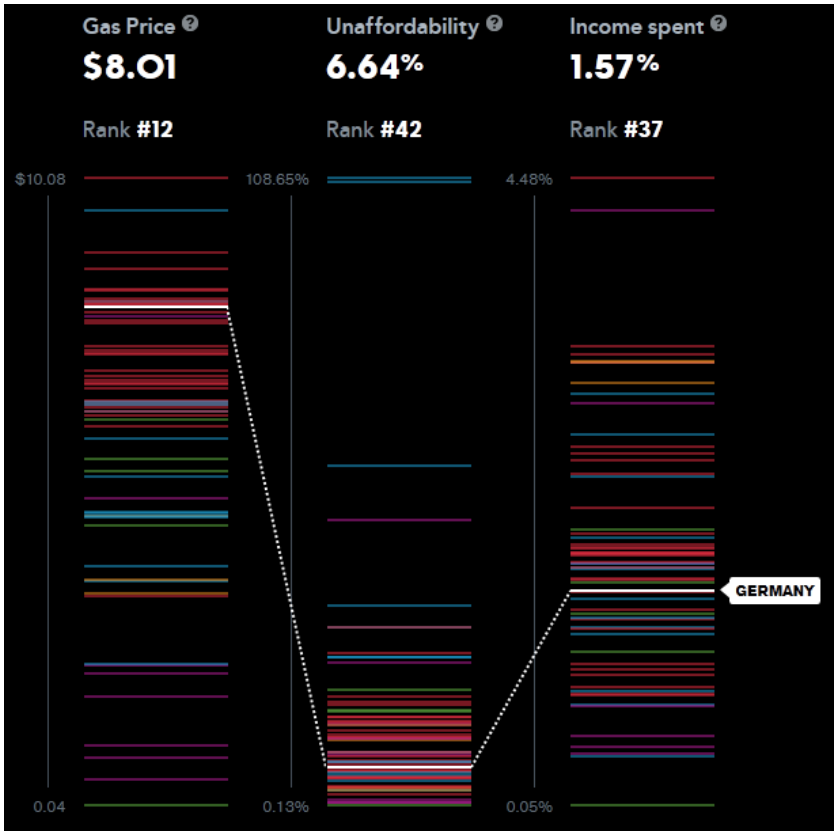
Source: ICCT, 2014.

On average gasoline prices in the EU are twice the level of prices in the United States

United States



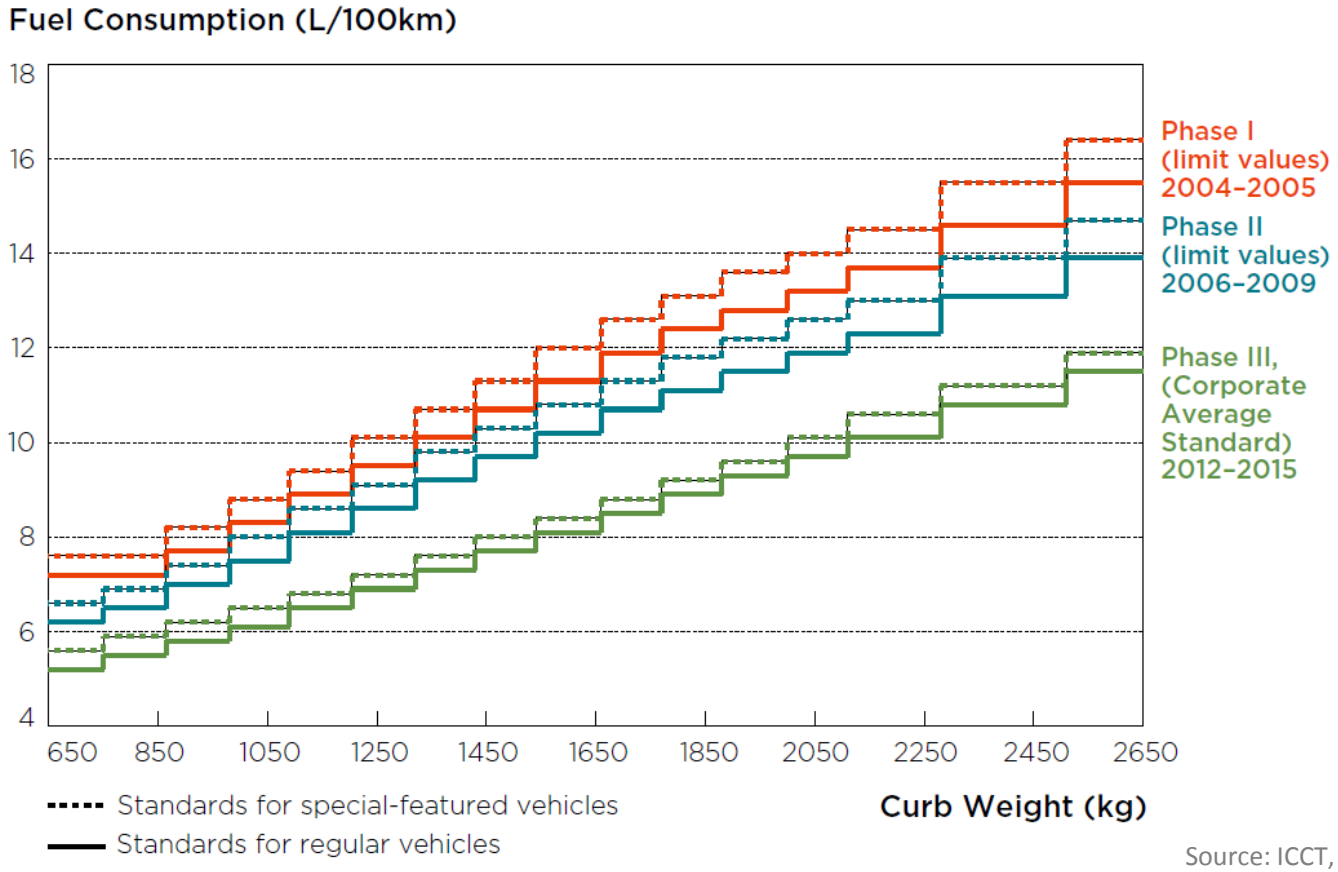
Germany



Unaffordability: Portion of a day's wages needed to buy a gallon of gas.
Income spent: Portion of annual income spent on gas purchases.
Data for Q3 2013.

Source: Bloomberg, 2014.

Mainland China

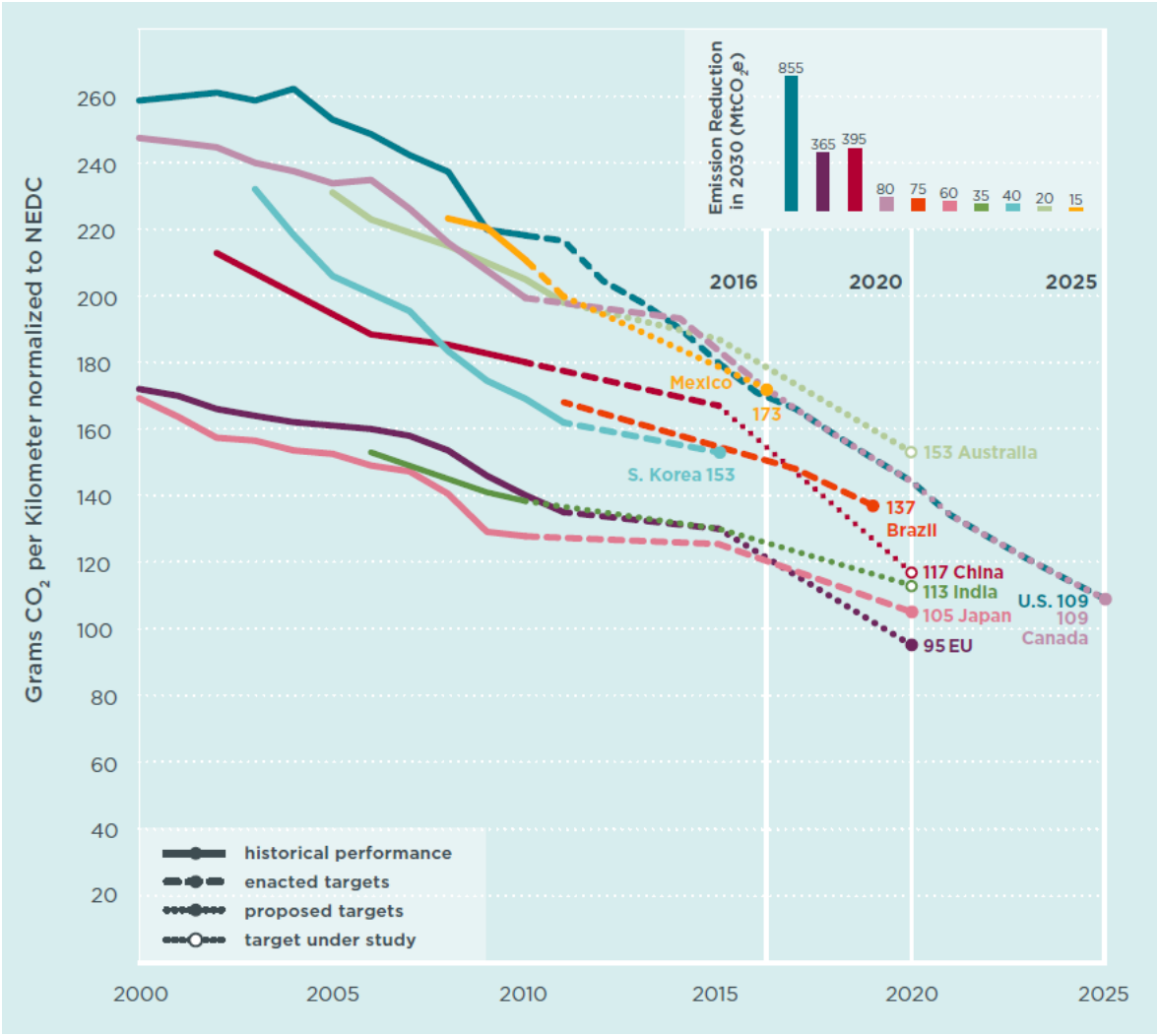


Source: ICCT, 2014.

- Subsidies to for vehicles that outperform current Phase III standards (MIIT, 2014).
- Subsidies for PHEVs/EVs based on vehicle range (MOST and MIIT, 2014).

A limit of 5.0L/100 km has been proposed for 2020 (Phase IV) (January 2014).

Per-mile CO_2 emissions standards by region



Source: ICCT, 2013

Framing Questions: How to think about the combined global impact of fuel economy standards?

- **Considerations:**
  - How will higher passenger vehicle efficiency affect **fuel use and prices**?
  - By how much will **vehicle cost** change due to efficiency improvements? How will **consumer vehicle demand** react?
  - Considering both direct and indirect effects of policy, what is the energy, CO_2 emissions and economic impact?
    - Rebound and leakage effects.
    - Effects of policy cost on broader economy – ***welfare effects***

- ***Our approach:***
  - Uses a carefully calibrated CGE model with a disaggregated passenger vehicle sector to investigate energy, emissions, price, and sensitivities to mobility demand assumptions.

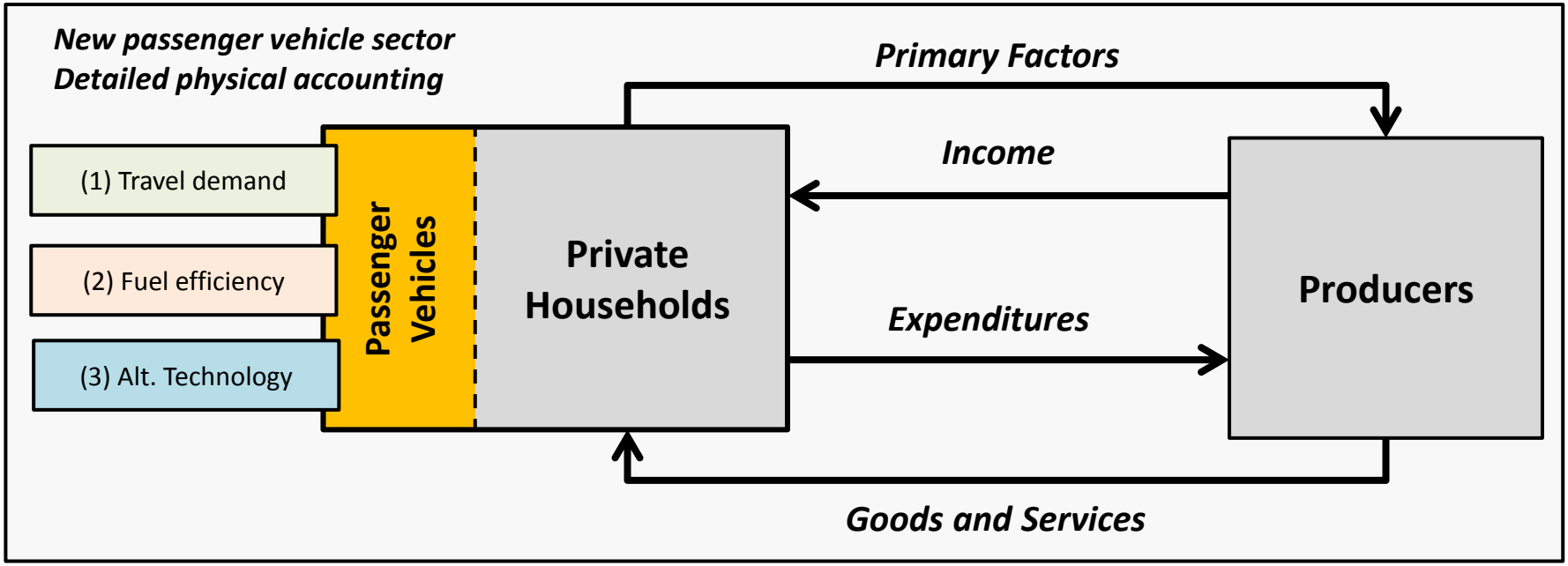
The MIT EPPA model is used to simulate the impact of fuel economy standards

		Technology & Fleet Detail		Sector coverage & macro-level feedbacks		
Author	**Method**	**Includes advanced vehicle technologies and fuels**	**Fleet turnover – vehicle sales and scrap**	**Economy-wide coverage of energy use**	**Macro-economic feedbacks to income and prices**	**Fuel economy responds endogenously to prices**
Bandivadekar et al., 2008	Fleet modeling / scenarios	**X**	**X**			
Yang et al., 2008	Fleet modeling / scenarios	**X**	**X**			
Greene & Plotkin, 2011	Fleet modeling / scenarios	**X**	**X**			
Morrow et al., 2010	NEMS model (sector-specific models ties to a macro-model)	**X**	**~**	**X**	**~**	
Schafer & Jacoby, 2006	Coupled CGE, MARKAL, mode share models	**~**		**X**	**X**	**~**
Karplus, 2011	CGE model	**X**	**X**	**X**	**X**	**X**

~ - indicates that the issue is partially addressed.

MIT EPPA model is used to simulate the impact of fuel economy standards

The MIT Emissions Prediction and Policy Analysis Model



EPPA-HTRN

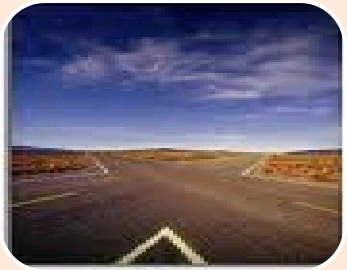
- Multi-sector, multi-regional computable general equilibrium model
- Technologies compete based on cost
- Prices are determined inside the model
- Can apply policies, e.g. cap-and-trade, fuel tax

Code	Region	Code	Region
USA	United States	ASI	East Asia
CAN	Canada	CHN	China
MEX	Mexico	IND	India
JPN	Japan	BRA	Brazil
ANZ	Australia & New Zealand	AFR	Africa
EUR	Europe	MES	Middle East
ROE	Eastern Europe	LAM	Latin America
RUS	Russia-plus	REA	Rest of Asia

Passenger vehicle transport in a CGE framework: Three main developments

(1) Travel demand trends

- Empirically-based relationship: Income and travel demand
- Trends in developed / developing countries



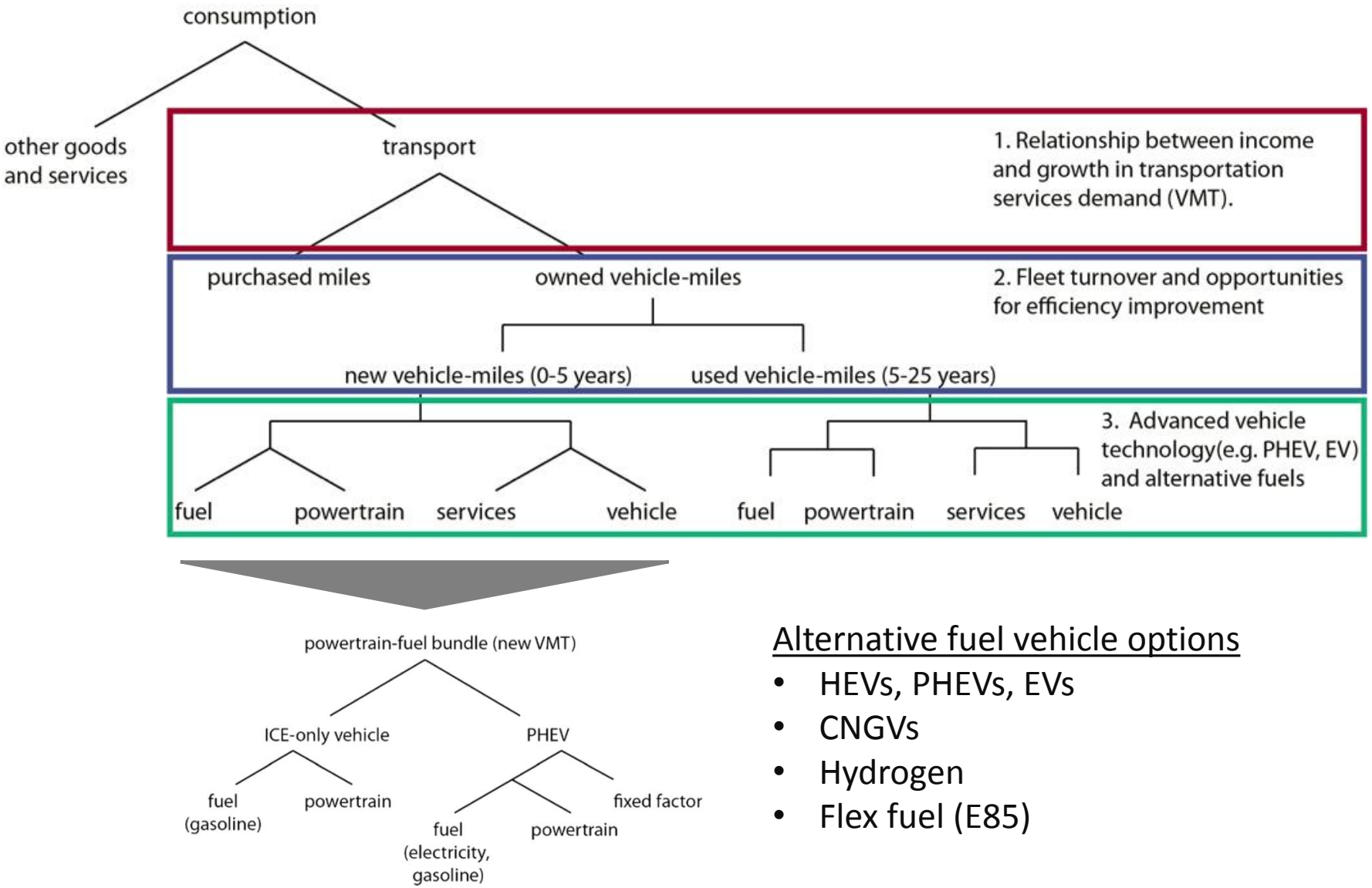
(2) Fuel efficiency improvement opportunities

- New vehicle efficiency increases with fuel price
- New and used vehicles represented explicitly

(3) Alternative fuel vehicles and fuels

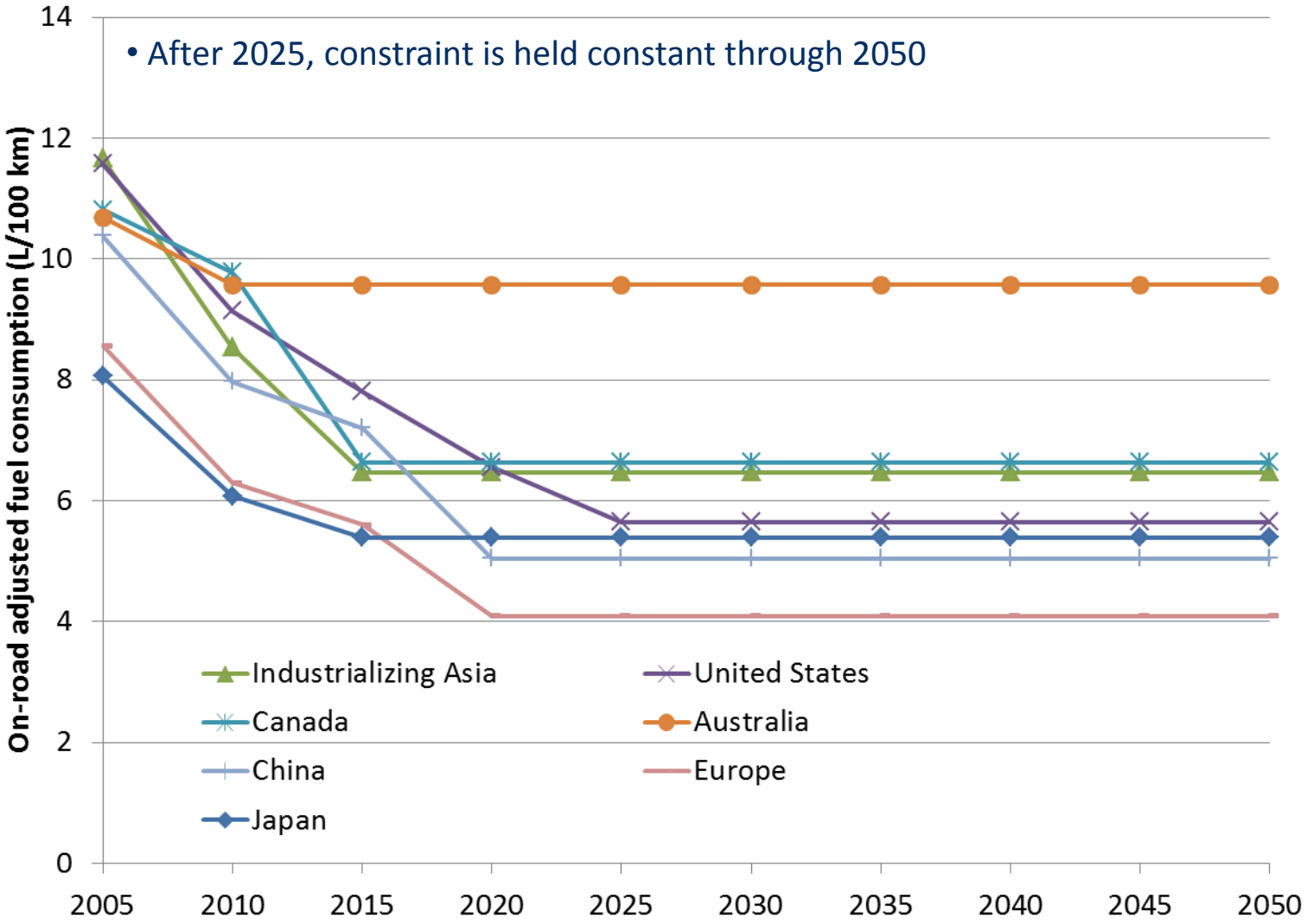
- Alternative fuel vehicles : HEV, PHEV, EV, CNGV, H2FC, FF
- Alternatives fuels : electricity, hydrogen, natural gas, biofuels

Modeling Approach: Household-owned passenger vehicles



<u>Alternative fuel vehicle options</u>

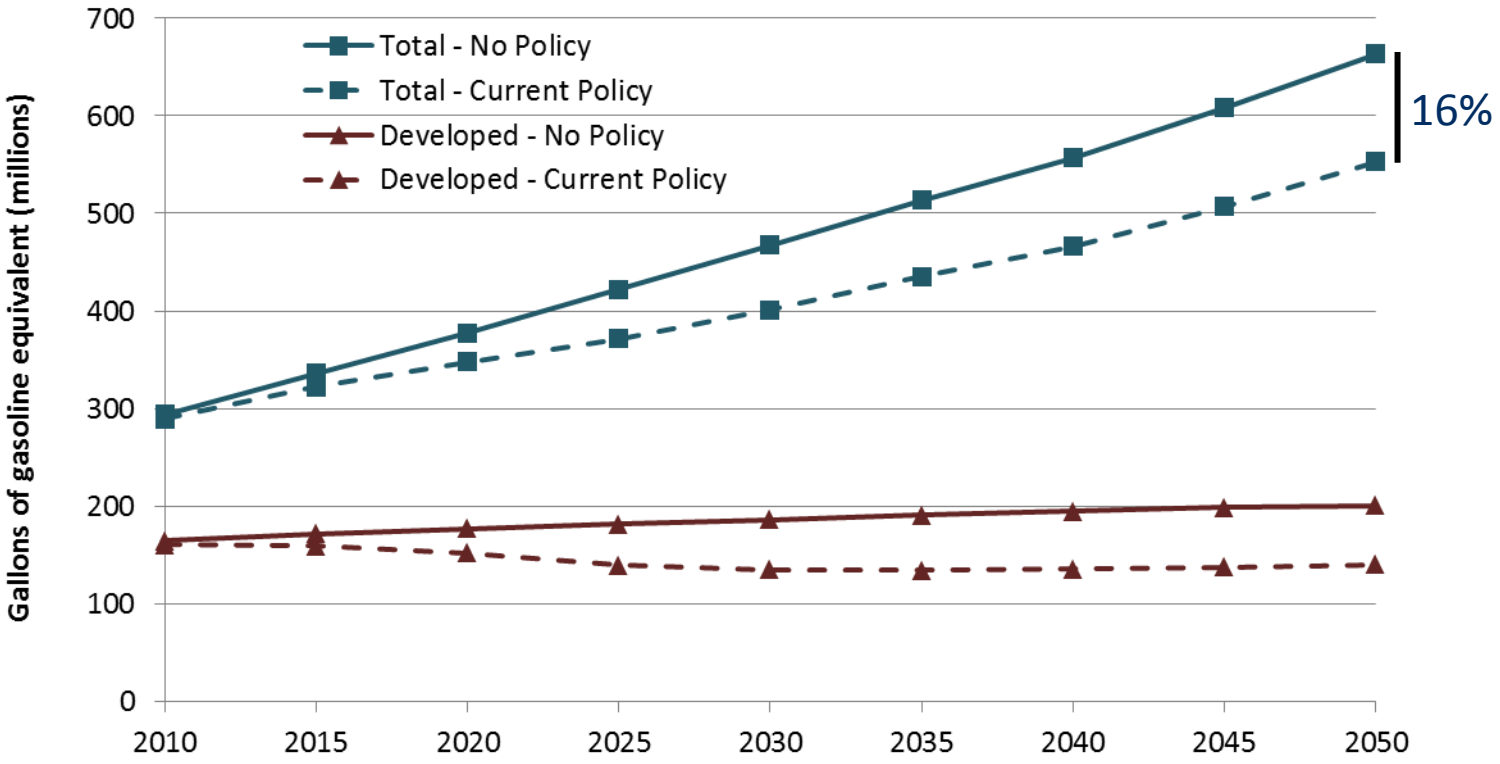
- HEVs, PHEVs, EVs
- CNGVs
- Hydrogen
- Flex fuel (E85)



- Fuel economy policy implemented in the CGE framework as a constraint:

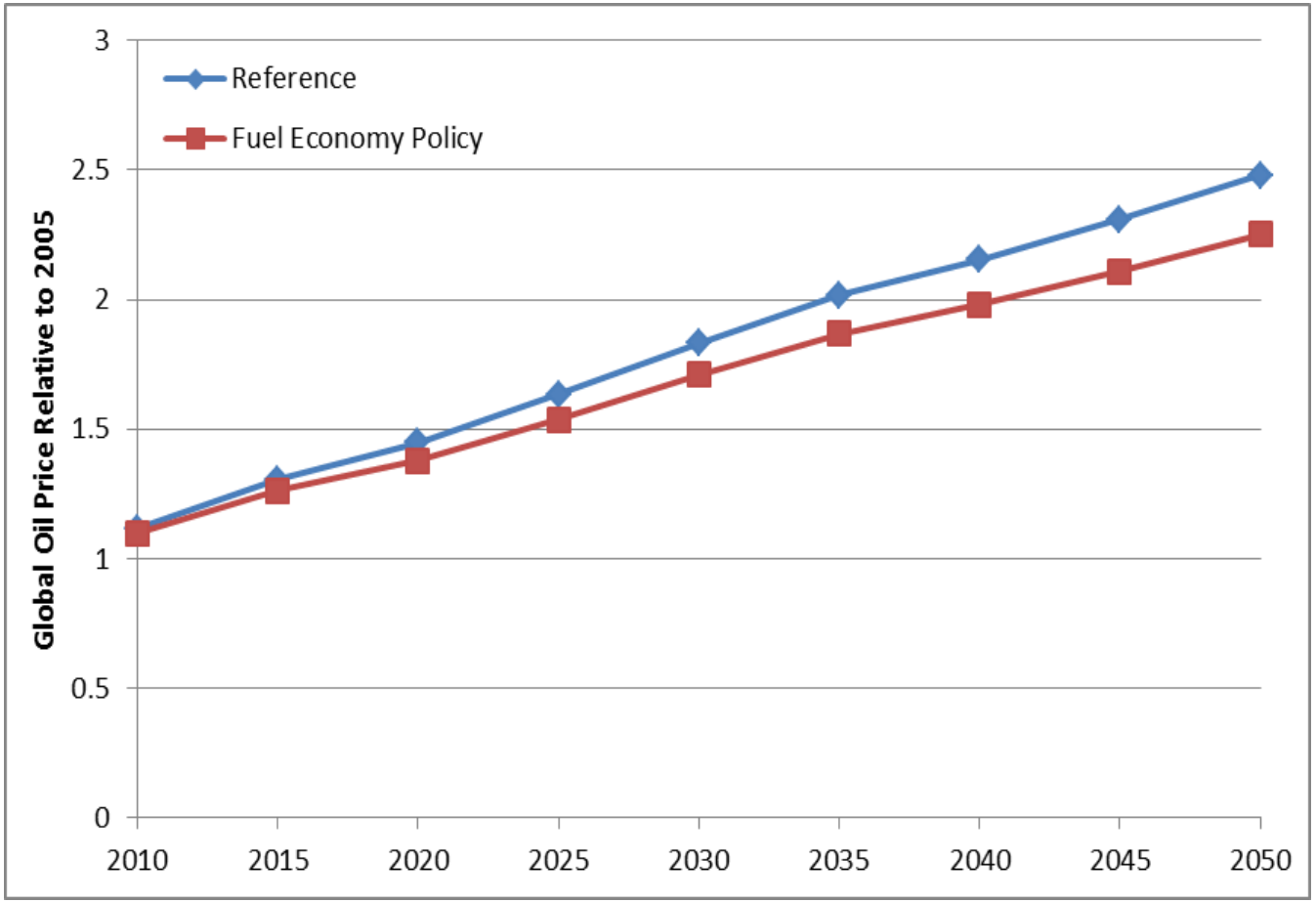
New vehicle fuel economy in year t → $FES_t \leq A_t \, (Q_{f,t_0}/Q_{VKT,t_0})$ ← Initial year new vehicle fuel economy

Global demand for refined oil use in passenger vehicles continues to increase through 2050 with policy



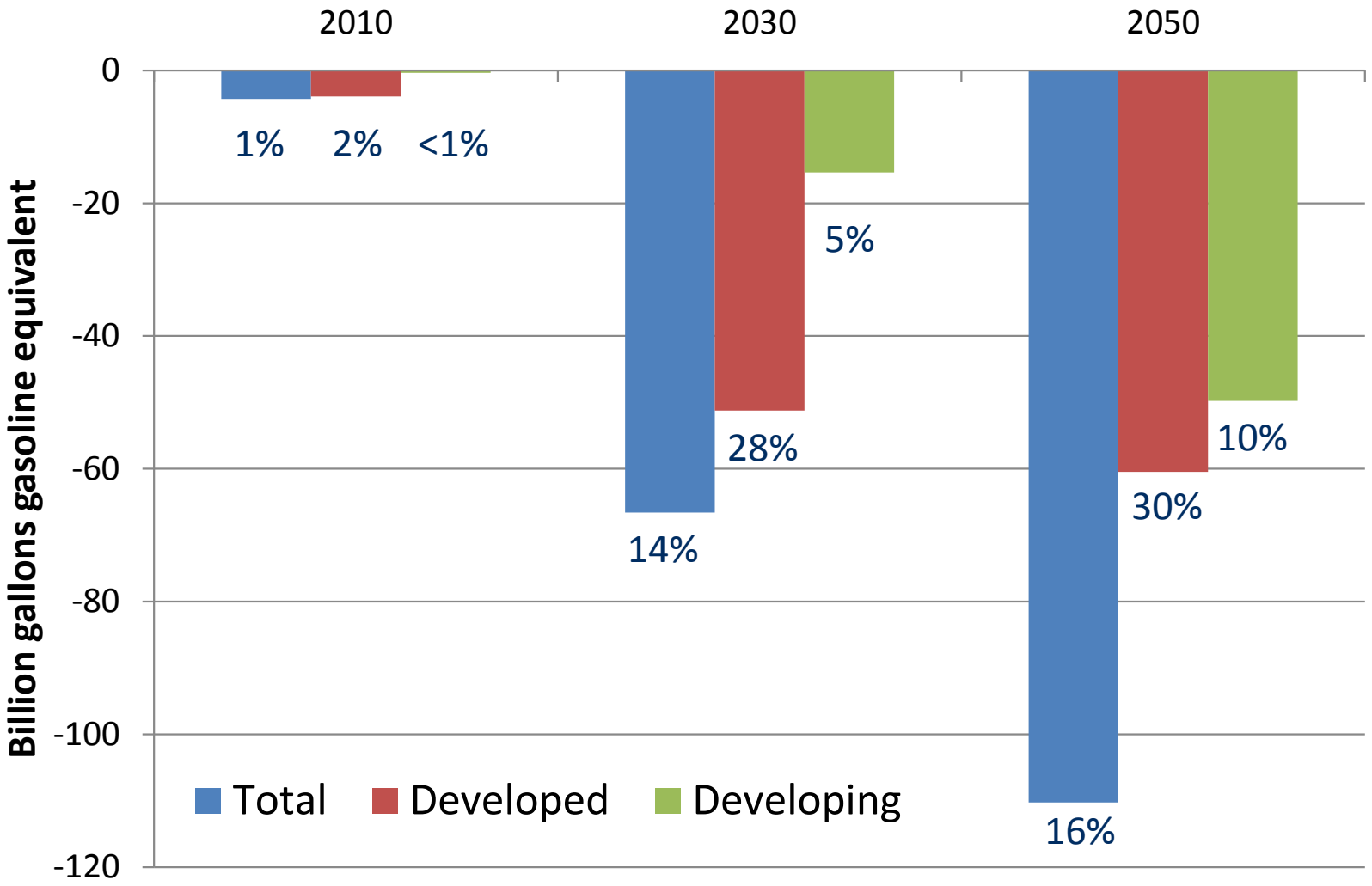
• Model results: Current FES policies would reduce global refined oil use by around 16% in 2050 relative to baseline—much of the reduction comes from the developed countries (lower red lines).

Current fuel economy policies results in downward pressure on global refined oil prices

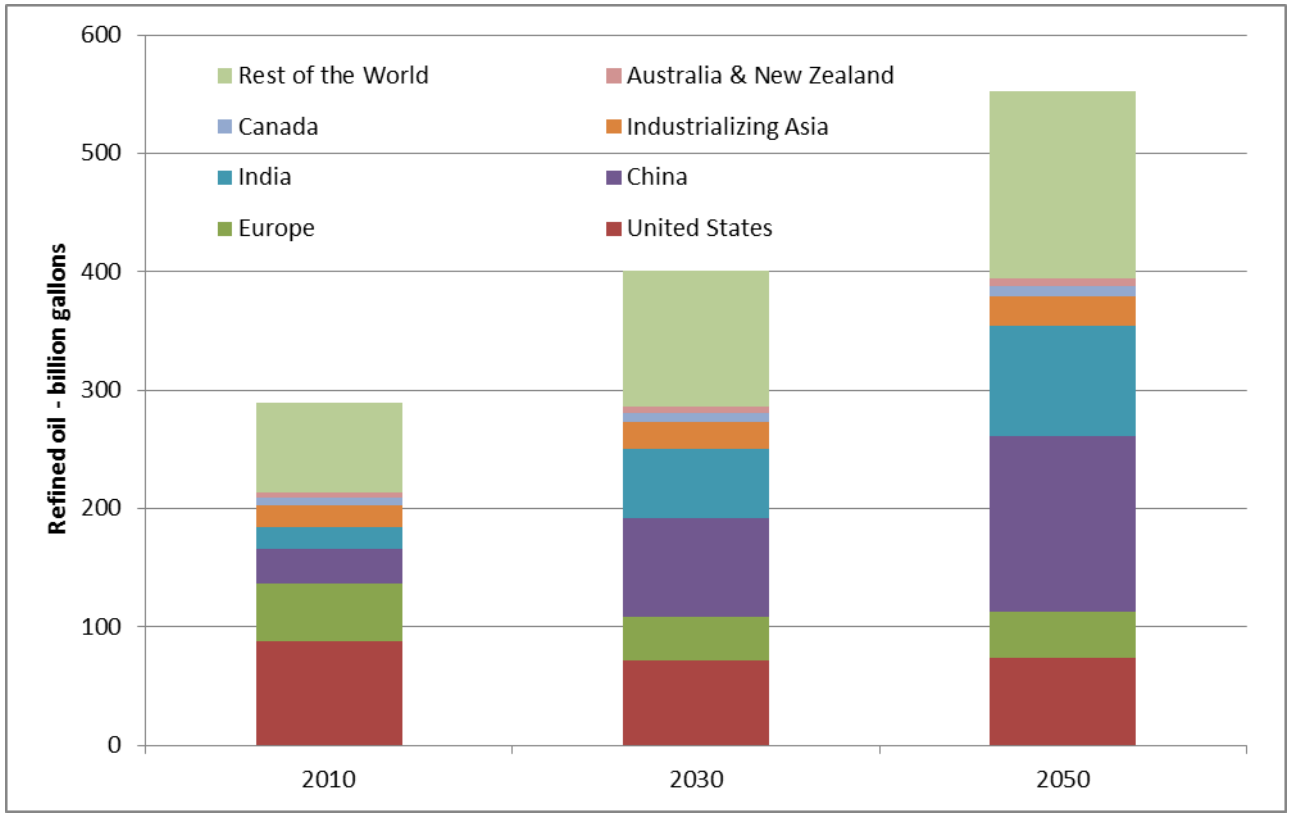


Current fuel economy standards reduce passenger vehicle refined oil use most in the advanced industrialized countries

(reduction shown in percent for each regional group)

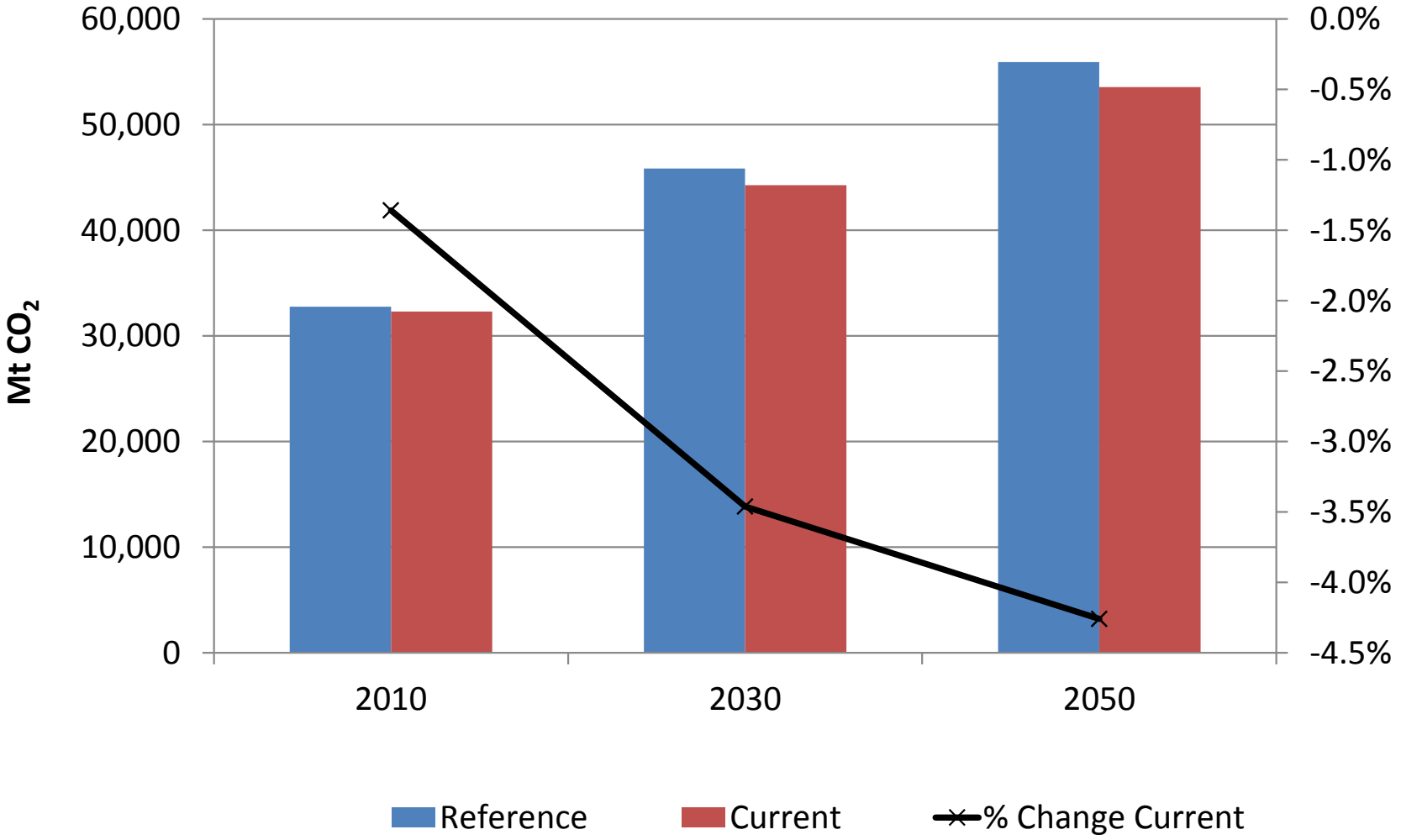


China and India contribute a growing share of total passenger vehicle refined oil use

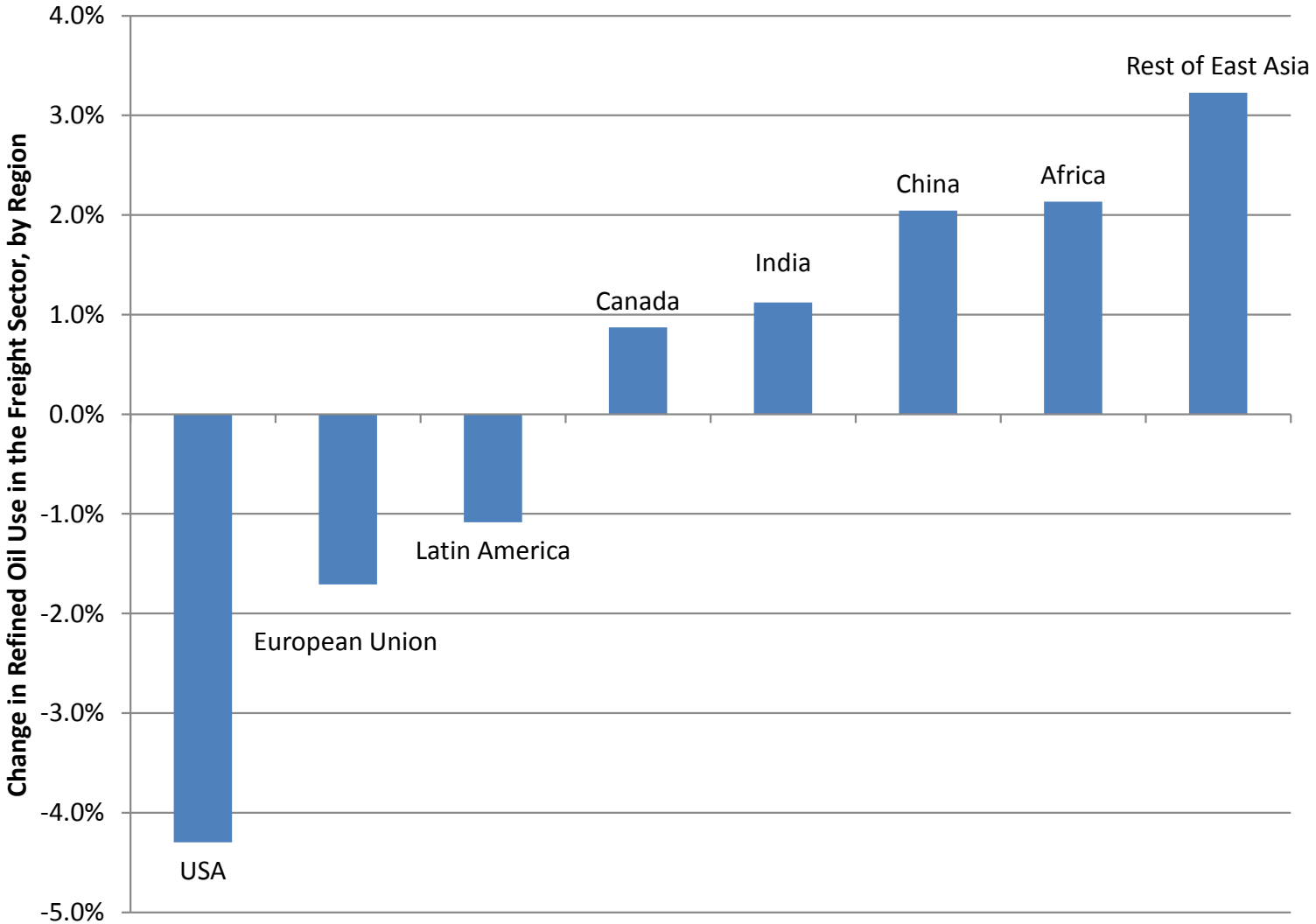


Fuel economy policy is applied in this simulation. Includes light-duty passenger vehicle fuel use only.

FE standards are not very effective at reducing global CO_2 emissions – only 4% reduction under current policy



Impact on one non-target sector: Refined oil use by road vehicles not classified as passenger vehicles

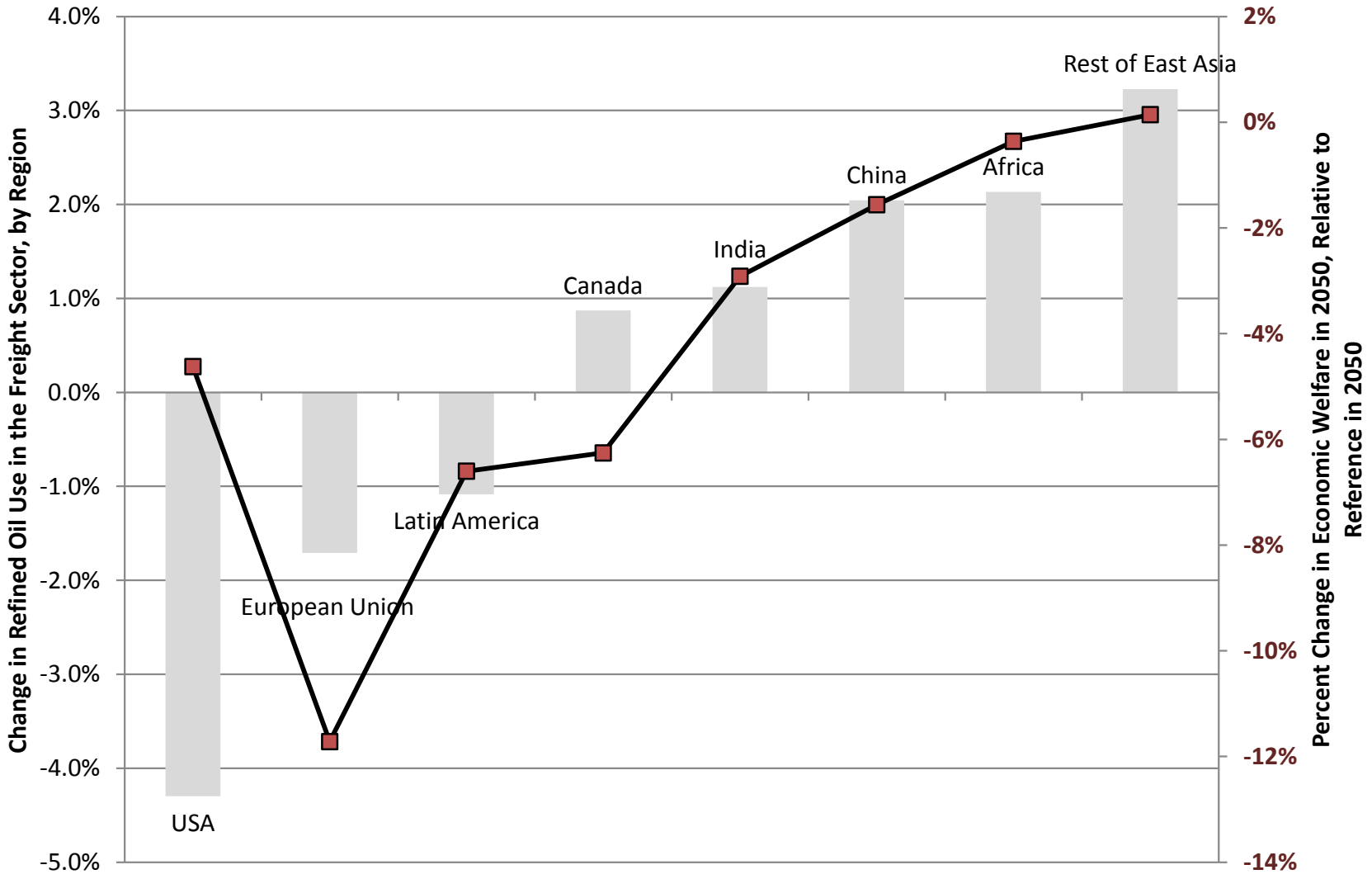


Driven by two offsetting effects:

Lower fuel prices

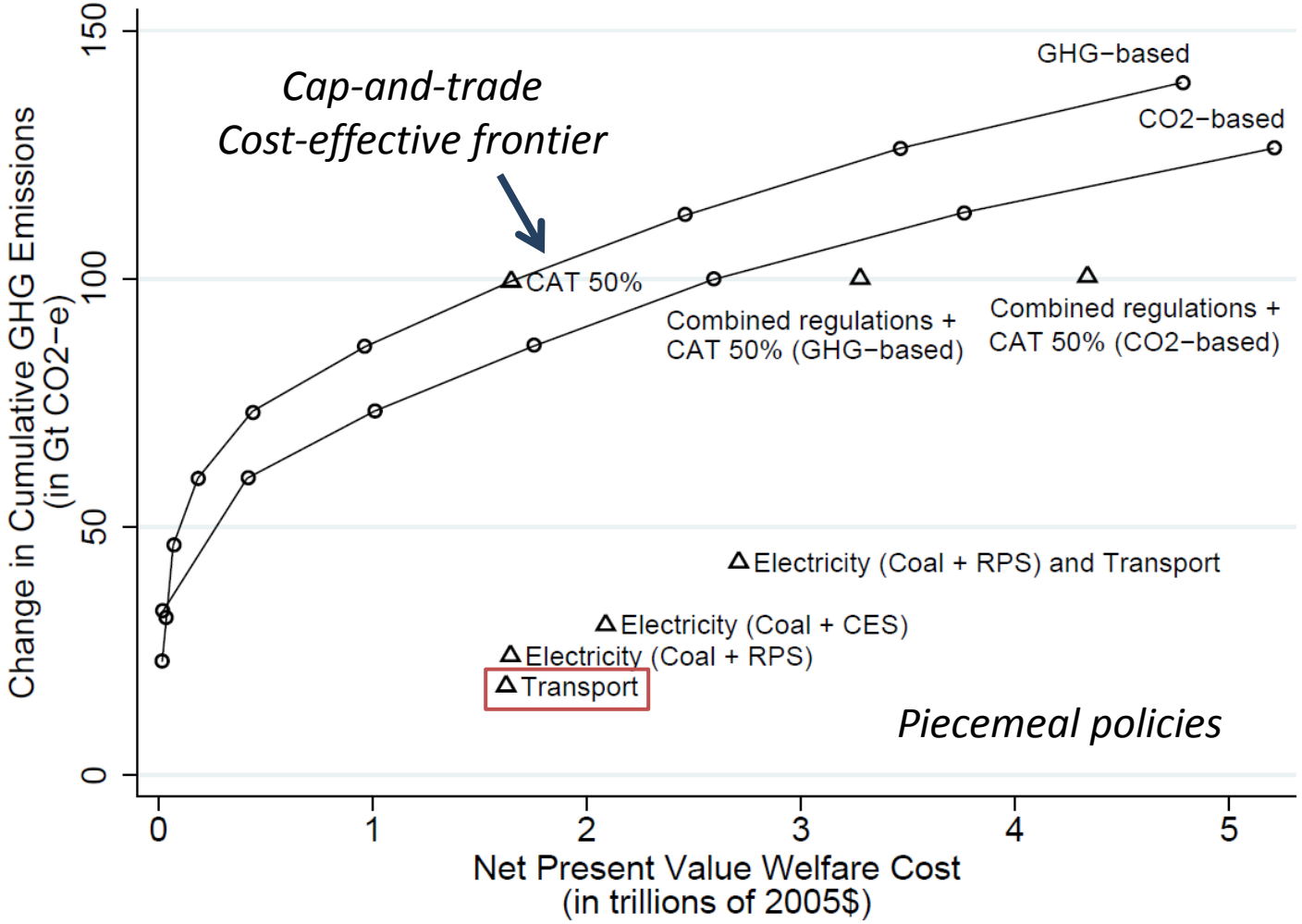
Policy impact on economic activity

Impact on one non-target sector: Refined oil use by road vehicles not classified as passenger vehicles



Assumes all improvements come from off-the-shelf technologies, no “loopholes”.

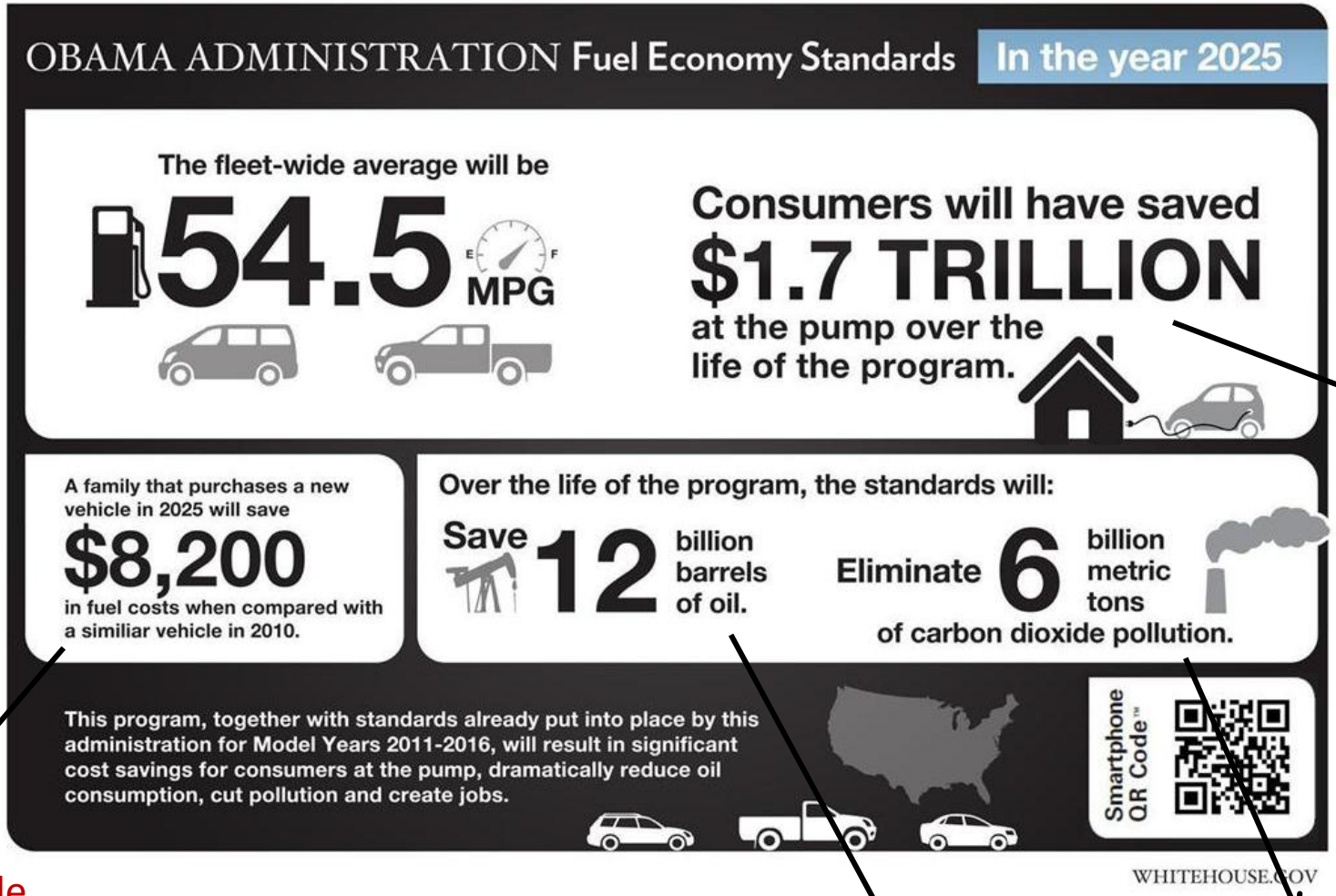
Recent Joint Program United States Climate Policy Comparison:
New vehicle CO_2 limits is an expensive climate change policy!



Source: Rausch and Karplus, 2014. JP Report.

Impacts of the United States Fuel Economy Program *considering general equilibrium effects*

Not shown:
Economy-wide consumption loss in 2025 is around 5%.



Depends on gasoline price: **U.S. $1.3 – 1.4 trillion**

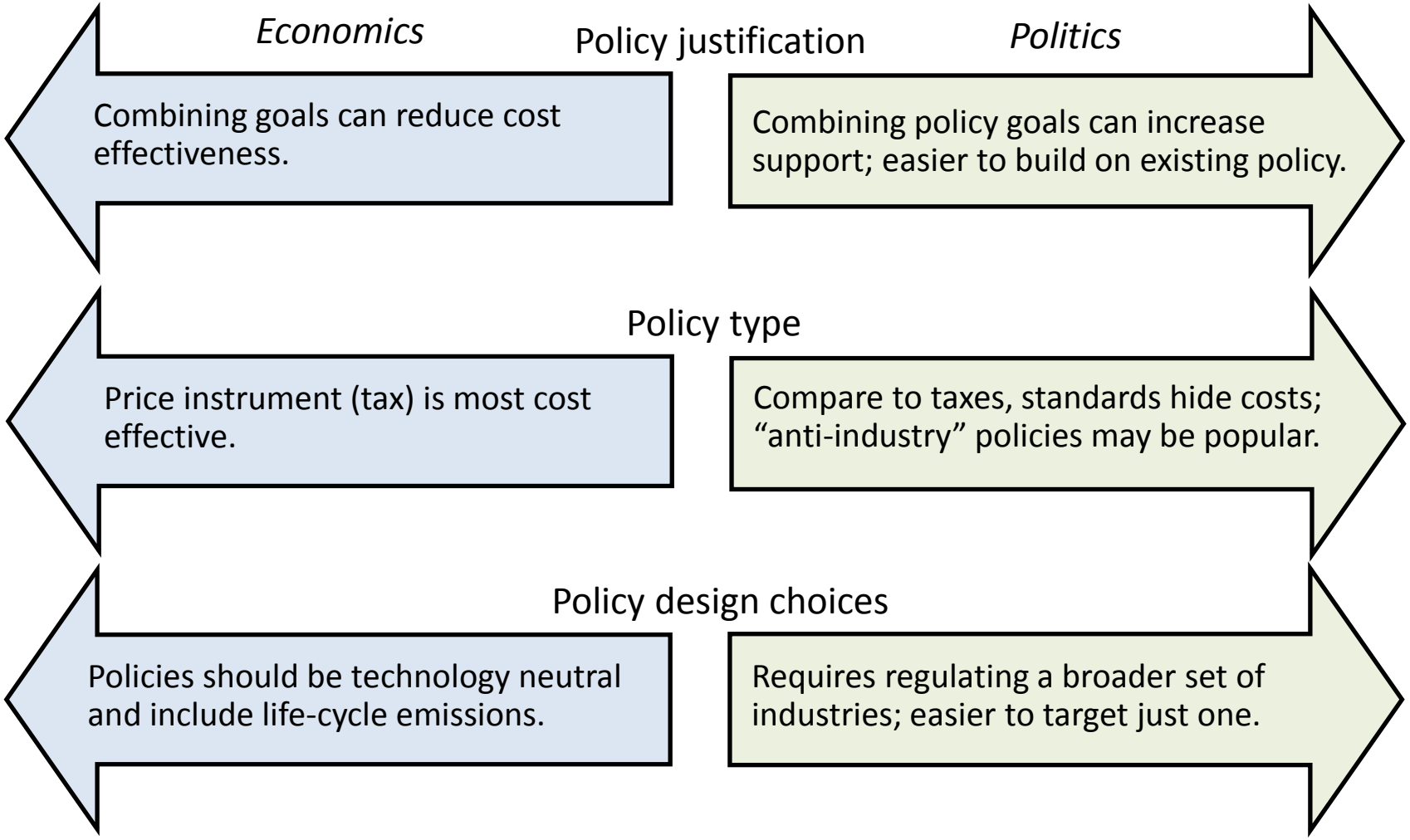
Vehicle prices will go up.

Results based on Joint Program EPPA model analysis.

Save **around 11 billion** barrels of refined oil.

Eliminate **around 4.9 billion** metric tons CO_2.

If fuel economy standards are such an expensive way to reduce CO_2 emissions, why are they so widespread?



So far, we have seen politics win out over economics.

Takeaways

- **Fuel economy/per-mile CO_2 emissions standards are now well established as part of climate policy in many nations.**
- **Current passenger vehicle fuel economy standards will have limited impact on energy security and global climate.**
  - Current announced fuel economy standards reduces global passenger vehicle fuel use by 16% in 2050.
  - Globally, CO_2 emissions are reduced by 4% in 2050.
- **Tough fuel economy requirements in the U.S. and Europe may subsidize use overseas.**
- **Making hidden costs more visible could strengthen support for policy alternatives.**
  - Point out economy-wide indirect effects (leakage and rebound).
  - Raise awareness of global fuel market context in national policy process.

Thank you for your attention.

Source: The New Yorker/CondeNast Collection.