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SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS

An Institute of Transportation Studies Program

The Role of Fuel Economy in Saving Resources

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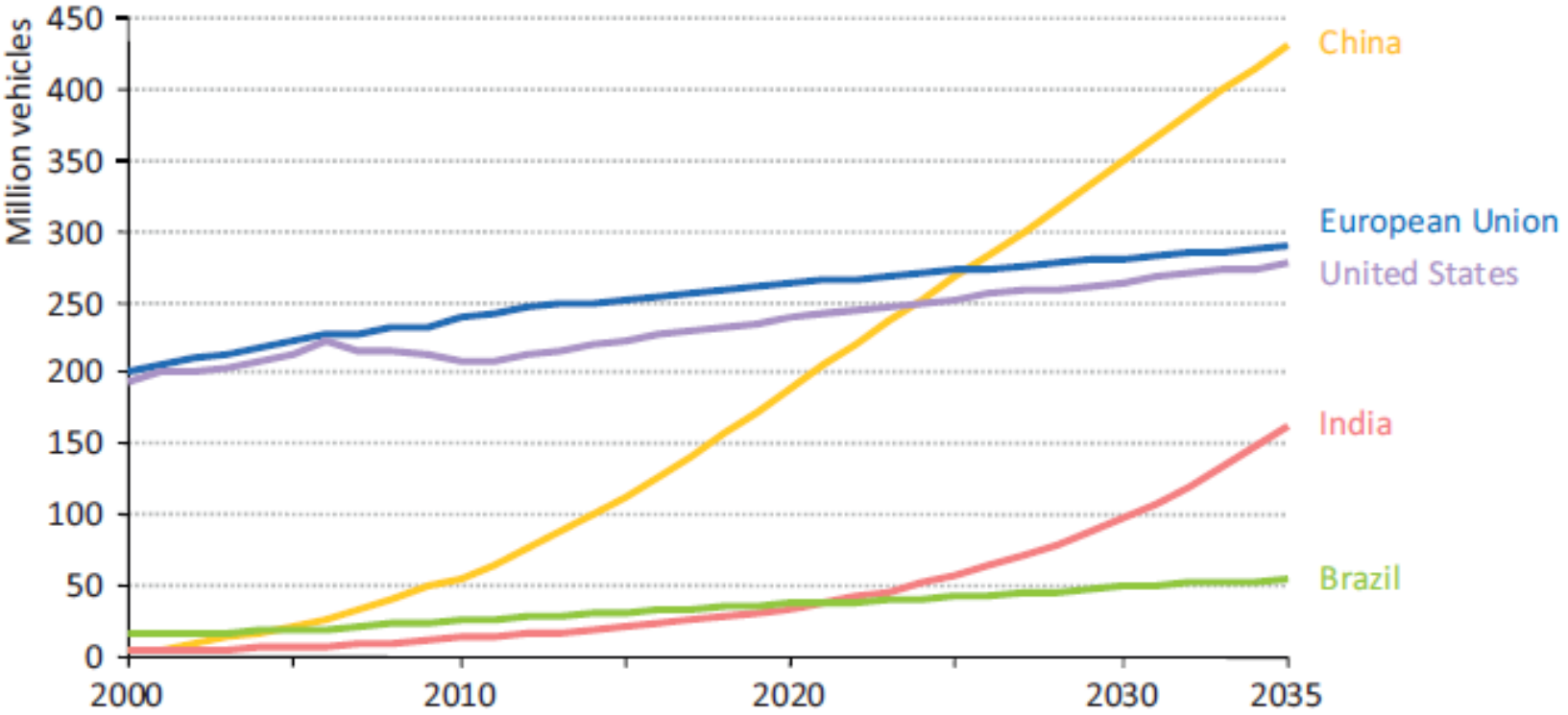
Typical national objectives related to transportation/fuels policies

- Reduce oil dependence (diversify fuels)
- Improve balance of payments
- Reduce pollutant emissions
- Reduce greenhouse gases
- Promote domestic economies/jobs

IEA WEO 2012: heading toward 2 billion cars

OECD is fairly saturated, but rest of the world is not.:

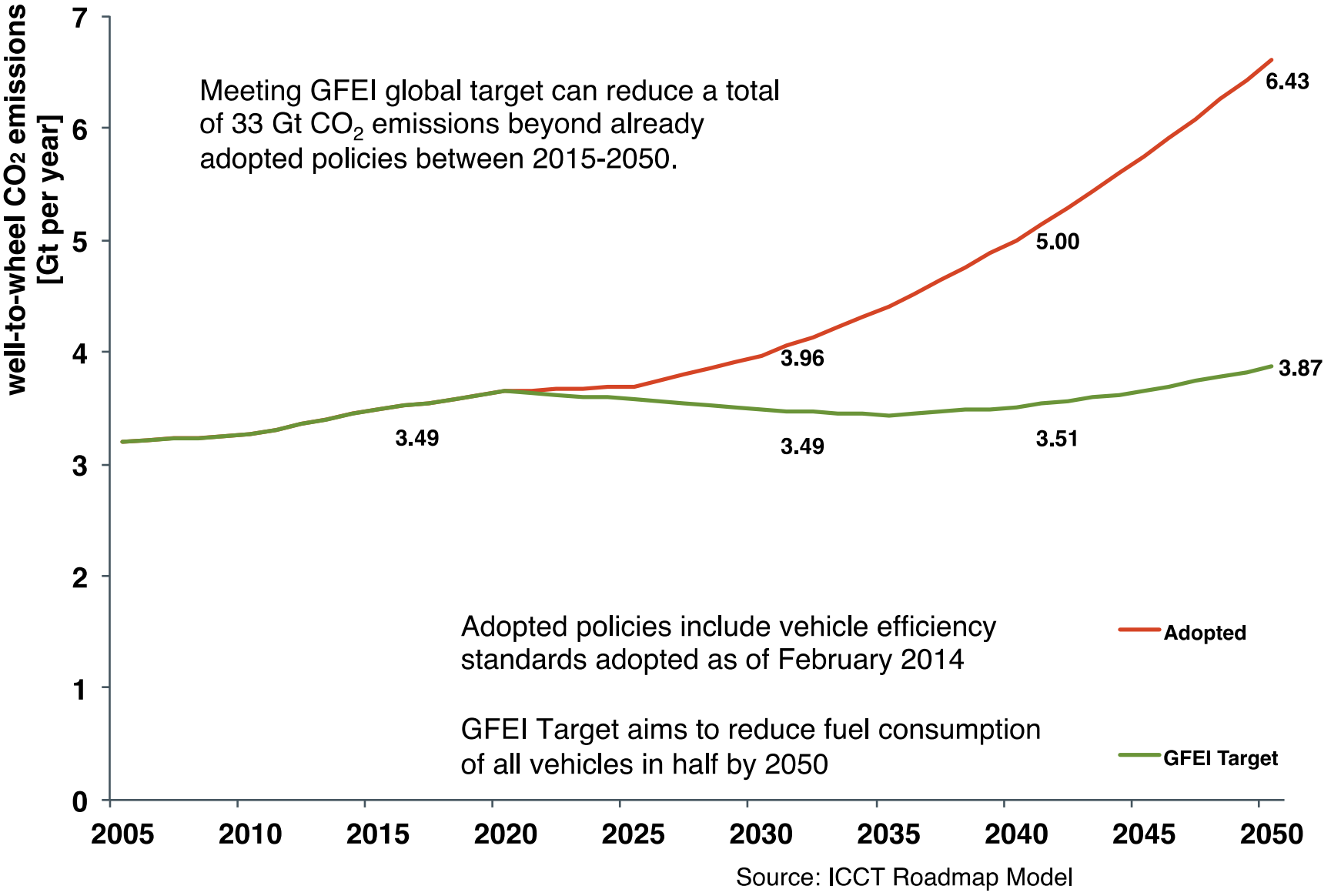
Figure 3.6 ▷ PLDV fleet in selected regions in the New Policies Scenario



GFEI Targets

	2020	2030	2050
New Cars	**30%** reduction* in L/100km compared to 2005 Engines, drive- trains, weight, aerodynamics.	**50%** average improvement globally Hybridisation of most models.	**50% +** globally Significant contributions from Plug-in vehicles
Total fleet	**20%** reduction With lag time for stock turnover; includes eco-driving, maintenance	**35%** reduction	**50by50**

Meeting GFEI targets can stabilize global light-vehicle CO_2 emissions, despite more than a doubling of vehicle fleet.



Source: ICCT Roadmap Model

Fuel economy improving, but not fast enough…

Table ES1 • **Fuel economy evolution compared to GFEI target**

		2005	2008	2011	2030
OECD average	average fuel economy (Lge/100km)	8.1	7.6	7.0	
	annual improvement rate (% per year)	-2.2%		-2.7%	
		-2.4%			
Non-OECD average	average fuel economy (Lge/100km)	7.5	7.6	7.5	
	annual improvement rate (% per year)	0.4%		-0.6%	
		-0.1%			
Global average	average fuel economy (Lge/100km)	8.0	7.6	7.2	
	annual improvement rate (% per year)	-1.7%		-1.8%	
		-1.8%			
GFEI target	average fuel economy (Lge/100km)	**8.0**			**4.0**
	required annual improvement rate (% per year)	**-2.7%** 2012 base year →			**-3.0%**

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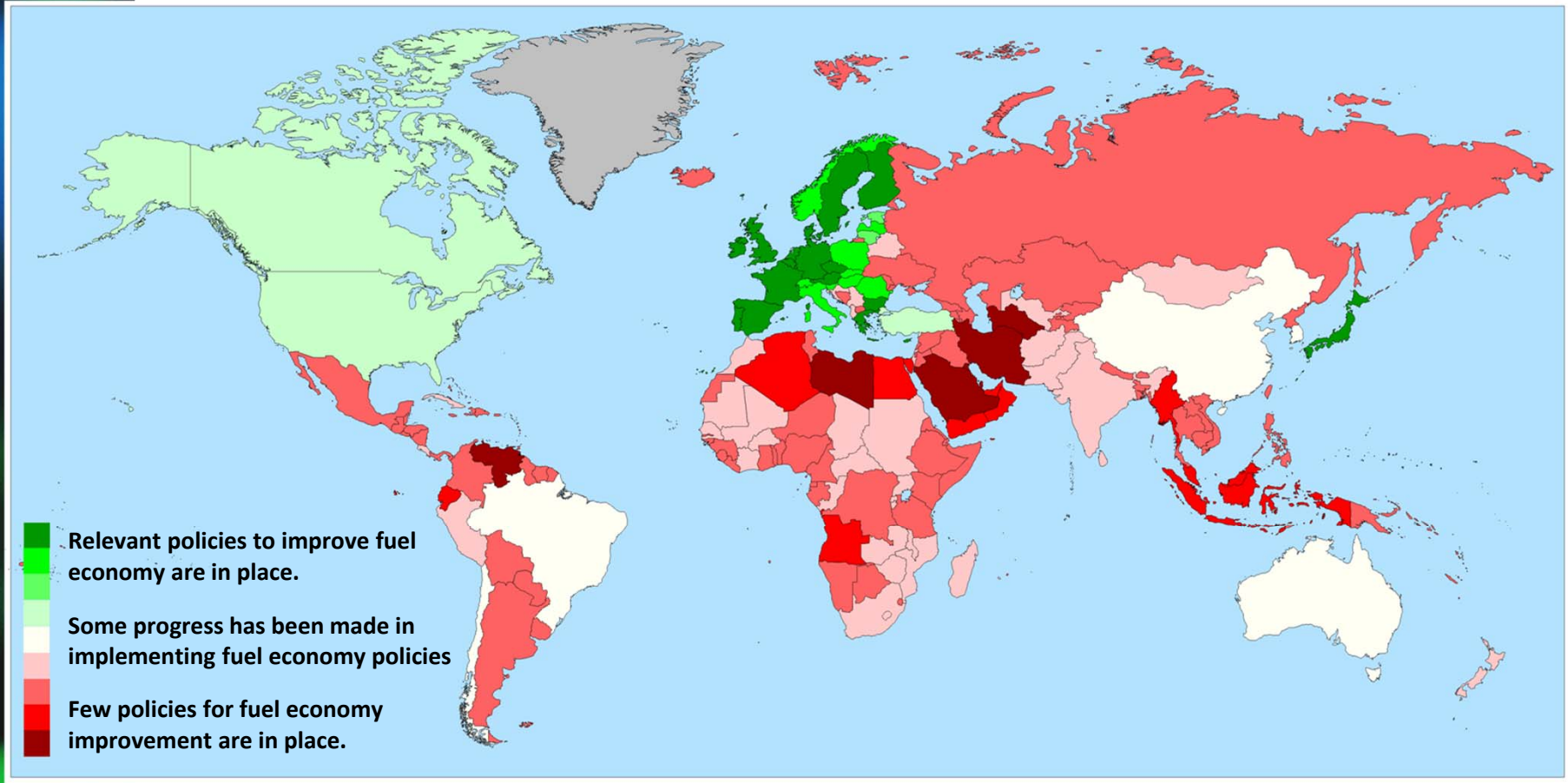
The IEA has recently created a fuel economy readiness index

Countries are at various points in developing fuel economy policies



Source: IEA Fuel Economy Roadmap, July 2012

LDV efficiency improvements still have tremendous potential

ICE potential, through hybridization and light-weighting (NRC, 2013)

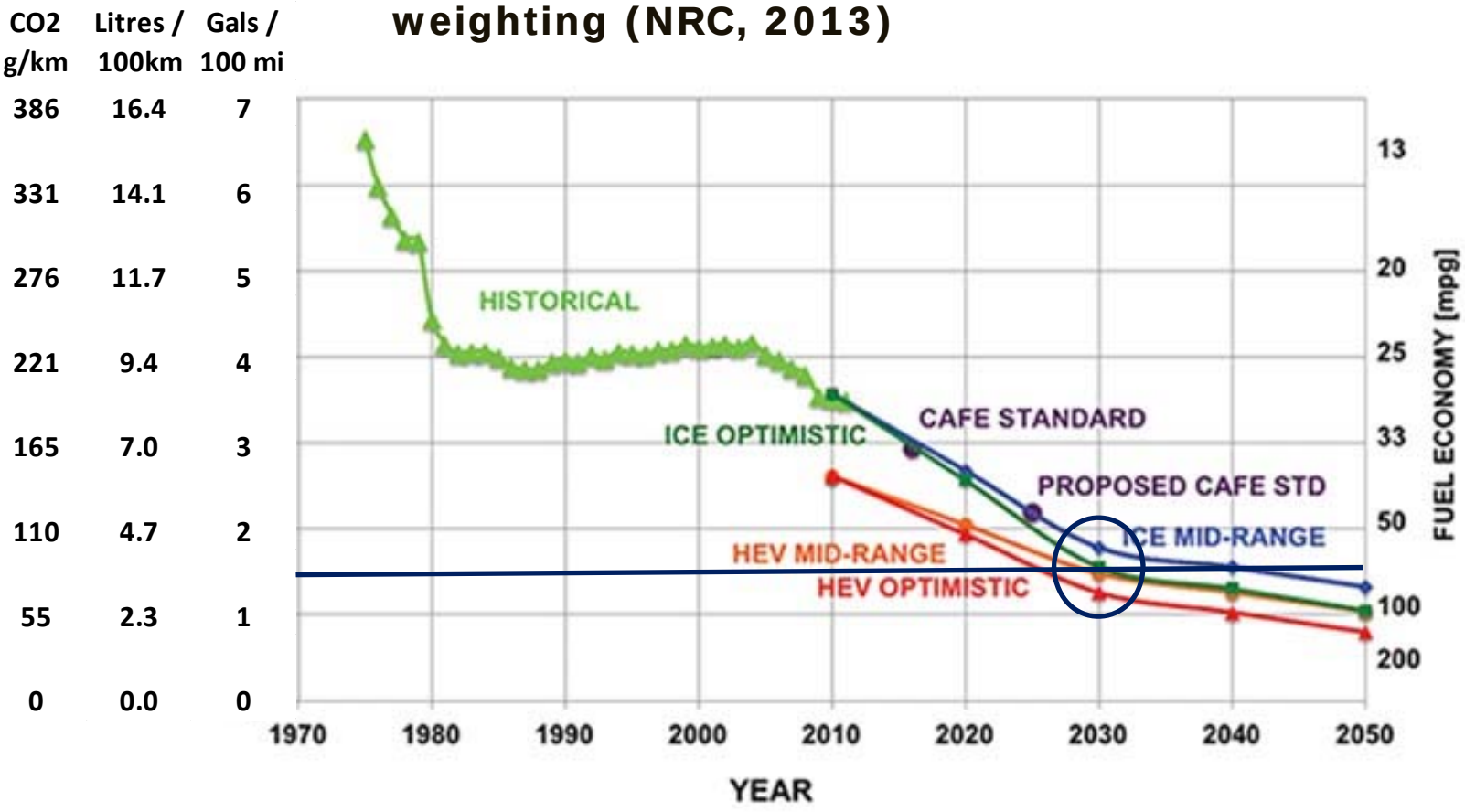


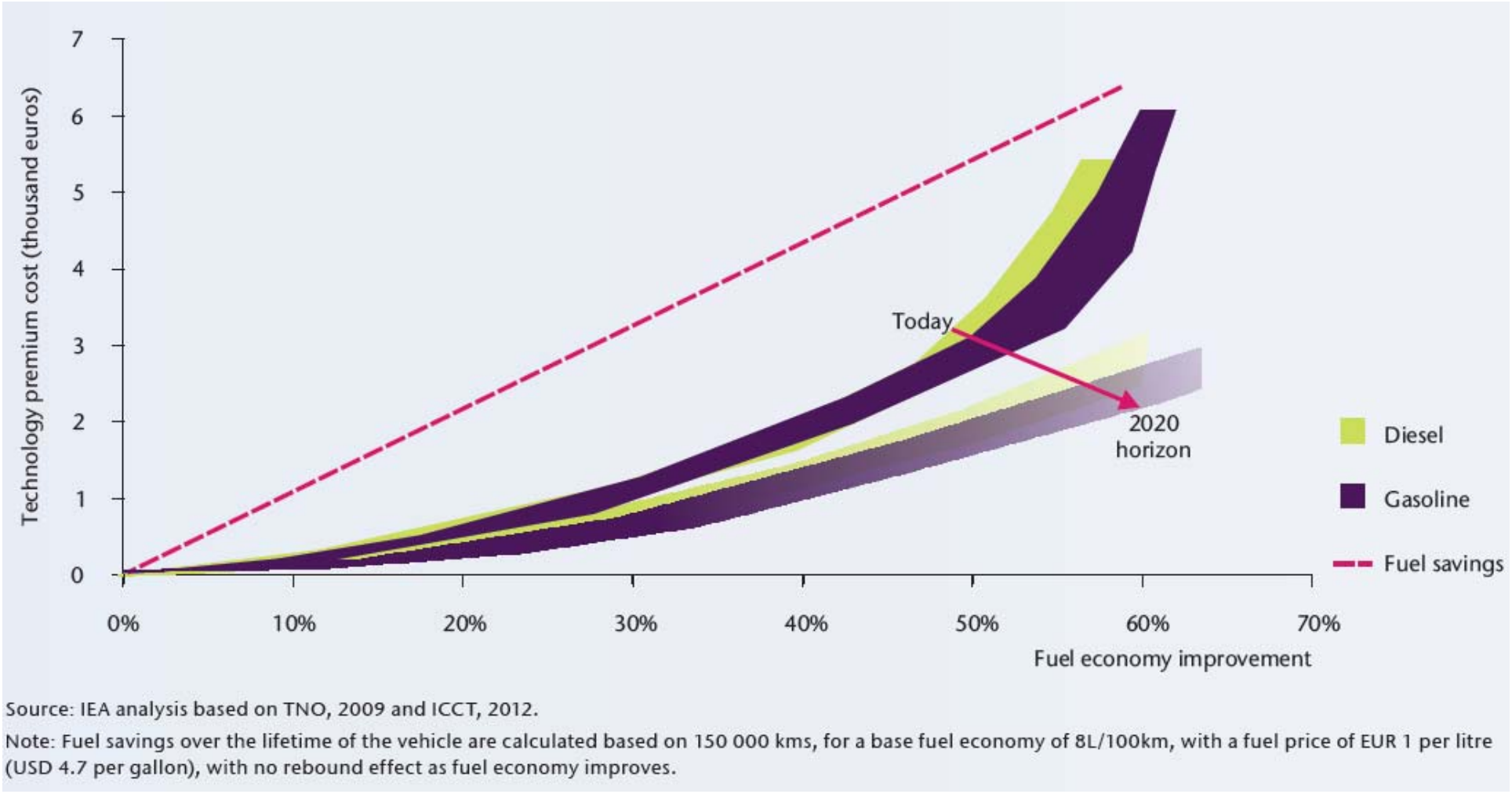
FIGURE 2.1 Historical and projected light-duty vehicle fuel economy.
NOTE: All data is new fleet only using unadjusted test values, not in-use fuel consumption.

Potential Fuel Economy Improvements to 2030

From the U.S. NRC 2013 report:

- **Light-weighting of up to 25% in 2030, 50% in 2050 relative to 2010**
- **High efficiency accessories (e.g. air conditioning, lighting, tires)**
- **High efficiency engines (including but not limited to hybridization)**
  - E.g. 25% improvement from turbocharged, downsized direct injection gasoline engines
- **Overall Impacts:**
  - By 2030, potential for 50% reduction in fuel consumption/CO2 per km at $2000-3500 per vehicle (through hybridization)
  - 66% reduction by 2050 at somewhat higher cost

The cost of fuel economy improvements will likely decline over time



Source: IEA analysis based on TNO, 2009 and ICCT, 2012.

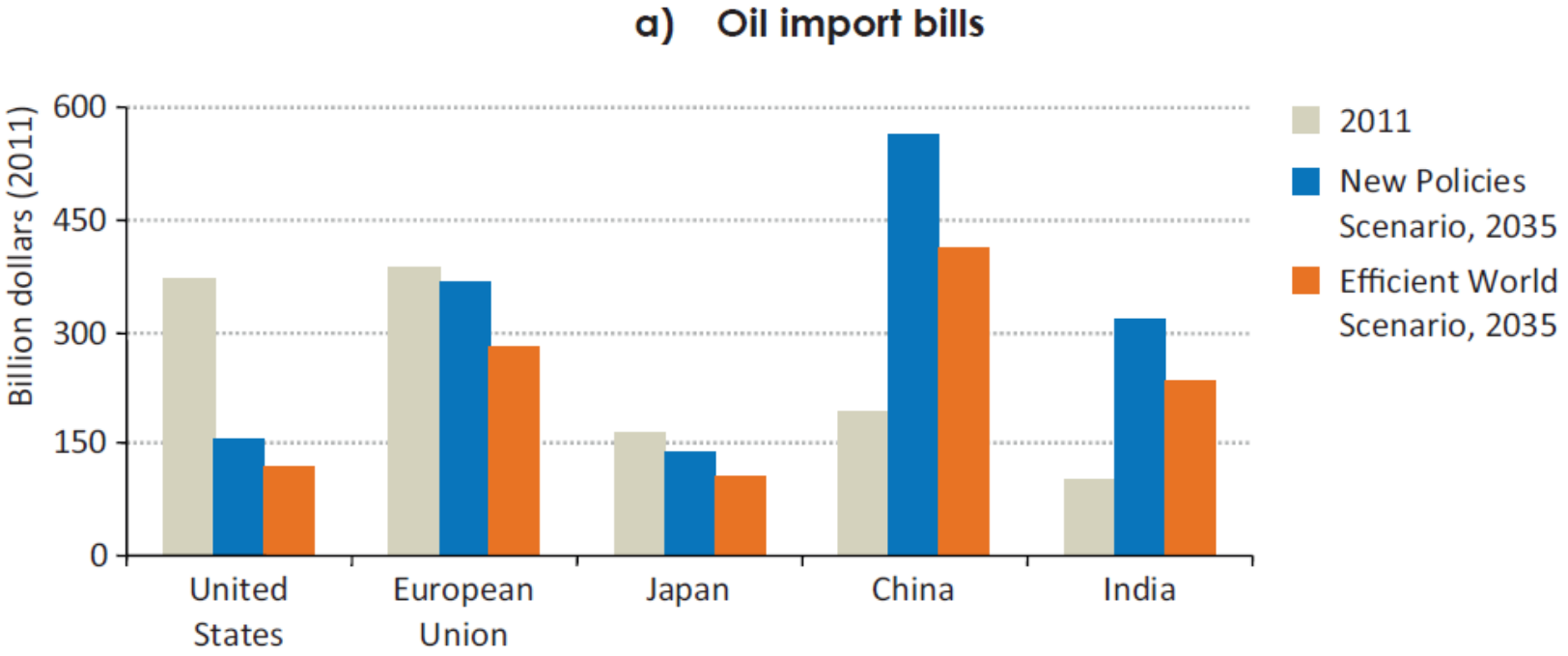
Note: Fuel savings over the lifetime of the vehicle are calculated based on 150 000 kms, for a base fuel economy of 8L/100km, with a fuel price of EUR 1 per litre (USD 4.7 per gallon), with no rebound effect as fuel economy improves.

- Analysis for the IEA "Technology Roadmap on Fuel Economy of Road Vehicles" showed that fuel economy of passenger cars could be improved by 50% at additional costs of around 3000€ per car

Improving efficiency can save $billions

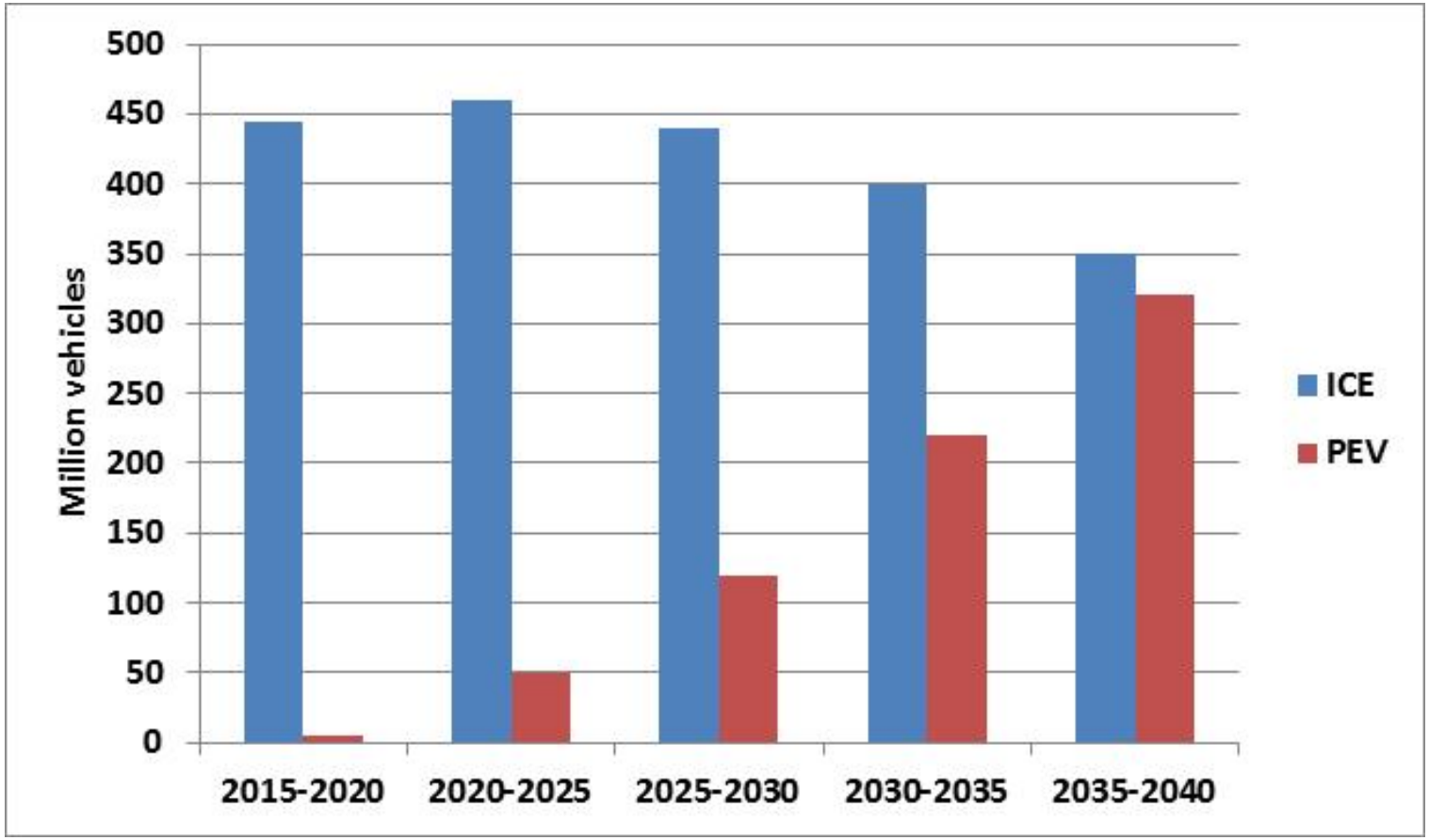
Countries could dramatically cut their fuel import bills in the future…

Figure 10.9 ▷ Fuel import bills in selected countries by fuel and scenario



Source: IEA World Energy Outlook 2012

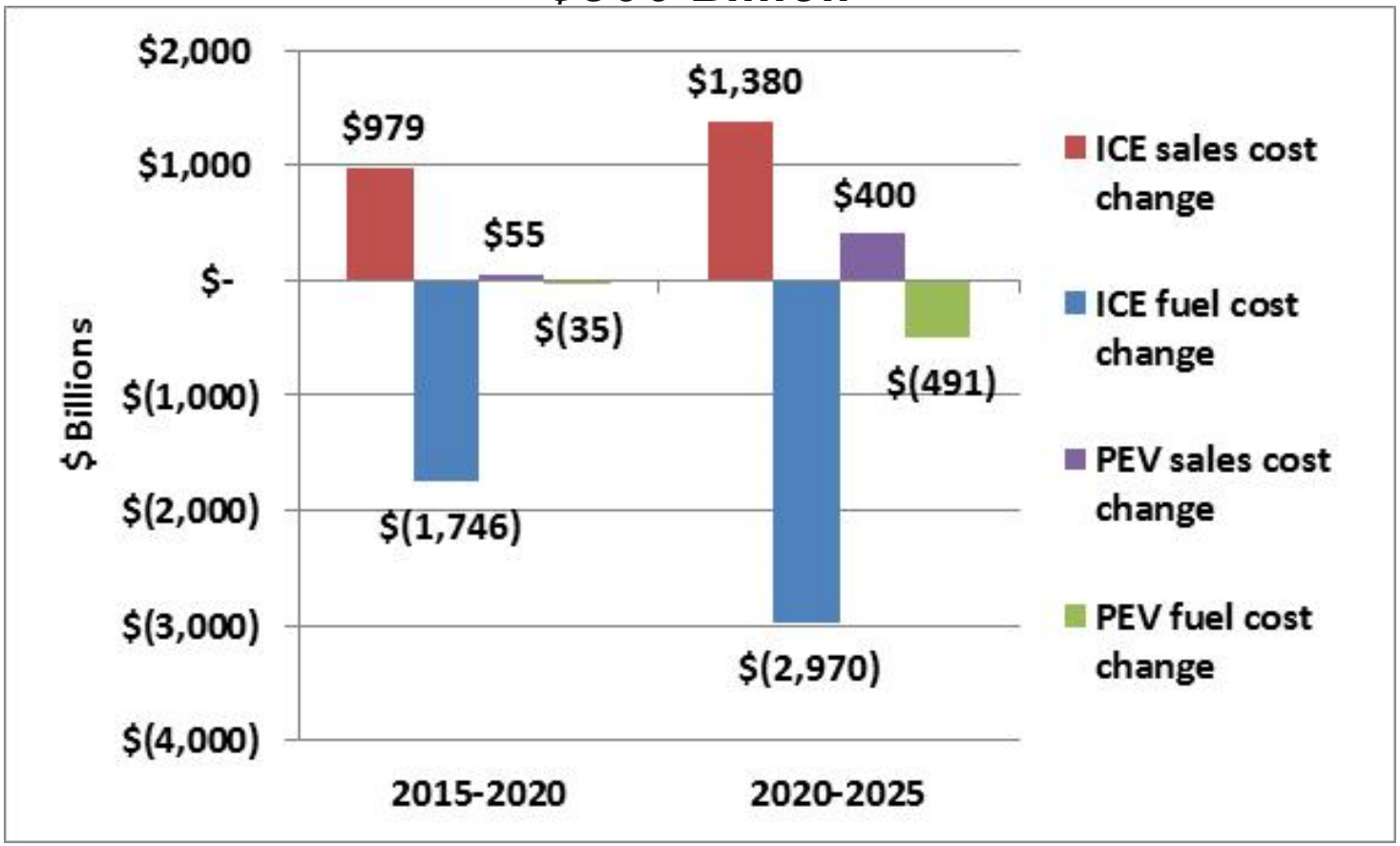
But the next 2-decades will likely be ICE-driven, even with rapid Plug-in Vehicle (PEV) growth



Note: this aligns with the IEA ETP 2012 2DS Scenario except with only 5 million PEV sales by 2020 instead of 20 million.

IEA 2-degree scenario: fuel economy has much bigger savings than the cost of PEVs

Fuel economy improvements save $2.4 Trillion in the same time frame when PEV's have incremental purchase cost of $500 Billion



Looking at CO2 tells a similar story

Fuel economy improvement provides bigger and cheaper CO2 reductions though 2035. Then PEVs prevail.

	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040
CO2 savings from ICEs (Gt)	5.4	7.5	7.9	7.8	7.1
CO2 savings from PEVs (Gt)	0.1	1.1	3.0	6.1	9.7
Cost from ICEs ($/t)	$ (143)	$ (212)	$ (214)	$ (215)	$ (198)
Cost from PEVs ($/t)	$ 211	$ (81)	$ (143)	$ (175)	$ (201)

Well-to-wheel CO2-eq emissions, cumulative over each 5 year period. Assumes 2.7 kg/L liquid fuels, 400 dropping to 200 g/kWh for electricity.

Some Conclusions

- Strong fuel economy improvements will save drivers over $2 Trillion over the next 10 years, and much more in years after.
- Launching PEVs worldwide will initially have higher purchase costs, of a quite uncertain magnitude; $500B reflects very large volume sales and could be considered a high estimate.
- One can imagine a feebate system that generates a sustainable funding stream for the introduction of large numbers of PEVs and other low-carbon vehicles.
- Fuel economy could get us half way to a low carbon LDV system, but we will likely need PEVs to get the rest of the way, especially after 2030.
- PEVs are projected to become more cost-effective than fuel economy improvement after 2030 or 2035.
- Getting there will require building ZEV markets starting now…

Thank You!

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