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SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS

*An Institute of Transportation Studies Program*

# How vehicle fuel economy improvements can save $2 trillion and help fund a long-term transition to plug-in vehicles

**Policy Institute, NextSTEPS and GFEI Webinar**
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GFEI
GLOBAL FUEL ECONOMY INITIATIVE
www.globalfueleconomy.org

FIA Foundation
for the Automobile and Society

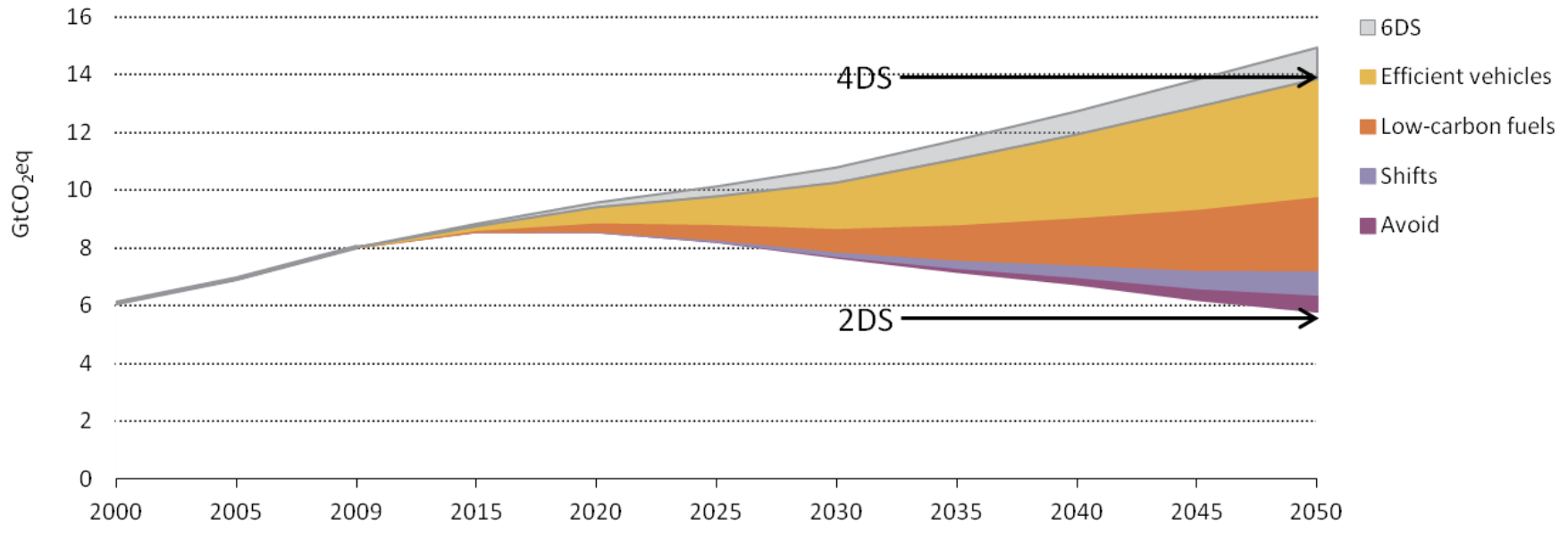
www.steps.ucdavis.edu

# To cover today

- **Background: IEA two degree scenario**
- **Role of fuel economy (FE) improvement from Internal Combustion Engine (ICE) vehicles**
- **Role of plug-in electric vehicles (PEV)**
- **Relative costs and fuel savings from these technologies**
- **Policy implications**
- **Some takeaways**

# Deep Transport CO2 Reductions in IEA ETP-2012 2 Degree Scenario (2DS)

- FE improvement from ICE vehicles plays largest role, particularly through 2030



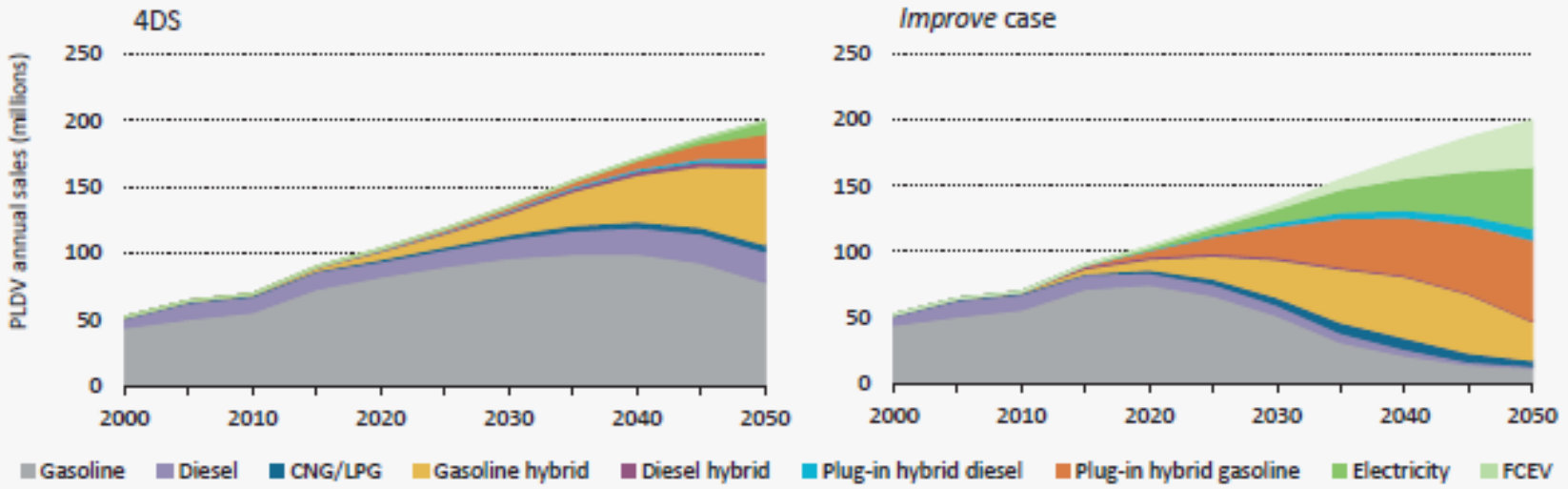

**Source: IEA Energy Technology Perspectives (2012)**



International Energy Agency

# By 2050 automakers will need to sell mainly near-zero emission vehicles (plug-ins and fuel cells, or PEVs)

**Figure 13.18** Global portfolio of technologies for passenger LDVs



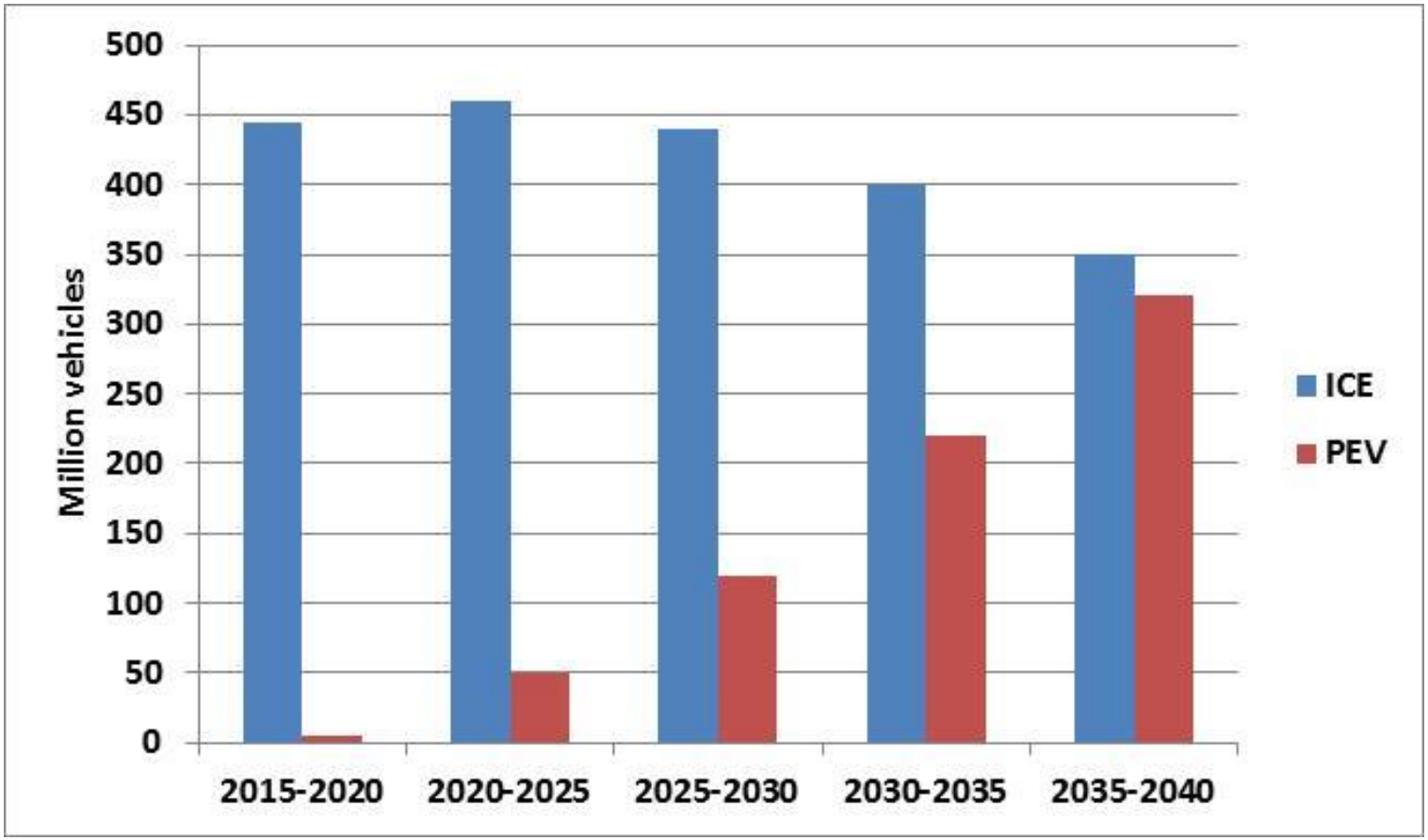

**Key point** *In the Improve case, electric, PHEV and FCEVs together account for nearly three-quarters of new vehicle sales in 2050.*

**Source: IEA Energy Technology Perspectives (2012)**



International Energy Agency

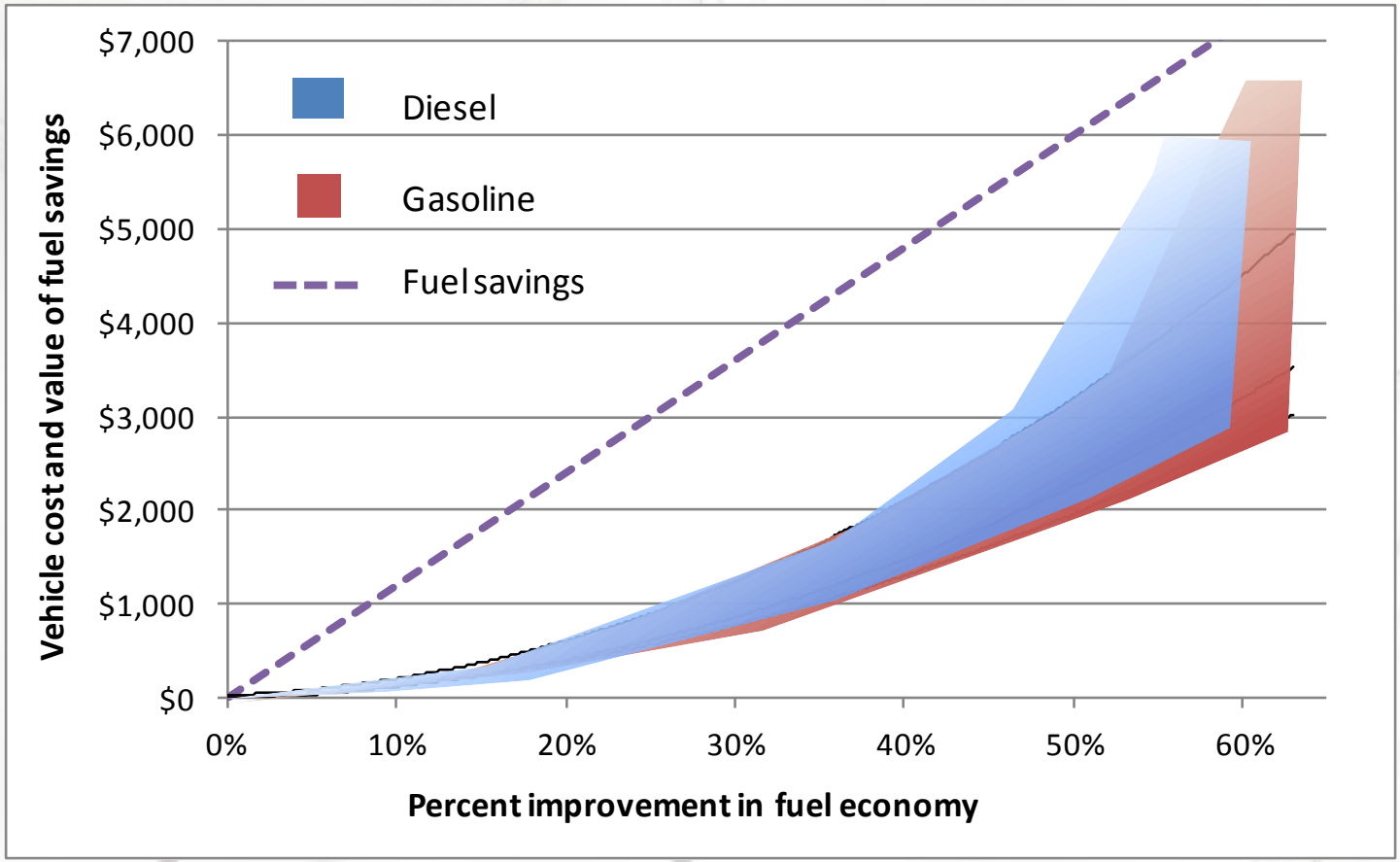
# But the next 2-decades will likely be ICE-driven, even with rapid PEV growth




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

# Fuel Economy Improvements are very cost-effective

***Fuel savings more than pays for fuel economy improvements in light-duty vehicles***

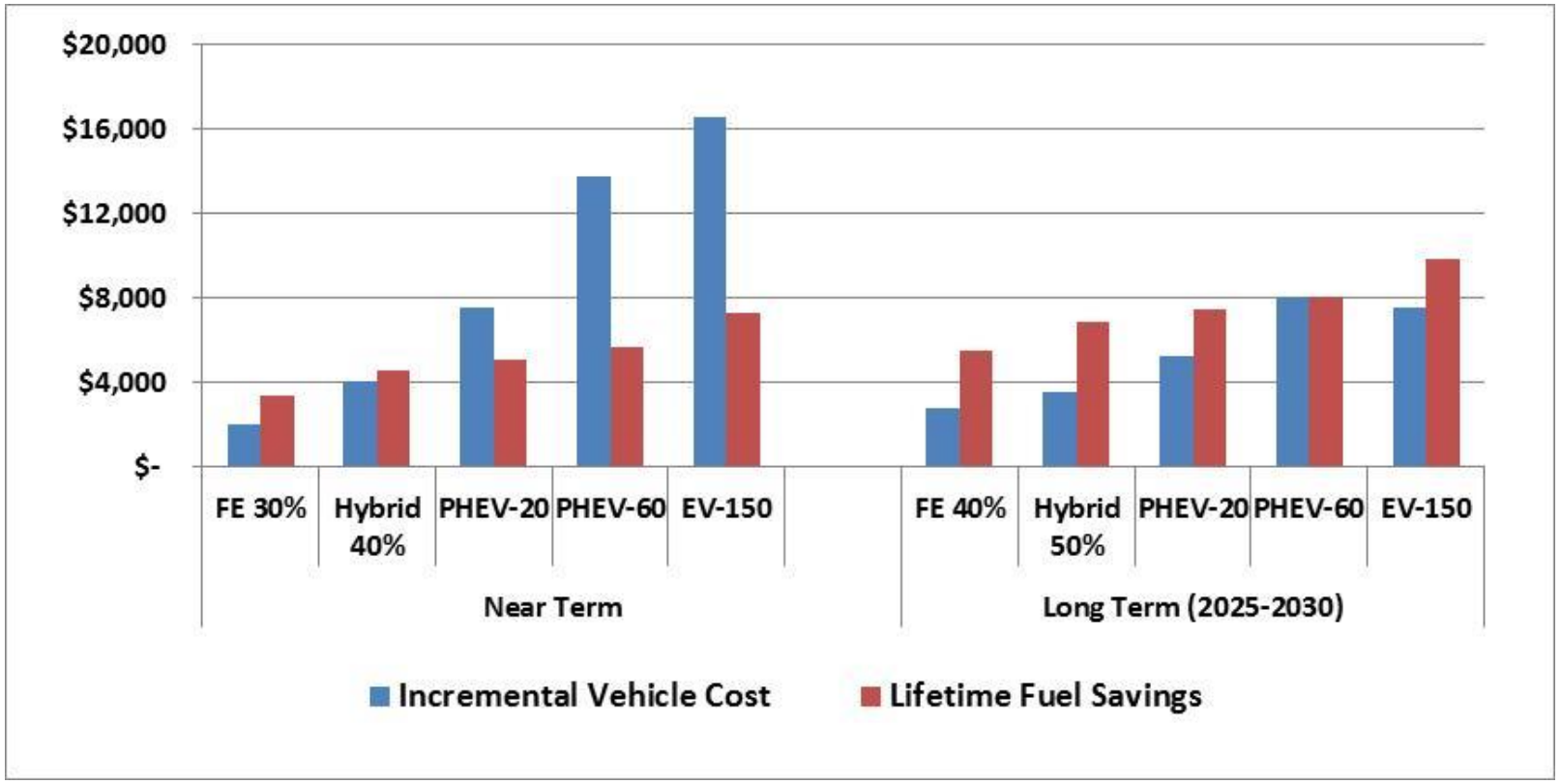



**Source: IEA Fuel Economy Roadmap, July 2012**

International Energy Agency

# Some cost/benefit estimates

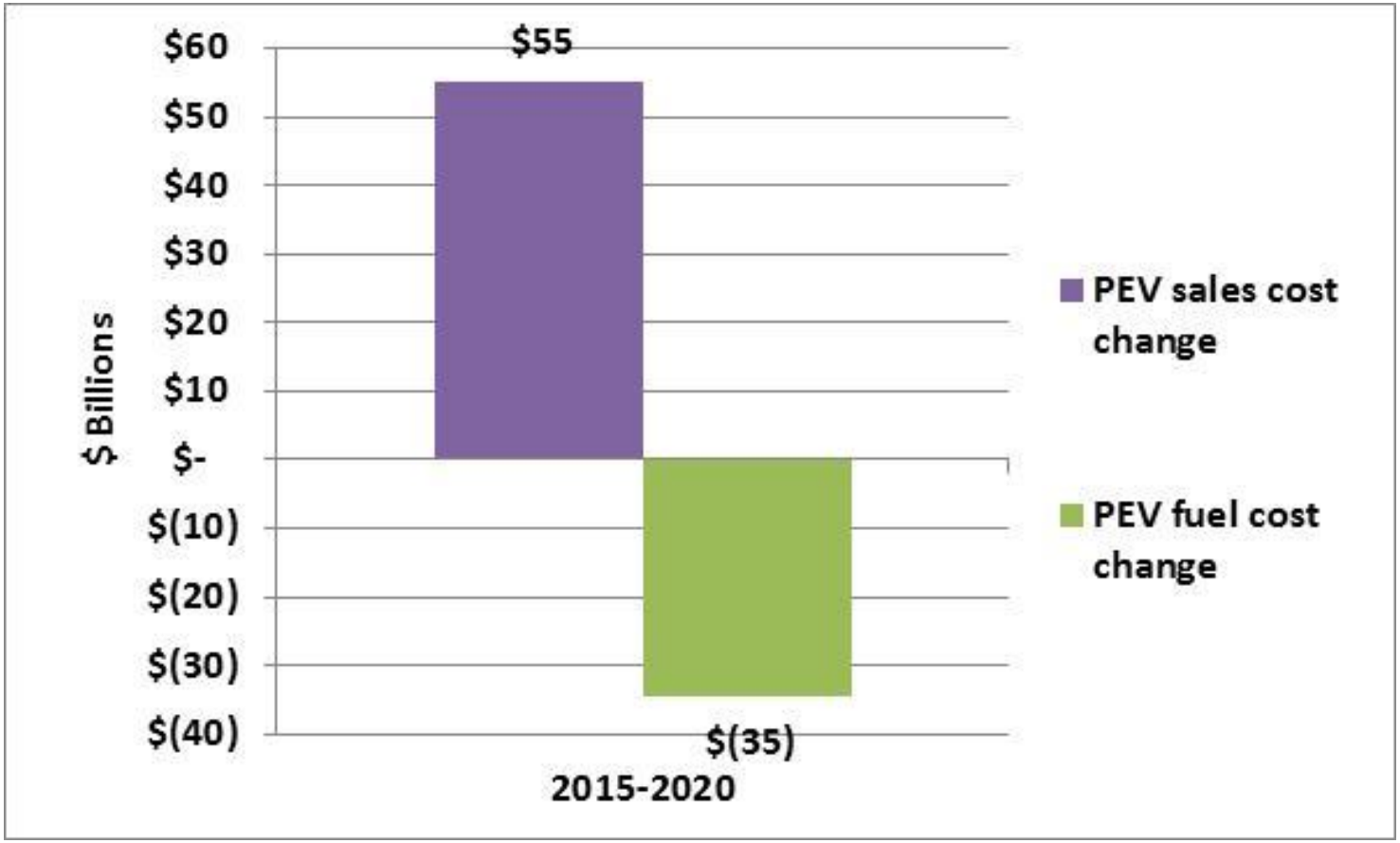
## FE Improvement, hybrids, PEVs v. a base ICE vehicle over time




**Notes: "FE 30%"=fuel economy improved by 30% in L/100km; "PHEV-20"= plug-in hybrid with 20 km electric range; fuel savings estimated over 160k kms of driving; all related to a base gasoline vehicle of 9 L/100km; oil prices $100/bbl near term, $130/bbl long term; battery costs decline over time from $600 to about $300/kWh**

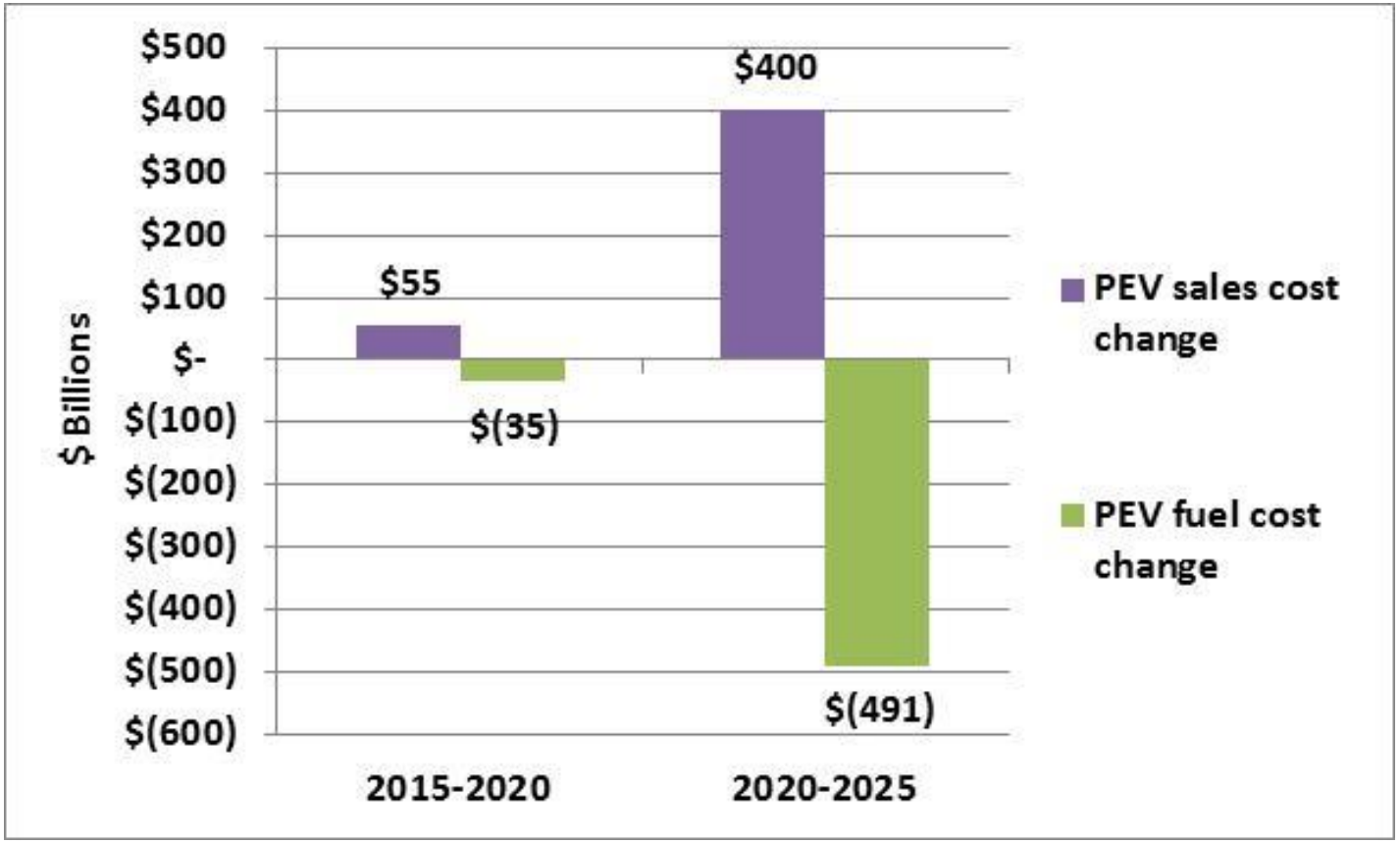
# 2015-2020: PEV sales cost is much higher than base vehicle, but saves fuel as well

***For sales of 5 million PEVs with cost assumptions used here, vehicle cost increase is over $50 billion, fuel cost savings $20 Billion less***



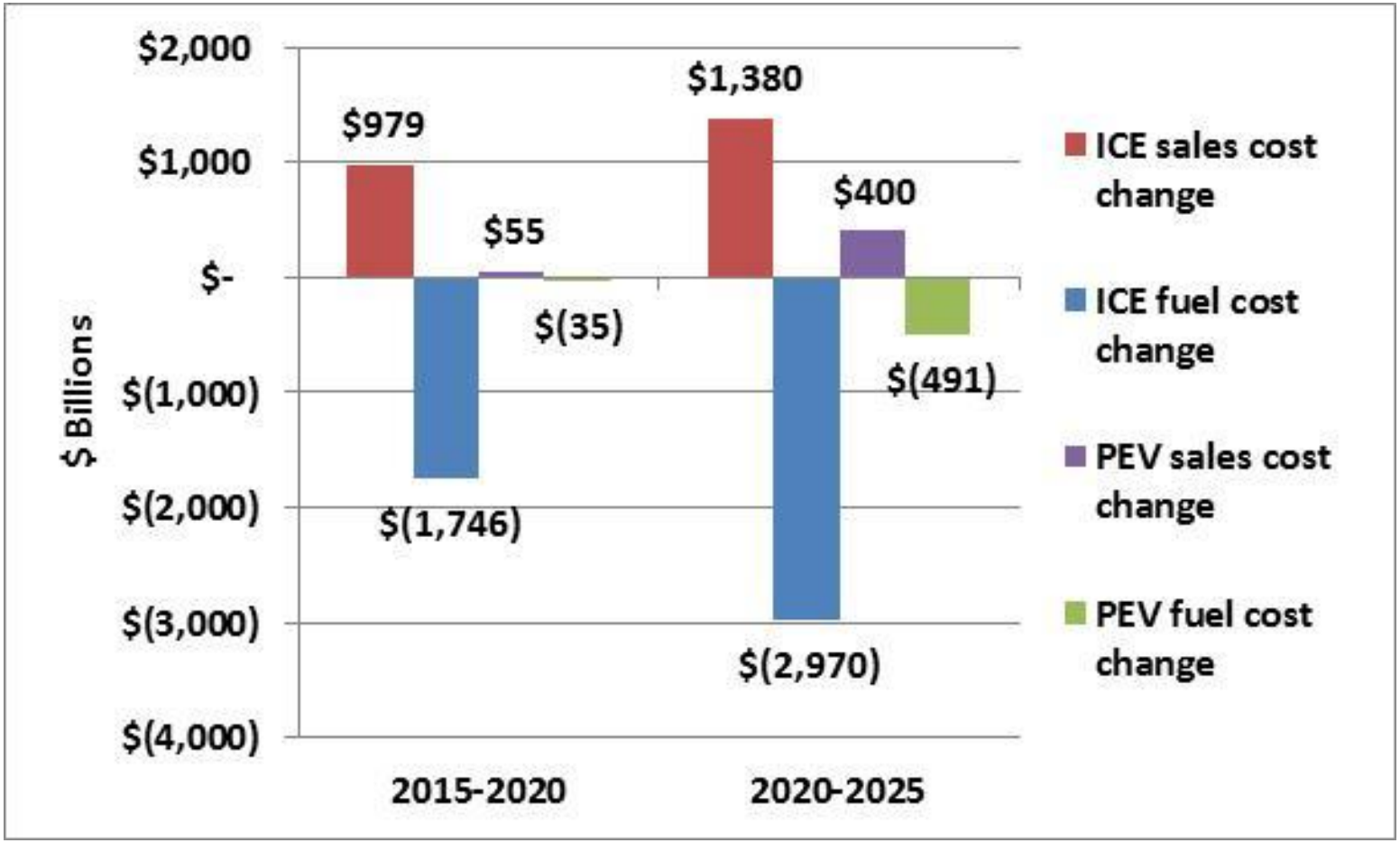
# PEVs could break even or better (benefits > costs) in the 2020-2025 time frame

***Vehicle cost increase exceeds $450B for 50M in sales through 2025, though fuel savings is greater $500B+***



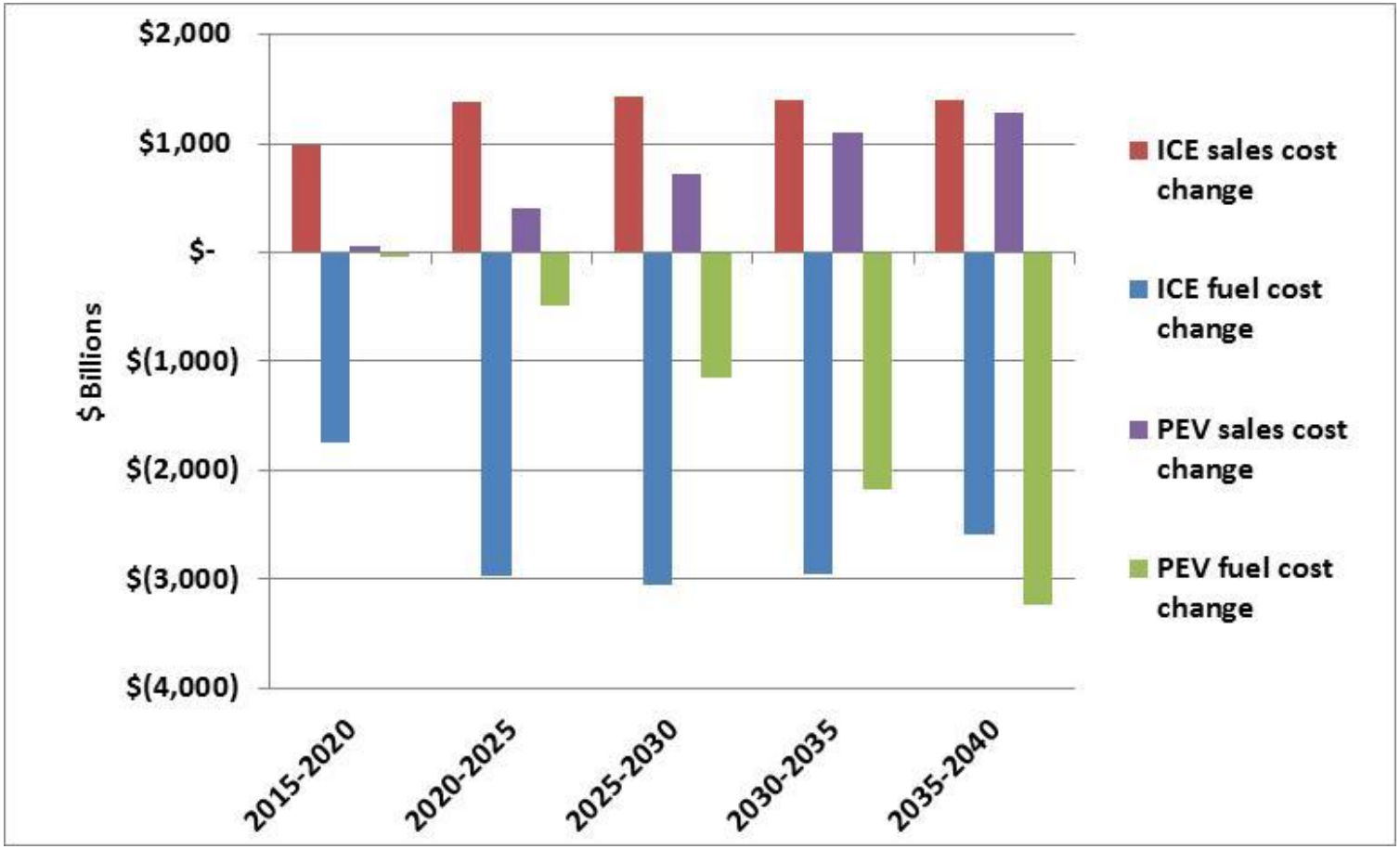
# If we add ICE vehicle fuel economy savings into the mix, it changes the perspective

***Fuel economy saves a net $2.4 Trillion in the same time frame when PEV's may require incentives***



# After 2025, PEVs become increasingly important, and increasingly cost-effective

***2030-2040, Fuel economy has a net savings of $2.7T, PEVs have a net savings of $3.0T and rising***



# 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.***

# Initial takeaways from the analysis

1. Compared to today's vehicles, future conventional vehicle fuel economy could be doubled in MPG terms
   - Globally, roughly a $3trillion investment in improved fuel economy would result in a $5trillion fuel savings, for a $2 trillion net savings

2. PEVs are estimated to have an incremental purchase cost of up to $500 billion between 2015-2025

3. There are many factors affecting this, including relative fuel prices and the rate of cost reduction of key components such as batteries.

4. As we find today, consumers may still value strong financial incentives to encourage PEV purchases for some time

# Who pays and who benefits?

- Much of the LDV fuel economy improvement expected over the coming years is already required (at least in OECD countries)
- Vehicle incremental costs are directly born by manufacturers, but ultimately by consumers
  - Also true for PEVs, but these costs are so high that it seems society must contribute in order to build a market
- Fuel savings accrue directly to consumers, though slowly over vehicle life (this may be several owners)
- Consumers may not fully value fuel savings, and will not likely perceive the "contrapositive case"

# Thought experiment: Transition funding via a feebate

- There will be around 1 billion ICE vehicles sold worldwide from now to 2025
- This scenario has 50 million PEVs on the road by 2025, 5% of the world fleet.
- If $500B were spent to incentivize PEVs through 2025, This would average $10,000 per vehicle (!).
- This subsidy equals $500/vehicle for each of the world's 1 billion ICE vehicle sales over this time frame.
- A feebate system could be structured around this.
- Alternatively, a tax of around $0.07/L ($0.25/gal) would cover this transition cost.

# 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…

# Potential additional research

- Could add more advanced vehicle types (e.g. FCEVs), though not expected to significantly change the results.
  - Sensitivity analysis on the assumptions in this paper, particularly if done systematically, would be useful
- Should/can we identify a total incentive amount for PEVs that society can get behind, and how to generate sustainable funding for this?
- What role do other policies play (e.g. ZEV mandates, FE standards) and how do they shift costs and benefits?
- How would a feebate interact with fuel taxes, fuel economy standards and ZEV-type programs?  Are they complementary?

# Thank you!

## Questions welcome

**Feel free to contact me at lmfulton@ucdavis.edu**