# The Economic, Energy, and $CO_2$ Emissions Impacts of Proposed 2017-2025 Vehicle Fuel Economy Standards in the United States


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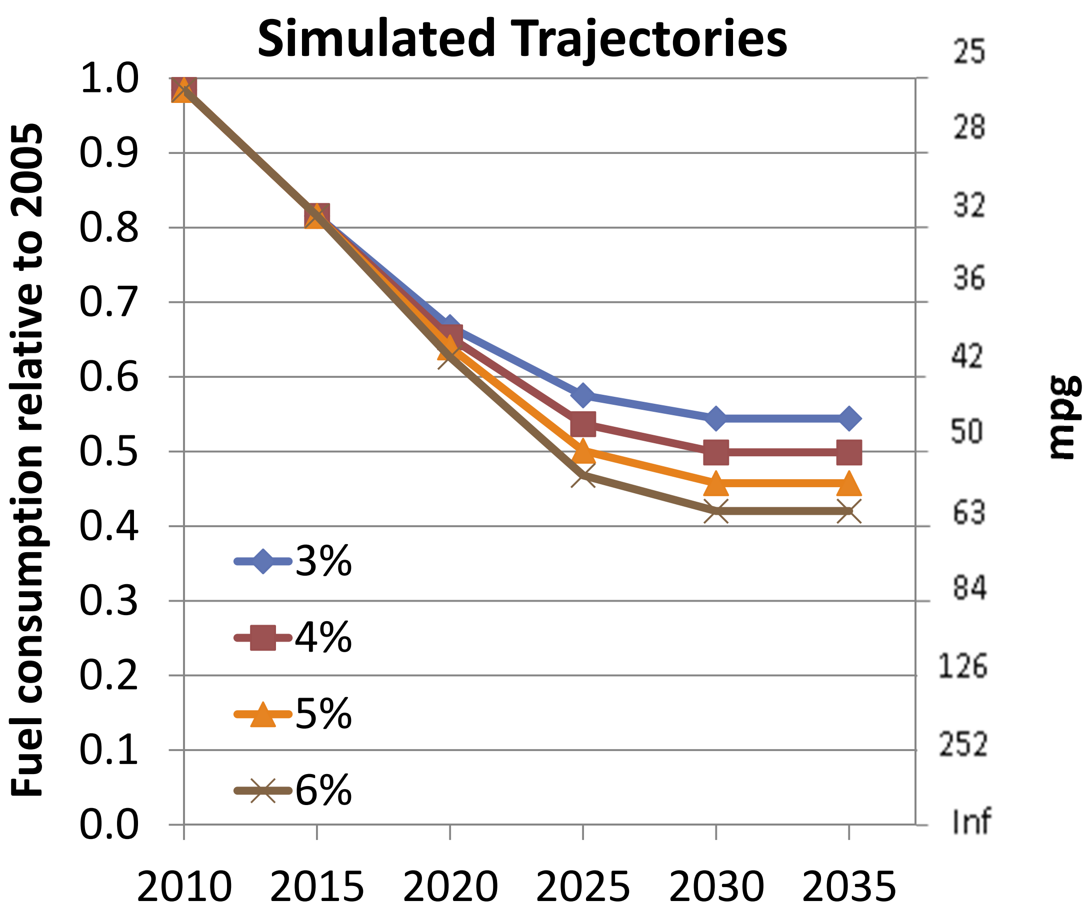
# Overview of this presentation

1) **Background** – U.S. fuel economy / $CO_2$ regulations through 2025
2) **Method** – Energy-economic model with detailed representation of vehicle efficiency options and costs
   → Consider sensitivity to high / low vehicle tech cost
3) **Results** – Assess economic, energy, and $CO_2$ impact of regulations
   → Fuel economy standard at different levels of stringency
   →Adding a tax to fuel economy standard
4) **Conclusions**

# Which target trajectory should be chosen for the 2017-2025 new vehicle new vehicle CAFE Standard?




***Impacts:***

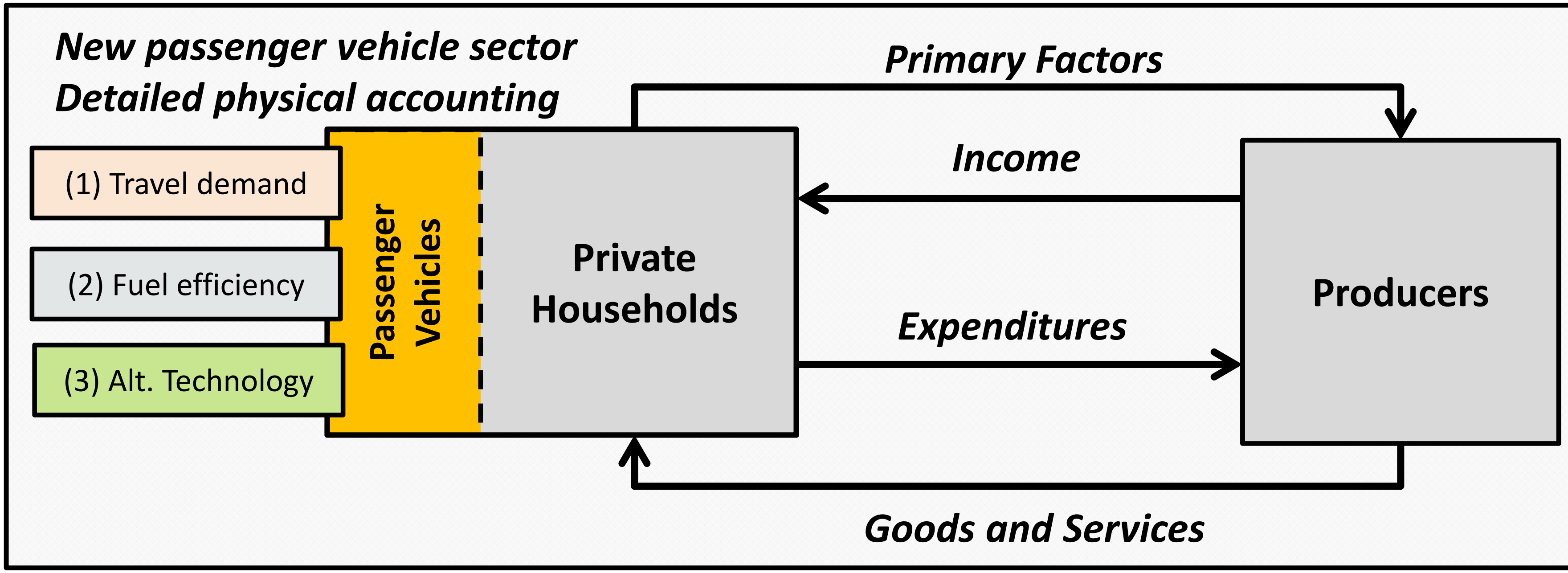
- Gasoline reduction
- $CO_2$ emissions
- Economic welfare
- Average cost of fuel use and $CO_2$ emissions

***Sensitivity to:***

- Advanced technology cost
- Fuel tax

# Model framework

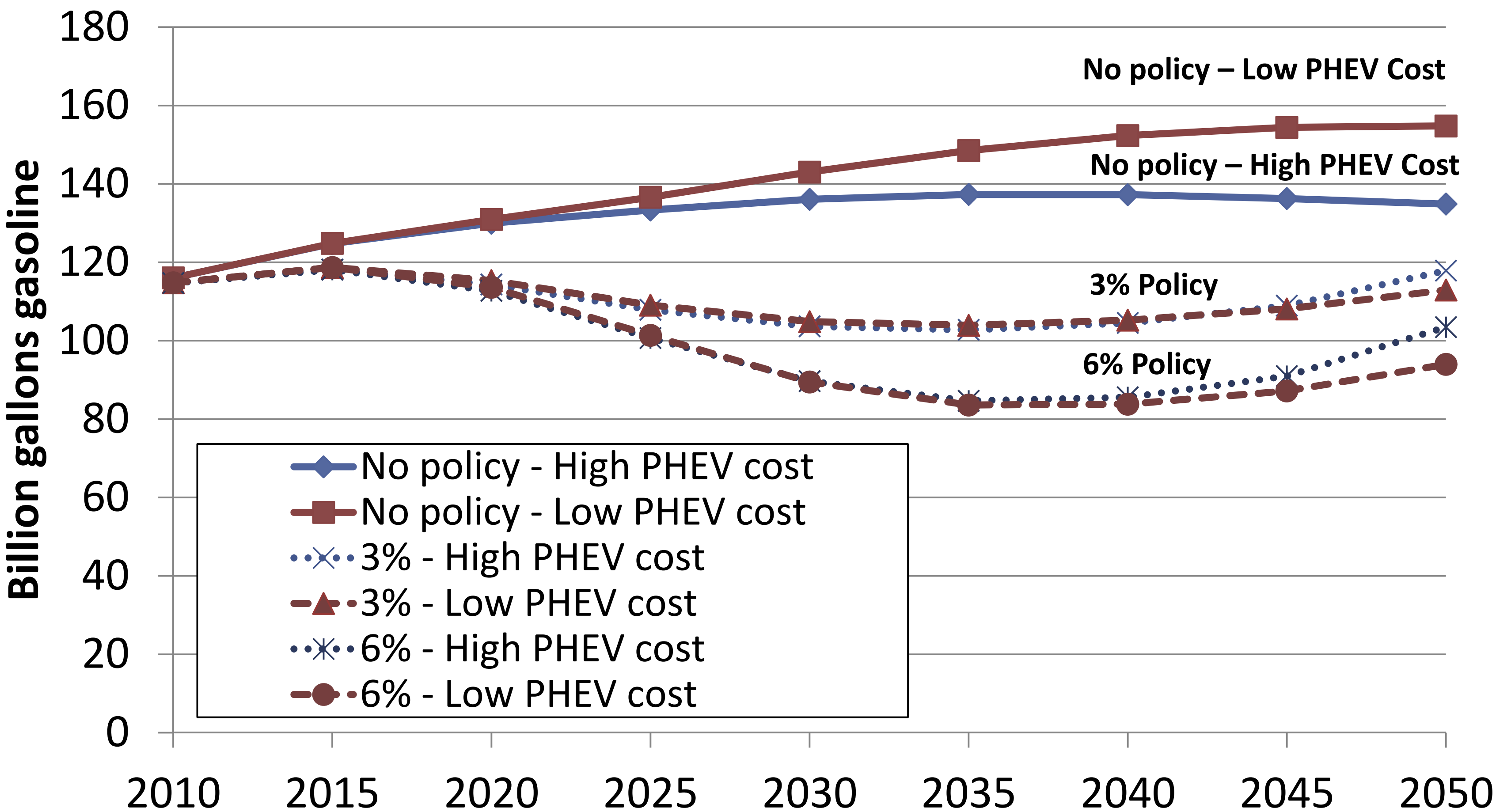
**The MIT Emissions Prediction and Policy Analysis Model**




***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

# The plug-in hybrid electric vehicle (PHEV) technology cost assumption can strongly affect the baseline




**Low PHEV cost** – 10% vehicle markup relative to 2004 ICE

**High PHEV cost** – 30% vehicle markup

# Impact on vehicle-miles traveled (VMT) depends on target stringency, PHEV cost scenario

| (1) Scenario Name | (2) FE % increase year-on-year | (3) PHEV cost | (4) % change VMT in 2030 |
|---|---|---|---|
| *0% – Low* | *No Policy* | *L* | N.A. |
| 3% – Low | 3 | L | 0.2% |
| 4% – Low | 4 | L | -0.1% |
| 5% – Low | 5 | L | -0.8% |
| 6% – Low | 6 | L | -2.1% |
| *0% – High* | *No Policy* | *H* | N.A. |
| 3% – High | 3 | H | 0.6% |
| 4% – High | 4 | H | 0.4% |
| 5% – High | 5 | H | 0.0% |
| 6% – High | 6 | H | -0.8% |

***Three important effects:***

- **Baseline VMT – affected by PHEV cost**
- **Fuel price per mile decreases**
- **Vehicle capital cost increases**

**Model captures combined effect.**

# Higher PHEV adoption in all low PHEV cost cases, reduces role of ICE improvement

| (1) Scenario Name | (2) FE % increase year-on-year | (3) PHEV cost | (4) % change VMT | (5) 2030 % PHEV in new VMT | (6) 2030 new ICE on-road mpg |
|---|---|---|---|---|---|
| *0% – Low* | *No Policy* | *L* | N.A. | *10.3%* | *23.0* |
| 3% – Low | 3 | L | 0.2% | 22.6% | 29.1 |
| 4% – Low | 4 | L | -0.1% | 23.2% | 31.1 |
| 5% – Low | 5 | L | -0.8% | 23.6% | 33.4 |
| 6% – Low | 6 | L | -2.1% | 23.9% | 36.2 |
| *0% – High* | *No Policy* | *H* | N.A. | *0.3%* | *23.0* |
| 3% – High | 3 | H | 0.6% | 16.3% | 30.4 |
| 4% – High | 4 | H | 0.4% | 16.8% | 32.5 |
| 5% – High | 5 | H | 0.0% | 17.1% | 35.1 |
| 6% – High | 6 | H | -0.8% | 17.4% | 38.0 |

***Low PHEV cost***

- **Higher PHEV adoption to meet standard**
- **ICE improves less**

***High PHEV cost***

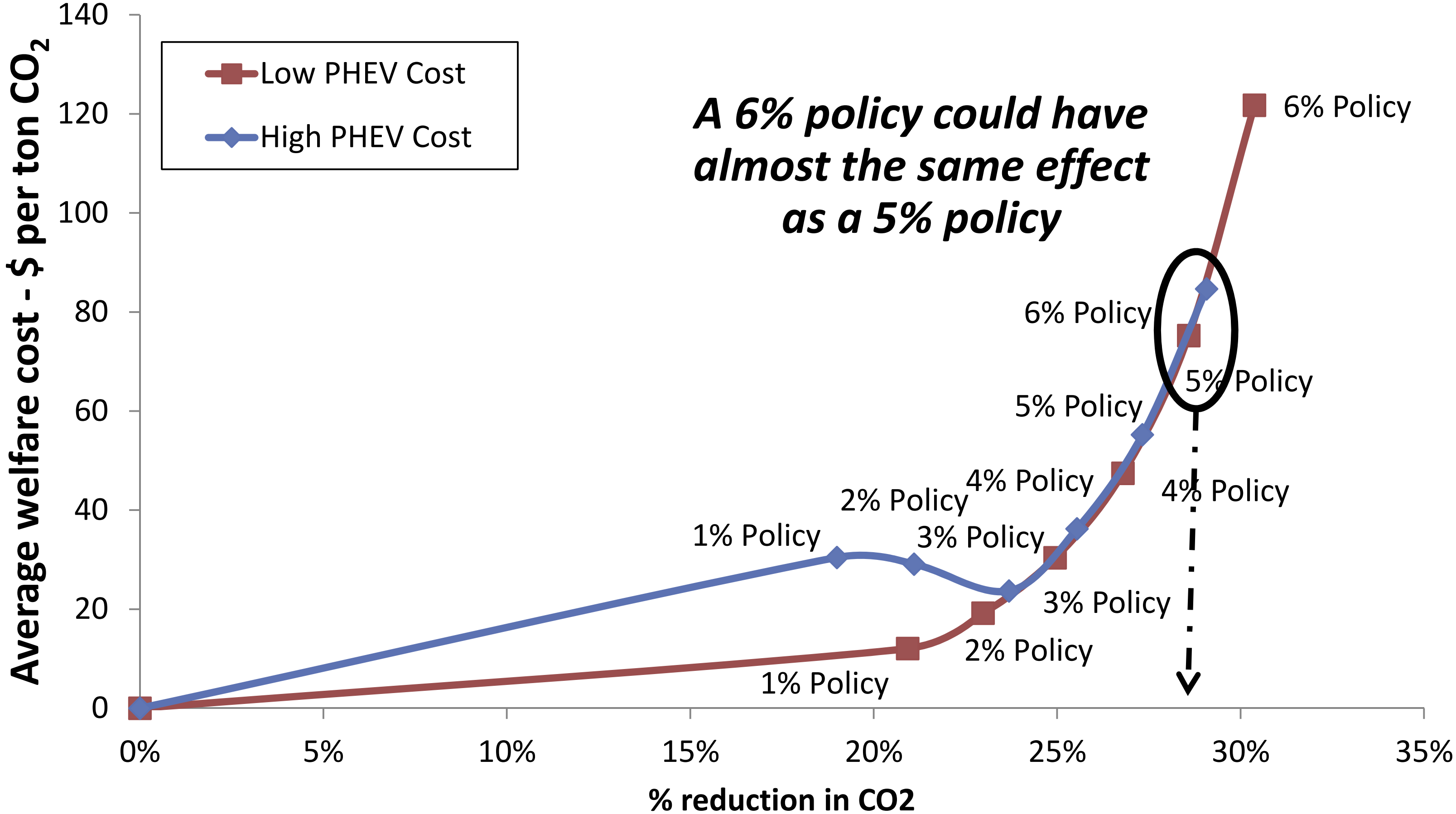
- **Lower PHEV adoption to meet standard**
- **ICE improves more**

# Measured impacts of regulation strongly depend on the baseline case assumptions

| (1) Scenario Name | (2) FE % increase year-on-year | (3) PHEV cost | (4) % change VMT | (5) 2030 % PHEV in new VMT | (6) 2030 new ICE on-road mpg | (7) Cumulative $CO_2$ emissions 2010-2050 (bmt) | (8) Cumulative $CO_2$ reduced 2010-2050 (bmt) | (9) Cost per year 2010-2050 (NPV dis. $2004 billions) | (10) Cumulative welfare loss (NPV dis. $2004) |
|---|---|---|---|---|---|---|---|---|---|
| *0% – Low* | *No Policy* | *L* | N.A. | *10.3%* | *23.0* | *60.6* | *N.A.* | *N.A.* | *N.A.* |
| 3% – Low | 3 | L | 0.2% | 22.6% | 29.1 | 45.6 | **15.0** | **9.8** | -0.16% |
| 4% – Low | 4 | L | -0.1% | 23.2% | 31.1 | 43.9 | **16.7** | **17.3** | -0.27% |
| 5% – Low | 5 | L | -0.8% | 23.6% | 33.4 | 42.2 | **18.5** | **30.0** | -0.47% |
| 6% – Low | 6 | L | -2.1% | 23.9% | 36.2 | 40.4 | **20.3** | **53** | -0.84% |
| *0% – High* | *No Policy* | *H* | N.A. | *0.3%* | *23.0* | *57.0* | *N.A.* | *N.A.* | *N.A.* |
| 3% – High | 3 | H | 0.6% | 16.3% | 30.4 | 45.9 | **11.1** | **8.5** | -0.13% |
| 4% – High | 4 | H | 0.4% | 16.8% | 32.5 | 44.3 | **12.7** | **13.6** | -0.21% |
| 5% – High | 5 | H | 0.0% | 17.1% | 35.1 | 42.8 | **14.2** | **21.9** | -0.35% |
| 6% – High | 6 | H | -0.8% | 17.4% | 38.0 | 41.2 | **15.8** | **36.5** | -0.58% |

***$CO_2$ reduction and welfare loss due to policy increase with target stringency, magnitudes affected by low cost PHEV assumption.***

# Average welfare cost of regulation in 2025



# Should CAFE be combined with a tax?
## Again baseline and role of vehicle/fuel costs matter

| Scenario Name | FE % increase year-on-year | PHEV cost* | % change VMT in 2030 | 2030 % PHEV in new VMT | 2030 new ICE mpg | Cumulative $CO_2$ emissions (bmt) | Cumulative $CO_2$ reduced (bmt) | Cumulative welfare loss (NPV dis. \$2004) |
|---|---|---|---|---|---|---|---|---|
| *0% – Low* | *No Policy* | *L* | *N.A.* | *10.3%* | *23.0* | *60.6* | *N.A.* | *N.A.* |
| 5% – Low | 5 | L | -0.8% | 23.6% | 33.4 | 42.2 | **18.5** | **-0.47%** |
| 5% – Low – T | 5% + Tax | L | -0.1% | 23.7% | 33.4 | 42.5 | **18.1** | **-0.38%** |
| *0% – High* | *No Policy* | *H* | *N.A.* | *0.3%* | *23.0* | *57.0* | *N.A.* | *N.A.* |
| 5% – High | 5 | H | 0.0% | 17.1% | 35.1 | 42.8 | **14.2** | **-0.35%** |
| 5% – High – T | 5% + Tax | H | -0.8% | 17.1% | 33.4 | 41.9 | **15.1** | **-0.52%** |

**Tax in Low PHEV cost CAFE scenario reduces cost effectiveness (average cost per ton $CO_2$ reduced).**

**Tax in High PHEV cost CAFE scenario increases cost effectiveness.**

# Tougher standards are not always better
## Need to consider systems-level feedbacks

- In the case of a vehicle fuel economy standard (CAFE), average cost of reductions in gasoline or $CO_2$ may be lowest for less stringent policies under consideration.
  - Important to pay careful attention to the marginal cost of fuel economy/$CO_2$ improvements.
- Baseline matters—may be very different depending on technology cost.
- Adding tax to CAFE can raise / lower cost effectiveness.
  - Depends on baseline, role of fuel/vehicle cost per mile.

# Thank you!

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