A Presentation to the California Energy Commission
Integrated Energy Policy Report Lead Commissioner Workshop

The Role of Well-timed Subsidies in Transitioning Motor Vehicles to Sustainable Energy

David L. Greene
Howard H. Baker, Jr. Center for Public Policy, University of Tennessee
Department of Civil & Environmental Engineering
University of Tennessee
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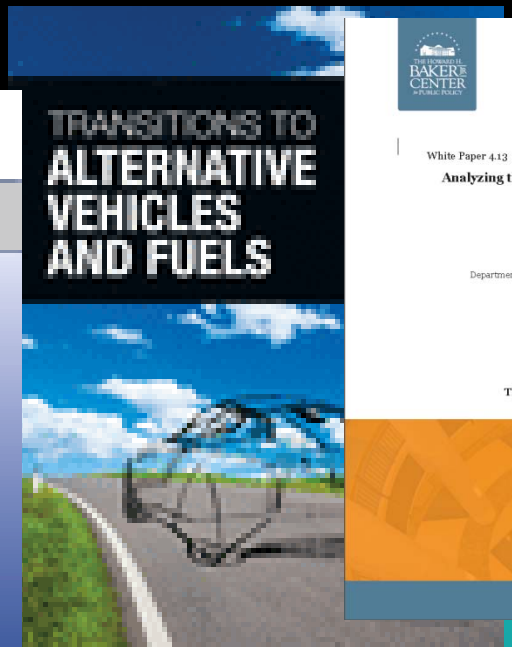


Getting to an 80% reduction in GHG emission requires a large-scale energy transition.

Global Energy Assessment:
"Without question a radical transformation of the present energy system will be required over the coming decades."
GEA, 2012: *Global Energy Assessment – Toward a Sustainable Future*, Cambridge University Press, Cambridge UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria.

IPCC Mitigation Study:
"The only safe path forward is to arrive at a carbon neutral world in the second half of this century."
Ms. Figueres, Executive Secretary, UNFCCC.
http://unfccc.int/files/press/press_releases_advisories/application/pdf/pr20141304_ipccwg3.pdf

NRC Transitions Study:
"Vehicles and fuels in the 2050 time frame would have to include at least two of the four pathways: much higher efficiency than current vehicles, and operation on biofuels, electricity, or hydrogen (all produced with low GHG emissions)."
NRC, 2013, *Transitions to Alternative Vehicles and Fuels*, National Academies Press, Washington, DC.

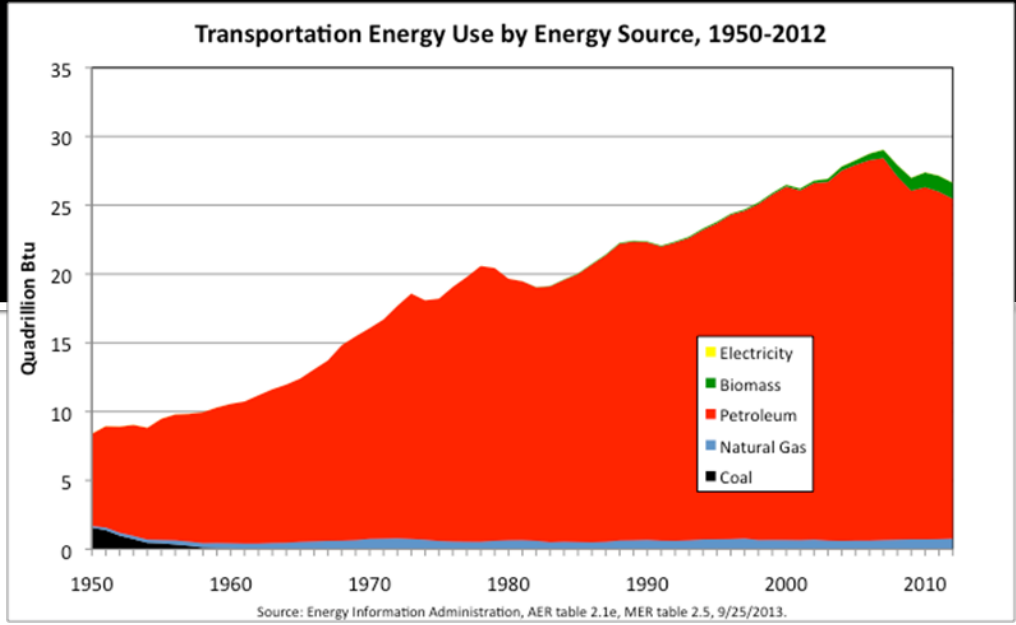
Accomplishing an energy transition for the public good poses a new challenge for public policy.

- Takes decades: social vs. private discount rates critical.
- Requires technological progress: inherently uncertain.
- Externalities +: e.g., monopoly power in world oil market.
- Other market shortcomings: e.g., energy paradox.
- Creates network external benefits & positive feedbacks
  - Value of fuel availability to car buyers
  - Learning-by-doing spillover
  - Reduction of risk-aversion of majority
  - Value of choice diversity vs. scale economies
- Deep Uncertainty
  - Future markets
  - Technological change
  - New knowledge of processes
- Beyond internalizing externalities

What have we learned?

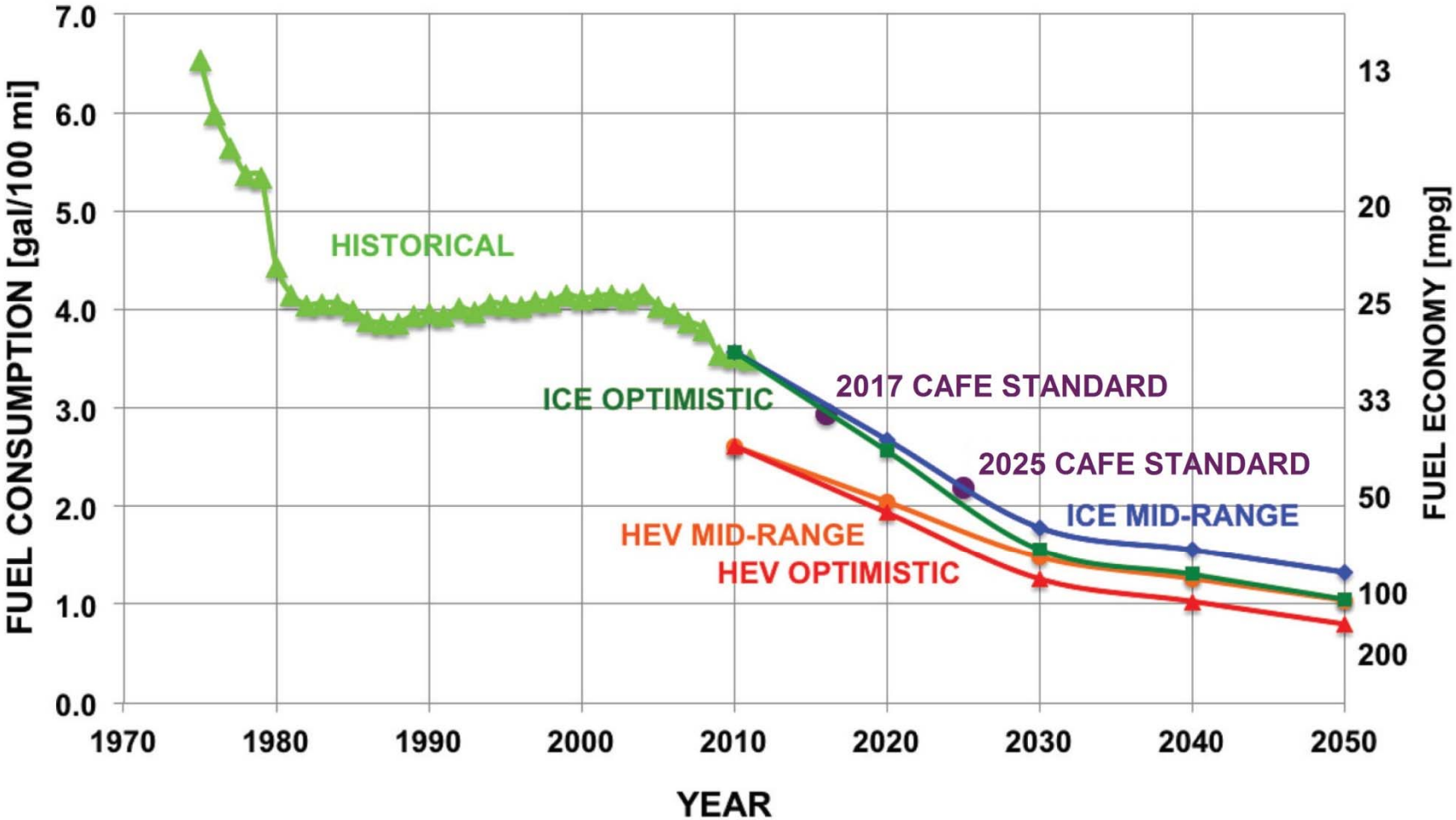
- NRC Transitions to Alternative Fuels and Vehicles
  - "Scenarios will consider technology as well as policy options and consider the likelihood of achieving 50 percent reduction in petroleum consumption by 2030 as well as 80 percent reduction in petroleum consumption and greenhouse gas emissions by 2050."
- ICCT Study of Transition to Electric Drive in CA
  - NRC model, market & technology assumptions
  - Interaction between CA + 177 States and Rest of US
  - Analyses of policy timing & intensity
  - Greater emphasis on uncertainty

It will not be easy.

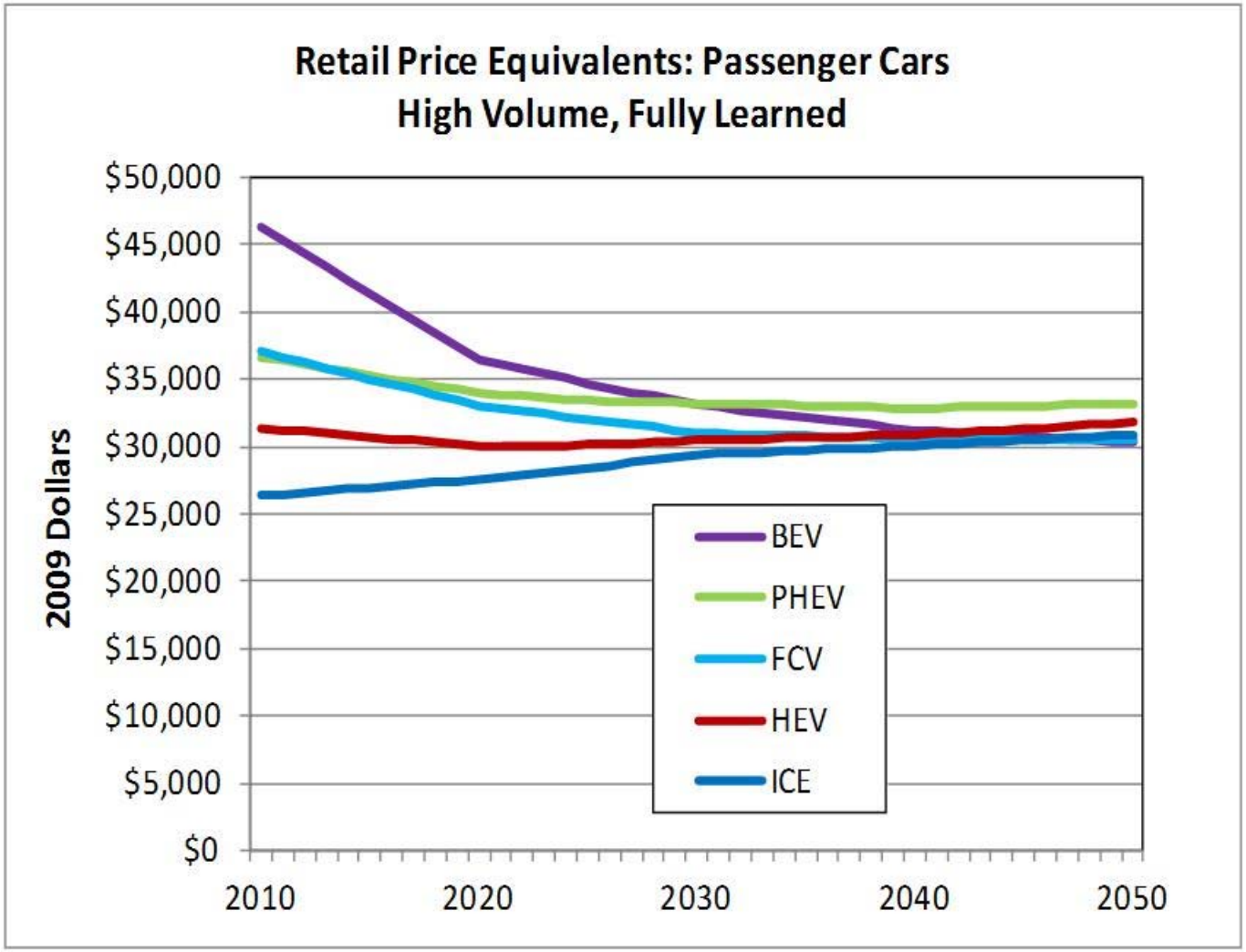


- Requires:
  - Fuel economy standards > 90 mpg
  - At least 10 billion gallons of low C biofuel
  - Adjustment of motor fuel taxes
- Plus at least one of the following:
  - Hydrogen fuel cell vehicles
  - Plug-in electric vehicles
  - 45 billion gallons of low-C biofuel

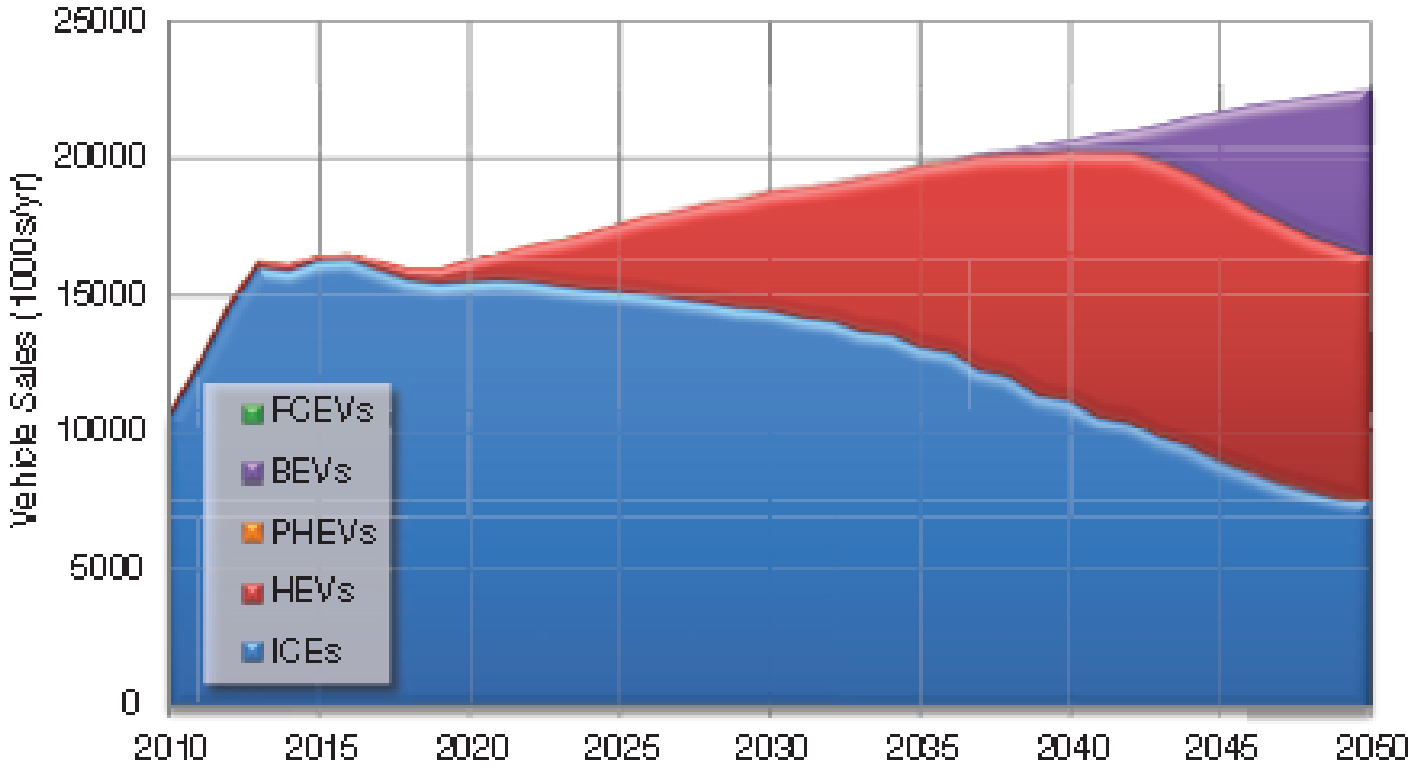
Continuously improving energy efficiency appears to be a necessary strategy.



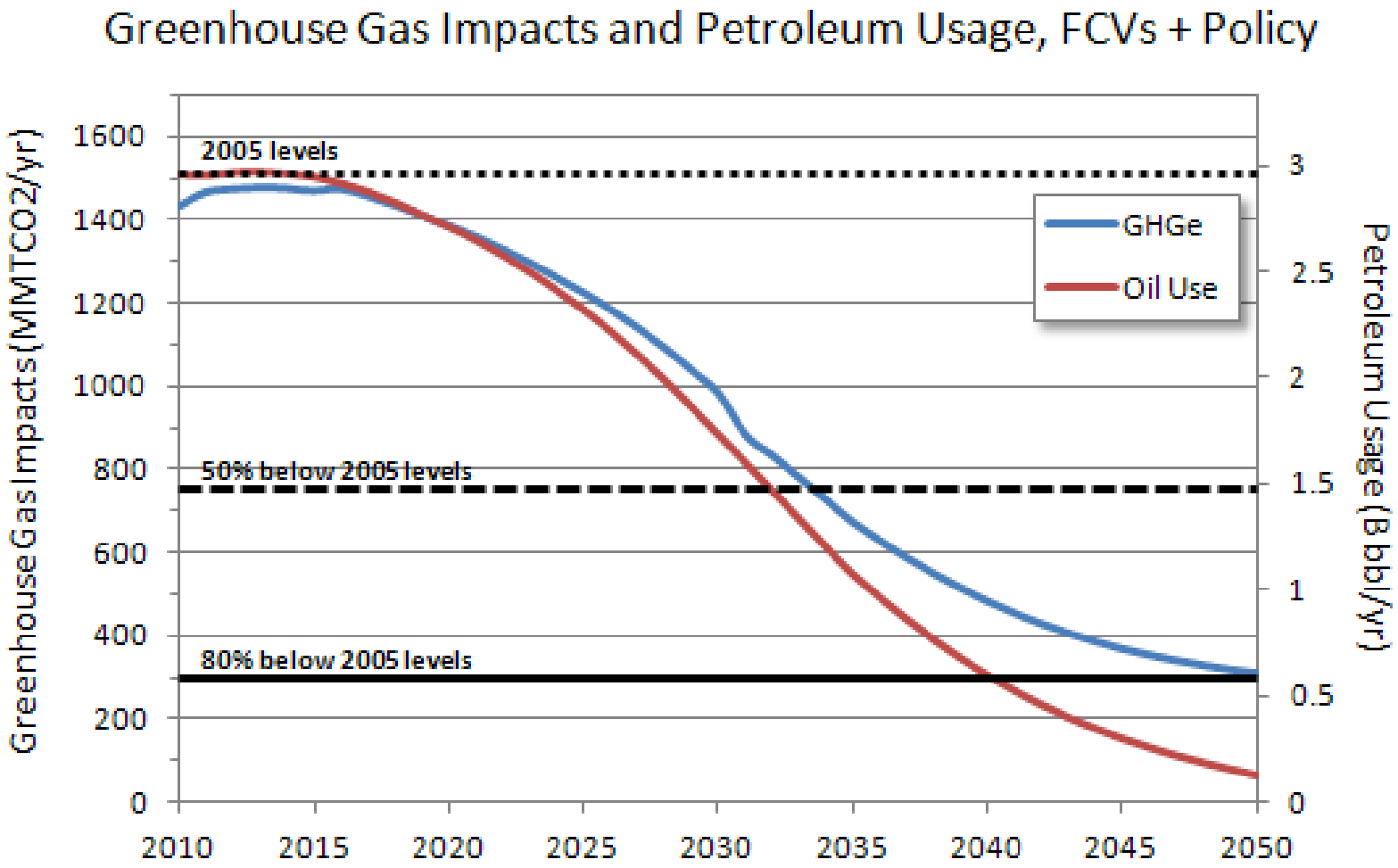
By reducing power requirements, efficiency eventually makes e-drive vehicles cheaper than ICEs.



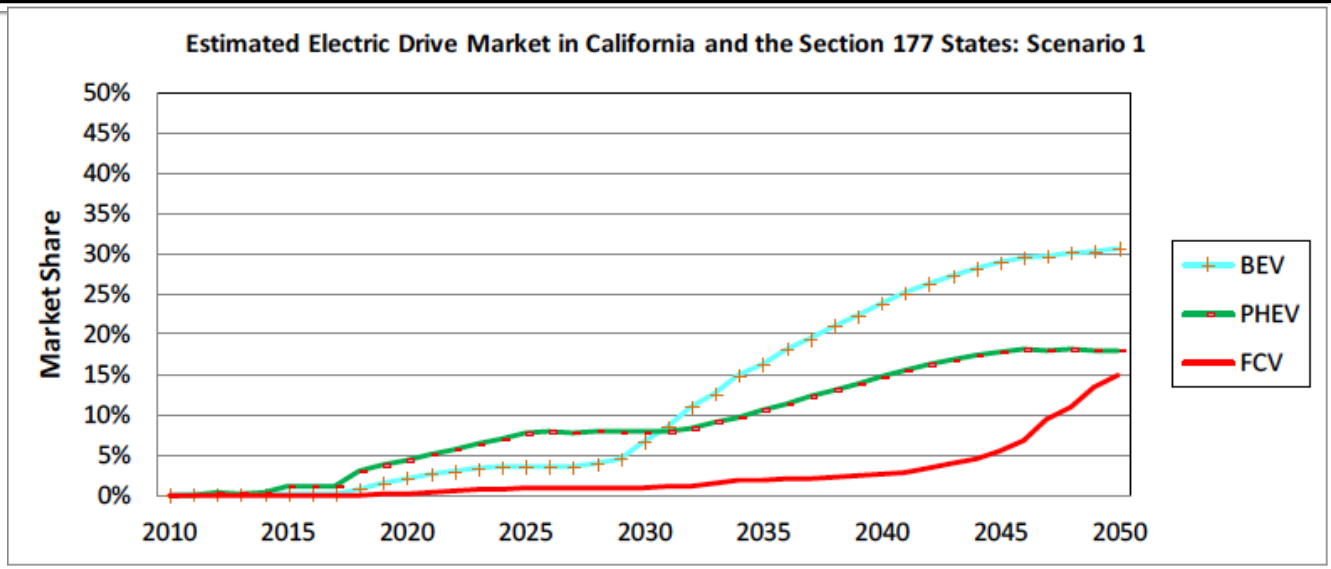
Internalizing externalities is not enough: fuel economy & emissions standards plus technological progress and a highway tax indexed to MPG.
No vehicle subsidies after 2016, no early infrastructure.

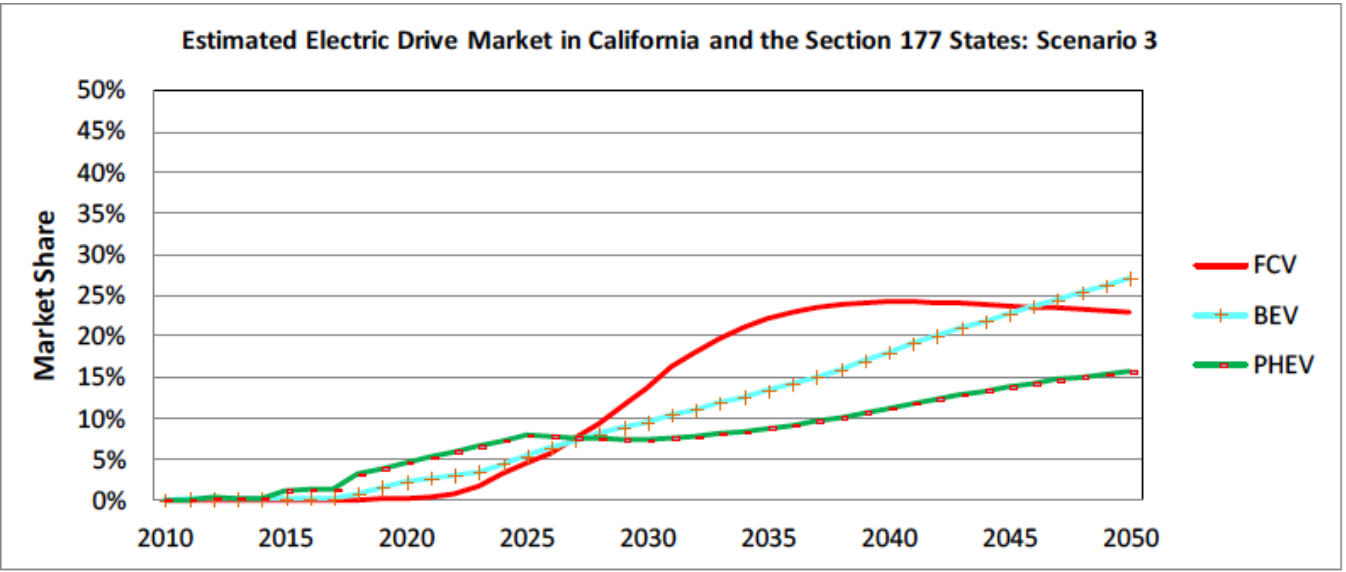


Even a successful transition takes decades.

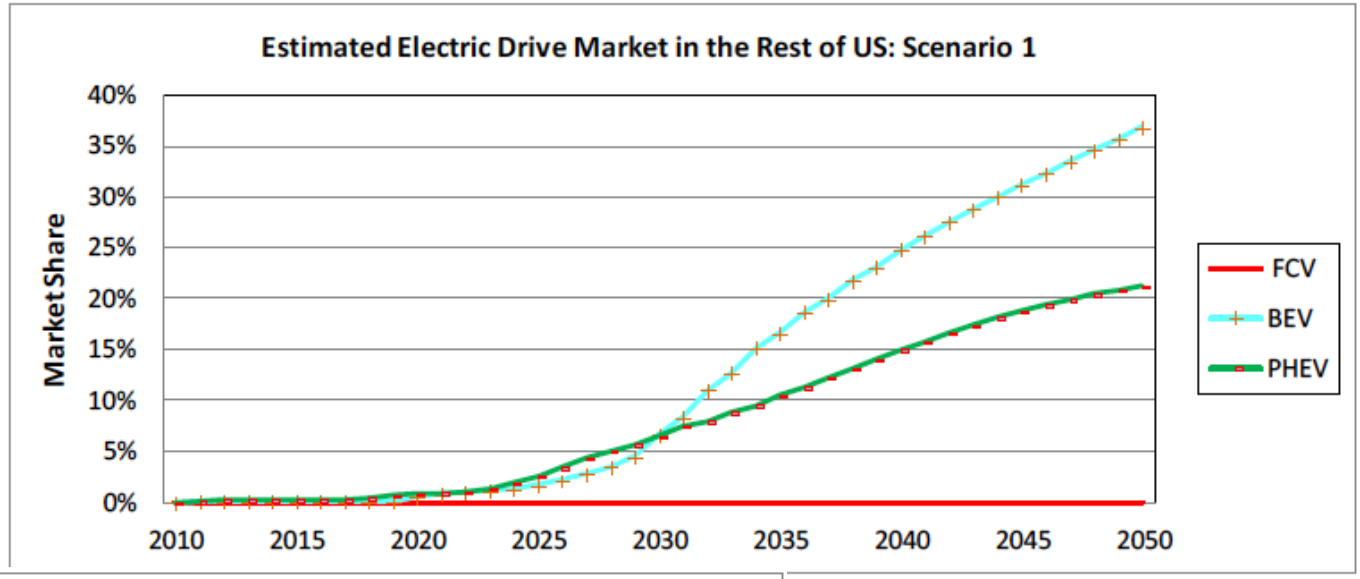


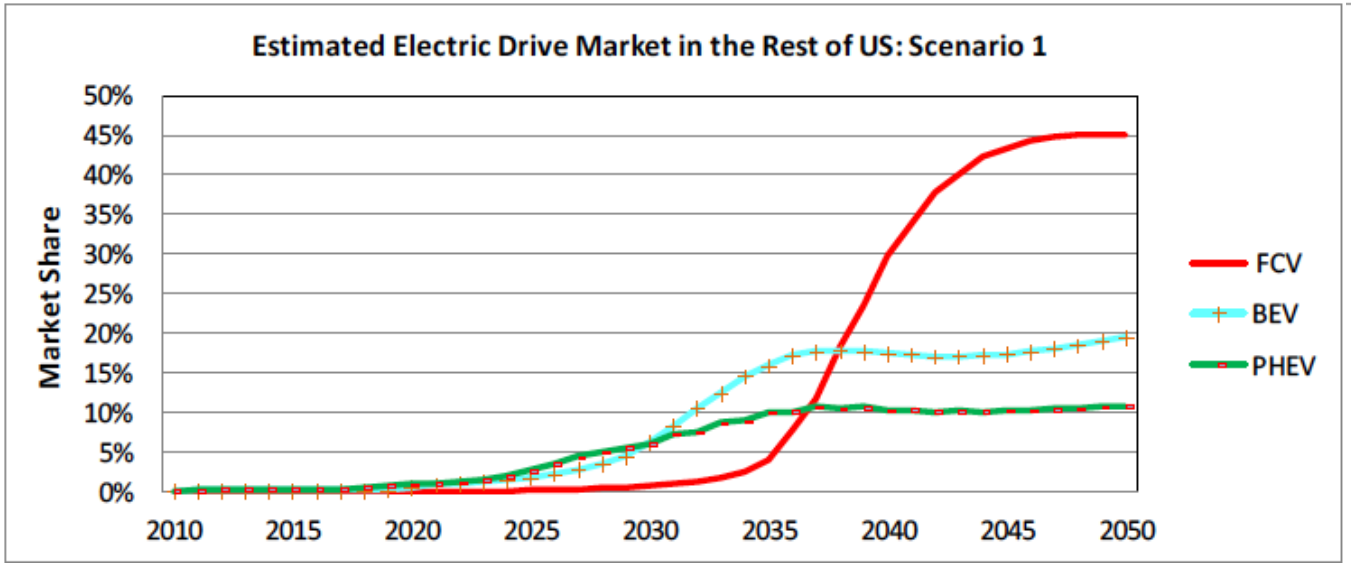
The rest of the U.S. matters, but so does the rest of the world.



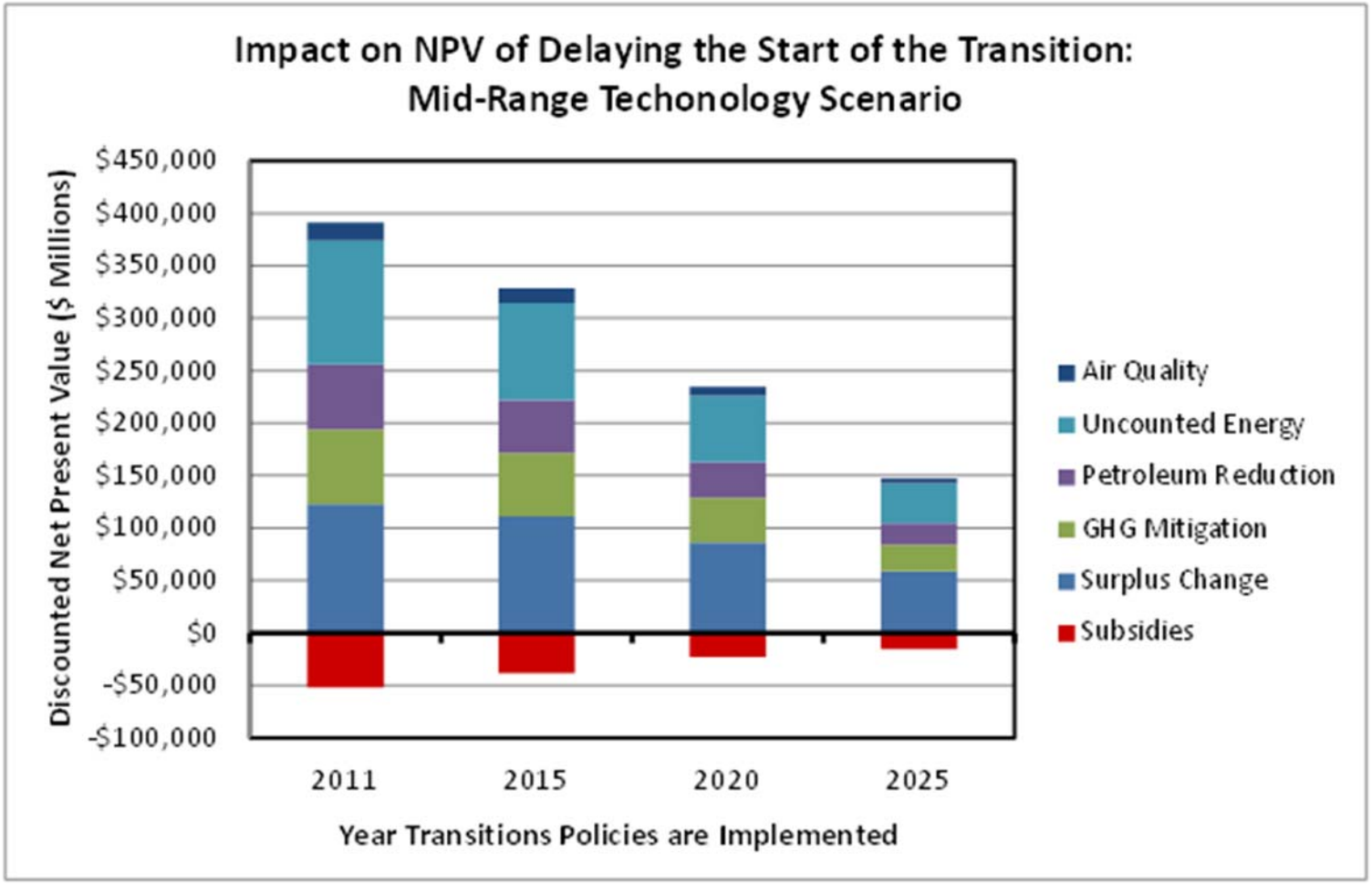


Infrastructure is critical, especially for hydrogen fuel cell vehicles.

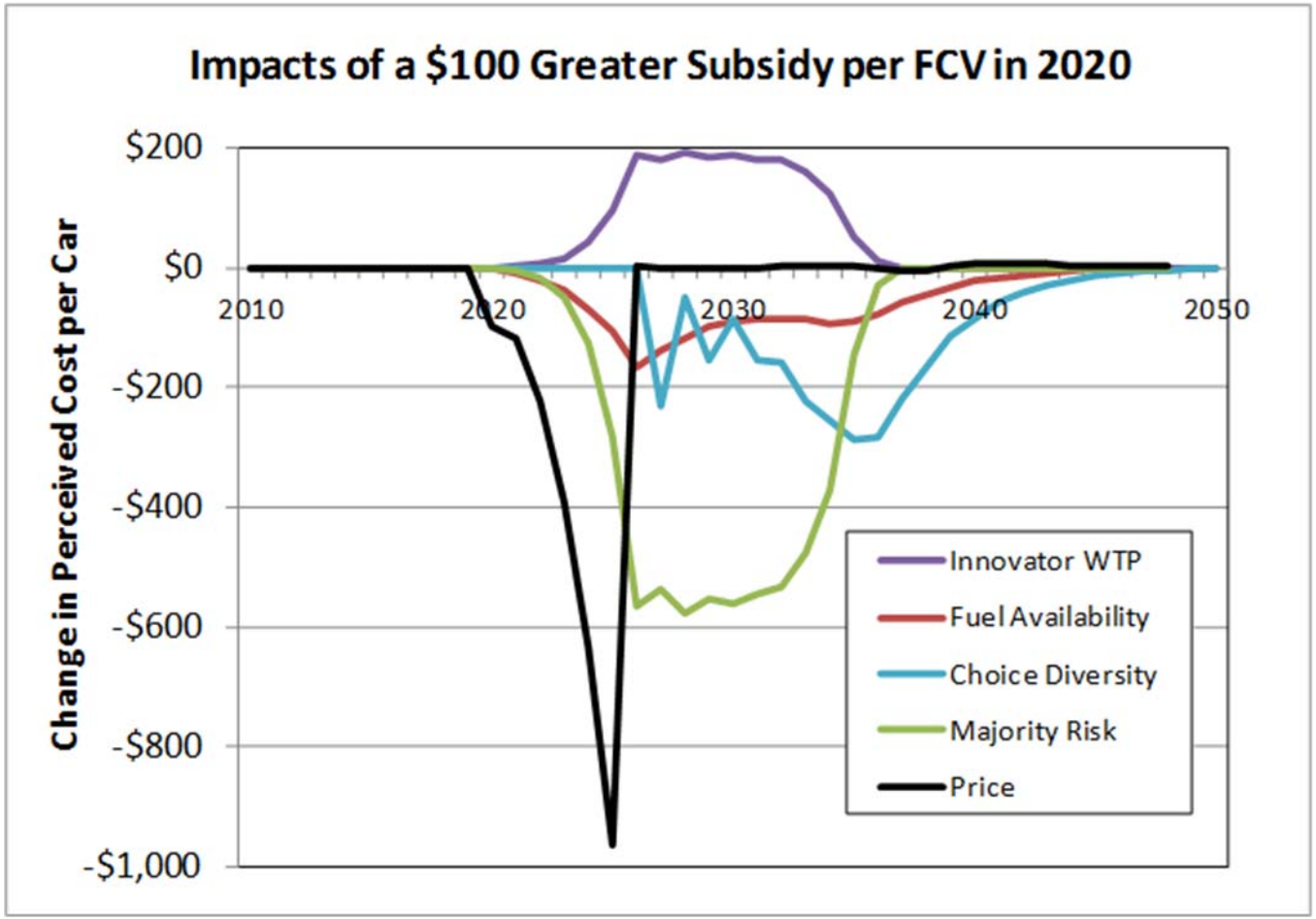




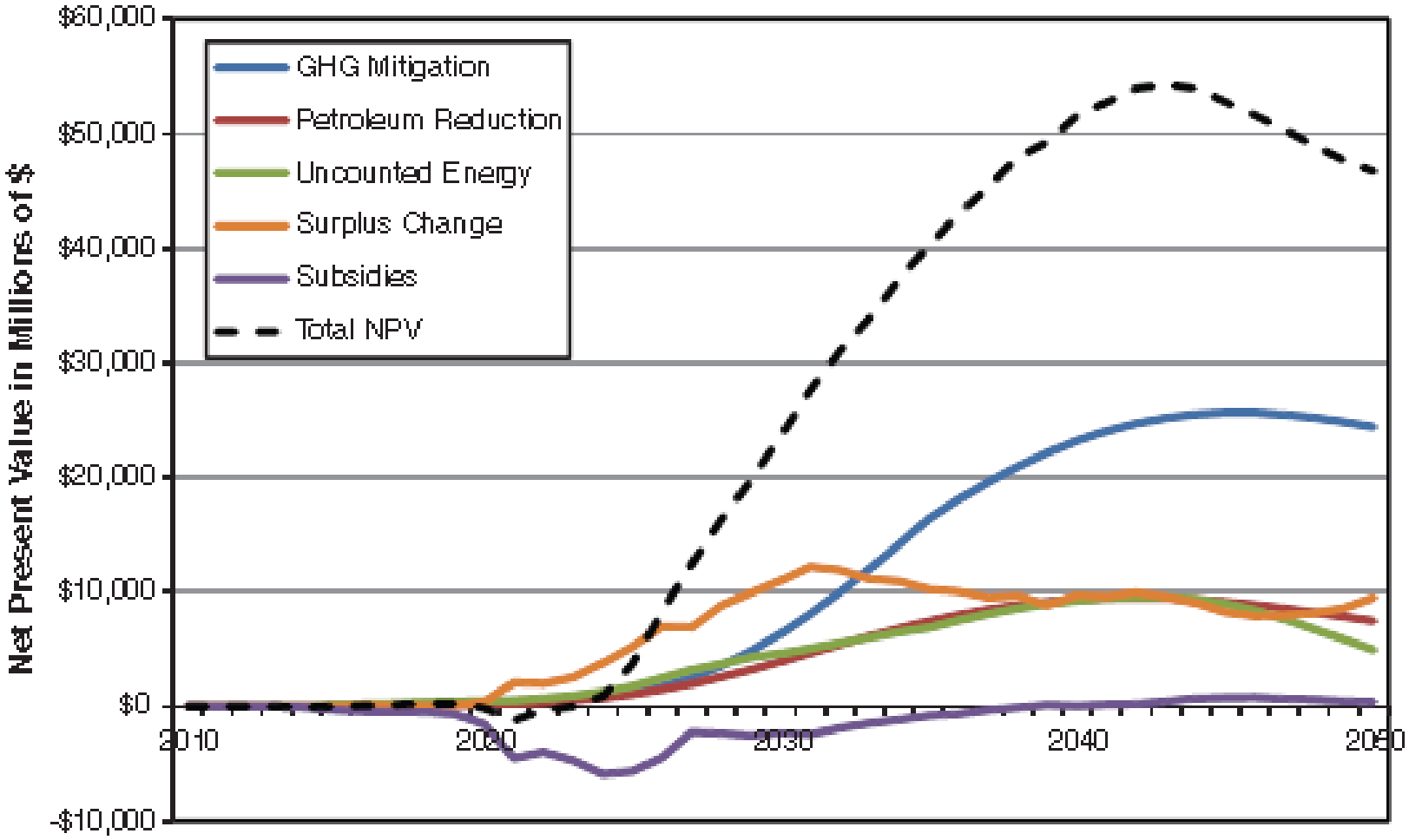
The timing and intensity of policies matter.



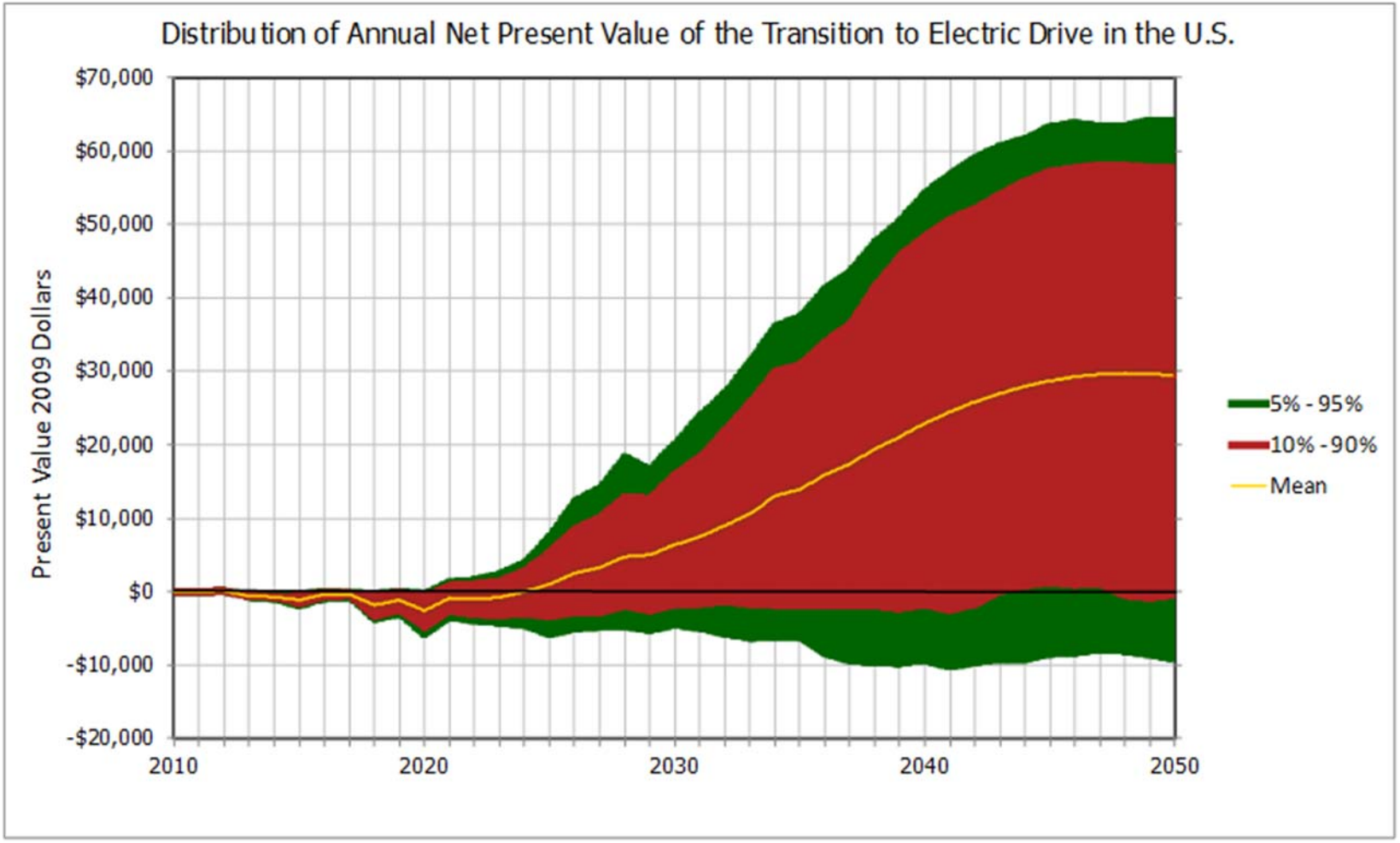
Positive feedback effects can be very strong. (from ICCT analysis, for California + ZEV states)



Total benefits appear to be an order of magnitude greater than total excess costs.



Uncertainty is profound. Adaptive policy is almost as good as optimal policy.



THANK YOU.

Understanding the transition process better would reduce uncertainty.

1. Innovators/majority: How many? How much? How long?
2. How important is fuel availability?
3. How important is limited range/long recharging time?
4. How many PEV buyers will also purchase level 2 charging?
5. How valuable are workplace & public recharging?
6. How valuable is diversity of choice?
7. How big are scale economies?
8. What will future technology costs be?
9. How will costs be affected by learning by doing?
10. How important is coordination with the rest of the world?
11. How sensitive are consumers' to vehicle and fuel prices?
12. What are viable policy & business models for early recharging and refueling infrastructure?
13. Which policies are most cost-effective and acceptable?