

2010 – 2025 Scenario Analysis

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DOE Hydrogen Program

DOE Hydrogen Program

- The President's Hydrogen Fuel Initiative commits \$1.2 billion over five years to research, develop, and demonstrate hydrogen and fuel cell technologies.
- In support of this initiative, the DOE Hydrogen Program works with industry, academia, national laboratories, and other federal and international agencies to:
 - Overcome critical technical barriers through research and development of hydrogen production, delivery, and storage technologies, as well as fuel cell technologies for transportation, distributed stationary power, and portable power applications
 - Address safety issues and facilitate the development of model codes and standards
 - Validate hydrogen and fuel cell technologies in real-world conditions
 - Educate key stakeholders in the transition to a hydrogen economy



DOE Hydrogen Program

The Hydrogen Future

- If these research efforts succeed in meeting technical targets and industry can begin to realize the business case, hydrogen fuel cell vehicles could begin to reach the commercial mass market in the 2020 timeframe.
- Hydrogen fuel cell vehicles have the potential to eliminate carbon emissions from the entire fuel cycle:
 - Hydrogen produced using renewable resources and nuclear energy results in virtually zero greenhouse gas emissions.
 - Hydrogen produced from coal using carbon capture and sequestration technologies results in virtually zero greenhouse gas emissions.



National Academies' National Research Council

- The National Academies, through its National Research Council (NRC), reviews the research and demonstration programs of DOE's Hydrogen Program every fourth year as directed by the Energy Policy Act of 2005.
- In February 2004, the NRC released its *The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs* report, which summarizes the committee's findings and recommendations on hydrogen research planning. This important document will help guide the program in the years ahead.

2010 -2025 Scenario Analysis

Roles of the Federal Government and Industry

- For this relationship to work, the program's pre-competitive research must be adopted by the industrial partners
- DOE should analyze the implications of alternative market interventions for the technical goals of the Freedom CAR and Fuel Partnership.

FreedomCAR in the Policy Context suggested by NRC

- Cap-and-Trade Programs
- Motor Fuel Taxes
- CAFÉ Standards
- Subsidies

Other Prior Congressional Programs

- Vehicle tax credits to public
- Fuel tax abatements
- Federal government early buy down programs
- Loan Guarantees
- Investment tax credits

State Program

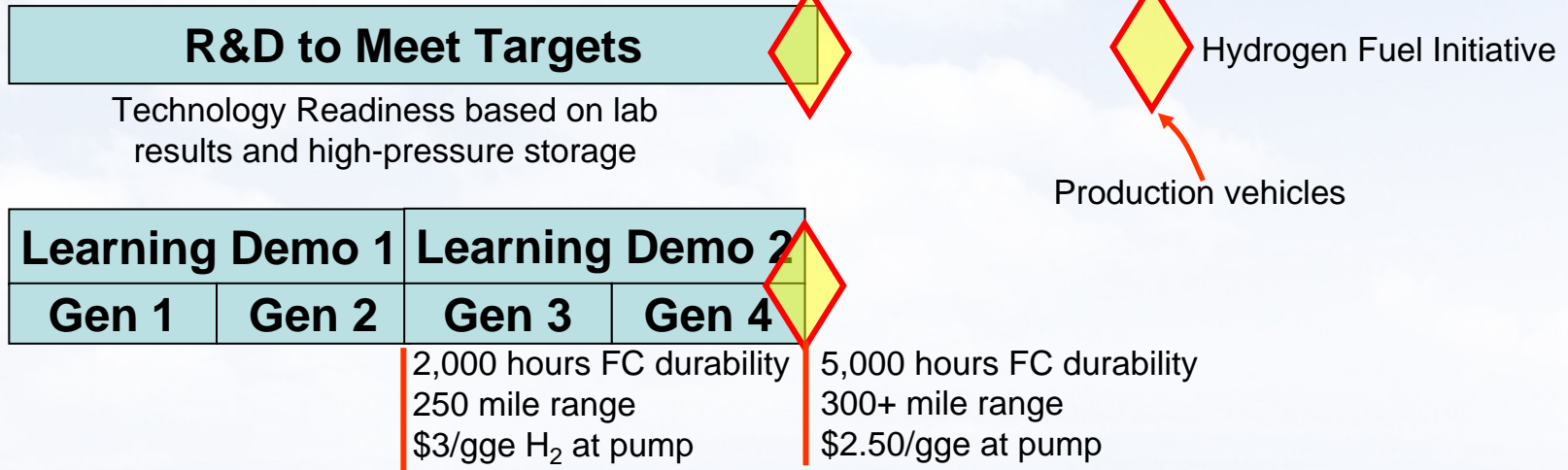
- ZEV Mandate

These scenarios are provided for transition analyses as recommended by the National Research Council to evaluate the transition phase and do not represent any specific policy recommendation.

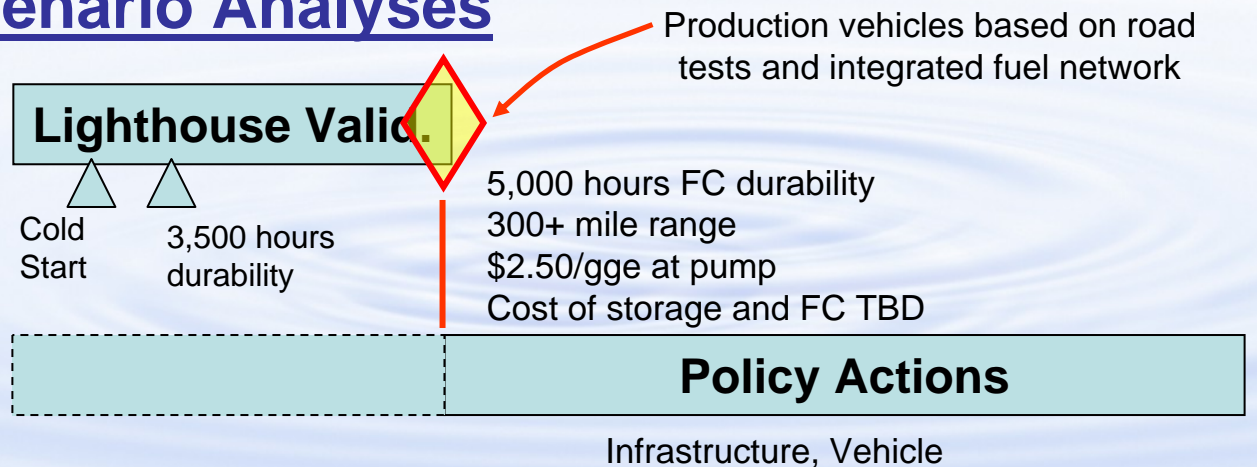
2010-2025 Scenario Analyses



Hydrogen Fuel Initiative



Alternative Scenario Analyses



2010 – 2015 Baseline Scenario

● Fuel Cells

- Demonstrate 5,000 hours life in laboratory (2010)
- Demonstrate low cost competitive fuel cell stack (2010)
- Cold start capability in laboratory (2010)

● Storage

- 5,000 or 10,000 psi compressed storage tanks
- Low pressure liquid hydrogen
- Low pressure material systems

● Hydrogen Production

- \$3.00/gge untaxed when produced in quantity
- Use of Existing Hydrogen Production Capacity

● OEMs have indicated 100s of vehicles/year if targets are achieved

- starting 2010 or 2012
- Fleet vs Consumer

● Integrated fueling network (2015)

● ZEV mandate

● Would be capable of going into mass production

2010 – 2025 Scenario Analysis

Focus on near-term nascent hydrogen economy

Stage 1:

- Forecourt
- Cluster or network from mid-size plant
- Use existing infrastructure
- Investigate liquid delivery systems

Stage 2:

- Nascent interconnect system

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Market Penetration Scenarios

The following scenarios represent the estimated penetration of hydrogen fuel-cell vehicles (HFCV) given different government incentives:

A. Hydrogen Fuel Initiative

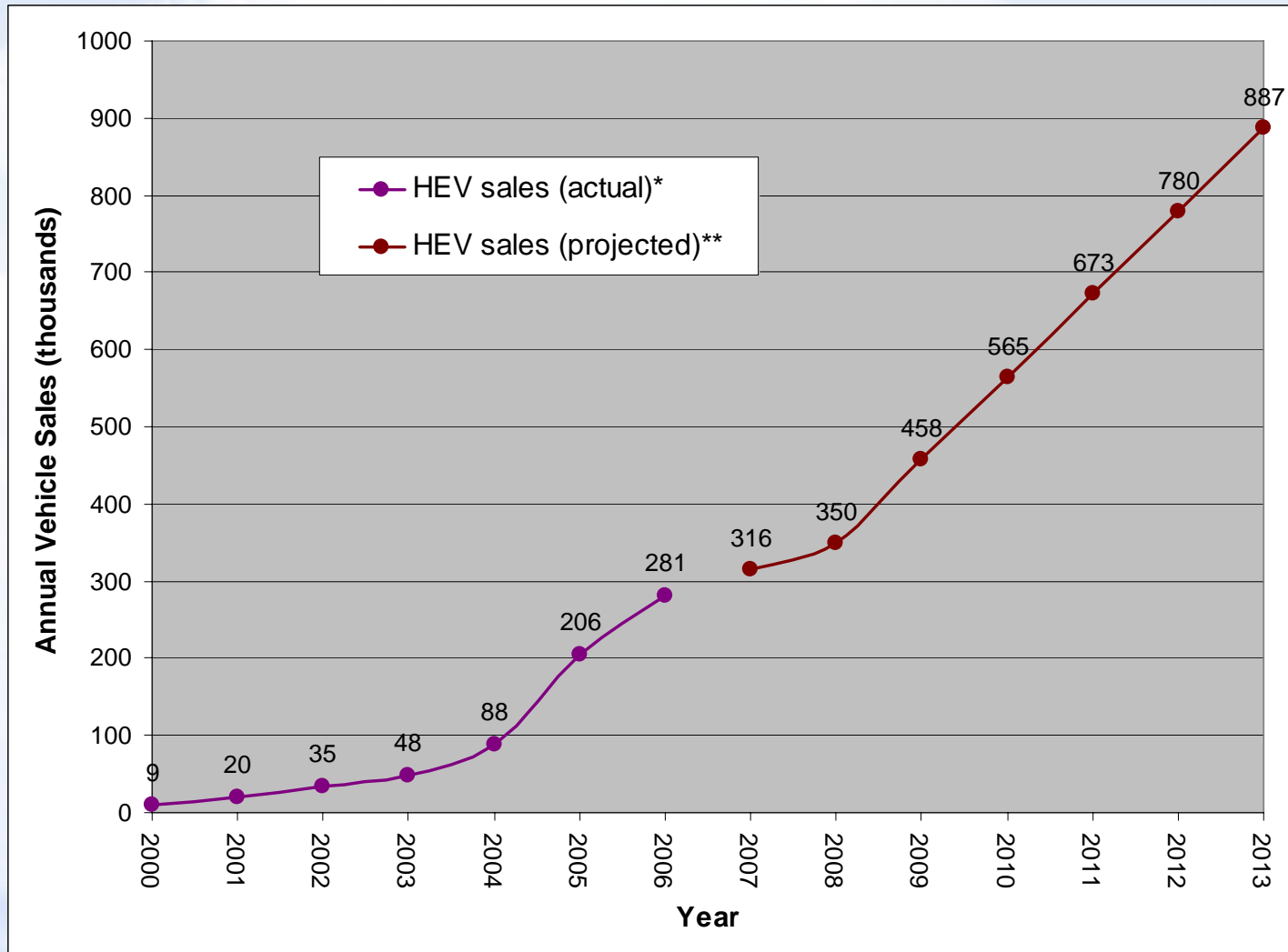
B. Accelerated introduction with “alternative market intervention” strategies:

Scenario 1: In 2015 HFCVs are introduced into the market. The government introduces a program to support the introduction of hundreds to *thousands* of vehicles per year by 2012 and by 2018 the government supports introduction of *tens of thousands* of vehicles per year. This option is expected to have a market penetration of 2.0 million HFCVs by 2025.

Scenario 2: The government supports the introduction of *thousands* of HFCVs by 2012, and *tens of thousands* by 2015 and by the *hundreds of thousands* by 2018. This strategy is expected to have a market penetration of 5.0 million HFCVs by 2025.

Scenario 3: The government supports the introduction of *thousands* of HFCVs by 2012, and *millions* by 2021. Expected market penetration is 10 million by 2025 with support for multiple OEMs and multiple vehicle models.

Actual and Projected U.S. HEV Sales



*Data through 2006 From hybridcars.com May 16, 2006

**Data beyond 2006 from JD Power and Associates HEV Outlook

Table of Introduction Rates (thousands of vehicles sold per year)

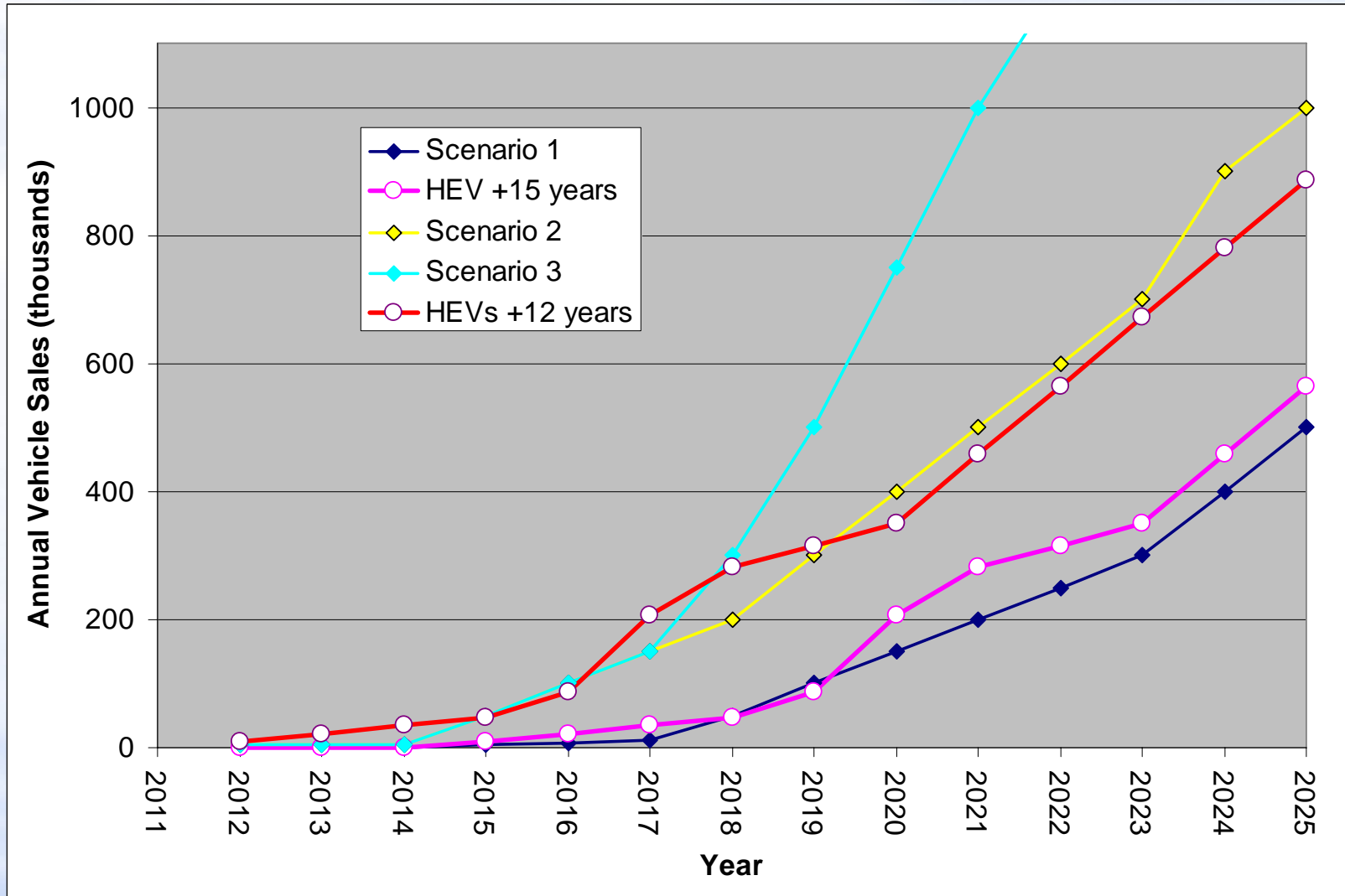
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total (M)
Scenario 1	0.6	0.8	1.1	5	8	12	50	100	150	200	250	300	400	500	2.0
HEV +15 years	0	0	0	9	20	35	48	88	206	281	316	350	458	565	2.4
ZEV mandate +3 years	0.6	0.8	1.1	5	8	12	15	17	18						0

Scenario 2	1	2	2	50	100	150	200	300	400	500	600	700	900	1000	4.9
Scenario 3	1	2	2	50	100	150	300	500	750	1000	1200	1500	2000	2500	10.1
HEVs +12 years	9	20	35	48	88	206	281	316	350	458	565	673	780	887	4.7
ZEV mandate	5	8	12	15	17	18									0.2

3 Scenarios are updated versions of the ones presented at the DOE 1/26/06 transition workshop

HEV Data through 2006 From hybridcars.com May 16, 2006, beyond 2006 from JD Power and Associates
HEV Outlook

HEV Sales Compared to DOE's Four H2 FCV Vehicle Introduction Rate Scenarios



4 Scenarios are updated versions of the ones presented at DOE 1/26/06 transition workshop