

## Visions of a Sustainable Future

# Transition to a Hydrogen Future: Scenarios for the U.S.

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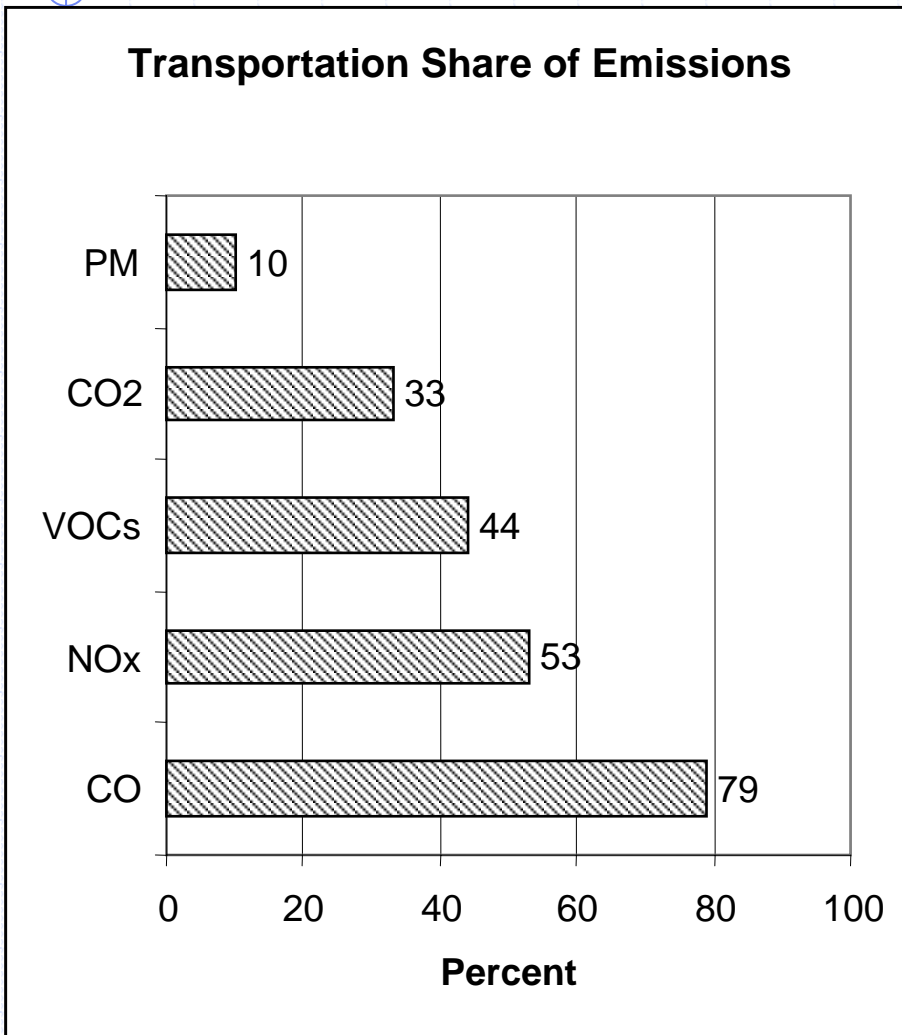
Presented at the IMVP Japan Briefing Meeting

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# Overview

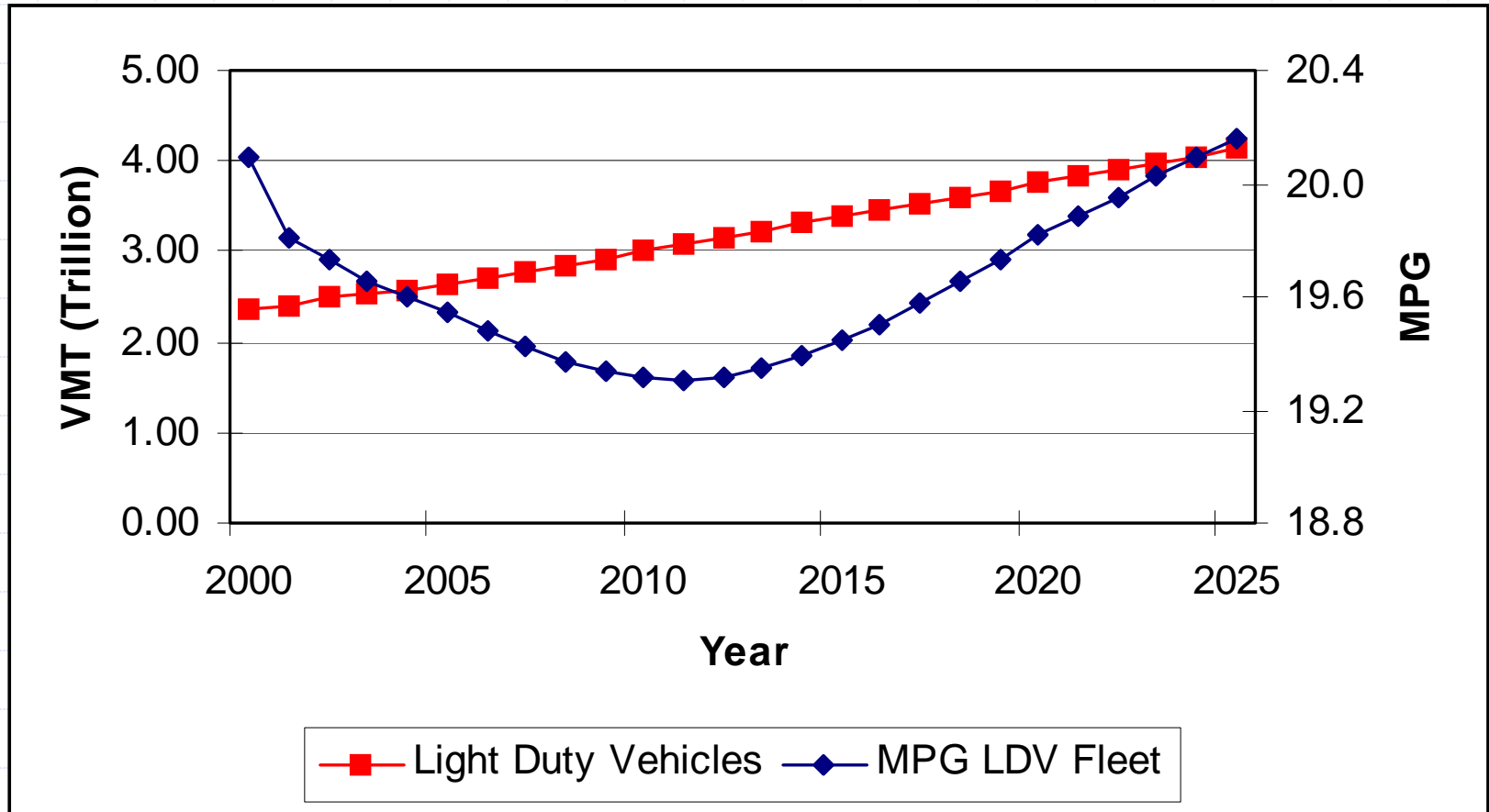
- ◆ Problems in the U.S.
- ◆ Future solutions
- ◆ The use of scenarios
- ◆ Questions for consideration
- ◆ Future research needs
- ◆ Conclusion

# Problems: Environmental Impacts



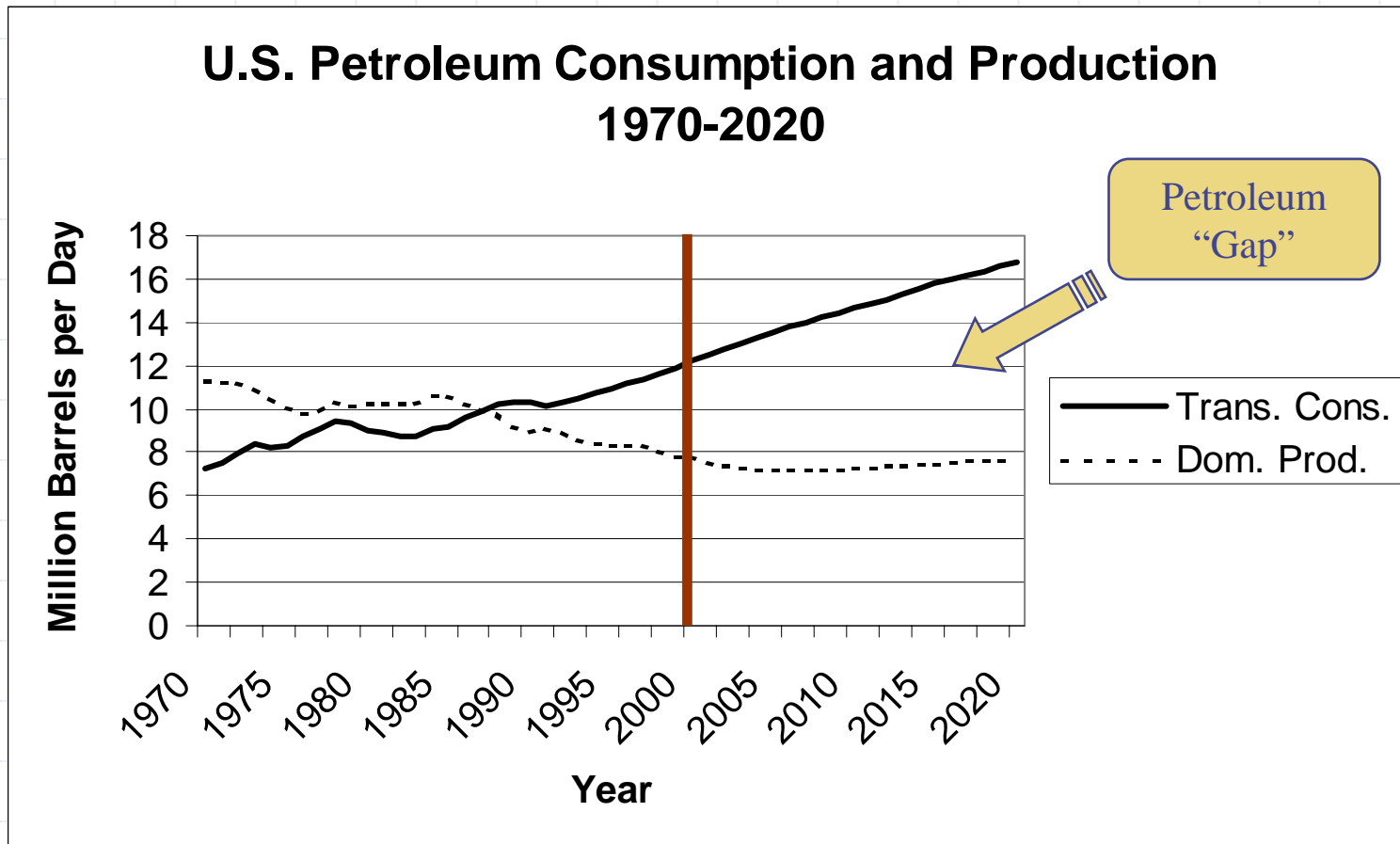
**Still a major contributor, despite reductions in new vehicle emissions achieved over the last decade.**

# U.S. Forecast VMT and MPG



Source: EIA, *Annual Energy Outlook 2003*, DOE/EIA-0383(2003), January 2003.

# Problems: Petroleum Dependence

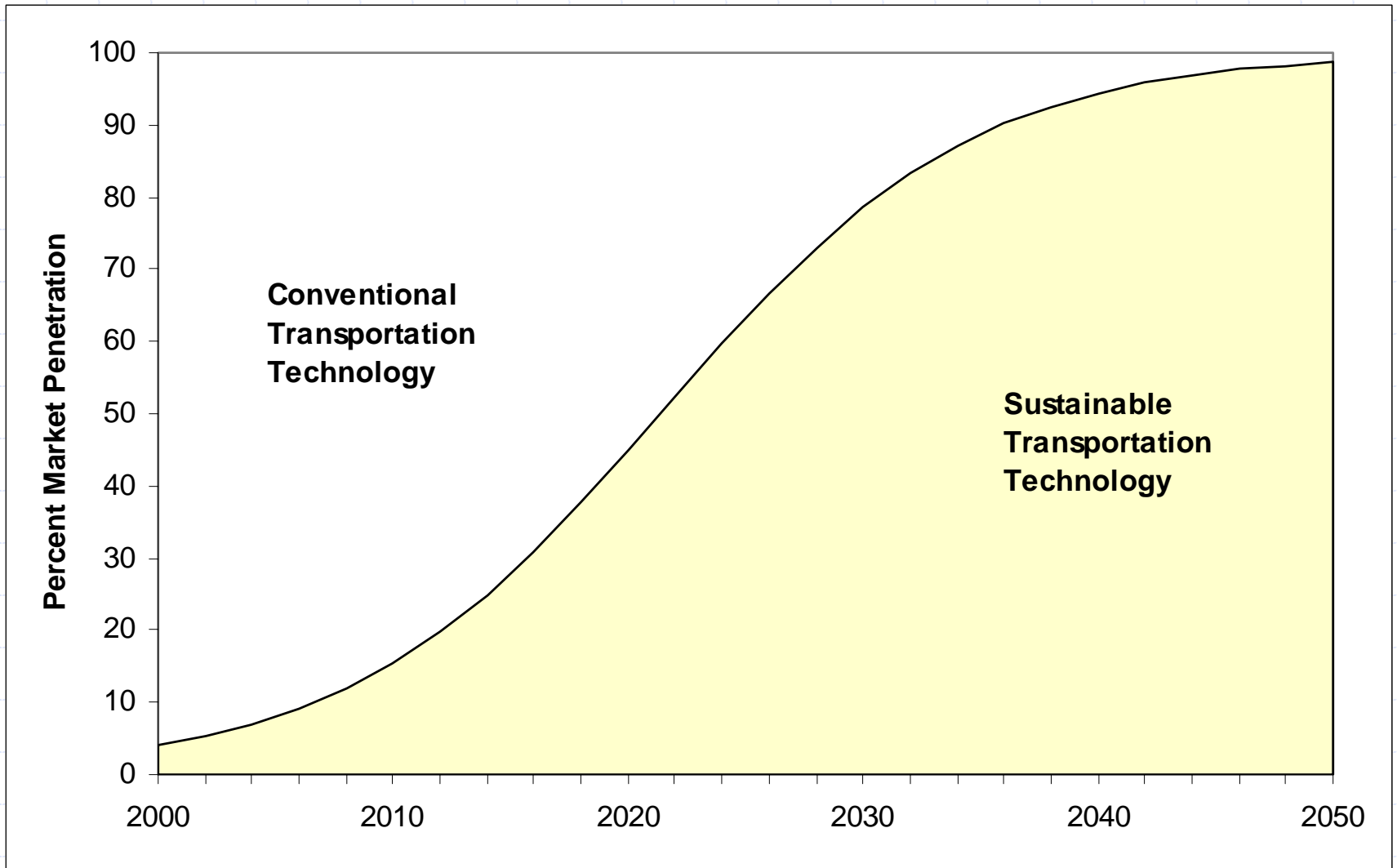


Source: EIA, *Annual Energy Outlook 2003*, DOE/EIA-0383(2003), January 2003.

# Some Solutions

- ◆ Improved efficiency
- ◆ Alternative fuels
- ◆ Pure electric
- ◆ Hybrid-electric vehicles
- ◆ Hydrogen fuel cell vehicles
- ◆ Others?





But how do we get  
from HERE...

...to THERE?

# U.S. Federal R&D Focus

## ◆ FreedomCAR

- “Affordable full-function cars and trucks that are free of foreign oil and harmful emissions, without sacrificing safety, freedom of mobility, and freedom of vehicle choice.”

## ◆ FreedomCAR Focus

- Reduce vehicle weight
- Improve energy production and storage
- Advancing ICE
- Building electronic components
- Developing hybrid electric drivetrains



# U.S. Policy Focus

- ◆ Existing Tax incentives for HEVs and AFVs
- ◆ Energy Policy Act of 2004?
  - Grant programs and demonstrations
  - CAFE standards
  - Fuel cell vehicle program
- ◆ International Partnership for the Hydrogen Economy

# Key Question for U.S. Markets

## ◆ TECHNICAL:

- What technologies will drive this transition?
- What “technology sequence” will occur?
- How will new technologies support or compete with each other? (For example, will hybrids support or supplant the need for hydrogen?)

## ◆ ECONOMIC:

- What economic factors will affect markets and consumer preferences?
- How will prices for oil and alternatives affect markets?
- How will vehicle production costs affect market development?

# Key Questions (continued)

## ◆ ENVIRONMENTAL:

- How will environmental issues affect technology development and acceptance?

## ◆ POLITICAL:

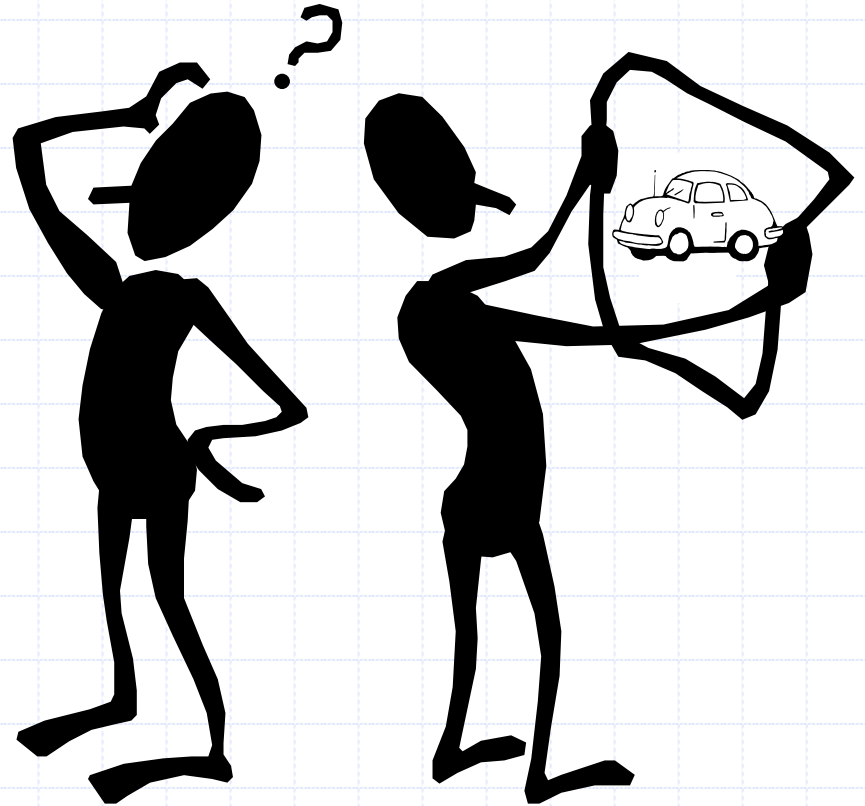
- How will government policies affect new technology market development?
- How will government R&D expenditures be spent?
- How will mandates or incentives be used?

## ◆ SOCIAL/DEMOGRAPHIC:

- How do U.S. demographics affect the technology transition?
- How do global economic development and population growth affect market development in the U.S. and abroad

# The Most Challenging Question

How does a company plan for the future under these uncertainties?



# The Use of Scenarios

- ◆ Different from traditional forecast planning
- ◆ “A tool for ordering one’s perceptions about alternative future environments in which decisions might be played out.” (Schwartz, 1996)
- ◆ Purpose: “To generate projects and decisions that are more robust under a variety of alternative futures.” (Van der Heijden, 1996)
- ◆ “Scenario building helps an organization envision a future in order to develop plans, programs, or policies that allow it to respond to, change, or create that future.” (Winebrake, 2003)

# Process of Scenario Building

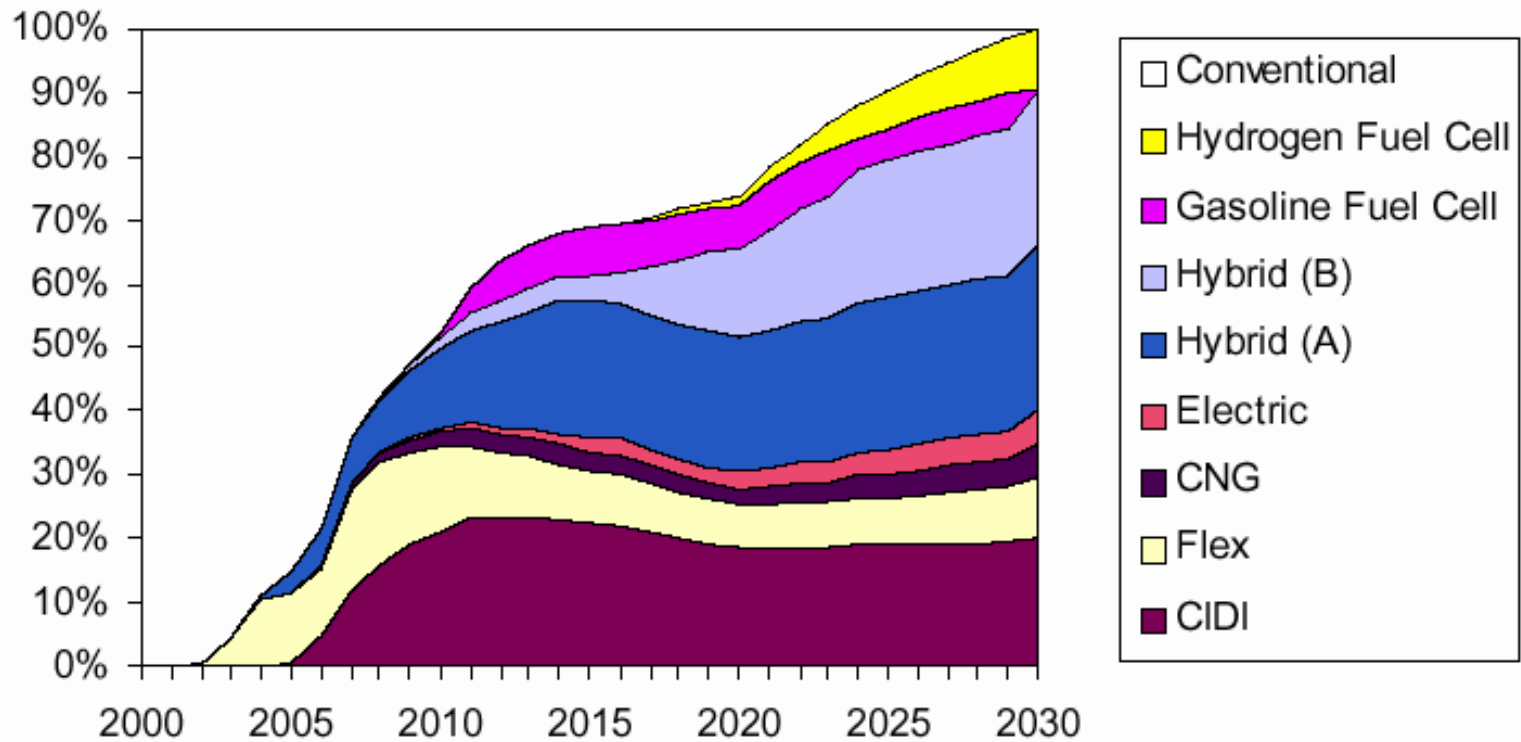
## ◆ Formal process

- Identify focal issue
- Identify driving forces or variables
- Rank forces by importance and uncertainty
- Select scenario logics
- Flesh out the scenarios
- Determine implications—robust decisions
- Select leading indicators and “signposts”

# Scenarios from the Energy Field

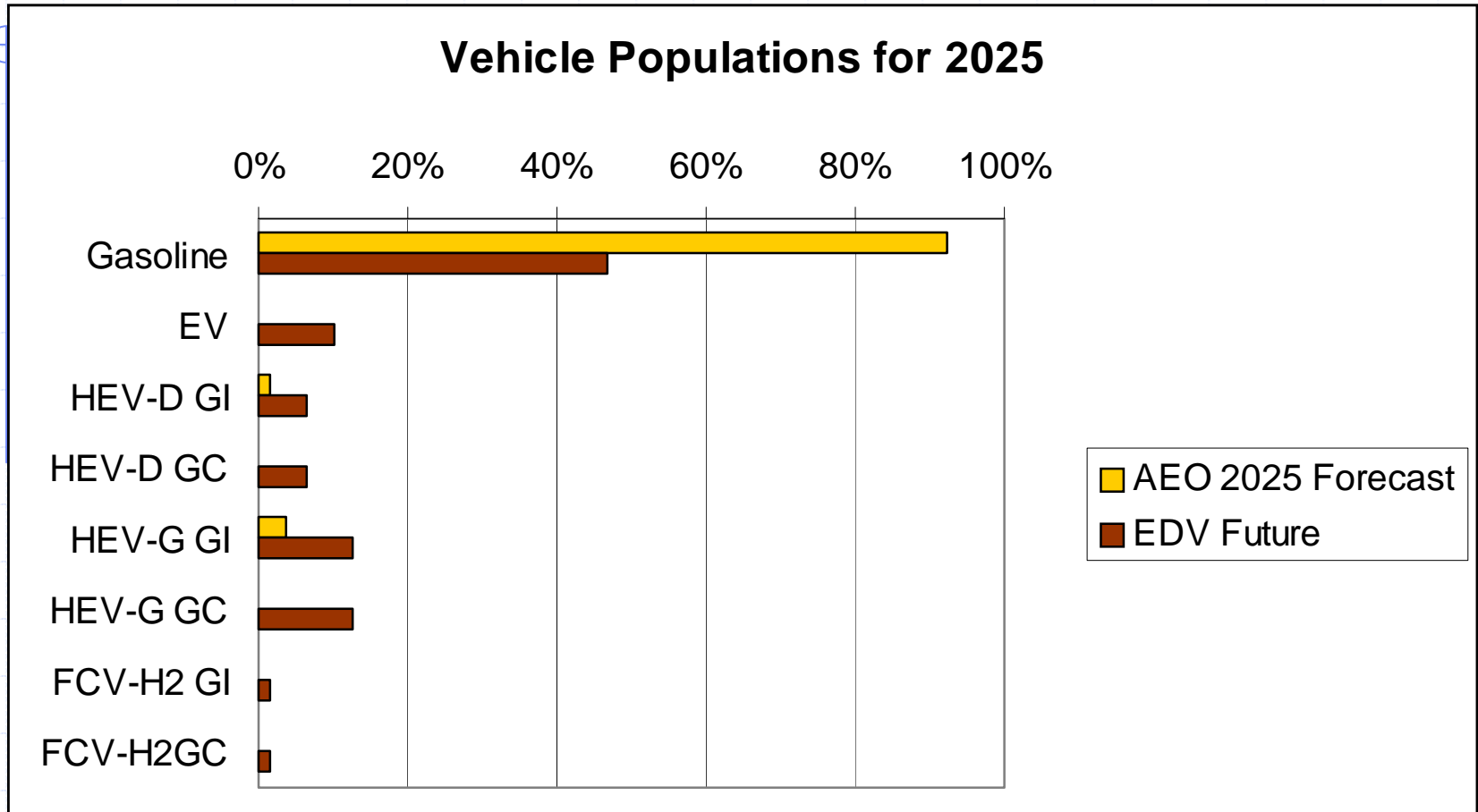
- ◆ American Public Transit Association
- ◆ DOE: (1) Energy 2050, (2) Quality Metrics, (3) Five-Lab Study
- ◆ IIASA/WEC: Global Energy 2100
- ◆ IPCC: Emissions Scenarios
- ◆ Shell Oil: Scenarios to 2050
- ◆ WBCSD: Future Energy
- ◆ EPRI (EDV Futures)

# U.S. Department of Energy Quality Metrics Work





# Annual Energy Outlook 2025 v. EPRI Study



EV=battery electric; HEV=hybrid electric vehicle; D=diesel; G=gasoline  
GI=grid-independent; GC=grid connected; FCV=fuel cell vehicle; H2=hydrogen

# Problems with Recent Examples

- ◆ Lack of systematic analysis relevant to automakers' concerns
- ◆ No focal decision considered (e.g., Where should my company focus R&D investment?)
- ◆ Transition period not well-investigated (“time-warp” problem)
- ◆ Dialogue among decision-makers and experts often weak—scenario building should be used to frame debate
- ◆ Indicators and signposts rarely identified
- ◆ More like alternative forecasts than a true scenario building process

# Research Needed

- ◆ Scenario building targeted at automakers' decision making during the transition period between now and a potential hydrogen future
  - Development of scenario building framework
  - Development of mechanism for dialogue among business and government leaders about the future
  - Identification of signposts, leading indicators, and perhaps a "road map" for planning purposes



# Questions and Discussion