

***Petrostocks 2009: Stockpiling
in New Market Realities***

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***STRATEGIC ALTERNATIVE FUELS —
Could Anything Replace Petroleum?***

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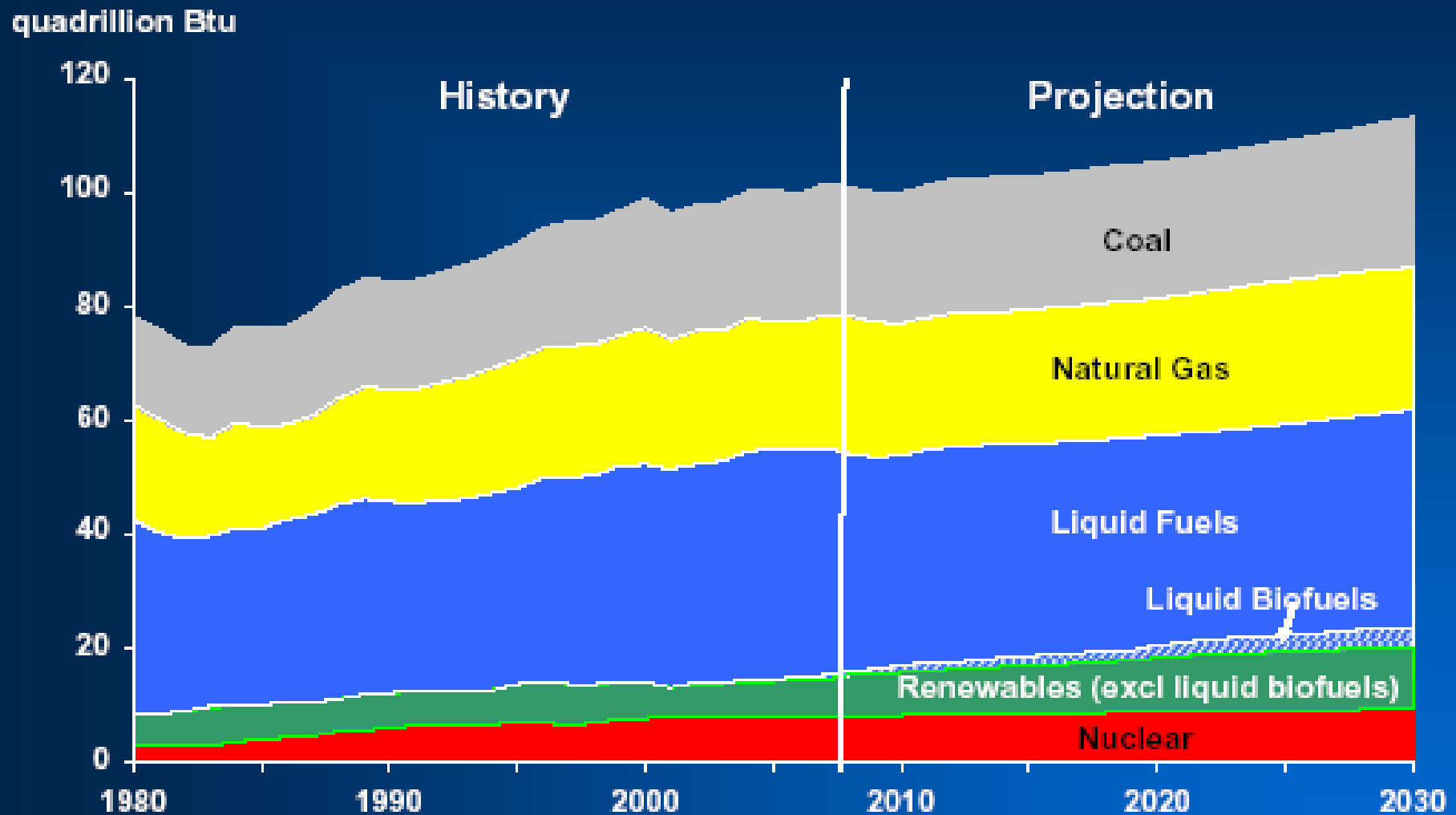
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Strategic Value of Altfuels

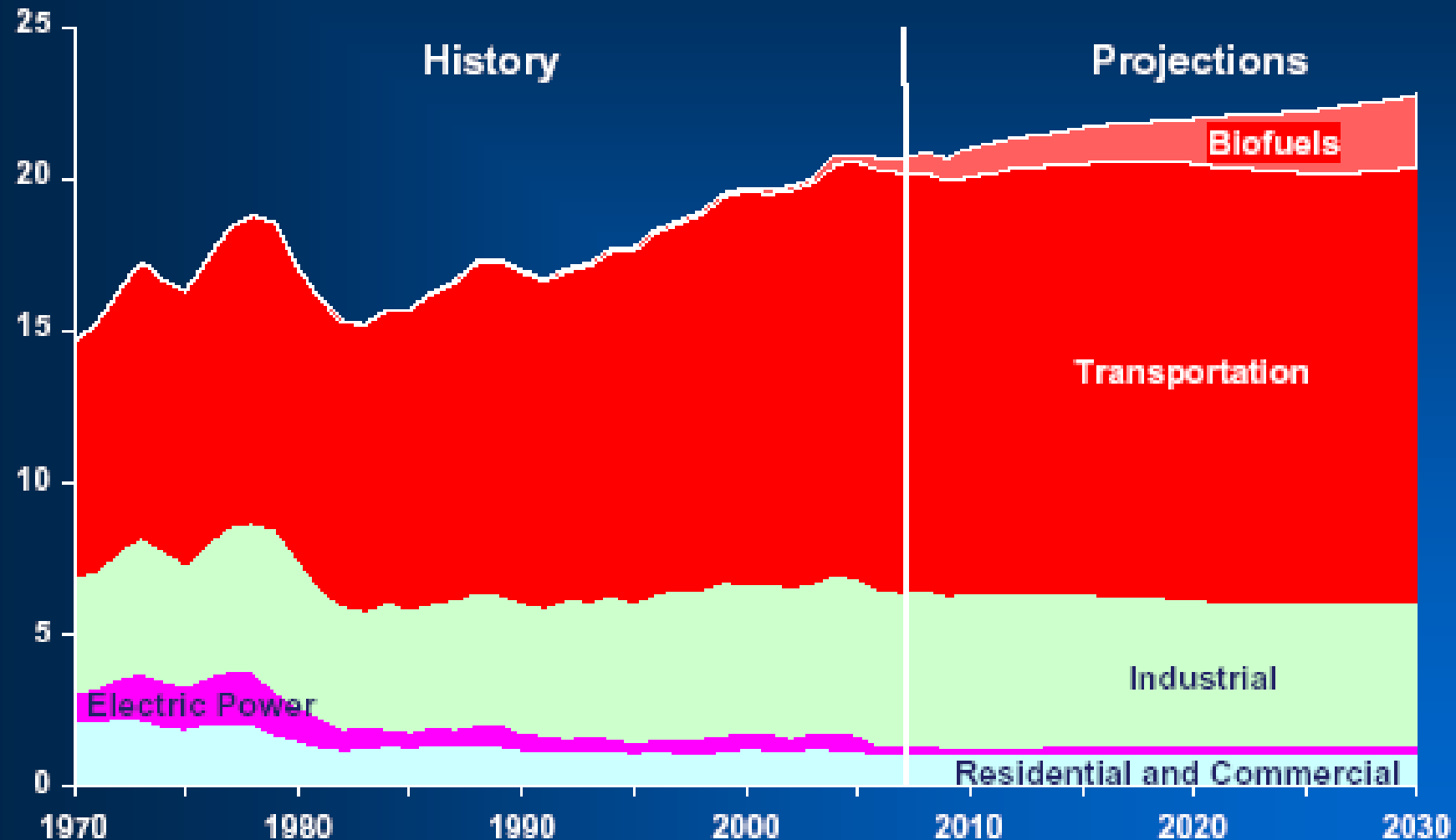
- ▶ **Remedy poor U.S. fuel diversity**
- ▶ **1/3 of carbon emissions are from the transportation sector**
- ▶ **Shift toward a more domestic resource base**
- ▶ **Reduce international security maintenance—large budget and diplomatic costs**
- ▶ **Grow new domestic primary and supplier industries**
- ▶ **U.S. oil import bill \$2-6 T in next ten years**
- ▶ **Fuel and feedstock concentrated in vulnerable areas**
- ▶ **Fuel demands flattening + altfuels coming = dampened price volatility**

Non-fossil energy use grows rapidly, but fossil fuels still provide 79 percent of total energy use in 2030



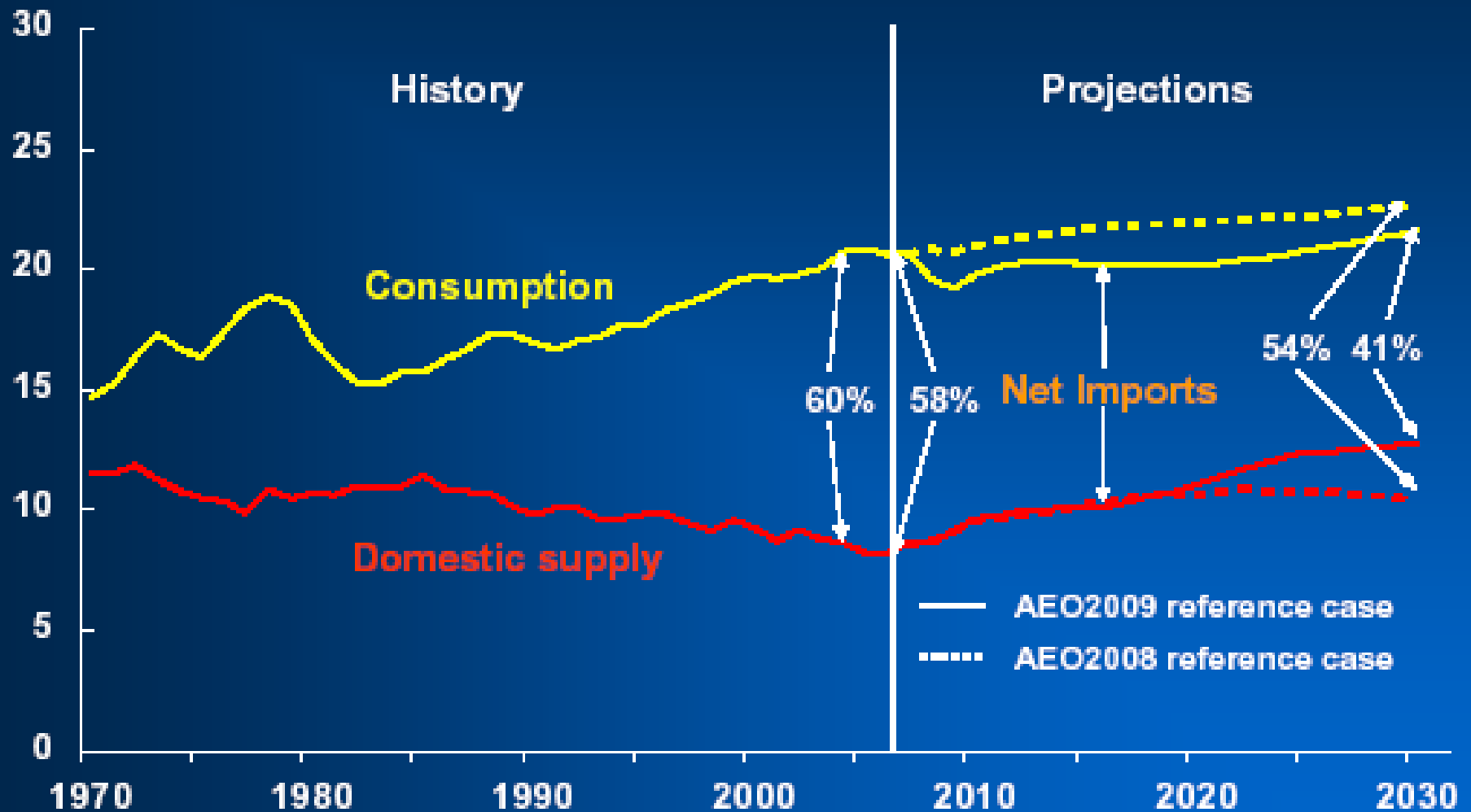
Petroleum-based liquids consumption is projected to be flat as biofuels use grows

million barrels per day



Net dependence on imported liquids declines dramatically over the next 20 years

million barrels per day





Altfuels Policy — a Pizza or a Stew?

- ▶ **Federal energy policy — floating clumps of random flavor for every taste**
- ▶ **Finding substitutes for oil is very hard work**
- ▶ **Every feasible alternative needed**
- ▶ **At \$100/b, \$1 in biomass H₂ could replace \$7.5-\$11.5 in oil/\$1 in coal for \$10-\$15 in oil ~ “surplus” builds supply infrastructure**
- ▶ **Figure out how to cooperate among advocates**
- ▶ **Corn ethanol not our best analog—must learn from this drama—every advanced fuel needs incentives**
- ▶ **\$28 B in U.S. subsidies and worldwide backlash, overcapacity, closed plants—B:C?**



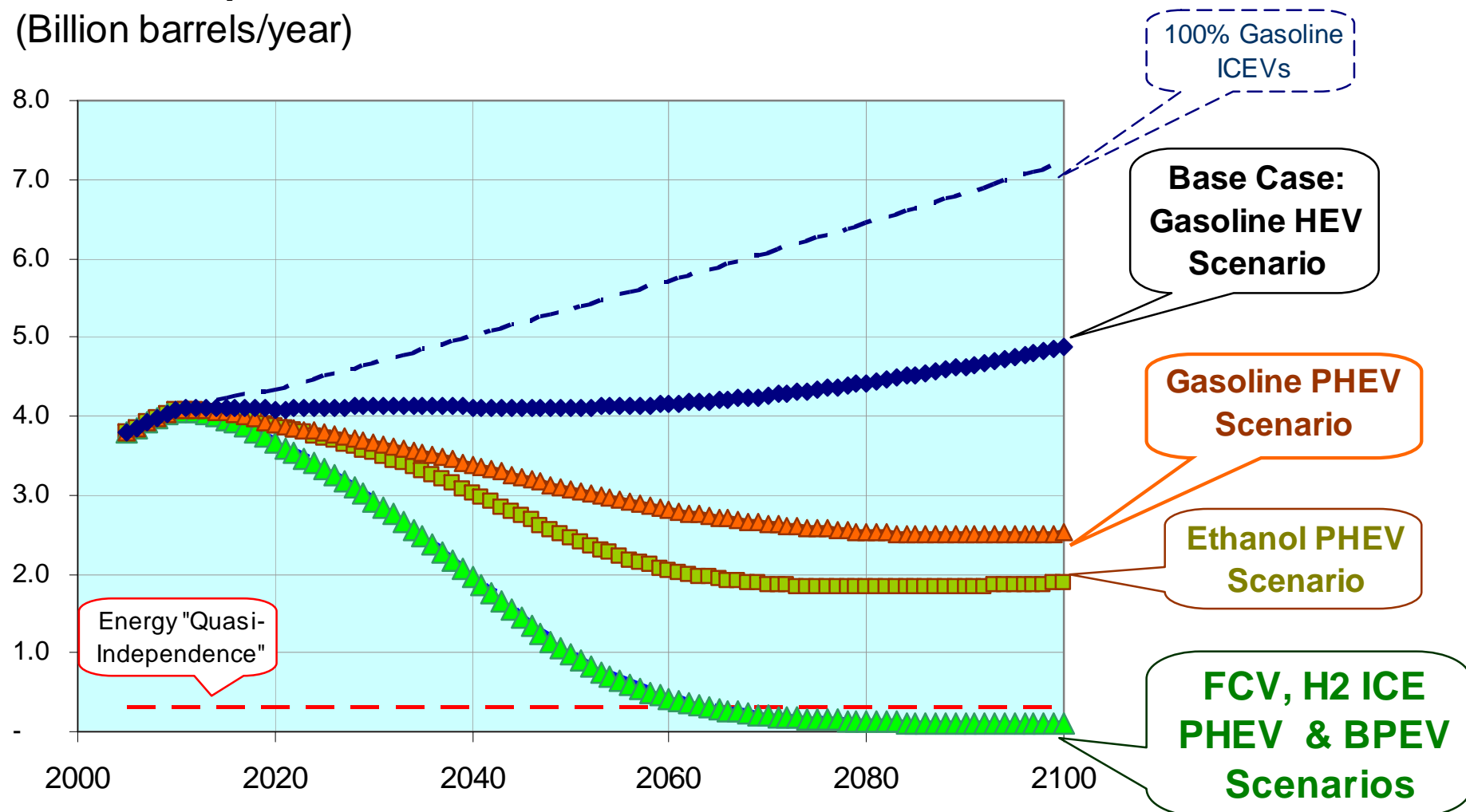
A Formidable Undertaking

- ▶ **PHEV, HEV, H2 and FC vehicles — making a bulletproof ultratech device for noble savages**
- ▶ **Unparalleled in U.S. history?**
- ▶ **Apollo and Manhattan had a single customer — enabling narrow, non-commercial technologies to flourish outside a market**
- ▶ **A different measure of science and technology for mass benefit — key symbolic value**
- ▶ ***Needs brave and patient private investment — more \$ been spent on R&D for Rogaine and Viagra?***



LDV Oil Use

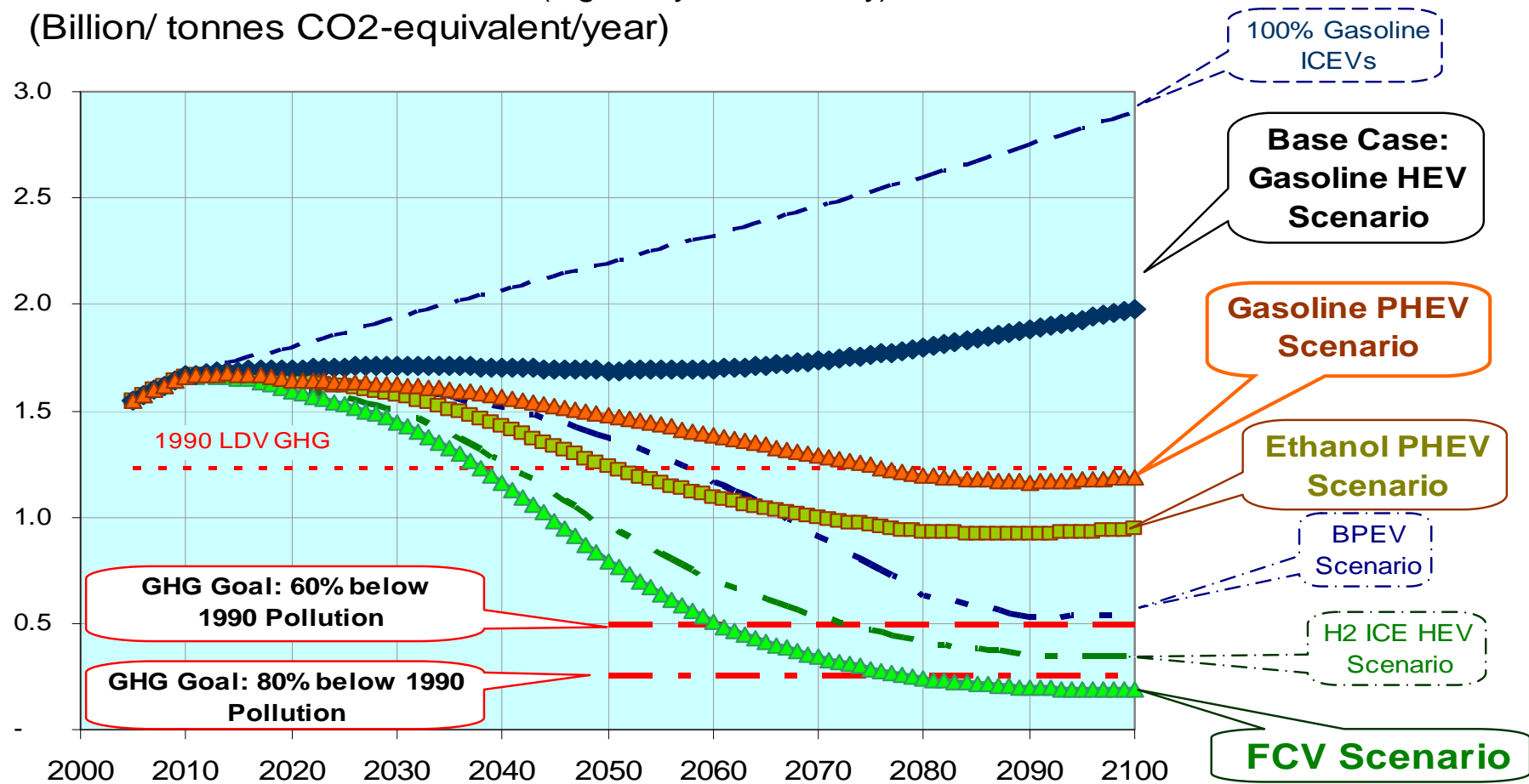
Oil Consumption (Billion barrels/year)





GHG: All Vehicle Types

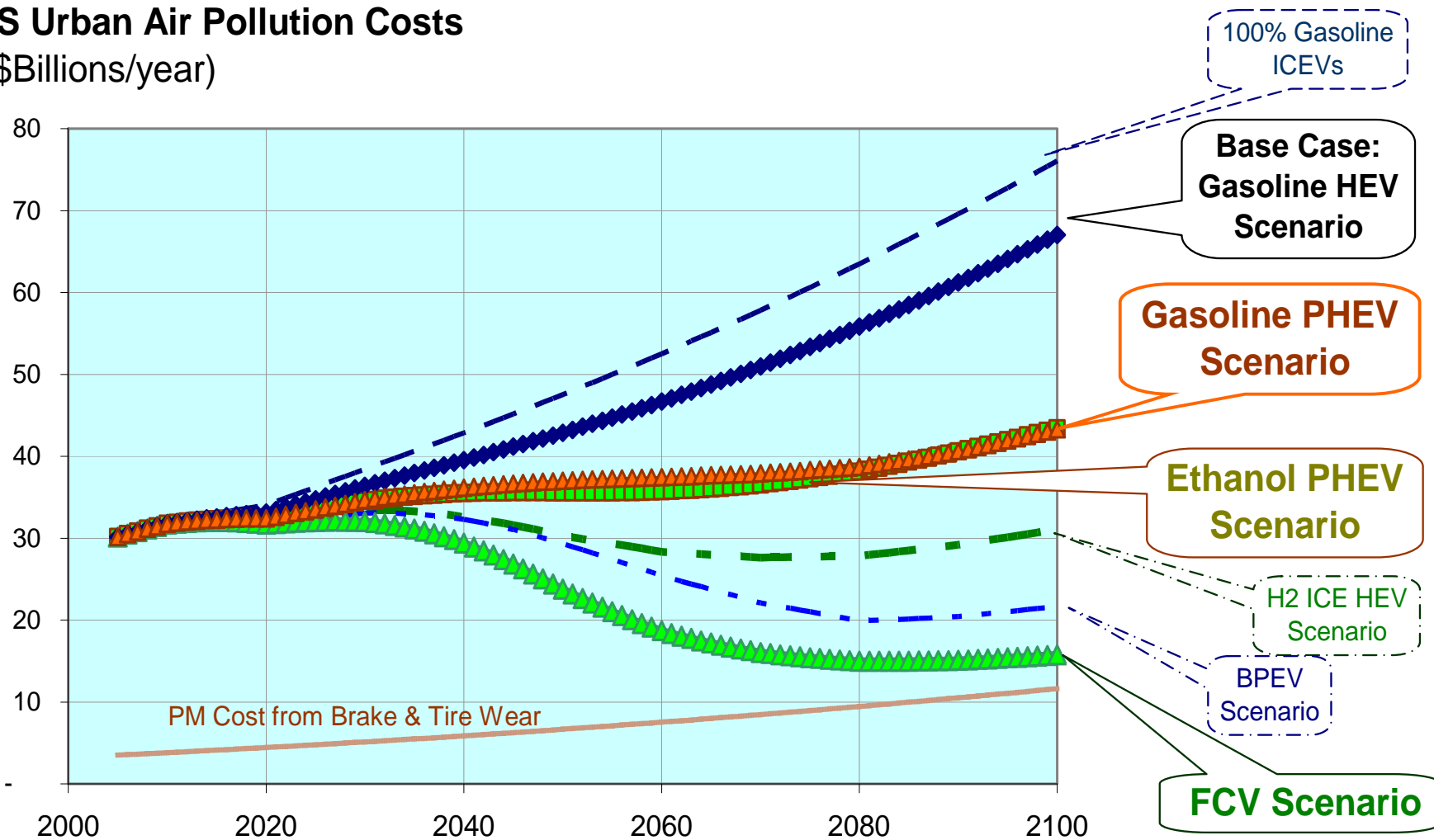
Greenhouse Gas Pollution (Light duty vehicles only)
(Billion/ tonnes CO₂-equivalent/year)





Urban Air Pollution

US Urban Air Pollution Costs (\$Billions/year)



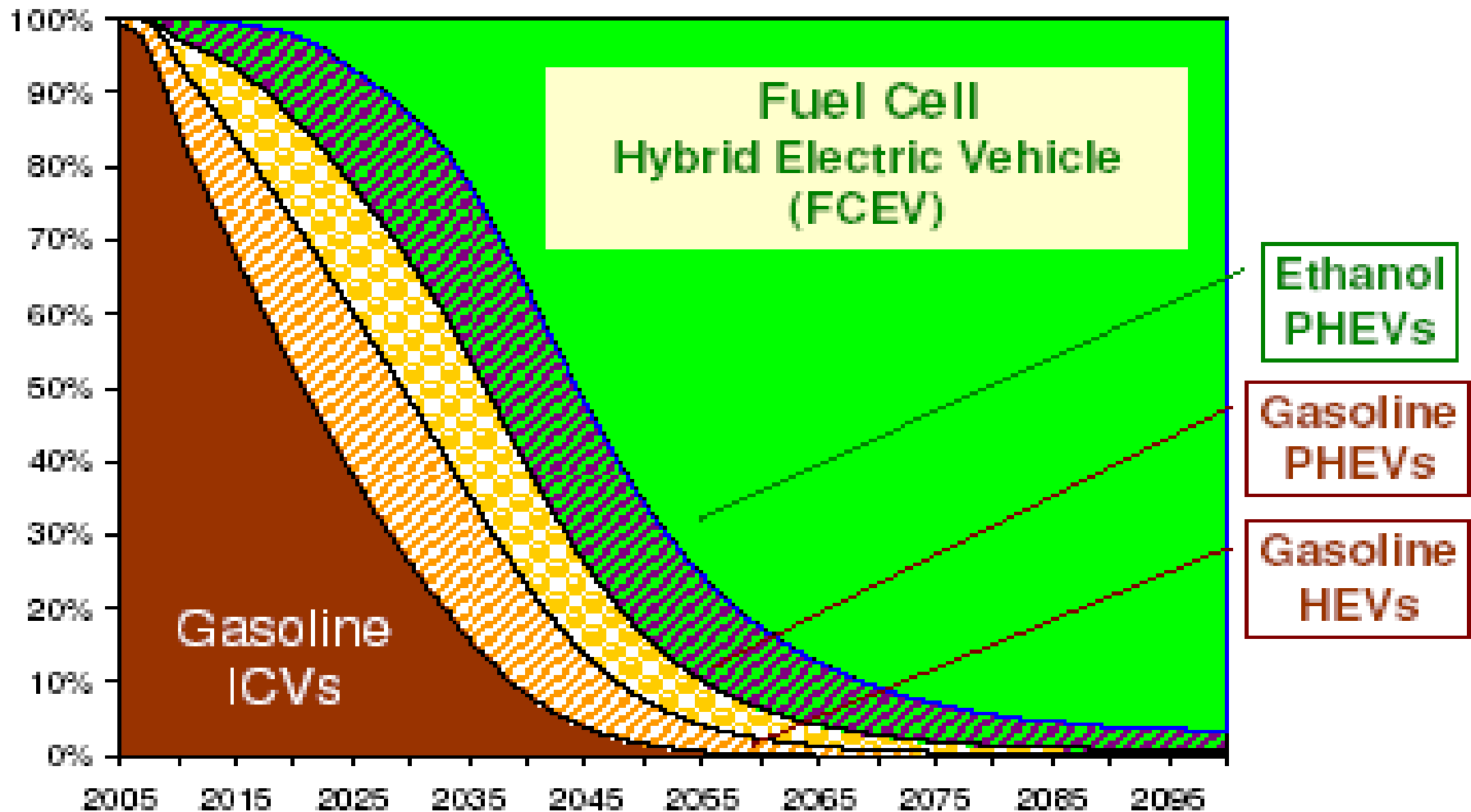


ICEV, FCV, BEV, PHEV Scenario Market Shares

(50% Market Share Potential by 2043)

Percentage of New Car Sales

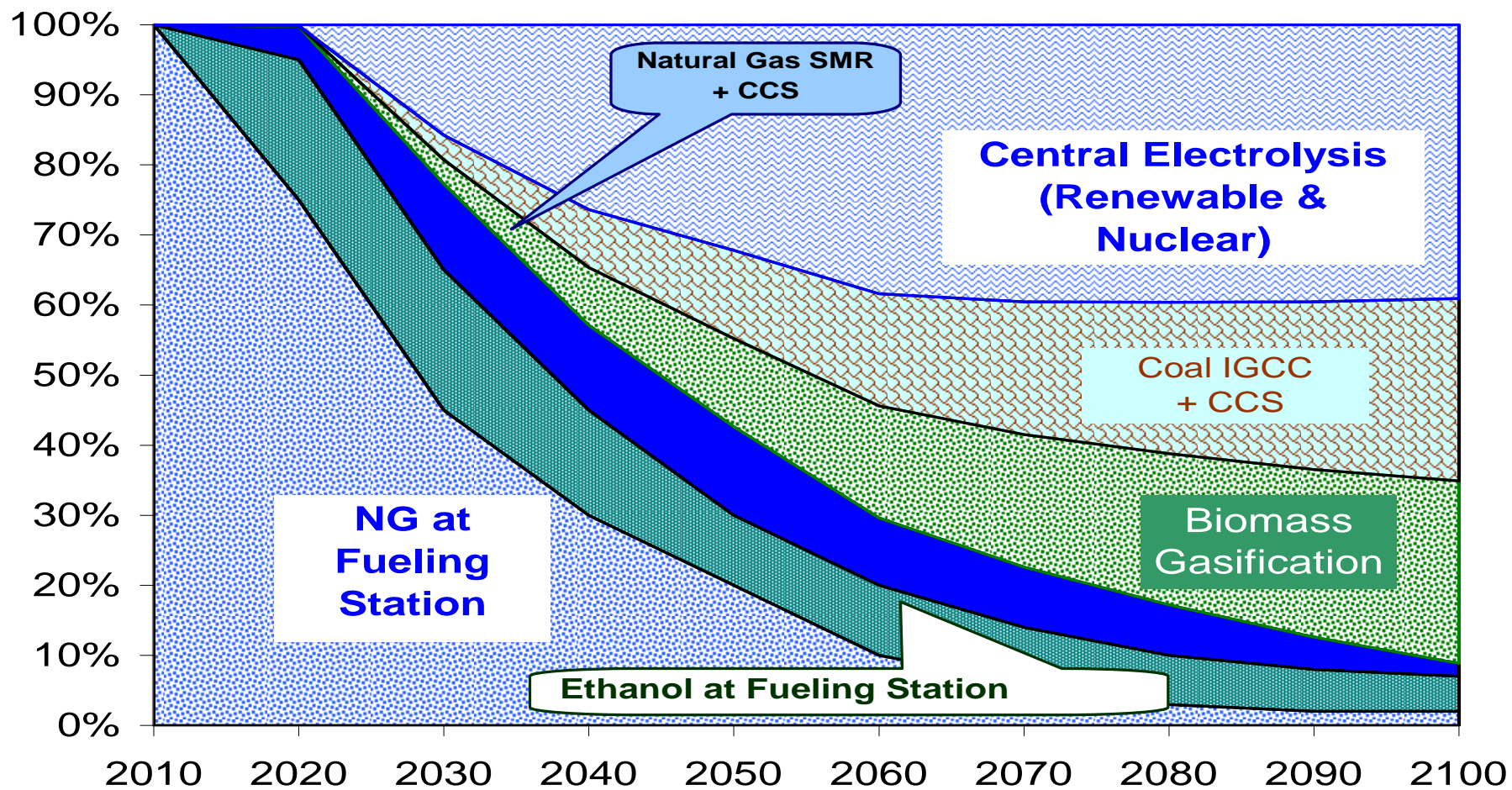
(All-electric CD Mode for PHEVs)





Greening H2

Hydrogen Production Sources



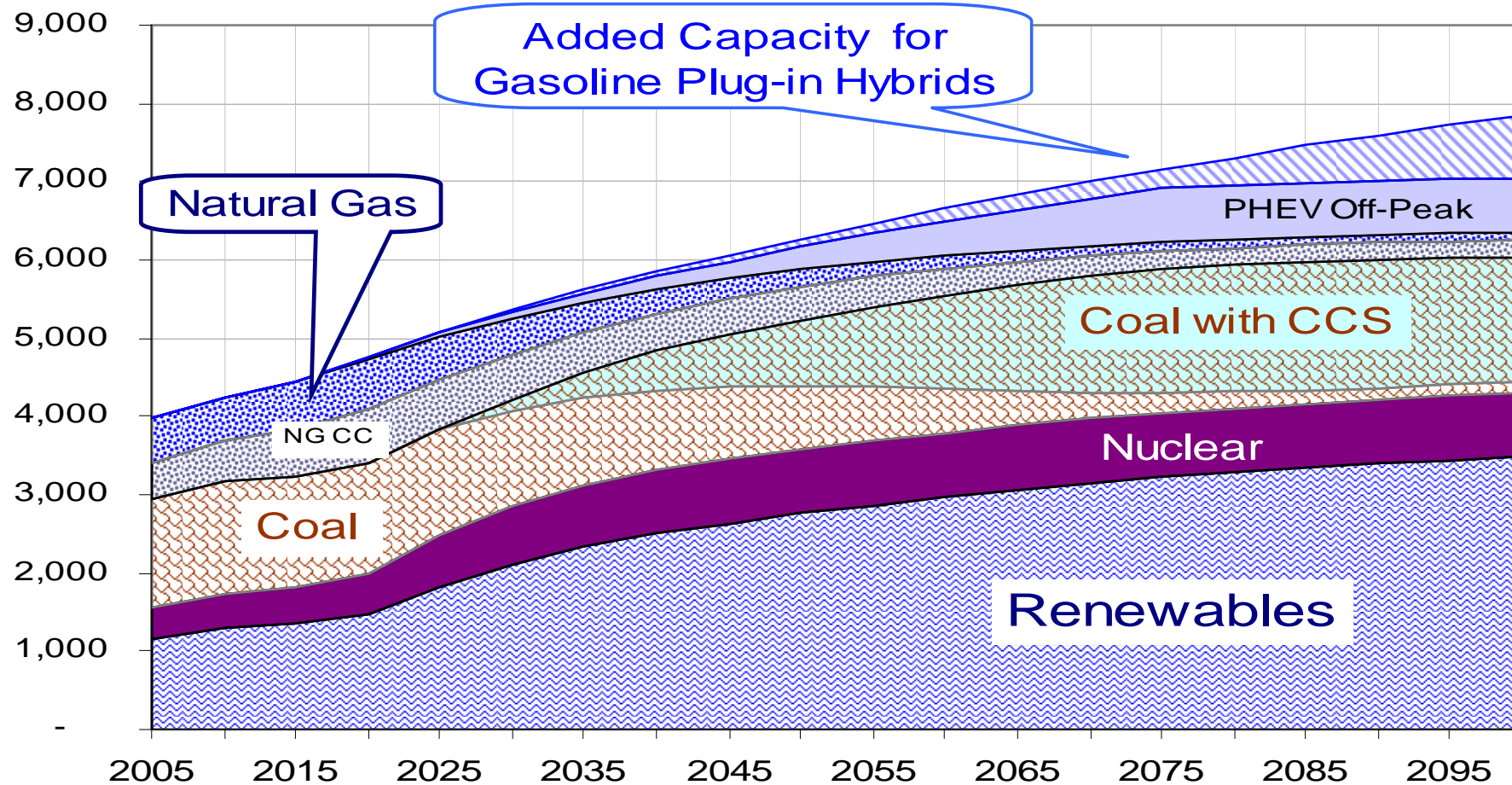


Greening the GRID

California/WECC Electricity Consumption Scaled to US

(Billion kWh/year)

Carbon Constrained Case





Varied Sources of H₂

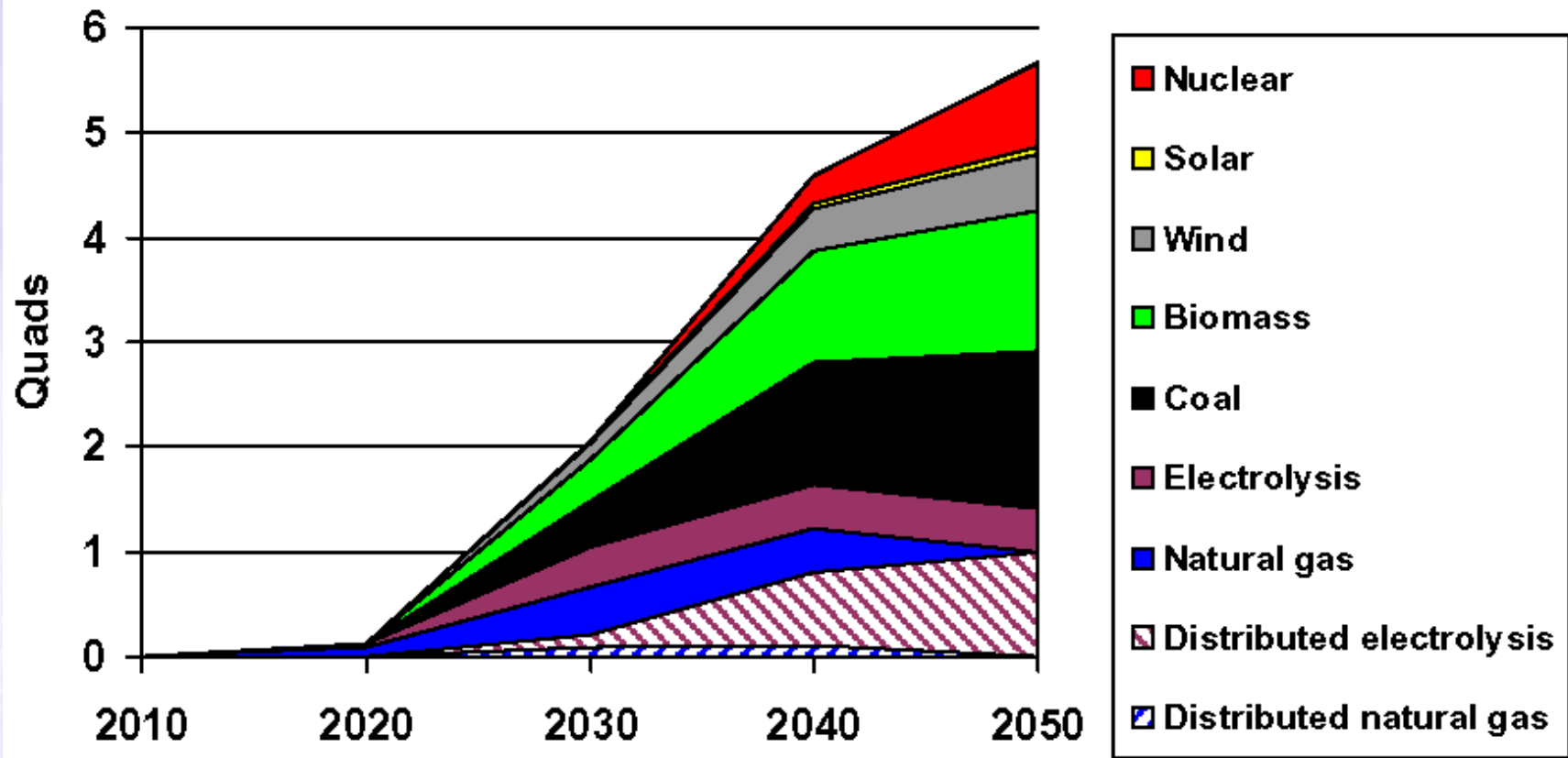


FIGURE 3.8 Resource Fuels Used to Produce H₂ in GYOW: United States



STRATEGIC CONCEPTS & POLICY ACTIONS

- ▶ ***Protect the transportation sector***
- ▶ **Shrink oil demand, replace with cleaner altfuels**
- ▶ ***Supply/demand systems most vulnerable and expensive when at capacity—with no diversity***
- ▶ ***Domestic altfuels relieve pressure, restore stable equilibrium, dampen price/supply volatility***
- ▶ ***Heavy government RD&D, subsidies to build new markets “Speed costs \$, how fast do you want to go?”***
- ▶ **Climate legislation accelerates advent of altfuels**
- ▶ **State and local fuel, carbon taxes could place floor under prices; CA Low Carbon Fuel Standards**



RETHINKING an ADAPTIVE SPR

- ▶ **Future much unlike the past, 1976 isn't here anymore—altpuels create a long threat holiday?**
- ▶ **When, and under what conditions, should SPR review its options?**
- ▶ **How long can oil be the marginal feedstock?**
- ▶ **Much to be learned yet about “green” altpuel market survival**
- ▶ **Heavy USG, international investments in altpuels**
- ▶ **Substitute for oil w/out creating new vulnerabilities/threats**
- ▶ **Don't allow strategic thinking to be OBE**



CREATING an ADAPTIVE SPR

- ▶ **Confluence of many factors**
- ▶ **Principal variables method of management**
- ▶ **2005-2015 wedge shapes future capability**
- ▶ **Oil demand curve—area of inflection 2015-2025**
- ▶ **Vehicle AOI 2010-2025**
- ▶ **When does “consumer surplus” drop?**
- ▶ **When altfuels replace shaky marginal suppliers—
or core suppliers?**
- ▶ **Nigeria, Venezuela, Angola, Katrina, TAPS; 10%,
20% of total imports?**



ACTIONS

- ▶ **Sell, privatize, trade oil in SPR—incrementally as opportunity affords**
- ▶ **At \$130/b in 2030, worth \$97 B**
- ▶ **Establish ready altfuel feedstock reserves—
altfuels and energy carriers like electricity and
hydrogen too difficult to store**
- ▶ **NPOSR for oil to replace coal in ships ~ 1912 E.O.**
- ▶ **Much coal, oil, land is Federal—switchgrass
plantations, surplus commodities?**
- ▶ **Congress just gets tired**
- ▶ ***“The future will be better tomorrow.”: D. Quayle***



H2&FC Vehicles by the Hundreds





H₂ Fuel Cell Speed Record Cars



- ▶ ***Buckeye Bullet II***
- ▶ ***Purpose built streamliner***
- ▶ ***Ohio State Univ.***
- ▶ ***286.5 mph—FIA H₂FC record, 9/08***
- ▶ ***Ford/OSU team***
- ▶ ***Fusion stock body shape***
- ▶ ***FIA H₂FC record, 8/07***
- ▶ ***207.3 mph***
- ▶ ***~ 770 hp***



Energy Policy Act of 2005 – H2 Legislative Goals

- ▶ **Government needs to be a more reliable partner with industry**
- ▶ **Larger public investments ease the risk of developing transformational technologies**
- ▶ **Broader authority, permanent program authorization, and more resources to build on the President's *Hydrogen Fuel Initiative***
- ▶ **Enhance R&D in critical areas**
- ▶ **Accelerate progress — reshape programs to create more quality technical solutions more quickly**
- ▶ **Help drive market transition by early USG adoption, tax incentives**



TITLE VIII-HYDROGEN

▶ 802. Purposes

- enable and promote comprehensive development, demonstration and commercialization with industry**
- make critical public investments that build links to industry and the research community**
- build a mature H₂ economy that creates fuel diversity**
- sharply decrease US dependency on foreign oil**
- create, strengthen and protect a sustainable energy economy**

More Reading

- *The Hydrogen Economy: Opportunities, Costs, Barriers and R&D Needs (National Academy of Sciences, 2004) + Transitions to Alternative Transportation Technologies (July 2008)*
- *Low Carbon Fuel Standards (Institute of Transportation Studies, Univ. Of California Davis, Sperling and Yeh, National Academies of Science Winter 2009)*
http://www.arb.ca.gov/fuels/lcfs/1208lcfs_issues.pdf
- *Domestic Alternative Transportation Fuels (Hinkle and Bromaghim, for the National Rural Electric Cooperative Association, July 2008)*
- *GREET Well-to-Wheels Analysis of Fuel Cell Vehicles (Wang and Wu, Argonne National Laboratory, 2007)*
- *Analyzing the Transition to Hydrogen-Powered Transportation (Greene and Leiby, Oak Ridge National Laboratory, 2007)*
- *National Hydrogen Association, H2 Initiative (C.E. Thomas, August 2008)*
- *Hydrogen Fueling Infrastructure Assessment (Gross, Sutherland and Mooweer—GM and Shell, 2007-8)*
- *Hydrogen Demand, Production and Cost by Region to 2050 (Singh et al, Argonne National Laboratory, 2005)*