SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS

A Research Summary for Decision Makers

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Part 2: Pathway Comparisons

Analyzing single-fuel pathways has given us a basis for comparing these pathways in terms of how well they promise to meet important objectives for the transportation system of the future. The four chapters in this section take a comparative approach to fuel economy and cost, fuel infrastructure requirements, and environmental impacts.

- **Chapter 4** focuses on the question of how much each pathway promises to trim fuel consumption relative to today's conventional vehicles. It also asks how the cost to the consumer of various types of vehicles will compare some number of years in the future, particularly when the price of gasoline is factored in. To begin to answer these questions, the researchers ran computer simulations of the operation of a midsize passenger car and a small/compact SUV at three points in the future: 2015, 2030, and 2045. They compared advanced higher-efficiency engines, hybrid-electric vehicles, and all-electric vehicles with a conventional vehicle marketed in 2007.

- **Chapter 5** looks at the infrastructure development required if biofuels, electricity, and/or hydrogen are to assume major roles as transportation fuels over the next several decades. It also examines the challenges—given that today's transportation system is 97-percent dependent on petroleum-based liquid fuels. For each fuel pathway, the chapter considers and compares system design, resources, technology status, cost, reliability, transition barriers, and policies that might be needed to provide incentives for new infrastructure development.

- **Chapter 6** considers the matter of reducing greenhouse gas (GHG) emissions from vehicles and fuels, one key to lessening transportation's contribution to the climate change problem. This chapter presents much of what is known about the relative emissions of GHGs from battery, fuel cell, and plug-in hybrid electric vehicles versus conventional internal combustion engine vehicles. It provides background on the issue of GHG emissions and their climate impact, reviews and compares recent estimates of GHG emissions from the fuel cycles of various types of electric vehicles, and examines the potential for electric vehicles to rapidly scale up to meet the climate challenge.

- **Chapter 7** considers the environmental impact of transportation fuels and vehicles beyond GHG emissions—impacts on land, water, and materials. Biofuel and oil production in particular can result in land-use impacts that must be acknowledged and weighed. Production of fossil fuels, biofuels, electricity, and hydrogen all have water footprints that must be considered. And advanced vehicle technologies use materials that might become a barrier to development if they are either scarce or else concentrated in a few countries. This chapter focuses on work comparing the sustainability of different fuel/vehicle pathways along these lines.