

# SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS

A Research Summary for Decision Makers

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## Part 1: Individual Fuel/Vehicle Pathways



We start by characterizing individual fuel pathways and accompanying vehicle technologies. Biofuels, which are here today and also under development for the future, can be used in internal combustion engine vehicles (ICEVs) as well as in hybrid vehicles. Electricity can be used in battery electric and plug-in hybrid vehicles, which are slowly making their way into showrooms. Hydrogen can be used in ICEVs, but our primary interest here is its use in fuel cell vehicles, a rapidly developing technology that could be available within the next 5 to 10 years. The three chapters in this part examine multiple aspects of the biofuels, electricity, and hydrogen pathways, including technical status and outlook, environmental impacts, infrastructure requirements, transition scenarios, and policies and business strategies needed to support the pathway.

- **Chapter 1** examines biofuels, which have the advantage that they can be made to resemble conventional fuels and in some cases can easily be incorporated into the existing fuel distribution system, easing transition issues. At the same time, biofuels face challenges with respect to resource availability, cost, and environmental and economic impacts. This chapter draws on detailed modeling of future biofuel infrastructure that has been done in response to policy goals for renewable fuels. We describe current and future biofuels production technology and develop biofuel supply curves for the United States.

- **Chapter 2** focuses on electricity and its use in plug-in vehicles of both the hybrid and pure electric variety. Electric-drive technology promises clean skies, quiet cars, and plentiful fuel produced from nonpolluting domestic sources, but it faces a fundamental challenge: how to store energy and supply power. This chapter draws from several streams of research—including testing of battery technology, modeling of the electricity grid, and eliciting consumer data regarding PEV design interests and potential use patterns—to sort through the hype and improve understanding of this pathway and the advances it must make to become competitive with ICEVs.
- **Chapter 3** explores hydrogen, a fuel pathway with the long-term potential to greatly reduce oil dependence as well as transportation emissions of greenhouse gases and air pollutants. Complex technical and logistical challenges must be overcome before a hydrogen-based transportation system can become a reality. This chapter discusses some of the major questions regarding future use of hydrogen in the transportation sector and highlights STEPS research on these issues.