Life-Cycle Analysis of Alternate Pathways for Production and Delivery of Hydrogen for Vehicles

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While there is considerable interest in alternative fuels among policy makers, automobile manufacturers, and fuel providers, there are substantial economic and technical challenges to significantly decrease our reliance upon petroleum for fuels. Hydrogen is currently being promoted as one of the leading options for an alternative transportation fuel. There are many options for the production of hydrogen using energy from both fossil fuels and renewable sources. Currently, the majority of hydrogen worldwide is produced via gasification of a fossil fuel feedstock and steam reformation of natural gas. These two production methods are the focus of this study, as they represent current technology and are the most likely to be utilized at the beginning of a transition to hydrogen.

This study quantifies the effects of hydrogen production and distribution from well to pump using the Life Cycle Analysis (LCA) framework. The LCA is performed with a Bill of Processes approach using the economic input-output (EIO) LCA model developed at CMU and available on the web at www.eiolca.net. The application of the Bill of Processes method to the LCA, through identifying process steps and mapping them to appropriate EIO sectors, will be discussed.

The goal of the LCA is to evaluate seven alternate pathways to produce and distribute hydrogen. Five of the pathways evaluated include production of hydrogen, liquid fuels, and substitute natural gas (SNG) from hydrogen. The liquid fuels and SNG (two pathways each) are transported to centralized reforming stations at the city gate or distributed refueling stations for hydrogen production. The final two pathways include central station production of hydrogen through steam reforming of methane from domestic and international sources. The total emissions of greenhouse gases and criteria pollutants for each pathway are evaluated and will be presented along with this study's conclusions.

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