Using STREET to Determine Air Quality Impacts of H_2 Infrastructure and Fuel Cell Vehicles

OVERVIEW

Replacing gasoline vehicles with fuel cell vehicles is proposed as a strategy to help meet environmental, energy security, and natural resource challenges. The work presented here designs future scenarios for hydrogen infrastructure in southern California and determines the associated greenhouse gas (GHG) and air quality impacts through the application of a novel engineering tool referred to as STREET (Spatially and Temporally Resolved Energy and Environment Tool). STREET is a comprehensive, land use-based planning tool that integrates capabilities such as fuel supply chain simulations and the UCI-CIT atmospheric chemistry and transport model. It has been developed with support from government regulatory agencies and in partnership with industry stakeholders. Generally, the application of STREET can provide information for decision makers who will implement policies and business strategies related to California's energy and environment goals.

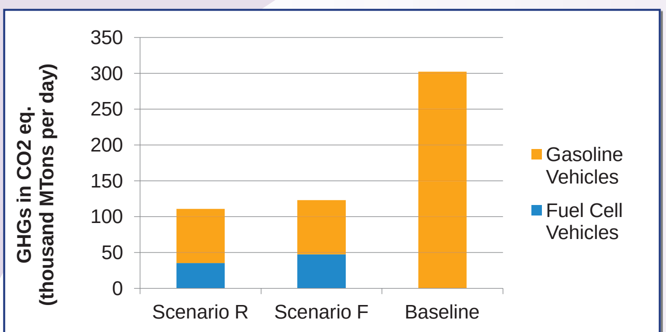
GOALS

Apply STREET to the South Coast Air Basin (SoCAB) of California to:

- Design scenarios for the deployment of fuel cell vehicles in the SoCAB in the year 2060.
- Design spatially and temporally detailed scenarios for a hydrogen supply chain infrastructure that will support fuel cell vehicles in the SoCAB.
- Determine the greenhouse gas emissions associated with future scenarios for hydrogen infrastructure and fuel cell vehicles.
- Model the air quality impacts of future scenarios for hydrogen infrastructure and fuel cell vehicles using the UCI-CIT atmospheric chemistry and transport model.
- Compare results to a baseline case comprised of improved, future gasoline vehicles.

RESULTS

Vehicle turnover and historic examples of market adoption suggest that fuel cells vehicles could comprise 75% of the light duty automobile fleet by the year 2060 if conservative estimates are used.



GHG emissions associated with H_2 infrastructure scenarios compared to advanced gasoline vehicles.

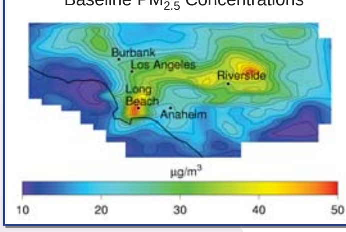
Example of a Spatially Resolved H_2 Infrastructure Scenario

RESULTS (continued)

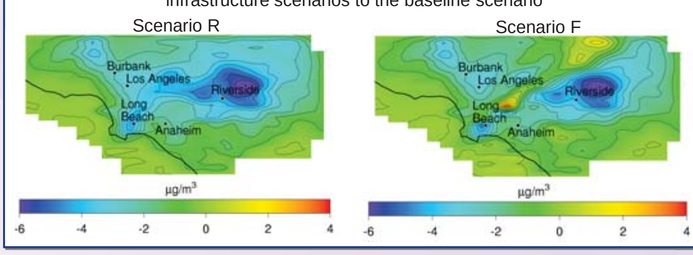
Reductions in GHG emissions from light duty automobiles of 60% or more are observed, regardless of whether hydrogen is generated more from fossil fuels (Scenario F) or renewable energy sources (Scenario R).

Reductions in peak 8-hour-average ozone and 24-hour $PM_{2.5}$ of up to 10% and 15%, respectively, are observed in the hydrogen infrastructure scenarios when compared to advanced gasoline vehicles.

Baseline $PM_{2.5}$ Concentrations



Change in 24-hour $PM_{2.5}$ concentrations when comparing hydrogen infrastructure scenarios to the baseline scenario



RECENT PUBLICATIONS/PAPERS

Environ Sci Technol, 43 (2009) p. 9022-9029. Determining air quality and greenhouse gas impacts of hydrogen infrastructure and fuel cell vehicles.

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