Houston Hydrogen Transportation Pilot

Christine Ehlig-Economides – PI

US DOE Office of Fossil Energy and Carbon Management (FECM)

UH Hydrogen Symposium
April 17, 2024

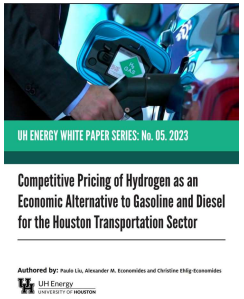
Sensitivity of Carbon Storage Costs for Hydrogen Generated by Steam Methane Reforming with Carbon Capture (SMRCC) in the United States

Preliminary Example Summary

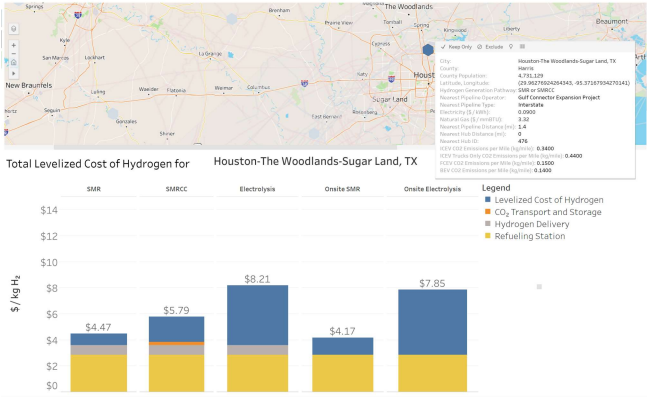
White Paper Findings

- Compares hydrogen (H_2) generation pathways
- Shows that gaseous H_2 should be competitive with gasoline and diesel for transportation in the Greater Houston Area

Authors:
Paulo Liu
Alexander M. Economides
Christine Ehlig-Economides

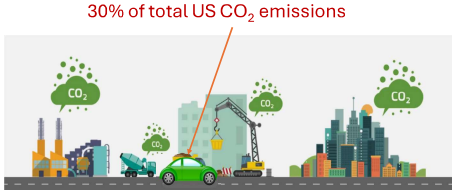


Dashboard Output – Greater Houston Area

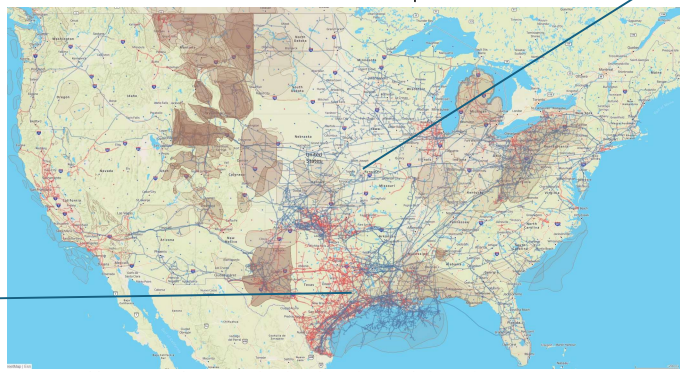


- Chose Woodbine Aquifer Woodbine Formation (Clastic, 25 gigatonne CO2 storage capacity)
- Potential Hub Location (PHL) located on top
- National Energy Technology Laboratory (NETL 2017) CO_2 Saline Storage Cost Model: Transport: \$6.11/tonne CO_2 = \$0.06/kg H_2, Storage: \$16.38/tonne CO_2 = \$0.16/kg H_2

United States (US) Government's Goal: Net-Zero by 2050



Dashboard Map

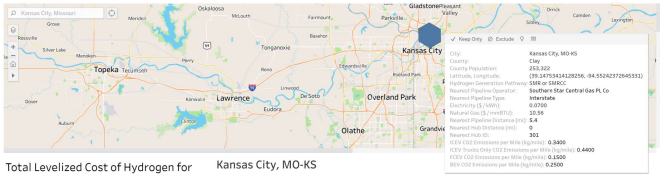


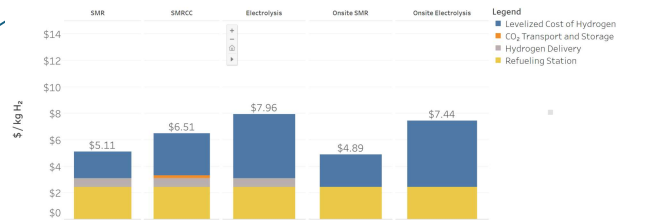
Tableau™ map showing Red Hubs: Electrolysis and Blue Hubs: SMR or SMRCC
Brown Areas: Saline aquifers from National Carbon Sequestration Database (NATCARB)
Pipelines (Red: Intrastate, Blue: Interstate, Green: Gathering) from Energy Information Agency (EIA)

LTCH = LCOH + LCT + LCRS

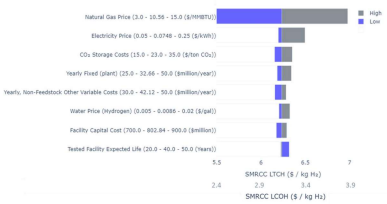
- LTCH – Levelized Total Cost of Hydrogen (H_2) Reported in \$ per kg H_2
- LCOH – Levelized Cost of H_2 Generation
- LCT – Levelized Cost of H_2 Transportation
- LCRS – Levelized Cost of H_2 associated with the costs of refueling stations for consumer sales

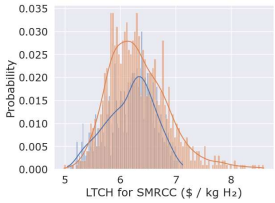
Dashboard Output – Kansas City





- Chose Ozark Plateau Aquifer Arbuckle Formation (Dolomite, 43.5 gigatonne CO_2 storage capacity)
- Approximately 100 miles to Potential Hub Location (PHL) near Kansas City Missouri
- National Energy Technology Laboratory (NETL 2017) CO_2 Saline Storage Cost Model: Transport: \$5.10/tonne CO_2 = \$0.05/kg H_2, Storage: \$25.68/tonne CO_2 = \$0.26/kg H_2





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Project Inspiration

White Paper Findings

- Compares hydrogen (H_2) generation pathways
- Shows that gaseous H_2 price should be competitive with gasoline and diesel for transportation in the Greater Houston Area

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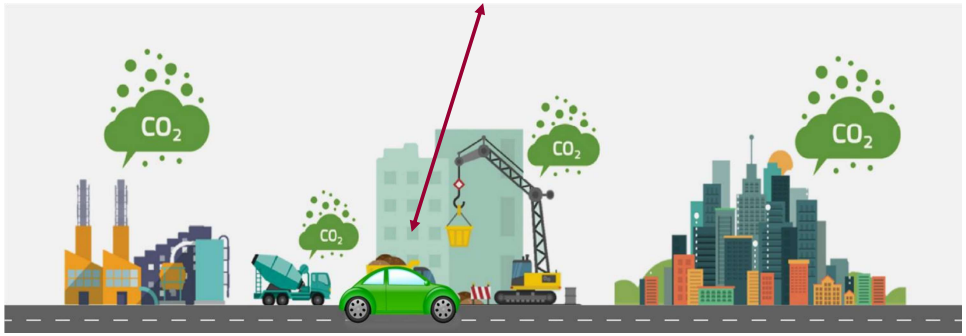
30% of total US CO_2 emissions

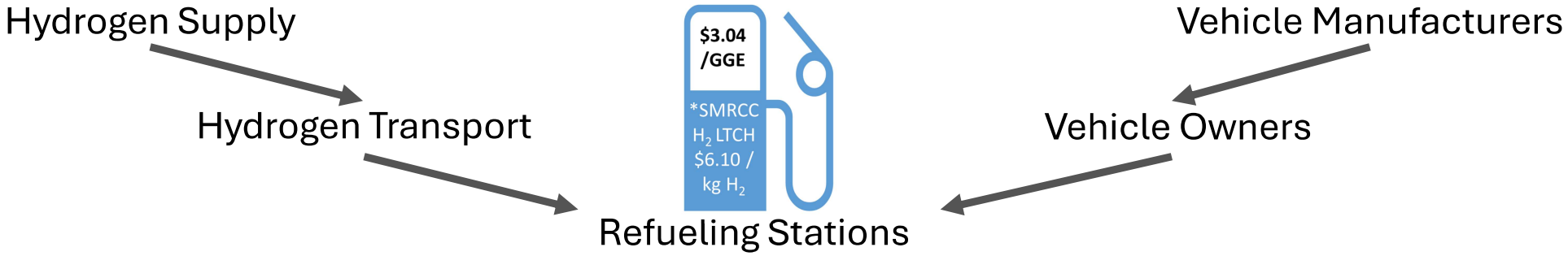


Competitive Pricing of Hydrogen as an Economic Alternative to Gasoline and Diesel for the Houston Transportation Sector

Authored by: Paulo Liu, Alexander M. Economides and Christine Ehlig-Economides

UH Energy
UNIVERSITY OF HOUSTON

DOE Funded Houston Hydrogen Transportation Pilot



Estimates for Greater Houston Area using NREL and ANL Tools

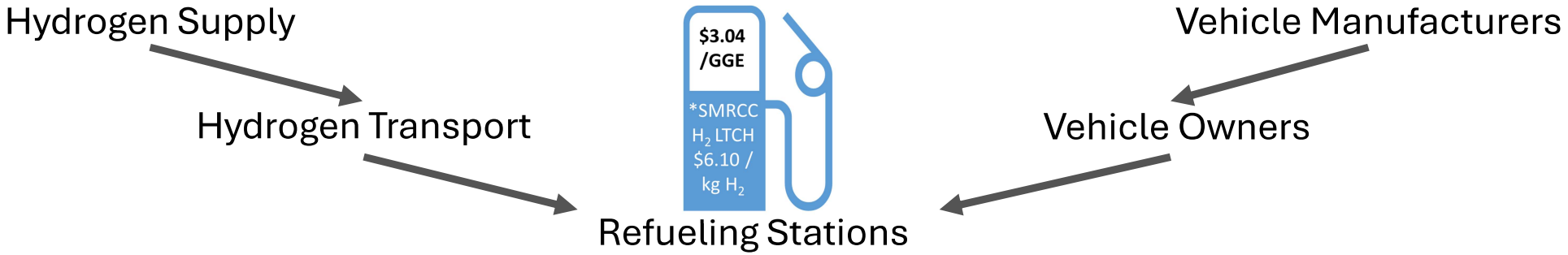
Category	Average Mileage	Unit Price	Price per Mile
ICEV	26 miles per gal	$2.91/gal	$0.11/mile
ICEV (Trucks only)	20 miles per gal	$2.91/gal	$0.15/mile
FCEV	**67 miles per kg**	**$6.10/kg H_2***	**$0.09/mile**
BEV	2.86 miles per kWh	$0.07/kWh	$0.02/mile

*Based on SMRCC cost

Category	Average Mileage	CO_2 Emission	CO_2 Emission per Mile
ICEV	26 miles per gal	19.6 lbs CO_2/gal	0.7 lbs/mile
ICEV (Trucks only)	20 miles per gal	19.6 lbs CO_2/gal	1.0 lbs/mile
FCEV	67 miles per kg	21.9 lbs CO_2/kg H_2	0.3 lbs/mile*
BEV	2.86 miles per kWh	0.81 lbs CO_2/kWh	0.3 lbs/mile

*Based on SMR

DOE Funded Houston Hydrogen Transportation Pilot



Environmental and Community Risks

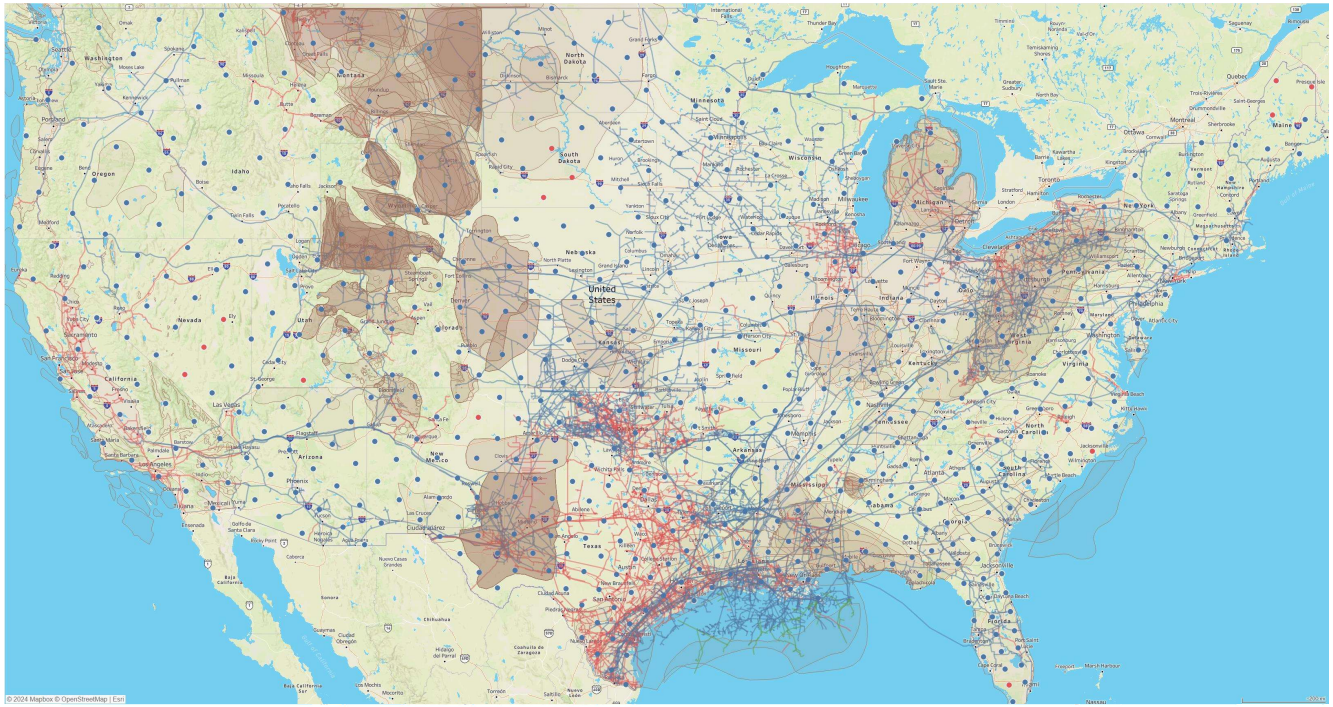
Community Impacts

Stakeholder Engagement

Workforce Development

Environmental Justice

National Perspective



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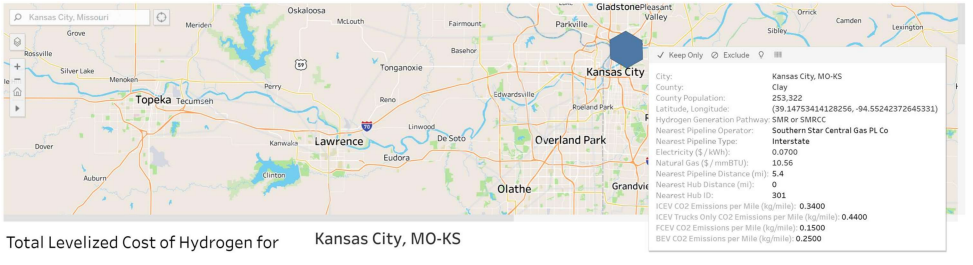

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Levelized Total Cost of Hydrogen Calculation

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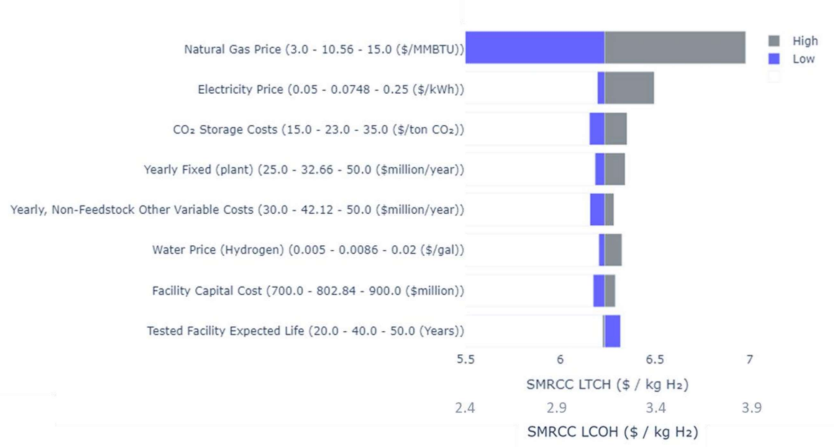

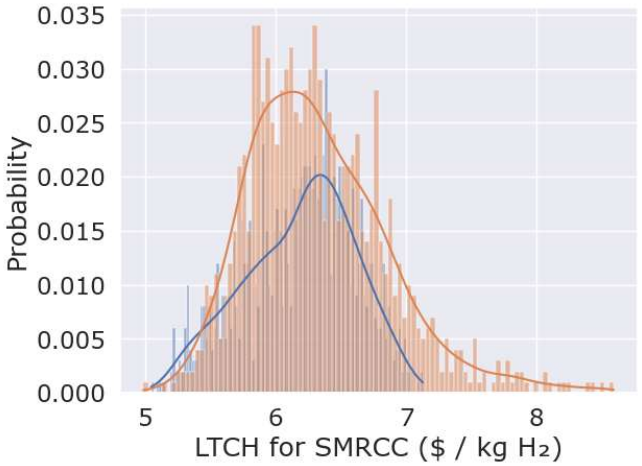

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