UCDAVIS
Energy Futures Research Program
Institute of Transportation Studies

STEPS+ Energy Futures Program
Summary of Planned Projects for 2024

As of January, 2024

Project 1. Analysis of California ZEV Transitions and Costs

Project Description: This project builds on previous papers and research on CA and US ZEV transitions. The project creates new, updated scenarios and will document all vehicle and fuel related costs, compared to business as usual. We will also link these vehicle scenarios to needed refueling scenarios and estimate charging and H2 refueling infrastructure costs considering LDVs and MHDVs separately. We will assess costs of policies such as the Low Carbon Fuel Standard and the Inflation Reduction Act. We will also evaluate environmental costs such as greenhouse gas and air quality impacts. Lastly, we will evaluate impacts from direct air capture and job-related impacts.

Project 2. Global ZEV Transitions – Model Development and Outlook Report

Project Description: We have begun developing a new UC Davis global sustainable transportation model that will include analysis for up to 30 countries/regions. We will have the initial road vehicle model done in Q1 of 2024, then extend this model to other modes and consider supply chain aspects over the rest of the year. The model will provide us with strong capabilities to model a range of global/regional transportation/energy/materials questions. The first phase of analysis will center on vehicle demand/sales/stock projections for cars and trucks, technology market share projections, vehicle use/energy impacts; later analysis will include battery requirements, materials requirements, materials flows, vehicle secondhand market trade, vehicle end-of-lie projections, vehicle production/trade scenarios by region to match demand, cost considerations, and policy implications. The goal is to have the model fully developed in 2024 with related papers; We will then produce a major “sustainable transportation outlook report” in 2025.

Project 3. Critical Minerals and Supply Chains

Project Description: This modeling project reviews critical minerals and supply chain implications for the US, EU, and global south regions. We will assess mineral supply risks focusing five key minerals (Li, Ni, Co, Mn, Gr). We recently published our first of these papers, on Graphite. We will be analyzing the impacts of the US IRA and the EU CRM Act on these specific mineral supply chains as well. We are working with key partners to create a multilateral framework for a global south council on critical materials. This will focus on creating downstream diversification for critical mineral-rich countries, enabling participation of developing countries in global mineral value chains. We will do specific India-focused work, such as helping develop a lithium sourcing strategy and inform India’s long-term critical mineral policy. This work will then be broadened out to cover a range of “global south” countries later in the year or in 2025.

Project 4. Ongoing Modeling of CA LCFS Market Developments

Project Description: This project builds on previous LCFS market modeling and focuses on current and future LCFS program development in California. 2023 draft rules are limited in scope, and while we are on target to reach CARB's projected 2030 target of 30%, increasing supply of hydrotreated lipid-based fuels (with HEFA renewable diesel, HEFA alternative jet fuel dominating) is likely to keep credit prices low while posing serious sustainability risks. We are using FPSM to engage with the current rulemaking proposal, with a brief paper updating our December 2023 report. RNG continues to be a controversial topic; EF researchers are currently working on a RIMI-supported project to explore approaches to additionality assessment in this space. The UC Davis LCFS Web Data tool is still being updated; we plan a California or multi-jurisdictional status review for 2024.

Project 5. LCFS Research & Modeling Needs

Project Description: EF researchers continue to model low carbon fuels market developments surrounding the LCFS and related policies in other jurisdictions. This includes work on EV credit quantification, additionality determination, credit market modeling, and feedstock sourcing and supply (and land use change risks). We are also collaborating with ORNL to update their BioTrans biofuel supply model to include the effect of state-level alternative fuel policies and continue to engage with stakeholders in jurisdictions considering adopting an LCFS or similar program (e.g., U.S. Midwest, New York, New Jersey, New Mexico, and Hawaii), or with one (California, Oregon, British Columbia, Canada). Lastly, indirect land use change remains a concern with few solutions; we have begun examining how framing in terms of uncertainties, especially but not exclusively in the absence of more in-depth research and modeling in this area, can inform policy.

Project 6. LCFS Transitions in Shipping and Aviation: CA and International

Project Description: This project is a transition study of on-road fuels to aviation, and extension of CA LCFS credit model to include aviation. Funded by Climateworks, this project will identify merit order of end uses for alternative fuels. It will consider hydrogen, and the difference between directly fueling vehicles vs. input to liquid fuel vs. stationary sources. It will also consider biofuels, including those derived from existing on-road fuels as well as new technologies to better understand prioritization of on-road ICE applications or aviation/marine over time. There will also be some international work in this area, building on a US/EU policy landscape study with potential to include a fuel policy evaluation in India and Brazil. Note also that the ORNL work mentioned in the LCFS research and modeling project includes biofuels used in aviation and shipping.

Project 7. Extension of Hydrogen Modeling and Scenarios to Cover Non-Road Models

Project Description: This project builds on 2023 hydrogen spatial modeling work published here, to update and deepen this work in several respects. This will include integrating new vehicle travel and hydrogen fueling demand analysis, supply chain work, and electricity sector analysis of hydrogen (as described in the following project blurbs). It will also particularly extend previous work with a particular "deep dive" analysis of ports/shipping, airports/aviation, and rail in California. If resources permit, it will also include addition of some industrial H2 demand, such as refining and chemicals, based on hydrogen price analysis. The analysis will consider hydrogen both as a direct end-use fuel and feedstock for other fuels (e.g. shipping fuel) and will have a spatial component. This work is funded in part by the California SB1 program and completed in cooperation with UC Berkeley and the Energy Efficiency Institute.

Project 8. Spatial and End-Use Infrastructure Siting Work

Project Description: This project concentrates on a detailed analysis if hydrogen station design, siting, and growth in numbers, particularly for heavy-duty vehicle stations. While we will pay particular attention to the HDV stations, we will also examine LDV and the interactions that exist between the two types. Analysis will be conducted with GIS tools and our STIEVE spatial model. We will include ongoing analysis of technologies and systems (e.g. liquid vs gas transport/storage), and the implications for full pathways, costs, and emissions.

Project 9: Hydrogen System Supply Chain Study

Project Description: This project is linked with the previous project (#8). We will use SERA to track pathways from hydrogen production to end use, including all production for use within the state. Other scenarios will also be explored including H2 produced near or far, connected, or unconnected to grid, storage issues and transportation options. We will also explore production technology alternatives and roles (electrolysis vs. biomass).

Project 10: LCA Work Including Leakage

Project Description: This project assesses the current understanding of hydrogen leakage, reviews the literature, reports on leakage estimates for different parts of the supply system and different design factors, and identifies current areas of concern. We then will assess the potential for cutting leakage in the future via technologies and system design. We will use the information derived from this work to better track the hydrogen leakage associated with our spatial modeling and estimate atmospheric warming implications.

Project 11: H2 DEI and Equity Study

Project Description: This project will perform a DEI/Equity study for H2 systems. The primary research will be conducted through interviews and potential surveys targeting individuals in position of influence (e.g. community leaders), various stakeholders, and public. Questions aim to better understand views on H2 and H2 plans, and what influences these views. We will use the learnings to suggest strategies for addressing concerns and increase support for plans and specific actions and investments.

Project 12: Next Electric Power/H2 Study

Project Description: This project is a follow up on 2021-2022 electric power and H2 study. We are upgrading our GOOD electric power/dispatch model (changing it from GAMS to a pure python model) to allow for deeper H2 analysis within electric sector. This is part of our on-going work to understand the potential role of H2 for energy storage with the electricity system. We will also examine the potential and cost of producing electrolytic H2 for end use as it relates to the storage role, and for “soaking up” excess renewables in the process.