# STEPS+ Energy Futures Program
# Summary of Proposed Projects for 2025

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## Project 1. Analysis of US and Global ZEV Transitions and Costs

**Project Description:** This project builds on our previous research and papers on CA and US ZEV transitions. The project will create new and updated scenarios at the US level, reflecting expectations under the new administration. It will also, working with our European Research Center ETERC, use our new GSTEM model to develop global scenarios of ZEV uptake, with resulting impacts on energy use, CO2 emissions and costs. We will document all vehicle and fuel related costs, and compare these to a business as usual scenario tailored to the US and individually for other major countries and regions. The US analysis will explore the effects of different potential policies and technology adoption scenarios.

## Project 2. Critical Minerals and Supply Chains

**Project Description:** This modeling project will extend the 2024 analysis that reviewed critical minerals and supply chain implications for the US, EU, and global south regions. We will continue to assess mineral supply risks focusing on five key minerals (Li, Ni, Co, Mn, Gr). We recently published our first of these papers, on Graphite. We will also develop mineral-specific scenarios linked to global/regional vehicle sales and stock using the ETERC GSTEM model, in development. We will also continue to work with key partners in the newly formed multilateral framework for a global south council on critical materials. This focuses on creating downstream diversification of critical mineral-rich countries, enabling participation of developing countries in global mineral value chains.Our 2024 work, which was focused mainly on India, will be broadened out to cover a range of “global south” countries in 2025.

## Project 3. Global Low-Carbon Fuels production and trade modeling

This project will create a prototype module for our global GSTEM model to track global low-carbon fuel supply, demand and trade. It will include biofuels, hydrogen, and liquid fuels such as methanol, ammonia, and other e-fuels. Based on our planned GSTEM global/regional transportation demand scenarios (including road, rail, shipping and air) going out to 2050, we will estimate transportation LC fuels demands in major countries and regions, and create an initial set of estimates of how these could be met with various kinds of fuels, and where these fuels could originate from. Special attention will be made to biofuels opportunities, costs, and (sustainability) limits, and the role of hydrogen as an end-use fuel as well as a feedstock for making other fuels (along with its use in industry). The initial stage will involve literature review (such as existing models and studies) and the collection of data to establish a base year situation. Projections will be built off of this. This is seen as a multi-year study, with potential year 2 activities being development of fuel supply curves and endogenizing trade functions - possibly with a linear program. The best overall modeling approach will be determined as part of this 2025 “year 1” project.

## Project 4. Global vehicle size / weight study

This project will continue a string of research projects in cooperation with ITDP, a sustainable transportation NGO, with co-funding from them and FIA Foundation, to build in an analysis of future potential LDV size/weight evolution to estimate the potential impacts on energy use, CO2 emissions, and batteries to the extent the global fleet evolves to be EV/PHEV. We will use the global ETERC GSTEM model to assist with this project. We have previously conducted similar studies focused on electrification and modal shift in cities, known as the "Compact Cities Electrified" series, available on the ITDP website - e.g. the US one is available here. This project will extend those.efforts with this vehicle size/weight analysis, and also extend our previous cost analyses to consider vehicle size and battery requirements. The result will be a UC Davis/ETERC/FIA Foundation global report. We will share the analysis and underlying data with EF sponsors.

## Project 5. Ongoing Modeling of LCFS Market Developments

This project is largely completed, but with some follow-on work in 2025. The main work was published as an ITS technical report (Updated Fuel Portfolio Scenario Modeling to Inform 2024 Low Carbon Fuel Standard Rulemaking) and has contributed to material submitted to CARB via several technical comment letters on the LCFS regulatory docket (e.g. UCD Feb 20 2024 LCFS Comment, UCD Comments on April 10 LCFS workshop, UCD August 27 2024 Comment on 15 day amendment package). We plan to publish one or more blogs wrapping up the current rulemaking and providing a long-term LCFS outlook and will continue to work with CARB in the post-rulemaking period to help track the market and identify new trends.

More generally, we will continue to maintain and update the Fuel Portfolio Scenario Model to provide guidance on LCFS related issues, and hope to deploy our more sophisticated GAMS-based credit market model for policy analysis in 2025. We may also produce a LCFS status review (either focused on CA, or multi-jurisdictional), if it would be of interest to the policy community.

## Project 6. LCFS Research & Modeling Needs

EF researchers are leading several efforts to develop better analytical tools for fuel policy applications, and have identified others for future work. Notably, we are developing a model of refinery-level decision making to help project how biorefineries will navigate the long-term transition from making renewable diesel to sustainable aviation fuels. A different project seeks to characterize how life cycle analysis methodology affects credit generation under the LCFS, using dairy digesters as an initial test case. We are also collaborating with Oak Ridge National Laboratory to update their Biotrans model for biofuel production.

As further background, jurisdictions around the world are adopting policies to reduce emissions from transportation to meet GHG reduction targets; the LCFS has become a model policy in that effort. There are several pressing questions for which researchers lack adequate analytical and modeling tools. This project continues to engage with policymakers to determine what analytical questions are most pressing, and develop policy-relevant solutions for near-term implementation. These include low carbon fuels market and policy compliance models, understanding the impact of long-term energy efficiency resource standards, EV credit quantification, and additionality determination. We are engaging with stakeholders in a variety of U.S. states considering adopting the LCFS, have selected by New Mexico for a contract to provide technical assistance to their regulatory agency during its development and implementation of a LCFS.

## Project 7. LCFS Transitions in Shipping and Aviation: CA and International

EF researchers collaborated with the ITS-Davis European Transport and Energy Research Centre (ETERC) on a study comparing the policy approaches to aviation and marine fuels adopted by the U.S. and E.U., the report Comparative Assessment of the EU and US Policy Frameworks to Promote Low-Carbon Fuels in Aviation and Shipping was published in September 2024.We are currently assessing its impact to determine what follow-up work may be called for. The study evaluating bio-refiner decision making, mentioned above, will likely also play into this effort. We remain engaged with policymakers on a variety of topics related to aviation and marine fuels.

Further background: as jurisdictions implement policies to reduce GHG emissions, it is increasingly apparent that aviation and marine fuels will need more assistance than the current policy portfolio provides. While previous analyses have often considered fuels in these sectors individually, market conditions and technological trends across the broader transportation fuel sector must be taken into account. We continue to work in this area, to better understand how aviation and marine fuels will fit into, and interact with, the broader portfolio of measures used to decarbonize on-road transportation. It will consider hydrogen, and the difference between directly fueling vehicles vs. input to liquid fuel vs. stationary sources. It will also consider biofuels and determine prioritization of on-road ICE applications or aviation/marine. There will also be some international work in this area, considering a US/Eu policy landscape study as well and as a fuel policy evaluation in India and Brazil.

## Project 8: Next Electric Power/H2 Study

**Project Description:** This project is a follow up on 2021-2022 electric power and H2 study and will be undertaken if we have the resources and researcher availability. We have completed the upgrading of our GOOD electric power/dispatch model (changing it from GAMS to a pure python model) to allow for deeper H2 analysis within the electric sector. Other end-use features have been added, such as better articulation of infrastructure requirements. We will 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. If we can secure sufficient funding (within STEPS or as a co-funded project), we are prepared to undertake a larger study that compares an “all electric” electricity and transportation sector in California vs one with hydrogen used both as an energy storage system and as an end-use energy system within the state, to estimate the additional costs/benefits of doing so.

## Project 9. Spatial and End-Use Hydrogen Infrastructure and Supply Chain Work

**Project Description:** This project incorporates our STIEVE and SERA modeling and will build on 2024 work as needed for ARCHES, and possibly for other regions (such as the Western states), with the idea of linking hubs and the areas between hubs. While we will pay particular attention to the HDV hydrogen developments (stations and connected supply chains), we will also examine LDV and the interactions that exist between the two types. We will also incorporate work done in 2024 on off-road hydrogen demand such as from airports, ports and rail. For all these modes and sectors, 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. Leakage will continue to play an important role in our analysis.

## Project 10: H2 DEI and Equity Study

**Project Description:** This project was postponed in 2024 since the student who would like to make this her PhD topic was not able to secure funding for doing a major survey, but this is expected for 2025, potentially in cooperation with ARCHES. 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.