STEPS 2015 Projects

Title	Team	Description	Primary Track(s)	Pathways	Geography
STEPS Scenario Model for Alternative Fuel Adoption in the U.S.	Joan Ogden (PI), Lew Fulton (co-PI), Dan Sperling	To explore transition issues, we have developed a simplified scenario model ("STEPS scenario"), for alternative fuel adoption in the United States that is broadly consistent with results from more complex energy/economic optimization (IEA 2012) and consumer choice models (NRC 2013). The STEPS scenario is used as a basis for estimating transition costs for "launching" various types of new vehicles and fuels, e.g. bringing them to lifecycle cost competitiveness with incumbent technologies.	1. Initiating Transitions, 4. Modeling - MAVRIC	All: Electricity, Hydrogen, Biofuels, Natural Gas, Petroleum	Global
Workshop on AFVs 2025 (May 12, 2015)	Lew Fulton (PI), Sonia Yeh, Joan Ogden	This STEPS one-day workshop (day 1 of 2) will explore transportation in the United States and California 5, 10, and 15 years from now in terms of baseline trends and targets. We will also provide commentary and discussion on those targets, explore the prospects for achieving targets and policy implications, and help set a research agenda for the STEPS 2015-2018 Program. The workshop will consider what types of methods and analysis techniques are needed and could be developed under the STEPS 2015-2018 Program to better analyze these questions, helping us set specific research projects and goals for the STEPS Initiating Transitions project.	1. Initiating Transitions, 4. Modeling - MAVRIC	All: Electricity, Hydrogen, Biofuels, Natural Gas, Petroleum	US and CA
Hydrogen Infrastructure for LDVs	Amy Jaffe (PI), Joan Ogden, Guozhen Lee (GSR), Daniel Schietrum (GSR)	Apply modification of the STEPS NG model to case of hydrogen infrastructure for light duty vehicles. Look at how much subsidy would be required to launch the H2 infrastructure, scale it up to profitability.	1. Initiating Transitions, 2. Future of Fuels, 3. Modeling - MAVRIC	Hydrogen	CA and US

PEV Transitions: "What is required for early alternative fuel/vehicle transitions to succeed?"	Tom Turrentine (PI), Dahlia Garas	Are we in the middle of a transition to plug in electric vehicles? The world market for PEV began in December 2010. In 2015, the number PEVs worldwide will reach 1 million. This project tracks basic statistics on the development of this market, including policies, product rollout, consumer response and infrastructure development on a world basis. Dr. Turrentine will also work on a new effort with Lew Fulton to characterize the evolution of this market for market projections. The PH&EV Center investigates the transition to electricity as a fuel, funded by State and Federal Agencies, as well as some support from automakers, conducting around $1-2 million in PEV transition research each year. The Center has developed three major data streams for the next 3 years, annual survey of the US auto market across 12 states (Dr. Kurani), surveys of PEV buyers across 14 states (Dr. Gil Tal) PEV infrastructure studies, used PEV markets (Dr. Turrentine and Gil Tal) and a major data collection (Dr. Mike Nicholas) from 250 PEV households. In the coming years, this data stream will be one of the primary and best sources of understanding of the transition to electricity in the world. Dr. Turrentine will provide a detailed description of this work and results highlights from this data collection effort at STEPS symposia.	1. Initiating Transitions	Electricity	Global
Lifecycle Cost Models (1. Advanced Liquid Fuel Vehicles and Hybrids, 2. Transitions to gaseous fuels-natural gas and hydrogen, 3. Transitions to Plug-in vehicles - EVs and PHEVs)	Andrew Burke (PI), Marshall Miller, Hengbing Zhao, Gustavo Collantes, GSRs	The purpose of this project is to develop a lifecycle cost of ownership model to support the deployment of electrified gaseous fueled vehicles. By tracking the new models/technologies that will be introduced by the auto companies from 2015-2030 these projections will form present and future baselines, which will be compared with more advanced transition vehicles in terms of performance, cost, and fuel avilability requirements. Research will include an assessment of how the markets for gaseous fueled vehicles of various classes will likely develop, how markets for hydrogen and natural gas vehicles may be related, and whether an increase in the market for natural gas vehicles could be a bridge to the more rapid expansion of hydrogen fuel cell vehicles. The success of the future mass marketing of electrified vehicles will be dependent on the battery technologies developed and the economics/costs/durability of the batteries.	1. Initiating Transitions, 4. Modeling - MAVRIC	All: Electricity, Hydrogen, Biofuels, Natural Gas, Petroleum	Global

Modeling and analyzing near term transitions to alternative fueled vehicles using a spatial regional consumer choice and fueling infrastructure model	Christopher Yang (PI), Michael Nicholas, Kalai Ramea (GSR), additional GSR	The research will combine two approaches into a spatially detailed analysis of consumer choice with geographic specification of refueling stations and charging availability in specific geographic areas (Southern California, San Francisco Bay Area, and others). 1) We will analyze consumer purchase decisions at an appropriately fine level of detail as they relate to demographic features such as income, population density, fuel availability, average travel distances and others. 2) A Geographic Information System (GIS) will be used as a tool for simulating a NMNL vehicle choice function with varying demographic and utility parameters across each population "node", and thus different choice probabilities and market shares for specific vehicle technologies (gasoline, hybrids, diesels, plug-in hybrids, battery electric vehicles, fuel cell vehicles, and natural gas vehicles)	1. Initiating Transitions, 4. Modeling - MAVRIC	Hydrogen, Electricity	Southern California, San Francisco Bay Area, at least one region outside CA, such as New York Metro Area
PEV Consumer Studies	Ken Kurani (PI), Nicolette Caperello, additional staff/GSRs	Specific topic TBD. Potentially: *"Leveraging Social Network Connections to Drive Alternative Fuel Transitions."* After the introduction of PEVs to the California market (and other markets), our survey research in 2014 shows that most car owning households in the state are unaware PEVs are for sale, have no knowledge of incentives such as the (CVR) or any other potential benefits and costs of owning and driving PEVs. Research has shown that PEV drivers and ICEV drivers who are aware of PEVs, initially heard about PEVs from coworkers, friends, or family, i.e., their social networks. The anticipated results are a description of whether and how personal social networks of PEV drivers diffuse PEV information and assist to translate this information into personally relevant assessments of PEVs for those people in the network who are not PEV owners. These data may prove essential to leveraging the experience of PEV buyers to promote PEV sales.	1. Initiating Transitions	Electricity	CA and US

Changing Impact of Technological Changes and Urbanization on Efficiency and Global Oil Demand	Amy Jaffe (PI), Rosa Dominquez-Faus (co-PI), Lew Fulton, Sonia Yeh, Yunshi Wang, Daniel Schreitum (GSR), additional GSRs	In this study, we seek to quantify the impact of digital resource productivity and advanced automotive technologies on future oil demand trends through a set of sector specific global energy demand modeling exercises, with detailed scenario analysis of possible trends in the global transportation sector. Efforts will include comparative global energy market modeling studies tapping tools such as GCAM and Arrowhead models as well as focused optimization case studies on 1) the potential for alternative fuels in the US and China's freight and China's light duty vehicle sector, 2) on the impact of urbanization in major cities on oil demand trends, and 3) on evidence of changes in demand patterns through the advent of digital internet of things software management on sector specific patterns of energy use in the United States.	2. Future of Fuels, 1. Initiating Transitions	All: Electricity, Hydrogen, Biofuels, Natural Gas, Petroleum	Global
Database and Analysis of Emerging Fuel Pathways in Key Policies (CA LCFS, RFS)	Julie Witcover (PI), Lewis Fulton, GSR	What can basic information about emerging fuel pathways in the main fuel policies (fuel type/CI, location of production, timing of application or approval) tell us about how alternative fuel markets are responding to the policy landscape? The research will use simple descriptive and exploratory data analysis to examine characteristics of new fuel pathways (frequencies, crosstabs, cluster analysis) as well as indicators of agency performance (e.g., pathway petition processing time)	2. Future of Fuels, 1. Initiating Transitions	Biofuels	CA and US, extendable to other jurisdictions (British Columbia, EU)
Screening for Sustainable Fuels - Towards a Workable Tool	Julie Witcover (PI), Lewis Fulton	How to identify and sustainably source feedstocks has emerged as a key challenge for biofuels. The research will compare different sustainability schemes developed by NGOs, policymakers, and industry, building on efforts to inform policy in Europe and developed by industry: do they identify a 'minimum dataset' of accessible indicators to flag fuel/feedstock sustainability issues or tradeoffs? How much do they need to be customized for particular feedstocks or locations (especially for California)? The research may also explore issues related to sustainability monitoring for existing pathways.	2. Future of Fuels, 1. Initiating Transitions	Biofuels	CA focus, lessons potentially applicable more broadly

The Potential for Low-carbon Vehicles in Cities Around the World	Lewis Fulton (PI), Aria Berliner (GSR), Anqi Zhao (GSR)	"Urban MoMo" has been used to create a baseline and one alternative scenario of future urban travel around the world, with a focus on travel by different modes and the potential impacts of a high modal shift scenario versus a baseline projection. This proposal will extend the work of the previous project to create a "Low-carbon Vehicle" (LCV) scenario that could be linked to the modal shift scenario, kept separate, or both. The approach will focus on improving vehicle technology and fuel efficiency. The results of this project will provide the first ever set of estimates of the potential for LCVs in cities around the world, barriers in specific parts of the world that must be overcome, realistic market penetration rates, and maximum market share rates by different milestone years such as 2030 and 2050. This project will also explore use of big data to understand mobility in Indian cities.	3. Global Urban Transport-GUSTO, 4. Modeling-MAVRIC	All: Electricity, Hydrogen, Biofuels, Natural Gas, Petroleum	Global
Generation Y Travel Survey: An International Investigation of Mobility Patterns and Vehicle-Related Aspirations of Millennials	Lewis Fulton (PI), Giovanni Circella	This project builds on research efforts currently underway at UC Davis to better understand travel patterns, behaviors and attitudes of young adults (“Millennials”, “Generation Y”) It will develop the design of a dedicated online survey, and the relative data collection and data analysis for a sample representative of the population of young adults (between 18 and 30) in California. This investigation will study the travel behavior and aspirations to purchase and use private vehicles of young adults, and the motivations behind them. It will have an international and urban aspect though not preclude US studies and some non-urban traveler studies as part of a broad comparison of young adult travel. The results from this study will be of interest for the scientific community, state agencies, environmental organizations, car-manufacturers and a vast audience of policymakers.	3. Global Urban Transport-GUSTO	Travel patterns, behaviors, attitudes	US and Global
Donate Your Travel Data: Building an International Travel Dataset One Android User at a Time	Gil Tal (PI), Michael Nicholas, Anqi Zhao (GSR)	Researchers are struggling to collect better data on actual travel behavior in a different locations over long time periods study travel behavior, changes in miles travel, mode choice, commute patterns and more by using the data collected by Google and is available to the android phone users. The study will include three tasks. (1) Exploring google data to evaluate travel mode, travel distance, average speed and other variables based on researchers personal data.	3. Global Urban Transport-GUSTO, 4. Modeling-MAVRIC	Travel patterns, behaviors, attitudes	Global

		(2) Developing tools to anonymize donated data by randomizing origins and destinations. (3) Developing a website to guide android users on the steps needed to download their data anonymize it and upload it to our website. (4) Collecting data in Davis and validating the tool accuracy.			
Deep New Mobility Services: Greenhouse Gas and Vehicle Travel Reductions from Future New Mobility Services	Caroline Rodier (PI), GSRs	Very little research has explored how new mobility options (e.g., dynamic ridesharing, smart jitney services, vehicle-sharing, and transportation network companies) may interact synergistically with one another and with land use, transit, and auto pricing policies. It is important to understand what the magnitude of those interactions might be with respect to VMT and/or GHG reductions The study uses the Bay Area and the Sacramento ABMs to examine the potential magnitude of markets for and VMT and/or GHG reductions from new mobility services in different combinations with and without land use, transit, and auto pricing policies. New mobility services will be combined with the region's sustainable community strategies and auto pricing scenarios to understand potential synergies for reductions in vehicle travel and greenhouse gas emissions.	3. Global Urban Transport-GUSTO, 4. Modeling-MAVRIC	Future Mobility Services	CA (Bay Area, Sacramento focii)
Energy Economic System Modeling to Support Policy Analysis: Modeling Analysis, Verification, Regulatory and International Comparisons (MAVRIC) - Various Modeling Track Projects	Sonia Yeh (PI), Lew Fulton, Chris Yang, Alan Jenn, David Bunch, Yueyue Fan, Amy Jaffe, Andy Burke, Gouri Shankar Mishra, Kalai Ramea, other staff/GSRs	The paper will contain the continued developments of a wide range of modeling tools for energy assessment and developing forecast, and evaluating alternative policies when evaluating policy scenarios. The research will also engage in modeling comparison efforts to improve the state of knowledge of plausible pathways/scenarios for future technology adoption, energy use, air quality and greenhouse gas (GHG) emissions, and policy impacts across a range of modeling tools to extract robust policy insights. Modeling tools will be used to identify barriers and progress toward meeting climate policy, energy, and sustainability (which include, but not limited to, air quality, air quality, water, and land use) goals. These efforts will serve as an independent effort to improve modeling practices in the area of sustainable transport with a geographic scope that includes California, the US and the world.	4. Modeling-MAVRIC	All: Electricity, Hydrogen, Biofuels, Natural Gas, Petroleum	CA, US, Global

Trucks Modeling: Modeling and Analysis of Emissions and Costs of Sustainable Truck Futures - Incorporating Spatiality and Decision Making into Future Scenarios	Christopher Yang (PI), Marshall Miller, Lew Fulton, Andy Burke, Hengbing Zhao, GSR	The research will develop a detailed truck model that can be used to analyze scenarios for the future deployment of trucks in the United States and in the state of California. The model will focus on analysis of low-carbon, low criteria pollutant truck technologies such as hybrid, natural gas, fuel cell and electric trucks across trucking sectors. It will incorporate a detailed representation of various truck classes and service demands, detailed estimate of truck efficiencies as a function of driveline, fuel, and sector, a representation of truck purchase decision making in a discrete choice framework, a stock-turnover model to account for truck purchase, vehicle scrappage, and resulting fleet energy and emissions performance. These elements will also be brought together in a specific regional framework to assess impacts of criteria pollutants on non-attainment areas.	4. Modeling-MAVRIC, 1. Initiating Transitions	All: Electricity, Hydrogen, Biofuels, Natural Gas, Petroleum	CA and US
Exploring alternative fuels for non-highway modes	Lew Fulton (PI), Rahael Isaac, Guozhen (Allen) Li (GSR)	This project will investigate advanced technology and fuel options for non-highway transportation modes (including rail, air and ships/ports). The focus during 2015 is on finishing studies on fuel options and refueling infrastructure requirements for these options for aviation and rail systems, Side-by-side comparisons are being developed of a range of fuels for commercial aircraft and passenger and freight train systems that take into account vehicle costs, fuel production costs, and fuel infrastructure costs in the near and longer term. Other issues around the viability of different fuels are also being considered (such as aircraft refueling time, fuel storage requirements, etc.). The results of this project will set the stage for an analysis in 2016 of the potential for the co-development of refueling infrastructure for multiple transport modes such as road/rail/airport in specific locations such as California, using a spatial model.	4. Modeling-MAVRIC, 1. Initiating Transitions	All: Electricity, Hydrogen, Biofuels, Natural Gas, Petroleum	CA, US, Global

Incorporating Strategic Business Behaviors in Infrastructure System Modeling	Yueyue Fan (PI), Zhaomiao Guo (GSR)	The main research goal of this project is to develop a modeling method for incorporating different interests and behaviors of multiple stakeholders in alternative energy infrastructure system modeling. The first model will look at the strategic investment planning of renewable energy considering infrastructure interdependence, uncertain supply and demand, and industrial competition in an oligopolistic power market. The second will focus on the competition among alternative liquid transportation fuel industries under various environmental policies. The anticipated research results include; A general SMPEC modeling & computing method that can be shared among STEPS researchers; A strategic energy infrastructure investment planning model in an oligopolistic power market; A transportation fuel portfolio model considering industrial competition under various environmental policies and programs; Engineering design insights and policy implications drawn from the two application studies.	4. Modeling-MAVRIC, 1. Initiating Transitions	All: Electricity, Hydrogen, Biofuels, Natural Gas, Petroleum	CA (Sacramento Metropolitan Utility District)
Modeling Vehicle Grid Integration (VGI): Value Assessment of Plug-in Electric Vehicle Deployment on the Grid	Dr. Joan Ogden (PI), Mark Lubell (PI), and Kadir Bedir (GSR)	Numerous studies have studied impacts of PEV deployment on the grid, however, the economic and environmental benefits of PEV-based grid services have not been studied extensively, and most analyses are underdeveloped, inconsistent or have not been validated by the vehicle-grid stakeholders. In this research, we propose a comprehensive analysis of PEV impacts considering both, distribution infrastructure and electricity generation, for a mid-size utility region. The results will help addressing the questions of; how can the existing VGI solutions be evaluated with considering electric utilities' individual grid operations; and what is the economic implications of enabling these VGI solutions to the PEV consumers modeling methodology will provide a roadmap for energy planners on how to evaluate technical and economic implications of major VGI solutions for two major agents; electric utility company and the PEV buyer.	4. Modeling-MAVRIC, 1. Initiating Transitions	Electricity	CA (Sacramento Region)

Improving Transportation Fuel Policy Design with Robust Decision Making	Richard Plevin (PI), Gouri Shankar Mishra (GSR)	The goals of this project are 1) to improve the efficacy of policies aiming to reduce the global warming intensity (GWI) of transport fuels by 2) improving the analytical methods used to design and analyze these policies. The project incorporates advanced modeling, "robust" decision-making methods, and high-performance computing to identify policy variants that perform well compared to alternatives in the context of uncertainty. Although the case study addresses fuel policies, the modeling framework and methods developed herein are applicable to a broad range of policies. This project will yield both a general software framework and a robustness analysis of alternative policies to mitigate the climate change impacts of transportation fuels, with recommendations for potential improvements to current policies.	4. Modeling-MAVRIC	All: Electricity, Hydrogen, Biofuels, Natural Gas, Petroleum	Global
Vehicle Controls and System Architecture	Francis Assadian (PI), Andy Burke (co-PI), Hengbing Zhao, GSRs	In this project, the optimization of an EV/HEV powertrain using a new physical concept will be addressed to investigate the feasibility of components such as ultra-capacitors. In addition, simultaneous optimization of the control algorithm and the physical model of the powertrain will be investigated. This simultaneous optimization should result in a more energy efficient and lower cost powertrain.	4. Modeling-MAVRIC	Electricity, Petroleum	Global