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SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS

An Institute of Transportation Studies Program

DAY 1 - STEPS WORKSHOP: ACHIEVING TARGETS THROUGH 2030

Tuesday, May 12, 2015
8:15 a.m. – 5:30 p.m., with evening Reception & Dinner
UC Davis Conference Center, Ballrooms A and B

DAY 2 - STEPS SPRING 2015 SYMPOSIUM: PROGRAM TOPICS & INSIGHTS

Wednesday, May 13, 2015
8:15 a.m. – 5:00 p.m.
UC Davis Conference Center, Ballrooms A and B

Wi-Fi:	**Event Files:**
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Day 1: Tuesday, May 12, 2015
STEPS WORKSHOP: ACHIEVING TARGETS THROUGH 2030

The United States and California have in place a range of targets for energy and transport, including general 80-in-50 type targets (80% reduction in CO2 emissions by 2050) that have implications for transportation over the next 10-15 years, as well as specific targets such as California targets for LCFS in 2020, ZEVs in 2025 and oil use reduction by 2030. Policies have been put in place to meet these targets, but there remain huge uncertainties around manufacturers' ability to produced required types of cars, energy companies' ability to produce required fuels in sufficient volumes, and the willingness of consumers to buy vehicles and fuels in the volumes needed.

This STEPS 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 aim to achieve better understanding for the trajectories and pathways needed, address whether the policies in place appear likely to be sufficient (or need to be changed/augmented), and discuss the implications of policy and whether some targets appear unrealistic under any policy circumstances. As always, this STEPS workshop will offer a platform for the open exchange of ideas and efforts to establish areas of relative confidence and areas that will need further research.

Questions that will be considered during the day include:

- What will U.S. and California travel patterns and baseline energy use be in these future years? What key uncertainties must we live with?
- How will cars and trucks evolve given federal fuel economy and GHG standards? What will happen with advanced technologies (EVs, batteries, fuel cells, etc.)?
- How might ZEV targets be reached and what impact might this have on the broader U.S. and world markets? Same for low carbon fuel targets?
- What might be the fuel shares of different fuels in these years? And what might be the effects on oil/gas markets?
- How effective will current policies be in meeting various targets? What other policies might be more effective and/or more desirable? What are the critical uncertainties and unknowns, and what are the best ways to address those uncertainties?

Finally, 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* and *Modeling* project areas.

8:15 a.m.	Registration and Coffee
8:45 a.m.	**Welcome and Intro Remarks (UC Davis)** • Lew Fulton, STEPS Director and Global Mobility Lead, ITS-Davis
9:00 a.m.	**Session 1: the Baseline picture to 2030 (VMT, energy use, oil/gas trends)** • Joan Ogden (moderator), STEPS Director and Initiating Transitions Lead; Professor, UC Davis • David Daniels, Chief Energy Modeler, Office of Energy Analysis, US DOE

	• Robert Gardner, Manager, Economics and Energy Division, Corporate Strategic Planning, ExxonMobil • **Discussion**
10:00 a.m.	Coffee break
10:15 a.m.	**Session 2: Targets and existing policies:** how are policy makers trying to change things by 2030, how is this different than the baseline? What are the key challenges? • Lew Fulton (moderator) • Jake Ward, Analysis Manager, U.S. DOE Vehicle Technologies Program • Ryan McCarthy, Science & Technology Policy Advisor, Office of the Chair, CARB • Robert Wimmer, National Manager, Environment Research, Technical & Regulatory Affairs, Toyota • Catherine H. Reheis-Boyd, President, Western States Petroleum Association • **Discussion**
12:10 p.m.	Lunch
1:00 p.m.	**Session 3: Technologies and fuels**: how much are we relying on hitting certain vehicle (car and truck) and fuel technology targets and certain fuel types to achieve goals? Are the targets at this level achievable in the time frame? Where should we be by 2020/2025/2030? Strategies for dealing with missing tech targets? • Amy Jaffe (moderator), Exec. Dir. Energy and Sustainability, UC Davis • Mike Hartrick, Senior Regulatory Engineer, Fiat Chrysler Automobiles • Jennifer Rumsey, VP Engineering, Engine Business, Cummins • Jeffrey Jacobs, Vice President, Chevron Technology Ventures • James Ellis, Director of Electrification and Electric Vehicles, PG&E • **Discussion**
2:45 p.m.	Coffee break
3:00 p.m.	**Session 4: The role of policy**: What new policies might be needed in order to hit targets? What must be assessed in designing such policies? • Sonia Yeh (moderator), Research Scientist, UC Davis • Roland Hwang, Director, Energy & Transportation Program, NRDC • Lisa Snapp, Director, Climate Analysis and Strategies Center, US EPA • Alex Keros, Manager, Advanced Vehicle and Infrastructure Policy, GM • Sharon Burke, Senior Advisor, New America • **Discussion**
4:45 p.m.	**Session 5: What does it mean for research?** Gaps in understanding, needed research areas, potential projects for STEPS 2015-2018 • Dan Sperling (moderator), ITS-Davis Director and Professor, UC Davis • **Discussion**
5:30 p.m.	Adjourn
6:00 p.m.–9:00 p.m.	**Reception & Dinner** *(All Day 1 and Day 2 attendees are invited)* Our House Restaurant 808 2nd St, Davis, CA 95616

Day 2: Wednesday, May 13, 2015
STEPS SPRING 2015 SYMPOSIUM: PROGRAM INTRODUCTION & INSIGHTS

This STEPS one-day symposium (day 2 of 2) will introduce and discuss new research projects and insights under the new STEPS 2015-2018 Program as well as new research areas of significance to consortium members and invited experts.

8:15 a.m.	Continental Breakfast

8:45 a.m.	**Session 1: Launching the STEPS 2015-2018 Program & New Projects**
	• **Program Overview** (Paul Gruber, STEPS Executive Director)
	• **Initiating Transitions 2015-2030:** What is required for early alternative fuel/vehicle transitions to succeed? (Joan Ogden and team)
	  ○ Transition costs
	  ○ PEV Market Update (Tom Turrentine, Director, PH&EV Research Center)
	  ○ Respondent: Steven Cliff, Assistant Director of Sustainability, Caltrans
	  ○ **Discussion**
	• **The Future of the Fuels Industry:** How will changing geopolitical landscapes and disruptive technology in the oil and gas and clean technology industry impact future business models and the competition of fuels? (Amy Jaffe and team)
	  ○ Intro to oil and gas truck (Rosa Dominguez-Faus, Postdoctoral Researcher)
	  ○ Global natural gas modeling results (Sonia Yeh)
	  ○ CNG urban cycle zones (Nathan Parker, Postdoctoral Researcher)
	  ○ Initial modeling of RNG (Daniel Scheitrum, Graduate Student)
	  ○ **Discussion**
	• **Global Urban Sustainable Transport (GUSTo):** How will a rapidly urbanizing world affect demand for transport and energy? How can we transition to sustainable transportation in a rapidly urbanizing world with ever-growing need for mobility? (Lew Fulton and team)
	  ○ Potential for Low-carbon Vehicles in Cities Around the World (Lew Fulton)
	  ○ Donate Your Travel Data: Building an International Travel Dataset One Android User at a Time (Gil Tal, Professional Researcher)
	  ○ iTEM: International Transportation Energy Modeling Comparison (Gouri Shankar Mishra)
	  ○ **Discussion**
	• **Modeling Analysis, Verification, Regulatory and International Comparisons (MAVRIC):** What do improved and cross-compared economic/ environmental/ transportation/ energy models tell us about the future of sustainable transportation? (Sonia Yeh and team)
	  ○ CA-TIMES modeling and CCPM (California Climate Policy Modeling Comparison Dialogue) updates (Sonia Yeh)
	  ○ Uncertainty Analysis: Monte Carlo Analysis of GTAP and GCAM (Rich Plevin, Research Scientist)
	  ○ **Discussion**

11:30 a.m.	**Poster Session** Team members present at their posters
12:30 p.m.	**Lunch is served; continue Poster Session**
1:30 p.m.	**Session 2: New Mobility and Optimal Use of Big Data for Sustainable Transport** • Moderator: Sonia Yeh • Mike Tamor, Henry Ford Technical Fellow, Ford • Kevin Novak, Head of Data Science, Uber • Caroline Rodier, Associate Director, ULTRANS, ITS-Davis • Jeff Gonder, Senior Engineer, Center for Transportation Technologies and Systems, NREL • **Discussion**
3:00 p.m.	Coffee break
3:15 p.m.	**Session 3: Sustainable Pathways for Trucking** • Moderator: Lew Fulton • Patric Oulette, Chief Technology Officer, Westport Innovations • David Kayes, Executive Engineer of Environmental Compliance, Daimler Trucks NA • Miguel Jaller, Professor, UC Davis • Lisa Mirisola, Program Supervisor, Science & Technology Advancement, South Coast AQMD • **Discussion**
4:45 p.m.	Wrap up
5:00 p.m.	Adjourn

Posters

#	Title	Presenter/Team	Description
1	**California TIMES (CA-TIMES) Model: Modeling Optimal Transition Pathways to a Low Carbon Economy in California**	Saleh Zakerinia, Sonia Yeh, Chris Yang	The CA-TIMES model represents energy supply and demand sectors in California and simulates the technology and resource requirements needed to meet projected energy service demands. Multiple scenarios are developed to analyze the changes and investments in low-carbon electricity generation, alternative fuels and advanced vehicles in transportation, resource utilization, and efficiency improvements across many sectors. Results show that major energy transformations are needed but that achieving the 80% reduction goal for California is possible at reasonable average carbon reduction cost relative to a baseline scenario.
2	**COCHIN-TIMES: Incorporation of Vehicle Choice in Energy Systems Models and their Implications for Climate Policy analysis**	Kalai Ramea, Sonia Yeh, Chris Yang, David Bunch	Energy systems models have been at the heart of climate policy analysis in many agencies (including IPCC) since the 1990s to develop long-term emissions scenarios. Historically, as most policy regulations were imposed on the supply sector, these models are quite rich in technological details on the supply side, but lack behavioral realism on the demand-side. This limitation is being widely discussed within the modeling community now, as energy policy development not only involves how energy is being produced, but also how it is consumed. COCHIN-TIMES model is a novel methodology that bridges this gap by bringing in consumer choice on the demand side, and it illustrates the modeling improvement through the light-duty vehicle sector investments.
3	**Complex Air Quality Implications from Low Carbon Energy Scenarios for CA in 2050**	Christina Zapata	Two energy scenarios, with and without a carbon target constraint, were analyzed from the cost-minimization CA-TIMES energy model. Differences in technologies, fuels, and sectors were reviewed for each scenario and potential criteria pollutant emissions impacts were estimated. Preliminary results of air pollution implications in historically polluted San Joaquin Valley and the South Coast Air basins will be previewed and discussed.
4	**Evaluating Policy Efficacy: What should we invest in?**	Jeff Kessler	Using the Technology Innovation Systems framework, it is possible to track innovation, and to assess what supports or drives deployment and adoption outcomes. This research provides evidence as to the kinds of policies that promote technology innovation and adoption of biofuels at the state level.

5	**Analysis of Feebates and Household Impacts in California**	Julie Schiffman and Lew Fulton	This analysis builds on the 2008 to 2011 UC Davis feebate study. It focuses on feebate design alternatives that might best meet requirements related to a low carbon/ZEV vehicle roll-out over the coming decade. It attempts to a) understand how to meet specific revenue requirements, b) study ZEV-specific consumer behavior modeling, e) study the distribution of costs and benefits across demographics. The study uses data from the 2010 to 2012 California Household Travel Survey and an PH&EV survey of PEV car buyers.
6	**Generation Y Travel Survey**	Giovanni Circella, Aria Berliner, Lew Fulton	This project seeks to better understand travel patterns, behaviors and attitudes of young adults (“Millennials”, “Generation Y”). It will develop and carry out an online survey, and analysis the data from this survey, for a sample representative of the population of young adults (between 18 and 34) 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.
7	**Understanding urban development and transport in Indian cities**	Anqi Zhao	Initiatives to plan for sustainable transportation and identify infrastructure challenges require access to meaningful, dynamic, and timely datasets regarding urban development and transportation system. Yet, there are key information gaps in rapidly urbanizing countries like India. This project addresses these challenges by leveraging multiple urban data sources, ranging from conventional data source such as socioeconomic data and satellite images to emerging "urban big data" sources such as geo-tagged social media data, citizen-created maps, and real-time traffic data.
8	**Analysis and Scenarios of Low-Carbon Options for Heavy Duty Trucks**	Lew Fulton, Marshall Miller, Christopher Yang	This new research project will analyze scenarios for the future deployment of trucks in the United States and California. A new model will be constructed that incorporates a detailed representation of various truck classes and service demands, truck attributes such as cost and efficiency across driveline, fuel, and sector), a representation of truck purchase decision making in a discrete choice framework, a stock-turnover model and resulting fleet energy and emissions performance. The model will be used to develop forward-looking scenarios with a 10-15 year focus.
9	**Rail Energy Update: Options for Passenger and Freight Rail Propulsion**	Raphael Isaac	We have expanded our earlier rail analysis, which focused on passenger rail, to the freight rail sector. With much larger amounts of fuel in use, fuel costs become much more significant. In addition, the large amounts of fuel require the use of tender cars for LNG and LH2, which add to the cost for alternative fuels for freight. Overall, we find that the ideal options for freight propulsion are not necessarily the same as is the case for passenger rail.

10	**Dynamic Optimization of Natural Gas Refueling Infrastructure for Freight Trucks**	Dan Scheitrum, Nathan Parker, Yueyue Fan, Rosa Dominguez-Faus, Amy Jaffe	Use of natural gas, both LNG and CNG, as a vehicle fuel has the potential to be successful in select vehicle market segments based upon favorable economies. Our model finds the profit maximizing location to site refueling stations and micro-liquefaction plants while still satisfying local route demand. We are updating the model to account for renewable sources of natural gas and their preferential treatment in the market.
11	**Emerging Biofuel Pathways in Policy (2 projects)**	Julie Witcover, Lew Fulton	Building on NextSTEPS work identifying trends in emerging biofuel pathways and tracking policy incentives, the research will build and analyze a database of emerging fuel pathways in key policy programs, focusing on key characteristics. A second component will examine existing sustainability schemes (by business, policy, and NGOs) for insights on ways biomass is assessed for low-carbon bioenergy potential.
12	**Modeling Grid Impacts of PEV Deployment: Case Study of Sacramento Region**	Kadir Bedir and Joan Ogden	This research addresses the question of how PEV-grid stakeholders can quantify the technical impacts of PEV load, and economic value from PEV-based grid services. I developed optimization algorithms for PEV consumer adoption of demand-side management (DSM) scenarios in the Sacramento region, and performed Monte-Carlo simulations in Matlab. The preliminary results show that widespread PEV adoption may have a significant impact on the annual peak demand and on the distribution system, depending on the DSM scenarios.
13	**Infrastructure Planning for Public Fast Charging Stations in a Competitive Market**	Zhaomiao (Walter) Guo	This study presents a mathematical model that supports fast charging infrastructure planning under uncertainty and competition. Uncertainty about future electric vehicles adoption rate is modeled explicitly. Based on preliminary numerical results, we find that the investment pattern could be affected by consumers' weights on charging price and charging availability: if consumers care more about charging availability, the investment may cluster to a few locations; on the contrary, the investment may diffuse through out the network.
14	**An Overview of Tesla Battery Electric Vehicle Adopters**	Scott Hardman	This project inestigates early adopters of Tesla battery electric vehicles. 155 questionnaire survey responses were gathered in 2014, the results are presented in brief here. The results show that Tesla adopters are of exceptionally high income, very well educated and in multi-car households. The results also show that these people adopted a Tesla due to performance, environmental, technological and aesthetic motivations. The respondets have a extremely preferential opinion of their vehicles, this leads to them being likely to continue with electric vehicle ownership in future vehicle choices.

15	**Life Cycle Assessment of EV Traction Batteries**	Hanjiro Ambrose and Alissa Kendall (PI)	This study explores dynamic life cycle assesment of the environmental and material burdens of EV traction batteries, including manufacturing and vehicle use-phase. Several lithium cathode arrangements (LiNi0.8-0.85Co0.1-0.15Al0.05O2, LiFePO4, LiMn2O4, Li(Ni0.37, Co0.37, Mn0.36)O2), as well as anodes (Graphite, LiTiO2 and SiNW), are being used in or considered for mass market vehicles. These traction batteries will be used in a variety of vehicle applications, including battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and heavy-duty EVs (P-HDVs/HDEVs). Vehicle use-phase emissions performance will depend on the emissions factors for the utility grid supplying power to these vehicles. We present priliminary results on lithium demands, storage requirements, on-road performance, and battery manufacturing emissions for a US PEV fleet.
16	**Global EV Scenarios**	Tom Turrentine, Gil Tal, Aria Berliner, Lew Fulton	This project investigates the factors that will likely influence the market uptake of plug-in electric vehicles (PEVs) over the next 15 years, and provide a set of scenario projections of sales of PEVs around the world through 2030. It will further link these to a set of projections of their likely impacts (energy savings, CO2 emissions reductions) using the IEA Mobility Model. The main study will develop a new approach to characterizing PEV markets and potential future developments in a number of major vehicle markets around the world (with primary focus on major markets - US, EU, Japan, China, India and possibly one or two other countries).
17	**Integration of Sustainable Fueling/Charging Systems with Grid Energy Storage at Highway Rest Areas**	Hengbing Zhao and Andrew Burke	This research will study the feasibility of the deployment of the renewable hydrogen fueling stations/EV fast charging stations at Highway Rest Areas and their integration with the utility grid as energy storage. Integration with utility energy storage will make the fueling/charging stations more sustainable in terms of accessibility, efficient use of land, economic feasibility, and scaling up.
18	**Advanced Vehicle Technology Studies for STEPS 3**	Hengbing Zhao and Andrew Burke	This project investigates advanced hybrid vehicle technologies, transition to geseous fueled vehicles, and transition to EVs and PHEVs. Energy storage requirements for various types of electric drive mid-size passenger cars are studied. considering real-world driving conditions, the effect of accessories such as heating and cooling on fuel economy, energy consumption and electric range of EVs and PHEVs have been simulated. Natural gas hybrids and hydrogen fuel cell vehicles are also analyzed in terms of cost and emissions.
19	**Attracting customers through hydrogen station placement – Flow capture and its influence on refueling and purchase**	Michael Nicholas	The study investigates placement of hydrogen refueling stations, focusing on flow capture's influence on refueling and purchase.

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SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS

An Institute of Transportation Studies Program

Sustainable Transportation Energy Pathways Program (STEPS)
www.steps.ucdavis.edu

STEPS is the major multidisciplinary research consortium within the Institute of Transportation Studies at the University of California, Davis. The consortium is comprised of 40+ PhD-level faculty and researchers and graduate students from UC Davis, 20+ industry and governmental partners, and 20+ outside expert organizations. Our mission encompasses research, outreach, and education:

- generate new insights and tools to understand the transitions to a sustainable transportation energy future for California, the US and the world,
- disseminate valued knowledge and tools to industry, government, the environmental NGO community, and the general public to enhance societal, investment, and policy decision making,
- train the next generation of transportation and energy leaders and experts.

The STEPS 2015-2018 program is generously supported by these sponsors (incl. pledges and commitments):

- Auto: BMW, Cummins, Daimler, Ford, Fiat Chrysler, GM, Honda, Renault, Toyota, Volkswagen, Westport
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- Government: California Air Resources Board, Caltrans, South Coast AQMD, U.S. DOE, U.S. DOT, U.S. EPA

STEPS has initiated a 2015-2018 research program. The main program areas and overarching research questions are:

- **Initiating Transitions 2015-2030:** What is required for early alternative fuel/vehicle transitions to succeed?
- **The Future of the Fuels and the Oil & Gas Industry:** How will changing geopolitical landscapes and disruptive technology in the oil and gas and clean technology industry impact future business models and the competition of fuels?
- **Global Urban Sustainable Transport (GUSTo):** How will a rapidly urbanizing world affect demand for transport and energy? How can we transition to sustainable transportation in a rapidly urbanizing world with ever-growing need for mobility?
- **Modeling Analysis, Verification, Regulatory and International Comparisons (MAVRIC):** What do improved and cross-compared economic/environmental/transportation/energy models tell us about the future of sustainable transportation?

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Survey - STEPS 2030 Targets Workshop and Spring 2015 Symposium

Please complete online (log in at www.steps.ucdavis.edu; password: STEPS2015) or complete and return to Paul Gruber or Beth Bourne.

Your Name and/or Organization (optional):

_____

1. How did these events help improve your state of knowledge of STEPS issues (i.e., critical transition dynamics for alternative fuels and vehicles)?

2. What were your key insights from this event?

3. In your opinion, who gave the best presentation? Why?

4. Which poster did you like best: Poster #_____ Why?

5. What could we improve upon?

6. What new or promising research areas should we be tackling in 2015 and beyond?

Other feedback?