



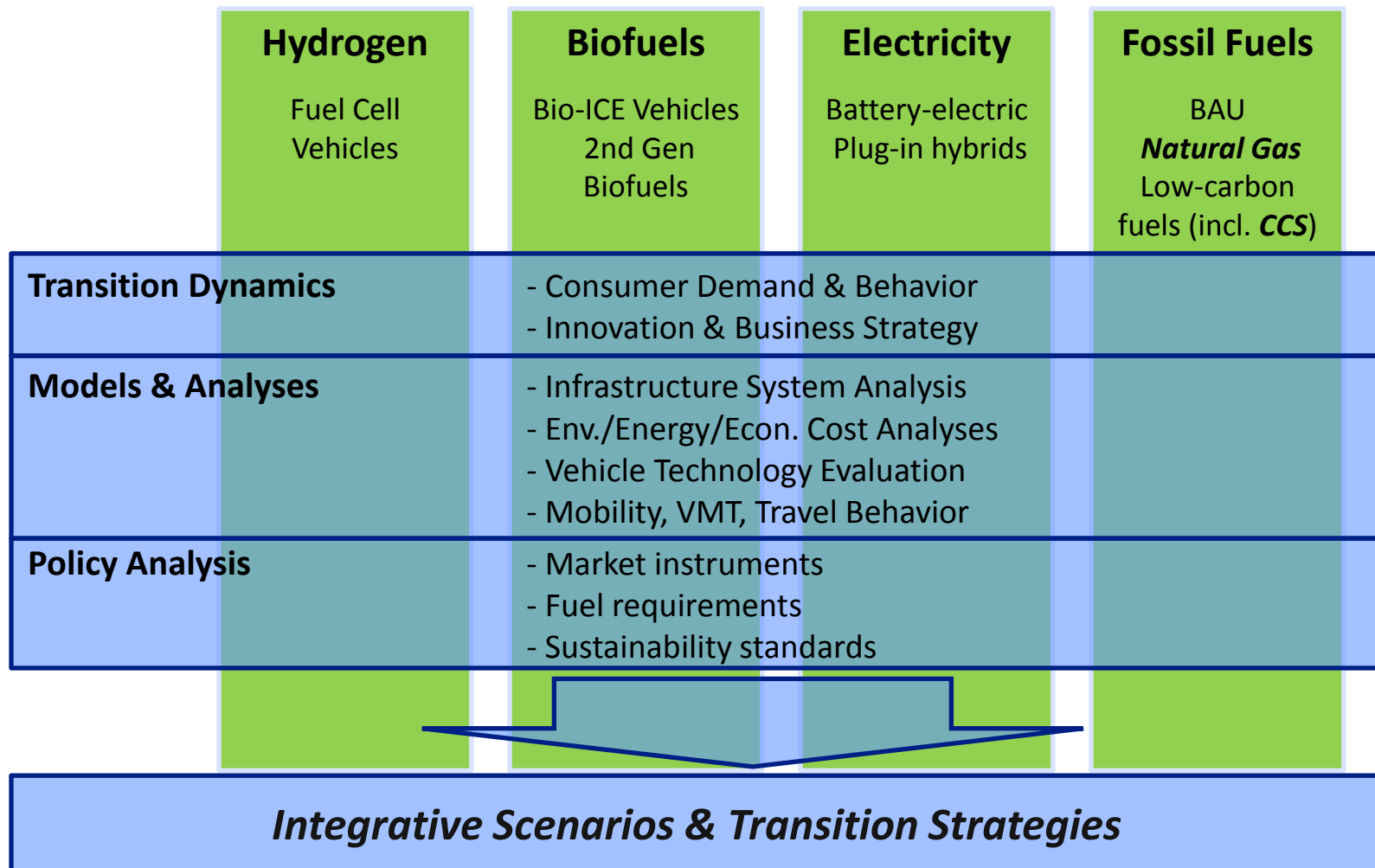
Sustainable Transportation Energy Pathways (STEPS)

Welcome! STEPS Fall 2015 Symposium

December 10, 2015

Joan Ogden, Director

STEPS research framework: designed to enable analysis and comparison of alternative fuel and vehicle transitions



STEPS 2015–2018 (*STEPS3*): Understanding Critical Transition Dynamics for Sustainable Transportation

Four Key Research Themes :

1. Initiating Transitions 2015-2030

What is required for early alternative fuel/vehicle transitions to succeed?

2. The Future of Fuels and the Oil and Gas Industry

How will changing geopolitical landscapes and disruptive technology in the oil and gas and clean technology industries impact future business models and the competition of fuels?

3. The Future of Global Urban Sustainable Transport (GUSTO)

How will a rapidly urbanizing world affect transport and energy demand?

4. Modeling Analysis, Verification, Regulatory and International Comparisons (MAVRIC)

What do improved and cross-compared energy/economic/environmental/transportation models tell us about the future of transportation?

STEPS Leadership: top experts on alternative fuels, vehicles, policy, oil and gas, EVs, and scenario modeling



Joan Ogden, Professor/STEPS Director: world's top expert on *economic assessment of fuels, esp. hydrogen*



Lew Fulton, STEPS Director: leading analyst on *global sustainable transport scenarios*, formerly at IEA



Dan Sperling, Professor/STEPS Co-Director/ITS-Davis Founding Director: leading global expert on *sustainable transportation and policy*



Amy Myers Jaffe, Exec. Dir., Energy & Sustainability: leading global expert on *oil and gas and sustainable energy*



Andy Burke, Research Engineer: leading expert on *vehicle technology evaluations*, esp. batteries and supercapacitors



Sonia Yeh, Research Engineer: leading *energy modeling* known for innovative strategies on big data, GIS mapping and *national policy*



Tom Turrentine, Dir., PH&EV Research Center: consumer response to alternative vehicles, esp. *PEV market*

STEPS3 builds upon our robust set of models

- **CA-TIMES:** Energy System Model for California
- **CCPM:** CA Climate Policy Modeling dialogue project
- **GCAM:** Global Change Assessment Model
- **MoMo:** Global Transport Energy Model (IEA)
 - Assessing the Impacts of Rapid Uptake of Plug-in Vehicles in Nordic Countries
- **iTEM:** International Transport/Energy Model Comparison Project
- **GBSM:** Geospatial Biorefinery Siting
- **Natural Gas** Infrastructure model
- **Hydrogen** station siting and rollout models
- **EV charger siting & rollout** models
- **CCS system** model
- **TOP-HDV:** California truck projection model
- **ADVISOR:** vehicle energy use simulation model
- **Water, land, materials & energy** modeling

STEPS 2015 Program Stats

- **36 publications and reports** in 2015 (18 in peer-reviewed journals)
- **22 STEPS 2015 projects** represented today in presentations and posters
- **22 PhD-level faculty and staff researchers**
- **18 PhD and MS graduate students**
- **10 major STEPS events** with industry, policymakers, NGOs, academics
- **5 degrees granted** in 2015 (3 M.S., 2 Ph.D.)
- **3 webinars** on white papers covering natural gas and sustainable trucks
- **Research insights and blogs** emailed every 2-4 weeks throughout 2015

STEPS 2015 Major events with industry, policymakers, NGOs, academics

- *STEPS Advisory Board Meeting* Dec. 11
- *STEPS Fall Symposium 2015* Dec. 10
- *STEPS Lookback Analysis Workshop* Dec. 9
- Assessment of Critical Barriers and Opportunities to Commercialize Medium and Heavy Duty Truck Technologies in CA Dec. 3
- Technological, Economic and Environmental Potential of Natural Gas as a Sustainable Transportation Fuel in the US Oct. 1
- Critical Barriers and Opportunities to Accelerate Biofuels and Biomethane as Transportation Fuels in California Sept. 17
- STEPS Advisory Board Meeting Aug. 18
- STEPS 2030 Targets Workshop & STEPS Spring 2015 Symposium May 12-13
- Assessment Meeting on “Critical Barriers to Commercialization of Emerging Alternative Fuel, Vehicle and Infrastructure Technologies in CA” Mar. 17
- California Climate Policy Modeling Dialogue at UC Davis Feb. 23

Agenda for today's STEPS Fall 2015 Symposium

KEYNOTE: Relevance of COP21 for US/CA regulations & STEPS research

HIGHLIGHTS FROM STEPS 2015 RESEARCH

- **Presentations (w/ Q&A and Discussion)**
 - Current Markets and Consumer Trends
 - Transitions and Scenarios
 - Insights on Future Fuels
- **Poster Session**

POLICY PANEL: How Important are Tradable Credits?

PREVIEW OF STEPS 2016

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SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS

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APPENDIX



1. Initiating Transitions 2015–2030

What is required for early alternative fuel/vehicle transitions to succeed?

Motivation & Value:

Significant progress in alternative fuels and vehicles has been achieved over the past decades but none of the alternatives have reached mass-market scale. We appear to be on the cusp of an initial transition for several new sustainable transportation technologies. This research area aims to understand the potential and likely role of alternative fuels and vehicles over the next 15 years. We examine technology progress, stakeholder roles, transition dynamics, commercialization strategies, and the role of policy in driving and supporting transitions during this critical period.

Key Research Questions:

- What can we learn about the barriers and opportunities and the costs and benefits of introducing new fuels and vehicles?
- How are vehicle rollouts proceeding for electric vehicles, natural gas, biofuels and hydrogen? Which strategies are proving effective, and which are not?
- What have we learned about the policy landscape for sustainable transportation?
- How much public and private investment is needed to reach cost competitiveness with incumbents?
- What values, thresholds, limits, or other indicators signal the need for change to investments, policies, or other behavioral levers?
- What is required to develop a business case for new fuels and vehicles?
- How does adoption of alternative fuels up to 2030 impact the outlook for meeting longer-term sustainability goals and realizing different sustainable transportation futures?

2. The Future of the Fuels Industry

How will changing geopolitical landscapes and disruptive technology in the oil and gas and clean tech industry impact future business models and the competition of fuels?

Motivation & Value:

Transformational technologies are changing the oil and gas industry, with dramatic impacts on energy trade, the competition of fuels, and the composition of future energy demand. This research area focuses on how the fuels industry will adapt to geopolitical and technology changes and climate concerns over time and how the industry will meet the challenges of rising demand for sustainable fuels.

Key Research Questions:

- In the absence of strong policies leading to sustainable transportation, what is the baseline outlook for future oil demand, and how might it change over time?
- How will the proliferation of big data analytics and the internet of things constrain growth in demand in the coming two decades?
- What role will changing automotive technologies and mobility services, e.g., car and ride sharing, have on oil demand?
- What are possible mixes of fuels and vehicles over time in a carbon-constrained world?
- What is the future role of liquid fuels versus gaseous fuels and electricity? How might biofuels penetrate liquid fuels markets?
- What do abundant, unconventional natural gas resources mean for the low carbon future?
- What are future technology and fuels options for the heavy duty, aviation and marine sectors?
- How will industry respond to regulatory and/or societal demands for reduced greenhouse gas (GHG) emissions and improved environmental quality for air, water, land use and materials?
- How might the oil industry transition to more sustainable fuels?

3. GUSTo: The Future of Global Urban Sustainable Transport

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?

Motivation & Value:

The world's urban population is expected to rise from 3.5 billion today to ~7 billion by 2050. This research area focuses on transitions to more sustainable urban transport and compares developed and developing cities, regions, and countries. The role of information and communication technologies (ICT), big data, new mobility paradigms, integration of modes, and introduction of new fuel and vehicle technologies will be addressed holistically to describe likely future trends and identify forces and factors that might change VMT and system formats from an energy and GHG perspective.

Key Research Questions:

- What are the likely growth trends for urban travel around the world, taking into account shifts in land use, modal shares, new types of vehicles, and car ownership and use? What are the social, personal, political, economic, and technological constraints on the rates of change? Which of these tend to resist change, and which compel change?
- How will urbanization affect future transport and energy demand?
- What are the implications of growing and evolving cities for CO2 emissions, transport and energy infrastructure requirements, and materials requirements?
- How might different types of policies play a role in improving alternative modes and deploying alternative fuels in this context? What are the possible impacts of greater use of ICT?
- How much and what kinds of investments and supporting policies will be needed to achieve more sustainable mobility? How does the picture differ around the world, and what trends appear likely to be global?

4. MAVRIC: Modeling Analysis, Verification, Regulatory and International Comparisons

What do improved and cross-compared energy/economic/environmental/transportation models tell us about the future of transportation?

Motivation & Value:

STEPS 2015-2018 will continue to develop a wide range of models and related tools to conduct research and create future scenarios. This research area will increase the focus on innovative tool development, validation—including a review of previous modeling results from today's perspectives to learn and improve models—and comparison with other existing methods. These efforts will directly support priority research activities but also serve as an independent effort to assess the state of modeling and improve modeling practices in the area of sustainable transport, with a geographic scope that includes California, the U.S. and the world.

Key Research Questions:

- What do existing models at the California, U.S. and international levels tell us about different possible energy and transportation futures and the paths to those futures?
- How have the forecasts and models of market adoption of new vehicle and fuel technologies developed during the STEPS 2007–2010 and NextSTEPS 2011–2014 programs performed relative to their actual market penetration? What lessons can be learned and applied to improve our future models and forecasts?
- How do model projections and scenarios compare and what can we learn from each?
- How can a wide range of diverse and divergent scenarios/modeling outcomes be used to help inform decision-making and policy design in the face of significant uncertainty? Are there robust strategies that we can identify?
- What assumptions are being made and which ones matter most? What metrics of change over time are required to assess the comparative likelihood of alternative energy pathways, including one dominated by shale oil and gas, meeting sustainability goals and timelines?
- How can we improve our own scenario making and use our own models in a better fashion to help us assess policies?

STEPS 2015 Projects: Initiating Transitions

STEPS Scenario Model for Alternative Fuel Adoption in the U.S.

Workshop on AFVs 2025 (May 12, 2015)

Hydrogen Infrastructure for LDVs

PEV Transitions: "What is required for early alternative fuel/vehicle transitions to succeed?"

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)

Modeling and analyzing near term transitions to alternative fueled vehicles using a spatial regional consumer choice and fueling infrastructure model

PEV Consumer Studies

STEPS 2015 Projects: Future of Fuels and the Oil and Gas Industry



Changing Impact of Technological Changes and Urbanization on Efficiency and Global Oil Demand

Database and Analysis of Emerging Fuel Pathways in Key Policies (CA LCFS, RFS)

Screening for Sustainable Fuels - Towards a Workable Tool

STEPS 2015 Projects: GUSTo - Global Urban Sustainable Transportation

The Potential for Low-carbon Vehicles in Cities Around the World

Generation Y Travel Survey: An International Investigation of Mobility Patterns and Vehicle-Related Aspirations of Millennials

Donate Your Travel Data: Building an International Travel Dataset One Android User at a Time

Deep New Mobility Services: Greenhouse Gas and Vehicle Travel Reductions from Future New Mobility Services

STEPS 2015 Projects: MAVRIC - Modeling, Analysis, Verification, and Regional and International Comparisons

Energy Economic System Modeling to Support Policy Analysis: Modeling Analysis, Verification, Regulatory and International Comparisons (MAVRIC) - Various Modeling Track Projects

Trucks Modeling: Modeling and Analysis of Emissions and Costs of Sustainable Truck Futures - Incorporating Spatiality and Decision Making into Future Scenarios

Exploring alternative fuels for non-highway modes

Incorporating Strategic Business Behaviors in Infrastructure System Modeling

Modeling Vehicle Grid Integration (VGI): Value Assessment of Plug-in Electric Vehicle Deployment on the Grid

Improving Transportation Fuel Policy Design with Robust Decision Making

Vehicle Controls and System Architecture

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