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New UC Davis Study Offers Surprising Insights on Biofuels

“Three Routes Forward for Biofuels” Finds Today’s Improvements Can Boost Tomorrow’s Innovations

DAVIS – A scientific study released today by the Institute of Transportation Studies at UC Davis (ITS-Davis) examines how an incremental approach to supplement advanced innovation in biofuels can help California and the nation meet clean fuel and lower emission standards. The study, “[*Three Routes Forward for Biofuels*](#),” helps chart a new path toward the sustainable use of biofuels as a low-carbon, renewable fuel source – with improvements today leading toward breakthroughs tomorrow.

“Improvements are now quietly occurring at existing biofuel facilities that will make major future innovations more likely,” said Dr. Lew Fulton, the study’s lead researcher and co-director of the Sustainable Transportation Energy Pathways (NextSTEPS) program at ITS-Davis. “Our research shows that we should not ignore incremental changes while we’re trying to find leapfrog solutions in California and the U.S.,” said Fulton.

The study identifies three routes for biofuels produced at biorefineries: (1) an “incremental” route in which small improvements are made at existing plants, (2) a “transitional” route in which cellulosic “bolt-on” production and other innovations leverage existing investments; and (3) a “leapfrog” route that focuses on major technological breakthroughs in cellulosic and algae-based pathways at new, stand-alone biorefineries.

Together these routes suggest a new way to think about the future of biofuels in the U.S. and a strategy to help achieve California’s Low Carbon Fuel Standards (LCFS) and national Renewable Fuel Standards targets. California’s LCFS has encouraged a series of incremental changes on how biofuels are produced for the country’s long-term renewable fuel goals, researchers noted.

The study also looks at the emerging trade-off between investment risk today and future reduced carbon emissions. Incremental improvements occurring at biorefineries (such as process efficiency) could result in reductions in GHG emissions and in many cases have a payback period of less than two years for the fuel producer. The nation’s small and medium-sized biorefineries are generally willing to take this risk.

Given the large volumes of conventional biofuels in the U.S. (about 15 billion gallons in 2013), these incremental improvements at corn ethanol and biodiesel plants add up to significant overall carbon

dioxide reductions. By 2030, the improvements will translate into annual reductions of 20-30 million metric tons in the rated GHG emissions of these biofuels. That is equivalent to removing 750,000 to 1.5 million passenger cars from America's roadways.

Most of the activity now for GHG reductions and technological innovation is happening at existing corn ethanol biorefineries which are creating efficiency and process improvements. More than 90 percent of U.S. biofuel currently comes from corn ethanol, but other biofuels will be part of the future mix.

Researchers found that moving toward a large-scale, sustainable biofuel future will require continued technology development and a favorable policy environment that encourages innovation and investments in large-scale, low-carbon leapfrog solutions. However, incremental and transitional routes should not be ignored and may play a critical role in future progress, according to the study.

The study notes the policy landscape must evolve as leapfrog technologies (cellulosic or algae-based) scale-up and achieve commercialization. Leapfrog technologies have not gained much traction despite large amounts of support at the federal level. These technologies are not inherently environmentally sustainable and policies will be needed to ensure that they deliver on their promised environmental performance.

“On the national level, it's important that revisions to the Renewable Fuel Standard encourage investments that reduce GHG emissions at existing refineries. California's Low Carbon Fuel Standard already does this to some degree,” said Fulton. “A comprehensive and well-executed federal policy can help build a bridge from today's biofuels to advanced, future biofuels that deliver on biofuels' environmental promise.”

LINK – [Three Routes Forward for Biofuels: Incremental, Transitional, and Leapfrog](#)
(Four-page Summary)

LINK – [Three Routes Forward for Biofuel: Incremental, Transitional, and Leapfrog](#)
(White Paper, 42 pages)

About the [UC Davis Institute of Transportation Studies](#)

The Institute of Transportation Studies at UC Davis (ITS-Davis) is the leading university center in the world on sustainable transportation. It is home to more than 60 affiliated faculty and researchers, and 120 graduate students. ITS-Davis is partnered with government, industry, and non-governmental organizations to inform policy making and business decisions, and advance the public discourse on key transportation, energy and environmental issues.

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