Electricity more efficient than ethanol as energy pathway from biomass

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(PhysOrg.com) -- Electricity or ethanol, which is the better use of our nation's biomass crops when it comes to powering vehicles? Our government seems to have chosen ethanol, recently announcing nearly $800 million of research money devoted towards biofuels, far more than they have committed towards bioelectricity. However, a recent study published in the journal Science seems to suggest that they, like me at the Kentucky Derby, may be backing the wrong horse. The team, led by researchers at UC Merced and Stanford, have found that bioelectricity outperforms ethanol across a wide range of input parameters, in terms of transportation efficiency as well as emissions.

Energy is radiated to earth from the sun and stored by crops in molecular bonds. To harness and use that energy, we need to break those molecular

bonds, typically by burning the crops. This method for harnessing energy has probably been mankind's longest, ever since man discovered that one can burn wood to produce heat. In fact, until the 1860's the U.S. used biomass in the form of wood for nearly 91% of all energy consumption. The biomass from crops such as corn can also be distilled into ethanol , which we can burn to produce energy. This research addressed two alternative energy pathways for biomass: Converting biomass into ethanol to power internal combustion vehicles or converting biomass into electricity to power battery electric vehicles. The technology to convert biomass into electricity already exists, and can be implemented using biomass boilers or integrated gasification combined cycle power plants (www.aesenergy.net/).

There is a limited amount of land available to devote towards growing crops for biofuels before the sacrificing of land for foodcrops begins to inflate commodity prices. Therefore, the efficiency of such technology is of utmost importance. The study finds that bioelectricity outperforms ethanol in both transportation kilometers per area of crops per year, and greenhouse gas emissions. A small SUV driving on the highway can travel 56% farther in an electric vehicle powered by bioelectricity than in a gas engine powered by ethanol. A similar calculation was performed over a range of vehicle classes (small car up to full size SUV) and for both city and highway driving. Bioelectricity powered vehicles went on average 81% further than vehicles powered by ethanol. Greenhouse gas emissions were also lower for the case of bioelectricity. Furthermore, for the case of bioelectricity, CO_2 gas can be sequestered at the power plant, resulting in a net removal of CO_2 from the air.

The study concludes that a given area of bio cropland would deliver more transportation and less greenhouse gas using a bioelectricity energy pathway rather than ethanol. Also, bioelectricity would further encourage electric transportation which is compatible with other green energy sources such as wind and solar. The researchers plan to continue

this study, and factor in excluded criteria such as impacts on water resources, battery toxicity and recycling, air pollution, and economic constraints. Economically speaking, it is important to remember that the competiveness of ethanol depends on the price of petroleum, while the competiveness of bioelectricity depends on the cost of wind, coal, solar, and nuclear. Overall, the paper clearly shows that more research needs to be done before the country chooses ethanol over bioelectricity as the energy pathway of choice from biomass.

More information can be found at *Science*, May 7, 2009, 10.1126/science.1168885.