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The Future of Biofuels

Trend six: Top 12 Areas for Innovation to 2025

Washington, DC, January 14 —The DC-based research and consulting firm Social Technologies recently released a series of 12 briefs that shed light on the top areas for technology innovation through 2025. “Biofuels,” by futurist Mark Justman, is the sixth trend in the series.

“Innovation in biofuels production will increase the potential to shift a portion of the global fuel supply away from conventional fossil-fuel resources,” Justman forecasts. “In addition to biofuels being a CO₂-neutral fuel source, innovations will make biofuel production increasingly cost-competitive with conventional fuel sources.”

Technology overview

Biofuels are liquid fuels created from the chemical transformation of plants and other forms of biomass. Currently, two primary biofuels are in commercial production: ethanol (a gasoline alternative commonly produced by the fermentation of plant sugars in corn, sugarcane, and beets) and biodiesel (produced through the processing of vegetable oils from soy, rapeseed, and palm trees).

“New technologies are expanding through the range of biomass feedstocks to include agricultural wastes, timber wastes, switchgrass, and biomass wood crops like willow and poplar,” Justman explains. “Another technology—biomass gasification—gasifies any form of biomass to create a synthesis gas that can be refined into liquid fuels. These new technologies can improve production efficiencies and widen the potential resource base for biofuels production.”

According to a study by the US Department of Energy, the US’ biomass resources have the potential to displace more than 30% of petroleum fuels by 2030.

Drivers of biofuel innovation

- **National security**—Energy dependence is gaining attention as a national security concern, Justman says. “Developing economies like China and India are entering into bilateral purchase agreements with energy producers to help guarantee their future fuel supplies. In the US, concern about dependence on oil imports, especially from politically unstable regions, is expanding interest in biofuels.”
- **Environment**—Biofuels are considered to have carbon-neutral greenhouse gas emissions, appealing to those concerned about progressive climate change.
- **Subsidies**—Biofuel subsidies in the US range from \$5.5 billion to \$7.3 billion per year. EU countries are giving preferential tax treatment to the use of biofuel blends such as B5. For each liter of biodiesel used in blends, tax savings can range from EU 0.47 in Germany to EU 0.40 in Italy, EU 0.33 in France, and EU 0.29 in Spain and the UK.

Challenges ahead

Biofuels are more expensive than conventional fuels, but costs are likely to drop as technological innovations boost production efficiency. Still, there will be other challenges for biofuels in the future, including:

- **Food-versus-fuel concerns**—Current use of food crops like corn as the feedstock for biofuels is driving up price for several agricultural commodities. These costs are being transferred through the agricultural production chain to the dairy and meat industries, which rely on corn meal for animal feeds. “Higher corn prices have also led to rising prices in Mexico for consumer staples



like tortillas—which resulted in street demonstrations involving upwards of 75,000 protestors,” Justman notes. “In the short term, food-versus-fuel concerns could generate negative public backlash, but in the longer term nonfood biofuel feedstocks are likely to emerge.”

- **Energy return on energy invested**—Biofuel production is currently an energy-intensive process, and the relatively low energy return on corn ethanol makes biofuel production costs rise in line with overall energy costs—thus impeding them from making a large contribution to the energy supply. “However, researchers are actively seeking to improve efficiencies at every stage of biofuel production, including growing more productive biomass crops, reducing fertilizer input, and finding more efficient processes for fermenting or distilling biofuels,” Justman explains.
- **Logistics problems**—Biomass crops are seasonally harvested, bulky, and increasingly costly to transport. “Logistics challenges could be improved through the diversification of feedstocks and by creating efficient small-scale processing facilities that are closer to abundant supplies of feedstocks,” Justman suggests.

Implications

Justman says that while the challenges facing biofuel expansion are real, in the longer term technology innovations will help support continued expansion of biofuels production.

“Biofuels critics often extrapolate today’s inefficient corn-to-ethanol production practices into the future, where biofuels expansion quickly hits a brick wall of limited availability of cropland for biofuels,” he explains. “However, this vision of the future for biofuels minimizes the transformational impact that future technology innovations will have in the biofuels sector.”

Justman notes several of the potential “gamechanging” technologies for the future of biofuels:

- **Ethanol turbocharging**—Ethanol has less energy density than gasoline, lowering vehicle miles-per-gallon. However, MIT researchers are studying small turbocharged engines that run on gasoline but have a separate fuel injection system for ethanol. This approach can boost engine efficiency and enable fuel savings of up to 20–30%.
- **Waste to fuel**—Existing biomass-gasification technologies can use any biomass feedstock, including agricultural and forestry wastes. New technologies like plasma-arc gasification allow unsorted municipal solid wastes to be turned into electricity and liquid fuels. This approach to biofuels production would have no impact on agricultural lands, and could take advantage of the existing garbage-hauling urban infrastructure.
- **Hydrogen injection**—Researchers at Purdue University are exploring the use of supplemental hydrogen during biofuel gasification to triple the yield of biofuels. During conventional biomass gasification, up to 60–70% of the carbon content in the biomass is converted to CO₂ or CO instead of being converted into fuel. By adding supplemental hydrogen during the gasification, all the carbon in the biomass can be converted to liquid fuel. Theoretically, this approach could triple biofuel production yields, and reduce land requirements for biofuels by two-thirds.

Learn more

To talk to Mark Justman about other business implications, forecasts, and how this innovation will impact consumers in the three Worlds, contact Hope Gibbs, Social Technologies’ leader of corporate communications, at: hope.gibbs@socialtechnologies.com.

About) Mark Justman

Mark Justman joined Social Technologies in 2003 as a senior writer/ analyst. His work has focused on tracking and analyzing consumer and technology trends in the automotive, retail, and energy industries. A professional futurist since receiving his MA in future studies from the University of Hawaii in 1999, Mark’s primary interest is identifying the emerging issues and discontinuities that have the potential to impede, accelerate, or modify extrapolative trends. Prior to Social Technologies, Mark worked at the Institute for Alternative Futures, where his project work included construction of biotechnology scenarios for the UK’s Economic and Social Research Council (ESRC) and creation of an interactive forecasting tool for healthcare on behalf of the World Health Organization. **Areas of expertise:** Energy (green, renewable, oil), the future of US politics, future of technology



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