California’s new regulations for transportation-fuel carbon emissions are shaking up the biofuels industry. When biofuels first took off, corn ethanol was touted as having the potential to cut carbon emissions by nearly 20%. But now the carbon intensity of corn ethanol can exceed that of gasoline under the state’s Low Carbon Fuel Standard (LCFS), which was adopted in April 2009 and requires a 10% cut in greenhouse-gas emissions by 2020. Moreover, the impact of the new regulations could be widespread because they are set to be the basis of fuel standards elsewhere in the country and world.

“Two years ago crop biofuels were elevated as saviors, now they’re seen as a negative force,” says Pamela Ronald, a UC Davis plant pathologist and vice president of feedstocks at the Emeryville-based Joint BioEnergy Institute. “But the science hasn’t changed at all.”

What has changed is the way California estimates carbon emissions from transportation fuels. Under the LCFS, the carbon intensity of a fuel accounts for all emissions, from production to use. In addition, crop-based biofuels are accountable for emissions from converting wildlands to agriculture because this releases plant and soil carbon dioxide into the atmosphere.

Called land-use changes, these conversions can be direct or indirect. The former include conversions of nonagricultural land to cornfield, while the latter include conversions of soybean to corn field that in turn result in nonagricultural land–to-soybean conversions elsewhere, to satisfy global demand. Including indirect land-use change is what bumped up corn ethanol’s average carbon intensity in the new regulations.

Controversy over indirect land-use change

Scientists are mixed on holding biofuels accountable for indirect land-use changes. Opponents include David Zilberman, a UC Berkeley agricultural and resource economist. “It’s arbitrary, difficult to calculate and damaging in the long run,” he says. “It will impede the industry. People will think twice about investing in advanced, second-generation biofuels.”

On top of that, Zilberman does not think the new regulations will work. “It’s like a band-aid. The state is trying to solve a global problem with a local solution,” he says. Instead, Zilberman advocates accounting for just direct carbon emissions combined with land protections such as ecological service–based fees or bans on biofuels produced from converted wildlands.

Similarly, Ronald and more than 100 other California scientists signed a letter in March 2009 asking the state not to penalize biofuels for indirect land-use changes. “It doesn’t make sense to burn down tropical forests or use really fertile agricultural land for crop biofuels, because there are other ways to produce biofuels,” Ronald says. “The biofuel industry can plant perennial grasses rather than corn on marginal or abandoned agricultural lands.”

The biofuel industry also has options even under the new LCFS. For example, corn ethanol’s carbon intensity varies with the production method, ranging from 10% more than gasoline for biorefin-
eries fired by coal to nearly 20% less than gasoline for those fired by natural gas, and lower still for those fired by biomass. “The LCFS is a performance standard, so the industry can make changes to meet the requirements,” says Bryan Jenkins, a UC Davis biological and agricultural engineer who directs both the UC Davis Energy Institute and the California Renewable Energy Collaborative.

Supporters of California’s approach to biofuel standards include Chris Somerville, a UC Berkeley plant biologist who directs the UC Berkeley–based Energy Biosciences Institute (EBI). “In my opinion, the sole purpose of biofuels is to do something that’s environmentally positive, and the argument for including indirect land-use change is good,” he says. However, Somerville cautions that further evaluation is needed before calculating carbon emissions from indirect land-use changes.

“The big question is how to calculate it — the data are not good,” Somerville says, adding that so far the state has set standards for only corn and sugar cane ethanol, and that EBI economics research will help the state set standards for additional biofuels. About 90% of conventional biofuels are bioethanols from a variety of starch- or sugar-rich crops, and the rest are biodiesels from vegetable oil, used cooking oil and animal fat.

**Beyond California**

The controversy over California’s LCFS notwithstanding, more states may be poised to adopt similar regulations. Eleven Northeastern and Mid-Atlantic states have committed to developing a regional LCFS based on California’s, and they expect to draft a memorandum of understanding (MOU) by the end of 2009. Likewise, British Columbia and Ontario signed a 2007 MOU to match California’s LCFS.

The U.S. Environmental Protection Agency also included accounting for indirect land-use changes in
Potential biofuels, left to right. Biomass from eucalyptus, an oily Australian hardwood, could be heated at high temperatures to produce “bio-oil” for fuel. Native to the North American prairie, switchgrass has been used for conservation plantings and cattle feed; it produces high yields with minimal inputs, and can sequester carbon in soils for extended periods. Poplar hybrid trees are characterized by rapid growth and easy propagation. Rice hulls are currently being burned for electricity, and rice straw can be converted into low-cost ethanol.

International Energy Association. Promising feedstocks for advanced biofuels include agricultural residue, which is plentiful in California; logging and tree thinning residue, which is plentiful in California and the Pacific Northwest; switchgrass, which is native to Midwest; and municipal green waste.

Beyond carbon

The new California regulations could also favor biofuels from nonfood crops that are grown either in rotation with food crops or as cover crops. Good candidates include grasses and mustards, which could yield bioethanol and biodiesel, respectively. Nonfood crops can also offer additional environmental benefits, such as controlling soil pests and clearing soil of selenium and other toxic elements or compounds. “Right now the focus is on global climate change but there are many other important environmental issues,” says James Stapleton, plant pathologist and natural resources coordinator for the UC Statewide Integrated Pest Management program. “We also have to consider soil, water and other air-quality issues” (see California Agriculture, Vol. 63, No. 1).

However, favoring nonfood crop biofuels could also have drawbacks. “Although this is politically expedient, it may very well limit industry innovation and farm production options,” Jenkins says.

As EBI’s Somerville observes, nothing is black and white when it comes to biofuels. But he remains optimistic, adding that “we’re having a good debate and going in a good direction.”

— Robin Meadows