FUEL FACTS

The First Step to Greener Biofuels:
Making Better Biomass Production Profitable

As gasoline prices soar, global warming emissions rise, and we come off one of the warmest winters on record, it is more urgent than ever that we develop low-carbon and sustainable biofuels that can serve as an alternative to fossil fuels. Biomass provides the fundamental units of energy in biofuels—energy captured from the sun as plants grow and draw on limited resources such as land, water, and soil nutrients. It can be obtained from crop residues, dedicated energy crops, perennial grasses, and fast growing trees like poplars. But even the most efficient and clean biofuel refinery cannot turn unsustainable biomass into a sustainable biofuel. Better biofuels must do more than reduce carbon emissions; they must be made from biomass that does not compete with our food supply and is grown using farming practices that result in cleaner water and healthier soils. The Natural Resources Defense Council (NRDC) believes a technology-neutral, Greener Biofuels Tax Credit that directly rewards producers for creating biofuels that protect both our climate and natural ecosystems is the best way to encourage the development of new and broadly sustainable biomass cropping systems.

Compared to our current dependence on corn and soybeans for biofuels, the potential to grow higher yielding energy crops on land that is idle and not suited for growing food makes them an attractive feedstock for biofuels. But making even a modest dent in our fossil fuel consumption will require significant biomass production, placing demands on land with consequences for farm income, food and feed production, and ecosystem services. To be economically sustainable, biomass must yield an income that exceeds a farmer's costs of production, including foregone returns from alternative uses of land. If market prices, based solely on the energy content of different biomass feedstocks, are insufficient to make their production economically viable, government subsidies may be required while the industry develops.

NRDC
THE EARTH'S BEST DEFENSE

For more information, please contact:

Nathanael Greene
(212)727-4482
ngreene@nrdc.org
switchboard.nrdc.org/blogs/ngreene

Sasha Lyutse
(212) 727-4603
slyutse@nrdc.org
switchboard.nrdc.org/blogs/slyutse

www.nrdc.org/policy
www.facebook.com/nrdc.org
www.twitter.com/nrdc

Follow us on twitter:
@NRDCRenewables

NRDC's Greener Biofuels Tax Credit Will:

- **Reward comprehensive environmental performance** by tying payments to lifecycle greenhouse gas emission reductions and soil and water conservation on the farms where biomass is produced.
- **Be technology neutral** by applying to all fuels (ethanol, biodiesel, butanol) and all feedstocks (corn, cellulose, algae, vegetable oils).
- **Support innovation** by paying more to biofuel producers who employ advanced processes like renewable power and choose environmentally preferable feedstocks grown using the best management practices.
- **Be streamlined** by developing workable reporting systems for farmers, biorefineries, and the Internal Revenue Service.

ENERGY CROPS MUST BE BOTH ENVIRONMENTALLY AND ECONOMICALLY SUSTAINABLE

A Greener Biofuels Tax Credit would reward biofuel refineries for choosing environmentally preferable feedstocks—such as wastes, sustainably harvested cover crops, or perennial energy crops like switchgrass and willow—that require little land disturbance, fertilizer, or irrigation to grow, and so reduce carbon emissions. Furthermore, it would reward refineries for purchasing that biomass from farmers who actively manage their acres to reduce tillage, improve soil health, and minimize erosion and pollution runoff. The profitability of producing energy crops will depend on the prevailing market price for biomass and any government incentives made available to producers. The relative profitability of growing different biomass feedstocks will also vary by region, as will the trade-offs that farmers are likely to face as they decide to switch from a conventional crop to biomass production.

A study sponsored by NRDC examined the profitability of growing energy crops in different U.S. regions, estimating the minimum or "breakeven" price a farmer in Illinois, Michigan, and Oklahoma would require to switch from the state's most profitable cropping system to producing one of five biomass crops: corn stover, miscanthus, switchgrass, native prairie grasses, and poplar.[1] Together with the market price of biomass, breakeven prices were used to determine the extent to which farmers in these states would need to be subsidized to produce biomass, both on marginal land and cropland.

As shown in figures 1 and 2, among the three perennial grass systems examined, miscanthus has the lowest costs of production, ranging from $35 to $87 per dry ton (DT) of biomass when planted on marginal land, and $43 to $103 per DT on cropland. Breakeven prices for switchgrass ranged from $46 to $100 per DT, and $73 to $135 per DT, depending on whether production costs, such as the cost of land, harvesting, and chemical inputs such as fertilizer, were low or high. Breakeven prices for mixed prairie grasses were $69 to $109 per DT on marginal land and $99 to $177 per DT on cropland. On the higher end, the breakeven cost of hybrid poplars systems on Oklahoma cropland was $389 per DT.

At a biomass market price of $50 per DT—a price used in many economic models of biofuels—it would therefore be profitable to produce miscanthus on marginal land in Illinois and Oklahoma, switchgrass on marginal land in Oklahoma, and even miscanthus on cropland in Oklahoma if production costs are low. If prices rise to $60 per DT, as shown by the black dotted line in figure 2, it would also be profitable to produce miscanthus in Michigan, as well as switchgrass in Illinois on marginal land (in the low-cost scenario). The large subsidy needed to induce poplar production in regions like Oklahoma makes it unlikely that they could be grown at any meaningful scale.

Figure 1: On-farm breakeven cost including marginal land rent ($ per Dry Ton)

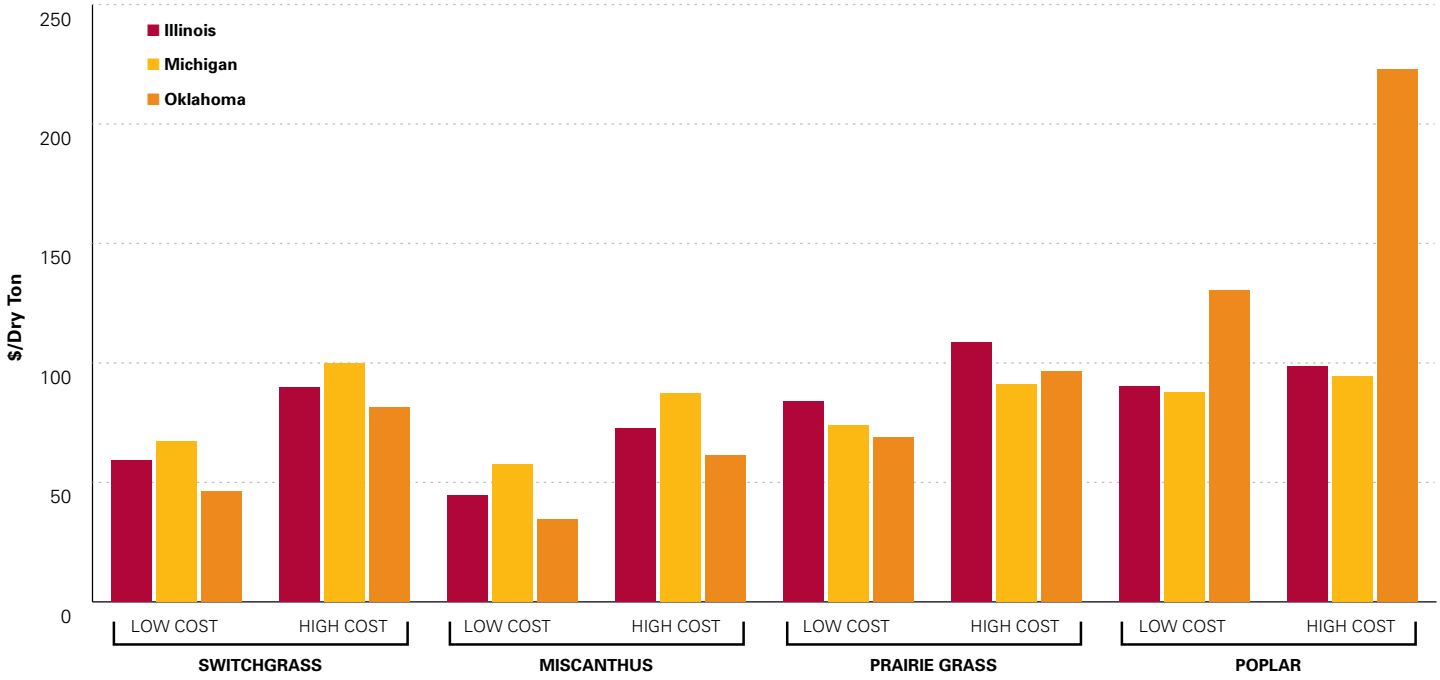
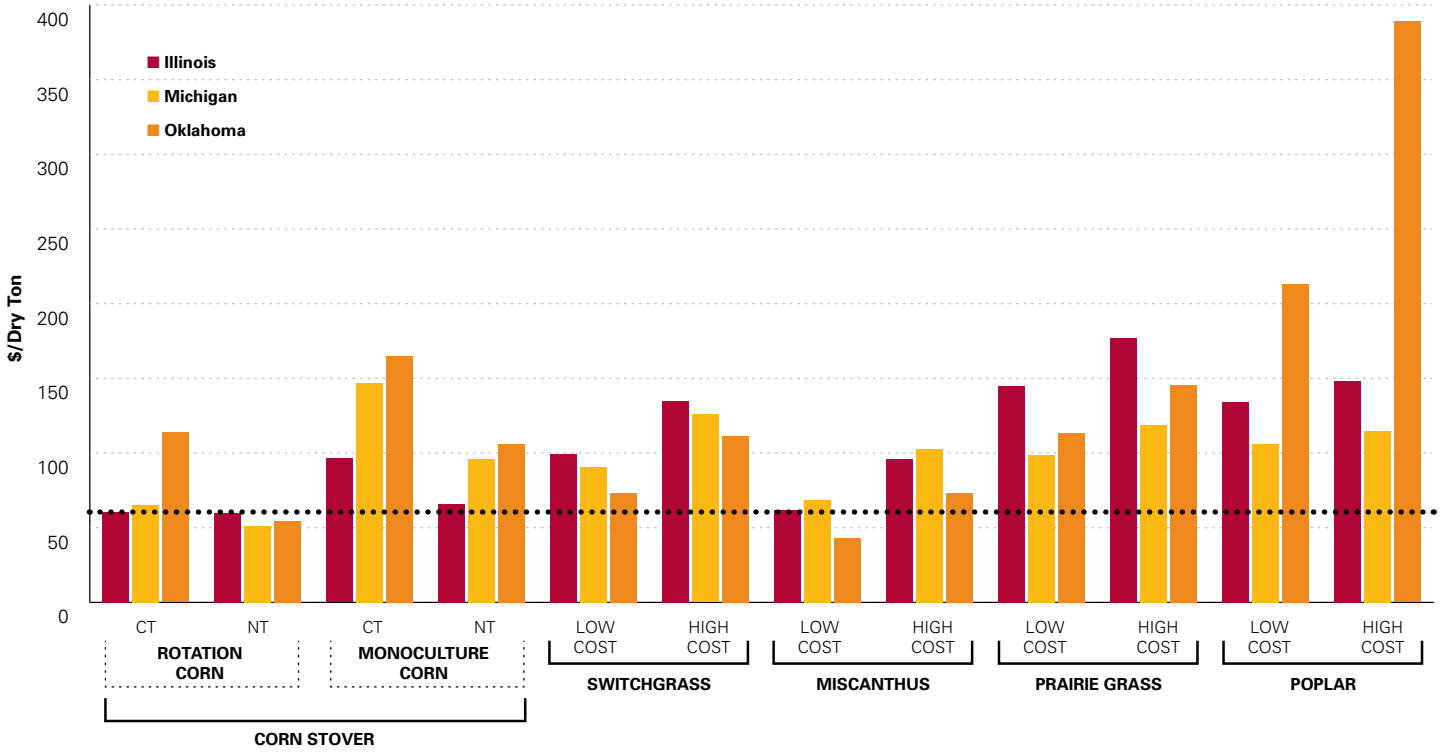


Figure 2: On-farm breakeven cost including cropland rent ($ per Dry Ton)



CT = conventional tillage NT = no till

••••• black dotted line indicates a biomass market price of $60 per dry ton

These results show that energy crop production is significantly cheaper on marginal land than on cropland. This suggests that farmers are likelier to grow biomass on marginal lands, avoiding competition with food or feed production. If we want to see energy crops grown on cropland for environmental reasons—for example, to reduce soil erosion and nitrogen leaching and increase biodiversity—then subsidies would be required. At a biomass price of $50 per DT, a farmer would need $12 to $19 per DT in subsidies to grow a high yielding perennial like miscanthus if production costs are low, and $23 to $52 per DT if they are high. Considerable subsidies ($19 to $34 per DT) would be required to induce farmers to grow mixed grasses, even on marginal land and with low production costs. These would be even higher if production costs turn out to be high or if policymakers wish to encourage their production on cropland.

Among sources of biomass grown on cropland, corn stover is potentially less costly than most dedicated energy crops, with a breakeven price range of $51 to $60 per DT under a rotation corn system with no till.[2] At biomass prices of $60 per DT, it would therefore be profitable to harvest stover produced this way in all three states without any subsidies. Because of these relatively low costs, there is particular interest in using residues, such as corn stover as biomass feedstocks.[3] But corn farmers know that corn stover is far from being a waste. Stover, like other residues, is critical to maintaining soil quality, both by protecting against wind and water erosion, and by returning nutrients and organic matter to the soil. As a result, a fraction of the biomass produced in corn and other systems must be left on-field.[4]

PUBLIC SUPPORT SHOULD TARGET SUSTAINABLE PRODUCERS AND SUPPORT INNOVATION

A new generation of refineries will be unable to produce the biofuels we need without policies that reward farmers who grow environmentally sustainable biomass and carefully manage their land for yield and ecosystem services. NRDC is working to protect and monitor existing programs like the Biomass Crop Assistance Program, which help farmers grow the sustainable biomass that's critical to sustainable biofuels, and support performance-based biofuels policies like the Greener Biofuels Tax Credit. While some forms of biomass may be profitable without government subsidies, other energy cropping systems, desirable for their ability to deliver valuable ecosystem services, may require additional public support. The size of the subsidy needed in different regions will depend on the overall costs of production, as well as biomass crop yields and crop prices, and not all biomass cropping systems will be economically viable in all regions. Understanding where different types of biomass can be cultivated sustainably and at what cost is key to designing the smart biomass incentives we need.

1 Rotation corn with no-till in Michigan and Oklahoma and corn-soybean rotation with conventional tillage in Illinois.

2 The study distinguished between stover harvested from monoculture corn systems and corn-soybean rotations, as well as corn grown using conventional tillage vs. no-till. Assumed rates of stover removal ranged from 38 percent to 70 percent, based on an estimate that 50 percent of residues can be removed from fields if no-till or conservation tillage is practiced and 30 percent can be removed if conventional tillage is used. Malcolm, S. (2008) "Weaning Off Corn: Crop Residues and the Transition to Cellulosic Ethanol." Paper Presented at the Transition to A BioEconomy: Environmental and Rural Development Impact, Farm Foundation, St. Louis, MO.

3 As of publication, there were at least three biofuel companies working with corn stover in the U.S.: Poet, Dupont & Abengoa.

4 In the analysis, corn stover production was constrained to sustainable levels to preserve soil and water quality by preventing run-off. If there is interest in preventing farmers from collecting excessive residues, they will need to be compensated for the foregone income from corn stover.