

ENVIRONMENT

# Tweaking Photosynthesis

By altering how plants turn sunlight into chemical energy, scientists hope to produce biofuels that make economic sense

**For years researchers** have been trying to figure out the best ways of making plants produce biofuels. But there is a fundamental problem: photosynthesis, the process by which plants convert sunlight into stored chemical energy, is highly inefficient. Plants turn only 1 to 3 percent of sunlight into carbohydrates. That is one reason why so much land has to be devoted to growing corn for ethanol, among other bad biofuel ideas. And yet plants also have many advantages: they absorb carbon dioxide at low concentrations directly from the atmosphere, and each plant cell can repair itself when damaged.

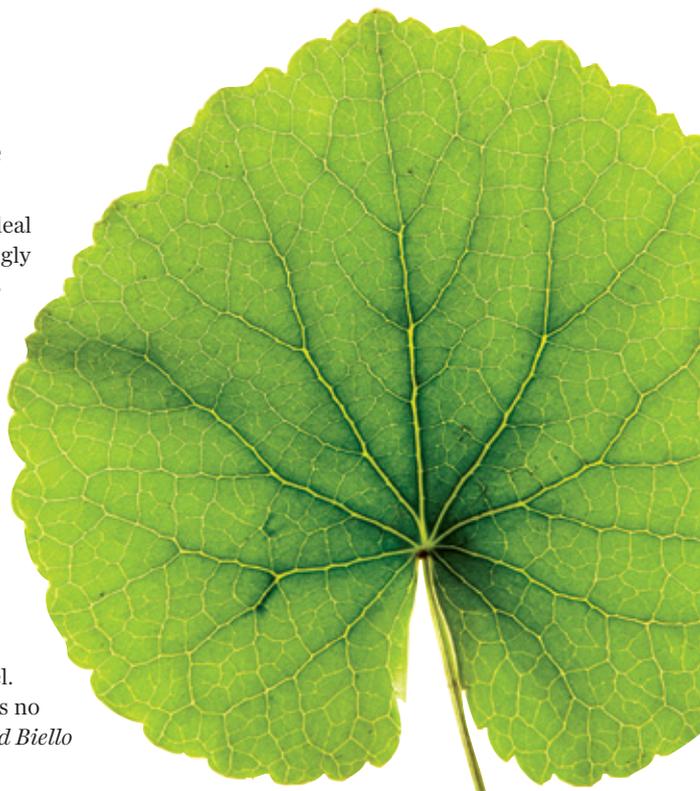
Scientists have begun a new effort to soup up photosynthesis and help humans make greener fuel. The U.S. Advanced Research Projects Agency for Energy, known as ARPA-e, has funded 10 such projects so far, most of which use genetic engineering to tweak a plant's DNA-based instruction manual for growth, pigments, and the like. The largest grant—more than \$6 million—has gone to the University of Florida to alter pine trees to make more turpentine, a potential fuel. Another project, led by Davis, Calif.-based Arcadia Biosciences, is aimed at inducing fast-growing grasses such as switchgrass to produce vegetable oil for the first time in history.

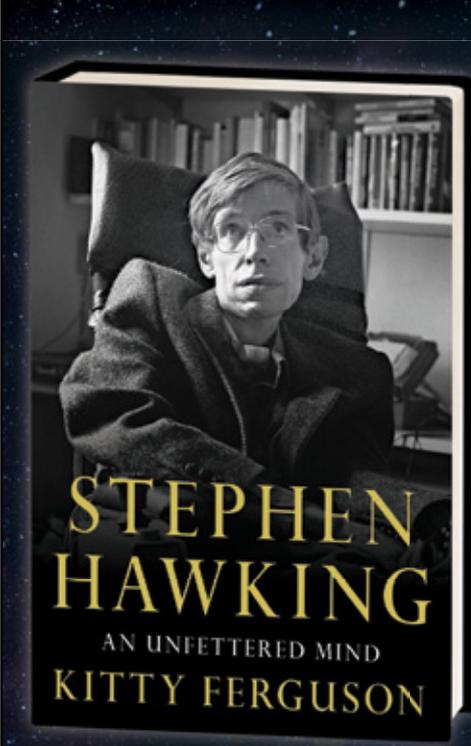
In the future, engineers might create a black plant that would absorb all incoming sunlight or a plant that uses different wavelengths of light to power the different steps of photosynthesis; plants now use the same wavelengths for everything. An engineered biofuel-producing plant might even have smaller leaves, reducing its own energy demands for growth, or it might no longer store energy as sugar but turn it directly into a hydrocarbon molecule for human use as fuel.

The scientists in the program, dubbed PETRO, for *plants engineered*

to replace oil, will also have to deal with the challenges of increasingly limited water supplies for crops and public skepticism of genetically modified organisms. And they will face competition from efforts to replace photosynthesis altogether, such as ARPA-e's own Electrofuels program, which aims to induce microbes to make hydrocarbons, or from efforts to build artificial leaves that use the electricity from solar cells to split water into oxygen and hydrogen for use as fuel. For plants, simply being green is no longer enough.

—David Biello





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