

NEW FUELS AND FEEDSTOCKS

ETHANOL'S EVOLUTION

Generation 1.5: Energy Through Synergy

For years, ethanol producers have suggested that the next generation of biofuels and bioproducts will not be produced exclusively by new, stand-alone, greenfield facilities. Rather, they believed that conventional ethanol plants would be amongst the first producers of advanced and cellulosic biofuels via the adoption of synergistic “bolt-on” technologies. This vision became reality in 2015, as numerous corn ethanol plants worked to install or start up new processes allowing onsite production of everything from cellulosic ethanol to zein protein to renewable diesel.



Examples of evolutionary “bolt-on” innovations include:

Adkins Energy, LLC, near Lena, Illinois, installed the capacity to produce **2 million gallons of biodiesel** per year using corn distillers oil extracted onsite.

Construction of a **zein protein** extraction plant is under way at **Big River Resources, LLC**, in Galva, Illinois. Zein is used as a feedstock for plastics and other industrial products.

Construction began in the fall of 2015 at **Central MN Renewables** in Little Falls, Minnesota, to install **Green Biologics Ltd.’s butanol** and **acetone** production technology.

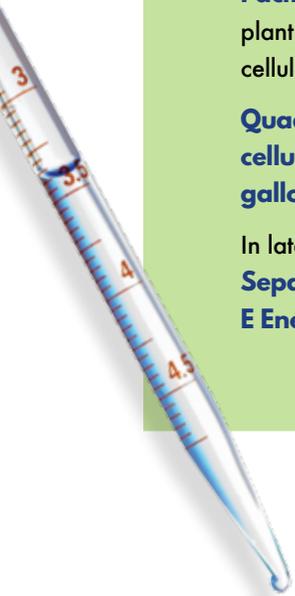
The **CHS** dry mill at Annawan, Illinois, is adding a co-located **5-million-gallon-per-year biodiesel** facility that will use corn distillers oil as the feedstock.

East Kansas Agri-Energy, LLC, in Garnett, Kansas, is building a co-located facility that will use corn distillers oil to generate **3 million gallons of renewable diesel** per year.

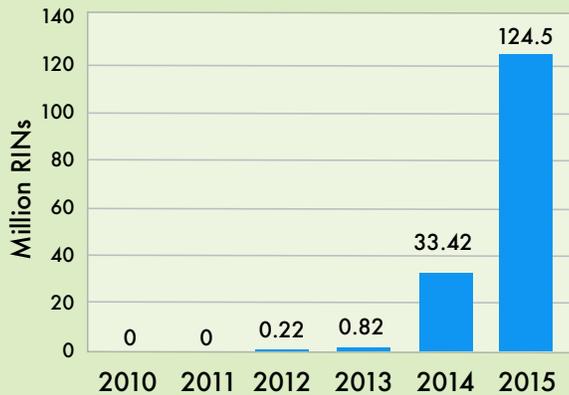
Pacific Ethanol, Inc. began production of **cellulosic ethanol** at its Stockton, California, plant in late 2015. The plant uses **Edeniq, Inc.’s Pathway Technology** to convert **corn kernel fiber** into nearly **1 million gallons** of cellulosic biofuel annually.

Quad County Corn Processors near Galva, Iowa, was the first conventional ethanol plant to produce **cellulosic ethanol** from **corn kernel fiber** in 2014. QCCP uses **Cellerate** technology to produce **2 million gallons** of cellulosic biofuel annually.

In late 2015, **Redfield Energy, LLC**, near Redfield, South Dakota, completed installation of **ICM’s Fiber Separation Technology (FST)**, which allows the plant to improve efficiency and diversify coproduct streams. **E Energy Adams, LLC**, is also installing the ICM FST process at its plant in Adams, Nebraska.



Cellulosic Biofuel RIN Generation



Source: U.S. Environmental Protection Agency

The year 2015 marked a seminal moment for cellulosic ethanol, as commissioning or production began at the nation’s three largest commercial-scale cellulosic ethanol facilities. Together, the three facilities have the ability to produce 75 million gallons of cellulosic ethanol per year when running at full capacity.

Abengoa’s facility in Hugoton, Kansas, has the capacity to generate up to 25 million gallons of cellulosic ethanol annually from locally sourced agricultural residues. Meanwhile, the DuPont biorefinery in Nevada, Iowa, will also use agricultural residues like corn stalks to produce up to 30 million gallons per year. Finally, POET-DSM’s Project Liberty in Emmetsburg, Iowa, has the capacity to produce 20 million gallons of cellulosic ethanol per year from corn residue. In addition, the idled INEOS Bio facility in Vero Beach, Florida, has the ability to produce 8 million gallons of cellulosic ethanol per year from wood and vegetative waste.

DuPont Cellulosic Ethanol (Nevada, IA)

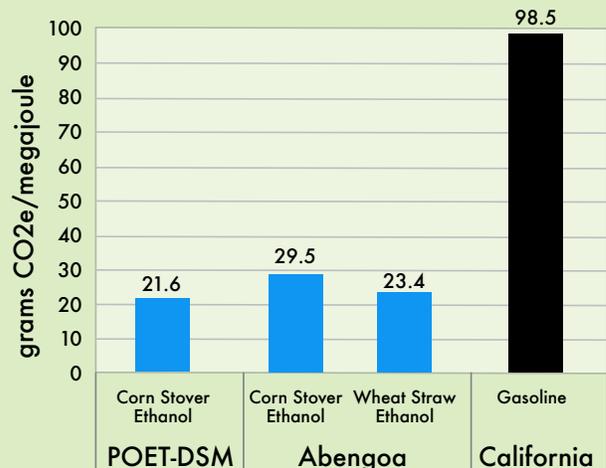


Abengoa Bioenergy Biomass of Kansas (Hugoton, KS)



Although 2015 was a breakthrough year for the cellulosic biofuels sector, many challenges remain. Market instability and policy uncertainty have continued to hamper growth. EPA’s mismanagement of the RFS cellulosic waiver credit program continued to undercut cellulosic RIN values and exacerbate inefficiencies in the fledgling cellulosic biofuel marketplace. The year ended with a bit of good news, however, as Congress provided a two-year extension of the Second Generation Biofuel Producer Tax Credit and other tax credits. Still, the industry needs long-term policy solutions; and RFA will continue advocating for measures that provide enduring certainty and market access.

Analysis by the California Air Resources Board Finds that Cellulosic Ethanol Reduces GHG Emissions by 70-80% versus Gasoline



Source: California Air Resources Board