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Cellulosic Bioethanol

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Jonny Goyal
Principal Analyst

With contributions from
Tony Pavone

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Abstract

Cellulosic ethanol is gaining increasing recognition from the global community as one of the great promises and alternatives for the sustainable production of ethanol. Cellulosic ethanol can be used to reduce a nation's dependency on volatile imported fossil fuels and bring about socioeconomic development with reduced negative impact to the environment and reduced contribution to climate change. The critical difference of this technology to the currently established biomass-to-fuel systems (e.g., the corn- and sugar-based ethanol production system), is that cellulosic ethanol can be produced from a wide variety of biomass waste feedstocks, including agricultural plant wastes (e.g., corn stover, cereal straws, and sugarcane bagasse), forest industry wastes, organic wastes from industrial processes (e.g., sawdust and paper pulp), the organic fraction of municipal solid and liquid waste, and a wider range of alternative energy crops (nonfood crops) grown specifically for fuel production, such as switchgrass.

Cellulosic ethanol is a second-generation bioconversion technology used to produce ethanol from lignocellulosic biomass. This report discusses the different factors playing a role in the chemistry of the cellulosic ethanol process—what works best for the process and what does not. All of these parameters are vital and part of this report, the objective of which is to examine some of the commercial cellulosic ethanol plants operating as of 2017, to evaluate their economics, and to offer a financial impact assessment on the economics resulting from variations in different process parameters.

We chose three different commercial cellulosic ethanol plants for evaluation in this report. The cases evaluated in this report are following:

- Case I—POET-DSM's 25 million gallon/year cellulosic ethanol plant in Emmetsburg, Iowa
- Case II—DuPont's 30 million gallon/year cellulosic ethanol plant in Nevada, Iowa
- Case III— Beta Renewables' 20 million gallon/year cellulosic ethanol plant in Crescentino, Italy

Though cellulosic ethanol technology has now entered commercial scale, the recent announcements by DuPont and Beta Renewables to put their plants on sale speak to how critical it is to run a cellulosic ethanol plant economically. This report discuss these aspects in detail, as the economics associated still remains a challenge, and further research and development are needed to continue to reduce plant CAPEX and OPEX, with improvement in ethanol yield. In this report, we have used Aspen Plus™ and IHS internal tools to work out a process design and its economics for each of the above cases. This report also summarizes possible solutions that could improve bioprocessing, including the development of genetically engineered strains and emerging pretreatment technologies that might be more efficient and economically feasible.

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IHS Customer Care:

Americas: +1 800 IHS CARE (+1 800 447 2273); CustomerCare@ihs.com
Europe, Middle East, and Africa: +44 (0) 1344 328 300; Customer.Support@ihs.com
Asia and the Pacific Rim: +604 291 3600; SupportAPAC@ihs.com