



## ZeaChem Advantages

ZeaChem's new approach to cellulosic ethanol provides technological, economic and environmental advantages compared to traditional ethanol and other cellulosic ethanol processes.

### Process

ZeaChem uses a hybrid approach; the biochemical pathway for the most efficient fermentation with respect to carbon conversion (ZeaChem's acetogenic process produces no CO<sub>2</sub>) and then a thermochemical pathway for hydrogen production from the non-sugar lignin stream. For every bone dry ton (BDT) of feedstock, ZeaChem's technology will produce a theoretical maximum of 156 gallons of ethanol, with an expected yield of approximately 135 gallons per BDT (gal/BDT). Accounting for yield per acre, this is five times more than corn based ethanol processes and about three times more than other cellulosic processes, either biological (enzymatic) processes or thermochemical (gasification) processes. ZeaChem's high-yield process gives it sustainable competitive advantage in both economics and environmental impact.

As the graph below demonstrates, advances in ethanol technology and auto efficiency can increase land productivity by a factor of 10.

	Farm Yield	Factory Yield	Auto Efficiency	Land Productivity
Corn Ethanol	150 Bu/ac/yr	2.7 Gal/bu	14 mi/Gal EtOH	5,670 mi/ac/yr
Cellulosic Ethanol <sup>1</sup>	7.5 BDT/ac/yr	90 Gal/BDT	14 mi/Gal EtOH	9,450 mi/ac/yr
Advanced Cellulosic Ethanol (ZeaChem Inc.) <sup>2</sup>	15 BDT/ac/yr	135 Gal/BDT	14 mi/Gal EtOH	28,350 mi/ac/yr
Advanced Cellulosic Ethanol + Auto Efficiency	15 BDT/ac/yr	135 Gal/BDT	25 mi/Gal EtOH	50,625 mi/ac/yr

<sup>1</sup>Biochemical, thermochemical or syngas fermentation average

<sup>2</sup>Hybrid combination of biochemical + thermochemical process

### Economic

ZeaChem's advantage in operating costs puts its process at a competitive advantage to both corn based ethanol producers and cellulosic ethanol competitors. Given its 40% yield advantage, ZeaChem's process has the lowest operating (<\$1.00) and capital cost (~\$4.00) per gallon. Assuming a yield of 15 BDT/acre, a biomass farm with an approximate 5 mile radius could support a ZeaChem biorefinery with capacity of 100 million gallons per year (MM GPY). This translates into net land productivity rates nearly five times higher than existing approaches.

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## Environmental

The ZeaChem process results in a high yield of ethanol per ton of feedstock because the process efficiently utilizes all fractions of the feedstock. The effectiveness of this process results in a fuel that, when substituted for traditional corn-based ethanol or gasoline, will produce substantial verifiable carbon emission reductions. Compared to gasoline, ZeaChem's process delivers a 94-98% reduction in greenhouse gasses as calculated by the US Department of Energy/ Argonne Labs GREET Analysis.