

Q. Who is Gevo?

A. Gevo is pioneering the development of capital efficient biorefinery systems to provide renewable, cost effective building block products to the fuel and chemical industries. Gevo's biorefineries will convert renewable raw materials into isobutanol and renewable hydrocarbons that can be directly integrated into existing processes to deliver environmental and economic benefits. Gevo is committed to a sustainable biobased economy that meets society's need for plentiful food and clean air and water. Gevo employs 55 people and is headquartered in Denver, CO. It is a venture backed company with some of the cleantech sector's leading investors.

Q. What is Gevo's stage of development in 2010?

A. Gevo is on the verge of commercialization. In September, 2009, Gevo announced two significant events. In alliance with ICM, Gevo successfully completed construction and began operations at a one million gallon per year commercial demonstration facility in St. Joseph, MO, the first successful retrofit of an ethanol plant to produce isobutanol. Gevo also launched Gevo Development, LLC to finance and develop a fleet of biorefineries based on retrofitting existing ethanol plants. These plants will be retrofit using the Gevo Integrated Fermentation Technology[®] (GIFT[®]) to produce isobutanol for sale to refinery and chemical customers.

Q. What distinguishes Gevo from its competitors?

A. Gevo is the first company to demonstrate an ethanol plant retrofit to commercial scale production of isobutanol, a versatile platform chemical. Isobutanol has wide uses in the solvents and plastics markets and is a second generation biofuel that can be blended into gasoline or be converted into hydrocarbons to make "green gasoline", diesel and jet fuel. Products made from isobutanol have a reduced carbon footprint and other environmental performance features compared to crude oil derived materials. Gevo aims to begin commercial scale production in 2011 and plans to have 400 million gallons of capacity by 2014. While Gevo is currently focusing on traditional ethanol plants, its technology is able to convert cellulosic sugars, too. Once cellulosic conversion technology is available, Gevo will be able to produce cellulosic isobutanol from biomass.

Q. What is Gevo's commercialization strategy?

A. Gevo's butanol technology was designed expressly to fit into existing ethanol plants with the addition of a proprietary unit to separate the butanol during production. Gevo plans to finance the retrofitting of its partner ethanol sites. The advantage of this strategy is that with a small incremental investment, current ethanol plants can add the flexibility to make either alcohol. The addition of the butanol capacity will enable ethanol producers to access wider markets and expand the opportunities for corn-based ethanol capacity.

Q. Is butanol a threat to the ethanol industry?

A. No, Gevo's technology will add value to the existing ethanol industry by providing additional product options. Traditional ethanol plants retrofitted with Gevo technology will have the flexibility to produce ethanol or isobutanol. Gevo's technology provides a rapid and low capital route to the production of a second generation

biofuel with the added benefit of being applicable to both the fuel and the chemicals industry. Gevo strongly supports the ethanol industry and believes that there is room for both products in the fuel mix of the USA.

Q. Who is ICM?

A. Gevo has an exclusive alliance with ICM, the world's leading engineering company for the biofuels industry. ICM has designed and built almost 75% of the operating ethanol plants in the USA. ICM is the exclusive engineering partner with Gevo on isobutanol in the USA. ICM operates an ethanol demonstration facility in St. Joseph where they test new equipment, develop new process technologies and train their customers. In collaboration with ICM engineers, Gevo installed its proprietary GIFT® processing technology and used its biocatalyst to produce isobutanol, thus demonstrating that it can rapidly and cost effectively retrofit an existing ethanol facility to produce isobutanol. This has never before been accomplished.

Q. What is butanol and biobutanol?

A. Butanol is a naturally occurring alcohol that can be produced industrially from the petrochemical feedstock propylene. It can also be produced via fermentation of carbohydrates just like ethanol in which case it is called biobutanol. Standard automotive engines can run on isobutanol blended into gasoline at any ratio. Isobutanol has some features making it attractive to refiners and blenders, namely, higher energy content than ethanol, lower RVP and it can be handled directly by traditional distribution and refining infrastructure. Isobutanol can be readily processed to make hydrocarbon fuels and biobased plastics, bottles and other products.

Q. How is Gevo's isobutanol made?

A. Isobutanol can be made from fermentable sugars from corn, sugar cane or biomass just like ethanol. Gevo has developed proprietary biocatalysts (cell factories) to make isobutanol directly, i.e., without other co-products. Gevo has also developed proprietary technology for the economic separation and recovery of its isobutanol. Once cellulosic conversion technology has been commercialized, Gevo will be able to produce cellulosic butanol.

Q. Are there different kinds of butanol?

A. Yes, while there are four different butanols, the two primary kinds are *n*-butanol and isobutanol. They have slightly different chemical structures but both can be made via fermentation of sugars and both can be applied in the fuels and chemical markets. Gevo has developed isobutanol.

Q. What are the benefits of isobutanol in the chemicals industry?

A. There are economic and environmental benefits. Gevo's isobutanol will replace petroleum derived butanol thereby providing chemical companies with a feedstock option to manage volatile price swings and sporadically tight supply markets. On the environmental front, isobutanol is a platform chemical to make PET (plastic bottles), polymers, rubber and other chemicals. When made from isobutanol, these products all have a lower carbon (GHG) footprint. Consumers and regulatory authorities have a great interest in biobased products made from renewable raw materials.

Q. What are the benefits of isobutanol in the transportation fuels industry? Is it a "drop-in" fuel?

A. Gevo's isobutanol is a clean, renewable and low RVP blendstock that can be integrated into existing distribution and refinery operations. It can be further processed to make hydrocarbons to be used as fuel components in gasoline, jet fuel and diesel. Isobutanol provides blenders/refiners with a way to meet the Renewable Fuel Standard (RFS) with an alternative to ethanol. The low RVP allows blenders/refiners to meet the ozone standards of the clean air act with an oxygenate that has higher energy density and can be blended into gasoline at higher concentrations than ethanol without engine modification.

Q. When gasoline contains isobutanol, is the blend ratio limited to 10%, i.e., is there a “blend wall” issue?
A. No, isobutanol can be blended into gasoline at any ratio without any modification of current automobile or small engines.

Q. What is RVP and what does it have to do with the Clean Air Act?

A. Volatility is the property of a liquid fuel that defines its evaporation characteristics. RVP is an abbreviation for "Reid Vapor Pressure," a common measure of and generic term for gasoline volatility. EPA regulates the vapor pressure of gasoline sold at retail stations during the summer ozone season (June 1 to September 15) to reduce evaporative emissions of volatile organic compounds (VOC) from gasoline that contribute to ground-level ozone (smog) and diminish the effects of ozone-related health problems.
<http://www.epa.gov/OMS/volatility.htm>

Q. Is isobutanol a biofuel and will it be granted a Renewable Identification Number (RIN) when produced?

A. Yes but at a higher value. Because isobutanol has 30% higher energy content than ethanol, a gallon of isobutanol will get 1.3 RINs while a gallon of ethanol would get one. Hence, obligated parties will be able to comply with the RFS2 with isobutanol or ethanol.

Q. Does butanol qualify as an “advanced biofuels” as defined in the RFS2?

A. The RFS2 establishes several categories of advanced biofuel. An advanced biofuel (except ethanol) can be made from corn starch if it achieves a 50% reduction of GHG emissions vs. gasoline. Cellulosic biofuels must achieve a 60% reduction. Gevo's isobutanol from retrofit ethanol plants may qualify as an advanced biofuel if it meets the 50% GHG reduction.

Q. Is isobutanol toxic?

A. There is a preponderance of evidence of public information on the biodegradation and toxicology on Isobutanol. In a robust summary report by a panel of toxicologists from the SIDS OECD assessment on Isobutanol, many of the studies referenced state that isobutanol is readily biodegradable and the main environmental conclusion from the report is that "Isobutanol is currently of low priority for further work due to its low hazard profile." In another report from IPCS (International Programme on Chemical Safety) that was sponsored by the World Health Organization (WHO) states that Isobutanol is readily biodegradable and it is degraded in significant amount within a few hours, and degradation would be expected to be complete within a few days and thus isobutanol does not bioaccumulate. Isobutanol also occurs naturally in a variety of fruits (e.g., cherry, grape, apple, raspberry) and is added to foods and beverages as a flavouring agent (e.g., butter, cola, fruit, liquor, rum and whiskey) (WHO, 1987).