

## Genomatica and Braskem Confirm Direct, Single-Step Biological Production of Butadiene

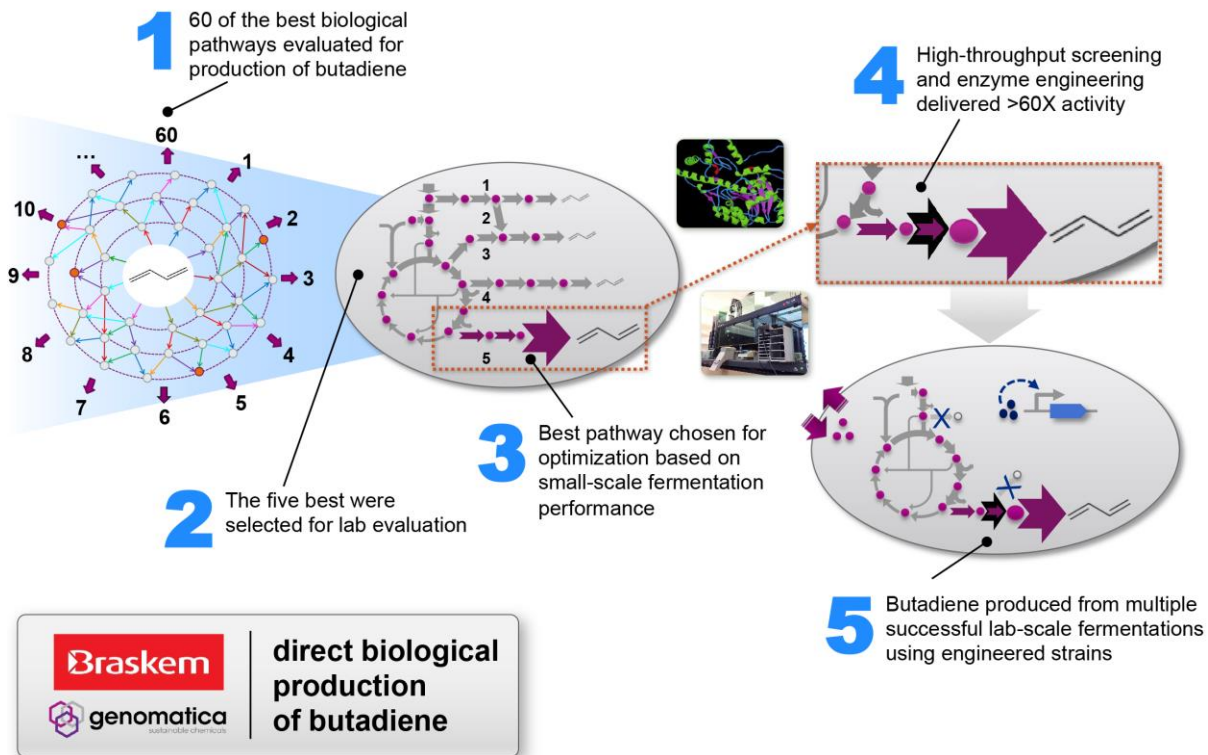
*Project achieves lab-scale milestones*

São Paulo, Brazil and San Diego, CA, November 23, 2015 – [Genomatica](#) and [Braskem](#) announced they have been successfully producing butadiene at lab scale since June 2015, using their direct, bio-based process. The companies are jointly developing a commercial process for the on-purpose production of butadiene made from renewable feedstocks, as announced in December 2013.

Butadiene is a raw material used in the production of rubber for tires, as well as for electrical appliances, footwear, plastics, asphalt, building materials, and latex. The demand for butadiene is over 20 billion pounds per year worldwide, and growing. By producing a renewable butadiene, the everyday products made with it, like tires, can become more sustainable, with a smaller environmental footprint.

Program results include:

- 1) *Direct, continuous production:* The program team has successfully developed a microorganism that consumes sugar and converts it to butadiene at lab scale, in two-liter fermenters. Butadiene has been produced, collected and measured continuously, over the course of multiple days for each fermentation.
- 2) *Development of multiple direct pathways and novel enzymes:* To develop an optimal process, Genomatica used its computational tools to figure out every possible way that a microorganism could theoretically make butadiene, and identified 60 potential biological pathways. The five best were selected for experimental validation, conducted by Genomatica and Braskem teams in San Diego and Campinas, along with full-time visiting scientists from Braskem at Genomatica's Innovation Center. The team explored a large number of enzyme candidates, applying environmental sampling and metagenomics, for each step in the potential pathways. Genomatica then multiplied enzyme activity 60-fold on non-native substrates using its high-throughput screening and enzyme engineering capabilities.
- 3) *More intellectual property:* The program team has significantly added to the extensive intellectual property that Braskem and Genomatica have in this field. This work speaks to design of optimal microorganisms and processes; supports subsequent development stages; and represents an important competitive advantage.



*Shown here: Braskem and Genomatica have successfully achieved direct biological production of butadiene at lab scale.*

“Our joint team has made good use of Genomatica’s integrated bioengineering platform, including its computational techniques and high-throughput cloning and screening, to quickly hit a key milestone,” said Nelson Barton, Senior Vice President R&D, Genomatica. “Our ‘rational’ approach to strain design should enable faster, more predictable scale-up and better economics as we advance the program.”

“We’re delighted to share this strong technical progress,” said Patrick Teyssonneyre, Innovation and Technology Director, Braskem. “This sets a foundation for an important new process for the industry. The work we are doing with Genomatica is another example of the success of our open innovation system, which aims to provide our customers with competitive advantages in their businesses. We believe that renewable chemistry is an important part of their future and ours.”

From its origin, in 2002, Braskem invests in technological processes that result in greater efficiency and sustainability of its products. In addition to the project with Genomatica, Braskem has been producing polyethylene from ethanol since 2010, labeled as ‘I’m green™’, and has another cooperative agreement with partners to develop green isoprene.



### About Genomatica

[Genomatica](#) is a widely-recognized leader in bioengineering. It develops biobased processes that enable its partners to produce chemicals a 'better way,' from alternative feedstocks, with better economics and greater sustainability than using conventional feedstocks and processes.

The [GENO BDO™ process](#) has produced thousands of tons of BDO; BASF and Novamont have licensed it and then expanded their agreements; and Cargill offers production support services. The BDO produced with our process continues to extend further into the market, with validation from firms including [Invista](#) (Lycra® spandex), BASF ([PolyTHF®](#)), DSM, Lanxess, Toray, and Far Eastern New Century.

Genomatica is using its bioprocess engineering platform and over 600 patents and applications to develop processes for additional chemicals. These include [butadiene](#) and [polyamide intermediates](#), together with partners Versalis and Braskem.

Genomatica has earned tremendous recognition for its innovative technology and its commercialization track record, including the [Kirkpatrick Award](#), for 'the most noteworthy chemical engineering technology commercialized in the world,' and the [2015 World Economic Forum Technology Pioneer](#) award.

### About Braskem

Controlled by the Odebrecht Group, Braskem is the largest thermoplastic resins producer in the Americas, with annual production capacity of over 16 million tons of resins and other basic petrochemicals. With revenue of R\$53 billion, it is the world's leading producer of biopolymers – polyethylene derived from sugarcane ethanol (Green Plastic) - with annual capacity of 200,000 tons.

With the purpose of improving people's lives by creating sustainable solutions in chemicals and plastics, Braskem is present in over 70 countries, operates 36 industrial units located in Brazil, USA and Germany, and employs approximately 8,000 team members. It is also leading the construction of a petrochemical complex in Mexico in partnership with Mexican group Idesa, with investments estimated at US\$5.2 billion.

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