



# Smart Biomaterials from Sustainable Biomass

Haldor Topsøe MOSAIK™ Technology  
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# Consumers Want Greener Products

Pull is getting stronger

**Coca-Cola Produces World's First PET Bottle Made Entirely From Plants**  
By: The Coca-Cola Company | Jun 3, 2015

**Nestlé and Danone team up to produce green plastic**  
Food and drinks groups commit funding to develop plastic from waste sawdust

**Will Lego's \$150 Million Sustainable Plastics Challenge Make Biobased the Norm?**  
June 20, 2016 by Jessica Lyons Hardcastle

**Suntory pursues 100% bio-based beverage bottles**  
Collaboration between Suntory and renewable chemical company Anellotech enters next supplier completes installation and development of testing facility.



**Coca-Cola, Ford, Heinz, Nike and Procter & Gamble join forces in PET Technology**  
Top brands to develop 100% plant-based PET (BioPET)  
June 2012, the Coca-Cola Company (Coca-Cola), Ford Motor Company (Ford), H.J. Heinz Company(Heinz), NIKE, Inc. (Nike) and Procter & Gamble (P&G) created the Plant PET Technology Collaborative (PTC).  
Already December 2009 had marked game changing by Coca-Cola launching its innovative PlantBottle™ package.  
With the 30 percent mono-ethylene glycol (MEG) portion made from plant-based resources, this was a big step toward reducing the company's dependence on fossil-based materials for making its PET plastic packaging.

**FIRST SUSTAINABLE LEGO® BRICKS WILL BE LAUNCHED IN 2018**

**NESTE & IKEA take leadership in bio-based home furniture**

## Can Biomass Replace Oil?

In some cases, biomass can not only replace oil – it can be a better option.

- Biomass offers a lot of “chemical functions” that can be reused or slightly altered.
- The global production of bio -based polymers is expected to more than triple from 5.7 million tons in 2014 to approximately 17 million tons in 2020.
- The anticipated growth rates are far higher for bio -based polymers compared to oil -based polymers



## Predicted EU bio -based production and private investment in 2025

<b>Product category</b>	<b>CAGR (%)</b>	<b>Bio-based production in 2025 (kt/a)</b>	<b>Total private investment (EUR million/a)</b>
Platform chemicals	10	353	128
Solvents	1	80	16
Polymers for plastics	4	353	144
Paints, coatings, inks & dyes	2	1,151	437
Surfactants	4	1,974	805
Cosmetics and personal care products	3	687	349
Adhesives	10	462	195
Lubricants	1	254	63
Plasticisers	3	83	52
Man-made fibres	3	738	494
<b>Total</b>	<b>2</b>	<b>6,134</b>	<b>2,683</b>

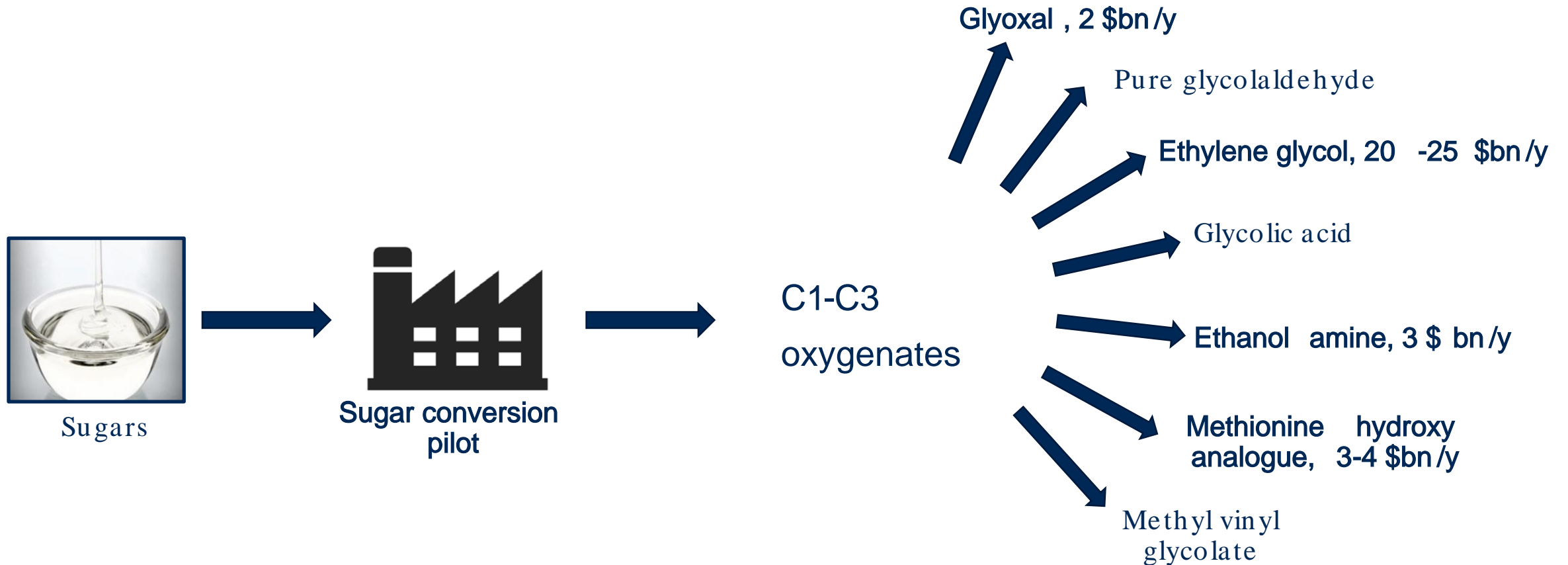
## The shift from fossil -based to bio -based chemicals has moved closer

- Haldor Topsøe's MOSAIK™ technology produces chemicals from biomass at a cost that can compete with that of traditional oil-based chemicals.
- Cost often put an end to the desire of lawmakers, industry, and consumers to replace oil with sustainable raw materials, such as biomass. However, new technology can change that.
- Haldor Topsøe researchers have devised a novel process that produces several chemicals from biomass – at an attractive cost that can compete directly with similar oil-based chemicals.



# MOSAIK™ is a new platform for Oxygenated Chemicals from Biomass

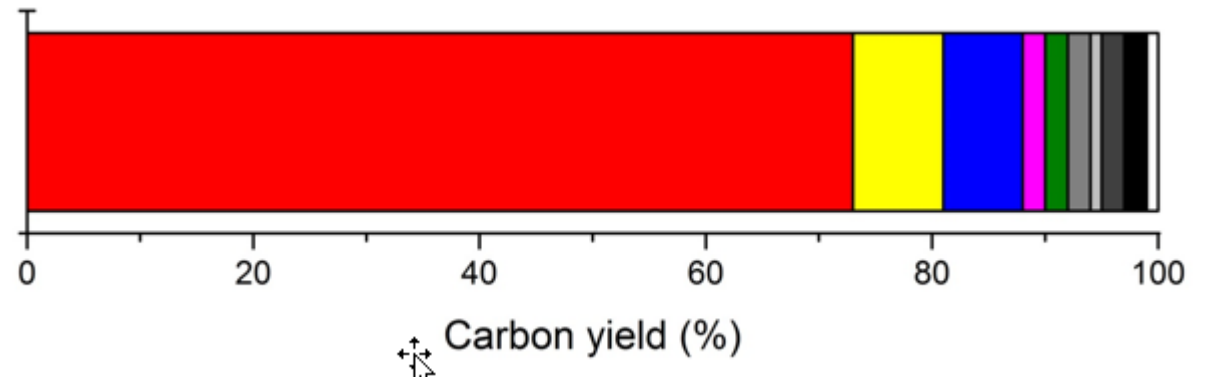
Oxygen retained in the C1-C3 is a competitive advantage compared to e.g. gasification



# Product composition

## C1-C3 oxygenate products

- Process is highly selective towards C1 -C3 with 85% of carbon in useful compounds



# Technology Upscaling

10 years of R&D and proven in pilot scale

2011



5-10 g glucose per hour

2013



60-90 g glucose per hour

2014



(External)  
500-1000 g  
glucose per hour

2018



50 kg  
sugars per hour





# Partnerships

- In 2017 Topsøe and Braskem made a partnership to commercialize ethylene glycol production from Topsøe MOSAIK™ technology, based on sugar as bio feedstock
- Ethylene glycol is a platform chemical for PET plastics
- Innovation Fund Denmark invested in the development of the MOSAIK™ technology platform in 2017



# MOSAIK™ demo plant in Lyngby, Denmark

## Process validation in 50 kg/h hot demo scale plant

Summer 2017  
Engineering  
started

May-Dec 2018  
Construction

Jan-Feb 2019  
Commissioning

Since Mar 2019  
Operation and  
optimization



# Conclusions

- The market for bio-based platform chemicals is expected to grow in the next 5 years
- Our objective is to commercialize the MOSAIK™ technology which is a platform for a number of chemicals
- A full scale plant can be up running +2023 for producing a platform chemical for PET plastic