



## SELF HEALING CONCRETE (SHC)

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- Innovation & sustainability
- Opportunities & struggles
- A personal perspective

## Outline

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1. Introducing Corbion
2. The Corbion innovation engine
3. Chemistry 101 for SHC
4. The bumpy innovation road
5. Reflections and discussions

## Corbion: Who we are today



### Sustainable Food Solutions

- Preservation
- Functional systems
- Single ingredients

### Lactic Acid & Specialties

- Lactic acid
- Lactic acid derivatives
- Biopolymers

### Incubator

- Omega-3 (DHA)
- Algae protein
- Co-polymer platform

- € 986.5M revenues (2020)
- € 158.8M adjusted EBITDA
- Over 2250 employees
- 13 manufacturing facilities across the globe
- Unique technology: fermentative production of organic acids, fats and oils

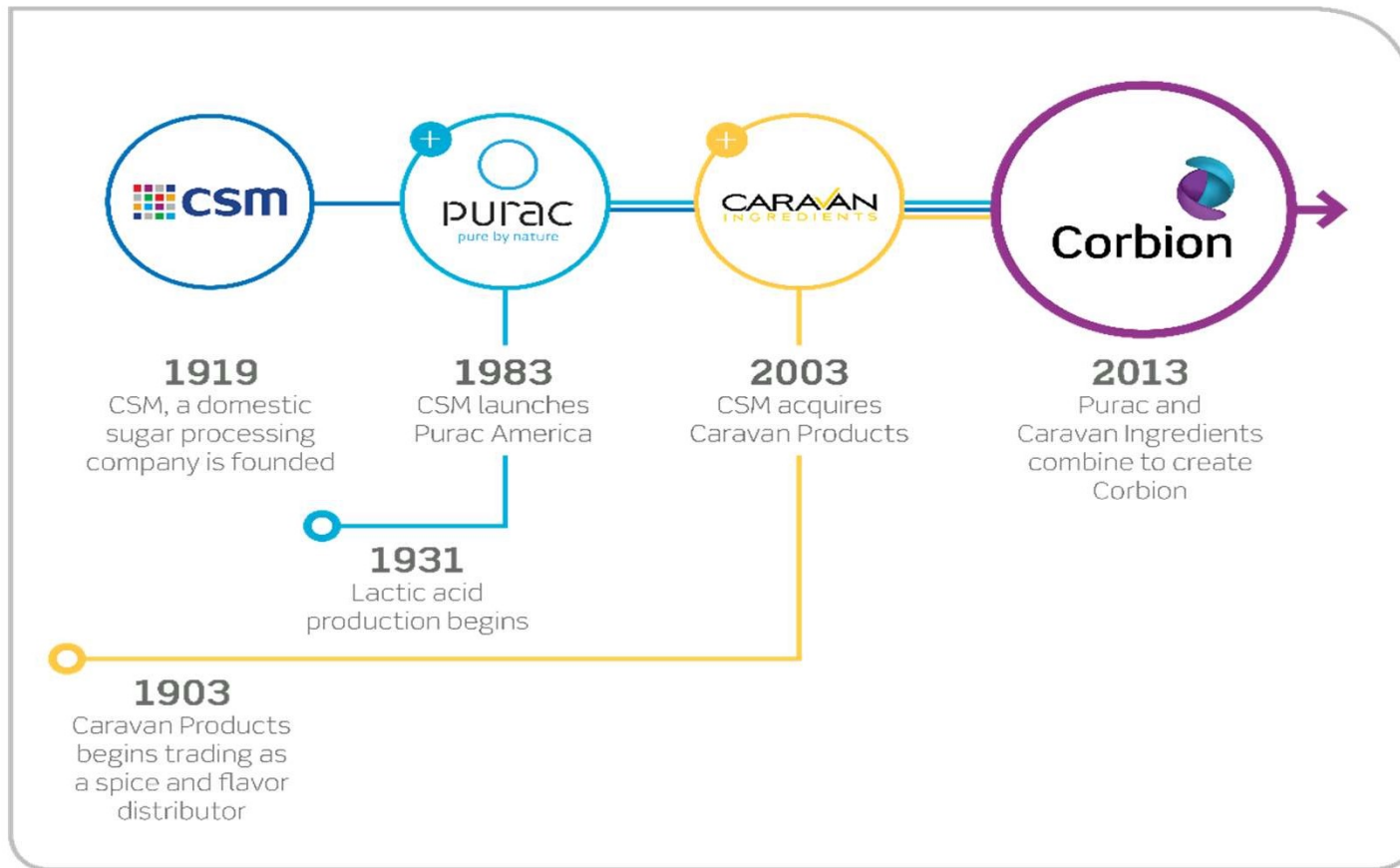


Preserving food and food production

Preserving health

Preserving the planet

## The evolution of Corbion






# 'We preserve what matters'

## United Nations – Sustainable Development Goals – Contribution

	2020	2025	2030
% of products contributing to preserving food and food production, health and/or the planet <sup>1,2</sup>	61%	>70%	>80%
% of innovation projects contributing to preserving food and food production, health and/or the planet <sup>1,3</sup>	100%	100%	100%

 <b>2 ZERO HUNGER</b>	% of products contributing to preserving food and food production <sup>1,2</sup>	30%
	% of innovation projects contributing to preserving food and food production <sup>1,3</sup>	60%
 <b>3 GOOD HEALTH AND WELL-BEING</b>	% of products contributing to preserving health <sup>1,2</sup>	34%
	% of innovation projects contributing to preserving health <sup>1,3</sup>	94%
 <b>12 RESPONSIBLE CONSUMPTION AND PRODUCTION</b>	% of products contributing to preserving the planet <sup>1,2</sup>	50%
	% of innovation projects contributing to preserving the planet <sup>1,3</sup>	84%

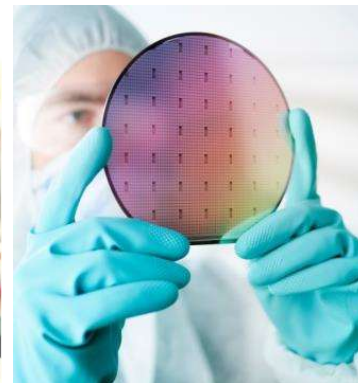
1. Products/innovation projects for which there is evidence that the product/innovation projects contributes to the identified impact categories.
2. By revenues.
3. By expected revenues in year 5 after commercialization.



## Our lactic-acid based products are powered by nature – Enabling you to replace fossil-based acids in a variety of applications

### Our markets

- Bioplastics
- Controlled drug delivery
- Resorbable Orthopedics
- Electronics
- Pharma
- Agrochemicals
- Home & Personal Care
- Animal Health



### Our products give our customers:

- Improved functionality
- Lower cost in use
- Recyclable and compostable
- Enhanced environmental credentials

## Creators helping creators

Corbion spends  $\approx$  4% of sales on R&D.

Partnering with our customers, suppliers and academic partners inspires us to develop sustainable technologies that not only solve our customers' problems, but also address the challenges facing the industry and our society in the 21<sup>st</sup> century and beyond. Only through close collaboration we believe we can make a difference.



Bioplastics:  
Poly Lactic Acid (PLA)



Resorbable Lactide-based  
Polymers



Hot Melt Adhesives



Self-healing concrete



Microalgae-based ingredients  
for plant-based products



## Chemistry 101 - introduction into SHC

- Concrete cracks and is reinforced with steel
- 10 years ago TU Delft innovated on limestone-producing bacteria
- Bacteria exposed to oxygen and water => convert to Calcium Carbonate
- How to survive mixing, pouring & curing?
- Controlled release when cracks appear
- TUD approached Corbion => co-creation
- Lactic acid, bioplastics, controlled release, scale
- 1<sup>st</sup> phase to prove technical concept
- 2<sup>nd</sup> phase: spin-off from TUD => Green Basilisk (2014)
- 3<sup>rd</sup> phase: first SHC (beyond lab scale) available in 2017

The percentage concrete contributes to global CO2 emission?



## The stakes and potential market is BIG

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### Self healing Agents

- Concrete water damage = serious issue
- Workable solutions available yet none ideal
- Market for concrete admixtures is ~ 16B U\$
- Addressable market is ~ 2B US\$ (waterproofing admixtures)
- Attainable market (2020) is several hundred M U\$
- Validated technical proof and the 4<sup>th</sup> generation product



## Now it get's complicated....

### *The bumpy innovation road*

- Building cheap ⇔ 30 years maintenance
- Construction industry: regulated and conservative
- Our 4<sup>th</sup> generation product is still pre-pilot scale
- Complex value chain (business model canvas)
- Which segment to go after (virgin / repair)
- Building scale ahead of demand
- How to define success?
- Lifespan patents



**Corbion**  
*Keep creating*

## Link to background information

- <http://www.corbion.com/media/773237/corbion-shc-4.pdf>