Biological solutions: Meet the challenge of producing more with less in a sustainable way for the benefit of agriculture while achieving the Sustainable Development Goals (SDGs)

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Rethink Tomorrow

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Biological solutions contribute to the SDGs

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Across the agricultural value chain

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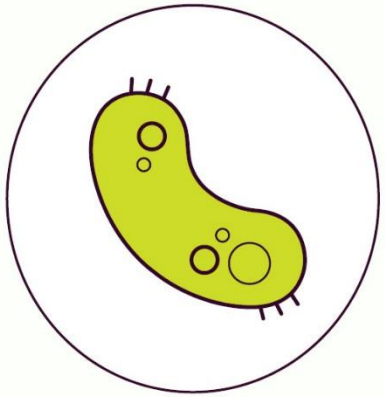
Novozymes BioAg and The BioAg Alliance

The BioAg Alliance, a partnership between Novozymes and Monsanto, researches beneficial microbes like bacteria and fungi that have a huge impact on a plant's growth and health.



Beneficial microbiome

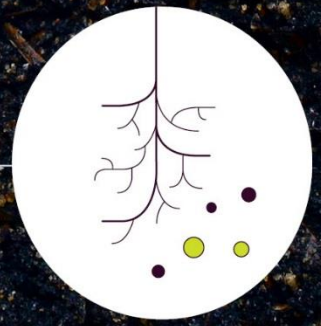
- Supply plants with beneficial nutrients like nitrogen and phosphorus
- Enhance root growth, giving plants a good start and physical support
- Protect plants from diseases and repel pests
- Help plants tolerate conditions like heat, flood and drought

Above ground

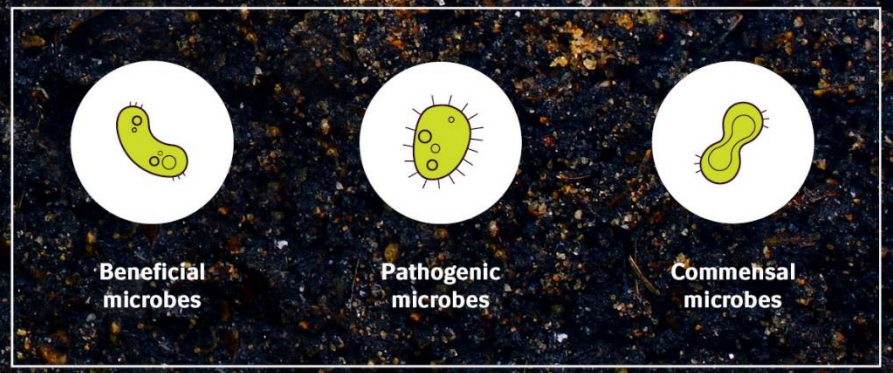
Phyllosphere: A plant's leaves and stems can have up to 10 million microbes on each square centimeter.

Soil

Rhizosphere: A tablespoon of soil contains a truly astronomical number of microorganisms, members of as many as 50,000 distinct species.



Types of microbes



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BioAg products benefit to climate change

Increase yield	Water and nutrient efficiency	Stress tolerance	Carbon sequestration
• Improve uptake of nutrients and increase yield compared to non-treated crops. Thus more food, feed, and fuel is produced per hectare of land reducing energy used per unit yield.	• The efficient use of nutrients positively impact GHG production through reduced fertilizer use, especially nitrogen, which has a very energy-intensive production process.	• Increase plants tolerance to abiotic stresses such as high temperature, rainfall and drought and recovery from them.	• Biological yield enhancers give larger crops and larger root systems. This leads to a higher level of soil organic carbon.

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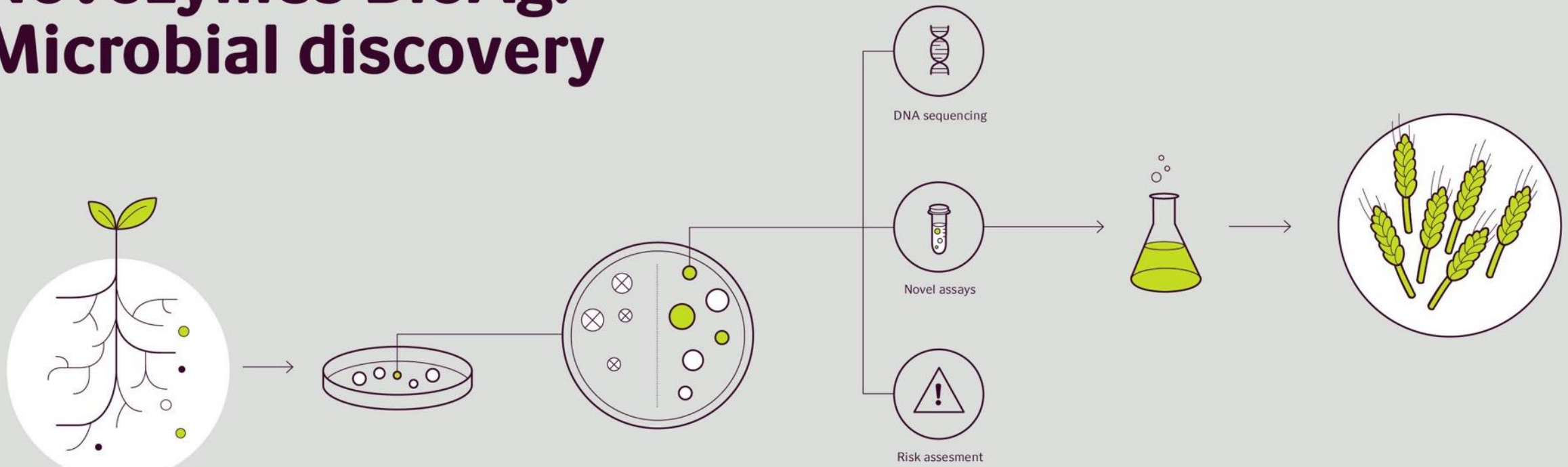
Novozymes BioAg: Microbial discovery



1 Collect

Soil samples are collected from targeted fields all around the country by agronomists

2 Grow

From these samples, thousands of microorganisms are grown in special media and under special conditions

3 Identify

Pure colonies of the isolated micro-organisms are DNA-sequenced, identified, characterized and classified

4 Potential

Novel assays are developed to screen the identified microorganisms for their potential benefits

5 Testing

Beneficial microbes are then fermented, formulated and field tested

6 Measure

In field testing, the potential of the microbes in increasing fertility and yield and in crop protection is measured

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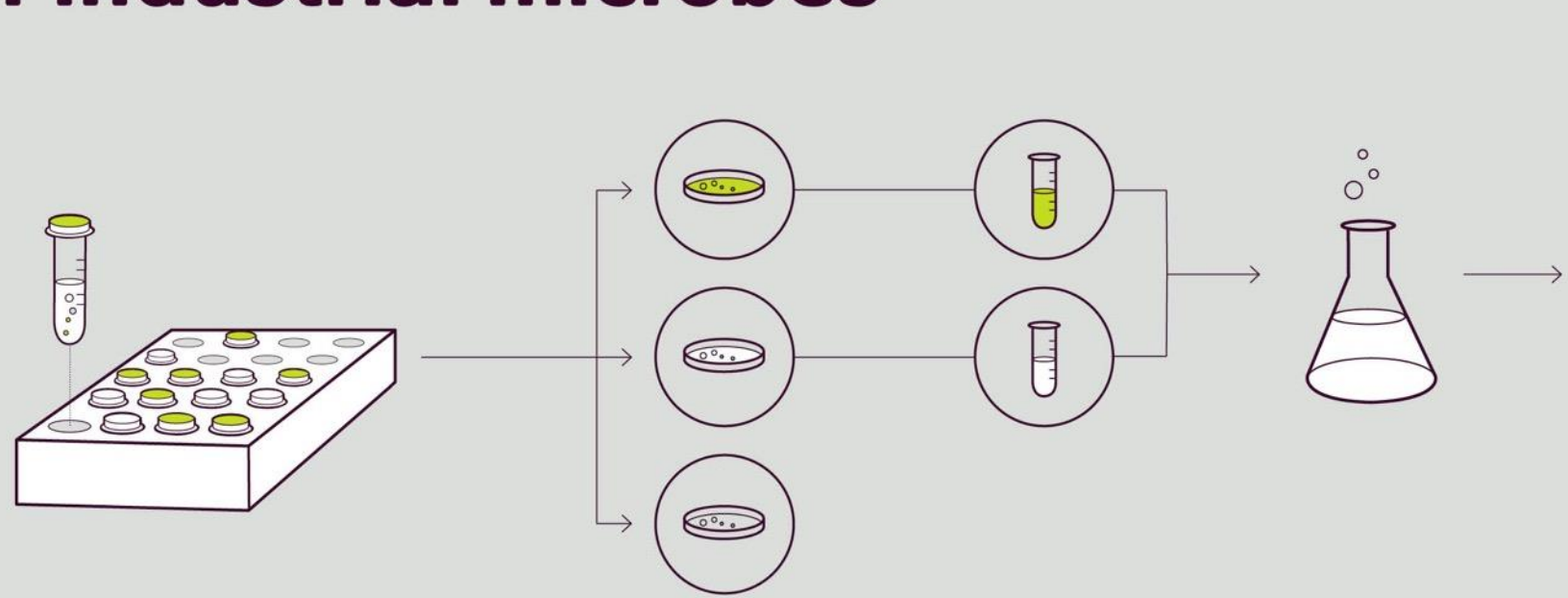
Novozymes BioAg: Fermentation and production of industrial microbes



200.000.000
Scale-up

1 Assay
Growth in microtiter plates

2 Isolation
Microbes are isolated

3 Testing
Testing in shake flasks

4 Pilot Scale
Testing in lab

5 Production
Fermentation scale-up by a factor of 200.000.000 by volume

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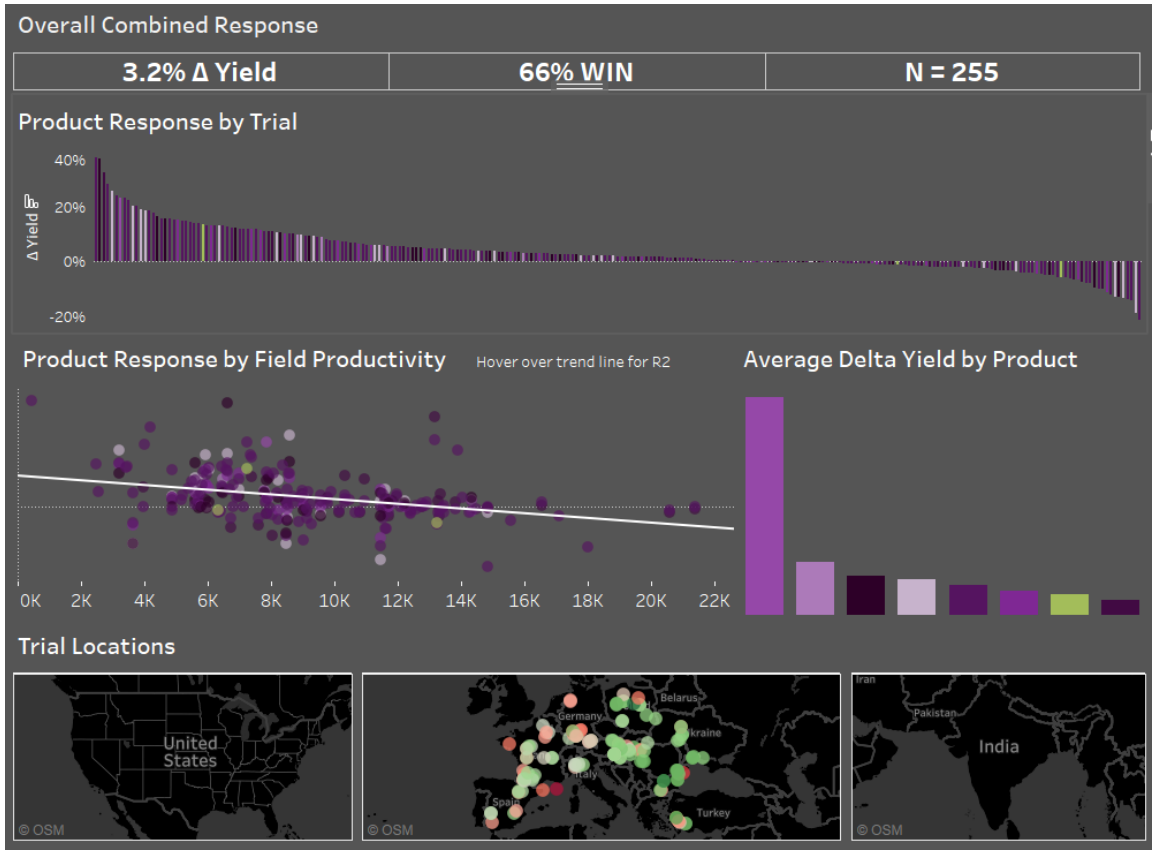
Quantifiable Sustainability with Biostimulants

- Less CO2 produced per unit of production
- Increased Yields



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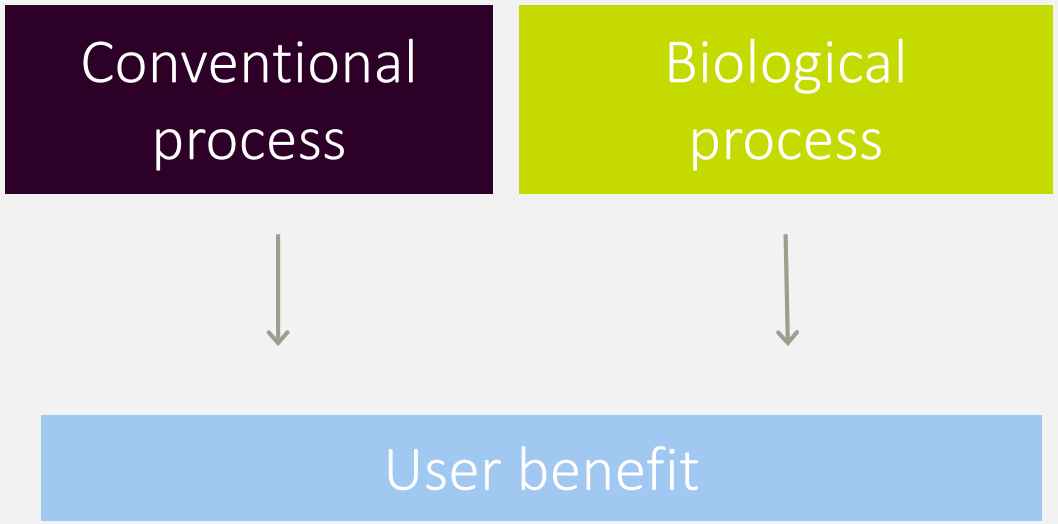
Quantifying Sustainability



… same benefit to the user – but **different environmental impact**

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Lifecycle assessment (LCA) Environmental assessment from “cradle to grave”

Raw Material Production

Enzyme Production

Enzyme Use

Waste Water Treatment

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Method and databasis

LCA studies are conducted in agreement with ISO 14040 standards on LCA

LCA data are derived from

- Novozymes' own production
- Novozymes' supplier's production
- Novozymes' customer's production
- Public LCA databases
- Literature

Modelling is performed in SimaPro 8 LCA software

Impact assessment method: CML-IA baseline

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LCA studies address four resource indicator

Fossil fuel

Agricultural land

Minerals

Water

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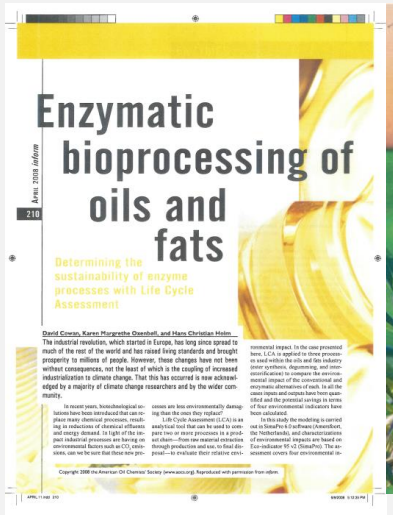
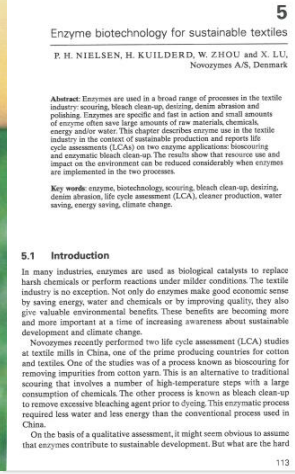
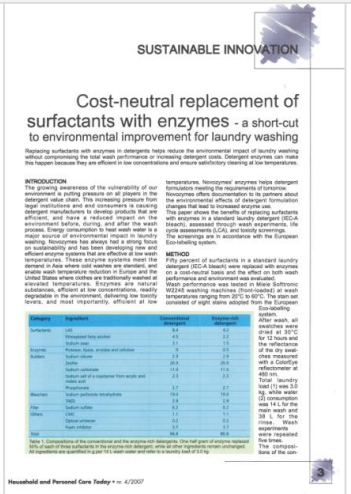
Life cycle assessment - LCA







We link business and sustainability

We have used LCA since 2004 to estimate the impact of our solutions in R&D, in production and when used by our customers

LCA studies are conducted and verified by a third party in accordance with ISO 14040 and published in various journals

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Reducing customers CO_2 impact

In 2015, Novozymes helped customers save

60 million

tons of CO_2 through the application of Novozymes' products, equivalent to taking 25 million cars off the road

Detergent:
100 kg CO_2
per ton of laundry

Animal feed:
80 kg CO_2
per ton of feed

Textile:
1100 kg CO_2
per ton of fabric

Cereals:
110 kg CO_2
per ton of bread

Agriculture:
15 kg CO_2
per ton of corn

Beverage:
25 kg CO_2
per 1000 liters of beer

Leather:
100 kg CO_2
per ton of hide

Paper making:
150 kg CO_2
per ton of pulp

Vegetable oil:
44 kg CO_2
per ton of oil

Starch based biofuel
1100 kg CO_2
per 1000 liters of ethanol

Biomass based biofuel:
2200 kg CO_2
per 1000 liters of ethanol

Cosmetics:
190 kg CO_2
per ton of fatty acid ester

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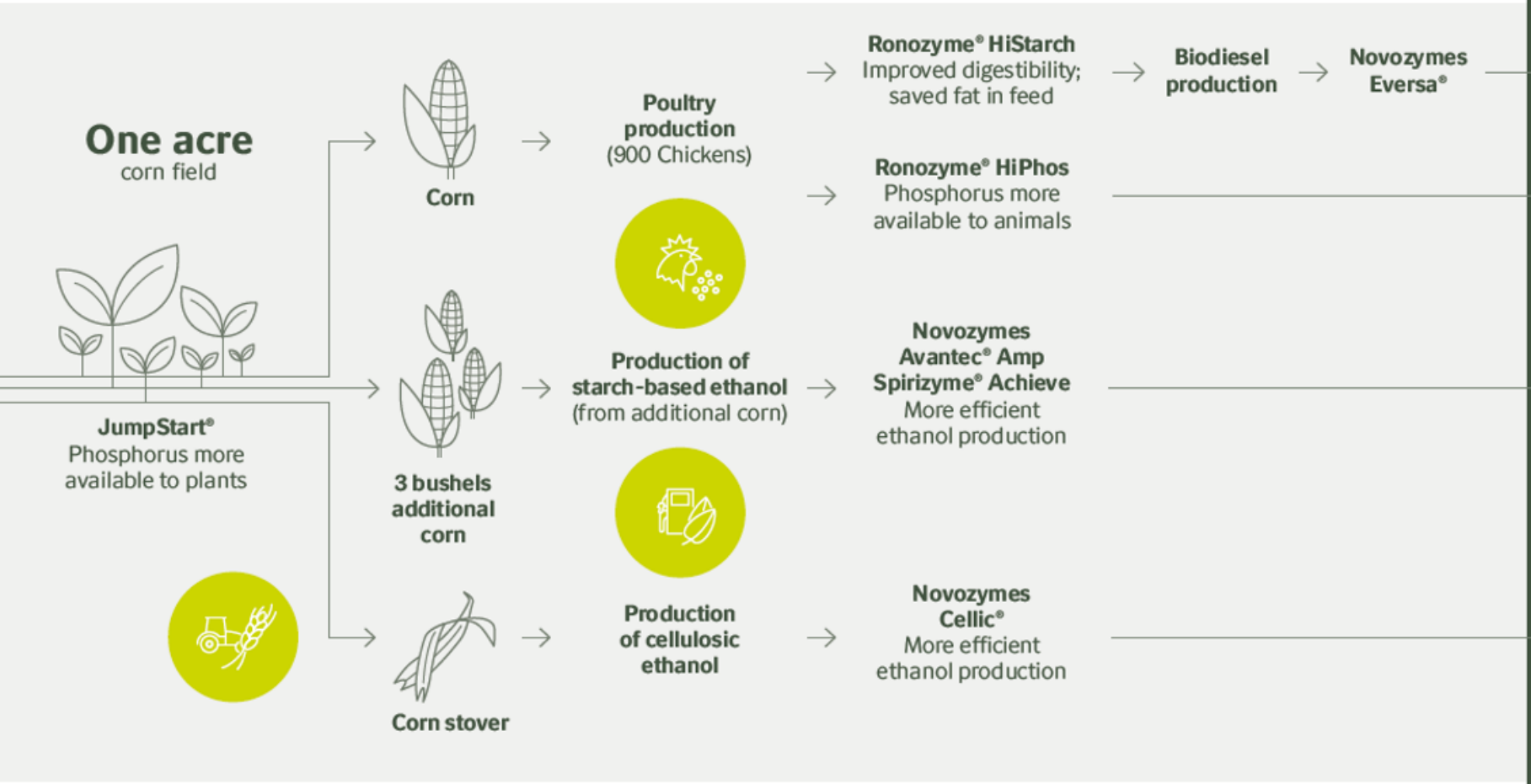
The Acre Study:
Here's how much more we could get from one acre of corn

Imagine you take one acre of corn, and see how you can increase productivity. New report from Novozymes measures how much more value can be generated using biosolutions in ethanol, crop and poultry production. The results? More feed, food and energy, less CO_{2e} emissions.



Avoid

1.1 metric tons

of CO_{2e} emissions

13 US gallons

biodiesel

12 pounds

pure phosphorus saved, reduced feed costs

3 US gallons

starch-based ethanol*

32 pounds

more protein-rich animal feed**

100 US gallons

cellulosic ethanol

230 kWh

electricity

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Perspectives

TODAY

60 million ton CO_2 per year

About 60 million ton greenhouse gasses are avoided every year by Novozymes' customers because they have moved to Novozymes biological solutions

Carbon footprint study conducted by Novozymes in 2015

TOMORROW

The potential is even greater.

More than **200 million ton CO_2** could be avoided if all known enzyme technology was implemented in industry

More than **1 billion** ton CO_2 could be avoided if all known biotechnology was implemented

WWF (2009): Industrial biotechnology

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Promising elements are already in there

- Novozymes welcomes Commission´s Communication “The Future of Food and Farming” in:
  - Recognising the role of the CAP in harnessing the bioeconomy
  - Exploring an obligatory EU nutrient management plan and incentives for precision farming for the new CAP as it could create opportunities for biological solutions
  - Recognising the role of the new CAP and farmers in achieving the SDGs
- Novozymes also welcomes EUR 10 billion under Horizon Europe to support R&I in food, agriculture, rural development and the bioeconomy as announced in the MMF proposal published on 2 May 2018

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From recognition to implementation: A call for actions

The new CAP should facilitate the transition to a sustainable farming sector. This would require a policy that:

- Promotes the available bioeconomy solutions and measures as sustainable ways for greening the EU agri sector and achieve the SDGs
- Embraces innovative solutions based on scientific evidence
- Allows and encourages farmers uptake of biological solutions as environmental friendly practices

Overall, the CAP should not only focus on the WHAT but also provide indications on tools available on HOW to achieve more sustainable farming even if indicative, establishing a toolbox could help member states and farmers achieve their objectives cost-effectively.

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Thank you

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