



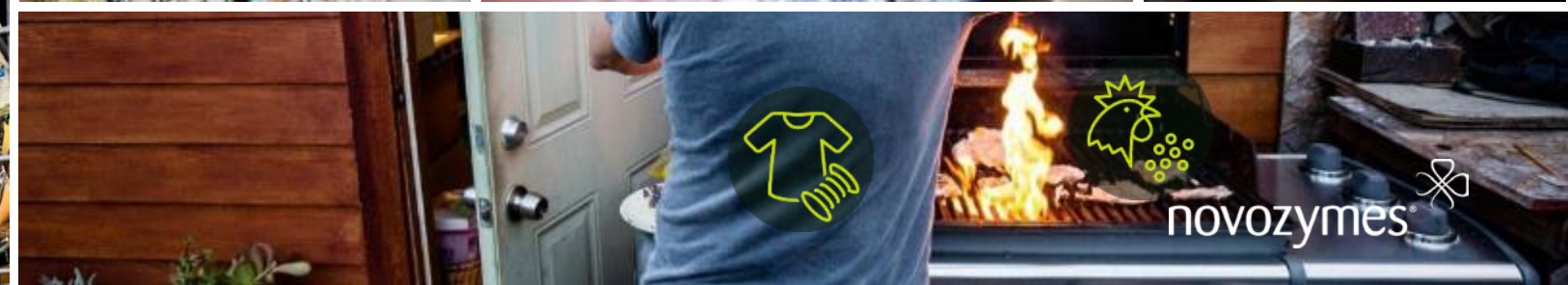
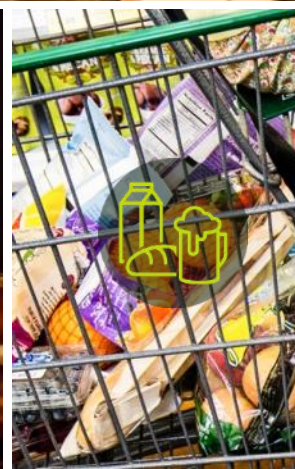
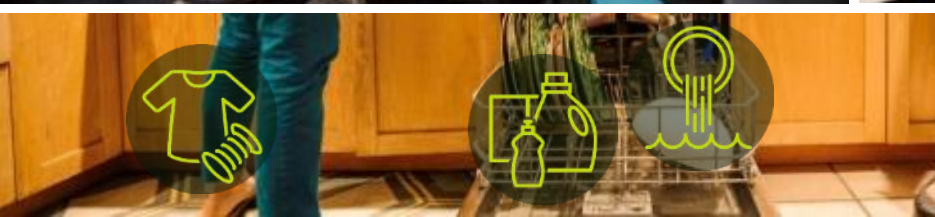
# Enabling the 2G Ethanol Industry Globally – A Novozymes perspective

**Santonu Kashyap**  
Head, Biorefining Commercial, India

04 March, 2020



**Uniquely diversified group**  
- creates synergies and opportunities



## Novozymes at a glance

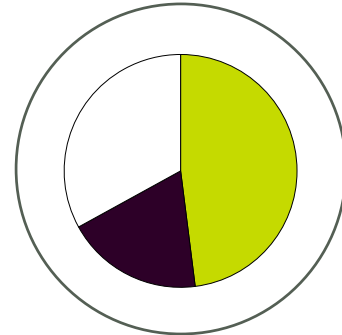


# World's Largest Dedicated Biotechnology Company



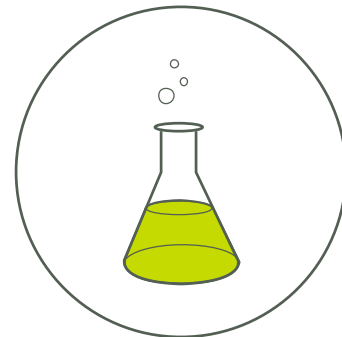
## Global

- ~6,500 employees
- Major production footprint in Americas, Asia, Europe
- Sales in 140 countries



## Market Leader in industrial enzymes

- ~48% Novozymes
- ~19% DuPont
- ~33% others



## R&D intensive

- ~1,400 R&D colleagues
- ~7,000 patents
- ~13% of sales invested in R&D

We account for 2/3 of the entire global investment in developing enzymes, dedicating 13-14% of our total revenue to R&D



**Unrivaled  
research and  
innovation**

**2/3**



**The biorefining platform addresses three key dilemmas**

# The biorefining platform addresses three key challenges recurrent in climate change discussions



## Challenge 1

No silver bullet solution



## Challenge 2

No crystal ball to predict new technology adoption



## Challenge 3

Need for negative emissions

If you want to know more...

Report is available free of copyright at

[Novozymes.com / bioenergy](https://www.novozymes.com/bioenergy)



*“Modern bioenergy is the overlooked giant of the renewable energy field”*, **Fatih Birol, IEA**

*“Bioenergy is a great way of balancing variable electricity production”*, **Kimmo Tiilikainen, Finnish Minister of Environment and Energy**

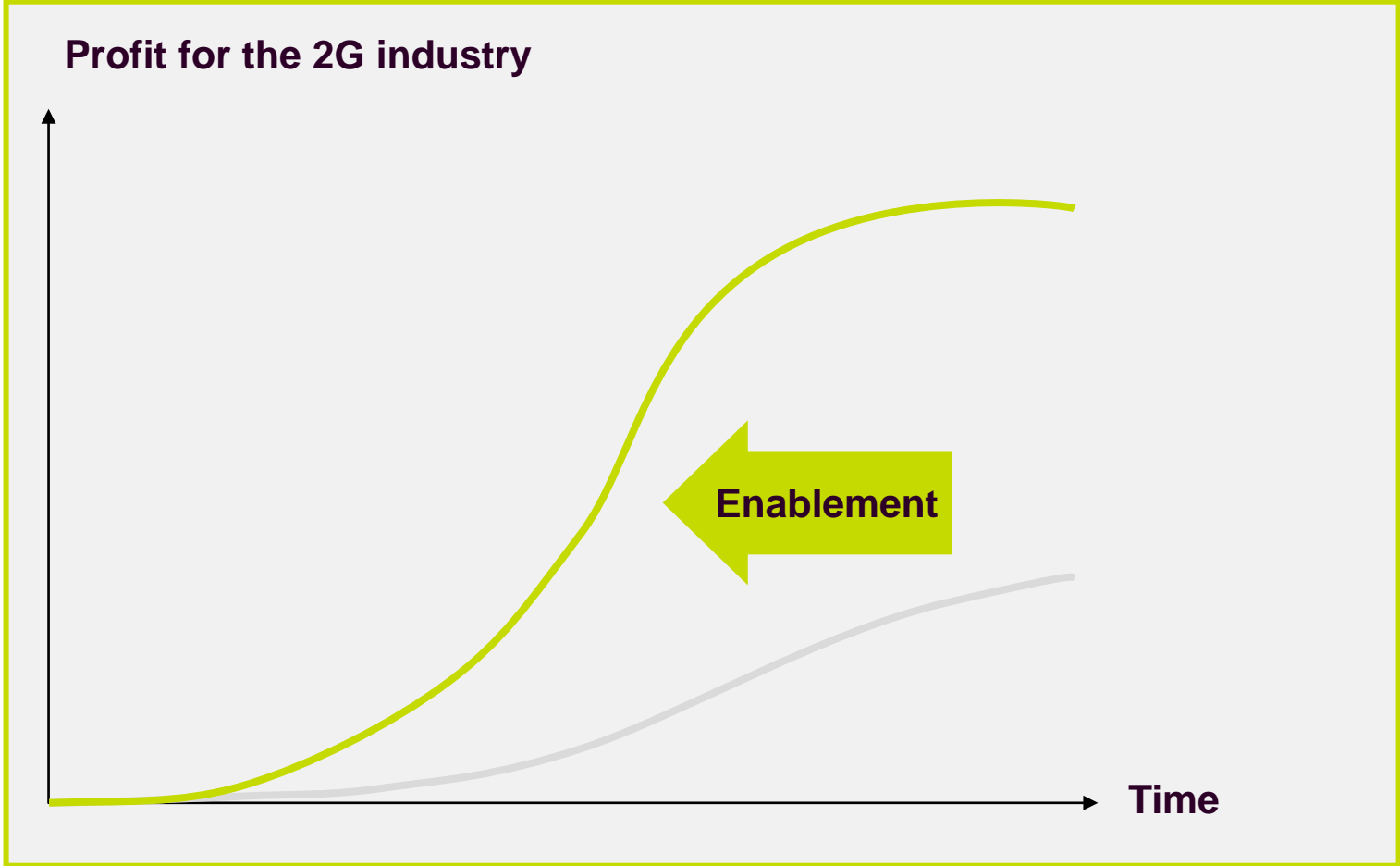


**Together with our partners we Learn, Innovate, Voice  
and Enable the 2G dream**



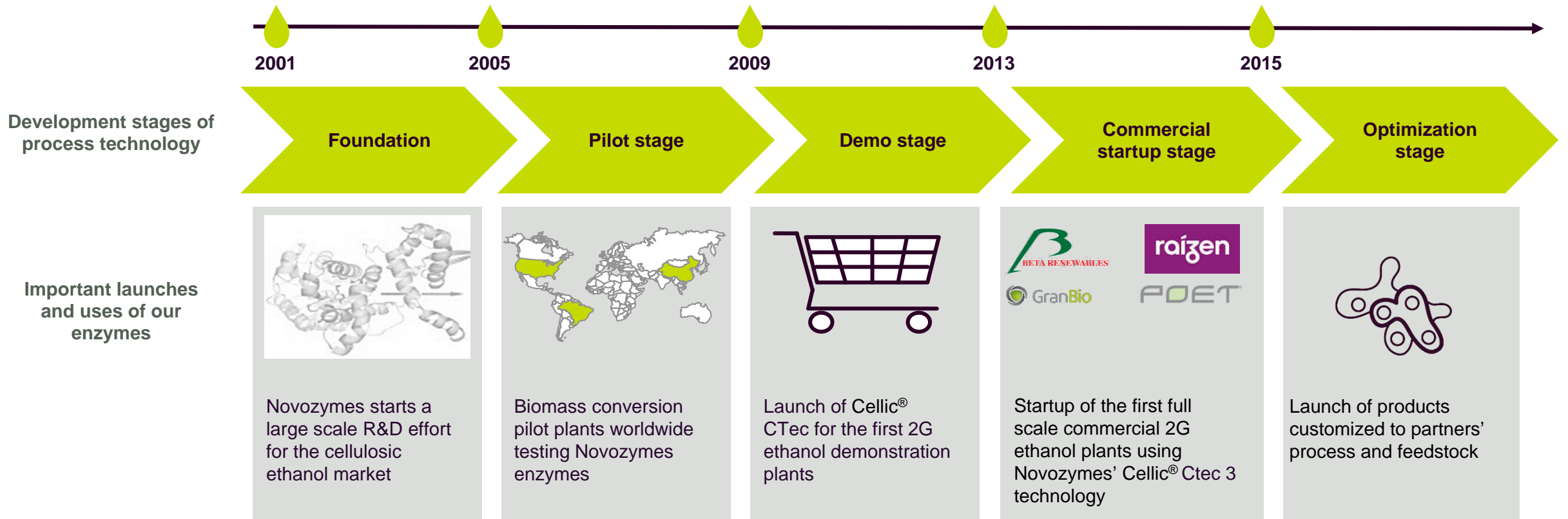
# Our approach has been and continues to be to enable the 2G industry

## Ambition



- R&D
- Established supply setup
- Advocacy
- Competitive and committed pricing
- Efficient risk sharing

# 2 decades of large scale R&D and business development to become the leader in the 2G biotech space



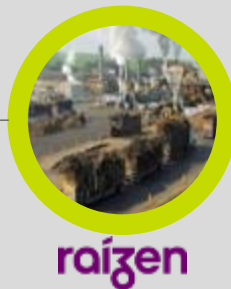
Enzyme cost improvements



Current Partners in India (>10 years of work with Praj)



# There are 5 commercial scale enzymatic 2G plants in the world



Novozymes  
enzymes

...contributions to  
the 2G industry:

1. Most potent enzymes in cellulosic space (developed in past 20 years)
2. Reliable, fully demonstrated multi-hub supply model globally
3. 2G Yeast available
4. Optimized with all technologies available globally
5. Active collaboration with Praj in India for past 10 years

# Past and new trends in cellulosic biorefineries

## Wood

- Continuing projects on ag-residues and energy crops (esp. India & Brazil)
- But high growth in wood/ forest residues projects in North America & EU

## Acid and/or Neutral Steam Explosion

- All projects in commercial scale are neutral steam explosion or acid
- Most projects close to investment decision are neutral steam explosion or acid

## Bottlenecks not where originally expected

- No problems on biotech side
- Biomass handling / preparation and pretreatment as the key bottlenecks (Erosion/corrosion, clogging ... and in general misalignment between original pulp and paper purpose and actual 2G conditions)

## EU and India resurgence

- New “bubbling” in the EU cellulosic biorefinery projects
- India leading the pack
- China as the new potential market with big SOE push
- Americas waiting for local success before domestic and international expansion

# Past and new trends in cellulosic biorefineries

## Integration / Shared Utilities

- Core equipment is expensive and risky enough, so the best projects are co-located with a 1G plant or in an industrial complex with shared utilities
- 

## Onsite / Offsite

- All full scale plants currently running with offsite enzyme supply
  - Most technology providers rely on offsite enzyme supply
  - Most publicly developed projects rely on offsite enzyme supply
  - However, onsite has some wind thanks to
    - Clariant, POET/DSM etc
    - Lack of global coverage by Novozymes competitors (means that the first plant is likely to become their future hub)
- 

## Lignin Valorization

- Mostly burnt today, but many working on higher value applications
  - Good mid-term prospect for biorefineries, as today's IRRs are achieved while burning half the energy content
- 

## Other topics

- CO2 capture in 2G plants (like in several EU 1G plants today) would ensure heavily negative carbon emissions
- “End game” for sugars is likely biochemicals and shipping/aviation, but most projects still focus on light duty as ethanol is the cheapest to decarbonize transport

# A few principles derived from our market observations

1

Getting the biotech right is key, but getting the mechanics and biomass related processes right is even more important

2

Low cost inputs are key, but smooth operations are even more important

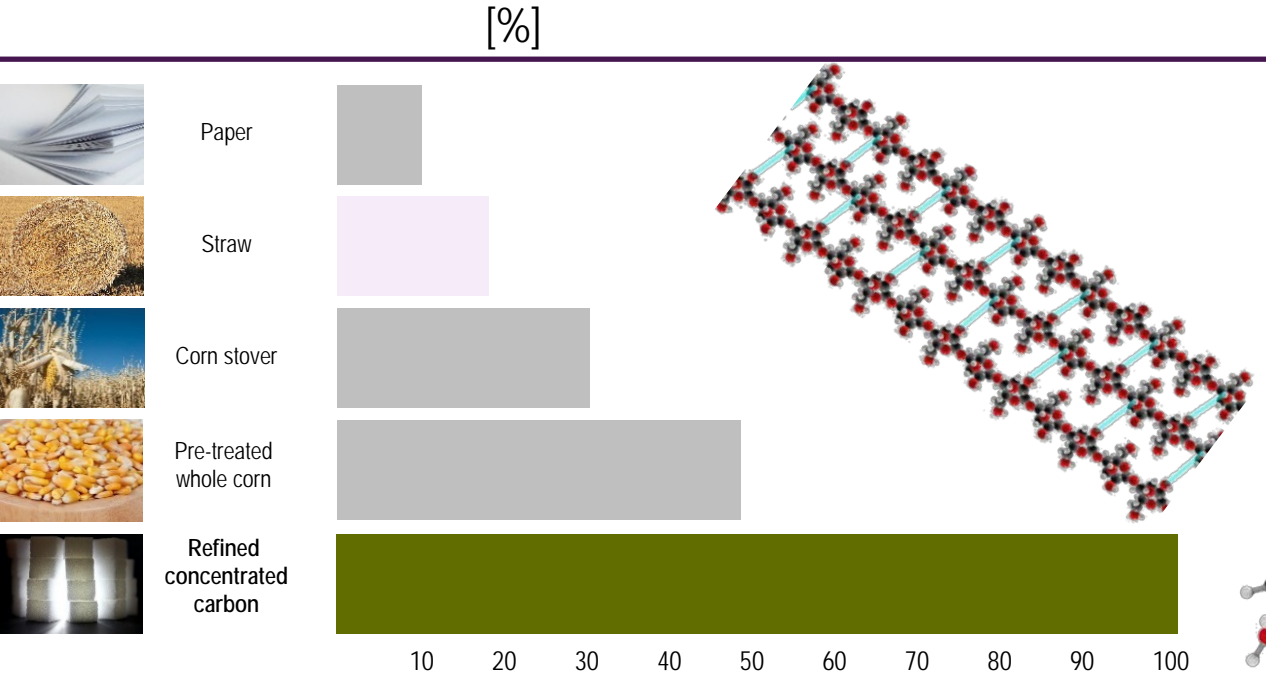
3

Fancy stuff is good, but buying flexibility is even more important

# Novozymes has explored alternative carbon sources

- viscosity challenges force water into the enzyme production processes – CAPEX/OPEX goes up

Fungal fermentation in lab: Enzyme yield per substrate



# With a continuous innovation machine & high quality standards

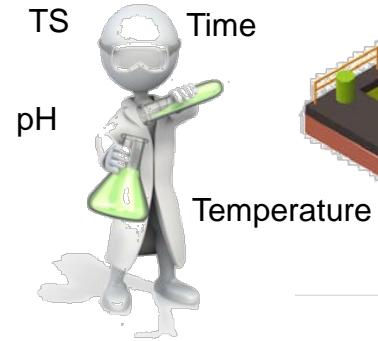
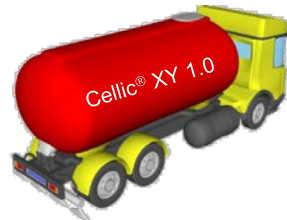
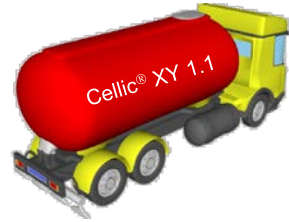
- you get flexible product composition matching your feedstock, processes, regulatory and quality needs



~ 1600 employees in R&D



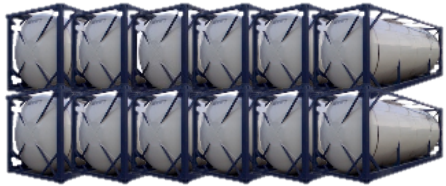
> 700 products in 30+ industries





# With enzyme supply from Novozymes

- you get flexible product supply



## Is onsite a no go for Novozymes?

We were among the first to bring both IP, running at full scale new machinery and concepts that enable onsite / co-location / integration ... but we believe that using our megahub is the most competitive



(11) **EP 1 735 454 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:  
**10.05.2017 Bulletin 2017/19**

(21) Application number: **05736399.6**

(22) Date of filing: **10.03.2005**

(51) Int Cl.:  
**C12P 19/04 (2006.01) C12P 7/06 (2006.01)**

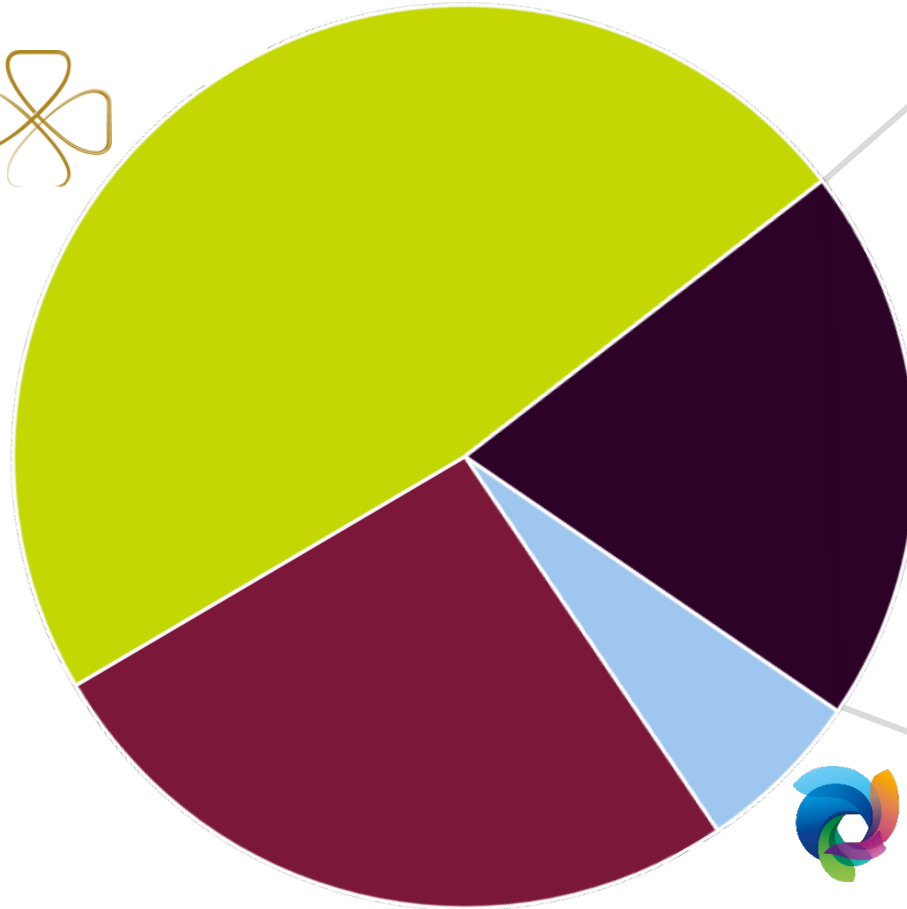
(86) International application number:  
**PCT/US2005/008325**

(87) International publication number:  
**WO 2005/100582 (27.10.2005 Gazette 2005/43)**

# In line with our strong commercial position ...

## Global enzyme market share

novozymes 



AB Enzymes  
AMANO  
ADISSEO  
ELANCO  
ADM  
HUVEPHARMA  
CHR. HANSEN  
Longda  
vtr  
LALLEMAND

DU PONT

 DSM

novozymes 

**... we offer a supply chain unrivaled in scale and scope, thereby guaranteeing supply security and most competitive prices**



**Blair, NE  
(US)**



**Franklinton, NC  
(US)**



**Kalundborg  
(Denmark)**



**Tianjin - TEDA  
(China)**



**Suzhou - Hongda  
(China)**

# Novozymes India:

## Snapshot



#1 Industrial enzyme supplier



Consistent double digit Growth



650+ employees



35+ years of presence

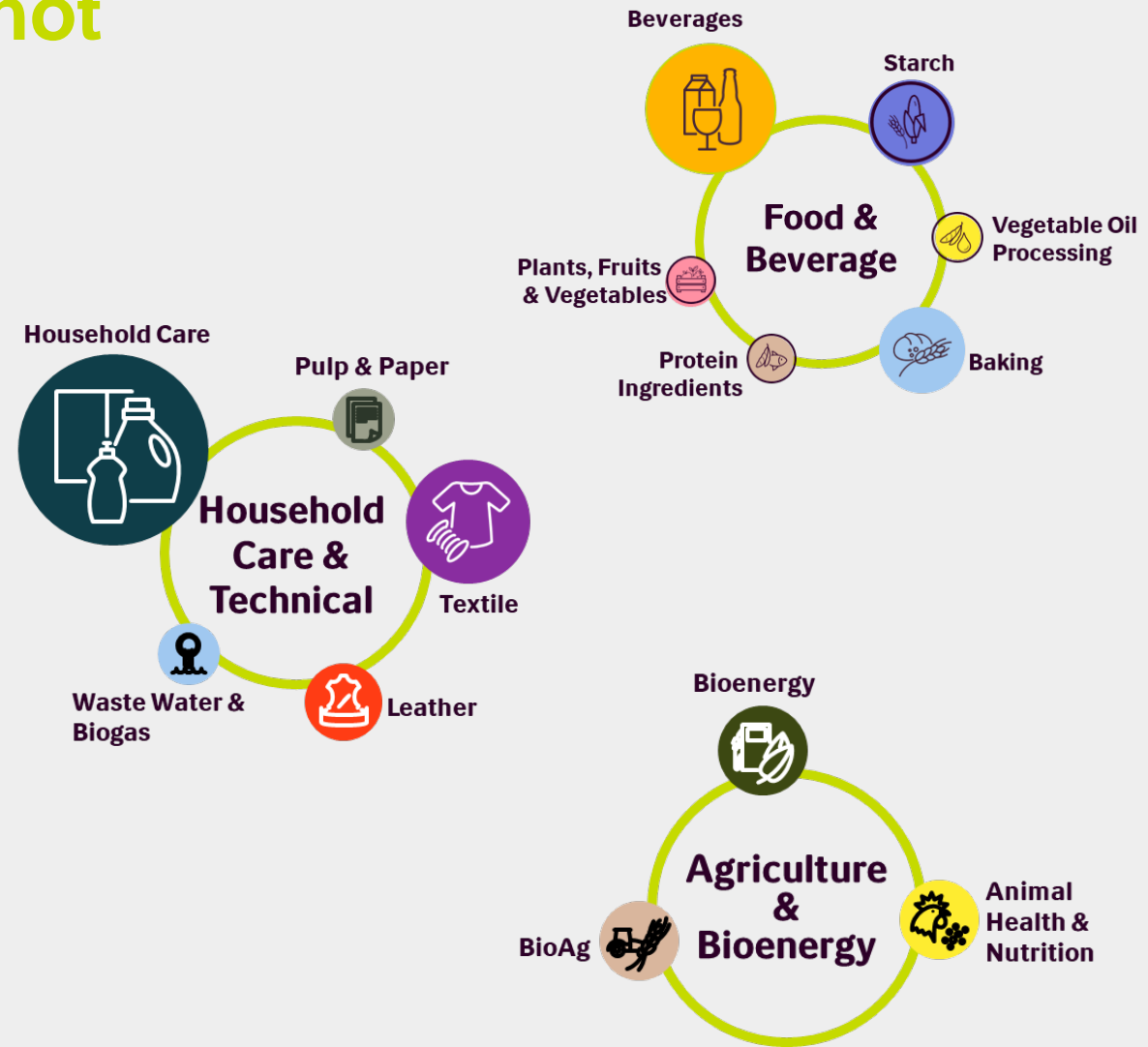


Commission of Production facility near Mumbai



Spread across South Asia

Corporate office in Bangalore & satellite office Delhi, Mumbai & Bangladesh



novozymes®   
Rethink Tomorrow