



R&D and Innovation

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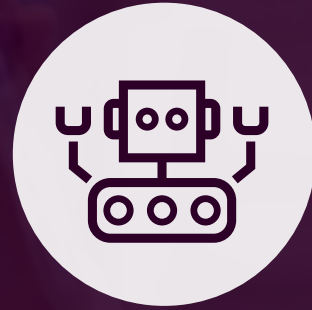
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Defining trends that impact technology development ... and **enable opportunities** for Novozymes

Trends



Increased access to data (digitalization)



Increased automation



Increased regulatory complexity



Better and cheaper genome sequencing and gene editing technologies

Opportunities



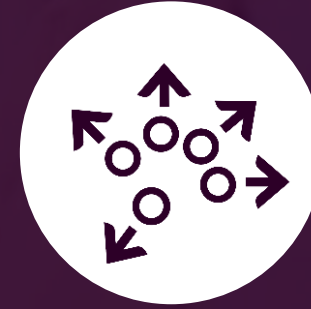
Tailored innovations



Increased technology leverage across platforms



Increased and more impactful innovation

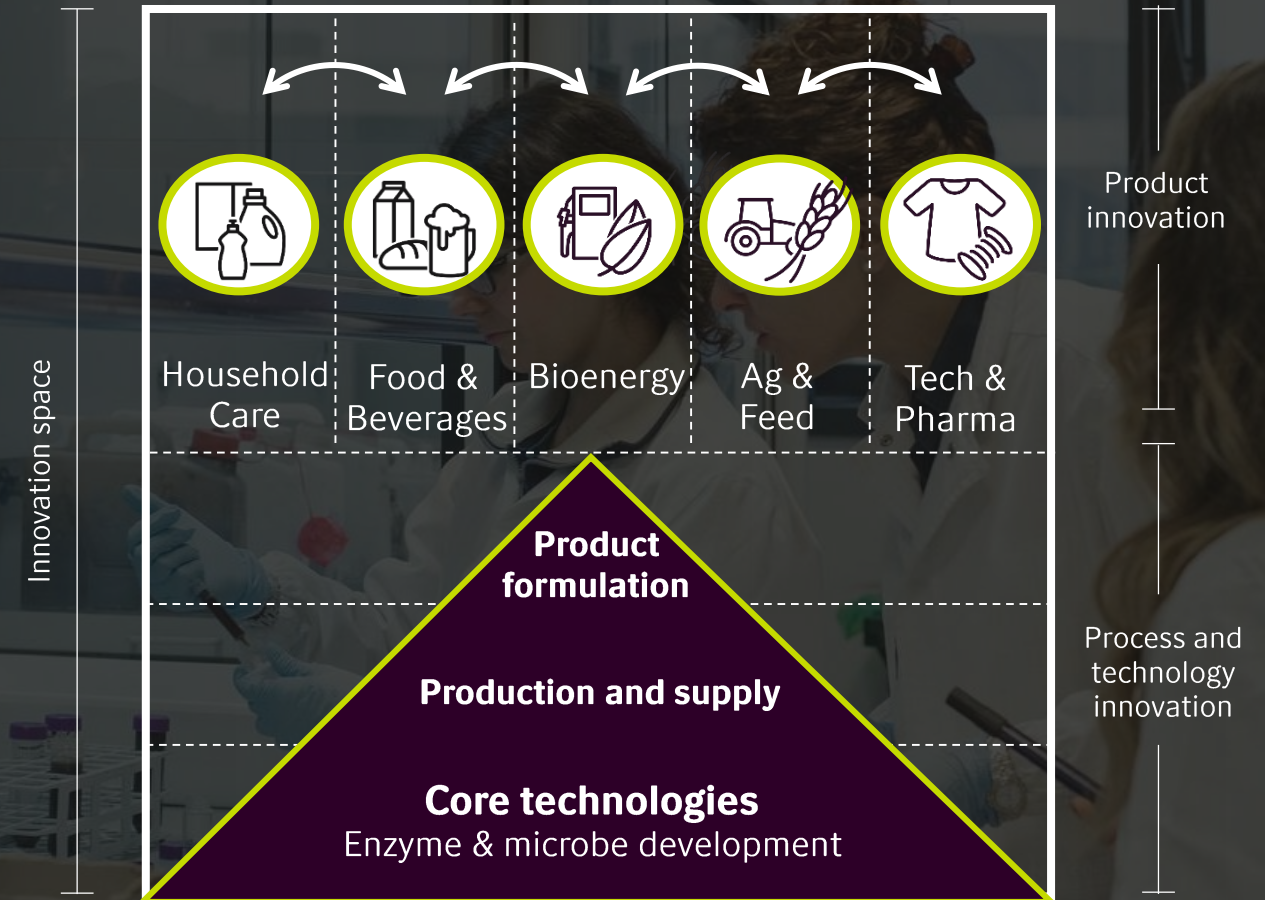


Expansion of the innovation space

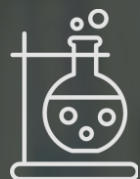
Our business is to turn **amazing science** into sustainable **biological solutions**

Our R&D strategy

- Capitalize on critical mass and expertise to develop new cutting-edge technology and innovation
- Enable cross-fertilization to leverage innovation and synergies across industries
- Secure technology leadership through continued investments and technology scouting



Decentralized R&D meets local needs faster and better



19 sites

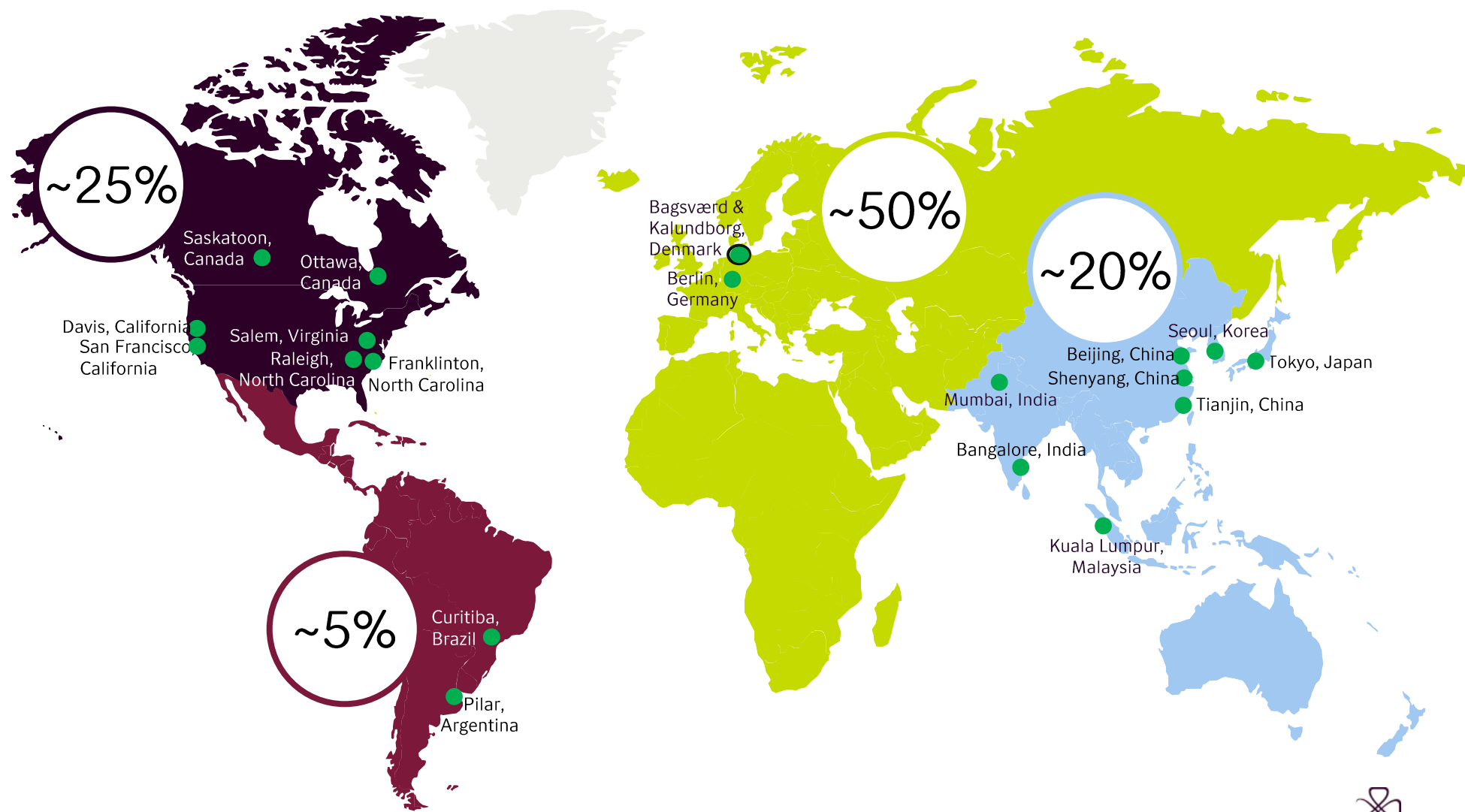
Strengthens our market presence and provides access to global technology and competencies



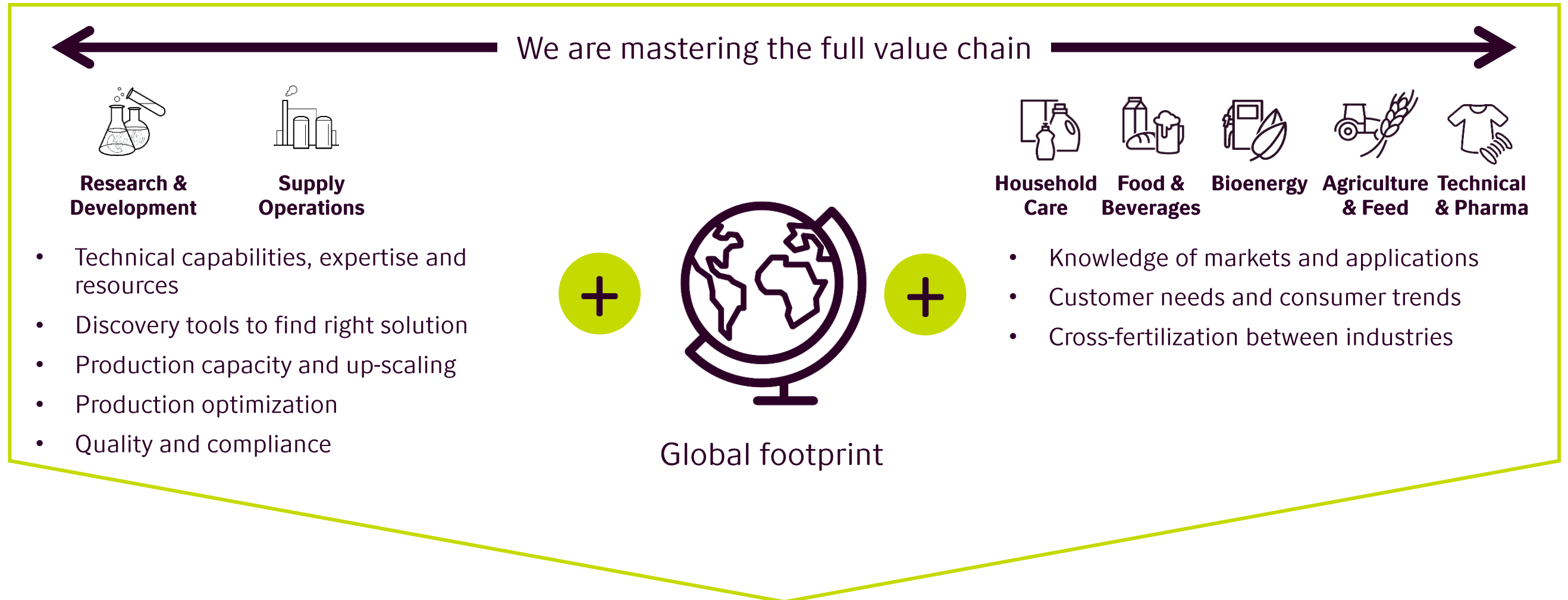
~1,600

R&D employees

Decentralized R&D means that we can meet local needs faster and better while still leveraging our unique competences globally

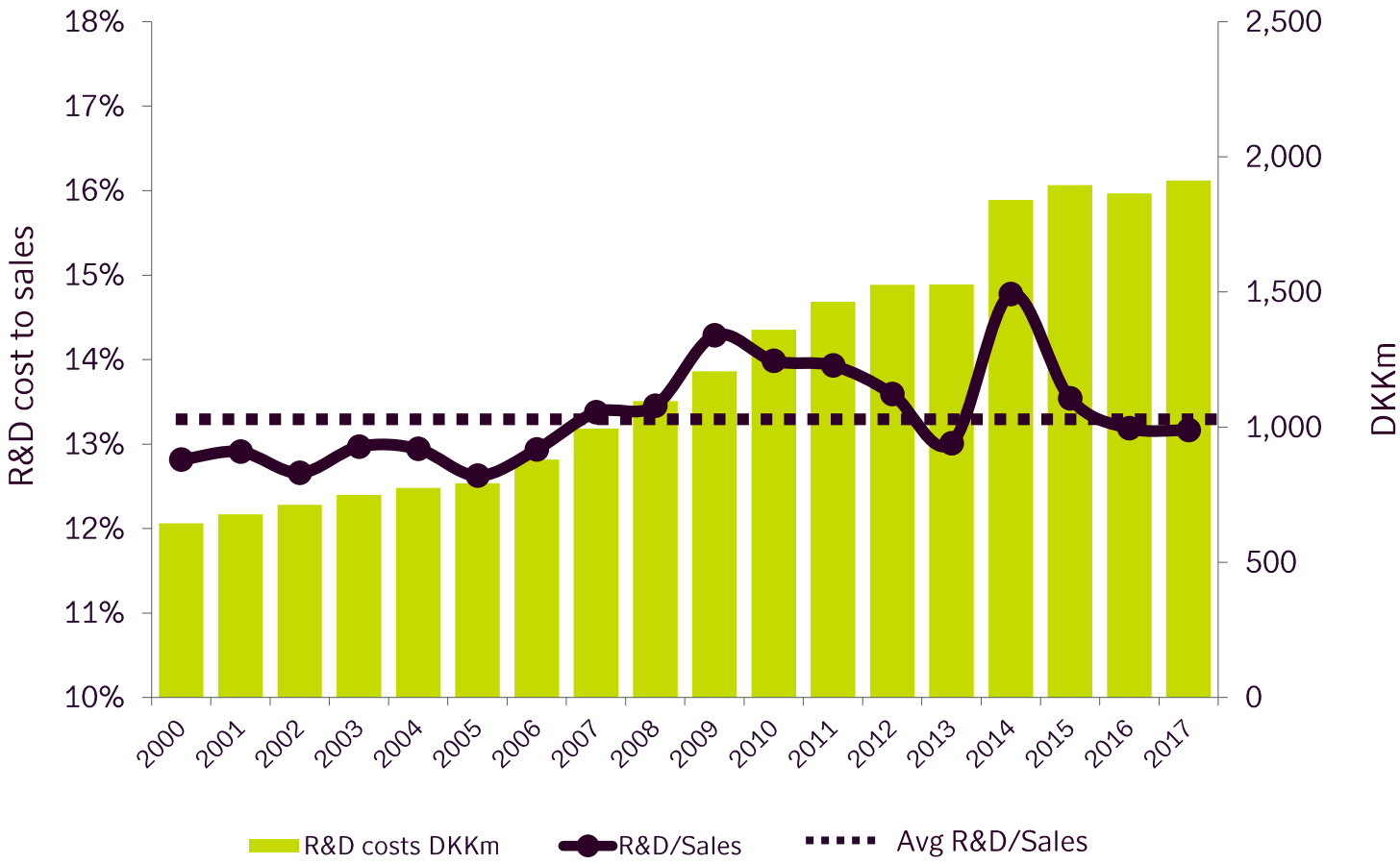


Global leadership in enzyme and microbe development arise through a combination of competitive advantages



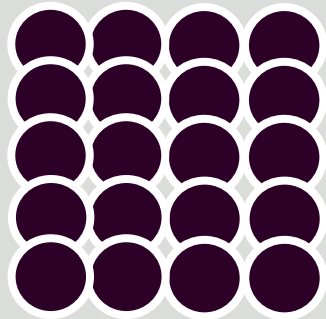
Novozymes' unique position to drive innovation opportunities

Our **technology leadership** is built on significant R&D investments

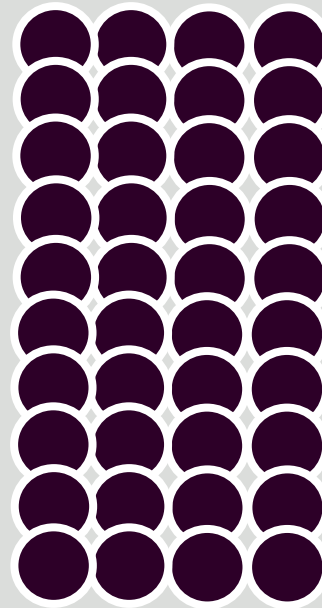
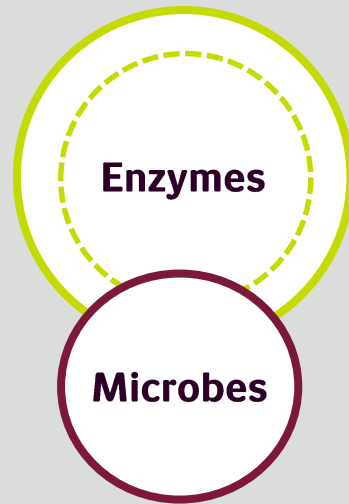


Our **broad technology platform** allows us to open up opportunities in new areas and diversify our business

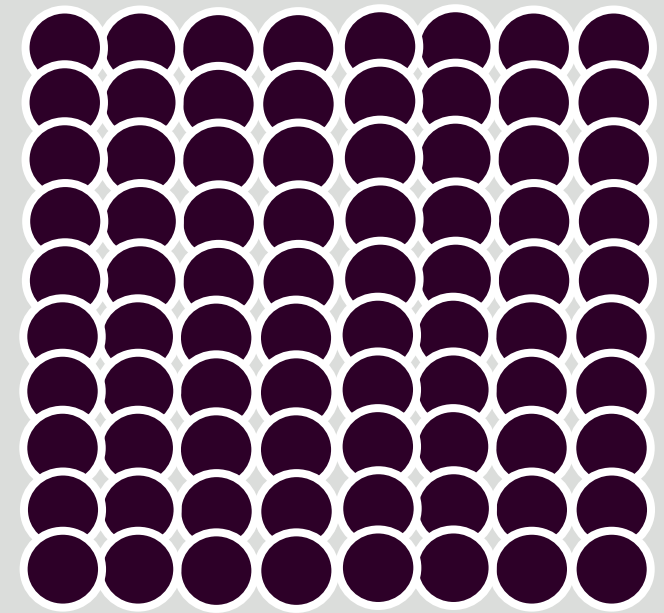
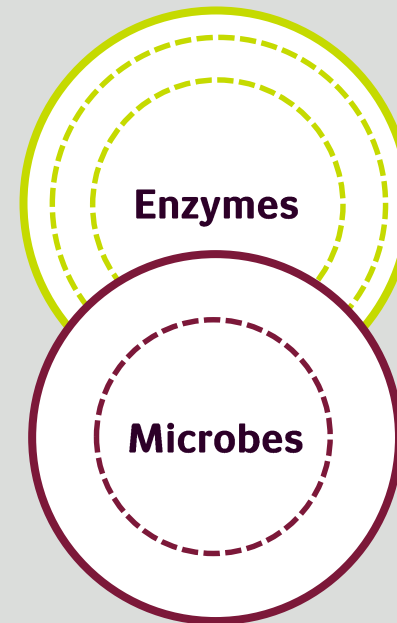
Past



Present



Future



~20 industries

Examples



Detergents Textiles Beverages Baking

+40 industries

Examples



Nutrition Bioenergy BioAg Animal Feed Grains

New and potential industries

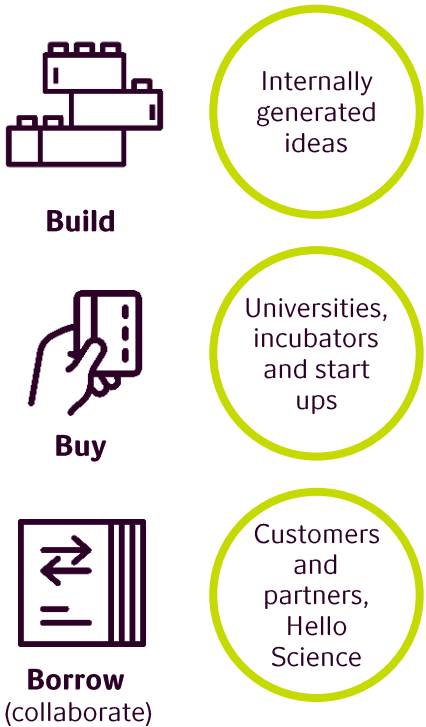
Examples



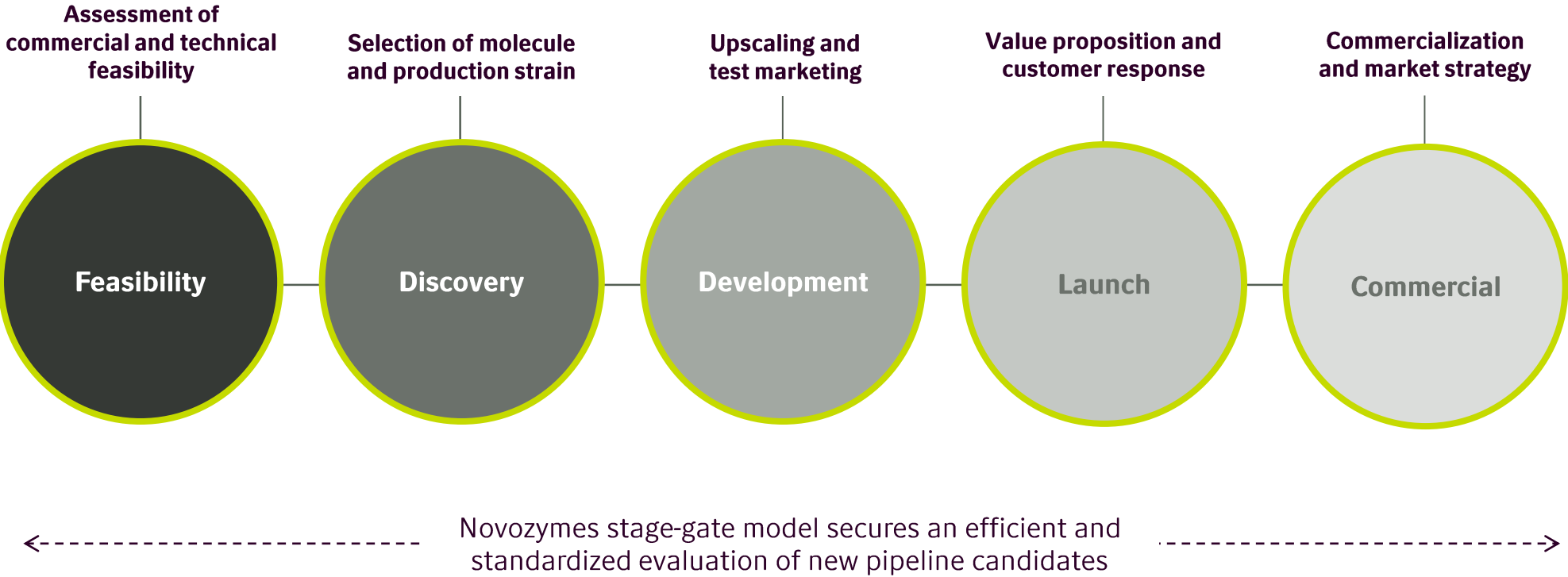
Clean water Palm oil Animal Health Sugar cane Other?

Product development happens on **several levels**

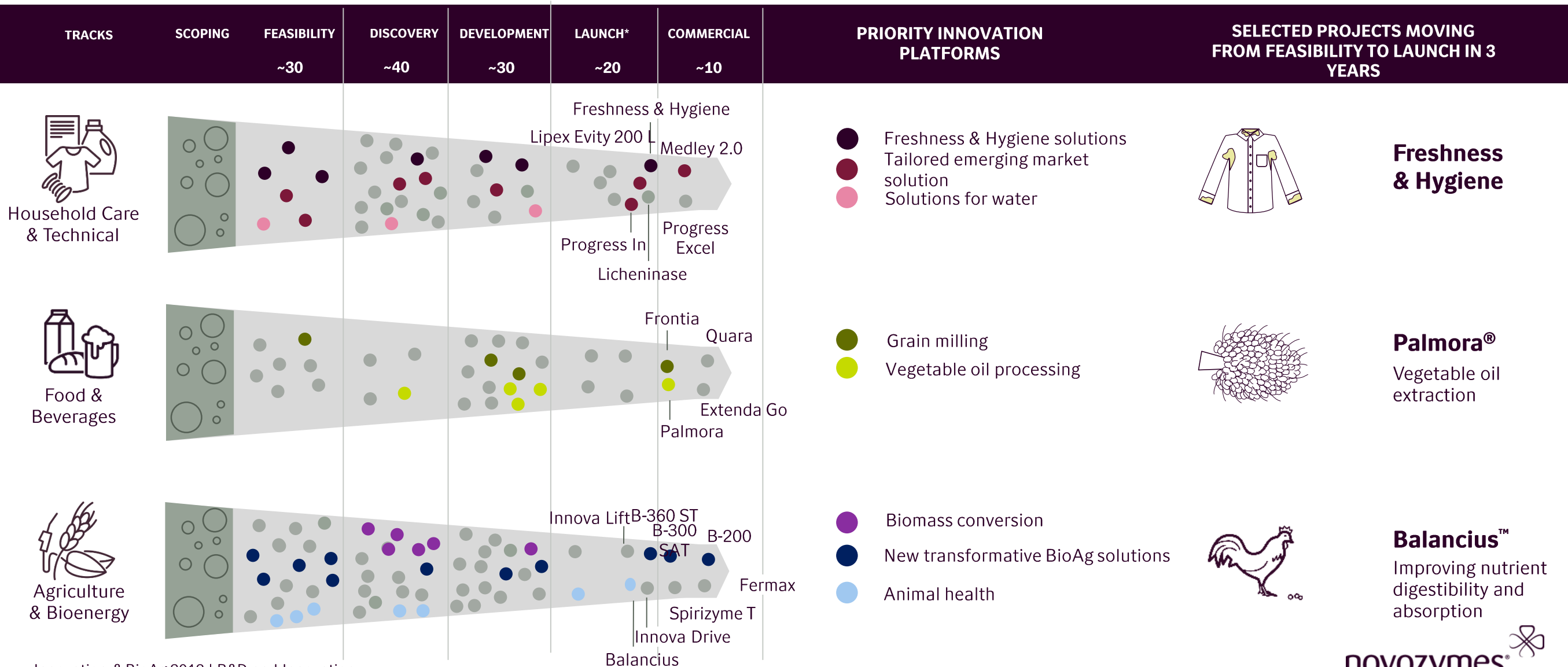
Ideation



Novozymes stage-gate model



The breadth of our innovation pipeline has never looked stronger supported by exciting progress from our priority platforms



New technology is continuously making us **more efficient**



**More impactful
innovation**



**From ~5 years
to ~3 years**

**Increased pipeline selectivity
to accelerate time to market**

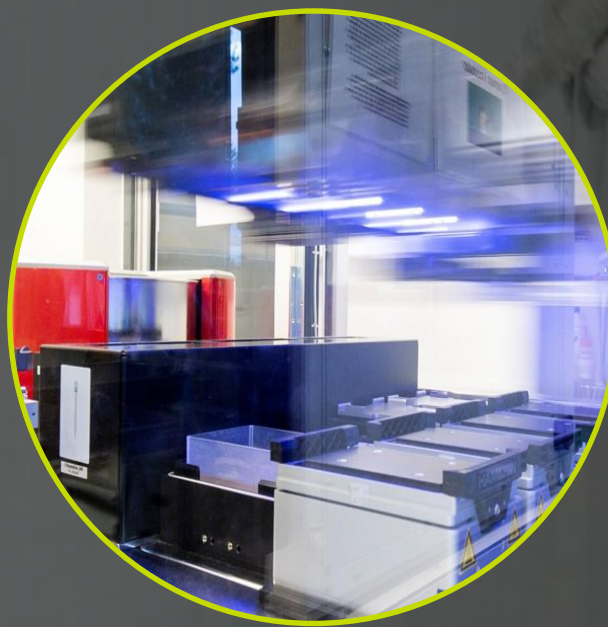


**The efficiency gain amounts
to the total production
capacity installed today**

We are staying at the forefront of technology development to secure **our leading position**



Manual



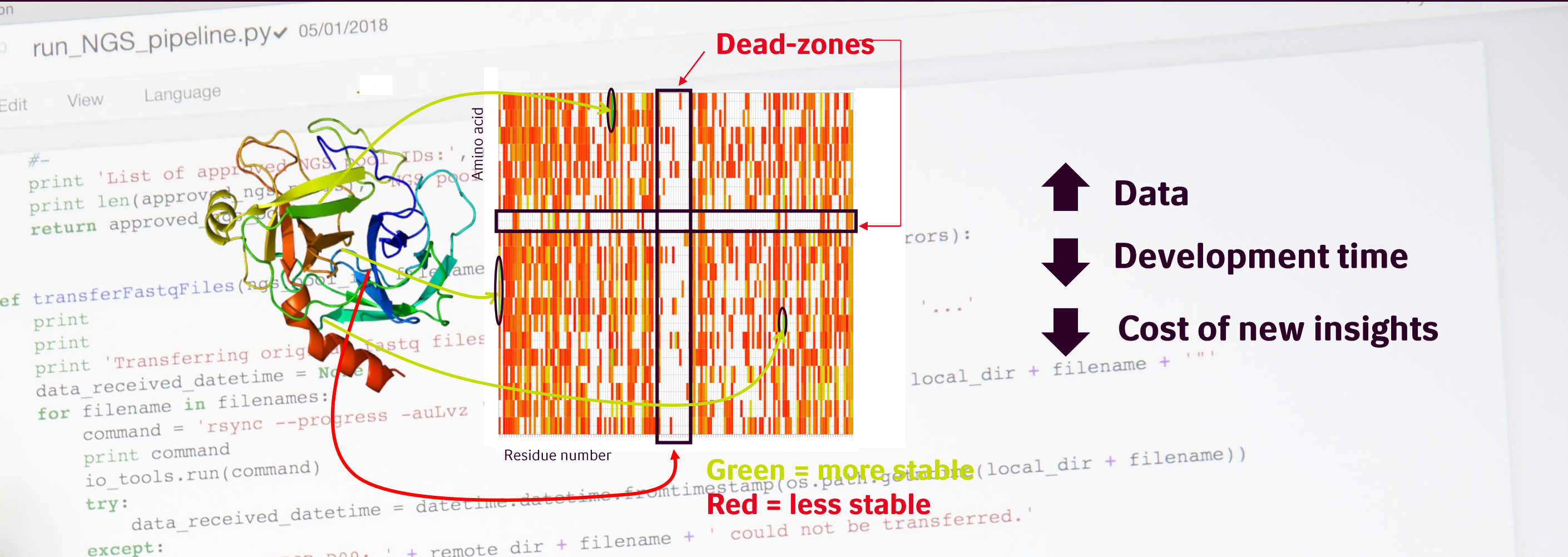
Automation



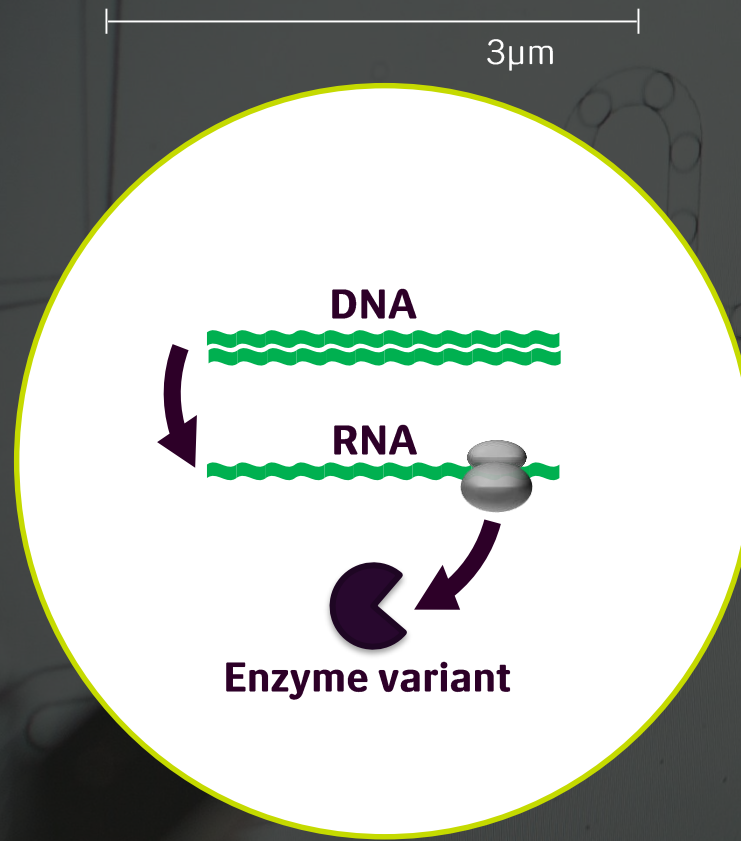
Digitalization

- ↑ **Data**
- ↑ **Analytics**
- ↑ **Capacity for screening**
- ↓ **Time spent in lab**
- ↓ **Development time**

Illumina NGS technology has revolutionized the way we do **protein engineering**



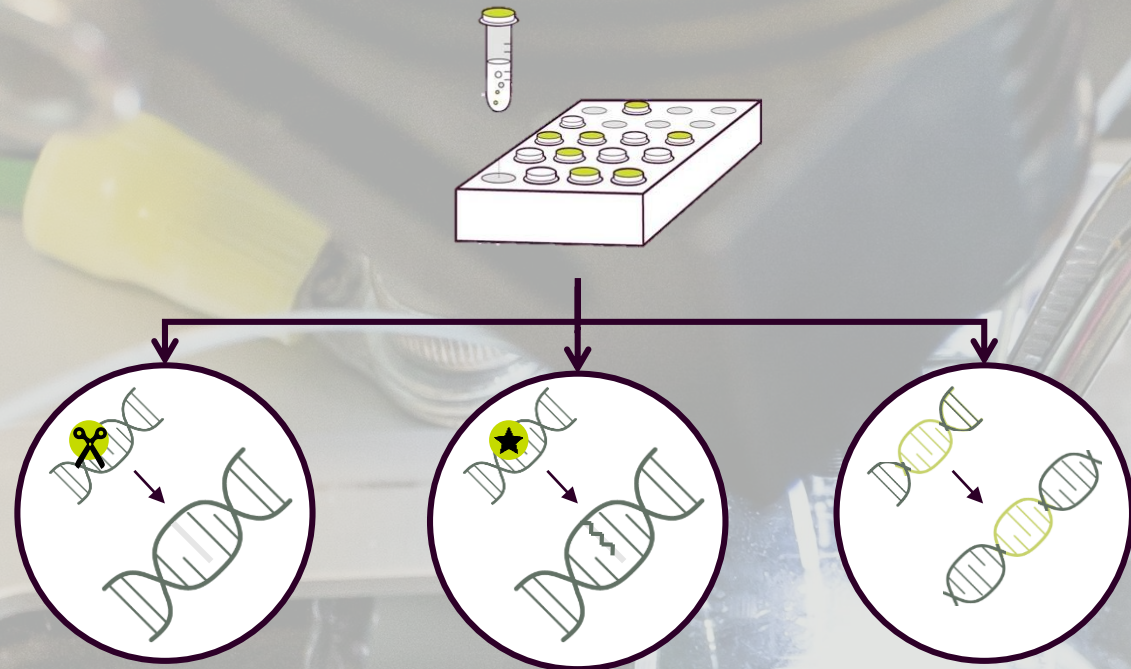
Technology development allows for massive parallel screening: **bigger libraries, better answers**



Key advantages

- Biology's central dogma in a droplet
- Billions of parallel reactions
- \$0.000001/reaction
- Rapid cycle times (< 2 days)

CRISPR Cas9, Mad7d and similar technologies make **gene-editing faster, cheaper** and allow for more automation



Deletion/insertion
Loss or gain of function

Mutation
Increase or reduction of function

Cloning
Totally new functionalities



Precision
Changes only occur in targeted positions



Speed
Manipulation & screening are much quicker and cost less

Data-management tools and machine learning reduce development time and open for new discoveries



Design and execute experiments

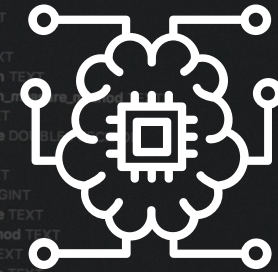


Harvest and ingest data



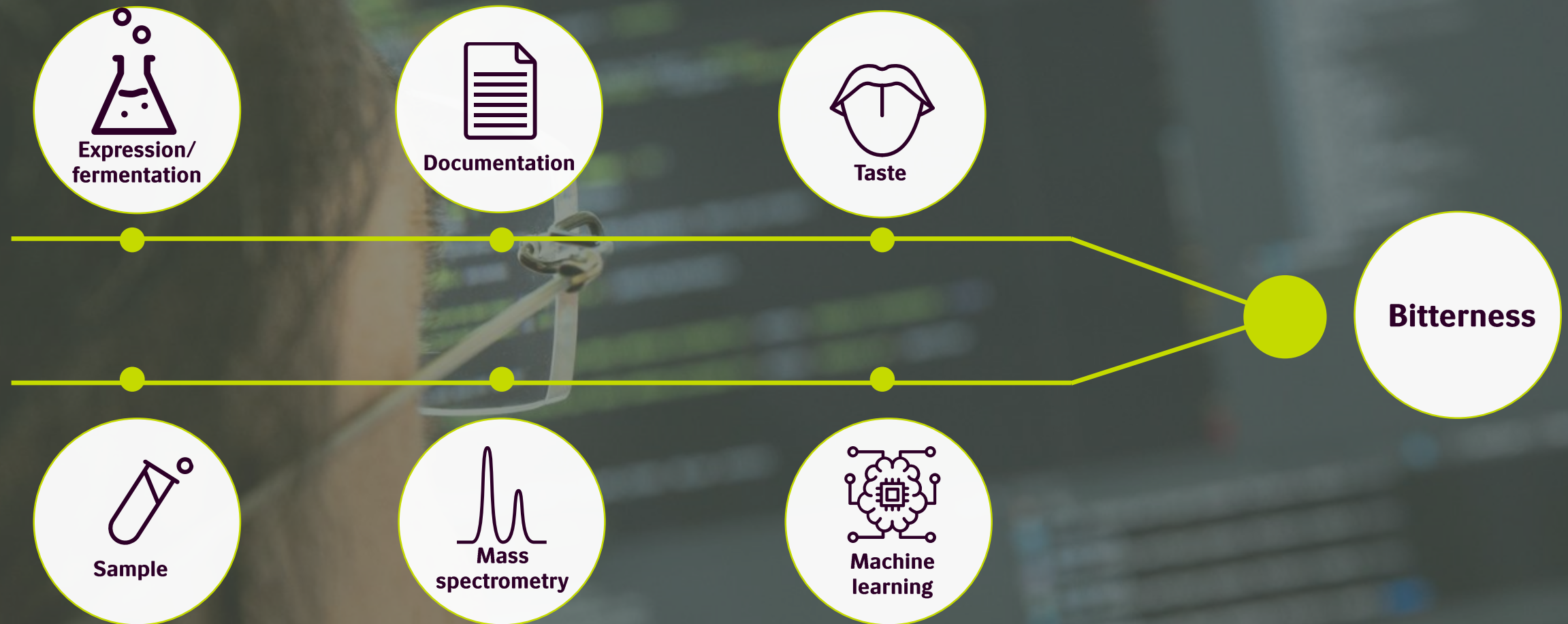
Preparing data for analysis

Implementation of machine learning



Data analysis and knowledge sharing

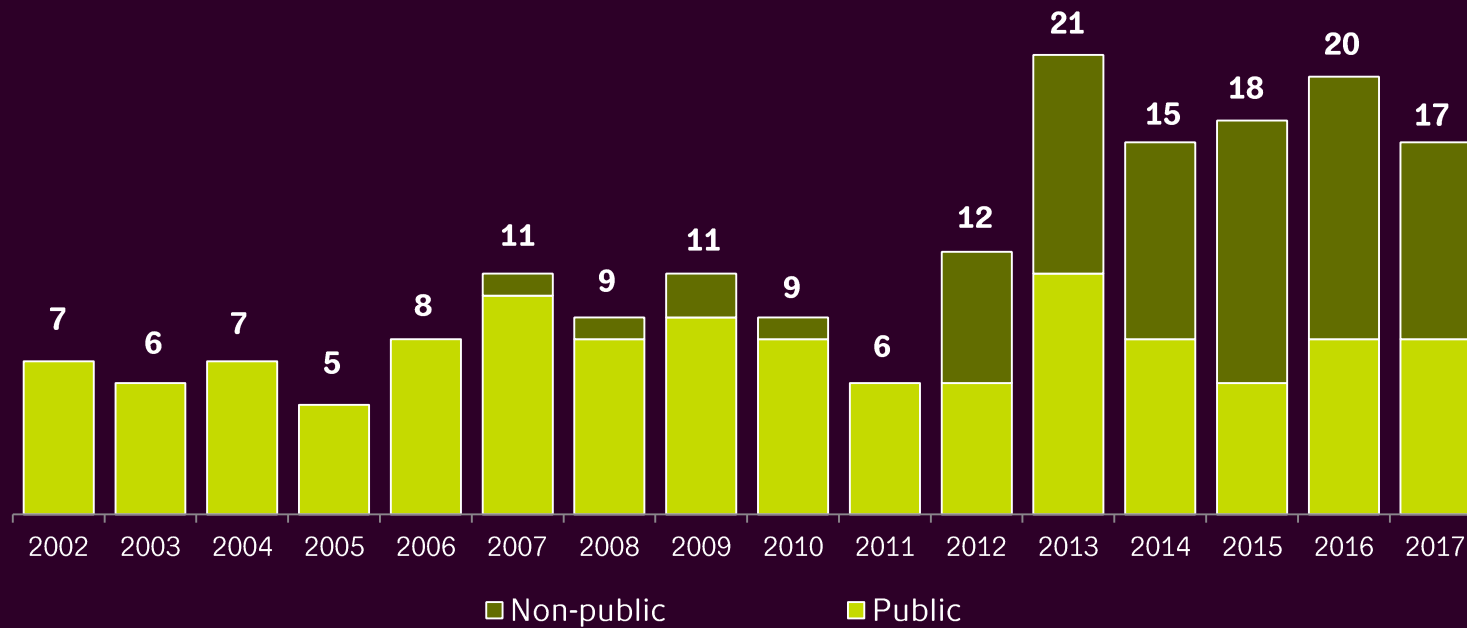
Machine learning is helping us to **predict bitterness** in food products



Better and faster... the breadth and speed of our innovation is increasing constantly

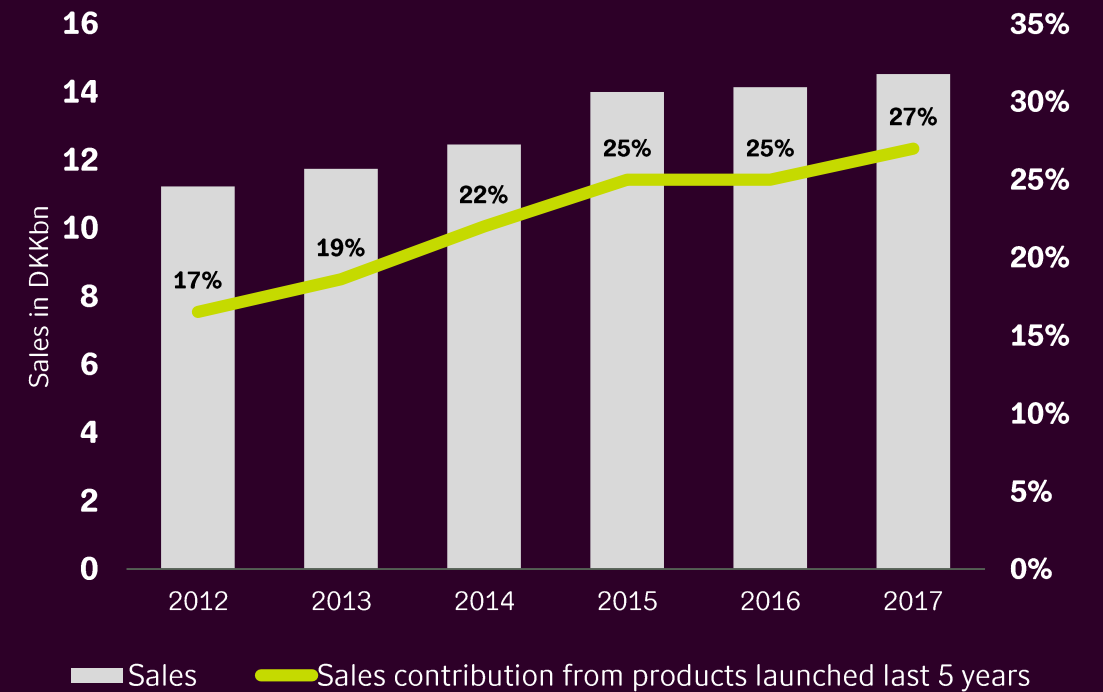
Increasing innovation bandwidth

Since 2013 average number of launches has more than doubled



Contribution from new innovation is increasing

+25% of today's sales comes from innovation launched less than 5 years ago



Technological advances open up for completely **new application** areas...

Water emerging as a critical challenge



Driving investments and policy-making



4% underlying market growth¹



DKK 4,800bn¹ OPEX + CAPEX annually



DKK 150bn chemical spending¹



Creating new biotechnology opportunities for Novozymes



Improving sludge dewatering



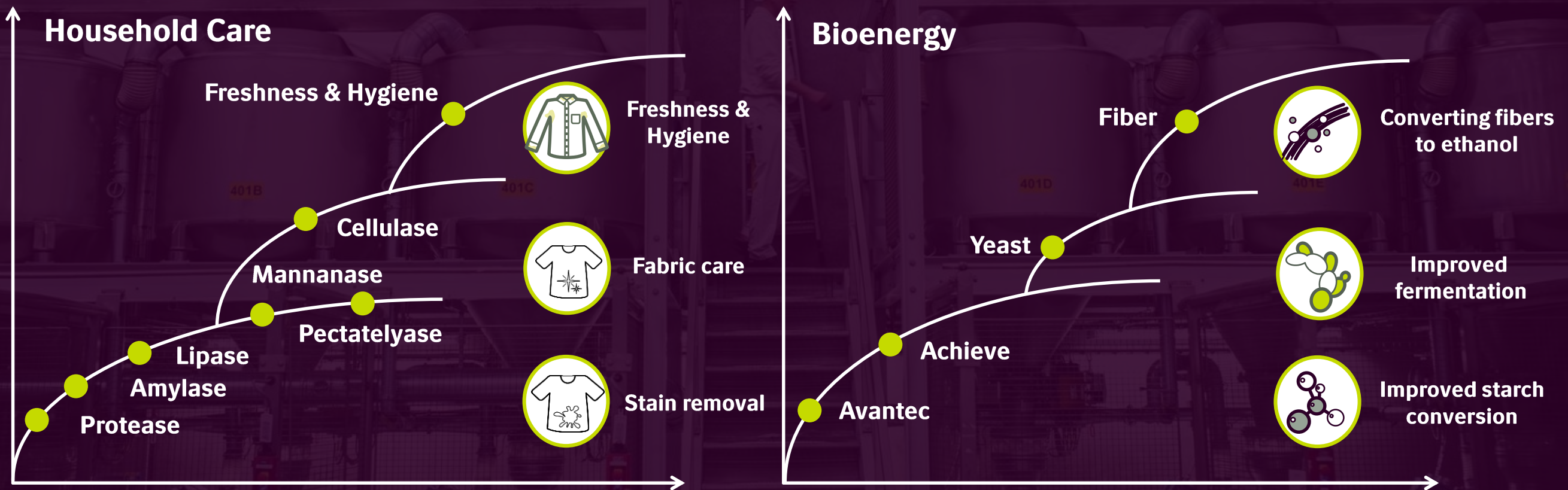
Optimizing membrane cleaning



Reducing total nitrogen content

¹Source: Global Water Intel (2017)

We continue to find **new uses** for our technology within existing industries



Key messages

- ✓ Digitalization and automation open up for more tailored and impactful innovation
- ✓ Novozymes competitive advantages lie in scale and cross-fertilization while still mastering the full value chain
- ✓ We will continue to invest significantly in R&D to maintain our position as technological leader
- ✓ The breadth and speed of our innovation is constantly increasing
- ✓ Our pipeline has never looked stronger and we continue to find new areas for diversifying our business through our technology base



Questions

R&D and Innovation