enewable fuels & chemicals – Genencor's perspective

ICA Forum, Gent

Colin Mitchinson November 3, 2011

Renewable Fuels & Chemicals - Genencor's Perspective

- Introduction to Genencor
- Genencor as part of DuPont
- The BioBased Economy
- Renewable Fuels & Chemicals
- Industry Collaborations
- Industry - Academia

Our mission since 1982

Through innovation and responsible practices, we deliver bio-solutions that improve industry performance and sustainability.

DANISCO
First you add knowledge...





GENENCOR®
A Danisco Division

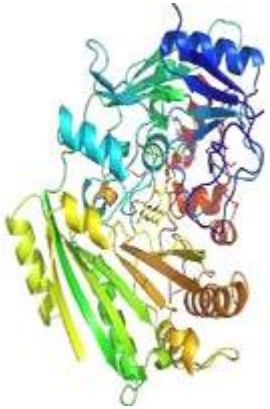






Genencor in brief

Leadership	• Early biotechnology pioneer – in 1982 Genentech & Corning Glassworks formed Genencor • A leader in industrial enzymes with 380 distinct commercial products • 3,500+ owned and licensed patents and applications
Revenue & growth	• Revenue: $767 million USD in 2009-2010
Our people & outreach	• ~ 1,500 employees worldwide • 100 job openings in a time of global recession • Partnering with 50 universities & government labs to conduct research
Sites	• 14 production sites in USA, Europe, Asia, Africa & South America • 4 R&D centers in USA, Europe and China



Industrial Enzymes

Animal Feed Enzymes

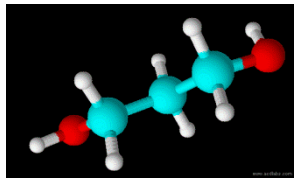
Cellulosic Enzymes

Food Enzymes

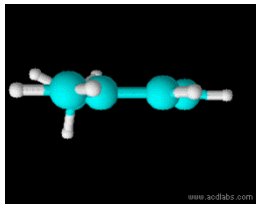
Fabric & Household Care

Grain Processing

Textiles Enzymes



1,3-Propanediol



BioIsoprene™ Monomer

Biochemicals

Lysine

Threonine

Tryptophan

Indigo

Biotin

Ascorbic Acid

1,3-Propanediol

BioIsoprene™ Monomer

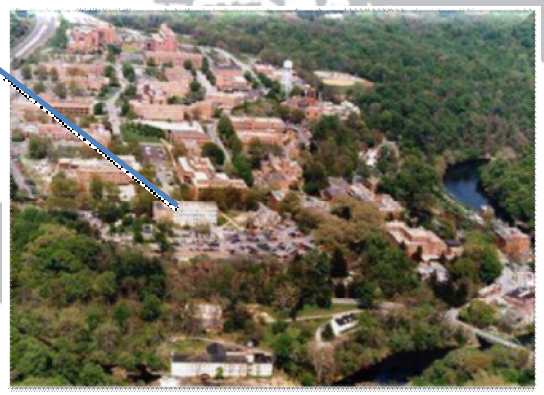
May 2011: DuPont acquires majority stake in Danisco A/S

DuPont Industrial Biosciences – 5 Research Centers

Brabrand, DK
Leiden, NL

Wilmington

Palo Alto, CA



Shanghai, PRC

DuPont Industrial Biosciences – Production

- 16 production sites worldwide in five continents
- ~20,000 customer orders processed each year
- Our products ship to 87 different countries
- Annual supply volume of ~150,000 metric tons


(Cedar Rapids, Iowa)


(Cape Town, South Africa)


(Grindsted, Denmark)


(Beloit, Wisconsin)


(Vaasa, Finland)


(Jokioinen, Finland)


(Jämsänkoski, Finland)


(Hanko, Finland)


(Arroyito, Argentina)


(Sohna, India)


(Brugge, Belgium)


(New Century, Kansas)

(Kingston, NC, USA)


(Wuxi, China)


(Vonore, Tennessee, USA)

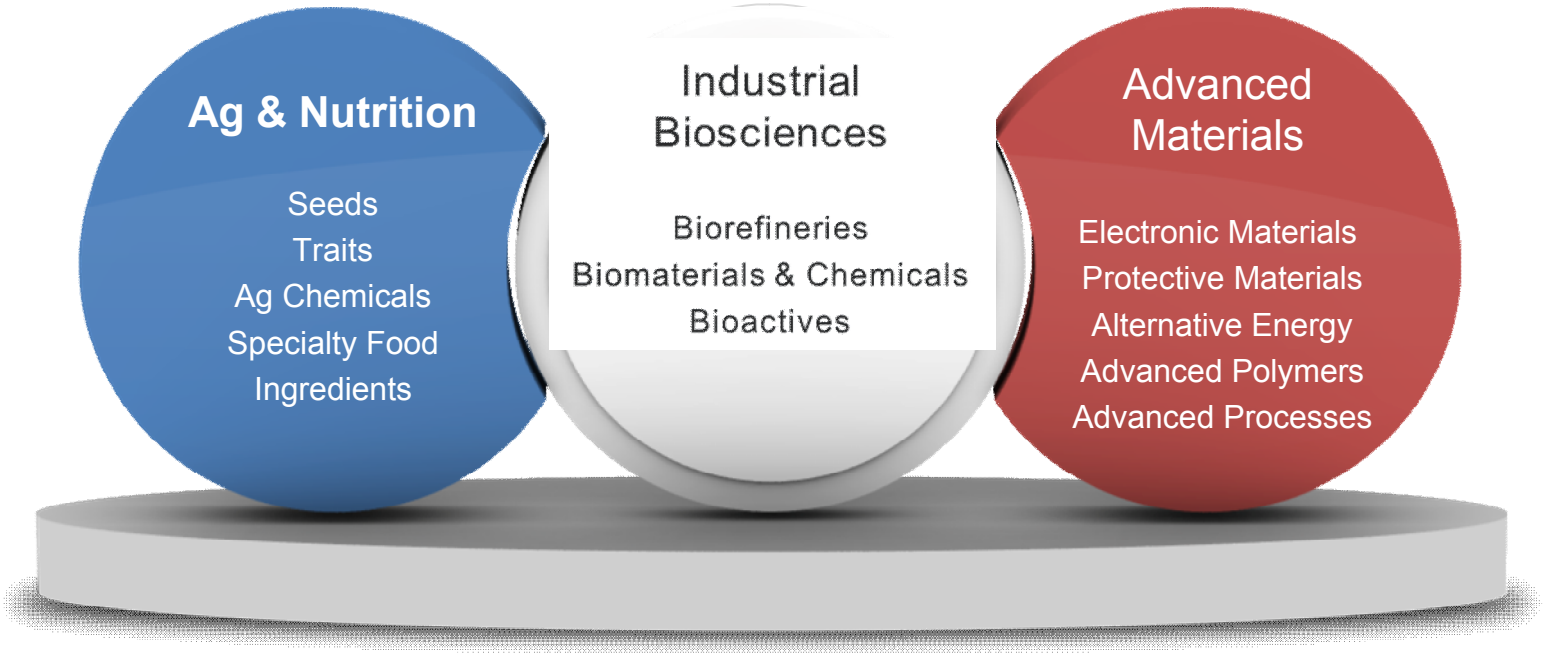

(Naantali, Finland)

DuPont Growth Strategy

To be a premier market-driven science company and create value for our customers

Building three world-leading, integrated competencies:

- Ag & Nutrition
- Bio-based Industrials
- Advanced Materials & Processes



GENENCOR®

DUPONT®

THERE ARE ALMOST 7 BILLION REASONS WHY WE SHOULD WORK TOGETHER.

As the world's population approaches seven billion, the challenges facing humanity have never been greater. Fortunately, the solutions to many of the most fundamental challenges can be found in science. But providing for the food, energy and safety needs of a growing population will require more than science alone. It will require many people working together. People who can collaborate across borders, companies, governments, organizations and cultures to devise solutions—both large and small—that improve the lives of people around the world.

DuPont has a rich history of scientific discovery that has enabled countless innovations and made life better for people everywhere. And today, we're working with more people, in more places, to make life the best that it can be. *Welcome to The Global Collaboratory.*

Visit dupont.com/collaboratory to learn more.

DUPONT®

TOGETHER, WE CAN FEED THE WORLD.

The earth's population will *increase by 150,000 people per day* for the next 40 years, which means the world will *need to increase food production by 70% in that same period*—even as the relative number of acres that can be cultivated globally shrinks. To feed our increasing numbers, we will need to find ways to grow more food per acre.

50% 50% of our research funds go to making more and higher-quality food available to people globally.

2X The yield potential of our hybrids is approximately twice that of average yields.

TOGETHER, WE CAN DECREASE DEPENDENCE ON FOSSIL FUELS.

By 2030, the world will consume 60% more energy than today. And while the demand for energy grows, the supply of fossil fuels will not. *Deep expertise in microbiology, fermentation, polymer science and electrochemistry* will help make possible the transition from fossil fuels to more sustainable alternatives.

DuPont and Danisco have developed an integrated biorefinery technology to deliver cellulosic ethanol, which produces 80-100% fewer greenhouse gases than gasoline.

4 MILLION High-performance DuPont™ Tedlar® makes it possible to supply reliable solar power to more than 4 million homes each year.

TOGETHER, WE CAN PROTECT WHAT MATTERS MOST.

As our population grows, so do the threats to human safety and well-being. Globally, over 1,000,000 people per year lose their lives to workplace injuries alone. DuPont is working with *companies, governments, academics and scientists* on a vast range of materials, products and consulting solutions that protect life and our environment.

Working with companies around the world, DuPont has provided workplace safety training to over 3 million people.

3,000 HUMAN LIVES More than 3,000 law enforcement lives have been saved by wearing body armor, as documented by the VACP/DuPont™ Kevlar Survivors' Club®

The BioBased Economy:
Solutions for everyone, everywhere

Population 2011: 7 billion → 2050: 9 billion

FOOD

Concern

- Affordable and healthy food
- 30% of all food goes to waste

Solution

- Ingredients enhancing taste, texture, safety and nutrition
- Extend shelf-life and preserve freshness
- Cost reduction and value-improving solutions

HEALTH

Concern

- Healthy food for all
- Overweight

Solution

- Dietary supplements supporting physiological benefits and nutrition claims
- Ingredients contributing to digestive, immune, bone, cardiovascular and oral health as well as weight management

ENERGY

Concern

- Global warming and dependence on fossil fuels
- Balanced use of land

Solution

- Enzymes for reduction of water and energy
- Products for 1G and 2G biofuels
- DDCE: cellulosic ethanol technology

CHEMICALS

Concern

- Environmental impact from petrochemicals
- Fluctuating oil & energy prices

Solution

- BioIsoprene™ collaboration with Goodyear
- GRINDSTED® Soft-N-Safe

The BioBased Economy: Industrial Biosciences

- **Biorefineries**
  Converting agricultural feedstocks into fuel, chemicals and biomaterials.
- **Biomaterials and Chemicals**
  Leveraging our industry expertise and applications skills to develop new higher value markets.
- **Bioactives**
  Enzymes, peptides and performance proteins that provide high value to a broad range of applications and producers in markets such as food, animal nutrition, fabric and household care, textiles, pulp & paper, personal care and aquaculture.

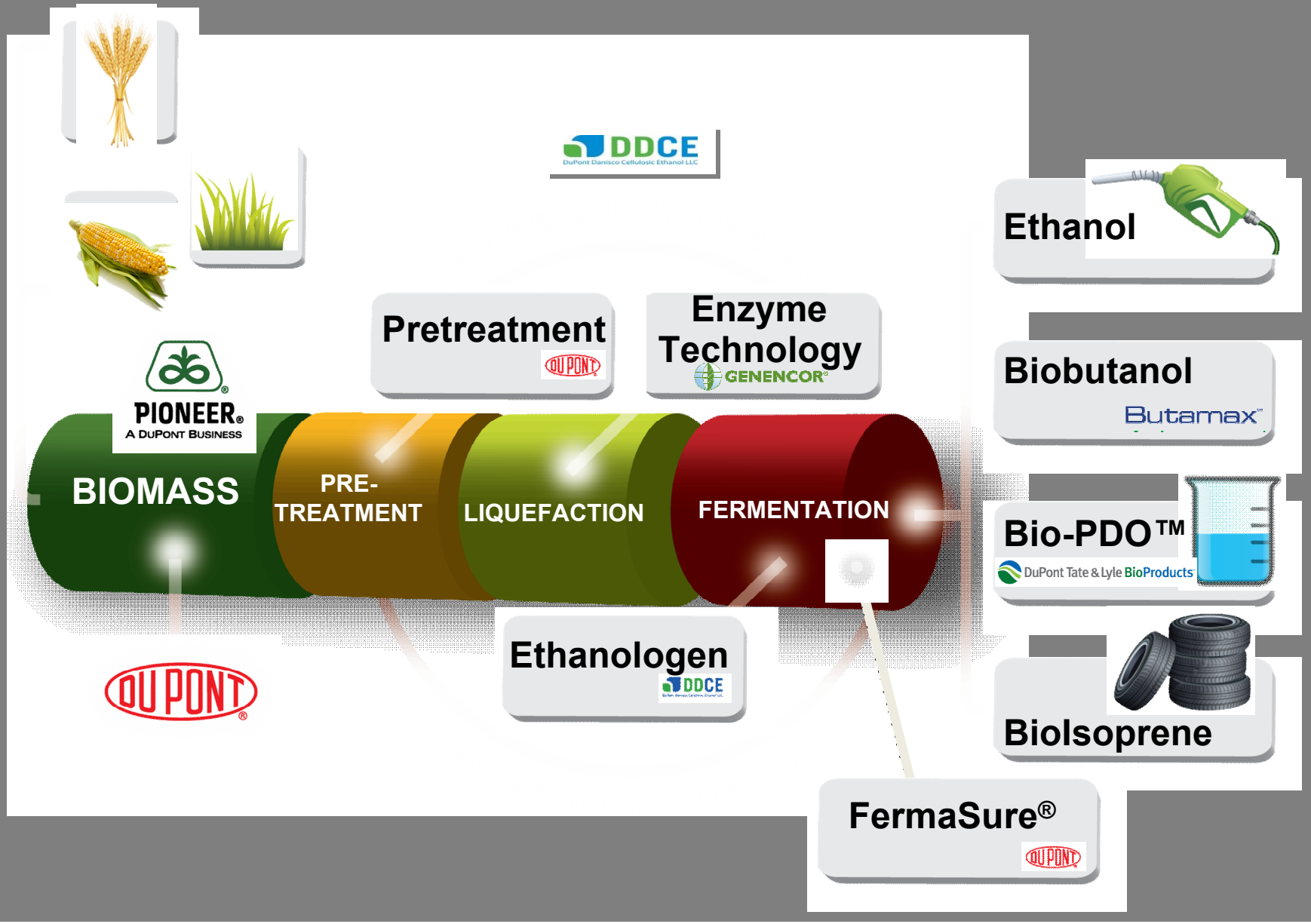
GENENCOR®

DUPONT®

Together we can accomplish what can't be done alone

Creating renewable fuels & chemicals from agricultural products

Enabling the biobased economy through our unique expertise



DuPont Cellulosic Ethanol Production Ready for Deployment

Operating demonstration scale facility in Vonore, Tennessee (US) since 2010

- Partnering with Genera Energy and University of Tennessee

Setting up commercial feedstock supply model

- Collaborating with custom harvest experts, equipment providers, Iowa State University to carry out comprehensive study

Developing commercial stover-to-ethanol biorefinery to start up in 2013

- Synergy with co-located grain plants

Deployment strategy includes commercial operations and licensing model

DuPont Addressing Key Imperatives of Biofuel Growth

Cellulosic Ethanol: Non-food Feedstocks

Advantages:

- >60% greenhouse gas reduction
- Non-food sources and marginal land
- Multiple feedstock available
- Additional income for farmers

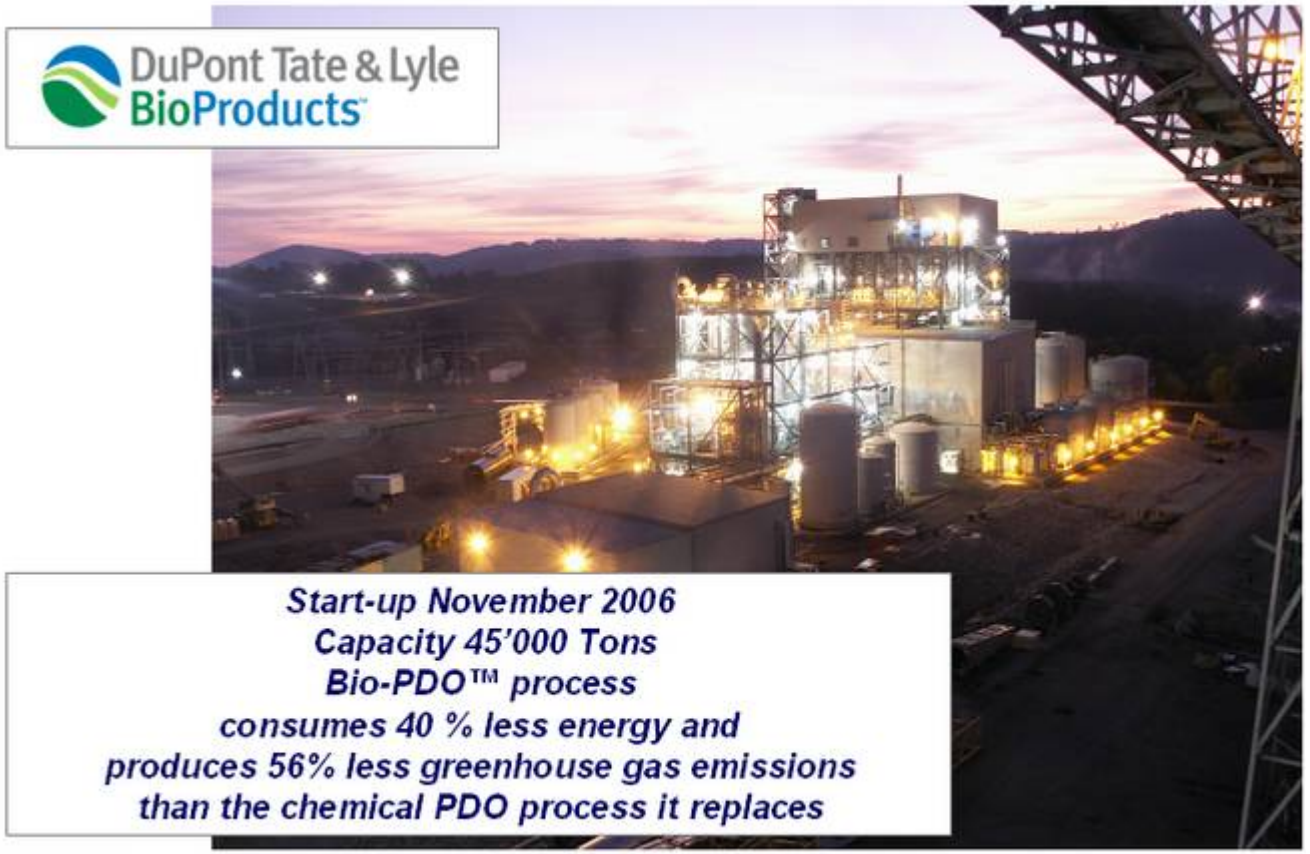
Biobutanol: Better Fuel

- Drop-in fuel
- High blends without infrastructure changes
- Refinery can use more fractions of oil
- Higher energy content

Low Cost, Low Carbon, Scalable, Sustainable

Bio-PDO™: The First Commercial Biorefinery

- Historical ability to deliver successfully provides support for future investments



Genencor and Goodyear jointly develop BioIsoprene™ technology

Genencor and The Goodyear Tire & Rubber Company are developing an integrated process to manufacture BioIsoprene™ at industrial scale.

- A collaborative research initiative
- Joint multimillion-dollar investment

BioIsoprene™ product is a biobased, renewable alternative to the petroleum-based isoprene.

- BioIsoprene™ is a "business platform C5 chemical: other uses include polymerisation to high carbon fuels.
- Genencor will lead commercial development

Concept tire – not available to consumers

Renewable Fuels & Chemicals: Key Messages

Our biofuel technology and commercial potential are real.

- DuPont has proven our ability to bring new, advanced, bio-based technology to market, with commercial products available today.
- Once the first commercial plants are underway, we intend to make our technology available to others through licensing, enabling a more rapid rate of capacity build around 2015.

Multiple renewable fuels will be needed to meet future transportation needs.

- The first generation ethanol market provides a critical foundation, and its long-term viability is necessary for the successful development of next-generation advanced biofuels.
- The relative proportion of grain going into fuel will decline over time as ag production expands, existing biofuel plants continue to improve efficiency, and use of non-grain sources increase.

Policy stabilization and consistency are critical.

- Establishing and commercializing a new biofuel technology is a massive undertaking.
- Change or uncertainty in a policy platform is counterproductive and discourages innovators, entrepreneurs, and potential partners at a critical time in advanced biofuels industry development.

EU Policy needs for a budding biobased economy

- **Knowledge Biobased Economy (KBBE) Strategy**
- Strong focus on under-utilised biomass, the need for resource efficiency, job creation and innovation, and on communication - ‘what’s in it for the consumer’
- **Revision of the Common Agricultural Policy (CAP)**
- It should support the biobased economy strategy – non food crops
- It should support rural development strategies – regional biorefineries
- **Horizon 2020 (Research & Development & Innovation)**
- Funding schemes should cover gaps in KBBE strategy: demo plants
- **Stimulate Market Demand – Lead Market for biobased products**
- Indicative or binding targets for certain bio-based products
- Member States - preference to bio-based products in tender specifications
- Clear and unambiguous European and international standards

DuPont Approach to Renewables

Focus on large, market driven opportunities enabled by the integration of chemistry and biology from renewable substrates...

- Broadly participate across value chains
- Target areas where our integrated science can create unique advantages
- Systematically evaluate opportunities for incumbency and scale
- Use partnerships to expand market opportunities, accelerate speed to market and maximize value
- Decouple the food and biomaterials/biofuels supply chains quickly as technologies develop

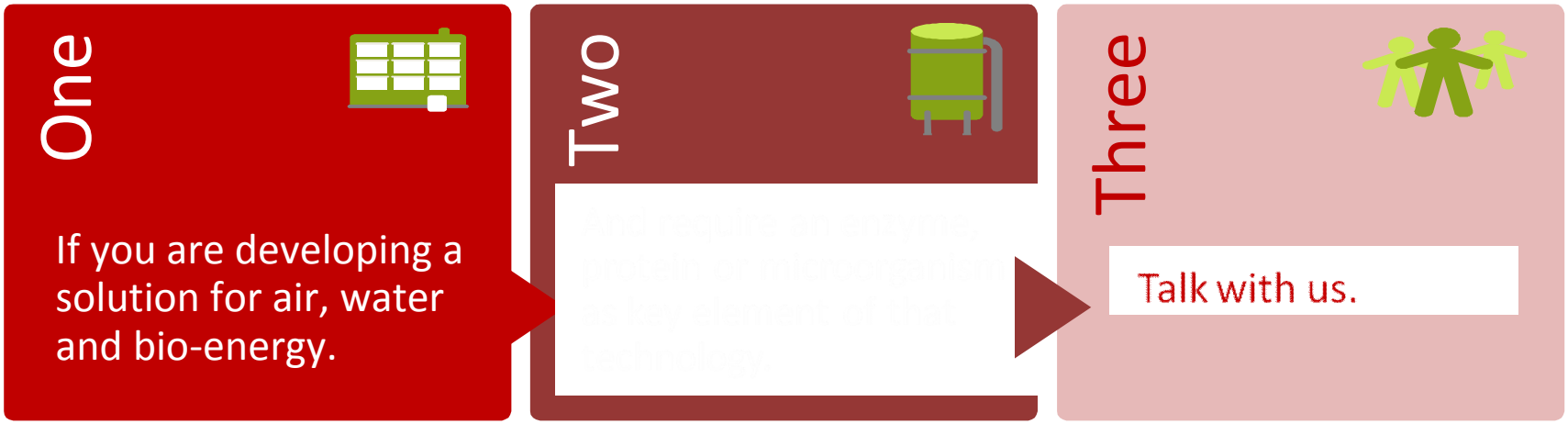
The BioBased Economy requires Collaboration

Building upon our skills, together

takes more than technologies and discoveries to advance our industry.

- It takes a different way of thinking.
- We know how to collaborate with companies in and outside of our sector.
- The real challenge is finding partners outside our scope and radar.

GNext - Our Inclusive Innovation Initiative



Welcome to the Global Collaboratory™

Industry – University Collaborations

"Fee for Services"

- (Mode often used with outside companies.)
- University Centre of Excellence model: Similar to intra- & inter-university sevice charging.
- Can extend to method, assay & process development.
- Easy: Low / No Intellectual Property developed.

Industry – University Collaborations

Research Collaboration: Can cover a wide spectrum of interactions

Examples:

- Leuven University: Long term collaboration with Danisco in Xylanase enzymology (baking enzymes).

- Swedish Agricultural University (SLU) Uppsala: Structural Biology group headed by Mats Sandgren.
  - ca. 1998 – present: Started for a specific (Cel12A) structure. Evolved into wide-ranging Glycosyl Hydrolase structure study.
  - Now also includes a Biogas consortium

- University of Gent: Enzymology group headed by Kathleen Piens.
  - ca. 2000 – 2007: Started for a specific (Cel12A) enzyme. Evolved into wide-ranging Glycosyl Hydrolase enzymology study.
  - Combined SLU & Gent: Very strong Structural Enzymology Collaboration

Industry – University Collaborations
Risks / challenges for industry:

- IP ownership and access at commercially viable costs.
  - Specially challenging for Industrial Biotechnology vs Pharma margins.
- Publication needs vs protection of IP.
- Expert academic groups working with commercial competitors.
  - “Chinese Walls”
  - Large collaboration consortia: 1 + 1 = 0
- Maintaining alignment with company needs
  - Negative: “Sheep herding”
  - Positive: Maintain fundamental vs applied research focus

Industry – University Collaborations
Benefits for industry:

- Expertise not present in company.
- Specialised resources where permanent hire not fully justified.
- Fresh perspective from outside experts / peers:
- Avoid Not Invented Here (NIH) syndrome.
- Requirement for publication ensures rigorous research.
- Sustained focus on a specific research topic (versus problem solving):
- Fundamental research vs Applied research

Industry Expectations for Academia

- Align their long term research strategy to address societal challenges that industry cannot address alone.
- e.g. Industrial Biotechnology industry has recognised its role in addressing some world challenges such as climate/environment (GHG emissions), food availability / efficiency, & biobased alternatives.
- . We need academia to weigh into public debates, and provide a more educated objective assessment from trusted experts.
- In Industrial Biotechnology space there are a lot of controversial public debates (food vs fuel, Indirect Land Use, GMOs, nanotech,) – industry alone will never be the trusted voice in such debates.
- By being an objective voice to policy makers academia can have high influence on legislation that can impact both of our sectors (R&D funding, demo plant funding, controversial policy on GMOs).
- Continuous contact/networking with industry to see where such trends are going.

The BioBased Economy – A Call to Action