

Sustainable (Bio-)Chemistry the way out of Fossils

Bioeconomy in the Baltics
Inspiration conference

June 15th 2012

The logo for Nordbiochem LLC features the company name in a blue sans-serif font. A green leaf icon is positioned above the letter 'i' in 'biochem'. Below the name, the letters 'LLC' are centered between two horizontal green bars.

Nordbiochem
LLC

“The stone age did not end because we had a lack of rocks and the oil age will not end because we have a lack of oil.”

Sheikh Zaki Yamani

Sustainable (Bio-)Chemistry is the way out of Fossils

**Shortage of oil forces to changes in our
(fossil) mind:**

- to treat the ways out,
- biomass is an alternative carbon source without lying millions of years in the earth (becoming fossil),
- biomass is useful not only for burning it (down), but for making common materials

Ethanol

as the most known biochemical

- is a perfect **useful chemical** for producing materials
- useful, but „dangerous“ **foodstuff**
- **wrong energy carrier**
 - for to produce 1 liter ethanol more than 1 liter oil is in the total cycle needed
- By producing (fermentation) of **1 molecule ethanol**
 - **1 molecule CO₂** will additionally generated (= 100 million tons yearly worldwide)
 - **½ of raw material is wasted** ⇒ low efficiency
- **Alternately Lactic Acid fermentation converts 95%** of raw material ⇒ the only efficient fermentation technology today

Weaknesses of petrochemistry

- Administrative factors
 - Prevention of climate changes and limitation of CO₂ output demands new investments into chemical industry
 - REACH-regulations limits the use of hazardous chemicals and will stop a number of plants and production of many traditional chemicals
- Demand for chemicals and polymers grows quicker than petro chemistry can supply
- Crisis of oil processing
 - Amortization period is very high – up to 30 years and over
 - New investments into petrochemistry are seen as risky
 - In a “oil-country” like USA, there have been no real new investments into oil refineries since end of 1980-s, but instead into various alternative technologies

The challenge – “replacement chemistry”

Chemical industry has reached the doorstep to brake though of industrial biotechnology as a replacement of petrochemistry.

- Petrochemistry consumes 15-20% of world oil production
- Propylene-chemistry (C3-chemistry) has permanent lack of raw material because of competition with petrol from the same fraction of the oil cracking process
- The current yearly output of the Propylene-chemistry lies on the level of 80 mil.t and 100 bil.€
- By forecasts, 1/3 of abovementioned will be replaced by white biochemistry

Implementation of the replacement chemistry will start as soon as an effective high volume fermentation technology is available – like now developed by NordBioChem.

NordBioChem

As a private, profit oriented R&D management company:

- NordBioChem has created a **unique**
- fully protected with several patents
- **technological platform for Lactic-acid-chemistry**
(we call it **Nordbiochemistry™**)
- firstly in the world allowing competitive high-volume
- **replacements for petrochemicals** as standardized commodity chemicals and
- significant **reduction of CO₂ emission** and **toxic** reaction components.

Contributions to replacement chemistry by NordBioChem

- NordBioChem has developed whole technological platform starting with a **Lactic Acid fermentation** technology suitable for large-scale production and combined it with new solutions in **catalytical** mechanisms and **chemical derivatisation** technologies
- This allows replacements in petrochemistry in an annual market share of about 8 mil. tons and 10 bn. €
- The NordBioChem's fermentation technology is
 - developed until large scale pilot unit (1 m³) and
 - confirmed through independent secondary opinion by Germany's Leibniz-Institute

Intellectual Property Rights (IPR)

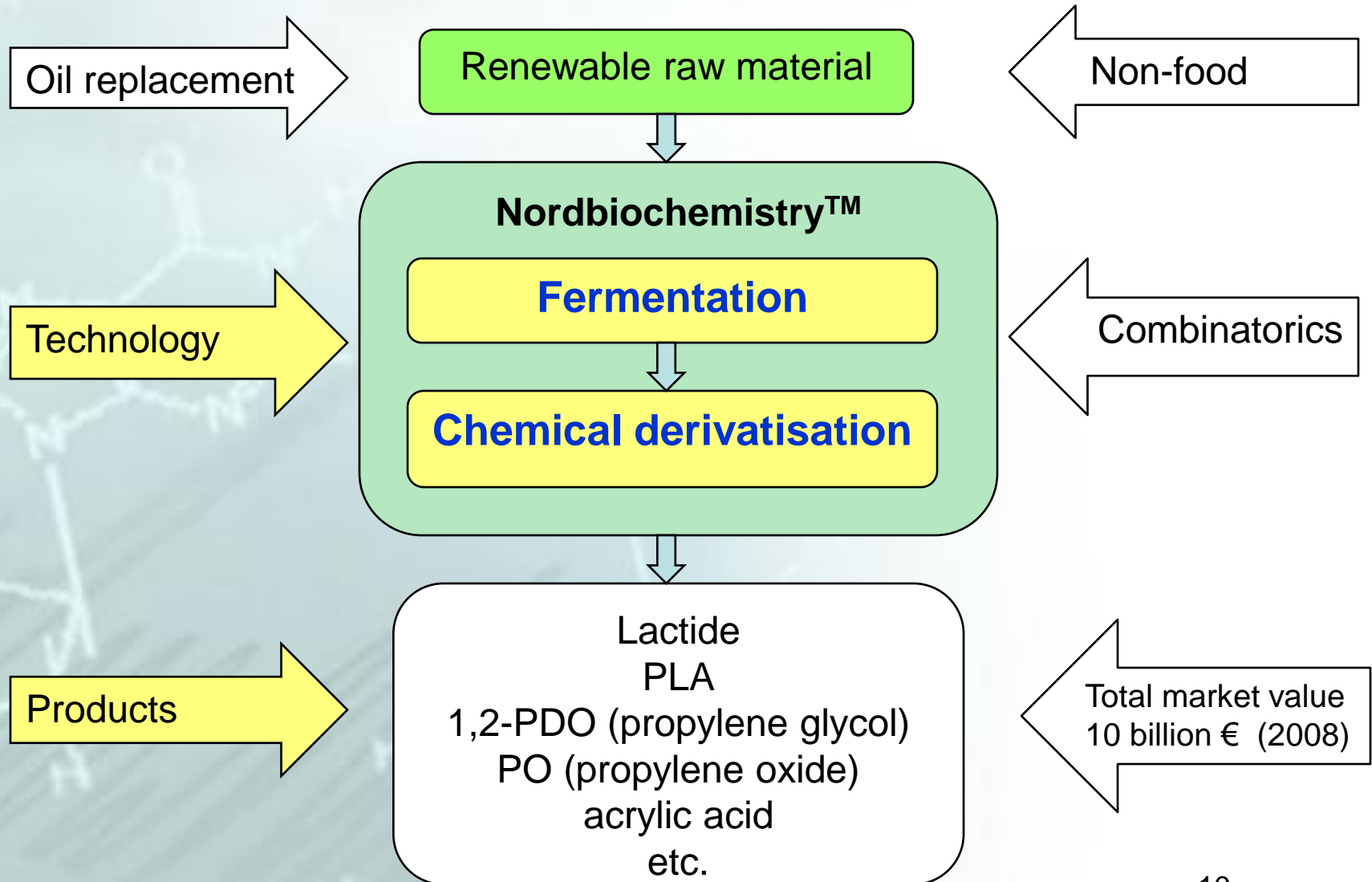
NordBioChem finances R&D activities, acts as applicant and owner of commercial rights.

In some cases members of NBC are also inventors of patents.

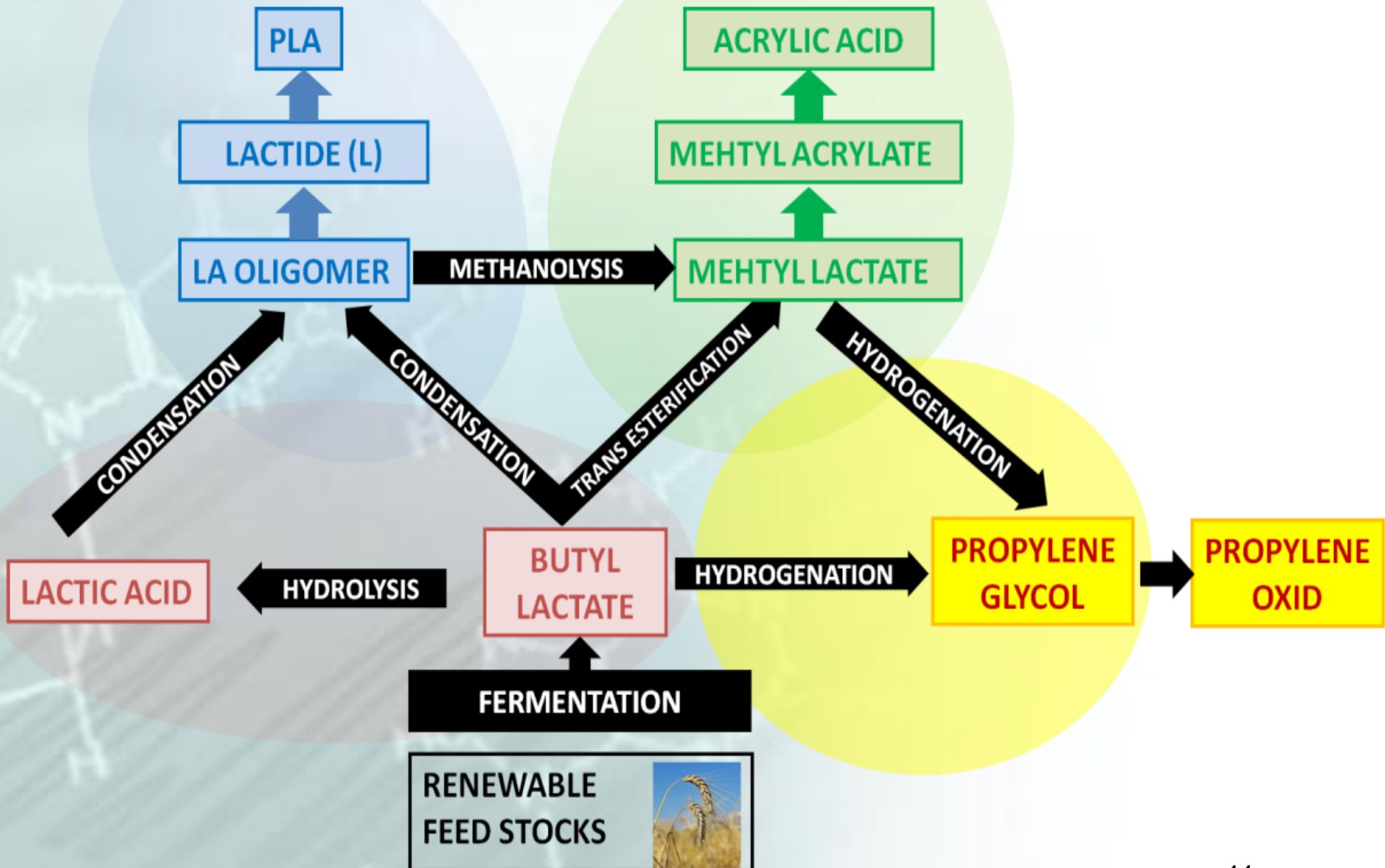
NordBioChem's patents *(as of 2012):*

- Published Patents 11
- Filed patent applications 9
- Applications in preparation 15

Nordbiochemistry™



Technology Focus of Nordbiochemistry™



Key advantages of Nordbiochemistry™

- Worldwide first industrial size cost-effective fermentation technology allowing competitive replacements to petrochemistry.
- Competitive at oil price level ca. USD 40-50 per barrel
- Raw materials (non-food, low-quality):
sugar derivatives (e.g. molasses), starch or cellulose
- The implementation of Nordbiochemistry™ decreases considerably the capital expenditures and shall lower the production costs of relevant chemicals up to 40%
- Affects markets with current size of 80 billion EUR

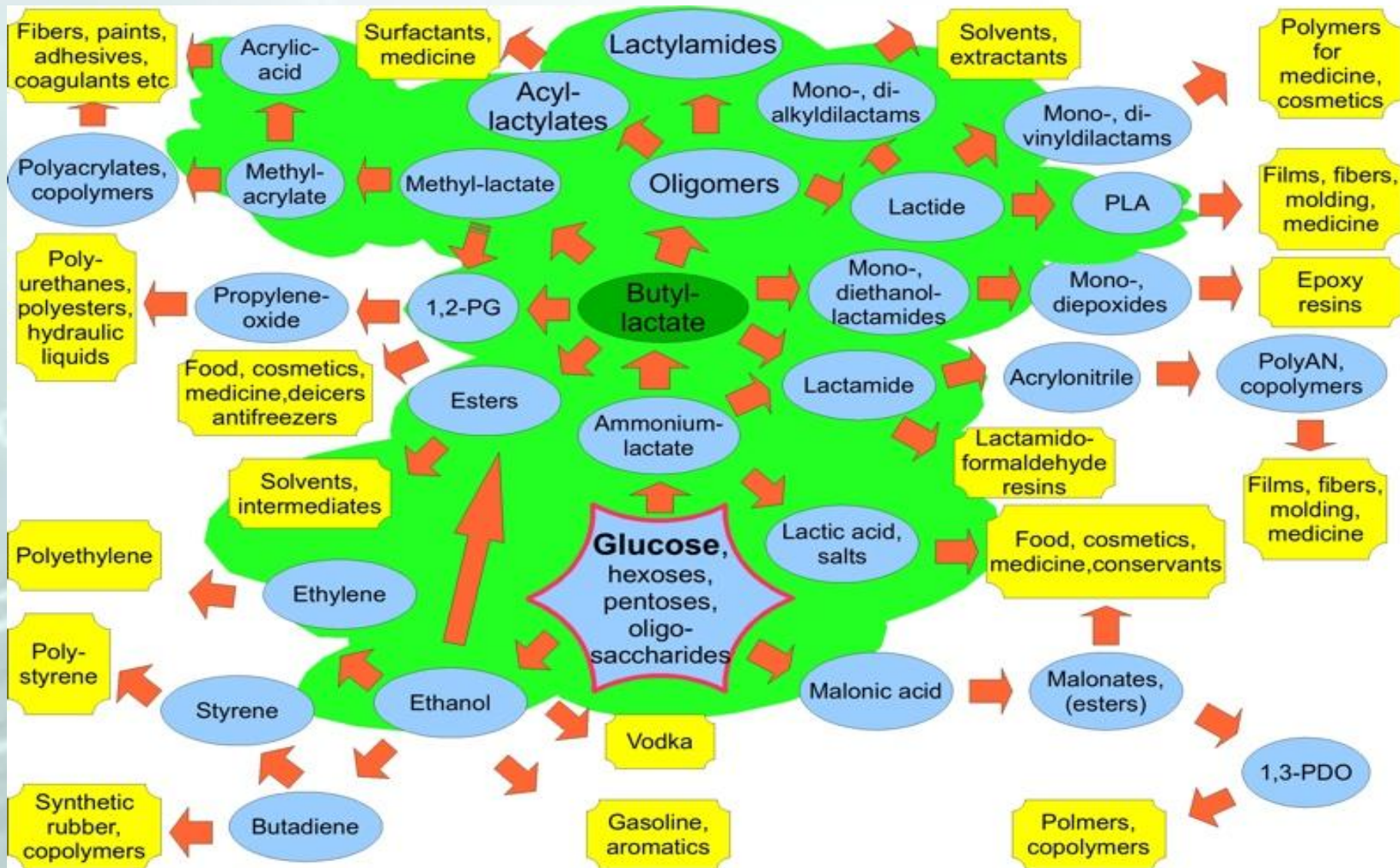
Thank you

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Nordbiochemistry™ Technology platform



Technology Focus of Nordbiochemistry™

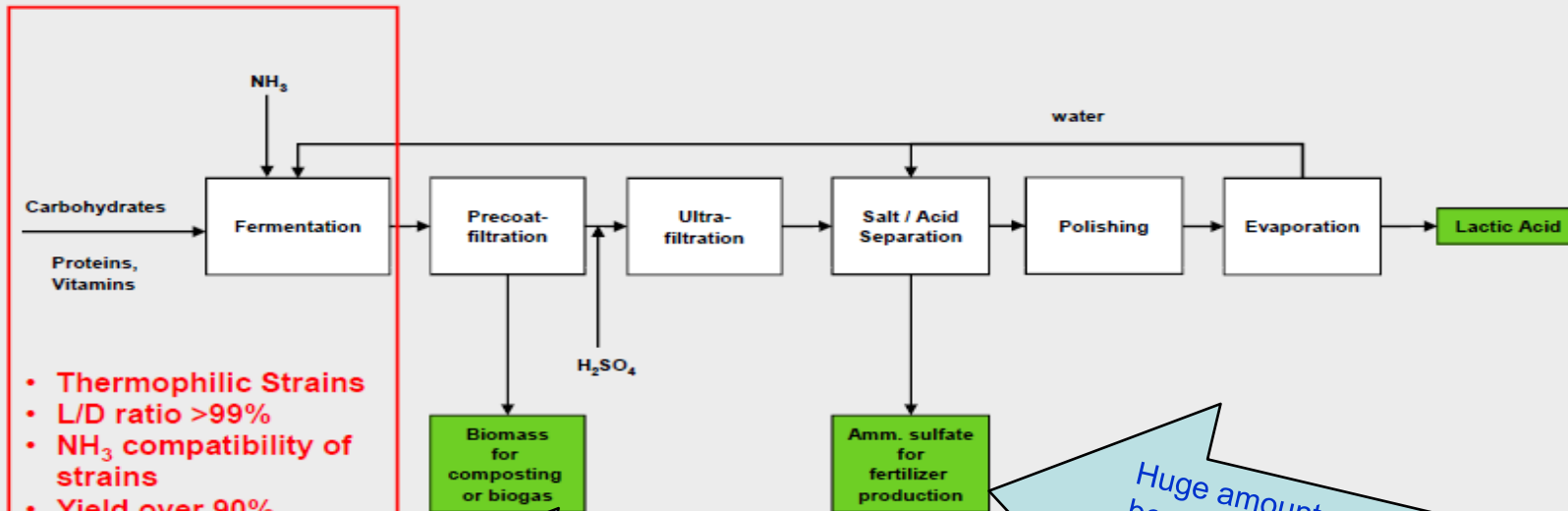


Alternative technologies

Uhde's presentation on EFIB, Lissabon Oct.20th, 2009

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The Uhde Process



- Thermophilic Strains
- L/D ratio >99%
- NH₃ compatibility of strains
- Yield over 90%
- LA Titer over 120 gpl
- Productivity over 4g/lh

NordBioChem's fermentation process is ran by produktivity of 60-90 g/l/h for industrial size pilot and 240 g/l/h at highest labor tests

Huge amount of waste, even if it could be used as a fertilizer. NordBioChem's fermentation process generates max 0,06 t waste per 1 t LA-solution

Uhde

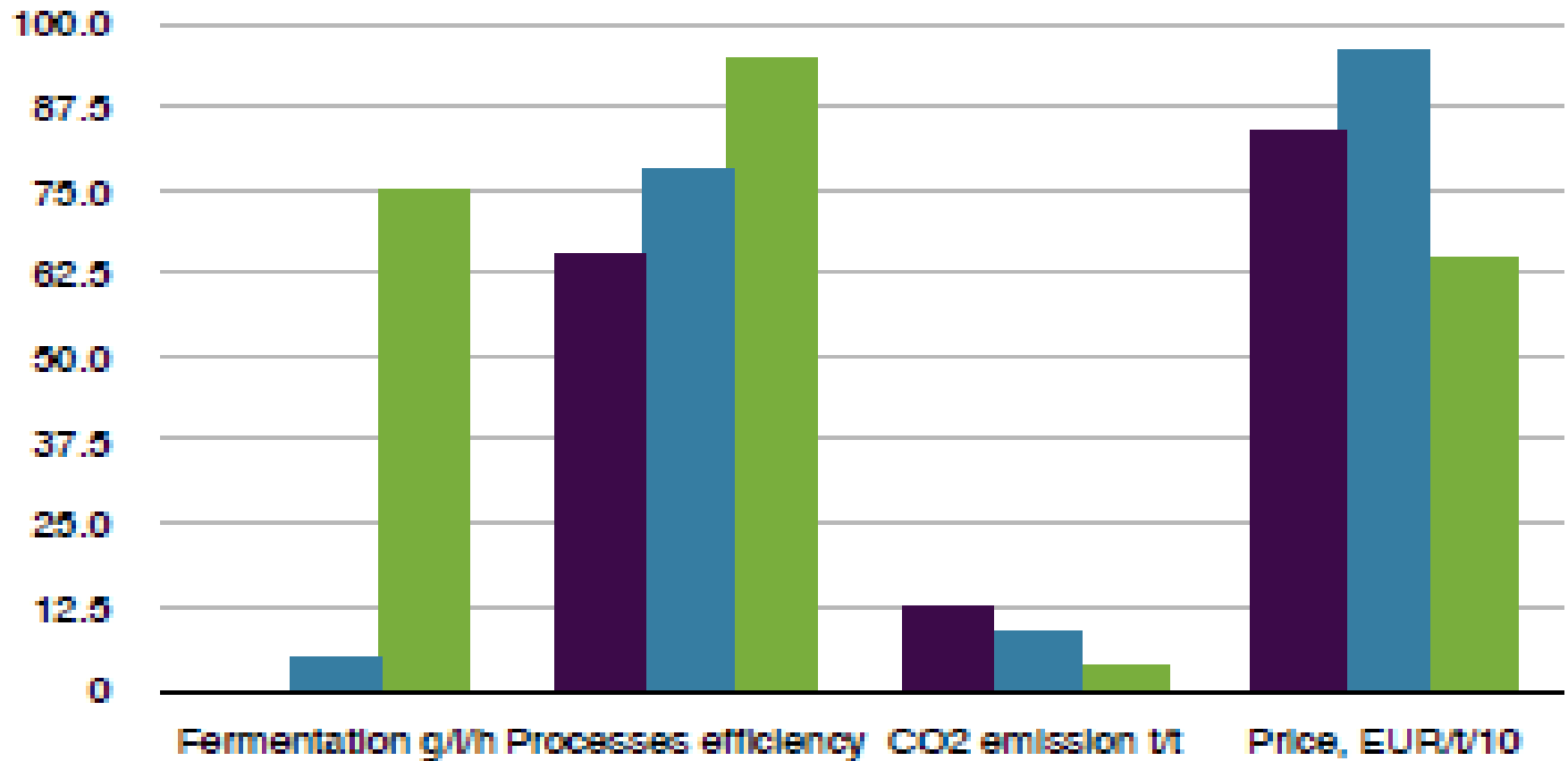


ThyssenKrupp

Comparison of production processes of Polypropylen

Petrochemistry Traditional white chemistry Nordblochemistry

Comparison of PP differently produced



Market value of selected products

Total markets	million t/y	billion €/y
• 1,2 PDO	2,4	3,4
• PO	7,1	8,5
• Acrylates	4,1	5,1
• PLA	0,4	0,7

LA co-Polymers substitute Markets, estimation to 2020

- Demand of the Polymers 8,5 million t/y
- Growth of the markets 4,7 % annually
- Market size 14,5 billion €/y

Market share of white biotechnology

Accurate sales figures for white / industrial biotechnology sales are not available.

McKinsey Consultancy predicted ca. Y2000, that white biotechnology would be applied to 10-20% of all chemicals sold in 2010, i.e. equivalent of EUR 200-400 billion.

Other estimates seem to follow a consensus that industrial biotechnology accounts to about 3-4% of total global chemicals sales 2020, resulting in EUR 50-70 billion, out of which about 15% is **using renewable sources (EUR 7.5-10.5 billion)**