



Forest industry resource efficiency:
Borregaard Industries
Innovation in an advanced Biorefinery

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Agenda

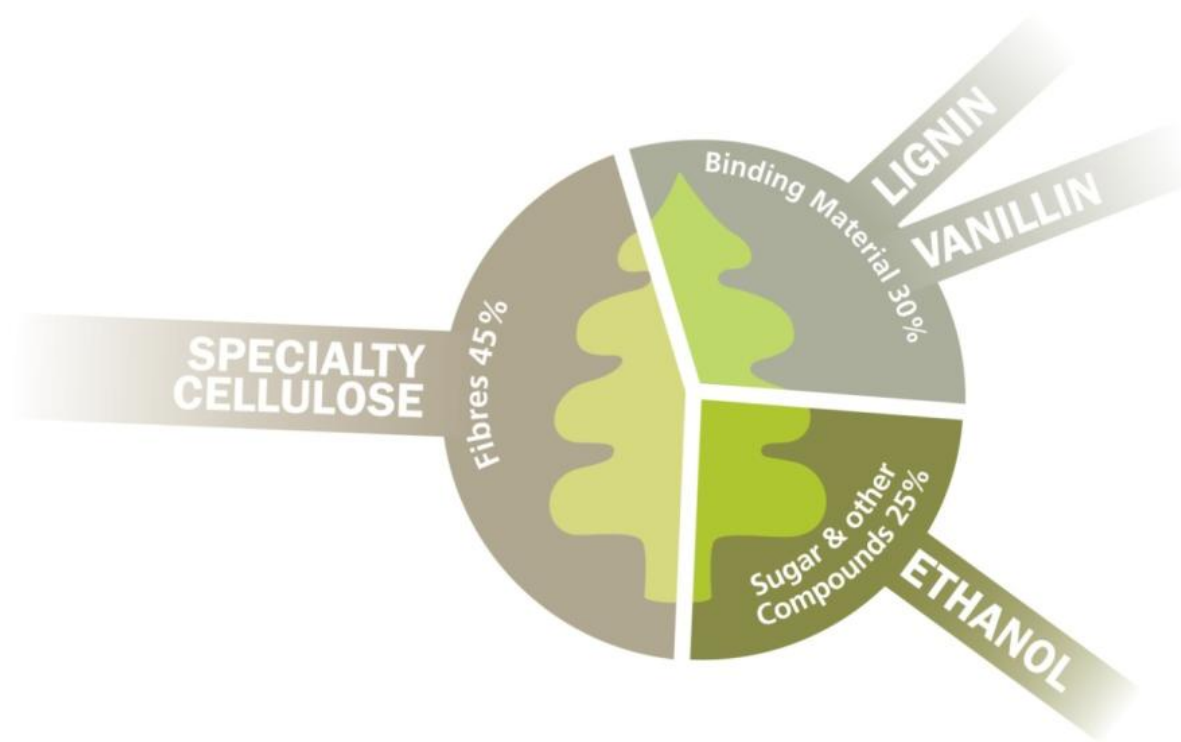
- Borregaard's biorefinery concept
- The innovation system
- The R&D organisation
- Framework conditions
- Outcome of Borregaard's innovation effort



Borregaard

The Sustainable Biorefinery

Borregaard is the global leader in biobased chemicals
A niche player with a specialised product portfolio



Borregaard's biochemicals are sustainable and environmentally friendly substitutes to petrochemicals

Advanced biorefining *Borregaard Sarpsborg*

- 450 mill. USD turnover
- 730 employees
- 85 man years dedicated to innovation
- Consumes: 1 mill. sm³ spruce/year
- Produces:
 - 150.000 ton speciality cellulose
 - 150.000 ton speciality lignin
 - 1500 ton biovanillin
 - 20 mill. l 2.gen. bioethanol
 - 200 GWh bioenergy
 - 30 GWh biogas

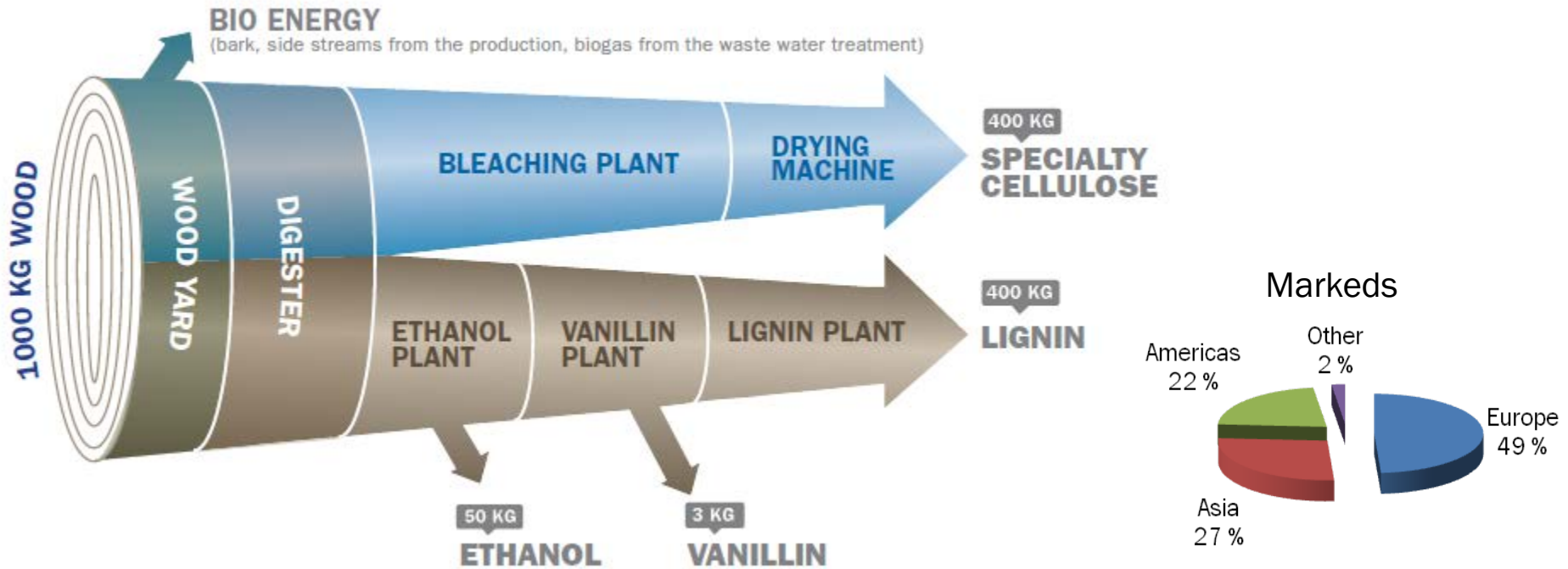


IEA's def of Biorefinary
"Biorefinery is the sustainable processing of biomass into a spectrum of marketable products"



Borregaard is the world's most advanced biorefinery

High raw materials utilisation - products with a wide range of applications



Cellulose	Lignin	Vanillin	Ethanol
Construction materials	Concrete additives	Food	Pharmaceutical industry
Cosmetics	Animal feed	Perfumes	Bio Fuel
Food	Mining	Pharmaceuticals	Paint/ varnish
Tablets	Batteries		Car care
Paint / varnish	Briquetting		
Filters	Soil Conditioner		
Textiles			



Borregaard's biorefinery concept – sustainable, with products that can substitute oil based alternatives

Raw Material



Natural
Renewable
Non toxic
Non GMO
Sustainable sourcing

Processes



Reduced emissions
Energy conservation/
renewable energy
High raw material utilisation
Risk management

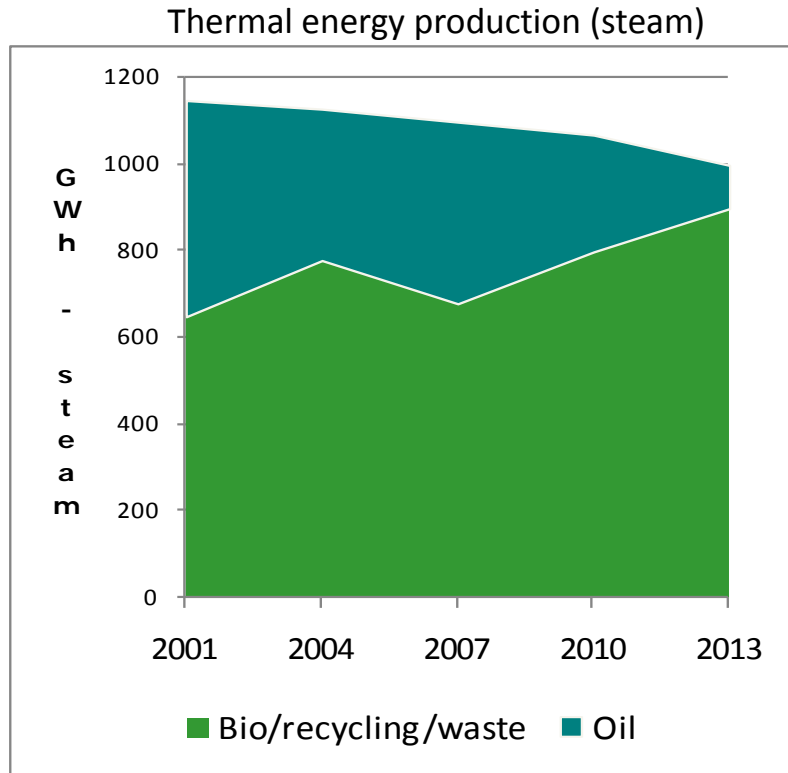
Products



High performance
Substitutes oil based
products

Independent Life Cycle Analysis confirms favourable GHG-footprint for our biochemicals compared to relevant alternatives

Significant investments at the Sarpsborg Site to improve climate footprint



- The thermal energy base load is today covered by renewable sources and waste incineration
- Plans for new top load plant will remove use of (heavy) fuel oil
- Investment in increased bio gas production for captive use

Reduced energy costs and greener products

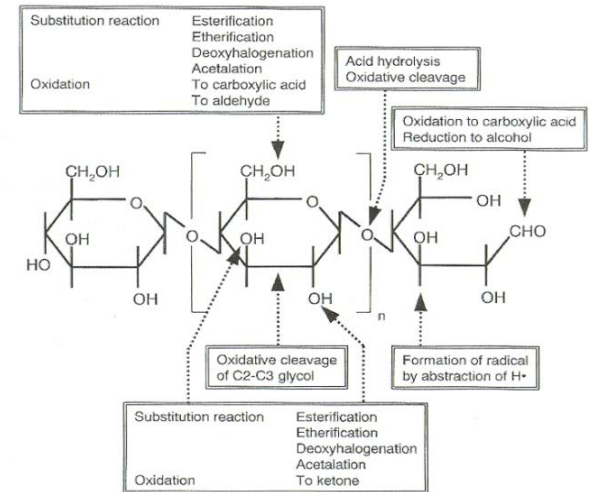
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Innovation in Borregaard

Innovation is the process of generating and implementing new ideas and solutions
increasing the value added to our customers



Why innovation

In 1889 – established

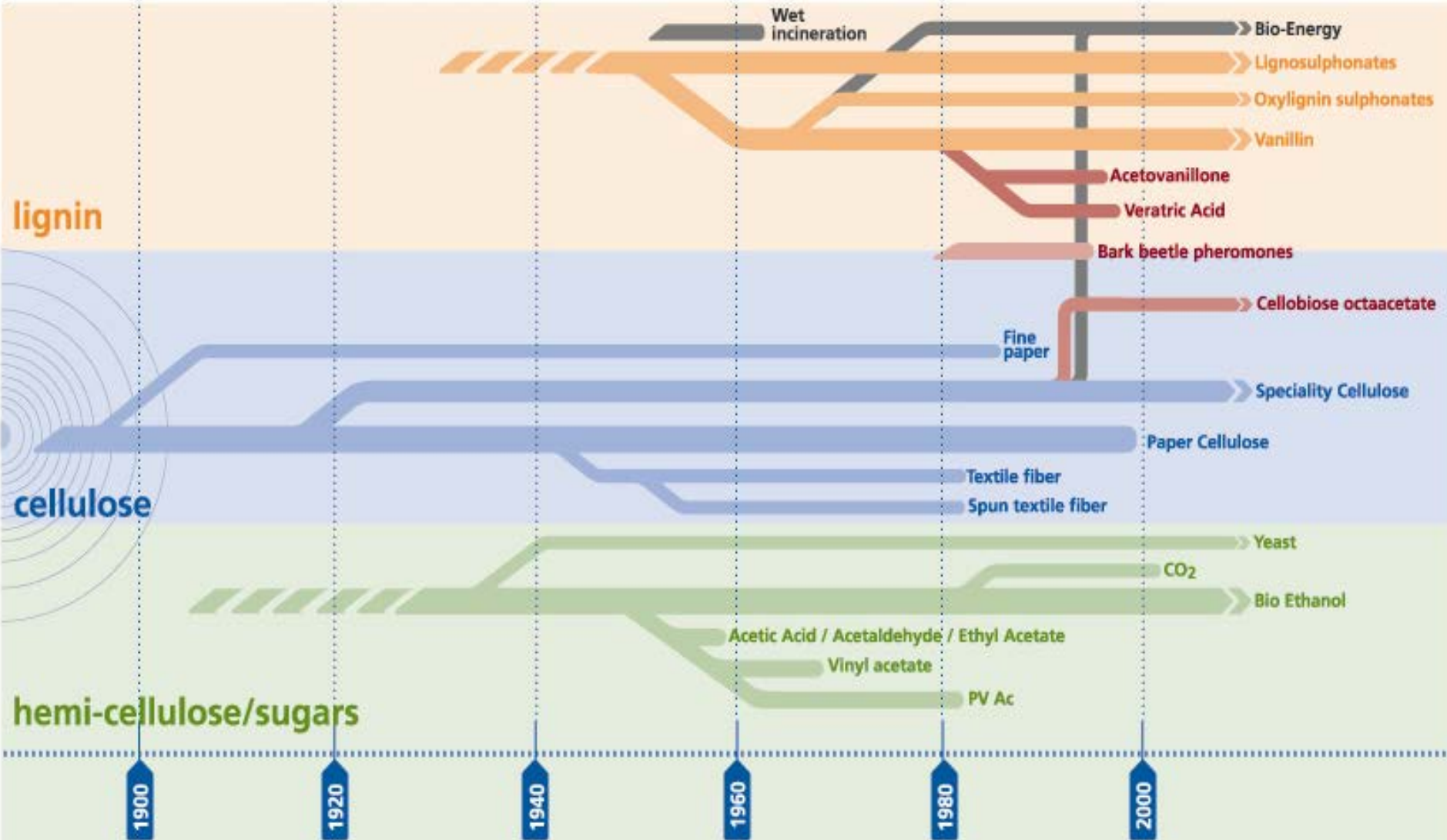
- Competitive edge
 - Cheap timber
 - Cheap energy
 - Cheap labor
- Foreign
 - Technology
 - Capital

Today

- High cost
 - Raw materials
 - Energy
 - Labor
- Competitive edge - competence
 - Technology
 - Market
 - Innovation

Borregaard's Biorefinery history

BORREGAARD'S BIOREFINERY



Innovation model

Ideas from sales, technical application, R&D, production, external partners

Idea database

IMT

IMT = Innovation Management Teams
Cross functional team of line managers

Inter disciplinary
development work

Scale-up and
commercialization

Co-work with:

- customers
- universities
- institutes
- consultants
when required

Main goals and deliverables innovations

*Plan, accomplish and document projects
defined and prioritized by the IMTs*

- Development of new
 - processes
 - products
 - Applications
- Optimization of existing
 - processes
 - products
 - Applications

- Inter disciplinary projects
- Prioritized by IMT

50 % of our effort on
step change innovations

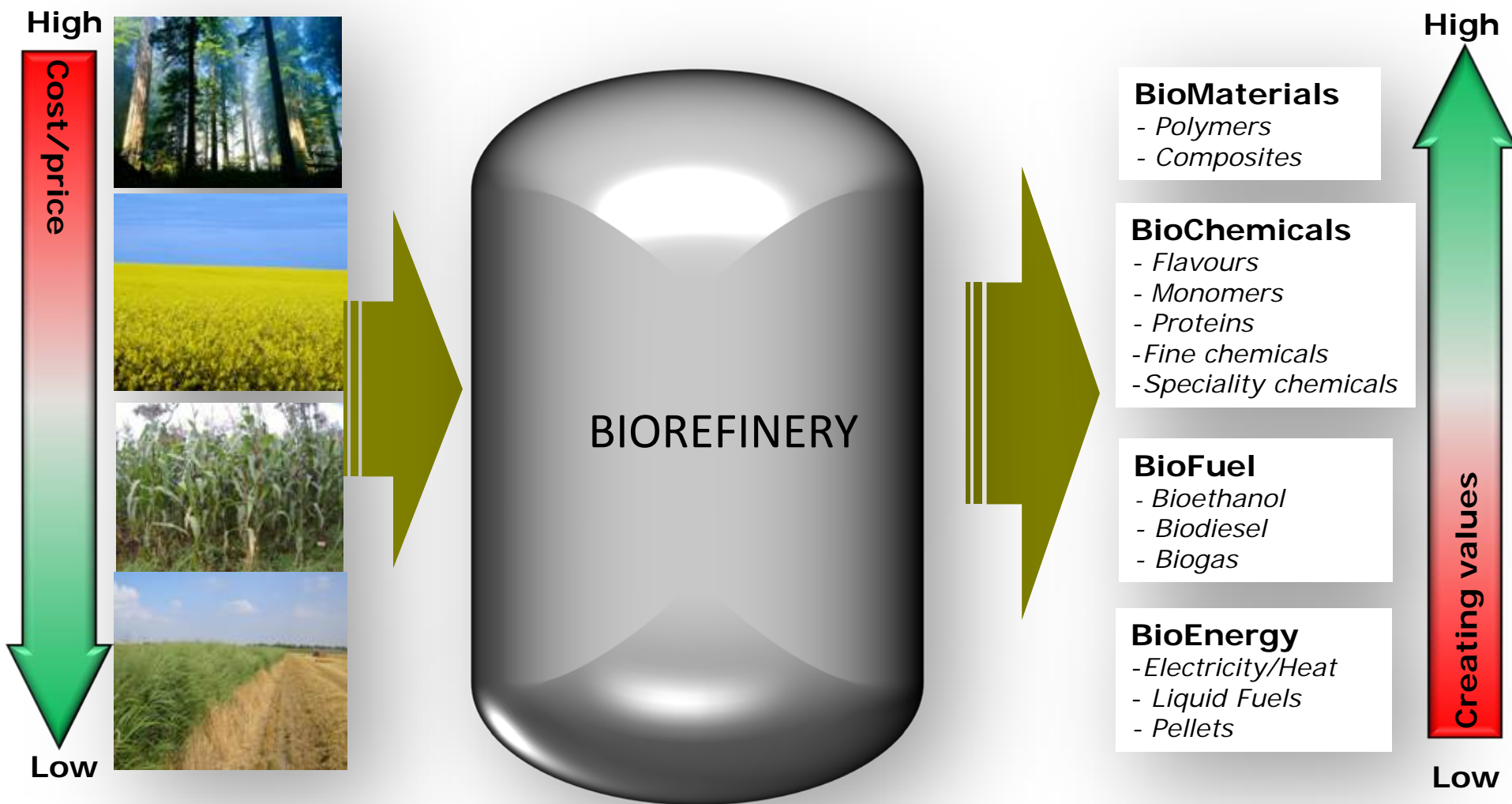


Some key success factors i innovation

- Broad and in-depth knowledge base
 - Internally
 - Through strategic co-work
 - Close customer contact
- Anchoring
 - In top management
 - In the company strategy
- An implemented innovation model
 - Make technological development and development of business case integrated process
- Speed and patience
- Creativity – put into system

Innovation requires:
- investments
- structure
- culture
- urge
... and a bit of luck

Biorefinery options - value creation





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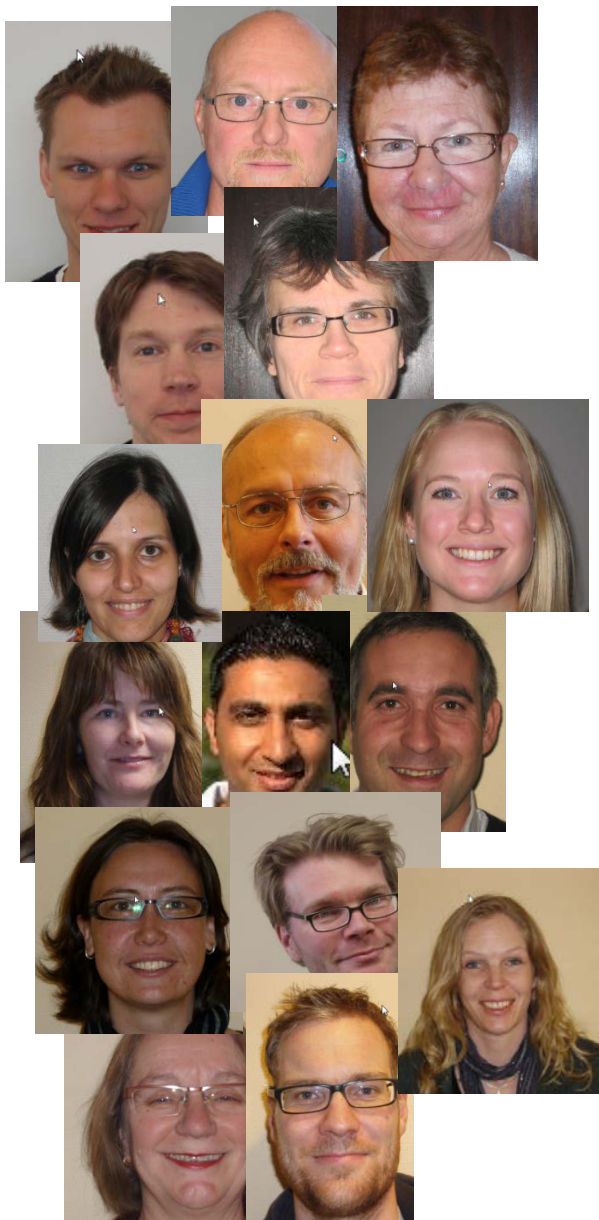
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Borregaard

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R&D staff



Number of employees	70
Number of M.Sc	12
Number of Ph.D	25
Average experience (years)	10
Female employees (%)	47
Average age	41



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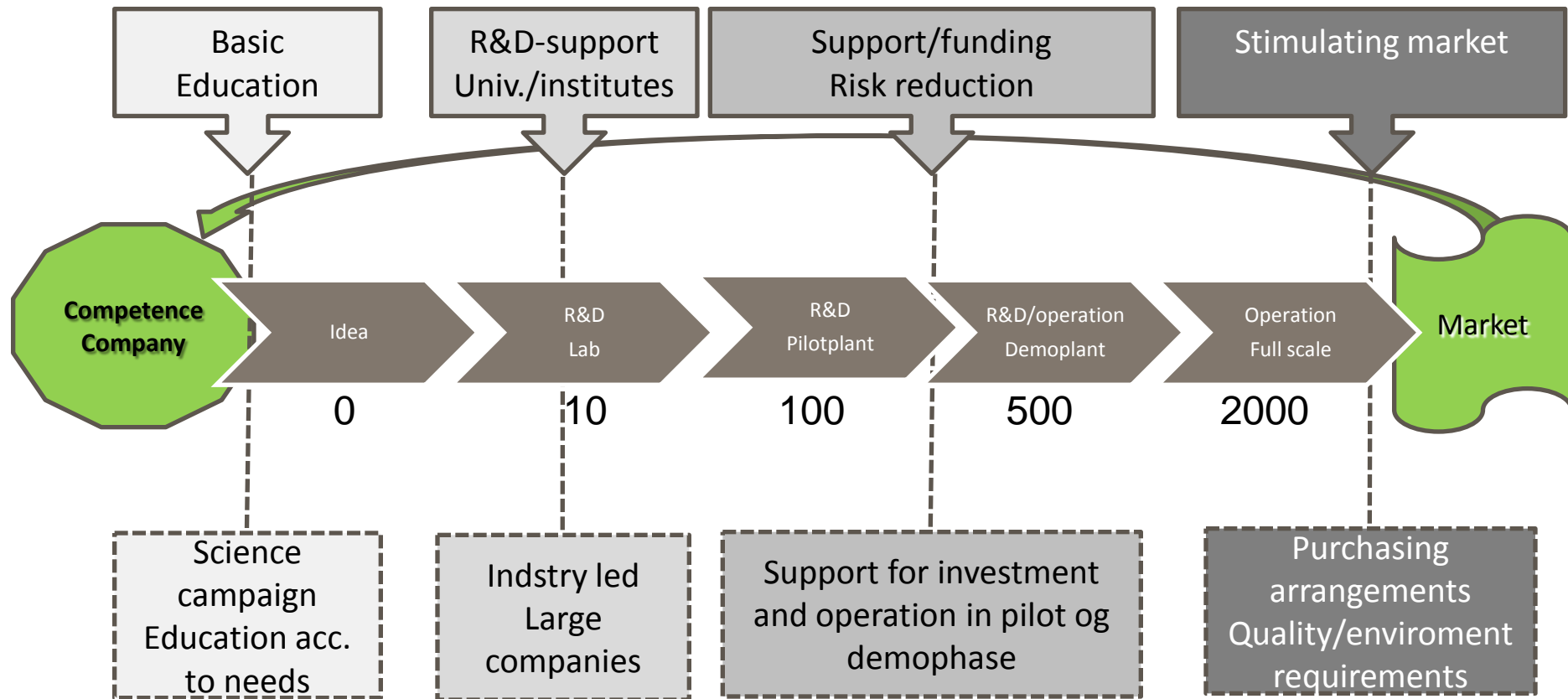
Borregaard

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Innovation is a long value chain

All links must be reinforced/supported – also from the authorities



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Borregaard

The Sustainable Biorefinery

Borregaard - an organisation for Innovation



New cellulose based materials

- Knowledgebased value creation from sustainable biomass
- R&D spending close to NOK 100 million/year
- Some 20 % of Borregaard's revenues - from new products



Environmentally friendly products to the agro sector



Patent application for new process for 2G bioethanol



Development of new processes within EHS



Utilisation of "new" biobased raw materials