

Welcome to Borregaard

The world's most advance biorefinery

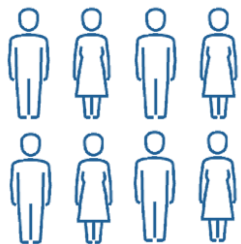
Visit from Poland 7.9.2022

Gudbrand Rødstrud

Technology Director Business Development

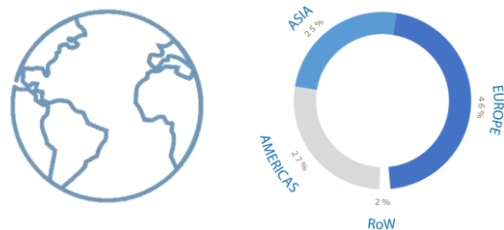
Borregaard key figures

Employees



1070

Borregaard in the world



Business in

13

countries

Sales to

100

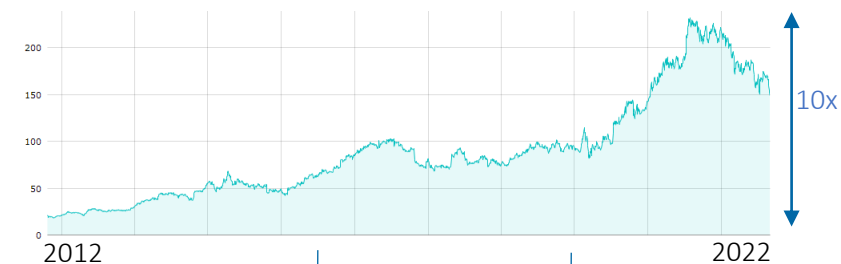
countries

Sales outside Norway

95

percent

Economy



Turnover

5.8

billion NOK

Result

1.4

billion

Investments

700

million

Raw material



1 million

m³ Norwegian Spruce
375,000 tonnes lignin raw material

Production

Lignin
Speciality cellulose
Bioethanol
Vanillin
Cellulose fibrils
Fine chemicals

700

Products

Innovation



Innovation
intensity

3-5%

of turn over

Sales of new products

12-20%

of turn over

Sustainable substitutes to petrochemicals

**SPECIALITY
CELLULOSE
& CELLULOSE
FIBRILS**

▲ 45% FIBRES



**BIOPOLYMERS
& BIOVANILLIN**

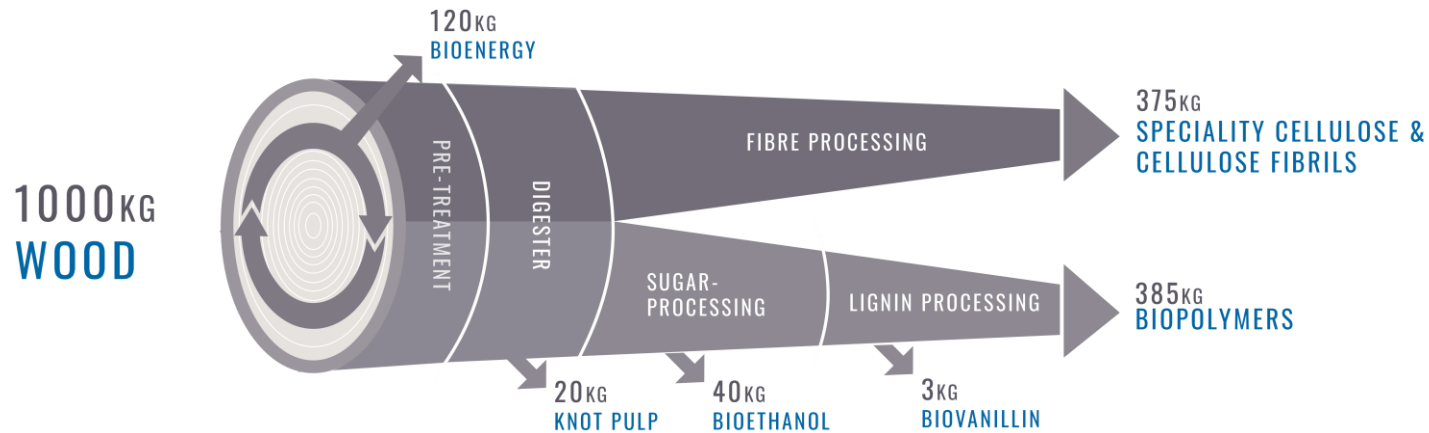
▲ 30% LIGNIN
(BINDING MATERIAL)

BIOETHANOL

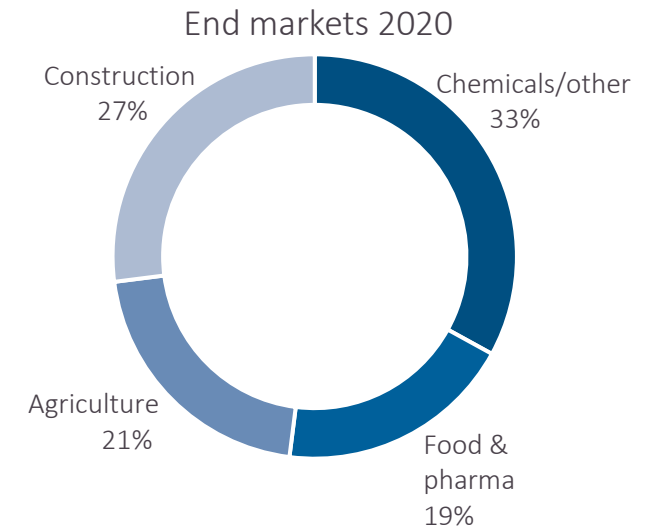
▲ 25% SUGARS

Advanced biorefining allows high raw material utilization

Integrated production system serving diverse markets



94%
UTILISATION



SPECIALITY CELLULOSE

- Construction materials
- Filters
- Inks and coatings
- Casings
- Food/pharma/personal care
- Textiles

CELLULOSE FIBRILS

- Adhesives
- Coatings
- Agricultural chemicals
- Personal care
- Home care
- Construction

BIOPOLYMERS

- Concrete additives
- Animal feed
- Agrochemicals
- Batteries
- Briquetting
- Soil conditioning

BIOVANILLIN

- Food and beverages
- Perfumes
- Pharmaceuticals

BIOETHANOL

- Biofuel
- Disinfectants
- Pharmaceutical industry
- Home and personal care products
- Paint/varnish
- Car care

Turning all parts of the wood log into products

The “LIGNIN COMPANY”
Leading supplier of lignin based performance chemicals

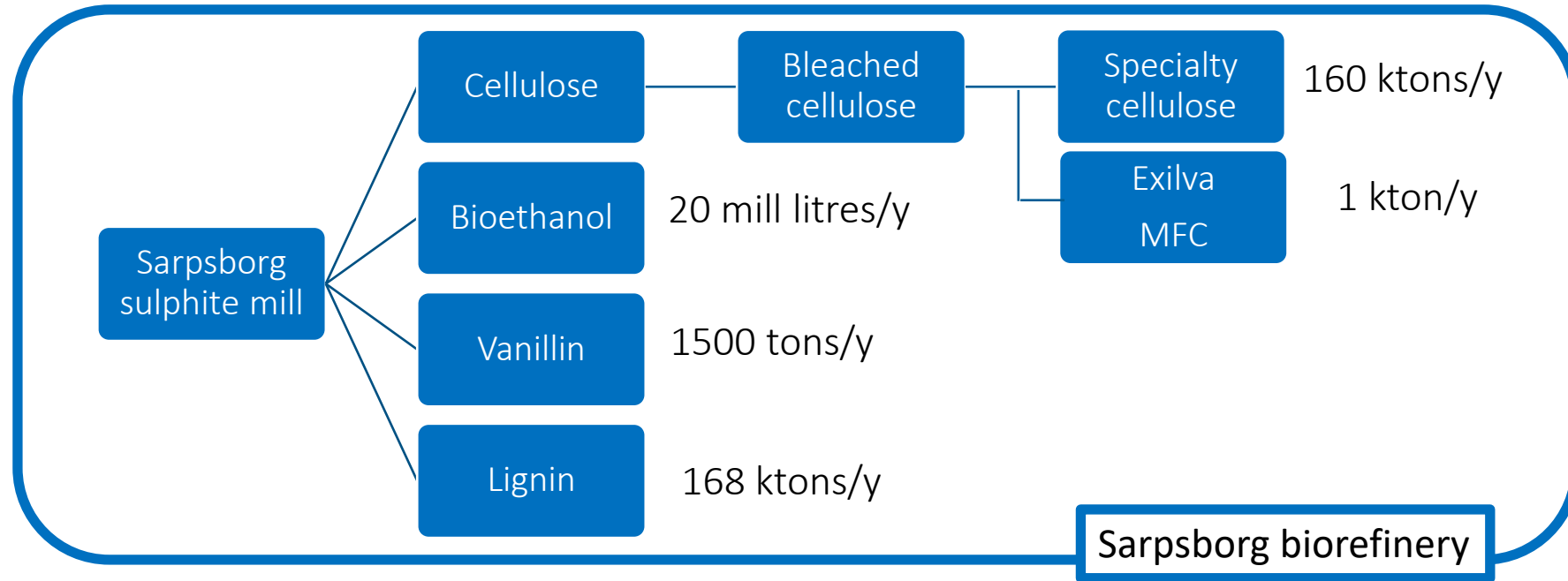
Top 3 supplier of high quality specialty cellulose

Only supplier of vanillin from wood

Only supplier of high purity MFC

Top 2 producer of ethanol from wood

Leading supplier of x-ray contrast

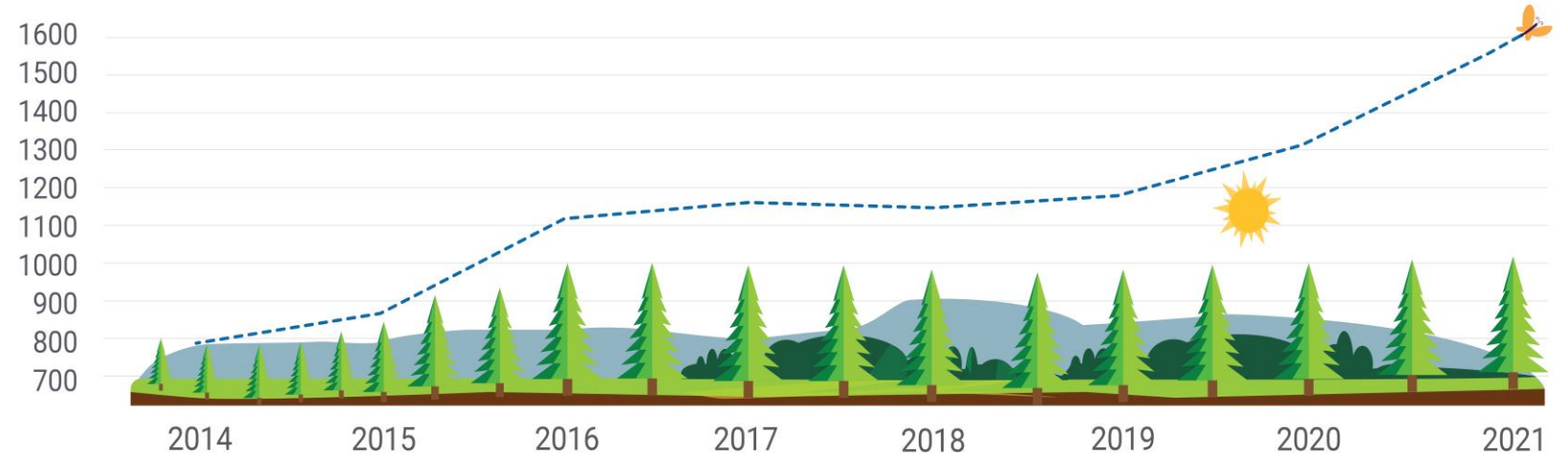


Increasing value creation

Specialization and continuous improvement are central points in our strategy.

Energy efficiency, increased value of the products and direct emission reductions improve the environmental profile and is a profitable strategy

VALUE CREATION, NOK PER SOLID CUBIC METER WOOD FROM BORREGAARD'S BIOREFINERY



VALUE CREATION IN NOK PER TONNE OF SCOPE 1 AND SCOPE 2 CO₂ EMISSIONS



Biopolymers



Animal feed
Agrochemicals
Batteries
Briquetting
Soil conditioning
Concrete additives

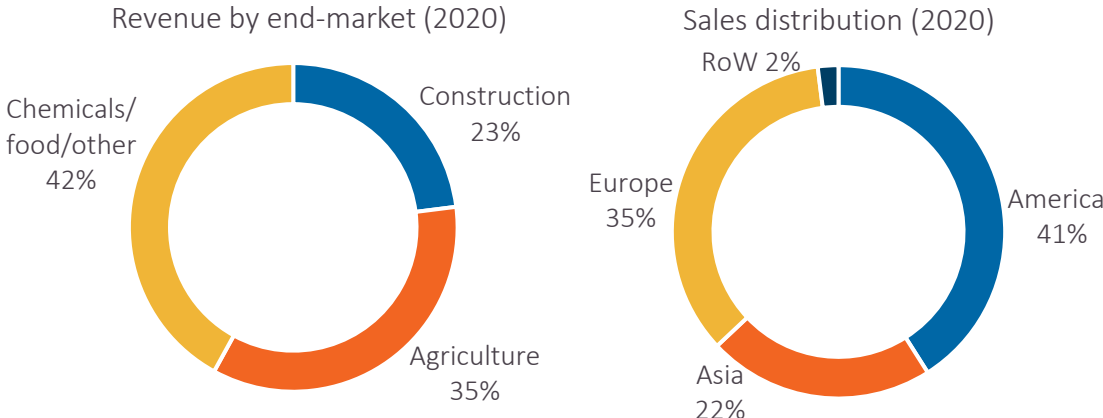


Diversity: Around 620 products to 3,000 customers

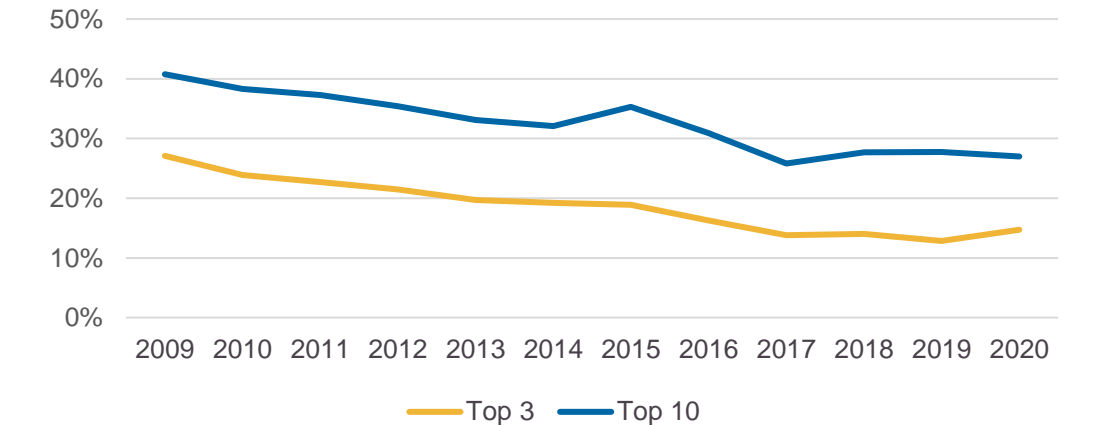
BioSolutions properties

Properties	Applications
Binding agent	<ul style="list-style-type: none"> • Ceramics • Dust solutions • Feed • Granulation aid
Dispersing agent/ rheology control	<ul style="list-style-type: none"> • Carbon black and pigments • Concrete admixtures • Dyestuffs • Metals and minerals • Micronutrients • Plant protection and plant nutrition
Crystal growth control	<ul style="list-style-type: none"> • Batteries • Oil field chemicals • Water treatment
Functional additive	<ul style="list-style-type: none"> • Antioxidants • Complexing agent • Phenol replacement • SoftAcid • Soil conditioner • UV protection
Flavours and fragrances	<ul style="list-style-type: none"> • Food • Fragrances • Personal care • Pharmaceuticals

Revenues by end-market and region¹⁾



Top 10 and top 3 customers in % of revenues



Speciality Cellulose



Construction materials
Filters
Inks and coatings
Casings
Food
Pharma
Personal care
Textiles



Cellulose Fibrils



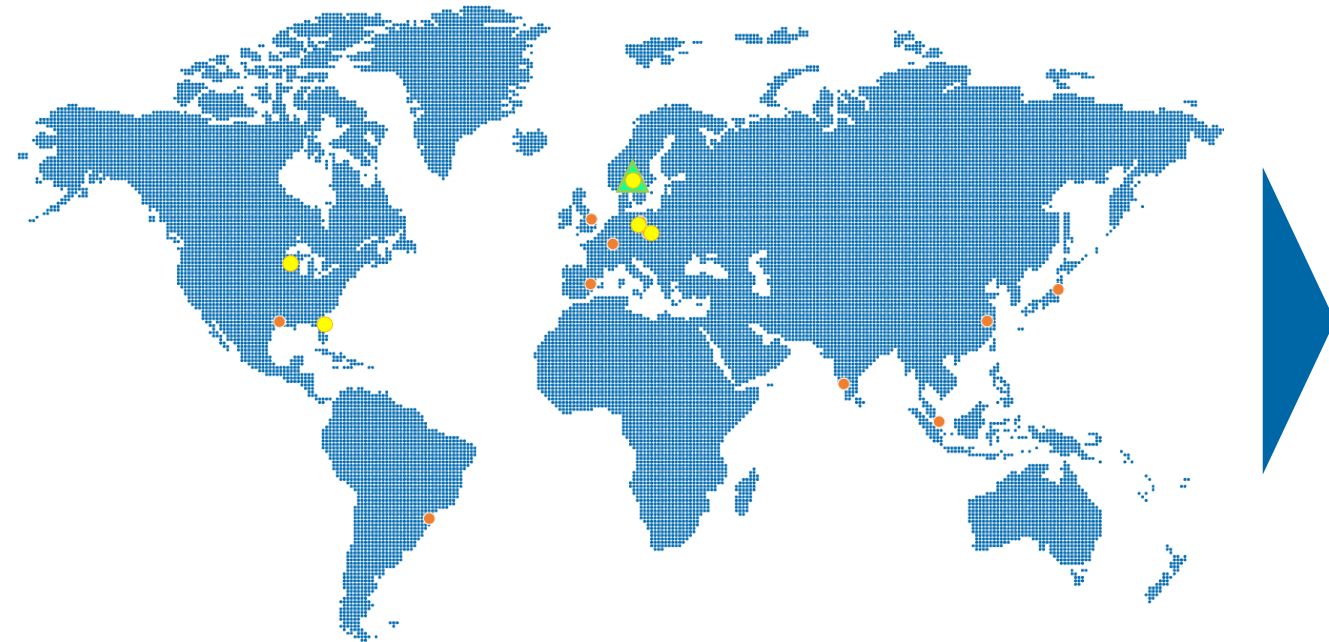
- Adhesives and sealants
- Paints and coatings
- Agricultural chemicals
- Paper & packaging
- Personal care and cosmetics
- Home care and cleaners
- Construction

Bioethanol



- Biofuel
- Disinfectants
- Pharmaceutical industry
- Home care
- Personal care
- Paint/varnish
- Car care

International business with plants and sales offices in 13 countries



- ▲ Norway: HQ & full biorefinery
- 4 other lignin plants
- Strategically located manufacturing to supply customers efficiently
- Intimacy with a global customer base through a fully controlled sales and marketing network
- Earnings stability due to diversification
- Well balanced between mature and emerging markets

Sustainability – an integral part of market offering



Natural, renewable,
sustainable raw materials

Sustainable and certified wood

- Documentation
- PEFC and FSC standards
- Lignin raw material from certified forests



Efficient and sustainable
production and value chain

Reduced emissions improve LCA

- Target based CO₂-reductions
 - Energy conservations
 - New/green energy sources
- Reduced emissions to water and air
- “Greener” logistical solutions



Sustainable
biochemicals

Products add sustainability value

- Climate: LCA shows favourable GHG footprint
- **Biobased:** Natural raw materials preferred
- **EHS:** Non-toxic, harmless products

LCA reports published regularly

- Borregaard has contracted with third parties to regularly assess our environmental footprint since 2008.
 - Results are published
- LCA's
- EPD's
- Comparative LCA with competing products
- LCA within development projects to ensure the processes and products will be environmentally friendly
- LCA in development projects as feedback to process development to pinpoint where the best options for improvement of the GWP and environmental footprint are.
- Certified wood as main feedstock, large fraction of renewable energy and long tradition in focus on reduction of GHG footprint result in best performing products on the market within most categories.

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The 2019 LCA of products from Borregaard, Sarpsborg

This report documents the modelling and environmental results for 8 products from Borregaard in Sarpsborg. The work has been performed from March 2020 to June 2021, and it is directly based on the work done in phase I/II in 2008, the 2010 update and the 2015 update. In this study life cycle assessment (LCA) methodology has been used.

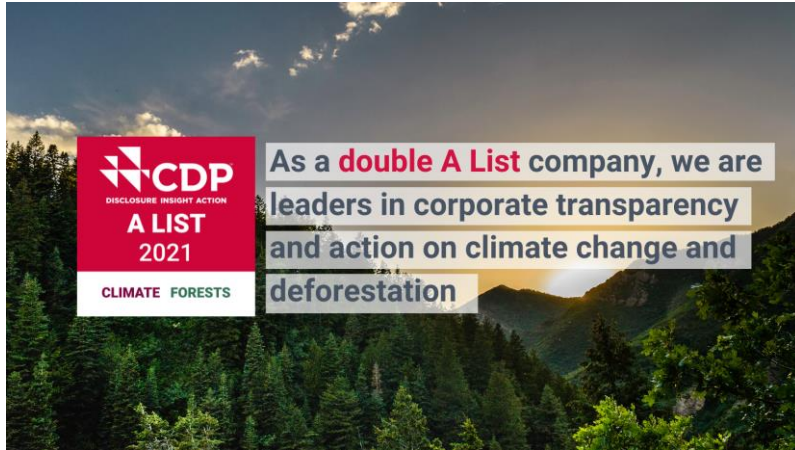
For most indicators and products, the burdens have decreased compared with 2014. It is, however, difficult to draw conclusions regarding the lignosulfonates, as the LCA model has changed since the 2014 modelling. Steam, chemicals and direct emissions are the most important explanations for changed burdens for Borregaard's products. Reduced direct emissions from the ethanol factory have contributed to reduced eutrophication burdens for several products.

The relative burdens of the life cycle phases are shown in Figure 1.

Indicator	Product	Production and transport of timber and wood chips	Production and transport of chemicals	Production and use of electricity	Production and use of petroleum products (fuel)	Combustion of waste at the biorefinery	Various
Climate change indicator	Cellulose	~10%	~10%	~10%	~10%	~10%	~50%
	Ethanol (95%)	~10%	~10%	~10%	~10%	~10%	~50%
	Vanillin	~10%	~10%	~10%	~10%	~10%	~50%
	Hydrochloric acid	~10%	~10%	~10%	~10%	~10%	~50%
Eutrophication potential	Cellulose	~10%	~10%	~10%	~10%	~10%	~50%
	Ethanol (95%)	~10%	~10%	~10%	~10%	~10%	~50%
	Vanillin	~10%	~10%	~10%	~10%	~10%	~50%
	Hydrochloric acid	~10%	~10%	~10%	~10%	~10%	~50%

Figure 1 Relative results for the life cycle phases, from cradle to gate for four products from Borregaard, shown for the two indicators climate change and eutrophication. For the eutrophication indicator, the life cycle phase 'Various' is closely linked to direct emissions from Borregaard. Transport to customer is not included.

Climate change and the environment – targets and rating



In 2021, Borregaard has committed to even more ambitious climate reduction targets, in line with the 1.5°C goal¹

- Targeted reductions in GHG emissions (scope 1 and 2):
 - 46% absolute reduction by 2030
 - Net-zero target, 90% absolute reduction by 2050
 - Base year = 2020

Further improved CDP² rating in 2021

- Highlighted as a global leader in corporate climate action
- Borregaard among top 20 companies out of 13,000 reporting:
 - A score within Climate Change four years in a row
 - A score within Forest
 - A- score within Water security



Platinum from the sustainability assessment company EcoVadis³.

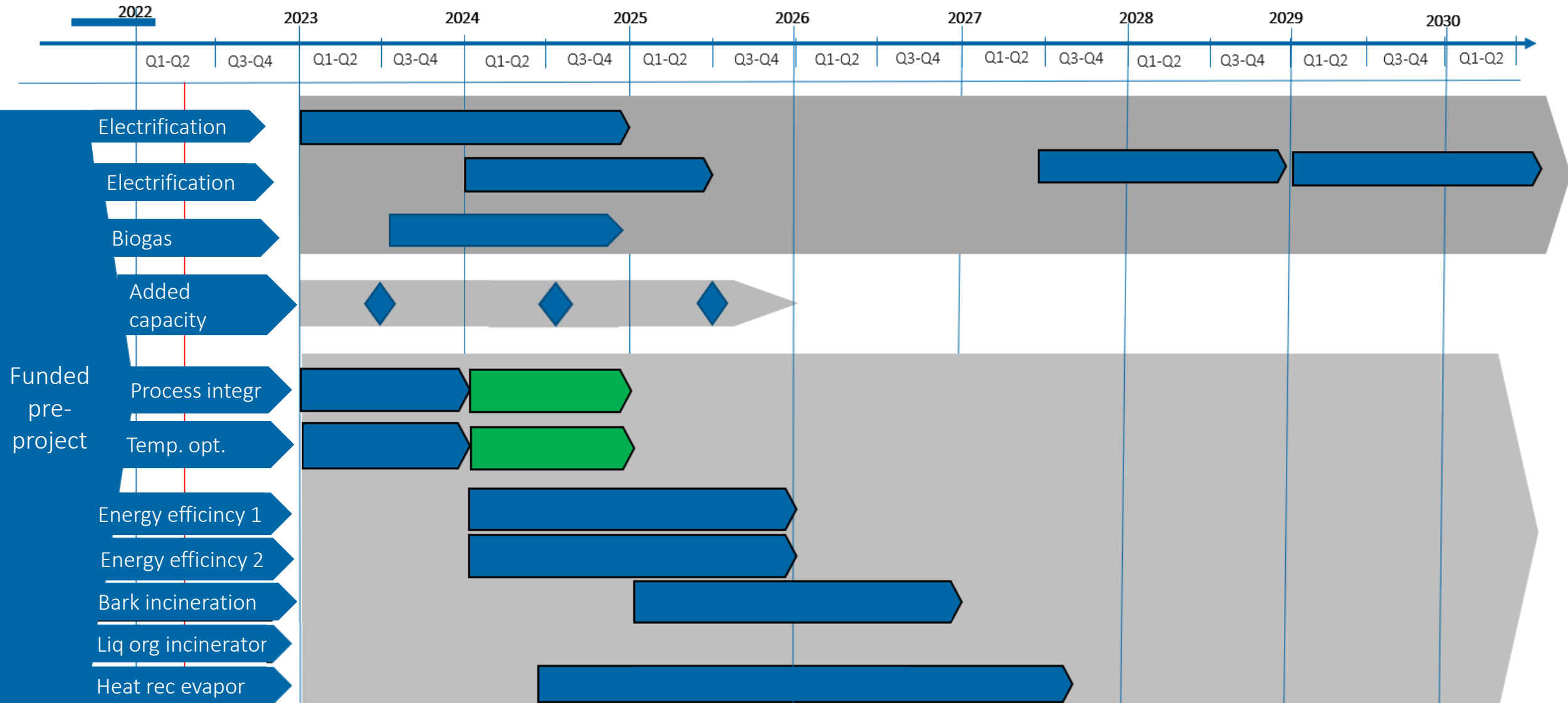
- Of over 90,000 rated companies, only 1% achieved a platinum rating in 2022.
- EcoVadis ranks the companies in four categories: Environment, Labor and human rights, Ethics and Sustainable procurement.

1. SBTi – Science Based Target initiative –The Science Based Targets initiative (SBTi) is a collaboration between CDP, the United Nations Global Compact, World Resources Institute (WRI) and the World Wildlife Fund for Nature (WWF).

2. CDP – Carbon Disclosure Project. No-profit organisasjon
<https://www-cdp-net.translate.google.com/en? x tr sl=en& x tr tl=no& x tr hl=no& x tr pt=sc>

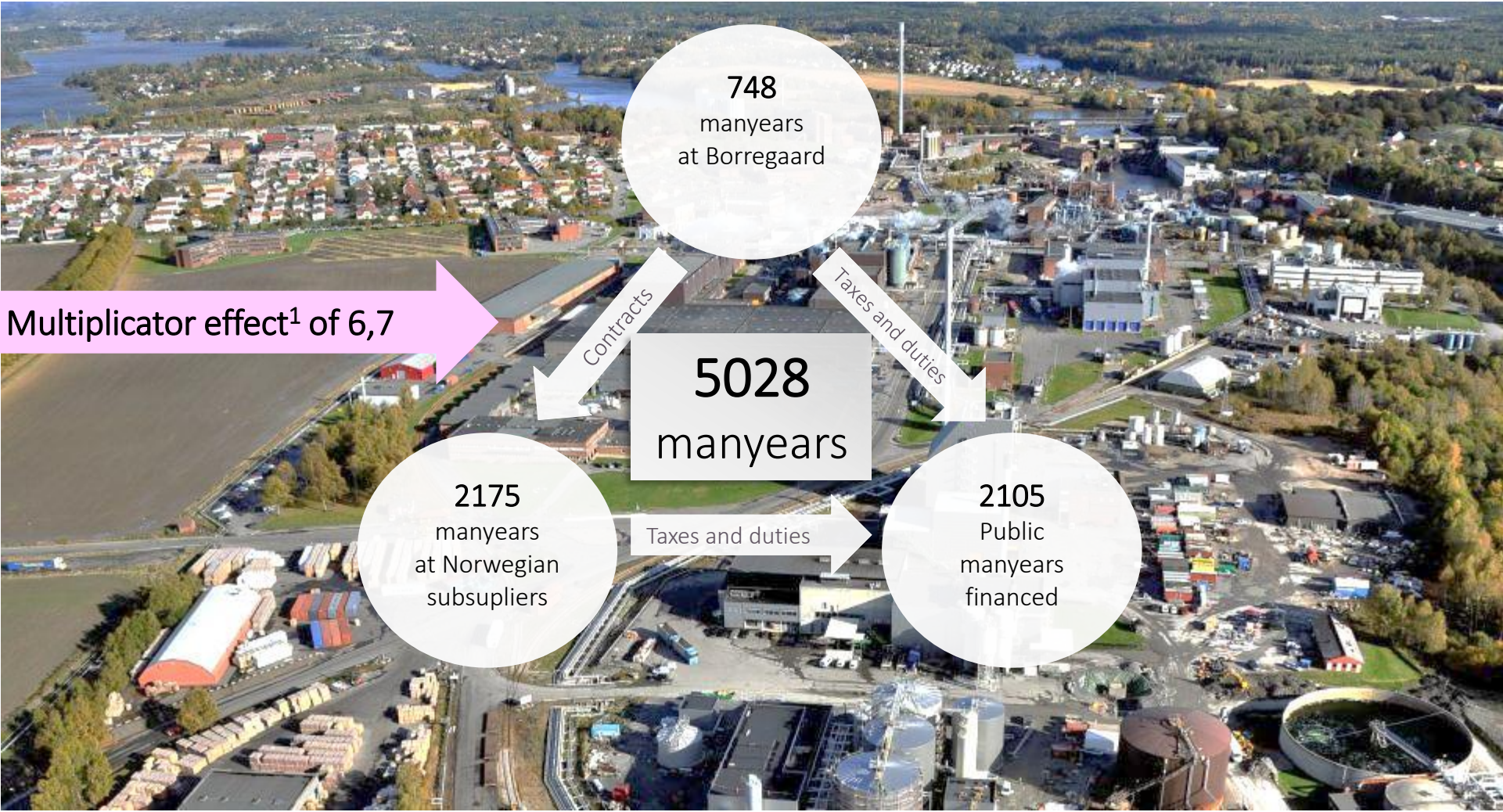
3. The EcoVadis methodology is based on international sustainability standards (Global Reporting Initiative, United Nations Global Compact, ISO 26000), and is monitored by a scientific committee of sustainability and supply chain experts, to ensure reliable third-party sustainability assessments.

Concrete plans to reach zero emission by 2050



Industry as platform for social welfare

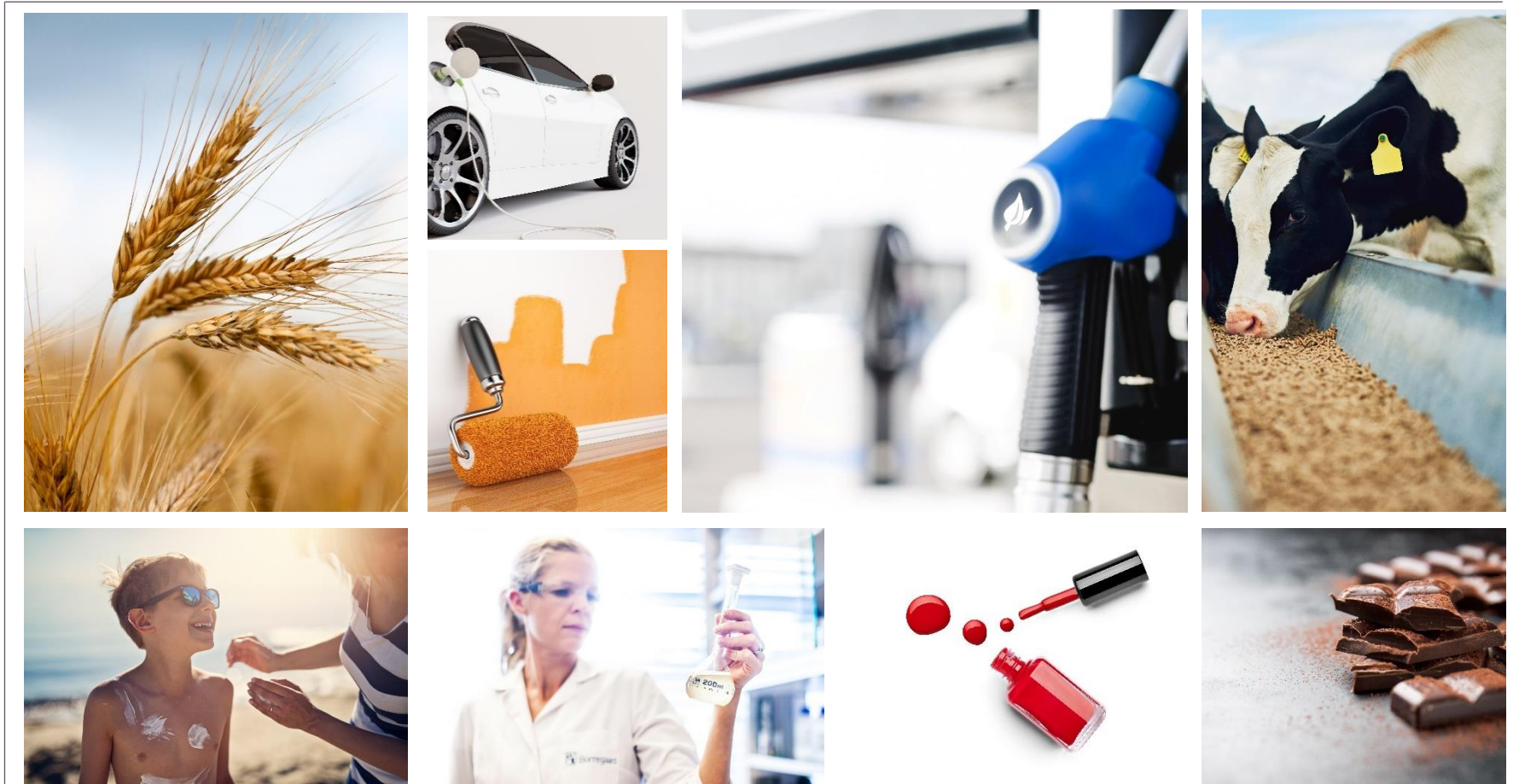
Borregaards operations in Sarpsborg



Large ripple effects - High value creation - NOK 1.2 billion/year in taxes and fees for the community (NHO, 2014)

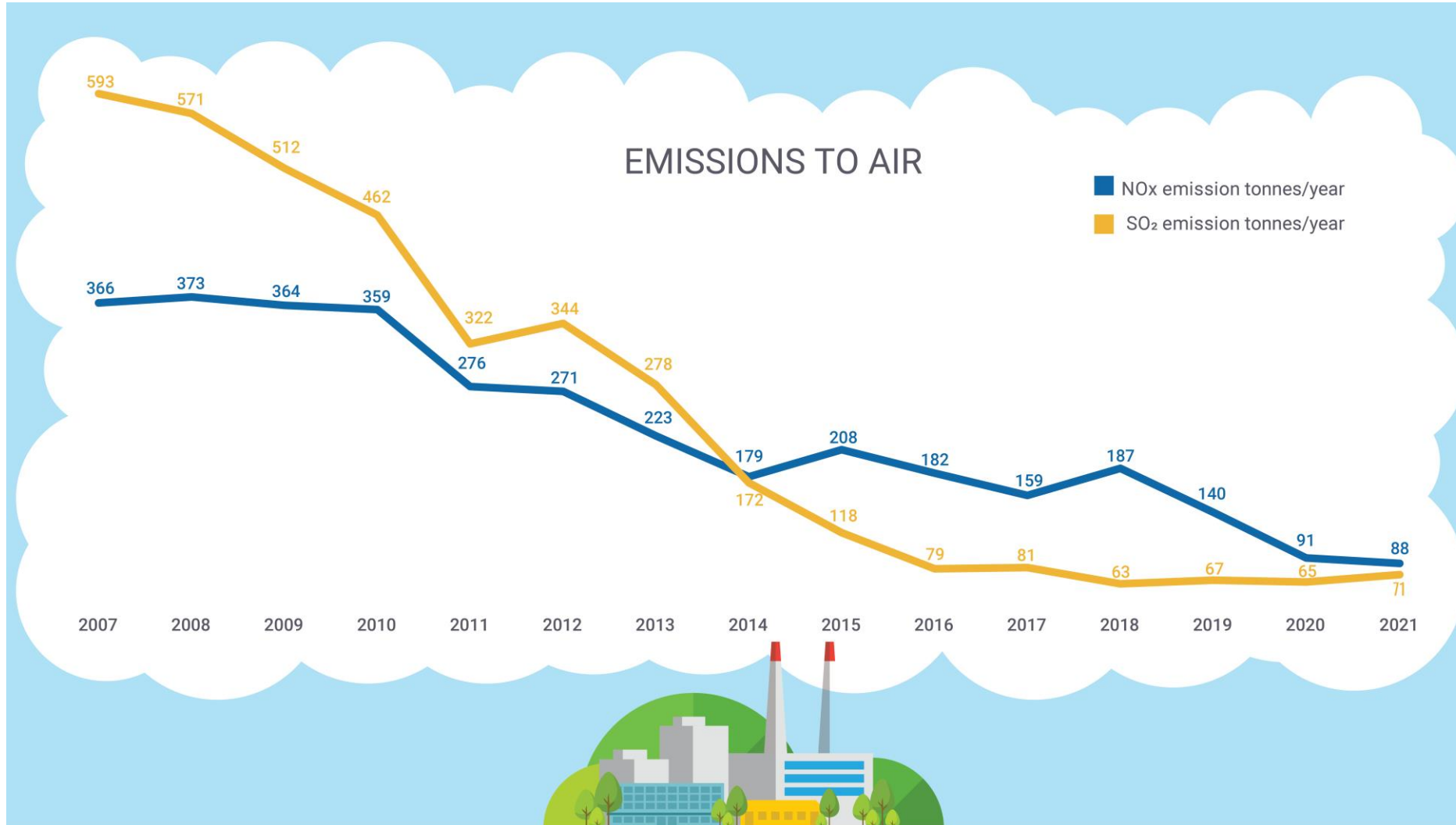
1. One man-year in the company adds 5.7 extra man-years outside the company, a total of 6.7 man-years

Oil or biomass – from black to green carbon

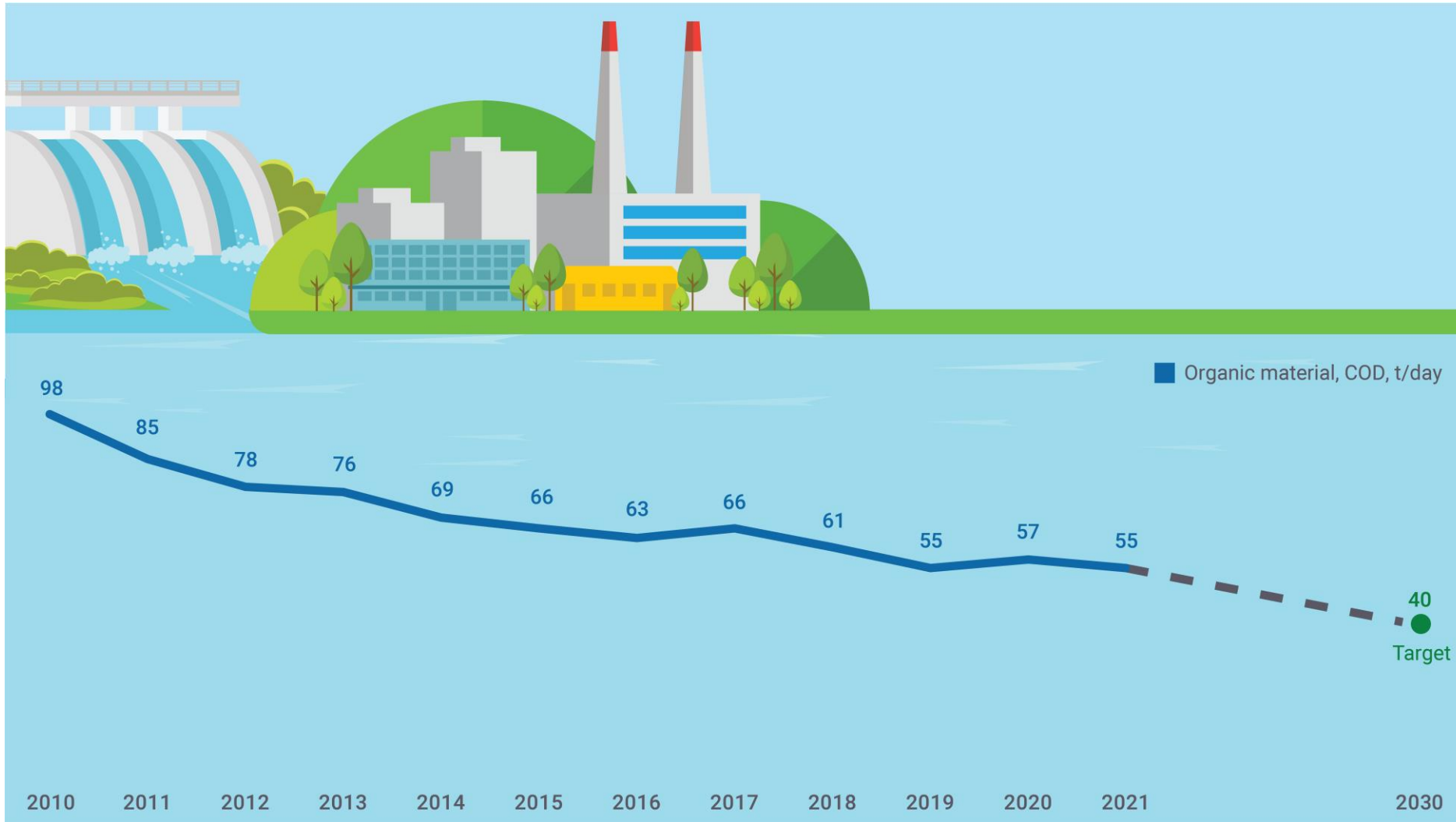


Sustainable chemicals,
materials, ingredients,
fuel

Reduced emissions to air



Reduced emissions to water



R&D and innovation

- Innovation Management Teams
- 90 employees in R&D and innovation
 - of which 69 at the research centre in Sarpsborg –
 - 22 has a PhD degree
- R&D and innovation spending 2021: 173 million NOK
 - Equals ~3% of revenues¹
- IP strategies for each BU and major innovation projects



1. Typically 10x more than traditional P&P industries

14% of Borregaard's revenues in 2021 came from new products



Innovation collaboration

- Collaborates with external institutes and partners when we benefit from it
- Collaborates with customers if possible
- Important parameters: Confidentiality, ownership of IP, Freedom to operate
- Applying for R&D support when appropriate
 - IN, NFR, EU, SkateFunn
 - Theme must match the announcements
 - Innovation Height,
 - Size (bureaucracy, timing)
- We entertain a large network of collaboration partners within academia, research institutes, suppliers, customers and consultants.
- We only develop new products and processes that improve the environmental impact for the company (scope 1 & 2) and/or for the customers (scope 3).
- Net Zero 2050 => New projects must meet the goal of zero emissions in 2050, or have a concrete plan for how it can be achieved.



New ESG related challenges within innovation in the near future

- An unclear and partly unpredictable regime of EU regulations under preparation. Paradoxes and contradictions between different proposed regulations and established standards.
- Chain of custody – mass balance
Standard under preparation, risk of mistrust among consumers. Should it be possible to sell "bio-based" products that do not contain a single bio-based carbon atom?
- LULUCF¹
To what extent should forests be protected or the biomass harvested to replace oil? At the moment, protection is the strongest focus => less access to biomass in Europe in the next 10-20 years. Set back for the Green shift.
- CDR² – Carbon dioxide removal
What counts as carbon removal will change. Today, the use of CO₂ in soft drinks is considered CO₂ removal. There is talk of new requirements for a minimum of 100 years of storage to be counted.
- PEF³
In the current draft, bio-based intermediates will not turn out to be more environmentally friendly than oil-based. The accounts are settled only at end-of-life.
- RePowerEU – investment package to make the EU independent of Russian oil and gas by 2030
- The taxonomy
- Projects that reduce emissions globally may conflict with the emissions requirements of one of the companies in the value chain and thus not be carried out.
- New projects **must** include requirements for NetZero 2050.
 - They must already satisfy those requirements or have a concrete plan for how it can be achieved.
- NetZero 2050 will require large investments that will compete with investments in increased capacity, new processes and new products.

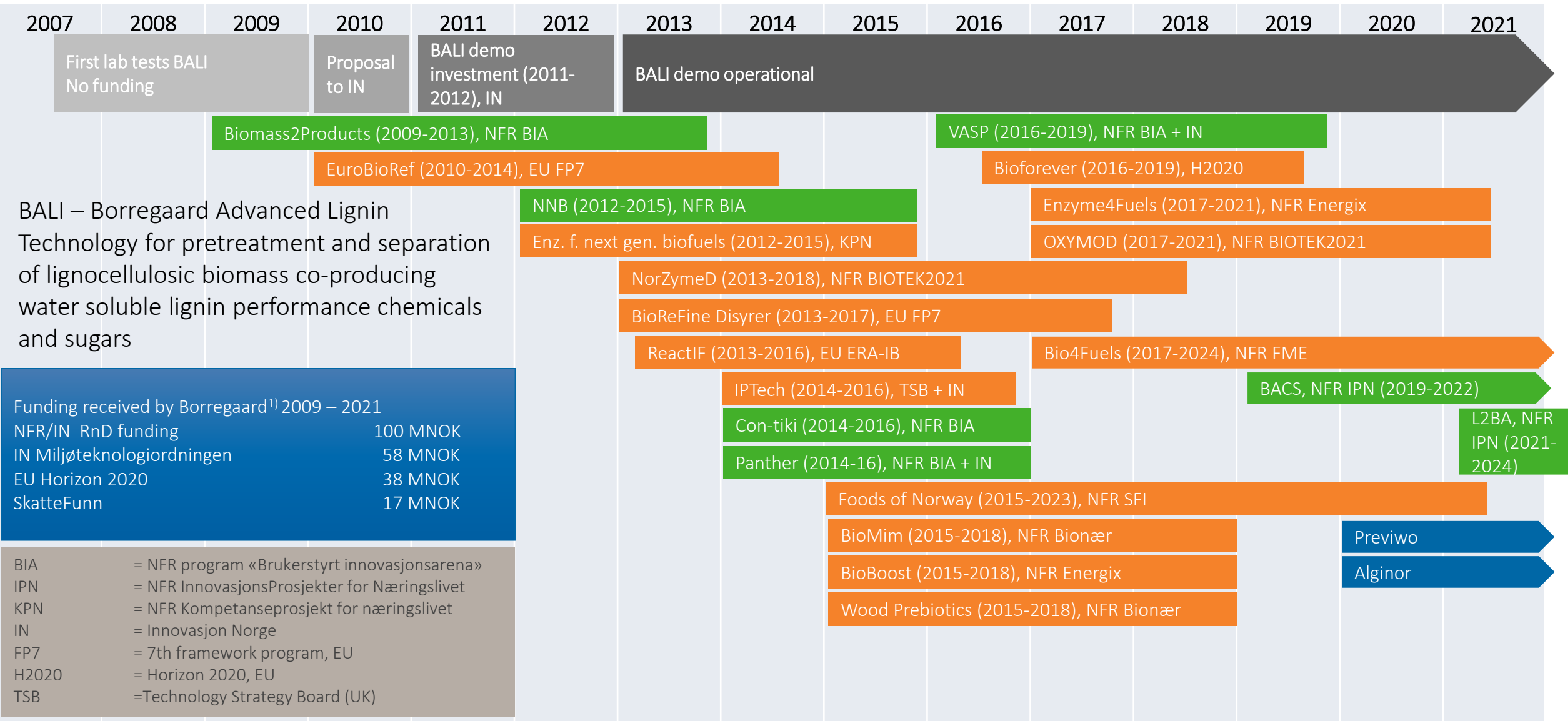
1. Land Use and Land Use Change and Forestry draft regulation.
2. Carbon Dioxide Removal) EU legislation and standard
3. PEF – Product Environmental footprint

Innovation at Borregaard – some of our successfactors

- Long-term and strategic approach to innovation
 - Member of BIC from the start, active in the preparation of the themes in the SIRA (in BBI) and SRIA (in CBE) programs and also in the annual calls for proposals. Active with input to relevant other programmes. Input to authorities (eg Forest 22, Process 21).
- Innovation is firmly on the agenda of the board and top management. Innovation is a core point of the strategy.
- Tolerate risk and manage risk.
- Train employees in the support systems, internal training and external courses
- Capacity to follow up closely and make use of the new knowledge (especially important in collaboration with academia)
- Active, contributing and demanding partner
- Continuous networking to be in position
 - In presentations, we often use the chance to tell what needs and innovation challenges we have
- Everyone involved must understand the nature of innovation work
 - You don't know the result in advance, the only known thing is the goal.
 - It is important to have mechanisms that can effectively handle the need for changes when dictated by the results or framework conditions (completely different management philosophy compared to e.g. construction projects).
 - For capital-intensive industry (production facilities): Early phase projects have relatively low costs, projects closer to the market have large costs without the risk being particularly reduced. Often encounter pilot trials (requires investment, a lot of resources) or even full scale trials when that is the only option.

Example of a project pipeline

Borregaard led project	External projects where Borregaard participate using the BALI Pilot	BALI Pilot	BALI Pilot made available to external org. at cost.
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Funding received by Borregaard¹⁾ 2009 – 2021

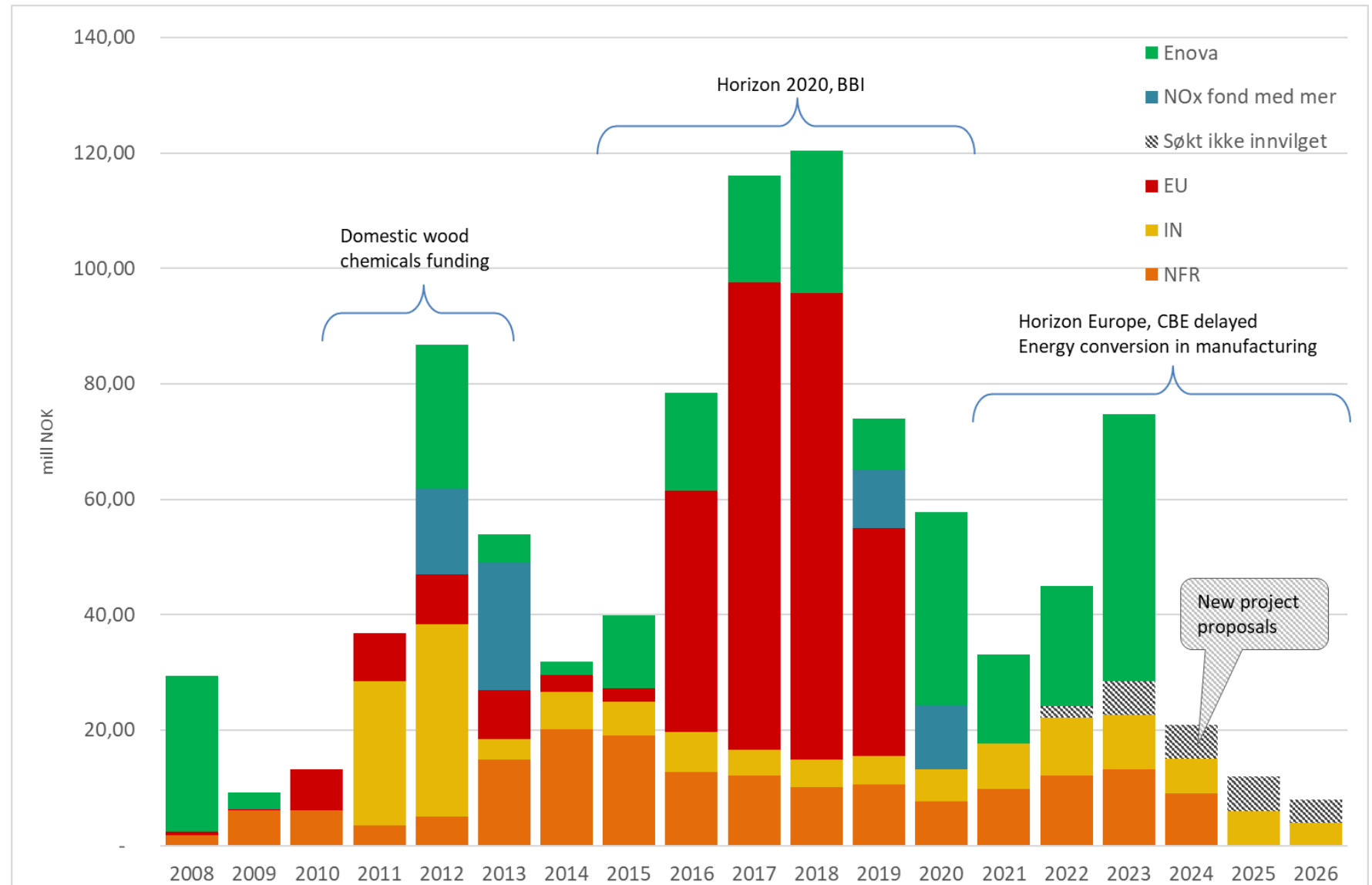
NFR/IN RnD funding	100 MNOK
IN Miljøteknologiordningen	58 MNOK
EU Horizon 2020	38 MNOK
SkatteFunn	17 MNOK

BIA	= NFR program «Brukerstyrt innovasjonsarena»
IPN	= NFR InnovasjonsProsjekter for Næringslivet
KPN	= NFR Kompetanseprosjekt for næringslivet
IN	= Innovasjon Norge
FP7	= 7th framework program, EU
H2020	= Horizon 2020, EU
TSB	=Technology Strategy Board (UK)

1) Funding received by Borregaard. In all external projects, only fraction received by Borregaard. In Borregaard lead projects, also including funding received by partners.

Public funding of innovation

- Public grants are considered a third party independent quality assurance of the funded projects
- Substantially increases the exploratory innovation efforts
- Building net-work, academia, suppliers and customers
- Important risk reduction
- Borregaard has been very successful in grant proposals and have a well established system for proposal writing, project management and reporting to funding bodies.



Borregaard looking to invest in biobased start-ups

Over more than 130 years in operation, Borregaard has developed into one of the world's most advanced biorefineries. To leverage this competence Borregaard is actively looking for investment opportunities.

In 2021 Borregaard invested in Alginor – a start-up with an ambition to build a biorefinery platform based on kelp biomass.

What we are looking for in companies/technologies

- Conversion of biobased raw materials to chemicals and materials
- Strong ESG profile
- Specialisation potential
- Synergy with Borregaard's existing business and competence
- Significant revenue potential (10-100 MEUR)
- Time to market < 5 years



For further information, please reach out to:

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Dr. Martin Lersch, CTO Business Development, martin.lersch@borregaard.com

What can Borregaard offer beyond capital?

- A global presence (production, sales offices)
- Broad application know-how from 130+ years of market presence
- A broad network of existing customers and collaboration partners
- Extensive experience from internal start-ups
- A strong sustainability track record
- An established organization with support functions for manufacturing, QC/QA, purchasing, marketing, sales support, logistics, HR/corporate
- Established CRM with inbound marketing
- A culture for continuous improvement (organization and process)
- Experience from being a digital forerunner for Industry 4.0
- Competence in fields relevant for start-ups: funding opportunities, regulatory, commercialization, IP, RD&I
- Access to pilot/demo plants



Biorefinery Demo – a state of the art demonstration facility

The pilot and demonstration facility Biorefinery Demo was commissioned in 2013 for the scale-up of Borregaard's own BALI biorefinery process. Since 2018 the plant has been used for other projects, both internally in Borregaard and for external customers. The demo plant with a highly skilled and creative staff is available for hire on a weekly basis (Mon-Fri).

The plant is well equipped for conversion of biomass into biobased chemicals and materials. Examples of equipment available:

- Bioreactors 30, 300 and 3000 L
- Hydrolysis reactors 3 x 4 m³
- Equipment: decanter, centrifuge, screw presses, filters, evaporators, UF, ion-exchange, hammer mill
- Total storage tank capacity of about 150 m³



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