CASE STUDY #4

The biorefining process in the SUBLEEM plant.

ABSOLUTELY SUBLEEM

PROJECT: SUBLEEM biorefinery

LOCATION: Denmark

STARTED: 2016

LEADER: Dr Anne Christine Steenkjær Hastrup

Denmark is one step closer to green change, with the development of a food-grade pilot scale biorefining plant. But is the nation's industry equipped to embrace this transformation?

By Martin Kovacs

The Danish Technological Institute's (DTI) SUBLEEM biorefinery project has been exploring the extraction of raw materials from plant waste, with the aim of harnessing existing resource streams to yield value-added products. The initiative is expected to create additional economic value for businesses, along with sustainability and climate benefits.

DTI Director, Bioresources and Biorefinery, Dr Anne Christine Steenkjær Hastrup noted that while green biomass processing continues to evolve at a broader level, she is confident it will become an increasingly standard procedure in the coming years. "It's inevitable that we will be using all resources in the most optimal way," she added.

With wastewater biogas extraction a long-established process in the water sector, Dr Hastrup pointed to

a natural progression in the ongoing development of various other biomass optimisation processes aimed at the production of high-value products.

"I would say it sprang from the bioenergy and bioethanol sector initially, and it was a good stepping stone into looking at the whole process of how can we use biomasses in a cascading way for new applications," she said.

"Where you have a waste stream or biomass residue that's not being used to its full potential, and then fractionating it into multiple streams and creating more value."

BACKGROUND AND CHALLENGES

While biomass processing has attracted significant research interest at a university level in recent years, Dr Hastrup explained that local industry momentum had been comparatively lagging – with the independent and non-profit DTI seeking to bridge this gap, facilitating technology development and industrial maturing.

The goal of the SUBLEEM project was creating a pilot plant to act as a hub for industry, providing the infrastructure needed to ultimately substantiate the economic viability of biorefining processes.

"Our task was to identify obstacles preventing biomass processing development, and we found that industry was really in need of a place for the upscaling and validation of different processes," Dr Hastrup said.

"The idea was to create generic biorefining infrastructure where industry in collaboration with the DTI and universities could develop, test and validate potential processes."

The pilot plant was structured to accommodate biorefining methods such as enzymatic hydrolysis, with Dr Hastrup advising that it has the capacity to handle pretty much any food grade compliant biomass.

While the plant's flexibility is one of its strengths, its generic design has also presented challenges, with the facility striving to cater to the diverse requirements of industry.

"A key challenge has been meeting all the requests from different companies, because since the plant is generic, companies have multiple ideas about how they want to process different materials," she said.

"Every time they have a request, we might be working with a new biomass, process development or unit of operations. That's one of the reasons why it's constantly evolving, because the needs are changing."

EVOLUTION OF TECHNOLOGY

The SUBLEEM pilot plant has transformed over the years with the integration of additional separation equipment. This has paved the way for an increasing array of processing methods and the production of a wider range of products from green biomasses.

The project's focus pivoted to food grade biorefining with a 2018 expansion – enabling production of purified proteins, dietary fibre and biologically active substances. Replacing imported raw materials ➤

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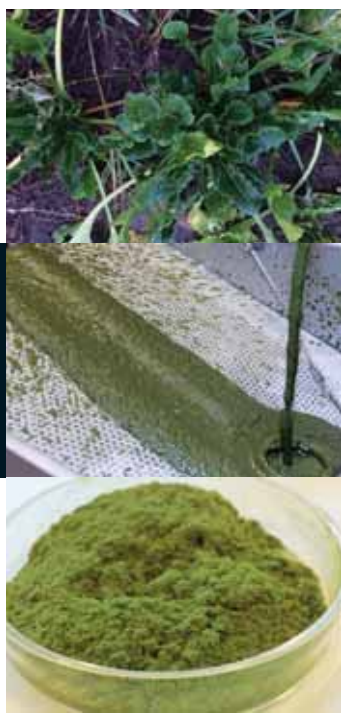
THE TIMELINE

2016–2018: The SUBLEEM project commences. The plant initially encompasses mills and wet mills; two 800 L tanks and two 200 L tanks; enzymatic and chemical reactions; pasteurisation, shifting, decanter and separator; and spray drying.

JANUARY 2018: SUBLEEM 2.0 is launched, focusing on green biomasses, incorporating ultrafiltration and column chromatography.

JUNE 2020: SUBLEEM 2.0 project comes to an end.

2022: Two new projects projected to move to demonstration scale.



The potentials in biomasses are evaluated by the SUBLEEM team, along with side stream for production.

Images supplied by the Danish Technological Institute

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Dr Anne Christine Steenkjaer Hastrup in the SUBLEEM pilot plant.

can bolster local industry and contribute to sustainable change, with green biomass derived from sources including brewers' spent grain, alfalfa and grass, sugar beet tops, straw, seaweed and algae.

"Interest from the food sector changed operations in the pilot plant, as we added extra equipment to make the separation even more specific, and then we made some further adjustments to comply with food safety and food grade standards," Dr Hastrup said.

"We've also focused on water uses in the processes. How can we either decrease use or reuse the water, and within the last year especially – how can we use the water streams and the soluble things in the water streams, as they come out of the process."

With the project becoming increasingly focused on the optimisation of its various streams, assessing how water is used and weighing up how it can be harnessed to deliver additional value was a logical next step.

"There may be soluble nutrients in the water, sugar-rich water streams, where we could potentially add a fermentation step, using the nutrients and the sugar as a feedstock, which can then be added after the biorefining process," she said. "Another thing we have been looking at is how we can use waste streams for microalgae production, which can be used for animal feed."

FUTURE FOCUS

There are two projects poised to move to demonstration scale, with the challenge now being to effectively transition from batch-scale pilot production to continuous production.

"The technology is there, but daring to take that next step sometimes prohibits the processes moving forward as quickly as they potentially could," she said.

In seeking to make the technology more economically feasible, Dr Hastrup said SUBLEEM will continue to focus on adding extra value to process components, with the view of enabling multifaceted product development.

However, collaboration is critical to ensure processing technologies are effectively developed, drawing on the combined knowledge of a diverse range of sectors.

"The challenge is going to be bringing everybody together on this. There's the water management and utilisation, the food and feed industry, and more," she said.

"The biorefining sector needs knowledge from the water sector to optimise and make sure that they have sustainable processes which take water use into account, because that's going to be one of the key factors for producing a sustainable product."

THE FUTURE OF BIOENERGY IN AUSTRALIA

2020s

47% of Australia's renewable energy production

3% of total energy consumption

2030s

Around **$10** billion in extra GDP per year

26,200 new jobs

9% reduction in emissions

6% more waste diverted from landfill

2050s

Up to **20%** of Australia's total energy consumption

Source: Australia's Bioenergy Roadmap 2021