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SYMBIOMA

Technology Innovations and Business Models for Valorisation of Industrial Waste Biomass in Sparsely Located Enterprises

Circular economy cases and their business models in Swedish brewing and distilling industry

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Contents

1 Breweries & distilleries in Sweden and their business models

In Sweden, brewers' spent grain (BSG) and yeast are the main by-products from breweries, and are usually used as animal feed or, in some cases, for biogas production. The amount has been estimated to about 800 000 tons (wet weight) (Avfall Sverige, 2008)[1]. However, this figure does not account for any of the large number of micro-breweries that have emerged in recent years; the production in these new micro-breweries is difficult to estimate.

In the Swedish NPA region 94 beverage companies are registered including 29 breweries and 5 distilleries (Allabolag.se). All breweries are small and are microbreweries with less than 19 employees. Based on the conducted interviews, certain reflections and conclusions could be highlighted: production and waste volumes are rather small, and the long distances and lack of a branch organization hinders closer collaborations. For most breweries, waste is not a major obstacle and they are happy to get rid of it for no or low costs. The entrepreneurs (the owners of breweries) have a passion for beer but not the same passion for waste utilization and that together with the resource constrains of SMEs results in low activity for the development of circular waste business models. Even though the owners of breweries would like to see a better utilization of the waste products but preferably with little effort from their side.

In addition, during interviews it has been learned that the main waste product from the breweries, spent grain, is commonly collected by farmers, that have cows or pigs, without any payments involved. To be allowed to sell animal food, expensive permits would be needed which hinders SMEs from selling their spent grain. In the regions where no or too few farmers exist, alternatives must be found and the potential for innovation is higher. For example, the use of spent grain in sourdough bread is currently being explored. Private people can also pick the spent grain as fertiliser. One brewery that has no farmer close by, transports the remaining spend grain to the local district heating supplier for energy recovery. Some of the CO2 and the energy from cooling is reused in the production process.

1 Avfall Sverige /The Swedish Waste Management Association Link: https://www.avfallsverige.se/

In addition, the main challenges to the development of circular business models based on their by-products are the small, irregular waste volumes produced by the beverage processes that cannot be stored properly. This together with legal restrictions on the potential use and resource limitation leads to a situation where brewers do not sell any of their waste products. There is potential that energy or biogas producers could pay for the biomass, or legislation changes that the production of food or animal food would easily be allowed from such wastes or by-products.

1.1 Case 1: Microbrewery

Is a microbrewery that produces beer in Norrbotten. The brewery was founded in 2014 and by 2020 has a large variety of beers. In 2019, they produced 10 000 litres of beer. The company follows trends and has a great willingness to collaborate for example with tourism industry. So far, they have 3 owners and look for expanding. In their assortment there are beers from 2.25 to 10% alcohol strength (v/v%), 4 standard beers and provisional products that follow seasonal trends thus discovering opportunities to innovate the production line.
The most common ways to utilise the production waste is to send away spent grain for the animal feed (collected by the farmer), wastewater and spent yeast to municipality sewage system. Some energy from cooling and CO2 is reused in the production. They are also involved in a project where spent grain is used to feed mealworms by also recovering heat from a datacentre.

1.2 Case 2: Microbrewery

A microbrewery with sustainability and innovation "thinking" that produces beer in Swedish Lapland. The brewery was founded in 2017, with production commencing in the second part of 2018. There are five owners and one employee. The owners are highly educated e.g. in chemical science and have good understanding of the properties of the waste material. The most preferred ways to utilise the production waste is to send away spent grain for the sourdough bread which is baked in a local restaurant. Private people can also pick up the spend grain to use it as fertiliser. They can bring the rest of the spend

grain to the municipalities district heating plant. Their different way of handling the produced waste is due to the lack of farmers in the region. They also recover some CO2 and energy.

1.3 Case 3: Small beverage company

A small beverage company inspired by the culture and landscape in the most northern part of Sweden, Norrbotten. The beverage company produces beer, Christmas and Easter must, soft drinks with unique natural ingredients. One of the unique ingredients as well as a product is the spring water filtered for centuries originating from Sulitelma's glacier at the Arctic Circle. The spring water is also sold internationally (Germany and Norway).

There are 6 employees in the production site. The company's aim is to work sustainably with everything from raw materials, packaging, to production and shipping. "Must" production is about 8-10 thousand bottles per day (during Christmas and Easter times), and 6-7 000 bottles of beer.

The most common ways to utilise the production waste from the beer production is to give the SG to a pig farmer in Boden a small town which is located about 40 km from the production site). The farmer comes to pick up SG 2-3 times per month by own costs. There is very low production waste from the soft drinks production. The overall wastewater goes directly to the municipality sewage.

2 Future opportunities for waste handling:

- Biogas/energy production would pay for biomass
- Larger scale for bread production
- Small scale dryers to enable storage and transport

3 Bottlenecks / challenges for efficient waste handling:

- Legal restrictions
- No collaboration /common projects
- Distance/ location

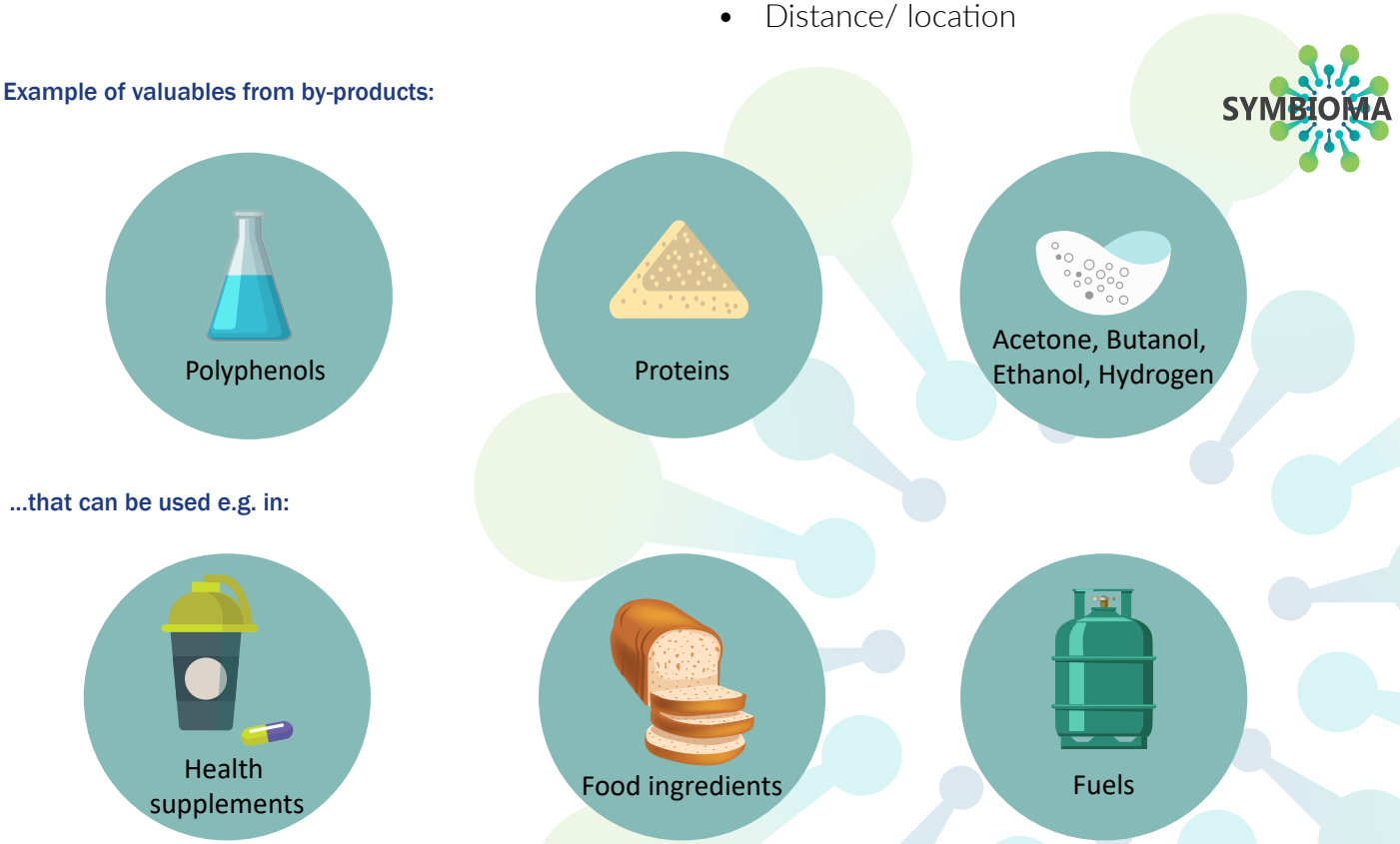

Figure 3: Valorisation possibilities of brewing and distilling by-products

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