

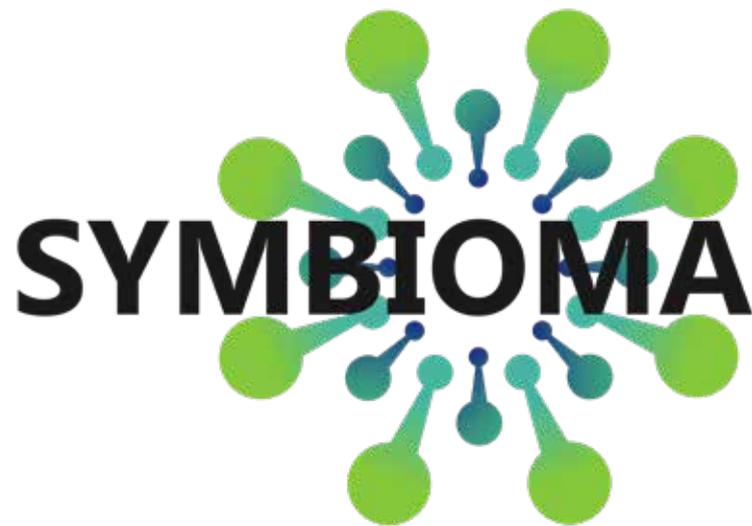


Northern Periphery and
Arctic Programme
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EUROPEAN UNION

Investing in your future
European Regional Development Fund



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

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

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1 Breweries and their business models in Finland

In the NPA region there are 21 small breweries (producing less than 10 million litres of beer annually), additionally 9 breweries are in less than 150 km proximity to the NPA border (Pienpanimoliitto,2020)¹. Small breweries in and close to NPA regions produce some 8 million litres of beer annually. Only 7 breweries in NPA are producing more than 100 000 litres of beer, others are microbreweries, some of them produce less than 10 000 litres annually.

In the Finnish NPA region, a big brewery, Olvi Ltd, which produces annually 219 million litres of beer is also located (Olvi, 2020)².

Finnish whisky industry is also small scale, it is represented with 5 distilleries. In the NPA area there is one distillery in East Finland. It produces 120 000 liters of pure alcohol annually (data from interview). From time to time small batches of alcohol are distilled in several breweries, e.g. in Tornio.

Figure 3 shows location of breweries and distilleries in the Finish NPA area.

The main by-product, brewers Spent Grains (BSG) is used mostly as feed to animals with few exceptions where it is used for biogas production. Farmers usually pick up the BSG quantities by themselves. Such collection practices aid a potential reduction in the transportation costs by the brewery, and in addition saves biowaste handling costs, which depending on the region can be between 50-90 €/ton.

Based on the EU waste hierarchy, BSG utilisation as animal feed should be prioritised (Directive 2008/98/EC, 2008)³. The cascading use of resources and especially of biomass prioritise higher value uses that allow the reuse and recycling of products and raw materials and promotes energy use only when other options are starting to run out. Using BSG as feed first also reduces environmental impact of beer or whisky

1 Pienpanimoliitto Ry website <https://pienpanimoliitto.fi/>

2 Olvi Corporate responsibility report, 2019.

https://www.olvigroup.fi/app/uploads/sites/2/2020/04/8.-Olvi_Corporate_responsibility_report_2019.pdf

3 Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (Text with EEA relevance) OJ L 312, 22.11.2008, p. 3–30 (read from <https://eur-lex.europa.eu/eli/dir/2008/98/oj>)

production as it reduces need for virgin feed sources for animal production.

Higher value products which can overpower pre-treatment and transport costs would inspire entrepreneurs in creation of value chain for better utilisation of waste and side streams.

Although BSG is mentioned as main by-products, need for investments to energy recovery solutions was mentioned as a priority in most of the interviews. It is understandable, brewery is energy and water intensive process, up to 10 litres of water is used to produce 1 litre of beer in a linear process.

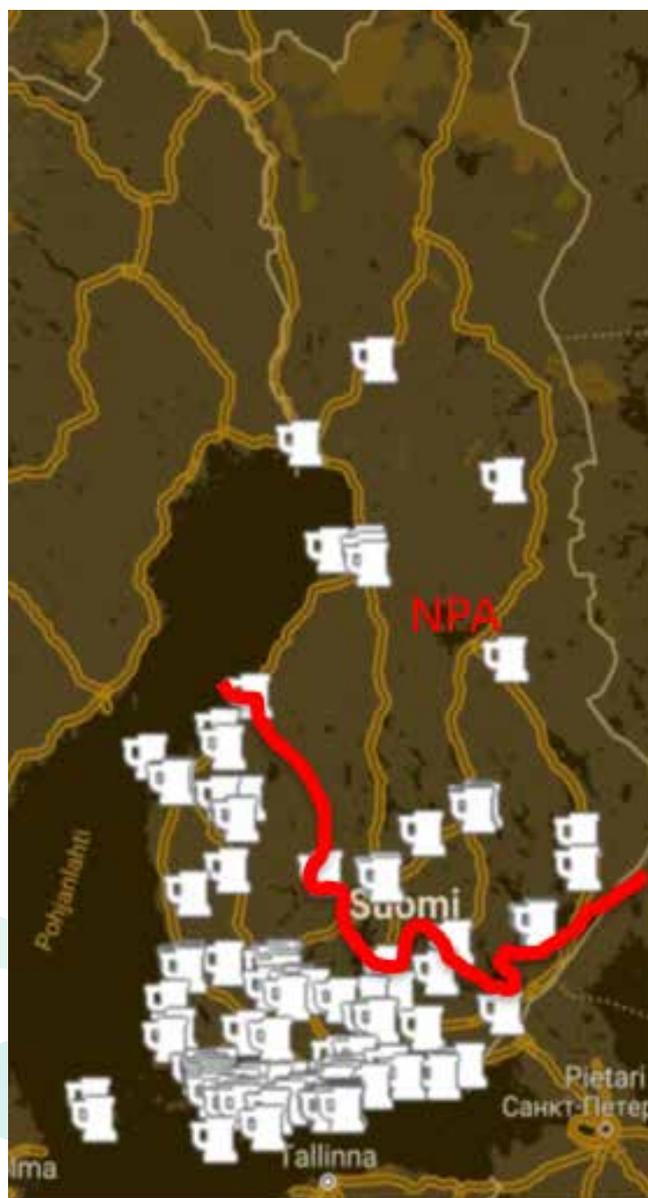


Figure 3 Finnish small breweries (image borrowed from pienpanimoliitto.fi).

1.1 Case 1: Brewery (interview)

Case 1 brewery is the biggest brewery in the category of small breweries, it produced 440 000 litres of various beers in 2019, and also recently started production of whisky. Capacity is planned to increase in future as a new production line is being planned. The brewery is owned by a company, which not only develops and verifies recipes for brewery, but also provides laboratory services, including preparation of yeast cultures, enzymes and extracts for the brewers and distilleries. The brewery is situated near the border between Sweden and Finland and therefore has market in both countries, also cooperates with breweries in Sweden.

The company invested in 2016 into fully automated brewing process and has a personnel strength of 10 employees. Although the company has very modern technology process, side and waste streams are fairly utilised. The BSG quantities after the mashing process is currently utilised as an animal feed, with the other streams considered as waste. The spent yeast is drained to the municipal wastewater plant as well as all other liquid streams emanating from the brewery processes.

For future cooperation on by-products and side stream utilisation, a potential network with other breweries can be established. This is since within a 130km proximity radius of the brewery, there are 4 breweries in Finland and 1 in Sweden.

1.2 Case 2: Micro-Brewery (interview)

A microscale brewery situated in Kokkola., which employs 3 people. The company currently produces about 25 000 litres of beer currently. The brewery has strong interest in developing special yeasts for beer produced, is working with researchers from Umeå University. Due to small scale production, the amount of waste produced is relatively small, and wastewater pre-treatment is not required and therefore all the liquid streams are presently discharged to the municipal sewage plant. Only BSG is given away to farmers as feed, who are responsible for the BSG pick-up. The company saves 40 €/batch (50 batches annually) from this arrangement.

Drinking water from municipal supply is used for cooling and it is not recovered, therefore energy recovery is one of the biggest interests by company.

The closest brewery for potential collaboration in the future is situated about 40 km away, with more breweries in distances of 100-120 km.



1.3 Case 3: Iso-Kallan Panimo Oy

(information from report by Pesonen et al., 2018)

1

The brewery is situated in Kuopio, East Finland. It currently has an annual capacity of production of 100 000 litres. Iso-Kalla intends to triple its production from the current 100,000 liters in the near future. The brewery plans to expand its product range by the additional manufacturing of gin, whiskey, and vodka after the completion of the expansion process.

The production waste streams are very similar to other beer productions facilities. The produced BSG is transported to biogas production (distance of 15 km). Small amounts of BSG is given to a producer of bread. To make this latter utilisation on a bigger scale, the drying of BSG would be needed.

In the near proximity of the brewery (20 km radius), there are 3 other microbreweries, and 2 more if 100 km distance is deemed economically acceptable. Iisalmi, which is some 80 km from Kuopio is home of Olvi Oy, one of the biggest beer producers in Finland.

Iso-Kallan Panimo was seeking to find farmers to utilise their BSG, however the search was not successful. Olvi Oy though in their environmental responsibility report (Olvi, 2019)² claimed that their BSG is being fed to cattle. This could mean, that farmers in surrounding area have a choice and prefer to make contracts with bigger companies who can provide them with the meal constantly, and with stable supplies, rather than deal with small producers. On the other hand, if Olvi is interested in upgrading utilisation of BSG to higher value products, small breweries from surrounding area could benefit from it also. In this respect, Kuopio region has potential to establish new process for conversion of BSG to more valuable products.

1 Peetu Pesonen, Raimo Hämäläinen, Teemu Ukkola, Nuutti Siira (2018), Iso-Kallan Panimo Oy, Seminaarityö. <http://materiaalivirrat.fi/download.php?id=102> . Accessed 17.3.2020

2 Olvi Corporate responsibility report, 2019.

https://www.olvigroup.fi/app/uploads/sites/2/2020/04/8.-Olvi_Corporate_responsibility_report_2019.pdf

1.4 Case 4: Beverage company

The company is situated in East Finland, with operations in several locations. It has broad range of products: berry juices, wines, liqueurs, as well as distillery products, such as gin, whisky, and other spirits. The production plant is in Iломantsi, where whisky is produced and is stored at Valamo monastery (Heinävesi), which is a distance of 135 km away. The fermentation process for the company is carried out only in Valamo, with distillation units available both in Valamo and in Iломantsi.

Brewing and distilling capacity in Valamo is for 120 000 dm³ of pure alcohol. SG (spent grain) from the production is shared to farmers, however there are too little cattle in the near proximity to consume all of the produced SG, resulting in some of the BSG being dumped. To preserve the SG, the company is adding formic acid. Pot ale left after distillation process is used as fertilizer, which is spread on the fields nearby.

For process cooling and for cleaning, lake water is used, which brings about a significant reduction in process costs. Heat recovery from water would be also beneficial, but not currently employed since the company has limited space for storing water.

For potential collaboration opportunities, the closest distillery /brewery to Valamo is a brewery in Joensuu (62 km), with 6 other small breweries in about 120km distance radius.

In the Iломantsi plant, there are 6 distillation units of different sizes. These units are used for production of gin. The alcohol for production is purchased from the market.

The main concern in the Iломantsi plant is benefits from hot water streams which are generated during the cooling of distillation units. The water is clean drinking water and after use is directly released to the municipal sewage plant. With the outlet water temperature being as high as 70°C, the potential for heat recovery has been discussed with a local energy company. However, no agreement reached so far.

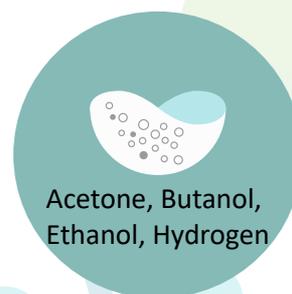
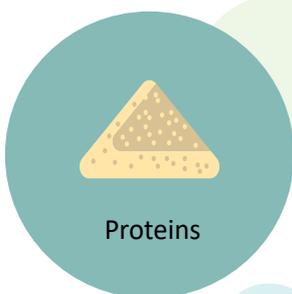
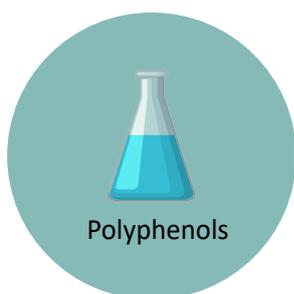
2 Future opportunities for waste handling

- It is clear, that the waste and side streams of the brewing industry are underutilised and therefore there are a lot of opportunities for future development.
- BSG is utilised as animal feed or for biogas production, the possibility for extracting valuables, such as proteins from it would bring additional value for this by-product.
- New products using BSG could be developed, such as e.g. bakery products.
- Spent yeast in most cases was not recovered or further utilisation any way. This by-product is however a protein rich product and could be used at least for animal feed, or further upgraded for other uses.
- Pot ale from distilling process is rich in proteins, which could be extracted and further valorised.
- Significant amount of CO₂ is produced during the fermentation process. The CO₂ is currently not captured or used. If economically feasible, a solution would be available, with the captured CO₂ could be used instead of purchased CO₂ and could be also be sold to other food industries or uses.

3 Bottlenecks / challenges for efficient waste handling

- Breweries in Finnish NPA area are small and sparsely located and in many cases distance from brewery to brewery can be more than 100 km. Kuopio region could be an exception, several breweries are located nearby and the presence of a big scale brewery might open new possibilities for creation of added value products from waste and side streams.

Example of valuables from by-products:



...that can be used e.g. in:



Figure 4: Valorisation possibilities of brewing and distilling by-products



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