

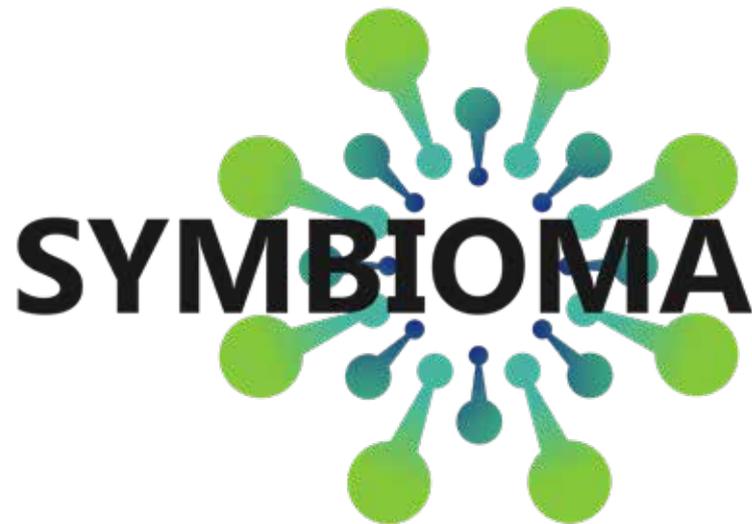


Northern Periphery and  
Arctic Programme  
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Technology Innovations and Business Models for Valorisation of Industrial Waste Biomass in Sparsely Located Enterprises

## Circular economy cases and their business models in Irish potato industry

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## 1 Potato processing

Potato is one of the most important agricultural crops for human consumption and high amount is produced worldwide every year. In particular, the EU produced about 60.7 million tons of potatoes (FAOSTAT, 2020)<sup>1</sup>. Potato peel is currently considered a zero-value or rather low value by-product, which occurs in large amounts after industrial potato processing and can range from 15 to 40% of initial product mass, depending on the various peeling or processing methods.

Food waste utilization causes great concern in food industry in Europe and many scientific works and projects on this topic offer solutions and original approaches towards possible valorisation of potato peels (Sepelev and Galoburda, 2015).

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Figure 1 represents a summary of the major wastes and by-products originating from the potatoes production and processing industry.

In Figure 2 is pictured a schematic process of potato processing and generated by-products with their most common current uses.

1 FAOSTAT 2020. FAOSTAT Crops. Available online: <http://www.fao.org/faostat/en/#home> (accessed on 9 January 2020).

2 Sepelev, I., & Galoburda, R. (2015). Industrial potato peel waste application in food production: a review. *Research for Rural Development*, 1, 130-136.

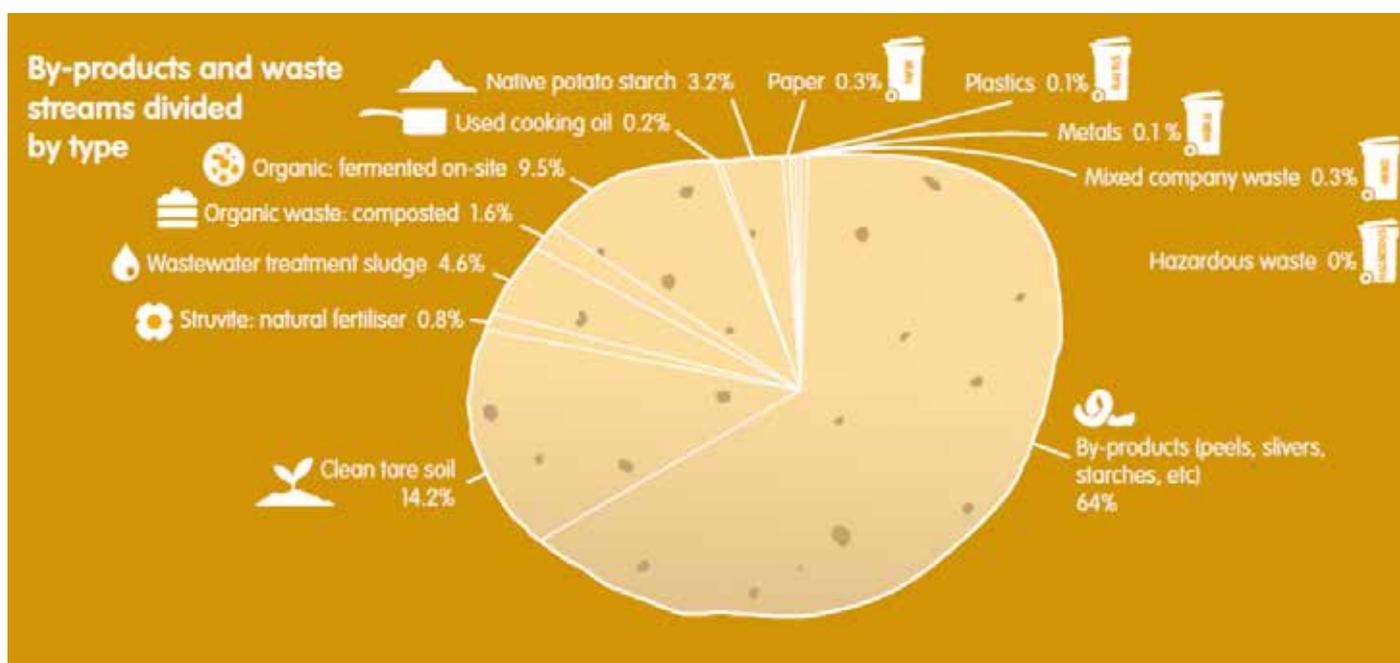


Figure 1. Schematic representation of the potato processing main wastes/by-products and the percentage composition of the different waste types (EUPPA, 2016).



## POTATO PROCESSING AND GENERATED BY-PRODUCTS

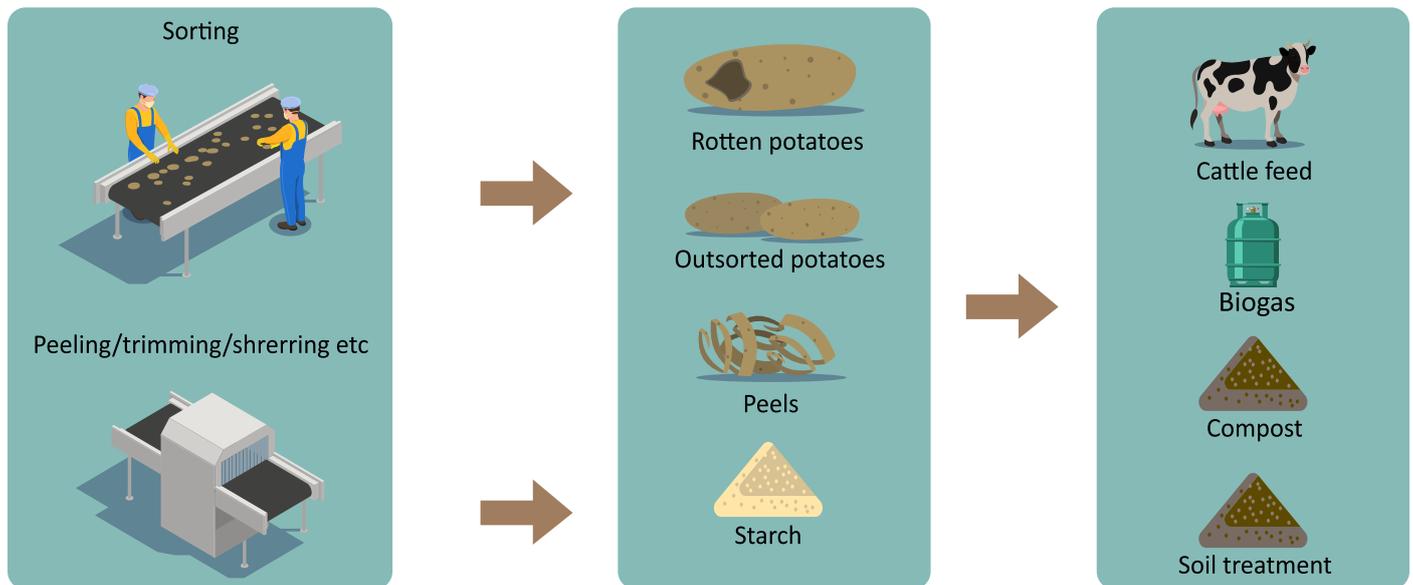


Figure 2 Schematic picture of potato processing and generated waste with it's common uses.

### 2 Potato industry and existing business models in Ireland

Potatoes are the world's fourth largest crop behind corn, rice, and wheat and is synonymous in Ireland as a staple food crop with an average annual potato consumption of 85kg per person, (2½ times higher than the world average). The Irish potato market comprises 540 potato growers and approximately 9,000 hectares and is valued at €195 million to the Irish economy. Potato yields can be variable depending on seasonal climate conditions with averages of approximately 40-45 T/HA reported by Ireland's agriculture and food development authority An Teagasc.

Potatoes grown in Ireland can be broken down into four main growing types:

*Early Potatoes:* Harvested in June and supply the market until early September.

*Main Crop Potatoes:* 70% is sown to a variety called Rooster, has the greatest area and through refrigerated storage, can supply the market year-round.

*Salad Potatoes:* Smaller in size (quicker to cook) are supplied from August to December.

*Seed Potatoes:* Grown to supply the source of the majority of the next year crop.

The Irish Farmers Association (IFA) estimates that 50,000 tonnes of potatoes are commercially

peeled in Ireland every year. In addition, they estimate that upwards of 30,000 tonnes of potatoes remain on Irish farms as waste each year, either as out-grades or surplus to market requirements. Predominantly, waste from Irish potato production and processing is generated as a result of screening, grading, peeling, trimming, slicing, blanching and disintegration processes. It is one of the main issues facing the industry and threatens expansion within the sector. Potato crop residues generated during primary production (on farm) can play a vital role in servicing the farm ecosystem. In this regard, potato waste is used as a 'closed loop' solution on Irish farms as waste can contain high levels of moisture leading to putrefaction in a short period which promotes antimicrobial activity and use as a dietary fibre source for animal stock such as pigs.

A typical potato processing plant can generate 6-10 % potato peel waste (PPW) from the peeling process as well as other wastes (15%) from other trimming and cutting processes which can create disposal, sanitation, and environmental problems for the industry. Potato peels possess excellent nutritional characteristics which make it ideal to be utilised into bio-products due to it being rich in cytotoxic glycoalkaloids such as

$\alpha$ -solanine and aconine, carbohydrates, high in starch (8-28%) and about 1-4% protein. To realise higher value-added chains, the industry stipulates that the up-scaling of optimised techniques for the extraction of antioxidants and other bio-actives is necessary in order to utilize potato waste as a valuable by-product for use in functional foods. Currently, both solid-liquid and pressurized liquid extraction techniques for the extraction of antioxidants are employed (see Figure 3)

### 2.1 Case: Food company 1

The company produces a variety of vegetables and ingredients to the Irish wholesale and food manufacturing plants. All their produce is sourced from Bord Bia registered local farmers with the potato crop a prominent product comprising peeled, sliced, diced, wedges, jacket, baby and baker potato varieties. The company has been proactive in the application of intelligent processing to upgrade their products waste streams into new functional vegetable fibres for use as texture ingredients in food. Reacting to market demand for 'less processed' and 'more natural' food ingredients, the company have realised a use from their repurposing waste vegetables into functional food fibres containing both soluble and insoluble fibre fractions

that possess different textural and nutritional functionalities. They have achieved this in collaboration with the Irish Farmers Association, the Irish Environmental Protection Agency (EPA) and an independent product development group (CyberColloids Ltd) who specialise in hydrocolloids, focusing on food, nutrition and industrial applications.

### 2.2 Case: Potato company

This company is an Irish family farm business founded in 1982 and is one of Ireland's leading growers, packers and distributors of fresh produce to retailers nationwide. Their production facility comprises 1500 m<sup>2</sup> of packing space and 5000 m<sup>2</sup> of storage space.

The company operate a Zero Food Waste ethos within its facility thanks to measures taken for channelling visually impaired produce to food processing, community food banks and stock feed sources. Their advocacy work for food waste prevention has seen them being awarded (Repak Award 2016) for efforts to promote waste prevention in particular their collaboration with FoodCloud (a social enterprise initiative that connects businesses with surplus food to charities) to collect crops leftover after harvesting.

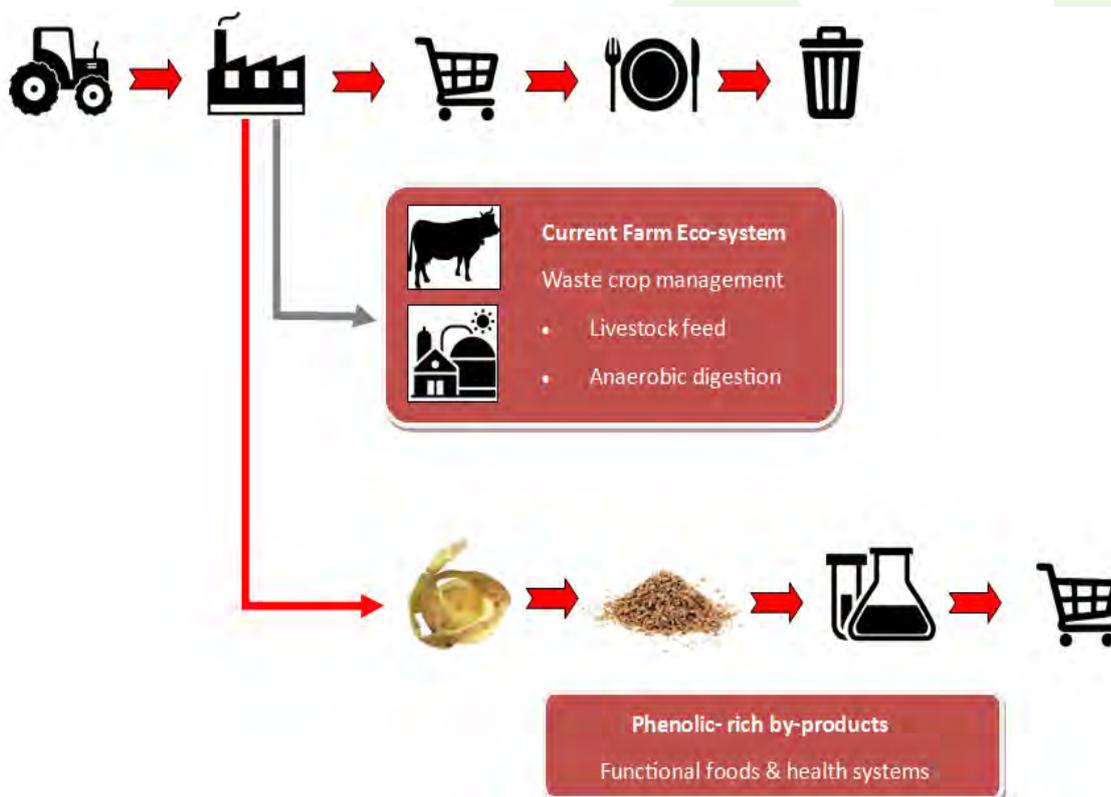


Figure 3 Valorisation of potato peel waste (PPW) into functional food ingredient.

*“From a business point of view, it makes sense to use every resource we have at our disposal. Growing and selling potatoes and vegetables, we are in a high volume, low margin business. This means that investment in more efficient production methods and recovery of by-products is crucial and that we have to take decisions from a sustainable point of view”,  
Eleanor Meade: Business Manager, Meade Potato Company*

The company is also implementing plans to include operating a potato starch manufacturing facility for the extraction of starch from their potato peelings for use in the ingredients market.

### 3 Future opportunities for waste handling

- Extraction of Phenolic Compounds from Peel: Potato peel waste (PPW) as a basis for phenol extraction, ethanol, lactic acid and enzyme ( $\alpha$ -amylase and  $\beta$ -mannanase) production through fermentation, and edible film production.
- Health benefits: PPW extract has high antioxidant, antimicrobial and anticarcinogenic use potentials within health systems.
- Functional foods: Traditionally, texture in food (e.g. gelling in jams, thickening in dairy based drinks and desserts and water binding in meat products) has been provided using hydrocolloids. Hydrocolloids, also known as gums, are increasingly seen as “artificial” and food companies are looking for more natural alternatives. Food fibres are not additives but are food ingredients and thus offer a clean label alternative. Re-use of potato peel waste (PPW) into new textural functional fibres (e.g. superior water binding ability, viscosity and gelling behaviour) for use as texture ingredients in food exist.

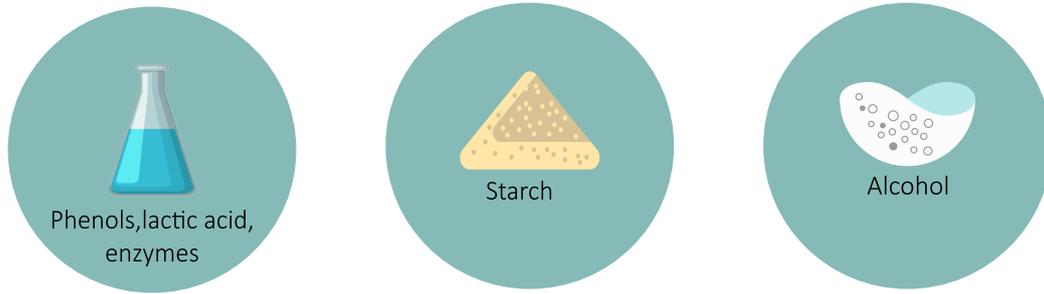
### 4 Bottlenecks / challenges for efficient waste handling

- Technological challenges: Potato waste processing is complex and requires several efficient processing steps, equipment and techniques. The peeling process is a central part of production and an area that can be problematic. If mismanaged it can lead to excessive waste. Technological solutions that are reliable and adaptable to manage many potato varieties is necessary in order to mitigate against such losses. Downstream processing steps to reduce loss at the peeling stage requires a reduction in peeling time and the removal of aggressive post peel brushing.
- Potato Starch: An Teagasc (Ireland's Agriculture & Food Development Authority) has highlighted that Ireland's volume of starch and starch based products sold is not sufficient for the establishment of a starch production industry stating that with small volumes any production processing facility would have to be able to export competitively to the UK and EU destinations which could be hampered by higher freight cost. As starch potato growing and processing are interdependent, a careful and thorough feasibility study would be necessary to see if production would be viable against a background of international competition. Some private commissioned studies have been carried out indicating a challenging business case outlining that a commitment of all stake holders would be a prerequisite to achieving a potato starch industry.

## POTATO BY-PRODUCT POSSIBILITIES



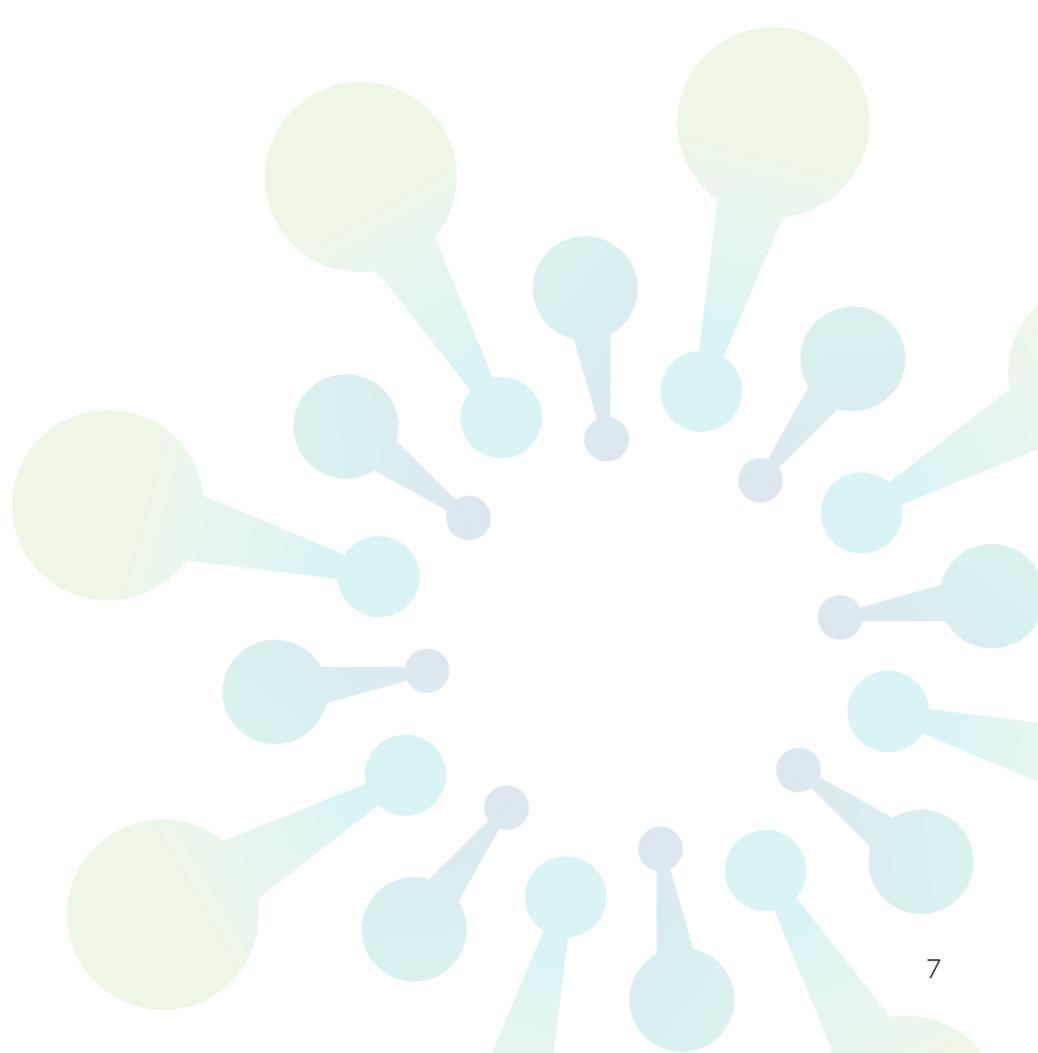
Example of valuables from by-products:



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



Figure 4 Possibilities of the potato industry by-products



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### Other partners



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