What types of circular business models for creating value from agro-waste?

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Circular economy is an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. It operates at different levels (micro, meso and macro) with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations (Kirchherr, 2017). The circular economy is enabled by novel business models.

The objective of this research is to identify and characterise different types of business models that create value from agricultural waste and by-products via cascading or closing loops.

Create value from agricultural waste and by-products is challenging due to the heterogeneity, seasonality and perishability of resources. Enterprises dealing with agro-waste also need to take into account the contamination risk, the price uncertainty on agriproduct markets and the geographic dispersion of resources. Moreover, there are different valorisation opportunities in alternative sectors leading to new products and applications, with a lower or higher value, as outlined in the value pyramid for biomass valorisation (Rood et al., 2017). From a business perspective, valorising agro-waste requires a reverse logistics, a new vision of customer-supplier relationships, new forms of organization and new marketing strategies, at the crossroads of various value chains.

Several propositions have been made for sustainable or circular business models classification (Lewandowski, 2016). The ReSOLVE framework proposed by the Ellen MacArthur Foundation is based on the different strategies 'regenerate, share, optimise, loop, virtualize, exchange' (EMF, 2013). Bocken et al. (2014) divide sustainable business models into eight archetypes which describe the main type of business model innovation: technological, social or organisational. According to Fielt (2013), a characterisation of each business model type should include specific classification criteria (e.g. level of innovation) and business model framework elements, such as customer, value proposition, organisational structure, economics and/or other value dimensions.

We have selected six cases (out of 33 cases studied in the EU project NOAW) from France, Germany, the Netherlands and Italy, converting agricultural by-products into valuable products via a circular economy (cascading or closing loops) approach. Qualitative semi-structured interviews have been performed for all cases except for a biorefinery, already largely been documented in literature (Schieb et al., 2014). The cases have been analysed according to the type of organisational structure, resources and transformation processes, value propositions, key partners, customers, strategic approaches and type of business model innovation (table 1).

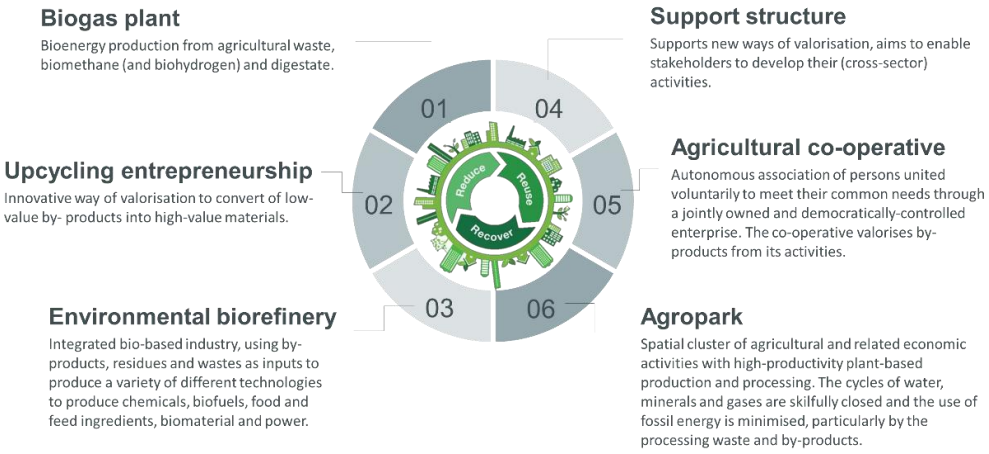
Table 1. Cases analysed.

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Type of organisational structure	Farmer with a biogas plant	Agribusiness park	Union of wine cooperatives	University spin-off	Local cluster of different stakeholders	Eco-industrial cluster
Resources and transformation process	Pig manure & vegetables; anaerobic digestion	Combined heat electricity and water recirculation systems	By-products from wine; extraction process	Cow manure and wine; anaerobic digestion	Organic urban food and agro-waste; anaerobic digestion	Cereals and sugar cane by-products; full scale biorefinery
Value proposition	Heat, electricity, fertilizer	Heat, electricity	Compost, ingredients for food & pharma industries	Electricity, fertilisers, PHA for bio-materials	Biogas, network	Plant proteins
Key partners	Local farmers	Vegetable producers (greenhouses) and traders	Cooperatives and research	Cooperative, two other universities	Local authorities, enterprises and research	Agrofood enterprises, research
Customers	Public supplier, households and wholesaler	Data-centres use electricity and produce heat for greenhouses	Enterprises	Feed-in of electricity	Local enterprises	Enterprises
Strategic approach	Enlarge product portfolio for mixed market sectors	Networking, economies of scale	Innovation, mixed market sectors	Innovation, upscaling, pilot-scale demonstration, consultancy	Networking, niche strategy (organic)	New markets for large volumes of unused by-products

Innovation type	Technical	Organisational	Technical	Technical, Organizational (services)	Social, organisational	Organisational, technical

These six cases represent six types of circular business models for creating value from agro-waste and by-products. They differ in their way of value creation (from lower to higher value) and/or in their organisational form as shown in figure 1: biogas plant (case 1), upcycling entrepreneurship (case 4), environmental biorefinery (case 6), support structure (case 5), agricultural cooperative (case 3) and agropark (case 2).

Figure 1. Typology of circular business models for valorising agro-waste and by-products.



The typology shows the diversity but also a complementarity of circular business models that create value from agro-waste and by-products. The classification is useful because it advances the conceptual understanding of business models and may provide practical recommendations for other businesses, investors and resource or equipment suppliers in understanding the positioning and long-term perspectives of the business. Although the analysis identifies different circular business models, the results represent only the first step to create a value cascading model in which agricultural resources use is optimised. The typical agricultural characteristics (heterogeneity, fluctuating volumes of resources, flexibility in production) still need to be integrated to create synergies and ensure that the highest value is achieved, and the environmental impact over the whole life cycle is minimized.

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