

Sustainable and Circular Business Models: Experiences from Waste4Soil Project

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Abstract: Horizon Europe project Waste4Soil addresses the local transformation of food processing residues (FPR) into bio-based soil improvers through a circular, systemic and multi-actor approach. Within this wider project, Work Package 6 focuses on circular business models, standards, social acceptance and investment-oriented exploitation pathways [1–4]. This research-in-progress paper reports early experiences from developing business models in Waste4Soil by applying the PREPSOIL business model canvas in connection with participatory workshops, expert-based evaluation and case-specific business background analysis [6,7]. The paper is structured around four interlinked task areas: (i) business background analysis and drafting of business canvases, (ii) standards and certification-related framing, (iii) co-creation of sustainable and circular business models, and (iv) social acceptance and investment perspectives [6]. Methodologically, the work combines context-setting interviews, small-group interaction, brainstorming, value proposition analysis, PREPSOIL canvas drafting, and a fast-track multi-criteria expert evaluation process [6]. Preliminary results suggest that the PREPSOIL canvas offers a useful bridge between technological development, stakeholder engagement and exploitation planning, especially when circularity performance, competitive advantage and resilience are used as shared evaluation criteria [6,7]. The paper contributes an emerging process description and identifies key questions for further development concerning methodological robustness, transferability across Living Labs established in Waste4Soil and other projects, and the integration of standards, social acceptance and investment readiness into circular business model design [6–8].

Keywords: circular business models; PREPSOIL; Waste4Soil; soil improvers; food processing residues; social acceptance; standards; investment readiness

1 Introduction

Waste4Soil aims to develop applicable recycling pathways that transform food processing residues into soil improvers through a circular, systemic and multi-actor approach at regional level. The project combines technological development, Living Lab activities, evaluation and exploitation planning in order to reduce food waste and improve soil health. The project also develops a standardized evaluation framework and operates through seven Soil Health Living Labs in different European contexts [1–4]. In this setting, Work Package 6 (WP6) addresses a central challenge: how to translate promising technical and environmental solutions into sustainable, investable and socially accepted business models [4,5].

This paper focuses on the business model development work carried out in WP6 by Savonia and partners. The emphasis is not on presenting final business models, but on documenting and reflecting on an emerging process of co-creation that uses the PREPSOIL business model canvas as a structuring device [6,7]. The paper is motivated by the need to better understand how circular business models can be developed for soil improver value chains where the technological solution, regulatory environment, user needs, market formation, social acceptance and investment logic are all still evolving [5,8].

The paper is organized according to four WP6 task areas highlighted in the project work: Task 6.1 business background and drafting of canvases, Task 6.2 standards, Task 6.3 business models, and Task 6.4 social acceptance and investments [6]. By structuring the paper around these task areas, we aim to show how business modelling in a Horizon Europe soil mission context becomes both an analytical and a participatory process [1,6].

2 Current understanding: circular business model development in a soil mission context

The Waste4Soil concept stresses that a relevant soil improver production system must be aligned with farmers’ needs and food industry resources while being environmentally sustainable, economically viable and socially acceptable [5]. This means that business model development cannot be detached from local value chains, standards, stakeholder interests and citizen perspectives. Moreover, the project’s emphasis on Living Labs implies that business models should not be treated as static firm-level templates only, but as evolving arrangements connecting producers of residues, technology providers, farmers, intermediaries, public actors and other stakeholders [2,4,5].

The PREPSOIL business model canvas offers a relevant point of departure for such work. In the Waste4Soil WP6 material, PREPSOIL is presented as a tailored framework for Soil Living Labs and Lighthouses, supporting long-term sustainability and stakeholder engagement [6,7]. In contrast to a narrow commercial canvas logic, the tool helps to position business development within broader soil mission goals, land-use contexts and intervention areas. In addition, the WP6 working material combines PREPSOIL with value proposition thinking in order to map customer jobs, gains and pains alongside products and services, gain creators and pain relievers [6].

At the same time, the development of business models for food processing residue valorisation faces a specific methodological challenge: the object of business modelling is not a single final product, but a socio-technical system in transition. Questions of standardisation, regulatory compliance, quality assurance, social legitimacy and investment timing are part of the business model itself rather than external conditions only [5,8]. This makes business model development a useful object for research-in-progress, because the process by which the model is constructed may be as important as the model outcome [6].

3 Research design and methodological approach

The methodological approach presented here is practice-based and iterative. The current paper draws on WP6 development work that combines structured business background analysis, business model canvas drafting, participatory discussion and expert evaluation [6]. In the WP6 instructions used in Waste4Soil, the business model creation process is described as a sequence including context setting, identifying ideas, evaluating identified items, core value analysis, workshop interaction and the building of a circular economy business model (see Figure 1). The context-setting phase includes interviews, small-group interviews, brainstorming, problem-area mapping and criteria setting [6]. Additional information

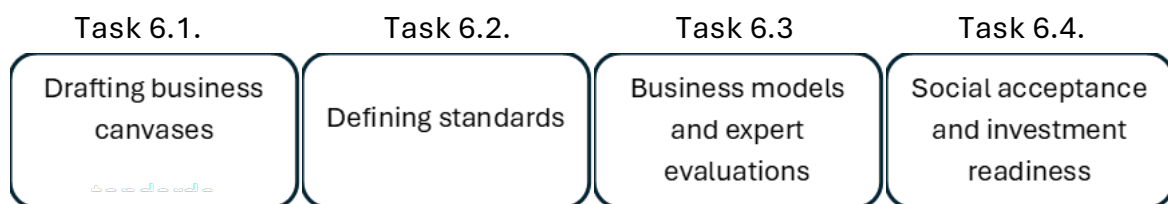


Figure 1. Tasks and their practices.

WP6 includes four tasks (Figure 1):

Task 6.1, business background and drafting of canvases, provides the empirical starting point. Here, the purpose is to understand each business case in its operational context: the type of food processing residue involved, the intended transformation route into a soil improver, likely users and customers, expected gains, critical pains, partners, logistics and value creation mechanisms [6]. The drafting of canvases is therefore not a purely desk-based exercise but a structured synthesis of case knowledge, stakeholder input and evolving project learning.

Task 6.2, standards, is included as a framing dimension in the business model process. At this stage, the work does not yet provide a final standards solution for all cases, but it integrates standardisation and certification questions into the business model logic. In practical terms, this means asking how product quality, comparability, compliance with EU rules and possible ISO-related approaches affect customer trust, legitimacy and market uptake [5,6]. In addition, adherence to recognised standards plays a crucial role in designing clear, reliable and comparable product labeling, which further strengthens transparency and consumer confidence. Standards are therefore treated as both a boundary condition and a possible source of competitive advantage. Complying with standards is also important because potential future investments will not be possible if standards and regulations are not followed.

Task 6.3, business models, forms the integrative core of the work. The PREPSOIL canvas is used to articulate the business model as a combination of value proposition, stakeholder configuration, sustainability perspective and implementation logic [6,7]. Rather than searching immediately for a single optimal model, the process has generated and refined alternative elements and options. These are then subjected to expert-oriented evaluation using a fast-track format in which evaluators can score selected dimensions on a scale from 1 to 5 and provide verbal comments [6].

Task 6.4, social acceptance and investments, broadens the analysis from technical-commercial feasibility to societal and scale-up feasibility. In the WP6 evaluation material, the business model development process explicitly invites experts to assess the relevance, feasibility and alignment of the evolving model [6]. In this paper, that logic is extended by considering how social acceptance and investment readiness can be addressed as early evaluation dimensions rather than as issues left for the end of the project [8].

For the current stage, some evaluation criteria have been particularly visible and operational in the process: sustainability (of food system), circularity performance, regulatory/legal compliance, resilience and investment readiness. These criteria create a shared language for discussing the relative strengths and weaknesses of evolving business model options. The paper reports the process and initial interpretations rather than validated comparative results across all business cases. The aim is to encourage actors to start thinking at an early stage about what would make their solution attractive both to customers and to potential investors.

4 Preliminary results from Tasks 6.1–6.4

A first preliminary result is that business background analysis and canvas drafting (Task 6.1) help to make hidden assumptions visible [6]. In early discussions, technology-centered descriptions often emphasised process efficiency, nutrient recovery or material transformation. Likewise, sustainability is often seen as a key competitive factor, which is naturally important but only one part of the overall value. When translated into a PREPSOIL and value proposition logic, however, the discussion shifted towards who benefits, under what conditions, and through which combination of product, service, partnership, logistics and legitimacy [6,7]. This has been especially useful for identifying where a technically promising pathway still lacks a sufficiently precise user value proposition.

A second preliminary result is that standards-related considerations (Task 6.2) are not merely a downstream compliance issue. In the circular soil improver context, standards influence perceived reliability, safety, comparability and trust [5,6]. In most cases, the processing of food residues into soil improvers or fertilizers occurs without dedicated product-specific standards. Classification and regulatory guidance rely primarily on European Waste Catalogue (EWC) codes, which focus on waste management rather than product quality, safety, or performance. As a result, comparability between products, market trust, and the design of clear labeling remain limited. Integrating standardisation in this context could therefore enhance transparency, support customer confidence, and open new opportunities for competitive advantage within the business model. They shape whether the output is viewed as a waste-derived material, an accepted soil improver or part of a broader sustainability-oriented offering. Operating in compliance with standards is also a prerequisite for investors to consider the idea viable. Preliminary work suggests that the integration of standards into business model thinking can strengthen the articulation of value proposition, risk reduction and market credibility, but it may also reveal trade-offs related to costs, complexity and time to market [5,6].

A third preliminary result is that the PREPSOIL canvas is useful in Task 6.3 because it accommodates a wider sustainability and stakeholder perspective than a narrow revenue-cost framing alone [6,7]. In the Waste4Soil setting, business model development is intertwined with Mission Soil objectives, Living Lab co-creation and cross-regional learning [2,4]. The PREPSOIL structure appears to support this by helping participants to form a deeper understanding of the customer value created by the soil improver (/solution), connect local case realities with broader intervention areas and longer-term sustainability pathways [7]. The PREPSOIL Canvas and Value Proposition Canvas help to discuss the customer value aspects with partners, and their understanding about the customer benefits have improved, which is important part of commercialisation of solutions. At the same time, further work is needed to assess how consistently different partners interpret and apply the canvas.

A fourth preliminary result is that social acceptance and investment readiness (Task 6.4) should be handled as design variables within the business model process [6,8]. Social acceptance is not only about public attitudes in a general sense, but also about how farmers, food industry actors, local communities, advisors and policymakers perceive the legitimacy, usefulness and risks of waste-derived soil improvers. Investment perspectives similarly extend beyond traditional profitability calculations to include replication logic, scale-up pathways, risk-sharing and the fit between technology maturity and financing instruments [1,8]. Preliminary observations indicate that when these perspectives are discussed early, the business model becomes more realistic and strategically oriented.

5 Discussion

The research-in-progress results indicate that the Waste4Soil WP6 process is best understood as business model co-creation rather than business model selection [6]. This distinction matters. In many innovation settings, a business model is treated as a near-final representation of how value will be created and captured. In Waste4Soil, the business model emerges from interaction among technological possibilities, soil mission goals, local actors, standards, evaluation criteria and future scale-up needs [2,5,6]. The process therefore has a methodological character of its own and deserves explicit reflection.

One methodological implication is that the PREPSOIL canvas may serve as a boundary object between disciplines and stakeholder groups [7]. It gives enough structure to support comparability, while remaining open enough to accommodate case-specific realities and sustainability dimensions. However, this is also a potential weakness: if the canvas is interpreted too loosely, comparability

across cases may suffer. A next research step is therefore to analyse how the use of the canvas varies between cases and which facilitation practices support methodological consistency [6,7].

A second implication concerns evaluation. The current process uses expert scoring and verbal feedback as a fast-track way to refine models [6]. This offers practical value, yet it raises questions about validity, selection of evaluators, weighting of criteria and the relationship between expert assessment and broader stakeholder acceptance. Further development could combine expert-based assessment with more explicit user and stakeholder validation across Living Labs [4,8].

6 Practical implications

For project-based innovation work, the main practical implication is that circular business model development should start early and run in parallel with technical development, not after it [6]. The business background work in Task 6.1 helps prevent overly generic exploitation narratives. The integration of standards in Task 6.2 helps connect business logic with legitimacy and market readiness [5,6]. The PREPSOIL-based work in Task 6.3 supports co-creation across disciplinary and organisational boundaries [6,7]. The focus on social acceptance and investment in Task 6.4 improves the realism of future replication and scale-up discussions [6,8].

For innovation managers and policy-oriented projects, the current approach suggests that business model tools are most useful when they function as conversation platforms rather than form-filling devices [6,7]. The value of the process lies in making assumptions explicit, comparing alternatives, identifying missing partners or capabilities, and linking sustainability ambitions with operational choices.

7 Conclusions

This paper has presented an early account of how Waste4Soil WP6 develops sustainable and circular business models by using the PREPSOIL canvas in a participatory and evaluation-oriented process [6,7]. The contribution at this stage is primarily methodological: the paper shows how Tasks 6.1–6.4 can be connected into a coherent research and development logic that links business background analysis, standards, business modelling, social acceptance and investment thinking [6,8].

The work remains in progress. No final comparative judgement is yet made about the superiority of particular business model options across cases. Instead, the current findings suggest that the PREPSOIL-based approach is promising for structuring co-creation, surfacing assumptions and integrating sustainability, legitimacy and scale-up considerations into business model development [6–8]. The next phase of the research will deepen the empirical comparison of cases and strengthen the methodological basis for evaluation and transferability.

Acknowledgements

This paper builds on work carried out in the Waste4Soil project. The project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101112708 [1]. The paper reflects the authors' current work-in-progress interpretation of WP6 activities.

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Areas for feedback & development

1. Methodological robustness: Does the proposed combination of PREPSOIL canvas drafting, participatory workshops and fast-track expert evaluation provide a sufficiently rigorous basis for a research-in-progress contribution on business model development?
2. Standards integration: How can standards, certification and regulatory framing be better operationalised within the business model process without turning the paper into a purely legal or compliance-focused analysis?
3. Social acceptance and investments: What would be the most convincing way to connect social acceptance analysis and investment readiness to the core business model discussion in a way that is empirically grounded and useful for both researchers and practitioners?
4. Comparative potential: What kind of case comparison logic would strengthen the paper in the next version: cross-case comparison between Living Labs, deepening of one focal case, or typology-building across technological pathways?