Training 2: Attracting private investment for biowaste-to-soil improver innovations

Module scripts - English

Co-funded by the European Union

Co-funded by the European Union (Grant n°.101113011) Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or REA. Neither the European Union nor the granting authority can be held responsible for them.

BIN2BEAN project

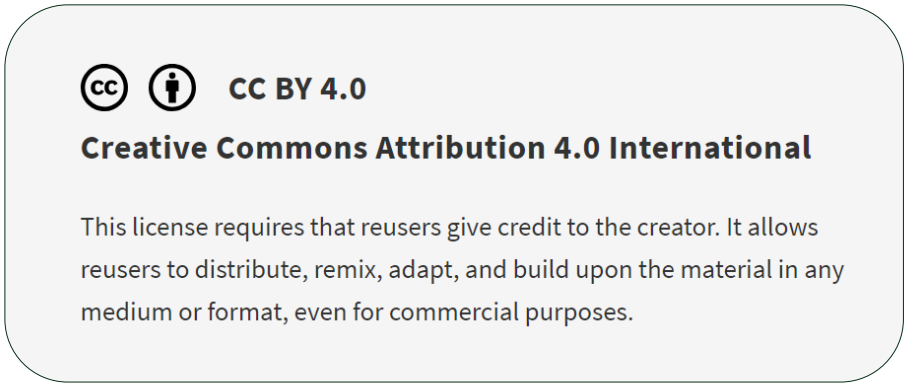
Training course #2: Attracting private investment for biowaste-to-soil improver innovations

Author: Sara Daniotti (Consorzio Italbiotec)

Contributors: Chiara Ciotti, Francesca Freddi, Henning Friege

Date of publication: September 2026

BIN2BEAN – Accessing and applying for public funding and grants © 2026 is licensed under Creative Commons Attribution 4.0 International. The licensing applies to all the supporting material and slide decks associated with this training.



Documents citation: Daniotti S., Ciotti C., Freddi F., Friege H. (2026) : *BIN2BEAN – Attracting private investment for biowaste-to-soil improver innovations.*

Objectives of the training

This training is part of the work of WP5 – task 5.4 within the BIN2BEAN project.

Objective: This training equips entrepreneurs, SMEs, and innovators working in the biowaste-to-soil improver sector with practical tools and strategies to attract private investment. As part of the BIN2BEAN training series aimed at bringing circular innovations to the market, the session combines a general introduction to the private investment landscape with sector-specific insights, giving participants a full picture of what it takes to secure funding for circular bioeconomy ventures.
Target audience: Entrepreneurs and SMEs operating in the bio-waste valorization sector, specifically those producing soil improvers.

Structure of the training

- 5 video modules (10-15 minutes each)
- Each video is accompanied by optional downloadable support material (slide deck, glossary, checklist, reference links)
- Delivered at first as a webinar, it is now accessible through asynchronous mode.
- Final quiz to obtain a certificate of participation
- Scripts available in English, Greek, Dutch, German, Italian.

Content of the online training session on theoretical background

Module 1 – Overall objective of the training
Objective: Introduce the course and its relevance to the biowaste-to-soil improvers value chain.
Supporting material: Slides

Module 2 – The private investment landscape: who are business angels, venture capitalists, and other key actors in the circular bioeconomy, and what do they look for?
Objective: Provide an overview of the main forms of private financing and help bioeconomy initiatives understand which investors to approach at different stages of development.

- Grant, debt and equity
- Investor types and funding stages
- What investors look for

Supporting material: Slides, investor map

Module 3 – The Business Model Canvas as a tool to communicate your value proposition to investors
Objective: Show how to build and communicate a credible business model to investors.

- Map the value chain
- Identify key actors
- Validate assumptions

Supporting material: Slides, BMC bibliographic materials

Module 4 – Investing in biomass processing facilities: how do you prepare for an investment decision?
Objective: Explain how to turn a plant concept into a structured investment case.

- Market and plant analysis
- CAPEX and OPEX estimation
- Business plan and NPV

Supporting material: Slides, example calculation investment, publications, BIN2BEAN D3.1

Module 5 – Practical example: calculation of an investment in a biowaste processing plant
Objective: Apply investment analysis to a concrete bio-waste treatment plant case

- Plant inputs and outputs
- Costs and revenues
- NPV, sensitivity and break-even

Support material: Slides, example calculation investment

Videos script and training content

Module 1 – Overall objective of the training

Objective: Introduce the course and its relevance to the biowaste-to-soil improvers value chain.

Speaker: Sara Daniotti, Consorzio Italbiotec

Script:
Hello and welcome to the BIN2BEAN training series, designed specifically for entrepreneurs and small businesses working in the biowaste-to-soil improvers value chain. Today, we are here to talk about attracting private investment for biowaste to soil improver innovations. The objectives of our training will be the following:

- we will start by navigating the private investment landscape for circular bioeconomy ventures.
- We'll also understand what investor looks for and also who you can contact.
- Then, we'll move through how to communicate your value proposition effectively to those investors.
- And finally, we'll understand how to prepare the key technical, economic and organizational elements needed for an investment decision, also through a practical investment calculation approach to a biowaste processing plant.

So, what will you learn today?

- WHO the key private investors in the circular by economy are
- WHAT investors look for before funding a venture
- HOW to pitch your value proposition with a business model canvas
- HOW to prepare for an investment decision on a processing facility
- HOW to calculate investment for a biowaste plant.

To make the most of this training:

- Watch each video module. They're concise and practical, so you can fit learning into your daily schedule.

- Download the support materials. Slides, glossaries, checklists, and helpful links are all provided to deepen your knowledge.
- Explore translations. Scripts are available in different languages if you prefer to study in your native language.
- Take the final quiz. Completing the quiz will earn you a certificate of participation - a valuable asset for your professional journey.

Module 2 – The private investment landscape: who are business angels, venture capitalists, and other key actors in the circular bioeconomy, and what do they look for?

Objective: Provide an overview of the main forms of private financing and help bioeconomy initiatives understand which investors to approach at different stages of development.

- Grant, debt and equity
- Investor types and funding stages
- What investors look for

Speaker: Chiara Ciotti, Italbiotec srl

Script

I will first clarify some key definitions to ensure that we all use the same terminology when talking about investors. I will then explain who private investors are, particularly in this sector, and at what stage they typically invest in a venture or project. Finally, I will provide some insights into what investors look for in a project before deciding to invest.

Types of funding: grants, debt and equity

Before discussing specific investors, it is important to understand the three main types of funding available to finance a venture or startup: grants, debt and equity.

Grants are probably the type of funding you are most familiar with. They are usually provided by public bodies, such as regional or national authorities or the European Commission through programmes like Horizon Europe, although private foundations can also provide grants. The main characteristic of grants is that they do not need to be repaid. You receive a specific amount of money to carry out defined activities within your project, generally over a limited period of two to four years. As long as the funding is used correctly and for the agreed activities, you are not required to pay it back.

Debt, on the other hand, is money that must be repaid with interest. The organisation providing the money is called a lender, which, to simplify, can be a bank.

Banks do not want to share the risks associated with your startup or venture. They generally lend money to companies that are financially robust, meaning they have regular revenue streams. They also want to see sufficient value in the company to recover their money if the company stops making repayments. For this reason, debt is usually a funding option that becomes relevant at a later stage in a venture's development.

Equity is the type of funding we will focus on today when discussing private investments. Equity means exchanging shares in your company for capital. An investor provides money in exchange for ownership of a portion of your company. This means the investor shares the risks associated with your venture and may lose the money invested. However, the investor's objective is to acquire shares and eventually sell them at a higher price, generating a financial

return. These three definitions are important for understanding the different types of investors and how they operate. Today, we will focus specifically on equity investors.

Who are private investors?

There is no single type of investor. Different investors operate at different stages of a company's development, and each has different objectives and expectations.

Friends, Family and Fools (3F): The first category is commonly referred to as the 3F: Friends, Family and Fools. These are usually the first people to provide funding to a new venture. Their investment decisions are primarily based on trust and personal relationships. They may be family members or close friends who believe in your ability to succeed rather than focusing on the specific technology you are developing. This type of funding is generally relatively easy to access, although the amounts involved are usually small. However, it is important to remember that these investments can become difficult to manage later, precisely because of the close personal relationships between the entrepreneur and the investors.

Business Angels: The second category consists of business angels. Business angels are private individuals, often former entrepreneurs, who decide to invest their own money in new ventures. They can usually make investment decisions relatively quickly and often want to maintain close contact with the entrepreneurs they support. When looking for a business angel, it is important to seek not only funding but also what is commonly called smart money. This means identifying investors who can support the development of your idea or project by providing relevant knowledge, experience, insights and connections. The right business angel can help you move faster by contributing much more than financial resources.

Venture Capital (VC) is probably the type of investor most people have in mind when they talk about private investment. Venture capital funds typically have a lifespan of around 10 years. They acquire a minority stake in a company with the objective of selling that stake at a higher price after a few years. An important aspect to remember is that venture capital funds do not invest indefinitely. They generally aim to sell their shares within approximately five to eight years, or at most 10 years, after investing. This timeline is particularly important because it is not really negotiable. Venture capital funds are not individuals investing their own money. They raise capital from other investors and are responsible for generating returns within a defined period.

Corporate Venture Capital (CVC) is closely related to traditional venture capital. In this case, a large industrial company establishes its own investment fund. The financial mechanisms are similar to those of a venture capital fund, but there is an important difference in the investment objectives. Corporate investors are not necessarily interested only in financial returns. They may also be interested in technologies that complement their existing activities or could be integrated into their business, for example by adding new products to their portfolio. This is particularly relevant in the bioeconomy sector. Corporate venture capital investors may provide much more than money. They might offer access to industrial facilities, supply feedstock for testing and validating a technology, or even become the final customer for the technology or product being developed. For this reason, corporate investors can represent particularly valuable partners for ventures operating in the bioeconomy and related sectors.

The key message is that you need to **understand which investors to approach and at what stage**. A venture capital fund may not be the right investor for your company today. Depending on your stage of development and your needs, a business angel or a corporate venture capital investor might be a more appropriate choice.

It is therefore essential to understand when different investors typically invest and what they expect in exchange for their capital.

The funding journey of a startup

To better understand how these different investors interact with companies, it is useful to look at a typical funding journey.

Startups generally raise capital through successive investment rounds, commonly referred to as pre-seed, seed, Series A, Series B and so on. The amount of funding raised usually increases as the company develops.

At the beginning, most funding comes from Friends, Family and Fools and business angels.

As the company grows, it typically starts approaching more structured and institutional investors, such as national or international venture capital funds. Corporate venture capital investors can also become relevant at different stages of this journey.

At later stages, companies may also begin approaching banks and accessing debt financing, as they become more financially stable and less risky from a lender's perspective.

It is also important not to forget the role of public funding alongside private investment.

Combining private investment with public funding opportunities can significantly support a company's development.

At the earliest stages, funding may come from university grants or incubator and accelerator programmes. Later, companies can access European funding programmes, such as the EIC Pathfinder and, at more advanced stages, the EIC Accelerator.

The main point is to be aware of the different funding opportunities available and to approach the appropriate organisations at the right time.

What do investors look for?

Having discussed who investors are and when they typically invest, the next question is what they actually look for when evaluating a company.

Whether you are talking to a business angel, a venture capital fund or a corporate investor, the discussion usually revolves around five main elements.

One important point is that **product and technology are only part of the investment assessment**. Coming from a biotechnology background myself, I understand that scientists often consider the product or technology they are developing to be the most important aspect of their venture. However, this is not the only element that needs to be strong before approaching an investor.

The **team** is crucial. Investors want to understand who makes decisions, who owns the company, which competencies are already available within the team and which ones are still missing. It is perfectly normal for some competencies to be missing, especially in the early stages of a venture. What matters is recognising these gaps and having a clear understanding of the team's capabilities.

The **market and traction** are equally important. It is not simply a question of demonstrating that a large market exists. Investors want to know who your potential customers are, how much they are willing to pay and whether your proposed price is acceptable.

They may ask whether you already have agreements or contracts with potential customers and whether your customers are other companies or individual consumers.

These aspects are closely connected to the **business model and the financial projections**, which we'll be discussed in more detail in Module 3 and 4.

Ultimately, the underlying question for an investor is very simple: If I invest in this venture today, how will I get my money back?

Additional considerations for bioeconomy, circular economy and biotechnology ventures

There are several additional aspects that are particularly relevant when discussing investments in bioeconomy, circular economy and biotechnology ventures.

Time to market: The first is time to market. In these sectors, bringing a new product or technology to market generally takes years rather than months. We all know that developing a new technology, validating it and eventually commercialising it requires considerable time. However, it is important to remember that venture capital funds typically have a lifespan of only 10 years. They therefore need to see a realistic possibility of recovering their investment, ideally within approximately eight years. For this reason, companies must be able to demonstrate a credible pathway towards generating returns for their investors.

Regulatory approval: The second crucial aspect is the pathway to regulatory approval.

This is particularly relevant for ventures developing new products, as regulatory requirements or policy gaps can significantly influence the time and resources needed to reach the market. These uncertainties also affect an investor's decision on whether to finance a particular venture. Until a product can legally be sold, it cannot generate commercial revenue. It is therefore essential to understand from the beginning which regulatory requirements apply to your product. This could include CE marking, novel food authorisation or other specific regulatory procedures.

From an investor's perspective, having a clear regulatory pathway is often preferable to operating in an area where regulations are uncertain or undefined. Even if obtaining regulatory approval takes three years, investors can account for this timeline and the associated costs in their financial planning. It is much more difficult to assess an investment opportunity when there is no clear indication of how or when a product will be authorised for commercialisation.

Feedstock security: In the bioeconomy, the input material used by one company is often a waste stream generated by another organisation. Investors therefore want evidence that the necessary feedstock is available not only today but also in the coming years. It is important to demonstrate that your venture will have access to sufficient raw materials throughout its development and commercial operation. This could involve establishing agreements with feedstock suppliers and, where possible, working with multiple suppliers to reduce the risk of supply disruptions.

Customers and willingness to pay: Finally, it is important to consider the demand for the final product. You need to understand who your customers will be and whether they will be willing to pay the expected price. Bio-based products often come with a price premium compared with conventional alternatives already available on the market. It is therefore essential to determine whether customers will accept this additional cost and, more importantly, what will motivate them to pay it.

Examples of investment journeys

There are already several startups and ventures that have successfully gone through these funding journeys.

The important message is that **every venture follows its own path**. There is no single, predefined model that every company must follow.

For example, some ventures initially raise capital from family offices and private investors while also obtaining substantial grant funding. They may then combine these resources with additional private investments. Other companies may rely mainly on regional investors, while some approach international investors from the beginning.

One example is NovaFit, which received significant investments from corporate venture capital investors, including ADM and Cargill.
These corporate investors contributed not only financial resources but also access to customers and feedstock.
This illustrates how different funding strategies and investor relationships can support the development of a venture, particularly in sectors where industrial partnerships are important.

Identifying potential investors in Europe
For ventures operating in Europe, it is useful to know that there are also specialised investment funds focusing on particular sectors. These are often referred to as vertical funds. For example, some funds invest specifically in the bioeconomy, circular economy, agri-food or soil-related sectors. They will generally consider investing only in companies whose activities fall within their defined areas of interest.
In addition to these specialised funds, there are corporate venture capital investors and industrial groups that may be interested in acquiring companies or integrating their technologies. To help you identify potential funding opportunities, I have prepared **a list of approximately 40 European investors**. This list will be available on the website as supporting material. Although it is not a comprehensive overview of all investors operating in Europe, it provides a useful starting point. For each investor, the list includes information such as the investment stage, typical ticket size, sectoral focus and main areas of interest.

Final recommendations
Before concluding, I would like to leave you with a few key recommendations.

1. Remember to take one step at a time. There is no need to rush through the different stages of developing and financing your venture.
2. Make sure you have a clear strategy for securing both your feedstock supply and your potential customers, particularly before approaching investors.
3. Choose the investors you approach based on the nature of your project, its stage of development and its specific needs.

Module 3 – The Business Model Canvas as a tool to communicate your value proposition to investors

Objective: Show how to build and communicate a credible business model to investors.

- Map the value chain
- Identify key actors
- Validate assumptions

Speaker: Francesca Freddi, Italbiotec srl

Script
In this module, we are going to discuss how to effectively communicate your value proposition to investors.
When presenting a business idea to investors, one of the most commonly used tools is the **Business Model Canvas**, introduced in 2010. Most of you are probably already familiar with it. The Business Model Canvas is a one-page framework that helps represent all the key elements of a business. It allows you to understand whether you have considered everything

necessary, including your customer base, how you intend to reach your customers, your costs and how your business will generate revenue.
There is extensive literature on how to represent and develop business models, and the Business Model Canvas remains a very useful tool.
However, when applying it to the bioeconomy, some additional considerations are needed. As mentioned in Module 2, the bioeconomy is a complex sector involving many different actors, and the time required to bring products and technologies to market can be significantly different from that of other sectors.
For these reasons, although the Business Model Canvas is a valuable tool, we need to consider how to use it appropriately in the bioeconomy.

The Business Model Canvas should be the conclusion, not the starting point

The first consideration I always like to emphasise is that the Business Model Canvas should be the conclusion of your analysis, not the starting point.
You should complete the canvas only after conducting all the necessary studies and gathering the information required to fill it in properly.
What does this mean in practice? Especially when developing a business in the bioeconomy, the first step should be to understand the context in which you intend to operate. You need to identify the actors involved, the existing relationships and agreements, and the dynamics that characterise the sector. As much as possible, you should also validate your assumptions before even starting the design phase of your business model.
To illustrate this, let's assume that I want to start a business within the biowaste valorisation value chain. The first thing I should do is start from the value chain, not from the canvas. The design phase of the business should come only after this preliminary analysis has been completed.

Mapping the value chain

The first step is to map the value chain in which the business will operate.
In the case of biowaste valorisation, we can simplify the value chain into four main blocks:

1. Someone who generates the biowaste.
2. Someone who collects and transports it.
3. Someone who treats or processes it.
4. Someone who uses the final product.

However, it is important to remember that additional actors may influence the value chain, either by supporting or limiting your business activities.
For example, in local biowaste management, municipalities and regulatory authorities play a key role in enabling or restricting certain activities.
You therefore need to understand the broader context surrounding your business.
Example: collecting food waste from restaurants. Let's assume that I want to establish a company that collects food waste from restaurants because I believe they generate sufficient volumes to make this a viable business opportunity. Once I have mapped the value chain, I know that my business would operate in the transportation segment. This means that I would need to interact with actors upstream, namely those generating the biowaste, who would most likely also pay for my collection service. At the same time, I would need to interact with downstream actors who would receive the biowaste I collect.
At this point, I should ask myself several questions:

- What do I receive from the value chain, in terms of biowaste and financial resources?
- What do I give back to the value chain?

- What value does my service or product provide?
- Most importantly, what existing activity, service or solution would my business replace?

This last question is particularly important.
As I mentioned earlier, you will most likely be entering an already established value chain.
Unless your technology or service is truly disruptive, you will either create synergies with existing actors or compete with someone already operating in that market.
This is why I strongly emphasise the importance of mapping the context before designing your business model.

Mapping the actors and stakeholders

Once you have mapped the value chain, you can start identifying the actors surrounding your business.
There are many methods available for stakeholder mapping, and extensive literature is dedicated to this topic. For example, the Ecosystem Pie Model provides a comprehensive approach to mapping stakeholders and their relationships.
However, the most important aspect is not which specific methodology you choose, but that you actually carry out this analysis. You should map not only the stakeholders who could benefit your business but also those who could potentially block or limit its development.
As illustrated by the previous example, some actors may either support or hinder your business, depending on how you involve them from the beginning. Understanding these relationships allows you to develop strategies to overcome potential barriers or actively involve relevant stakeholders in your value proposition.
Example: the role of treatment plants. Returning to the food waste collection example, a treatment plant could already have agreements with the municipality, potentially preventing it from accepting biowaste collected by your company. Alternatively, your business might not generate sufficient volumes to make collaboration attractive for the treatment plant. Both situations could represent barriers to your business. On the other hand, your collection service could provide additional value to the treatment plant, making it an important partner in your business model.
This illustrates why understanding stakeholders and their existing relationships is essential before moving forward with the business design.

Validating assumptions before investing

As I mentioned at the beginning, testing and validating your assumptions before investing is particularly important in the bioeconomy. There are two main reasons for this.
First, the bioeconomy is a complex sector in which businesses are strongly interconnected.
You will most likely not be able to cover the entire value chain, or even multiple segments of it, independently. Your business will therefore depend on other actors operating upstream or downstream.
Second, many bioeconomy ventures require capital-intensive investments, particularly when industrial facilities or processing plants are involved.
This makes the traditional lean methodology, commonly taught in business courses, less suitable for certain bioeconomy business models. The lean approach typically involves making assumptions, testing them and adapting the business model along the way. However, this approach becomes much more difficult when implementing your business idea requires investing millions of euros in an industrial plant.

In such cases, you cannot simply make assumptions and test them after making the investment. You need to validate them beforehand.
There are two main types of evidence that should be gathered before designing the business model.

- **Market evidence:** the strongest forms of market evidence include formal agreements with potential customers or partners. At a minimum, interviews and direct interactions with stakeholders can help demonstrate that there is genuine interest in the product or service you intend to offer. The objective is to provide evidence that someone actually needs or wants what your business proposes.
- **Technical evidence**: it is particularly relevant when the business requires investing in a production plant. Technical evidence can be generated through economic analyses or by demonstrating that the technology or plant operates successfully at a relevant scale. These aspects will be discussed in more detail in the next presentations. What matters most is that you can provide this evidence, because investors want proof that your assumptions are valid.

The cost of validation and the Valley of Death

One of the main challenges associated with this preliminary assessment is that validating assumptions is both time-consuming and expensive.
I know this from my own experience as a consultant working in this field, where validating business assumptions is part of my job. This creates a significant bottleneck.
Technology owners often do not have sufficient financial resources to invest in the analyses needed to validate their business models.
At the same time, investors may be unwilling to invest because there is not enough evidence to demonstrate that the proposed business is technically and economically viable.
This situation contributes to what is commonly referred to as the Valley of Death.
In my view, investors should also contribute to financing these preliminary analyses, as they help reduce the risks associated with subsequent investments.
However, I understand that implementing this approach can be complex.
For this reason, leveraging public funding to support these activities could be a very useful strategy.

Completing the Business Model Canvas

Once the preliminary analyses have been completed, we finally have the information needed to fill in the Business Model Canvas. If we have carried out the previous steps properly, we should be able to complete its different sections relatively easily.
The Business Model Canvas is a well-known framework, and its structure is easy to understand. This is one of the reasons why it remains such a useful tool for communicating a business idea to external stakeholders, including investors.
However, I would like to emphasise that the traditional Business Model Canvas introduced in 2010 is not the only available option. Over the past 15 years, many variations and adaptations of this framework have been developed. These different models can all be useful, provided that you have already completed the necessary preliminary analyses, including value chain assessment and validation of your assumptions.
The Business Model Canvas can certainly be used as a brainstorming tool. However, I believe its greatest value lies in its use as a communication tool, once the necessary analytical work has been completed.

There are many different business model frameworks available in the literature, and the examples presented here are intended simply to provide an overview of some of these approaches.

Key takeaways

To conclude, what have we learned in this module?

1. the Business Model Canvas and its variations are valuable tools for presenting and communicating your business idea.
2. particularly in the bioeconomy, it is essential to map the value chain and the actors involved before designing the business model. You need to understand the existing relationships, identify potential barriers and opportunities, and validate your assumptions before completing the canvas.
3. Validation comes at a cost. It requires time and financial resources, but it is also the only way to reduce the risks associated with complex and capital-intensive investments, which are typical of the bioeconomy. This is the main trade-off that entrepreneurs and investors need to consider.

Module 4 – Investing in biomass processing facilities: how do you prepare for an investment decision?

Objective: Explain how to turn a plant concept into a structured investment case.

- Market and plant analysis
- CAPEX and OPEX estimation
- Business plan and NPV

Speaker: Henning Friege, N3 nachhaltigkeitsberatung dr friege & partner

Script:

The purpose of this module is to support decision-making when considering an investment in a biowaste processing plant, with particular attention to negotiations with potential lenders and other individuals or organisations willing to finance the business.

As discussed earlier, these may include banks, company shareholders, friends or other investors.

It is important to remember that the waste management and recycling market is not particularly transparent. Moreover, once a waste processing plant has been installed, it generally cannot be used for other purposes. Consequently, banks and other investors will closely examine your business plan and ask detailed questions to ensure that their investment can generate a return or that the loans provided can be repaid. In the next module, we will present an example of an investment calculation for a combined aerobic and anaerobic treatment plant.

The structure introduced in this presentation can be used to develop your own business plan. A supplementary Excel file is available on the BIN2BEAN website, allowing you to enter data related to your planned facility.

The main elements of a business plan

Every business plan begins with an evaluation of the market situation, the expectations of potential customers and the availability of raw materials.

Based on the information collected during this initial assessment, it is possible to develop a plan for an appropriate processing technology.
This planning phase concludes with a preliminary estimation of the investment required.
In particular, we will consider the following elements:

1. Demand and market analysis.
2. Plant sizing and capacity.
3. Investment analysis and plant design.
4. Calculation of operating costs.
5. Revenue forecasting.
6. Preparation of an income statement.

These elements provide the foundation for assessing the technical and economic feasibility of a biowaste processing facility.

Market opportunities for biowaste valorisation

Biowaste valorisation is essential for achieving European recycling targets, including the objective of reaching a 65% municipal waste recycling rate by 2035.
At the same time, there is an urgent need for soil improvers in many European regions. Continuous losses of humus are reducing soil fertility and increasing the risk of soil erosion.
According to the European Waste Framework Directive, separate collection of biowaste has been mandatory since 2024.
Furthermore, the Landfill Directive requires Member States to reduce the amount of municipal waste sent to landfill to 10% or less of the total generated by 2035.
These regulatory developments create significant business opportunities in the bioeconomy.
However, the introduction of separate biowaste collection has often been delayed, particularly in Southern, Southeastern and Eastern Europe.
We have observed this within the BIN2BEAN project, especially in Greece.
Some cities still do not collect biowaste separately and instead promote home and community composting, which generally involves only a relatively small proportion of households.
It is also important to remember that biowaste is not generated exclusively by households.
Other significant sources include restaurants, hotels, supermarkets and the food industry.
Responsibilities for the collection and treatment of these waste streams depend on national regulatory frameworks.
As a result, there may be considerable opportunities to develop business models based on the valorisation of waste biomass, particularly from commercial sources.
Your business does not necessarily need to focus on household biowaste. It is important to investigate which waste streams are available in your city or region.

Possible business models

A business model for biowaste valorisation may involve providing treatment services to one or more municipalities that do not wish to process biowaste themselves.
Alternatively, it may focus on waste collection and recycling services for private customers, such as restaurants, supermarkets and potentially homeowners. The type of biomass involved can vary significantly, ranging from food waste and green waste to specific industrial residues.
In addition to conventional municipal biowaste, collecting and valorising particular biomass streams may offer advantages.

Examples include green waste, garden hedge cuttings or combinations of municipal biowaste with specific agricultural residues.
We have just published a list of business models based on bio-waste and other organic residues in Europe. This is part of a publication which includes a Master's and a Bachelor's thesis from Leuphana University. You can find this paper here.

Assessing regional waste management conditions

Before developing a business concept, it is essential to examine the waste management policies and conditions in the region where the facility would operate. This involves reviewing the current situation, future waste management plans and the quantities of biowaste already collected separately.
One useful indicator is the amount of separately collected biowaste in relation to the number of inhabitants. This can help estimate the gap between the quantities currently collected and the quantities potentially available for treatment.
As a rule of thumb, **approximately one-third of household waste in Europe consists of biowaste.** In other parts of the world, the proportion can be higher. For example, biowaste may account for more than 40% of household waste in parts of Asia and up to 50% in some African regions.
It is also important to identify existing processing facilities in the region and assess their treatment capacities. Because biowaste has a relatively high specific weight, transporting it over long distances is generally not cost-effective. This limits the geographical area in which competing treatment facilities are likely to operate.
Relevant information can be obtained from various sources, including national, regional and local waste management plans, agricultural statistics, farmers' associations, chambers of commerce and regional waste management companies. There is a large amount of information available, but the challenge is identifying the data that are most relevant to your specific business plan. Regional statistics on crops and livestock can also provide an initial indication of the agricultural residues potentially available for co-composting. These resources should therefore be considered when assessing the availability of raw materials and potential competitors.

Understanding the needs of potential customers

One of the most important questions is: What do your potential customers actually need?
Before approaching farmers, potting soil producers or other interested companies, it is advisable to familiarise yourself with the characteristics and quality of regional soils.
Information on soil quality can be found in publications from the European Soil Bureau Network. Although these resources often provide maps at relatively small scales, they can still offer useful regional overviews. More detailed soil maps may also be available from national agencies. The European Soil Atlas describes the sources and impacts of soil degradation, pollution and other soil-related issues. I also recommend consulting the maps published by the European Soil Observatory (EUSO), which provide information on several important soil health parameters. These resources are available online. Together, this information can help identify the main needs of farmers and determine how compost or digestate could address them.
Relevant parameters include soil organic carbon, pH, buffering capacity and nutrient availability. Conversely, if soils already contain excessive amounts of nitrogen or phosphorus, the application of digestate may not be appropriate.

In such cases, a soil improver with a relatively high ratio of carbon to readily available nutrients may be more suitable.
The next step is to investigate these needs in greater detail through direct discussions with farmers and potential industrial customers.
At this stage, you should also address the make-or-buy decisions and define your position within the value chain, as discussed in the previous presentations on business models and the Business Model Canvas.

Selecting the processing technology and defining plant capacity
Once the market conditions and customer requirements have been assessed, we can move towards an initial estimation of the investment required for a biowaste processing facility.
The first step is to define the type of facility. For example, will you invest in a composting facility or an anaerobic digestion plant? This decision should be based on discussions with potential waste suppliers, including municipalities and commercial waste producers, as well as information on regional soil conditions, existing treatment plants and market requirements. It is also essential to ensure that the biowaste intended for processing is of suitable quality. Even with state-of-the-art separation technologies, impurity levels above approximately 3–5% cannot be tolerated in the input material.
More detailed recommendations regarding suitable treatment facilities are available in the project's publications, particularly Deliverable D3.1, which can be accessed through the website.
Once the treatment technology and required capacity have been defined, it becomes possible to estimate the initial investment using a cost-to-capacity calculation.

Estimating investment costs through cost-to-capacity calculations
A cost-to-capacity calculation provides a relatively simple method for estimating the capital required for a new processing facility.
The first step is to collect information on the investment costs of existing facilities that use the same treatment technology. Ideally, data should be collected from several facilities rather than relying on a single example.
You then need to identify an appropriate cost-scaling exponent for the selected processing technology. These exponents can be found in the technical literature.
As a rule of thumb, values of approximately 0.6 for anaerobic digestion facilities and 0.65 for composting facilities can be used, while distinguishing between smaller facilities, with capacities below 500 tonnes per day, and larger facilities exceeding this capacity.

The cost-to-capacity formula
The investment required for a new facility can be estimated using the following relationship:

$$C_{\text{new}} = C_{\text{existing}} \times \left(\frac{Q_{\text{new}}}{Q_{\text{existing}}} \right)^{n}$$

Where:

- C_{new} is the estimated capital requirement for the new facility.
- $C_{existing}$ is the known investment cost of an existing comparable facility.
- Q_{new} is the planned capacity of the new facility.
- $Q_{existing}$ is the capacity of the existing facility.
- n is the cost-scaling exponent.

The calculation must also be adjusted to account for differences in cost levels between countries and changes in prices since the reference facility was constructed.

Adjusting for changes in costs over time

Changes in investment costs over time can be accounted for using a price adjustment factor, referred to as F(t).

This factor can be obtained from statistical data, ideally using a relevant cost index for the machinery industry. The calculation compares the cost index for the year in which the reference facility was constructed with the corresponding index for the current year.

This makes it possible to update historical investment figures before using them to estimate the cost of a new facility.

The cost-to-capacity method is intended as a preliminary estimation tool.

It provides a rough indication of the required investment without immediately undertaking the time-consuming process of preparing a detailed engineering-based cost assessment.

However, the reliability of the estimate must be progressively improved as the technical planning advances.

There is a direct relationship between the level of detail in the technical design and the certainty of the overall investment estimate.

Calculating the total investment

Once the preliminary cost-to-capacity estimate has been prepared, it is necessary to calculate the total investment required for the facility. This includes more than the machinery and mechanical equipment associated with the selected treatment technology.

Other important cost categories include land acquisition or leasing, project development, engineering services and building construction.

Depending on the size and characteristics of the facility, additional buildings and infrastructure may also be required, such as facilities for workers.

All these elements must be included to obtain a more complete picture of the investment.

Assessing investment opportunities and risks

Once the investment estimate has been developed, the next step is to assess the associated opportunities and risks. This requires examining the technical, conceptual and financial cost drivers that could significantly affect the investment.

Technical and operational cost drivers. Technical cost drivers include the specific operating conditions of the facility. For example, biowaste treatment facilities may experience highly reducing or oxidising conditions, which can vary over time and influence the requirements for equipment and materials. It is also important to consider the strategic factors that may affect operational performance over a period of 10 to 20 years. One fundamental question is whether the required input materials will remain available throughout this period.

Conceptual cost drivers. Conceptual cost drivers relate to decisions made during plant design and development. These may include the selection of different suppliers, the need for custom-made solutions and the degree of automation. Construction delays are another important consideration because they can significantly increase investment costs. Delays may result in higher component prices, losses caused by postponed commissioning and additional expenses for construction supervision.

Financial cost drivers. Financial cost drivers must also be considered. One example is an unfavourable ratio between equity and debt. If your own capital represents only 10% of the required investment, the remaining 90% will need to be financed through debt. This can

substantially increase the overall financial burden, not only because of the amount borrowed but also because of the interest payments required.

The role of the EU Taxonomy Regulation. The EU Taxonomy Regulation is another factor that needs to be considered in the financial assessment. In the European Union, banks and other financial institutions are required to report on the sustainability of their lending activities. Biological waste treatment is generally considered a sustainable activity under this framework, but the Do No Significant Harm principle requires financial institutions to examine specific technical aspects. These may include greenhouse gas emissions, water consumption and potential environmental hazards, including impacts on biota. A new organic waste treatment facility should therefore undergo the relevant environmental assessments before receiving its operating permit. These requirements should also be seen as an opportunity to gain a comprehensive understanding of your investment and to prepare for discussions with the competent authorities.

Long-term strategic considerations

The strategic conditions affecting your business may change over time. For this reason, it is important to assess whether the waste streams you intend to process will remain available over the next 10 or 20 years. This is generally more predictable for municipal biowaste, but it may be less certain for specific industrial waste streams used in co-composting or co-fermentation, particularly residues generated by specialised food industries. The regulatory framework for biomass valorisation should also be examined carefully. Even if your project fully complies with existing legislation, it is important to monitor potential legislative amendments that may be under discussion. European organisations such as the European Compost Network and Municipal Waste Europe actively represent the interests of their sectors in Brussels. Their websites can provide useful information on emerging policy developments and possible regulatory changes. It is also advisable to periodically update your market assessment. This should include monitoring new competitors entering the market and reviewing relevant tendering procedures. Public procurement rules and the contracting procedures applied by private companies may differ, including across European countries. These factors can influence how your business operates and how it accesses potential customers.

Integrating marketing and waste collection into the business model

Based on the experience gained within the BIN2BEAN project, it is strongly recommended that the marketing of the final products be integrated into the business model.

Although this may not directly affect the initial investment calculation, it is an important prerequisite for the long-term success of the business.

Managing biowaste collection directly may also be an interesting option. However, this would require additional investments in equipment such as collection trucks and waste bins, as well as higher personnel costs.

Direct control over collection activities could be particularly valuable when working with agricultural co-substrates, as it would provide greater control over the availability and management of these waste streams. The advantages of integrating collection activities should therefore be assessed against the additional costs involved.

Completing the business plan and evaluating financial viability

At this point, you should have the information needed to begin developing a complete business plan for your biowaste processing facility. The plan should include detailed

estimates of investment costs, operating costs and expected revenues. One important indicator for evaluating financial viability is the Net Present Value (NPV). NPV provides an estimate of the financial return associated with an investment by considering the present value of future cash flows. This is particularly relevant to shareholders, banks and other potential investors, who want to understand whether the investment is financially attractive. However, calculating NPV alone is not sufficient. I strongly recommend conducting a sensitivity analysis to evaluate how changes in key assumptions might affect the business plan. This allows you to assess the potential consequences of disruptions or unexpected changes in operating conditions, costs or revenues.
An example of this type of analysis will be presented in the next module.

Conclusion
The objective of this Module was to provide a structured approach to evaluating an investment in a biowaste processing facility, from the initial market assessment and selection of suitable treatment technologies to the estimation of investment costs, identification of risks and evaluation of financial viability.
The framework presented can serve as a starting point for developing your own business plan, supported by the supplementary Excel tool and the additional resources available through the BIN2BEAN project.

Module 5 – Practical example: calculation of an investment in a biowaste processing plant

Objective: Apply investment analysis to a concrete bio-waste treatment plant case

- Plant inputs and outputs
- Costs and revenues
- NPV, sensitivity and break-even

Speaker: Henning Friege, N3 nachhaltigkeitsberatung dr friege & partner

Script:
Introduction
In this unit, we will examine an example of an investment calculation for a combined anaerobic digestion and aerobic treatment facility.
This type of facility is particularly relevant when dealing with mixed biowaste consisting of food waste and garden waste, as is commonly the case in many cities.
The example considers a facility with a processing capacity of up to **40,000 tonnes per year**.
We assume that the incoming biowaste originates from households and gardens and consists of approximately 75% kitchen waste and 25% green waste.
The objective is to demonstrate how to estimate the technical performance, investment requirements, operating costs, revenues and financial viability of such a facility.

Description of the treatment facility
The biowaste arriving at the facility is first subjected to a pre-sorting process to remove visible impurities, such as plastic bags and residual waste.
This is followed by screening to separate material fractions larger than 80 mm, which is a common procedure in biowaste treatment facilities.

The primary objective of the facility is to produce biogas through anaerobic digestion, which can then be used to generate electricity and heat. The remaining material is subsequently separated and treated through a composting process.
The facility therefore consists of two main treatment sections: an anaerobic digestion unit and an aerobic composting unit, supported by the necessary pre-treatment and material separation systems.
As a rule of thumb, one tonne of biowaste can generate approximately 100 cubic metres of biogas containing around 58% methane. This corresponds to an energy content of approximately 580 kWh per tonne of biowaste.
When biogas is used in a gas engine, approximately 38% of this energy can be converted into electricity. Part of the remaining energy can be recovered and used as thermal energy, while the rest is lost during the conversion process. This provides an initial indication of the facility's potential energy output.

Technical assessment and material balances
The technical assessment begins with defining the main input and output parameters.
In this example, the incoming material consists of a mixture of 75% food waste and 25% green waste. Using these input characteristics, together with the lower heating value of methane, it is possible to calculate the expected efficiency and energy performance of the facility.
The main parameters considered include the annual biogas production volume, hourly biogas flow rate, total gas yield, electricity generation and recoverable thermal energy.
The biogas is used in a gas engine to produce electricity, while the recovered heat can be used for different purposes. For example, it could be used to dry wet wood, heat a nearby swimming pool or supply heat to other users in the surrounding area.
The annual gross energy generation is one of the most important output parameters for the subsequent economic assessment.
In addition to electricity and heat, the facility produces approximately 37,000 tonnes of digestate. This digestate can be further processed through composting. The material is separated into different fractions, including a liquid fraction and a solid digestate fraction.
The solid digestate can be composted to produce a soil improver, while the liquid fraction can be managed separately. These outputs represent additional products or materials that must be considered when evaluating the overall performance of the facility.

Estimating the investment costs
The next step is to estimate the investment required to construct and operate the facility. The investment calculation includes several components:

- The anaerobic digestion plant.
- The combined heat and power (CHP) unit.
- Material processing and separation equipment.
- Exhaust air ducts and biofilters.
- The composting unit.
- Building and construction works.
- Storage facilities for liquid fertiliser.
- Planning costs and contingencies.

Storage capacity for liquid fertiliser is particularly important because the material cannot necessarily be used immediately after production. It may therefore need to be stored until suitable application conditions are available.

Planning costs and contingencies are also included in the calculation, generally corresponding to approximately 5% of the investment costs.
Another important consideration is that different components of the facility have different depreciation periods. For example, the technical equipment used in biogas and composting plants may have depreciation periods ranging from approximately 10 to 15 years.
Building works, on the other hand, generally have a longer useful life, often exceeding 20 years. These differences must be reflected in the financial calculations.
The fixed costs include depreciation and interest. For this example, we assume an interest rate of 8% for equity and 2.5% for debt. These values are illustrative and can vary depending on the financing conditions and the characteristics of the investment. Based on the assumed financing structure, the resulting interest rate used in the calculation is approximately 4.7%.

Calculating operating costs

In addition to the initial investment, it is necessary to estimate the annual costs associated with operating the facility. These include land leasing costs, potentially calculated over a period of 20 years, as well as personnel costs, vehicle leasing and diesel consumption.
Another important cost category is the disposal of impurities removed from the incoming biowaste. It is essential to remember that incoming biowaste is rarely completely free from contaminants. These impurities must be separated during pre-treatment and subsequently disposed of through appropriate waste management channels. The associated costs can increase significantly as the contamination level of the incoming biowaste rises.
Maintenance is another important operating expense.
For biowaste treatment facilities, annual maintenance costs are commonly estimated at approximately 4% of the investment costs. Additional operating expenses, including taxes and other charges, must also be considered.
Together, these elements provide the basis for estimating the annual operating costs of the facility.

Revenue forecasting

Once the investment and operating costs have been estimated, we can calculate the expected revenues. For this example, we use indicative prices typical of the German market. However, these figures can vary significantly between countries and regions, including within Europe.
The assumptions used in this example are summarised below.

Revenue source	Assumed price
Electricity	€0.14/kWh
Fertiliser	€25/tonne
Compost	€15/tonne
Biowaste treatment	€35–55/tonne
Green waste treatment	€40/tonne

The electricity price is based on an assumed value of 14 cents per kilowatt-hour.
For fertiliser, a price of €25 per tonne is considered a favourable value, although actual prices may be lower.
For compost, €15 per tonne represents an indicative price for Northern Europe, while higher prices may be achievable in some Southern European markets.
The revenues associated with incoming biowaste are calculated using gate fees, with assumed values of €35–55 per tonne for biowaste and €40 per tonne for green waste.

These figures must be adapted to the specific market conditions of the country or region where the facility will operate.

Based on the assumptions described above, the example produces the following annual results:

Annual revenues	**€3.9 million**
Capital costs	€1.5 million
Operating costs	€1.9 million
Estimated net profit	€450,000

These results suggest that the facility could generate a positive annual profit.
However, profitability in a single year is not sufficient to determine whether the investment is financially attractive over its entire lifetime.
For this reason, we also need to calculate the Net Present Value.

Net Present Value (NPV) analysis

The next question is whether the facility will generate sufficient economic returns over time to justify the initial investment. To answer this, we calculate the **Net Present Value (NPV)**.
The NPV calculation requires several inputs: the initial investment, the annual cash flow, the discount rate and the period over which the investment is assessed.
The annual cash flow is calculated by subtracting operating costs from revenues.
In this example, the estimated annual cash flow is approximately €2 million.
The discount rate reflects the financial assumptions used in the calculation.
As the depreciation periods for the main technical components range from approximately 10 to 15 years, an analysis period of 12 years is considered appropriate.
The NPV can be calculated using a standard financial formula, which can easily be implemented in Excel.
The estimated Net Present Value is **+€3.5 million**, based on an analysis period of 12 years.
A positive NPV indicates that the facility is expected to generate returns above the level required by the investment assumptions. In other words, the project creates economic value over time and can therefore be considered financially favourable.
This is one of the most important indicators for shareholders and potential investors when evaluating a business plan.

Sensitivity analysis

Although the initial results appear promising, an investment decision should never be based on a single set of assumptions.
Actual operating costs and revenues may turn out to be higher or lower than expected.
For this reason, a sensitivity analysis is necessary to understand how changes in the main financial parameters affect the NPV. In this example, we examine the effects of changes of approximately 5% or 10% in revenues and operating costs.
Sensitivity to changes in revenues: If operating costs remain constant and annual revenues decrease by 10%, the NPV falls to approximately zero. This means that the investment would essentially reach its break-even point. The result shows that revenue is a particularly critical factor for the financial viability of this facility.
Sensitivity to changes in operating costs: If annual revenues remain constant and operating costs increase by 10%, the NPV remains positive. This indicates that the facility can absorb a certain increase in operating costs without becoming financially unviable.

The comparison reveals that the investment is substantially more sensitive to reductions in revenues than to increases in operating costs. This is particularly important because gate fees and energy sales account for a significant proportion of the facility's income.

Break-even analysis and margins of safety

The sensitivity analysis can be complemented by a break-even analysis. This allows us to determine how much revenues can decrease or operating costs can increase before the NPV becomes negative.

Revenue margin of safety: On the revenue side, the margin of safety is approximately 9.9%. This means that annual revenues could decrease by slightly less than €400,000, from approximately €3.9 million to around €3.5 million, before the investment reaches the point at which it no longer creates positive economic value.

Operating cost margin of safety: On the operating cost side, the margin of safety is considerably larger in relative terms. Operating costs could increase by approximately €385,000, reaching around €2.3 million annually, before the NPV becomes negative.

The figures confirm the findings of the sensitivity analysis. The facility has a relatively comfortable buffer against rising costs but a much narrower buffer against declining revenues.

This is exactly the type of insight that a well-prepared feasibility assessment should provide. It helps decision-makers understand which financial parameters present the greatest risks and where risk management efforts should be concentrated.

In this example, the main priority should be securing stable, long-term revenue streams, particularly through reliable gate fee agreements and energy sales.

Preparing your own feasibility study

Using this example as a starting point, together with an assessment of your local regulatory framework and market conditions, you can develop a feasibility study for your own biowaste treatment facility.

The supplementary Excel file provided through the BIN2BEAN website will allow you to carry out similar calculations using assumptions specific to your planned investment.

It is important to remember that the level of detail used in preparing the investment calculation affects the reliability of the results.

The more accurate and comprehensive your technical and financial assumptions are, the better your assessment of the investment will be.

Conclusion

This example illustrates how the technical and economic feasibility of a combined anaerobic digestion and composting facility can be evaluated.

Starting from the characteristics of the incoming biowaste and the expected material and energy outputs, we have examined investment costs, operating expenses, potential revenues and financial performance. The results indicate a positive NPV under the assumed conditions, while the sensitivity and break-even analyses highlight the importance of securing stable revenues. These calculations provide a useful basis for discussions with banks, shareholders and other potential investors.

We wish you the best of luck with your investors and your investment! And don't forget to check our other training in the BIN2BEAN series!