PHOSave
Deliverable D7.4 Business model for European fertilizer producers

Partner responsible:

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<th>Participant organization name</th>
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Executive summary

This document (named D7.4) describes the Business Model (BM) related to the industrial scale up of the PHOSave project.

Three of the key challenges faced by the PHOSave project were to ensure sustainability for:

1. the underlying industrial and production processes;
2. the environmental and social impacts (circular economy);
3. the economic and financial structure.

As recalled in this document, we already defined and addressed the main activities related to the identification of the relevant stakeholders and the actions to be performed in order to properly communicate and disseminate the PHOSave technology. In this deliverable we identify and characterize all the key factors contributing to balancing costs and revenues originated by scaling the PHOSave technology to the industrial level and by turning the initial stakeholders’ enrolment into business.

For the sake of clarity, we recall that the deliverable D1.1 gave a preliminary description of the marketing approach and an overview of the actual and potential customers for the markets of reference. We have further developed these concepts within the deliverable D7.3 by means of a detailed Marketing and business/commercialization plan. The latter, is the natural starting point for developing and understanding the present BM.

It is worth mentioning that this document identifies a potential BM coherent with the stage of progresses of the PHOSave project. It is reasonable to believe that it will evolve while the stakeholders and the pool of key partners will grow, and the financial structure established.

Such a dynamic model would enable the project to satisfy both the entrepreneurial needs of industrial/commercial partners to proceed with clarity and speed, while ensuring the dissemination related to the PHOSave technology benefits.

The adoption of a shared and flexible BM is essential to allow a sustainable spread of the PHOSave project and its economical exploitation.

The document D7.4 is structured as follows:

1. A short introduction regarding the project pillars and the relations to other tasks (chapter 1)
2. Description of the BM and the related Business Model Canvas (chapter 2)
3. Scalability, profitability, and risk analysis (chapter 3)
4. Cost Structure and Revenue Stream (chapter 4)

1 Introduction

1.1 The PHOSave pillars

The PHOSave project has been extensively described through several previous deliverables. For the sake of simplicity, we list below the four principal objectives that we aimed to achieve with PHOSave:

1. Standardize and establish an eco-friendly and traceable waste process related to phosphorous;
2. Make available raw materials that are currently imported from abroad (EXTRA EU);
3. Decrease of traffic and gas emission due to transport of waste from Italy to Northern Europe;
4. Enlargement of the activity with creation of new jobs.
The PHOSave project aims at assisting and promoting the operative diversification of the ProPHOS Chemicals Srl across the following markets:

- Waste collection of phosphorus-based extinguishing powders;
- Micro-granular fertilizers manufacturing;
- Extinguishing powders manufacturing;
- Flame retardants for chipboards industry manufacturing.

The BM presented here crosses these four activities, yet still it is focused on the final production of micro granular fertilizers for the reasons that will be declared in the next sections.

1.2 The relations to other deliverables and tasks

As anticipated in the Executive Summary, this document is connected to other tasks and deliverables:

- D1.1 Interim Report with Commercialization Plan released on the 30th of June 2017 and revised on the 29th of June 2018;
- D7.1 Communication plan and activities;
- Task 7.1 to 7.5 Dissemination activities and market introduction;
- D7.3 Marketing and Business/Commercialization plan

Most notably, the deliverables D7.1 and D7.3 identify the target audience for the communication activity and the main features of the products and services to be destined to the stakeholders. The documents contain a thorough and comprehensive discussion about the market approach and some other critical elements that we are going to include in the present BM and Business Model Canvas:

1. Key stakeholders (i.e. partners in the BM);
2. Distribution and Communication Channels;
3. Customer profile.

Furthermore, in the deliverable D7.3 we reported a detailed SWOT analysis, useful to understand the risk dimension of this BM.

2 Business models

In this chapter we introduce the general BM related to PHOSave. It is worth mentioning that both the communication and the marketing strategies are broadly operating on three main targets including the Firefighting, the Wood and the Agricultural sectors. However, as the main purpose of the project is to implement eco-sustainable technologies for the recovery of raw materials to manufacture high-quality fertilizers, we believe that this last point should deserve some special attention. Indeed, the PHOSave project has the explicit scope to recover the exhausted extinguishing powders (ABC powders) via an eco-innovative chemical/physical solubilization process and successively employ this material to make micro-granular fertilizers.

2.1 The Value Chain

This model is based on the value chain reported in Figure 1.
Figure 1 - Schematic representation of the PHOSave value chain. It includes all the critical steps from the collection of exhausted powders up to the production and commercialization of finite products based on the PHOSave technology.

The value chain model allows the description of the PHOSave workflow with a limited and defined number of primary and support activities. In particular we identify:

1. The collection of exhausted extinguishing powders (primary activity);
2. Logistic of the powders to the Recovery Platform (support activity);
3. Research and Development activity and implementation of the PHOSave plant (support activity);
4. Powder recovery, chemical and physical treatment of the waste powders and production of high-quality raw materials (primary activity);
5. Production of micro-granular fertilizer (primary activity);
6. Marketing and Sales activity of main stream (fertilizers) and side (extinguishing powders and flame retardant) products (primary activity)

Normally, the process of supplying is considered a support activity. In the case of PHOSave, the collection of waste powders represents the first step of the revenue stream. Once the waste reaches the Recovery Platform it is suitable for the treatment in the PHOSave plant and converted into new phosphorus raw materials. Ideally, the PHOSave plant is nearby or even connected to an industrial production plant dedicated to processing phosphorous materials into higher value products such as micro-granular fertilizers. The marketing and sales activities aim at furtherly improving the value of the product which is finally delivered to the end user (e.g. farmers) through the distribution channels that have been explored and detailed in the D7.3 Marketing and Business/Commercialization Plan.

As mentioned, the processed products (powder or granular) containing phosphorus are destined to the agricultural, wood, and the firefighting markets. Here we focus on few aspects concerning the fertilizer production from raw materials recovered via PHOSave. In particular, this BM highlights three main values:

1. Development and production of speciality fertilizers “heavy metals free”. As discussed in the technical deliverables (D3.1) the recovery treatment allows the significant drops of dangerous metals that are sometimes relevant in Mono Ammonium Phosphate (raw material) supplying. This opportunity generates an advantage for the fertilizer producer that can envision a specific market positioning in agreement with some restrictive European regulations;
2. Maximization of the revenue/cost ratio. This BM foresees the integration of the Recovery Platform, PHOSave and granulator plants minimizing the logistic and the raw material supplying costs while maximizing the revenues due to the higher value of the processed materials;
3. Spreading the PHOSave model to the international scale. This BM is somehow tailored to the ProPHOS Chemicals needs and vision. However, it explicitly considers the scalability scheme reported in Figure 2, allowing for the consolidation of the technology and increasing of our revenue based on a licensing model.

Figure 2 - PHOSave access to market, which includes selling of products for the agricultural, wood and firefighting sectors. The scheme also reports the scalability of the PHOSave model in Europe through a licensing model.

Not only new products, but also environmental benefits are common aspects of PHOSave. Indeed, the widespread use of PHOSave technology will maximize the profitability of those stakeholders joining the BM while contributing three main issues:

1. providing a solution to the problem of exhausted extinguishing powders (i.e. which is a special waste);
2. reducing the CO2 emission in the industrial chain;
3. converting wastes in almost pure raw materials (i.e. 95% pure phosphorus as tested in lab scale).

2.2 Preliminary analysis

The construction of the BM is based on the preliminary analysis of the market and the resources available including the communication and commercialization (deliverable D7.1 section 3 and D7.3 section 4.3). However, unlike other markets, the one of fertilizers is not documented in detail and in terms of statistical analysis. This is due to the following three conditions:

1. The company collecting the statistical data is usually the same one involved in commercializing the final products. This make the pool of data particularly heterogeneous and biased by the different enterprise natures and structures;
2. The data are heterogeneous on a geographical base, affected by the different legislations and micro-market structures;
3. The different players in this market are fragmented into several submarkets including the commodities, the specialties, the granular, the micro-granular, the liquids, and for each of these further segmentations are due to the mineral or organic source of the fertilizer.
As a further explanation of the three points listed above, we mention the presence of different international organizations representing the fertilizer manufacturers (e.g. IFA https://www.fertilizer.org/ or Fertilizer Europe http://www.fertilizerseurope.com), the end users (i.e. COCERAL http://www.coceral.com and similar) and other broad audiences of EU stakeholders (i.e. European Sustainable Phosphorus Platform – ESPP - https://phosphorusplatform.eu). This fragmented scenario becomes more complex if all the national and regional organizations are take into account.

Moreover, the identity of the optimal customer to fit the PHOSave BM is relatively broad as confirmed by the variety of stakeholders, some specialized in manufacturing mineral fertilizers (i.e. usually well-structured and medium/big size enterprises), others with focus on the organic nutrition (i.e. including all possible sizes ranging from the corporations to self-production for self-consumption or little local businesses).

For these reasons the BM has not been driven by the characterization of the targeted customer or the potential selling volumes but most generally on the identified dimension of scalability, and profitability and risk (see section 3).

2.3 The Business Model Canvas

The Business Model Canvas that follows (ref. Osterwalder et al., 2010) describes the PHOSave business model using nine basic building blocks, covering four areas of business: Customers, Offer, Infrastructure and Financial aspects. This model is based on the aggregation of factors that contribute to generate costs and revenues separately. These two blocks are dynamically connected each other through the Value Propositions, which define the value of products and services offered to the customers, delivered through the distribution channels while involving partners, resources and activities.

Although this BM includes markets in the wood and firefighting sectors (i.e. which are important stakeholders of the PHOSave), its main target is the fertilizer market. There are several reasons that justify this choice. The most relevant are the higher marginality, profitability and the direct connection of PHOSave to common values inspired by eco sustainability and raw materials’ quality for the soil nutrition. Moreover, the data collected by the Fertilizers Europe organization (http://www.fertilizerseurope.com) and FAO (www.fao.org) describe an industrial sector of primary importance, which generates a turnover as high as 10.9 Bln of €, involving investments for 1.3 Bln €, 78’500 employees, more than 120 production sites and an overall R&D activity estimated in 66 Mln in 2015. (Figure 3 - The mineral fertilizer industry in a nutshell representation)
Coherently with these data, the overall demand and consumption of NPK (nitrogen, phosphorous and potassium) fertilizers has been growing linearly since 2008 suggesting some correlations with the technology progresses and the population growth. Figure 4 and the related table shows the global nutrients consumption since 2008 expressed in millions of Tons of NPK fertilizers per year.

**Figure 4** – World demand for fertilizer nutrient use since 2008 (N+P2O5+K2O) and related details for the forecast model between the 2015-2020 (thousands tonnes).
### Business Model Canvas

#### Key Partners
- Waste Recovery Platforms
- Firefighting sector associations including the Security Consultants
- Fire Departments and Fire Brigades Organization
- Wooden Chipboard Certifying Organization
- Agricultural Organizations and Consortiums

#### Key Activities
- Communication of the TECHNOLOGY
- Commercial agreement for the collection of phosphorus-based wastes
  - Manufacturing of:
    1) Micro-granular Fertilizers
    2) Extinguishing powders
    3) Flame retardants
- Engagement and Dissemination through the Firefighting associations including the Security Consultants

#### Key Resources
- Exhausted Extinguishing Powders
  - Extraction Solvent
  - Non-phosphorus minerals

#### Value Propositions
- We offer an INNOVATIVE, SUSTAINABLE and GREEN patented technology, which is called PHOSave that enables phosphorus wastes to be converted into HIGH-VALUE products for the Fertilizer and Firefighting markets
- Development and production of specialty fertilizers "heavy metals free"
- Maximization of the revenue/cost ratio by supplying high-quality raw material generated by wastes providing a solution to the problem of exhausted extinguishing powders reducing the CO2 emissions in the industrial chain converting wastes in almost pure raw materials

#### Customer Relationships
- All segments expect to be informed concerning the opportunity to achieve a sustainable supplying of phosphorus raw materials at a lower price
- The Agricultural customers expect to be ensured concerning the suitability of the processed fertilizers for the most common crop applications. Moreover they expect to deal with efficient products
- The Firefighting customers expect to be ensured concerning the performance of the final processed products (extinguishing powders and flame retardants) which is expected to be comparable to the standard ones

#### Channels
- The collection and recovery service will be sold through direct channels
- The derived products for the agricultural market (fertilizers) will be sold through distribution channels
- The derived products in the firefighting markets (extinguishing powder, fire retardant) will be sold through direct channels

#### Customer Segments
- Fertilizer Producers (Agricultural Market)
- Fertilizer Distributors (Agricultural Market)
- Farmers (Agricultural Market)
- Fire Extinguisher Producers (Firefighting Market)
- Fire Extinguisher Service Companies (Firefighting Market)
- Panel Producers (Wood Market)

#### Cost Structure
- PHOSave plant start-up
- Logistics for the Exhausted Powder collection
- Human resources, Chemicals and consumables involved in the PHOSave process
- Marketing and Communication activities
- Certification fees for the Fire Fighting products and Field Trials for the Agriculture

#### Revenue Streams
- Exhausted Extinguishing Powders Disposal Service
- Raw material market
- Fertilizer > Flame Retardant > Extinguishing Powder (in order of profitability)
- License based model supporting the PHOSave scaling process to other European regions
Here below contains the short description of all nine building blocks of the BM as structured in the Business Model Canvas.

**Key Partnerships**
The success of the PHOSave BM depends on the ability to perform the key activities that allow the efficient production and commercialization of processed phosphorous-based fertilizers and, to a lesser extent, flame retardants/extinguishing powders. The following partnership arrangements allow the business to focus on its Key Activities:

- **Develop firm relationships with Waste Recovery Platforms**: these structures play a critical role in collecting/storing the exhausted extinguishing powders from the Fire Extinguisher Service Companies. An important feature of these partners is the logistic that should allow an easy access to the facilities.
- **Develop firm relationships with existing and potential asset contributors**.
- **Establish relationships with technical development hubs**.
- **Establish relationships with Firefighting sector associations including the Security Consultant** in order to improve the reputation of the PHOSave technology and raise awareness of the waste recovery service.
- **Establish relationships with Fire Department and Fire Brigades organizations**: this partner category is strategic to develop and enforce the vigilance activity on the correct waste procedures while educating the market according to the PHOSave approach.
- **Establishing relationships with the Agricultural Organization and Consortiums**: as the agricultural is the main customer segment of this BM, one of the strategic partners is represented by farmer aggregations and consortiums that share common interests and objectives. Due to the influence that such organizations have on farmers, it is important to exploit their network in order to share information and benefits derived by PHOSave.
- **Establish a relationship with the Wooden Particle Board Certifying Organization**: as one of the downstream products of PHOSave can be applied to the wood market, one of the key partners should operate in the certification and testing the resistance to flames.
- **Establish relationships with representative trade bodies** especially in the agricultural sector.
- **Maintain and increase engagement with academic community**.

**Key Activities**
The PHOSave business expects to deliver its proposition through four key activities spanning from the technology and project dissemination, the commercial agreements, and the industrial production. In particular:

- **Communication of the technology**
The PHOSave technology is innovative and applied for the first time to the recovery of phosphorous from waste powders. As detailed in the deliverable D7.1 Communication Plan and Activity, the stakeholders’ audience is broad and characterized by different backgrounds and business interests. The communication and dissemination activity as described in the above-mentioned document is a critical activity for the success of the PHOSave BM.

- **Marketing activities**
As described in the document D7.3 Marketing and business/commercialization plan, we already characterized the target market based on the PHOSave product/service offering. In the document we detailed the two service activities reads, which are the exhausted extinguishing powders disposal and phosphorous recovery, which directly generate value for the Fire Extinguisher Service Companies. Later, the converted raw material take part to the manufacturing process of Fertilizer, Flame Retardant and new Extinguishing Powders generating value for the Agricultural, Wood and Firefighting markets. The understanding of the effective markets that can incorporate the PHOSave business has been a key activity since the earliest stages of the project. Other sub activities include:
  - Activities and promotions to support brand development
  - Consolidation of brand identity
  - Creation and distribution of marketing materials
  - Improve social media effectiveness

- **Engagement and Dissemination through the Firefighting Associations including the Safety Consultant**

- **Commercial agreements for the waste collections**
One of the most critical activities of this BM concerns the commercial agreement with partners that are already involved, or that will start a business, in the collection of wastes containing phosphorous. Both logistics and storage activities impact on the profitability of this BM justifying some particular attention to this key activity.

- **Support asset development and the creation of new assets**
  As a further development of the previous point, the creation of new assets facilitating the collection and more in general the early life-cycle of wastes is a strategic activity in order to maximize the business margins. The creation of Recovery Platforms connected by easily accessible hubs is an activity that improve the success probability.

- **Activities and promotions to increase uptake of asset development approach**

- **Identify and engage potential stakeholder’s customers and contributors**
  As detailed in the D7.1 Communication Plan and Activities, the initial pool of stakeholders (i.e. first shell) is supposed to develop dynamically along with the project and the business activities. This activity includes all the actions described in the D7.1 – Table 3, including the creation of informative materials and the analysis of Key Performance Indicators (KPIs).

**Key Resources**

All the strategic partners and key activities need assets and resources in order to support the PHOSave business. Some of these are services, raw chemicals or research activities connected to the PHOSave technology.

- A regular flow of Exhausted Extinguishing Powders;
- Chemicals for the PHOSave extraction process including organic solvents;
- Non-phosphorous based raw materials for the synthesis of fertilizers and flame retardants;
- The validated interoperable assets and supporting materials;
- A regular flow of new assets
- A regular flow of case studies and Exemplars in order to feed some of the key activities listed above.

**Value Propositions**

The PHOSave model offers an innovative, sustainable and green technology that enables the recovery and valorisation of phosphorous from exhausted extinguishing powders. The technology patented within the PHOSave brand employs chemical and physical steps in order to purify the wastes collected from the firefighting market and providing high-quality raw material. The latter, is characterized by the highest purity grade that has been reached so far with a recycling process ensuring the absence of *silicone oil* and *heavy metals* (i.e. both relevant aspects in the wood and fertilizer markets).

The quality grade of the recovered raw material allows its employment for the production of higher value products such as flame-retardants and most notably NP and NPK micro-granular fertilizers. Hence, the PHOSave technology is a strategic value for those manufacturing companies that share large needs of phosphorous raw materials for the production of fertilizers or chemical additives. The implementation of the PHOSave plant next to their local production generates a sustainable flow of high-quality raw materials increasing marginality and lowering the environmental impacts.

The PHOSave technology incorporates well with the most common values of firms operating in the agricultural field. Concepts as sustainability, eco-compatibility, raw material quality, reduction of CO2 greenhouse emissions, and smart logistics, are some of the strengths of the proposed technology that match well with the identity of the potential PHOSave customers.

**Customer Relationships**

Part of the customer relationships that are common with the Communication Activities as detailed in the D7.1 where all the possible stakeholders were included. Here we define what the customers expect to be informed about concerning the PHOSave business:

- **Sustainable supply of Mono Ammonium Phosphate**
  All the customers need to be informed and updated about the possibility to have access to a continuous supply of phosphorus-based raw materials generated by the PHOSave plants. The key informative features to be transferred are the quality of the converted wastes and how the PHOSave implementation will impact on their profitability.

- **Efficiency of micro-granular fertilizers and eco-sustainability**
As the main target concerns the agricultural market, the customers expect to be aware of the efficacy of the fertilizers produced by the raw materials converted by the PHOSave plant. A relevant section of the Communication and Dissemination activity is dedicated to the collection of experimental thesis on crop applications in order to provide evidences on the efficiency and efficacy of the micro-granular fertilizers. The messages should include and stress how the technology per se is a sustainable evolution of the traditional fertilizer productions and how the micro-granular technology is an innovative and alternative solution for an eco-compatible nutrition of a broad range of crop families.

**Efficiency and quality of flame retardants**
The wood target is a side market where the PHOSave technology can be integrated concerning the granulation of phosphorous-based flame retardants. The main features that the customers expect to be aware of are the quality compliance of the additive in agreement with the national and the European regulations, and the product efficacy. The latter, is a broad topic that highly depends on the customer business, and the national and European guidelines in matter of panel fireproofing. As the previous one, this customer relationship involves the significant contribution not only from the research and development department (or partner’s research laboratory), but also the tight collaboration with the wooden particle board certifying organizations.

**Channels**
In this section we define how the PHOSave propositions are promoted, sold and delivered. It is expected that the distribution channels may change during the business evolution in order to improve efficiency and efficacy.

- The collection of the exhausted extinguishing powders is performed by an authorized company (e.g. ProPHOS Chemicals) that organizes the logistic from the Firefighting Service Company to a temporary authorized storage. (i.e. within the European regulation). From this collecting site the wastes are destined to the Recovery Platform. The strategic advantage proposed by the PHOSave BM is to integrate the recovery platform with the PHOSave recovery plant and ideally with the granulator for the production of fertilizers or fire retardants. This will rationalize the logistic and increase marginalities.
- Based on the PHOSave technology, the raw material flow derived is employed for the production of fertilizers. This implies the opportunity to sell via Distributors or directly to the End Users (i.e. farmers). A detailed description of these segment targets has been reported in D7.1 section 3. Currently, ProPHOS Chemicals aims at investing in the distribution channel instead of directly selling to the end users.
- The firefighting (i.e. wood and extinguishing powders) customers are going to be reached via direct channel

**Key Customers**
The key customers are stakeholders involved in the Agricultural, and in lesser extent, the Wood and Firefighting markets. They are connected to this BM as the end users or dealer of processed products (i.e. fertilizers, flame retardants or extinguishing powders) or they can be the licensor of the PHOSave technology and most likely producers themselves of fertilizers. They have been discussed in detail in the deliverable D7.1 Communication plan and activities. Here below we schematize the customer segmentation and their specific connection to the PHOSave BM:

- **Fertilizer Producers**
  Large and medium size companies involved in the production and commercialization of fertilizers. These customers are interested in two potential streams of business, in other words the distribution of fertilizers under Private Label/Co-branding policy or the integration of the PHOSave technology in licensing for their own production. The strategic advantages potentially introduced through PHOSave is supposed to be a key argumentation of this target.

- **Fertilizer distributors**
  It includes the wide distribution of fertilizers. They are not interested in the PHOSave implementation but in the fertilizers obtained employing its technology. The advantageous prices offered thanks to the raw material recovering is a key message for this target.

- **Farmers**
  Even if for the specific case of ProPHOS Chemicals, farmers are not an ideal customer target. The PHOSave technology allows the Fertilizer Producers of Distributors to reach the agricultural end users directly. It is a sensitive target as they are the final investors and their revenue depends mostly on the efficacy of the fertilizers. Hence, a tailored message (i.e. as described in the D7.1) needs to be applied to this customer in order to convince them on the high quality of the products and the responsible way to use fertilizers.

- **Panel Producers**
Well established firms with a long-term experience. This customer tends to be loyalty secured and the competitor suppliers are hard to be removed. Nonetheless, their needs in terms of chemical additives such as the flame-retardants are usually large justifying the integration of PHOSave in a framework similar to ProPHOS Chemicals.

- **Fire Extinguisher Producers**
  Spanning from large to small companies, which are usually sensible to eco-friendly messages. This target is likely interested in the extinguishing powders supply at the most favorable price/quality compromise. However, as with the Fire Extinguisher Service Companies (i.e. see below), this is not a hot target for the processed powders. Indeed, it is realistic to believe that the partners/customers providing the waste materials to sustain the PHOSave plant won’t be willing to purchase recovered materials. It is worth mentioning that this target is currently a competitor as the Extinguisher Producers often mediate the disposal service of the exhausted powders. The implementation of the PHOSave technology turns these actual competitors in potential customers for the waste recovery service.

- **Fire Extinguisher Service Companies**
  This segment is a key customer for ProPHOS Chemicals. This customer is governed by country regulations that request to periodically replace the exhausted extinguishing powders. As the Fire Extinguisher Producers, they might be potential customers for the recovery service.

**Other minor targets**
- Primary Industrial Stakeholder groups
- Primary Agency and Governmental Stakeholder groups
- Primary academic and or Educational Stakeholder groups

**Revenue Streams**
In this section we list the main revenue sources derived from the entire PHOSave business cycle. It includes the cash flow derived from product selling or services but also the potential value of the recovered raw materials. In particular, we identify:

- Exhausted extinguishing powders disposal services. As mentioned, this is a crucial activity that allows the constant supply of wastes, which are the primary sources for the PHOSave treatment. For this revenue stream the customers are identified in the firefighting segment.
- The potential value of the recovered raw materials (50% monoammonium phosphate + 50% ammonium sulfate). This product can be sold as raw materials, but valorised by the higher quality due to the absence of heavy metals.
- As a further development of the previous point, the recovered raw material can be used for other products processing allowing for high-quality micro-granular fertilizers, flame retardants and extinguishing powders (i.e. the list of products is coherent with their priority and profitability).
- PHOSave Licensing fees, royalties, joint venture and partnership. To maximize the return on revenues, minimizing the environmental impact and realizing an efficient circular economy, the fastest way to widespread this technology is to replicate the model presented in this project in other countries and companies. Such a scheme allows for a reinforcement of the partners involved, a better and faster market penetration as well as the creation of virtuous cooperation.

**Cost Structure**
In this section there are the main costs that ProPHOS Chemicals or any other licensor would have to face setting up the PHOSave business cycle. The list includes the effective costs for the installation of the plant, all the chemicals, consumables, human resources, and the marketing activity. Depending on the target, firefighting or agricultural, some certification fees may apply in order to register one specific product. In particular, we identify:

- PHOSave plant start-up
  This cost structure includes all the standard process behind the plant sizing, projecting, authorization fees and installation
- Logistics for collection and storage of the exhausted extinguishing powders
  Depending on the place where the PHOSave plant is going to be settled (i.e. in the case of ProPHOS Chemicals, North of Italy) the logistics for the waste collection may represent a relevant cost centre.
- Human resources, chemicals and consumables
• Marketing and communication activity
  Communication and dissemination of the project are important activities of PHOSave. In deliverable D7.1 we highlighted strengths and risks for the communication strategy and we identified targets and stakeholders for an effective dissemination.
• Certification fees
  This cost depends on the kind of product and its reference market.

3 Scalability, profitability, and risk analysis
To the best of our knowledge, the PHOSave technology is a unique solution capable of recovering the exhausted extinguishing powders, into high-quality raw materials, characterized by superior physical and chemical features when compared to the natural sources. Part of this advantage is due to the almost complete reduction of heavy metals during the recovery process. Furthermore, the PHOSave process is able to separate silicone oil from the mineral components that are used to produce the extinguishing powders. This aspect is of critical importance as it guarantees the eco-compatibility of the technology and it extends to a wider scope, the application of the derived products. Most notably, the PHOSave technology avoids soil, air and water contamination resulting from pollutants over a long period of time.

As anticipated, the BM presented is driven by three main dimensions: 1) the model scalability, 2) its profitability, and 3) the risk analysis. If the latter is somehow connected to the evaluation of the strengths, weaknesses, opportunities and threats, which have already been discussed in the deliverable D7.3, the scalability and profitability dimensions are relatively new concepts. They find their clear definition in this document.

3.1 The Scalability Dimension
The scalability of PHOSave is its capability of handling a growing amount of work. The ideal scalability is reached by a linear output growing under an increased load of resources. This dimension is critical for the PHOSave implementation as it allows for part of the revenues based on the licensing model (Figure 2) and it assists the brand identity consolidation. Moreover, the scalability is influenced by internal and external factors:
• Internal factors
  These are intrinsically connected to the company operating within the PHOSave framework (e.g. ProPHOS Chemicals). They include:
  ➢ Communication and dissemination abilities;
  ➢ Expansion attitude by means of acquiring new assets, involving new stakeholders and partners, finding large volumes of key resources at competitive prices.
• External factors
  These depend on factors that cannot be directly managed by the PHOSave owner or licenser. They include:
  ➢ Access to local ports and logistic hubs;
  ➢ Integration of the logistic network;
  ➢ Availability of large volumes of exhausted extinguishing powders;
  ➢ Access to local Recovery Platform;
  ➢ Possibility for integration of Recovery Platform to the PHOSave plant and the granulator for manufacturing fertilizers;
  ➢ Market quotation and availability of pure raw resources such as monoaommonium phosphate;
  ➢ Competitive technologies.

By analyzing each new potential market and quantifying each factor listed above provides a rational estimation of the success probabilities when exporting the PHOSave model to other European regions. This estimation is tightly connected to the profitability that ensures the model scaling to be efficient on the economy bases.

3.2 The profitability dimension
The profitability is a financial metric that is used to assess a business's ability to generate earnings compared to its expenses and other relevant costs incurred during a specific period of time. This dimension is positively influenced by the market price of pure raw materials. (i.e. monoammonium phosphate)
A series of Profitability Ratios have been taken into account to evaluate what the PHOSave BM to adopt. Specifically:

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<th>Margin ratio</th>
<th>Gross margin ratio</th>
<th>Net profit margin ratio</th>
<th>Operating ratio</th>
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Due to a series of variables affecting the final result (fiscal legislation, depreciation of fixed assets, and so on), the best benchmark appears to be a variant of “Gross margin Ratio”, understood as total sales revenue minus its cost of goods sold (COGS), divided by total sales revenue, expressed as a percentage.

Gross Margin (%) = \frac{Revenue - COGS}{Revenue}

The variant is based on the assumption that the gross margin number represents the portion of revenue that the company retains as gross profit.

PHOSave process structure allows to obtain a series of well identified new revenue emerging from the recovery chain. These revenues appear as an additional pure margin in a production contest if analyzed individually. In fact, without considering COGS, it is possible to isolate the following families of revenue:

- exhausting extinguishing powders disposal service;
- recovered raw material value (monoammonium phosphate and ammonium sulfate)
- gross margin on the final selling price

The sum of these revenues represents the gross profit of the PHOSave recovery process in the assumption of a direct management of it.

However, to ensure a long-time sustainability of the BM, and a widespread diffusion of the PHOSave methodology outside Italy, the BM should be balanced in scalability, profitability, and risks aspects. Due to this, the direct approach presents a series of risks, such as important start-up costs, unknown legislation, and competitors.

On the opposite side, the sale of turnkey plants would lead to one-off revenues, with little effects in the long term. So, the PHOSave technology, licensing to fertilizer producers, combined to:

1. a series of collateral services (hardware and database know-how, sophisticated laboratory analysis, multitasking external assistance, specialty fertilizer formulations),
2. agreements or joint ventures capital,

seems to be the most profitable and sustainable way.

3.3 The risk analysis

The PHOSave risk analysis is strictly connected to the SWOT presented in the deliverable D7.3. It can be applied both to the case of ProPHOS Chemicals in the development of the PHOSave business and to any other company joining the model in their local region and combining the technology to their own business. As described in the previous deliverables there are some key factors that support the business development:

Positive effects:

- Good understanding and implementation of the technology
- Optimized cost productions
- Flexible productivity
- Partnerships with R&D oriented companies
- Developing their own R&D
- Growing market price for raw materials

Negative effects:

- Low marginality for finite and processed products
- No access to port facilities and logistic hubs for the collection of exhausted extinguishing powders
- Small network within the firefighting market

Swot Analysis
4 Cost structure and revenue stream

Considering the cost structure for the business model for PHOSave, four main headings should be taken into consideration.

I. Being that PHOSave is an industrial process; it implies invest into equipment and plants. ProPHOS acquired specific information and experiences during the project period, having realized a complete pilot-plant. These data will permit other companies to build new plants with the right dimension and capacity. The PHOSave plants appear perfect as synergy integration for fertilizer production companies. Collected data show that the whole investment could be covered within two-three years, depending on the revenues developed and on the exploitation of the plant production capacity.

Another important aspect is that a scale-up of the first installation can be realized with a modular engineering allowing for a big reduction on the investment obligations side.

II. Human resources represent a fundamental element in an industrial process. PHOSave integration into an existing fertilizer production activity, clearly maximizing the scale economies. Particularly, a right dimensioning of the plant should foresee a 24h activity. Therefore, new human resources will be needed, with a personnel rotation structure respectful of laws, security and working conditions.

III. Like human resources, utilities and consumables in the PHOSave production methodology show interesting scale economies. These cost families are strictly connected to the output production. ProPHOS analyzed a continuous stream of data on this matter. Result evidences confirm that the adoption by a fertilizer producer of a PHOSave plant, whose engineering is properly studied, has a lower impact on the utilities and consumables side.

IV. Countries legislations constitute a key element for several aspects. In Europe on the exhausting firefighting powders issue, we have presence of EU laws and single country laws. This affects:

a) the exhausted powders collection and the disposal service structure;

b) the complying to environmental standards requested by law; and

c) the speed of the market penetration.

Stream revenue
As for the revenue streams, ProPHOS discussed different options. As said above about “Profitability”, the PHOSave recovering process fits very well with fertilizer producer companies.

However, the wood sector and still the extinguishing powders sector are not ignored, as the opportunity to develop and sell a new family of flame retardants and high performing powders.

Whilst validation of a single business model was not achieved, it was established that a hybrid model was likely the most viable, and that future works should be undertaken in developing the hybrid model adapting it to every individual territory (markets and customers).

We reiterate that the revenue streams consist in:

1) Revenue for exhausted extinguishing powders disposal services. PHOSave will generate cash flow revenue both for the service directly managed in Italy, than for other European Countries managed with economic partnership agreements.

2) Revenues from recovered raw materials (50% monoammonium phosphate + 50% ammonium sulfate). The PHOSave technological goal is to recover about the 95% of the 50% monoammonium phosphate plus the 50% ammonium sulfate, contained in the exhausted extinguishing powders. These are big components in the value chain, although this part of revenue is related to the raw material market quotation. Figure below shows the DAP quote trend in the latest 5 years.

![DAP Quote Trend](image)

After a decline, market quotes started an uptrend and the outlook for 2018 seems to confirm this growing trend. Recent economic turbulences such as import duty “war” and “Brexit” could affect the price of raw materials. Obtaining raw materials in an almost pure form from the PHOSave recovering process enables mitigation of price fluctuations while ensuring a stable cost production structure. The best usage of these recovered monoammonium phosphate and ammonium sulfate is in the fertilizer industry. This is due to their high quality that allow for producing specialty fertilizers. Furthermore, fertilizer producer companies could exploit big synergies between their existing plants and the integration of PHOSave technology. The construction of the PHOSave plant during the project period will allow ProPHOS to maximize this aspect directly in its chain production. With proper agreements ProPHOS will seek to expand its business in the European market.
3) Revenue from licensing fees, royalties, joint ventures and partnerships are crucial in the proposed hybrid model to exploit the PHOSave technology in a fast way. Intellectual Property and Access Rights will be contracted between the parties to agree and to define the basic principles for protecting Intellectual Property Rights (IPR) deriving from project activities. This framework allows for an effective collaboration among partners for reaching the production and research objectives, as partners know that their IPR and know-how are protected. Agreements will establish the rules for the collaborative work to be undertaken in future project cooperation and at the same time they will define the boundaries to protect the IPR of partners. Agreements in every form will be adopted, and will achieve big opportunities of revenue for all the stakeholders.

To conclude, for PHOSave technology, a hybrid Business Model appears as the best candidate to assure a sustainable revenue stream structure, with a direct management of ProPHOS Chemicals srl for Italy, and the exploitation of PHOSave in other European markets through specific agreements.