Triggering the creation of biomass logistic centres by the agro-industry

SUCELLOG: IEE/13/638/SI2.675535

D6.3
Auditors Guide

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About SUCELLOG project

The SUCELLOG project - Triggering the creation of biomass logistic centres by the agro-industry - aims to widespread the participation of the agrarian sector in the sustainable supply of solid biofuels in Europe. SUCELLOG action focuses in an almost unexploited logistic concept: the implementation of agro-industry logistic centres in the agro-industry as a complement to their usual activity evidencing the large synergy existing between the agro-economy and the bio-economy. Further information about the project and the partners involved are available under www.sucellog.eu.

Project coordinator

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RESEARCH CENTRE FOR ENERGY RESOURCES AND CONSUMPTION

Project partners

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About this document

This report corresponds to D6.3 of the SUCELLOG project –Auditors guide. It has been prepared by:

SPANISH COOPERATIVES
Agustín de Bethencourt 17, 28003 Madrid
E-mail: cooperativas@agro-alimentarias.coop
Tel: +34 91 535 10 35

With collaboration and input from CIRCE

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1. Introduction

SUCELLOG supports the creation of biomass logistic centres inside agro-industries covering the gap of knowledge faced when willing to start this new activity. Within work package 6 (WP6), SUCELLOG provides an auditing service facilitating the decision-making to the agro-industries interested in becoming a logistic centre.

The present document is a guide to be used by the auditor or by the agro-industry itself when performing an economic feasibility study of the new business line. The feasibility assessment has two aims:

1. Provide the minimum price that the solid biomass produced should have to overcome production costs. This minimum price will serve to understand if the product can be competitive in the market of the region/area.

2. Determine the viability of the project from the economic point of view.

It is important to highlight that this guide has two "partner" documents elaborated by SUCELLOG project. These two documents can be downloaded in the website, without them this guide has no sense, so a prior careful look to them is recommended to understand the meaning of all the aspects included in it:

- An excel-sheet where the auditor will have to include certain data about costs (of the raw material, of the pre-treatment operations, of the personnel costs, etc.) and the sheet will calculate the figures to be evaluated in order to determine the feasibility of the project.

- The "Handbook for medium-aware users: How to make a feasibility study" (Handbook 2) which gathers all the information about the aspects that will be treated in this guide, the importance of each of it and how to reach it. All technical aspects of the new business line will be treated in this document.

Additionally, it could be of interest to review the feasibility studies of 4 real cases of agro-industries in Europe that were performed within SUCELLOG-WP4. All cases were assessed using the same excel sheet and principles that are presented in this auditor's guide. Documents can be downloaded in the website in English and in the corresponding national languages.

In case you are not familiar with biomass issues yet, a careful look to Handbook for beginners: the basic demand of information (Handbook 1) is highly recommended.

2. Feasibility study

As it was said in the introduction, the audit will be the tool to develop an economic feasibility study of a new activity as biomass logistic centre.

However it is essential to understand 4 important issues before starting the evaluation:

- There is a market where the agro-industry can sell the products and which are their quality specifications.
- There is raw material (in quantity and quality) to make the expected production.
- There are logistic chains that can supply the raw material (there are or can be easily created).
- The facilities of the agro-industry are able to manage the raw material.

These 4 issues are treated in the Handbook 2 (the first 2) and in Handbook 1 (the last 2) and should be clear enough for the performance of the auditing.

This auditor guide will just assess the opportunities from the economic point of view with the aim of helping decision-making and of showing the different business options to the agro-industry.

For the economic study, different scenarios could be consider depending on several items such as type of raw material to be used or the quality and the format of final product.

A summary of the steps to be followed is presented below. Details can be found in the next sections. All the calculations needed for each part of the economic feasibility study will be described according to the excel-sheet designed for this purpose.

3. Step 1: Determination of the minimum selling price

The minimum selling price (€/t of product) is the price at which the logistic centre would be able to sell the product covering:

- Production costs.
- Amortization rate of the investment in equipment required for production (if desired).
- The minimum profit stated by the agro-industry (if any).

At a first stage, the cost of production (€/t) of the solid biomass by the agro-industry will be deeply analysed. This includes: the cost of the raw material which is going to be used for the production of solid biomass, the pre-treatment costs, the personnel costs, other costs associated to the final production cost as the transportation cost of sales to the consumer, storage costs, etc.

If any investment is needed, the agro-industry might want to charge a rate of amortization in the price of the product (€/t) during the period of years in which the investment wants be recovered.

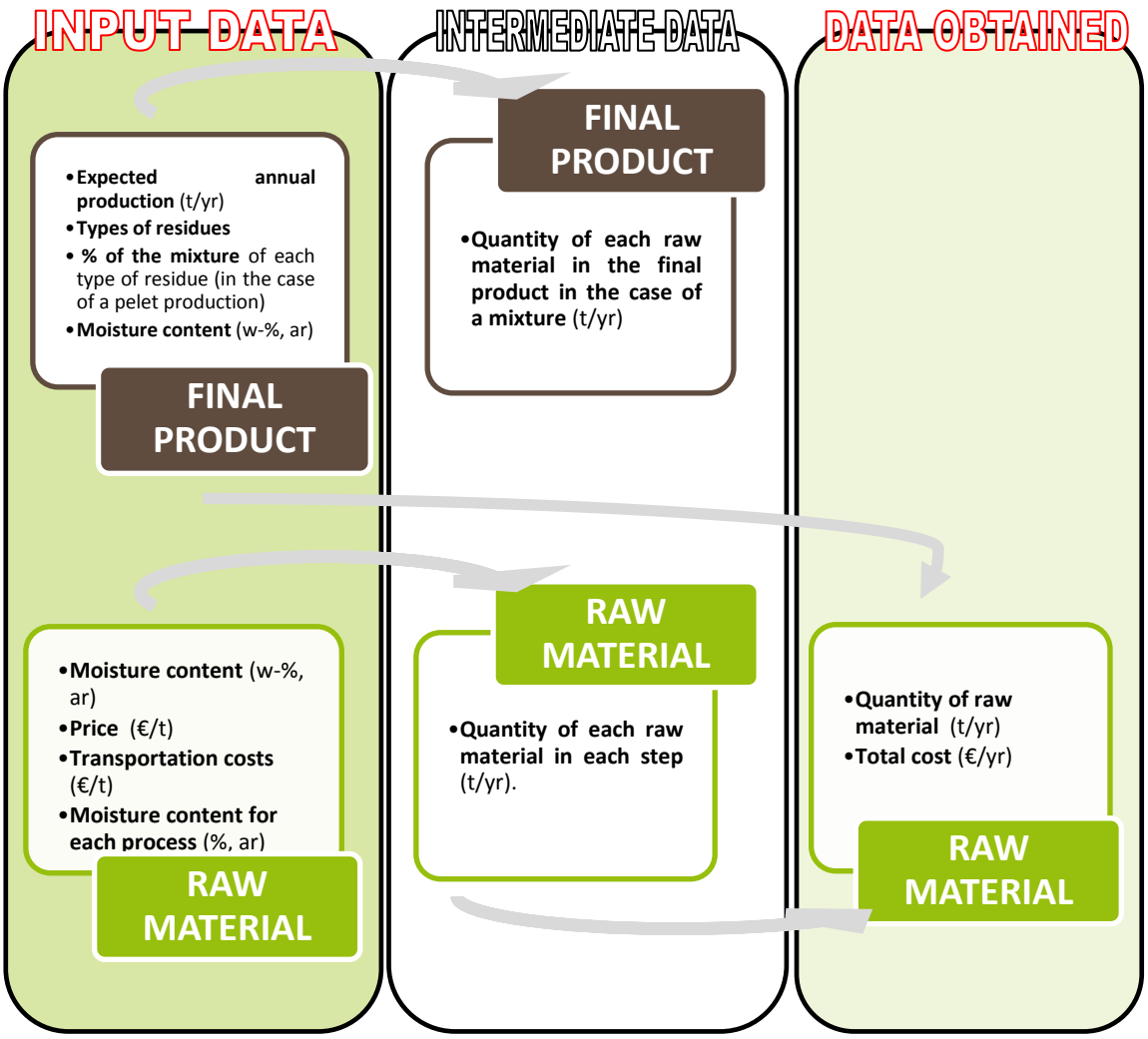
Finally, regarding the profit, the agro-industry might want to set a minimum value (€/t). Otherwise the agro-industry might not want to start this business line.

3.1. Calculation of production costs

3.1.1. Raw material purchasing cost

One of the most important share of the final product cost will come from the cost of the raw material. In that sense, it is essential to determine the quantity of the raw material that will be required to make X tons of the final product, which will depend mainly on the moisture content of the raw material and of the final product. For example: if the product desired is a pellet (whose moisture content is around 10 % on wet base) and the raw material has 40 % moisture content, a drying process will be required to achieve the product moisture content. The removal of water means a loss of weight that should be taken into account when calculating the amount of raw material to be purchased for a certain quantity of product.

Therefore the most important items to be calculated are **the quantity and the total cost of the raw material required for the expected amount of final product**. For that, in the excel sheet, it should be necessary to include some data in the tab “Raw material purchasing cost” according to the following scheme:



NOTE: ***"w-%, ar"*** is referred to "weight percentage as received, that is, on wet base, kg of water per kg of green product.

Input Data:

As it is shown in the scheme, the data to be included will be referred to both the final product and the raw material

- **Final product:** It could be a product made with only one type of residue or made of several types of residue (for example mixed pellets made of straw and wood).
  - **Expected annual production**: tonnes per year of the final product.
  - **Types of residues** the product will be composed of.
  - **% of the mixture** of each type of residue in the mixed pellets (if applicate; if the product is not a mixture of different resources then include 100 %).
  - **Moisture content** (w-%, ar) of the **final product**.This data is fixed by the corresponding international standard for the case of the pellets (10 %). In the case of other products, the agro-industry should state which is the moisture content of the potential consumer (25 % for wood chips can be acceptable).

- **Raw material:**
  - **Moisture content** (w-%, ar) of each of the **components of the final product** (raw material fresh).
  - **Moisture content** (w-%, ar) of the **raw material in each step** (after storage and before drying, after drying and before pelletising, , etc).
  - **Price** (€/t) of **each of the components of the final product**, transport to the agro-industry not included. This price should exclude VAT.
  - **Transportation cost** (€/t) of each of the **components of the final product**.

Intermediate data:

By the introduction of the data referred above, several data will be automatically obtained.

In a first step, with the basic data of the final product, **the quantity of each type of residues in the final product** (t/yr) will be obtained in the case that the final product is a mixture of several resources.

Secondly, since the total pre-treatment cost (€; see next section) will depend on the amount of raw material treated, it is important to know the quantities that are fed to each process. Therefore, for example for the pellet production, it is required to know how many tons will be chipped, how many tons will be dried and finally how many tons will be milled and pelletised. These quantities are different because in each process the moisture content varies. So, inserting the **moisture content** (w-%, ar) **of the raw material in each step**, the amount of **raw material that enters each process** (t/yr) will be automatically calculated. Two considerations should be beared in mind for this purpose in the case of pellet production:

- It should be known if the raw material must be dried or goes directly to the pelletising stage (sometimes the resource is around 15 % (w-%, ar) and most probably drying is not required).
- The moisture content of the raw material should be around 13-14 % (w-%, ar) before starting the pelletising stage. This ensures a final moisture content of 10 % (w-%, ar) in the resulting pellets.

Data obtained:

The **quantity of raw material** (t/yr) needed for the new business activity and the **total cost** (€/yr) of it will be determined.

3.1.1.1. Consideration for the production of a mixed agro-pellet

When the aim is to produce an agro-pellet, it should be considered that there is a standard (ISO 17225-6) counselling on the final quality to be achieved. Not fulfilling these requirements can lead to a problem in energy conversion.

Therefore, in this case, before including the quantities of each raw material in the tab called “Raw material purchasing cost”, a previous quality-check should be performed.

In the tab called “1.1 Only for agro-pellet product”, the chemical characteristics of the different raw materials of the mixed agro-pellet should be inserted. Most important characteristics are: calorific value on dry base, ash content on dry base and chlorine content on dry base. If they are not known, values from bibliography can be included as a first approach (see average values coming from the standard ISO 17225-1 for some resources).

To obtain the mixture that fulfils the standard quality values, the user should play with the percentage of content for each raw material in the final mixture. A colour code will warn when the requirements from the agro-pellet type B are not achieved.

The user should bear in mind that in some cases the inclusion of wood can be a solution to upgrade the mixture quality.

3.1.2. Pre-treatment cost

After the purchase of the raw material, it has to be conditioned to achieve the product quality requirements demanded by the consumer. The pre-treatments processes change the characteristics of the raw material in terms of format (pelletising), moisture content (drying), particle size (shredding, chipping, milling) and amount of fines (screening). They are processes of high energy consumption and for this reason are considered an important part of the production cost. Storage costs, both of the raw material and of the product should be also taken into account and in this Auditors Guide will be included in the pre-treatment cost.

The higher the quality requirements, obviously the higher the pre-treatment costs and in turn, higher prices in the solid biomass market.

The pre-treatment process line will be determined by two variables, the main characteristics of the residue to be treated (moisture content for example) and the quality characteristics of solid biomass to be produced. Few examples are shown below:

If the desired product is a straw pellet, after purchasing the straw it should be evaluated the moisture content. This value will provide the information to understand if a drying process is required. Pellets should have a value of moisture content around 10 % (w-%, ar) and therefore if the straw is purchased at 15 % (w-%, ar) most probably would not need drying. A small reduction of moisture content will, however, come from the pre-treatments that will object of: shredding if it comes in bale format, chopping, milling and pelletising.

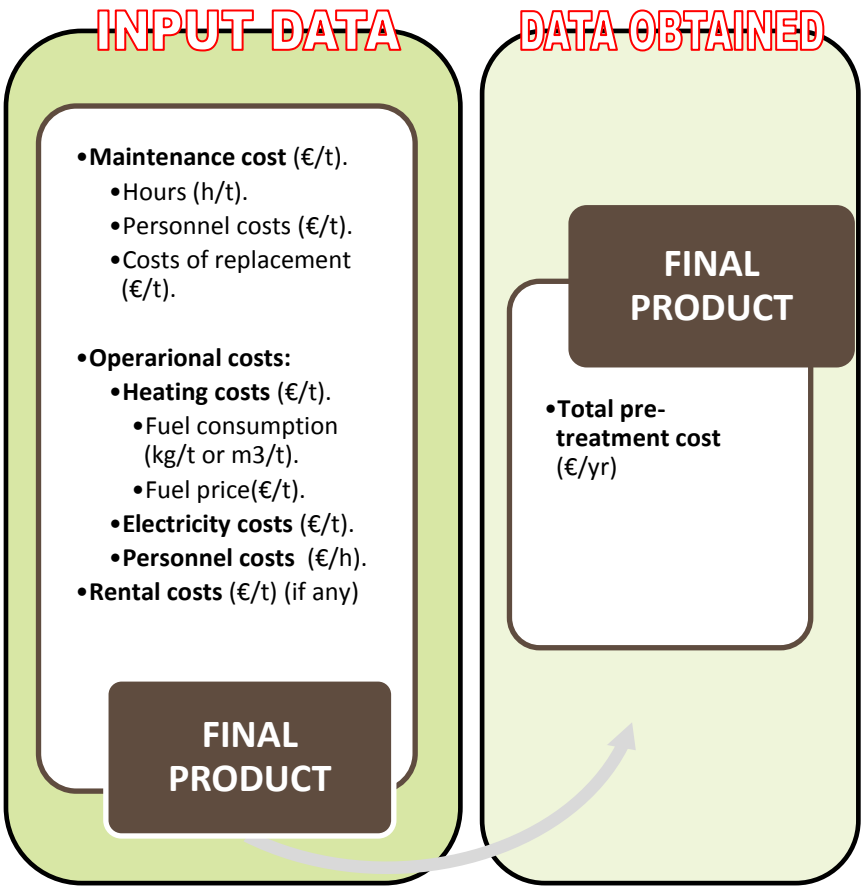
Corn cobs could be used for the production of several kinds of product format. If the consumer requires loose cobs (no grits) at a moisture content of 25 % (w-%, ar), because his/her boiler is prepared for that particle size and moisture, it will not need

any conditioning since most probably natural drying will reduce moisture content to that level. However, if the consumer demands the corn cobs grits at 10 % (w-%, ar), the cobs will need chopping and drying until they reach the desirable parameters. Finally, for the production of pellets, it would be firstly necessary chipping and drying followed by milling and pelletising.

In the case of the use of wood chips for the production of mixed pellets, a drying process will be required for achieving the suitable moisture content (10 %, w-% ar). Depending on the size of the chips, a previous reduction particle size before the drying process could be also needed (depending on the maximum particle size stated by the dryer manufacturer in order to ensure a proper drying).

If the raw material is olive pomace and the desired product to be sold in the market is olive pits, the pre-treatments would be: centrifugation, drying and screening for dust removal.

Having this information as starting point, the **pre-treatment cost** should be calculated including some data in the tab “Pre-treatment cost” following the scheme:



Input Data:

Once the pre-treatment processes required are defined, it is necessary to know or to estimate their cost: **electricity and heating costs** as well as **maintenance costs**. Sometimes it is not so easy to get this data for a product that has never been used by the agro-industry. Since costs are highly variable from country to country, data from bibliography should be taken into consideration only if no other solution is found. In these cases, a conservative extrapolation from the costs of the usual product is recommended taking into account the characteristics of the new material and the different flow in the equipment. For example: a dehydration facility can have a dryer capacity of 14 t/h with lucerne but with straw it decreases to 10 t/h since the feeding system is not designed to work with this type of material, which is lighter. The costs of drying straw are different from the ones of lucerne, not only because of the different initial/final moisture content of the resource but also because in one hour of operation it is processed 10 t of straw in contrast to 14 t of lucerne. The person in charge of the operation will help to define the cost figures. **ALL VALUES SHOULD BE INCLUDED AS €/t OF MATERIAL AT THE INLET OF EACH EQUIPMENT**.

- **Maintenance costs (€/t of material at the inlet):** This cost should be known **for each type of raw material** and **for each phase of the production process**. It includes several items like:
    - **Hours used for the maintenance (h/t):** number of hours spent for the maintenance of the equipment used in each operation.
    - **Personnel cost (€/h):** in the tab called “Personnel costs”, for the person in charge of the maintenance, it should be placed the salary and the number of working hours per year in order to reach the hourly rate.
    - **Cost of replacement parts of the equipment (€/t):** this cost should also be considered. For example, the knives in the milling system or the die in the pelletiser are periodically replaced.

- **Operational costs (€/t of material at the inlet):**
    - **Electricity cost (€/t of material at the inlet):** It should be necesary to know or to estimate the cost of the electricity that each needed process is consuming (in some cases the electrical cost of the drying is negligible).
    - **Heating cost (€/t of material at the inlet):**
        - **Fuel consumption (kg/t or m3/t):** for the dryer mainly, it is essential to understand the amount of fuel consumed.
        - **Fuel price (€/t):** It should be necesary to know or to estimate the cost of the fuel (natural gas, biomass, etc) needed for each stage of the process.
    - **Personnel cost (€/h):** in the tab called “Personnel costs”, for the person in charge of the operation, it should be placed the salary and the number of working hours per year in order to reach the hourly rate.

- **Rental cost (€/t):** If that is the case, the cost derived from the rental of a machinery has to be included as part of the pre-treatment cost.

Data obtained:

The **total pre-treatment cost (€/yr)** for the new bussines activity will be determined.

3.1.3. Personnel

In the corresponding tab of the excel sheet "Personnel" it should be needed to include:

- **Personnel cost**: in this tab it should be included the personnel cost referred to:
  - **Maintenance:** it should be placed the personnel costs for the company (€/yr) and the number of working hours per year (h/yr) in order to reach the hourly rate (€/h).
  - **Operational:** personnel costs for the company (€/yr) and the number of working hours per year (h/yr) to reach the hourly rate (€/h).
  - **Support:** another personal required for the new business line (general manager, sales manager, administration department, etc. Apart from the personnel costs for the company per year (€/yr), it should be identified the % of the total salary dedicated to the neww business activity with the purpose of knowing the total costs of support personnel **(€/yr)**.

It should be bore in mind that the personal associated with operational and maintenance labours should be used to calculate the "Pre-treatment costs".

3.1.4. Production cost and cost division

The production cost is the sum of:

- Purchasing costs.
- Pre-treatment costs.
- Personnel cost (support personnel only)

In this case, the **production costs (€/t of product)** will be automatically calculated in the tab "Production cost". The distribution of costs obtained will be graphically represented in order to understand which is the share among costs and, if needed and possible, where to decrease costs.

3.2. Investment cost - Amortization rate

The possible **investments** to carry out for the new business line should be analysed and included in the "Investment" tab of the excel sheet. An amortization rate should be charge to the product selling price if desired.

3.3. Minimum profit

In the tab called "Minimum Profit" it should be placed the **minimum profit** per unit of product (€/t) required by the agro-industry to start operation and cover possible risks.

3.4. Minimum selling price

As said in the introduction of section 3, **the minimum selling price for the product (€/t)** is the sum of the production costs, amortization rate and minimum desired profit. This minimum selling price ensures therefore the production of the new business activity covering these 3 expenses. It will be automatically calculated in tab "Minimum selling price".

With the purpose of comparing the final product with the competitors, sometimes the minimum selling price should also include the transport costs to the consumers.

4. Step 2: Evaluation of competitiveness in the local market

To assess the success of the new product in the market, the minimum selling price of the product should be compared with the current solid biomass sold locally/regionally. A study of the biomass market should be therefore performed determining format of the products, their price and their quality characteristics (see Handbook 2 section 1.2).

Two important things should be taken into consideration for the evaluation:

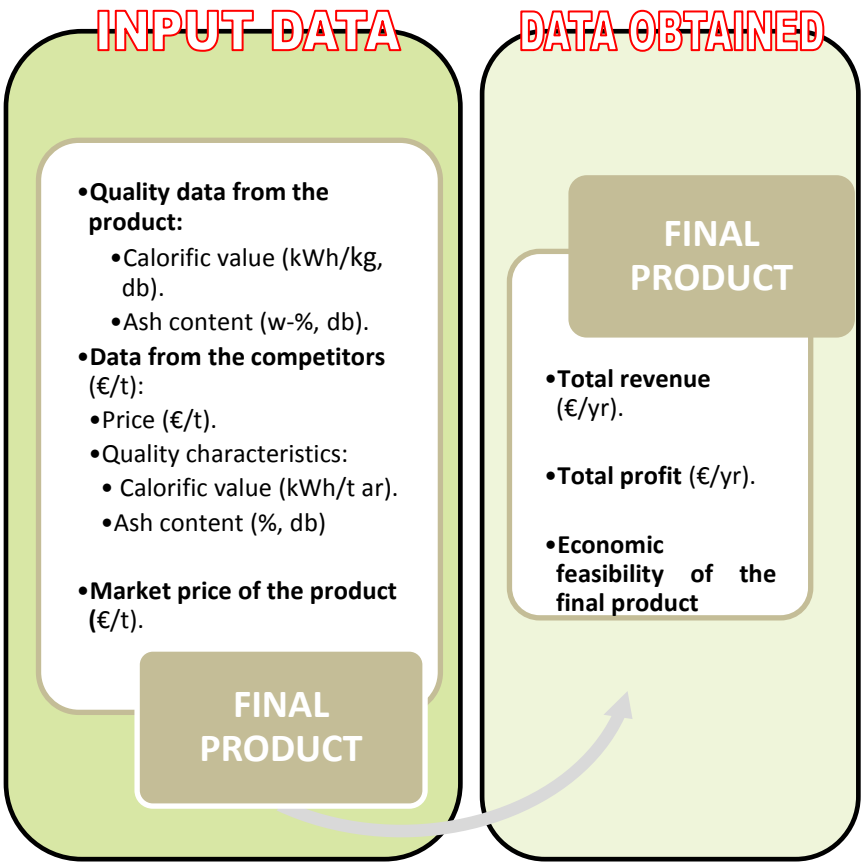
- **The comparison between products should not be made in terms of price per ton (€/t) but in energy cost (€/kWh) and ash content (w-%, db).** Since in some of the cases, the products offered by the agro-industry logistic centre do not have a real market price yet, an estimation has to be done taking into consideration the price of similar products in terms of format and quality (calorific value and ash content).

- **It is essential to make the comparison in the same base concerning VAT and transport. If the competitive products prices include these two items then, they both should be discounted in order to be comparable to the minimum selling price of our product (or the other way round).**

The comparison will conclude if the minimum selling price of the product is acceptable, too high or too low. If it is considerably higher than the competitors, then

the calculations of the minimum selling price should be revised and adjusted. If, on the contrary, the price is reduced compared to other similar products, a higher price of the products should be fixed (market price), resulting in an additional profit.

The following information should be added in tab “Evaluation of competitiveness” by the following scheme:



NOTE: “***%, db”*** is referred to “weight percentage on dry base, kg of water per kg of dried product” ***w-%, db***.

Input Data:

- **Quality data from the product:** reference values of calorific value (kWh, db) and the ash content (w-%, db) of different products have been included in the Handbook 2. In the excel sheet the corresponding values for the product should be set. Calorific value will be automatically corrected with the final moisture content of the product. The minimum selling price in €/kWh will be automatically calculated and will allow to compare the final product with the competitors.

- **Data from the competitors:** the price and the quality characteristics of the products that can be competing with the final product should be included. It should be important to know which kind of costs are included in the price of

the competitors, that is, for example, transport to the final consumer, storage, taxes.
    - Price (€/t; transport and VAT excluded)
    - Quality characteristics: Calorific value (kWh/t ar) and ash content (w-%, db)

- **Market price of the product (€/t):** from the comparison with competitors, set a convenient price of the product in the market. This price will set the incomes of the project.

Data obtained:

- **Total revenue (€/yr):** It is the result of the **quantity** of the final product (t) sold at the **market price** (€/t).
- **Total profit (€/yr):** It is the result of considering the **quantity** of the final product (t) and the **real profit for the market price** (€/t).
- **Economic feasibility of the final product:** in accordance with the comparison between the **market price of the product** and the **minimum selling price of the product**, it could be possible to estimate the most suitable products for the logistic centre in economic terms.

5. Step 3: Assessment of the project profit

The balance between the incomes and the expenses will define the profitability of the project. A series of economic indicators like the **NPV** (net present value), the **IRR** (internal rate of return), the **ROS** (return on sales) and the **payback** (in case of investments) will be calculated for this purpose in the tab “Profit”

The only data to include in the sheet is the discount rate set by the agro-industry.

All the **expenses** (€/yr) are automatically calculated:

- Investments.
- Raw material purchasing costs.
- Pre-treatment costs.
- Personnel.
- Transport to consumers.

In the same way, the **incomes** (€/yr) will

- Sales revenue.

If there is any additional income is obtained from the development of this activity it should be also included.

The resulting economic indicators should be presented to the agro-industry (the meaning of each indicator is explained in the Handbook 2, section 3) since the governing body is the one who has to evaluate the convenience of the project according to results.

6. Conclusions

This document pretends to be a simple guide to make an economic feasibility study for a new business line as biomass logistic centre.

Since each case has their own particularities, the reader should not use the guide and the excel-sheet as an “untouchable” document. On the contrary, both may be modified according to the data inputs able to be gathered from the agro-industry.

In order to accompany this economic assessment with an evaluation of the technical viability of the new activity, a recommendable starting point will be an adequate read of the “Handbook for medium-aware users: How to make a feasibility study”.