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Procedia Environmental Science, Engineering and Management

22nd International Trade Fair of Material & Energy Recovery and Sustainable Development, ECOMONDO, 6th-9th November, 2018, Rimini, Italy

Selected papers (4)

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Aims and Scope

Procedia Environmental Science, Engineering and Management (P - ESEM) is a journal focusing on publishing papers selected from high quality conference proceedings, with emphasis on relevant topics associated to environmental science and engineering, as well as to specific management issues in the area of environmental protection and monitoring.

P - ESEM facilitates rapid dissemination of knowledge in the interdisciplinary area of environmental science, engineering and management, so conference delegates can publish their papers in a dedicated issue. This journal will cover a wide range of related topics, such as: environmental chemistry; environmental biology; ecology geoscience; environmental physics; treatment processes of drinking water and wastewater; contaminant transport and environmental modeling; remediation technologies and biotechnologies; environmental evaluations, law and management; human health and ecological risk assessment; environmental sampling; pollution prevention; pollution control and monitoring etc.

We aim to carry important efforts based on an integrated approach in publishing papers with strong messages addressed to a broad international audience that advance our understanding of environmental principles. For readers, the journal reports generic, topical and innovative experimental and theoretical research on all environmental problems. The papers accepted for publication in *P – ESEM* are grouped on thematic areas, according to conference topics, and are required to meet certain criteria, in terms of originality and adequacy with journal subject and scope.

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GUEST EDITORS

Fabio Fava, born in 1963, is Full Professor of "Industrial & Environmental Biotechnology" at the School of Engineering of University of Bologna since 2005. He has about 140 papers on medium/high IF peer-reviewed international journals of industrial and environmental biotechnology, sectors in which he coordinated the FP7 projects NAMASTE and BIOCLEAN and participated in other 7 FP7 collaborative projects. He is vice-chairman of the "Environmental Biotechnology" section of the European Federation of Biotechnology (EFB). He is the Italian Representative in the "Working Party on Biotechnology, Nanotechnology and Converging Technologies" at OECD (Organization for Economic Co-operation and Development), Paris, in the "European Strategy for the Adriatic and Ionian Region" (EUSAIR) and in the "Western Mediterranean Initiative" (WEST MED). He is member of the "Expert Group on Biobased Products" (DG GROW, European Commission, EC) and is the Italian Representative in the a) Horizon2020 Programming Committee "European Bioeconomy Challenges: Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research" (SC2, DG RTD, EC), b) "States Representatives Group" of the "Public Private Partnership BioBased Industry" (BBI JU)(DG RTD, EC) and c) BLUEMED Strategic Board (DG RTD and DG MARE, EC). Finally, he is the scientific coordinator of the International Exhibition on green and circular economy ECOMONDO held yearly in Rimini (Italy).

Grazia Totaro, born in 1976, has a degree in Chemistry (University of Ferrara), a Master's Degree in Science, Technology & Management with a specialization in Environmental Chemistry (University of Ferrara) and a PhD in Materials Engineering (University of Bologna).

She worked at the R&D Centre of Basell Polyolefins in Ferrara for 2 years in the frame of a project addressed to the development of a novel methodology for qualitative and quantitative analysis of additives in polymers. She also worked at ARPA, Regional Agency for Environment in Ferrara, division Water Analysis. Then she started working at the school of Engineering of the University of Bologna for a Ph.D. in Materials Engineering (2007-2010). After that, she had a scholarship "Spinner 2013" in cooperation with Reagens spa (San Giorgio di Piano) on novel PVC nanocomposites. Now she is post doc fellow at the same school on new polymer-based nanocomposites from renewable sources and inorganic fillers. She also worked at the laboratoire de Chimie et Biochimie Pharmacologique et Toxicologique (Université Réné Descartes) in Paris in 2001 and was visiting professor at the Ecole Nationale Superieure de Chimie (Université Blaise Pascal, Clermont Ferrand, FR) in 2012 and 2015. Dr. Totaro has about 25 scientific papers and several participations at conferences and scientific schools. She collaborates on Ecomondo from 2013.

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ECODESIGN APPLIED TO REAL ESTATE MARKET: COST BENEFITS ANALISYS*

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Ecomondo convention: "The effects of industrial symbiosis on productive and territorial systems"

Abstract

The paper aims to identify the impacts of eco-sustainable building on the environment and how EcoHouse properties differ from the traditional property market in relation to related costs, any benefits in the medium-long term and the materials used. Eco-sustainability and sustainable development are issues that involve, as well as the natural environment, particularly the economic and social environment, and for this reason it is appropriate to carry out an analysis showing the relative benefits in terms of impact on the environment, including reference to reduction of pollutant emissions, recycling of resources, and economic savings for society. EcoHouse Immobiliare is a company founded by a group of experts with twenty years of experience. The product offered insure a significant cost-saving, about the consumption of resources for the maintenance of the household. In fact, an optimization of resources can be achieved through the use of the equipment included such as: solar panels, hot water boilers and systems for thermal and sound-proofed insulation, that minimize energy wastage and promote, at the same time, the development of a circular economy in which the output of one process becomes the input of another, so that better preserve the environment for future generations. A decisive feature that differentiates it from traditional buildings is the use of laminated wood for the construction of the internal structure of the house, which, in addition to determining a higher resistance to seismic phenomena, represents an eco-sustainable alternative to the materials normally used for the construction of buildings. The market in which the company is located is configurable to a narrow niche of the traditional one. Therefore, this paper, in addition to pursuing the above mentioned objectives, aims at raising the consumer awareness with a perspective of environmental integration with everyday life.

Keywords: circular economy, eco-design, passive house, sustainable buildings

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1. Introduction

Different architectural approaches related to the design of sustainable homes concern structures with a low impact on the environment, through an appropriate use of resources available and specific construction methods (Kilbert, 2016). However, before considering the performance of the building, it is appropriate to highlight some factors that determine the sustainability of the house (Clasadonte et al., 2005). First of all, the location of the house, which has a very important role on the final result in terms of savings and is linked to the concept of "where". After considering the right place for the construction and the framework, it is necessary to take advantage of the orientation of the structure, that is linked to the concept of "how" (in relation to the heliothermic axis and the cardinal points), to ensure the greater well-being of users and respect for ecological and environmental parameters. The principles of positioning, which are closely linked to the location of the project, aim at the correct placement of the structure in order to enhance its performance, also taking advantage of the typical meteorological conditions of the territory (Goldmann and Cicalò, 2012).

Although not always possible, the presence of glazed surfaces in the facades of the house increases the likelihood that passive solar gain will have a positive effect on the energy and cost savings. To balance the presence of numerous transparent surfaces, which allow the entrance of heat and natural light, it is necessary to consider a proper lining and suitable insulation of indoor spaces, without resorting to traditional heating or cooling techniques. The heat generated by the influence of sunlight indoors can be retained by insulating enclosures and structures acting as insulation chambers, in order to ensure the proper thermal mass at any time of year. Another method to promote an optimum use of sunlight is the presence of photovoltaic panels (Beukers and Van Hinte, 2005). Among the main factors that influence the eco-sustainability of the project, it is necessary to pay attention to the use of natural materials, free of toxins and harmful products for the environment and users. Certified wood is a privileged material in the construction of ecologically sustainable buildings, thanks to its advantageous properties (Abalos, 2009, Castelli, 2008). The purpose of this article is to compare the difference, in terms of costs and benefits, between a traditionally built house and an eco-sustainable built house.

2. Material and methods

The Cost-Benefit Analysis (CBA) is a method used to highlight the convenience of a monetary investment, and helpful in understanding the potential of building construction techniques dealt with in this paper. The CBA allows analysing in monetary terms the benefits and costs of an investment, considering both qualitative and quantitative factors. Direct costs can be easily quantified, while indirect costs can be more difficult to identify. For this reason, often, in order to identify indirect costs, the methods used are: the method of the contingent assessment, the cost of travel method or the opportunity cost method. The CBA therefore allows a clear vision of the economic and social return of an investment, above all thanks to the possibility of comparing the positive and negative aspects of the alternatives available on the market. In this paper, by using this tool, it was possible to highlight the economic and environmental benefits of using laminated wood compared to the use of traditional building materials. Specifically, the materials used, and the relative prices are presented in Table 1. The laminated wood used has the certification of conformity (CE) that prove its quality and origin.

Table 1. List of used material

Material	*Quantity*	*Price*	*Unit*
ABETE WOOD GL 24 MC	400,00	540,00	MC
PERLINED CM 2 MQ	2200,00	9,00	MQ
ANTI-DUMB OSB TYPE C MM 9 MQ	1500,00	4,00	MQ
BLOCKBOARD PINE IN SWEDEN SP. 2,7 N	100,00	90,00	PZ
TABLES IN PINE OF SWEDEN SP. 10	36,00	340,00	MC
LAMELLAR IN PINE OF SWEDEN SP. 1,80 MQ	200,00	55,00	PZ
WALL 5*5 MC	100,00	5,40	PZ
WOOD BATTEN MC	100,00	1,50	PZ
POLISTIRENE CM 3 MC	50,00	95,00	MC
LOW DENSITY STYROFOAM. CM 20 MC	300,00	72,00	MC
VAPOUR BARRIER MQ	1500,00	2,50	MQ
THERMO-COVER HIP-TILE	1500,00	28,00	MQ
COLMO ML	200,00	15,00	ML
FRONT PLUGS FOR THERMO-COVER N.	250,00	9,00	PZ
FONDALINA MQ	2500,00	4,50	MQ
BITUMINOUS SHEATH MM 4 MQ	2500,00	3,20	MQ
GRAY RASANTE MQ	750,00	9,00	PZ
DRYWALL	3600,00	10,00	MQ

The cost of an eco-sustainable property is very competitive compared to a traditional one, especially because of the use of wood instead of a large amount of cement, which requires precise criteria from the point of view of the acoustic and thermal insulation that entails a considerable economic expense.

Other differences that entail economic savings compared to traditional buildings are:

- From a thermal point of view, the use of a 3,5-kW photovoltaic system is able to fully satisfy the daily needs of a house;
- From the point of view of water, the use of 300-liter solar thermal system combined with an 80-liter electric boiler can integrate the evening water requirement;
- The exploitation of rainwater, which is supported for the use of various sanitary, while in the summer season is used the town water supply is used.

The resistance class of a lamellar wood element is determined by the resistance class of the same lamellas that compose it and their arrangement within the structural element. The resistance class of the individual boards making up the slats is determined in accordance with the UNI EN 14081-1 standard which specifies the requirements for the visual and machine classification of structural solid wood.

The assignment of the resistant profile of the individual slats is therefore based on the classes listed in the UNI EN 338 standard which provides the characteristic values of the resistance properties for each class, and the rules for the assignment of wood types (i.e. combinations of species, provenance and category) to the classes. The standard applies to all coniferous and broad-leaved wood for structural use.

Through the main characteristics and properties of laminated wood we can mention:

- High fire resistance, equal or superior to steel and reinforced concrete, thanks to the slowing of the combustion of the material that occurs due to the good thermal insulation of the carbonized surface layer;
- Low environmental impact;
- The absorption of the humidity of the surrounding environment, thanks to the structural porosity of the material;
- The reduced thermal conductivity, which increases its insulating properties;
- The reduced energy required in the production process, lower than that required for the construction of houses with artificial or traditional materials;
- The fast installation;
- Excellent mechanical resistance, which guarantees compliance with earthquake-proof building standards;
- The possibility of reuse and recycling the materials.

The choice made by “EcoHouse Immobiliare” to approach the world of green building has depended on two closely interrelated factors: the decline of the traditional real estate market that has occurred recently and the numerous State incentives to abandon the traditional methods of construction in favour of methods focused on environmental sustainability. These two reasons, together with an essential entrepreneurial nature, have pushed the company to undertake a new professional path in line both with the regulations and with the market.

3. Experimental: EcoHouse Immobiliare

The company “EcoHouse Immobiliare”, based in Adrano (CT), was founded by a group of experts with twenty years of experience, they are also one of the first builders in Sicily of certified A ++ class residence. Strongly aware of the concepts of eco-sustainability and sustainable development, the “Brand EcoHouse Residence” has the important objective of combining the economic convenience of a comfortable home with the needs of an environmental nature, guaranteeing not only tangible economic savings but, above all, safeguarding the future of the environment. The "Excellent Home", a term specifically chosen by “EcoHouse Immobiliare” to define its buildings, is made according to special living and quality standards and, in particular, as well as being completely autonomous from the energy point of view, thanks to photovoltaic systems, with plants for the recycling of rainwater and floating floor with integrated heating system, ensures the environmental sustainability of the materials used and the low environmental impact respecting all the criteria of anti-seismicity.

The process of construction of the houses begins with excavations and then with the placement of the lean concrete where the foundations will rest; then on the foundations the lamellar wooden pillars are fixed by using suitable brackets. Subsequently the floor is laid on the slab. Once the structure is completed the walls are built, the complete window frames are placed, and the external areas are arranged in the following way: the himoff pits and the relative wells are placed, then the connections are made to all the external railings and gates installations.

4. Results and discussion

The "EcoHouse" company uses natural materials, such as laminated wood, made with a technological method of pressure bonding that reduces the inherent defects of solid wood. Lamellar wood beams are used in the construction of the load-bearing structure, consisting of a foundation made of ventilated concrete by an igloo system that creates condensation chambers, to prevent moisture rising. The thermal insulation of the structure is encouraged by the use of a polyurethane and polystyrene envelope, combined with an external coating in water-repellent wood and glass fibre. Once the beams have been set up, aluminium brackets are fixed to increase the seismic capacity of the entire structure.

The eco-sustainability criteria also concern constructive methods and design choices. The decision to develop interior spaces by exploiting the solar orientation of the building, respects the ecological parameters that provide for the adaptation of the structure to the pre-existing conditions of the site (Antonucci et al., 2015). In fact, the orientation of the sleeping area to the north and the living area to the south, allows to ensure inside the house the optimal climatic conditions in relation to the functions of the different spaces. Also, the choice of using the most prominent projections on the main facade is functional to the internal microclimate maintenance, in fact the presence of roofs and horizontal surfaces allows the structure to have shaded areas, avoiding excessive overheating due to sunlight. In addition, the layout of the main parts of the house undermines the traditional conformation typical of neighbouring houses, providing a secondary access located in the more shaded facade, oriented towards the east, and inserting plant elements that act as a screen for habitable spaces.

Respect for the surrounding environment and the exploitation of the conditions of the existing context take place not only through direct interventions, but also through design choices regarding the dwelling systems. In the case study considered, specific systems were used in particular:

- Foundations: made of reinforced concrete according to traditional techniques, using concrete rck 30 and steel reinforcement type fe b 44k, these materials are chosen for their high resistance to climatic factors and therefore their durability;
- Crawl space in the foundation: made of pvc elements (igloo) to allow foundation ventilation. This technology avoids the deterioration of materials and this is one of the most advanced technologies;
- Bearing structures: made of lamed wood of the type gl 24, which identifies the elasticity of wood (very high in this case) with DIN 1052: 2008 certification, which ensures quality and properties, with sections and dimensions corresponding to the calculations approved by civil engineering;
- Connections: concerning wood-cement and wood-wood of the retractable type and in this case, those of the Rothoblaas company, which is the leader of the sector, will also be used, also complying with the calculation plans approved by the civil engineering department;
- Roofing: made with thermo tile that offers a better performance from the point of view of thermal insulation and a higher execution speed.

Furthermore, the company chose to use water-based paints, which increase the physical well-being of the inhabitants and prevent the dispersion of toxic materials into the environment. Finally, the decision not to completely comply with the parameters of the passive house protocol is functional to the proposal of a cheaper price for buyers, in order to make the inhabitants of the area aware of the principles of sustainable architecture through a competitive cost that places the home in a position of advantage over traditional competitors.

The innovation introduced by the company is related to the construction methods and to the marketing policy aimed at making potential customers more ecologically aware (Fig. 1). From the construction point of view, an efficient use of available resources guarantees the effective achievement of the established eco-sustainability objective. As far as the marketing policy is concerned, after having carried out appropriate market analyses, the company decided to advertise the house proposing a price slightly below the current market price. Such a price policy, although initially causes a slight decrease of income gained by the property, has an incentive function as it gives the company the opportunity to draw on a wider client base and facilitates the awareness of the population to the issue of sustainability environmental.

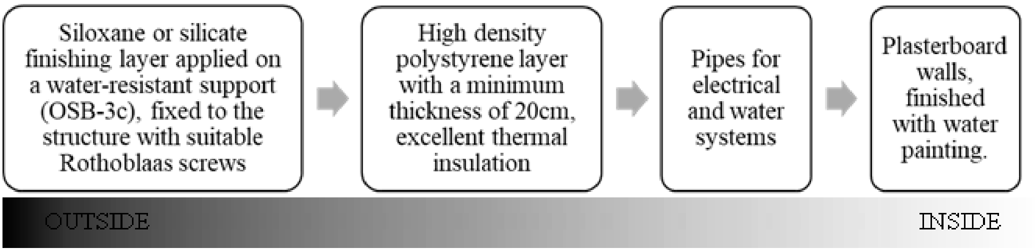
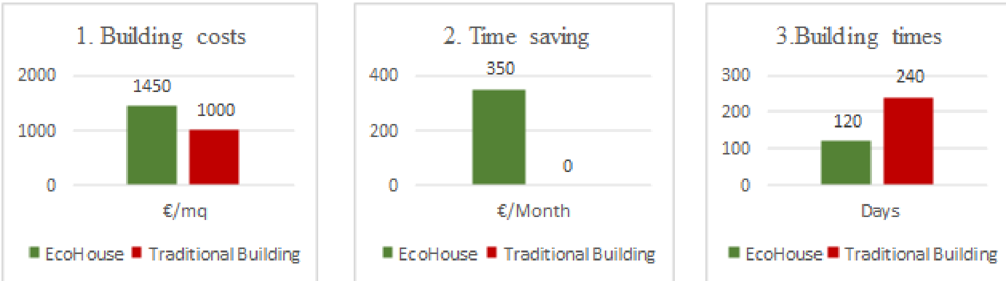


Fig. 1. The structure of the walls from the outside to the inside

The systems inside the house are arranged in this way:

- Heating: built under the floor structure with the use of the radiant type, with a hot and cold system, which is therefore used in all seasons. It is powered by water circulation chiller. The whole system is electrically powered;
- Electric: made with the classic techniques that comply with current regulations, powered by a 3.5 kW photovoltaic system suitable to meet the energy needs of the entire house;
- Water and sanitary: made with multi-layer pipes, powered by municipal water network for the civil network, while for health (wc, showers, sink, etc.) will be powered by rainwater accumulated in a special underground tank;
- In addition, there is a solar thermal system, to produce hot water of about 300L that is well beyond the needs of the house;
- Air recycling: to guarantee the healthiness of the house avoiding the creation of mold;
- Isolation: foresees the presence of fixtures made of solid wood with a thickness of 80/90 mm with a 25 mm 6/12/6 low emission glass chamber with Radon gas to obtain the maximum thermal impedance.

Although the initial cost differences (Fig. 2a) of an "EcoHouse" can discourage the buyer, it can be seen that these do not represent a loss, but an investment, which in the face of higher initial costs then generate future benefits in terms of savings (Fig. 2b); the estimated saving of € 200/230 per month deriving from electricity savings, through the use of solar systems for heating and electricity production, all supported by the air recycling and insulation plant; € 90/120 per month are further saved due to reduced water consumption; these optimizations lead to an estimated total saving of €350 per month. Finally, a substantial difference is represented by the time necessary for the actual construction of the two buildings: while the construction times of an EcoHouse house are around 120 days for a house built according to traditional methods, it takes at least 240 days.



(a) (b) (c)

Fig. 2. Comparison analysis between houses built through traditional methods and materials and "EcoHouse": (a) building costs, (b) time saving, (c) building times

5. Conclusions

In recent years, the attention to the environment has grown increasingly due to a question of social ethics, but especially because of the environmental deterioration of our planet. According to statistical surveys, in fact, humankind currently consumes 1.5 times the capacity of our planet.

The increase in CO_2 emissions, CFC emissions, which are main causes of the ozone hole, global warming, the increase in acid rain and the extinction of some animal species, are just some of problematic phenomena that afflict the Earth and that require to be fought.

There have been numerous environmental conferences aimed at limiting the damage caused by humankind's destructive activities. Significant steps have been taken in the last decades but, above all, it is of fundamental importance that an awareness is reached able to limit the negative externalities deriving from the action of humankind.

In the building sector, as previously specified, numerous regulations have been issued that encourage construction companies to use techniques with low environmental impact and "greener" materials, but unfortunately, the process of awareness of the population is slow and faces numerous obstacles.

Through this paper, it has been highlighted how the use of natural materials, such as wood or hemp, despite involving an increase in the cost of production of the house and, consequently, an increase in price, determine a saving in the medium-long term: from the economical point of view, ensuring better insulation, from acoustic-thermal point of view, reducing energy consumption and, at the end, in environmental terms, ensuring lower emissions and above all reducing the water footprint, favouring, at the same time, the possibility of obtaining energy from sources alternative and renewable.

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CIRCULAR ECONOMY AND THE BENEFITS OF BIOMASS AS A RENEWABLE ENERGY SOURCE*

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Abstract

In this paper the use of olive oil biomass waste as a secondary raw material for the production of Energy is studied. In fact the olive pomace can be transformed by means of composting and/or anaerobic digestion processes from a refuse to a resource. By exploiting this waste it is possible not only to reduce the quantity of waste, but it could also be a potential source of additional revenue for the entrepreneur and an undeniable stimulus for the territory's development. This paper is written with the help of F.A.T. Snc, a Sicilian family-owned oil mill, and with the entrepreneur Giuseppe Borzì, who represents the third generation of this family business. The business is focused on the olive growing and olive cold pressing, as well as on the production of wine and soaps. The entrepreneur is also interested in the development of new systems for the exploitation of the olive pomace, which is currently sold, but could be used as an ecological fuel for energy production. Unfortunately, biomass is often understimated in the reality of today's renewable energy sources, as it has low energy density, yet it is nonetheless very interesting since it represents the triumph of circular economy.

Keywords: circular economy, biomass, olive pomace, renewable energy source, waste-to-energy

1. Introduction

The assessment of company performance is no longer focused on a mere comparison of traditional factors of production. Performance increasingly depends on elements which, although having only an indirect impact economically, significantly influence the company's competitive capacity (Bortolotti, 2017). The environmental impact of anthropic activities is

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subjected to increasing attention from stakeholders. It is therefore necessary to include environmental considerations in the process of firm management, following a circular approach, focusing on the waste as a resource for another productive process, and this is the objective of the F.A.T. oil mill.

Currently the energetic system is essentially based on non-renewable energy sources, that satisfy nearly 96.5% of the entire global energy requirements, while renewable energy sources provide only a minimal 3.5%. However, given the unavoidably long regeneration periods of the fossil energy sources and the speed with which this sources are depleted by human activity, it is likely that they will be exhausted in a relatively near future. Moreover, considering the substantial environmental damage caused by the excessive use of fossil energy sources -like the greenhouse effect and the hole in the ozone layer- it is clear that the use of renewable energy sources will be increasingly important in the Energy scenario of the future.

The research for new raw material that can substitute the traditional ones, which are progressively running out, maintaining at the same time high quality standards and reducing costs is one of the main goals of sustainable development. Sustainable development is a model of progress that aims to satisfy current human needs without compromising the opportunity of future generations to satisfy the same needs; the management of a resource is said to be sustainable if the natural capacity of reproduction is known, it is not exploited beyond a certain threshold, that can be identified with the period of natural reproduction of the resource itself.

The aim of this paper is to make companies in the Sicilian olive oil producing sector aware of the recovery of the waste in order to apply the concepts of the circular economy; to such intent we have undertaken a collaboration with the F.A.T. oil mill, that boasts a long experience in the cultivation of the olive trees and in the production of extravirgin olive oil.

In such a context, the current energy supply, but also the future, constitute an issue that has a strategic role (Chinnici et al., 2015). It is in fact well known to the governments all over the world that the global demand for energy will increase quicker than the demographic growth; as a matter of fact, worldwide energy consumptions have increased by 50% in recent years and oil, gas and coal provisions are believed to last for a hundred years at most. Another important issue regards the effect of fossil fuels in terms of CO_2 in the topic of climate change (Chen and Wu, 2017). In this context the necessity for renewable energy sources is impelling and biomass and organic refuses represent an effective alternative to traditional fossil fuels. Residual biomass is widely disposable and allows energy production with reasonable costs; coherently to this premises the F.A.T. olive oil mill is introduced, which implements a model of industrial metabolism that enables the use of the byproducts of the olive oil extraction process as a resource to produce electricity both for the self-consumption and/or for the selling to other firms or to privates, aiming to make investments grow.

2. Materials and method

Italy's agricultural wealth dwells in the wide variety of crops and in the quality and quantity of typical productions. Another typical element of Italian agriculture is the multi-functionality of the firms: in fact the production of energy from renewable sources (biomass), social farming and precision agriculture that provides an optimal use of pesticides and manure, allows entrepreneurs not only to increase the opportunities for incomes, but also to implement the solution to consumers' demand for environmentally friendly products. The merceologic sector of extra virgin olive oil production is going to be analyzed: currently the olive growing accounts for about 18 million plants, distributed on a surface of approximately 160.000 hectars and provides incentives to the development of the territory besides job opportunities. The term biomass refers to each organic substance, of vegetable or zootechnical origin, from dedicated crops or deriving from waste and residues of various productions, from which it is possible to obtain energy through thermochemical or biochemical processes. Biomass is a renewable and inexhaustible resource for the production of other forms of energy. The biodegradation process is made possible by fungi and bacteria and is fed by other micro-organisms such as the actinomycetes that act on the mature compost, the protozoa and the macro fauna (Fiorese, 2007). Vegetable biomass absorbs carbon dioxide from the atmosphere during the growth phase and returns it during the combustion phase. The processes of transformation of the energy possessed by biomass are grouped into three different branches: combustion, pyrolysis and gasification.

Combustion: it is the most traditional process. It requires the reduction of the water content of the biomass that is obtained through the drying process. The heat is generated thanks to oxidation reaction of the carbon in the presence of sufficient oxygen.

Pyrolysis: it is a process of thermochemical conversion of organic substance. This process takes place through the transformation of biomass with heat and lack of oxygen. Pyrolysis can be applied to any organic material as long as it has a low water content (<15%).

Gasification: it is a physic-chemical process through which a solid fuel is transformed into a gaseous fuel. The gas obtained, called Syngas, is a mixture of nitrogen, methane, hydrogen, carbon monoxide and other gases (Candolo, 2005). Physical conversion is essentially a process of mechanical pressing of grains with a high oil content. The final result of squeezing is a fuel oil that can be used directly as fuel for slightly modified diesel engines.

One of the most important features of the biomass consists in being easily available and accessible in the territory (therefore it can be considered a local resource) and it can be used with a vast range of technologies. In the phase of ignition of the biomass boiler there is issue of well visible smoke, composed by water vapor and elevated levels of particulate matter and gaseous emissions (some of which can be toxic), because of an incomplete combustion, but when the boiler reaches the operating temperature emissions drastically decrease. The CO_2 budget of these process is therefore null, and so it does not contribute to the greenhouse effect. While imagining a supply chain with a low environmental impact, it is also necessary to valorize the by-products of the process to make the oil industry more profitable and self-sufficient from an energetic point of view.

3. Case study

The F.A.T oil mill is situated in Nicolosi, in eastern Sicily. It is a family business started 30 years ago by Borzì and Serafica. It develops as a family-owned firm focused on local traditions and respect for the territory. The core business is represented by olive growing from which extra-virgin olive oil is extracted (Figs. 1, 2). Based on estimates and on previous budgets, there are many costs linked to the production of a liter of olive oil: it is valued at 0.16£/kg; on average the mill produces about 15.000 quintals of oil per year.

The main annual costs are due to labor; other substantial costs are the ones for the pressing mats and disks (the costs of disks are usually divided and amortized in 2-3 years), maintenance, energy, water (that are negligible because the F.A.T. oil mill owns a water well) and wastewater disposal. Analyzing the operation of by-products disposal, part of these costs cannot be reduced (the ones related to vegetation water disposal), while other production residues can be exploited and allow a lowering of pertinent costs. The solid part of olive pomace, called “nocciolino”, allows revenues derived from direct selling of biomass (about 0.12£/kg).

Fig. 1. F.A.T. snc oil mill logo

Fig. 2. From olives to olive oil

In recent years, the company has implemented a diversification strategy by encouraging the production of wine, wheat and soaps. Moreover, being in a popular area, being near Mount Etna, it encourages educational and touristic itineraries for schools. There is also a spring where water coming directly from Etna is available and a small lodge in which typical products of the territory are served and can be purchased. Recently the firm has acquired new machines and equipment in order to achieve a quality certification, so as to join new markets.

In the medium-long term objectives the company wants to create an energy plant fueled by residual biomass from the productive process: the “nocciolino”, in fact, is characterized by a high calorific value, above 6.05kWh / kg (www.polandwood.com), which makes it convenient as an ecological fuel. Olive oil is a typical Italian product and an essential food in the Mediterranean diet. On a global level Italy is one of the largest producers of this food, that is the result of a long process in which the following phases can be distinguished (Fig. 3):

- *Olive harvesting:* in Italy occurs generally in the period from October to December.
- *Carriage and weighing:* olives are weighed so a first esteem of the product can be made.
- *First storage:* olives remain in special bins in order to preserve them from temperature peaks and mold.
- *Washing:* olives are defoliated and washed immersing them in a tank of water.

- *Milling:* the olives go through a mechanical arm and become oil paste, a product in part made of a solid part (thanks to olives' core) and a liquid part (olive juice). The first part is called pressing and the olives go through a pressing machine made of hammers; the second part is the traditional milling: olives are poured in a millstone and then are finished by the mixers.
- *Kneading:* this process removes emulsions from oil paste, collecting the liquid in bigger drops through a slow movement of mass and its heating.
- *Squeezing:* this process makes the separation of must from olive pomace, filtering with mechanical or hydraulic presses.
- *Separation:* in this phase the must still contains a small quantity of water that will be separated in a mechanical way through rotation at high speed. The liquid that will leave the machinery is olive oil.
- *Storage and bottling*: the final product is turbid due to the natural residue and is kept resting for some months (www.frantoiosanmartino.it).

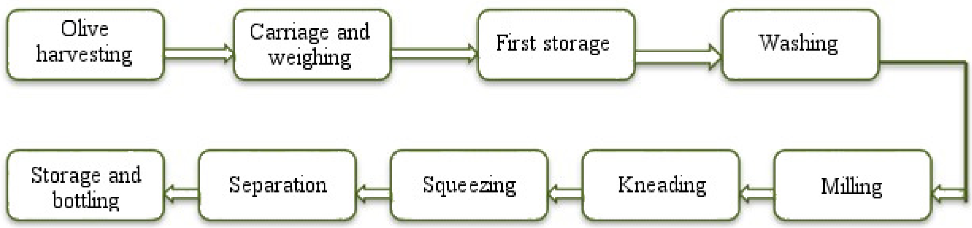

Fig. 3. Extravirgin olive oil: steps in the production process

This process releases some important residues such as: pomace, solid olive residues and reflux waters from vegetation that derive from the phase of transformation of the olives. This waste is dangerous due to the high organic polluting load, nevertheless, if properly dealt with, it can be used as manure. Pomace instead can be distinguished in virgin pomace, originated in oil mills, and exhausted pomace, that originates in "sansifici", where the olive pomace goes through a process of chemical extraction in order to produce the sansa oil, which has a lower market value. The solid olive residue called "nocciolino" is considered biomass fuel and it can be used inside the oil mill for heating the water used for the kneading or it can be sold on the market, as a substitute to wood pellets. Currently the firm uses part of the "nocciolino" to generate heat in a specific boiler, and sells the remaining part.

4. Results and discussion

Through this analysis it has been shown that the use of biomass in the agricultural sector as a secondary raw material for energy production would be highly advantageous, as biomass is abundantly available as production waste. In particular, among the various technologies applicable to the agricultural sector it is highly convenient the introduction of a biomass energy cogeneration plant, which exploits the gasification technology, i.e. the thermochemical combustion process of biomasses in a high temperature environment (about 1000°C). The product of which is a gaseous fuel (mixture of carbon monoxide, methane and gaseous hydrogen) called Syngas, which will be the input to be fed to the cogenerator. The implementation of an investment of this type to the case study oil mill, however requires huge initial investments, about € 900.000 for a 200kW power plant. Despite that it is estimated that initial costs can be easily covered in a medium-long term thanks to the consequent reduction of energy costs (which currently costs to the F.A.T. oil mill about 3.000 € a month), given the favorable conversion rates.

To give some estimates in terms of numbers, regarding the environmental benefits, it can be defined that annually a similar plant produces approx. 1.600.000 kWe of energy, which corresponds to 704 tons of petroleum oil saved and about 782 tons less CO_2 per year (www.cnreurope.eu). The reasons why gasification lends itself to being one of the best choices among the technologies previously analyzed lie in the substantial advantages that this technique allows to obtain: a low environmental impact (this plant has got extremely low emissions into the atmosphere and produces vitrified waste); an important economic feedback (because the initial economic investment is covered in medium-long terms by the lowering of the costs of biomass disposal and the drastic costs reduction related to the purchase of electricity), a high performance of the plant (with its favorable ratio kWh products / kg of biomass used); a stabilization of energy costs (people who invest on a biomass plant protect themselves from probable increases in fossil fuel prices); reduced operating costs and other advantages at a management level (the plant is of modest size, totally automated and manageable remotely).

5. Conclusions

The aim of this study has been that to assess the energetic potentialities of the residues of the olive-growing supply chain. The system of production of bioenergy from the residues of the cycle of production of the oil is in expansion, contributing to the creation of new jobs and is an opportunity of development. In fact, the opening of agricultural companies to the energy market allows income from their activities to be diversified and integrated, giving greater economic stability to the agricultural firms.

It has been demonstrated in fact that the use of biomass as a second raw material for the production of energy is highly convenient for activities of the agri-sector. Nonetheless, most small and medium-sized enterprises in the agricultural sector cannot afford the essential high initial investments for the purchase of a biomass plant, so the international legislation, through the P.S.R. 2014-2020, in the measure 4.1. regarding the incentives for the agricultural enterprises, has a role of primary importance in this context, thanks to the non-repayable contribution of the 50%. In the future it is hoped that virtuous models will be adopted in Sicily, pushing the Sicilian agricultural enterprises to the modernization of the processes and the productive techniques in an eco-efficiency point of view. The use of more modern machineries will allow in fact a certain energetic saving, while the use of the biomass for energy purposes will represent an additional source of profit for the enterprises of the sector and an indisputable source of competitive advantage.

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CASE STUDY OF ACCIAIERIE DI SICILIA: THE MASS BALANCE AS A CONTRIBUTION TO INDUSTRIAL SYMBIOSIS*

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Abstract

With the aim of shifting towards a circular and green economy different organizations should create a network capable of foresting eco-innovation and long-term culture change, to create and share mutually profitable transactions and to improve business and technical processes. This study was carried out using the mass balance, which represent one of the activities for industrial symbiosis. This tool is based on the principle of mass conservation states and it is used to calculate flows and compositions, such as those referring to in and out process streams, taking into account data, specifications and other information already known. The mass balance allows companies to implement a sustainable industrial system, making it possible to quantify and reduce physical flows such as flows of substances, flows of raw materials and flows of physical matter. The mass balance will be applied to the production cycle of Acciaierie di Sicilia S.p.a, a company operating in the iron and steel sector, which environmentally speaking is considered the most world-changing and highly energy-intensive sector.
Furthermore, a supplier audit is scheduled for satisfying regulatory requirements. However, this should not be seen as a mere execution of regulations but rather as an opportunity for continuous improvement. From this point of view industrial sustainability is intended as a balance between expectations of growth in business value, protection of the environment, protection of health and safety of workers and satisfaction of its customers.

Keywords: environmental protection, industrial symbiosis, mass balance, supplier audit,

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1. Introduction

The model of economic growth that has characterized the last 150 years of history, is defined as "linear economy". An industrial market economy, based on the extraction of constantly new raw materials, mass consumption and waste production once the end of the product's life has been reached. An economy from the cradle to the coffin for the great masses. Many environmental effects such as the contamination of the sea and the earth, the dramatic condition of waste and greenhouse gases, caused this flow of extraction and dismissing of materials and consequentially bloody wars for the control of raw materials and strong social inequality.

To elaborate a model of alternative development to linear economy, distinguished thinkers have developed alternative ways to valorize raw materials and avoid pollution from fossil sources by promoting efficient production, recycling, eco-design, energy and renewable sources. The result of all these years of research and experimentation, for a more sustainable world, has merged into the concept of circular economy, a model of economy that reduces and eliminates waste, differentiates the sources of material supply and lengthens the cycle of life, maximizing value in use and consumer products.

The classical definition of circular economy is that of: "an economy designed to regenerate itself. In a circular economy the flows of materials are of two types: the biological ones, able to be reintegrated in the biosphere, and the technical ones, destined to be revalorized without entering the biosphere ".

2. Materials and methods

To perform the study, Material Flow Analysis (MFA) was used. This type of mass balance is an important tool for the evaluation of mass flows, based on the overall market data (National, Continental or World). It also provides useful information on flows for disposal and recovery, which represent potential sources of material (Konijn et al., 1997). In this way the MFA quantifies the real potential of the outputs to be recovered in the supply chain.

This tool, combined with the most known LCA, supplies information on the future environmental impacts resulting from today's management decisions. The use of Mass Flow Analysis (MFA) is an innovative methodological approach for determining the reserves in use of a material, which there are no examples of in Italy. This method supports the identification of critical points in a supply chain or a recovery process. Therefore, this tool is suitable both for national or regional assessments of management policies and for companies in the recycling or recovery sector.

The study on the potentialities of flows entering their plants and the assessment of potential impacts from new processes are strategic points for investment choices or technological improvements. The analysis of the flow of matter (MFA-M Analysis) refers to the analysis of all inputs and outputs of the production process, including: extraction or collection, chemical transformation, manufacture, consumption, recycling and disposal of materials. Furthermore, it is based on calculation in physical units (usually in terms of tons) and quantifies the inputs and outputs of all processes. On the one hand, accounting subjects are chemically defined substances (e.g. carbon or carbon dioxide) and while the other hand natural compounds (for example wood) or technical or "bulk materials". MFA has often been used as a synonym for accounting of flow of matter and for this reason it shows a clear link with the economic accounting (Yu et al., 2007).

The results obtained from these analyses are often used as input for further analysis, necessary to quantitatively evaluate the final risks from special substances. Several studies have been conducted on copper, mercury, lead and zinc, nutrients such as nitrogen and phosphorus, mainly due to eutrophication problems, have also been considered. for the search for effective reduction measures. Carbon flow is also studied using this method because of the link with the global warming and dependence of fossil fuels. The accounting for carbon dioxide and greenhouse gas emissions, the study of their trends, the causes, the responsible technologies, and the measures for reduction have recently been the aim of this tool (Zeman, 2007).

The macro-sectors of the MFA are:

1) Management of resources, to obtain information regarding the time of achievement of a critical state of consumption or accumulation of a reserve or pollutant,
2) Waste management, determination of the composition of waste streams, crucial for the allocation of the same to the best available treatment and to design innovative and more efficient ones;
3) The closure of industrial cycles, whose potential for accumulation of pollutants in goods and deposits requires a thorough assessment of the aspects at stake.

3. Acciaierie di Sicilia S.p.A.

Acciaierie di Sicilia S.p.A. is part of Alfa Acciai group since its foundation, in 1998 and also, represents the only steel company in Sicily. The company is situated in the industrial area of Catania and can produce up to 500.000 tons per year. The production of the steel in bars and coils is created by the electro fusion of the scrap that the company obtain from Sicilian firms. This allows the company to be linked with more than 200 collaborators.
The productive process in Acciaierie di Sicilia S.p.A. is of the “solid charge” type, it is expected the fusion at the electric oven of scrap with additives, ferroalloys and recarburizers. The use of the electric oven allows the company to reuse material that otherwise will be discarded, allowing the recycle and putting the company in a position of advantage to its competitors. The production process is a complicated process that can be divided into these different phases:

1) Preparation of the charge baskets
2) Fusion
3) Pre-refining
4) Tapping
5) Continuous casting, where the melted scrap is transformed and let solidify in billets, which are just parallelepipeds 11 m long with a section of 300 mm. These represent the semi-finished product of the company and they can be already sold instead of being transformed once more.
6) Rolling Process

The final product are the steel bars and coils with sections that goes from 8 mm to 32 mm and that are identified with the company brand hot stamped during the rolling process, reproduced longitudinally at a distance of 800 mm. To realize the productive process in the most efficient way, Acciaierie di Sicilia S.p.A. has divided his own site in different departments. Every department has a different role in the productive process and all the department are linked each other. Specifically, Acciaierie di Sicilia S.p.A. is divided into:

- steelworks
- mill
- scrap treatment

4. Results and discussion

In order to elaborate a material flux analysis or MFA, it is useful to split the productive process into two departments. These are:

- Steel department
- Hot Rolling department

These two departments are the ones that arouse major interest, also, they are the two units where the production of the different products of Acciaierie di Sicilia S.p.A. is concentrated. As follows some graphics are shown of the inputs and the outputs. Some of these measures are referred to the percentage of the total production.

Steel department

Table 1 shows which are, and in which percentage, the materials uses in the productive process of the first department. As output there are 314.451 TONS of produced billets, to reach these numbers are used different materials as: scrap, cast iron, ferro- alloys, lime, coke, internal recycled scrap and more. It is easy to understand how the majority of the used material is the scrap, that Acciaierie di Sicilia S.p.A. transforms into a final product, as the company received them from the providers and after all the needed assessment. This represent the most relevant point, with the 89.34% of the output used, which is made up of recycled material for the 98% (for which the company owns different certifications) that the company receives from the providers and then uses for their own production.

The second most important point is composed by the scrap from internal recycles, this represent the 3% of the material used for the steel department's production. At least, with the 7.74% there are cast iron, ferro-alloys, lime and other materials.

Table 1. Materials used in the productive process of Steel department

Billets producted (in tons)	314.451
INPUT	
Scrap	89.34 %
Internal recycled scrap	2.92 %
Cast iron, ferro-alloys, lime, coke, Ecc	7.74 %
Total	100%*

**values in percentage of the total production*

Hot rolling department

This unit has as input, the output of the previous department. However, there is the possibility to sell the billets as finished product so, not all the billets are transferred from the steel department to the hot rolling department. Table 2 shows how 282.086 of the billets produced are moved to the hot rolling department. In this unit the billets will be transformed into rolls and bars (Table 3).

This division uses a different type of prime material, indeed the most important value is represented by the water and the energy used (Table 4). An important value is the quantity of energy used, this is around 116 MWh/ton, that is the quantitative of energy used by the company to produce a TON of laminate (Worrell, 19977).

Table 2. Inputs in Hot rolling department

Hot rolling department billets	282.086

Table3. Output from Hot rolling department

Total rolling	272.699
Total bars	253.871
Total rolls	18.827

Table. 4. Input of water and the energy

Energy used	116 MWh/ton*
Natural gas	23 m3/ton*

**values in percentage of the production in tons*

The UNI EN ISO 14001:2015 standard requires different precautions that the company have to adopt. Indeed, there are different dangerous substances used as input into the productive system of Acciaierie di Sicilia S.p.A. These substances can be assorted into different macro-categories, for example: additives, electrodes, oils, refractory, recarburizers, lime, irons, silicon, fat. To improve the security of the workers and the environmental safety the UNI EN ISO all the precautions for using dangerous substances must be adopted. Due to this, the company requires from every provider, two fundamental documents to reduce risks: the safety form and the technical form.

The company must identify and manage the risks linked to the substances that they product and sell to the E.U., prove how to use these substances without risks and inform the users on how manage risks. If these risks cannot be managed, the authority can impose limitations to the use of the substances and also the most dangerous substances have to be substituted with less dangerous substances, in the long period. Moreover, Acciaierie di Sicilia S.p.A. analyses the substances used by the providers too.

The ISO 14001 requires to set the environmental requirements of the procurement process and into the monitoring and controls of the outsourcing process, this is required to update the certification to its last version. In this way is reaffirmed the importance of a process act to evaluate all the possible risk and environmental damages caused by actors linked in indirect way to the company. UNI EN ISO 14001 requires, to be updated, the execution of an external audit. The audit process can be divided into different parts:

1. Call the providers
2. Submit an self-assessment questionnaire
3. Audit process
4. Analysis of the results

This last point has to verify that the company that collaborate with the society respect all the UNI EN ISO 14001 principles. Furthermore, the audit process is a great instrument that allows to the companies to meet each other and collaborate to improve themselves, in a continuous improvement vision.

5. Conclusions

Over the years numerous instrument have been made and improved to provide a more conscious and “green” industrial production. The mass balance, the security form and the audit process, allows big and small company to reach this objective, because they are instruments that allow environmental and cost efficiency to be achieved

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CREDIT WORTHINESS INSIDE GREEN FINANCE. ENVIRONMENTAL SENSITIVITY ANALYSIS ON AGRI-FOOD CHAINS *

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Abstract

Green finance is a broad term that indicates financial loans and policies, which encourage the development of a more sustainable economy; it includes also the environmental industrial pollution control, the water hygiene and the biodiversity protection.
The purpose of this paper is to propose the inclusion of the environmental compartment inside the process of evaluation of the credit worthiness, during the financing process granted by banks. To reach this purpose, an innovative research on environmental sensibility has been carried out through a specially elaborated questioner, which has also been completed by some industries on the agri-food sector in Sicily. The results, after being elaborated on purpose, they can be the base of a decisional support model for the evaluation of the grade of the environmental variable businesses' perception, which must be considered when bank calculates the score that it assigns to the firms. This research demonstrates that the action of consider environmental factor during evaluation of credit worthiness, it can become a winning strategy both as an incentive for enterprises both as a tool of rationalization of loans. In addiction this strategy allows to destine the financial resource to performing firm from the environmental point of view, with the purpose to direct its investments in a green economy vision.

Keywords: Green finance, green economy, investments, proactive company, sustainable process

1. Introduction

The Sustainable Development Foundation Report about the Green Economy shows the analysis of the strategic issues about the green economy in Italy: greenhouse gas emissions, efficiency and savings energy, renewable sources, the circular economy, eco-innovation, eco-friendly agriculture, natural capital and sustainable mobility. There could be

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possible worsening of greenhouse gas emissions in Italy: there was increase of CO_2 emissions on the 2015 and decrease in 2016, while there will be a new increase on the 2017 in particularly in the electrical sector (www.fondazionesvilupposostenibile.org). In this sector, emissions had been declining for years but since 2014 they have grown from 309gCO_2 / kWh to 330 gCO_2 / kWh in 2016. However, data for the first half of 2017 show an improvement.

There was a decline in renewables investments, from 3.6 billion in 2013 to only 1.7 in 2016. Twenty years ago the 80% municipal waste ended up in landfills instead the separate collection and recycling were non-existent; the 26% waste has gone to landfill, and separate waste collection has reached 47% today. The green economy is necessary to achieve sustainable development, and to safeguard the earth in the future, it’s considered by many people as the only credible possibility of development. The term “green jobs” is used to indicate all those activities in the agricultural, manufacturing and service sectors, which contribute to preserving and increasing the environmental quality and sustainability of the economic system (Campiglio, 2013).

The enterprises have several tools to achieve green growth, and many of these consist of EU regulations. There are economic policy and voluntary tools. The tools of economic policy allow the enterprises to respect the requests made by the supervisory authority. The voluntary tools, instead, are characterized by their voluntary application by the polluter. Moreover, there are various economic incentives, created by national and supranational government authorities, with particular reference to "green" facilitated finance. In the world, among the economic policy instruments about Convention on Climate Change, we can mention: the Kyoto Protocol of 1997 (https://eur-lex.europa.eu). The Protocol of Kyoto’s objective was the reduction of greenhouse gas emissions, in the period 2008-2012, for a quantity equal to around the 5% 1990’s issues.

The purpose of this paper is to propose the inclusion of the environmental sector in the credit value assessment process, during the financing process granted by the banks.

2. Materials and methods

For companies it is necessary to understand what technologies and tools can use to achieve their purposes by external funding. Funding can be direct and indirect. In the case of direct funding (grants and contracts), the allocation of funds is managed by European institutions, which organize procurements for goods, works, services (training courses, studies, conferences, IT equipment). Indirect funding is managed by national and regional authorities, which receive almost 80% funding from the EU budget. Funding can be made from the 5 major European funds (European structural and investment funds): European Regional Development Fund - Regional and Urban Development (ERDF); European Social Fund - Social Inclusion and Good Governance (ESF); Cohesion Fund - economic convergence of less developed regions; European Agricultural Fund for Rural Development (EAFRD) European Maritime and Fisheries Fund (EMFF). The decision to provide EU funding is taken by local financial institutions such as banks, venture capital investors or business angels (informal investors).

The European Community has allocated European funds to orient the market in a “green direction”. The European Cohesion Policy, the EU's main investment policy, has planned a program of € 50 billion for year from 2014 to 2020 and believes in the strengthening of the productive chain that do green economy. For example, POR FESR Sicilia 2014-2020 contributes to the European Strategy for sustainable and inclusive growth, directing it to the recovery of structural delays in the Sicilian region and to the achievement of social and territorial greater cohesion economic (Deliberazione n. 382, 2017).

The object that concern the energy sector is number 4 - OT - Priority Axis 4 - Sustainable energy and quality of life. Axis 4 is characterized by energy efficiency actions for: public buildings and residential (after energy audit); public lighting (within a framework of sustainable urban regeneration - PAES - Sustainable Energy Action Plan - Covenant of Mayors) (Bertoldi, 2010); production activities (process and product innovations and renewables); support for the development of small-scale renewable energy oriented towards self-consumption (linked to efficiency); smart distribution networks-Smart-Grids (reduce bottlenecks); cogeneration and trigeneration (electricity and heat); sustainable urban transport (through sustainable mobility planning tools).

The Green finance is one of the fundamental tools for the process of economic systems and infrastructures transforming in order to obtain the global green economy. At the end of November 2012 in the UK the first Green Investment Bank of the world was created with a capital of £ 3 billion from government sources and hopefully it will generate at least the same resources from private capital (Bertoldi, 2010). The UK Green Investment Bank's goal is the green economy as center of the UK economic recovery with funding in the clean energy sector - in particular offshore wind energy and waste and biomass energy production - and in energy efficiency to create a low-carbon economy development, in the United Kingdom, in Europe and in the world. There are many other tools; there are funds for the management of green capital to invest in companies and green economy projects. There are credit institutions that have green funding lines to support the businesses and families' investments in the energy saving and efficiency sector, or in the energy renewable production sector; such as better insulation of buildings, or photovoltaic and solar thermal sector projects. Also there are the green bonds, the project bonds, the venture capital funds specialized in the field of green investments. The carbon finance tools are very important, among all, because they support financing project to reduce greenhouse gas emissions and to adapt to the impacts of climate change.

According to Abi Lab, in 2016, the Italian system banking used 2.3 billion from several banking institutions to finance the green economy (www.abilab.it).

The banks have got an important role to achieve our goal and they should finance green technologies and projects to reduce pollution and the carbon footprint. The bank, for example, could introduce subsidies to reduce interest rates and to reduce credit cost towards companies that pay attentions to reduction of their environmental impact. As regards innovative finance tools, we can mention the so-called Green Bond. In July 2014, the S & P Green Bond Index was structured to monitor the Green Bond market. This index, which has control standards, includes only bonds whose collection is intended for the environmentally financing projects.

3. Experimental

It has been submitted an innovative and experimental questionnaire to investigate the environmental sensitivity of Sicilian companies. The questionnaire, proposed in this paper, aims to introduce in the system both the quantitative information regarding the company's environmental impacts and qualitative information regarding company policies, voluntary certification tools and eco-sustainable financial statements. The thematic areas are: the air, water, waste and energy sectors. These parameters, appropriately measured, highlight if the company follows the mandatory environmental legislation of reference, or when it doesn't, in this hypothesis the company will be subject of administrative sanctions. Also the parameters indicate the company ability to respect the environment and orientation to socially responsible management This self-evaluation companies' method encourages the proactive adoption of environmental policy tools to obtain benefits of cost reduction and better business reputation, so as to increase turnover and reduce the credit cost. The questionnaire, in particular, has been proposed to companies operating in the Sicilian agri-food sector.

Therefore, the ultimate goal is to evaluate the technical feasibility of the assignment a score that is added to the rating that the banks attribute to the companies in the process of financing evaluating. The questionnaires were compiled during a direct visit to the companies only in a few cases, in fact the favorite way is the electronical one or sometimes an interview to the entrepreneur. Furthermore, we were related collaborative relationships with a branch bank's manager in Catania, in order to evaluate the implementation of the environmental consideration on the bank rating.

4. Results and discussion

It is possible to realize some verifications to see the relationship between firms' bank rating and their environmental and social awareness. These analyses could be including inside the Corporate Social Responsibility (known as CSR rating), that consists in value increase for firms that are socially and environmentally responsible, as well as the whole product cycle. The CSR rating, even if it is not still used by banks, it could become an important economic and financial support for decision makers, and an instrument used to direct managers in making control of their sustainable management and their environmental and social risk. That indicator could become useful to measure environmental performances of firms, and it could also promote excellent standards for financial market ratings, and moreover it could permit an integration of environmental, social, financial, bookkeeping factors inside the decisional process of firms and investments (ratesustainability.org).

The evaluation of credit worthiness carried out by the bank filial consists in using a score: it is a quantitative and automatic analysis based on statistic models that uses a huge range of historical information of analyzed firms, for example budgets, balance-sheets, sector they belong to, and payment habits. The result is a score between 1 and 10, that expresses the evaluation of the missed payment probability (or default probability) of the firm. In particular: • 1-3: excellent • 4-6: medium • 6-7: low • 8-10: dangerous • >10: in default.

So the bank gives a "decreasing" score, meaning that lower is the score, more trustworthy is the firm, and lower is its probability of default. Therefore, inside the score process, the evaluation of the results of the environmental questioner should be inserted, together with factors we shown before.

Our survey, after asking some general information about the frim, it shows possible maintenance and management annual costs and also some structural investments that every firm could afford to improve its environmental performances. So this data is then compared with the others referent to dimension, product sector, and firm segmentation. To reach the aim of consider the environmental awareness inside the credit score that measure the credit worthiness, the purposed questioner should be analyzed in its financial and economic variables, which means operating costs of the income statement of last year budget, together with investments made during last year (as shown in Table 1). So we decide to calculate an environmental score, which can be deduce from tab1. In particular, every item of the table is evaluated in this way:

- One point for each relevant cost/investment item that the firms approach
- One point less for each item that it's relevant for the firm, but that it doesn't afford, taking in count the type of industrial activity made by the same.
- Zero point for each item that the firm do not afford, but that are considered not so relevant, and so not necessary

The final environmental score is the one highlighted in green (with a value of 11 in the case shown in Table 1). This is obtained by adding every "x" on all cost investment item each other, and by deducting the ones that firm do not afford. After all surveys, the average value was 8.77, and median value it was 8. Instead, regarding to second table of survey, it is a list of environmental parameters, and it is useful for a technic translation of data. In fact, it contains data regarding the follow-up of the impact that the firm has during his production cycle, or also during its activities: especially inside several environment polluting compartments; atmosphere pollution, water pollution, solid and acoustic (Matarazzo et al., 2017). Therefore, the bank can evaluate, using this table, how much the firm is able to respect existing legislations inside some products sectors.

Table 1. Example of a compiled check list with economic-financial parameters

ENVIROMENTAL MANAGEMENT COSTS	***CONSIDERABLE***	***NON SPPORTED***	***SCORE***
Sewer connection charges		X	
Maintenances and repairs water resources purification	X		
Cost of solid waste disposal		X	
Cost of liquid waste disposal	X		
Costs of atmosphere emissions monitoring		X	
External consultancy	X		
Employee medical visits	X		
Andjustment work safety	X		
Number of accidents at work	X		
TOTAL COSTS	6	3	3
INVESTMENTS			
Investments to reduce water consumption	X		
Investments to reduce toxic substance emissions	X		
Investments on new technologies for electricity reduction	X		
Containers for separate waste collection	X		
Investments for water recycling		X	
Dust extraction system	X		
Chimney filters	X		
Investments on Renewable Energy Sources		X	
Enviromental Certification	X		
Social and ethical Certifications	X		
Enviromental Balance		X	
Ecological brands	X		
Investments on firefigting equipment	X		
Investments for health and safety in the workplace	X		
TOTAL INVESTMENTS	11	3	8
TOTAL COSTS and INVESTMENTS	17	6	11

After having estimate, the environmental score, we evaluate the possibility to insert this score inside the bank process of calculating the traditional score during leading activities. In particular, we decided to operate as illustrated in Table 2.

Table 2. Environmental score

Environmental score < 5	The bank score increases of 1 point
Score between 6 and 9	The bank remain the same
Score > 9	The bank score decreases of 1 point

Source: Personal elaboration

The criterion we used consists in reward firms that possess a high environmental score, through a reduction of the traditional bank score (that was decreasing as we said before). So, for example, an environmental score of 11, from table 2, implies a one point decrease of bank score, making firm more reliable. In this way, we propose to insert the environmental awareness, inside factors that are normally used during rating process.

In this case study, the environmental awareness, which is calculated using "green" costs and investments within firm's balance, it takes an important role, if we consider that through the assignment of a point plus or minus, the bank score can change until 10 %. The second table is equally important, because the bank can quantitatively evaluate firms' impact, taking in considering the carried out activities and so also potential polluting items belonging to production activities.

Environmental firms' impact can be put into prospective of different activity sector, the industrial district firm belongs to and also of most evolved process and technology available on national and international markets. Moreover, the application of this instrument can also interest the bank institutions, with the aim to limit the potential impact of environmental firm's compart over the expected and unexpected loss on loans granted. The reduction of environmental risk and impact, by being aware, and so by obtaining good scores in the proposed check-list, it can also have an impact on pricing and tax of interest on loans, in favour of firms.

5. Conclusions

This case study has analyzed the median sensitivity of the Sicilian entrepreneur in a fundamental sector, namely the agro-food sector. Discovering a medium-high sensitivity of the Sicilian entrepreneur on environmental issues, justifies the broad consideration that Eco sustainable issues have within the various sectors of the economy, as well as the financial sector. The case study has shown that environmental sustainability is becoming a factor that entrepreneurs consider increasingly important for communication and the creation of a corporate image that is innovative.

To conclude it is possible to say, the tools that the companies have to implement sustainable investment in the Green Finance are: direct and indirect funding, structural funds, European investment funds, have an high score, through the CSR rating, in order to obtain credit facilities by banks.

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CARBON FOOTPRINT EMISSION'S EVALUATION OF A HIGH CONTROL CO_2 LEVEL WINE COMPANY*

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Abstract

Recent awareness of ecological disasters has led the management to change the way they see the environment considered now as an opportunity for the future.
Companies have to implement some technical tools, such as the "eco footprint", to understand how much natural resources they use and how much time they need to regenerate themselves. Particularly, CO_2 emissions deriving from agri-food companies constitute one fifth of global greenhouse gases.
In this regard, one of the most striking and significant factors deriving from the production process is the emission of gas defined as Carbon footprint. This is the subject of an assessment of the corporate performance about the Sicilian winery Nicosia Spa located in Trecastagni.
The instrument used for the evaluation is the "method composed of financial accounts" and finally, the outcome of this research is to update and compare them with European companies working in the same sector.

Keywords: carbon footprint, emission's evaluation, green economy, proactive company, sustainable winery

1. Introduction

Today, working with and for the environment is one of the main strength of cutting-edge companies. This because, it is possible to notice with a thorough planning and a bit of foresight how man and society depend on nature and probably all sectors of the economy benefit directly or indirectly from it (Brink, 2014). It has been proven that the forward-looking use of natural resources introduced to the production process improves not only the ecological aspect, reducing the percentage of environmental impact, but also the economic

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and ethical image of the company. This promotes a "green" policy through accurate investments that aim to both reduce the costs incurred and to achieve greater future revenues thanks to a high value of the surrounding area.

A process that, in greater dimensions, aims to advance the entire economic system of a country. Moreover, one of the events at the top of today's political agenda is global warming and the reduction of greenhouse gas emissions (Weidema, 2008). Thus, the green economy becomes a solution and no longer a problem for companies that are subject to an evolution of their "modus operandi", by implementing innovative management systems, giving rise to a new way of doing business. It has been scientifically analyzed how 1/5 of the air pollution is caused by the agri-food sector, and in detail, by the wine-producing holdings and the relative CO_2 emissions (Carbon Footprint), the subject of this paper. The wine-sector, considered one of the most important and historical sectors of the agro-food industry, is also the most impacting due to the use of fertilizers and pesticides (Puig, 2017), which significantly pollute the territory and the inputs used, becoming a major factor of the pollution.

The Carbon Footprint is the sum of all CO_2 emissions that have occurred during the life cycle of the product (Hertwich, 2009), and is widely used to demonstrate the non-sustainability of consumption patterns on an individual, local, national and global scale, (Niccolucci, 2008) thus becoming the most used indicator in the agri-food sector. To calculate the effect of the ecological footprint, different types of inputs are reconnected first to their area of origin (water, land) needed to produce resources or assimilate emissions. The areas are then further converted to their global equivalent (GHA, ground handling agent) by means of yield and equivalence factors. However, it should be emphasized that interannual variations could imply a considerable source of uncertainty for each denomination (Molina, 2015). Recent research has shown the important interannual variations that can be found within the same name related to GHG emissions in the same viticulture phase, due to changes in the yield, in the fertilization and in the use of protective agents of the wine (Vazquez-Rowe, 2012).

The competitive positioning of the regions characteristic of this new phenomenon has become a strategically important aspect (Getz, 2006), since, given the exponential growth of the sector, numerous geographical areas have become more careful in trying to attract more tourists. A typical example of this is Southern Italy, known as “Mezzogiorno”, which through its history and culture gives life to unique products, exploiting its peculiarity to increase the potential attraction of the place (Di Gregorio, 2006). Of course, thanks to the favorable weather conditions and the charm of local traditions, wine can be included in the list of the most representative products of the South, which is the oldest source of wine production.

2. Materials and methods

The Carbon Footprint is an indicator regulated internationally by the norm issued by the International Organization for Standardization (ISO 14064: 2006), which address some disciplines, divided into three parts that require:

1. to design and develop greenhouse gas inventories;
2. to quantify, supervise and report on reductions and removal of greenhouse gases; 3. to clarify the guidelines for conducting validation and verification of information on greenhouse gases.

The origin of the emission of gas comes from the concept of ecological footprint exposed for the first time by Wackernagel and Rees (1996) and refers to the biological production required to sustain hectares of human population (Pandey, 2011). Consequently, the Carbon Footprint based on the protocol Greenhouse gases (GHG) can be defined as the set of gases such as: CO_2, methane, nitrogen oxides and fluorides emitted during a production process. As a matter of fact, with a proper corporate management aware of environmental sustainability the emission of greenhouse gases can be reduced by 25% because produced in particular by work in the fields (11.3%), the use of plant protection products (6%), electricity consumed (9.2%) and bottling (42.6%) (Puig, 2017).

The importance of the Carbon Footprint lies in the fact that its calculation helps in business management because stakeholders, and more precisely investors, read it as an investment risk indicator (Hertwich, 2009) and consumers instead perceive it as an environmental indicator. If analyzed in reference to the agri-food and beverage sector, it allows the market share and customer satisfaction to be improved (Rugani, 2013), and this favors the continuous creation of management models designed to optimize both the management and the relationship with the environment.

In this regard, there are many models the models created to analyze and calculate this indicator, some models are proposed on the basis of mathematical functions to calculate the emissions of gas; consequently, they allow to take decisions both in the short and long term. (Benjaafar, 2013). Firstly, there is, a model based on the division of emissions on three levels stands out: the first includes natural and oil combustion emissions; the second, instead, electricity and steam; and the third, lastly, cradle-to-gate. Because of this peculiarity, it has been applied in different contexts such as companies in the publishing and energy sector, allowing a more pertinent management based on this indicator (Matthews, 2008). Secondly, a model is hypothesized, in which the calculation of the total greenhouse gases emissions occurs by multiplying the emissions by the corresponding operational activity data (Bonamente, 2016). Furthermore, a model used for the calculation of the costs due to GHG is the EOQ model, actually the economic order quantity model that is able to calculate the final cost by considering the oil price and the amount of greenhouse gases emitted by the single company. It is a calculation that takes into consideration several variables such as: annual demand, annual costs, volume orders, oil price and greenhouse gas emissions. For this reason, the EOQ model lends itself to the calculation of peculiar indicators on the basis of the formulation of different theorems that can limit the company's outgoing cash flows following such emissions (Hua, 2011). Another model used is the "Soil organic matter model" that calculates the impact of emissions per bottle of wine through functions (Bosco, 2013).

This paper will be based on the Doménech model, the MC3, method composed of financial accounts (Penela, 2009), whose emissions calculation are made through a matrix that expresses the emissions in tons (T) and in ground units. The figure below indicates the matrix which includes the main categories of resources and products that a company requires and also the waste generated by the production process and the use it makes of the land sector. The calculated CCFP (corporate carbon footprint) indicator includes direct and indirect CO_2 emissions generated in the production process keeping constantly into consideration the emissions included in the Kyoto protocol and GHG. Through this figure emission of all a company's products and services consumed are shown.

There are six groups of columns: the first group corresponds to the different products consumed by the company, the second group specifies the emissions of the different products in their respective units of measurement, the third group expresses the productivity of the goods in tons per hectare and it shows the energy produced expressed in joules per hectare. The fourth group shows the distribution of emissions among the different categories of land. The fifth column groups the total emissions and the sixth describes them in subsequent sections (Penela, 2009).

Table 1. Structure of the spreadsheet showing the CEF/CCFP matrix of consumption versus BPS

PRODUCT CATEGORY	ANNUAL CONSUMPTION					PRODUCTIVITY		FOOTPRINT BY BPS TYPE							
	Consumption units [unit/year]	Euros without VAT [Euro/year]	Tons [t/year]	Energy intensity [GJ/t]	GJ [GJ/year]	Natural [t/ha/year]	Energy [GJ/ha/year]	Fossil energy [Ha*EF]	Cultivable land [Ha*EF]	Pastures [Ha*EF]	Forests [Ha*EF]	Built-up land [Ha*EF]	Sea [Ha*EF]	TOTAL CEF [Ha*EF]	COUNTERFOOTPRINT [Ha*EF*FR]
1. ENERGY															
1.1 Electricity															
1.2 Fuels															
1.3 Materials															
1.4 Construction materials															
1.5 Services															
1.6 Wastes															
2. LAND USE															
3. FISHING AND AGRICULTURAL RESOURCES															
4. FOREST RESOURCES															

t: tonnes; EF: Equivalence factor

3. Case Study: Nicosia S.p.A

Nicosia S.p.A is a medium-sized company located in Trecastagni (CT) that boasts more than a century of activity in the wine sector. Today it continues to operate in a dynamic, modern and efficient way with the ability to look to the future in full respect of tradition, not forgetting to enhance the Etna wine. Today the company is a family run business, as in the past and plans investments concerning the modernization of the bottling line and the installation of photovoltaic panels.

Thanks to the company's care and attention both for the raw material and for its processing in the cellar, it favors the most prestigious indigenous varieties and international varieties best adapted in Sicily, being able to boast customers both nationally and internationally from Russia, Brazil, Ireland, Germany, Poland, Spain and the Czech Republic. The Trecastagni winery consists of 4,000 m^2, covering a total area of 27,000 m^2, between the wide wine-making area, the analysis laboratory, the modern bottling line and the underground cellar. It produces healthy wines, respecting the environment with the aim of bringing a "zero impact" wine to the tables of consumers. The completion of the Organic and Vegan Certification process has represented a further goal that joins the international certifications obtained over the years: from UNI EN ISO 9001: 2015 to the Environmental Certification UNI EN ISO 14001: 2015, from BRC Food & Beverage at the International Food Standard (IFS).

Under the environmental, biological and vegan certifications; being a proactive company with respect to the environment and a leader in the sector, it has set itself the virtuous objective of obtaining the Water footprint, Carbon footprint and LCA certifications. Being a sustainable company, it adopts an integrated viticulture because it tries to solve the viticultural problems by putting together different approaches and choosing those with greater efficiency and with the lowest environmental impact. It privileges biological control and agronomic systems and, when this is not possible, the targeted and minimal use of products that biodegrade rapidly in the environment.

An important aspect is the precision and differentiated viticulture. For this reason, in 2014, the company has joined the project "Magis" which allows the satellite mapping of the vineyard identifying the various points in need of attention and then acting locally.

For the future, the implementation of a photovoltaic system is proposed, to permit the energy independence. The beginning of a total or partial in-house production (80%) of the organic wine and finally the installation of a new production plant through which is estimated to reduce about 30% of energy consumption.

4. Results and discussion

Before proceeding to the analysis of the results, it should be noted that the company Nicosia S.p.A is a leading company in its sector and for this reason attentive to the needs of the environment and the stakeholders with whom it interacts. In this regard, it is equipped with an environmental policy to ensure that the activities, products and services comply with legal requirements and company objectives. This policy is inspired by the concepts of continuous improvement and Risk Based Thinking. The emissions of this company precisely because of its extremely but positively proactive attitude, are minimal, as confirmed by the MC3 application model previously outlined.

On analyzing the production cycle, emissions are found during the early stages of the production cycle, the grapes are not harvested using machines or vehicles but manually, consequently no gas is emitted and the plan is fully reflected of environmental policy in full respect of the surrounding ecosystem. The impacting phase considering the "cradle" of the production process is the transport of the grapes using tractors fed with oil that then generate COx which pollute the air. This part of the process is particularly difficult to control as the company benefits from different vineyards, including Monte Gorna, 2.5 km from the winery, and that of Vittoria (RG) which it does not own and where the "Cerasuolo di Vittoria" is produced. Between the two, the most impacting is definitely the latter because in addition to transporting the grapes from the vineyard to the warehouse which is more or less 1 km, it also includes the journey to the winery based in Trecastagni.

The distance between the two cities is 103 km, so the journey is not indifferent and emissions can be contained with the use of vehicles that install catalytic converters to complete the combustion process; or, using vehicles to methane that, although polluting, impacts less than the classic fuel, known as gasoline. Once, the grapes have been delivered to the company, they are subjected to various processing processes. Of particular mention for the purpose of this study is the wine-making phase, or fermentation of the grapes because they contain a substance called "ferment" which is a producer of CO_2. Although, as shown by the model, this quantity is negligible which is 0.81 grams of CO_2 per liter of must, insignificant compared to almost five thousand hectoliters of must produce, so no method has yet been suggested to store the CO_2 produced and reusing it alternately as a source of energy. The company proves itself to be at the forefront by supporting glass bottle import costs which, unlike an internal production, would unjustifiably increase the amount of CO_2 produced in the production process. At the "semi-variable" CO_2 emission level, it's possible found electricity and the use of refrigeration and air conditioning systems. As far as electricity is concerned, it is not possible to separate the consumption due to the production process, certainly higher, than that used for the lighting of the restaurant adjacent to the company headquarters.

The data concerning plants containing F-gas instead of are easier to understand. The company is annually, in accordance with the provisions of Article 16 paragraph 1 of Presidential Decree No. 27 of 27 January 2012, must declare equipment containing fluorine and currently has four of which, three fixed used for refrigeration containing respectively:

- R-407 C refrigerant containing 26 kg of refrigerant charge;
- R-410 A refrigerant containing 52 kg of refrigerant charge;
- R 404 A refrigerant containing 17 kg of refrigerant charge and a fixed one used for air conditioning containing R-410A refrigerant containing 15.2 kg of refrigerant charge.

They are used to refrigerate the tanks and thermo-condition them according to the outside temperature, to keep the quality of the grapes and of the already fermented wine intact and of course for the company's conditioning system. At the end of the production process, the distribution of the products in the different sales points in Italy and abroad, impacts. although for the international borders the "Franco confine" protocol is used, the product is distributed by Nicosia S.p.A up to the border and it will be the other distributor's responsibility to import it into their country. During the process no waste products are produced, disposal is not contemplated and therefore emissions are not counted at this stage. Lastly, the company is defined as proactive because of the total annual production it impacts 0.371 tons on almost 5000 hl of must produce. For this reason no investments are assumed, under 80,000 tons produced, since most of the emissions are due to the fermenters which are natural substances cannot be eliminated in the grapes. Consequently, with these production volumes an investment would only be an extra cost to bear that could look away the correct business and environmental management.

Carrying on using this model, it is possible to compare Nicosia S.p.A with a Spanish winery where CO_2 emissions have been spotted around 5.47 tons as a result of calculation about the total production amount of 30.000 tons. These data are proportionally higher than Nicosia's ones, but it's clear that they do not depend only on the production but also on chemical products that are used in the process and by-products of glass. (Penela, 2009)

Comparing this company with other companies in other sectors, a study carried out on a Spanish company producer of wood pallet (Alvarez, 2015), it is understandable how analyzing the entire production cycle, the management realize what is the most impacting production segment. In this case, it is the wood harvest with 28.7% respecting to the other phases and on the total of emitted CF around 8,1 kg per functional unit on the total of 1 600 000 of functional unit. This calculation referred to 2012, it has surely helped the company to modify the management of this phase using sustainable inputs. Highlighting, moreover, one of the advantages of method composed of financial accounts.

5. Conclusions

MC3 method used to analyze Nicosia S.p.A has shown, as a result, how this company is proactive and how an investment produced to limit the emissions cannot have success, seeing as that the winery does not emit even the 1% on the total of production.

This allows, on the other hand, to understand the utility of this instruments using the matrix (figure 1). In fact, the matrix through simple calculations leads to an optimal result to emissions calculations and to the choice of strategic and operative decisions.

Among the strategic decisions, the green marketing ones are also counted which simplify company management from an external point of view as far as relationship with stakeholders is concerned because these decisions concern above all environment protection. Then, from an internal point of view, because extending controls and acquiring international certifications is enhanced the quality of the product and the production.

Finally, it is possible to demonstrate how the calculation of Carbon Footprint applying the MC3 model entails a lot of advantages such as: being a complete and flexible model, because of its application to every kind of company, seeing as it collects the consume data of all production inputs, services and production waste. Its calculation does not require extended input and, in the end it is a simple method due to its easy comprehension by all employees. The innovations consist in the reduction of the emission produced by different inputs used for the execution of productive combination, and in the implementation of focused action. This permit not to delete entire production segments too much impacting but only check and review the factors used in those phases which cause the pollution.

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