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Edited by Simona Scalbi, Arianna Dominici Loprieno, Paola Sposato

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Recovery of waste streams from agroindustry through industrial symbiosis in Sicilia

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1. Abstract

Industrial Symbiosis can be considered as a strategy for sharing and valorising resources (including materials, energy, water, assets, expertise, logistics, capacity, equipments) between companies, so that a non-product produced by an industry can be used as an input by someone else (synergy). ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) in 2011 started the project "Ecoinnovation Sicily" for the development of the first Italian Industrial Symbiosis Platform (Platform) to be implemented in Sicilia Region (among many other issues). The Platform addressed, in particularly, to small and medium enterprises (SMEs) and other local stakeholders, offers many other tools, beyond the industrial symbiosis, useful for supporting industries for the eco-innovation. This paper explains the methodology for the identification of potential synergies and the pathways for their actual implementation, with the specific focus on streams coming from agroindustry.

2. Introduction

The industrial simbyosis (IS) approach reflects the recent European strategies (EU COM, 2011, 2012, 2014) of decoupling economic growth, environmental impacts and natural resource consumption. There is a growing interest towards IS since it boost the resource efficency, enhance the circular economy and fosters the eco-innovation. Different IS models can be applied, e.g. following the network approach or the industrial park one (like e.g. Kalundborg) (Chertow, 2004; Lombardi and Laybourn, 2012). Through IS the closure of resources cycle can be realised switching from an open system, where non-products are wasted, to a closed one where non-products have added-value destinations, in a Life Cycle Thinking perspective. ENEA in 2011 started the project "Ecoinnovation Sicily" for the development of the first Italian Industrial Symbiosis Platform to be implemented in Sicilia Region (among many other issues) (Cutaia et al, 2014). The Platform, addressed, in particularly, to small and medium enterprises (SMEs) and other local stakeholders, offers many other tools, beyond the industrial symbiosis, useful for supporting industries for the ecoinnovation (regulatory database, simplified tools for LCA and Ecodesign, Best practices database, GIS system) (Cutaia et al, 2015 a-b). The ENEA platform started creating a network among companies, willing to share resources. . Waste and residues from one company can become resources in input for one other company (or companies), in short they can realise a "synergie". During three operative meetings, about 90 participating companies have shared more than 400 input-ouput data (resources requested as input or available as output). These data, geo-referred and elaborated by ENEA, allowed the identification of more than 600 potential synergies between partecipating companies. Resource streams have been classified in 6 categories: 1) paper and cardboard products; 2) excavation materials, construction/demolition waste; 3) plastics/plastic products;

4) metals/metal products; 5) equipment; 6) waste/by-products from agroindustry (agricolture, exhausted vegetable oils, food products, bio-materials from livestock and fisheries). The last one is focused in this paper.

3. Population of database and recruitment of companies

The first step of the implementation of IS in Sicily concerns companies recruitment, started by creating a regional companies database. First steps of the project have been addressed at networking and promoting activities at regional level (in Sicily) and at national and international level too (Cutaia et al, 2015c). After, 3 operative meetings took place in Sicily, as summarised in Table 1.

	COMPANIES	DELEGATES	SHARED RESOURCES	POTENTIAL SYNERGIES IDENTIFIED DURING MEETINGS
SIRACUSA 1 (28/03/2014)	36	44	+200	+160
CATANIA (24/10/2014)	36	42	+200	500
SIRACUSA 2 (4/11/2014)	11	12	29	0

Table 1: Operative meetings held in Sicily in 2014. Summary of results.

Collected data were uploaded on the ENEA IS platform (Cutaia et al., 2015a-b), georeferenced and elaborated, so new potential synergies have been identified, in addition to those identified during the operative meetings. Resources have been classified as: materials; energy; expertise or consultancy and service; logistics and transports; capacity and equipment.

4. Industrial symbiosis for waste and byproducts from agroindustry in Sicily

The agro-industry sector in Sicily plays an important role in the regional and national economy. The impact of agriculture on the regional economy is 3.6%, resulting slightly higher than the average in south Italy (3.1%) and the national average (1.8%), and absolutely one of the highest in Italy (after Basilicata, Molise and Calabria). According to the 6th ISTAT Census of Agriculture, Sicily is the second region in Italy, after Puglia, for the number of farms, 219,677 in 2010 (13.6% of the total). According to the 9th ISTAT Census of industry and services, the food industry and beverage industry in Sicily has 6,828 active businesses, which account for 30.2% of the active companies in the manufacturing sector of the island. This quota is the highest in Southern regions (24.5%) and in Italy as well (13.7%).

Among the category “materials”, shared resources identified as “waste and byproducts from agroindustry” generated 50 synergies between 21 companies with different size and core business and different types of streams (fruit and vegetable scraps, wood cuttings, pasteurized milk whey). For these waste streams, different options of treatment and recovery have been investigated. The detailed analysis of these synergies has led to the identification of three main final destinations: energy recovery (3 synergies between 4 companies), material recovery for compost production (14 synergies between 9 companies) and material recovery for livestock feed production (9 synergies between 5 companies). The pathways of these synergies have been summarized in layouts. The simbiosis pathway on “energy recovery from scraps from agro-industry” has been sub-divided in: Anaerobic digestion for biogas production, characterized by scraps with a high content of organic substance that affects the rate of degradation of the substrate such as citrus scrap,

vegetables scrap, fruit scrap, peel of citrus fruit, pasteurized milk whey; Pyrolysis, which includes scraps with a lower calorific value very high such as wood cuttings of olive, vines, almonds and carob trees; grape and olive pomace, grape marc and dregs; table-grapes scrap processing.

Using data provided by participating companies, literature and technical data, it was possible to characterize those steams according to the characteristics required for the two treatment systems (biogas and pyrolysis plant), both for the characteristics of the product in input to the processes, and both for the outgoing one, for every step of the synergy's layout. In this way each potential synergy has been identified and trackeld from the point where the scarp is produced to the product obtained. The layout of "livestock feed production from agro-industrial scraps" involves 4 Sicilian companies of three different provinces: 3 companies that give resources as output (mainly citrus pulp, named "pastazzo") and one that requires resources as input. Enea has identified 7 potential synergies between the 4 companies.

5. Discussion and conclusion

Two Operative Handbooks on the symbiosis pathways for the energy recovery and livestock feed production from waste agrifood have been realised by ENEA to summarize the synergies and their main issues. Concerning the simbiosis pathway on *energy recovery*, the quantity and availability make these scraps very interesting, both from an environmental and economic point of view. As some of these resources are landfilled, with very high costs and impacts, ENEA has highlited that there are no obstacles for their utilisation, neither legal, as these scraps can be classified as byproducts and not as waste, nor technical, based on the characteristics required for the two plants. One concern comes from their seasonal availability; therefore the feeding of the plants must be assured by a set of organic scraps and waste streams available throughout all the year. A second major concern comes from the distances between the scraps' production sites and the plant, that can influence the cost of transport and the consequently the economic feasibility of the synergy. Concerning the *livestock feed production*, two regulatory aspects are relevant: the regulation on citrus pulp (Italian Law, 2013) has clearly recognized it as a byproduct of citrus useful for livestock use, taking it away permanently from waste legislation; European regulation on citrus pulp as feed materials on livestock feed (EU 68/2013) and regulatory requirements must be met before the feed livestock can be placed on the market.

Industrial Symbiosis approach redefines the waste concept by breaking the traditional meaning; the operative meetings represented an opportunity for participating companies to give a new meaning to their waste, to be considered as precious resources, which can be shared with other companies with mutual benefit. A proactive approach from involved companies is crucial for enhancing the possibilities of finding synergies between companies: the more they share information on their resources, the more matches between companies can be found through the implementation of the industrial symbiosis platform.

Industrial symbiosis platform could be used as a planner, if its dataset covers a region or a defined area, since it could allow the identification of recoverable and reusable waste streams in that area, attracting sustainable inward investment (overcoming magnitude problems, if any). Moreover, companies move their mind toward sharing concepts (at the base of sharing economy) and cooperative approach.

In this sense IS is a powerful tool for ecoinnovation at systemic level considering not only economic benefits and environmental advantages but also social issues and long-term culture change for companies, that are the way for the transition to green economy.

6. References

[1] EU COM, (2011), Roadmap to a Resource Efficient Europe; EU COM, (2012), European Resource Efficiency Platform (EREP). Manifesto & Policy Recommendations, European Commission; EU COM, (2014), Towards a Circular Economy: A Zero Waste Programme for Europe.

[2] Chertow M.R., (2004), Industrial Symbiosis, In: The Encyclopedia of Earth, Lifset R. (Ed.)

[3] Lombardi R.,Laybourn P,(2012),Redefining industrial symbiosis, Journal Industrial Ecology,16,28-37

[4] Cutaia et al., (2014),"The Project for the Implementation of the Industrial Symbiosis Platform in Sicily: The Progress after the First Year of Operation"in: "Pathways to Environmental Sustainability. Methodologies and Experiences", Salomone, R., Saija, G. (Eds.), Springer International Publishing.

[5] Cutaia et al., (2015a) Environmental Engineering and Management Journal, Vol.7, 14/2015 in press.

[6] Cutaia et al., (2015b) "A systematic methodology for industrial symbiosis approach development at a regional scale", Proceedings of IWWATV 2015 Conference.

[7] Cutaia et al., (2015c) "Comparison between networking approaches for industrial symbiosis projects ongoing in Italy" Book of abstracts ISIE Conference 2015 University of Surray, Guildford 7th-10th july.

[8] Italian National Institute of Statistics, (2011) "9th Census of industry and services" ISTAT (2011), On line at: http://censimentoindustriaeservizi.istat.it/ .

[9] Italian Law n. 98/2013,art. 41- quater Converting, with amendments, Law 21 June 2013, n. 69.

[10] Commission Regulation (EU) No 68/2013 of 16 January 2013 on the Catalogue of feed materials Text with EEA relevance