Solid Waste Reuse in the Balkan-Mediterranean Region

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Abstract. The wide implementation of circular economy and industrial symbiosis in the Balkan and Mediterranean region lags behind most of the other European countries. The economic crisis has had a significant impact to the local businesses, eliminating new investments. Regarding specifically solid waste, which is the type with the highest increase in terms of annual generation over the last decade, the situation is aggravated by the lack of national or regional strategies. In this paper, taking into consideration the results of the implementation of SWAN research project, which led to the design and development of a digital solid waste reuse platform for the Balkans, our objectives are: (a) to compare the current state of solid waste management in four different countries (Albania, Bulgaria, Cyprus, Greece), (b) analyse the opinions of various directly involved actors on solid waste management issues and on their familiarisation with new concepts such as circular economy and urban/industrial symbiosis; and (c) compare the feasible business models in all four countries, in terms of their quantitative and qualitative characteristics.

Keywords: Industrial Symbiosis, Solid Waste, Balkan Region, Business Models

1. Introduction

The main objective of the SWAN project was, as already mentioned, the design and development of a digital solid waste reuse platform for the Balkans (University of the Aegean, 2020). A further equally significant goal of the project is to safeguard the management of the knowledge gained, the synthesis of the results and the definition of the prerequisites for the viability of this venture after the completion of the project. Within this context, this paper will be drawn up to present the experiences, current state of affairs and the future plans in all the countries-partners and show their similarities and differences related to the scope of this project. These need to be taken into account in order to determine common best practices, develop transnational waste reuse value chains and establish new tools, like the SWAN digital platform (Angelis-Dimakis et al, 2021), as a vehicle for the establishment and the spread of circular symbiotic schemes.

Following this brief introduction, the paper is structured as follows. Section 2 looks at the solid management situation in the four countries involved in the project. Section 3 presents and comments on the main findings drawn from the data collected from solid waste sources and potential receivers in the four countries. Finally, Section 4 summarises the conclusions.

2. Solid Waste Management

Over the last ten years, Greece, Cyprus, Albania and Bulgaria have updated their waste management plans and have defined their strategy, policy and targets of waste management on a national level, aligning their policies with EU. Nevertheless solid waste management still remains a major structural challenge for all the above countries despite their differences (European Commission 2019a, 2019b, Anon, n.d.).

Landfilling remains as a general practice the most common method of waste disposal but the number of illegal landfills that are still operational or in need of relocation, has fallen over the years. However, according to the European Commission's 2018 'Early Warning Report', all 4 countries are at risk of not meeting the 2020 municipal waste recycling target of 50%(European Commission, 2018).

The low absorption rate of European funds, which could be invested in waste management and circular economy projects, is a long standing and serious problem. The main reasons for that are, the lack of reliable data and the difficulties in cooperation among the authorities assigned with the management of the funds and the potential beneficiaries (European Commission 2019a, 2019b, 2019c, 2019d).

It is obvious that although serious steps have been made over the last years in all four countries, there is still a lot of work to be done in the waste management field in all of them. Only a small proportion of the waste is recycled and/or used as secondary raw material. There is a need to introduce a clear and well-defined strategy regarding a

waste management market. Moreover, the number of waste management companies is small compared to the average for the EU countries. Finally, for certain types of waste, there are no viable solutions for material recovery.

Concluding, it may be argued that in all four countries there is plenty of room for the introduction of new waste management policies and the further enhancement of practices registered in the context of circular economy. It is obvious that despite the differences in the level of circularity among those countries they are still lagging considerably behind most the EU countries. The need to increase the awareness of all the stakeholders involved, develop a progressive and homogenous institutional framework along the lines of the green deal and the adoption of modern practices and knowledge management mechanisms in circular economy are key prerequisites for every country but also for their network. The fact that three of those countries are already EU members and Albania goes through the accession process facilitates their realization. The development of know-how and the transfer of best practices through both the European cooperation mechanisms and the free-market synergies could have a significant impact on the shaping of a modern approach to waste management in all four countries.

3. Data Collection

As part of the SWAN project, a questionnaire was distributed to various solid waste sources and potential receivers industries and municipalities. The questionnaire was built around three main sections: (a) main characteristics of the respondent (name, type, location); (b) major solid waste streams and potential input streams that will be considered for waste reuse; (c) knowledge around the concepts of industrial symbiosis and willingness to participate in symbiotic schemes.

The total sample consisted of 81 units for Albania, 153 for Bulgaria, 108 for Cyprus and 216 for Greece. The following three sections summarize the findings of the questionnaires and draw some initial conclusions before analyzing further each country separately.

3.1 Public Perception

This subsection looks at the familiarisation of all the participants with the basic concepts of circularity and their willingness to participate in industrial symbiosis projects.

The following four questions were chosen as the most representative, ones in order to analyse the opinions of various directly involved actors:

- Q1: Are you familiar with the concept of circular economy?
- Q2: Are you familiar with the concept of industrial symbiosis?
- Q3: Are there any existing symbiotic links in the company?
- Q4: Would the unit be interested in participating in symbiotic value chains?

Figure 1 summarizes the answers of the involved actors in three of the examined countries. As it can be pointed out:

- Most of the respondents in all countries are familiar with circular economy.
- Their familiarisation with industrial symbiosis is lower, as expected, since it is a more specialised topic.
- The rate of implementation of industrial symbiosis links is rather poor in all countries,with the exception of Greece.
- The respondents in all countries were very willing to participate in industrial symbiosis projects.

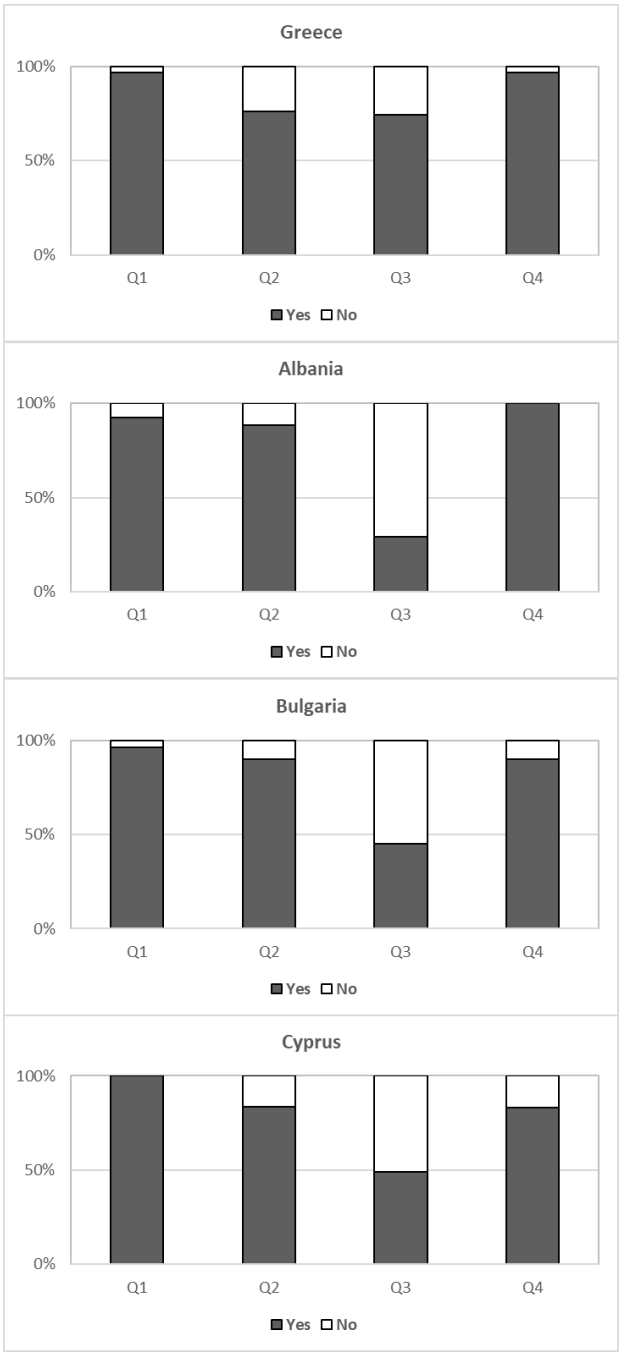

Figure 1. Public perception on Industrial Symbiosis and Circular Economy

3.2. Industrial Profiles

This subsection looks at the profile (size and type) of the industries participated in the research in the four countries and the findings are summarised in Figure 2.

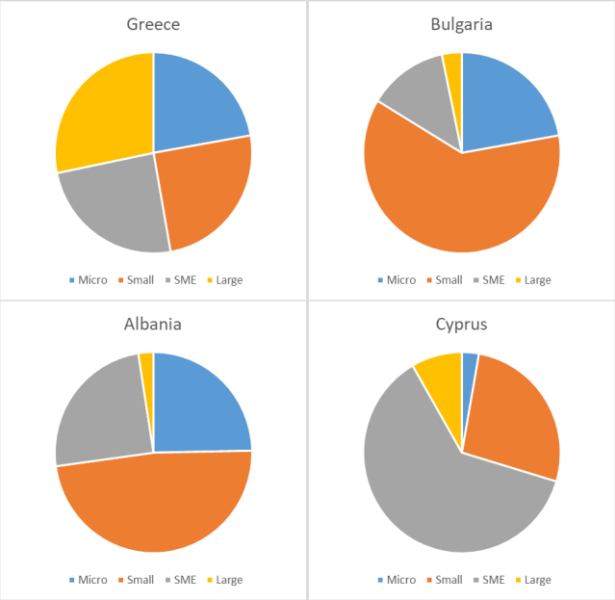

Figure 2. Size profile of the industrial sites

Greece has a more uniform sample in terms of size, since all four categories are equally represented. There are no crop or animal production sites in the sample, which makes sense since the analysis focused on the region of Attica, which is mostly urban. There are many different sites of various types (just one site of each type in many cases). The most common types are metal production (10%), food production (6%) and paper manufacturing (5%).That makes it difficult to draw conclusions on a sectoral basis. The majority of the business models proposed will be on the basis of an individual industry.

The majority of the sites (84%) in Bulgaria are micro enterprises or small firms. The sample is dominated by crop and animal production and related service activities (23%). From the remaining industrial sites, the most common types are metal manufacturing (22%), brick manufacturing (6%), wastewater treatment (7%) and electricity production (6%).

Albania is characterised by a similar profile with Bulgaria, in terms of size, since 73% of the sites are micro enterprises or small firms. However, there are a few sites or just one site of each type in most of the cases, which again makes it difficult to propose symbiotic schemes on a sectoral basis. The most common types of industrial sites are food production (10%) and furniture manufacturing (5%).

Finally, 62% of the industrial plants that answered the questionnaire in Cyprus are small and medium enterprises (SMEs). Food production companies (17%) are the majority of the sample. The other remaining common types involve quarries and mining sites (15%), wastewater treatment (8%) and brick manufacturing (7%).

3.3. Available Waste Streams

This subsection looks at the composition of the waste streams, as identified in the completed questionnaires for each country. Waste streams are defined as streams that the holder discards or intends or is required to discard, based on the Directive 2008/98/EC.

Table 1 provides an overview of the most common waste types of all the units involved in each of the four countries. The value in the last column indicates the number of waste streams of that type, for all the respondents. As it can be seen, 56 of the Greek units in the sample have recorded paper waste streams, 21 of the Albanian units have recorded plastic waste streams and so on.

Table 1. Most common waste types for the four involved countries

Type of Waste	Number of Streams
Greece	
Paper and Cardboard Waste	56
Metallic Non Ferrous Waste	54
Mixed Materials	48
Chemical Waste	47
Vegetal Waste	31
Plastic Waste	30
Used Oils	28
Albania	
Mixed Materials	33
Plastic Waste	21
Household Waste	18
Paper and Cardboard Waste	15
Bulgaria	
Metallic Ferrous Waste	67
Plastic Waste	61
Household Waste	57
Paper and Cardboard Waste	40
Wood Waste	32
Used Oils	29
Metallic Non Ferrous Waste	28
Cyprus	
Plastic Waste	65
Paper and Cardboard Waste	61
Glass Waste	36
Vegetal Waste	31
Household Waste	25
Common Sludge	22

Although these values are not fully representative, as they do not give an indication about the quantitative characteristics of the waste streams (quantity, seasonal availability), they can guide an initial discussion about the focus of potential collaborations schemes.

By looking closer at the proposed business models based on the best practices database, incorporated in the SWAN platform, it can be concluded that:

- The large number of streams and the wide variety of waste types, in combination with the big number of industries involved in the sample, makes it very difficult to draw generic conclusions for Greece. A more detailed case by case analysis is required to be able to draw more valid conclusions.
- The only feasible symbiotic schemes in Albania, can be based on plastic (mostly, since these constitute one of the major streams) or metallic waste streams.
- The only identified business model in Bulgaria, is the exchange of fly ash between power plants and cement industry.
- The proposed potentially feasible business models in Cyprus are based on plastic waste, industrial and common sludge (with cement industry being the main consumer) as well as paper and cardboard packaging. There are also a few individual cases based on food industry waste streams but further research is required.

4. Conclusions

The scope of this paper was to look at the findings of the SWAN project in the four countries (Albania, Bulgaria, Cyprus, Greece) involved and (a) to compare the current state of solid waste management (b) analyse the familiarisation of the stakeholders with new concepts such as circular economy and urban/industrial symbiosis; and (c) compare the feasible business models in all four countries, in terms of their quantitative and qualitative characteristics.

The main conclusions are summarised below:

- Serious steps have been made over the last years in the waste management field in all four countries but there is still a lot to be done. However, despite the differences in the level of circularity among them, they are still lagging considerably behind most of the EU countries. Hence, there is plenty of room for the introduction of new waste management policies and the further enhancement of practices registered in the context of circular economy.
- The familiarisation of the stakeholders in the waste management field of all countries with the concepts of circular economy and industrial symbiosis is high and the same goes for their willingness to participate in industrial symbiosis projects. These findings reflect their particular interest for these issues, which is largely related to both their financial pursuits and the obligation to comply with the prevailing institutional framework. However, the current rate of implementation of such projects is low.
- The majority of the industries that participated in the project were SMEs and small industries of various types, which constitute the backbone of the national economy, not only in the four countries of the project but in many other European countries as well. Such industries have traditionally had an extra difficulty in adopting new trends, mainly due to the shortage of financial and other means. Hence, their high degree of familiarisation with circular economy and industrial symbiosis concepts is very encouraging for their future prospects.
- The Circular Economy Business Models are mostly collaborative in the case of SMEs. While collaboration often occurs spontaneously, in many cases there is a need for external facilitation. Industrial symbiosis networks, as well as clusters and eco-industrial parks, with their concentration of research and business and tradition of cooperation are all suitable breeding ground for such models.
- The number of identified business models depends on the quality and the variety of the collected data. A more complete feasibility assessment was carried out for the case study of Cyprus, built around food and cement industry. This does not mean that there are no feasible business models for the remaining three countries, but that the financial data collected were not enough to formulate business models and/or assess their economic feasibility.

References

Anon, (n.d.), Municipal waste generation and management: current situation and distance to target, https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjw1e

Angelis-Dimakis A., Arampatzis G., Pieri T., Solomou K., Dedousis P. and Apostolopoulos G. (2021) "SWAN platform: A web-based tool to support the development of industrial solid waste reuse business models", Waste Management & Research: The Journal for a Sustainable Circular Economy, 39(3).

European Commission(2018), Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regionshttps://eur-lex.europa.eu/resource.html?uri=cellar:1dfc5184-c003-11e8-9893-01aa75ed71a1.0006.02/DOC_1&format=PDF

European Commission (2019a), Country Report Greece 2019 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances, Commission staff working document.

European Commission (2019b), Albania 2019 Report, Commission Staff Working Document.

European Commission, (2019c), Country Report Bulgaria 2019 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances, Commission Staff Working Document.

European Commission (2019d) Country Report Cyprus 2019 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances, Commission Staff Working Document.

University of the Aegean, (2020), Design and development for proposed list of profitable business models for Greece, Deliverable 5.3.1 Matching, Interreg, Project S.W.A.N. - a digital Solid Waste reuse plAtform for BalkaN