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Assessment of Waste Management Practices in Cyprus The case of Nudging at Cyprus University of Technology

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Abstract:

Waste management issues are prevalent in many parts of the world. Member states of the European Union (EU) are expected to follow the guidelines of the Waste Framework Directive set by the EU. The directive includes targets intended to facilitate waste management practices such as recycling and landfilling. Unfortunately, several countries in the Mediterranean regions are failing to meet these targets, one such country being Cyprus. The country is the third largest generator of municipal waste in the EU and majority of the country's waste (approx. 80%) are landfilled, while just 19% are recycled. Cyprus has failed to meet the target for recycling 50% of the municipal waste by 2020. Much of the problems can be attributed to the fact that the country lacks good infrastructures such as recycling facilities and services for separate processing of recyclables and biodegradables.

Cyprus University of Technology, situated in the city of Limassol, is a leading university in country that values environmental protection and sustainability and has won several awards for depicting their commitment towards sustainable development. Owing to their good environmental record, a study was conducted at this university in the form of a waste audit and nudging experiment along with a complimentary questionnaire. Nudging is a concept in behavioural science which proposes positive reinforcement through the form of indirect suggestions as a strategy to influence decisions and behaviours of individuals or groups. Nudging was undertaken through the intervention of an informative sign at the recycle bins. The waste audit was separated into two periods, control (without nudging) and intervention (with nudging). Later, a questionnaire was distributed to students to understand their attitudes and behaviours towards recycling and the nudging experiment. This research is analysed using a mixed method approach whereby data is collected and analysed using both quantitative and qualitative methods. A secondary data analysis was also utilised for recommending possible solutions to improving waste management problems in Cyprus based on recycling initiatives in other countries, particularly from the Mediterranean region.

The research found that there has been an increase in the rate of recycling since nudging was introduced. The questionnaire results also implied that there is a general concern among students for recycling and that much more has to be done by the university to help with waste separation and recycling. The secondary analysis of literature also reveals Cyprus has a long way to go, but proper waste management can be achieved through the government's prioritisation of environmental protection and improvement of waste management infrastructures.

Although the findings in this research has been successful, it could have been further investigated if the waste audit period had been extended and more responses were acquired to the questionnaire. Additionally, conducting interviews of certain individuals could have provided more insight into the waste management challenges in the future.

Keywords: Sustainable Development, PMD, Paper, Recycling, European Union, Cyprus, Nudging

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Summary:

Cyprus needs to radically transform their current waste management system to be able to meet future recycling targets. Currently, much of the wastes from the country ends up being landfilled or shipped abroad due to lack of recycling facilities. However, landfilling and waste exporting laws are becoming stricter than before and good waste management is key for a country like Cyprus, which is one the third largest producer of municipal waste in Europe. Waste separation at source is a key solution to manage and treat wastes properly. Just as much as separating wastes, it is equally important for the country to prioritise waste management laws and become self-sufficient.

Through the application of both quantitative and qualitative methods, this thesis explores the possibility of Cyprus improving their waste management system and nudging to increase rates of waste separation and recycling. A waste audit and nudging experiment along with results from questionnaire carried out at Cyprus University of Technology suggests that majority of students care about recycling, but mandatory education is required to inform them how to recycle. A simple nudge like the usage of sign at recycle bins to inform students of recyclables and non-recyclables is effective to influence their behaviour to increase waste separation rates. Secondary research on other Mediterranean country's strategies to tackle waste management also highlights that Cyprus has the capability to improve their waste management system. Future recommendations for improving the research includes: an increase in the duration of waste audit, the necessity of higher questionnaire response rate and input of interview answers from relevant persons. A more extensive study can be undertaken if these recommendations are employed.

Keywords: Sustainable Development, PMD, Paper, Recycling, European Union, Cyprus, Nudging

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1. Introduction

Environmental management and sustainability are challenges for Cyprus. The country suffers from poor waste management performance, with high waste production, low recycling rates and strong dependence on landfilling, including in illegal facilities. (European Commission, 2017). For several years, the municipal waste generation has remained much higher than the EU average. The landfilling rate of municipal waste collected in the country is approximately 80 % compared to the EU average of 28 %. Recycling accounts for 19 %, including 4 % of composting, which is also significantly below the EU average (44 %). (European Environment Agency, 2019b)

According to the Eurostat data (European Environment Agency, 2019b), the amount of waste heading to landfill has dropped in the EU from 55% in the year 2000 to only 24% in 2016, however, Cyprus was way off the target. The target set by EU is for only 10 per cent of municipal waste to end up in landfill by 2035. Coming only third to Denmark and Malta, Cyprus produces 640 kilos of municipal waste per capita per year, much greater than the EU average of 482 kilos (Kassandra, 2019). Moreover, Cyprus has missed the target for municipal waste recycling, set at 50%, which was required to be achieved by 2020. The last two illegal landfills that were uncontrolled in Cyprus were closed in 2019 after receiving fines as much as 30,000 euros per each day of delay from the EU since 2013. There are no recycling facilities but two sorting facilities. After wastes are collected only glass materials stays in Cyprus where they are reused for production of cement and other building materials, whereas all other sorted recyclables are shipped overseas to countries which includes Greece, Lebanon, Thailand and India for management, due to problems such as lack of infrastructure for recycling and inefficiency in energy (Chrysostomou, 2019). Cyprus is now working actively to encourage people to recycle and bring national waste management plans in line with the EU legislation through various schemes such as separate collection of recyclables and reducing amount of wastes going to landfill. This is apparent through the shutdown of illegal landfills and recycling initiatives developed in local municipalities. These new developments are essential for the island to avoid dependence on exporting waste and become self-sufficient in order to meet future EU targets, since many countries are returning their imported wastes including China and India.

Recycling and waste separation are crucial for the country to become sustainable as Cyprus generates high amount of municipal wastes that have a low rate of recycling and poor waste sorting. With the closure of the remaining illegal landfills in the country, EU is proposing a complete ban on sending recyclable waste to landfill by 2025. In addition, the EU is putting forward much stricter restrictions on their export regulations and cracking down on illegal shipments including a ban of waste export from EU to non-EU country. On the basis of these regulations and the country's poor waste management, this thesis will aim to study how Cyprus can self-sustain their waste management processes to meet future European Union Targets.

In the city of Limassol, an average person produces 600 kg of waste per year and recycles just 60 kg, which is about 10%. Under EU rules, each country should recycle 70% of its waste by 2030 (Hadjioannou, 2019c). There are several ongoing projects that the Limassol municipality intends to implement to encourage residents to increase rate of recycling. Among the initiative is the first recycling facility in the country that was opened in Limassol in April 2019. Separating as much waste to increase recycling is a key factor to environmentally friendly waste management. First part of this thesis will examine the reasons why Cyprus has a long way to go in waste management and propose some recommendations through desk study on current situation with the EU and the country's capabilities in managing waste. A second part will examine an experiment conducted at building Papadopoulos and Andreas of Cyprus University of Technology on the basis of nudge theory to study changes in rates of recycling of primarily municipal waste and student's attitudes in general towards recycling and waste separation.

Cyprus University of Technology (CUT) was established in 2004 in the city of Limassol and is a leading university in Cyprus that values environmental protection and sustainability (cut.ac.cy, 2019). The organisation has been awarded at least one award each year for the last six years such as Green Public Procurement and Environmental Leadership awards from the Environment of the Ministry of Agriculture, Natural Resources and Environment. The university is the first Cypriot university certified by the EMAS (Eco-Management and Audit Scheme) which highlights the university's efforts to protect the environment and make the campus green (Green.cut, 2019). These achievements make the university a good place to conduct a nudging experiment to study student's behaviour towards recycling and waste separation of two categories of municipal recyclables – PMD (Plastics, Metal packaging & Drink cartons) and Paper, and non-recyclables (waste). Nudging is a useful strategy for shaping changes in specific behaviour, such as to promote pro-environmental behaviours, in a desired direction through interventions such as modifications in environment without impeding on one's rights or limiting choices (Lehner, Mont and Heiskanen, 2016). A waste audit along with nudging experiment at a local university such as CUT aimed at students will give us an indication as to what extent Cyprus is ready to transform its waste management system through recycling initiatives that arise from positive reinforcement of student's waste separation behaviours.

The basis of the nudging experiment includes an initial study funded by Climate-KIC, the EU's main climate innovation initiative, conducted in October of 2019 at the university (Korsunova 2019). This study has made it evident that there is a lack of knowledge on recycling and separation amongst students. Also, there have been surveys in the EU and Cyprus, such as the one conducted by the European Commission (2014) which reveals Europeans are concerned about raising awareness to recycle, to separate wastes and getting educated on proper waste management, as they consider it to be significant to a well-functioning economy. This research will build onto the existing study at university that will explore whether recycling behaviour could be improved through the use of nudging. The experiment is conducted at two buildings specifically – Building Andreas and Building Papadopoulos, which hosts around 80% of the 3000-student population.

This thesis is separated into 7 parts – Introduction, Background, “Nudge Theory”, Methodology, Results, Discussion and Conclusion. The following section “background” is split under three topics. First it gives an overview of waste management legislation in the European Union mainly surrounding municipal waste and targets set by the EU. Secondly, we will investigate how Cyprus is managing their current waste situation in line with the EU legislation. Lastly, we will study the city of Limassol regarding recycling, where the nudging experiment at the university has taken place. Proceeding the background will be “Nudge Theory”, a section that explains nudging as a conceptual framework and why use of “informative nudges” can be applied at CUT. Next comes the methodology section that explains the use of a mixed methods analysis undertaken to collect and analyse the waste audit and a complimentary questionnaire sent to the students. From the literature review in background, using sub-questions, the following research question has been formulated:

“How can Cyprus self-sustain their waste management processes to meet future European Union Recycling Targets”

The quantitative and qualitative methods utilized such as statistical and content analysis to analyze the results of the audit and questionnaire correspondingly, will be explained in the methodology section. Secondary desk research to suggest recommendations to improve waste management system in Cyprus will also be described. Afterwards, the results section will provide results to the waste audit, nudging experiment and the student questionnaire. Discussion of the results then take place along with suggestions for improving waste problem in Cyprus based on literature in background and possible recycling solutions for the university. The recommendations under the discussion section will scrutinise the research and the nudging experiment in general and describe how they could have been improved to conduct a more extensive study. The conclusion section finally summarises the research findings.

2. Background

2.1 EU Waste Management Framework

Waste management planning allows for a country, whether it be nationally, regionally or locally to take into consideration of existing environmental and economic conditions, define objectives that need to be met, formulating relevant strategies and identifying necessary means of implementation (Europa, 2019) Every EU member state is required to design a waste management plan by Article 28 of the Waste Framework Directive (WFD). Some of the basic rules regarding waste management planning includes:

- The need to evaluate plans at least every sixth year and revised when necessary.
- The plans must be accessible to stakeholders and general public on a website. They should have the opportunity to participate in the elaboration of the plans as well.
- Member states should inform the European Commission of the plans, once they are adopted and revised.

In addition to the Waste Framework Directive, a Circular economy action plan was adopted by the European Commission in early 2020 with the aim to ensure that the resources used are kept in the EU economy for as long as possible (European Commission, 2020). Circular economy is when the value of resources, materials and products are sustained in the economy for as long as possible, while ensuring the amount of waste produced is reduced and of good quality that could be reused. The focus of the newly created circular economy action plan will be on avoiding waste and transforming them onto quality secondary resources. The plan also includes actions intended to minimise EU exports of waste and tackle illegal shipping. Circular economy solutions will be tailored to the outermost regions and islands, due to their dependence on resource imports, high waste generation fuelled by tourism, and waste exports. As of now the commission has not further proposed what specific solutions, they intent to provide nor when they would be introduced.

2.1.1 Municipal Waste Generation

Waste minimisation is of high priority under the Waste Hierarchy established under the Waste Framework Directive in Article 4 (Eurostat, 2019). The hierarchy is in an order and starts from prevention to reuse, then recycling and finally disposal, whereby disposal, such as through landfilling should be the last resort.

Municipal wastes consist of everyday items that are utilised and discarded by the public. They come from our homes, businesses, schools and hospitals. The reduction in municipal waste generation is a vital measurement of waste prevention and changing consumer patterns. While municipal waste only accounts 10% of the total generated waste or around 30% of waste excluding mineral wastes, focussing on municipal wastes rather than industrial waste reflects the consumption patterns that are not affected by manufacturing sectors in a country.

Statistics on production and treatment of wastes from member states are collected every two years to measure trends and monitor implementation of EU waste policy. The collected data helps to examine the recycling and recovery rates in light of the targets set out in the EU waste legislation. Progression towards Sustainable Development Goals (SDGs) such as SDG 11 (Sustainable Cities and Communities)

and SDG 12 (Responsible Consumption and Production) with particular focus on target 12.4 - responsible management of chemicals and waste as well as target 12.2 - sustainable management and use of natural resources (UN, 2020), can be evaluated through waste related stats, and they are a part of circular economy framework.

In the European Union in 2018, a total of 220 million tonnes of municipal waste was generated (European Commission, 2020). This amounted to roughly 492 kg of waste per person, which is comparable to 490 kg recorded in 2017. Cyprus was one of the top three producers of municipal waste among the EU states with 637 kg (Denmark generated 766 kg and Malta 640 kg). The figure below depicts municipal waste generated from all EU member states in 2018 including the EFTA (European Free Trade Association). It is acquired from Eurostat, a Directorate-General of the European Commission, whose main responsibility is to provide statistical information to institutions of the European Union.

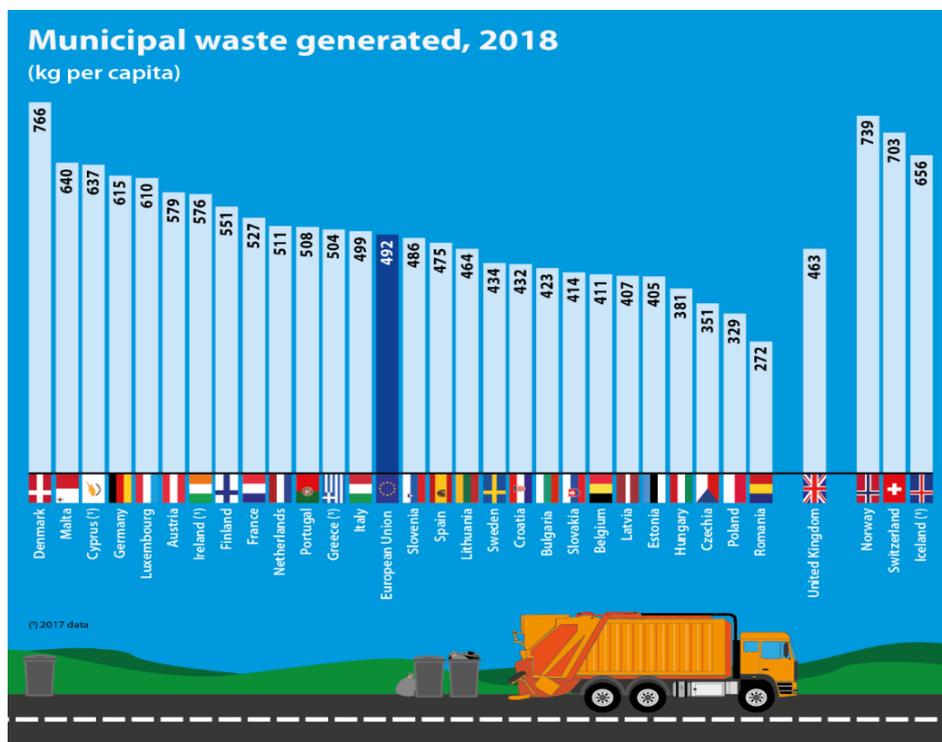


Fig.1. Municipal Waste Generation among EU states in 2018 (Europa.eu)

2.1.2 Targets

2.1.2.1 Landfill Targets

The Landfill Directive from EU applies targets to reduce the quantity of municipal waste landfilled to be able reduce emissions associated with waste management (Europa, 2019). With 1995 as the reference year, municipal waste to landfill were to be reduced to:

- **75 %** in 2006
- **50 %** in 2009
- **35 %** in 2016
- **10 %** in 2035

Later, a legislative proposal was adopted by the commission in July 2014 to review the waste related targets in Directive 2008/98/EC and Directive 94/62/EC. The proposal aimed to phase out landfilling by 2025 for separated recyclable wastes including metals and glass, corresponding to a maximum landfilling rate of 25%. The EU executive is also pushing for a complete ban on sending recyclable waste such as paper and plastic to landfill.

2.1.2.2 Recycling Targets

A Circular Economy package was adopted by European Commission which contains a revised legislative proposal on waste to push Europe's transformation towards a circular economy (Europa, 2019). This legislation highlights targets for waste reduction and creates a path for waste management and recycling. Key targets of the proposal include:

- Target of 65% recycling of municipal waste by 2030
- Target for recycling 75% of packaging waste by 2030
- To support recovery and recycling schemes

In addition, by 2030, all plastics packaging under the EU market must be reusable or recyclable in a cost-efficient manner.

2.1.3 Waste Reporting

Municipal waste treatment data are broken down into the categories of incineration (separately for with and without energy recovery), landfilling, recycling (excluding composting or fermentation) and composting/digestion (European Commission, 2017). This is illustrated in the flow chart below:

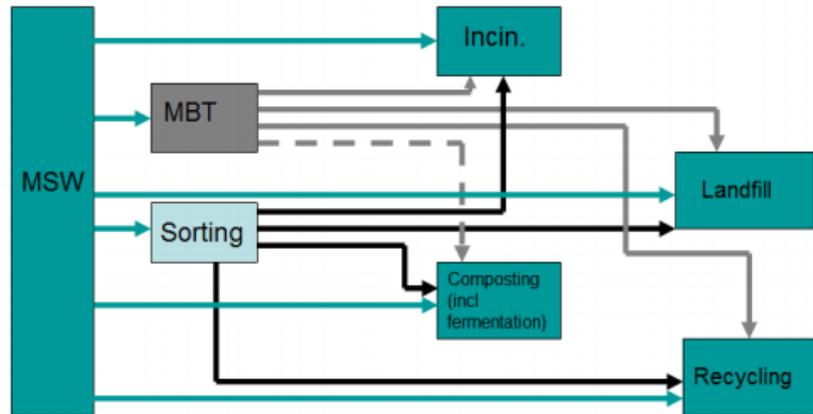


Fig.2. Municipal Solid Waste Treatment Steps (European Commission, 2017)

Member states should deliver information on the treatment infrastructure and waste collection scheme (Eurostat, 2013). Reporting has to be performed by delivering three different data sets. The first data set should contain statistics on waste generation, the second data set on statistics on waste treatment and third set on data concerning treatment infrastructure and coverage of the waste collection scheme. All regional level waste generation should also be reported at national level.

2.1.4 Waste Shipment

Regulation 1013/2006/EC sets up procedures and control regimes for the shipment of waste, depending on the origin, destination and route of the shipment, the type of waste transported and the type of treatment to be used to the waste at its destination. A copy of the report for the previous year in accordance with Article 13(3) of the Basel Convention is required to be sent by member states to the Commission before the end of each calendar year. In order to minimize the discrepancies observed in the export and quantities of waste, states are requested to report all notifiable waste streams and not only hazardous waste (European Commission, 2019). It is important that codes such as Y-18, which implies waste is hazardous is not applied when shipping non-hazardous wastes, as this could be presented to be in violation with waste shipment regulations, even if this was not intended.

Approximately 20% of the waste shipped in 2005 in the EU was for disposal while the remaining 80% was shipped for recovery operations (European Environment Agency, 2019a). There is not enough information on how wastes imported from EU is managed in other countries and there are few restrictions on wastes shipped within the EU. States can decide on banning of specific import and export of waste within the EU. The ratio of waste shipped for recovery and disposal has remained steady throughout the years that the waste framework directive's objective is for member states to eventually move to self-sufficiency in waste disposal.

2.1.4.1 Illegal Waste Shipments

The Waste Shipment Regulation applies to all member countries and forbids the export of waste from the EU to developing countries for disposal purposes, and strictly regulates the export of recyclables, specifically by procedures of prior written notification and consent (Greenport, 2010). All hazardous

waste export from EU to non-EU are also forbidden. Shipments that don't comply with regulations are illegal.

Illegal shipments cause problems such as adverse impact on environment and human health, impact on trade and undermines international policy efforts. Instances of illegal exports of waste must be reported to EU Commission every year. It is reported that illegal exports estimate between 6000 and 47000 tonnes with an average of 22000 tonnes per year. The number of non-hazardous waste shipments such as plastic and paper has also increased in the last ten years with much of it destined in China. In 2007, the EU shipped more plastic and paper waste to the Asian market than within the EU.

Recently, the EU Commission adopted the “European Green Deal” among which they express the view that the member states should stop exporting its waste outside of the EU and that they will revise the rules on waste shipments and illegal exports (EUWID, 2019). Besides, many developing countries are also sending back the wastes to the wealthy nations. This poses the risk of increased incineration and landfilling of wastes like plastic waste within EU. Thus, EU must find circular ways of managing its waste e.g. via the waste hierarchy of reducing, reusing and recycling. So, responsible consumer behaviour and proper waste separation and disposal are required in order to increase recycle rates.

2.2 Cyprus Waste Management

As mentioned earlier Cyprus being a small island nation, generates high amount of wastes per person and municipal wastes compared to other EU states. The Department of Environment (DoE) that is responsible for implement waste legislation in Cyprus states that policy on waste management is based on the waste hierarchy (Department of Environment, 2020). They aim to reduce/eliminate the negative effects of the generation and management of waste, promotion of reuse, recycling and recovery to reduce the disposal in landfills. This must be achieved through the implementation of the Waste Law of 2011 (L.185(I)/2011) and the Packaging and Packaging Waste Law of 2002 (L.32(I)/2002) and their amendments.

The waste management plan was developed by DoE in 2012, but it was only after consultations and new political decisions, that it was adopted, with three years delay, by ministers in November 2015 as 2015-2021 Municipal Waste Management Plan. The objectives set were:

- 40% separate collection on the total rate of municipal solid waste by the year 2021 with the ultimate target of 50% until 2027 (from 20% in 2012);
- 50% of recyclable materials (paper, plastic, metal, glass) in municipal waste to be prepared for reuse by 2020

An independent waste prevention programme was set up for the period 2015 – 2021, which contains all the points required by article 29 of the Directive 2008/98/EC of the EU.

2.2.1 Recycling Rates

The waste composition from various waste streams in Cyprus is displayed in the table below (Europa, 2014).

Parameter	Value
Population	
Total (inhabitants)	868.940
Waste generation	
Total (tn)	541.520
Total (kg/cap/y)	623,20
Waste composition (%)	
Organics	41,47
Paper	25,70
Plastic	14,77
Metal	3,25
Glass	2,66
Wood	2,08
Other	10,07
Waste management	
Waste treated (% of MSW in 2013)	9%
Waste recycled (% of MSW in 2013)	12%
Waste landfilled (% in 2013)	79%

Table.1. Waste Composition of Waste Streams in Cyprus (Europa.eu, 2014a)

According to a report from the commission on the ‘dirtiest’ EU countries, Cyprus is one among the top four countries with poorest rates of recycling (European Parliament, 2019). Cyprus recycled just 17% of its waste in 2016 and along with 13 other member states, they were off the target set at 50% of total waste recycled by 2020.

Cyprus’s recycling rate of municipal waste is 16% which is well below the EU average of 46%. Even though there was a decrease in 2009-2014, the landfilling rate increased again in 2016, and an estimated 76% of the waste was landfilled against an EU average of 24% (Europa, 2019).

The reasons reported by EU Commission for Cyprus’s failure to meet targets includes (European Commission, 2018):

- lack of infrastructure and collection systems for recyclables and for diverting waste away from landfills;
- lack of coordination between different administrative levels;
- lack of incentives (incl. economic instruments) to prevent waste and improve recycling

2.2.2 Rising Tourism

Cyprus, being among one of the most popular tourist destinations in the world has seen rise in tourist numbers throughout the years. This has made managing wastes to become more complicated. Separate categories of waste bins are being installed in hotels and visitor hotspots to increase rate of recycling (Raymond and Irving-Swift, 2017). The government believes increased recycling also helps keep the increasing costs of waste management from the tourism industry down and improve the economy through creation of jobs.

A high degree of environmental awareness, involvement of the public and proper infrastructures in waste management issues are therefore required to be in line with EU waste management strategy and

legislation. New strategies are also needed to be developed to tackle issues arising from increasing tourism.

2.2.3 Waste Collectors and Exporters

There are two major companies that deals with collection and export of wastes in Cyprus: GreenDot and HTZ Minas, both of which operate in conjunction with each other. Cyprus Environmental Industries owns a commercial facility that sorts and processes the collected wastes (www.ceirecycling.com). They have a facility located close to capital city of Nicosia. Its business is now much broader based and one of the largest in Cyprus for waste, paper and plastic recycling and export (RecyclingWasteWorld, 2011). They collect packaging materials and plastics from a wide range of industrial sources such as printing houses, factories and shops. Such material is sorted in a fully equipped plant and then these are separated into different categories. Non-recyclable materials are removed, and the final product is compressed into bales for export. The company has an additional facility close by which sorts and processes public waste on behalf of Green Dot.

GreenDot Cyprus was established in 2005 and is the largest company dealing with separate collection of recyclables and their sorting in the country. They are responsible for the collection and treatment of household packaging comprising paper, glass, plastic bottles, metal packaging and Tetra Pak material. Waste management in general has improved since their formation (see figure 3 in section 2.2.8 for the different items collected in separate categories of waste). The business was set up as a non-profit organization with the initiative of the local industry and of the Cyprus Chamber of Commerce and Industry (CCCI) as the umbrella-organization. The company does not belong to a private individual but to 87 companies who are the shareholders of the organization, and is controlled by a Board of Directors (greendot.com.cy) Green Dot Cyprus undertakes the obligation and cooperates with more than 900 companies in the country to collect and recycle on behalf of its company-members and its members undertake the funding of these procedures through the fees paid to the Organization by its companies, such as members for the packaging of the products they sell. So basically, the cost of recycling is largely added on to the price of the products which the public purchases (greedot.com.cy) and it is all of us without exception who pay for recycling, whether we participate in it or not. The costs increase when items are not properly recycled. The collection and recycling of packaging costs much more than the value of the materials collected. Any possible surplus that the organization may have (if from expenditure one deducts the revenue) it is used for communication purposes or for the development of the organization. The total cost of the collection and recycling programme reaches roughly six million euros annually.

HTZ Minas Recycling Corporation is a business resulting from the merger of Hellenic Tzilalis and Minas Recycling company (RecyclingWasteWorld, 2011). The business expanded quickly and branched out into forms of commercial waste other than their initial business of recycling glass bottles. Their activity is already diverse with, in addition to managing glass, they sort and process plastic crates, Tetra Pak type foils, paper and packaging materials. They have introduced to their portfolio the collection and recycling of wastes from electrical and electronic equipments as part of a Cyprus wide scheme promoted by GreenDot. HTZ Minas has a sorting facility in Nicosia which deals with recyclable waste collected from household and commercial waste streams. They trade and export recycled material (including paper, metals and plastics to foreign markets)

The current fees imposed by GreenDot for various waste streams collection are presented in the table below:

	Domestic PW (€/tn)	Industrial/Commercial PWs (€/tn)
Glass	29,06	
Paper	47,14	43,31
Plastic		37,94
Ferrous metals	95,39	
Aluminum	21,38	
PET	105,89	
HDPE	105,89	
Wood		12,41
Paper packaging for liquids	122,75	
Other recoverable material	131,05	
Other non recoverable material	157,27	
Other		50,27

Table.2. Fees for Waste Collection (Europa.eu, 2014b)

2.2.4 Waste Export

In a report on illegal exporting submitting to the Basel Convention in 2015, Cyprus has answered some of the problems they face with regards to shipment of wastes (Basel, 2015). They have stated that in the last 10 years there have been five cases of which two consisted of paper and plastic waste export rejected by India from their recovery facility due to low quality and not meeting certain specifications.

In another case, Cyprus forwarded plastic waste to Greece without informing them beforehand. While importing paper waste, Indian authorities did not respond with any information or feedback and so the waste had to be returned to Cyprus.

Some of the common challenges that were identified in the reports includes:

- Lack of or inappropriate domestic legal or institutional framework to implement and enforce some of the regulations
- Lack of access to adequate informational about movements of hazardous and non-hazardous wastes deemed to be illegal
- Lack of awareness by disposers about requirements of Basel convention
- Lack of cooperation/coordination at the national level among relevant entities in combating illegal traffic
- Difficulty in disposing of waste in an environmentally friendly manner.

In another report submitted in 2018, Cyprus expressed that there is a lack of cooperation at the international level, and lack of technical capacity to detect cases of illegal traffic. Lack of specialised trained staff is attributed to inability to cooperate but the Department of Environment states they conduct 'self-training', and at the same time provides some training for police and customs officers on tracking illegal shipments of waste

About waste exports, Cyprus deals with approximately 100 pre-notified waste shipments per annum, and approximately 700 non-notified waste shipments (e.g. green list shipments).

Although no adequate statistics could be provided on illegal waste shipments, the inspection plan for Cyprus indicates that unauthorised destinations or non-accepted shipments of waste appeared to be the main causes of illegal waste shipments. These largely concerned hazardous waste but also included paper and plastic wastes.

2.2.5 Environmental Crime

There has been no action plan or similar strategic document against environmental crime that has been adopted by the Cypriot authorities (EU Council, 2019). Despite the DoE being responsible for plans and programmes within its specific capabilities, it cannot take its own decisions on environmental policy as decision-making in Cyprus is focused within government with minimum roles for local authorities. It is the Council of Ministers that has the overall responsibility for the formulation of environmental policy.

There is lack of statistics provided by the DoE in almost all the institutions. According to the information provided, only the DoE keeps some statistics, but feedback from relevant institutions are not included. Due to the lack of statistical data, the main trends in waste crime cannot be identified. Nevertheless, the Cypriot authorities consider illegal disposal a main trend in environmental crime. Several complaints from citizens and companies are being received by the DoE concerning waste management and pollution.

While the country has taken part in projects funded by the EU, Cyprus has not benefited from funding to prevent and fight waste crime since there are no dedicated national budget allocated for the prevention of waste crime. Problems have also been reported in relation to a lack of communication/cooperation with authorities in developing countries, particularly in cases where waste is exported as non-hazardous.

2.2.6 Potential Abuse of Power

Kassandra, a section from the New Europe newspaper published in Brussels, Belgium, reports on cases of mismanagement and wrongdoing across Europe. In 2019, they released an article revolving around the Cypriot Auditor General Odysseas Michailidis stating that he has abused his power often influencing decisions resulting in poor governance particularly with regards to the recycling situation in the country (NewEurope, 2019). He influenced a proposition for EU financed waste plant near the city of Limassol that encompasses poor quality processes and has allowed it without technical assessment or quality precautions. Due to the result of substandard quality services the tender was unable to perform the work and comply with the contract. The successful implementation of the integrated waste management technology would have increased recycling in Cyprus. Such abuse of administrative role has also put barriers in the EU efforts towards resolving issue of waste management in Cyprus. These actions breach the union's public procurement rules.

2.2.7 Infrastructure Problems

GreenDot Cyprus, is the organisation responsible for collecting and managing majority of the waste in the country. But rather than processing the waste they sort them due to lack of recycling facilities. Only glass is crushed and utilised, while the rest is sorted in two local facilities, one in Moni and other in

Latsia, and then send abroad to other countries all over the world including Greece, Lebanon, China, Thailand and India (Chrysostomou, 2019). Although this results in much of the waste removed from the country, it is reported that majority of the waste exported abroad are not actually treated by several countries but put in their own landfills.

Infrastructure problems such as technological issues are thought to exist in sorting plants where much of the solid waste cannot be dried efficiently which in turn makes them unsuitable for burning. These wastes typically end up in the nearest landfill. Greens MP Charalambos conveyed that building these plants were a mistake since it does not fulfil the EU directive 2008/98 since disposal should only be attempted as a final alternate solution to waste management. In May 2017, the EU initiated a process that forced Cyprus to face fines around 30,000 Euros for each day of delay to shut uncontrolled illegal landfills. Following a visit in October by European Environment Commissioner Karmenu, the EU gave Cypriot government more time. The closure of the last illegal landfills signals government’s efforts to control the disposal of wastes in line with European directives.

Under proposed EU legislation, the new goal is to increase recyclables of municipal waste to 55% by 2025, and no more than 10% should end up in landfills by 2035. To achieve this target reducing infrastructure problems and introducing new recycling facilities should become a priority for Cyprus.

2.2.8 Recyclables and Non-Recyclables

GreenDot claims that there is a confusion among people over what is collected, especially when it comes to plastic. There are seven types of plastic of which only some are dealt with by GreenDot. They do not collect plastic wrappers, aluminium foils nor plastic cups and plastic plates. Their argument is that the system concentrates on collection of material which can be easily and efficiently recycled. Hence, a large portion of plastic waste thus are labelled as being ‘non-recyclable’.



Fig.3. Categories of waste collected by GreenDot (greendot.com.cy, n.d)

The above image illustrates the different varieties of recyclables collected by GreenDot. The items highlighted in yellow are things considered to be waste and as a result not sent to sorting facilities. It is interesting that plastic (PMD) and paper plates and cups are not collected in the category of recyclables and are only collected as waste. It is not clear as to why this is as these items are generally classified as recyclables in general waste management systems. Even though paper cups are considered as not recyclable due to most cups being produced with small amount of plastic coating inside the cups, or to hold the paper materials, today several companies and coffee chains such as Starbucks and Caffe Nero are making paper cups that can be recycled (Morrison, 2020). Compostable or recyclable paper cups could be reality in the future. This could drastically reduce the negative impacts of these cups on our environment as many end up in landfills and our oceans. Also, certain recycling facilities exist that can use technology to break down paper cups if they're clean to be made into reusable materials. Besides this, HTZ Minas have also stated they collect mix paper materials for recycling. On the other hand, the drink carton under PMD category gives of the impression that straws are recyclable when they are not due to their small diameter and not getting processed in recycling facilities, as they often fall off from machines during cleaning processes.

Some have argued waste recycling companies often do not collect certain recyclables for cost cutting measures in recycling and sorting procedures. Unfortunately, this cannot be confirmed with the case of GreenDot.

2.2.9 Future Waste Management Initiatives

2.2.9.1 Pay as you Throw

Financial Mirror reported that Cyprus was to follow other member states in adopting a “pay as you throw” tax scheme to encourage more recycling to meet future EU targets (Financial Mirror, 2019a). Even so, due to the lack of essential resources (including financial) and infrastructure, municipalities are concerned whether it would be feasible. With the recent shutdowns of landfills in Cyprus, a significant majority, about 70% of the waste will be needed to be handled at recycling plants. Lanarca's mayor Andreas Vyras expressed that more people should be encouraged to separate their recyclable waste from non-recyclable, and that “waste separation at the source” is the best way forward.

According to agriculture minister Costas Kadis, this kind of model will see users pay in advance for all garbage they wish to be collected through purchase of a custom garbage bag, at a relatively high cost (Hadjioannou, 2019b). Bags will only be filled with materials that cannot be recycled and so persuades citizens to fill as few bags as possible.

2.2.9.2 Waste Sorting

In 2019, Cypriot government also announced plans of paying their citizens for sorting waste. They are working to improve environmental situation for their recycling and disposal (Grekodom, 2019). In April, a waste recycling plant began operations. PCC Recycling, a Poullaides Group company, brought their modern plastic recycling technology from Austria and Germany to Cyprus (Lindner & Starlinger, 2019) The facility can convert more than 10,000 tons of plastic waste per year into plastic pellets which reduces the need for plastic wastes to be exported or landfilled. This would reduce the use of primary raw materials and turn plastic waste into new products such as plastic packaging. The ministry of Agriculture of Cyprus stated that with the help of private sector that brings waste recycling facilities, Cyprus would be able to meet their environmental goals and meet EU's stringent recycling targets.

There are plans from authorities to install Pandomats across shopping centres for recycling empty plastic bottles for small cash rewards. The devices can also be configured to receive aluminium cans. They believe this should encourage people to sort out their wastes. Several chain of stores in Cyprus already expressed their interest to install such machines within their territories.

In March 2019 a conference was held in Nicosia where circular economy was discussed. Apart from the separate waste collection system for PMD, paper and glass materials (GreenDot Cyprus) established to meet EU demands, the minister of agriculture said that there were plans for “separate collection of organic waste and separate collection of recycle streams”. (Nicholaides, 2019). He went on to predict that recycling and reuse of municipal waste will increase to 55% by 2025, 60% by 2030 and to 65% by 2035 and highlighted the importance of reducing all municipal waste produced going to landfills to 10% by 2035, a target set by the EU. He concluded by stating that his ministry is undertaking revisions to the national municipal waste management strategy and waste prevention program.

2.2.9.3 Standpoint of GreenDot Cyprus

GreenDot believes there are some actions and or legal interventions which are required for achievement of recycling goals. These actions are already implemented in other European countries with have been a success in contributing substantially to the increase of public participation in recycling schemes (Greendot.com.cy, 2020). The following are some actions that have been recommended by GreenDot:

(i) Mandatory sorting at source

Separation of materials and sorting at source (otherwise known as recycling) is optional at present in Cyprus. There is currently no legislation that mandates this behaviour as it is up to the public to initiate programs for recycling. GreenDot thinks that to increase public participation of recycling and waste separation, sorting at the source must become mandatory.

(ii) Implementation of “Pay as you Throw”

As mentioned earlier, a “Pay as you Throw” (PAYT) scheme is being discussed for adoption in the country. This can encourage participation in recycling programmes. PAYT essentially means those who throw away less waste pay less, and the easiest way for anyone to reduce their amount of waste and its related costs is to separate waste at source and recycle.

(iii) Involvement of municipalities in reduction of waste

GreenDot believes local authorities should take more responsibility to try and reduce waste and recycle more. While some authorities are trying to make a change, others do not do enough. Local municipalities can make a huge difference towards cost efficiency and is necessary for them to set targets towards the state. Doing so can have the state reward those municipalities working to increase recycling and sanction those who remain unconcerned.

(iv) Implementation of existing legislation

Another reason for Cyprus having low recycling rates is thought to be the inability of the state to enforce existing laws concerning management of waste. GreenDot is concerned that enacting new laws to achieve desired results is meaningless while existing laws are not imposed.

2.3 Waste Management in Limassol

The data presented in table 3 below is extracted from a statistical report from GreenDot and reveals the amount of PMD (Plastic-Metal Packaging, Drink Cartons) and Paper collected (in tonnes) between the years 2015-2018 in Limassol compared to the total collection in the country (Greendot, 2019). The city is the second largest in the country behind Nicosia. There is a visible increase in both categories of recyclables throughout the years in Limassol. While there is a steady increase in amount of PMD, the amount of paper waste has declined overall in Cyprus. However, Limassol has experienced an increase in paper collected from the city. In 2018 Limassol accounted for 31.5% and 29% of the total PMD and paper waste respectively in 2018.

Household Collection (tonnes)

		PMD				PAPER			
Region	Population	2015	2016	2017	2018	2015	2016	2017	2018
Limassol	189005	2218	2498	2686	3028	2704	2822	2896	2939
Total National	683620	7691	8102	8962	9603	10687	10263	10076	10076

Table.3. Collection of PMD and Paper from Households from 2015-2018 in Limassol compared to the National Total (GreenDot, 2019b)

The charts below shows the quantities per capita (kg) in Limassol of quantities of recyclables collected from 2007 to 2018. A decrease is identified between 2011 to 2015, but then the amount increases steadily to 2018.

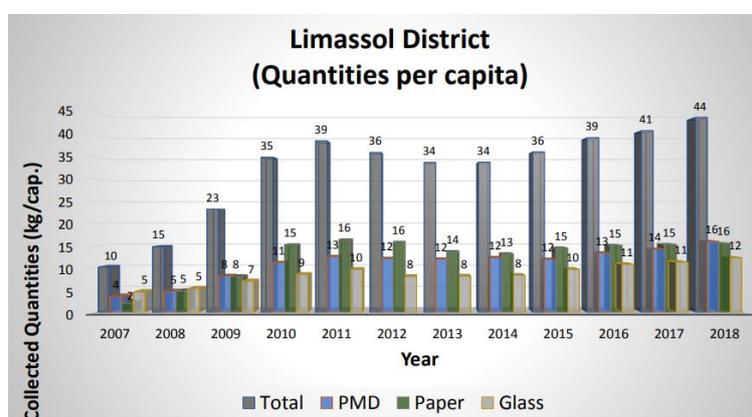


Fig.4. Quantities of recyclables collected in Limassol between 2007 and 2018 (GreenDot, 2019a)

The increase in collected recyclables could be a reflection on the increasing consumption patterns and or the increasing population. In either case this is an indication that there will be a need for larger quantities of wastes to be managed in the future.

2.3.1 Waste Management Projects in Limassol

Recently, the Limassol municipality, where Cyprus University of technology is situated announced they were implementing two new recycling and composting programmes as it seeks to properly manage waste in a city where only about 10% of waste per person is recycled (Hadjioannou, 2019a). On average, a resident in Limassol produces 600 kg of waste per year and recycles just 60 kg. Under the European Union rules, each country should recycle 70% of its waste by 2030. Households in Ekali region will take part in the pilot programme in which they will be given free bins of mixed waste, composting bins and recycling bags. Some of the incentives that the municipality would offer include a reduction of the annual refuse tax, free parking at municipal parking spaces and city's zoo for a period of time and free entrance to certain events. Another program consists of the installation of autonomous mechanical composters in three points in Limassol by the sea.

As previously mentioned, in April 2019, PCC recycling company introduced Cypellets, the country's first plastic recycling facility began operation in the city of Limassol (Recycling-magazine, 2019). This

is another positive indication that Cyprus is actively working to solve their ongoing waste management challenges and realising a more circular economy. The new projects are supposed to boost the Cypriot solid waste management to be in line with EU regulations and contribute to sustainable development of Limassol.

2.3.2 Previous Studies

The estimated annual costs for segregating collection are around 5.9 million euros, a 40% increase over its current costs of 4.2 million euros (European Parliament, 2017). However, the 5.9 million euros likely assumes that all the recyclables are collected and does not include revenues from the sale of recyclables. These costs can only be reduced if the rate of waste separation is increased. The studies mentioned below reveal efforts to understand problems within waste separation and increase recycling rates.

In the past several projects such as the LIFE Pilot Project have shown Cypriots have an enthusiasm for recycling (Parpal et al., 2003). This project resulted in increased levels of recycling where seven different bins were set up for collecting different recyclables. It was a success since participation was high but showed that many residents did not commit to placing each individual can or bottle one after the other in each bin. Large quantities of recyclables were collected but they had poor separation rate due to which exporters were unable to accept the amounts collected. Recycling was only feasible for limited materials such as metals, paper and plastic.

In another study, a public awareness campaign surrounding environmental management problems was conducted via telephone interviews with a group of 445 residents (15-59 years old) from municipality of Limassol. Results showed that most people thought it was necessary for municipalities to provide environmental information (figure 5) as current information provided was insufficient (see figure 6). The report concluded that there is a need for increasing public awareness and environmentally friendly behaviour.

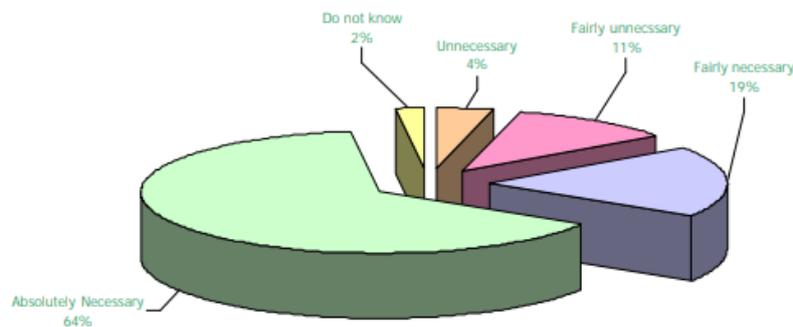


Fig.5. Need for Municipalities to provide Environmental information (Parpal, Torre et al., 2003)

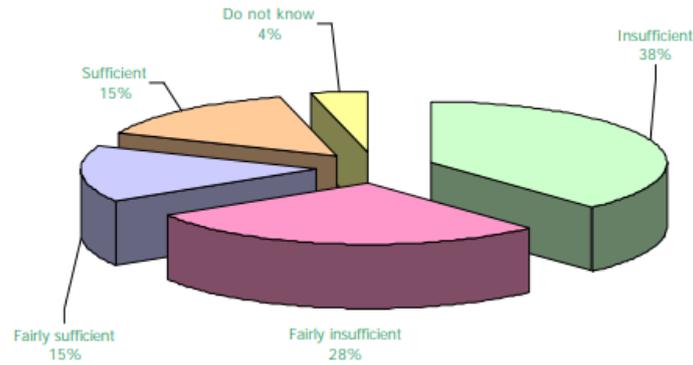


Fig.6. Satisfaction levels among residents on Environmental information provided by municipalities (Parpal, Torre et al., 2003)

In October 2019, the Green Office of Cyprus University of Technology (CUT) cooperated with Climate-KIC to promote engagement of university community with the topic of climate change. Within the framework of this cooperation, students and staff at the university were interviewed regarding what they would have liked to change related to environmental issues in the university and in the city of Limassol. Altogether, there were 28 interviews, 6 with staff and 22 with students (Korsunova 2019). One of the findings revealed that the students were not fully aware how and what to recycle. Thus, it has been suggested that improving visual and/or written communication on the recycling bins in the university campus can improve the recycling rates.

2.4 Recycling strategies in the Mediterranean

Like Cyprus several other countries around the world especially in the Mediterranean region are facing similar issues in waste management and recycling. These countries are also failing to meet EU targets and responding with introduction of several new initiatives and developments to improve their waste management system. Cyprus has the capability to improve their system based on some of these initiatives.

As mentioned previously Malta produces the second largest municipal waste per capita per year and has a recycling rate of just 7% with over 83% going straight to landfill, the highest rate in the EU (Mamo, 2020). However, few plans to counter the poor recycling rate have taken place in the country. In 2016, the Ministry for Sustainable Development, Environment and Climate Change (MSDEC, 2016) released a medium-term strategy and action plan called “Greening our Economy – Achieving a Sustainable Future” that covers many circular economy concepts (MSDEC). It mentions some of the methods to achieve high recycling rate and reduction in land waste such as introduction of separation and recycling systems, as well as educational programmes in schools. The ministry has also established a circular economy roadmap titled “Malta’s Sustainable Development Vision for 2050”, a long-term framework for progressing sustainable development in Malta that focuses on identifying existing gaps in the efforts where further development is needed. One of the visions in this roadmap include improved design concepts that make products more durable which in turn can help recyclers to disassemble products to easily recover more valuable parts.

In 2018, to encourage waste separation at homes, the government of Malta launched SORT IT OUT campaign where all residences in Malta and its island of Gonzo were entitled to collect a set of four

bins for separate waste streams – sanitary, glass, mixed waste and mixed recycled waste (Wasteservmalta.com, 2018). This meant separate collection of organic wastes such as garden and food wastes were also introduced. The bins feature lids which are coloured differently to indicate different types of wastes. The program was a success with increased household waste separation that saw the collection of almost 32,000 tonnes of organic waste.

Greece is another country like Cyprus that paid heavy fines for mismanagement of waste. The country landfills much of its municipal waste (81%) with just 16% being recycled. In 2019, Greece launched a pilot recycling program entitled “New Generation of Recycling” in five municipalities aiming to meet EU targets (Xinhua, 2019). Residents in the municipalities were given a series of incentives including financial support to participate to reduce waste. Three cents of a euro were to be earned by residents who deposited each plastic, glass or metal packaging at many of special recycling kiosks across the regions. This will help recyclers to collect most of the material for recycling. When applied, the program could eventually encourage citizens to separate waste at its source and contribute to resolving the issue of recycling

Another country facing waste management issues in the Mediterranean is Croatia with around 77% of municipal waste produced buried in landfills and only 21% recycled, according to Eurostat report in 2016 (Javanovic, 2018). In 2019, three municipalities joined nine other municipalities in their official Zero Waste strategy and entered ZeroWaste Europe network. The network is supported by PRE-KOM, a sustainable waste management national leader in Croatia with good results in reduction, separate collection and recycling (Kosak, 2019). The factors in these results arise from activities such as intensive education of all age groups and reasonable payment system with discounts for various households as incentives. PRE-KOM also has built a local infrastructure for treatment of wastes including recycling yard, sorting facility, compost plant and the first RE-USE centre in the country, which is essentially a centre that collects discarded items such as furniture and clothing for restoration and sales rather than disposing them in landfills. There are also discussions on waste separation becoming mandatory in the future in Croatia. Separate collection and charging of waste collection by amount are to become an obligation according Balkan Green Energy News (2017). Non-compliance with regulation could see fines of up to 106,230 euros for cities and municipalities while individual penalties for not following the system are to be determined once payment of garbage collection is set up.

Croatia also has access to 475 million euros for waste management from the EU’s Competitiveness and Cohesion Operational Programme for the adoption of waste management plan for the years 2017-2022. The plan emphasises on developing a recycling and recovery system to separate waste and reduce the amount of mixed municipal waste. According to World Travel & Tourism Council (2018) there has also been a push for establishment of the Croatian Sustainable Tourism Observatory and several international conferences on sustainable tourism. Along with France, Croatia is also among the countries that have implemented steps toward EU Single-Use Plastics Directive in banning disposable cutlery, glasses and plates. This is an ambitious step that provides incentive for countries such as Cyprus to follow suit and take steps to reduce their plastic consumption.

Landfill taxes represent as another efficient method to financially discourage landfills as a waste management option in order to achieve EU recycling targets. However, several countries have yet to implement such laws. In 2014, Greece and Croatia announced the introduction of a landfill tax, though as of now this has not been implemented in either countries (WWF, 2019).

3. Nudging Theory

Thaler and Sunstein (2008) define a nudge as “any aspect of design that alters people’s behaviour in a predictable way without forbidding any options or significantly changing their economic incentives” Nudging has been proven to be a vital technique for stimulating changes in context-specific behaviour. There are several types of nudging that explores the role of choice architecture and nudges in shaping behaviour in desired direction (Lehner, Mont & Heiskanen, 2016). Governments have successfully employed nudging tools for example, in public health campaigns and even recycling schemes. Nudges are therefore promising tools for promoting a wide range of environmentally friendly and sustainable consumption patterns. They also help us to examine further as to what extent they are effective in changing behaviour. Nudges are designed in ways that promotes behaviours in good judgement in an individual’s long-term interest, thereby not restricting their range of choices. As per Thaler and Sunstein’s report (2008), nudges are likely to be more effective if they are in line with people’s ideal choices and values (i.e., helping people to do what they ideally would like to do).

In behavioural sciences, nudges fall under what we call “choice architecture”. These are modifications to the physical environment to alter the way choices are presented to people that may increase the chances that a preferred or default choice will become more attractive. For example, a restaurant can place different types of food in various order and this can influence what food customers choose (Thaler and Sunstein 2008). This can be to promote special food types, cost efficiency for the restaurant or even help customers choose healthy food options. Hence, by changing the layout of the store, choice architects may have effect on peoples’ behaviour. Nudges comprises four tools: simplification, changes to physical environment, changes to default policy and use of social norms (Lehner et al., 2016).

‘Green nudges’ such as the experiment conducted in this research aim to promote sustainable and environmentally responsible behaviour. These nudges are about correcting behaviours that will lead to improvement in overall waste management processes. Green nudges are becoming increasingly important in the area of policymaking (Schubert, 2017). Research has already been done on the use of green nudges as policy-making tools and as a strategy to stimulate a circular economy.

There are two categories of green nudges, first category of green nudges are the nudges that exploit people's desire for a pro-environmental self-image. This can be through making product information simpler or let people take notice of certain important product features. The second category of green nudges are the nudges where the desired pro-environmental behaviour is set as and referred to as green defaults. This is because people do not like to choose actively and setting defaults helps them to increase environmentally friendly behaviour.

3.1 Nudging by Policy

As previously stated, policy makers for many years have utilised behavioural sciences such as nudge, in different countries and sectors to systematically incorporate behavioural insights into policy implementation. Examples include, a medical centre in Qatar, that managed to increase the uptake of diabetes screening by offering to test people during Ramadan as people were fasting irregardless, so the worry of having to not eat before your testing was eliminated. It was convenient and timely for the two key components to become a successful nudge. Another example includes 3D illusions of “floating zebra crossing” in towns in India and Iceland, above the ground, which are designed to warn drivers to slow down (Nicolas Schwab, 2017). This has shown to increase pedestrian safety and decrease accidents. Singapore has employed many remarkably simple nudges (Keating, 2018). They include waste bins that are placed away from bus stops to separate smokers from other bus users. Also, utility bills display your energy consumption in comparison with your neighbours to invoke a sense of precaution. In an effort to improve recycling rates, city of Edinburgh in Scotland reduced the size of the trash bins distributed to residents. This forced users to separate their recyclables. Consequently, the city increased recycling by 85 percent (Edinburgh News, 2015).

3.2 Intervention Design

The designing of a nudging intervention usually begins with a comprehensive analysis of the behavioural problem or goal. This analysis usually involves mixed methods approach (Creswell & Plano Clark, 2011) that employs usage of secondary data, field study, observations of the populations and current trends in order to understand the underlying challenges preventing the intended behaviour. Four types of nudges or interventions can be distinguished (House of Lords, 2011):

- 1) Provision of information - involves policies that provide information and feedback as well as policies that focus on framing and simplifying information.
- 2) Changes to the physical environment - include interventions that alter the setting or context, such as changes to placing of food in stores.
- 3) Changes to the default policy - to shift the default option, for instance, smaller sizes of trash bins to increase recycling rates.
- 4) Use of social norms - the provision of information.

3.2.1 Informative signs

Informational nudges are simply the providing of information which acts as a nudge. Several experiments such as one conducted by Sussman et al., (2013), highlighted how informative signs were encouraging and successful when using nudging at a cafeteria at a university in Canada. Another study that aimed to improve recycling rates across six university campuses in Sweden investigated the effectiveness of different types of signs (signs with text, pictures, memes etc) (McNabb, 2017). The researcher found that simple signs with a recycling symbol and a small amount of text when placed near recycling bins statistically improved recycling rates.

3.2.2 Visual Presentation of Intervention

For a recycling experiment, recycling bins with their visual effects and their distinctive appearance can function as the best factor to oblige citizens to participate in recycling activities. When promoted, while delivering information and increasing availability and accessibility of appropriate recycling bins, the participation levels in a recycling program can significantly increase which results in positive behaviour (McNabb, 2017). Recycling bins might also be covered with lids of different bright colours or have openings with coloured borders and bear various graphics or logos. For example, the usage of the “green dot” logo, a trademark renowned internationally has contributed to the synchronisation of national measures for waste management with the principles of EU Directive 2004/12/EC (Keramitsoglou & Tsagarakis, 2018).

3.3 Ethics of Nudging

Before an individual or group examines how they can perform a nudge, they need to determine whether they should be attempting to change behaviour in the first place. In this respect, it is crucial that where possible the public’s views are considered, and permission is acquired, when introducing interventions. The most common objection to nudging is that it can violate people’s freedom (Bousquet, 2017). This argument insists that people should be able to make choices unobstructed and free from external influence. Supporters of this argument may insist that, especially in a democracy, where individual freedom is a core value, other actors should not be in the business of influencing citizens’ decisions. However, this common position makes the false assumption that there exists such a thing as an unobstructed decision. Cass Sunstein (2015), during his tenure as Administrator of the White House Office of Information and Regulatory Affairs under President Barack Obama—explained “It is pointless to object to choice architecture or nudging as such. Choice architecture cannot be avoided.

Nature itself nudges; so does the weather; so do customs and traditions; so do spontaneous orders and invisible hands.” Nudges are therefore unavoidable in our daily lives regardless of whether they are deliberate or not.

3.4 Nudging Recycling experiments

There are studies about the use of nudging in the context of environment and sustainability. Previous studies already show the effectiveness of nudging in increasing recycling behaviour. Barile et al. (2015) found that the effectiveness of incentives like a nudge depends on the characteristics and level of environmental morale, where nudges are most effective when there is a high level of environmental morale among people. If people do not recycle their wastes where they live, nudging as a tool to increase recycling has potential, because “nudges work best when citizens know that something is right and just need to have that choice brought to the forefront of their mind” (Moseley & Stoker, 2013, p. 8).

Several nudging experiments conducted have been proven to be effective to increase recycling. For instance, in a discussion paper submitted to Norwegian Agricultural Economics Research Institute, it was found that households in Kristiansand district of Norway that received letters with information on proper recycling behaviour increased their share of recycled waste by an average 2% points over first 7 months that the letter was received (Milford, Øvrum & Helgesen, 2015). Households that already had a descent recycling rate also increased their recycling after receiving the letter. A different study indicated that university students in Pisa, Italy, recycled their plastic cups more often after implementation of nudging techniques such as changing position of the bin and presenting messages regarding recycling (Cotic et al., 2018). A similar nudging intervention undertaken by a student at Uppsala University, Sweden with signs at recycling stations also showed there was significant changes in the way students recycled (Mcnabb, 2017).

Sometimes certain factors outside of our control can influence rate of recycling. Particular demographic studies in nudging recycling experiments have shown the willingness to recycle tends to increase with age. Also, women were found to be enthusiastic to recycle more than males while scoring higher on environmental morale (Barile, Cullis & Jones 2015) The level of education is also important and is implied by Milford et al., (2015), that higher the education levels people possess the more they tend to recycle. On the contrary, some other studies show no effect of the level of education (Samuelson & Støyle, 2016)

3.4.1 Nudging in the Mediterranean

Recycling bin designs has been shown to be important in guiding and changing waste management practices of a Greek town (Keramitsoglou & Tsagarakis, 2018). From the imposition of recycling scheme components, the various colour signage, the different types of recycling bins per material, have all shown positive results in rates of recycling. The researchers suggest that a connection might exist between the colour of the recyclable material and the colour of the bin.

To the best of the author’s knowledge a nudging intervention to promote recycling had not taken place before in Cyprus or within a Cypriot University. This thesis could serve to provide basis for employment of such strategies to increase recycling in a large scale and for longer term in the country.

4. Methodology

4.1 The case of recycling at Cyprus University of Technology

A mixed methods approach, consisting of quantitative and qualitative approach was taken to this research to collect and analyse the waste audit and questionnaire. To understand the waste situation at the university, an evaluation of the current recycling program was conducted through observation and data from university records. Since its formation, GreenDot Cyprus collects and manages three streams of recyclables PMD, Paper and Glass. Cyprus University of Technology which hosts around 3000 students and 400 academic staff members in Limassol has recycle bins installed in all the department buildings in the three categories of waste (PMD, Paper which are recyclables and a non-recyclable waste category). A separate large recycle bin exists for the collection of glass waste. Striving to be a “green” university through their Environmental Management Office, they apply practices such as energy management, hazardous waste management, environmental awareness events and the use of recycle bins. Events such as the Limassol marathon that runs every year is guided by the university and encourages participants in waste separation and recycling (MUSKITA, 2018). These are also reasons that make the university suited for a nudging experiment. This section will examine recycling and waste disposal opportunities at the university. All the pictures of the bins were taken by the researcher himself.

The image below is of the recycling bins that are found inside of the buildings in campus. This is one bin divided into three waste streams (PMD, Paper) and a general waste category. They are colour coded into blue for PMD, brown for Paper and green for general non-recyclable waste.



Fig.7. PMD, Paper and Waste Bins

Figure 7 above depicts the recycle bin that is used to separate PMD (Plastic, Metals, Drink Cartons) with Paper and non-recyclable wastes. There is a recyclable sign on top of the bin with names of corresponding waste streams written. The colour of plastic bin bags also indicate which disposable item goes into the category, clear bags for PMD, black bags for waste and brown bags for paper. It is worth

noting that sometimes, the bin bags found in the bins are not placed accordingly to this colour coding as seen in the image below:



Fig.8. Inaccurate bin bags placed for waste categories

In this instance, the black bags are placed for the PMD (blue) category while the clear bags are for the Waste (green). This might suggest there is a likelihood that students would discard their items in the wrong category of the bin.

The waste separation is decided according to the kind of wastes collected by GreenDot as pointed out in figure 3 of section 2.2.8. There is no separate collection of organic waste such as food waste for composting or for treatment in anaerobic digestion plants and these wastes are accepted into the non-recyclable waste category. Municipalities such as in Limassol have not yet developed or implemented a system for separate collection for this waste under the waste management plan.

The paper and PMD recyclables are then collected by the cleaners at the university and disposed off into large brown and blue bins (figure 9) outside respectively for collection by GreenDot.



Fig.9. PMD and Paper and Bins outside of building Andreas

The non-recyclable black bins which contains mixed wastes are then either disposed off in bins shown below (figure 10) or sometimes they are kept beside the road for street collection.



Fig.10. Waste bins located outside building Andreas

Figure 11 shows a glass collecting recycling bin outside of building Papadopoulos.



Fig.11. Glass recycling bin

In building Andreas that only has one recycling bin, there are also two separate medium sized bins for collecting Paper and PMD recyclables as represented below in figure 12.



Fig.12. Separate recycling bins for Paper and PMD recyclables

There are also couple of small separate recycling bins (PMD and Paper) installed close to the cafeteria outside.



Fig.13. PMD and Paper bins located beside the cafeteria outside

Besides the recycling bins, students also have the option to dispose of their rubbish in several general waste bins, most of which are situated outside the buildings as shown in the below image. These bins

are more common at the university premises than the recycling bins and are found in communal areas such as the cafeteria.



Fig.14. General waste bins found around the campus buildings

4.2 Pilot study:

This nudging experiment will serve as basis to understand if simple signs can contribute to changes in separation of wastes to be in line with future EU targets for recycling and whether Cypriots are ready to separate their wastes to meet the targets. It is also based on the possibility of Cyprus improving their waste management system over the years with introduction of recycling facilities and schemes to encourage recycling. On this aspect, several items were classified as recyclables namely paper and plastic cups and plates in order to conduct the nudging experiment as it is important for Cypriots to separate and manage all kinds of recyclables to prevent wastes ending up in landfills or exported. Recycling as much as possible helps ensures future EU targets are met.

Before conducting the experiment, a pilot study was undertaken to determine the best location at the university, position of the recycling bins and time for carrying out the waste audit and nudging intervention. Following Creswell and Clark's approach (2011), a mixed usage of field study, observations of current recycling situation and student population was employed for pilot study for determining best conditions to carry out the experiment. Upon consultation with the Environmental Policy Officer at the university, it was decided that two lecture buildings, Andreas and Papadopoulos would be a good location. This was because both buildings had around 80% of students, approximately 2700 students visiting to attend classes here. It was also interesting since building Papadopoulos had 6 recycling bins installed, 2 bins on each of the 3 floors while building Andreas (with one floor) only had one recycling bin. The six bins were given numbers 1 to 6. It would be possible to do a comparison of both buildings in terms of how well they perform in the nudging experiment.

4.2.1 Location of the bins:

There were no recycle bins installed inside classrooms. As stated earlier the bins in building Papadopoulos were numbered 1 to 6. Number 1 and 2 bins were located on the second floor, number 3 and 4 on the first floor and number 5 and 6 on the ground floor. Bin numbers 1,3 and 5 were located close to the elevator (lift) against the wall of the building, while bins 2 and 4 were placed adjacently to the bin next to the lift. Bin 6 on ground floor was parallelly positioned to bin 5 and was almost at the centre of the hallway. All the bins were easily noticeable since they were close to the classrooms

nearby. Having bins close to the lift also made them stand out as several students take the elevator to first and second floor for their classes. As per McNabb's research (2017) mentioned in section 3.2.2, having availability and good accessibility to the recycle bins meant participation in the nudging experiment would result in positive behaviour.

In building Andreas only one recycle bin exists and so it was not numbered. As the building only has one floor, the bin was positioned centrally in an area where there was communal study space in the hallway. This made the bin noticeable as students who pass by or sit around the tables in the area could see the bin.

4.2.2 Time of Audit:

For the time of waste audit, it was decided to be held just after lunch break (13 hrs- 14hrs), between Monday to Friday. This would be the period when most students are in class after using the recycle bins and when it is expected the bins to be full. These hours were also chosen after cooperation with the cleaning team at university, to ensure the bin bags would not be cleaned out before conducting the audits. Carrying out at a fixed time ensured the minimisation of potential inaccuracies and biased results. It was decided to conduct audit between 13.00-13.30 at building Papadopoulos and between 13.30-14.00 at building Andreas.

4.2.3 Period of Control and Nudging Intervention:

The control audit period was kept for 5 days. This was due to the fact that students at the university were close to starting their exams later in December and majority of the students would not be having classes nor would they attend the university during this period. As a result, the next 12 days had to be used for nudging intervention since it would take time for students to notice the signs and eventually increase the rate of waste separation. This would make the nudging intervention more effective. The total period of the waste audit lasted for 17 days.

4.2.4 Auditing Procedure:

The waste audit consisted of counting the number of items in the three waste streams (PMD, Paper and Waste) in each recycle bins. The number of discrepancies in items were also noted, i.e. number of Paper and Waste items in PMD, number of PMD and Waste in Paper and number of PMD and Paper in Waste. Most occurring incorrectly disposed items were also identified.

4.3 Nudging Sign:

All four types of nudging as specified by the House of Lords (2011) report (section 3.2) can be applied to the designing of this intervention. The sign is meant to bring modification to the recycle bins, with waste items categorised as default while providing information using social norms concerning recyclables and non-recyclables.

Cardboard boxes were utilised to make the sign. The boxes were cut into A4 size for the size of the poster, a handle was also made from the boxes and both were attached and turned into a sign. An A4 poster with pictures of incorrectly disposed items from audit of control period (see section 5.1) were made using images from Google and Microsoft PowerPoint. This is a form of informative nudging as mentioned by Sussman et al., (2013). Simply providing information can be successful in encouraging students to separate wastes. Also, this type of nudging was chosen since previous Climate-KIC research at university highlighted that many students did not know how to separate their wastes. The pictures were placed into the three waste categories (PMD, Paper and Waste), while indicating that two of them

were recyclables while the other was non-recyclable (waste) and it went to landfill. These were written in both Greek as well as in English to ensure all students could understand the meaning.

Logos of recyclables and non-recyclables were added to the respective category as well. The poster colours as seen on top of the bin (blue, brown and green) were given to the poster and the waste items were categorised under them. Visual presentation of the signs with their distinctive appearance can serve as the best factor to motivate students to participate in the recycling as studied by McNabb (2017) in his research. Five signs were made and attached to the side of the bins directly using tape. One at building Andreas and four at building Papadopoulos (ground and second floor), while first floor bins were left as control. The below image (fig.15) represents the poster and the sign attached to the recycle bins:



Fig.15. The designed poster with sign attached to recycle bins

The poster has paper and plastic cups under Paper and PMD category respectively as opposed to what GreenDot recycles. This is to ensure most wastes are recycled and does not end up in landfills to since paper and plastic cups are off high proportions of waste in the university. This can also help us analyse if students would separate most of the wastes.

4.3.1 Trial and Error

The signs were up on the evening of the last day of control period. But the next morning, the sign on the ground floor of building Papadopoulos had fell onto the floor, while two signs on the second floor were missing. The sign attached to bin in building Andreas was found disposed in the recycling bin. These were the main reasons considered for these errors:

- The signs were not taped properly as it might have come off the bin
- The cleaning team were not informed and or it obstructed the job of cleaning out the bins

Using a stronger tape, the signs were then reattached. This ensured they would not fall of the bins even when cleaning out the bin bags. The cleaning team were once again informed as there was a miscommunication earlier about the beginning of the nudging intervention. The signs were checked throughout the nudging period to ensure they were left attached properly to the bins.

4.4 Questionnaire Design:

At later stage of nudging period, a semi-structured questionnaire containing pre-defined and open questions was created using google forms to understand students' thoughts on the experiment and distributed to them through email by the Student Welfare Office. It was decided that the audit study would be aimed at students since it's the responsibility of the future generation to ensure they recycle properly to manage waste. The recycle bins are also mostly used by the students. The questionnaire also contained a photo of the nudging sign so that students who didn't notice the signs or visited the buildings that had them could also comment indirectly by looking at the poster and sign in the photo. The aim of questionnaire was to study students' attitudes towards recycling at the university, their thoughts on the nudging experiment and whether the university should do more to promote recycling and separation. Basic demography questions would also collect few information about the participating students. Later, a Facebook post was also up from the green office of the university, post from Students Environmental Club and up on university community's Facebook group. The posts had link of the questionnaire that students could access and answer questions. Before the questionnaire distribution some face to face interviews were collected from students directly who were at the place where the signs were up. The interview however only asked the same questions from the questionnaire and the responses were later on added manually into google forms. The researcher attempted more face to face interviews before he finished his time at the university. This was to ensure adequate amount of responses would be collected. Moreover, questionnaire would also be distributed through Facebook messages and WhatsApp group to reach as many students as possible. However, the best technique to reach students has been through the distribution from Student Welfare Office as they were able to send the emails to all the students at university.

The questionnaire was left open on google forms and collecting responses after the nudging experiment and even after students' examination period for some time. It was once again forwarded to students through the student welfare office. And it was up again on the Facebook and Instagram page of the Green Office at the university, but this time 10 8gb USB sticks were being offered as part of a random draw of those who participated in the questionnaire. Email addresses were asked for those interested to participate in the draw once they had completed the questionnaire. The questionnaire was closed after collecting a total of 86 responses and being kept open for 12 weeks and 2 days. This was a poor response rate but regardless of this, the data produced some valuable insights.

4.4.1 Ethical consideration

A disclaimer was included at the start of the questionnaire that mentioned the aim behind the questionnaire. Also, all the respondents were informed that they would remain anonymous and that their participation was completely voluntary and that at any point they were free to withdraw from it.

4.5 Analysis:

A mixed methods approach is taken to this research whereby the researcher must collect and analyse both quantitative and qualitative data within the study (Yin, 2017). The analysis of this thesis consists of four complementary parts: waste audit analysis, complementary questionnaire analysis with use of descriptive statistics, content analysis of the supportive short open questions in the questionnaire and finally a secondary data analysis for recommending possible solutions to improving waste management problems in Cyprus.

4.5.1 Waste Audit:

The aim of the waste audit analysis is to illustrate the impact of the nudging experiment in numbers. Quantitative statistical analysis that would be descriptive would be applied for examining the waste audit before and after intervention. The results from waste audit were recorded onto a notebook and

later on transferred into Microsoft Excel. This allowed for statistical analysis of the audit and would provide basic summaries of the measurements and ability to present results in table and various graph forms for comparative inspection. Due to the short period of audit, an average of the number of items collected were utilised from the analysis. These results of the excel analysis were presented using tables.

Several studies and journals on scientific writing affirm the critical role that tables, figures, and graphs play in enhancing the quality of results. Scientific tables and graphs can be utilized to represent sizeable statistical data in an effective manner (Springer, 2011). Tables and figures catch the eyes of the readers because they recognise it as easy reading, as compared to reading a worldly information of the same content. The tables can be interpreted quickly and give a larger amount of information in a short time to the readers.

Utilising chart generating features on excel, various bar graphs and pie charts were generated. This allowed for statistical analysis for comparison. This is a type of analysis used for comparing groups where differences occur (Niroumand et al., 2013). This included comparing results from control period with intervention period for the recyclables, and comparison between bins. It also enabled charts to be produced to measure decreases in discrepancies in the audit.

4.5.2 Questionnaire:

4.5.2.1 Pre-defined Questions Analysis:

Once the responses of the questionnaire were collected, the summary of the responses was downloaded which contained the data results of the pre-defined questions presented in graphical pie and bar charts. This made for easy interpretation and simple analysis. Furthermore, a feature of google forms allowed for all the results to be exported into a spreadsheet. The spreadsheet was then downloaded, and it allowed for content analysis of the open questions to be carried out.

4.5.2.2 Content Analysis:

The qualitative study is for the questionnaire that would be analysed using mainly content analysis that would help identify certain themes (Erlingsson & Brysiewicz, 2017) from the results for example, participants thoughts on the experiment, how it could have been improved, what is the most popular suggested solution to recycling, etc.

Content analysis for this paper is both quantitative (on counting and measuring specific responses) and qualitative (interpreting and understanding the responses). “Code” themes and concepts within the open answers from students were analysed to find most popular responses. The following flow chart demonstrates the steps in content analysis process (tutor2u, n.d)

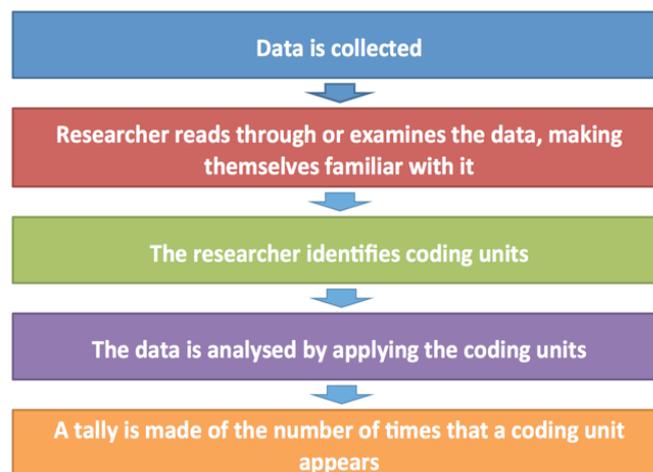


Fig.16. Steps in a content analysis process (tutor2u, 2018)

The responses to the questionnaire were exported onto Microsoft Excel to start the coding process. A code and count process were utilised to understand how many students gave a particular response. It involved categorising responses with similar words/phrases under common themes. This method analysed the responses from the open-ended questions in the questionnaire. In place of “codes” themes were generated to be grouped together. Using the spreadsheet, a table was created where all the generated themes were written and a number 1 was put beside it every time the theme is mentioned. The number was then tallied up to count how many times the themes emerged, and a rank was given in order of the number of times the themes emerged. The data was then categorised into bar charts for visual representation of the counts. The table (4) below shows an example of how the themes were categorised:

Words/Phrases	Corresponding themes	Occurrences	Rank
more bins, recycle bins outside, place more bins, new bins	More Recycling bins	13	2
Educate students, give classes, lectures, workshops, give info on climate change	Education on climate change	25	1
Recycling events, activities, programs	Initiating recycling programs	5	4
Take away black bins, remove general bins	Remove general black bins	4	5
Specially designed bins, innovative bins	Specially designed bins	3	6
Bins should specify waste, need signs	Bin labelled with specific wastes	8	3
Stop printing paper	Paper copies	1	7

Table 4. Categorisation of themes from content analysis

Statistical analysis on the predefined questions would also be applied to the questionnaire to study number of people who separated and did not separate waste after nudging, how many uses recycle bins as opposed to other bins (general waste bins which are black in colour) etc.

4.5.3 Secondary Data Analysis

In this research secondary data has been utilised to study EU policies in waste management and recycling initiatives among other Mediterranean countries. Secondary data analysis is the use of existing data from someone else to find answers to research questions that is different from the questions asked in original research (Johnston, 2014). The utilization of this existing data provides a viable option for researchers who may have limited time and resources. The data for this research is mainly derived from European Union and Eurostat websites. Other websites where secondary data has been collected includes the Department of Environment in Cyprus. Few news articles have also been used. The data will help in cross-examining policies, current EU and Cyprus standpoint in recycling and identify areas of issues that can be explored in depth to ask conceptual problems.

On the other hand, secondary data analysis will help us explore possible solutions to waste management and recycling problem in Cyprus and answer the theoretical sub question from the main research question. This will be based on background section (2.4) explaining other Mediterranean country’s approach to recycling and waste management along with some answers from the questionnaire study. Comparing Cyprus to other Mediterranean countries is appropriate since most of these nations face similar problems in managing their wastes i.e. lacking facilities and infrastructure, lack of separate collection, education concerning recycling. Furthermore, the governments in Mediterranean has not prioritised sustainable development or waste management in their national legislation. Suggestions and

recommendation for improving waste management system (mainly municipal) will be discussed in the discussion section of this thesis.

Sub-questions were developed for the three-part analysis of the nudging experiment along with the secondary data analysis for investigating best possible solutions to improve some of Cyprus's waste management problems. These questions formed part of the following main research question being investigated:

How can Cyprus self-sustain their waste management processes to meet future European Union Recycling Targets

Theoretical sub-questions:

1. What changes should Cyprus introduce to their current waste management system to be in line with meeting EU regulations?

Empirical sub-questions:

2. How can CUT promote good recycling behavior in the long term to better support EU recycling targets
3. To what extent does nudging intervention increase the proportion of correctly disposed of recyclables?

5. Results

5.1 Current waste disposal behaviour

Before designing the nudge poster, it was important to understand the existing recycling behaviours in the university. The current recycling system does not sort plastic or paper cups and plates. Through inspection and audit during the control period, plastic and paper cups were found to be of considerably high usage at the university. Almost half of each waste items were found to be disposed in their respective category of the bin (PMD & Paper), while the rest of the items were disposed in the waste category. Student almost never separated their plastic straws from the cups and a high proportion of straws were found discarded in the PMD category. Since straws are difficult to be recycled, attributing to their small size, it was very important for them to be separated from the recyclables and disposed in waste bin. High numbers of plastic bottles were also discarded in waste category of the bins on certain days

The control period also saw a high number of used papers such as tissues that were non-recyclable mixed with clean paper items in the Paper category of the bins. Aluminium foils that were used to wrap food which automatically becomes a non-recyclable waste were found to be left in PMD. Many leaflets that were clean and sometimes books and sheets of paper were spotted in the non-recyclable waste category. Plastic lids of paper cups were also not separated from the cups itself. These discrepancies were noted for designing of the nudging poster.

The bins on first and second floor of building Papadopoulos were almost comparable as they had similar amounts of items discarded. For this reason, it was decided to have the intervention on ground and second floor while first floor will be left as control.

5.2 Waste Audit Analysis

The average number and proportions of PMD recyclables at Papadopoulos building for both control and intervention period are shown below in table 5. The reason for taking an average instead of total number of items during the audit is because the researcher noticed that for one of the days during control period bins 5 and 6 did not contain any waste. Also, there were two days that saw an unusually high number of items in certain bins due to events taking place in the buildings, which meant more students, staff and other members had visited the buildings causing fluctuations in the number of items deposited in the three waste streams.

The average number and proportionate of PMD recyclables at Papadopoulos building for both control and intervention period are displayed below in table 5:

BIN NO.	CONTROL PERIOD (Average from 5 days)			INTERVENTION PERIOD (Average from 12 days)			Absolute Change (%)
	Correctly recycled PMD	Total PMD items	Correctly recycled proportion (%)	Correctly recycled PMD	Total PMD items	Correctly recycled proportion (%)	
1	10	17.4	57.4	8.5	12.9	65.8	8.4
2	3.2	4.5	71.1	4.6	5.9	77.9	6.8
3	6.8	13.2	51.5	7.8	12.5	62.4	10.9
4	4.2	6.4	65.6	3.5	6.25	56	-9.6
5	3.5	5.75	60.8	6	9.25	64.8	4
6	3	5.5	54.5	7.25	11.25	64.4	9.9
Total	30.7	52.75	58.1	37.65	58.05	64.8	6.7

Table.5. Proportion of correctly recycled PMD for control and intervention period at Papadopoulos

***Note - Bin no. 3 and 4 are highlighted in grey as they were left as control during the 17-day audit period.**

The rate of recycling for PMD have increased on all bins except one as seen in the table above. In total all six bins combined saw an increase of 6.7% in correctly recycled PMD items. Surprisingly, the highest and lowest rate of PMD recycling came from bin 3 (10.9) and 4 (-9.6) respectively. This was not expected since both bins were from the first floor and were kept as control bins without intervention. Reasons for increase could include that students passed by or used the bins that were nudged in the building before so they could have known where to discard their plastic bottles, cups etc. The reasons for decrease could be due to wrong coloured bin bags sometimes placed in the recycling bin (see fig 8 from section 4.1). Not having the correct colour coded bin bags to the respective waste might lead to students inaccurately discarding their waste items.

The average number and proportionate of Paper recyclables at Papadopoulos building for both control and intervention period are shown below in table 6:

BIN NO.	CONTROL PERIOD (Average from 5 days)			INTERVENTION PERIOD (Average from 12 days)			Absolute Change (%)
	Correctly recycled Paper	Total Paper items	Correctly disposed proportion (%)	Correctly recycled Paper	Total Paper items	Correctly disposed proportion (%)	
1	5.6	11.4	49.1	6.25	8.75	71.4	22.3
2	3.8	6	63.3	4.3	5.75	74.7	11.4
3	3.6	9.6	37.5	3.5	6.4	54.6	17.1
4	3.4	5	68	2.5	4.5	55.5	-12.5
5	3.8	5.6	67.8	6.25	8.4	74.4	6.6
6	1.6	3.2	50	5	7.1	70.4	20.4
Total	21.8	40.8	53.4	27.8	40.9	67.9	14.5

Table.6. Proportion of correctly recycled Paper for control and intervention period at Papadopoulos

***Note - Bin no. 3 and 4 are highlighted in grey as they were left as control during the 17-day audit period.**

The paper category on the recycle bins have seen the highest percentage increase (14.5%), with the biggest change taking place at bin no. 1 on the first floor (22.3%). This bin has had the greatest number of items discarded than any other bin in the building. Despite not having the intervention, control bin 3 was met with an increase in percentage of correctly recycled paper waste while bin 4 once again saw a decrease. The reasons for the increase in paper recycling could include that there were high proportions of paper cups being disposed in the paper category when compared to waste category. Also, many leaflets, sheets of paper also found disposed in the paper recycling category.

The average number and proportionate of waste items at Papadopoulos building for both control and intervention period are shown below in table 7:

BIN NO.	CONTROL PERIOD (Average from 5 days)			INTERVENTION PERIOD (Average from 12 days)			Absolute Change (%)
	Correctly disposed Waste	Total Waste items	Correctly disposed proportion (%)	Correctly disposed Waste	Total Waste items	Correctly disposed proportion (%)	
1	7.8	18	43.3	6.9	14.5	47.5	4.2
2	5	9.2	54.3	5.75	9.75	58.9	4.6
3	5	12.4	40.3	5.8	12	48.3	8
4	1.8	5.4	33.3	3.5	8	43.75	10.45
5	2.2	4.6	47.8	5.25	8.9	58.9	11.1
6	3.6	6.6	54.5	5.5	10.5	52.3	-2.2
Total	25.4	56.2	45.1	32.7	63.65	51.3	6.2

Table.7. Proportion of correctly disposed Waste items for control and intervention period at Papadopoulos

***Note - Bin no. 3 and 4 are highlighted in grey as they were left as control during the 17-day audit period.**

On average there has been an increase of 6.2% in correctly disposed of non-recyclables. Bin no 5 saw the highest increase (11.1%) followed by bin no 4 (10.4%). This indicates more students were separating used paper and tissues from clean paper recyclables. Sometimes straws were also being separated from the cups. While bin 5, located on ground floor saw an increase, Bin 6, located on the same floor saw a decrease (-2.2) in rate of waste disposal. This could be due to certain events taking place on the ground floor of the building on two separate occasions. During these events, the cleaners have to deal with the bags filling up quickly. This could have led to many people not taking time to observe the sign and dispose items incorrectly. Also, the cleaning schedule could have been affected with bins having unusually high or low number of items at the time of the audit.

In building Papadopoulos, the Paper category saw the highest increase in correctly recycled paper items while the non-recyclable bin category saw the lowest increase. The amount of Paper and PMD wastes collected from Limassol has increased over the years as depicted in Table 3 and figure 4 respectively (section 2.3) in the background section (GreenDot, 2019b). That's why it is important to separate more recyclables such as paper and PMD items at source as it can reduce the financial burden of segregating wastes after they are collected (European Parliament, 2017).

The average number and proportionate of PMD, Paper and Waste at Andreas building for both control and intervention period is shown below in table 8:

CONTROL PERIOD (Average from 5 days)				INTERVENTION PERIOD (Average from 12 days)			Absolute Change (%)
	Correctly Disposed Items	Total Items	Correctly Disposed Proportion (%)	Correctly Disposed Items	Total Items	Correctly Disposed Proportion (%)	
PMD	7.4	14	52.8	8.3	14.1	58.8	6
PAPER	4	8.6	46.5	6.6	9	73.3	26.8
WASTE	6	12.2	49.1	6.8	12.9	52.7	3.6

Table.8. Proportion of correctly discarded PMD, Paper and Waste items for control and intervention period at Andreas building

Once again, the Paper category of the bin saw the highest increase in correctly recycled items (26.8%) while the Waste category saw only an increase of 3.6%. The reasons for successful nudging in building Andreas could be due to the fact that there was already an existing separate Paper and PMD bins in the building (see fig 12 from section 4.1). These larger bins had pictures of corresponding items at the front that informed them of what were considered to be Paper and PMD recyclables. This could have had an effect on students since the existing separate bins by the entrance of the building could make them recognise immediately what were recyclables and non-recyclables.

To understand better the proportions of each items in the waste categories, bar graphs and pie charts were created for building Papadopoulos and Andreas correspondingly. Each category of waste was given their respective colours as indicated on the recycle bin (blue for PMD, brown for Paper and Green for Waste). As Niroumand et al., (2013) suggested, utilising these graphs for analysis makes it for easy interpretation as data can be represented in an effective manner while presenting discrepancies for comparison. The results for these proportions of items from the audit are given in the following section.

5.2.1 Waste Discrepancies in building Papadopoulos

The average no. of items in PMD category during control and nudging period are compared with each other below:

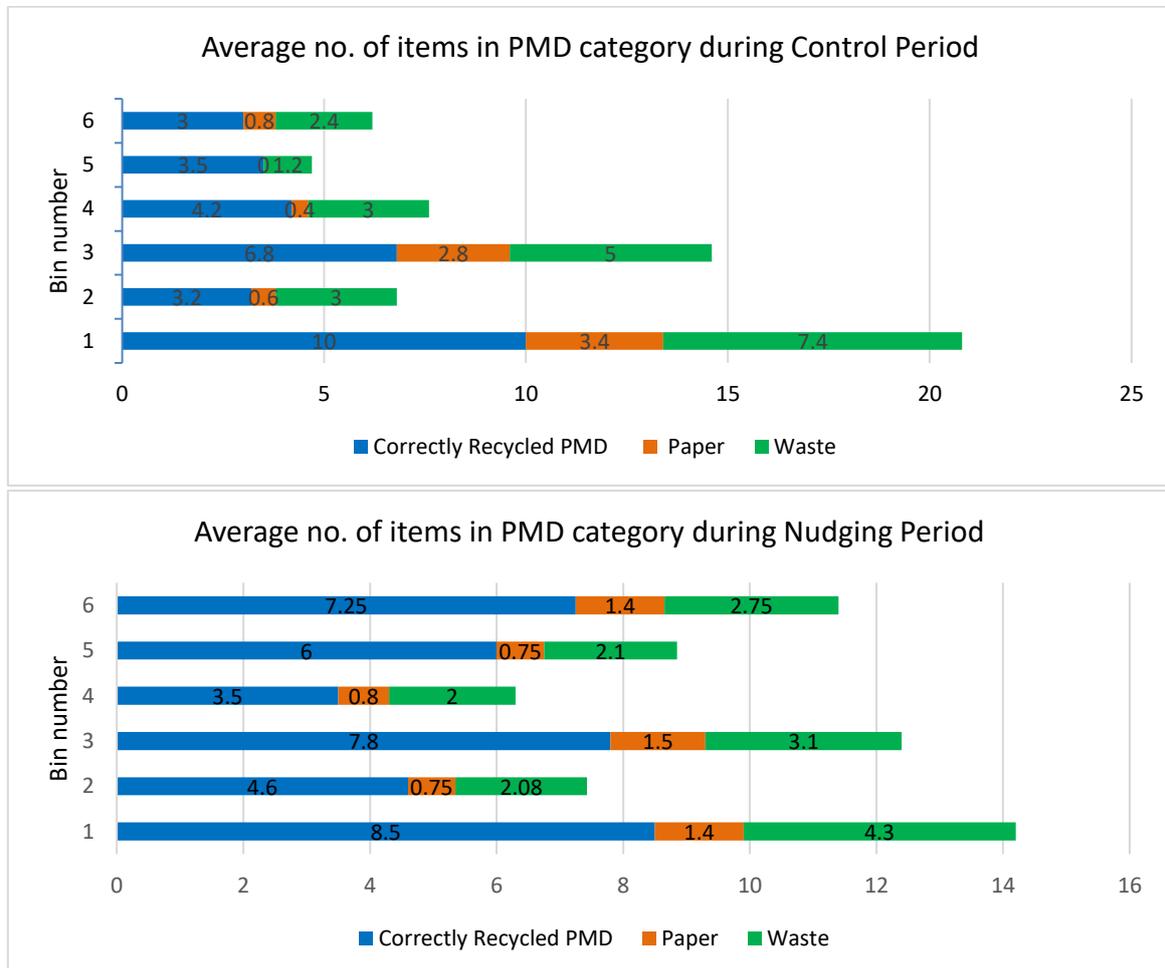


Fig.17. Proportion of average no. of items in PMD for control and intervention period at Papadopoulos

***Note - Bin no. 3 and 4 were left as control during the 17-day audit period.**

In general, apart from bin no. 4 (which was left as control), the PMD items held the highest proportion of items during nudging when compared to the control period.

The average no. of items in Paper category of the bins during control and nudging period are compared with each other below:

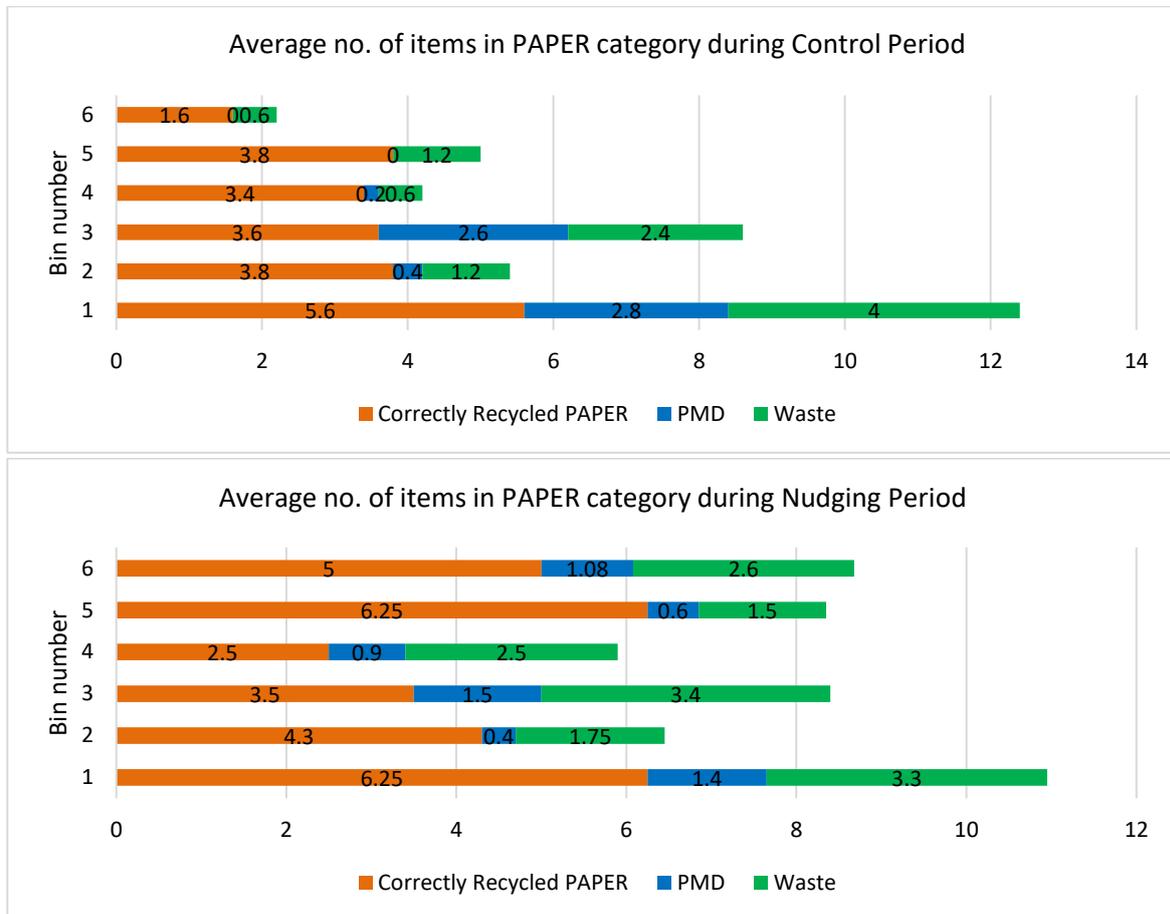


Fig.18. Proportion of average no. of items in Paper category for control and intervention period at Papadopoulos

***Note - Bin no. 3 and 4 were left as control during the 17-day audit period.**

Bins 3 and 4 that were left as control on the first floor did not show positive results. Both bins saw a decrease in the correct proportion of items in the paper category as there was bigger proportion of PMD and Waste items in these bins. All the other bins had higher ratio of Paper items compared to PMD and Waste. This is another indication that Paper category obtained the best results from the nudging intervention.

The average no. of items in non-recyclable Waste category of the bins during control and nudging period are compared with each other below:

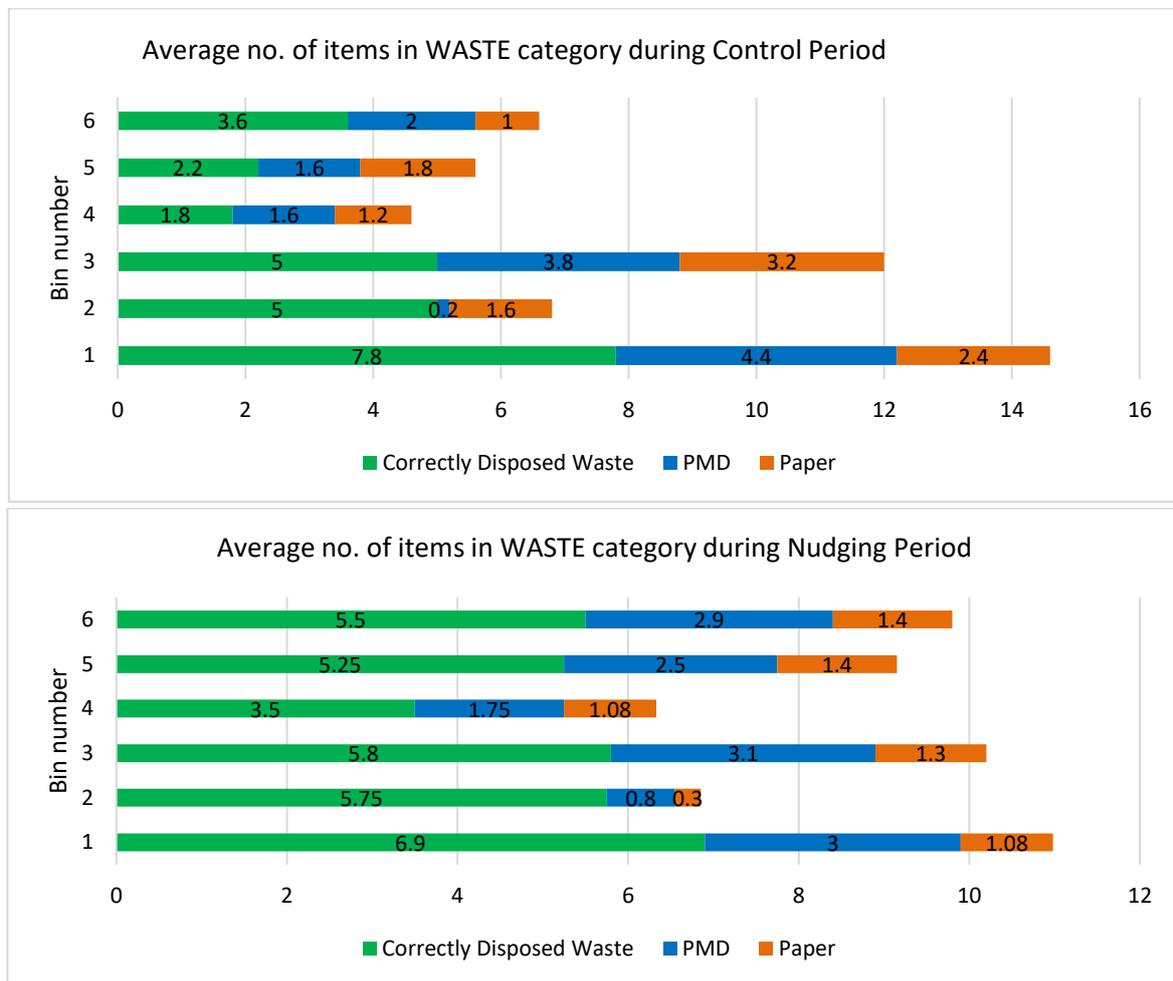


Fig.19. Proportion of average no. of items in Waste category for control and intervention period at Papadopoulos

***Note - Bin no. 3 and 4 were left as control during the 17-day audit period.**

While the average number of waste items disposed of during the nudging intervention only saw a small increase of 6.2% (table 7) from control period, the waste items were more correctly disposed off when compared to PMD and Paper items in the category. As it can be seen in the above figure, apart from bin 1 on the ground floor, all other bins saw higher number of waste items discard in the waste category when compared to PMD and Paper items. The reason for bin 1 of waste category having lower proportions of waste items could be due to the events that were mentioned earlier that saw a high number of people using the bins on the ground floor, which could have led to the discrepancies.

5.2.2 Waste Discrepancies in building Andreas

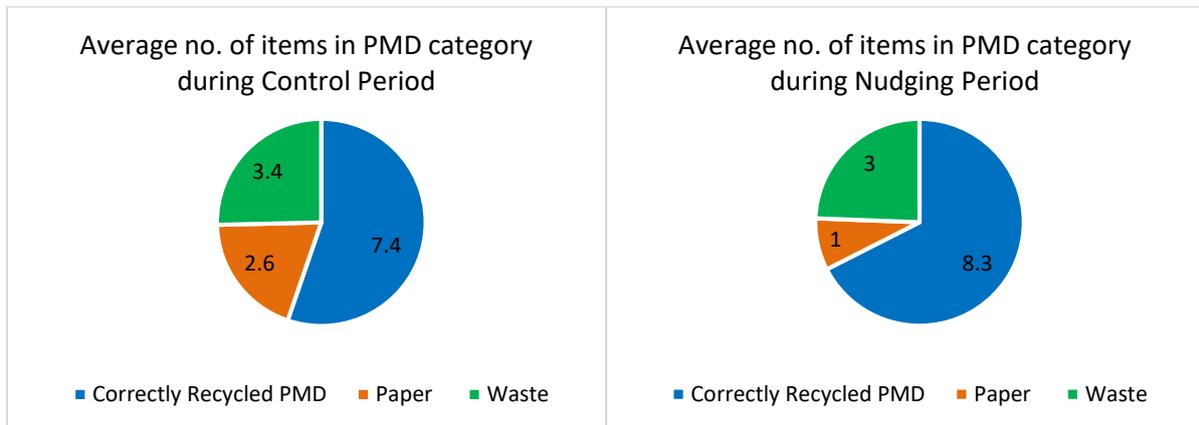


Fig.20. Proportion of average no. of items in PMD for control and intervention period at building Andreas

The above graphical comparisons of the pie chart show there has been a decrease in discrepancies in the PMD category of the bin. This highlights there has been an increase in correct separation of waste items according to the nudging poster. It could be an indication that Paper items such as paper cups were separated from plastic cups.

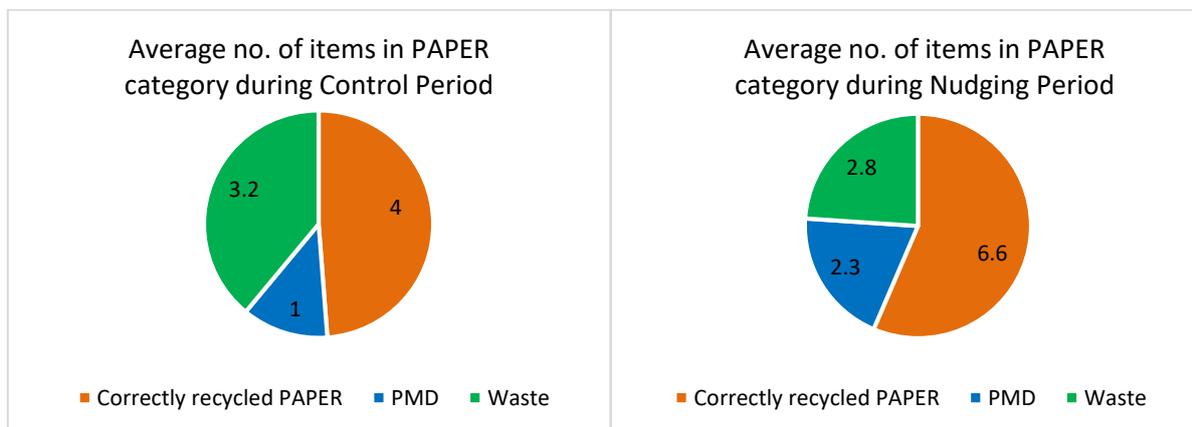


Fig.21. Proportion of average no. of items in Paper category for control and intervention period at building Andreas

The above graphical comparisons of the pie chart show how much discrepancies there were before in the paper category during the control period as there were more PMD and Waste items combined together when compared to Paper items. The number of waste items went drastically down during the intervention which could suggest more leaflet, clean sheets were correctly recycled in the Paper category. It also shows there has been an increase in recycling of Paper waste.

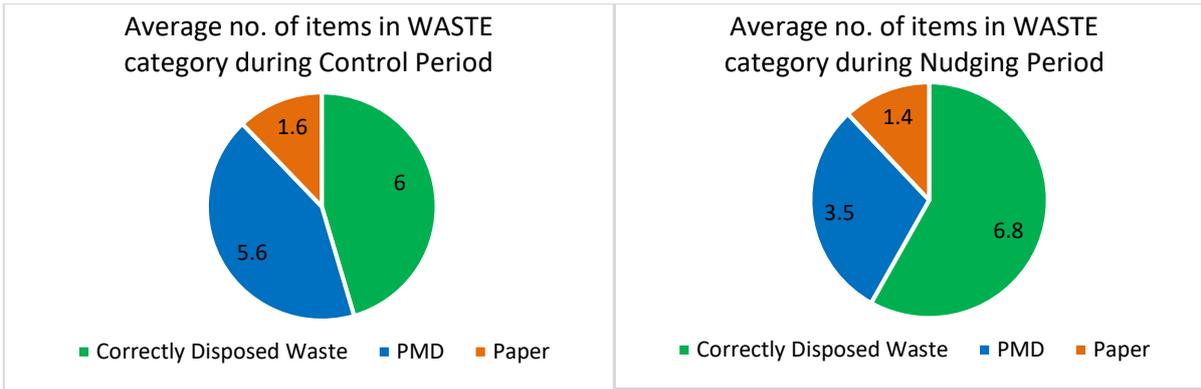


Fig.22. Proportion of average no. of items in Waste category for control and intervention period at building Andreas

The above graphical comparisons of the pie chart illustrate how much discrepancies there were before in the Waste category during the control period since PMD and Paper waste items were significantly higher than Waste items. This suggests more plastic cups (considered as non-recyclable in Cyprus) were correctly recycled in the PMD category.

5.3 Questionnaire Results

There were 86 participants to the questionnaire. Below is the analysis of all 13 questions including demography.

1. *Do you care about recycling and waste separation?*

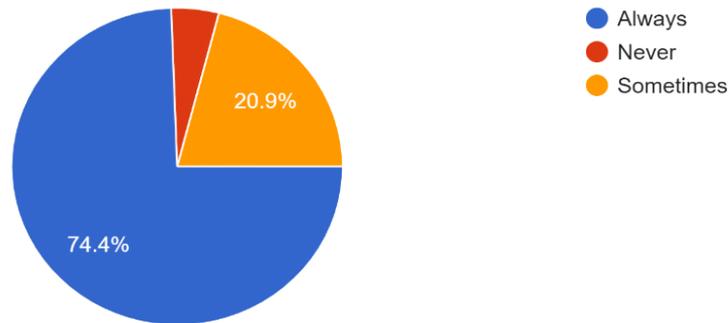


Fig.23. Percentage of students who care about recycling

This question was mandatory. As you can see from the above chart most of the students answered that they care about recycling and waste separation (74.4%). 20.9% of them however answered they only care sometimes, while 4.7% i.e. 4 respondents answer they never care about recycling. The answers to the following questions will help us determine the reasons as to why students have answered in this manner.

2. *Where do you get information regarding recycling/waste separation?*

Once again, all 86 participants have answered this question. They could choose more than one option from four, “university”, “school”, “online sources” and “I don’t get much information”. They were also allowed to input additional answer outside of the predefined choices. The answers they chose to add manually were analysed using content analysis and the most recurring answer was chosen to include in the result. Phrases such as “local authority”, “municipality” were grouped together. Terms referring to “Facebook”, “twitter” were grouped into “online sources” category. The graph below presents the top five answers:

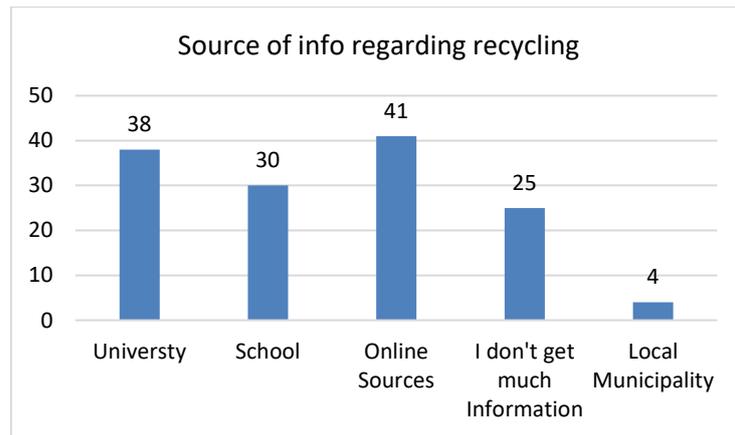


Fig.24. Source of information regarding recycling

Most of them felt online sources such as the internet, Facebook and other social media provided them most of the information concerning their source of information on recycling. They also think the university and school is an important platform for getting educated on recycling and waste separation. However, 25 responses were directed towards I don’t get much information which could be an indication as to why recycling rates remain low.

Moreover, a new answer generated by the participants was “local municipality”, even though it remains low (4 responses), municipalities perhaps plays the biggest role in recycling, as they determine what are recyclables in the city and provide the bins and services for collection for waste management. This compliments with the results from a previous study in the report from Parpal et al., (2003) described in section 2.3.2 in background, in which the participants (64%) in Cyprus felt it was necessary for municipalities to provide environmental information and that current information from municipality were insufficient (38%).

3. Do you normally use black general bins or recycle/separation bins in the university?

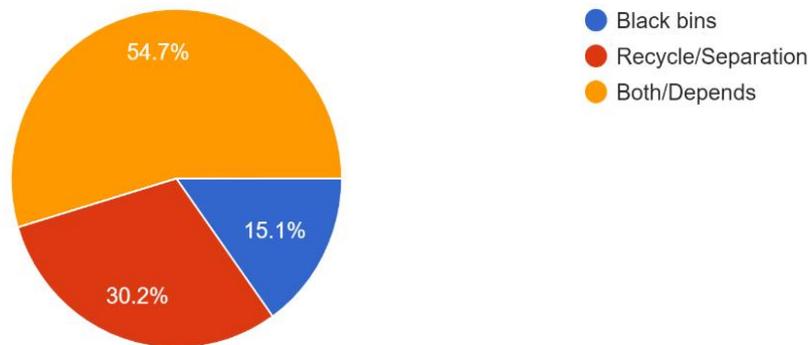


Fig.25. Proportion of students who use recycle bins, black bins or both bins

As mentioned in the background section, the university has several general waste bins along with recycling bins. Out of 86 participants (54.7%) stated they use both types of bins and it depends, most probably as it is based around the student’s location at the university, in or outside buildings etc, for their waste disposal. This is problematic since students could discard all kinds of wastes including recyclables in the black bins even though they are only meant to accept non-recyclables.

4. When using recycle bins at the university, do you separate your wastes? (If “No” please answer as to why you don’t separate)

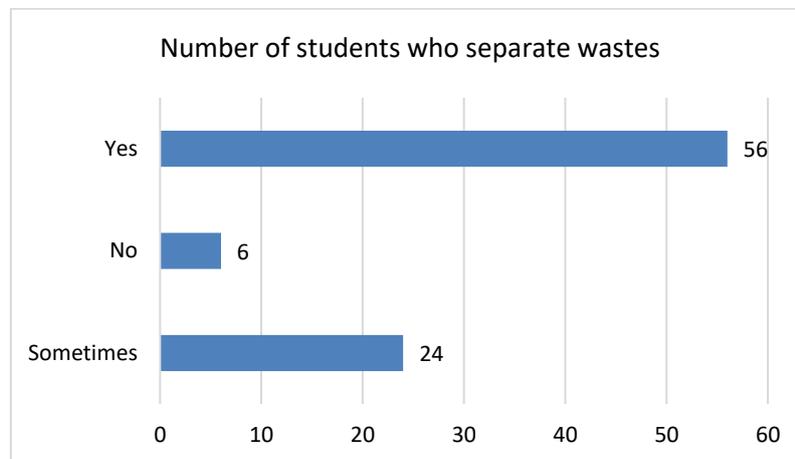


Fig.26. Number for students who separate wastes

Fifty-six students out of 86 responded they separate their wastes. Six students answered they don’t separate while twenty-four students only separate sometimes. Unfortunately, while there was an option to elaborate as to why students did not separate their wastes only one chose to answer. His only response was “Don’t know what goes where and how and don’t have time to separate”. This reflects on a previous research finding (mentioned in section 2.3.2) conducted at the university by Korsunova (2019), where in interviews some students stated that they were not fully aware of how and what to recycle. We can only assume that this would be the case why some students don’t separate their wastes. Upon inspection on the questionnaire results on exported excel sheet, it is worth noting the person who gave this response was also one of the students that responded he never cares about recycling and waste separation in the first question.

5. *Did you see the sign regarding waste separation at the bins? (If no, please skip to question 7)*

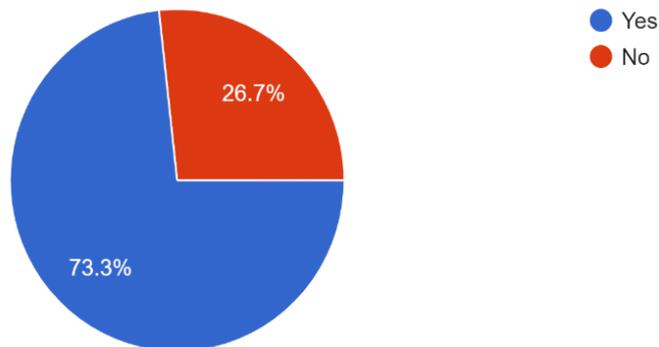


Fig.27. Proportion of students who noticed the intervention sign

Out of 86 participants, 23 stated they did not see the sign at the bins. This could be because those that answered “No” do not visit building Andreas or Papadopoulos for their classes or they simply did not pay enough attention to take notice of the sign at the buildings. Those that answered “No” were asked to skip the next question and answer question no 7.

6. *Did you separate your wastes after you saw the sign at the bins?*

Sixty-eight students came across the sign at the buildings and had used the recycle bins. Out of sixty-eight 97.1% (66 students) said they separated their wastes at the recycling bins while two students answered they did not separate. This also goes along with the study reported by Parpal et al., (2013) that in general most Cypriots do have enthusiasm for recycling.

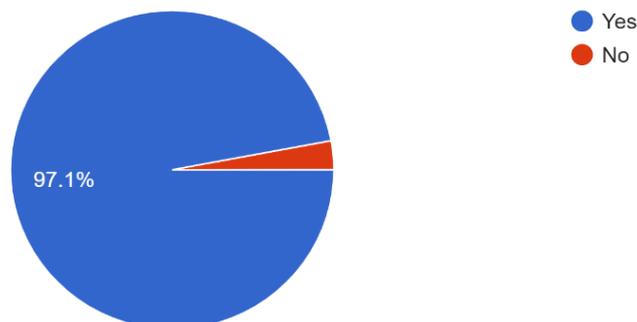


Fig.28. Proportion of students who separated their waste after noticing intervention sign

7. *General thoughts on the sign and the experiment. Do you think it helps with separating wastes? Please answer why you think it does or does not help.*

Before asking this question, a photo of the sign on the bin was attached to the questionnaire so that students who didn't see the sign at the buildings could still comment on it after skipping the previous question. Like question no.4 this question also had a minor error. While it's a mandatory question, the predefined “Yes or No” choices were not separated from students giving their thoughts on the

experiment, thus leading to not all participants answering “Yes” or “No” with their thoughts. On the other hand, some students only gave their thoughts. 81 students answered “Yes” or No”

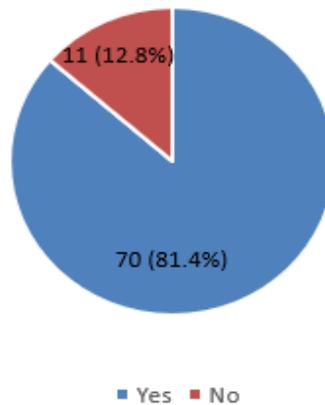


Fig.29. Proportion of students who thinks the intervention helps separate wastes

Out of 81, 70 students said the sign helps them separate waste, while 11 answered “No”.

Forty students responded as to why the sign and experiment helps recycling, while 16 responded why they don’t think the sign and experiment helps recycling. Once again, using content analysis, the open answer part of this question was analysed and recurring phrases or words that contained similar themes were grouped together. Using this approach, three of the most popular reasons each were selected as to why the sign does and does not help.

Figure 30 below highlights the most popular answers. The reasons why they help include “Pictures help in separating wastes” (23 responses), “most bins don’t show what are recyclables and non-recyclables” (12 responses) and because “they stand out due to less words and more pictures” (3 responses). Nudging with pictures have previously been proven to be effective to increase recycling, such as the one conducted by McNabb (2017) in Sweden. Informative signs that separates recyclables from non-recyclables have also been effective in an intervention conducted in Canada as suggested by Sussman et al., (2013).

The reasons why students suggested it does not help include “Cyprus lacks recycling facilities, so students don’t care” (5 responses), “Cypriots don’t check the signs and would ignore” (5 responses) and “Educating students was more important” (3 responses) than having such signs.

Other reasons students think were that it helps the environment and the signs should stay permanent on the bins. As to why it doesn’t help, some other reasonings include that students don’t understand why they should recycle, and that they often use general waste bins. One student also mentioned that the sign is not very clear.

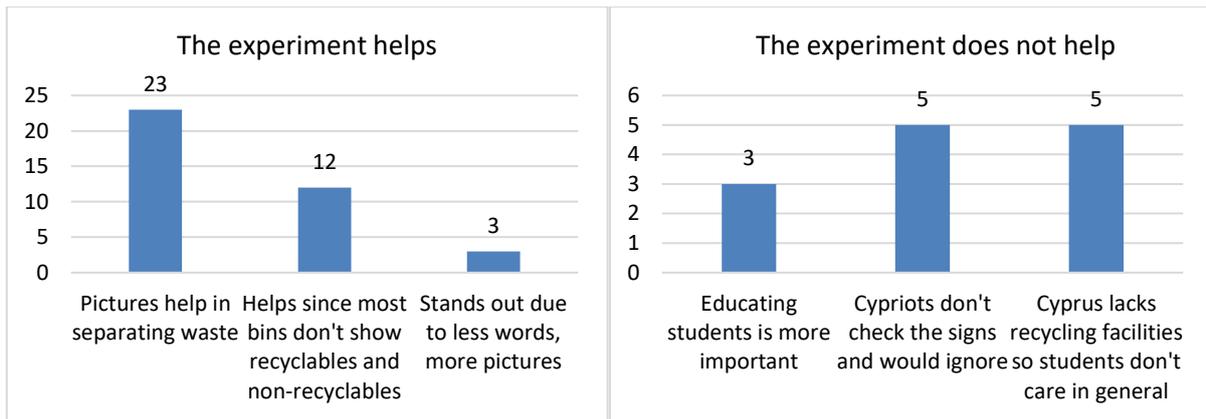


Fig.30. Reasons why the intervention helps or does not help with waste separation.

8. *How could the experiment have been done differently to help students separate wastes?*

This was another open question that was mandatory and answered by all participants. Several of them gave more than one suggestion on how the experiment could have been improved. Using content analysis six of the most popular suggestions were extracted and are displayed in the graph (figure 31) below:

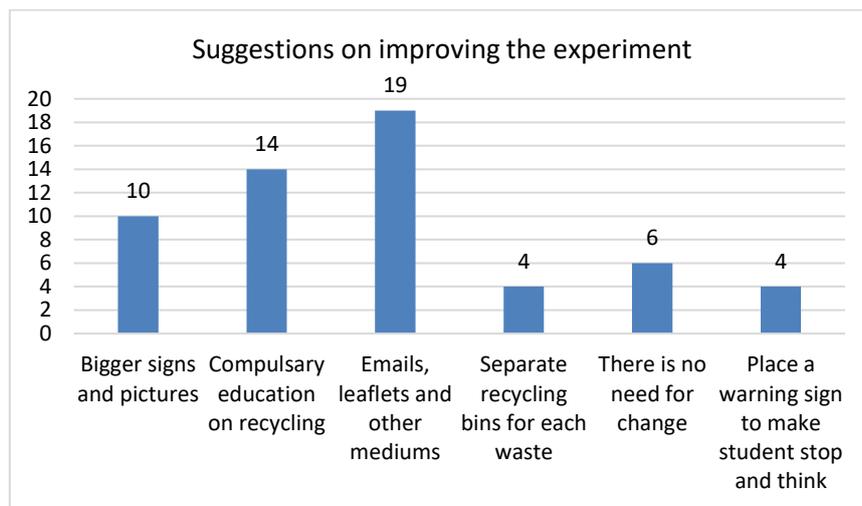


Fig.31. Suggestions on how the experiment could be improved

Majority of the participants suggested informing them through emails, leaflets and other forms of communication mediums would be effective. Some of them imagined sending them an email before carrying out the nudging intervention would have made students more aware of waste separation, which in turn could produce better results during the audit. Research conducted by Milford Øvrum & Helgesen, (2015) supports this suggestion since they found out that households in Norway that received letters with information on proper recycling behaviour increased their recycling rates.

The second most popular answer was compulsory education in the form of classes, lectures and workshops, since students believe there is a general lack of knowledge on recycling because courses do not emphasise the importance of recycling. Others suggested the experiment could have used bigger signs and pictures as well as placing a warning sign to make students stop and think before throwing their wastes as a means to grab their attention. Six answers implied that it wasn't necessary to improve the experiment further as the existing sign did the job well.

9. Do you think the university should do more in the future to help with recycling? If “Yes” please answer what they can do.

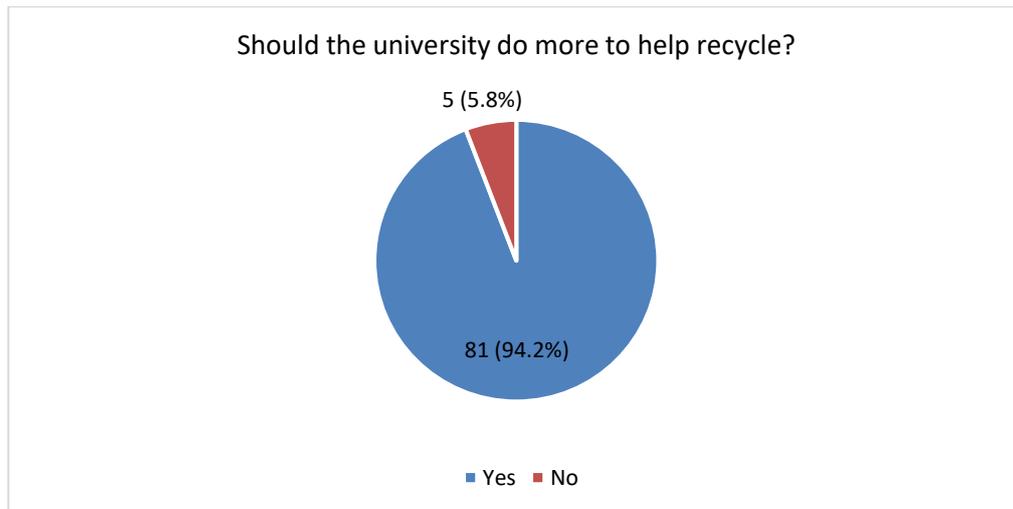


Fig.32. Proportion of students who think the university should do more to help recycle

Another mandatory question that saw an overwhelmingly 81 students respond that the university should do more in future to help with recycling. Nevertheless, only 58 respondents suggested what the university can do to help with recycling. Utilising content analysis, fifteen different suggestions were identified from the fifty-eight respondents, out of which the six most common answers were sorted and highlighted below:

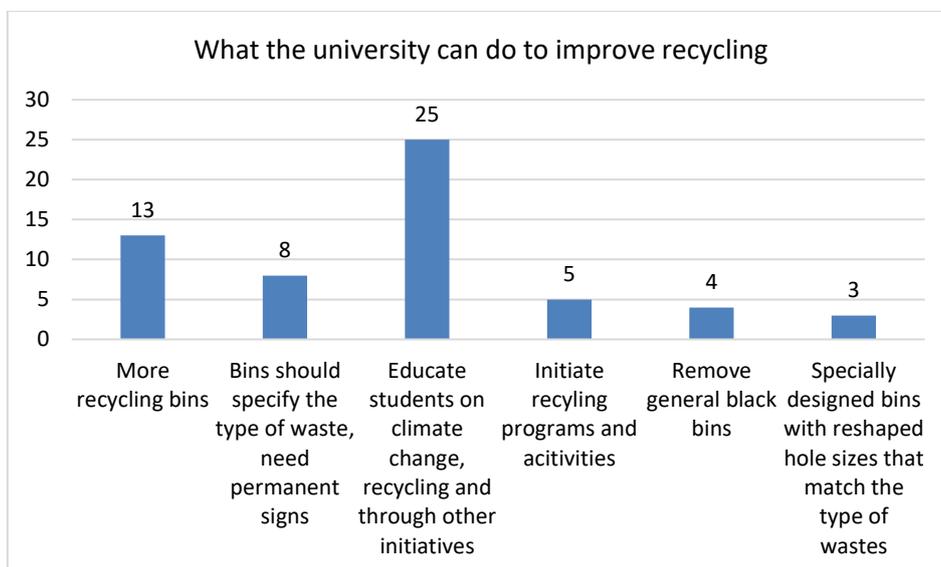


Fig.33. What should the university do to increase recycling rates?

The most suggested response for improving recycling at the university was to “Educate students and local community on climate change, recycling and through other initiatives”. Among this answer, one student suggested “through European programs” such as Erasmus as ways to inform students importance of protecting the environment. Education on environment and climate change is essential

as highlighted in their study by Barile et al., (2015). The researchers found nudges to be most effective when there is a high level of environmental morale among people. As Mosley & Stoker (2013) also indicates, nudges work when citizens know that something is right. The choice of waste separation must be presented to students through education.

The second most common response was to have “more recycling bins” in and around the university. This could enforce positive behaviour where students would have to dispose of their recyclables in recycling bins. The third most popular suggestion was that “bins should specify the type of waste, need permanent signs”. This answer would indicate that students felt the usage of signs with pictures of waste in the experiment was the best way to increase recycling rates. The next answer was to “initiate recycling programs and activities” as they felt the university currently does not provide students opportunities to take part in more recycling schemes.

Four answers suggested the need to remove general waste bins from the university as there are lot of these bins around the campus buildings than recycling bins. The black bins were mostly around communal areas such as the cafeteria where recyclables such as plastic bottles and cups would be mixed with non-recyclables such as food waste and tissues. Removing some general bins maybe an effective technique as nudging intervention in Edinburgh, Scotland have resulted in an increase in recycling after reducing the size of trash bins (Edinburgh News, 2015). This is because people are naturally obligated to separate waste at recycle bins when trash bins are smaller and accepts small number of items. The sixth common answer among the participants was that if bins were designed in ways that they would only accept the type of waste they were intended to, there is a possibility more students would recycle.

It is worth noting that one of the student participants who answered the university does not need to recycle stated that since the country had “no recycling facilities and management was not good” the university did not need to take additional measures to improve recycling.

The next set of questions were all mandatory and related to students’ demography (education, age, gender). It was decided the responses to these questions would not have a significant influence on the research and therefore would not be analysed in relation to the questions above to study recycling at the university, due to the low response rate for the questionnaire. There was also no single answer that stood out more than the rest. Nevertheless, the initial automatic analysis from Google Forms for three questions were saved and they are presented below:

5.3.1 Demography Results

The low response rate makes it difficult to suggest or assume that certain demographic factors have an influence in the rate of recycling at Cyprus University of Technology. Section 3.4 under nudging has described how past nudging studies have shown demography directly related to willingness to recycle. Some of the factors includes having higher level of education corresponding to an increase in recycling. Also, an increase with age showed an increase in recycling. Additionally, more women in general recycle more than males (Milford et al., 2015).

Regardless of low number of responses, it is interesting to see the below graph that presents the results for number of male and female participants who answered question 4 (“when using recycle bins at the university, do you separate your wastes?”)

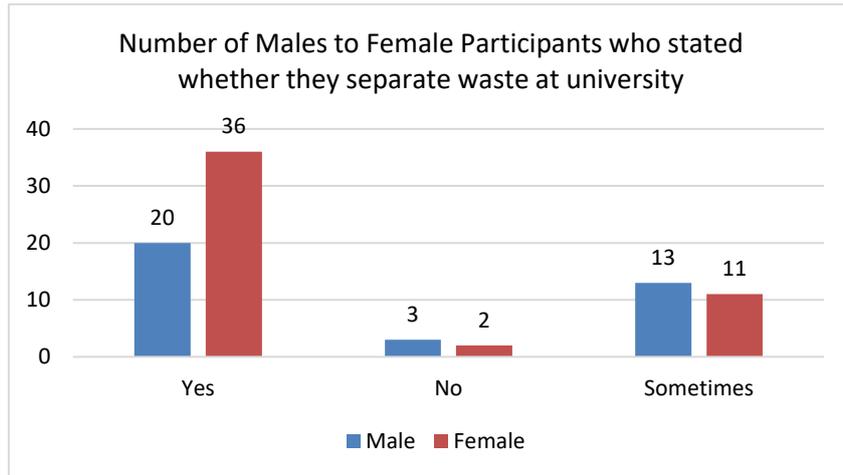


Fig.34. Male and Female respondents who separate wastes at the university

While the difference between both Males and Females who answered “No” and “Sometimes” is negligible, more Female participants answered “Yes” and that they separate their wastes at the university. Also, more female participants were there in this study than male, as seen in the chart below:

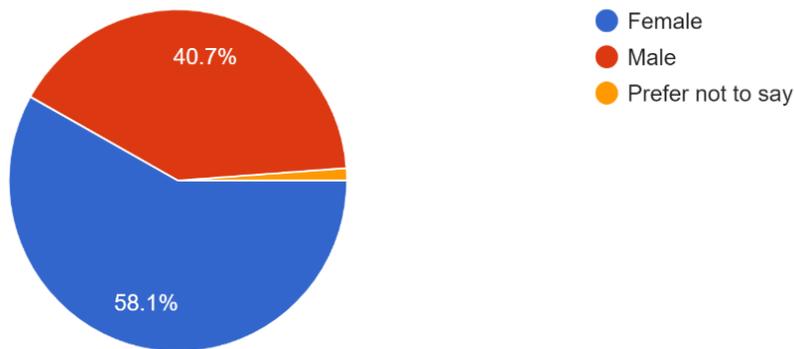


Fig.35. Male to Female participants in the questionnaire

A minor trend is also noticeable from the education background as shown below. Less number of students from 1st year has answered when compared to those studying in third, and fourth years.

Current Education:

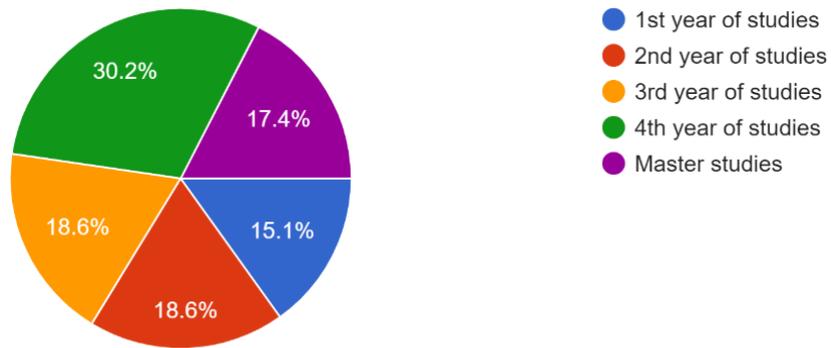


Fig.36. Proportions of respondents from various educational years

Although there is a fluctuation, with regards to age, there is a slight trend where an increase with age has resulted in increase of participants for the questionnaire:

What is your age?

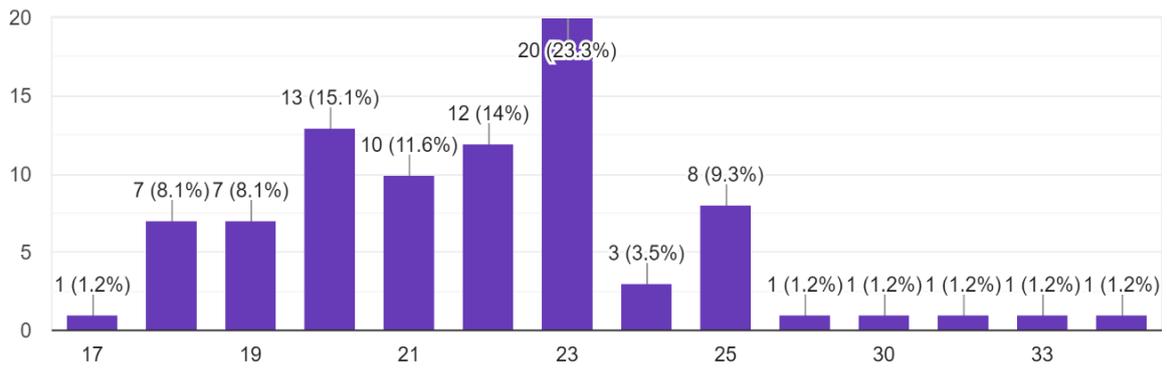


Fig.37. Ages of questionnaire respondents

6. Discussion

6.1 Improving Waste Management in Cyprus

The secondary analysis gives us an insight into what Cyprus can learn from other countries especially from the Mediterranean counties on how to deal with their waste problem to be in line with EU recycling regulations. Hence, the following theoretical sub-question is answered in this section:

“What changes should Cyprus introduce to their current waste management system to be in line with meeting EU regulations? “

As international laws are becoming more stringent around waste shipping and landfilling, and more countries are sending back their waste imports (EUWID, 2019), it is vital for Cyprus to become self-sufficient in managing their own wastes and drastically increase their recycling rates. They must actively work and cooperate with the European Union to update the national laws on waste management and fund infrastructure for recycling facilities. Despite adoption of the relevant EU waste legislation at national level, it faces difficulties in its implementation, mainly due to lack of infrastructure, responsibilities among the authorities and knowledge among communities (Chrysostomou, 2019). The largest share of municipal waste is landfilled inappropriately, and this trend could continue as Cyprus still produces very high amount of waste per capita. Despite closing all illegal landfills, a large proportion of the wastes would still end up in other landfills. There are various strategies for local municipalities, companies and communities to increase recycling and reduce waste. Here are some recommendations based on secondary research analysis on how Cyprus can improve their waste management system:

- Formulate and launch a “Cyprus Circular Economy Roadmap”, including targets to reduce raw material consumption, introduction of recycling facilities and developments in infrastructure to decrease dependency on export and landfills to become a circular economy by 2050
- Introduce nation-wide bio-waste collection and invest in anaerobic digestion plants to treat biodegradable waste such as food waste
- Introduction of a landfill tax to discourage landfills as a waste management option
- Mandatory binding of municipal waste recycling targets for municipalities, with penalties if they are not met
- Implementation of the proposed pay-as-you-throw scheme
- Allocate a dedicated budget solely to improving waste management system
- Introduce incentives to make consumers recycle/ reuse more (i.e. by receiving money upon return, vouchers, lower tax, reward, recycling centres should be free of charge)

In addition to these recommendations, educating people on a nationwide level, about the importance of proper waste management and the benefits of recycling such as protecting our natural environment and oceans is a necessity. Also, it is necessary to educate about the negative effects (i.e. climate change) of not recycling properly. Educating children from a young age could instigate a behavioural change in Cypriots and make them stop and separate their wastes before discarding them. Malta’s “Greening our Economy – Achieving a Sustainable Future” strategy that covers many circular economy concepts mentions the introduction of educational programmes in schools (MSDEC, 2016). A “Circular

Economy Roadmap” strategy for Cyprus could include similar concepts of educational programs concerning recycling and environmental protection.

SDG’s such as target 12.4 “Responsible management of Wastes” (UN, 2020) should be incorporated into the national legislation and the Cypriot authorities must take into consideration the suggestions from GreenDot Cyprus since they collect and manage most of the wastes in the country. Mandatory sorting at source should be made using implementation of existing legislation. Those that do not separate their wastes can be forced to pay fines (Greendot.com.cy, 2020). Furthermore, local municipalities should play a larger role in separate collection system, since there is a lack of separate collection of organic and food wastes. Malta’s program of separate collection of organic wastes have been a success with collection of around 32,000 tonnes (Wasteservmalta.com, 2018). If Cypriot government launched a similar program with distribution of bins for separate collection, large quantities of organic waste can be diverted from landfills and used for energy recovery. To encourage participation financial support or incentives such as free entrant to events or free parking can be given to residents such as the recycling and composting program that was undertaken in 2019 in Limassol (Hadjioannou, 2019a).

Those in government who might be abusing their power such as the Auditor General should not be tolerated (NewEurope, 2019). Waste management is a critical issue in the country and ministers and auditors should prioritise sustainable waste management to promote reducing, recycling and recovery of waste materials. Although Cyprus has access to EU funds for improving waste management situation, they must dedicate a budget exclusively to improve infrastructure and waste management treatments. Otherwise, the money may be exploited to make investments elsewhere. Waste exports should be reduced and more recycling facilities such as the plastic recycling facility in Limassol (Recycling-magazine, 2019) should be financed as this can reduce considerable amount of illegal shipping in the future. Strategies such as nudging may be essential in influencing people’s recycling behaviours. Simple nudging interventions such as the usage of informative signs used in this research may make a key difference in waste separation rates. But this is also only possible if Cyprus promotes the separation of all recyclables as large amounts of wastes such as plastic cups are considered non-recyclable (figure 3, greendot.com.cy). To increase the reuse and recycling of municipal waste to 55% by 2025 and 60% by 2030 as per the minister of Agriculture, the Department of Environment will need to revise their National Waste Management Plan to include most of these recommendations.

6.1.1 Improving Recycling Rates at CUT

The following empirical sub-questions have been answered through the audit and questionnaire study.

1. How can CUT promote good recycling behavior in the long term to better support EU recycling targets
2. To what extent does nudging intervention increase the proportion of correctly disposed of recyclables?

The results from the waste audit shows that nudging does have the potential to increase separation and recycling rates at Cyprus University of Technology. The university has a lot of capability to promote good recycling behaviour and increase their recycling rates in the future. Cyprus and the city of Limassol are currently realising several recycling initiatives and CUT has an opportunity to capitalise

on this since the university stands out among the rest in the country for their good record in environmental management (cut.ac.cy, 2019). It is clear from the audit and questionnaire that when recycle bins are labelled and indicate which waste items they accept; most students are encouraged to increase their recycling behaviour. Correctly disposed Paper items have shown the highest increase in both buildings, with PMD recycling rate coming second place. And there is a small increase in correctly disposed Waste items. This is also evident from the two separate recycling bins that exist in building Andreas since they have shown good waste separation rate from initial observation of the bins. Providing simple information on recyclables and non-recyclables is effective to make students stop and think before disposing their wastes.

Most students felt that they already separate their wastes at the recycle bins, but many (94.2%) believe the university should do more to improve the current recycling system. This includes the need to educate students on climate change and importance of recycling, introducing more recycle bins around the campus and specification of type of wastes on the bin with permanent signs. Recycling programs and activities can also inform and persuade students to recycle more. Removing some of the general waste bins can also automatically influence behaviours to make use of the recycling bins more often as 54.7% of students stated they use both general and recycling bins around the campus, while 15.1% use black bins more often.

Overall, the research has established that Cyprus has a long way to go to improve their recycling rates, but they have the capability to self-sustain their waste management processes to meet future European Union recycling targets.

6.2 Research Limitations

Several limitations existed due to time constraints and lack of resources to be able to carry out this research more extensively. This section will look into the waste audit and questionnaire study and recommend suggestions for improving such an experiment in the future.

6.2.1 Waste Audit and Nudging

Both the control audit and intervention period have to be longer to acquire more reliable results. It would have been interesting to study the differences in rate of recycling if the audit period ran for at least a month. Perhaps the recycling rate during intervention would have increased significantly since recycling attitudes could be influenced over time and thus producing more reliable results. The analysis could have determined if at a longer intervention period, more students increase the rate of waste separation.

The nudging intervention can also be improved using the suggestions that students reported in the questionnaire. Having bigger signs and pictures at the bins and sending emails and leaflets for communicating information on recycling can also help spread awareness in the university about the nudging experiment undertaken. Having a warning sign on the bin to make students stop and think before discarding their waste is also good to promote correct waste separation. Besides compulsory education at university for recycling, a one-off lecture or workshop could have helped increasing the recycling rate too. It could however be argued whether distributing extra information about recycling to the students is in fact “nudging”, although such education could have improved questionnaire response rate.

Introducing separate recycling bins as part of the research study would not have been financially feasible, but it is worth considering how students would have behaved if separate bins existed for PMD, Paper and Waste as at the moment all three categories are implemented onto one bin.

6.2.2 Questionnaire

The low rate of responses could have been improved if incentives such as the distribution of USB sticks from random draw as a reward for participation were initiated from the time the questionnaire was sent. Information and a link to answer the questionnaire could have been spread through leaflets and posters around the campus as this helps to spread awareness regarding the experiment. If there was more time to have face to face interaction with students, it could have boosted the number of responses as well.

If responses collected were high enough around 150-200, then the results of the demography could have given us an indication as to whether there is a link between the student's background on their behaviour towards recycling. It could be investigated if age, gender or year of study has an impact on whether the students care/recycle at university.

Additionally, the open-ended questions should have been separated from closed questions in order to have become mandatory to be answered. Doing so would have ensured all participants would have given their thoughts on the signs and suggestions to improve recycling.

6.2.3 Interviews

Research could have also included interviews conducted with officials from local Limassol Municipality or GreenDot Cyprus to understand some difficulties and challenges in improving the waste management system. Interview with an official such as Mayor of Limassol, if feasible, would have given more insight into future recycling initiatives in Limassol. Interview with the Rector or Vice President of the university could give us understanding into why there is a lack of recycle bins or separate recycling bins.

7. Conclusion

This paper concludes that Cyprus needs to radically transform their waste management system in order to meet EU goals, but the transformation can start locally from universities such as Cyprus University of Technology. The nudging experiment has been successful in generating recommendations on how the university can improve their current waste management system. Simple intervention such as informational signs can push residents to think about how to separate their wastes. In the future when conducting waste audit and nudging experiment, it would be more effective if both control and intervention periods were longer. The recycling rates could have improved substantially, and the analysis could determine percentage of increase or decrease during the nudging period. Comparisons could have been made between weeks to notice if there are any differences. The questionnaire response rate could also have been improved if bigger signs or posters were utilised, incentives were provided, and questionnaire distribution through creation of posters or leaflets were employed. Interviewing key people responsible for waste management in Cyprus such as from GreenDot, Limassol Mayor or Rector from university can give us more understanding onto what challenges are difficult to overcome and why there are lack of recycling bins.

The suggestions on improving waste recycling at university is also applicable to the country as a whole since people in general have positive views of recycling and understand the importance of it. Waste separation at source can stop the country from landfilling majority of their municipal waste, but proper infrastructures for recycling need to be in place in Cyprus that would reduce the dependence on waste export as well. Educating on the importance of recycling from a young age can show an increase in positive behaviour towards it. Recycling initiatives and incentives to the general public can encourage more people to take part in recycling programs. Cyprus has failed to meet the 2020 recycling targets, so apart from local recycling developments and education, future targets can only be met if waste management legislation is enforced and the plan is revised.

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Finally, I want to thank my family and friends for giving me the strength and support. Without their unconditional love, especially during these difficult times, I would not have been able to complete this paper.

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