LIFEPAYT – Tool to reduce waste in South Europe

Final Report

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Project LIFE PAYT – Tool to reduce waste in South Europe (**LIFE 15 ENV/PT/000609**)
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LIFE15 ENV/PT/000609

Final Report

Covering the project activities from 01/09/2016 to 31/12/2021

Reporting Date

November/2022

LIFE PAYT – Tool to reduce waste in South Europe

Data Project

Project location:	Portugal: Coimbra, Aveiro, Condeixa-a-Nova, Lisboa Grécia: Athens, Vrilissia Chipre: Larnaka
Project start date:	01/09/2016
Project end date:	31/12/2019 **Extension date:** 31/12/2021
Total budget:	2,517,571 €
EU contribution:	1,351,945 €
(%) of eligible costs:	60 %

Data Beneficiary

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List of keywords and abbreviations

AdB	Advisory Board
ANMP	National Association of Municipalities
APA	Portuguese Environmental Agency
CCDRC	Commission for Coordination and Development for Regional Centre (PT)
GP	Green Procurement
EGF	Environmental Global Facilities
ERSAR	Water and Waste Services Regulatory Authority
ESGRA	Association of Waste Management
IPC	Polytechnic Institute of Coimbra
LCA	Life-cycle assessment
MSW	Municipal solid waste
NGO	Non-governmental organisation
NTUA	National Technical University of Athens
PB	Project Board
PR	Progress Report

Executive Summary

LIFE PAYT - *Tool to reduce waste in South EUROPE* tested the adoption of PAYT waste tariffs, which encourage waste prevention and source segregation practices, fostering separate collection. The objective was to demonstrate that PAYT tariffs are possible in the South of Europe and lead to a reduction in unsorted waste and to an increase in material recovery from source segregated recyclables. It was also an objective to extend developed methodologies to other municipalities in the South of Europe, thus contributing to a resource efficient Europe and to the implementation of the European environmental strategies and Policies.

LIFE PAYT started **01.09.2016**. At an initial stage, the project logo, website and Facebook page were developed (**action D1**), the first leaflets were printed and distributed (**action D3**) and an Advisory Board was set up (**action D2**). Market consultation took place (actions **B1**, **B2**) in order to define and acquire the equipment necessary to make the transition to the PAYT system in each of the 5 municipalities, and required adjustments to the technical solutions were made. After long tendering procedures (in all the 5 municipalities), the equipment was finally acquired, and the field implementation started at all demonstrations sites.

In **AVEIRO**, 26 PAYT street waste containers (660 L) with controlled access were installed and access cards were given to the citizens (05.2018). The containers were returned to the supplier because the rotating drum frequently jammed. The lids were redesigned, and the prototype lid was constructed and tested in the field (09.2019). A second stage of field implementation took place (25 PAYT containers, 15.09.2020 to 16.11.2020).

In **VRILISSIA,** PAYT containers that registered waste weight were built and field tested (12.2019). The 1st operational phase took place 06.2020. By 07.2020, 30 PAYT containers were in place at the demonstration site (2nd operational phase), 10 were placed in 01.2021

and the last 8 in 06.2021. Several problems were identified during the field implementation (batteries, distortion of lid, locks, vandalism, hardware) and each time an issue was raised, containers were taken out from the field for repair or repaired on site. Field implementation was until 11.2021.

In **LARNAKA**, a PAYT door-to-door bag collection scheme was set up. By 06.2020 all necessary equipment had been purchased (440 bins, 64, 000bags, 67,200 bag stickers, 2 portable scanners, 2 tablets). In 06-07.2020 the bags and bins were delivered to the residents of the pilot area. Stickers and barcodes for each household were prepared and delivered (10.2020-11.2020), technical staff training took place (10.2020), testing took place (01.11.2020-31.01.2021) and the field implementation was from 02.2021 to 09.2021.

In **CONDEIXA** a door-to-door PAYT system with individual bins was set up for commerce and services. A pilot test was carried out (06.2017). 880 RFID tags were put on waste bins (11.2020), a database of waste containers and owners was created, software and hardware were installed, 2 collection vehicles were retrofitted (01.2021). The field implementation (02.2021-12.2021) involved all non-domestic waste producers. Anomalies arose on a daily basis and constant requests for corrections were sent to the supplier. From 03.2021 onwards additional monitoring was carried out on a selected sample of 50 waste non-domestic producers to validate collection parameters, ensure that the collection was being properly registered and to gain confidence that the software and hardware were fully operational. The integration of field collected data and the billing system of the municipality started (12.2021).

In **LISBON** a PAYT scheme for large waste producers was set up based on bin identification (using the serial number of the container) and a database was compiled, accessible through an app. Large waste producers (previously not identified as such) were looked up and new contracts were established (reaching 134 contracts in 2020). A sample of 15 entities was selected as a control group for close monitoring with the aim of verifying at each site the correct use of containers and the contamination of recyclable fluxes with non-target materials.

Before, during and after the field implementation, actions related to the participatory process and communication with the populations were carried out, as well as training of all the relevant stakeholders (**action B6**). A PAYT collaborative platform was developed and the interface was made available, with the Citizens Portal being put online (**action B3**). Concomitantly, alternatives to unsorted waste discarding were provided to the populations (**action B4**): new drop-off points for recyclables (in **AVEIRO** and **CONDEIXA**) and waste containers for recyclables (in **LISBON**) were installed or distributed. Schemes for home composting and "building" composting were put in place, and the relevant equipment (composting kits) was distributed in **AVEIRO**, **LARNAKA** and **VRILISSIA**. A PAYT waste tariff model was developed in an excel spreadsheet (**action B5**). This model was tested using real data from the municipalities and improved. For improved usability, an online app was created, the PAYT TARIF SIMULATOR.

Data collected during the field implementation was used to develop economic studies for the upscaling of the PAYT system to the whole territory of the municipalities of **Aveiro, Larnaka** & **Vrilissia (Action B7)**. The studies are valuable assets to prove PAYT positive feedback on local economy and provide evidence to the involved Municipalities of the benefits of PAYT implementation and are being used by the municipalities to define actions plan and future strategies on waste management. Meetings took place with regulating entities to ensure that the knowledge acquired in the LIFEPAYT project is incorporated into new policies & regulations. Also for this purpose, 2 documents with recommendation on the implementation of the PAYT were written, one for Portugal and one for Greece. A *Guide on PAYT implementation targeting local authorities* was also prepared. The "LIFEPAYT TOOLBOX" was developed: it is an on-line app compiling the most relevant tools developed within LIFEPAYT for maximising the rolling out the project results.

For monitoring the project impact, a relevant set of environmental indicators was defined, and characterization campaigns were held in all locations, providing input data to calculate the waste production baseline (**Action C1**). A Life Cycle Assessment was performed. A set of economic and social indicators were defined and surveys to the target population were

developed and applied in all locations and a comparison before/after the project (**Action C2**). A cost-benefit analysis was also performed (Action **C3**).

A network of PAYT municipalities was created (Action D6), which allowed sharing experiences among municipalities. 8 newsletters and 1 final video were released, showing LIFEPAYT implementation at demonstration sites. A virtual visit was prepared for each demonstration site. 5 workshops took place, over 30 presentations were made about the project and 10 articles were published. LIFEPAYT was on the national TV twice and once in the radio.

Activities developed in the scope of project management included the creation of work plans for each partner, preparation of the risk plan, control of the implementation of the green public procurements among others. All actions (19) were completed, all milestones were reached and all deliverables were prepared. Direct environmental and economic benefits from PAYT were quantitatively verified, resulting from the increase in separate collection of recyclable materials (AVEIRO, LARNAKA and LISBON) and a decrease in mixed waste (Aveiro and Larnaka). Derived from this, positive effects such as lessening of carbon footprint (**-463 t CO_2 eq)** and savings of natural resources were observed.

Each of the participant municipalities chose its own technological approach for the PAYT implementation, adapted to the particular features of each location. For the companies taking part in the development of new technological solutions, new business opportunities have been opened. The experience gained during LIFEPAYT is considered as a highly valuable achievement and the acquired know-how and tools developed pave the way for further adoption of PAYT in other locations. There is also rising awareness among local authorities, with implications in future replication: there has been interest for the project from other municipalities and countries and there are cases of PAYT implementation under way in some municipalities.

1. Introduction

Project LIFEPAYT aimed at developing activities necessary for the implementation of the specific objectives for waste set out in the Roadmap for a Resource-Efficient Europe and the 7th Environment Action Programme, contributing to promote the waste hierarchy (prevention, re-use and recycling). LIFEPAYT had four main objectives:

- Reduce residual waste from household and commerce;
- Increase recycling rates for packaging materials;
- Demonstrate that PAYT is feasible, changing local decision makers, technical staff mind-set, in Southern European Municipalities, resulting in benefits and contributing to the implementation of EU environmental strategies and targets;
- Promote the replication of the concept to wider regions with the same problems.

Environmental problem

Current municipal waste management practices in Portugal, Greece and Cyprus have failed to achieve high recycling rates and will have difficulties in assuming EU waste environmental targets for 2020. The selective collection of materials by the current drop-off containers is not efficient: less than 15% of all light-weight packaging is presently recovered and valorized, while the remaining is sent unsorted (highly contaminated) to Mechanical and Biological Treatment (MBT) and Landfill (58%, 2013). Recycling rates are not increasing in most Municipalities, but stagnant, or even decreasing. The scenario is similar in most part of South European Countries. Decreased waste production means less waste collected, transported and landfilled, and thus decreases the pollution and energy costs associates with these pathways. LIFE PAYT aims at changing the current environmental targets status to creating the right conditions to increase source segregation and a different attitude towards waste management at local level in Southern European Countries. Most probably, under present conditions, without a appropriate PAYT systems, the recycling targets will be difficult to reach allowing resources to be landfilled

extraordinary efforts will be needed to better implement the waste hierarchy and to meet the Directive´s Targets.

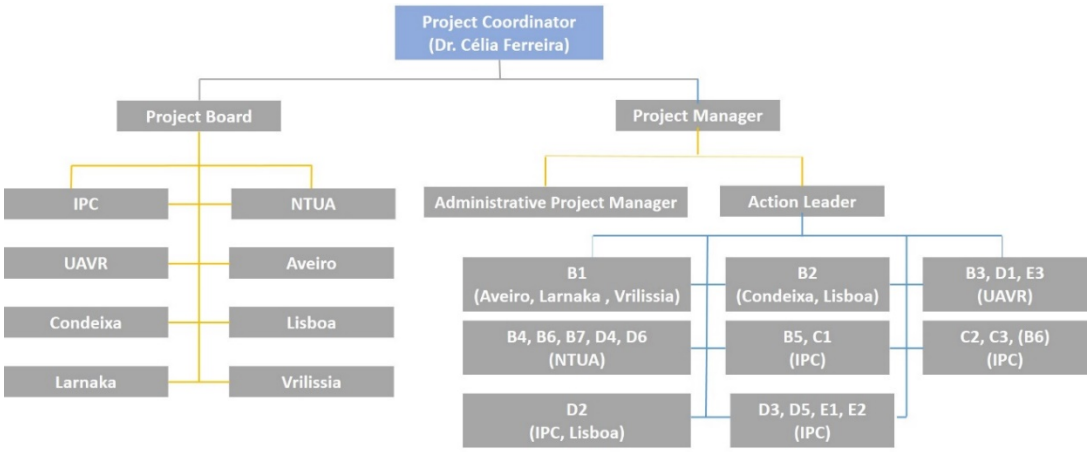
Hypothesis demonstrated/verified by the project

At the beginning of the project no Municipality in Portugal had a fully implemented PAYT system. Waste charging situation in Portugal, Greece and Cyprus, as well as in other South and Southeast European countries is similar, with flat flee system predominating, with little information available on PAYT and the issues of waste reduction. Citizens, commerce, services actively engaged in source segregation and recycling were not paying a fair fee for their waste and did not feel rewarded, leading to decreased commitment.

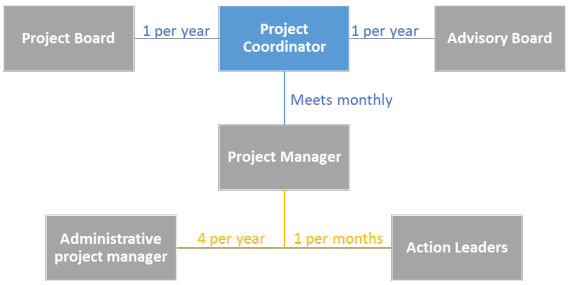
LIFEPAYT aimed to create the right conditions to apply PAYT systems and thus increase source segregation and a different attitude towards waste management at local level. Applying a volume limit for the amount waste increases awareness, and also the quality of separate collection. New residual waste containers and bins together with a fair and equitable waste tariff encourage people to behave more consciously regarding the production of waste and in diverting light-weight materials (paper, glass and packaging to recycling). Demonstration sites where PAYT schemes are successfully implemented contribute to transform decision makers (elected officials; technical staffs) mind-set and eliminate misconceptions regarding PAYT systems in countries in South Europe.

2. Administrative part

Project Coordinator, Project Board, Project Manager, Administrative Project Manager and Action Leaders were foreseen in the proposal. There was a change in meeting periods and the figure of Technical Director was eliminated. After these changes, the structure of LIFEPAYT management was:



The new dynamic within LIFEPAYT was:



9 Project Board (PB) meetings were held in Lisbon (25.11.2016), Athens (26 & 27.06.2017), Aveiro (29.01.2018 and 06&07.06.2018), Condeixa (06&07.06.2019 and 22.11.2019), and on-line at 21.05.2020, 05.11.2020 and 07.12.2021.

The Advisory Board was composed by relevant stakeholders as foreseen in the proposal and comprises one group with Portuguese institutions (16 entities and 21 representatives) and another group with Greek and Cypriot institutions (13 entities and 14 representatives).

During the project, there were several meetings in person and Skype meetings with the Advisory Board, beneficiaries and action leaders. All these meetings have allowed a close and active follow-up by the management team (administrative project manager, project manager and project coordinator) of the activities of each partner.

The first visit from the External Monitoring Team to IPC took place on June 2017, the second visit on June 2018, the third visit on June 2019, the fourth visit on May 2020, the fifth visit on October 2020 and the last and final monitoring visit on December 2021 (see chapter 6.1, action E1), the last two with the participation of the Project Adviser.

The initially work plan defined will have to undergo some changes in the dates defined for the deliverables and milestones. The project had two postponements: in the first postponement, the final date was changed to March 31, 2021 and in the second postponement the date was changed to December 31, 2021 (See Action E.1 of Chapter 6.1).

IPC legal representative was replaced, but all the contacts are the same. Despite the delays that have occurred in the project implementation (as described in the section 6.2*)*, all actions were completed.

3. Technical part

3.1 Technical progress, per Action

The description of the project's actions is presented below.

B.1. PAYT at household level – three case studies in three Southern countries			
Start date (proposal):	01/10/2016	**Actual start date:**	01/10/2016
End date (proposal):	30/09/2019	**Actual end date:**	30/11/2021

In **AVEIRO**, the acquisition of 26 containers (660 L) with controlled access was approved by the mayor (04.2017) and the required budget was approved at the municipal assembly meeting (07.06.2017). The supplier was selected, and the contract was signed (05.05.2017). 26 containers (660 litres) with controlled access were installed and access cards were given to citizens (05.2018). Shortly after, the containers were returned to the supplier because the rotating drum frequently jammed (major drawback). The supplier redesigned the lids, changed the rotating drum, and a prototype of a new lid was made. This prototype was field tested (09.2019) at the demonstration site and small problems were identified and corrected in the next months. Field implementation restarted (08.2020) with the installation of 25 PAYT containers (26 were planned, but 1 was lost by the previous equipment supplier) and removal of regular waste containers (15.09.2020). Field implementation stopped after 2 months (16.11.2020).

In **LARNAKA** a call was launched for 70 waste bins with an access control system, for a weighing scale on a waste collection vehicle and for home composting kits (14.12.2018). One offer was received covering all the technical specifications, but with an unexpectedly high cost. A market consultation was conducted, and the products found had a higher cost than originally foreseen in the proposal. The tender was reissued (04.06.2019) for 30 waste bins with an access control system but no offers were received. After several unfruitful attempts (details in end-of action Report B1) an alternative technical solution was decided

(29.01.2020), based on door-to-door collection with bins and bags bearing tags with the ID of the household and wrist-held readers for the collection team. The call was launched (26.02.2020). 440 bins were purchased (15.04.2020); 64,000 bags (for 10-month field implementation) were purchased (offer approved 27.03.2020); 67,200 bag stickers were ordered and acquired; 2 portable hand-held scanners and 2 tablets were under offering procedure until 20.05.2020. By 06.2020 all necessary equipment had been purchased (bins, bags, bag stickers and the portable hand-held scanners). In June/July 2020 the bags and bins were delivered to the residents of the pilot area. The stickers and barcodes for each household (168 barcodes x 400 houses) were prepared and delivered (Sept/Oct 2020), technical staff training took place (10.2020), testing took place (01.11.2020-31.01.2021) and the field implementation was from 02.2021 to 09.2021.

In **VRILISSIA,** the technical specifications and relative paperwork for tender were prepared (07.2017). The technical solution was changed to a PAYT weight-based system (following indications of the scientific and Greek market research and the existing local waste management plan). Specifications were readjusted and tender was launched (12.2018). 1 offer was received (03.2019). Construction started and 10 bins were field tested (12.2019). Problems were fixed. 23 waste bins had been constructed by 05.2020. 15 waste bins were field installed (1st operational phase, June/July 2020). By 07.2020, 30 waste bins (in total) were installed at the demonstration site (2nd operational phase). 10 waste bins were located at the end of 01.2021 and the last 8 at the beginning of 06.2021. Several problems were identified during the field implementation (batteries, distortion of lid, locks, vandalism, hardware) and each time an issue was raised, containers were taken out from the field for repair or repaired on site. Field implementation was until (23.11.2021).

The technical details of this action are given in the End-of-action report B1 (Annex 1). Milestones and deliverables are shown in the following table.

Milestones and Deliverable	Proposal Deadlines	Real deadlines
(M) Tender calls are launched on the modification of containers	09/2016	**AVEIRO**: 11/2017; **LARNAKA**: 14.12.2018 (1st); 04.06.2019 (2nd); **VRILISSIA**: 12.2018
(D) Collective waste containers (65 in AVEIRO; 70 in LARNKA and VRILISSIA) are enclosed with the access control system, comprising rotating chambers and accessories	01/2021	**AVEIRO** (i)**:** 05.2018 (1st container model); 08.2020 (2nd container model) **LARNAKA** (ii): 15.04.2020 **VRILISSIA**(iii): 06.2021
(M) Modified collective containers are in place and citizens have access cards to the containers	01/2021	**AVEIRO:** 05/2018 (1st container model); 09/2020 (2nd container model); **LARNAKA**(iv): 02.2021; **VRILISSIA**(v): 07.2020

NOTES: (i) number of containers was changed to 26 in AVEIRO; (ii) this deliverable refers to waste bins for door-to-door collection due to changes in the technical solution; (iii) number of containers was changed to 43 in VRILISSIA; (iv) this milestone refers to the start of door-to-door collection due to changes in the technical solution (v) vehicles have not been retrofitted due to changes in the technical solution, so are not included in the milestone.

B.2 Implementing PAYT tariff scheme for commercial waste producers in Condeixa and Lisbon

Start date (proposal):	01/10/2016	**Actual start date:**	01/10/2016
End date (proposal):	30/09/2019	**Actual end date:**	31/12/2021

CONDEIXA: The number and volume of waste containers that best suit the non-domestic producers were defined using a survey (04.2017). A pilot test was carried out (06.2017) to help defining the technical specifications for the tender, during which 1 waste collection vehicle was retrofitted with an RFID reader, antenna & console, 200 RFID tags were installed in 200 waste bins from commercial establishments and a management software was installed. The pilot test highlighted that waste collection vehicle was very old and prone to mechanical problems and so the municipality decided to wait for new waste collection vehicles in the process of being acquired before launching the tender to retrofit the collection vehicles. The acquisition of a new hardware and software solution was a very lengthy process; the tender call is launched (09.2019). 880 RFID tags were put on waste bins (11.2020), a data base of waste containers and owners was created, software and

hardware were installed, 2 collection vehicles were retrofitted (01.2021). The field implementation (02.2021-12.2021) involved all non-domestic waste producers (commerce and services) and in the first part the parametrization took place, with anomalies being detected almost on a daily basis and constant requests for corrections being sent to the supplier. From 03.2021 onwards additional monitoring was carried out on a selected sample of 50 waste non-domestic producers to validate collection parameters, ensure that the collection was being properly registered and to gain confidence that the software and hardware were fully operational. Non-domestic waste producers being monitored were contacted (10.2021-12.2021) and made aware of the advantages of joining the new PAYT tariff through the delivery of leaflets and technical visits. The integration of field collected data and the billing system of the municipality started (12.2021). CONDEIXA will continue with the implementation of the PAYT system after the end of LIFEPAYT. Other activities in the scope of the B2 action were the amendment of the municipal regulation of the urban waste management service to set the rules for the new PAYT system and the new PAYT waste tariff.

LISBON: a tender was launched for the purchase of 420 waste containers, a supply contract was signed (03.2017) and the containers were delivered and were installed (05.2018). An international tender was launched for the acquisition of RFID tags, KIT to upgrade waste collection vehicle and route software and the supplier was selected (12/2016). One of the applicants complained about the decision and it was sent to court. A resolution in the timeframe of the project was not envisaged so an alternative (based on the serial number of the container instead of RFID tags to identify the owner and type of waste in each container collected) was proposed to EASME (06.2018) and approved (report of the 2nd Monitoring Visit). New large waste producers were continuously identified, and new contracts were being established (contracts along time were: 81 in 2016, 89 in 2017, 104 in 2018, 145 in 2019, 134 in 2020). A sample of 15 entities was selected as a control group for close monitoring (based on their activity field). Monitoring took place (10 visits per month to different large waste producers), with the aim of verifying at each site the correct use of containers, the separation of waste and the potential contamination of recyclable fluxes with non-target materials. COVID-19 caused the suspension on the monitoring that was

underway and many of the large waste entities were closed and/or operating on a very small scale (2020-2021). After the end of LIFEPAYT, Lisbon Municipality will continue to follow and monitor the waste producers with contract, but given a change in Portuguese legislation it will not pursue the establishment of new contracts with large waste producers, in the same way.

More details can be found in the **B2 End-of-Action Report** (annex 2). Milestones and deliverables for this action are shown in the next table.

Milestones and Deliverable	Deadlines of the proposal	Real deadlines
(M) Tender calls are launched for equipment and external assistance (takes place before project starts, shortly after evaluation results are known)	10/2016	**CONDEIXA**: 09/2019 **LISBON**: 03/2017 (waste bins); 12/2016 (vehicle upgrade and tags)
(D) 880 bins (240L) waste containers with RFID tags in C1 and 420 waste containers (1100-L) in L1*	12/2016	**CONDEIXA**: 11/2020 **LISBON**: 04/2018
(M) Waste containers carrying RFID chips are in place and waste collection vehicles are retrofitted	03/2021	**CONDEIXA**: 01/2021 **LISBON**: NA**
(M) 50 new PAYT-based waste contracts are established in LISBON	12/2019	**LISBON**: 12/2019

* In the proposal text it is mentioned 420 waste containers but in the budget is 210, so 210 units were considered in this action (other 210 units are considered in action B4); ** In LISBON this milestone is not applicable (NA) because the underlying technical solution has changed.

B.3 PAYT collaborative platform – information right at your fingertip

Start date (proposal):	01/03/2017	**Actual start date:**	10/01/2017
End date (proposal):	01/07/2019	**Actual end date:**	31/12/2021

This task started earlier than planned (need to fasten the initial architecture definition and key concepts together with the procurement process taking place at the municipalities). The development focused in the base components of the PAYT Portal, the PAYT Data Open Data Interfaces and the user manuals, in alignment with subtasks B3.1-5. The task included

5 subtasks which together provide the PAYT Platform. The software is available as Open Source Software at https://github.com/life-payt for reuse by external parties.

Task B3.1 was devoted to the Data Aggregation System, which consists on the creation of a data broker, enabling data reported by waste bins, waste trucks and other personnel, to be collected, classified, and distributed. The task was completed using the STOMP, MQTT and AMQP standards through a RabbitMQ software system, and the overall architecture was presented at an international conference (see action D3).

Task B3.2 considered the design of a collection of components, which can process information and store it in a big data aware storage system, enabling extensive data mining by data scientists. A survey of the existing legal framework regarding storage and processing of personal information applicable to LIFE PAYT project was carried out. This is of particular importance since the platform must abide not only to Portuguese laws, or Greek laws, but also to the European laws in order to maximize the reusability of the software developed. The storage considers both small producers and large producers, identification cards, containers, operators, locations, and other relevant characteristics identified by the remaining partners.

In Task B3.3 a custom web portal was developed enabling scientists and other stakeholders to have insight over the status of the demonstration sites. The resulting software platform was made available at https://portal.life-payt.eu, through a common portal for all municipalities. After the user is identified, a tailored interface is available, which takes in consideration the user profile. The Portal provides 3 distinct views: platform administrators, municipality staff, and end citizens. The view destined to administrators allows management of tenants and authentication data, without access to the user data and targets the system administration team (UAVR). The municipality view allows access to the citizen management of each municipality, issuing of new passwords, upload of consumption and tariff data, and visualization of key statistics. It was fully used by AVEIRO. Other municipalities had internal tools that provided this functionality, or the pilot did not require the use of an integrated operations portal.

Task B3.4 focused on the Citizen Portal feature of the web portal, providing information for each citizen regarding their waste production, location of bins, simulated tariff, and real tariff. Furthermore, citizens can be either large or small producers, with internal logic and interfaces specifically tailored to each use case. Small producers place their wastes in bins, or there is a collection process, while large producers have dedicated bins for each waste type. The Citizen Portal was advertised directly to the citizens involved in the AVEIRO Pilot, through leaflets and a card with predefined credentials. We expected a total of 1000 citizens accessing the platform if the 5 municipalities were integrated. The values obtained only for AVEIRO are optimistic as they indicate that approximately 62% of the Aveiro citizens showed interest in checking their data. Because the development of the pilots with the remaining municipalities was delayed, and the interface of the PAYT Portal was not advertised as the official interface for those municipalities. The total number obtained is below the target performance indicator in global terms, while being way above the expectations for a single pilot.

Task B3.5 considers the Interfaces for the systems and processes that already exist at the premises of the several municipalities. These sub-systems provide information in the most appropriate format for operation technicians, ranging from reports or emails to direct communication between information systems, through the well-known API's. The integration status is the following: AVEIRO: Full integration with municipality solution vendor. Portal exposed to citizens and used by municipality staff; CONDEIXA: Integration with the municipality waste management solution, frontend interfaces developed, but not exposed to citizens; Lisbon: Data model integrated in the Portal and processed, frontend interfaces developed, but not exposed to citizens; LARNAKA and VRILISSIA: Data integration processes developed to receive data and create open datasets.

The details about the sub-actions of action B3 are described in detail in the End-of-action Report B3 (Annex 3). Milestones and deliverables are shown in the next table.

Milestones and Deliverable	Deadlines of the proposal	Real deadlines
(D) Citizens portal and PAYT platform manual	12/2017	Concluded on 12/2017
(M) PAYT operations portal is available	01/2018	Online on 1/2018
(M) Citizens portal is online	02/2018	Online on 1/2018

B.4 Reduction measures a la carte

Start date (proposal):	01/10/2016	**Actual start date:**	01/10/2016
End date (proposal):	30/09/2018	**Actual end date:**	31/12/2021

B4.1. Enhancing Recycling Services Collection for Commercial Waste Producers

In **CONDEIXA** 60 new drop-off points for recyclables were installed (05.2018) (of these, 7 funded by LIFEPAYT). Door-to-door collection of recyclables for the non-domestic sector started (**08.2018**) in the center of the town for paper/ cardboard, plastic metal and glass and outside town center (**05.2021**) for paper/cardboard. In **AVEIRO**, 5 drop-off points for recyclables (cardboard, plastic and glass packaging waste) were installed (**04.2018**) and door-to-door collection of recyclables in commerce and services started. In **LISBON** 210 containers for recyclable waste were acquired (**03.2017-04.2018**) and distributed to non-domestic users.

B4.2. Promoting Home Composting

In **AVEIRO**, 3 home composting training courses took place (**06.2018**, **09.2020** and **26.06.2021**) during which 22 home composting kits were distributed. 3 follow-up visits took place to residents who joined home composting. In **VRILISSIA**: An on-site survey conducted by the Municipality highlighted its higher population density and no detached houses were identified. Therefore, home composting was converted into “building” composting, a concept in which one apartment building has a composter in the common areas at the ground floor and caddies are distributed to apartment owners to store biowaste in the kitchen before taking it to the composter. 20 high-capacity composters (500L) were

distributed to the citizens and 10 composters were placed at public parks for LIFE-PAYT project implementation. 400 pairs of caddies were distributed to the citizens (400 caddies with solid sidewalls + 400 with perforated sidewalls, total 800 caddies) **(06.2020)**. Additional 150 caddies and 26 composting bins were substituted due to having been destroyed or broken during the usage. A rewarding initiative was formulated for citizens participating in PAYT project and a Decision of the Municipal Board of Vrilissia Municipality (ΑΔΑ: ΩΗΓ0Ω9Ρ-ΒΣ2) providing a 10% discount in municipal taxes for residents was released. Citizens were informed about home composting (**07.2020-10.2020**). In **LARNAKA,** two versions of home composting kits were described, and the technical specifications were delivered for the tendering procedures. The 1st option (home composting bin for use in small yards, balconies, or interior along with a caddy for the biowaste collection) was replaced by a 2nd option (municipal composting+one caddy per household), following the results of a questionnaire applied to the residents to assess willingness to participate and availability for attending home composting training. 40 composting bins of 280L+438 caddies were purchased (**03.2021**), 16 composters were placed in public green parks, 3 in schools (**05.2021**) and 3 in apartment buildings. A **trainer** was hired to monitor municipal composting twice a week and the families and schools participating in composting were trained (**05.2021-06.2021**) by Health inspector. The remaining bins will be delivered to schools after the end of the project. Details of this action are given in the End-action report for Action B4 (Annex 4). Milestones and deliverables for this action are shown in the next tables.

Milestones and Deliverables	**Proposal deadlines**	**Real deadlines**
(D) 7 Depot containers for recyclables (C1) and 210 units of 1000L-waste containers for recyclables (L1)	02/2017	**CONDEIXA**: 05/2018 **LISBON**: 03/2017
(D) 400 home composting kits, comprising one composter + 1 caddy (100 units in A1; 150 units in V1; 150 units in LA1)	04/2017	**AVEIRO**: 06/2018 **VRILISSIA**: 06/2020 **LARNAKA**: 15.03.2021
(M) Home composting bins are distributed and in use and recycling drop-offs are installed	06/2017	**AVEIRO**: 06/2021; **LARNAKA**: 05.2021; **VRILISSIA**: 06/2020 (1st set; 12/2021, 2nd set); **CONDEIXA**: 05/2018

B.5 Design of a fair and equitable waste tariff			
Start date (proposal):	01/03/2017	**Actual start date:**	01/03/2017
End date (proposal):	01/03/2018	**Actual end date:**	31/12/2021

5.1. Estimate and Forecasting Waste Generation: The activity was developed for AVEIRO and 3 scenarios were elaborated regarding the production of waste: high, medium and low.

5.2. Required Technical Options Investment Costs: a description of the technical options chosen for AVEIRO and inherent investment costs was made, as well as visits to the site of implementation and observation of the equipment in interaction with the surrounding area.

5.3. Administrative and Technical Feasibility: The feasibility analysis for AVEIRO was developed taking into account the results obtained in the campaign of characterization of waste carried out and with the inherent costs of waste management.

5.4. Economic Sustainability, Financial Analysis and Revenue Stability: In this activity, the economic sustainability of waste management for AVEIRO was examined considering the present revenues and expenses as well as future ones with the implementation of the project.

5.5. Calculation Methodology, Ratings and proposed tariff.

Using the knowledge gained in the previous steps, a PAYT waste tariff model was developed in a spreadsheet **(03.2017 – 11.2018):** the model comprises a fixed and a variable component and distinguishes between domestic (households) and non-domestic waste producers (commercial establishments, companies or working places. The spreadsheet was sent to 2 municipalities for testing, AVEIRO (LIFEPAYT beneficiary) and S.J. MADEIRA (not a LIFEPAYT beneficiary, but was in the process of design its own PAYT tariff, and therefore a good opportunity to test the tool). Using feed-back comments from these municipalities, the spreadsheet was improved technically and in design, translations (PT,

EN, GR) were done, and the user's manuals (in the 3 languages) were prepared (**12.2018-06.2021**). The model was upgraded **(06.2021-12-2021)** to include the separate collection of biowaste (new legal framework issued in 12.2020 in Portugal by DL 102-D/2020) and it was decided to remove Portuguese specificities in order to make the tool easier to use. The model was sent again for testing to some of the beneficiary municipalities (AVEIRO, CONDEIXA and LARNAKA) and feed-back was received and incorporated in the model.

An on-line app started to be developed as an interface to the PAYT tariff model and a script of a web tutorial was prepared **(11.2021-12.2021**) (additional output). The web tutorial will be recorded (after the end of the project) and included in the on-line APP, as help to users of the tool.

Detailed information on action B5 can be found at Annex 5. Milestones and deliverables for this action are shown in the next table.

Deliverable and Milestone	**Deadlines in the proposal**	**Real deadlines**
(M) Waste Collection Forecast for each municipality and overall costs for the PAYT system are estimated [only for AVEIRO]	30-07-2017	10/2018
(M) Final version of PAYT tariff model is released after Consensus Building with different stakeholders (e.g. Public and Decision Makers at Municipal Level)	31-07-2017	12/2021
(D) PAYT Waste Tariff Model for Municipalities (Worksheet to Design PAYT Rate Structure) - software and user's manual (in EN, PT and GR)	31-10-2017	**06/2019:** First version **10/2021:** Last version

B.6 Information and training for citizens and authorities			
Start date (proposal):	01/11/2016	**Actual start date:**	01/11/2016
End date (proposal):	01/05/2019	**Actual End date:**	31/12/2021

B6.1. Training for Technical Staff and Elected Officials.

CONDEIXA: field visit to Recklinghusen and Ahlen (Germany) where a PAYT system is in place (2 participants, 04.2017); training on the software platform (6 participants, 14.05.2020); 1st and 2nd courses for drivers and waste operators (8 participants, 14.07.2020; 11.05.2021, 8 participants).

AVEIRO: field visit to "MaiaAmbiente", a public waste company developing a PAYT initiative (6 participants, **13.06.2017**); field visit to LIPOR (3 participants, **08.08.2018**) to discuss waste containers with controlled access; training session (**24.04.2018**) for the municipality staff and SUMA's staff (private company providing waste collection to the municipality) involved in waste collection; training course for local elected representatives of the Parish "UF Glória e Vera Cruz" (6 participants, **19.07.2018**) to explain LIFEPAYT and clarify doubts posed by citizens to the Parish.

LARNAKA: training for technical staff (03.06.2017, 10 participants); training for elected officials (Town Hall, 15 participants, 08.06.2017); training of collection teams (drivers+waste opperators) (6 participants, **5.10.2020** and **7.10.2020**).

VRILISSIA: session for technical staff (30 participants, **7.06.2017**, Municipal Cleansing Services); training for elected officials (15 participants, **7.06.2017**, Town Hall). **Portuguese beneficiaries:** technical visit to VitrusAmbiente Guimarães (16 participants, **15.11.2017**), to see a PAYT pilot; online training course "Waste Management and PAYT Tariff Systems" for elected officials and decision-makers (**24.06.2021**).

B6.2 - B6.3 Participative Process & Communication Campaign dedicated to Waste Management and PAYT:

AVEIRO: 1st participative process during a local event (action D4) targeting consensus building (Municipal Assembly Building, 25 participants, **8.06.2017**); large stickers with text "This container is going to change" were glued to existing street waste containers and a circular letter explaining the implementation of LIFEPAYT was sent to residents (**23.04.2018**); an "Eco Kiosk" distributed access cards to the waste containers, clarified doubts and got feed-back (**02-16.05.2018**, 50% of residents); a letter was sent by the mayor (**08.2020**, 694 addresses) detailing the reinstallation of improved PAYT containers and the next steps; "Eco Kiosk" was installed again (**31.08.2020-05.09.2020** and **12.09.2020,** 187 people) to distribute access cards and flyers, explain the project, clarify doubts and demonstrate the use of PAYT bins; final meeting with stakeholders (closing the participative process) in the street, talking to residents, asking for feed-back, clarifying doubts, explaining how the bins work and raising awareness for the environmental issues underlying the project (29 people, half an hour talk with each resident, **8-15.10.2020**). Awareness stickers were glued on the waste bags wrongly left on the ground and posters were set up in local shops about proper waste disposal practices (**10.2020**).

VRILISSIA: evaluation of the existing waste management scheme (Antonis Tritsis Park, approx. 80 participants, 09.04.2017); information on LIFEPAYT (Rematia Park, **21.05.2017**, approx. 120 participants), including door-to-door invitations; information corner at the annual open flee market (**25.05.2017**, approx. 300 participants) where residents were informed about LIFEPAYT and could comment on it; leaflet and questionnaire distribution (Followgreen recycling awards for schools, **12.5.2019**); information corner at event (**19.5.2019**, Rematia Park); information corner of LIFEPAYT (premises of the municipal Cleaning Service)+hot line. From **04.05.2020**, after a 42-day lockdown due to COVID: municipal notification distributed door-to-door (**28.05.2020**) about the start of implementation and next steps; owners of households and apartment building managers were informed as waste bins were gradually installed, via phone calls,

and for those who accepted (this was during COVID-19 restrictions) a household visit to explain how to use the waste bins (**15.05.2020-08.10.2020**).

LARNAKA: meeting with residents (Town Hall, **31.10.2018**) for the evaluation of the existing waste management scheme and informing about LIFEPAYT; visits to the local Primary School in order to inform students about the project (**14** and **15.2.2019**); information about the project focusing on raising environmental awareness on alternative waste management options (Environment Festival, Larnaka, **7.4.2019**); door-to-door information to residents on the project (**17.5.2019**); phone calls to residents to inform about changes in waste collection and door-to-door distribution of bags/bins to the residents (**06.2020-07.2020**); Cypriot authorities took new safety measures and restrictions on movement and gatherings gradually increased, hindering the communication process (**26.08.2020-01.2021**); door-to-door leaflet distribution to residents (together with the distribution of bags/stickers/barcodes) and collection of citizens' opinions and doubts about the project (**26 to 30.10.2020**), closing the participative process.

LISBON and **CONDEIXA**: the participative project/communication campaigns are closely related to the waste reduction courses, reported in document "Training Courses on Waste Reduction. Course materials and participant list" (Annex 6a).

B6.4 Home Composting Training:

AVEIRO: 3 home composting training courses (**09.06.2018**, **26.09.2020**, **26.06.2021**, 25 participants, fig. 8).

VRILISSIA: composting information day (Rematia Park, **20.05.2018**); Workshop on Home Composting (Rematia Park, **8.12.2018**); on-site Home Composting Training (**07.2020-10.2020**).

LARNAKA: personalized home composting training to schools and residents (**05.2021-06.2021**).

B6.5 Master Composters: Due to the pandemic, it was not possible to implement this idea of having a master composter in the demonstration sites.

A detailed description can be found at the End-of-action report B6 (Annex 6b) and on the document "Training Courses on Waste Reduction" (Annex 6a). Milestones and deliverables:

Milestones and Deliverable	Proposal	Real deadlines
(D) Communication Campaign dedicated to Waste Management and PAYT	03.2017	31.03.2017
(M) Training Courses for home composting are delivered to the target audience and participants	05.2021	**AVEIRO**: 09.06.2018, 26.09.2020, 26.06.2021; **VRILISSIA**: 20.05.2018, 08.12.2018, 07.2020-10.2020; **LARNAKA**: 05.2021-06.2021
(M) Participative Process (Consensus Building): Meeting with Public / Decision Makers at Municipalities takes place	06.2021	**AVEIRO**: 08.06.2017; 2.05.2018-16.05.2018; 31.08.2020-05.09.2020; 12.09.2020; 8.10.2020-15.10.2020; **VRILISSIA**: 21.05.2017, 25.05.2017, 12.05.2019, 19.05.2019, 28.05.2020, 15.05.2020-08.10.2020; **LARNAKA**: 31.10.2018, 14-15.02.2019, 07.04.2019, 06-07.2020; 26-30.10.2020; **LISBON** 01.2019-12.2020; **CONDEIXA**: 03.2021- 12.2021
(M) Waste Reduction Campaigns are launched	06.2021	**AVEIRO**: 09.06.2018; **VRILISSIA**: 28.05.2020; **LARNAKA**: 20.06.2020; **LISBON**:17.04.2019; **CONDEIXA** 03.2021
(D) Training Courses on Waste Reduction (course materials and participant list)	06.2021	31.12.2021
(M) Closing the Participative Process - Final Meeting with Stakeholders- Consensus is achieved	08.2021	**AVEIRO**: 8.10.2020 -15.10.2020; **VRILISSIA**: 08.10.2020; **LARNAKA**: 30.10.2020; **LISBON**: 01.2019-12.2020; **CONDEIXA**: 31.12.2021

B.7 Rolling out the project results from the five demonstration sites to National and European levels			
Start date (proposal):	Oct 2018	**Actual start date:**	Jan 2018
End date (proposal):	June 2019	**Actual end date:**	Dec 2021

B7.1 Economic Study for the up scaling of the PAYT System to the whole territory of the Municipalities of Aveiro, Larnaca & Vrilissia:

Data collected during the implementation stage was used to develop economic studies for the upscaling of the PAYT system to the whole territory of **Aveiro, Larnaka** & **Vrilissia** (Annexes 7a-c). The studies are valuable assets and of utmost important to prove PAYT positive feedback on local economy and provide evidence to the involved Municipalities of the benefits of PAYT implementation. They will be used for the Municipality action plan and future strategies on waste management.

B7.2 Recommendations & development of technical specifications for PAYT implementation and related legislation in Portugal: In order to roll-out the knowledge acquired in the LIFEPAYT project and ensure that is widely used and translated into new policies & regulations and is integrated into existing or new technical specifications several meetings took place at national and local levels and 2 documents were written: "*Recommendations on the implementation of the PAYT System and related legislation in Portugal*" (Annex 7d and 7e) and "*Recommendations for the development and implementation of PAYT schemes in Greece*" (bilingual GR/EN) (Annex 7f).

B7.3 Guide on PAYT implementation for local authorities. A *Guide on PAYT implementation for local authorities* was prepared in English and in Greek (annex 7g, 7h). A *"Short Guide to PAYT implementation in Portuguese municipalities"* was prepared in Portuguese (annex 7i), maximizing the rolling out of the Project amongst the Portuguese municipalities, through a more appealing design, language simplicity and conciseness. The on-line app "LIFEPAYT TOOLBOX" (additional project output) started to be developed and will be completed in 2022 (After the end of the project). This app compiles the most relevant tools developed within LIFEPAYT and will be a powerful tool for rolling out the

project results (see annex 7j for more details). The list of milestones and deliverables is presented next.

Milestones and Deliverable	Deadlines in the proposal	Real deadlines
(M) Meetings with relevant entities take place to discuss legislations and technical specifications for PAYT	03/2021	12/2021
(D) Guide on Municipal Implementation of PAYT under the socioeconomic context of Southern Europe (>40 pages) and Studies to measure the impact on the economy of the up scaling the PAYT system	09/2021	10/2021
(D) Recommendations for development of technical specifications for PAYT implementation and related legislation in Portugal	09/2021	10/2021

C.1 Environmental impacts evaluation

Start date (proposal):	01/10/2016	**Actual start date:**	07/11/2016
End date (proposal):	30/09/2019	**Actual end date:**	31/12/2021

C1.1 Definition of a relevant set of indicators: A set of 11 environmental indicators to measure and evaluate the project outcomes was defined (**02.2017**).

C1.2 Establish the baseline: Waste characterisation campaigns took place in AVEIRO (06.2017 and 11.2020), CONDEIXA (03.2017 and 12.2021), LARNAKA (05.2019 and 11.2021), LISBON (09.2018 and 03.2020) and VRILISSA (11.2020 and 12.2021). A life cycle analysis (LCA) was performed (annex 8a) and the initial values for the environmental indicators were calculated (01.2021).

C1.3 Periodically monitoring of the project's environmental impact: Data was collected from each demonstration site to monitor the project environmental impact: AVEIRO (09.2020–11.2020) and VRILISSIA (09.2019–11.2021) registered the number of times

each user card was employed for accessing PAYT bins, LARNAKA registered the number of bags collected per each household (01.2021–09.2021), CONDEIXA registered the number of times each waste bin was collected (05.2021–12.2021) and LISBON monitored the collection capacity contracted by each Large Waste Producer (01.2017–10.2020).

C1.4 Overall environmental comparison before and after the project's implementation: Fulfilling the environmental indicators previously defined and performing of a Life Cycle Assessment at the end of the project, to analyse in environmental terms the effects of PAYT implementation (12.2021). The results of indicators showed that mixed MSW generation decreased a 30% in AVEIRO and LARNAKA, while source separation increased 94% in AVEIRO and 33% in LARNAKA. In LISBON, mixed MSW did not decrease, and source separation had only a slight increase by 6%. In CONDEIXA and VRILISSIA no reliable results were obtained. The LCA results were presented showing an assessment focused on carbon footprint and depletion of fossil resources related to the waste management at the demonstrations sites, showing reductions in the carbon footprint of 13% in AVEIRO, 66% in Larnaka and 11% in LISBON.

A detailed description can be found at the End-of-Action Report C1 (Annex 8b) and on the document "Report on Life Cycle Assessment" (Annex 8a).

The list of milestones and deliverables is presented next.

Deliverable and Milestone	Proposal Deadline	REAL DEADLINE
(M) Environmental Baseline is set	01/2021	01/2021
(D) Updated LIFE Project Specific Indicators Call excel table (to be included in the Progress Report)	08/2017	08/2017
(D) Updated LIFE Project Specific Indicators Call excel table	10/2018	02/2018
(D) Life Cycle assessment on PAYT application to the study sites	10/2021	12/2021
(D) Updated LIFE Project Specific Indicators Call excel table (to be included in the Final Report)	11/2021	12/2021 (to be submitted with Final Report)

C.2 Socio-economic impact assessment			
Start date (proposal):	01/10/2016	**Actual start date:**	01/04/2017
End date (proposal):	30/09/2019	**Actual end date:**	31/12/2021

C2.1 Definition of a relevant set of indicators: 12 indicators were defined to measure, evaluate and communicate the socio-economic consequences of the LIFE PAYT project (03.2018).

C2.2 Establish the baseline: Initial and final values of the indicators were calculated (baseline) at each project location using (i) statistic available data (ii) surveys to the population and establishments – done in AVEIRO (04.2018 and 06.2021), CONDEIXA (01.2020, only initial), LARNAKA (05.2019 and 09.2021), LISBON (04.2020 and 04.2021) and VRILISSIA (06.2020 and 12.2021). 337 answers were obtained for the initial survey and 124 for the final survey.

C2.3 Periodically monitoring of the project's socioeconomic impacts impact: This sub-action was intended for reporting the evolution of costs and revenues for each participant municipality, a task which was feasible for the Portuguese municipalities and for Larnaka, but not for Vrilissia due to the complexity of the tariff scheme. The task was completed for the beginning and end of the implementation phase (12.2021).

C2.4 Overall socioeconomic comparison before and after the project's implementation: Based on the surveys and economic questionnaires made in the beginning and in the end of the project, a comparison between the two moments was performed (12.2021). The results could be obtained for all indicators in AVEIRO, LARNAKA and LISBON. They show that the PAYT system was well received despite the problems experienced, and the economic effect for the municipality is positive – unless for Lisbon where MSW generation did not decrease. A detailed description can be found at the End-of-action report C2 (Annex 9b) and on the document "Report on the project's socio-economic impact" (Annex 9a).
The list of milestones and deliverables is presented next.

Deliverable and Milestone	Deadline	Status
(M) Socio-economic Baseline is set	01/2020	06/2021
(D) Report on the project's socio-economic impact over its lifetime (to be included in the final report)	11/2021	12/2021

C.3 Costs and benefits – long term sustainability assessment

Start date (proposal):	01/10/2016	**Actual start date:**	01/02/2017
End date (proposal):	30/09/2019	**Foreseen end date:**	31/12/2021

A model was developed based of Full Cost Accounting methodology (FCA), for reproducing the costs and benefits derived from the adoption of a PAYT policy for the case of similar municipalities to those which participated in the project.

Four theoretical models were developed for AVEIRO, CONDEIXA, LARNAKA and VRILISSIA. (LISBON demonstration site addresses waste collection from large waste producers and due to legislative changes, this is no longer under the responsibility/scope of the municipalities, so it made no sense to build a theoretical model for LISBON).

The main assumption to build the models were the upscaling of the same PAYT scheme which was tested as a pilot experience to the entire municipality. The models considered the investments required for equipment and its amortisation periods, the expected evolution of operational costs and revenues from the tariff – according to the trends in waste generation based on what was observed in the pilot experiences – and external aspects which will influence the financial performance of waste management in the near future, such as the modifications to be introduced in the value of environmental taxes for waste management and the generalisation of separate collection of biowaste to be implemented in the next years.

The results were structured in three scenarios:

(i) Business-as-Usual (BaU), corresponding to a situation where neither PAYT nor separate collection of biowaste are adopted, so that waste management continues to work in the next years with the same previous configuration,

(ii) Only PAYT scenario, where a variable charging scheme is introduced but without separate collection and

(iii) PAYT + Biowaste scenario, where the separate collection of biowaste is introduced along with PAYT.

The results show that BaU scenario will not be financially sustainable in the long term due to the increased costs induced by the growth of waste generation, especially in those cases where an incremental value of the landfill taxes to be applied gradually makes the expenses unaffordable, unless high values of waste tariff are applied. Therefore, the conclusion for the municipalities is that the investment of adopting PAYT combined with biowaste separate collection appears to be the best option for keeping the financial sustainability of the waste management system in the future, as well as lessening its environmental footprint. The amortisation of the necessary acquisition of new equipment has a considerable weight on the expenses, but this effort might be alleviated with external financial support such as the one provided by the LIFE programme.

A detailed description can be found at the End-of-Action Report C3 (Annex 10b) and on the document "Costs and benefits resulting from the implementation of PAYT schemes at demonstration sites" (Annex 10a).

The list of milestones and deliverables is presented next.

Deliverable and Milestone	Deadline	Status
(M) Preliminary Report on Costs and benefits resulting from the implementation of PAYT schemes at demonstration sites is ready and sent for discussion to the stakeholders	05/2021	11/2021
(D) Report on costs and benefits resulting from the implementation of PAYT schemes at demonstration sites	11/2021	12/2021

D.1 Development and updating of the project's interactive website

Start date (proposal):	01/10/2016	**Actual start date:**	01/09/2016
End date (proposal):	31/12/2019	**Actual end date:**	31/12/2021

An initial version of the website was ready (**24.11.2016**) supporting the Portuguese language. The website was completed with sections for foreign visitors and for Greek/Cypriot citizens, being available in English, Portuguese, and Greek (**01.2017**). The webpage was complemented by Flickr and Facebook areas. Flickr provides dissemination material and two Facebook pages (in Portuguese and in Greek) provide direct contact with the local communities. From **01.2017** the website entered it is maintenance phase, with security patches and product upgrade and the addition of new content related to the project implementation. From the beginning to end of the project (31.12.2021) there were 15950 sessions (access to the website) by 10673 users.

More details can be found in the "End-of-action report D1" (Annex 11).

Deliverable	Proposal Deadline	Actual deadline
(D) Project's website, logo and social presence	31.01.2017	31.01.2017

D.2 Launching event – Development network on PAYT at municipal level:

Start date (proposal):	01/10/2016	**Actual start date:**	01/10/2016
End date (proposal):	30/09/2019	**Actual end date:**	31/12/2021

The launching event took place (24.11. 2017, "*Salão Nobre dos Paços do Concelho*", Lisbon, 119 participants) with relevant stakeholders present: municipalities (approx. 50%), waste&recycling private companies, regional waste management systems, research institutions, central and regional administration and public institutes (APA – Portuguese Environmental Agency and ERSAR – Water and Waste Regulatory Entity).

The beneficiaries of project LIFE PAYT were also present. The Steering Committee henceforth named Advisory Board (AdB) was established (06.2017) comprising a group with Portuguese institutions and a group with Greek and Cypriot institutions. The Portuguese AdB group is composed by 16 entities and 21 representatives and the Greek-Cypriot AdB includes 13 entities and 14 representatives. The AdBs include stakeholders as foreseen in the proposal. Meetings of the **Portuguese AdB** took place (**29.01.2018**, Aveiro; **21.11.2019**, Condeixa). The last meeting (scheduled for 2020) was canceled due to the pandemic. It should be noted however, that the interaction with the AdB board extended beyond the formal meetings: AdB members were present at all events organized (Workshops, training sessions, guided visits) and invited to participate with oral presentations, which greatly contributed to the public and open discussion on the topic, thus fulfilling the role of the AdB. The **Greek and Cypriot AdB** were regularly invited to the meetings that took place in Greece and Cyprus. An online **Greek and Cypriot** AdB meeting took place (**20.12.2021**) co-organised with the Project workshop on sustainable municipal waste.

A protocol was drafted for establishing a Network on PAYT at municipal level. However, this was re-thought due to the lack of flexibility for including new members and it was decided that a more informal approach was beneficial, and the network was established by collecting all the contacts of the institutions participating at the launching event (**24.11.2016**). New contacts were added regularly to the list (currently > 400 contacts). The network is maintained through the regular launching of a newsletter. More details on this action can be found in the "End-action Report D2" (Annex 12b) and on the "Advisory board report" (Annex 12a).

The list of milestones and deliverables is presented next.

Deliverable and Milestone	Proposal deadline	Actual deadline
(M) The launching event takes place and the network is created	31-12-2016	24.11.2016
(D) Final Report of the Steering Committee	30-09-2019	31.12.2021

D.3 Development and distribution of informative and dissemination material

Start date (proposal):	01/10/2016	**Actual start date:**	01/10/2016
End date (proposal):	30/09/2019	**Actual end date:**	31/12/2021

DEVELOPMENT OF PRINTED MATERIAL

OVERALL project: **3 versions/275 copies**: *flyer* about the project (objectives, strategy and expected results) – in English (EN) (95 copies), in Portuguese (PT) (170 copies); in Greek (GR) (10 copies). **3 versions/200 copies**: *"business" cards* (contents: project identification, funding, webpage and name of beneficiaries): EN (20 copies), PT (170 copies) and GR (10 copies); **3 versions/200copies**: *Bookmarks* (contents: project identification, funding, webpage, email contact and beneficiaries): EN (20 copies), PT (170 copies) and GR (10 copies); **3 versions/4 units:** *roll-up* (bilingual EN/PT) with project identification, funding, webpage, beneficiaries (v1: portrait, 1 unit; v2: landscape big, 1 unit; v3: portrait, 2 units). **4 versions/8 units:** *information boards* (project identification, strategy and expected results) placed at the premises of all beneficiaries at strategic locations for high impact (formats: A1, A3 and 1650x550mm).

AVEIRO (in PT): **1 version/1000 copies**: *leaflet* with invitation to the local event. Sent by regular mail a few days before the event. **1 version/100 copies**: *Poster* announcing the local event, set up in local shops a few days before the event. **4 version/1780 copies**: Flyers – v1: project implementation at AVEIRO (320 copies)**;** v2: flyers on how to use the PAYT waste container (1200 copies); v3: improved version of v2 (200 copies); v4: guidance on home composting distributed to the participants of the composting workshops (60 copies). **3 version/ 256 copies**: stickers - v1: large, 26 units (glued to existing collective waste containers to inform that these will be changed); v2: small, 30 units (instruction glued near to the card reader in PAYT container); v3: small, 200 units (to be glued on unproperly disposed bags). **2 version/622 copies**: poster (A4) – v1: to incentivise participation in socio-economic on-line surveys, with link; v2: to raise awareness on bag disposal and hotline, set up in local shops.

LARNAKA (in GR): **3 version/345 copies**: flyer – v1: Information about project implementation for residents (345 copies)**;** v2: Information about project implementation for commerce (345 copies); v3: general information about the project; **1 version/ 1200 copies**: stickers (glued to the waste bins).

VRILISSIA (in GR): **2 version/517 copies**: flyer – v1: Information about project implementation (204 copies)**;** v2: Information about composting (313 copies).

CONDEIXA (in PT): **2 version**: flyer – Information about project implementation.

LISBON (in PT): **2 version/500 copies**: poster – v1: Guidance and general instructions on how to properly separate waste (250 copies); v2: Calendars to fill in the week-days for the collection of waste fractions (250 copies).

DIGITALISED INFORMATIVE MATERIAL:

8 LIFE PAYT newsletters, 3 press releases, 1 video clip (5'57'') showing LIFEPAYT implementation at demonstration sites (in Portuguese, with English subtitles); Not originally foreseen, but also prepared were: 1 video for the 1st project Workshop (2'13'') and 5 individual videos for demonstration sites (AVEIRO (9'30''), CONDEIXA (9'30''), Larnaka (1'47''), Lisbon (10'28''), Vrilissia (4'06''). The CD-ROM foreseen with the proceedings was not produced because the events were held on-line so the proceedings were made available to be downloaded from the web page.

INTERVIEWS/PRESENCE IN THE MEDIA:

2 presences on national TV (SIC channel); 1 video interview on a national newspaper ("Jornal de Notícias", on-line edition); 1 presence on national radio (station: Antena 1); 41 general public articles in local press; 29 internet articles; 1 specialized press article; **OTHER**: 30 presentations of the project; 10 articles in international peer-reviewed journals or conference proceedings; 1 specialised press article.

Details of all these materials are presented in more detail in the End-of-action report D3 (Annex 13).

The list of milestones and deliverables is presented next.

Deliverable and Milestone	Deadlines in the proposal	Real deadlines
(D) Set of leaflets, brochures, newsletters, posters and information boards, to be released at the start, mid-term and close to the end of the project	30-11-2021	30-11-2021
(D) 1 videoclip (5-10min) showing PAYT implementation at demonstration sites	30-09-2021	31-12-2021
(D) Articles in international peer-reviewed journals, posters or presentations of conference communications, internet articles, specialised press articles, and general public articles in the local press	30-11-2021	30-11-2021
(M) LIFE2015 information boards and posters are in place	31-03-2017	31-03-2017

D.4 Local events, guided tours and workshops

Start date (proposal):	01/06/2017	**Actual start date:**	01/06/2017
End date (proposal):	31/12/2019	**Foreseen end date:**	31/12/2021

D4.1 Local events: Local events took place in AVEIRO, Municipal Assembly building (08.06.2017, 25 participants) and VRILISSIA (28.06.2017) and LARNAKA (02.03.2018).

D4.2 Guided tour to the demonstration sites: Local events and virtual guided tours showing the implementation of the project at the 5 demonstration sites tours took place together, during the Final Workshop (online, 09.12.2021). **D4.3 Project workshops:** Two workshops were organized in Portugal (Condeixa-a-Nova, 21.11.2019, 106 participants; on-line, 06.05.2021, 131 participants) and two workshops were organized in Greece (18.11.2021, on-line, 38 participants; on-line, 20.12.2021, 28 participants). The final Workshop took place in Portugal (09.12.2021, on-line, 118 participants). The Proceedings

of the final conference was made in electronic version and all the presentations and recordings are available (https://www.life-payt.eu/en/article/programme_proceedings_en).

A more detailed description is presented in the End-action Report D4 (Annex 14).

The list of milestones and deliverables is presented next.

Deliverable and Milestone	proposal deadlines	Real deadlines
(D) Electronic and print edition of the Conference Proceedings*	12/2021	12/2021
(M) 5 Workshops	10/2021	12/2021
(M) 10 Guided Tours to demonstration sites and 10 local events	10/2021	12/2021

* Only electronic version was prepared, due to the event being held on-line; ** 3 local events took place in person, and the remaining local events and guided tours took place virtually

D.5 Layman's Report

Start date (proposal):	01/06/2017	**Actual start date:**	01/12/2021
End date (proposal):	31/12/2019	**Foreseen end date:**	31/12/2021

The Layman's Report for the Project LIFEPAYT was produced (12.2021). The main aim of this document is to inform the decision-makers and non-technical audience on the objectives and the results achieved within the project and to present and disseminate the projects objectives, actions and results to the general public. Two bilingual versions of the document were prepared: English/Portuguese and English/Greek. 25 copies of each version were printed and electronic versions are available from the project website.

Deliverable and Milestone	proposal Deadlines	Real deadlines
(D) Electronic and printed version of the Layman's report	11.2020	12.2021

D.6 Network with other projects

Start date (proposal):	01/01/2017	**Actual start date:**	01/01/2017
End date (proposal):	31/12/2019	**Foreseen end date:**	31/12/2021

Multiple projects of direct and indirect interest to LIFEPAYT project have been identified and communication was established by the work team, indicatively:

Athens Biowaste (LIFE10 ENV/GR/000605); **Waste2Bio** (LIFE11 ENV/GR/000949); **PAVEtheWAySTE** (LIFE14 ENV/GR/000722); **Recycling@Home** (LIFE11 ENV/GR/000950); **ISWM TINOS** (LIFE10 ENV/GR/000610); **Greek Task Force**, LIFE National contact points of Bulgaria and Hungary; **Fisikolipasma.GR**; **Followgreen.GR**; **DRYWASTE** (LIFE08 ENV/GR/000566); **WASP Tool** (LIFE10 ENV/GR/000622); **FENIX** (LIFE 08 ENV/E/000135); **Waste4think** (Horizon 2020); **PAYT project at the Municipality of Aglantzia**, Cyprus; **SMARTBIOWASTE** (City Council of Aveiro, Veolia, 2BWebConnect); **AveiroSteamCity** (ERDF, within the European Programme Urban Innovative Actions); among many others.

More details of this action are given in the End-action report D6 (Annex 16).

The milestone table is presented next.

Deliverable and Milestone	**Deadlines in the initial/reformulated proposal**	**Real deadlines**
(M) Networking established with at least 5 other projects	31.07.2017	07.05.2017

3.2 Main deviations, problems and corrective actions implemented

The main problem encountered were delays in the implementation of actions B1 and B2 due to the late acquisition of waste collection equipment required to establish the link between the producer of waste and the amount of waste discarded. This is central to the implementation of a PAYT tariff scheme. This delay in the acquisition is due to several reasons, explained next.

B1 and B2 actions

One of the main problems was the long time required for tender/direct treaty procedures, since changes took place in internal requirements and in the national regulations (Greece). Delays in the tender procedures were also related to the election periods during which acquisition procedures could not move forward (2 municipal elections in PT and 1 municipal election in GR).

Delays in tender procedures resulted also from lack of offers from companies and the need to reformulate and re-issue tenders. Finally, there was complaints by opponents resulting in a blockage of the acquisition process until a decision was reached by the court.

A deviation relevant to report was the need to adjust the technical PAYT solutions foreseen in the proposal to the specificities of each demonstration site and to the time available to implement the project given the delays in the tender procedures.

The modifications were all reported to EASME/CINEA and special care was taken to ensure that the impact of the project was not reduced.

Another problem found was the lack of turnkey solutions available in the market for closed-access containers and for ICT solutions to transmit data that can be trusted. This meant that in in some cases new containers needed to be developed and extensively field tested and improved, adding extra delays to the implementation. Finally, the COVID-19 pandemic meant all face-to-face services were suspended for some periods, supplies of equipment and material were delayed, repair time-of response increased, which meant overall delays

in most of the activities in actions B1 and B2. Services were closed for long periods of time, and sometimes they did not re-open after the pandemic periods, and this affected mostly Action B2, reducing the number of non-domestic waste producers involved.

The next table summarizes the most relevant deviations/problems found by each beneficiary during project implementation.

Problem/deviation	AVEIRO	LARNAKA	VRILISSIA	CONDEIXA	LISBON
Tender procedures		xxx	xxx	x	xxx
Municipal Elections	x		x	x	x
Trouble finding suitable technical solutions on the market	xx	xx	xx	x	
Need to develop new equipment	xxx		xxx		
Long periods of field testing required	x		xxx	xxx	
Changes required to technical solution	x	xx	x		x
COVID-19	xx	xx	xx	xxx	xx

Notes: x- some impact; xx - strong impact; xxx - high relevance impact

Detailed information is presented in **End-of-action Report B1** (annex 1) and **End-of-action Report B2** (Annex 2).

B3 action

There were several relevant situations that imposed refocus of the teams and modifications to envisioned software structure:

The General Data Protection Regulation (GDPR), combined with the integration with municipalities and the usability to citizens, resulting in the portal storing data that could have personal meaning. This implied a reasonable change in the underlying software construct so that the GDPR is respected, resulting in a multi-tenant architecture with strong data encryption, a well-established data catalog, and the development of label based data access methods.

The slow progress from the municipalities created situations where the development had to be based on model with higher flexibility, so that all relevant use cases are observed. This resulted in increased complexity for the software platform, and in particular, to the access control mechanisms and database model. Because the development of the pilots with the remaining municipalities was delayed, the total number obtained is below the target performance indicator in global terms, while being way above the expectations for a single pilot. As a corrective measure, the focus switched to integrating backends and data, and not the frontend.

Due to the competitive nature of hiring a computer science engineer, which was aggravated by the pandemic, and the project timeline, UAVR faced severe constraints in creating and operating a stable team. Moreover, the Aveiro landscape changed, and it is becoming an important engineering hub with a relevant number of companies establishing offices in the city. The average pay to a new graduate, without any other experience, is also above what the grants considered for the project. As a limited corrective measure, the UAVR team resorted to hiring developers enrolled in a master's degree, instead of being enrolled a PhD degree or at the final stage of a master's degree.

B4 action

In sub-action *B4.1. Enhancing Recycling Services Collection for Commercial Waste Producers* the results largely surpassed the expectations, with the implementation of extra (not originally planned) door-to-door collection of recyclable waste at AVEIRO and CONDEIXA and with the number of drop-off points higher than the those initial planned as a result of the interest and collaboration of ERSUC, the Regional Waste Management Company.

In sub-action *B4.2. Promoting Home Composting,* the composting scheme was converted into "building" composting in VRILISSIA and municipal composting in LARNAKA (section 6.1). It was necessary to substitute several caddies and composting bind that were

destroyed or broken during the usage in Vrilissia. The numbers of the home composting equipment have changed accordingly to: 57 home composters (500L) + 950 caddies (10L), in VRILISSIA and 40 composters (280L)+438 caddies (10L) in LARNAKA. In AVEIRO 100 home composting kits for detached and semidetached houses were planned, but this number was poorly accounted for and in this area there were only 50 detached/semi-detached house. Thus, only 50 composting kits were acquired. The delivery of the home composter kits was delayed in VRILISSIA, LARNAKA and AVEIRO due to the restrictions imposed by the COVID-19 pandemic, which prevented the training course and distribution of containers to take place on time; for LARNAKA and VRILISSIA additional delays occurred because the tenders were associated with the tenders for the equipment in Action B1, which suffered huge delays (see action B1).

B5 action

This action took longer than originally anticipated due to (i) real data from the demonstration sites not being available on-time due to delays in action B1; (ii) The waste tariff regulation was revised by the Regulating Entity in Portugal in 2018; and (iii) improvements were made to the tariff tool to accommodate the new regulations on the separate collection of biowaste issued in Portugal in December 2020. Due to delays mentioned in (i), it was decided to focus efforts on the development of the calculator tool in itself, and not on data acquisition, so the first milestone was achieved for Aveiro but was deemed unnecessary for the other municipalities, since overall cost estimation for PAYT and waste would be done later in action C3 “Cost-benefit analysis”. The objectives defined in the proposal were largely surpassed given several issues not originally foreseen, namely: (i) The tariff model developed includes the separate collection of biowaste; (ii) an app was developed as an interface for the tariff model.

B6 action

The pandemic caused by covid 19 and all the associated restrictions, such as isolation and confinement, led to the cancellation of the master composter initiative, to the postponement of some of the training, participative process, and communication campaign, and to the redesign of some initially envisioned actions related to communication and the participative process.

C1, C2 and C3 actions

There was a delay in the establishment of the environmental and socio-economic baselines which is highly related to the progress in actions B1 and B2. In those areas where the implementation of the project has advanced to the beginning of the experimental phase – namely, in Aveiro –, the activities in action C1 and C2 have moved forward also as expected. In the other municipalities facing delays with the implementation of experimental phase (Condeixa, Larnaka, Vrilissia) or a redefinition of the project (Lisbon), progress in actions C1 and C2 was postponed.

[paragraph deleted from the public version of this report, due to personal data protection]

The main difficulty faced in the development of Action C1 was obtaining useful and reliable data, due to the technical difficulties and alterations experienced by the project. In the experiences more focused on households (Aveiro, Larnaka and Vrilissia), it was difficult to assess the real impact achieved by the PAYT system, since not all the population in target areas participated on a regular basis, except for Larnaka and Aveiro where the experience was restricted to a selected group of households. Nevertheless, in those places where the assessment was possible, this found relevant reductions in mixed household waste generation – higher than 30% – and, conversely, relevant increases of source separation of recyclable materials, in line with the goals expected. In the project experiences focused on non-domestic waste producers (Condeixa and Larnaka), the

assessment was also difficult due to the high variability of behaviours found between the different establishments involved, influenced by economic dynamics governing their activities. Nonetheless, the assessment in Lisbon found a slight growth on the ratio of source separated materials for recycling, even though mixed MSW generation increased, according to the economic trends.

In **Action C2**, difficulties were found when trying to isolate genuine effects of LIFE PAYT project from other external factors. The different pricing systems in the participant municipalities make difficult a simple comparison between each other for the same indicator. Other shortcomings were found in the absence of price regulation for recyclable materials in Greece and the change of MSW collection company in Aveiro. A deeper analysis, more focused in the particular features of each location and with larger population samples, would be needed in future similar actions to overcome this difficulty.

There are no deviations to report in **action C3**.

D1, D2, D3, D4, e D6 Actions

Action D1: started earlier (**01.09.2016**) than planned because it was deemed important to get the project website ready by the date of the launching event. There was the need to postpone this action until the end date of the project, because a continued update of the website content was required to communicate the project development and news.

Action D2: the project team was not able to hold one of the meetings with the Advisory Board due to the COVID-19 pandemic The AdB follows the Project during its full duration, so this action was postponed, following the dates of the project.

Action D4: due to the restrictions imposed by the COVID 19 pandemic only the 1st local events at AVEIRO, LARNAKA and VRILISSIA and the 1st workshop were carried out in

person, face-to-face. The remaining local events, workshops and the guided tours had to be reviewed and adapted to the circumstances and were converted to on-line events. Only electronic version of the final workshop proceeding was prepared, due to the event being held on-line.

For **Actions D3, D5** and **D6** there are no deviations or modifications to report.

E1, E2 and E3 Actions

[section text deleted from the public version of this report, due to personal data protection]

Action E2 and **E3**: No deviations or modifications to report

3.3 Evaluation of Project Implementation

Generally, the overall goals set by the project in form of Key Performance Indicators (KPIs) have been met with respect to the increase in source separation of recyclable materials and prevention of greenhouse effect gases (GHG) emissions, but not regarding the decrease of mixed MSW generation.

This is due to the large size of the project in Lisbon, compared to the rest of municipalities: if all the results are added together, because the mixed MSW generation did not decrease in Lisbon, this result masks the fact that Aveiro and Larnaka actually did.

An overview of the achievements of LIFEPAYT against the objectives and expected impacts foreseen in the proposal is presented next.

Foreseen in the proposal	Actions	Achieved			Evaluation
		Yes	No	P	
Objective: Reduce residual waste from household and commerce **Expected results**:					
-Reduction of household residual waste at least in 30% and up to 40% at the target sites.	**B1** **B2** **B4** **B6** **D3**			X	Aveiro: 31% reduction Condeixa: inconclusive Larnaka: 31% reduction Lisbon: 3% increase Vrilissia: inconclusive
- Increased home composting: 10% of all detached houses take up home composting, with 200 kg per year bio-waste household diverted from Landfill.				X	Aveiro: 22 in 58 households (38%). Larnaka: 3 in 331 households (1%) + 19 public composting bins. Vrilissia: 30% of demonstration site.
- Modernized and optimized residual waste collection by introducing software and hardware tools (RFID, ID cards, monitoring collection) with an expected reduction in CO2-eq emissions through direct reduction in fossil fuel consumption (10 a 15 % of present carbon footprint at target Municipalities)				X	Aveiro: 13% CO_2 eq. reduction Condeixa: inconclusive Larnaka: 66% CO_2 eq. reduction Lisbon: 11% CO_2 eq. reduction Vrilissia: inconclusive
- Evaluation of the project's environmental, social and economic impact over its lifetime: 14 868 tons of waste reduction at the demonstration sites when project ends and 360 000 tons/year at the replicability sites 5 years after.			X		1187 tonnes increase (mostly in Lisbon)
Objective: Increase recycling rates for packaging materials **Expected results**:					
- Increased recycling rates for packaging waste (glass, paper, plastic and metal), currently between 6,3% and 21% at the demonstration sites, to between 15% and 30%.	**B4** **B6** **D3**			X	Aveiro: 25% Condeixa: inconclusive Larnaka: 20% Lisbon: 32% Vrilissia: inconclusive

Foreseen in the proposal	Actions	Achieved			Evaluation
		Yes	No	P	
Objective: Demonstrate that PAYT is feasible, changing local decision makers, tech. staff mind-set, in Southern European Municipalities, resulting in benefits and contributing to the implementation of EU environmental strategies and targets. **Expected results**:					
- Establishing a PAYT System that work as a cost-effective model to ensuring economic and environmental sustainability of municipalities in Greece, Portugal and Cyprus.	**B1 B2 B3 B5 C1 C2 C3**			X	
- Increased self-awareness through a citizen´s portal, providing economic and environmental information to both decision makers and the public.				X	
Objective: Promote the replication of the concept to wider regions with the same problems. **Expected results**:					
- Decision makers, technical staff at target Municipalities are able to risk PAYT fully into their territories, and able to replicate the gained experience in other similar Municipalities.	**B6 B7 D1 D2 D3 D4 D5 D6**	X			Several agents, mainly municipalities, but also the Regional Waste Management Entity (ERSUC) are very interested in implementing PAYT systems in their municipalities and have contacted the project team for discussion and help in the implementation of their own PAYT systems. IPC participated in a working group at the municipality of "S. João da Madeira" with the purpose of supporting an application for funding (POSEUR programme) a PAYT system in this municipality. The application was successful, and the municipality already started the implementation of PAYT. 2 municipalities even asked if they could join the project as full partners. Condeixa will for sure continue with the implementation of the PAYT system after the end of LIFEPAYT.

Foreseen in the proposal	Actions	Achieved			Evaluation
		Yes	No	P	
- Increased commitment of the research and technical communities: a web portal will provide scientists and municipalities insight over the current status at the demonstration site, and tools will be freely available (open source software) for other municipalities.		X			
- Improved articulation between waste management stakeholders at local and regional level		X			New collaborations emerged between the Regional Waste Management entity, ERSUC, and the municipalities of Aveiro and Condeixa Region, for the reinforcement of separate collection infrastructure and collection services (B4). The project team was also contacted by academia to provide information to master students doing their dissertations on PAYT tariffs, and numerous invitations to present the project were made.
- Development of a framework of guidelines and specifications for implementation PAYT targeting local authorities and a dedicated network.		X			PAYT Toolbox and network (see action B7 and D2)

A – Achieved: **Y** (YES); **N** (NO); **P** (PARTIALLY); E – Evaluation

3.4 Analysis of benefits

3.4.1 Environmental benefits

The assessment within Action C1 has made possible to verify quantitatively the environmental benefits from PAYT resulting from decreased waste generation and increased recycling. Even though reliable results are not available for all demonstration sites (in VRILISSIA and CONDEIXA the results are statistically inconclusive), in those cases where sound results are available (AVEIRO, LARNAKA and LISBON), these show a consistent diversion of mixed MSW – namely, recyclable materials – towards separate collection.

In residential neighbourhoods (AVEIRO and LARNAKA) the amounts of waste directed to separate collection were boosted, with an increase of almost 100% in Aveiro and more than 30% in Larnaka. Moreover, these two cases showed a 30% decrease in unsorted waste, which is very significant in environmental terms, since prevention is considered more beneficial than recycling in the waste management hierarchy.

In LISBON, where large waste producers were the target of the project, the effects observed were more modest: the source separation rate increased with respect to total MSW generation, but only 2%. Meanwhile, mixed MSW generation, as well as global MSW generation, did not decrease at all, but increased 8%, following the trends of economic growth – although for the group more closely monitored the results were better: mixed MSW decreased by 7%. In the other hand, the room of improvement of LISBON in source separation was smaller than in the other municipalities, since source separation rates of the non-domestic waste generation in the city were already comparably high at the beginning of the project.

Furthermore, the Life Cycle Assessment performed revealed that the environmental impact caused by the disposal of waste in landfills – and also by waste incineration in the case of

LISBON – is the most harmful effect of waste management. Hence, every fraction of municipal waste diverted from this final destination implied a positive environmental outcome. This effect is even more pronounced in the case of waste being prevented than in the case of waste being recycled, since the activity of recycling itself constitutes also a source of environmental impacts – even though in some impact categories its influence may be considered as beneficial, since it contributes to prevent the consumption of the equivalent non-recycled resources.

3.4.2 Economic benefits

Provided that every amount of unsorted waste discarded by citizens has a cost for the municipality, the MSW quantities diverted to separate collection or prevented can be counted as avoided expenses; for instance, in Aveiro more than 20,000 € per year were saved with the reduction of mixed MSW observed. Conversely, every material recovered for recycling will be sold to the recycling industry, thus generating a monetary income for the waste management company, estimated in almost 50000 € per year in the three municipalities with reliable results (AVEIRO, LARNAKA and LISBON).

Notwithstanding, the scale of the pilot experiences was too small to result in a significant economic impact in the global municipal budget for waste management, but both effects – avoided costs due to waste prevention and income from selling of recyclable materials – are still the main direct economic outcomes achieved by the project. These benefits should ultimately reach also the citizens in form of lower tariff values to be paid.

Some indirect economic benefits have been also achieved: the companies which took part in the development of new technological solutions have gained a valuable know-how, enabling them to open new business opportunities in an innovative field of activity which previously was not firmly established in the countries involved.

Business opportunities will arrive not only with PAYT systems, but also with the establishment of separate collection of biowaste to be implemented in the near future, which requires similar technological approaches to those tested in LIFE PAYT project, like the containers with limited access. All this future business projects will contribute to the development of local economy and employment.

3.4.3 Social benefits

In the social dimension, the project has contributed to make PAYT more widely known, as a viable strategy to revert the increasing generation of municipal waste. To this respect, the actions developed have shown the new system to the target population and highlighted their environmental responsibility as citizens.

The different communication channels have managed to reach most inhabitants of the concerned zones, especially in the residential areas, where several events took place. Awareness about the fairness in the price of waste management has been encouraged; this is relevant provided that, for instance in Aveiro a large part of residents showed a lack of knowledge about waste management pricing. A particular interest in the performance of the new system has been observed in the case of commercial establishments, since they usually generate every working day a large amount of waste.

In general, the concept of PAYT has been well received by the citizens – as reflected in the surveys done –, even though some criticism appeared regarding the malfunctions of the new waste bins.

Interest for home composting has also been detected, provided that the municipality will facilitate its implementation. The communication efforts have reinforced the perception of the population on the relevance of the waste problem and the importance of recycling.

Finally, in terms of employment, it is estimated that the project created **4,69** full time equivalent (FTE) jobs, comprising the own staff of the project in all the participant partners – all of them qualified employees. Additional new jobs were expectedly created within the waste management and recycling industry – non-quantified here.

In addition to this, additional work related to the development and construction of the new equipment has also been created. The exact number is undetermined, but it can be counted as part of the indirect and induced jobs envisaged in the initial proposal.

3.4.4 Replicability, transferability, cooperation

Within municipal authorities, it is concluded that in spite of the difficulties found, the awareness rising efforts made through the LIFE PAYT project are obtaining positive results.

The administrative and technical features associated to PAYT systems have been shown to the staff of the five participant municipalities in the several training events held, thus contributing to understand PAYT as an economically and technically viable, as well as environmentally beneficious methodology.

Although with different degrees of engagement, the five municipalities are continuing their implication with the project. Particularly, the municipal government of Aveiro has already expressed confidence in a future adoption of PAYT for the whole municipality after a successful pilot experience. In Condeixa the new PAYT pricing scheme for waste management has been already designed and officially approved, while other parallel strategies to PAYT are being put in practice, namely the introduction of door-to-door separate collection for commercial establishments. Both municipal mayors have publicly shown their support for the project. In the municipalities of Larnaca and Vrilissia the tender calls for the new PAYT waste containers have been launched, the latter has also purchased home composters. Only in Lisbon progress is slower; this is to some extent understandable

given the change in the legislative framework under which the municipalities should no longer provide waste collection services to large waste producer (unless a private company cannot be found to do this service).

The awareness rising made among local authorities and government bodies is also remarkable concerning a future replication of the project.

Out of the initial implementation areas, there has been already a lot of interest for the project from other municipalities and countries and several tools have been developed by LIFEPAYT that will foster replication, transferability and that can help other municipalities make the transition to PAYT tariffs, as explained in the report of action B7.

3.4.5 Best practice lessons

PAYT systems have been recommended by EU as a suitable instrument to reduce municipal waste generation and increase recycling. However, since its adoption is usually dependent on municipalities, there are not "universal" guidelines for implementation.[1] Remarkable examples of successful application throughout Europe have been studied for this project (from published literature, training with experts and technical visits).

Each participant municipality was free to choose its own approach for PAYT implementation and a variety of technological solutions were selected for the demonstration sites: pay-per-bin and pay-per volume with volume chamber in Portugal, pay-per-bag in Larnaca and pay-per-weight in Vrilissia.

The project tested the performance of these systems in the 3 countries, which otherwise had few previous experiences with PAYT. This enriched the know-how and benchmarking expertise in those systems. The results obtained – both positive and negative – are useful

[1] Bio Intelligence Service (2012), "Use of economic instruments and waste management performances"

for the generalisation of PAYT schemes in Southern Europe, and as such the lessons learnt were compiled in the documents issued within Action B7 namely recommendations for the development and implementation of PAYT schemes in Greece and in Portugal and the "Guide on municipal implementation of PAYT" (annexes 7d-7i).

3.4.6 Innovation and demonstration value

A lack of experience with PAYT schemes has been detected in the three countries involved. This limitation hindered the decision processes in administrative entities (municipalities and waste management entities), chiefly due to fear of a bad reaction by the population facing the new system – which actually happened to some extent when technical problems appeared, further complicating the process of implementation. Filling in this gap of knowledge, familiarising relevant stakeholders with PAYT systems has been a commitment of LIFE PAYT project, accomplished through the training initiatives performed within Action B6.

Furthermore, it was also a daring task for suppliers of waste management equipment, not used to the kind of equipment required for PAYT, which was specifically developed for the project. The different nature of the places selected for the project constituted a technological challenge regarding the technical feasibility of the implementation of a PAYT system.

As already mentioned in 6.4.6, each of the participant municipalities chose to develop its own technological approach for the actual PAYT implementation, adapted to the particular features of each location. This is considered as a highly valuable achievement of LIFE PAYT project. Moreover, there was no broad availability for waste management equipment suitable for PAYT schemes within the three countries involved, a situation which now has been improved thanks to the demands of LIFE PAYT project.

Priority was given to the development by local companies of new specific equipment adapted to the technical requirements of the project (waste containers, electronic and transmission devices, specific software…), rather than purchasing enclosed systems abroad. However, this choice resulted also in additional efforts being needed. In Larnaka, the high price demanded for acquiring suitable containers for a weight-based PAYT scheme made the municipality change their initial idea and alternatively switch the project to a PAYT bag scheme based on door-to-door collection. In Aveiro, Condeixa and Larnaka, some of this new equipment experienced difficulties when first tested on real service. This is not surprising when working with prototypes, as in this case. These technical troubles contributed to the delay and redefinitions of the project. Nevertheless, the experience gained during these processes is considered a positive outcome. This acquired knowledge paves the way for further adoption of PAYT in other locations by offering a variety of field-tested technical approaches.

3.4.7 Policy implication

Current waste policies at national and EU level are favourable to adoption of PAYT. However, the applicable legislation which regulates waste pricing schemes was still not adapted to PAYT variable charging in none of the three participant countries at the start of the LIFEPAYT project. Within this context, it was not easy for the participant municipalities to adapt their waste pricing scheme to the project, since no legal support existed for it.

The LIFE PAYT team directed its efforts at establishing contact and collaborating with the national regulatory entities and environmental agencies (see End-of-Action B7 in annex 7j), providing feedback regarding PAYT implementation at the beneficiary municipalities with the aim of contributing to the development of regulations and laws. Specifically in Cyprus new regulations are being issued comprising PAYT, one of which the very recent Regulation on Management of Municipal Waste by the Authorities of Local Governments, which was validated on the 7th of July, 2022 (please see

http://www.parliament.cy/images/media/redirectfile/23.03.058.087-2021.pdf). LIFE PAYT project team had provided feedback during the project to the Ministry of the Environment in Cyprus regarding PAYT implementation in Larnaka.

Also in Portugal, there was a revision in 2018 of the Portuguese regulation for waste fees, by ERSAR (The Portuguese waste and water regulatory entity) (Regulamento 52/2018, de 23 de Janeiro, published in the Portuguese official journal "Diário da República" issue 16/2018, Série II de 2018-01-23, pp 2759 - 2890) and a new framework law on Waste was published in 10.12.2020, and is entitled "Regime Geral de Gestão de Resíduos" (DL 102-D/2020, published in the Portuguese official journal "Diário da República"), legally allowing and encouraging the adoption of PAYT in Portugal for the first time. The new framework in Portugal now provides a more advantageous legal support for the PAYT project. As a consequence, municipalities began to redefine their waste pricing policies and, for instance, the municipality of Condeixa was, among those participating in the project, the first in preparing and approving a municipal pricing regulation establishing a PAYT policy for the whole non-domestic activities. This may result in a mutual benefit, since the environmental authorities can evaluate the effect of their decisions through the results of the LIFE PAYT project, bringing a further enforcement of PAYT initiatives, which already have begun to be developed in other Portuguese municipalities.

4 Key Project-level Indicators

The set of Key Project-level Indicators (KPI) was first updated in the Progress Report of August 2017 and thereafter again updated in the on-line version submitted in February 2018. Now, the final version of KPIs has been updated in the corresponding KPI webtool for LIFE projects. The values of the indicators represent the results obtained by the project at its ending moment, according to the targets established.

Those indicators related to the population scope of the project (1.6, 3.1, 8.1.1, 13 and 14.1) had been redefined following the recommendations made by EASME/CINEA. This is particularly relevant for the case of the project scope in Lisbon, which is much larger than in the other beneficiary municipalities. As a consequence, the numbers overshadow those of the other locations when all of them are aggregated in a single result. In the final form, the figures of Condeixa and Lisbon regarding area, population affected, and municipal waste generation are referred to the whole municipality for the sake of simplicity and coherence, although the outcomes registered as results were originated only by the population group targeted by the project, i.e. the waste producers comprised in the baseline of Action C1.

Taking into account this adaptation, the progress achieved by the LIFE PAYT project towards each of the targets established in the KPIs were reported in the digital platform. In terms of mixed municipal solid waste (MSW) reduction and greenhouse gas emissions (GHG) reduction, a summary is shown in the following table.

Indicator	Initial value	Final value	Result
Decrease of mixed MSW	278060 t	276578 t	**-1482 t**
Increase of source separated MSW	55246 t	56581 t	**+1335 t**
GHG emissions from MSW management and recycling	51476 t CO_2 eq.	5103 t CO_2 eq.	**-463 t CO_2 eq.**

The decrease in mixed MSW took place in three ways: mainly by separating more recyclable materials at the source of waste and sending it to recycle through separate collection, but also by adopting home-composting practice to manage biowaste at households and finally by adapting consumption habits to reduce waste generation; for instance: buying products with less packaging.

Regarding the rest of KPIs, they have been calculated in accordance with the numbers given in the Final Reports of the corresponding actions.

5 Comments on the financial report

The costs reported in the financial statements were incurred from **01/09/2016** to **31/12/2021**. The coordinating beneficiary and all the associated beneficiaries have updated accounts according to the normal accounting conventions imposed on them by law applicable regulations. Associated beneficiaries were requested to send to the coordinating beneficiary every six months a financial report including digital version of receipts and documents relating to the project (such as tender procedures, invoices, orders, payment receipts, pay slips and checklist of working hours).

All financial issues that have been mentioned during the monitoring visits and project reporting (progress reports and mid-term reports) are answered in annexes 17-18.

5.1 Summary of Costs Incurred

Comparison between approved and incurred

The eligible costs incurred within the reporting period compared to the approved budget are presented in the following table.

The differences between incurred and budgeted were mostly seen in 4 cost categories, namely **Travel and subsistence costs**, **External Assistance Costs**, **Durable costs** and **Other costs**. The main differences are explained next.

ELIGLE COSTS				
	Cost category	Budget (according to the grant agreement in €)	Incurred within the reporting period in €	% *
1.	Personnel	1 502 250,00	1 497 687,75	100%
2.	Travel and subsistence	66 470,00	37 208,25	56%
3.	External assistance	251 666,00	115 565,59	46%
4.	Durables goods: total non-depreciated cost	174 070,00	121 697,07	70%
	- *Infrastructure sub-tot.*	0	0	
	- *Equipment sub-tot.*	174 070,00	71 457,72	
	- *Prototype sub-tot.*	0	50 239,35	
5.	Consumables	51 967,00	52 557,54	101%
6.	Other costs	59 415,00	27 428,19	46%
7.	Overheads	**147 406,00**	**129 646,00**	88%
	TOTAL	**2 253 244,00**	**1 981 790,40**	88%

* Percentage of budgeted costs that were actually incurred

- Travel and subsistence costs

These costs were 56% of the costs originally foreseen because of the lockdown and restrictions to travel imposed by the COVID-19 pandemic. This limited those tasks involving travelling such as technical visits, project board meetings and dissemination. Nevertheless, several events were still organised or attended online, to keep as possible the planned dissemination of the project.

- External assistance costs

Cost incurred were 46% or the approved budget. The reasons are mostly due to changes in the technical solutions implemented at some of the demonstration sites (mostly Larnaka, Lisbon and also Vrilissia) of compared to the ones initially envisioned. Some of the costs eliminated were, for instance, the service to install on waste collection vehicles the KIT with RFID reader plus data storage and transmission or the service to add tags on the waste

bins, the service to install the card reader and associated equipment on the waste containers, the service to install the rotating drum on the lid of the waste container. The costs incurred by implementing alternative technical solutions were below the costs of the initial proposed solutions, and have been all previously detailed and justified in the requests for modifications made to EASME/CINEA during the project.

Services related to catering, photographer, bus rental, edition and publishing of workshop proceedings were also greatly reduced due to the COVID-19 pandemic that restricted the face-to-face organization of local events, site visits and workshops. The alternative solutions did not require any additional costs except for Professional Zoom license required to carry out 2 events. This has been reported in category "consumables" and the need was better explained in the next section "justification of unforeseen expenses".

- Durable goods cost

Incurred costs were 70% of those anticipated in the proposal, and this was due to changes in the technical solutions that were implemented, with more relevance to the LISBON and LARNAKA demonstration sites, where the new PAYT solutions required less equipment.

Within the category durable goods there was also a transfer of costs from "equipment" to "prototype". This change is related to the project implementation at AVEIRO demonstration site: due to the lack of ready-to-use market solutions it was necessary to develop a new container lid with controlled access (including the chamber for waste disposal with a fixed volume, all the software and hardware for the card reader and the physical support to hold the lid while the container was being emptied to the waste collection vehicle). The request to transfer costs from equipment to prototype was sent to EASME in the Amendment Request (dated 10.10.2019), where the details were thoroughly explained.

- Other cost

The difference in the planned versus incurred in this cost category was related to the elimination of costs related to:

- Gifts and awards for the participating households, expenses for the purchase of TV time and radio time, press releases, promotion to mass media. The gifts and awards for participating households were not given, due to the COVID restrictions, and the promotion and press releases were done, but without costs. The purchase of TV time was not done, given that the project had appeared already twice in the National Television

- Expenses related to the final conference (that went on-line) were also greatly reduced (pen drives, conference materials for the participants, transportation, translation in three languages, etc.)
- Expenses for the organization of the local events and site visits that were transferred to virtual events.

In respect to the calculation of personnel costs, detailed information is provided for all the beneficiaries. All salary components entering the calculation (including components included in the gross salary) are justified for all the beneficiaries and this information can be found for each partner within folder:

"1. Financial_Report" -> "2.Financial_Supporting_documents_SAMPLES"

Justification of extraordinary cases

[This section was removed from the public version of this report.]

5.2 Accounting system

[This section was removed from the public version of this report.]

5.3 Partnership arrangements (if relevant)

[This section was removed from the public version of this report.]

5.4 Certificate on the financial statement

Not applicable.

5.5 Estimation of person-days used per action

The person days reported in the following table were estimated based on working hours reported on the financial statements from all the beneficiaries and coordinator.

Action type	Budgeted person-days	Person-days spent	% of person-days spent
Action A: Preparatory actions	-	-	-
Action B: Implementation actions	8 767	8 971	102%
Action C: Monitoring of the impact of the project action	558	683	140%
Action D: Public awareness, communication and dissemination of results	814	670	82%
Action E: Project management	1117	1686	151%
TOTAL	**11 256**	**12 110**	**108%**

Deviation occurred in actions C – monitoring of the impact of the project actions (140%) and actions E – Project management (151%) and are related to the increase in project duration from 40 to 64 months.

Actions D were below initially foreseen (80%) due to COVID-19 restrictions on gatherings and travelling.

Tool to reduce waste in South Europe

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