Report on the development of socioeconomic indicators

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PAYT - Tool to reduce waste in South Europe

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LIFE Project	LIFE PAYT – Tool to reduce waste in South Europe
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1. Introduction

Solid waste management is one of the most serious challenges faced by local authorities not only because the generation of waste raises important environmental issues but also because of the high costs derived from its management. But waste management is a complex system that requires a lot of information, not only of technical and economic nature but also regarding the attitudes of families and companies that generate waste. Solid waste generation differ with socio-economic, demographic and household related factors as shown by several studies worldwide (e.g. Banar and Ozkan, 2008; Buenrostro *et al*., 2001; Chung, 2010; Daskapoulos *et al*., 1998; Grazhdani, 2016; Purcell and Magette, 2009). Income, household size, education level, country or region are commonly cited as explanatory variables of solid waste generation and recycling rates. A clear understanding of these factors is fundamental to understand the reasons for the success/failure of policy instruments as is the case of PAYT and to efficiently implement waste management strategies.

Nevertheless, as pointed out by Vieira and Matheus (2017), few studies have considered attitudes and behaviors, which are important aspects of waste management failures, maybe because social impacts tend to be more difficult to monitor and quantify as they require more in-depth studies, such as household surveys, which are time consuming and expensive to conduct.

The present report presents the studies carried out with the purpose of establishing a set of socioeconomic indicators within the framework of the LIFEPAYT project, based on the requirements and assumptions established in action C2. Several socio-economic and demographic data will be gathered to better understand the contexts in which LIFEPAYT will be developed but, for the purposes of action C2, only indicators aiming at assessing the socio-economic impact of the project actions on the local economy and population will be included.

These indicators provide measurable information, serving as the baseline for evolution analysis, establishing the degree of success of the project at the socio-economic level. In this way, it will be possible to evaluate the results in a compact and simplified way, demonstrating the rate of progress towards the initial objectives.

2. Methodology

The aims of the development of socioeconomic indicators for the project are to define a pattern of population behavior, its perceptions regarding waste management practices, as

well as the economic changes provided by the implementation of new procedures concerning waste management. In order to measure and document the effectiveness of project actions in relation to the initial situation, it is essential to establish a baseline and carry out the evaluation throughout the project. Thus, the collection of information will be done on three different moments: T1 - before implementation; T2 - during implementation: and T3 - after implementation. This periodicity is fundamental to establish the baseline (T1), which establishes the "picture" of the situation before the implementation of the project and allows to evaluate the changes occurring during the implementation period (T2) and to measure / interpret the fulfillment of the final objectives of the project (T3).

The selection of socio-economic indicators for measuring the impact of the project was based on the relevance for the LIFEPAYT research, ease of calculation and interpretation and data availability for the municipality level. The indicators will be the same for all of the pilot experiences, respecting the specifics of each zone, as well as the difference of the groups studied, namely households (domestic public) and commercial public.

The data needed to perform the calculation of the indicators will be drawn from two different sources: 1) municipality reports; 2) field questionnaire survey conducted in the target regions and applied to households (Annex I) and commercial sector (Annex II.). A questionnaire made to reflect a series of different variables dealing with socio-economic, demographic, housing structure and waste management policy factors of the study area was developed. The questionnaire was showed to a panel of experts, including economists, social scientists and solid waste experts and was then revised according to the judgments and recommendations from the experts. To refine the questionnaire, a pilot field test was conducted to assess the questionnaire's comprehensiveness and clarify potential areas of ambiguity.

3. Results and discussion

For the LIFE PAYT project a set of twelve socioeconomic indicators has been chosen. Every indicator is identified by an assigned code, ranging from SE1 to SE12. This proposed set of indicators is summarised in Table 1, including its measurement units, calculation formula and some methodological and framing notes.

Table 1. Set of socioeconomic indicators

INDICATOR			UNITS	CALCULATION FORMULA	METHODOLOGY	RELEVANCE
SE1	**MSW management cost for municipality**		€ / year	Cost target zone per year	Information provided by municipalities; extrapolation to target zone.	The implementation of PAYT will cause a change in the costs associated to MSW management, and may eventually lead to a reduction.
SE2	**MSW management revenue from domestic and non-domestic sectors**		€ / year	MSW tariff paid value in target zone per year	Information provided by municipalities; extrapolation to target zone.	It is expected that the adoption of PAYT may contribute to an eventual reduction of the taxes paid by the population due to less generation of unsorted MSW.
SE3	**Individual cost of MSW management**	**Commercials**	€	Hourly salary · Necessary hours	Information provided by questionnaires applied to commercial participants (Q.7)	
		Families	Degree of effort (mean score between 1-5)	$\frac{\sum individual\ scores}{\sum total\ \ answers}$	Information provided by questionnaires applied to families (Q.7) 1 – No effort 2 – Little effort 3 – Moderate effort 4 – Enough effort 5 – Much effort	
SE4	**Coverage of MSW management costs**		%	$\frac{\text{MSW tariff revenue}}{\text{Cost of MSW management}} \cdot 100$	Derived from indicators SE1 and SE2.	Currently many municipalities cannot afford the costs of MSW management entirely with revenues from taxes. It is possible to take advantage of the change of tariff induced by PAYT adoption to correct this situation.
SE5	**Economic revenue due to increased recycling**		€ / year	$\sum_{i}(\text{Units of recovered MSW i fraction} \cdot \text{Unitary price of MSW i fraction})$	Information on prices to be obtained from SPV and sold quantities to be known from management entities	Calculation of the revenues associated to the increased sale of recovered materials for recycling (which may help to cover the costs of collection and sorting).
SE6	**Potential employment gains**		No. jobs	$\sum_{i}\left(\text{Units of recovered MSW i fraction} \cdot \text{jobs created by unit MSW i fraction}\right)$	Estimations on potential job creation by recycling using literature review. The produced quantities would have been calculated for indicator E2.	Creation of employment is a social benefit directly from the increase of materials recovered for recycling. This job creation is higher than the potential employment decrease in alternative MSW treatments (e.g. landfills) and in production of primary raw materials substituted.
SE7	**Satisfaction with MSW collection system**		%	$\frac{\sum positive\ answers \cdot 100}{\sum total\ answers}$	Information provided by the questionnaire applied to families and commercial participants (Q.8)	Gauge the perception of satisfaction about the service provided

SE8	**Acceptance of MSW management pricing**	%	$\frac{\sum positive\ answers \cdot 100}{\sum total\ \ answers}$	Information provided by the questionnaire applied to families and commercial participants (Q.10.2)	Highlight the knowledge about the tariff
SE9	**Population percentage who separates MSW at source**	%	$\left(1 - \frac{\sum\ answers\ "I\ dont\ recycle"}{\sum total\ \ answers}\right).100$	Information provided by the questionnaire applied to families (and commercial participants Q.5)	Quantify the behaviour of the population regarding recycling
SE10	**Population percentage practicing home composting**	%	$\frac{\sum positive\ answers \cdot 100}{\sum total\ \ answers}$	Information provided by the questionnaire applied to families and commercial participant (Q.6.1)	Quantify the behaviour of the population in terms of composting
SE11	**Population perception on the importance of recycling**	Score mean (between 1-5)	$\frac{\sum individual\ scores}{\sum total\ \ answers}$	Information provided by the questionnaire applied to families and commercial participants (Q.4) 1 – Not important at all 2 – Not very important 3 – Relatively important 4 – Important 5 – Very important	Understand positioning regarding environmental benefits
SE12	**Project visibility**	%	$\frac{\sum positive\ answers \cdot 100}{\sum total\ \ answers}$	Information provided by the questionnaire applied to families and commercial participants (Q.16)	

In the next part, an explanation of the relevance of every indicator for the project and methodology of calculation will be offered.

- **MSW management cost for municipality (SE1)**

It is expectable that the implementation of PAYT will cause a change in the costs associated with MSW managing, eventually leading to a reduction in costs. The introduction of a scheme that makes people pay for what they really throw is thought as a crucial aspect in order to reduce undifferentiated waste quantities (Bonelli *et al*., 2016; Goorhuis *et al*., 2012; Su *et al.,* 2010) and, therefore, to reduce municipalities waste management costs. This indicator seeks to follow the municipality MSW managing cost along the project, using information provided by the municipalities.

- **MSW management cost for domestic and non-domestic sectors (SE2)**

With this indicator, it is expected to evaluate the extent to which the adoption of PAYT may contribute to a possible reduction of the tariffs paid by the population, due to the reduction of undifferentiated MSW. If the reduction occurs, it is to expect a decrease in the amount paid by households and commercial premises. Several authors have underlined the impact of pricing on waste generation, showing that an increase in the price of solid waste collection increases the demand for recycling (Emery *et al*., 2003; Fullerton and Kinnaman, 1996; Monavari *et al*., 2012; Oribe-Garcia *et al*. 2012)

Conversely, if behavioral change is small, and most of the population does not adhere to separation, there is a tendency for costs to increase. The comparison of the costs in T0 with the simulation of the tariff to be paid in T3 will provide indications on the progress in the private costs associated with municipal management, allowing to understand the influence of the project. The information in T1 will be provided by municipalities and in T3 will be attained by the project.

- **Individual cost of MSW management (SE3)**

The aim of this indicator is to understand the evolution of the cost/effort bear by privates in MSW management, not including the tariff. It is expected that throughout the project, participants will increase their time in MSW management, by separating, composting, etc., in order to produce less undifferentiated waste. These activities will impose a cost on families and companies that may outweigh the impact of PAYT.

The measurement of the indicator will be made in different ways for domestic and non-domestic participants. For non-domestic participants the time spent in MSW management

will be measured and then converted to a money value using the hourly salary. In the case of domestic participants, the idea is to evaluate their perception of household effort in MSW management, using a Likert scale with five levels (1 – No effort; 2 – Little effort; 3 – Moderate effort; 4 – Enough effort, 5 – Much effort). The Information needed to calculate SE3 indicator will be provided by the questionnaires applied to families and commercial participants (question 7). The comparison of the results in T1 and T3 will provide indications on the progress in the costs associated with private MSW management, allowing to understand the influence of the project.

- **Coverage of MSW management costs (SE4)**

Currently many municipalities cannot afford the costs of MSW management entirely with revenues from tariffs. It is possible to take advantage of the change of tariff induced by PAYT adoption to correct this situation, as the costs are expected to diminish as a result of less undifferentiated MSW production and increasing recycling. This indicator represents the percentage of MSW management cost of the municipalities that is covered by the tariffs charged. The information required for the calculation is derived from indicators SE1 and SE2. The comparison of the progress in the coverage level between T1 and T3 will allow to understand the impact of the project.

- **Economic revenue due to increased recycling (SE5)**

The purpose of this indicator is to understand if there are any economic benefits derived from PAYT as a result of increased recycling which may help to cover the costs of collection and sorting. To do so, the calculation of the revenues associated to the increased sale of recovered materials for recycling will be made. The information on prices and sold quantities will be obtained from recycling companies (SPV - Sociedade Ponto Verde in Portugal).

- **Potential employment gains (SE6)**

Job creation is a social benefit that stems directly from the increase in recovered materials for recycling. This job creation is greater than the potential decrease resulting from employment loss in alternative MSW treatments (e.g. landfills) and in the production of new raw materials. Estimations of potential net job gains by recycling show that for every 204 tons of recycled waste 1 direct job is created (FoE, 2010), with an economic value of 72,500 € per year (BIO Intelligence Service, 2011), plus 0.5 indirect jobs and 0.25 induced jobs for every direct employment (FoE, 2010). Detailed estimates for each fraction are shown in Table 2:

Table 2. Direct jobs created by recycling (FoE, 2010)

Recyclable Material	Jobs created per 1000 tons recycled
Glass	0.75
Paper	1.8
Plastic	9.3
Iron and Steel	5.4
Aluminium	11
Wood	0.75
Textiles	5
Biowaste	0.4
Average all recycling	4.9

Using these estimates, it is possible to calculate the number of potential employment generated by the improvement in recycling. The produced quantities of each kind of fraction (plastic, glass, paper, …) would have been calculated for indicator E2.

- **Satisfaction with MSW collection system (SE7)**

The aim is to understand whether or not the participants are satisfied with the MSW collection service provided by the local administration. As pointed out by Morlok (2017), the highest recycling rates and lowest residual waste quantities are achieved with weight-based systems when they are accompanied by well-developed infrastructure and supported by waste-aware citizens. This Information will be obtained in the survey to be applied to families and commercial participants in a simple Yes/No question (question 8). The indicator measures the percentage of participants who thinks that the waste collection system works well.

- **Acceptance of MSW management pricing (SE8)**

The financial question is decisive for PAYT systems, since a strong argument for its implementation is the reduction of the tariff for the population that correctly separates their waste. The focus of the indicator is the participant's opinion on the amount paid for the collection of urban waste, which allows investigate the knowledge about the tariff and to understand the population perception of the fairness of the tariff. In Portugal, for example,

the amount charged is linked to the water bill and goes unnoticed by the vast majority of users.

The indicator measures the percentage of participants that consider that the tariff they currently pay is fair. The information needed for the calculation is provided by the questionnaire applied to families and commercial participants (question 10.2).

- **Population percentage who separates MSW at source (SE9)**

The objective of this indicator is to establish the percentage population that practices waste separation at source at the beginning of the project (T1), so that it can later (T3) be compared to the indexes achieved with the implementation of the PAYT system.

The difference between the percentages is a strong indicator of the project success, since it is understood that the separation at source is a fundamental parameter in the behavioural transformation of the population. In fact, empirical research indicates that charging households by the amount of their waste generation helps increase recycling and reduce waste disposal (Grazhdani, 2016). The author shows that the implementation of a PAYT system increases the recycling rate by 1.87 percentage points.

The information needed for the calculation of the indicator is provided by the answers to question 5 in the questionnaires applied to families and commercial participants.

- **Population percentage practicing home composting (SE10)**

The main component of urban waste is the fraction of organic waste, being of fundamental importance to know the branches of the population that already practices composting. Composting is an important factor to be raised at the beginning of the project, for the same reasons as the ones highlighted regarding SE9 indicator.

Home composting is an easy practice, made feasible by the use of domestic composters, which are intended to be distributed to some participants at the beginning of the project. The participants that already practice composting will function as a control population, establishing the base level for this indicator.

The indicator measures the percentage of participants that practice home composting. The information needed for the calculation is provided by the questionnaire applied to families and commercial participants (question 6.1).

- **Population perception on the importance of recycling (SE11)**

The perception of the importance of recycling is an indicator that points to the relation of the population with the concepts of sustainability and circular economy. It refers to the importance that is assigned to recycling and to the commitment of the population to give the correct destination to MSW.

The indicator evaluates the perception of participants on the importance of recycling, using the mean of the evaluation obtained through a Likert scale with five levels (1 – Not important at all, 2 – Not very important; 3 – Relatively important; 4 – Important; 5 – Very important). The Information will be provided by the questionnaires applied to families and commercial participants (question 4). The comparison of the results in T1 and T3 will provide indications on the progress of the importance assigned by participants to recycling, allowing to understand the influence of the project.

- **Project visibility (SE12)**

In the course of the project, from start to the closing phase of the project, it is important to evaluate the progress on the knowledge of the population of the target areas regarding LIFEPAYT, in order to verify if the means of dissemination of the project fulfill its function of providing information about the implemented actions and the PAYT system. The indicator measures the percentage of participants that answer "Yes" to question 16 in the questionnaires to be applied to domestic and non-domestic participants at T1, T2 and T3.

As pointed out by Morlok *et al*. (2017), awareness raising is a key element for effective PAYT implementation because informed citizens understand and support the scheme. Further improvements in MSW management possibly could be achieved by better communication with the public about the economic and environmental opportunities available through waste recycling and diversion (Owens *et al*., 2000). The results from Grazhdani (2016), suggest that a euro increase in per capita education expenditure increases the recycling rate by 0.45 percentage points.

4. Conclusions

The set of indicators intended for evaluating the socio-economic impacts of the LIFE PAYT project has been presented and discussed. The indicators were selected according to the relevance for the project, simplicity and information availability. The indicators are mainly focused in two types of measurement: 1) changes in costs for municipalities, families and businesses; and 2) changes in the perceptions and attitudes of local people and commercial mangers towards waste management.

The measurement of the indicators will be regularly updated in order to provide the necessary temporal comparison and establish the progress in the impact of the project. Particularly, the indicators will be measured before the beginning of the project (ex-ante evaluation), during implementation (on-going evaluation) and after the project completion (ex-post evaluation), aiming to understand the evolution and the final impact of LIFE PAYT.

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