

DELIVERABLE D.T2.4.5: PA14, PA15, PA16: THEMATIC REPORT ON IMPLEMENTATION OF FOOD WASTE MANAGEMENT

Version 1
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1. Implementation of Food Waste Management: PA14 (ATM)

1.1. Feasibility Study overview

The aim of Pilot action 14 is to solve out the organic fraction from separate collected residual waste in order to produce biogas in local waste water treatment plants out of it. From the 52,000 t/a of household waste from the Innsbruck area (approx. 220,000 t/a) almost 12,000 t/a are food waste with a biogas potential of 4.4 Mio m³ biogas. Within the feasibility study various trials with different separation technologies have been conducted at testing installations and operational facilities to assess whether this food waste can be prepared as co-substrate for waste water treatment facilities.

Based on a mass balance modelling and economic evaluation the “wet preparation” achieves the highest biogas yield and the highest net savings compared to the currently employed incineration of this waste. Other options like the combination of a dry separation process consisting of a density table and optical sorting is also economically and environmentally positive. For this evaluation various assumptions and cross references to the co-digestions of clean organic substrates have been used. Of particular relevance for the sensitivity of the results are the mass balance and the properties of the different products. Some of these relevant figures refer to the behaviour of the substrate at the waste water treatment facilities. Both technical issues and the dewaterability of the sewage sludge are of high relevance.

Based on the latest trials with wet preparation this process shows advantages compared to the dry separation process and the press separation. The feasibility study therefore resulted in an agreement by all involved actors/stakeholders to continue with pilot / demonstration project on wet preparation.

1.2. Implementation of pilot actions

In the course of setting-up the pilot action a demonstration (pilot) plant needed to be established and the research design developed. Within a partnership of concerned companies (ATM, IKB, and AAG) as well as research institution (UIBK) the needs have been defined and a call for bids prepared. The Management Centre Innsbruck was chosen as pilot plant provider and with a lot of effort the plant was created (see picture below).



Figure 1: Building the pilot plant

In two demonstration phases the separation of organics from residual waste was tested. Therefore the low organic fraction (LCF, approx. 35 % organic) from mechanical sorting plant in Innsbruck was the input material. As first step the LCF was sieved with a 12 mm mesh and the material below 12 mm used for the further process. In modified containers (pulper) the material was solved with water and well mixed with a stirrer. Afterwards the suspension entered into the pilot plant (hydrocyclone) where i) organic rich substrate (biogas), ii) inert material (landfill) and iii) swimming layer (light material for incineration).

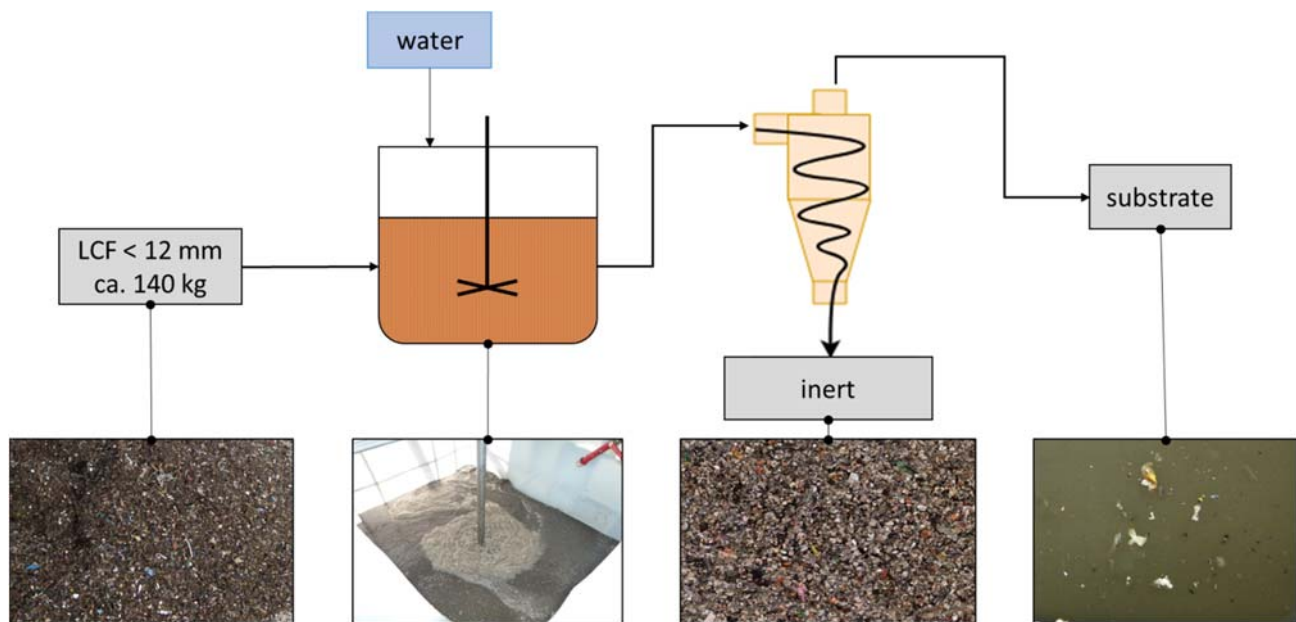


Figure 2: Flow diagram

The demonstration of the pilot plant - although some problems (blockage of pipes) occurred - was very successful and showed that technically the separation of the different fractions (esp. organic and inert) is feasible. All fractions were then analysed on their organic-inorganic matter content, biogas potential and mass balances calculated.

1.3. Problems and other important issues occurred during the PA implementation

All in all the whole approach - solving out organics from residual waste - is very challenging and tricky. The main actors IKB, ATM and AAG are working on this topic since 6 years in small steps. The most challenging aspect is the financial and personal resources for such a big project. Finally different funding was used to bring the development further. Within STREFOWA we had to chance to apply for the pilot plant nevertheless quite an amount of in-kind was needed to carry out the scientific supervision and documentation.

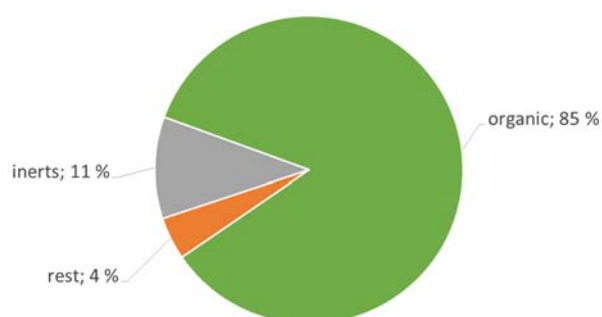
Besides and although involved actors were convinced about the innovative approach also other important actors in the process chain - namely the waste water treatment plant operators - needed to be involved and integrated. With several personal discussions and transparency the project team was successful in getting heard from this group.

Technically - as mentioned above - it was very challenging as single aggregates are available but not tested in combination before. So the team was claimed in react constantly about new findings and adjust the process. All in all the demonstration phase worked well although some problems with pumping are still to be solved.



1.4. Results and target groups reached

The demonstration resulted in new findings and results that are tremendous for next steps in order to apply full-scale application. Generally the hydrocyclone worked very well and gave a quite clean substrate for processing in fermenters (see figure). The organic content from input could be increased from 35 to 85 percent in the substrate. Calculating the potential biogas yield of the material from FUA Innsbruck about 1 Mio m³ could be gained. Another positive result was that the material that was separated from the hydrocyclone is rich in inerts (93.5 %) and therefore potentially ready for direct landfilling. As for landfilling an organic matter content of below 5% is needed a washing process will be needed.



After this demonstration phase preparations are going on to prepare the full-scale operation. Problems still exists with stirring and pumping of the material that needs to be solved in advance. The decision makers and actors involved are optimistic to solve those problems and set-up a full-scale plant within the next 3 years in FUA Innsbruck.

Describing the target groups that have been involved, pilot action 14 was in contact with the regional government of province of Tyrol (1 regional public authority) and there with several sections waste management, waste water management and on ministerial level. In the whole process the University of Innsbruck (education/training centre) was involved to establish feasibility study and support / scientifically supervise the demonstration phase. The 3 main actors ATM, IKB and AAG represent large enterprises that are interested in bringing the new approach running. As SME the Management Centre Innsbruck as pilot plant provider and the two waste water treatment plants in Zirl and Strass/Zillertal were involved.

TARGET GROUPS	QUANTIFICATION
Local public authority	0
Regional public authority	1
Interest groups including NGOs	0
Education/training centre and school	1
Large enterprises	3
SME	3



General public

0

<i>Pilot Action</i>	<i>Amount of waste avoided per PA</i>
<i>PA14</i>	<i>0 (approx. 5.000 kg treated)</i>

1.5. Sustainability and transferability of pilot actions on Implementation of Food Waste Management

The project consortium of ATM, IKB, AAG was satisfied with results from demonstration phase and will continue with approach to enter the full-scale level. All together the few uncertainties where collected that should be solved in near future. Two waste water treatment plants are willing to assist and contribute to the next developments in order to install the full-scale aggregate at their plant. The technology itself has led to further know-how on the hydrocyclone for the Management Centre Innsbruck (MCI). As a research and education institute the results and findings will be spread also to other regions and countries. Also the pilot plant is used by the MCI for further testing in future. The University of Innsbruck was from the beginning a main driver for this approach and will also spread the scientific results to a wider public and community. If the project team succeeds with the next steps and first full-scale operation the approach and technology is ready also for other regions and countries. As residual waste is treated all over Europe in mechanical (biological) sorting plants and renewable energy sources for biogas production are needed this approach might be demanded and transferred.



2. Implementation of Food Waste Management: PA15 (Rimini)

2.1. Feasibility Study overview

The aim of Pilot Action 15 was to optimise the collection of food waste in hotel restaurants. The optimisation was tested through options aimed at improving the efficiency of sorted waste collection, involving a sample of hotels in the Province of Rimini.

The feasibility study of Pilot Action 15, starting from an initial background analysis of existing laws and studies, identified the objectives and expected results, as well as the stakeholders to be involved. The feasibility study also stated that the project should be developed according to a timeline and through a series of activities grouped into main phases:

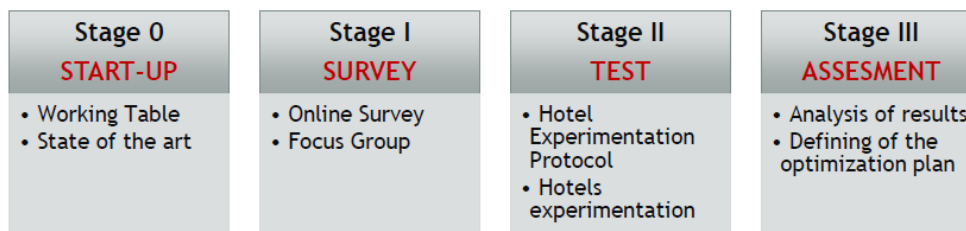


Figure 3: Pilot Action 15 stages and activities

➤ Stage 0 - Start Up

- **Working Table:** Stakeholders directly or indirectly involved participate in the working tables. The Working Table meets approximately every two months to initiate and coordinate tasks, learn about the results and make decisions about the pilot project.
- **State of the art:** Through the involvement of the local waste management company and the hoteliers' association, data is collected on the problems and analyses of food waste already carried out and on accommodation capacity.

➤ Stage I - Survey

- **Online Survey:** Invites hoteliers to give their feedback on the food waste management system anonymously. At the end of the questionnaire, hoteliers are invited to participate in the Focus Group.
- **Focus Group:** Group of hoteliers, chosen for their availability, experience and representativeness of the Rimini hotel sector that supports the working table in interpreting and contextualizing the results of the online questionnaire.

➤ Stage II - Test

- **Hotel Experimentation Protocol:** Based on the results of the previous phase of investigation, it establishes information such as: hotel testers, improvement actions, duration of experimentation, indicators to be measured.
- **Hotels experimentation:** The hotels identified for the experimentation adopt the improvement solutions selected for the testing period.



➤ Stage III - Assessment

- Analysis of results: Analysis and standardization of the data according to the "Hotel Experimentation Protocol" and discussion of the results at the Working Table to evaluate the solutions tested according to economic, environmental and management factors.
- Defining the optimization plan: Final report that includes the improvement plan. For each solution identified, investment costs, implementation times, mitigation of environmental impacts and optimization of organic waste management are highlighted.

2.2. Implementation of pilot actions

The hotels identified for the experimentation were involved in two phases: BAU phase (analysis of BAU - Business as usual, i.e. the hotels as they work in everyday life) and Improved Phase (IMP, in which improvement solutions were adopted).

The BAU phase lasted 14 days, while the improved phase lasted 14 days (for the times of assimilation of the improvement solutions). Between the two phases there was an interval of one week to allow the adoption of the improvement solutions to be tested.

The hotels participating in the experimentation are located in the Province of Rimini and were chosen on a voluntary basis following an initial involvement in the previous phases: Online Survey and Focus Group. In order to make the evaluation reliable, the objective was to involve at least a number of 3 hotels. Five hotels took part in the experimentation:

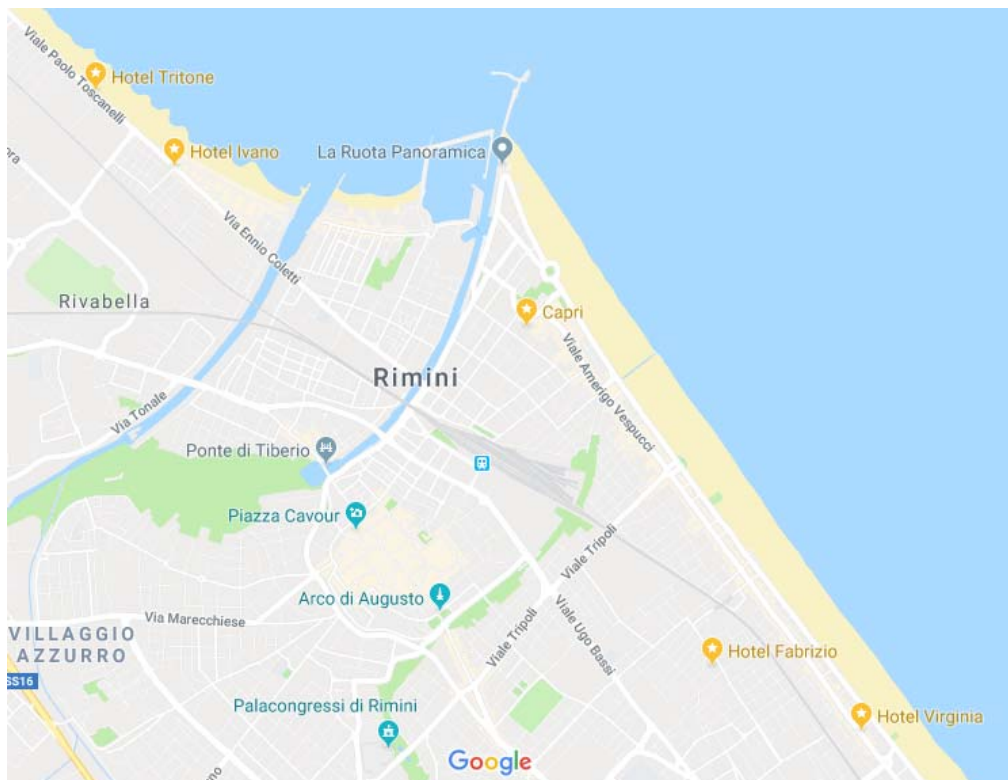


Figure 4 Testing hotels localization

The comparative assessment between the two phases (BAU Phase and Improved Phase) was done through the data collected during the sampling. The analysis is not only of an environmental nature, but economic-management parameters have been identified in order to be able to assess at 360° the improvement achieved by the hotels with regard to the management of organic waste:

Table 1 Table of indicators

THEMATIC	ID	Indicator	Description	Units of measurement
Economic feasibility	EF.1	Cost per cover	Cost to implement each improvement action per cover	€ cent
	EF.2	Monthly cost per "average hotel" in high season	Cost to implement each improvement action on an "average hotel" per month of high season	€
	EF.3	Monthly cost for all hotels in the Province of Rimini in high season	Cost to implement each improvement action on all hotels of the Province of Rimini per month of high season	€
Environmental Impact	EN.1	Quality of organic waste collection	Product analysis of waste	% composition
	EN.2	GHG avoided per cover	Comparison of GHG avoided by composting compared to waste-to-energy and landfill	g CO ₂ e



	EN.3	GHG avoided monthly per "average hotel" in high season	per cover Comparison on GHG avoided by composting compared to waste-to-energy and landfill for an "average hotel" per month of high season	kg CO ₂ e
	EN.4	GHG avoided monthly per all hotels in the Province of Rimini in high season	Comparison on GHG avoided by composting compared to waste-to-energy and landfill for all hotels in the Province of Rimini per month of high season	t CO ₂ e
	EN.5	Waste avoided by single-serve jam elimination per cover	Quantity of waste avoided by using jam dispensers instead of single-serve per cover	g waste
	EN.6	Waste avoided by single-serve jam elimination monthly per "average hotel" in high season	Quantity of waste avoided by using jam dispensers instead of single-serve per month of high season	kg waste
	EN.7	Waste avoided by single-serve jam elimination monthly per all Rimini's Hotel in high season	Quantity of waste avoided by using jam dispensers instead of single-serve per all hotels in the Province of Rimini per month of high season	t waste
Management Impact	MI.1	Improvement perceived by hotel managers	Survey of improvements	-
	MI.2	Improvement perceived by hotel staff	Survey of improvements	-
	MI.3	Improvement perceived by HERA	Survey of improvements	-

In order to quantify the benefits associated with an improvement action, it is necessary to use the functional unit, which is the reference to which all input and output study data are related. This experimentation used a 1-cover functional unit that is a served meal (breakfast, lunch or dinner) or a diner who eats.

The objective of the improvement actions was to make more effective the management of the staff produced in the kitchens of hotels and, at the same time, reduce the environmental impact by ensuring proper differentiation of food waste.

The improvement actions were identified by STREFOWA's Pilot Action 15 working group, after being the subject of an online survey and after being discussed with the hotels participating in the Focus Group. Each improvement proposal was then evaluated on paper in terms of project spendability and feasibility for the sector and its stakeholders.

After evaluating the various possible options during the various working tables, it was decided to implement the following aspects:

- ✓ Organic waste bins: The managers of the hotels participating in the experimentation had the opportunity to choose new bins for the collection of waste to be placed in their kitchens and in the areas of return of the dishes from the tables. The bins were supplied in two colours (red and white) to be used for the collection of the organic and undifferentiated fractions.



Figure 5 Filmop Sirius 60 litre bins and Filmop Polaris 90 litre bins



Figure 6 Filmop Pickup 45 litre tabletop bins

- ✓ **New compostable bags:** The hoteliers were provided with new compostable bags because those previously supplied by the local waste management company were very fragile and easily broken. Hotels were distributed bags of 2 different sizes, depending on the types and quantities of bins chosen. The breakage of the bags leads to a great loss of time for the staff, who are already very busy during the service. In this way it is possible to improve the actual management of the waste.



Figure 7 New compostable bags

- ✓ **Jam dispensers:** The elimination of single-dose jams used for breakfast helps to optimize the collection of organic matter as it prevents the metal film of the single-dose and the plastic tray end up in the collection of organic matter. It also contributes to a reduction in the waste generated. This improvement action for budget reasons has been tested on 1 of the 5 hotels, Hotel Capri, which received 5 jam dispensers „Ideaplast - Marmiciok“.



Figure 8 Jam dispensers

- ✓ Promotional kit, Informative poster and on-site support: As far as graphic materials are concerned, three types of materials were produced:
 - Promotional kit, composed of 1 glass sticker and 1 small playbill (A4 size);
 - Informative poster about foodwaste management (A1 size).

The promotional kit has been designed to promote commitment to this theme and the participation of the hotel in the experimentation. The aim was to make hotel customers aware of the issue of proper management of food waste and to meet the needs of customers who care about the environment. Both the glass sticker and the small playbill were produced with texts in two languages (Italian and English) that indicate participation in the project and explain the objectives of Pilot Action 15.

The informative poster, on the other hand, represents a quick means by which members of the staff of the kitchens of the hotels participating in the experimentation, can quickly know the correct conferment of most types of waste that are typically produced in a kitchen. The size of the poster (A1) and the inclusion of images for each type of waste were designed to speed up the recognition of waste so as not to slow down excessively the work of the staff during the hours of service.



Figure 9 Informative poster and Promotional kit

In addition, to help hotel staff understand and use all the solutions provided for testing, and in particular to provide precise guidance on how to make a proper separate collection of food waste and the information contained in the informative poster, was provided on-site support during the week off between BAU Phase and IMP Phase.



Figure 10 On-site support

SWOT Analysis:

Strengths	Weaknesses
<ul style="list-style-type: none"> - Real testing Pilot Action 15 has enabled the development of a "sustainable recipe" for optimising organic waste management. This was possible thanks to a concrete experimentation that allowed to evaluate the benefits in terms of a complex system (catering service), considering therefore all the predictable and unpredictable effects, otherwise not 	<ul style="list-style-type: none"> - More resistant compostable bags The Italian market for bag distributors has been called upon to develop new bags in compostable material for some years now. The latter, being very fragile, are in a phase of "evolution": it is hoped that, given the growing demand, new, more resistant products will soon be introduced on the market.



<p>identifiable by literature.</p> <ul style="list-style-type: none"> - On-site support Between the two phases of the experimentation (BAU and IMP phase), an on-site support was carried out during the adoption of the improvement solutions. - Multi-parameter methodology The Benefits of the Pilot Action were monitored by a panel of multi-parameter indicators: economic, environmental and management. Complex evaluations must be carried out with structured survey tools. - Representative sample Considering the complexity of the experimentation, the number of hotels involved for different levels of quality standards, seasonality and types of service offered represents a representative sample. - Tangible results The application of the "recipe" established by the Methodological Protocol has allowed reaching a level of purity of the organic waste collected equal to 99.66% against a previous situation (BAU) of 95.66% (+4%). 	<ul style="list-style-type: none"> - High staff rotation The staff involved in the kitchens of the hotels is subject to a high rotation due to the often seasonal character of the tourist service. Moreover, the heterogeneity of the countries of origin of the workforce slows down the learning process, because not all employees have the same sensitivity to environmental issues (in addition to any problems of a linguistic nature).
<p>Threats</p>	<p>Opportunities</p>



<ul style="list-style-type: none"> - Lack of public policy Risk of not spreading the virtuous model due to a lack of political tools by the Public Authorities to encourage the improvement of the quality of the sorted waste collected. - Cost of implementation Some solutions may be too expensive to implement (e.g. jam dispensers). - Heterogeneity at European level The implemented recipe may need to be customized depending on the contexts and countries in which it is proposed. - Staff management The results that can be achieved are closely related to the investment in training and staff involvement. There is a risk that this key management aspect will be overlooked. 	<ul style="list-style-type: none"> - Project of CSR (Corporate Social Responsibility) for Hotels Environmental-conscious hoteliers can attract more customers who are sensitive to environmental issues. - Replicate the project to scale The benefits that could be obtained if the entire tourism sector adopted the suggestions of Pilot Action 15 would guarantee significant reductions in environmental impacts and in the costs of the waste collection and disposal service. - Capitalising on an EU-wide basis Opportunity to obtain further benefits by spreading the "recipe" tested to other European Hotels. - Share best practices Opportunity to share the "recipe" with other associations in the tourism sector at European level, networking and sharing to improve it more and more.
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2.3. Problems and other important issues occurred during the PA implementation

No particular problems arose during the Pilot Action 15 experimentation.

A very important factor to take into account is the haste of the waiters due to the large presence of guests to be served in high season.

Compostable bags are a very delicate factor because they are fragile and tend to break when subjected to heavy weights.

The use of promotional materials (composed of 1 glass sticker + 1 small playbill (A4 size)), has not obtained particular attention from the guests of the facilities, probably not very sensitive to this issue. Among the suggestions for improvement of this action a hotel manager states that the kit should be associated with all the information/promotional material made available to guests in the individual rooms of the hotel.

Hotel staff often change from year to year, so there is a need to carry out a new training (on-site or by an handbook) of the staff every year, so that everyone knows what to do and how to best collect food waste.

As for the jam dispensers, the hotelier who tested them reported that care should be taken when refilling the dispenser (risk of jam loss) and that for some guests it is not clear how to dispense the jam. The hotelier then suggests that the model of the dispenser should be changed or that more attention should be paid to certain activities.



2.4. Results and target groups reached

TARGET GROUPS

Local public authority	<i>Municipality of Rimini</i>	<i>Meeting, call</i>
Regional public authority	<i>Province of Rimini</i>	<i>Project Partner: working table, call, meeting</i>
Interest groups including NGOs	<i>Federalberghi Rimini (Federation of Italian hotels and tourism associations)</i>	<i>Working table, call, survey</i>
Education/ training centre and school	-	-
Large enterprises	<i>HERA Rimini (Company that handles waste collection and management)</i>	<i>Working table, call, survey</i>
SME	<i>Hotel Fabrizio, Hotel Tritone, Hotel Virginia, Hotel Capri, Hotel Ivano,</i>	<i>On-site support, working table, call, focus group, surveys, experimentation</i>
	<i>Magris (bins supplier), Ideoplast (jam dispensers supplier)</i>	<i>Supply of equipment</i>
	<i>FinProject, Punto 3</i>	<i>Working table, call, meeting, on-site support</i>
General public	<i>Tourists</i>	<i>Promotional materials (glass sticker + playbill)</i>

Pilot Action 15 was not about the prevention of organic waste but about its management. A set of 13 indicators was established to assess improvements from economic, environmental and management points of view. Below are some of the calculated indicators.

ECONOMIC FEASIBILITY:

Table 2 Pilot Action 15 - Economic feasibility

	Cost per cover	Cost per an average hotel per month in high season	Cost per all Rimini's Hotel per month in high season
Set of bins (average) ¹	0,79 € cent	57,31 €	128.266,77 €
Compostable bags usage (average) ²	0,59 € cent	42,72 €	95.606,47 €

¹ Consisting of 2 «Pickup» bins (45 LT), 2,8 «Sirius» bins (60 LT) and 1,5 «Polaris» bins (90 LT).



Jam dispenser	2,42 € cent	175 €	391.650 €
Promotional kit ³	0,02 € cent	1,69 €	3.776,63 €
Informative poster ⁴	0,09 € cent	6,50 €	14.547,00 €

ENVIRONMENTAL IMPACT - Quality of separate collection of the organic fraction:

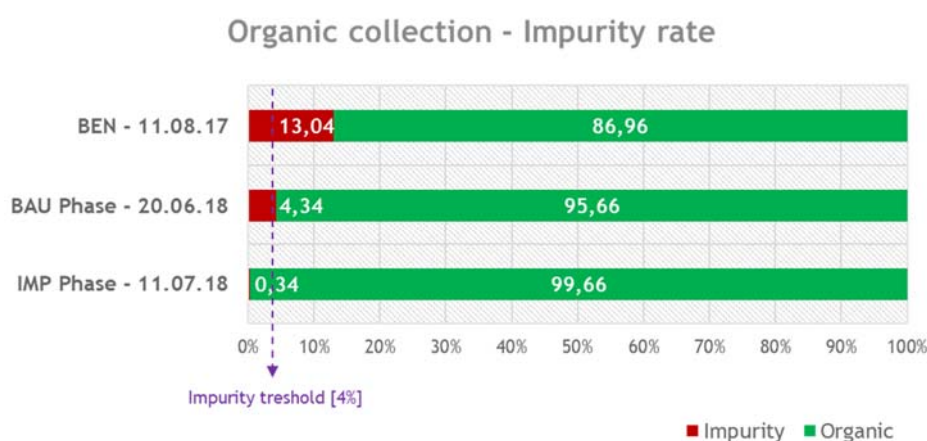


Figure 11 Pilot Action 15 - Impurity rate

ENVIRONMENTAL IMPACT - CO₂e Avoided⁵

Table 3 Pilot Action 15 - CO₂ Avoided

	Per cover [g CO ₂ eq]	Per an average hotel per month of high season [kg CO ₂ eq]	Per all Rimini's Hotel per month in high season [t CO ₂ eq]
Composting scenario vs waste-to-energy scenario	1,78	12,89	28,85
Composting scenario vs landfill scenario	98,90	714,82	1599,77

² Estimated bags prices based on market investigation of 0,32€/each for 70 LT bags and 0,79€/each for 120 LT bags.

³ Considering only printing costs (excluding design, €80).

⁴ Considering only printing costs (excluding design, €200).

⁵ Values calculated from the amount of waste generated in one day of TM (140 kg) and taking into account the emission factors published by DEFRA in 2018 (Department for Environment, Food & Rural Affairs, UK).



MANAGEMENT OPTIMIZATION - Managers' answers to the interview



Figure 12 Pilot Action 15: Managers evaluations

2.5. Sustainability and transferability of pilot actions on Implementation of Food Waste Management

Pilot Action 15 allowed to test the improvement plan implemented in 5 sample hotels and to evaluate the benefits from a management, economic and, above all, environmental point of view. At the same time, the main objective of the project is to have developed a "recipe" that can ensure excellent results in optimizing the management of food waste in the kitchens of hotels in Rimini, as well as throughout Europe. The study showed that it is therefore possible to improve further, even starting from a good basis.

The pilot action can be replicated anywhere and does not require special requirements. The solutions identified by market research are available on markets throughout Europe. In addition, the "recipe" for sustainable food waste management developed as part of Pilot Action 15 focuses heavily on management and training aspects related to facility managers and staff performing the correct collection.

As far as the measures to be taken to ensure the sustainability of the project are concerned, it is essential to ensure that the staff has understood how to use the tools provided and that they are committed.



3. Implementation of Food Waste Management: PA16 (WUELS)

3.1. Feasibility Study overview

According to Polish regulations separate collection of all biowaste (i.e. both garden and kitchen waste) will be mandatory by 2021 and all communities must incorporate it into its waste collection scheme. So far in some communities (e.g. Wrocław) kitchen waste is collected within mixed waste. In Opole garden and kitchen waste was already collected together in brown containers. 6 945 Mg of them were collected in 2017. Taking into account the number of inhabitant (126 139 at 2017), the amount of selectively collected biodegradable waste is 55 kg / inhabitant. Compared to other Polish communes and even to Western European communes, in which selective collection of bio-waste had already existed, this is a good result. However, from the study of waste morphology, which WUELS conducted in June 2018, it turns out that mixed waste still contains about 10% of biodegradable waste, which is about 3,327 Mg, or 26 kg / inhabitant. Of this amount, kitchen waste constitutes the vast majority - about 65%.

Compared to national and international background, this content of biodegradable waste in mixed waste is low. Despite this, there is a lot of room for improvement, i.e. reducing the level of kitchen waste among mixed waste.

3.2. Implementation of pilot actions

Pilot action 16 evaluates potential reduction of environmental impacts through improvement of the results of separate collection of kitchen food waste (thus reducing it's amount in mixed waste stream) in the city of Opole.

A biowaste collection scheme from households was already in place in Opole. During PA16 in selected areas of low-rise, medium-rise and high-rise premises additionally to the already existing system of outside biobins, biowaste collection sets (inside bin, 10 bags and info materials) were distributed. The scope of reached households included: 262 high-rise, 234 medium-rise and 122 low-rise premises; 167 households refused to accept the kits or could not be reached.



fig 1. Materials for biowaste collection set: a) bins, b) biodegradable bags, c) infomaterials

Over a period of several weeks prior to and after the distribution of the biowaste collection sets the amounts of both the residual and biowaste were monitored. Also waste sorting analyses were performed (3 rounds before distribution and 2 rounds after) to determine in detail the composition of both mixed and bio waste collected from each housing type, with a special focus on food waste.

The thus additionally separately collected kitchen waste is transferred from treatment in a Mechanical-Biological Pretreatment plant (within the residual waste) to a Composting plant (within the biowaste). However, as for the future an Anaerobic Digestion plant is planned in Opole, the treatment option of AD was modelled for the assessment of PA16.

Additionally a survey was carried among residents of involved households to assess their the behaviour and attitude considering kitchen waste and to obtain feedback about proposed improvement method.

3.3. Problems and other important issues occurred during the PA implementation

The main obstacle in the pilot action 16 was the withdrawal of the city with which the cooperation was planned. This situation repeated three times (Poznań, Wrocław, Wołomin). In each case the withdrawal took place at the last stage of promising negotiations, just before the conclusion of the agreement, and it's reasons were not clearly stated by the cities.

The problem was resolved by consistent searching for another partner city, which resulted in establishing cooperation with Opole in June 2018. Due to limited amount of time that was left, the scope of PA had to be slightly altered to make it suitable.



3.4. Results and target groups reached (max: 1 x A4)

[Following tables to be filled and results to be described beneath the table]

TARGET GROUPS	QUANTIFICATION
Local public authority	4
Regional public authority	
Interest groups including NGOs	1
Education/training centre and school	1
Large enterprises	2
SME	3
General public	1552

<i>Pilot Action</i>	<i>Amount of waste diverted per PA</i>
<i>PA14</i>	
<i>PA15</i>	
<i>PA16</i>	10,8 t over a 6 week period. This adds up to 40 kg/inh.yr for the average citizen.

Comparison of the collected amounts during 6 weeks before and 6 weeks after distribution of the biowaste separate collection kit, for the low-rise buildings an increase of 139% was observed. For the medium-rise buildings this was 65%, whereas for the high-rise buildings it was significantly lower at 5%.

Comparing the separate collection results of biowaste in the area where no biowaste separate collection kits were distributed, in the period 6 weeks after the distribution the amounts were 13% lower in the low-rise area and 15% lower in the middle rise area. For the high-rise area no data was available. As a conservative estimation no decrease was assumed.

Considering both the decline in the baseline scenario and the increase in the PA16, the total amount of biowaste collected additionally amounts to 152% in the low-rise, 80% in the middle-rise and 5% in the high-rise area. With a distribution in Opole of 20% low-rise, 20% middle-rise and 60% high rise (based on the number of collection routes) respectively, the city wide potential is estimated at 49%.

In absolute numbers the additionally collected biowaste amounts to 5,7 tonne in the low-rise, 4,1 tonne in the middle-rise and 0,1 tonne in the high-rise area. In the entire PA16 area this adds up to 10,8 tonne over the considered six week period. This is equivalent to respectively 113, 82 and 1,6 kg/inh.yr for the considered areas (including those inhabitants that did not receive the starting kit). Considering the residential distribution in Opole of 20:20:60, this amounts to 40 kg/inh.yr for the average citizen. With a population of 38 million and a calculated



net impact of 290 kg CO₂ eq./t., this leads to an estimation of over 1,5 mio t of kitchen waste diversion and consequently 441 thous. t CO₂ eq. savings per year.

The collected biowaste was actually treated in an open windrow composting plant. As this is not a proper technology for the future treatment of kitchen waste, an anaerobic digestion treatment was proposed in the assessment. This fits to the plans of the city of Opole, where the construction of such a plant is considered.

The results of the survey showed that for 64% of the respondents the proposed method (inside bin and bags) should increase the amount of collected kitchen waste and is considered convenient and hygienic.

3.5. Sustainability and transferability of pilot actions on Implementation of Food Waste Management (max: 1 x A4)

[Concrete measures taken during and after project implementation to ensure the sustainability of the project outputs and who will be responsible for the PA's sustainability; the idea about applicability and replicability of PA's by other organisations/regions/countries outside of the current partnership; to what extent it will be possible to transfer the outputs to other organisations/regions/countries outside of the current partnership]

Full results obtained from the pilot action 16 were forwarded to partners from Opole. They will be able to use them to implement corrections in the functioning of the kitchen waste collection system. The results will be particularly important when the planned investment in anaerobic digestion installations is realized.

The experience gained under PA 16 may also be useful for other cities in Poland seeking to introduce or improve the selective collection of kitchen waste to comply with applicable legal regulations. The results from Opole can be considered representative and scalable. Moreover the results of selective kitchen waste collection in Opole were already good at baseline and anyway the significant improvement was achieved. It can be assumed that in cities that do not have a well-functioning collection, the improvement will be at least as good or higher.

The results of PA 16 were presented for interested stakeholders at the Dissemination Workshop in Wrocław on September 26, 2019. Scientific papers presenting the results of PA 16 will be published in reputable journals.