



LIFE Project Number
LIFE15 ENV/GR/000257

LIFE PROJECT NAME or Acronym
LIFE-F4F (Food for Feed)



Annex Data

Action:	C Monitoring of the impact of the project actions
Partner:	ESDAK - HMU - HUA
Deliverable:	C1.7 Final evaluation of performance indicators

Table of contents

1.	EVALUATION OF PERFORMANCE INDICATORS	3
1.1.	WASTE – WASTE MANAGEMENT.....	3
1.2.	RESOURCE EFFICIENCY - GREEN CIRCULAR ECONOMY	3
1.3.	GREENHOUSE GAS EMISSIONS.....	4
1.4.	RESOURCE COVERAGE / RANGE OF THE ENVIRONMENTAL / CLIMATE CHANGE IMPACT	5
1.5.	IMPLICATION OF NGO (MANDATORY) INCLUDING INTERVENTIONS SUPPORTING EU ENVIRONMENTAL AND/OR CLIMATE CHANGE POLICIES AND OF OTHER STAKEHOLDERS	6
1.6.	INFORMATION AND AWARENESS- GENERAL PUBLIC REACHED AND/ OR MADE AWARE OF.....	8
1.7.	CAPACITY BUILDING	9
1.8.	JOBS.....	9
1.9.	ECONOMIC GROWTH	10
2.	EPILOGUE.....	11

1. Evaluation of performance indicators

Following the first evaluation of the F4F project's performance indicators (PI), in this report the evaluation of the same PI's is presenting for the total period of the project.

The concept for this Action and deliverable is the assessment of the impact of the project's realisation in a variety of parameters during the project's pilot and possible full-scale implementation.

During the project's progress, the first, the second and the third operational period (initial operational period, 1st full scale operational period, and 2nd optimum full scale operational period) of the project have been concluded. The complete list of key indicators for the project is reproduced below. Concerning the evaluation of performance indicators, from the whole period of the project the following indicators have been assessed, as presented in the paragraphs below.

1.1. Waste – Waste management

Description of indicator and target value

Annual reused quantity of food waste: 150 (metric tonnes per year). In total for the 3 periods of the project this is 450 metric tonnes.

A high level of consumption and tourist activity in the area is leading to increased waste generation. An estimated thirty thousand (30.000) metric tonnes of food wastes from the hospitality sector are produced in the area of the project annually. The management of waste is a major component of the Local Authorities' annual budget and management should provide optimal savings and benefit the community and the environment.

The project's actions aim to reduce the generated food residues by -0.5% annually.

Data

Reused quantity of food waste 2018 (7.5.2018 – 31.10.2018): **149.5 metric tonnes** (diversion from landfill: 0,5%).

Reused quantity of food waste 2019 (3.6.2019 – 31.10.2019): **144.2 metric tonnes** (diversion from landfill: 0,48%).

Reused quantity of food waste 2020 (20/6/20 – 16/12/20): **250.0 metric tonnes** (diversion from landfill: 0,83%).

Total = **543.7** metric tonnes of food residuals (Total diversion from landfill: **1.8%**)

Evaluation

During the whole period of the project, in total **543.7 metric tonnes** have been collected and treated (dried) in the pilot unit. This quantity has been recycled and consequently diverted from landfill. Therefore, this means that from the 30.000 metric tonnes of food waste that are produced in the area of the project from the hospitality sector, the 29.456,03 metric tonnes need to be disposed in landfill, thus 1.8% less. The project's actions diverted on average annually the **0.6%** of the hotels' generated food residues

1.2. Resource efficiency - green circular economy

Description of indicator and target value

No. of companies where green circular economy practices are implemented: 5

During the project and up to the end of it was estimated that at least 5 companies where circular economy practices are implemented will be involved. Such companies are relative to the waste management, hotels, animal farms, etc. When a full unit will be developed more than 50 companies is estimated to be involved.

Data

Number of companies where circular economy practices are implemented (2018): 4 hotels

Number of companies where circular economy practices are implemented (2019): 4 hotels from previous year, 1 new hotel added and 1 catering service. In total 6

Number of companies where circular economy practices are implemented (2020): 5 hotels, 12 supermarket's branches, 1 catering service and 1 restaurant. In total 19

Evaluation

The last operational period of the project, 19 companies where green circular economy practices are implemented have been involved with the project. The project achieved the aimed targets in terms of companies where circular economy practices are implemented.

1.3. Greenhouse gas emissions

Description of indicator and target value

Avoidance of GHG emissions

Avoidance of CO₂ by **50 metric tonnes CO₂eq up to the end of the project.**

Avoidance of Other greenhouse gases (CH₄) by **650 metric tonnes CO₂eq up to the end of the project.**

The reduction of GHG contributes positively to the mitigation actions of Climate Change.

Data

The decomposition of food residues disposed in a landfill is estimated that generates between **120** and **220** metric tonnes of biogas (carbon dioxide and methane), which corresponds (assuming that the biogas consists of 53% CH₄ and 47% CO₂) to the emission of **1.540** tonnes of carbon dioxide equivalent (t eCO₂) per tonne of food residues (t_{FR}) disposed (CH₄ = 1.445 t eCO₂/t_{FR} and CO₂ = 0.095 t eCO₂/t_{FR}) and **2.545** tonnes of carbon dioxide equivalent per tonne of food residues (FR) disposed (CH₄ = 2,341 t eCO₂/t_{FR} and CO₂ = 0.204 t eCO₂/t_{FR}), respectively.

The F4F process is estimated that emits **0,192** metric tonnes of eCO₂ per input tonne of food residues dried and thus this value extracted from the GHG emissions due to diversion of the food residues from landfill.

During May and October 2018, one hundred and fifty (**149,5**) metric tonnes of hotels' food residues have been diverted from landfill, resulting in the avoidance of **380,4 metric tonnes of CO₂eq**. Thirty-seven (**37**) metric tonnes of dried animal feed were produced as a result of the initial operation of the Solar drying/ Pasteurisation pilot unit.

For the period June – October 2019, one hundred and forty-four metric (**144,2**) tonnes of hotels' food residues have been diverted from landfill, resulting in the avoidance of **367,0** metric tonnes of eCO₂. Twenty-eight (**28**) metric tonnes of dried animal feed were produced as a result of the second operation period of the Solar drying/ Pasteurisation pilot unit.

For the period June – December 2020, two hundred and fifty metric (**250,0**) tonnes of hotels' food residues have been diverted from landfill, resulting in the avoidance of **636,3** metric tonnes

of eCO₂. Fifty-eight (**58**) metric tonnes of dried animal feed were produced as a result of the second operation period of the Solar drying/ Pasteurisation pilot unit.

During the entire operation of the F4F pilot unit, the emission of **733 - 1.280 metric tonnes of eCO₂** have been avoided.

Details of each operational period of the project are presented in Table 1 and Table 2. Both minimum (Table 1) and maximum (Table 2) potential biogas generation is included in the calculations.

Table 1. Food residues diverted and avoided GHG emissions of the F4F Project [*for 120 m³ of biogas generated per tonne of food residues disposed*].

	Food residuals diverted from landfill	Avoidance of eCO ₂ emissions (CO ₂)	Avoidance of eCO ₂ emissions (CH ₄)	Total	-F4F emissions of eCO ₂	Net avoided eCO ₂ emissions
May - October 2018	149,5	14,2	216,0	230,2	28,7	201,6
June- October 2019	144,2	13,7	208,4	222,1	27,7	194,5
June -December 2020	250,0	23,7	361,4	385,1	47,9	337,1
Total:	543,7	51,6	785,9	837,4	104,3	733,2
KPI	450	50	650			700

Table 2. Food residues diverted and avoided GHG emissions of the F4F Project [*for 220 m³ of biogas per tonne of food residues disposed*].

	Food residuals diverted from landfill	Avoidance of eCO ₂ emissions (CO ₂)	Avoidance of eCO ₂ emissions (CH ₄)	Total	-F4F emissions of eCO ₂	Net avoided eCO ₂ emissions
May - October 2018	149,5	30,6	349,9	380,4	28,7	351,8
June- October 2019	144,2	29,5	337,6	367,0	27,7	339,4
June -December 2020	250,0	51,1	585,2	636,3	47,9	588,4
Total:	543,7	111,1	1272,6	1.383,8	104,3	1.279,5
KPI	450	50	650			700

Evaluation

The pilot Solar drying/ Pasteurisation Pilot Unit has successfully been operated on a consistent basis, with no deviations from the set targets for KPI. Swift Action was taken (additional collection of food residues from supermarkets and the Heraklion army's restaurant) to avoid the consequences of the SARS-Covid 19 pandemic (SARS-CoV-2) and its impact on the tourist sector of Crete (Greece), in 2020-2021.

1.4. Resource Coverage / Range of the environmental / climate change impact

Description of indicator and target value

Total human population and area to be affected by the project

Total human population to be affected by the project (mandatory for floods/droughts, air, noise, climate adaptation): **11.000,00 of individuals** to be affected by the project

Permanent Population: **1.000,00 of individuals** to be affected by the project

Visitors / tourists: **10.000,00 of individuals** to be affected by the project

Total area to be affected by the project: **400 km² of total area** to be affected by the project

Data

7 May 2018 – 31 December 2020 (for the three operational periods of the project):

Total human population to be affected by the project (mandatory for floods/droughts, air, noise, climate adaptation): **More than 13.000,00 of individuals** were affected by the project, as more than estimated food waste quantity has been diverted and was utilized.

Permanent Population: **1.250,00 of individuals** was affected by the project

Visitors / tourists: **less than 10.000,00 of individuals** were finally affected by the project, as due to the covid-19 period the visitors / tourist were fewer than initially estimated.

Total area to be affected by the project: **400 km² of total area** was finally affected by the project as foreseen. There was any deviation in the estimated area of the project. The main difference is that beyond the hotels that participate in the project, also supermarkets were added, but into the same area.

Evaluation

The project achieved the aimed targets in terms of population and total area.

1.5. Implication of NGO (mandatory) including interventions supporting EU environmental and/or climate change policies and of other stakeholders

Description of indicator and target value

NGO: 3

Local Authorities: 2

Regional Authorities: 1

other interventions supporting EU environmental or climate change policies: 1

Data

NGO: 7

Local Authorities: 3

Regional Authorities: 1

other interventions supporting EU environmental or climate change policies: 1

Evaluation

5 NGOs related to the process have been involved with the F4F project. These are stakeholders mainly involved with the waste management, food waste “producers”, local authorities, as well as feed producing entities, in a meaningful way.

From the waste management sector.

Hellenic Solid Waste Management Association (HSWMA). Concerning the waste management sector there was an official communication by HUA (Professor Lasaridi) with the General Secretary of the Management Board (Mr Konstantinos Moustakas) of Hellenic Solid Waste Management Association. Mr Moustakas has been informed about the role and the actions of the F4F project and he was notified for the results and development of the F4F project. Also, as HSWMA is a member of the International Solid Waste Association (ISWA), there is a continuous interaction between members of ISWA and HSWMA. ISWA is the international network of waste professionals and experts whose mission is “to Promote and Develop Sustainable and Professional Waste Management Worldwide and the transition to a circular economy.”

NETWORK OF SOLID WASTE MANAGEMENT BODIES. The Network of Solid Waste Management Bodies (FODSA Network) is the body of scientific and syndicalism expression of the Solid Waste Management Bodies (FODSA) of the country. Within the LIFE-F4F project, Prof. Manios from HMU had relevant meetings with Mr Papadakis G., the manager director of FOSDA of Herssonissos. The involvement of the FODSA was mainly in the proposals for the waste management municipal taxation according to the new Law 4819/2021.

From the sector of the feed entities.

The European Association for Animal Production (EAAP) includes 11 Scientific Commissions, one of which is the Nutrition Commission. Partners from AUA have contacts with the committee of this commission and they have discussed the purpose and the results of the project. Within this contact, the project was hosted at the Annual Scientific Conference organized by EAAP in 2020, where the results and the scientific works realized in the framework of the F4F project were displayed and posted through the EAAP website.

FEFAC (European Feed Manufacturers' Federation) represents all European feed industries by providing technical, commercial, and legal support to its members. FEFAC's contribution to the FOOD4FEED project has been significant in providing legal support for the product to be legally marketed in the near future and informing its members about its production and features. FEFAC, aiming to implement the circular economy in its sector, is in constant discussion with the European Union, in order to seriously consider the possibility of using this F4F product as a dietary component at least in pets and in the next future in monogastric productive animals. The ultimate goal is the protection of the environment and natural resources, through the saving and utilization of valuable nutrients of the residues of all kinds of food.

From the animal feeding sector.

HELLENIC FUR FEDERATION. There was an involvement in the project of the Hellenic fur federation by HMU, as the final product has been sent to them and evaluated as feed component for fur animals. There was also a contact, through the Hellenic Fur Federation, with the International Fur Federation, which as an international Federation, is supporting EU on environmental policies and informed project partners about the opportunities of the final product in EU units for fur animals, mainly in Denmark.

ANIMAL WELFARE ASSOCIATIONS IN HERAKLION OF CRETE. There was an involvement in the project of the Animal Welfare Association, as the final product has been sent to them and evaluated as feed component for pet animals. There was an interaction concerning some notes for the mixtures of raw materials in order to optimize the final nutrient content.

From the food waste “producers” sector.

HELLENIC HOTELIERS’ FEDERATION. Prof Manios, from the project’s start up had intent interaction with the hoteliers federation, mainly from the prefecture of Crete. There was a substantial involvement and interest by the federation as many hotel managers were also involved in meetings and discussion, providing advice and suggestions for the needs of hotel units mainly in the food waste production and source separation into their units.

Local Authorities

Municipality of HERAKLION, Municipality of HERSONISSOS, and Municipality of MALEVIZI. These three municipalities were involved in the project with the participation of the hotels and supermarkets of their prefecture.

Regional Authority

From the REGION OF CRETE, the Department of Veterinary there was an implication concerning the information about the relevant legislation and advises about the full-scale operation unit. It seems that all the previously mentioned indicators have been achieved during the project.

Interventions supporting EU environmental or climate change policies

Contact with a member from the European Commission, with a letter referring the F4F project, the aim, the product, the results, and the requested legislation changes, that should be referred in the commission and taken into consideration.

1.6. Information and awareness- General public reached and/ or made aware of

Description of indicator

Website (number of individuals reached): 15.000 visits

Other tools for reaching/raising awareness of the general public

Events/exhibitions; print; other media (videos, broadcasts): 5,000 individuals

No. of copies of articles, newspapers or brochures distributed (print media): 25

Active participation in events: 500

Surveys carried out regarding awareness of the environmental/climate problem addressed (only obligatory for information and awareness projects)

General public (no. of individuals covered/survey): 500

Data

Website (number of individuals reached) from the beginning of the project up to the end of it: **26,702 visits (16,819 unique visits)**

Other tools for reaching/raising awareness of the general public

Events/exhibitions; print; other media (videos, broadcasts): through the dissemination events that the F4F project organize or participate, the printed material distributed, the participation in conferences, the printed and electronic press releases and finally, through the F4F video distribution, more than **8,000 individuals** have been informed.

No. of copies of articles, newspapers or brochures distributed: more than 23 press releases and 8 articles in newspapers and have been distributed during the project and 3 different leaflets have also been distributed during dissemination events. In total **34**.

Active participation in events: **800**

Surveys carried out regarding awareness of the environmental/climate problem addressed (only obligatory for information and awareness projects)

General public (no. of individuals covered/survey): 91 by FUB, 108 by AUA, 12 by HMU and 246 by HUA. In total, **457**

Evaluation

Withing the project's progress seems that indicators that concern information and awareness have been almost all of them achieved. However, it should be mentioned that due to COVID-19, the face-to-face interviews was difficult to be realized.

1.7. Capacity building

Description of indicator

Networking and other professional training or education

Professionals (No. of individuals trained): 200

Networking (No. of individuals): 80

Conferences (No. of individuals): 50

Open days – workshops (No. of individuals trained): 200

Data

Professionals (No. of individuals trained): **420**

Networking (No. of individuals): **120**

Conferences (No. of individuals trained): **195**

Open days – workshops (No. of individuals trained): **360**

Evaluation

The project achieved the aimed targets in terms of capacity building.

1.8. Jobs

Description of indicator and target value

Full-time equivalents (FTE) - Permanent (no. of FTE): 12,00

Unskilled: 2,00

Skilled: 10,00

Data

Full-time equivalents (FTE) - Permanent (no. of FTE): **18,00**

Unskilled: **9,00**

Skilled: **9,00**

Evaluation

For the operation of the pre-treatment unit 4 unskilled people will be requested (hand sorting), 1 for the general overview of the operation of the drying unit and 4 for the food waste collection support. The skilled permanent staff will be 1 manager, 1 production engineer/supervisor, 1 Sub-engineer / general duties, 1 secretarial support, 1 chemist for the requested analyses of the produced products and 4 drivers. The indicators concerning creation of jobs have been achieved.

1.9. Economic growth

Description of indicator and target value

Running cost/ operating costs during the project and expected (in case of continuation/ replication/ transfer after the project period): 200,000,00 €/year

Capital cost expected (in case of replication/ transfer/ continuation after the project): 1,500,000,00 €

Savings/ revenue expected in case of replication/ transfer/ continuation after the project: 2,000,000 €/year

Payback time: 3 years

Continuation/replication/transfer scope:

<i>Continuation and replication:</i>	1
<i>Continuation - Bank loans and others:</i>	1
<i>Replication - Public funding & bank loans:</i>	3

Data

According to the F4F – BPLAN that has been developed, two scenarios have been evaluated for a full-scale unit with capacity of more than 10,000tn/year.

1st scenario.

Development of 4 solar drying units (12m width and 120m length each one), with all required equipment and the relevant pre-treatment unit.

Running cost/ operating costs expected, in case of replication, after the project period: about 600,000.00 €/year.

Capital cost expected, in case of replication, after the project is estimated at about **4,250,000.00 €**

Savings/ revenue expected in case of replication/ transfer/ continuation after the project: **500,000.00 – 700,000.00 €/year**

Payback time: **4.7 – 6.3** years

Continuation/replication/transfer scope:

<i>Continuation and replication:</i>	1
<i>Continuation - Bank loans and others:</i>	1
<i>Replication - Public funding & bank loans:</i>	3

2nd scenario.

Development of 3 solar drying units (12m width and 120m length each one), with all required equipment, supported with sub-floor heating system and the relevant pre-treatment unit.

Running cost/ operating costs expected, in case of replication, after the project period: 450,000.00 €/year.

Capital cost expected, in case of replication, after the project is estimated at about **3,400,000.00** €

Savings/ revenue expected in case of replication/ transfer/ continuation after the project: **400,000.00 – 535,000.00** €/year

Payback time: **4.4 – 5.8** years

Continuation/replication/transfer scope: *Continuation and replication: 1*
Continuation - Bank loans and others: 1
Replication - Public funding & bank loans: 3

Evaluation

The projected estimations of the Business Plan, based on the operational data of the pilot unit, for a full-scale plant with an annual capacity of 10.000 tonnes are within the set targets values.

2. Epilogue

The Key Project-level Indicators (KPI) are a measurable value that demonstrates how effectively the F4F project is achieving key objectives. KPIs set for the F4F project are referred to a full-scale implementation of the F4F process, after the end of the project.

The F4F process has made significant progress towards the KPIs, during the entire period of operation. Five hundred and forty-four (544) metric tonnes of hotels' food residues have been diverted from landfill (KPI = 450), resulting in the avoidance of 733-1.280 metric tonnes of CO_{2eq} (KPI = 700). One hundred and twenty-three (123) metric tonnes of dried animal feed were produced as a result of the three operational periods of the Solar drying/ Pasteurisation pilot unit.

The pilot Solar drying/ Pasteurisation Pilot Unit has successfully been operated, with no major deviations from the set targets.