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Final Report

Covering the project activities from 01/09/2016[1] to 31/03/2021

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<31/03/2021>

LIFE PROJECT NAME or Acronym

<LIFE ECOMETHYLAL>

Data Project

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Data Beneficiary

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[1] Project start date

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2. List of key-words and abbreviations

Waste recycling, plastic waste, valorisation, gasification.

NRPW – Non-Recyclable Plastic Waste
TWS – Technological Watch Service of AIMPLAS.
CHGP – Catalytic Hydro-Gasification Plasma
KoM – Kick of Meeting
IPR – Intellectual Property Rights.
LCA – Life Cycle Assessment
FS – Financial Statements

3. Executive Summary

The project LIFE ECOMETHYLAL aims to demonstrate the valorisation of current non-recyclable plastic waste (NRPW) to obtain methylal, a highly valued and consumed solvent for the chemical industry as raw material. This valorisation has been obtained using an innovative technology for the plastic sector, an improved Catalytic Hydro-Gasification Plasma (CHGP) process, as opposed to actual landfill disposal of NRPW. The usage of CHGP is a mature technology for the treatment of homogenous biomass, but its use treating NRPW has not been demonstrated before. This demonstration has been the scope of this project, aiming to contribute significantly to the plastic "zero waste" in landfill.

The project started on 1st September 2016, with an initial foreseen duration of 36 months. Nevertheless, due to some important delays in one of the main actions of the project (the pilot plan construction), in July 2019 the beneficiary asked for an extension of the project. This extension was approved by EASME in August 2019. The official project end after the extension is 31st March 2021.

To achieve the project objectives, work was divided into 1 preparation action, 4 implementation actions, 3 project impact monitoring actions, 2 public awareness & dissemination actions, and 1 project management action.

All the deliverables have been achieved. Deliverables 2: Full pilot plant description and pictures of the different components built, Deliverable 6: Characterization of methylal obtained coming from the five plastic waste fractions studied in action B3, Deliverable 25 Report on the ecomethylal production: quantification, Deliverable 8: design of industrial plan (30 times higher than pilot plant) were especially important to confirm the progress of the project in terms of pilot plant demonstration ready to be used for different non-recyclable plastic fractions and use of the product obtained in different potential applications, industrial viability of the process to treat hight amount of residues.

Main problems encountered:

The main reasons for the initial delay in the pilot plant construction were some financial problems of BPP, who solved them obtaining new refinancing. Other problems encountered were the supply of key equipment of the pilot plant which were custom-made due to the special size of the plant. Although this was included in the contingency plan, the required time to have this equipment fully installed and in operation was higher than expected, and other technical problems arose due to their specificity. All the modifications done so far to the original plan were informed to the Monitor and Project Officer by mail in due time.

The consortium rescheduled the actions to minimize the effect of the delay. In this sense, the construction of the pilot plant was divided into two parts to minimize the delay drawbacks, prioritising the construction of the gasification unit over the synthesis one. The gasification unit was from a technical perspective the critical part or the plant since it determines the viability of the waste valorisation and the quality of the methylal to be produced. Results with the gasification unit confirmed that the waste fractions selected were adequate for its gasification, proving the technology could be adapted to the plastic sector.

The project then progressed in all the actions involved except in action B4, the only one that needed the plant to be entirely constructed. Nevertheless, some new technical issues delayed the liquid Ecomethylal production unit (Synthesis) making impossible to reach the previously proposed re-planning and, consequently, forcing the project to ask for an extension to reach its objectives.

The installations of the pilot plant on the two locations encountered different drawbacks as the adaptation of the different connections to the plant in ACTECO and the space limit in Mi-

PLAST. Fortunately, all these situations were solved with the intervention of the technical staff of all the beneficiaries.

In the last months of the project, the pandemic situation did not allow to finish the project when expected and for this reason there were several dissemination activities planned that were not arranged and there was a delay on the workshops organised in ACTECO and MI-PLAST.

Main Achievements

The main achievements in the different proposed actions have been the following ones:

- Action 1. Technical update of project starting: Summary of the state-of-the-art on thermal processes from plastic was produced. Statistics on plastic waste and their recovery were obtained, including their environmental impacts and legislation related to plastic waste disposal and its recovery as per project aims. Methylal market for industrial was reviewed, confirming the viability to produce it. EU produces only around 6% of the 800 kt/year of the estimated methylal consumption.
- Pilot Plant Construction: a full running pilot plant was ready at the end of July 2019, several modifications in the gasification unit improved the quality of the methylal synthesis and the productivity.
- Treatment and Conditioning waste: the NRPW wastes selected come from the following sectors: packaging, electric /electronica and automotive. The fractions selected were grinded up to 2 cm to be use as raw material in the ECOMETHYLAL treatment process. The properties of the different samples are included in D3: technical sheets.
- Running optimization of pilot plant & replicability in Croatia: the pilot plant start running in BPP, treating first 1700 kg of waste and later 500kg, in September, it was moved to ACTECO, where 900 kg were treated and finally transported to MIPLAST to ensure the replication with the treatment of 500 kg more of waste. D25 includes the ecomethylal production quantification.
- Characterization of the Methylal obtained in the CHGP and comparison with the commercial ones: The purity of the methylal obtained will determine the application, when less yield is obtained in the recycling process, the main applications are, paintings, adhesives, and coatings in the case of higher purities the methylal can be used as electrolyte in batteries applications.
- Monitoring of the environmental impact of the project actions & transference to EU. The implementation of an ECOMETHYLAL treatment of non-recyclable plastic waste (NRPW) has an environmental improvement in different impacts such as: Eutrophication, Global warming, Abiotic depletion, elements and Abiotic depletion, fossil fuels. This impact reduction is given by the sum of two effects, the recycling of these wastes and the use of the methylal produced (replacing a methylal of petrochemical origin).
- Life performance indicators: A control of the project and its results has been carried out through performance indicators. In general, all the objectives have been met, although it is observed that the reduction in energy consumption is less than expected, due, to the inherent characteristics of a thermal process, such as gasification, which also affects CO_2 emission and global warming.
- Monitoring of the socio-economic impact of the project actions & transference to EU: socio economic aspects were considered from the point of view of the implementation of a non-recyclable plastic waste treatment plant, in the D13 there were analysed the questionnaires

circulated during the project implementation. The companies attending the workshops answered to it. Technical, commercial and legal barriers were considered.

- Dissemination and communication of the project impacts: Website counting on 5,632 visits; A total of 38 press releases with 79 impacts, the first one with 42 impacts; 4 seminars with a total of 2,200 attendees, 7 conferences with a total of 1,650 attendees; 15 Fairs; 5 LIFE events; Networking with 5 European projects; 500 hard copies and more than 700 downloads of Layman's report the first two months after the project ended; 2 specific LIFE-ECOMETHYLAL workshops and one International Publication; More than 150 companies interested in the CHGP technology to develop a new business line or to manage their waste.

The application of the CHGP technology has been very attractively welcomed by stakeholders of the sector to treat NRPW fractions.

It has been shown that it is possible to treat non-recyclable waste using a combined gasification-synthesis technology, obtaining a substance (methylal) of interest to the industry.

4. Introduction

The use of plastic materials is extended to almost all sectors, being the plastic waste generated constantly increasing. During the period 2006-2018 the plastic waste collected increased 19% in EU28+NO/CH, landfilling around 7.25 million tonnes of waste[3] that produces an environmental impact besides not reducing plastic production. The plastic deposited in landfills does not contribute in any way to the recovery of materials and energy and, therefore, it is very inefficient in terms of resource utilisation, environmentally, economically and socially. Indeed, according to Plastics Europe[4], if landfilling of plastics is eliminated in Europe by 2025, there is a potential cumulative saving of 60 million tons of plastic waste by 2037, equivalent to 750 million barrels of oil.

Currently, waste to energy process and incineration are common options for NRPW elimination in comparison with landfill disposal, both from environmental and legal perspectives. The recovery of plastic waste is a current necessity and key objective in EU policies. This situation is more critical in countries like Spain and Croatia, with close to 50 and 75%, respectively, of plastic landfilling waste management strategies. This scenario is also observed in most countries without a landfill restriction implemented. Countries with landfill bans foster higher recycling rates[3].

European legislation (Waste Framework Directive, 2008/98/EC of the European Parliament and the Council, 19th November 2008, about wastes and through which determined Directives are abolished) introduces a five-step waste hierarchy where prevention is the best option, followed by re-use, recycling and other forms of recovery, with disposal such as landfill as the last resort. However, the conventional recycling is not always possible. Part of the plastic waste containing mixed plastics (normally immiscible in the same solvent due to the different chemical structure of the compounds present) is heavily soiled or degraded, so they currently cannot be recycled through traditional recycling processes. These residues are those called non-recyclable plastic waste (NRPW). There are other technologies that can valorise them using plastic waste high calorific value, and that are complementary to the traditional mechanical recycling, such as waste gasification, pyrolysis for chemicals and

[3] Plastics Europe, 2020. Plastics-the Facts 2020. Analysis of European Plastics Production, Demand and Waste Data (Brussels, Belgium).
[4] Plastics Europe, 2015. Plastics-the Facts 2014/2015 and Analysis of European Plastics Production, Demand and Waste Data (Brussels, Belgium).

energy production, but they are less efficient, less versatile, dirtier and more expensive that the CHGP technology proposed in LIFE-ECOMETHYLAL.

In this context, the LIFE-ECOMETHYLAL project focuses on the plastic waste and its recovery in valuable chemical products with low carbon footprint and with a relevant commercial demand in different markets as it is methylal (dimethoxy methane). LIFE-ECOMETHYLAL goal is to demonstrate the technical, environmental and economic viability of the CHGP technology on NRPW, obtaining as a result of this gasification an industrial grade of methylal. Compared to other technologies that generate residues that need to be treated, CHGP process leaves only a sand type material containing the mineral fraction that could be reused as a fertiliser or in the construction sector. Additionally, CHGP technology generates less CO_2 and no furans nor dioxins due to the cracking that occurs when the pyrolysis gas is exposed to the high temperature of the rotating plasma torch.

The LIFE ECOMETHYLAL project has shown that it is possible to treat non-recyclable plastic waste through a combined gasification and synthesis process.

The project has produced very positive environmental results:

- 3.6 tons of plastic have been prevented from being deposited in landfills.
- 1,772 tons of CO2 eq have been saved.
- The energy consumed has been reduced by 14,031 MWh.
- A total of 628 litres of methylal have been produced.
- A gasification process yields of 90% has been obtained.
- A yield of the synthesis process of 40% has been obtained.
- A yield of 36% has been obtained in the ECOMETHYLAL process.

In the long term, five years after the end of the project, the construction and implementation of the ECOMETHYLAL technology is planned in 4 industrial plants. This implementation would allow a reduction of 12,600 tons of waste in landfill / year, a reduction in energy consumption of 108,039 Mwh / year and a reduction of 8,421 tons of CO2 eq / year.

The implantation of these plants will also suppose economic and social benefits of the creation of new direct and indirect jobs (an average of 10 jobs per industrial plant installed), opening new markets for the plastic waste managers of plastic waste and to provide low footprint chemicals for the end users.

Additionally, it has been achieved:

- Collaborate in improving the economic and environmental efficiency of recycling companies to achieve the objective of "zero waste" (improvement of competitiveness).
- Demonstrate the local replicability of a plastic waste recovery strategy to other EU countries.
- To contribute to legislation, such as priority objective 2: “to turn the Union into a resource-efficient, green and competitive low-carbon economy” 7th EAP – The new general Union Environment Approach.

5. Technical part

5.1. Technical progress, per Action

One preparatory action (Action A) and four implementation actions (Actions B) have been developed to reach the project objectives. In addition, three monitoring actions (Actions C) complement the technical work developed to monitor its impact from different points of view: environmental, economic/logistic, legislative and socio-economic.

Beyond this, two actions for public awareness and dissemination of results (Actions D) and one action on Project management (Action E) have been developed.

ACTION: A1 Status of the project starting

Planned dates:	Start: September 2016	Duration: 3 months	End: November 2016
Actual dates:	Start: September 2016	Duration: 3 months	End: November 2016

- **Global status**: finished
- **Outputs achieved:**

  The work carried out so far is in line with the work scheduled at the beginning of the project. This includes:

  - Information collection and analysis of state of art, standards, legislation and other pilot plant construction (permits, materials etc).
  - Deliverable preparation.

Main results/Conclusions

- The waste hierarchy states that chemical recycling is a priority for energy recovery.
- The thermal processes to recovery plastics are complementary to the mechanical recycling.
- The gasification used in the project gives us a methyl product, therefore it is a process of chemical recycling.
- The methylal can be employed in the chemical industry (chemical intermediate and solvent) as well as fuel or fuel additive.
- The environmental impact of the process that is demonstrated in the LIFE ECOMETHYLAL project must be controlled and minimized.
- There is a lot of legislation related to the project. The most critical, and therefore necessary to keep in mind is the “Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)”. This legislation establishes the need for authorization in the following case: “disposal or recovery waste in waste incineration plants or in waste co-incineration plants: a) for non-hazardous waste with a capacity exceeding 3 tonnes per hour; b) for hazardous waste with a capacity exceeding 10 tonnes per day”.

ACTION: B1 Pilot plant construction

Planned dates: Start: Dec. 2016 Duration: 11 months Initially planned End: Nov. 2017
Planned End after Extension: Sept. 2019

Actual dates: Start: December 2016 Duration: 33 months End: December 2019

- **Global status**: finished
- **Outputs achieved:**

Burner with one dual gas feeding line (for syngas as working gas and propane as starting gas) was required to be built custom-made by the selected manufacturer, in order to make the gasification skid more compact due to the fact that this EcoMethylal production line was going to be transported to ACTECO and to Mi-PLAST project partners. This proposition was accepted by the manufacturer and they had to visit several times BPP's facilities to assure that the unit will work properly with the gasifier design. Their only motivation was that this work will enable them to manufacture future units for BPP.

Small syngas compressors and small steam plasma units for the syngas are not common in the industrial market and they both had to be custom-made built at a reasonable price. Manufacturers were positive to collaborate but none of them had one unit in stock. They are used to manufacture either large scale or laboratory scale compressors. Both options were very expensive. Small industrial scale units were required; therefore, it was necessary to wait several months to receive them in BPP's facilities.

Modified Catalysts Formulation had to be arranged with providers, to bring catalysts under regular commercial code but with the percentages and additives needed for the project. To maintain the supplier's guarantee, it was required testing on their side. Testing and formulation required were made fast but took more time than the programmed one.

Several clogging problems appear in the feeding system that were solved changing the screw and ensuring the dimensions of the waste received with the pre-treatment.

Several optimizations have been arranged during the last month of the action, such as: reduction of the methylal losses with the air used in the oxidation reactor with a new equipment separating the air used after the condenser.

All these problems were solved, achieving at the end of the action the final construction of the LIFE ECOMETHYAL plant.

Main results/Conclusions

- The construction of the pilot plant is finished, and preliminary general operation test are being carried out.
- The last modifications introduced in the Gasifier have improved drastically the constant quality of the obtained syngas.
- The quality of the syngas obtained meets the needs of the Methylal synthesis process.
- The by-product water is used in the gasification process, mixed with the plastic waste.
- As results of the above-mentioned modification in the synthesis process, an increasing productivity has been observed.

Below there are some pictures of the plant; on the left the gasification unit and on the right the synthesis unit.

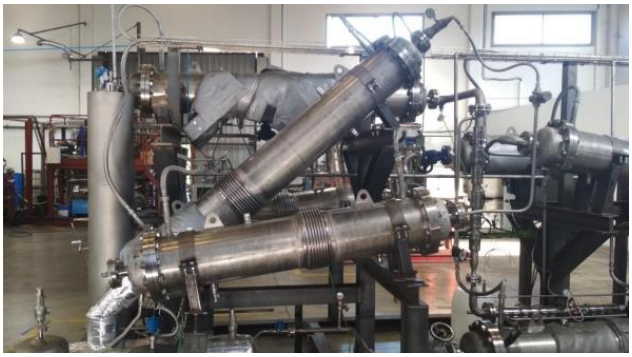

Figure 1. Pictures of the plant.

ACTION: B2 Treatment and conditioning waste

Planned dates: Start: Oct. 2016 Duration: 17 months Initially planned end: Feb. 2018
Planned End after Extension: October 2019

Actual dates: Start: October 2016 Duration: 34 months End: December 2019

- **Global status**: Finished
- **Outputs achieved:**

Analysis of the equipment necessary to adapt the waste processes in ACTECO required to manage the waste to be processed in the pilot plant.

Evaluation of the requirements for the installation of the pilot plant in ACTECO, regarding services and utilities (electricity, power, footprint and required space for the correct operation, fluid connections…). Definition of the space to install the plant and initial planification of the transport from BPP's facilities.

AIRESA visited companies from the three sectors selected (packaging, automotive and electric & electronic and even textile) to supply the raw materials for the project. In Valencia, the non-value plastic waste of automotive industry is able to provide the greater quantity of raw material to the project, then, to a lesser extent, the waste from the packaging sector, and in the last place, the plastic waste of electric/electronic sector.

AIRESA acquired the machinery needed to treat and condition the plastic waste to reach BPP's requirements: Shredder Scoiner suitable for all type of plastic and a Grinder Mayper also suitable for all type of plastics.

Automotive waste

Electric – Electronic waste

Packging waste

The selected waste streams by AIRESA were characterised physical and chemically, being adequate for its treatment in the CHGP plant. There were not important differences in the results obtained in each of the three sectors selected, so it is not foreseen a high impact based in the different composition of mixed plastic waste disposed to landfill among European countries. Only the ash content of the electric & electronic sector was significative different from the other two streams.

The plant built and tested at the BPP facilities was dismantled and transported to the ACTECO facilities.

The plant was installed in ACTECO considering the mechanical and electrical connections available as well as the gas line compressed air and water for the plant operation.

Gasification tests were performed with the mixture of plastic waste streams previously AIMPLAS perform the characterization of each residue to adapt the technology to it content.

Main results/Conclusions

- Some modifications were required in the waste pre-treatment lines to produce the waste that later feeds the LIFE ECOMETHYLAL plant.
- Although the waste streams comprise different types of waste and therefore are heterogeneous, currently in the samples treated it was not necessary to perform cleaning and extrusion of the wastes treated. SRF (Solid Recovered Fuel) waste analysis were performed to check whether they fit the purpose in the CHGP process.
- The selection of the space to install the pilot plant in the ACTECO facilities, as well as its requirements, was made.

ACTION: B3 Running optimization of pilot plant & replicability in Croatia

Planned dates: Start: Oct. 2017 Duration: 12 months Initially planned end: Oct. 2018
Planned End after Extension: October 2020

Actual dates: Start: August 2018 Duration: 38 months End: March 2021

- **Global status**: Finished
- **Outputs achieved**

Adaptation and optimization tests were carried out in the plant installed in ACTECO. The feeding system has been checked with cold and hot conditions in the pilot plant, being the waste correctly processed. The feeding flow has been adjusted to the requirements of the gasifier.

The power of the burner has been adjusted to the requirements of the gasifier.

Plastic waste samples have been successfully treated in the pilot plant when run in ACTECO facilities, confirming previous laboratory experiments.

A workshop was organised in ACTECO facilities which included a visit to the running pilot plant on the 29th of September. The event that showed the developed plant collected numerous stakeholders interested in the project development: waster managers, chemical production companies as well as administration representatives from the regional and national governments.

MI-PLAST carried several important actions and tasks through interviews and searching to define the current situation in Croatia regarding waste, waste legislation giving accent to plastic waste streams.

The experience of transport and installation in ACTECO were transferred to MI-PLAST for the preparation of the facilities, reception of the LIFE ECOMETHYLAL plant and its installation. The pilot plant was dismantled in ACTECO and transported to MI-PLAST, with the plant already installed in Croatia:

After the same and set-up, plastic waste was treated in this plant, demonstrating its operability and suitability regardless of the different proportions in the waste (different waste streams in Spain and Croatia). After the adjustments a workshop was organised in MI-PLAST on the 25th November in order to present the LIFE-ECOMETHYLAL project and the pilot plant to the most interested audience, Mi-plast put its efforts in collecting a list of chemical manufacturing companies, waste managing companies, plastics producers and associations of plastic producers, waste recyclers, collectors of electric and electronic waste, automotive sector companies. Government bodies such as The Ministry of Economy and Sustainable Development, Croatian chambers of economy, Local authorities such as City of Rijeka's department for development and entrepreneurship were also included.

After the workshop in Croatia the pilot plant travelled back to BPP facilities in Castellón in which the project test has been completed.

Among the three locations of the plant (BPP; ACTECO and MI_PLAST) an amount of 3.6 tonnes of waste was treated in total with a production of more than 540 kg of methylal. Not all the wastes were transformed into methylal, since they were used in the fine-tuning and optimization of each of the modules (gasification and synthesis) of the ECOMETHYLAL plant.

First running of the plant showed that CO_2 content was higher than expected due to an outside air leakage into the unit from the feeding system. needs to be decreased due to an air leakage. The leakage has to be detected but it seems related to the feeding system.

The final efficiency of the process is lower than expected, although it was considerably improved throughout the development of the project. Initially an efficiency of 80% was expected and a final efficiency of 36% by weight was obtained.

Main results/Conclusions

This action led to the following main results and conclusions:

- The disassembly, transport and assembly of the plant is feasible.
- The modular design is proven.
- The high hydrogen content together with the reduced light hydrocarbons content in the syngas obtained shows the good efficiency of the gasification process.
- Efficiency of the gasification process: 90%.
- Synthesis process yield: 40%
- Current performance of the LIFE ECOMETHYLAL process: 36%.

In relation to replicability in Croatia, it should be noted: 1) The replicability potential of CHGP plant in Croatia it is possible. 2) Due to the quantity of available non-recyclable waste in RC we recommended application of one module of BPP plant. 3) The national legislation on environmental protection with main reference to the waste and air is mostly harmonized with the EU legislation. New Commission Delegated Regulation (EU) 2020/2174 of 19 October 2020 (entered into force on 1 January 2021) on shipments of waste is very important for this project because this regulatory framework favours the implementation of the technology developed in the LIFE-ECOMETHYLAL project, converting locally waste that is currently hard to recycle into a chemical product used by the local industry in a profitable and sustainable way. 4) The plant can be financed from public sources, banks or private sources.

ACTION: B4 Characterisation of the methylal obtained in the CHGP and comparison with the commercial ones

Planned dates: Start: Oct. 2018 Duration: 8 months Initially planned end: May 2019
Planned End after Extension: March 2021

Actual dates: Start: June 2019 Duration: 19 months End: December 2020

- **Global status**: Finished
- **Outputs achieved:**

The methylal produced in the pilot plant was analysed and characterized to determine its composition. This characterization allows the identification of the presence of contaminants and the purity of the product.

In the synthesis process there were also involved other products such as: methanol, formaldehyde and water. The methodology selected was gas chromatography that determines the volatile and semi-volatile substances.

The applications of the current obtained methylal purity can be painting, adhesives and coating industries, if higher purity is obtained the methylal could be used as electrolyte for batteries.

The design of a higher industrial plant has been showed in D8, showing that the chemical recycling plant can be complementary of the mechanical processes with an acceptable conversion ratio reducing the carbon footprint since the emissions generated are not harmful. The plastic waste treatment at the waste management facilities avoids the transport of these materials to incineration plants and/or landfills, allowing the emissions associated with these processes to be drastically reduced.

> Problems encountered in the construction of the gasification unit delayed the construction of the synthesis part. Therefore, this action was rescheduled and started in June 2019.

Main results/Conclusions:

LIFE-ECOMETHYLAL project offers an innovative alternative to obtain methylal, improved the costs, availability, sustainability and environmental performance.

Waste managers and recyclers will benefit from the waste treatment into a new sustainable raw material instead of paying for the landfilling. The European market is hugely diverse in terms of waste management mainly due to infrastructure, legislation and strategies for each of the countries.

In the three different locations in which the ECOMETHYLAL pilot plant was running there were treated 3,600 kg of waste, which resulted in a production of 540 kg of methylal with a production ratio of 0.36 kg of methylal / kg of residue. This production ratio can be improved by scaling up the plant at an industrial level at has been estimated for the calculation that at industrial level it can be up to a 42% of total process efficiency, outside of the LIFE project frame, but as a basis the feasibility of the LIFE ECOMETHYLAL treatment is demonstrated.

The methylal market is large and, on the rise, both globally and in Europe, therefore it is expected that the flow is maintained.

The price is linked to the purity of the product, The average cost of methylal with a purity of 98% is approximately 0.028 USD/ml at laboratory scale. The purity also determines the application of the methylal in batteries, adhesives, coating and paints.

ACTION: C1 Monitoring of the environmental impact of the project actions & transference to EU

Planned dates: Start: Sept. 2016 Duration: 30 months Initially planned end: Feb. 2019
Planned End after Extension: Dec. 2020

Actual dates: Start: September 2016 Duration: 55 months End: March 2021

- **Global status**: Finished
- **Outputs achieved:**

The different waste management scenarios have been compared, analyzing different laws and situations in different countries, mainly in Spain and Croatia. These results were incorporated into the analysis carried out in action C3 "Monitoring of the socio-economic impact of the project actions &transference to EU" and in the corresponding deliverables D11 "Best practices guidelines for the replicability and transferability of the industrial plant in EU (environmental aspects)" , D13 "Socio-economic monitoring reports" and D14 "Best practices guidelines for the replicability and transferability of the industrial plant in EU (social and economic aspects)".

An environmental impact study was carried out of the different demonstration scenarios, following the international standards of application for the Life Cycle Assessment:

- ISO 14040 Environmental management – Life cycle assessment – Principles and framework.
- ISO 14044 Environmental management – Life cycle assessment – Requirements and guidelines. The Life Cycle Assessment methodology comprises four steps: (1) Definition of Goal and Scope; (2) Inventory Data collection; (3) Environmental Impacts Assessment; and (4) Interpretation of results.

Two scenarios were compared:

- The different NRPW treatment: actual and ECOMETHYLAL. In this case with different geographical scenarios (Croatia, Spain and Europe)
- The different origin of product (methylal): petrochemical (from fossil sources) and ECOMETHYLAL.

In each scenario, the different cases evaluated share the same goal and scope, but they differ on the data collected, thus in the resulted impacts.

- **Problems encountered**:

  The initial impacts of methylal of petrochemical origin were not modelled, nor were they found in the additional literature, so an analogous substance was selected as the basis for the comparison.

  As the project is based on the development of a pilot plant, the inventory data corresponds to it. This plant had a low production, and the residual heat was not used, so the impacts are high compared to a real industrial situation. Approximations were made to take this situation into account.

Main results/Conclusions

This action led to the following main results and conclusions:

- The technology developed is the modular technology, enabling its installation at the customer's home, running efficiently 24/7 with minimal human intervention.
- The possibility of installing a chemical recycling plant directly on the facilities of a mechanical recycling company allows a great synergy between the two industries, a

drastically reducing waste transportation costs and at the same time optimizing the utilization of the waste treatment lines of the mechanical recycling plant.

- The waste manager's facilities already have many of the services necessary for the operation of the chemical recycling plant as well as the permits to operate, which is a very important aspect for the rapid implementation of the chemical recycling plant.
- Two scenarios were compared in LCA:

  A) The different NRPW treatment: actual and ECOMETHYLAL. In this case with different geographical scenarios (Croatia, Spain and Europe) and B) The different origin of product (methylal): petrochemical (from fossil sources) and ECOMETHYLAL.
- The implementation of an ECOMETHYLAL treatment of non-recyclable plastic waste (NRPW) has an environmental improvement in different impacts such as: Eutrophication, Global warming, Abiotic depletion, elements and Abiotic depletion, fossil fuels. This impact reduction is given by the sum of two effects, the recycling of these wastes and the use of the methylal produced (replacing a methylal of petrochemical origin).
- This impact reduction is obtained by scaling the process from a pilot plant to an industrial size, having a continuous and stationary process, which allows optimizing energy consumption and other inputs such as nitrogen.
- This need is greater in specific scenarios, such as Spain where the energy mix presents more environmental impacts than the EU average and therefore the effect is greater.

ACTION: C2 Monitoring and measurement of LIFE performance indicators

Planned dates: Start: Sept. 2016 Duration: 30 months Initially planned end: Feb. 2019
Planned end after Extension: August 2020

Actual dates: Start: September 2016 Duration: 55 months End: March 2021

- **Global status**: Finished

Main results/Conclusions

In general, all the objectives have been met, although it is observed that the reduction in energy consumption is less than expected, due, as described in the D9 "Environmental evaluation report (LCA)" to the inherent characteristics of a thermal process, such as gasification, which also affects CO_2 emission and global warming.

In the horizon of five years, after the completion of the project, the implementation of at least 4 plants with ECOMETHYLAL technology is expected. The capacity would be variable, but it is expected that there will be 3 plants with a production capacity of 300 litres of methylal per hour and 1 plant with a production capacity of 600 litres of methylal per hour. Although, when doing the calculations, the efficiency of production of methylal from waste that was established in the project has been maintained (36%), the reality is that it is expected that with the scaling at an industrial level and some improvements in the own ECOMETHYLAL technology, this efficiency increases.

ACTION: C3 Monitoring of the socio-economic impact of the project actions & transference to EU

Planned dates: Start: Sept. 2016 Duration: 30 months Initially planned end: Feb.2019
Planned end after extension: August 2020

Actual dates: Start: September 2016 Duration: 55 months End: March 2021

- **Global status**: Finished
- **Outputs achieved:**

The main socioeconomic aspects to be taken into account in the implementation of a non-recyclable plastic waste treatment plant, similar to the one developed in LIFE ECOMETHYLAL, were analyzed.

A questionnaire was developed on the acceptance of a thermal chemical recycling process. The questionnaire that could be answered on the project's own website, in addition to being indicated in the newsletter and in the two workshops carried out, had a total of 102 responses.

The technical, commercial and legal barriers that may make it difficult for a treatment process such as the one developed in LIFE ECOMETHYLAL to enter the market were analyzed.

The legislation that must be taken into account for the implementation of a thermal chemical recycling process in Spain and Croatia was compiled, complementary to the one already compiled in the preparatory action A1 "*Status of the project starting"*of the project.

In parallel, the main aspects (economic, social and environmental) to consider for the installation of an ECOMETHYLAL plant (gasification / synthesis) for the treatment of plastic waste were analyzed. The best practices to be considered for this installation were defined.

Main results/Conclusions

The main aspects to take into account when considering the implantation of an ECOMETHYLAL plant should be:

- Geographic proximity to the waste generator.
- Local market of methylal.
- Continuous and homogeneous flow of waste.
- Waste stock
- Continuous operation of the industrial plant
- Proper sizing of the plant.
- Need for integrated environmental authorization for the plant.
- REACH compliance.
- Chemical recycling defined as material recycling.
- The market for the product obtained must be defined.
- Differentiation between chemical recycling and energy recovery.
- High calorific power of waste.
- Low halogen content of waste.

- Applicable to mixed waste.
- Pre-treatment of waste (shredding, separation, agglomeration / pelletization).
- Staff training.
- Product quality control equipment.

The main barriers to the implementation of the process are:

- Legal: 1) Failure to include references to chemical recycling in the EU recycling targets, 2) Lack of clarity/transparency in the differentiation between chemical recycling and energy recovery in thermal waste processes, 3) Disparity in the recognition of thermal technologies in the different EU countries and 4) Lack of legislation related to the end-of-waste condition for plastic waste.
- Technical: 1) Difficulties in handling the plant; requires specialized personnel more than mechanical recycling and 2) Not very homogeneous waste.
- Market: 1) Large variation in landfill prices (in some cases very low) that reduce the profitability of the process, 2) High cost and very long deadlines for the application of the REACH legislation in the products obtained in the process (registration of substances), 3) Difficulty in the commercialization of substances obtained through a thermal process (lack of market confidence) and 4) Price variation of the products obtained in the process.

ACTION D1: Dissemination Plan

Planned dates: Start: Oct. 2016 Duration: 30 months Initially planned end: Feb. 2019

Planned end after extension: March 2021

Actual dates: Start: October 2016 Duration: 55 months End: March 2021

- **Global status**: Finished
- **Outputs achieved:**

Sub action D1.1. Notice boards, project website and Layman's report:

Notice boards were designed printed and placed in each of the partners' facilities. Notice boards were designed in English, Spanish and Croatian. Some partners have printed two notice boards, one in the partner mother tongue and the other in English. In this way, we made sure that the dissemination purpose of the notice board might hit the target in a better way. (See Deliverable D15, already submitted).

The project website, http://www.life-ecomethylal.eu/ was developed and launched successfully as scheduled. It has two different types of areas: one for public audience and one private area. The public area promotes the project, allows dissemination of non-confidential results and allows public to contact the project consortium. The private area, accessible via login, includes confidential and project management documents and helps the partners to share information and communicate. (See Deliverable D16 already submitted).

Following the suggestions given by the External Monitor and the Project officer, after the Mid-Term Report, the website was regularly updated with relevant information related to the dissemination events of the project. It was also updated by including the results and their degree of achievement, with a bar showing the percentage of development in each of them.

It was also included a section about Stakeholders.

In the letter from EASME dated on 17/7/20 following the 4th Monitoring visit, it was requested to include an updated summary of the tasks carried out within each action and their results. This issue has been addressed through the 2 Newsletters published in September 2020 and February 2021, where the updated summary of the actions and their results are presented.

The visits of the websites are monitored through google analytics. There were expected 5.000 visits in the project website by the end of the project. The amount registered at the end of the project is 5.632.

Two Layman's reports have been prepared, one focused on the public, produced in English, Spanish and Croatian, and the other focused on policy makers, in English. The four of them are submitted with this Final Report as Deliverable D18.

Sub action D1.2. Networking activities with other LIFE projects:

AIMPLAS and MI-PLAST have contacted with other LIFE project through their active participation in LIFE Info-days and Networking Fairs, 3 in Croatia, 2 in Spain, and 1 online at European level with specific presentations of LIFE-ECOMETHYLAL. Those activities are described in Deliverable D17, submitted with this Final report.

Beyond this, some other specific networking meetings have been held with some European Projects like LIFE rPACK2L, LIFE EXTRUCLEAN; LIFE ZEROCABIN; Horizon 2020 BIOICEP; Horizon 2020 URBANREC.

Sub action D1.3. Other non-compulsory activities:

The LIFE ECOMETHYLAL project has also had an intensive dissemination activity through Information brochures, Articles in publications, Social networks, press releases, fairs.

A project **video was produced by October 2020**, in English subtitled in Spanish and Croatian, including an audible mention of the LIFE financial support. It is available at the link: https://www.youtube.com/watch?v=Vj5vzSVjhXI

Table. 1 Comparison of dissemination activities carried out with planned activities

Indicator of progress	Start	Planned End	Completion	Status
5 LIFE+ Information Boards	October 2016	February 2017	100%	Notice boards in Spanish, English and Croatian. (Deliverable 15)
Project Website (5.000 visits during the project life)	October 2016	February 2017	100% **(5632 visits in total)**	Deliverable 16
5 potential LIFE networking contacts for further collaboration/ business	February 2017	March 2021	>100%	Active participation in LIFE Networking Events (5): 3 in Croatia (March2017, May 2018, February 2019); 2 in Spain (May 2017, March 2020); 1 online in Brussels (April 2020) Projects (**>5**): Many contacts through the Networking events. Specific contacts with LIFE rPACK2L, LIFE EXTRUCLEAN; LIFE ZEROCABIN; Horizon 2020 BIOICEP; Horizon 2020 URBANREC
500 hard Laymans's report copies and 1000 downloads	March 2021	May 2021	72%	Layman' report already produced. It is submitted with this Final Report. 500 hard Laymans's report copies produced **720 Downloads**
5 seminar/ conferences with a total or 200 attendees minimum	October 2016	March 2021	160% of events 1550% of attendees	4 seminars with a total of 2,200 attendees 7 conferences with a total of 1.650 attendees (total 11 events)
2400 copies of project leaflets	October 2016	March 2021	100%	Leaflets designed, printed and distributed
4 sectorial articles with 20 impacts each	September 2016	March 2021	150%	9 sectorial articles with one impact each.
1 project video	At the end of the project	March 2021	100%	Available in October 2020
3 project press release with 20 impacts	September 2016, September 2017, August	March 2021	400%	1st press release with 42 impacts,33 impacts in newspaper, 8 impacts in website publications and 1 impact in radio 37 press releases more.

	2018			
3 Fairs	During the project	March 2021	500%	15 fairs: K fair (Dusseldorf 20/10/2016); Plastic Recycling Show PRS (Amsterdam 29/3/2017); Made from Plastics (Valencia 01/06/2017); Ecofira (Valencia 28/11/2017); Plastic Recycling Show PRS (Amsterdam 24/04/2018); Empack (Madrid 08/11/2017); IFAT (Munich 15/05/2018); World Recycling Plastics (Essen 26/6/2018); CONAMA Madrid (26/11/2018); Plastics Recycling Show Europe PRS Amsterdam (10/04/2019); CHEMPLAST Madrid (07/05/2019); K Plastic Fair (Dusseldorf 22/10/2019);Industry 2019 (Barcelona 22/10/209); Fira de Barcelona (Online 5/06/2020 online); Expotech 2020 (Online 16/10/2020)

Action D1 has successfully achieved the dissemination of the project objectives and results throughout different formats, channels and audience.

Main results/Conclusions

The dissemination activities have been implemented according to the plan agreed by the partners and the objectives in terms of communication set have been reached. To be noted, several articles published by Spanish media were based on partner's press release. All partners have actively participated in the project dissemination activities. The impact of the 1st Press Release was higher than expected. Attendance of project partners to fairs, technical conferences and seminars overcome the performance indicators planned. In the case of Networking activities, the number of activities is also higher than the scheduled.

There are many companies interested in the CHGP technology. The project is well received and generates great expectations among companies in the sector. All the companies have shown some interest in using this new line of waste treatment, either directly as a new business line or indirectly for the treatment of their wastes

The LIFE ECOMETHYLAL partners have contacted many different LIFE projects through their active participation in LIFE Info-days and Networking Fairs, 3 in Croatia and 2 in Spain, with specific presentations of the project, as well as 1 online at European level. Beyond this, some other specific networking meetings have been held with some European Projects like LIFE rPACK2L, LIFE EXTRUCLEAN; LIFE ZEROCABIN; Horizon 2020 BIOICEP; Horizon 2020 URBANREC.

Reactions and feedback obtained

Dissemination activities have received an overall positive feedback as shown in the achieved percentages. We have to highlight the interest of companies in the technology and project.

LIFE ECOMETHYLAL website statistics (1/09/2016 – 31/03/2021):

Nº Visits: 5,632 Users: 4,208. The top 5 in the ranking session are the following countries: Spain 32%; USA 8%; China 5%; France 3%; Netherlands 3%;

Other countries that have visited the website from EU are: Croatia, Germany, Finland, United Kingdom, Belgium, Italy, Austria and Poland.

Other countries outside EU that have visited the website are: Mexico, Brazil, India, Colombia, Japan, South Korea, Turkey, Argentina, Colombia, Philippines, Switzerland, Russia, Chile, Martinique, Ecuador and Egypt.

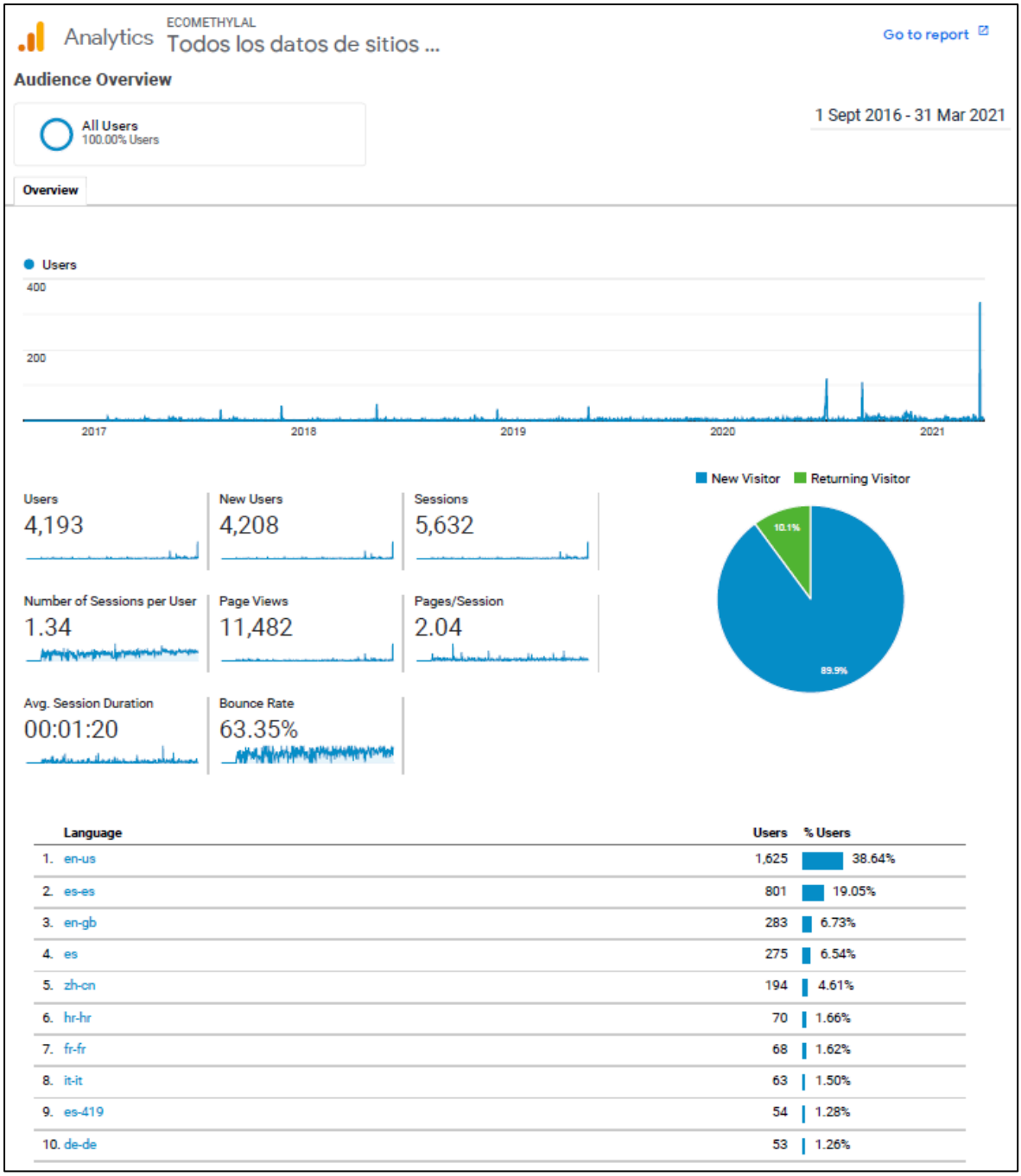

Figure 2. Web of LIFE ECOMETHYLAL. Analytics

ACTION D2: Communication of the project impacts (transference to stakeholders)

Planned dates: Start: March 2017 Duration: 24 months Initially planned end: Feb. 2019

Planned end after extension: October 2020

Actual dates: Start: March 2017 Duration: 49 months End: March 2021

- **Global status**: Finished
- **Outputs achieved**:

Sub action D2.1. Communication plan to stakeholders: The consortium partners prepared an internal list of 122 stakeholders to whom inform about the results of the project. Their profiles cover the whole value chain such us chemical, foam and paint manufacturers and chemical distributors as potential end users of Methylal, public bodies/administration, plastic industries and waste managers as plastic providers, as well as other related institutions.

Many different actions have been carried out to inform about the project positive impacts to the above referred stakeholders and to the society, industry and scientific community in general.

The main outputs are:

- Organization of 10 workshops organized by BPP in their facilities, including the visit of the pilot plant, for different interested companies most of them operate in Spain and international companies outside the European Community, one of these workshops was specifically held for a Japanese delegation another was for a Moroccan company and another for a delegation of South America company. The rest were held for Spanish companies.
- 13 In-situ visits to the pilot plant for specific interest Companies, organized by BPP
- 15 Online meetings organized by BPP
- 48 Meetings Face to face held by AIRESA through visits to potential clients specifically for LIFE-ECOMETHYLAL communication purposes.
- Participation of ACTECO in some specific Forum with Communication Purposes like the UNIDO Convention in Túnez 2018, Fakuma International Place for plastic processing.
- Visits to 4 Companies in Italy by ACTECO
- Specific contacts have been made by AIMPLAS with 25 interested companies.
- Communication with local/regional Authorities, directly, through the active participation in 5 LIFE Networking Events, and due to the synergies with some other European projects
- Organisation of the LIFE ECOMETHYLAL Workshop – Alicante, Spain. Face to face and online on 01/10/2020. Hosted by ACTECO, with the participation of BPP and ACTECO. 68 attendees
- Organisation of the LIFE ECOMETHYLAL Workshop – Rijeka, Croatia. Face to face and online on 25/11/2020. Hosted by Mi-Plast with the participation of BPP and Mi-Plast. 80 attendees
- The publication of an article in THE PROJECT REPOSITORY JOURNAL- Volume of 9 April 2021, that substitutes the initially foreseen LIFE general workshop in Brussels,

which due to the Pandemic situation could not be held.

Deliverable D 20 includes extended information on the above mentioned activities.

All these activities, due to its dissemination character are also listed in D19. Final clipping on dissemination activities.

Sub action D2.2. Exploitation and Business Plan:

The Exploitation and Business plan is obviously conditioned by the current TRL, which at pilot plant level can be positioned at 6. BPP plan is to be able to install and operate an intermediate size industrial plant as a preliminary step to scale the technology to TRL 9, co-investing with an Early Adopter that relies on the technology. A local chemical industry has been already identified for this purposed. The development of this plant will derivate into the building up of the 4 plants (1 of 600l/h and 3 of 300l/h) that have been identified in the KPI for the 5 years after the end of the project.

BPP has offered different opportunities to the Consortium partners: ACTECO, AIRESA and MI-PLAST in best and reasonable conditions than the other potential clients in the market.

Deliverable D21 presents the Exploitation and Commercialization plan to ensure project's continuity.

- Due to the Pandemic situation caused by COVID-19, some of the activities had to be made online. The final event related to the LIFE general workshop in Brussels has then be substituted by the publication of an article in THE PROJECT REPOSITORY JOURNAL- Volume published on 9 April 2021.

Comparison with the planned activities

The following table shows the level of consecution of the objectives of Communication activities.

In practice, the communication activities cannot be separated from Dissemination activities. Therefore, some of the objectives addressed through communication activities are also results from Dissemination activities. The following table shows the levels reached, considering the initial foreseen at the proposal time.

Table 2. Level of consecution of objectives in Communication activities

VHY (how help the project) & WHO	Target groups	Type or information	Communication channels	Goal	Objective	Reached
The presentations in those forums will raise awareness on the great potential of the new technology to be adapted/improved for other streams of waste contributing to the global aim of ZERO waste in 2030. AIMPLAS, MI-PLAST	Scientific Community (Universities, RTDs)	Reports and presentation on the general advance of knowledge and new potential applications	Congresses, Lectures, conferences, journals	To share knowledge	>300 people	>3.000

The potential clients of the technology applied for the plastic waste will know the economic and environmental benefits of ECOMETYLAL	Chemical and plastics processing industries. Chemical and plastics product developers	Information on the technologies applied and the improvements in properties' performance of the novel methylal.	On-site visits, videos, trade fairs, TECHNICAL WORKSHOPS	To share experiences, to mobilise sector interest	>100 industries	190
Public bodies and local authorities have the key to make citizens and industry aware of a change of mind it is essential to introduce standards/legislation that act as a trigger and starts a new trend.	Policy makers and administrations Regional and Local Authorities Regulators EC projects/policy representatives	Potential market evaluation, Lessons learnt, socio-economic impact analysis at international level, experience report, good practices, CO2 emissions and energy savings..	Website, Regional events, videos,on-site visits. LIFE WORKSHOP.	To raise awareness, to influence policy priorities, legislation and regulatory framework5	>20	20

Main results/Conclusions

According to the reactions of the companies visited, or the ones that have attended the workshops organised, the project is well received and generates great expectations among companies in the sector.

All the companies have shown some interest in using this new line of waste treatment, either directly or indirectly.

In particular, the following results can be highlighted:

- Regarding the BPP Technology:

Three BPP Technology representation contracts have been signed for South American countries; A license sale for the construction of small-scale gasification units for electricity generation from waste plastics; A pre-agreement for the sale of a gasification unit that treats plastic waste from the Packaging sector; A license sale for construction and operation of a Methanol synthesis unit. A license of construction and operation of a synthesis unit is currently in negotiation with a multination chemical industry.

- Most of the companies visited by AIRESA have a great interest in having their waste valued as more respectful with the environment. They refer both to the economic benefit that it would bring them, as well as the prestige it can give them, in order to become 0 waste companies.

- There are several companies, which due to their large size and being multinational companies, such as PPG, SRG GLOBAL, NOVAPET, etc … that have shown greater interest in evaluating the possibility of implementing the line, since they could save energy costs by obtaining of methylal, and also the self-management of their own waste. They are internally evaluating the possibility of implementation.

- Tecnova, Binova and Beccaria, have been interested in obtaining modular plants with capacity according to the waste they generate that allow the recycling of materials that

currently go to landfills. They have also seen it as a possibility to be able to offer it to their customers, most of them belonging to the plastics sector.

- Bergoplast has received the information with great interest and as a possibility of treatment of great viability for its waste that is currently mechanically recycled.
- At the Fakuma fair, the main recycling companies (Velox, Sir plastics, MBA polymers) took an interest in the progress of the project and the results obtained showing a high interest in the process. They are currently on the list of plastic producers as potential customers who may be interested in a modular plant according to the needs once industrial scaling is done.
- There are some recycler and converter companies interested in the CHGP technology to develop a new business line. Those companies are from Spain, Finland, Denmark, Russia and UK.

The Exploitation and Business plan is obviously conditioned by the current TRL, which at pilot plant level can be positioned at 6. BPP plan is to be able to install and operate an intermediate size industrial plant as a preliminary step to scale the technology to TRL 9, co-investing with an Early Adopter that relies on the technology. A local chemical industry has been already identified for this purposed. The development of this plant will derivate into the building up of the 4 plants (1 of 600l/h and 3 of 300l/h) that have been identified in the KPI for the 5 years after the end of the project.

How actions were modified - Any correspondence with Agency approving changes

Due to the Pandemic situation caused by COVID-19, some of the activities had to be made online. The final event related to the LIFE general workshop in Brussels has then be substituted by the publication of an article in THE PROJECT REPOSITORY JOURNAL-Volume published on 9 April 2021.

Reactions and feedback obtained

According to the reactions of the companies visited, or the ones that have attended the workshops organised, the project is well received and generates great expectations among companies in the sector, the current legal and regulatory scenarios showed that there are barriers to build up operational plants.

All the companies have shown some interest in using this new line of waste treatment, either directly or indirectly.

ACTION: E - Project Management

Planned dates: Start: Sept. 2016 Duration: 36 months Initially planned end: August 2019

Planned end after extension: March 2021

Actual dates: Start: September 2016 Duration: 55 months End: March 2021

- **Global status**: Finished
- **Outputs achieved:**

The project management structure and procedures were set up since the beginning of the project, as included in section 5 of this report.

Continuous environmental, technical, administrative and financial project co-ordination that been carried out to ensure the project management

Internal communication has been continuous and **periodic general meetings** as well as **technical bilateral meetings, and conference calls** have been organised and held in due time.

Reporting activities have been carried out as scheduled. 4 official reports have been produced: 1st progress report, Mid-Term Report, 2nd progress report and Final report.

Monitoring of the project performance at technical, environmental, financial and administrative levels has been continuous including a continuous **evaluation of progress indicators, milestones and potential risks.**

Communication with External Monitor and the Project Officer in EASME has been fluid and continuous. The project has counted on 5 visits by the External Monitor with the participation of the Project Officer in the visit of October 2020.

An after-LIFE Communication Plan has been prepared. It has been submitted with this final report as Deliverable D23.

Main results/Conclusions:

Sub action E1.1. Project management activities

The project management structure and procedures were established and have been running smoothly since the project beginning, after the KoM. All partners have taken part in the project management and reporting duties. Specifically, all have collaborated in the management tasks via communications by email/phone, providing feedback of their progress. Additionally, AIMPLAS, as coordinator, made the corresponding payment to partners of the pre-financing in due time.

Table 3 details the meetings of the consortium. The general meetings include the corresponding meetings of the Management, Communication and dissemination and Exploitation Boards.

Table. 3 Consortium Meetings

ACTIVITIES	RESPONSIBLE	DATE
Kick-off meeting	AIMPLAS	September 2016
LIFE2010 KoM Coodinators	EC	October 2016
6 month meeting	AIRESA	April 2017
1st Monitor Visit	BPP	May 2017

Technical Consortium Conference call	BPP	June 2017
15 month meeting	MiPlast	November 2017
Technical Meeting BPP – AIMPLAS	AIMPLAS	January 2018
21 month Meeting - Consortium Conference call	AIMPLAS	June 2018
2nd Monitor Visit	AIMPLAS	June 2018
Technical Meeting BPP – AIMPLAS	AIMPLAS	April 2019
34 month Meeting- Consortium Conference call	AIMPLAS	June 2019
3rd Monitor Visit	AIMPLAS	June 2019
Technical Meeting ACTECO– BPP – AIMPLAS	AIMPLAS	November 2019
Conference call MI-PLAST– BPP – AIMPLAS	AIMPLAS	December 2019
43 month Meeting – Consortium Conference call	AIMPLAS	March 2020
46 month Meeting - 4th Monitor visit Conference call	AIMPLAS	June 2020
Conference Call – AIMPLAS, BPP, ACTECO	AIMPLAS	September 2020
Consortium Conference call	AIMPLAS	September 2020
50 month Meeti–g - 5th Monitor visit, counting on the EASME attendance online	ACTECO-AIMPLAS	October 2020

AIMPLAS has been in continuous contact with the LIFE Monitor (Mr. Dimas Ramos) to solve management and administrative doubts and has organized the Monitoring visits.

The progress reports were delivered as follows: First Progress report in June 2017; Mid-Term report due in February 2018 was delayed until August 2018 counting for that on the approval by the project officer; 2nd Progress report in January 2020; Final Report produced in March 2020.

Technical, Administrative and Financial Monitoring has been successfully carried out counting on the experience of the beneficiary in project management, the commitment of associated partners, and the fluid communication with the External Monitor and the Project Officers of EASME.

The extension with the corresponding rescheduling of project actions, approved in August 2019 has been essential to allow the project to successfully reach its objectives.

Sub action E1.2. After – life Plan**.**

Its aim is to increase the visibility of the Project´s results raising public & private awareness to facilitate the expansion of the environmental benefits provided by the Project and to provide support and consultancy for their easy uptake and potential standardised use by relevant actors (policy makers, regulatory bodies…).

Sub action E1.3. Monitoring Project Risks. A project Risk log has been produced and periodically updated.

How actions were modified - Any correspondence with Agency approving changes

On 20th February 2018 the coordinating beneficiary, AIMPLAS, contacted the EASME Project Officer, Ms. Anna-Natasa Asik at this time of the project, to convey the consortium agreement on the project plan shift as a consequence of the pilot plant delay. This shift

involved most of the B actions as were rescheduled to accommodate the delay minoring the impact on the project length. These modifications were approved, after asking for extra explanation, on the email dated on 16/03/2018. Nevertheless, it was clearly specified that this new planning would need further examination.

The project then progressed but some new technical issues delayed the liquid Ecomethylal production unit (Synthesis) making impossible to reach the previously proposed re-planning and, consequently, forcing the project to ask in May 2019 for an extension to reach its objectives. The extension was approved in August 2019.

Initially an Audit Report was foreseen for BPP, as Deliverable D22. Nevertheless, this audit is not necessary after receiving from EASME the Letter Amendment No 1 to the Grant Agreement, in September 2018, related to the threshold for submission of the certificate on the financial statements.

5.2. Evaluation of Project Implementation

Methodology applied

During the project different methods have been developed and/or applied to achieve the described results. The most relevant are evaluated below:

- Pilot plant construction: The decision of prioritising the gasification part over the synthesis unit has been adequate to minimise delays and facilitate the adaptation of the technology to treat plastic waste. This allowed to modify preliminary designs and perform initial tests that confirmed that the waste can be treated (B1).
- Gasification at laboratory scale: Experiments performed at laboratory scale facilitated the scale-up of the technology to pilot scale to adapt it to treat plastic waste instead of biomass. These experiments were crucial since the mixing system was changed from horizontal to vertical mixing (B1).
- Gasification unit start up: Some modifications have been made to the initial gasifier design, to improve the efficiency, the design the bottom part of the gasifier was changed.
- Selection and grinding of waste: AIRESA selected the materials coming from the target sectors (B2). Samples of the NRPW wastes selected were pre-treated following BPP's requirements. Grinding to 1-2 cm particle size was performed showing that it was adequatefor both the feeding and gasification processes (B2).
- Synthesis unit start up and testing: the reactors were started separately, starting with the Methylal reactor and Oxidation reactor, followed by the gas to liquid reactor and then the DME reactor, finally the whole synthesis process. During the initial phase, there were some losses due to the air used in the oxidation reactor, modification was done to avoid it.
- Characterisation of samples: Samples selected where characterised by AIMPLAS to determine its physical and chemical characteristics using UNE EN methods which are indicated in the D3 (B2).
- Running Optimization: Adaptation and optimization tests that were carried out in the plant installed in ACTECO allowed to adjust the feeding flow as well as the power of the burner to the requirements of the gasifier.
- Replication in Croatia: Plastic waste was treated in this plant, demonstrating its operability and suitability regardless of the different proportions in the waste (different waste streams in Spain and Croatia).
- Characterisation of the methylal obtained: The analysis carried out allowed to confirm that LIFE-ECOMETHYLAL project offers an innovative alternative to obtain methylal, improved the costs, availability, sustainability and environmental performance. The analysis of some samples of methylal has continued, after the development of the project. It should be noted that on the return of the pilot plant at the BPP facilities, modifications have been introduced in the methylal reactor, to the reagent feeding systems and improvement on the internal flow of the reagents, which have allowed a better control of the reactor working pressure and temperature and a consequent improvement in the purity of the methylal obtained.
- Monitoring of the Environmental impact: The environmental aspects study and the comparison of different scenarios has allowed to determine that the implementation of an ECOMETHYLAL treatment of non-recyclable plastic waste (NRPW) has an environmental improvement in different impacts.
- Monitoring of the socio-economic impact of the project actions: This has allowed to find the main aspects to be taken into account when considering the implantation of an

ECOMETHYLAL plant and the main barriers to the implementation of the process.

- Dissemination actions: These have been carried out with the necessary adaptation to the Pandemic situation produced in March 2020. A big effort has been made and the project has gone far beyond what was originally planned, receiving an overall positive feedback and a great interest from more than 150 companies in the direct or indirect use of the technology.

The main project success has been to demonstrate that NRPW can be valorised to obtain a syngas of good quality and synthesizing it to methylal for it valorisation, confirming the potentiality of this technology to treat these wastes, although the gasification process has a small efficiency (36%), the synthesis unit goes up to the 95%, So far, the methodologies selected have been adequate. Optimising the plant development will result on better efficiency rates for pilot and industrial plants.

Results

The following table summarizes the results obtained up to now against the project objectives, as well as the degree of achievement and their evaluation.

Table.4 Results against project objectives and expected results

Action	Foreseen	Achieved	Evaluation
(A2) Status of the project starting	- Legislation which applies to the to the project aims. - Current thermal recovery processes. - Methylal market	- Environmental impact must be controlled a31uthorizased. - There is market for methylal usage in the chemical industry as well as fuel additive. - Directive 2010/75/EU establishes a limit of gasification treatment of 3 tones/hour for the need 31authorization.	The CHGP is complementary to mechanical processes. Expected trend to increase EU usage of methylal, which currently is mainly imported. The plant capacity does not exceed the limit of waste treatment, so 31authorization is not required.
(B1) Pilot plant construction	Pilot plant constructed	A full pilot plant with gasification and synthesis units was running and the methylal with a purity round 80%	The plant demonstrated that NRPW can be valorized to obtain a syngas of good quality and methylal ensure the use of the technology to treat the wastes.
(B2) Treatment and conditioning of the waste	- Adaptation of ACTECO's facilities. - Initial waste characterisation. - Definition and changes of industrial plant recycling flow to pre- treat the waste (crushing,metal detectors, cleaning, homogenisation…	Waste requirements have been defined. Wastes sources selected. Initial process requirements have been defined, and equipment in AIRESA has been installed. Currently with initial results only crushing and grinding is being performed. - Waste selected is adequate for gasification.	Flows from 3 sectors were planned to be used in the project: packaging, automotive and electric and electronic. Moreover, a new sector was added, which was the textile. The pretreatment grinding was the same for the fourth.

Action	Foreseen	Achieved	Evaluation
(B3) Pilot plant optimization and replicability in Croatia.	- Optimisation of operational parameters. - Identification and quantification of gasification/synthesis results. - Transfer of results to Croatia.	The efficiency of the first gasification process from wase to syngas is 36% and the synthesis process from syngas to methylal 90%	The efficiency of the total process can be optimized in a bigger industrial plant with higher capacity of waste treatment
(B4) Characterization of the Methylal obtained in the CHGP and comparison with the commercial ones	- Methylal physical and chemical characterisation - Comparison of ecomethylal with commercial grades. - Economic analysis of methylal costs - Design and economic viability of the industrial plant - Evaluation of the whole impact of the project	The methylal purity is around 80%, this value will determine the application of the product and therefore the cost of it. The methylal cost has been estimated in 1,2 €/l for a 80% purity. The technology developed by BPP reduces the plastic that ends up in landfills and produces a valuable output that contributes to the clean transition through circular economy	The methylal cost can achieve up to a 28 €/l for 98% purity. Applications as electrolyte in batteries are acceptable for higher purities. Technical, administrative and legal barriers should be overcome in or the be able to build up new industrial plants with higher capacity of waste treatment.
(C1) Monitoring of the environmental impact of the project actions & transference to EU	- To check that the environmental goals are reached during the project development. - Minimize the environmental impacts related to the project development, such energy consumption, waste treated or process efficiency. - Apply the updated legislation in the project.	ECOMETHYLAL treatment has an environmental improvement in different impacts, such as: Eutrophication, Global warming, Abiotic depletion, elements and Abiotic depletion, fossil fuels. This impact reduction is given by the sum of two effects, the recycling of these wastes and the use of the methylal produced (replacing a methylal of petrochemical origin). The regulatory legislation has been studied.	Energy is the most critical environmental aspect, since the process is thermal. The legislation applying in Croatia, Spain and Europe has been analysed.
(C2) Monitoring and measurement of LIFE performance indicators	Periodic Monitoring of the Key parameters (to correct deviations): - Waste treated in the project - Energy consumption/kg recycled waste - Efficiency of production of methylal - Quality of methylal	As detailed in D12 waste, energy-resource and efficiency in production indicators is less than expected.	The implementation of at least 4 plants will increase the efficiency as well as energy consumption by applying alternative sources such as microwaves. The purity of ecomethylal obtained will be increased with higher capacity treatment plants

Action	Foreseen	Achieved	Evaluation
(C3) Monitoring of the socio-economic impact of the project actions & transference to EU	- To monitor the impact of the project actions on the regional and national economy and population from Valencian Community- Spain and from Rijeka-Croatia.	Technical and market barriers, need to be overcome to ensure the success of the technology and the application in Europe. Further details are in D13	Legislations applying in Europe, Croatia and Spain has been studied.
(D1) Dissemination Plan	- Notice Boards, Project Website and Layman´s report - Networking activities with other LIFE projects - Other non-compulsory activities (Information brochures, Articles in publications, Social networks, press releases, fairs)	All the objectives reached.	The project has gone far beyond what was originally planned, receiving an overall positive feedback
(D2) Communication of the project impacts (transference to stakeholders)	- Complete the Communication Plan - Complete the Exploitation & Commercialization Plan to be applied within the following 6 -12 months after the end of the project.	- Communication Plan 100% completed. - Exploitation and Commercialization Plan produced as Deliverable D21	The project has gone far beyond what was originally planned, receiving a very positive answer from the main stakeholders and generates great expectations among companies in the sector. All the companies have shown some interest in using this new line of waste treatment, either directly or indirectly.
(E1) Project management	-Project Management Activities - After Life Communication Plan - Monitoring of the project Risks Results: · Internal economic project follow-ups (at the middle of each official reporting period). · Official reports · Deliverables and Milestones · 1 Kick-off meeting and Periodic meetings every 6 months · 1 Final meeting · 4 Conference calls · 10 stakeholders reached & 500 visits registered thanks to the After –LIFE communication plan	- Project Management activities, After Life communication Plan and Monitoring of the project risks satisfactorily carried out - Continuous internal economic follow-up carried out - Official report produced in due time - 1 kick-off meeting and periodic general meetings, bilateral meetings and Conference calls - 122 stakeholders reached and 5.632 Visits registered thanks to the After-Life Communication Plan	The project has been well managed. It has faced some important difficulties that have affected its technical progress. Despite this, and thanks to an intensive monitoring and a good communication with the External Monitor and the EASME, the project has finally reached its objectives. It was required to ask for a 19-months extension (approved in August 2019) and to reschedule the project activities

Results of the replication efforts

The replication as such was not foreseen, with respect to a manufacture of a new plant in another geographical location. It was decided this way because it did not contribute anything to the results of the project and implied a significant financial cost.

It was decided to replicate the operation of the plant and therefore the plant located in Spain was dismantled and moved to Croatia, where it was assembled and put into operation, with waste produced there. The replication was made based on the different origin of the waste, both by country (Croatia and Spain), and by origin (packaging, electrical-electronic, automotive or mixed, among others).

The results of this replication are:

- the ECOMETHYLAL plant is valid for the treatment of different plastics (different sectors and different countries).
- the ECOMETHYLAL plant is compact, modular and adaptable to different situations and companies.

Regarding the replication in the next years, an Exploitation and Commercialization plan to ensure project's continuity has been prepared, reaching the following main conclusions:

Due to the current state of technology development (TRL 6), the business model that has been thought to ensure a rapid development of technology and, at the same time, a protection of intellectual property and the possibility of introducing improvements or corrective actions of unexpected events, is to build, install and operate an intermediate size industrial plant as a preliminary step to scale the technology to TRL 9, co-investing with an Early Adopter that relies on the technology.

During the past year an Early Adopter has been identified, a local chemical industry, and the economic conditions are being negotiated to be able throughout this year to build and install in its facilities an industrial plant with a treatment capacity of up to 300 Kg of plastics from the packaging sector to be converted to methanol.

The objective of this plant is to demonstrate the technology in an industrial environment with high security requirement, under ATEX conditions, and operating for a prolonged period of time under 24/7 conditions.

After this demonstration, a larger module is coupled in parallel to this demonstration plant and it can be used as a demonstrator for other potential clients.

BPP offers different possibilities to the Consortium Partners, such as installing plants in partner´s facilities, making discounts to project partners, Airesa, Acteco and Mi-Plast in the case of purchasing an industrial plant and also restricting the sale of plants to projects partners competitors until a certain period of time has passed.

Three possibilities have been considered for the Consortium's Business Plan:

1st) Sale of plants or technology licence to produce Eco-methylal to chemical industries.

In this business value chain, BPP provides the industrial plant, ACTECO & AIRESA would contribute with supplying the raw material and AIMPLAS would give support on the characterization of the waste material

2nd) Sale of plants or technology licence to produce Eco-methylal to industries that produce waste or municipal companies, with the aim of reducing the volume of waste sent to landfill or incinerated.

They do not need AIRESA nor ACTECO.

3rd) Recycling plants <5,000Tn/year. AIRESA & ACTECO are their competitors.

Therefore, in these cases, BPP should provide preferential conditions to those project partners.

Effectiveness of the dissemination

Dissemination activities in the project were successful, the two workshops organised allow the general awareness of the technology in terms of accessibility to administrations and policy makers, referring to the exploitation and business development, some on the companies from the events have stablished contacts with BPP in order to apply the technology in different countries, in particular in Spain and Portugal.

The impacts collected along the project implementation in terms of website visits, up to 5632, press releases 38, 4 seminars with a total of 2,200 attendees, 7 conferences with a total of 1.650 attendees;11 Fairs; 5 LIFE events; Networking with 5 European projects; 500 hard copies and more than 700 downloads of Layman's report the first two months after the project ended; 2 specific LIFE-ECOMETHYLAL workshops and one International Publication; More than 150 companies interested in the CHGP technology to develop a new business line or to manage their waste showed that it is a key interested topic for the EU.

Policy impact

LIFE ECOMETHYLAL project has shown that a waste treatment process, consisting of gasification and a process of synthesis of the product as a substance, methylal is of interest to the chemical industry. It has therefore been shown that according to Directive 2008/98 / EC (*Directive 2008/98/EC of the European Parliament and of the Council of November 19, 2008 on waste and by which certain Directives are repealed*) it complies with the waste hierarchy and it is recycling material (chemical recycling).

This project has taken into account the applicable legislation and its results will help the implementation of some important policies such as the Circular Economy Plan or the Plastic Strategy or the Green Deal, which promote the recovery of waste and its introduction as resources.

It has been shown that the environmental impact related to the process and the obtaining of methylal is less than the landfill of the waste and the use of methylal of petrochemical origin; both in global warming, as in Eutrophication, and Abiotic depletion, elements and Abiotic depletion, fossil fuels.

The main barriers to the implementation of the process are legal, technical and market.

- Legal: 1) Failure to include references to chemical recycling in the EU recycling targets, 2) Lack of clarity/transparency in the differentiation between chemical recycling and energy recovery in thermal waste processes, 3) Disparity in the recognition of thermal technologies in the different EU countries and 4) Lack of legislation related to the end-of-waste condition for plastic waste.
- Technical: 1) Difficulties in handling the plant; requires specialized personnel more than chemical recycling and 2) Not very homogeneous waste.
- Market: 1) Large variation in landfill prices (in some cases very low) that reduce the profitability of the process, 2) High cost and very long deadlines for the application of the REACH legislation in the products obtained in the process (registration of substances), 3) Difficulty in the commercialization of substances obtained through a thermal process (lack of market confidence) and 4) Price variation of the products obtained in the process.

These barriers have been partly solved during the project, through meetings with companies and associations. The communication and dissemination that has been carried out is important, responding to the differences between chemical recycling and energy recovery or the application of specific regulations for these processes, such as REACH.

An evolution of European and national legislation regarding chemical recycling is expected in the coming years, including it in objectives, control methods and definition of a traceability / mass balance that helps to implement these technologies and that give confidence to companies for the investment in these processes.

5.3. Analysis of benefits

1. Environmental benefits:

Environmental impacts savings coming from the project are directly related with the amount of plastic waste that is not deposited in landfills, the production of methylal and its use replacing a methylal of fossil origin.

a. **Direct / quantitative environmental benefits:**

The implementation of an ECOMETHYLAL treatment of non-recyclable plastic waste (NRPW) has an environmental improvement in different impacts such as: Eutrophication, Global warming, Abiotic depletion, elements and Abiotic depletion, fossil fuels.

b. Qualitative environmental benefits:

The project has given visibility to the problem of non-recyclable waste and its solution through a chemical recycling process.

It has been shown that it is possible to recover waste that is currently going to landfill from quite different sectors and to complement it with mechanical recycling.

2. Economic benefits:

The project has meant an economic benefit due to the generation of employment itself during the project, in terms of the creation of new jobs (direct and indirect) that is counted at 5. But also, under an estimate of a development of 4 new plants, with a horizon of 2026, the creation of 40 new jobs (direct and indirect) is calculated.

3. Social benefits:

The job creation is also related to social welfare and job location; These are modular and small plants, which implies a greater geographic dispersion and therefore a greater distribution of employment and wealth.

The environmental improvement that the implantation of these plants implies has been demonstrated, which can be extended to the quality of life of the citizen, solving in a favourable way a real waste problem.

4. Replicability, transferability, cooperation:

The implementation of the process has been carried out in Spain and Croatia. The replication of the process in other countries is direct because the plastic waste used is very varied and the possibility of treatment in the ECOMETHYLAL plant has been demonstrated.

All European countries have a clear objective of reducing waste in landfills and this developed process is in line with this objective.

The transfer, after the project is direct, the technology has been tested and validated, therefore there is a clear way to purchase the equipment (industrial plant) and its implementation in any EU country.

Regard to replication at local and EU level, stakeholders were aware of the project due to the dissemination plan and the specific contacts made by the beneficiaries of the LIFE ECOMETHYLAL project. Besides, interest came indirectly from the different publications made by the consortium. Indeed, meetings have already been held with potential buyers of the technology during the development of the project.

It is important to take into account the commented aspects of best practices, to optimize the process (amounts of waste, homogenization, pre-treatment, continuous process, control of the methylal market, among other aspects).

5. **Best Practice lessons:**

Working with partners, stakeholders and companies in general, to improve to detect barriers and allow the plant to adapt to the reality of waste, showing its flexibility and adaptation. Likewise, it served to better explain the functionality of the plant and its adaptation to current and future legislation.

Local languages are also mandatory and highly appreciated: translation of the videos, guides and questionnaire contents into local languages allowed to make it more accepted by stakeholders and other companies.

However, also having the documents in English allows other countries to be interested and demand information about the project.

The specific workshops dedicated to the sectors involved were of great help to publicize the project, the technology and its benefits.

6. Innovation and demonstration value:

The Catalytic Hydro-Gasification Plasma (CHGP) treatment demonstrates that NRPW can be valorised to obtain a syngas of good quality and methylal ensuring the use of the technology to treat the wastes.

During the project itself it was found out that specially the gasification process was more challenge than foreseen in the initial design.

The stakeholders involvement approach has been in someway affected by the pandemic and due to the cancellation of several international events due to the alarm situation in Europe, several dissemination activities planned that were not arranged.

There was a delay on the workshops organised in ACTECO and MI-PLAST, however, there were in total more than 148 attendees and there was a positive feedback in the 102 fulfilled questionnaires received among the attendees.

Apart from the sectors included in the contract such as: automotive, electric electronic and packaging waste, textile waste was also used as raw material. This shows the great variety of waste that can be treated by this technology.

7. Policy implications:

Legal, technical and market barriers have been partly addressed approaching to the industrial companies, associations, administrations and public institutions, in addition, a layman report specific to afford the policy makers has been prepared and will be used in the after life activities planned.

The communication and dissemination that has been carried out is important, responding to the differences between chemical recycling and energy recovery or the application of specific regulations for these processes, such as REACH.

European regulations for general plastic waste, vehicle waste, electrical and electronic equipment, batteries and accumulators, containing persistent pollutants, packaging, incineration, REACH and landfilling,

6. Key Project-level Indicators

The table below shows the different Key Project -level indicators with their start values, end values and beyond 3 years values

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Table 5. Key Project-level Indicators

INDICATOR CODE	FIRST LEVEL DESCRIPTOR	SECOND LEVEL DESCRIPTOR	START VALUE	END VALUE	BEYOND 3 YEARS VALUE	UNIT	COMMENTS
1.5	Partial reduction of specific pressures/threats affecting the spatial extent of the project in comparison to the present level		0	3,6	12.600	m2	Landfill disposal surface reduced of post-consumer plastic waste per meter landfill pile-high. The numbers are calculated from the post-consumer waste used for the expected ecomethylal produced. 3.6 tons x 1m3/ton = 3.6 m2/m(pile-high).
1.6	Persons who may have been influenced via dissemination or awareness raising project-actions (reaching)		0	30	250	Number of other persons influenced /impacted independently of the project area	Workers involved in companies devoted to waste management within the project. Beyond three years: Peopled involved in plastic recycling industries (target group). 250 is an estimation based on the after LIFE plan (10 people per planned event)
3.1	02 01 04 waste plastics (except packaging)	Mass of non-appropriately managed waste	178.298	178.192,4	165.698	tn/year	Landfill disposal of post-consuming plastic waste In Valencian Region: 59.760 Landfill disposal of post-consuming plastic waste In Croatia: 118538 TOTAL Landfill disposal of post-consuming plastic waste covered in the project: 178.298. At the end: Waste processed in pilot plant (120 hours operation - 30 kg/hr) Beyond 3 years: Assuming 4 industries built. the 12,600 m2/year of reduction are calculated assuming 3 plants of 300l/h and 1 plant of 600l /h, operating 220 days /year during 2 shifts of 8 hours each and process efficiency of 42%. LIFE-ECOMETHYLAL plant treated 3,6ton running during 120hs, assuming that for 2 shifts of 8 hours each and 220 days per year treats 105,6tons/years,
		Mass reduction due to composting	0	0	0	tn/year	
		Mass reduction due to preparation for reuse	0	105,6	12.600	tn/year	
		Mass reduction due to waste prevention	0	0	0	tn/year	
		Mass reduction due to energy recovery	0	0	0	tn/year	
		Mass reduction due to appropriate disposal	0	0	0	tn/year	
		Mass reduction due to recycling	0	0	0	tn/year	
		Mass reduction due to appropriate storage	0	0	0	tn/year	
		Amount collected by project	0	105,6	12.600	tn/year	
		Mass reduction due to incineration with no energy recovery	0	0	0	tn/year	
		Mass reduction due to digestion	0	0	0	tn/year	

INDICATOR CODE	FIRST LEVEL DESCRIPTOR	SECOND LEVEL DESCRIPTOR	START VALUE	END VALUE	BEYOND 3 YEARS VALUE	UNIT	COMMENTS
4.1.1	Other type	--	954.623	940.592	846.584	kwh/year	Energy consumption to produce current levels of Methylal for the expected ECOMETHYLAL produced during the project and after 3 years. According to the LCA results a reduction in energy consumption of 108,039 Mwh / year is expected during the next 3 years. 14031 kwh/years is the reduction of energy consumption as a result of the methylal production, it is calculated at the end of the project see D12.
8.1.1	Industrial production/processes	--	73.404,6	71.633,6	64.983,6	Tons of CO2 /year	Carbon footprint from methylal production for the volume expected to be replaced during the project and 3 years after. Replacement from fossil sources. The treatment of 105,6 ton /year according to the treat of 3,6ton during 120 h in the project, it implies a reduction of 1771,1 ton of CO2 eq/year, with 3 plant of 300l/h and 1 plant of 600l/h, a reduction of 8,421 tons of CO2 eq / year is expected.
	Industrial production/processes	--	1	1	1	kg CO2/unit produced (production of material products or environmental outcomes)	
10.2	other	--	0	148	165	number of stakeholders involved due to the project	The stakeholders range cover from private companies (S.C. URBAN S.A., MCHT), to local producer associations (AVEP, ANARPLA, CICLOPLAST), public bodies (Ministry of Agriculture, Regional Government of Valencia) ... The calculation at the end of the project is based on the number of attendees to the 2 workshops organised (68 in ACTECO and 80 in MIPLAST) = 148 Not possible to estimate beyond 3 years. 165 is an estimated value
11.1	No. of unique visits	--	2.700	5.632	6.570	No. of unique website visits	These values are current visits to the website. The annual visits are reduced to a quarter per year.

INDICATOR CODE	FIRST LEVEL DESCRIPTOR	SECOND LEVEL DESCRIPTOR	START VALUE	END VALUE	BEYOND 3 YEARS VALUE	UNIT	COMMENTS
12.1	Members of interest groups / lobby organisations	--	0	148	165	No. of individuals	Networking and other professional training and education. At the end: 148 participants in 2 Workshops. Not possible to estimate beyond 3 years. 165 is an estimated value
13	Jobs	--	0	5	40	No. of FTE	The amount of hired staff is lower than expect due to the pandemic situation. Beyond 3 years: 40 (building of 4 industrial plants), 10 persons will be hired per plant due to the higher production capacity. The skilled staff in production is working during 8 hours shifts.
14.1	Running cost/operating costs during the project and expected in case of continuation/replication/transfer after the project period	--	0	2.039.142	37.141.462	€	
14.3	Private investor – loan	--			37.141.462	€	