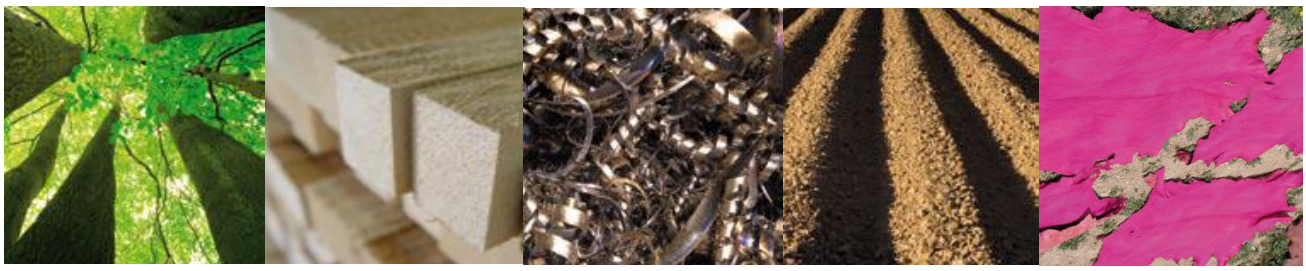

CIP Eco-innovation
First application and market replication projects
Call Identifier: CIP-EIP-Eco-Innovation-2013

Final Report

Less-Water Bev.Tech Project

Contract ECO/13/630314

Covering the reporting period from

01/10/2014 to 30/09/2017

Reporting Date

< 28/11/2017 >

Project coordinator:	**A DUE DI SQUERI DONATO & C. S.p.A.**
Project website:	**www.lesswaterbevtech.com**
Deliverable:	**D1.15 Final Report (FR), project quality assessment and improvement actions**

European Commission | Executive Agency for Small and Medium-sized Enterprises

TABLE OF CONTENTS

1. ACHIEVEMENTS OF THE ACTION 3
1.1 General progress 3
1.2 Results achieved as compared to what was planned in the project proposal 4
1.3 Deviations, problems and corrective actions taken in the whole project period 13
1.4 Progress regarding performance indicators 14

2. EVALUATION OF RESULTS 15
2.1 Results regarding market uptake and exploitation 15
2.2 Environmental benefits 16
2.3 Economic benefits 16
2.4 Measures taken to ensure the autonomous economic viability of the business 17

3. OTHER ISSUES 18

4. OVERVIEW ON HOURS SPENT 18

5. FINANCIAL REPORT 18

6. ANNEXES 18

1. ACHIEVEMENTS OF THE ACTION

This final technical implementation report contains all the needed information for EASME to evaluate the achievements of the action (project), the respect of the work plan and the small deviations occurred during the whole duration of the action. This includes financials and also an overview of hours spent by the staff allocated to the project per each partner and per WP.
The partners gave the project the nickname "Niagara" and commonly used it together or instead of the official acronym Less-Water Bev.Tech. This was to ease the communication activities (since the nickname is more appealing), providing a sense of water purity, which is the main idea behind the project.

1.1 General progress

The project was carried out by partners according to the scheduled timetable, without any particular problem or significant deviation to the original Gantt. Each of the scheduled task and deliverable has been duly produced by partners according to the responsibility set in the Annex I of the Grant Agreement.
The lead partner properly coordinated the overall project management and the cooperation among partners was excellent, ensured by different means, like physical and virtual meetings (via Skype™, WebEx™), phone call, very frequent e-mail exchange and many different accesses in the project management tool (BaseCamp™). All the deadlines and the action plans were agreed together with the partners, which have been very active since the project start.
As for the technical activities, partners strongly worked with the aim of choosing the type of processes to be implemented to recover wastewater from the production of beverages and fruit juices, planning of activities linked to recording of the operating parameters for the duration of the project and final analysis of the data collected with the preparation of the necessary conclusions.
Then partners worked to put in place the innovative system for water treatment and waste recovery dedicated to a plant for beverage preparation, starting from the needed design activities (namely, the design of each of the functional unit) to the engineering, integration and assembly in the client's premises, the CCdP - *Consorzio Casalasco del Pomodoro* (Fontantellato, Parma-Italy http://www.ccdp.it/), selected after having considered, contacted and visited other different options.
All the needed materials have been acquired to produce the water treatment system (both purchased and manufactured) and the full-scale pilot plant was actually installed in the client's premises on May 2016 with just one month of delay due to the needs expressed by the client in terms of layout and non-interference with the daily production processes.
Several industrial tests have been carried out and many different kind of wastewaters analysed: almost all the parameters respect the clients' standards, thus demonstrating that the tests support the good functionalities of the water treatment pilot system developed under the project.
These waters parameters were recorded thanks to a module for the automatic on-line download of all the data (readable via remote systems), with the generation of a panel indicating the synthesis of main results achieved by the water treatment system for deeper analyses. There is also the operators' manual in English and in Italian, with possibility to translate it into other languages.
The plant then needed some improvements made during the year 2017, as follows:

- the turbidimeter and flowmeter have been better calibrated;
- the self-cleaning filter to protect the ultrafiltration unit has been installed to operate also with those pollutants that gave the highest grade of turbidity, e.g. tomato juices, pears and orange cells;
- some small ameliorations on plant layout have been implemented.

The tests carried out after these ameliorations have shown the effectiveness of the self-cleaning filter to prevent the premature clogging of pre-filters, while ensuring the necessary ultrafiltration protection.
Presently, the water treatment pilot plant is still self-operating, directly controlled by the client and the system activities are monitored through the use of the remote system by partners.

In conclusion, the tests carried out are satisfactory and the results collected during the project enabled the new water treatment system to be effectively and satisfactorily presented to the potential stakeholders.
In the meantime, the profitable collaboration with the CCdP continues, with the aims of testing the effectiveness of the system also with new water pollutants; testing the system reliability over the time, the consistency and repeatability of the results obtained so far from both a chemical-physical and a microbiological point of view.
As for the fine-tuning of the existing business, the partners analysed the EU and MENA markets and the relevant industrial sector, by quantifying the technical strengths and the economic advantages that new water treatment system is able to produce to the customers, and how penetrate in these relevant markets.
In addition, over the lifetime of the project, the partners developed and carried out a massive, coherent and structured marketing campaign using many different instruments, with the goal to spread the new technology on the EU and MENA countries, but also other geographic areas like Sub-Saharian Africa (SSA), Mexico and Latin America. The marketing campaign aimed at increasing the loyalty of the existing customers and expanding the customer portfolio.
The dissemination activities have been carried out, in particular through the project web site www.lesswaterbevtech.com and promotional material in various languages (brochures, flyers, roll-up, technical presentation, etc.), specifically designed to be shown and distributed during sectorial exhibitions, direct customers' visits, public events to which the partners participated. Finally, dissemination through the scientific community is done attending international indexed conferences, workshops and publishing papers on high level ISI/Scopus journals.

1.2 Results achieved as compared to what was planned in the project proposal

All the project progresses, in comparison to the planned activities (as in Annex I of the Grant Agreement), are hereafter reported, work package by work package, identification of involved partners, including their roles, description of major subcontractors and involved stakeholders.
In **WP1 (Management)**, the kick-off meeting has been held on October 1st, 2014 at A Due Spa premises, in which all the partners and external experts took part, putting the basis for a sound tasks implementation since the very beginning of the project. Both Project Management Team and Project Quality Team were created, in addition to an Administrative Group. The meeting was organised into two different sessions in which both administrative and technical aspects of the project were deeply discussed and analysed. An action plan for the next tasks to be performed was prepared and agreed among partners.
Then, other ten different transnational meetings have been carried out, as scheduled (on December 3rd 2014, March 16th 2015, July 22nd 2015, December 10th 2015, March 10th 2016, September 20th 2016, November 29th 2016, March 22nd 2017, June 20th 2017, September 22nd 2017), in order to discuss and review on the project correct implementation, keeping all the key actors updated and fully coordinated. All the partners and external experts took part to such meetings. The adopted scheme was the same of the kick off meeting, so that both administrative and technical issues were discussed in different sessions and in sub-groups in order to define the next steps to perform to reach the project goals.
The web-platform for data sharing and communications among partners was set and updated with all the project materials as a Project Management tool (Basecamp™). In Basecamp™, which was on-line-based, all partners can easily and at anytime from anywhere do the following tasks: share files, check due dates, set discussions, collaborate on documents and activities, assign and review tasks.
The PR1, IR and PR2 were duly prepared, sent and approved by EASME. All the partners gave their contributions to finalise them, under the coordination of the lead partner.
All the action's performance indicators (at the end of the project) has been successfully carried out in order to monitor and measure environmental aspects, resource use, business, economic and market replication according to the classification and analytics included in Annex II. A new

monitoring and measurement of the performance indicators will be given two years after the end of the project.
The last activity was the preparation of this FR including both technical and financial data. All the partners produced their relevant part of report.
As for **WP2 (Design of a new water treatment and waste recovery system)**, the activities have been coordinated by the WP leader (Unibo) and strongly supported by A Due Spa. CVAR participated with a minor role.
The partners discussed much the activities for the scouting of clients, potentially interested for the installation of the pilot. Personnel from A Due and Unibo went directly to the possible clients' production plant for a survey on water usage and waste-water management. The collected samples have been delivered to the external and independent Laboratory in charge of the analysis. A Due and Unibo also took part in the H2O - Accadueo exhibition held in Bologna to find out further possible technical solutions.
One basic characteristic of the chosen client (*Consorzio Casalasco del Pomodoro*) was that to have already an Osmosis System that could guarantee a near-continuous flow rate, also located near the A Due headquarter, in order to ease the activities for the collection of data needed for the engineering phase.
In parallel with the selection of the clients, partners carried out the technical deliverables, with the aims to design the innovative system for water treatment and waste recovery dedicate to a plant for beverage preparation.
The purpose of the work was the choice of the type of processes to be implemented to recover waste water from the production of beverages and fruit juices, with the final aim to construct the pilot plant to recover this water to be installed at a beverage or juice manufacturing and bottling company, recording the operating parameters for the duration of the project and final analysis of the data collected with the preparation of the necessary conclusions.
Once the assembly, start-up and tuning phases of the water treatment system have been completed, partners slightly fine-tuned the designs according to the emerged requirements.
Finally, the partners developed a study to assess the feasibility of reducing the energy dependency from the grid of the proposed wastewater recovery and purification system starting from its energy requirement and supposing to have, from the food & beverage plant, some available biomass to dry and, then, to burn to produce steam and power. The comparison between the *as-is* scenario without this plant and the *to-be* scenario including such an energy system highlighted a strong environmental improvement (strength), while from the economic viewpoint the electricity cost was little higher (soft weakness). Above all, the required initial extra-investment almost doubled the overall plant cost. This represented the strongest barrier to the adoption of such an energy self-production solution (hard weakness). Nevertheless, further investigation is possible in the direction of reducing the energy cost by the increase of the system efficiency, the reduction of the rated module powers without a strong increase of the plant complexity.
Concerning **WP3 (Engineering, integration and assembly of the new water treatment and recovery system)** partners proceed towards the industrialisation and full-scale pilot plant assembly (i.e. water treatment system and water recovery system only, but not with biogas/mass energy plant).
The design of each functional unit prepared in WP2 was developed and industrialised so as to verify the goodness of the proposed idea. Particular attention was given to the new water treatment system and to the water recovery system. This new plant allowed the entire system to save about 198.000 m^3/(year plant) and an important amount of electric energy.
The most of the needed components that constitute the machinery were commercial items, already purchased after the preparation of the bill of materials in the MRP, but some of them needed to be subjected to further processing (for example to be cut and/or welded) and/or to be assembled or connected together according to the design of each individual functional groups and of the entire system. During these construction phase adequate A DUE internal manpower was required to perform the needed manual works.

The partners finalised the engineering and integration phases by March 2016 and the assembly phase at client's premises by April 2016, just one month of delay, due to the decision where to install exactly the plant by the client, *Consorzio Casalasco del Pomodoro* - CCdP (www.ccdp.it). In fact, the assembly of the pilot plant totally met the client requirements in terms of layout. The client indicated the exact place (also in terms of space) in which placing the prototype in order to the machine test does not create interference with the daily production processes.
The construction of the functional modules and the interfaces with the existing system have been duly made under the coordination of the lead partner (A Due Spa), seeing the participation of the other two partners with a minor role.
The activities performed in **WP4 (Start-up, tuning and performance/sustainability analysis)** concerned the installation of the water treatment system at the customer premises, finalised by May 2016, while the start-up initiated on June 2016 in terms of checking the correct hydraulic operations, testing the software with the needed integrations, tuning the various system parameters like pressure, flow, etc., calibrating all the instruments, optimising the chemicals dosage during the functioning and washing phases and, lastly, igniting the entire machinery.
The tests has started since June 2016 and carried out during the year 2017. The main points taken into consideration for the carrying out of the tests were the following:

a) the logistics complexity at client premises, well managed by partners;
b) the client provided with the production waste (concentrates) to add to the water in order to enlarge the tests;
c) the client provided with the chemicals (e.g. sodium, sodium hypochlorite, etc.) necessary for the sanitisation stages of the new water treatment plant;
d) the final evaluation on how reusing the treated waters (as an ingredient in the production line or for any other services and for utilities in the plant) has been done together by all the partners and the client in order to give the right value to the entire process.

Since the production waste (concentrates) has been collected and then inserted artificially (and not automatically) during the water treatment process, A Due and Unibo, in cooperation with the client, took various water samples an and analyse them at-line altogether with dedicated personnel at the clients' plant premises with the aim to verify each single condition. To benchmark and validate the plant performances, the samples related to the most significant tests, were analysed by SAVI LAB, an independent Chemical and Microbiological Laboratory.
However, the test had some delays due to the some internal problems by the client CCdP in terms of water provision and production of waste, in particular due to the fact that the tests were proceeding in parallel with the important season of tomatoes (summer). The delay did not have a major impact on the overall project implementation. Anyway, the partners took the occasion to perform some specific tests with waters containing tomato sauce.
Almost all the parameters respect the clients' standards, demonstrating that the first test supports the good functionalities of the water treatment system developed under the project.
However, the project team outlined the opportunity to add a self-cleaning filter on top of the purification chain, after the active carbon unit and before the ultrafiltration module. This plant feedback corrective action was done and the following tests have shown the technical performance after this improvement.
Therefore, on the basis of the new carried out tests, the partners prepared a performance and energy analysis, also with an environmental and economic indicator assessment. The collected data, both on- and off-line, allowed concluding about the quality of the purified water (and, consequently, about its reusability within local closed-loop chain) and about the efforts to get it in terms of energy requirements, chemicals and other auxiliaries.
The evidences from this highly representative set of plant tests allowed to conclude about the potential to purify wastewater at an output standard fully compatible with the F&B industry. From this viewpoint, the technical performance assessment allowed to definitely conclude about the fit of the proposed technical solution to the needs of the F&B industry.

As for the plant economic assessment, the system has shown a long-term sustainability and the value creation for the client CCdP with a pay-back period of about 2 years (without accelerated amortization policies) so that the initial investment is adequately remunerated.

In **WP5 (Business plan & exploitation)**, A Due and Unibo discussed and analysed both the EU and MENA markets and the relevant industrial sector, while CVAR did not take part in this WP, as planned. The analyses focused on the quantification of the technical strengths and the economic advantages that the new water treatment system is able to produce to the customers, and how penetrate in the markets, by carrying out a complete competitive analysis, with some highlights on opportunities and threats.

The proposed water purification and pure water saving technology perfectly fits with the EU market features. The developed technology is able to treat the wastewater of the production of different kind of beverages both NCB (Non-Carbonated Beverage**)** and CSD (Carbonated Soft Drinks).

This is a boundary condition, considering the variety of soft drinks produced in Europe and therefore the variety of contaminants that affect wastewater to be treated. The wastewater coming from the production plant for juice and nectars, for example, are distinguished by a significant concentration of organic matters and related fibre and puree. The pilot plant installed in Italy has proven to be able to purify wastewater contaminated with these substances, pear and tomato puree in particular.

Furthermore, the wastewater purification and pure water saving technology perfectly tackles the challenge of water scarcity that affects several European countries and, proposing this local closed-loop, match the policies of governmental authorities (both national and European) to save the natural resources with the circular economy. Finally, the local and regional differences of fresh and groundwater in terms of pollutant categories which contaminate the raw water are perfectly managed by the water treatment technology modularity.

MENA and Sub-Saharan area, nevertheless a high scarcity of water as a raw material, are distinguished by specific peculiarities which make an integrated water resource management almost impossible considering the current social, economic and institutional environment of these countries. Thus, all the measures and initiatives which target an efficient or even a reduced use of water resources are sought and welcomed. The commitment of international stakeholders, both public and private, is an opportunity to adopt effective water management techniques, in MENA area in particular. Furthermore, a remarkable chance is represented by the private investments of corporations which target to limit the water usage and to achieve water saving for their industrial processes due to economic, environmental, ethic and marketing purposes.

To spread the diffusion and facilitate the adoption of the proposed wastewater purification technology in MENA and Sub-Saharan region, some technical adaptations are needed: in particular it is necessary to modify the human-machine interface. The workers of MENA and Sub-Saharan beverage sector are, on average, less skilled compared to their European colleagues. Thus, the manual operations required for wastewater treatment plant tuning and maintenance have to be minimized or simplified by means of proper human-machine interfaces.

The Cost-Benefit Analysis have been carried out, with regards to the results of the application of the new integrated water treatment system to existing beverage production plant, to assess the effective impact in terms of ROI for the client. Globally, the economic analysis within the EU market confirmed the convenience of investing in the proposed technology. ROI ranges between 45% and 53%, the payback time is at year 3 and the NPV is highly positive at the end of the plant life-time. The economic analysis within the MENA market confirmed the convenience of investing in the proposed technology. ROI ranges between 31% and 34%, the payback time is at year 4 and the NPV is highly positive at the end of the plant life-time.

The economic convenience of industrializing the new technology has been verified also from A Due perspective: ROI is 68%, the payback time is at year 3 and the NPV is highly positive at the end of the plant life-time. In addition, A Due could be the first company to propose in the market this new integrated water treatment solution for the beverage processing, and this will allow the company to gain a bigger market share thanks to the first mover advantage.

Next to the economic and financial analysis quantifying the monetary assets behind the initiative of investing in the industrialization of the new technology, some soft-benefits are present and contribute to increase the loyalty of customers toward A Due (by widening the range of products and technologies offered) as well as the brand and image of A Due in terms of environmental and social responsibility (being the supplier of a technology conceived for raw water saving and water footprint reduction).

In **WP6 (Dissemination activities)**, the activities have been coordinated by the lead partner, with the active participation of the other two partners with different level of efforts (minor role for CVAR).

The website was put on-line, with the goal to carry out a better dissemination and communication of the new technology (www.lesswaterbevtech.com). With this regard, the website is dynamic, easily connectable with the main standard applications (e.g. Youtube, Vimeo, etc.), as a very useful tool for communication, where the actions' beneficiaries published information, since it is the main business card and window on the project to generate interest in all potential stakeholders.

The project logo was created, the project information sheet was prepared, updated and published in the Eco-Innovation website (http://ec.europa.eu/environment/eco-innovation/projects/en/projects/less-water-bevtech).

The partners organised two workshops: the first one during the Gulfood Manufacturing Exhibition in Dubai (UAE) on November 7th 2016, to which more than 30 persons participated, in order to take the occasion to present the technology implemented in the project to some possible and interested clients from the MENA region (www.gulfoodmanufacturing.com). The event was promoted also on the project website.

The second workshop was organised in Bologna (Italy) on November 14th 2016 to which more than 30 persons participated, with the aims to bring together professionals and researchers in order to discuss and validate the results achieved so far in the project. The topic was on both the results of tests and the project technology benefit demonstration.

The project team gave eleven project presentations, four of them during events related to Eco-Innovation or other relevant EU programs, to which the partnership was asked to take part.

The partners also participated in ten different public events, among which the major sector exhibitions and trade fairs, to meet partners and potential clients, showing the research project development, with a big emphasis on the technical features and the outputs of the new innovative water treatment system.

Appropriate pre-exhibition promotional campaigns, including e-newsletter (mass mailing reaching up to 5,000 contacts, where the project was introduced as one of the technological innovations presented at the fairs themselves), presence on exhibition websites, advertisement on trade magazines (paper and/or web), and on industry web portals in the field of food and beverage preparation plants, read by the specialized operators, has been organized in order to deliver information and maximize the visits of customers during these exhibitions. Also the project website and the company website (www.adue.it), the signature at the foot of e-mails sent by all A Due employees outside, LinkedIn posts from A Due LinkedIn account provide evidence and advertised the participation to trade fairs. In the various fairs, the Less-Water Bev.Tech project has been included in the online catalog (where available).

Dedicated promotional material in various languages (brochures, flyers, roll-up, technical presentation, etc.) has been specifically designed to be shown and distributed during exhibitions and during the direct visits to customers. To internally develop the distinctive capabilities and competences in the engineering, manufacturing and installation of the new technology, A Due's technicians, sales force and technical-commercial staff have been involved in many different activities concerning the new technology. Taking part as visitors to six trade fairs and conferences allowed the project team to obtain info and data take-over on the state of the art of water treatment technologies, on alternative solutions proposed from potential competitors, on possible suppliers of technologies provided in water treatment. During the trade fairs attended by A Due as exhibitor, A Due team not only focused on promotional activities, but also had the opportunity to collect these

info.
Furthermore, A Due has planned a series of training courses for all the sales force in order to get them ready for promoting the new water treatment system with the maximum efficiency.
Four Scientific papers have been redacted and issued to relevant scientific journals in the field of energy, water management and production process design and optimisation. These articles were particularly important for the dissemination of the new technology among the international academic community.
The Layman's report was produced to target at a non-specialist audience, also serving to inform decision-makers and non-technical parties of the project objectives and results. This printed report could provide a permanent record of the project that can be filed for future reference.
The final event was the so called "Clustering event" on Saving-Water technologies, designed to put together experts, researchers, end-users, EU funded projects (both in the CIP-Eco-innovation program and in other EU programs and with a space reserved for a presentation by a representative of EASME), and every potential stakeholder in innovations regarding Saving-Water, with the aim to present their result, demonstrate new technologies and innovative solutions, share best practices and discuss potential synergies.
The participating projects were: Life Answers, Life Celsius, Life Swss, Iwec and Less-Water Bev.Tech. It gave the occasion to know each other and understand better the activities implemented in the projects about the innovative industrial research, with possible suggestions for future international collaboration, based on common views and synergies. To give the event the utmost importance, it has been organised during the Drinktec fair held in Munich (Germany) on September 11th 2017 (www.drinktec.com).

As for the major subcontractors, after a transparent selection made comparing different offers, A Due Spa contracted the following bodies:
- Dr. Micaela Guerzoni, a chemical expert that intervenes in the design, engineering and testing of the water treatment system, with particular regard to chemical aspects;
- Eng. Maurizio Violi, an experienced engineer in water treatment process, which intervenes in the design, engineering and testing of the water treatment system;
- P.M.I. S.r.l., a mechanical engineering company for the support in the design and engineering of the mechanical parts of the water treatment plant;
- Savi Laboratori for the development of ad-hoc independent chemical analyses on water samples;
- SBA Cote d'Ivoire and Herve Zanini for specialised commercial relationship consultancies.

The following equipment were purchased by A Due Spa:
- Laboratory instruments for chemical analysis;
- Components for assembling the pilot RO water treatment system (including a CIP-Cleaning In Place washing system, originally not included but strictly needed);
- Components for assembling the pilot filtrating water treatment system (filtering, ultrafiltration);
- Components for assembling the pilot UV water treatment system;
- Pipe, wires and other components for assembling the water treatment pilot plant;
- Materials and other consumables for system integration and testing.

The table below reports the deliverables listed in Annex I of the Grant Agreement which correspond to the present reporting period:

Del. N°	Deliverable name	Type	WP N°	Delivery date from Annex I	Delivered (yes/no) and status (draft/final)	Submission with report	Forecasted delivery date	Comments on progress
D1.1	Project kick-off: meeting and action planning	Meeting minutes	1	1/11/2014	Yes - final	PR1	1/11/2014	None

Del. N°	Deliverable name	Type	WP N°	Delivery date from Annex I	Delivered (yes/no) and status (draft/final)	Submission with report	Forecasted delivery date	Comments on progress
D6.1	Project information updates (pre-defined)	text, ppt	6	1/12/2014	Yes - final	PR1	1/12/2014	None
D1.2	Project coordination meeting/sub-meetings #1	Meeting minutes	1	1/01/2015	Yes - final	PR1	1/01/2015	None
D1.11	Set up of an on-line web-platform for data sharing and communications among participants	File/Document sharing website	1	1/01/2015	Yes - final	PR1	1/01/2015	None
D1.3	Project coordination meeting/sub-meetings #2	Meeting minutes	1	1/04/2015	Yes - final	PR1	1/04/2015	None
D6.10	Project Website	Website	6	1/04/2015	Yes - final	PR1	1/04/2015	None
D1.4	Project coordination meeting/sub-meetings #3	Meeting minutes	1	1/09/2015	Yes - final	PR1	1/09/2015	None
D2.1	Design of double reverse osmosis water treatment plant	Report	2	1/09/2015	Yes - final	PR1	1/09/2015	None
D2.2	Functional unit upgrades and design actions	Report	2	1/09/2015	Yes - final	PR1	1/09/2015	None
D2.3	Water recovery system design	Report	2	1/09/2015	Yes - final	PR1	1/09/2015	None
D1.12	First Progress Report (PR1), coordination and timing control	Report + Project Information Sheet	1	1/10/2015	Yes - final	PR1	30/09/2015	None
D6.2	Project information updates (pre-defined)	text, ppt	6	1/10/2015	Yes - final	PR1	30/09/2015	None
D1.5	Project coordination meeting/sub-meetings #4	Meeting minutes	1	30/11/2015	Yes - final	IR	30/11/2015	None
D1.6	Project coordination meeting/sub-meetings #5	Meeting minutes	1	31/03/2016	Yes - final	IR	31/03/2016	None
D3.1	Double reverse osmosis water treatment plant engineering and realization	Pilot plant report	3	31/03/2016	Yes - final	IR	31/03/2016	None
D3.2	Functional unit integration and engineering actions	Pilot plant report	3	31/03/2016	Yes - final	IR	31/03/2016	None
D3.3	Engineering and realization of water recovery system	Pilot plant report	3	31/03/2016	Yes - final	IR	31/03/2016	None
D3.4	Engineering and realization of control and	Pilot plant report	3	31/03/2016	Yes - final	IR	31/03/2016	None

Del. N°	Deliverable name	Type	WP N°	Delivery date from Annex I	Delivered (yes/no) and status (draft/final)	Submission with report	Forecasted delivery date	Comments on progress
	supervising system							
D5.1	Final Business Plan formal definition (EU market)	Business Plan	5	31/03/2016	Yes - final	IR	31/03/2016	None
D1.13	Interim Report (IR), coordination and timing control. Financial control	Report + Project Information Sheet	1	30/04/2016	Yes - final	IR	31/05/2016	None
D6.3	Project information updates (pre-defined)	text, ppt	6	30/04/2016	Yes - final	IR	30/04/2016	None
D1.7	Project coordination meeting/sub-meetings #6	Meeting minutes	1	31/08/2016	Yes - final	PR2	20/09/2016	None
D1.8	Project coordination meeting/sub-meetings #7	Meeting minutes	1	31/12/2016	Yes - final	PR2	29/11/2016	None
D1.14	Second Progress Report (PR2), coordination and timing control	Report + Project Information Sheet	1	31/12/2016	Yes - final	PR2	31/12/2016	None
D5.2	Final Business Plan formal definition (MENA market)	Business Plan	5	30/09/2016	Yes - final	PR2	30/11/2016	Issued on delay without any impact
D5.3	Technology benefit demonstration and measurement. Technology adaptation. (EU market)	Report	5	31/07/2016	Yes - final	PR2	31/12/2016	Issued on delay without any impact
D6.4	Project information updates (pre-defined)	text, ppt	6	31/12/2016	Yes - final	PR2	31/12/2016	None
D6.14	Workshops organization	Workshop	6	31/07/2016	Yes - final	PR2	30/11/2016	Issued on delay without any impact
D6.15	Workshops organization	Workshop	6	30/04/2017	Yes - final	PR2	30/11/2016	Issued in advance without any impact
D5.4	Technology benefit demonstration and measurement. Technology adaptation. (MENA market)	Report	5	31/01/2017	Yes - final	FR	31/01/2017	None
D4.1	Plant start-up and operating parameters tuning	Report	4	31/03/2017	Yes - final	FR	31/03/2017	None
D5.5	Patents registration	Patent demands	5	31/03/2017	Yes - final	FR	31/03/2017	None

Del. N°	Deliverable name	Type	WP N°	Delivery date from Annex I	Delivered (yes/no) and status (draft/final)	Submission with report	Forecasted delivery date	Comments on progress
	and/or extension							
D5.7	Capabilities & Human Resources	Report	5	31/03/2017	Yes - final	FR	31/03/2017	None
D5.8	Economies of Scope & Technology Collaboration	Report	5	31/03/2017	Yes - final	FR	31/03/2017	None
D6.11	Scientific paper redaction	Scientific report	6	31/03/2017	Yes - final	FR	31/03/2017	None
D1.9	Project coordination meeting/sub-meetings #8	Meeting minutes	1	30/04/2017	Yes - final	FR	30/04/2017	None
D4.2	Performance & energy analysis, environmental and economic indicator assessment	Report	4	31/03/2017	Yes - final	FR	31/07/2017	Issued on delay without any impact
D4.3	Plant Life Cycle Assessment (LCA)	Report	4	31/03/2017	Yes - final	FR	31/07/2017	Issued on delay without any impact
D6.8	Layman's report (pre-defined)	Brochure	6	31/07/2017	Yes - final	FR	31/08/2017	Issued on delay without any impact
D1.10	Project coordination meeting/sub-meetings #9	Meeting minutes	1	30/09/2017	Yes - final	FR	30/09/2017	None
D1.16	Monitoring and measurement of the performance indicators (at the end of the project)	Report	1	30/09/2017	Yes - final	FR	30/09/2017	None
D2.4	Feasibility study of the beverage solid waste energy recovery via biomass plant	Report	2	30/09/2017	Yes - final	FR	30/09/2017	None
D5.10	Distribution, Promotion & Replication	Report	5	30/09/2017	Yes - final	FR	30/09/2017	None
D5.11	Cost-Benefit Analysis.	Report	5	30/09/2017	Yes - final	FR	30/09/2017	None
D5.6	First-mover & New technology standard exploitation	Installed innovative equipment; Report	5	30/09/2017	Yes - final	FR	30/09/2017	None
D5.9	Clients exploitation: Group 1: Big CSD Bottling Companies in EU and MENA – Technology partnerships	Installed innovative equipment	5	30/09/2017	Yes - final	FR	30/09/2017	None
D6.12	Scientific paper redaction	Scientific report	6	30/09/2017	Yes - final	FR	30/09/2017	None
D6.16	Public events participation	Public events	6	30/09/2017	Yes - final	FR	30/09/2017	None
D6.17	Clustering Event	Public Event	6	30/09/2017	Yes - final	FR	30/09/2017	None

Del. N°	Deliverable name	Type	WP N°	Delivery date from Annex I	Delivered (yes/no) and status (draft/final)	Submission with report	Forecasted delivery date	Comments on progress
D6.5	Project information updates (pre-defined)	text, ppt	6	30/09/2017	Yes - final	FR	30/09/2017	None
D6.7	Project presentations (pre-defined)	ppt, presentation, participation in events	6	30/09/2017	Yes - final	FR	30/09/2017	None
D6.13	Conference attendance	Meeting	6	30/09/2017	Yes - final	FR	30/09/2017	None
D6.6	Inputs to additional common information material related to eco-innovation actions (pre-defined)	input to	6	30/09/2017	Yes - final	FR	30/09/2017	None
D1.15	Final Report (FR), project quality assessment and improvement actions	Report + Project Information Sheet	1	30/09/2017	Yes - final	FR	29/11/2017	The present report
D1.17	Monitoring and measurement of the performance indicators (2 years after the end of the project)	Report	1	30/09/2019	No	N/A	30/09/2019	Not due
D6.9	Evaluation report including performance indicators (pre-defined)	Report	6	30/09/2019	No	N/A	30/09/2019	Not due

All the due deliverables with public dissemination level (PU) are in the project website for public download. The reference to EASME funding, the Eco-Innovation logo and the legal disclaimer are indicated in these published documents and wherever necessary.

1.3 Deviations, problems and corrective actions taken in the whole project period

No serious problems arose in terms of project implementation. However, after a careful analysis, the partners identified a slight problem in the original project formulation: the recovered water cannot be sent to the existing water treatment plant without do changing in its process. Therefore, considering that it is not easy (in terms of costs, stop time, warranty, etc.) doing such a modification in the existing plant, the partners decided to create self-standing new treatment plant that takes the waste water from the "Beverage Preparation Pant", treats this waste and feeds this recovered and purified water directly to "Beverage Preparation Plant". This did not affect the final achievements of the action.

Some improvements to the pilot plant were made after the carrying out of the first tests:

- the turbidimeter and flowmeter have been calibrated as they were not working well. This malfunctioning did not affect the right water treatment process and the backwashing of the ultrafiltration;
- the installation of the self-cleaning filter to protect the UF was needed. The installation of the self-cleaning filter was needed to operate also with those polluting inputs that gave the highest grade of difficulty, namely tomato juices, pears and orange cells. The functionality of the self-

cleaning filter was set to work every day or every hour measured, by counting the washing cycles with a SW that instantly gives (on-line) their usage percentages. This is also done to understand how much the substances used for the filters cleaning might pollute the waters;
- some small ameliorations on plant layout.

1.4 Progress regarding performance indicators

The indicators belong to environmental aspects, resource use, business, economic and market replication according to the classification and analytics included in Annex II.
As for the Improved Environmental Performance, the methodological background behind all values is detailed in the plant LCA. The environmental performance of Less-Water Bev. Tech. is highly positive according to a wide range of indicators. Differences between Annex II and the final values at the end of the project ("plant use" section) are due to plant configuration upgrades respect to the Proposal as demonstrated in WP2, WP3 and WP4 and in the related and already approved deliverables, while, the inclusion of the manufacturing and assembly phases reduce, as expected, the global savings and increase the release on the environment of some dangerous substances. Nevertheless, the global net balance between savings and impact increase is positive.

Indicators		*Comment/Details*	*Absolute Impact*	*Relative Impact*	*Absolute Impact*	*Relative Impact*	*Absolute Impact*	*Relative Impact*
			Annex II of the Less-Water Bev.Tech ("plant use")		*Final values at the end of the Project ("plant use")*		*Final values at the end of the Project ("from cradle to grave")*	
Greenhouse gas emissions	CO2		-2187 t/year	-29%	-2092 t/year	-85%	-1875 t/year	-76%
	Methane		-3813 kg/year	-33%	-2938 kg/year	-79%	-2664 kg/year	-72%
Air quality	Particulate matters		-6413 kg/year	-32%	-6320 kg/year	-98%	-6174 kg/year	-96%
	PM 2.5		-107.43 kg/year	-29%	-78.40 kg/year	-67%	-36.67 kg/year	-31%
	PM 10		-134.20 kg/year	-27%	-14.60 kg/year	-76%	-14.53 kg/year	-76%
	Resp. Organics/Inorganics		-0.738 DALY/year	-30%	-0.600 DALY/year	-78%	-0.450 DALY/year	-58%
Reduction / substitution of dangerous substances	Irritant / Corrosive	Nitrogen oxides, Sulfur dioxide	-8707 kg/year	-31%	-6653 kg/year	-76%	-5371 kg/year	-61%
	Mutagenic / Carcinogenic	Carbon, Iodine, Radon	-17'013'333 kBq/year	-46%	-8'191'280 kBq/year	-87%	27'587'570 kBq/year	293%
	Toxic	Copper, Nickel, Benzene, Butane	-2730 kg/year	-32%	113 kg/year	193%	240 kg/year	411%
	Persistent / Bioaccumulative	Lead, Cadmium, Chromium, Vanadium, Zinc	-0.43 kg/year	-6%	-32.63 kg/year	-46%	106 kg/year	149%
Waste management	Prevention	Any variation compared to the baseline	-	-	-	-	-	-
	Waste minimization	Any variation compared to the baseline	-	-	-	-	-	-
	Reuse of waste / Substance recovery	*Sludge reused in energy biomass plant **	*500 t/year*	-	*500 t/year*	-	*500 t/year*	-
	Material recycling	Any variation compared to the baseline	-	-	-	-	-	-
	Waste diverted from landfills	Any variation compared to the baseline	-	-	-	-	-	-
	Hazardous waste	Any variation compared to the baseline	-	-	-	-	-	-

** feasibility study*

Concerning the better use of natural resources, the strongest and most significant environmental benefit coming from the proposed technology is the raw water saving. This shows a net decrease of the water footprint from 100'000 litres to 67'000 litres per working hour (-33%). In addition, there is the possibility to decrease the grid energy consumption through the valorisation of the sludge from production lines. Such energy benefit is additional and depends on the inclusion of the biomass plant (out of the action's boundary) making the introduced technology fully energy independent from the national grid.

Indicators		*Comment/Details*	*Absolute Impact*	*Relative Impact*	*Absolute Impact*	*Relative Impact*
			Annex II of the Less-Water Bev.Tech		*Final values at the end of the Project*	
Water	Reduced water consumption	From UF and RO based technology	-198'000'000 liters/year	-33%	-198'000'000 liters/year	-33%
Energy	Energy from RES	Any variation compared to the baseline	-	-	-	-
	Reduced energy consumption	*From biomass plant for RO and purification **	*-450'000 kWh/year*	*-100%*	*-154'373 kWh/year*	*-100%*

** feasibility study*

With relation to the Economic Performance / Market Replication:
- the market replication is by a pilot installation in Fontanellato, Parma-Italy, at Consorzio Casalasco del Pomodoro - CCdP (www.ccdp.it);
- the market potential for the EU area, both in value and number of costumers is studied and detailed in the EU final business plan;
- the reduction of cost per unit or process is expressed through the annual cost reduction because of lower raw water footprint;
- the payback time for different markets (EU and MENA) and target clients (CSD and juices) is calculated together with NPV and ROI;
- the patent analysis reveals that the new water treatment system is beyond the scientific state of art but it does not completely fulfil the requirements for an immediate patentability.

Indicators		*Comment/Details*	*Absolute Impact*	*Relative Impact*	*Absolute Impact*	*Relative Impact*
			Annex II of the Less-Water Bev.Tech		*Final value at the end of the Project*	
Business development Market replication		Pilot installation at big CDS bottler	1	-	1	-
Market potential	market size in million Euros	Only for the EU market, growing at a CAGR of 6% between 2012 and 2017	200	-	240	-
	market size in number of customers	Only for the EU market. Relatively stable.	1'500	-	1'500	-
Entry in new transnational markets			none	-	none	-
Entry into different sectors	New sectors		none	-	none	-
Reduction of cost per unit or process		Reduction given by savings in water consumption. This calculation do not consider savings in energy consumption.	-150'000 €/year	-25%	-243'085 €/year	-56%
Payback Time	capital invested / net income	Payback time still quite long because market potential is still to be completely exploited by end of the project. This calculation do not consider the grant from CIP Ecoinnovation	11 years	-	3 to 4 years	-
Patents		New demands for patent deposited by end of project	2 European	-	none	-

2. EVALUATION OF RESULTS

2.1 Results regarding market uptake and exploitation

A Due developed the distinctive capabilities and competences in the engineering, manufacturing and installation of the new technology, so that technicians, sales force and technical-commercial staff have been prepared in many different activities that A Due put in place in order to develop a distinctive and specialized know-how concerning the new technology.

Quotations and offers were customised, following specific productive and economical needs of customers and potential stakeholders: this led A Due straight to its objective to implement, promote and sell the water treatment system as effectively as possible.

In addition to that, the existing Economies of Scope were strengthened in order to optimise production costs, thanks to shared use of its tangible resources, like raw materials, number of employed workers, distribution network, marketing policies, etc. and intangibles, like degree of specialisation and technological expertise, know-how of staff (i.e. same clients, same distribution channels, same promotional activities, etc.).

In order to increase the technical and technological value of the latter, A Due has established working relationships which involves technology collaboration with all key players in the sector: its sub-suppliers, its customers (from whose requirements stem most of the product innovations), its agents, consultants, the research centres (Universities of Bologna and Parma, the SSICA-Experimental Station for the Food Preserving Industry in Parma, etc.), local business associations.

A Due was also scouting potential partners with complementary technologies, or operating in different industrial sectors; all these technological/commercial co-operations are meant to potentiate market exploitation and replication of the water treatment technology, accelerating its penetration, also through the discovery of new sales channel.

Many marketing actions have been put in place during the sectorial exhibitions to which A Due participated. Mass mailing were carried out on the occasion of participation to industry fairs where the project is introduced as one of the technological innovations presented at the fairs themselves.

To spread the new technology on the EU and MENA countries, A Due developed and carried out a structured and coherent marketing plan targeting at industrial stakeholders. Visibility was given to the project through the project website www.lesswaterbevtech.com and on the website www.adue.it, which has a section specifically devoted to the project and recalls it also on its homepage.

Critical mass of visibility was given to the project through advertising and technical editorial editions in trade magazines (paper and/or web) and on industry web portals, as well as trough LinkedIn posts from A Due LinkedIn account https://www.linkedin.com/company/adue.

All these actions have been carried out to multiply the impacts of the project solutions and mobilise a wide market uptake, reaching a critical mass during the project and in the short to medium term.

Direct contacts (exchange of emails, calls, visits to customers or open-house held at A DUE headquarters, meetings at trade fairs) with existing customers and new potential stakeholders, were

established during all the project by A Due technical and/or commercial and/or service staff, as well as by A Due agents and/or representatives and business consultants.
Suitable informational/promotional material to be used in the meetings above has been provided, concerning the technical aspects (applied technologies and achieved results), economic benefits (investment and running costs, pay-back periods) and environmental performances: presentations, layouts, schemes, a video specially designed to make the new technology more easily understandable, panels, stickers, catalogues and brochures, gadgets customized with the project logo/name (pens, pencils, block-notes, 250ml water bottles with dedicated neck label, USB keys that were distributed after uploading the main info about the project and, once available, the Layman's report and project video).

2.2 Environmental benefits

The environmental sustainability of the proposed wastewater purification technology was assessed through the application of the ISO14040:2006 standard developing the LCA of the plant, including four steps: goal and scope definition; inventory analysis; impact assessment; interpretation of results. This LCA considered raw material extraction processes, manufacturing and assembly of components, transports, use and disposal at the end of life, in "a-cradle-to-grave" perspective. The main components of the system were Carbon Filter, Tanks, Prefiltration, Ultrafiltration, Reverse Osmosis, Ultraviolet Treatment, Cleaning in Place (CIP), Pump for water recovery.
The LCA analysis demonstrated that the construction, use and disposal of the innovative wastewater collection and purification plant have a minor environmental impact than the traditional one, without water recovery. So at an environmental point of view the introduction of the innovative plant object of this study is well desirable.
Although the construction and assembly phase has the lesser impact, in an Eco-design perspective, some elements of the actual prototype design can be modified in order to obtain minor environmental impact of the plant.
Particularly, since Reverse Osmosis, Ultrafiltration and Carbon Filter are the parts with the greatest impact, the manufacturing and assembly phases of these components are considered in order to find the processes or the sub-components generating the majority of the damage. In all the three used methods, the Reverse Osmosis Use appears to be the most impact phase, so, in order to reduce the impact of this plant component, the use of reverse osmosis (electrical consumption and maintenance) have to be redefined.
In general, as for the direct/quantitative environmental benefits, the global recovery efficiency of the proposed system, in mass, is close to 57% (recovered waters), matching the expected nominal value.

2.3 Economic benefits

The economic performance assessment aimed at validating the proposed technology and plant solution against economic metrics expressing the overall long-term sustainability of investing in the proposed plant for wastewater recovery.
According to the standard practice, the present economic analysis started from the evidences and reference indices presented above in the plant technical validation section and referred to the investments and rising costs (including opportunity costs due to savings) occurring during the plant lifetime. The so-called standard reference year (SRY) methodology was adopted together with the net present value (NPV) method.
The following table introduces the basic plant working parameters with reference to the SRY, representative of the full use of the pilot plant within the CCDP industrial environment (further representative of a common mid-size F&B industry).

PLANT WORKING PARAMETERS (Std. Ref. year)		
Nominal Plant Capacity	45,000	liters/hour
Overall avg annual utilization factor	0.90	%
Input flow rate	40,500	liters/hour
from "customer" RO	13,500	liters/hour
from filler PET	27,000	liters/hour
Avg annual worked days	320	days/year
Avg worked hours per day	20	hours/day

Given the annual standard water flows and requirements (power and chemicals) the cost & investment analysis is developed adopting a differential approach. The rising costs coming from the installation of the proposed plant are quantified including savings due to the raw water unused because of wastewater recovery and reuse. In addition, the extra-investment to install the new plant is included. The following table presents a synthesis of this step of the analysis.

COST & INVESTMENT DRIVERS			*Differential annual cash flows*	
Initial extra-investment (turnkey, all included)	355,000	€		
O&M cost (incidence on investment)	0.04	%	14,200	€/year
Cost of raw water (opportunity cost)	*0.00212*	*€/liter*	*-311,340*	*€/year (saving)*
Cost of grid electric power (industry)	0.20	€/kWh	59,279	€/year
Power factor (includes all needs & auxiliaries)	1.1435	Wh/l		
Cost of chemicals				
NaClO 15%	0.2160	€/liter	246	€/year
Soda 30%	0.2660	€/liter	262	€/year
HCl 30%	0.9525	€/liter	30,935	€/year
Antiscalant 100%	4.2000	€/liter	6,018	€/year
$Na_2S_2O_5$ 25%	0.3935	€/liter	1,128	€/year
General & other plant differential annual costs			5,000	€/year
	Contribution margin		**194,106**	**€/year**

The plant economic assessment highlighted its own long-term sustainability and value creation for the F&B industrial company with a pay-back period of about 2 years (without accelerated amortization policies) so that the initial investment is adequately remunerated.

2.4 Measures taken to ensure the autonomous economic viability of the business

Since the tests carried out during the project life were well satisfactory, the results collected enabled the new water treatment system to be effectively and satisfactorily presented to the potential stakeholders and customers. The testing of the system reliability will proceed over the time as well as the consistency and repeatability of the results obtained so far from both a chemical-physical and a microbiological point of view.

Presently, the water treatment pilot plant is still self-operating directly controlled by the client CCdP, and the system activities are monitored through the use of the remote system.

The profitable collaboration with the CCdP will then continue, with the aims of testing the effectiveness of the system also with new water pollutants and to show the system to other potential customers.

It was also agreed that the cooperation among A Due, UniBo, Cvar and CCdP will continue also beyond the project, in particular by investigating on new possible technologies (still under research) and methods to be applied in the future for the development of further innovative water treatment systems.

Understanding the alternatives to the ultra-filtration is the other objective of the collaboration, also investigating on similar projects.

3. OTHER ISSUES

No other issues to report.

4. OVERVIEW ON HOURS SPENT

The spent hours in the project are inserted in attached excel table. The following table summarises the total hours allocation among partners:

Partners	Hours in Annex I	Hour spent so far	%
1 - A Due S.p.A.	16.924	16.919	99,9
2 - University of Bologna	8.715	8.818	101,2
3 - CVAR Ltd	1.250	1.403	112,2
TOTAL	**26.889**	**27.140**	**100,9**

As for the allocations to the concerned WPs, reflecting the actual effort put by partners, the figures are the following:

Work Packages	Hours in Annex I	Hour spent so far	%
WP1	2.644	3.057	115,6
WP2	5.379	5.486	102,0
WP3	5.985	6.075	101,5
WP4	7.732	7.948	102,8
WP5	3.830	3.239	84,6
WP6	1.319	1.335	101,2
TOTAL	**26.889**	**27.140**	**100,9**

Every partner based these calculations on the personnel timesheets, which are stored in each partner's administrative archives, and at EASME disposal in case of any check, including all other justifications for these costs. The timesheets allow for an easy reconciliation of the whole working time of each single person.

5. FINANCIAL REPORT - omissis

6. ANNEXES - omissis

Mr. Simone Squeri
A Due Spa - CEO

_____

This publication has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of the partners project and can in no way be taken to reflect the views of the European Union.