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## Less-Water Bev.Tech Contract ECO/13/630314

**Monitoring and measurement of the performance  
indicators (2 years after the end of the project)**  
*Deliverable D.17 – WP1*

**Evaluation report including performance indicators  
(pre-defined)**  
*Deliverable D.9 – WP6*

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**Project website:** [www.lesswaterbevtech.com](http://www.lesswaterbevtech.com)



Juicy  
Technology  
and Sparkling  
Ideas



ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA



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PU	Public	✓
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

## Introduction

The present document is part of the activities carried out in Work Package 1 (WP1), which foresees the management of LESS-WATER BEV.TECH project, and Work Package 6 (WP6) about the dissemination activities.

All the WP1 and WP6 deliverables are hereafter reported:

Deliverable N°	Deliverable name (self-explanatory)	Type of deliverable	Quantification	For Publications: Language(s)	Accessibility of deliverable	Month of completion
D1.1	Project kick-off: meeting and action planning	Meeting minutes	1	EN	PU	1
D1.2	Project coordination meeting/sub-meetings #1	Meeting minutes	1	EN	PU	3
D1.3	Project coordination meeting/sub-meetings #2	Meeting minutes	1	EN	PU	6
D1.4	Project coordination meeting/sub-meetings #3	Meeting minutes	1	EN	PU	11
D1.5	Project coordination meeting/sub-meetings #4	Meeting minutes	1	EN	PU	14
D1.6	Project coordination meeting/sub-meetings #5	Meeting minutes	1	EN	PU	18
D1.7	Project coordination meeting/sub-meetings #6	Meeting minutes	1	EN	PU	23
D1.8	Project coordination meeting/sub-meetings #7	Meeting minutes	1	EN	PU	27
D1.9	Project coordination meeting/sub-meetings #8	Meeting minutes	1	EN	PU	31
D1.10	Project coordination meeting/sub-meetings #9	Meeting minutes	1	EN	PU	36
D1.11	Set up of an on-line web-platform for data sharing and communications among participants	File/Document sharing website	1	EN	CO	3
D1.12	First Progress Report (PR1), coordination and timing control	Report + Project Information Sheet	1	EN	PU	12
D1.13	Interim Report (IR), coordination and timing control. Financial control	Report + Project Information Sheet	1	EN	PU	19
D1.14	Second Progress Report (PR2), coordination and timing control	Report + Project Information Sheet	1	EN	PU	27
D1.15	Final Report (FR), project quality assessment and improvement actions	Report + Project Information	1	EN	PU	36

		Sheet				
D1.16	Monitoring and measurement of the performance indicators (at the end of the project)	Report	1	EN	PU	36
D1.17	Monitoring and measurement of the performance indicators (2 years after the end of the project)	Report	1	EN	PU	60

<b>Deliverable N°</b>	<b>Deliverable name (self-explanatory)</b>	<b>Type of deliverable</b>	<b>Quantification</b>	<b>For Publications: Language(s)</b>	<b>Accessibility of deliverable</b>	<b>Month of completion</b>
D6.1	Project information updates (pre-defined)	text, ppt	1	EN	PU	2,
D6.2	Project information updates (pre-defined)	text, ppt	1	EN	PU	12
D6.3	Project information updates (pre-defined)	text, ppt	1	EN	PU	19
D6.4	Project information updates (pre-defined)	text, ppt	1	EN	PU	27
D6.5	Project information updates (pre-defined)	text, ppt	1	EN	PU	36
D6.6	Inputs to additional common information material related to eco-innovation actions (pre-defined)	input to posters, articles for newsletters, visuals, interviews	on request by EACI	EN (or local, as appropriate)	PU	upon request
D6.7	Project presentations (pre-defined)	ppt, presentation, participation in events	max 2 times	EN (or local, as appropriate)	PU	upon request
D6.8	Layman's report (pre-defined)	Brochure	5-10 pages	EN (optional : others)	PU	34
D6.9	Evaluation report including performance indicators (pre-defined)	Report	max. 5 pages	EN	to be agreed	2 years after project
D6.10	Project Website	Website	Updated regularly	EN/(...)	PU	6,
D6.11	Scientific paper redaction	Scientific report	2	EN	PU	30
D6.12	Scientific paper redaction	Scientific report	2	EN	PU	36
D6.13	Conference attendance	Meeting	4	EN	PU	To

						define
D6.14	Workshops organization	Workshop	1 Worksh ops for 30 people	EN	PU	22
D6.15	Workshops organization	Workshop	1 Worksh ops for 30 people	EN	PU	31
D6.16	Public events participation	Public events	3	EN	PU	36
D6.17	Clustering Event	Public Event	1	EN	PU	36

In particular, Deliverable D1.17 and Deliverable D6.9 are about the assessment of the project performance indicators 2 years after the end of the project.

Such indicators belong to environmental aspects, resource use, business, economic and market replication according to the classification and analytics included in Annex II of Less-Water Bev. Tech.

Details about methods and values are given here concluding about the mid/long-term impact of the project on the market and the stakeholders.

In addition, the current status of the technology development, market actions and stakeholder technology awareness are provided benchmarking its evolution respect to the *end of the project* time.

# 1. Monitoring and measurement of the performance indicators (2 years after the end of the project)

## Relevant indicators to monitor

Executive Agency for Competitiveness and Innovation CIP Eco-innovation first application and Market Replication Projects Call 2013 Call Identifier: CIP-EIP-Eco-Innovation 2013					
INDICATORS				0	
Two years after the project					
Objective	Indicators	Absolute Impact	Relative Impact	Comment	
Improved Environmental Performance	Greenhouse gas emissions	CO2			
		Methane			
	Air quality	Particulate matters			
		PM 2.5			
		PM 10			
		Resp. Organics/Inorganics			
	Reduction / substitution of dangerous substances	Irritant / Corrosive			
		Mutagenic / Carcinogenic			
		Toxic			
		Persistent / Bioaccumulative			
	Waste management	Prevention			
		Waste minimization			
		Reuse of waste / Substance recovery			
		Material recycling			
Waste diverted from landfills					
Hazardous waste					
Better use of natural resources	Reduced resource consumption (excluding energy)				
	Water	Reduced water consumption			
Energy	Energy from RES				
	Reduced energy consumption				
Economic Performance / Market Replication	Business development / Market replication				
	Market potential	market size in million Euros			
		market size in number of customers			
	Entry in new transnational markets				
	Entry into different sectors	New sectors			
	Reduction of cost per unit or process				
	Payback Time	capital invested / net income			
Patents					

The previous table outlines the objectives, the effect and the impact indicators to monitor both at the end of the project and two years after the end of the project. Those that are relevant for the Less-Water Bev. Tech project are about:

- ✓ Greenhouse gas emissions coming from the plant use and the electricity production to fuel the plant.
- ✓ Air quality coming from the plant use and the indirect emissions to get the input factors.
- ✓ Dangerous substances emitted to the environment from plant wastes in air, water and soil.
- ✓ Waste recovery and, in particular, the waste reduction due to collection and reuse/valorization as secondary substances;
- ✓ Water footprint decrease because of raw water savings and wastewater collection for local reuse after purification;
- ✓ Energy (carbon) footprint decrease because of increase of process sustainability and reduction of grid/external energy use;
- ✓ Business development and action to tackle the market as first mover;
- ✓ Market potential assessment with specific reference to the two most relevant market areas, i.e. EU and MENA;
- ✓ Cost effectiveness as reduction in the process cost to get the input resources;
- ✓ Payback time to return on the initial extra-investment for plant installation;
- ✓ Patents to protect, where possible, the developed know-how getting and intangible competitive asset.

## Methodology, scenarios and references

The methodology behind the indicator assessment is different depending on the investigated objective and follows the approach adopted in Deliverable D1.16 to ease comparisons. In all cases a differential approach is used. The base *as-is* scenario is the open-loop plant with no wastewater recovery, purification and reuse, while the present scenario to assess includes the proposed technology as validated through the installed, tested and upgraded prototype and enhanced by other installations at relevant markets.

The “Improved Environmental Performance” objective is studied in accordance with the Life Cycle Assessment (LCA) standard as formalized in the ISO UNI EN 14000 series and with the support of SimaPro 7.3.3 by PRé Consultants software (Amersfoort, The Netherlands) data bank. Both Eco-indicator 99 Hierarchical version (EI99H) and IPCC 2007 Global Warming Potential (GWP) methods are used as impact assessment methods.

The investigated scenarios are two. The former is from a “cradle-to-grave” perspective including the manufacturing, assembly, use and disposal phases. The latter is focused on the plant use, only. Despite such a latter scenario is partial, it has the same boundaries considered when preparing the dedicated section in the Annex II of Less-Water Bev. Tech.

The “Better use of natural resources” objective is studied following the evidences from the prototype field-analysis, the plant installations at the client sites, and the *reference indices* calculated after the long-duration test.

Finally, the “Economic Performance / Market Replication” objective is based on the business analyses, strategic plan assessment and strategies formalized in the Business Plans of the Less-Water Bev. Tech initiative and actuated after the end of the project.

According to the EU and MENA business plans released at months 18 and 24 of the Project and accepted by EASME on Sept. 6<sup>th</sup> 2016, Ares(2016)2054089, and Oct. 17<sup>th</sup> 2017, Ares(2016)7201681, **the analysis focuses on three plants** (lifetime 15 years) updating, coherently, the Annex II of Less-Water Bev. Tech indicator values. In addition to this basis, input coming from the plant installations are included.

In detail, together with the plant prototype already installed and in operation at the end of the project, the following two other installations are done since the end of the project, i.e. replication action and market action:

1. worldwide bottler for Coca Cola brand. The installation site is in Ecuador and it is the second plant site by dimension for Latin America;
2. Coca Cola mid-size bottler in Algeria.

Lastly, the reader is asked to refer to the following released deliverables for the background and the detailed description of the steps to get the values presented here (in **bold** the most relevant).

“Improved Environmental Performance” objective: Deliverables **D1.16**, D2.1, D2.2, D2.3, D2.4, D3.1, D3.2, D3.3, D3.4, D4.1, **D4.2**, **D4.3**, D6.11 and **D6.12**.

“Better use of natural resources” objective: Deliverables **D1.16**, D2.1, D2.2, D2.3, D2.4, D3.1, D3.2, D3.3, D3.4, D4.1, **D4.2**, **D4.3**, **D6.11** and **D6.12**.

“Economic Performance / Market Replication” objective: Deliverables **D1.16**, **D4.2**, **D5.1**, **D5.2**, D5.3, D5.4, **D5.5**, **D5.9**, D5.10, **D5.11** and **D6.12**.

In the following, data for each objective are provided together with comments. Common hypotheses are to highlight preliminarily:

1. Scenarios are referred as:
  - *“Annex II of the Less-Water Bev. Tech (“plant use”)*” to indicate values from the Project proposal. Such values are adapted in accordance with EU and MENA business plan and refer to one plant operating for each of the 15 years’ lifetime.
  - *“Final values 2 years after the end of the Project”* to indicate values coming from the developed Action as presented in the released deliverables listed before. For the “Improved Environmental Performance” objective further distinction is done between *“plant use”* and *“from cradle to grave”* according to the boundary limits of the environmental analysis.
2. The developed plant configuration is updated respect to the Proposal, as demonstrated in WP2, WP3 and WP4 and in the related and already approved deliverables. Such upgrades change the context of the environmental analysis, i.e. from raw water to water purification (ref. Annex II of the Less-Water Bev. Tech) vs. from wastewater to water purification (ref. Final values 2 years after the end of the Project). This is in accordance with the goal of having a compact and self-standing purification unit to be sold as an additional module to the production line.
3. The biomass plant for energy self-production is out of the functional modules generating the indicators except for the two dedicated values presented in *italics*. As a consequence, for all the other indicators the energy needs are fully supplied by the grid generating costs and emissions related to the average EU energy mix.

## 2. Evaluation report including performance indicators

### “Improved Environmental Performance” objective

The following table presents the values of the “Improved Environmental Performance” objective for the proposed scenarios. The methodological background behind all values is detailed in Deliverable D4.3 about the plant LCA. The focus is on each plant replication according to the LCA assumptions of the aforementioned deliverable.

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 2 years after the end of the Project ("plant use")		Final values 2 years after 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	<i>Sludge reused in energy biomass plant *</i>	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	-	-	-	-	-	-

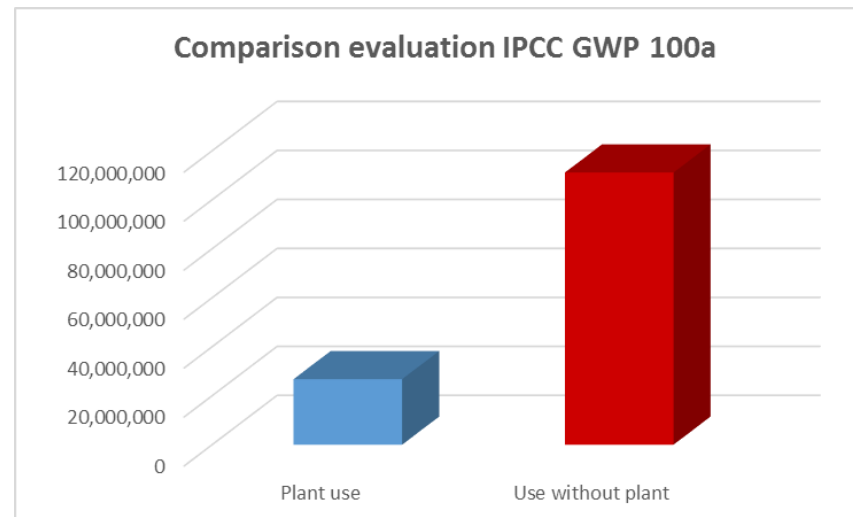
\*feasibility study

The environmental performance of Less-Water Bev. Tech. obtained at the end of the project is confirmed with a highly positive impact according to a wide range of indicators. Differences between *Annex II of the Less-Water Bev. Tech* and *Final values 2 years after the end of the Project “plant use”* are due to hypothesis 2, mainly, while, the inclusion of the manufacturing and assembly phases reduces, as expected, the global savings and increases the release on the environment of some dangerous substances. Nevertheless, the global net balance between savings and impact increase is positive. Differential aggregated results for the three installed plants considering the introduced indicators and adopting the GWP methodology are in the following.



Indicators		Comment/Details	Absolute Impact	Relative Impact	Absolute Impact	Relative Impact
			Final values 2 years after the end of the Project ("plant use")		Final values 2 years after the end of the Project ("from cradle to grave")	
Greenhouse gas emissions	CO2		-6276 t/year	-85%	-5625 t/year	-76%
	Methane		-8814 kg/year	-79%	-7992 kg/year	-72%
Air quality	Particulate matters		-18960 kg/year	-98%	-18522 kg/year	-96%
	PM 2.5		-235.20 kg/year	-67%	-110.01 kg/year	-31%
	PM 10		-43.80 kg/year	-76%	-43.59 kg/year	-76%
	Resp. Organics/Inorganics		-1.800 DALY/year	-78%	-1.350 DALY/year	-58%
Reduction / substitution of dangerous substances	Irritant / Corrosive	Nitrogen oxides, Sulfur dioxide	-19959 kg/year	-76%	-16113 kg/year	-61%
	Mutagenic / Carcinogenic	Carbon, Iodine, Radon	-24'573'840 kBq/year	-87%	82'762'710 kBq/year	293%
	Toxic	Copper, Nickel, Benzene, Butane	339 kg/year	193%	720 kg/year	411%
	Persistent / Bioaccumulative	Lead, Cadmium, Chromium, Vanadium, Zinc	-97.89 kg/year	-46%	318 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 *	1500 t/year	-	1500 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



**“Better use of natural resources” objective**

The following table presents the values of the “Better use of natural resources” objective for the proposed scenarios focusing on the three installed plants.

<i>Indicators</i>		<i>Comment/Details</i>	<i>Absolute Impact</i>	<i>Relative Impact</i>	<i>Absolute Impact</i>	<i>Relative Impact</i>
			<i>Annex II of the Less-Water Bev.Tech (amended according to approved Business plan)</i>		<i>Final values 2 years after the end of the Project</i>	
Water	Reduced water consumption	From UF and RO based technology	-594'000'000 liters/year	-33%	-594'000'000 liters/year	-33%
Energy	Energy from RES	Any variation compared to the baseline	-	-	-	-
	Reduced energy consumption	From biomass plant for RO and purification *	-1'350'000 kWh/year	-100%	-463'119 kWh/year	-100%

The strongest and most significant environmental benefit coming from the proposed technology is the raw water saving. This is widely discussed in [Deliverable D2.1](#) showing a net decrease of the water footprint from 100'000 liters to 67'000 liters per working hour (-33%). In addition, [Deliverable D2.4](#) outlines the possibility to decrease the grid energy consumption through the valorization of the sludge from production lines. Such energy benefit is additional and depends on the inclusion of the biomass plant (out of the Action boundary) making the introduced technology fully energy independent from the national grid. *Note. Up to date, the three installed plants do not include the biomass module.*

**“Economic Performance / Market Replication” objective**

The following table presents the values of the “Economic Performance / Market Replication” objective for the proposed scenarios.

<i>Indicators</i>		<i>Comment/Details</i>	<i>Absolute Impact</i>	<i>Relative Impact</i>	<i>Absolute Impact</i>	<i>Relative Impact</i>
			<i>Annex II of the Less-Water Bev.Tech (amended according to approved Business plan)</i>		<i>Final values 2 years after the end of the Project</i>	
Business development Market replication			3	-	3	-
Market potential	market size in million Euros	Only for the EU market, growing at a CAGR of 6% between 2012 and 2017	250	-	250	-
	market size in number of customers	Only for the EU market. Relatively stable.	1'500	-	1'500	-
Entry in new transnational markets			Middle East & Asia	-	Middle East, Asia, North and Latin-America, Africa	-
Entry into different sectors	New sectors		Pharma & Healthcare	-	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	3.33 years	-	3 to 4 years	-
Patents		New demands for patent deposited by end of project	2 European	-	none	-

In particular:

- ✓ Market replication is by:
  - plant pilot installation in Fontanellato, Parma-Italy, *Consorzio Casalasco del Pomodoro* - CCdP ([www.ccdp.it](http://www.ccdp.it)) as detailed in Deliverable D5.9;
  - plant installation at a worldwide bottler for Coca Cola brand. The installation site is in Ecuador;
  - plant replication at Coca Cola mid-size bottler in Algeria.
- ✓ Market potential for the EU area, both in value and number of costumers is studied and detailed in the EU and MENA final business plan released in Deliverable D5.1 and Deliverable D5.2;
- ✓ Entry in new markets around the world is a strong effort done during the two years after the end of the project period. In particular, in addition to the market replication at the previous first point, a major network of contacts, info exchange and preliminary quotations are done. A non-comprehensive list of business interests is in the following:
  - Algeria, quotations to two relevant local bottlers;
  - Egypt, quotation to a relevant local bottler;
  - Costa Rica, technology interest from a relevant local bottler;
  - Bolivia, technology interest from a network of local bottlers (juices, CSDs, beer, etc.);
  - Technology presentation to Coca Cola, with a potential of several plants in 28 countries for a B2B business of 605 clients and 187 brands;
  - B2B partnership with CLABER ECOLOGIA as encouraged in Deliverable D5.8;
  - Technology presentation during quotations of other businesses and company meetings.
- ✓ Entry in new sectors is still a “To Do” and it will be part of the in progress technology developments and dissemination.
- ✓ Reduction of cost per unit or process is expressed through the annual cost reduction because of lower raw water footprint. This analysis is detailed in Deliverables D4.2 and D5.11.
- ✓ Payback time for different markets (EU and MENA) and target clients (CSD and juices) is calculated together with NPV and ROI in Deliverable D5.11.
- ✓ 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. Full analysis is developed in Deliverable D5.5.

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