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Less-Water Bev.Tech
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Monitoring and measurement of the performance indicators (at the end of the project)
Deliverable D.16 – WP1

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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.

All the WP1 deliverables are hereafter reported:

Delive-rable N°	Deliverable name (self-explanatory)	Type of deliverable	Quantification	For Publications: Language(s)	Accessibility of delive-rable	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 Sheet	1	EN	PU	36

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

In particular, Deliverable D1.16 is about the assessment of the project performance indicators at 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 impact of the project on the market and the stakeholders.

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				**LESS-WATER BEV.TECH**	
At the end of 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				
Others					

The previous table outlines the objectives, the effect and the impact indicators to monitor at 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. Nevertheless, 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 and tested prototype.

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 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.

According to the EU and MENA business plan released at months 18 and 24 of the Project and accepted by EASME on Sept. 6th 2016, Ares(2016)2054089, and Oct. 17th 2017, Ares(2016)7201681, the analysis focuses on 1 plant (lifetime 15 years) updating, coherently, the Annex II of Less-Water Bev. Tech indicator values.

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 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 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 **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 at 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 at 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.

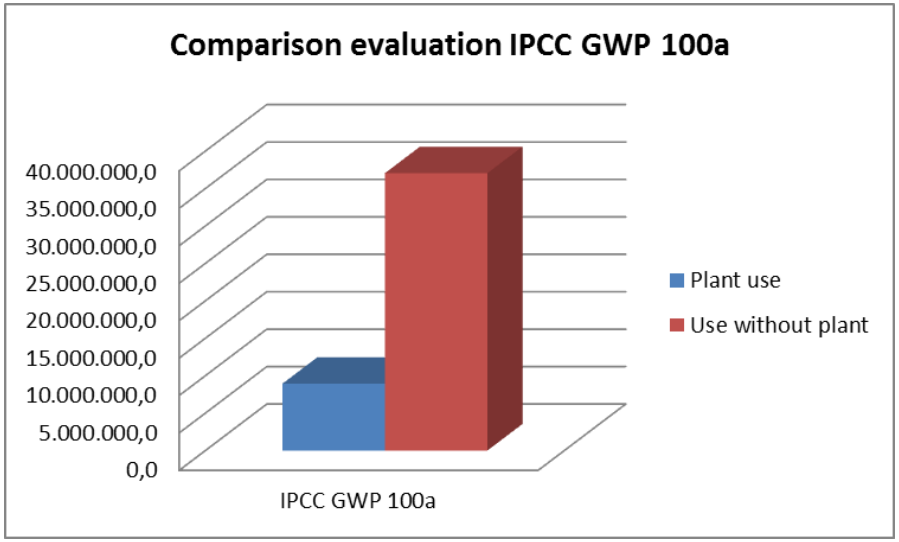
"*Improved Environmental Performance*" objective

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.

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*

The environmental performance of Less-Water Bev. Tech. is highly positive according to a wide range of indicators. Differences between *Annex II of the Less-Water Bev. Tech* and *Final values at the end of the Project "plant use"* are due to hypothesis 2, mainly, 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 as already discussed in Deliverable D4.3 adopting the EI99H and GWP methodologies. As example, the following graph shows the CO_2-eq. differential analysis adopting GWP.



"*Better use of natural resources*" objective

The following table presents the values of the "Better use of natural resources" objective for the proposed scenarios.

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*

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.

"*Economic Performance / Market Replication*" objective

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

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	-

In particular:

- ✓ Market replication is by a pilot installation in Fontanellato, Parma-Italy, *Consorzio Casalasco del Pomodoro* - CCdP (www.ccdp.it) as detailed in Deliverable D5.9;

- ✓ Market potential for the EU area, both in value and number of costumers is studied and detailed in the EU final business plan released in Deliverable D5.1;
- ✓ 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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