



Standard method and online tool for assessing and improving the energy efficiency of waste water treatment plants

H2020-EE-2014-3-MarketUptake

Deliverable D2.2

Selection and classification of real case studies

Acknowledgements & Disclaimer:

The ENERWATER project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 649819. Although the project's information is considered accurate, no responsibility will be accepted for any subsequent use thereof. The EC accepts no responsibility or liability whatsoever with regard to the presented material, and the work hereby presented does not anticipate the Commission's future policy in this area.

Due date of deliverable: 31st August 2015

Actual submission date: 1st October 2015

Organisation name of lead contractor for this deliverable: CUAS

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PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	X
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1 Scope of the document

In the present deliverable are presented the results of Task 2.2.

The purpose of this task is the identification of those wastewater treatment plants (WWTPs) that will take part in the project. These plants will serve as pilot plants where the energy monitor system will be installed and the developed methodology will be tested. A minimum of 50 plants will participate. Based on techno-scientific criteria, in the first phase of the project the consortium has identified a preliminary list of WWTPs. This task includes checking if selected plants fit the project's criteria and verifying as well the effective possibility of the selected WWTPs to participate in the study.

2 Selection and classification of real case studies

2.1 Preliminary selection of WWTPs

In order to cover the maximum range of the most widely used wastewater treatment techniques the consortium has preliminarily identified a list of 50 WWTPs. The selection was carried out based on criteria such as treatment technology, size, population served, age, presence of industrial wastewater rather than of parasitic water, presence of co-generation, climatology. The main characteristics of the preliminary WWTPs identified are reported in Table 1. This list includes fifteen WWTPs in Italy (ETRA SPA), twenty WWTPs in Germany (Aggerverband) and fifteen WWTPs in Spain (Espina y Delfin).

Table 1 - Preliminary list of WWTPs

No.	Name	Country	Flow (m ³ /day)	Capacity (PE)	Consumption (MWh/year)
1	Asiago	Italy	3,986	20,000	525
2	Bassano del Grappa	Italy	14,192	96,000	4,138
3	Tezze sul Brenta	Italy	16,801	100,000	1,664
4	Carmignano di Brenta	Italy	3,636	20,000	1,064
5	Cittadella	Italy	10,579	60,000	2,221
6	Onara	Italy	5,917	12,000	647
7	Battaglia Terme	Italy	3,540	10,000	602
8	Cervarese Santa Croce	Italy	1,761	7,000	350
9	Limena	Italy	3,050	20,000	1,111
10	Montegrotto Terme	Italy	4,129	20,000	983
11	Rubano	Italy	4,099	22,000	806
12	Selvazzano	Italy	2,663	20,000	972
13	Camposampiero	Italy	11,821	35,000	2,320
14	Vigonza	Italy	15,545	70,000	3,244
15	Cadoneghe	Italy	11,936	50,000	2,137
16	Rösrath	Germany	8,737	26,544	1,184
17	Krummenohl	Germany	17,698	29,342	985
18	Donrath	Germany	3,823	16,907	944
19	Wiehl	Germany	7,385	16,892	623
20	Lehmbach	Germany	5,236	17,044	811
21	Homburg-Bröl	Germany	8,352	19,459	819
22	Schönenthal	Germany	9,413	16,332	702



23	Bickenbach	Germany	8,062	18,396	657
24	Lindlar	Germany	3,480	8,965	667
25	Büchel	Germany	7,544	21,171	671
26	Rospe	Germany	8,657	17,828	518
27	Brenzingen	Germany	4,531	9,052	567
28	Overath	Germany	5,361	14,184	373
29	Weiershagen	Germany	4,999	12,543	502
30	Kürten	Germany	4,787	11,162	392
31	Volperhausen	Germany	3,863	8,461	452
32	Brunohl	Germany	5,932	10,518	417
33	Engelskirchen	Germany	6,079	10,567	436
34	Ründeroth	Germany	4,083	8,883	381
35	Bruch	Germany	1,620	4,461	320
36	Ordenes	Spain	2,250	7,500	316
37	Allariz	Spain	1,850	6,500	215
38	Boiro	Spain	6,300	21,000	583
39	Caldas	Spain	4,320	13,500	693
40	Carnota	Spain	3,700	20,000	172
41	Cerceda	Spain	250	1,000	133
42	Lalin	Spain	8,300	25,000	753
43	Meano	Spain	9,000	30,000	1,200
44	Sanxenxo	Spain	10,800	57,000	1,345
45	Mino	Spain	2,700	9,000	207
46	Ponte do Porto	Spain	1,250	4,000	148
47	Mondariz	Spain	1,800	6,000	198
48	Vilagarcia	Spain	13,800	55,000	2,320
49	Vilalba	Spain	3,000	10,000	328
50	Pardron	Spain	5,184	18,000	415

Total **317,801** **1,144,211** **44,230**

2.2 Final selection of WWTPs

The preliminary selected WWTPs were examined in order to ensure that the list of selected plants fits the project's criteria listed in paragraph 2.1. With that purpose the main plant characteristics were collected: plant process layout, chemical and physical characterization of the influent wastewater, main operating conditions.

To ensure the coverage of a wide range of wastewater treatment techniques the main equipment involved in each treatment stage (preliminary, primary, secondary, tertiary and sludge treatment) were identified.

Different types of preliminary treatment for grease and sand removal were considered while regards primary treatment the presence or the absence of primary sedimentation was contemplated. Considering its large impact on energy consumption, particular attention has been paid to secondary treatment. A wide range of chemical and biological process was selected: Conventional Activated Sludge (CAS), different configurations for Biological Nutrient Removal (BNR), Sequential Batch Reactor (SBR), tricking filter, Membrane Bio-Reactor (MBR) and Oxidation Ditch (OD). Additionally various aeration systems for activated sludge process were selected (large, medium and fine bubble diffusers rather than mechanical aeration system). For tertiary treatment chemical disinfection, Ultraviolet (UV),



rather than different technologies for filtration of the final effluent were selected. Finally, wide ranges of sludge stabilization and thickening/dewatering system were considered.

Furthermore, it is important to take account of existing energy production systems in the selected plants. Due to the wastewater treatment, the produced sludge can be fed into anaerobic digester for biogas production. The produced biogas can be used in a combined heat and power plant (CHP) to produce energy, which can be fed into the electricity grid or used to supply the WWTP with its own energy. As can be seen in Appendix A and Appendix C, 75% of the German plants, and one plant in Italy use a cogeneration to reduce the energy consumption of the plant or to earn money by supplying electric energy into the electricity grid. Additionally, the presence of a co-digestion plant for the treatment of the Organic Fraction of Municipal Solid Waste (OFMSW) in one of the Italian plant will allow studying the impact of that process on the whole energy balance.

Once WWTPs were identified the effective possibility to carry out the study in each of the selected plants was examined. With that purpose visits to facilities have been carried out in order to check switchboards position and especially to verify the possibility to install the energy metering systems on them.

This analysis has proved to be crucial during this phase of the project and as consequence some critical issues were highlighted. In Germany, due to the maximum capacity of switchboards of some of the WWTPs a change to the preliminary list of WWTPs has been proposed. In other cases the requirements for the data transfer were proved to be not possible. Due to this factors plant number 21, 30, 32 and 33 on the list were exchanged. Their substitutes are Brüchermühle, Much, Neunkirchen and Ufersmühle. The final list of German plants is shown in Appendix A.

Regarding the Spanish plants, Ponte-Baxoi WWTP replaced Meaño WWTP since during 2015-2016 Meaño WWTP will be no more contracted by Espina Y Delfin. However, thanks to the fact the two exchanged WWTPs shared the same treatment configuration no particular impact on the project is expected due to the exchange.

In the Italian plants, Villafranca Padovana WWTP and Mestrino WWTP substituted the Onara WWTP and Battaglia WWTP because they are going to be closed or joined to other plants.

The final list of selected plants can be found in the Appendix.

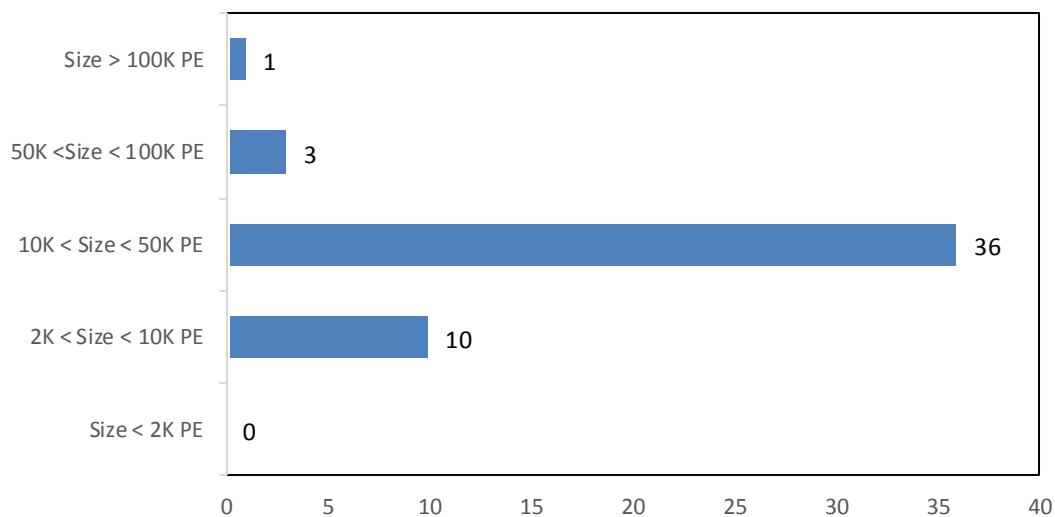


Figure 1 - Distribution of the 50 WWTPs from the final list, classified according to their size class

3 Appendix

Appendix A German Wastewater Treatment Plants

German Wastewater Treatment Plants								
No.	Plant name	Country	Technologies	CHP	Features	Size PE	Flow rate [m ³ /y]	Energy consumption [kWh/y]
1	Rospe	Germany	activated sludge	NO	Sludge transportation line	34,000	3,537,945	497,705
2	Wiehl	Germany	activated sludge	YES		22,200	2,618,145	634,383
3	Ründeroth	Germany	activated sludge	YES		14,000	1,552,710	318,468
4	Weiershagen	Germany	activated sludge	YES		15,800	1,713,310	390,133
5	Schönenthal	Germany	activated sludge	YES		20,000	3,712,050	579,123
6	Krummenohl	Germany	activated sludge	YES		40,000	6,734,615	957,020
7	Overath	Germany	activated sludge	YES		19,100	1,954,940	454,061
8	Brüchermühle	Germany	activated sludge	NO		5,333	1,157,050	250,074
9	Ufersmühle	Germany	tricklink filter, sand filter	YES	heigth differences	6,200	701,530	262,201
10	Seelscheid	Germany	membrane	NO		11,000	523,045	353,060
11	Bickenbach	Germany	SBR	YES		44,000	3,170,025	705,040
12	Volperhausen	Germany	activated sludge	YES		13,400	1,419,850	394,295
13	Much	Germany	activated sludge	NO		8,800	645,685	200,281
14	Brenzingen	Germany	filtration	YES		10,200	1,573,880	527,292
15	Büchel	Germany	activated sludge	YES		25,000	2,444,770	599,720
16	Neunkirchen	Germany	activated sludge	NO		13,000	834,390	183,893
17	Lindlar	Germany	filtration	YES		12,600	1,259,250	496,181
18	Bruch	Germany	activated sludge	YES		7,540	543,485	248,119
19	Lehmbach	Germany	activated sludge	YES		23,000	1,914,790	668,103
20	Rösrath	Germany	activated sludge	YES		35,833	3,211,270	1,099,650
	Total:			15		381,006	41,222,735	9,818,802

Appendix B Spanish Wastewater Treatment Plants

Spanish Wastewater Treatment Plants								
No.	Plant name	Country	Technologies	CHP	Features	Size PE	Flow rate [m ³ /y]	Energy consumption [kWh/y]
21	ORDENES	Spain	Oxidation ditch N&P bio removal	NO		7,500	821,250	316,000
22	ALLARIZ	Spain	Oxidation ditch N bio removal	NO		6,500	675,250	215,000
23	BOIRO	Spain	Oxidation ditch N bio removal + UV	NO		21,000	2,299,500	583,000
24	CALDAS DE REIS	Spain	Oxidation ditch N&P bio removal + UV	NO		13,500	1,576,800	693,000
25	CARNOTA	Spain	Oxidation ditch N bio removal + UV	NO	90% Industrial WW; Very low load	20,000	1,350,500	172,000
26	CERCEDA	Spain	Oxidation ditch N&P bio removal + UV	NO		23,750	91,250	133,000
27	LALIN	Spain	Oxidation ditch N bio removal	NO		25,000	3,029,500	753,000
28	MIÑO- PONTE BAXOI	Spain	Oxidation ditch N&P bio removal + UV	NO		8,500	930,750	314,000
29	MIÑO- RIBEIRA	Spain	Oxidation ditch N&P bio removal	NO		19,000	2,427,615	997,000
30	SANXENXO	Spain	Oxidation ditch N&P bio removal	NO		30,000	3,285,000	1,200,000
31	PONTE DO PORTO	Spain	Oxidation ditch N&P bio removal + UV	NO		4,000	456,250	148,000
32	MONDARIZ	Spain	Oxidation ditch N&P bio removal + UV	NO		6,000	657,000	198,000
33	VILAGARCIA	Spain	Oxidation ditch N&P bio removal + UV	NO	High load industrial WW	55,000	5037,000	2,320,000
34	VILALBA	Spain	Oxidation ditch N bio removal	NO		10,000	1,095,000	328,000
35	PADRON	Spain	Oxidation ditch N bio removal + UV	NO		18,000	1,892,160	415,000
	Total:			0		267,750	25,624,825	8,785,000



Appendix C Italian Wastewater Treatment Plants

Italian Waste Water Treatment Plants								
No.	Plant name	Country	Technologies	CHP	Features	Size PE	Flow rate [m ³ /y]	Energy consumption [kWh/y]
36	Asiago	Italy	active sludge	NO		20,000	1,770,980	500,003
37	Bassano del Grappa	Italy	activated sludge, trickling filter, filtration (3rd)	NO		96,000	3,995,025	4,178,602
38	Cadoneghe	Italy	activated sludge, filtration(3rd)	NO	final pumping station	50,000	4,936,625	2,042,051
39	Camposampiero	Italy	activated sludge, filtration(3rd)	YES	Anaerobic digestion together with OFMSW	35,000	4,350,580	2,260,338
40	Carmignano di Brenta	Italy	activated sludge	NO		20,000	1,349,405	1,076,772
41	Cervarese Santa Croce	Italy	activated sludge	NO		7,000	651,160	380,725
42	Cittadella	Italy	activated sludge	NO		61,500	4,307,730	2,038,126
43	Limena	Italy	activated sludge	NO	final pumping station	20,000	1,129,675	1,524,206
44	Mestrino	Italy	activated sludge	NO		12,800	832,200	421,348
45	Montegrotto	Italy	activated sludge	NO	final pumping station	20,000	1,520,590	967,756
46	Rubano	Italy	activated sludge	NO		22,000	1,562,200	788,628
47	Selvazzano	Italy	activated sludge	NO		20,000	1,810,765	857,958
48	Tezze sul Brenta	Italy	activated sludge	NO		100,000	5,447,260	1,678,786
49	Villafranca Padovana	Italy	activated sludge	NO		12,000	966,155	648,317
50	Vigonza	Italy	activated sludge, filtration(3rd)	NO		48,000	6,490,430	3,440,870
	Total:			1		544,300	42,110,780	23,392,257