>

DT 1.1.1

LIST OF BEST PRACTICES

LONG LIST OF BEST PRACTICES IDENTIFIED

30/11/2017

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1. INTRODUCTION

This deliverable provides a list of the most common technologies related to the treatment and management of sewage sludge arising from wastewater treatment processes, and for the treatment of the organic fraction of municipal solid waste (OFMSW). Following the topic of the project, the key focus of this list is on technologies and best practices concerning the generation of sewage gas (biogas) combining sewage sludge and OFMSW.

From the side of a conventional activated sludge wastewater treatment plant, the analysis of the technologies includes both sludge lines, excess sludge gained from the secondary settler and, primary sludge from the primary settler.

From the side of the OFMSW the analysis considers the wastes delivered at the treatment platform. All the operational activities done before this point are not considered in this deliverable.

The different technologies identified have been classified according to a general approach that consider pre-treatment technologies, treatment technologies (anaerobic digestion), and post-treatment technologies (biogas line, digestate line, sludge line, sanification). One chapter addresses issues related to monitoring and control. As already mentioned, the project is primarily focusing on upgrading of biogas from sewage sludge and wastes. Consequently, the listed treatment and post-treatment technologies only considers those related to the anaerobic digestion process. However, to support a holistic view on the issue of energy generation from wastewater the deliverable also presents additional sources of energy available at wastewater treatment plants (WWTPs).

2. PRE-TREATMENT TECHNOLOGIES

Pre-treatment of OFMSW and sewage sludge can have a double scope: (1) prevention of any damage of the successive machinery of the process by removing as much impurities as possible and (2) improving the biological availability of the substrate for the different bacteria families present in the anaerobic digestor.

It is possible to classify these methods following different criteria, in this document one of the most classical has been used taking in consideration the main effect that the process considered produce.

For this reason we consider the following pre-treatments:

- Physical
- Thermal
- Chemical
- Biological

Most of the above mentioned pre-treatments produce also some side effect, i. e. physical methods produce even some thermal effect, thermal treatments can facilitate some chemical or biological reaction.

A second scope of pre-treatments is to provide at the subsequent step the right size and level of humidity with a good degree of homogeneity of the inlet mass. For this reason especially when different substrates are used a good mixing level is important to prevent clogging in the pipe lines or unbalances during the biological process in order to facilitate the degradation of the organic matter.

2.1. PHYSICAL

ULTRASOUNDS

Where the technology is applied	**Who is appling the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Bamberg	Bamberg WWTP	WWTP of 280,000 PE	Ultrawaves ultrasound system for improvement of anaerobic digestion on waste water treatment plants Sludge treatment: Primary sludge (PS) and thickened waste activated sludge (TWAS)	Intensification of sludge digestion: degradation of VS increased from 34% to 58% Biogas production: increase of 29%
Dabrowa-Gornicza, Poland	Dabrowa-Gornicza WWTP	WWTP of 150,000 PE	Ultrasound technology	Full-scale installation since 2008 - increase in VS destruction of 25% - increase in biogas production of 25

LYSATE CENTRIFUGE

Where the technology is	**Who is appling the**	**Description of the platform**	**Description of the**	**Improvement in terms of**

applied	technology	treating implementing the technology	technology applied	Energy Production and/ or EE
Prague	Prague WWTP, PVK a.s., Veolia owned operator	WWTP of 1.250,000 PE	Lysatec knives applicated on Centrivit centrifuge	Intensification of sludge digestion: degradation of VS increased from 5 to 10% Biogas production: increase of 10%
Liberec	Liberec WWTP, SCVak a.s., Veolia owned operator	WWTP of 190.000 PE	Lysatec knives applicated on Centrivit centrifuge	Intensification of sludge digestion: degradation of VS increased from 5 to 10% Biogas production: increase of 10%

2.2. THERMAL

THERMAL ALKALINE HYDROLYSIS

Where the technology is applied	Who is appling the technology	Description of the platform treating implementing the technology	Description of the technology applied	Improvement in terms of Energy Production and/ or EE
Uelzen, Germany	WWTP Uelzen (Abwasserzwec	83,000 PE	PONDUS (Alkali	on average 22% higher methane

	kverband Uelzen)		hydrolysis)	production 21% less polymers used
Gifhorn, Germany	WWTP Gifhorn	65,000 PE	PONDUS (Alkali hydrolysis)	30% higher biogas production
Wolfsburg, Germany	WWTP Wolfsburg (Wolfsburger Entwässerungsbetriebe)	135,000 PE	PONDUS (Alkali hydrolysis)	No data Available
Köln-Stammheim, Germany	WWTP Köln-Stammheim (Stadtentwässerungsbetriebe Köln, AöR)	1,500,000 PE	PONDUS (Alkali hydrolysis)	No data Available
Nordhorn, Germany	WWTP Nordhorn	70,000 PE 202,000 PE	PONDUS (Alkali hydrolysis)	Reportedly 50% more biogas
Ratekau, Germany	WWTP Ratekau	45,000 PE	PONDUS (Alkali hydrolysis)	First results 38% more biogas

THERMAL PRESSURE HYDROLYSIS

Where the technology is applied	**Who is appling the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Geiselbullach, Germany	WWTP Geiselbullach (Amperverband, Cambi THP-C)	4,000 **(t DS/y)**	CAMBI Thermal Hydrolysis > 100 °C	
Venlo, Netherlands	WWTP Venlo	300,000 (PE) population	TurboTec	Up to 20% higher

		equivalent 5400+ t DS (intern) +1600 t DS (angeliefert)	Thermal Hydrolysis > 100 °C	biogas yield
Lingen, Germany	WWTP Lingen (Stadtentwässerung Lingen)	14,000m³/d 160,000 PE	LysoTherm Thermal Hydrolysis > 100 °C	-higher production of electricity -Higher heat production -less sludge -Less chemical demand
Davyhulme,UK	WWTP Davyhulme	91,000 t DS/year digestion plant will serve a population equivalent of 3 million people	CAMBI Thermal Hydrolysis > 100 °C	-Carbon emissions reduced by 32,000t CO2 equivalents/year -Reduced energy for drying and incineration
Howdon, UK	Northumbrian Water Ltd (NWL)	40,000 t DS/year 1,000,000 PE	CAMBI Thermal Hydrolysis > 100 °C	reduce NWLs carbon footprint by about 50 000 t CO2/ year.
Psyttalia, Greece	Psyttalia WWTP	15,500 metric tonnes DS/year 43 t DS/ day	CAMBI Thermal Hydrolysis > 100 °C	20% overall WWTP energy savings 15-20% expected increase in biogas production. Reduced carbon emissions
Lille	Lille Marquette-lez-Lille WWTP, operated by Veolia	WWTP of 650,000 PE	Excelys thermal hydrolysis	Sludge amount reduction by 30%
Edinburgh	Edinburgh	WWTP of	Thermal	Sludge

	Seafield WWTP	800.000 PE	hydrolysis – not specified	hygienisation and transformation to fertilizer
Billund	Billund BioRefinery operated by Billund-Vand		Excelys thermal hydrolysis	30% sludge amount reduction, 30% lower xenobiotics content

3. TREATMENT TECHNOLOGIES (ANAEROBIC DIGESTION PROCESS)

The process of anaerobic digestion is the biological process that can transform, in an environment without oxygen, the organic matter into biogas.

The process is a quite well known process and several technologies have been developed for different kind of substrates and different concentration of water in the inlet stream.

In this document not all anaerobic reactor designed for wastewater treatment have been considered because they are not applicable for the purpose of the project.

One of the most used classifications to describe the different anaerobic digestion processes is based on the water content of the feeding material.

For this reason we have identified the following main categories:

- Wet reactors working with a dry matter content up to 10 %
- Semidry reactors working with a dry matter content between 10 and 20%
- Dry reactors working with a dry matter content higher than 20 %

Other possible classifications taking in consideration the temperature of the process (psychrophilic, mesophilic, and thermophilic) or the flow dynamics inside the reactor (plugflow, upflow, downflow, cstr). These classifications will be described in DT 1.1.2 of the project where specific processes will be deeply clarified.

3.1. SINGLE STAGE DIGESTION PROCESS

COMPLETELY STIRRED TANK REACTOR CSTR

Where the technology is applied	**Who is appling the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Tortona (AL) Italy	Ecoprogetto Tortona digestione anaerobica	Platform treating 33.000t/y OFMSW and 2000t/y	Two one stage mesophilic anaerobic digestors	Energy produced 8400MWh$_{el}$/y Thermal power recovered 1MW (Ladurner, 2015)
Albairate (Milano) Italy	Ladurner	Platform treating 70.000t/y OFMSW	Two one stage mesophilic anaerobic digestors	Energy produced 17000MWh$_{el}$/y (ECOPROGETTO MILANO DIGESTIONE ANAEROBICA ALBAIRATE, 2015)
Pinerolo (To) Italy	ACEA Pinerolese	Anaerobic digestion of	One stage thermophilic	27500MWh$_{el}$/y produced and 14000MW$_{th}$/y

		50000t/y OFMSW and 33000t/y sludge	anaerobic digestor	recovered. Thermal energy recovered to heat a commercial area or 30000m2 and 4800m2 of private houses. The thermal energy provide also the energy to heat the sanitary water for such area.
Billund	Billund BioRefinery operated by Billund-Vand	35000 t/y OFMSW + agricultural	One stage thermophilic anaerobic digester WAASA	14.000.000 kWh of energy produced as biogas
City of Zagreb	Zagreb Wastewater Ltd.	Capacity of 1,2 mil PE and demand of 27,790 m3/h (BOD 90,000 kg/day)	Mechanical and biological treatment / AD	More than 70% of electricity demand is settled from its own production in biogas plant
Braunschweig, Germany	Steinhof WWTP	385,000 PE	Biological wastewater treatment, thermophilic sludge digestion and co-digestion with organic waste, cogeneration and recovery of biogas	- 30 to 50% more biogas - Production of 24 000m3 and 50 000 kWh of electricity per day
Malmö, Sweden	Sjölunda WWTP	550,000 PE	Biological treatment	- Utilization of produced biogas at the plant - Biogas upgrading for utilization as a vehicle fuel

3.2. TWO STAGES DIGESTION PROCESS

PROCESSES WITH SCHEME WITHOUT RETENTION OF BIOMASS

Where the technology is applied	**Who is appling the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Leeming	Leeming, Iona, UK, Veolia operates The site	80000 t of industrial biomaste and OFMSW	Two stage mesophilic anaerobic digestors	6000000 m3/y of biomethane to grid produced

3.3. BATCH PROCESS

INDUSTRIAL PROCESS: "BIOCELL"

Where the technology is applied	**Who is appling the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Rimini	HERA Group	45000t/y OFMSW	Dry anaerobic digestion with 11 biocell technology	Electricity produced 8000MWh/y (HERA, 2012)

4. POST-TREATMENT TECHNOLOGIES

4.1. BIOGAS LINE

Biogas is the main product obtained from the anaerobic digestion. Although it is possible to use it directly as product from the anaerobic digestion process, normally it is better to purify it to remove some chemical compound, as hydrogen sulphide, or water, that can generate some problem (e.g. corrosion) in the pipelines or in the devices where it will be used (CHP, boilers).

A second part of this paragraph is dedicated at the technologies used to upgrade the biogas to that level of purity that can allow its injection in the gas grids or used as biofuel.

At the moment this is the main driver in Europe for the production and use of biogas and probably even the most environmentally convenient.

4.2. BIOGAS PURIFICATION PROCESSES

4.2.1. DEHUMIDIFICATION

CHILLER

4.2.2. DESULPHURISATION

IN SITU: PRECIPITATION OF SULPHUR

BIOLOGICAL: SCRUBBING

MICROAERATION

Where the technology is applied	**Who is appling the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Lille	Lille Marquette-lez-	WWTP of 650,000 PE	Biogas H2S removal	Less efficient than expected

	Lille WWTP, operated by Veolia		system by sludge microaeration	

4.3. BIOGAS UPGRADING

ABSORPTION WITH ORGANIC COMPOUNDS

Where the technology is applied	**Who is appling the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Göteborg Energi	Gryaab AB		Chemical Adsoprion on anines	Realization year 2007 upgrading Biogas from Sewage sludge production of 60GWh at 4bars injected in the grid (Eric Zinn, 2016)

SCRUBBING

Where the technology is applied	**Who is appling the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Könnern, Germany		35.000t corn-silage + 15.000t liquid manure + 1.500t crop	Biogas upgrading PWS technology	Realized in 2007 Capacity 650 Nm³/h, equal to 42 mill. kWh p.a., with an investment cost of ca. 9.5 Mill. €
Kungsängens gård, Uppsala, Sweden	Uppsala Biogas Plant	25,000 t/y OFMSW and 3,000 t/y slaughter house waste	PWS technology	In 2013 produced 4.6MNm3 biogas/y, about 28.4 GWh used

				for 89% upgraded as vehicle fuel, 9% internal heating 2% combusted in the torch (Persson, 2014)
Zalaviz Waterworks, Company, Hungary	Zalaviz Waterworks	50,000 - 60,000m³ of surplus activated sludge generated on site, and sewage sludge imported from other local wastewater treatment plants.	PWS technology	1,000 –1,200 m³/day of biogas is produced from the digestion process.
Bern, Switzerland	ara region bern ag	Sewage sludge Organic waste	Chemical scrubber	1500 Nm3/h raw gas; 75% of biogas through digested organic waste
Allendorf (Eder), Germany		CO2 from biogas plant	LPSA	15 bis 55 m³/h SNG
Didcot, UK	Thames water	sewage/gas from wastewater treatment	Pressurised Water Scrubbing	100 Nm3/h raw gas 65 m³/h Biomethane Feed-in Capacity

PRESSURE SWING ADSORPTION

MEMBRANE TECHNOLOGY

Where the technology is applied	Who is appling the technology	Description of the platform treating implementing the technology	Description of the technology applied	Improvement in terms of Energy Production and/ or EE

WWTP Wiener Neustadt, Austria		Anaerobic digestion of a volume 10.500 m³ capacity (including Sludge as well as co-fermentation)	Membrane upgrading	Biomethane production from anaerobic digestion using sludge (250Nm³/h) to 450 Nm³/h by adding co-substrate. The 200Nm³/h were upgraded by using a membrane technology beginning in 2011
WWTP Zuchwil Emmenspitz, Switzerland		Substrate is only sludge from the WWTP	Membrane upgrading	
WWTP Beverwijk, The Netherlands	Pentair Haffmans	Substrate is only sludge from the WWTP	Membrane upgrading	2Mill. m³ biogas produced per Year in three digesters. After installation (based on calculations) 1.28 Mill m3 biomethan can be produced out of the 2 Mill m³ biogas.
Grenoble, France	Grenoble Alpes Métropole (METRO)	WWTP sludge	Membrane upgrading	110 Nm3/h raw gas

CRYOGENIC TECHNOLOGY

Where the technology is applied	**Who is appling the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Pinerolo (To)	ACEA	Anaerobic	Cryigenic	Biomethane production from

Italy	Pinerolese	digestion of 50000t/y OFMSW and 33000t/y sludge	upgrading	anaerobic digestion Pilot plant production of 2750m3 biomethane from biogas (Il biometano Acea, 2017)

POWER TO GAS

Where the technology is applied	Who is appling the technology	Description of the platform treating implementing the technology	Description of the technology applied	Improvement in terms of Energy Production and/ or EE
Avedøre, Denmark	BIOFOS A/S (WWTP Avedøre)	345,000 PE 25-30 mio. m3/year wastewater	- alkaline electrolyzer -Biological Catalysis (P2G-BioCat)	-upgraded gas injected into grid -first results: 90% of CO_2 of the biogas stream converted into methane -oxygen is used in activated sludge treatment basins, resulting in a decrease of up to 80% of the volume of gas for aeration -heat recycling for sludge pre-heating
Falkenhagen, Germany	Uniper Energy Storage GmbH		-electrolysis - catalytic methanation	-360 Nm³/h H2 production, injected into gas grid - new methanation unit expected to produce 57 Nm³/h SNG and heat will

				be used in veneer plant in July 2018
Haßfurt, Germany	Greenpeace Energy eG, Städtische Betriebe Haßfurt		PEM electrolysis	-use of renewable energy otherwise not injectable into electricity grid - 225 Nm3/h H2 produced -H2 injection into gas grid
Toia, Italy			Electrolysis CO2 capturing Electro-catalytic methanation	move surplus of renewable electricity from power grid to LNG distribution network not yet realized
Bad Hersfeld, Germany	Landwirtschaftszentrum Eichhof	Biogas plant	-electrolysis - methanation of CO2 of biogas stream	-Injection of methane into grid - ca. 4 m³/h SNG
Fos-sur-Mer, France	GRTgaz		-alkaline electrolysis -PEM electrolysis - methanation process (METHAMOD) with carbon capture	-200 m3/h H2 injection into grid -25m3/h methane production Under construction

4.4. REMOVAL OF COMPONENT TRACES

Where the technology is applied	Who is appling the technology	Description of the platform treating implementing the technology	Description of the technology applied	Improvement in terms of Energy Production and/ or EE
Budapest-north	Budapest-north WWTP	Biogas H2S and siloxanes removal	GAC	Reduced H2S and siloxanes content to approx. 0
Budapest-south	Budapest-south WWTP	Biogas H2S and siloxanes removal	GAC	Reduced H2S and siloxanes content to approx. 0
Braunschweig	Braunschweig WWTP	Biogas H2S and siloxanes removal	GAC	Reduced H2S and siloxanes content to approx. 0
Montpellier	Montpellier WWTP	Siloxanes removal	Activated carbon filers	Reduced siloxanes content to approx. 0
Prague	Prague WWTP, PVK a.s., Veolia owned operator	Biogas H2S and siloxanes removal	GAC	Reduced H2S and siloxanes content to approx. 0

4.5. BIOGAS USES

CHP UNIT

Where the technology is applied	Who is appling the technology	Description of the platform treating implementing	Description of the technology applied	Improvement in terms of Energy Production

		the technology		**and/ or EE**
Budapest-north	Budapest-north WWTP	WWTP with anaerobic digestion, 1300000 PE	CHP – piston engines	15.000.000 kWh of electricity produced
Budapest-south	Budapest-south WWTP	WWTP with anaerobic digestion, 410000 PE	CHP – piston engines, Jenbacher	15.247.100 kWh of electricity produced
Braunschweig	Braunschweig WWTP	WWTP with anaerobic digestion, 275000 PE	CHP – piston engines, Jenbacher	9.800.000 kWh of electricity produced
Prague	Prague WWTP, PVK a.s., Veolia owned operator	WWTP with anaerobic digestion, 160000 PE	CHP – piston engines, MWM DEUTZ	29.000.000 kWh of electricity produced
Zlin	Zlin WWTP, operated by MOVO, Veolia owned company	WWTP with anaerobic digestion, 207000 PE	CHP – piston engines, TEDOM	1.500.000 kWh of electricity produced

BIOMETHANE PRODUCTION (FEED-IN TO PUBLIC GRID)

Where the technology is applied	**Who is appling the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Leeming	Leeming, Iona, UK, Veolia	80.000 t of industrial biomaste and	DMT membrane biogas	6.000.000 m3/y of biomethane to grid produced

	operates The site	OFMSW	upgrading unit	

5. DIGESTATE LINE

Digestate represent the exhaust material obtained after the anaerobic digestion process.

It has still potential pollution content and therefore it must be further treated.

The quality of this material strongly depends on the quality of the inlet material in the process. If feeding material was polluted by heavy metal or other non-biodegradable substances the digestate will be affect by their presence and concentration.

This will determine strongly the fate of the digestate.

In any case the general approach at digestate management starts with the sloid/liquid separation, followed for the two stream by different technologies related at the possible solutions applicable.

5.1. SOLID LIQUID SEPARATION

SCREW PRESS

CENTRIFUGE

BELT PRESS

5.2. LIQUID FRACTION

AMMONIA STRIPPING

PRECIPITATION OF STRUVITE

Where the technology is applied	**Who is appling the technology**	**Description of the platform treating implementing the**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**

		technology		
Samoens (France)	Samoens WWTP	Phosphorus recovery from liquid phase after sludge solid/liquid separation	STRUVIA chemical phosphorus recovery	Phosphorus fertilizer production (Struvite)

PUMPING BACK TO WASTEWATER TREATMENT PLANT

5.3. SOLID FRACTION

COMPOSTING PLANTS

HYDROTHERMAL CARBONIZATION

PYROGASIFICATION

DIGESTATE USES

6. SANIFICATION TREATMENT

According to European Union Regulation EC1772/2002, substrates such as municipal solid waste (MSW), food waste (FW), and slaughterhouse wastes need to be pasteurized or sterilized before and/or after anaerobic digestion. The reason of this need is that in these wastes the possibility to have possible pathogenic contamination or undesired fermentation that anaerobic process cannot guarantee the perfect removal.

PASTEURIZATION

STERILIZATION

7. MONITORING AND CONTROL

Although each anaerobic digestor and each device (pumps, control probes, CHP units, upgrade unit, on line meters, ect.) are controlled through a monitoring and control system there isn't a specific technology that can be identified. In some case there are algorithms able to manage the anaerobic reactor conditions according to the substrate loading and with the process condition.

Most of the ICT systems are custom made starting from some basic units. The final monitoring system result as an assembling of different software modules generally strictly connected with one of the main supplier of the hardware of the process.

pH CONTROL

REDOX POTENTIAL CONTROL

SULFUR CONTROL

BIOGAS QUALITY CONTROL

BIOGAS FLOW CONTROL

FEEDING MATERIAL CONTROL

GAS PRESSURE CONTROL

OXYGEN CONTROL

8. ADDITIONAL ENERGY SOURCES

Beside the use of the chemical energy content of wastewater in the form of biogas wastewater also contains significant amounts of (low temperature) heat. Furthermore, the effluent of a WWTP might be used for hydropower generation. Finally the premises of a WWTP can provide opportunities for solar and wind power installations and also technical installations might generate reusable excess heat.

8.1. WASTEWATER HEAT AND COOL

The heat content of wastewater (from domestic, commercial and/or industrial warm/hot wastewater) can be recovery by means of a heat exchanger and a heat pump. The former is installed in the wastewater flow for heat extraction. The heat pump then boosts the extracted heat to higher temperature levels (space heating and warm water generation). By changing the flow direction between heat pump and heat exchanger, the system could also be used for cooling purposes.

Today, most applications for wastewater heat recovery are situated in the sewer system. However, also the effluent of a WWTP is a potential site for the recovery of thermal energy for internal and external use.

Where the technology is applied	**Who is applying the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Milan (MI) Italy	Nosedo WWTP	WWTP of 1250000 PE	Heat recovery from treated wastewater	Pilot plant for the heat recovery and cooling of the office building of 2000m^2 (R & G., 2012)
Weiz, Austria	Weiz WWTP, energy consumers	WWTP of 30.000 PE	Heat recovery from treated wastewater (WWTP effluent)	WWTP external heating and cooling of an office building and a car showroom (PT AWE, 2017)
Waiblingen, Germany	WWTP Waiblingen, municipal utility	WWTP size not documented	CHP and wastewater heat recovery from WWTP	WWTP external heat supply for 24 (public)

			effluent	buildings, supply distance 3,6 km (Müller et al., 2005)
Thalwil, Switzerland	WWTP Thalwil, Contractor	WWTP around 20.000 PE	wastewater heat recovery from WWTP effluent	WWTP external heat supply for retirement/ nursing homes, supply distance 1,5 km (Wherli, 2010)
Marseille	Marseille sewage system	Swimming pool heating from wastewater in sewer system	Energido system – heat recovery from wastewater	All year 27°C heating of swimming pool. 230 t of CO2 saved.

8.2. MECHANICAL POWER

HYDROPOWER

Where the technology is applied	**Who is applying the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Vienna, Austria	Vienna WWTP	WWTP of 4.000.000 PE	double regulated Kaplan turbine in the effluent	WWTP internal use of electricity, generation of up to 1.3 million kWh/a

				(about 2 % of demand) (ebs, s. a.)
Vienna, Austria	Vienna WWTP	WWTP of 4.000.000 PE	hydrodynamic screw in the effluent (upstream of the Kaplan turbine)	generation of up to 500.000 kWh/a (about 1 % of demand) (ebs, s. a.)

WINDPOWER

Where the technology is applied	**Who is applying the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Vienna, Austria	Vienna WWTP	WWTP of 4.000.000 PE	10 kW wind turbine (23 m height, 8,5 m diameter) at the WWTP premises	WWTP internal use of electricity (ebs, s. a.)

8.3. SOLAR POWER

PHOTOVOLTAICS

Where the technology is applied	**Who is applying the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Vienna, Austria	Vienna WWTP	WWTP of 4.000.000 PE	10 kWp (60 m² collector	10,500 kWh/a for charging

			size) at the premises of the WWTP (flat roof)	WWTP's 3 electric vehicles and e-bikes (ebs, s. a.)

SOLAR THERMAL

Where the technology is applied	**Who is applying the technology**	**Description of the platform treating implementing the technology**	**Description of the technology applied**	**Improvement in terms of Energy Production and/ or EE**
Vienna, Austria	Vienna WWTP	WWTP of 4.000.000 PE	88 kW (126 m² collector size) at the premises of the WWTP (flat roof)	reduction of district heat for water heating (shower, kitchen) by 25 % (ebs, s. a.)

8.4. EXCESS HEAT

HEAT RECOVERY FROM TECHNICAL INSTALLATIONS (AERATION SYSTEM)

9. CONCLUSIONS

From the analysis of the available technologies it is possible to see that there are many available technologies applicable in the field of EE and RES in the sector of waste water and waste treatment and management,

Some of these are not strictly related at the treatment of the wastes as heat recovery technologies or RES production with photovoltaic or wind power or others, but these technologies will became relevant in the next future because they could provide an additional energy for the reduction of the impacts of treatments plants in particular for the increase of the Urban Compatibility and acceptation from the population involved, of for the emerging technologies for biomethane production through biogas upgrading or power to gas utilization.

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