



THERBIOR

Thermal Energy Recovery from a Novel Sequencing Batch Biofilter Granular Reactor



Francisco J. Batlles Garrido
Claudio Di Iaconi
Ivan Muñoz

Water JPI
WaterWorks2014 Cofunded Call
8 May 2018, Larnaca, Cyprus

Contents

- Project Overview
- Project Timeline (1st year)
- Scientific and technological progress
- Collaboration, coordination and mobility
- Status of milestones/deliverables
- Stakeholder/Industry engagement
- Dissemination of the results
- Identified problems

THERBIOR Consortium

Academic sector

- Almeria University, The Solar Resource Assessment and Climatology Group and the International Management School group: **Coordinator**
- The National Research Council - The Water Research Institute (CNR-IRSA)

Private sector

- 2.-0 LCA consultants
- Hedera Helix Ingenieria y Biotecnologia S.L.

Project duration: **2 years**

Start date: 01.04.2016

End date: **31.03.2018**



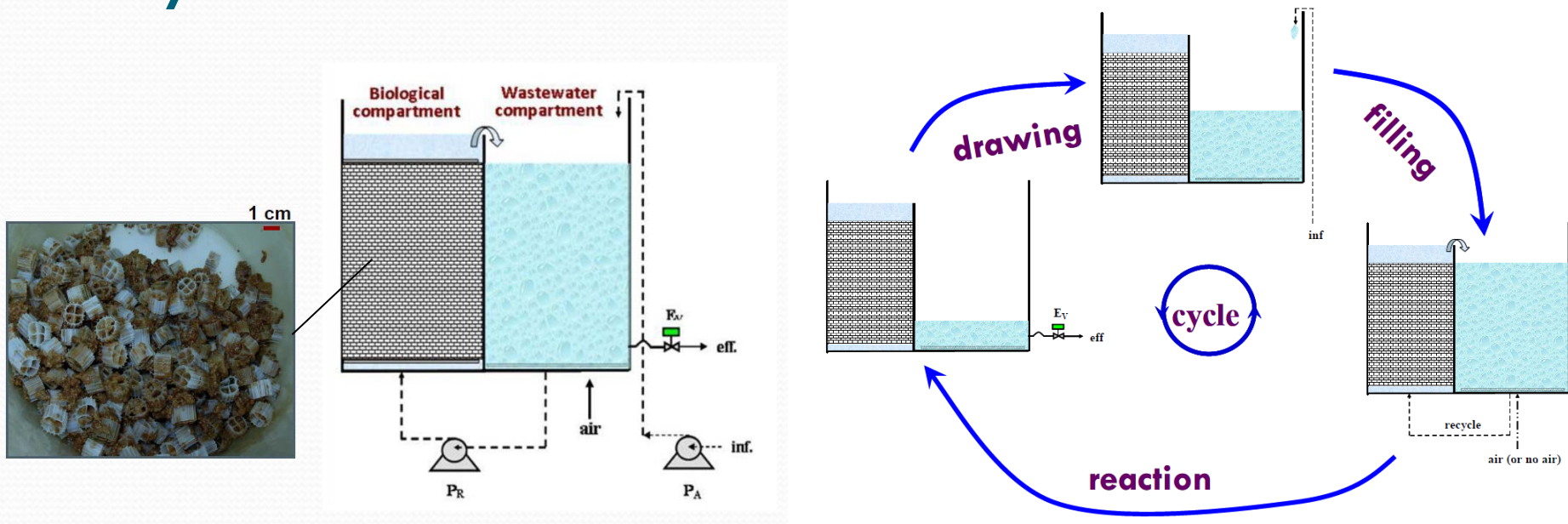
<http://www2.ual.es/therbior/>



Overall research aim

Development and demonstration of a fully off-grid, solar-assisted heat pump (SHP) coupled with the novel Sequencing Batch Biofilter Granular Reactor (SBBGR) as an innovative technological strategy to fight energy efficiency problems in WWTPs

Why a SBBGR in THERBIOR?



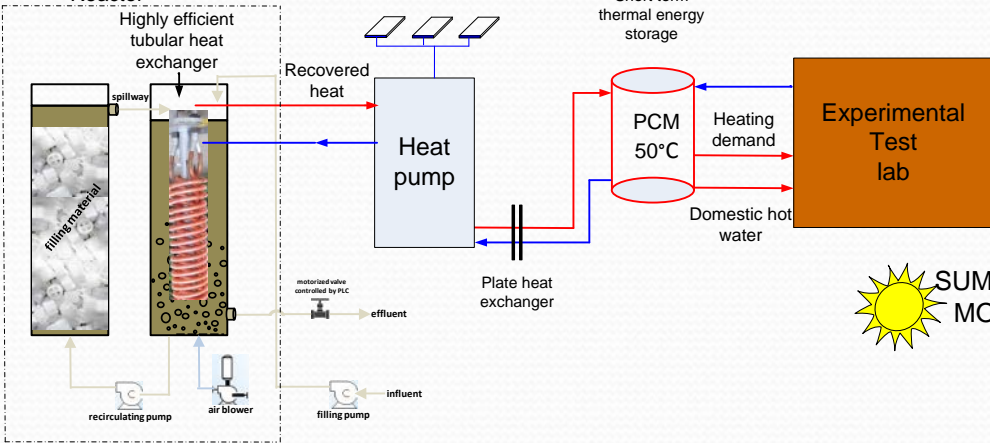
- Prevention of biofouling in heat exchangers
- Can operate at rather low temperatures
- Long SRT maximizes chemical energy release

The THERBIOR prototype

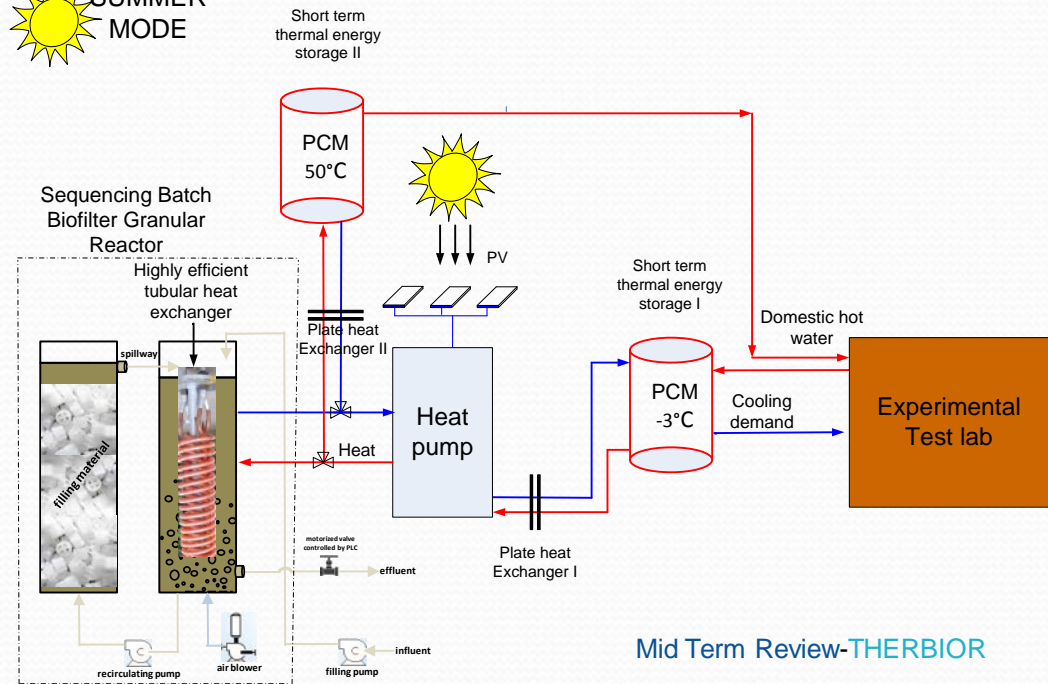


WINTER
MODE

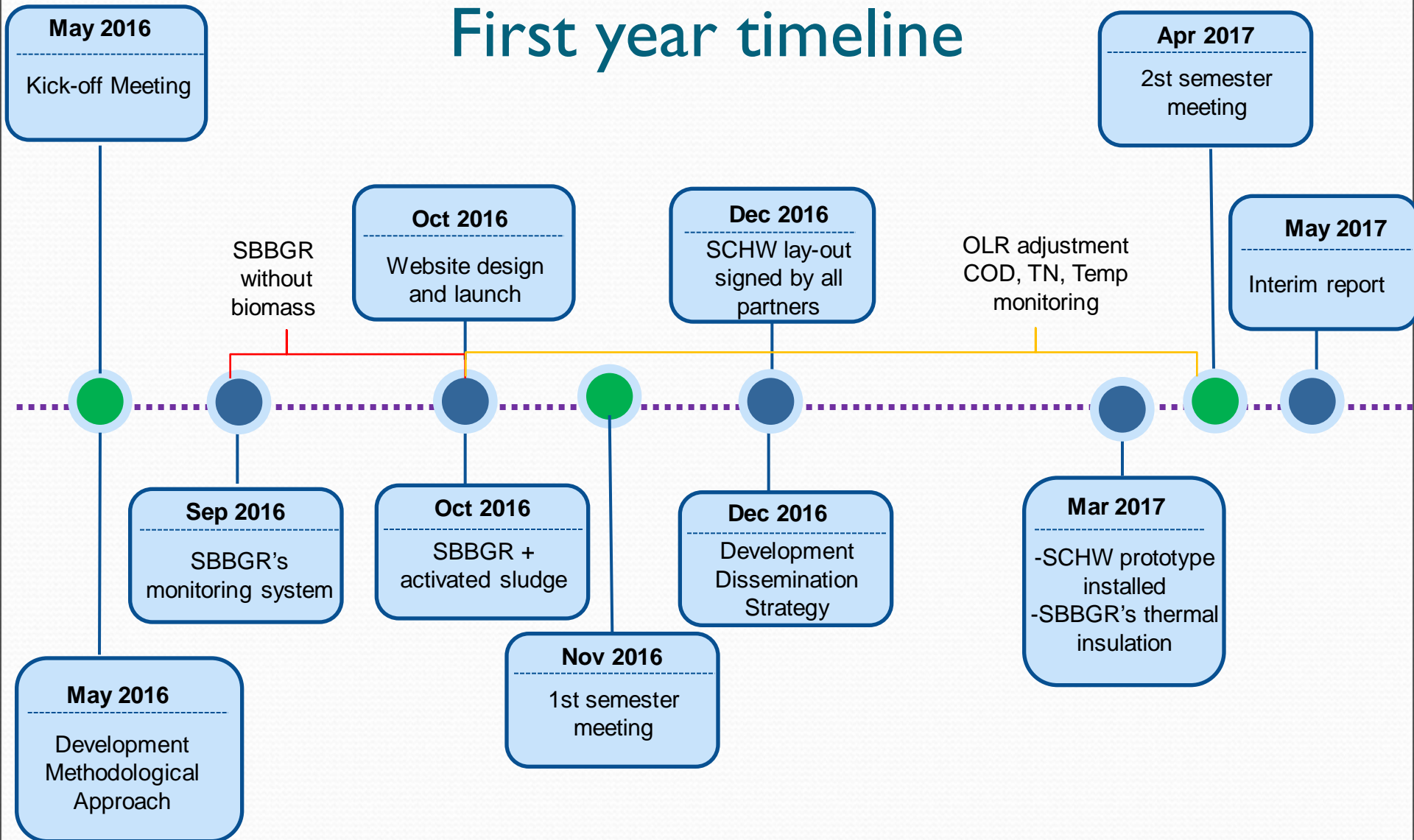
Sequencing Batch
Biofilter Granular
Reactor



SUMMER
MODE



Scientific and technological progress: First year timeline



Scientific and technological progress

May 2016



SBBGR and ETL at CNR-IRSA before start of the project

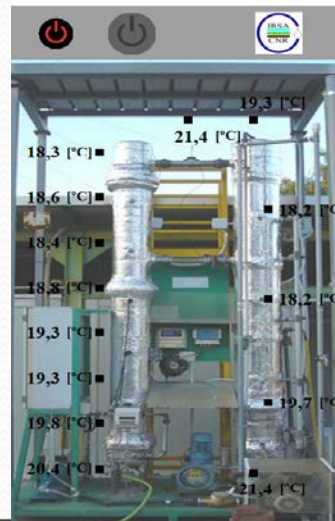
September 2016



SBBGR's supervision control and data acquisition system



THERBIOR



Weather station			
Sunny outdoor Temperature [°C]	26,0	wind vane [°]	292
Shaded outdoor Temperature [°C]	23,7	Anemometer [m/s]	0,0
Radiation [W/m2]	339	Humidity [%]	45,7

Water parameters			
Turbidity [NTU]	0	PH	8,6
EC [uS/cm]	353	ORP [mV]	109
DO [mg/l]	3,7		

Air and water circulation			
Daily water recirculation [l]	298	Airflow [SLPM]	8



March 2017



Data monitoring

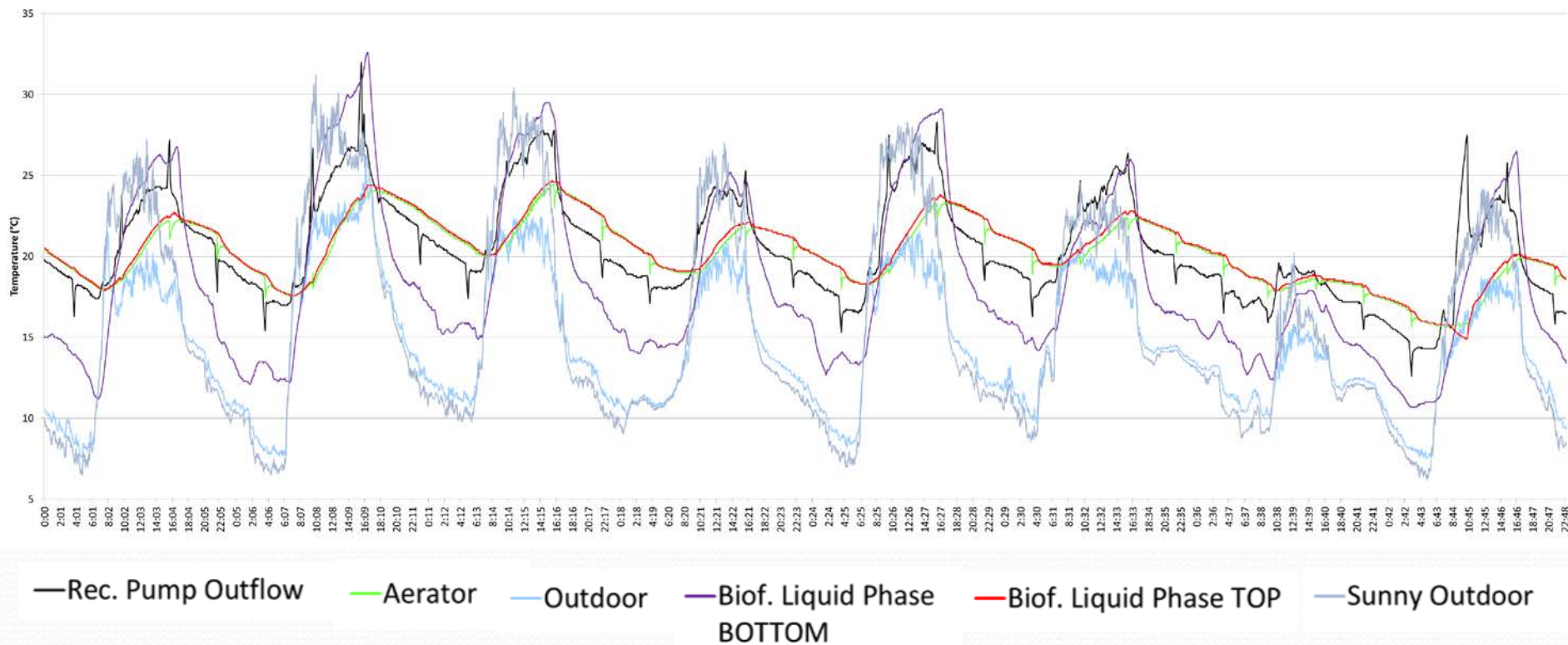
- SBBGR performance parameters (2 analysis per week)
 - COD
 - BOD
 - DOC
 - TSS
 - Nitrogen
 - pH
 - conductivity
 - Sludge production
- Thermal energy recovery parameters (continuous)
 - T in several points
 - Air and water flow and T

SBBGR performance

		Start-up	Feb-Mar'17
COD	Influent (mg/L)	398	926
	Effluent (mg/L)	31	74
	Removal (%)	92	92
TSS	Influent (mg/L)	104	207
	Effluent (mg/L)	19	35
	Removal (%)	81	83
TN	Influent (mg/L)	61	49
	Effluent (mg/L)	45	3
	Removal (%)	26	94
NH4+	Influent (mg/L)	49	36
	Effluent (mg/L)	0,4	1
	Removal (%)	99	98
P	Influent (mg/L)	8	6
	Effluent (mg/L)	6	5
	Removal (%)	25	18

SBBGR temperature profiles

20-28 March 2017



Life cycle assessment / life cycle costing

Reference scenario

Fossil fuels

Electricity from grid

Conventional heat pump system

Cooling, heating, DHW

User

THERBIOR scenario

Solar energy

PV panels

SHP system

Cooling, heating, DHW

User

Wastewater

SBBGR WWTP

Effluent

Heat from waste water

Natural resources
Emissions to air
Emissions to water
Emissions to soil

Capital costs
Operation costs

LCA

LCC

Mid Term Review-THERBIOR

Wastewater

Activated sludge WWTP

Effluent

+

Wastewater

SBBGR WWTP

Effluent

Heat from waste water

Natural resources
Emissions to air
Emissions to water
Emissions to soil

Capital costs
Operation costs

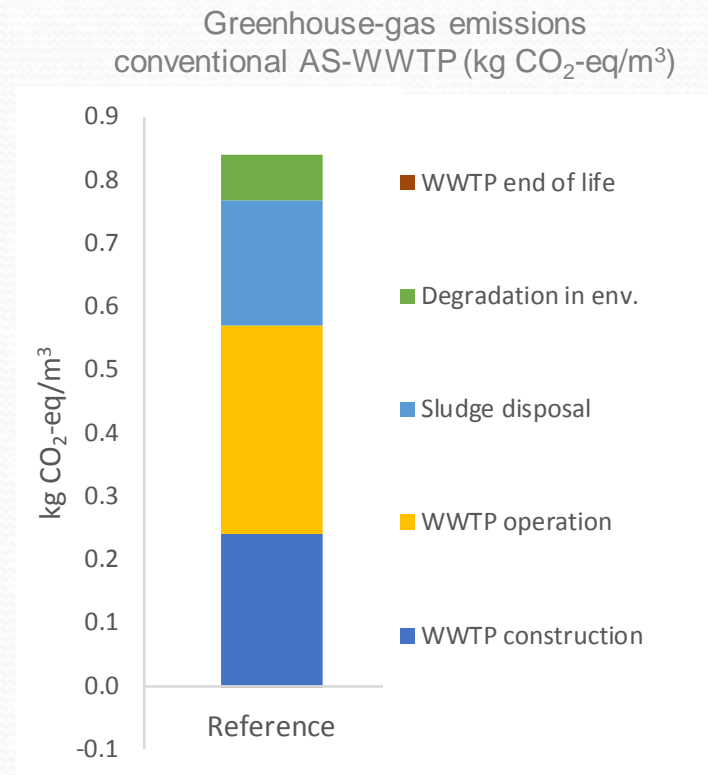
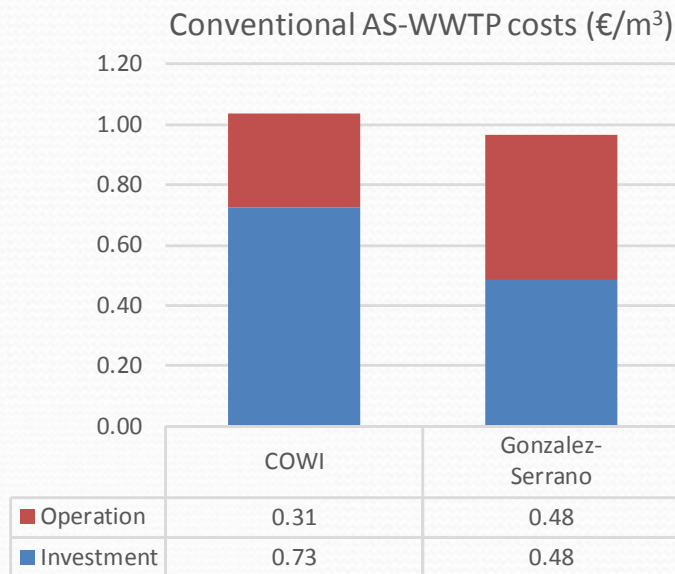
LCA

LCC

Mid Term Review-THERBIOR

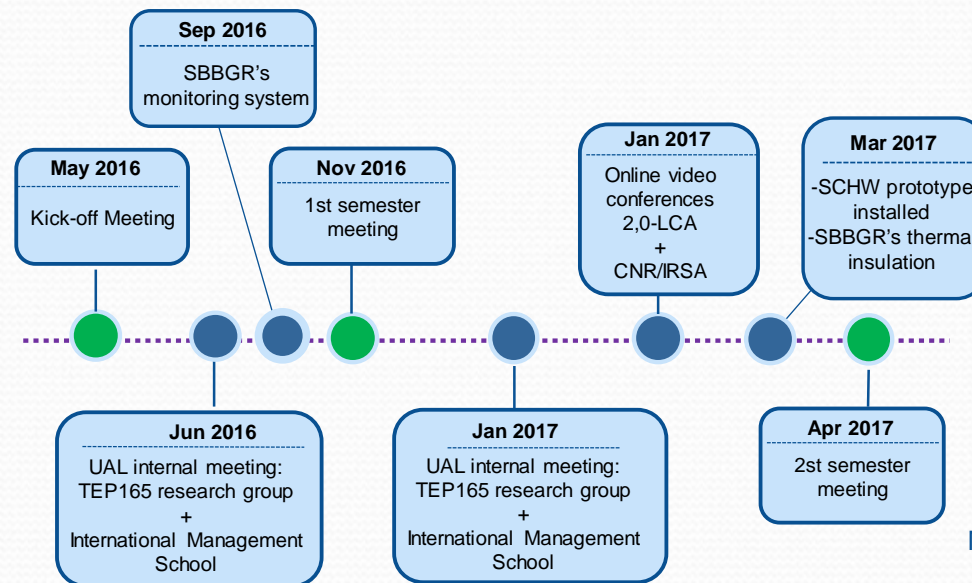
Life cycle assessment / life cycle costing

- First year progress:
 - Scoping the studies (5000-PE scenario)
 - Data sources for the reference scenario (mass balances, costs, etc.)
 - Establish a model in LCA software



Collaboration, coordination and mobility

- Consortium cooperation has led to design and implementation of the THERBIOR prototype in just 1 year
 - 3 consortium meetings (Rome, Almería, Barcelona)
 - Several bilateral partner meetings (face to face, online)
 - 2 installation campaigns (SBBGR monitoring system, SHP system)



Status of milestones and deliverables

All milestones foreseen for the reporting period **are achieved**:

- M0.1: kick-off meeting
- M0.2: 1st semester meeting
- M0.3: 2nd semester meeting
- M1.1: Measurement data and observations collected
- M5.1: Dissemination plan
- M5.2: Website

Status of deliverables foreseen for the reporting period:

- D0.1. Interim Report. **Accomplished**
- D1.1. Report on daily and seasonal temperatures trends and SBBGR reactor efficiency (M12 postponed to M18)
- D1.2. Report on the energy balance and thermal energy recovery rate evaluation (M12 postponed to M18)
- D2.1. Report on the PV selection and assembly design strategy. **Accomplished**
- D2.2. Selection of the efficient TEx technology submersed in the SBBGR reactor. **Accomplished**
- D2.3. Report on the PCM selection strategy. **Accomplished**
- D2.4. Report on the technology selection for the SCHW system. **Accomplished**
- D2.5. Description of the SCHW pilot plant's final design. **Accomplished**
- D5.1. Dissemination plan. **Accomplished**
- D5.2. Public information portal. **Accomplished**

Stakeholder & industry engagement

- Little stakeholder involvement so far, focus has been put on achieving the technical-scientific goals
- THERBIOR has been presented to two companies:
 - ICMEA: Italian SME providing engineering services
 - CISA: large Italian company working in the fields of solid waste, treatment of gaseous emissions and energy.
- Higher level of stakeholder involvement expected during the second year, in Bari and Almería

Dissemination

- Main output so far is the project's website:
<http://www2.ual.es/therbior/>

THERBIOR

HOME DESCRIPTION PARTNERS STAFF NEWS **DOWNLOADS** **LIVE** CONTACT

THERMAL ENERGY RECOVERY

from a Novel Sequencing Batch Biofilter Granular Reactor

Therbior is a research project funded by **European Union**



Description

THERBIOR focuses on the development, implementation and diffusion of technologies to improve energy efficiency in wastewater treatment plants (WWTPs) using a fully off-grid solar-assisted heat pump (SHF) system, applicable Europe-wide but centred on the Mediterranean region.

[More info](#)

Dissemination

- Publications:

- Puertas A M et al. *Finite element simulations of encapsulated phase change materials with density change upon melting*. International Conference on Solar Energy for Buildings and Industry. Palma de Mallorca, 11-14 October 2016.
- Puertas A M. et al. *Simulation of melting of encapsulated $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$ for thermal energy storage technologies*. *Energies* 2017, 10: 1-19. **Open access**

- Dissemination plan

THEBBIOR
Thermal Energy Recovery from a
Novel Sequencing Batch Biofilter
Granular Reactor

DISSEMINATION PLAN

Deliverable number D5.1
Dissemination level Public
Delivery date 30th March 2017
Status Version 1.0

Author(s):

Javier Martínez del Río
Fernando Estévez
José Céspedes-Lorente
Universidad de Almería

Encountered problems

- Sensor installation delayed from M5 to M6 due to CNR-IRSA closure in August 2016
- Slow WiFi connection at CNR-IRSA site precluded correct data acquisition until June of 2017.
- Overexposure of SBBGR to sunlight compared to a full-scale unit placed on the ground
- Insufficient data collected during the 2017 summer period



Project extension requested to JPI

New end date:

30/09/2018

- Thank you for your attention!

We Welcome your input