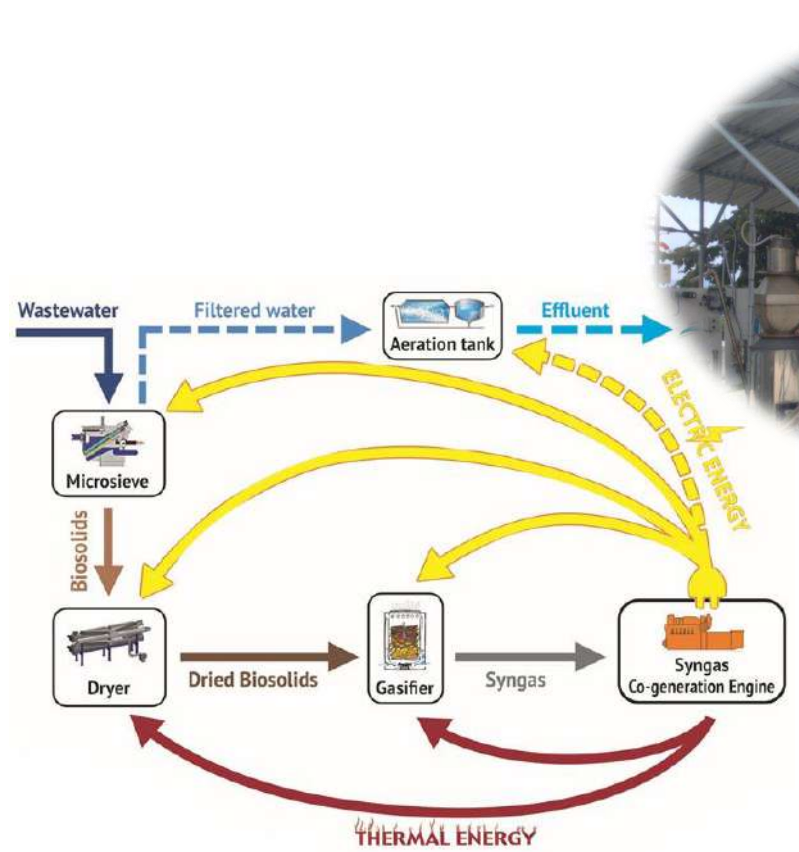
Layman's report

December 2024

New concept for energy self-sustainable wastewater treatment process and biosolids management

LIFE B2E4sustainable-WWTP **LIFE16 ENV/GR/000298** **www.biosolids2energy.eu**



INFORMATION

Project title: New concept for energy self-sustainable wastewater treatment process and biosolids management

Project acronym: LIFE B2E4sustainable-WWTP

Project number: LIFE16 ENV/GR/000298

Project duration: 01/09/2017 – 31/12/2024

Total budget: 1,993,855 €

EU contribution: 58.85 % (1,162,004 €)

Website: www.biosolids2energy.eu

E-mail: info@biosolids2energy.eu

Tel: +30 28210 37836

Coordinating beneficiary

Technical University of Crete, Greece
www.tuc.gr

Co-funding

With the contribution of the LIFE programme of the European Union and the Green Fund

Associated beneficiaries

DEVISE ENGINEERING S.A., Greece
www.devise.gr

CETENMA, Spain
www.cetenma.es

Water Sewerage Municipal Company of Rethymno, Greece
www.deyar.eu

KAPA ENGINEERING S.R.L., Italy
www.kapa-engineering.com

WWTP OF RETHYMNO, GREECE

Design data of WWTP of Rethymno

Parameter	Current phase	After extension (2028)
Population equivalent (residents)	74,000	126,200
Average daily influent (m^3/d)	17,880	28,170
Sewage influent (m^3/d)	200	200
BOD_5 (kg/d)	4,440	7,572
SS (kg/d)	4,800	8,100
TKN (kg/d)	750	1,215
TP (kg/d)	240	360

Effluent limits of pollutant loads

Parameter	Value
BOD_5 (mg/L)	≤ 25
COD (mg/L)	≤ 125
SS (mg/L)	≤ 35
Settleable solids within 2 hours in Imhoff cone (mL/L)	< 0.3
TN (mg/L)	< 15
NH_3-N (mg/L)	≤ 2
Fats - Oils (mg/L)	< 0,1
Floating solids (mg/L)	= 0
Colibacteroids (population/100mL)	< 500

PILOT PLANT LOCATION

LIFE B2E4sustainable-WWTP

OBJECTIVES

- Upgrade of overloaded activated sludge WWTPs.
- Protection of aquatic environment against pollution caused by WWTPs effluent.
- Sustainable management of biosolids.
- Energy production from energy-rich biosolids.

FACTS

- Under-performing activated sludge Wastewater Treatment Plants (WWTPs).
- High energy requirements of activated sludge WWTPs.
- Insufficient biosolids management.
- Municipal wastewater contains 3-6 times the energy required for treatment.
- Biosolids produced through microsieving contain low moisture and high energy.
- Gasification has higher energy yield, compared to anaerobic digestion.

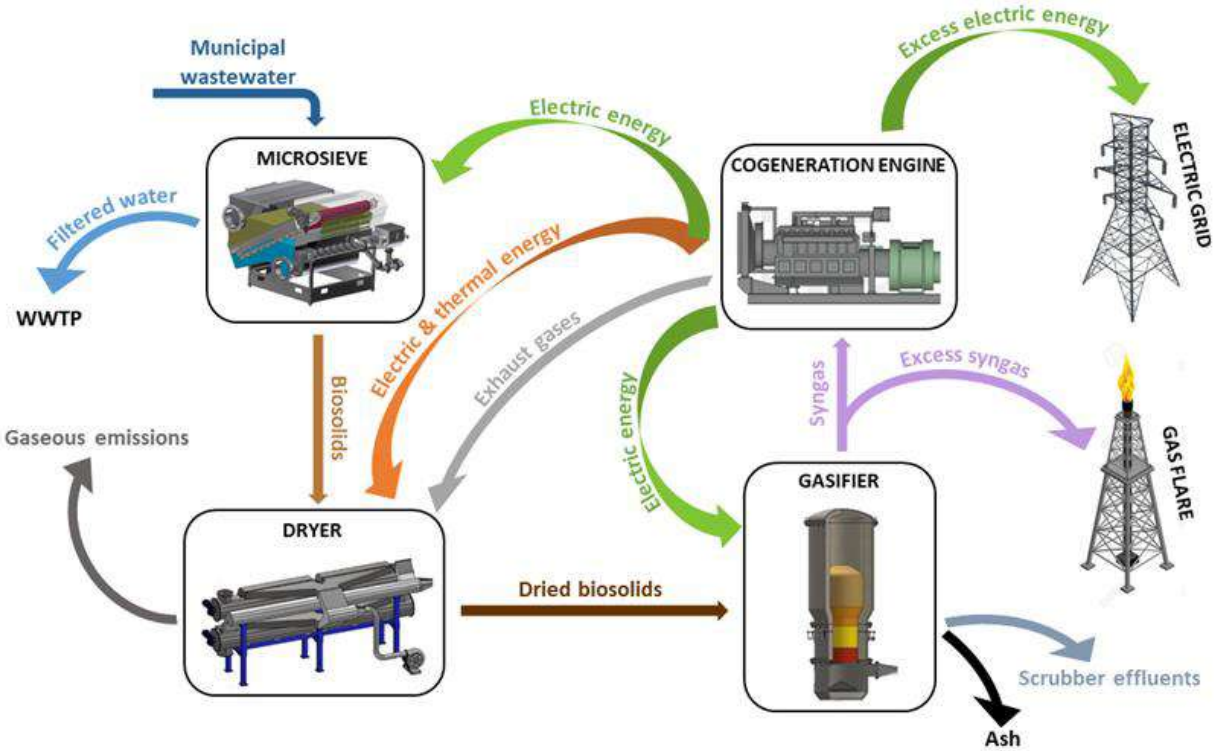
PROJECT OUTLINE

- Microsieving → Removal of primary biosolids, upfront of the aeration tank using a rotating belt filter.
- Drying → Moisture removal from microsieved biosolids.
- Gasification → Syngas production from dried microsieved biosolids.
- Syngas combustion → Production of thermal and electric energy.

PROJECT FACTS

- Wastewater capacity: ~ 5,000 m^3/d
- Biosolids management: ~ ½ ton/d
- Biosolids Higher Heating Value: ~ 21.5 MJ/kg
- Syngas production: 1,800-2,400 Nm^3/d
- Target electric energy production: 30-50 kW

LIFE B2E4sustainable-WWTP



Mass and energy flows in the pilot plant

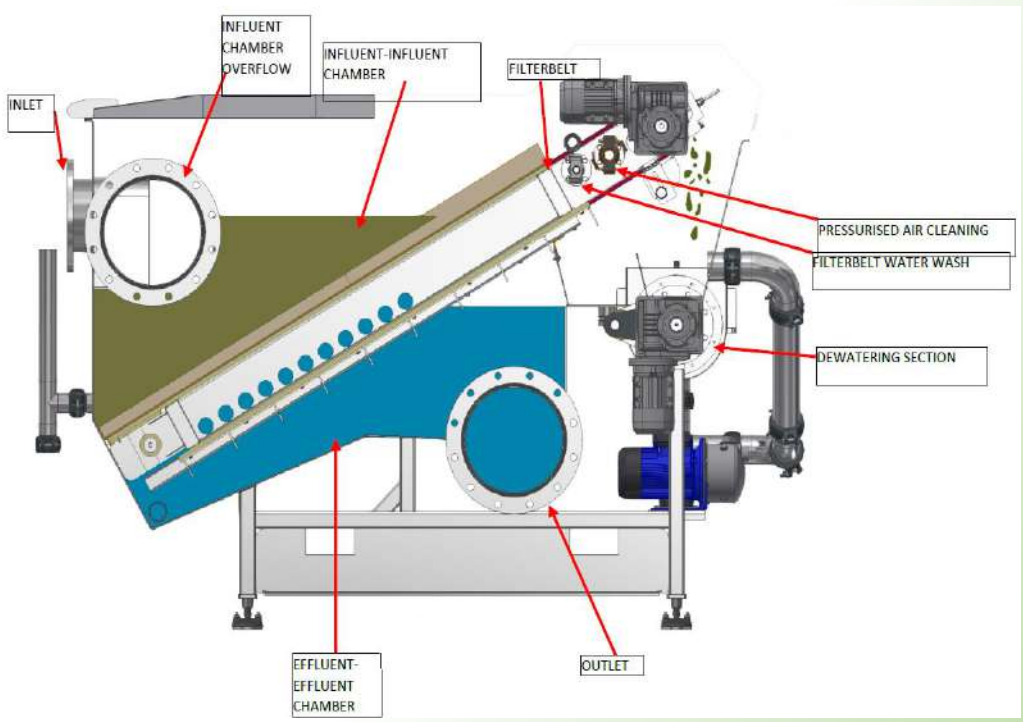
Photograph of the pilot plant

WASTEWATER PRETREATMENT → MICROSIEVING

- Fine mesh sieve produces biosolids with solid content up to **45%**, suitable to be used as gasifier feedstock.
- Requires **5%** the area of an equivalent capacity primary clarifier.
- The biosolids have high **potential for gasification & production of syngas.**

Microsieve

Microsieved biosolids

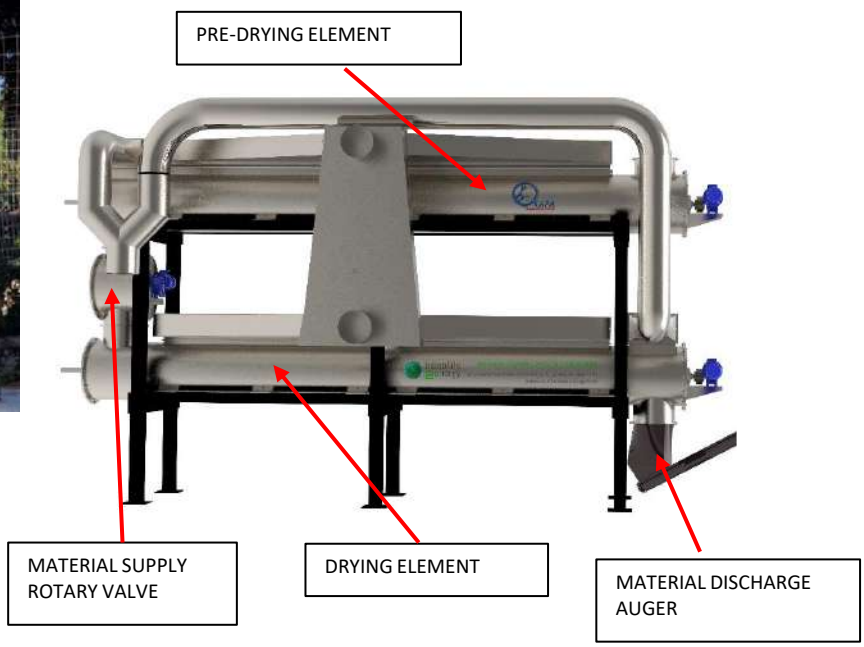


BIOSOLIDS MANAGEMENT → DRYING

- The dryer, bases its operation on the agitation of humid material in the flow of **hot air produced by the gasifier** as exhaust gases.
- Special conveying and simultaneous continuous **agitation augers**.
- Before the end of each module, humid air is sucked in from the **suction circuit**.
- In each module is introduced **hot and dry air** by the hot air distribution system.

Dryer inlet

Dryer



BIOSOLIDS VALORIZATION → GASIFICATION - ENERGY PRODUCTION

System description

- **Feeding system**, for providing the dried and microsieved biosolids to the gasifier.
- **Storage tank** followed by a **briquetting machine**.
- **Downdraft gasifier** (biosolids feeding capacity by 15 kg/h; syngas production by 30 m^3/h) equipped with an ejector for air supply.
- Cyclone, straight tube heat exchanger, granular biomass filter and scrubbers for **syngas treatment**.
- **Syngas analyzer and flowmeter** for the treated syngas.
- **Combustion flare** for the combustion of excess/unsuitable syngas, equipped with a flame monitoring system.
- **Co-generation engine** (12kW power) for syngas combustion and production of thermal and electric energy.

Briquetted biosolids

Syngas flame

Syngas analyzer

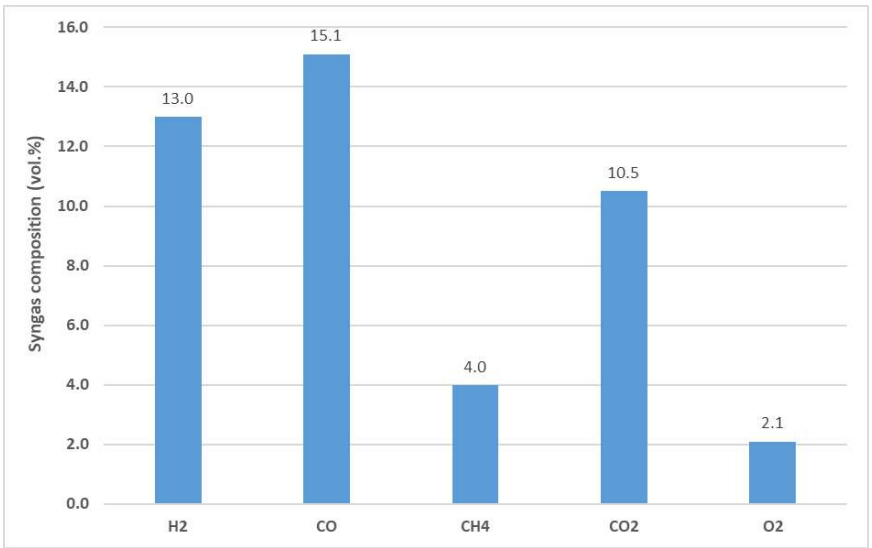
Co-generation engine

Gasification – energy production system

Mobile environmental laboratory for onsite analyses

SYNGAS COMPOSITION THROUGH THE GASIFICATION OF PRIMARY BIOSOLIDS

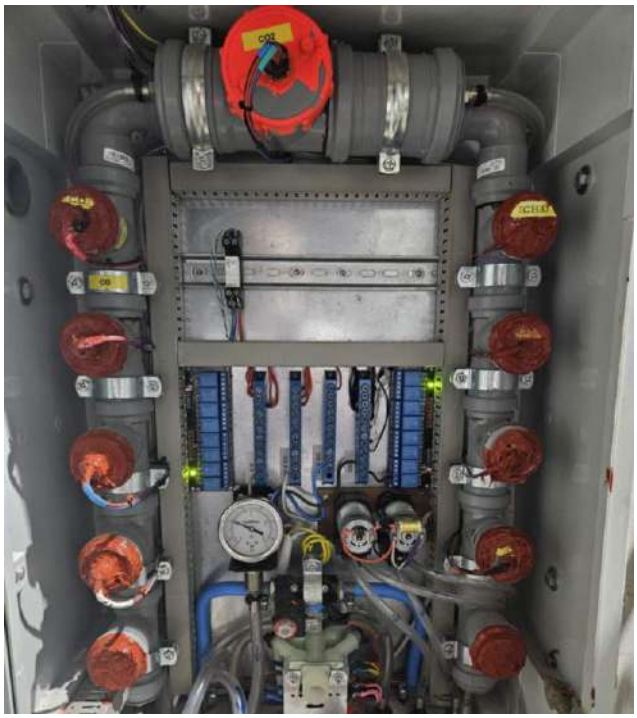
Syngas average composition from gasification of primary biosolids



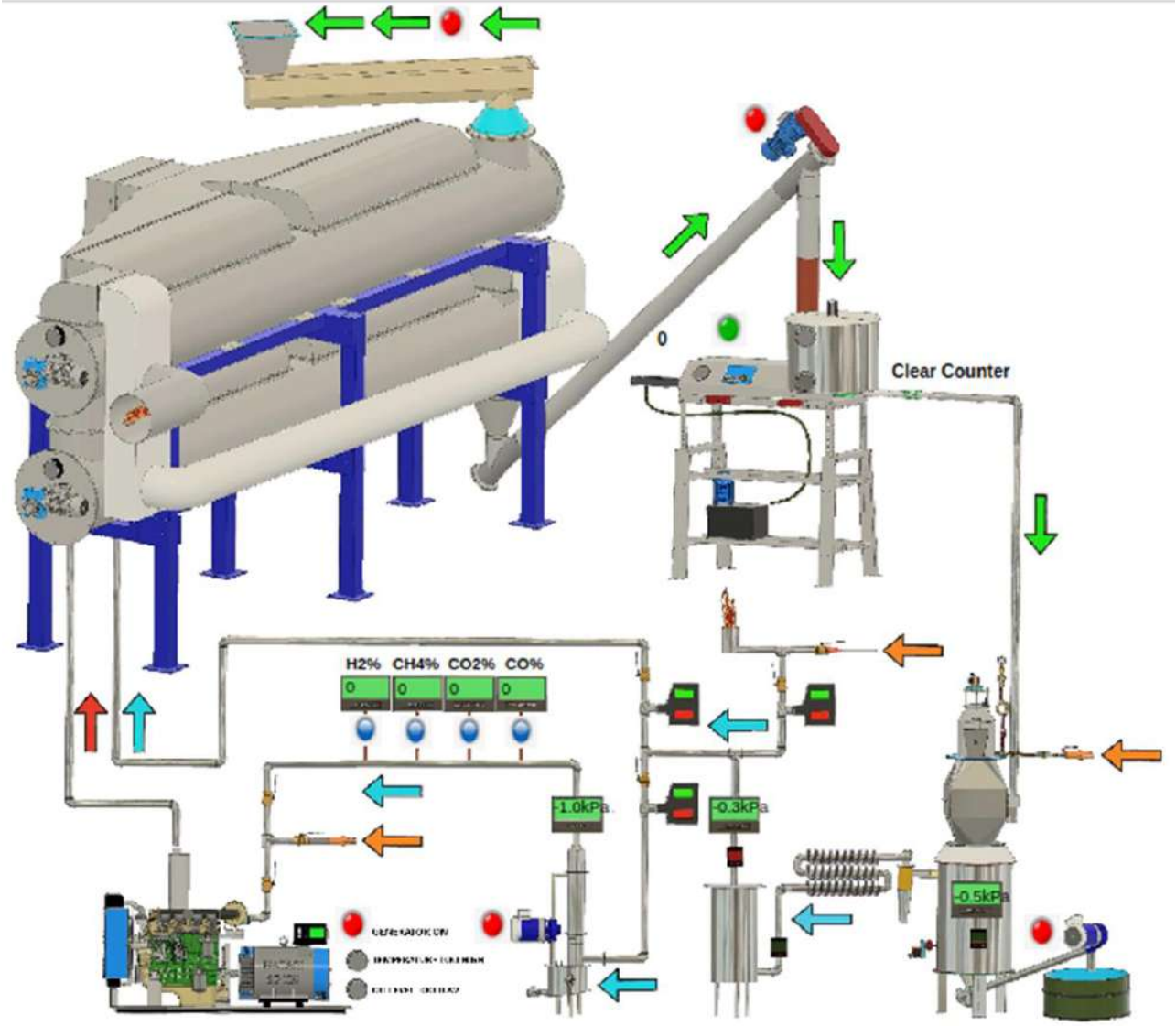
Experimental period November 2023–October 2024

GC analyzer

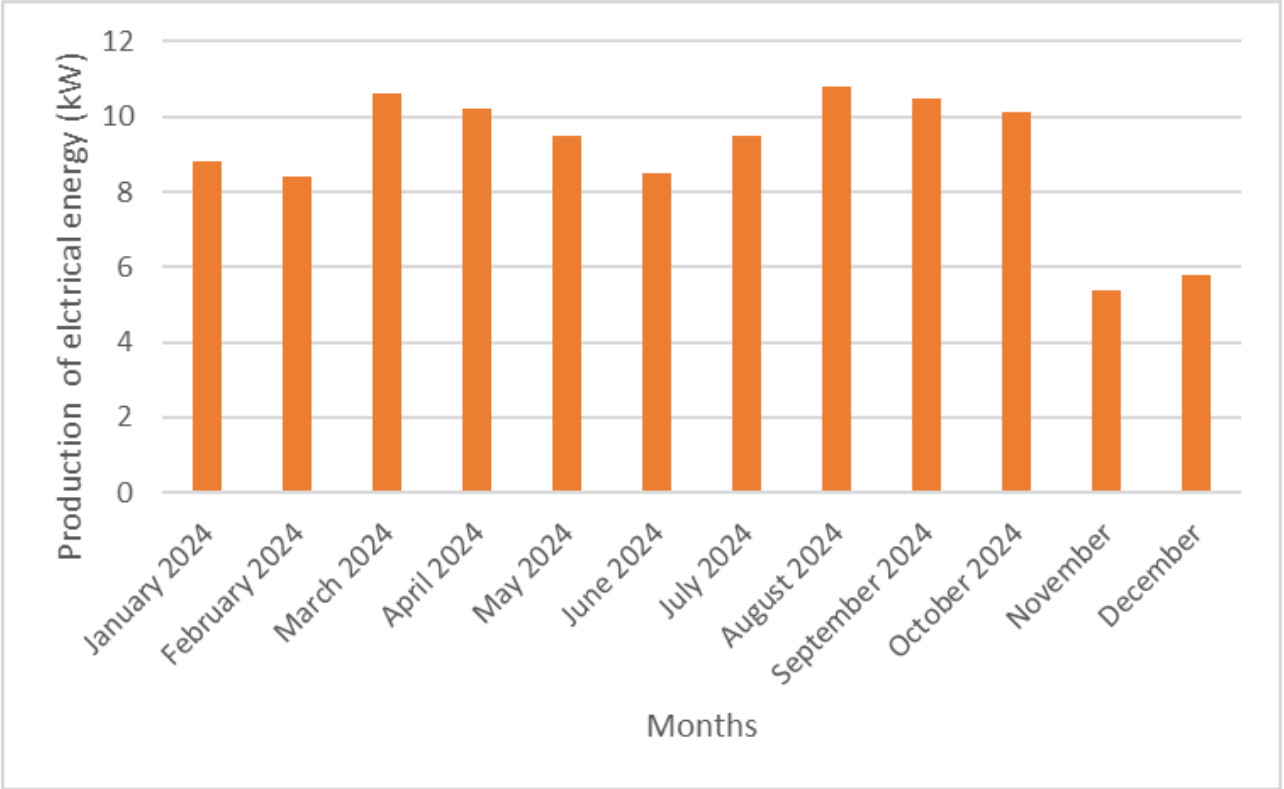
Syngas measurement system



PROGRAMMABLE LOGIC CONTROLLER UNIT



ELECTRICITY PRODUCTION

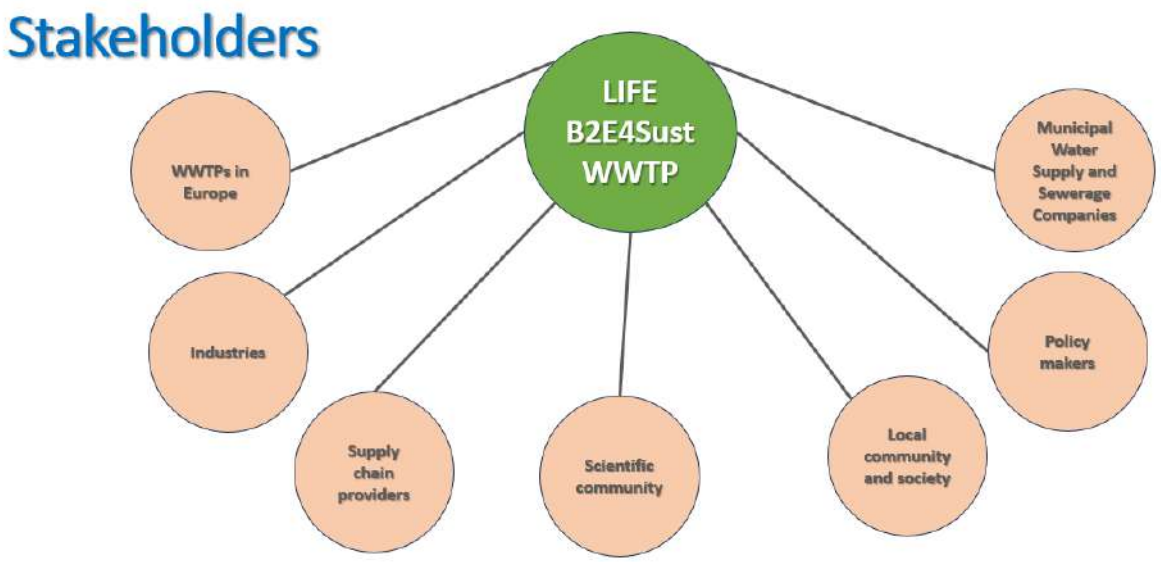


❖**The production of the electrical energy during the gasification trial is presented. The average value of electrical energy was calculated equal to 9 kW.**

STAKEHOLRDERS OF THE PROJECT

Stakeholders in an industrial project can significantly influence its success or failure. Internal stakeholders, such as project sponsors and team members, drive the project by providing resources, expertise, and decision-making. External stakeholders, including regulatory authorities, suppliers, and the local community, can impact timelines, compliance, and social acceptance. Effective stakeholder management ensures their concerns are addressed, fostering collaboration and minimizing opposition. Ultimately, stakeholders shape the project's progress, outcomes, and alignment with broader economic, environmental, and social objectives.

The LIFE B2E4sustainable-WWTP are :



ENVIRONMENTAL BENEFIT OF THE PROJECT

The LIFE B2E4sustainable-WWTP demonstrates the valorization of the produced biosolids for electric energy production (through gasification), thus reducing further the net energy consumption of the WWTP, and consequently reducing the emission of greenhouse gases. More particularly, environmental results of the application of the LIFE B2E4SustWWTP at the WWTP of Rethymno are the following:

Reducing of the secondary sludge 5.4% from January to October 2024

Reduction of carbon footprint of the WWTP coming from the sludge reduction

KEY RESULTS OF THE PROJECT

The key results of the LIFE B2E4sustainable-WWTP are the following:

- Production of significant amount of green energy that can make the new process selfsustainable and eliminate biosolids mass through gasification.

- High reduction in energy requirements for municipal wastewater treatment plants, compared to conventional extended aeration process.

- A reduction of carbon footprint of WWTP coming from the energy reduction and from the production of green energy.

- A production of primary biosolids with solids content up to 45% (just out of the microscreen), compared with 5% of primary sludge.

- A complete sterilization of the produced biosolids (primary and secondary) and a reduction of sludge to the minimum possible mass of ash content (5-10% of dry matter).

- A high reduction of footprint for the removal of primary biosolids, up to 20 times compared to primary clarification.

- An improvement in secondary treatment of wastewater due to the lower concentration of TSS and BOD.

Participants of the project conference www.susteng.eu

CINEA project visit at the end of the project

Stakeholders - related scientific community visits to the pilot plant

Project team members at the kick-off meeting

Technical University of Crete

ΔΗΜΟΤΙΚΗ ΕΠΙΧΕΙΡΗΣΗ ΥΔΡΕΥΣΗΣ ΑΠΟΧΕΤΕΥΣΗΣ ΡΕΘΥΜΝΟΥ Δ.Ε.Υ.Α.Ρ.

DEVISE ENGINEERING S.A.

cetenma Centro Tecnológico de la Energía y del Medio Ambiente

KAPA engineering

Life

GREEN FUND

Website: www.biosolids2energy.eu

E-mail: info@biosolids2energy.eu

Tel: +30 28210 37836

biosolids 2 energy

Layman report