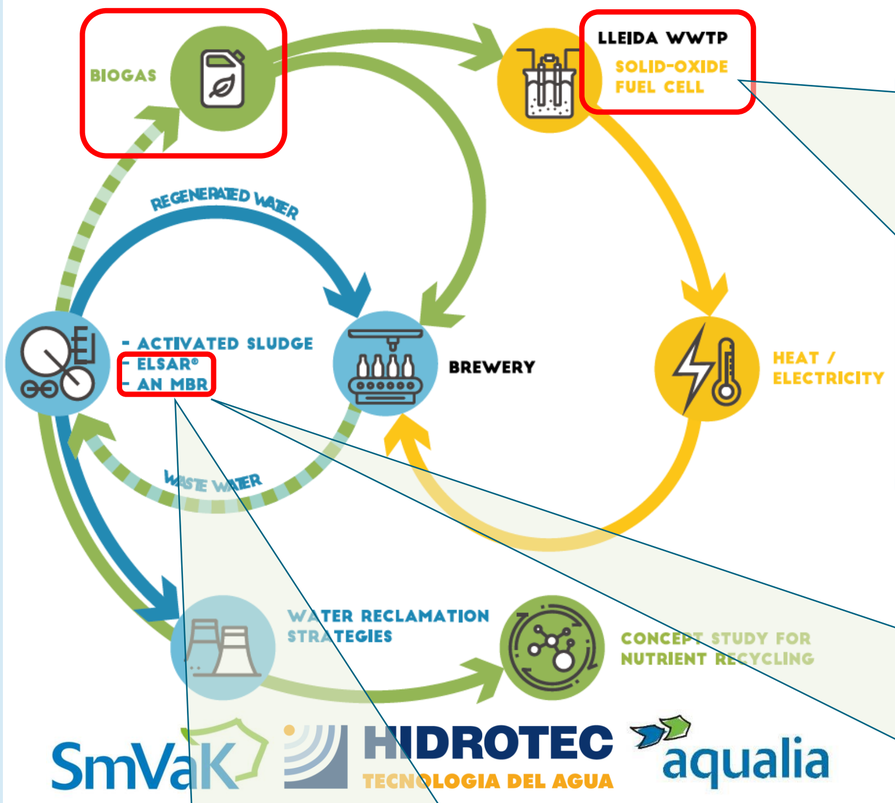
ULTIMATE

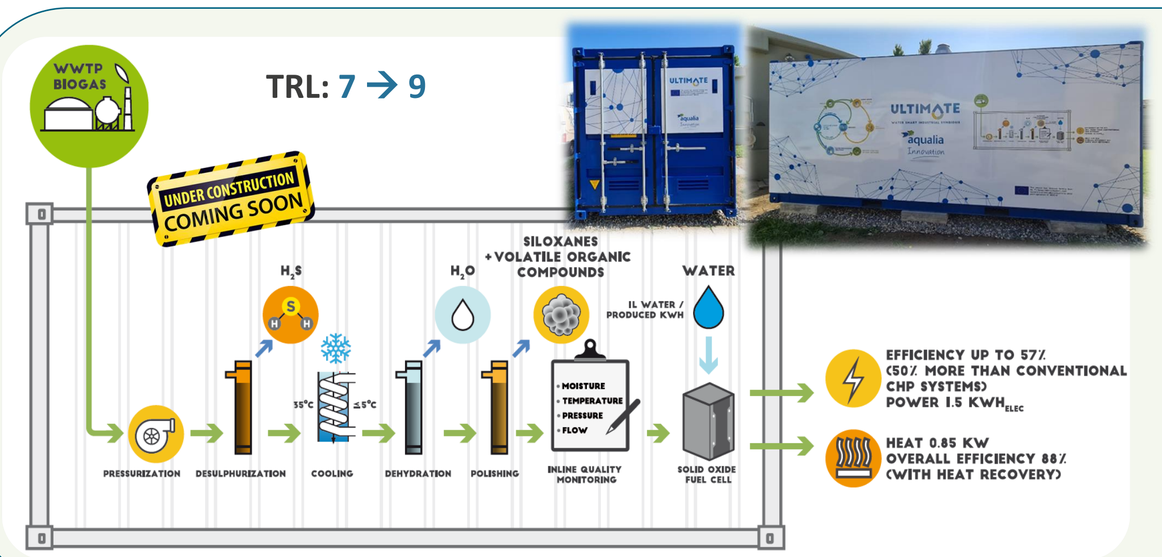
WATER SMART INDUSTRIAL SYMBIOSIS

TRANSITION FROM LINEAR TO CIRCULAR ECONOMY

in the nexus of the water sector & intensive water consuming industries.

CS5 – Anaerobic treatment of brewery wastewater and biogas production



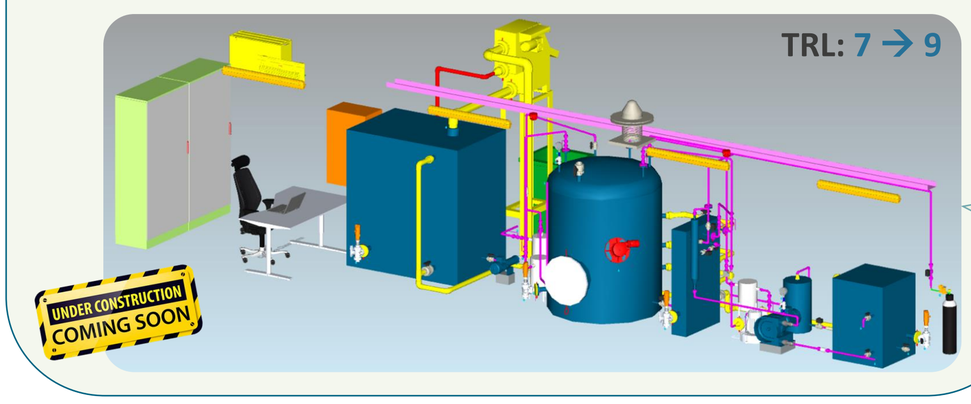


Objective SOFC (*Solid Oxide Fuel Cell*)

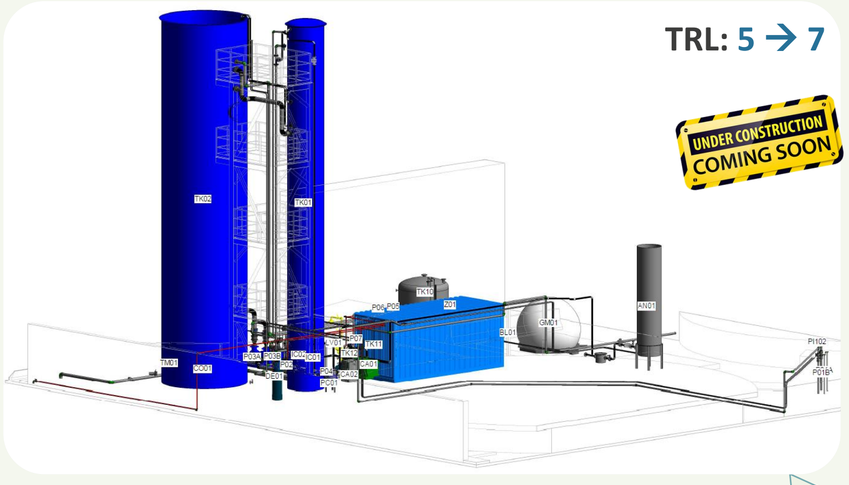
- Demonstrate SOFC viability fed with biogas as a competitive “2.0” alternative to conventional Combined Heat & Power (CHP).

Objective AnMBR (*Anaerobic Membrane Bioreactor*)

- Monitor feasibility, energetic efficiency and pollutant removal performance.
- Online measurement & integration of fouling-linked parameters



- Reactor features: Flow 2 m^3 brewery wastewater/h ; Organic Loading Rate 200 kg COD/d ; Mesophilic range (30 - 37ºC)
- Expected results:
  - 95% COD removal
  - 3,5 Nm^3 biogas/h



Objective ELSAR® (*ELectro-Stimulated Anaerobic Reactor*)

(EP 2927196 A1)

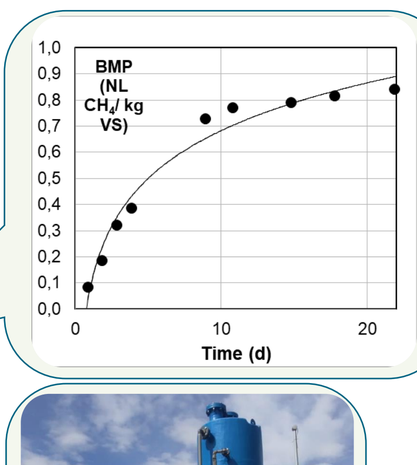
- Design, build and operate the first full-scale ELSAR®, obtaining bioH_2 and a better performance than conventional High-Rate Anaerobic Reactors (HRAR), including nutrient removal.
- Validate ELSAR® as water smart industrial solution

- Reactor features: Flow 20 m^3 brewery wastewater/h ;Organic Loading Rate 2000 kg COD/d ; Mesophilic range (30 - 37ºC) ;
- Expected results:
  - 90% COD removal
  - 31 Nm^3 biogas/h

First results.

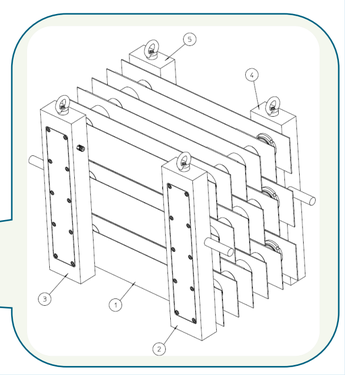
→ Performance lab and bench tests showed that **ELSAR® outperforms HRAR in terms of removal performance, biogas productivity and process robustness, either under standard or under stress operational conditions**[1]. These results fit with other research on bioelectrochemical anaerobic digestion (BEAD) [2]. Moreover, ELSAR® showed ability to remove nutrients significantly [1,3].

→ Biochemical methane potential (BMP) tests allowed to estimate a potential of 0,31 Nm^3 CH_4/ removed kg COD, showing a **satisfactory anaerobic biodegradability of the brewery wastewater**. This result is consistent with other sources and validates the election of an anaerobic treatment (like ELSAR®) on the chosen wastewater.



→ Despite the promising results, upscaling is still considered **a challenge**, requiring an optimum balance between cost-effectiveness of the electrochemical implementation and the configuration that allows significant improvements vs. HRAR. According to previous tests [1,3], the **ratio electrode surface : reactor volume of ELSAR® is significantly lower than other BEAD configurations** [2], which might be a good strategy to find the abovementioned balance.

→ However, the fact that in ELSAR® the used fluidized anode (like granular activated carbon) has to coexist with granular biomass adds **new challenges to the hydrodynamics of the reactor**.



→ In order to minimize further risks, before the upscaling several configurations will be tested using **existing lab-scale and pilot-scale ELSAR®**. Affordable materials will be preferably selected as anodic and cathodic collector materials: **carbon fiber and stainless steel** are, respectively, the main candidates, although other materials are not discarded.

References:

[1] Asensio Y. *et al*. Upgrading fluidized bed bioelectrochemical reactors for treating brewery wastewater by using a fluid-like electrode. Chemical Engineering Journal, 406, 2021.

[2] Park, J-G. *et al*. Towards the practical application of BEAD: Insights into electrode materials, reactor configurations, and process designs. Water Research, 184, 2020

[3] Asensio, Y. *et al*. ME-FBR: An energy-efficient advanced solution for treating real brewery wastewater with different initial organic loading rates, JECE, 9, I.6, 2021.

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