EUBCE
31st European Biomass Conference & Exhibition

BLAZE

Co-funded by the Horizon 2020 programme of the European Union

Overview of the BLAZE project

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Coordinator of BLAZE and GICO projects

GICO2
Gasification Integrated with CO2 capture and conversion

The projects have received funding from the European Union's Horizon 2020 research and innovation programme

Indirectly heated steam gasifiers

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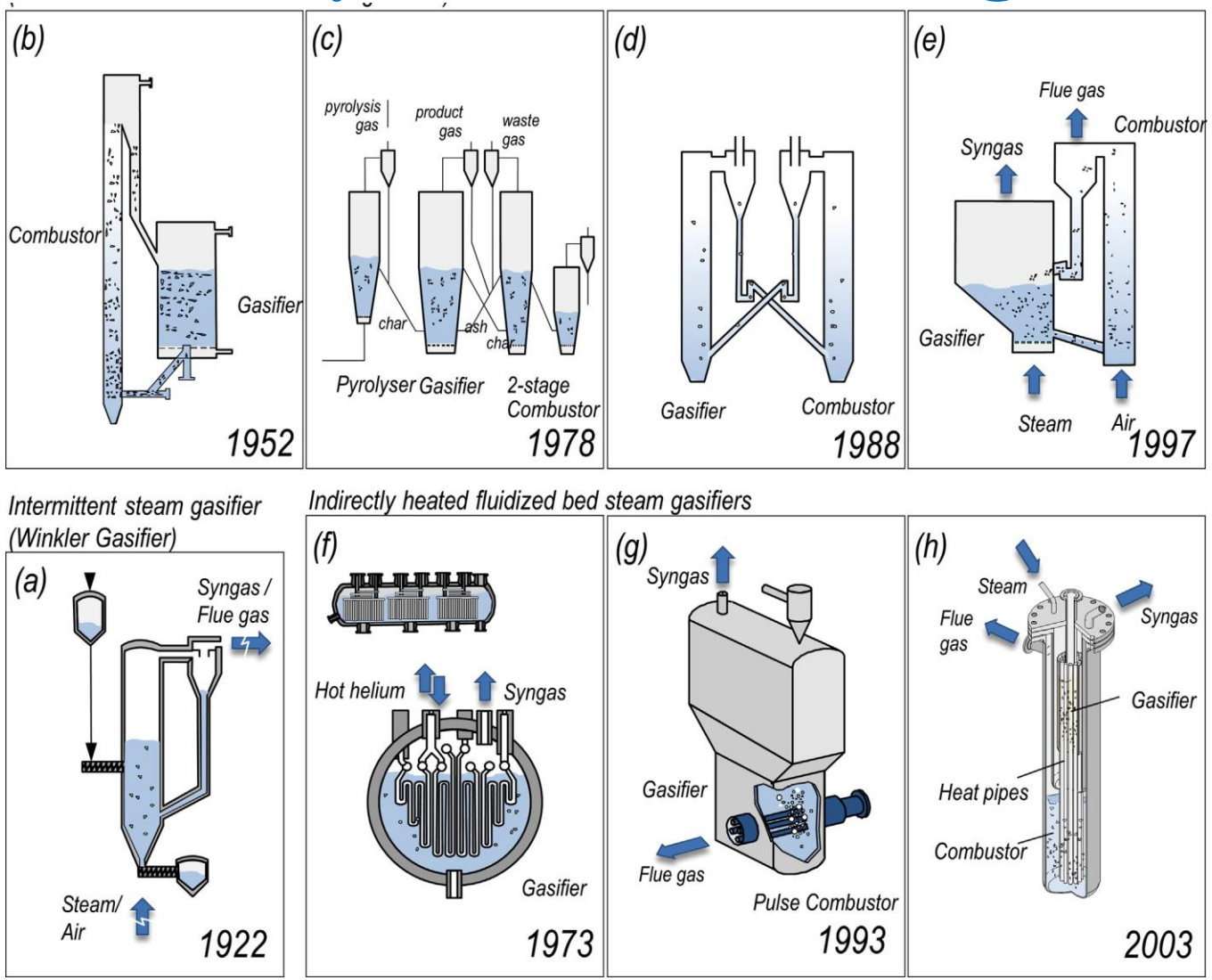
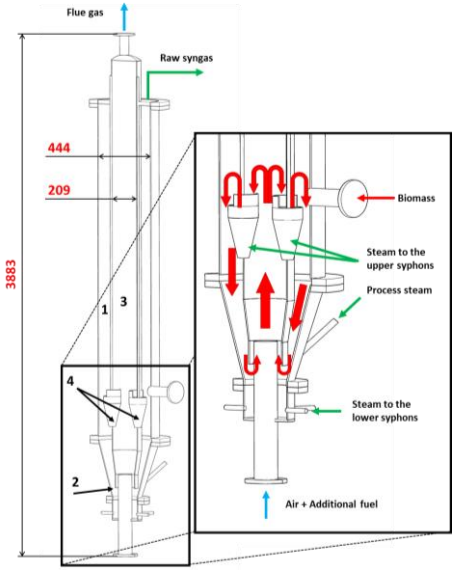


(a) Winkler gasifier. Interconnected fluidized bed gasifiers
(b) Rayners moving burden gasifier
(c) FLUGA process
(d) Battelle's FERCO gasifier
(e) Gussing bubbling gasifier + circulating combustor
(f) MGB gasifier
(g) MTCI gasifier
(h) Biomass Heatpipe Reformer.

J. Karla, T. Proll., Steam gasification of biomass in dual fluidized bed gasifiers: A review, Renewable and Sustainable Energy Reviews 98 (2018) 64–78



2016-2023
Bubbling combustor within bubbling gasifier
From UNIFHY to BLAZE
European projects

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CHP IN EU-28 (Eurostat)

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- 120 GWe (ST 50%, CC 25%, ICE 13%, GT 10%): 362 TWh -> ≈3000 AEh
- 300 GWth: 775 TWh -> ≈ 2500 AEh
- Space heating ≈ 50% rocess heating (main Germany, Italy, Poland, Netherlands)
- Natural gas ≈ 50%, solid fossil fuels and peat ≈ 20% , oil and oil products 5%, biomass (timber by-products, black liquor, wood, straw, animal waste, OFMSW) attained 20% but there is difficulty in converting different biomass feedstocks in a Reliable and Economic (Efficient and Clean) way
- Biomass for energy **main source of renewable energy** in the EU, with **heating and cooling sector largest end-user**
- Zero Energy Buildings (ZEB&ZED) from 31st December 2020 (public from 31st December 2018)
- Commission's proposal (2021) to revise the Renewable Energy Directive promotes a gradual shift away from conventional biofuels to advanced biofuels (mainly produced from **non-recyclable waste and residues**)
- 2030 EU Renewable, emission, efficiencies targets

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BLAZE Biomass Low cost Advanced Zero Emission small-to-medium scale integrated gasifier - fuel cell CHP plant

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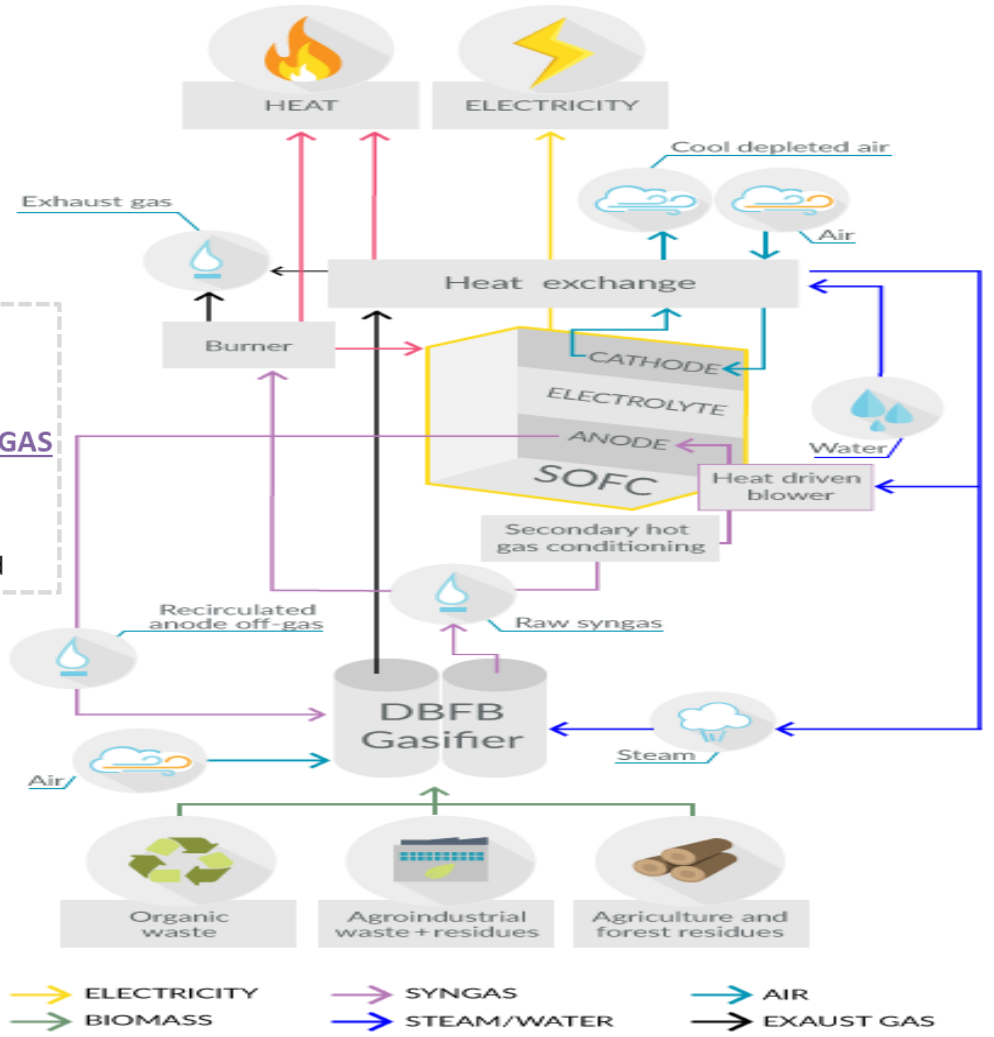
Flexible electricity supply and heat integration with agro, industrial or buildings



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OBJECTIVES

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The technology is developed for a **CHP capacity** range from **small (25-100 kWe)** to **medium (0.1-5 MWe)** scale

Parameter	Current	SET-PLAN	BLAZE (target)	BLAZE (model)
Overall efficiency	≈ 65%	≈ 75%	≈ 90%	≈ 80%
electrical efficiency	≈ 25%	>30%	≈ 50%	≈ 45%
investment cost	≈ 10,000 €/kWe	50% reduction	≈ 4,000 €/kWe	≈ 8,000 €/kWe
operating cost	≈ 0.10 €/kWh	50% reduction	≈ 0.05 €/kWh	≈ 0.10 €/kWh
electricity production cost	≈ 0.20 €/kWh	50% reduction	≈ 0.10 €/kWh	≈ 0.27 €/kWh
Negligible gaseous and particulate matter emissions				

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BLAZE in Numbers

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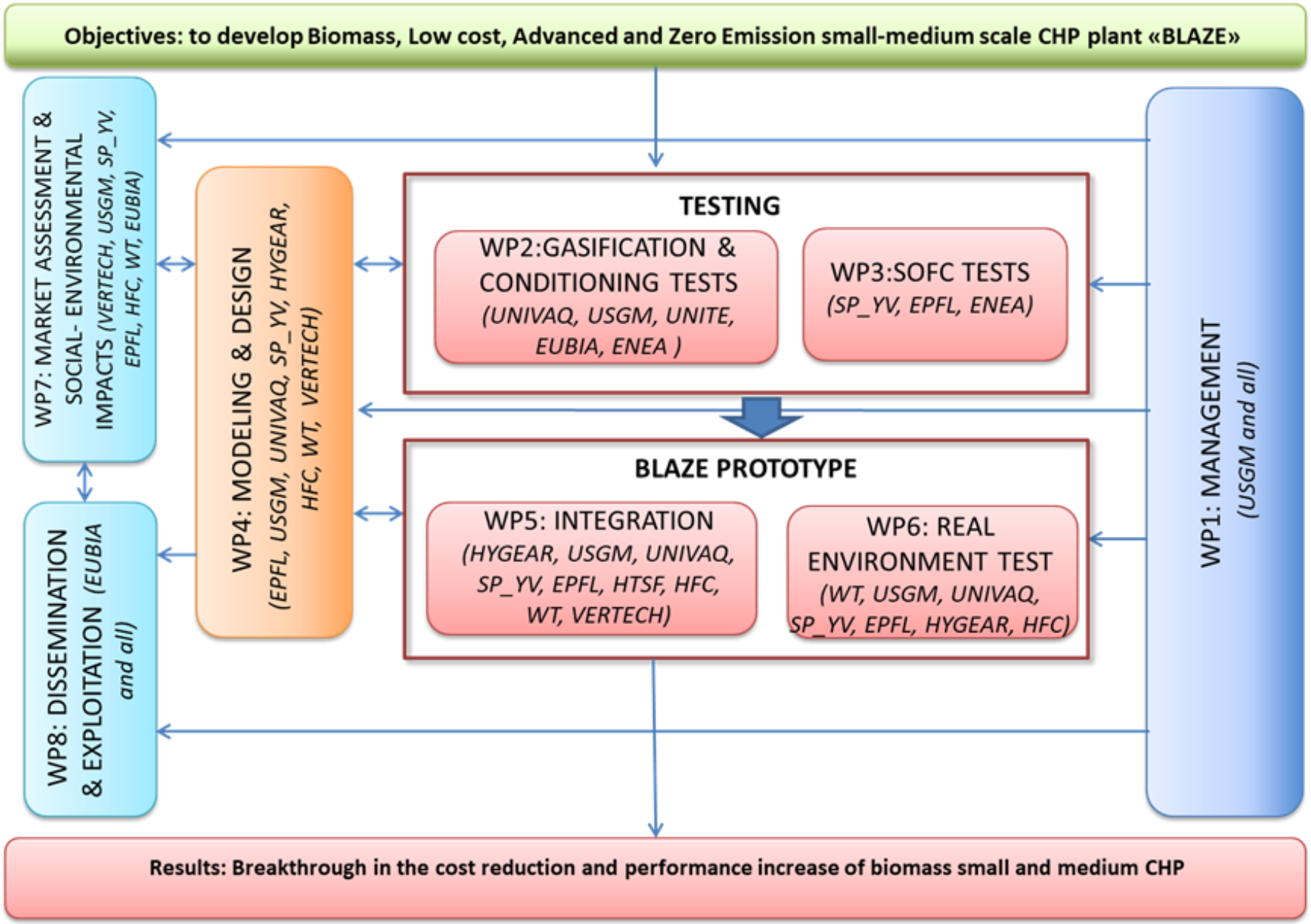

- *8 WPs*
- *3+1 years project*
- *4.000.000,00 € funded*
- *10 partners*
- *38 deliverables*

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PARTNERS

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Research

Companies

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DELIVERABLES: 9 public, 29 confidential

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- **D4** **Biomass selection for small-to-medium scale gasification-SOFC, characterisation and supply strategy**
- **D5** **Bio-syngas composition and contaminants and related gasifier parameters and bed materials**
- D6 Tar catalysts selection and filter candles, D7 High temperature primary and secondary sorbents selection for inorganic compounds
- D8 Button cells and short stacks delivered, **D9 Report summarising the literature review,** D10 Button cell tests, D11 Short stack tests
- **D12** **System models considering component operating windows and plant CHP operating scenarios**
- D14 Design of the thermally driven and gas bearing supported recirculation device - Report
- **D15** **Techno-economic optimisation for optimal conceptual CHP plant design with heat exchangers and BoP**
- D13 CFD models of the BFB gasifier and hot gas cleaning & conditioning system integrated
- D16 Final PFD proposal, D17 Model & Design validation using real environmental tests.
- D18 Filter candles filled with catalysts delivered and integrated, D19 25 kWe Large Stack Module delivered and integrated
- D20 Design book of the BLAZE CHP plant, **D21 Assembled CHP system**
- D22 Gasifier and conditioning system characterization. **D23 SOFC CHP operation at the integrated pilot plant**
- D26 Techno-Economic analysis of Pilot plant, **D24 Life Cycle Assessment**
- D25 Economic feasibility report
- **D27** **Health and safety study**, **D28 European and local legal and non-legal limitations, barriers and standards for BLAZE**

6 DELIVERABLES TO BE FINALISED.

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38,028 BLAZE CONFIGURATIONS

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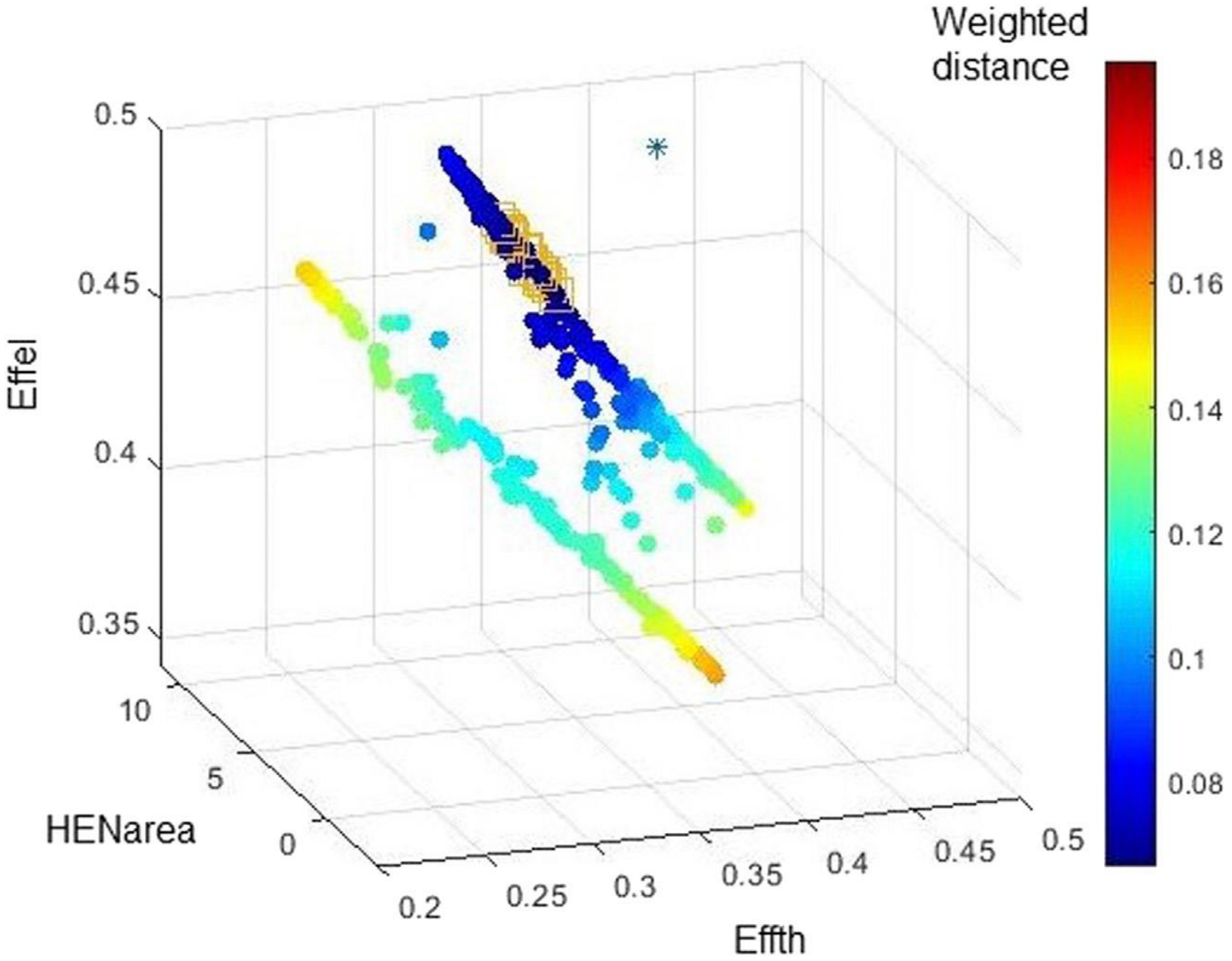

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P&ID, LAYOUT, REALIZATION

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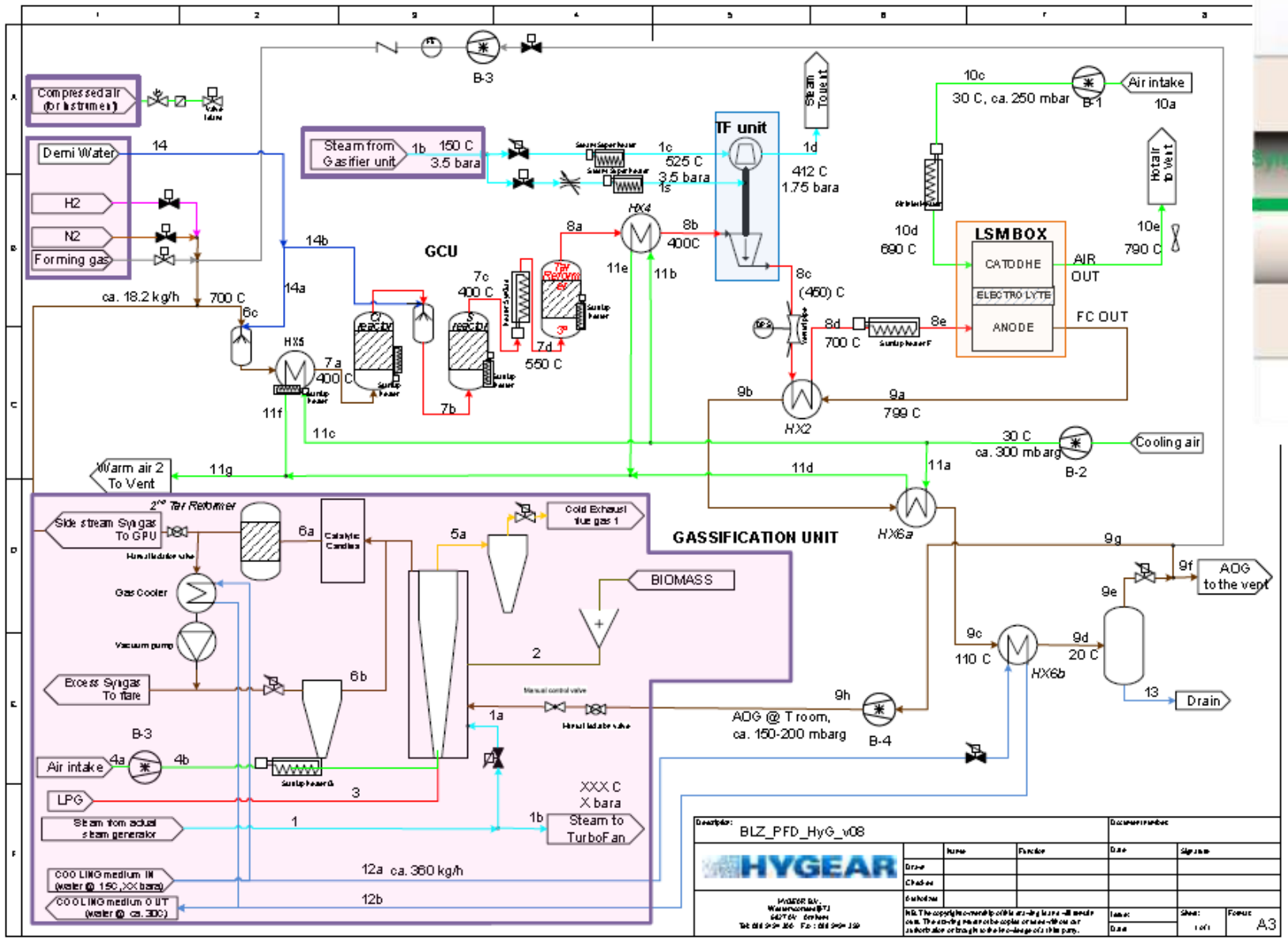

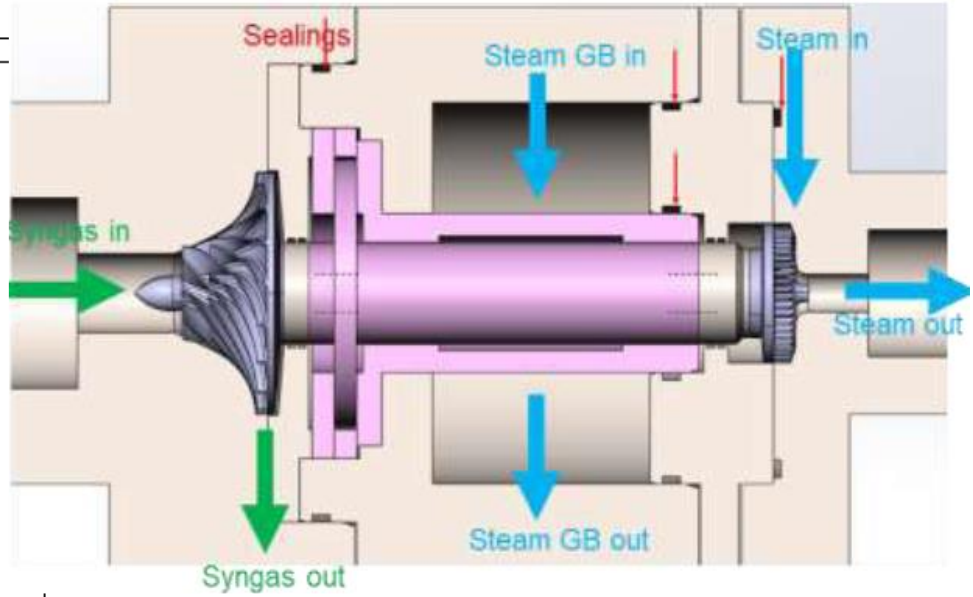

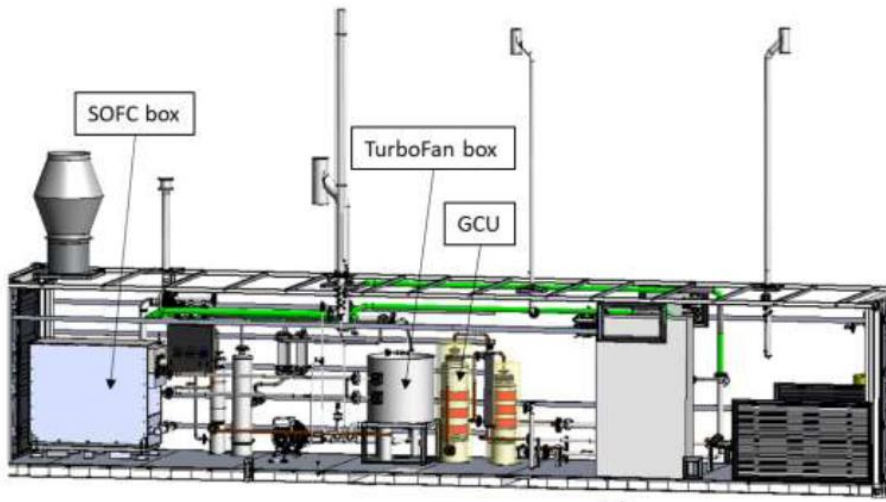

the European Union's Horizon 2020 research and innovation programme

COLLABORATIONS

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- Data exchange regarding the following topics:
  - Biomass characteristics, theoretical/technical/economic/legal potential, end users
  - Pretreatments (e.g. Hydro Thermal Carbonization (HTC) and Pyrolysis)
  - Indirectly heated steam gasification with or without Sorption Enhanced Gasification
  - Hot Gas Conditioning (particulates, tar, Sulphur and Chlorine compounds): catalysts and sorbents
  - Solid Oxide Fuel Cells (SOFC/SOEC)
  - Membranes (from high temperature particulate filters to perovskite membranes for oxygen separation)
  - Related lab scale test rigs procedures
  - LCA, Techno-Economic, Market analysis

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Papers in Journal and data in Zenodo

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WP2	Data	**Biomass** selection for small-to-medium scale gasification-SOFC, **characterisation and supply strategy**	Zenodo	https://zenodo.org/badge/DOI/10.5281/zenodo.3822063.svg
WP2	Article in Journal	Development of a Chemical Quasi-Equilibrium **Model of Biomass Waste Gasification** in a Fluidized-Bed Reactor by Using Aspen Plus	Energies	https://doi.org/10.3390/en13010053
WP2	Article in Journal	Evaluation of **sorbents** for high temperature removal of tars, hydrogen sulphide, hydrogen chloride and ammonia from biomass-derived syngas by using Aspen Plus	International Journal of Hydrogen Energy	https://doi.org/10.1016/j.ijhydene.2019.12.142
WP2	Article in Journal	Deactivation Model Study of High Temperature H2S Wet-Desulfurization by Using ZnO, Kinetic and Thermodynamic Study of the Wet Desulfurization Reaction of ZnO Sorbents at High Temperatures	Energies	https://doi.org/10.3390/en14238019
WP3	Article in Journal	Experimental Procedures & First Results of an Innovative **Solid Oxide Fuel Cell** Test Rig: Parametric Analysis and Stability Test	Energies	https://doi.org/10.3390/en14082038
WP3	Publication in Conference	Main issues of the impact of tar, H2S, HCl and alkali metal from biomass-gasification derived syngas on the SOFC anode and the related gas cleaning technologies for feeding a SOFC system: A review	International Journal of Hydrogen Energy	
WP5	Publication in Conference	Theoretical and Experimental Investigation of a 34 Watt **Radial-Inflow Steam Turbine** with Partial-Admission, Influence of Large Relative Tip Clearances for a Micro Radial Fan and Design Guidelines for Increased Efficiency	Turbo Expo Conference and Exhibition	https://asme-turboexpo.secure-platform.com/a/solicitations/105/sessiongallery/5468/application/45543
WP5	Article in Journal	Biomass Steam Gasification, High-Temperature Gas Cleaning, and SOFC Model: A **Parametric Analysis**	Energies	https://doi.org/10.3390/en13225936
WP5	Article in Journal	Triple-mode grid-balancing plants via biomass gasification and reversible solid-oxide cell stack: Concept and thermodynamic performance	Applied Energy	https://doi.org/10.1016/j.apenergy.2020.115987
WP5	Data	System models considering component operating windows and plant chp operating scenarios	Zenodo	https://zenodo.org/badge/DOI/10.5281/zenodo.4494082.svg
WP5	Article in Journal	Performance evaluation of an innovative 100 kWth dual bubbling fluidized bed gasifier through two years of experimental tests: Results of the BLAZE project	International Journal of Hydrogen Energy	
WP6	Article in Journal	Preliminary Results of Biomass Gasification Obtained at Pilot Scale with an Innovative 100 kWth Dual Bubbling Fluidized Bed Gasifier	Energies	
WP7	Article in Journal	**Techno-economic optimization** of an integrated biomass waste gasifier - solid oxide fuel cell plant	Frontiers Energy Res. - Process	https://doi.org/10.3389/fenrg.2021.665585
WP8	Publication in Conference	Results of the H2020-LC-SC3-RES-11 BLAZE project: biomass low cost advanced zero emission small-to-medium scale integrated gasifier fuel cell combined heat and power plant	EUBCE	

DISSEMINATION

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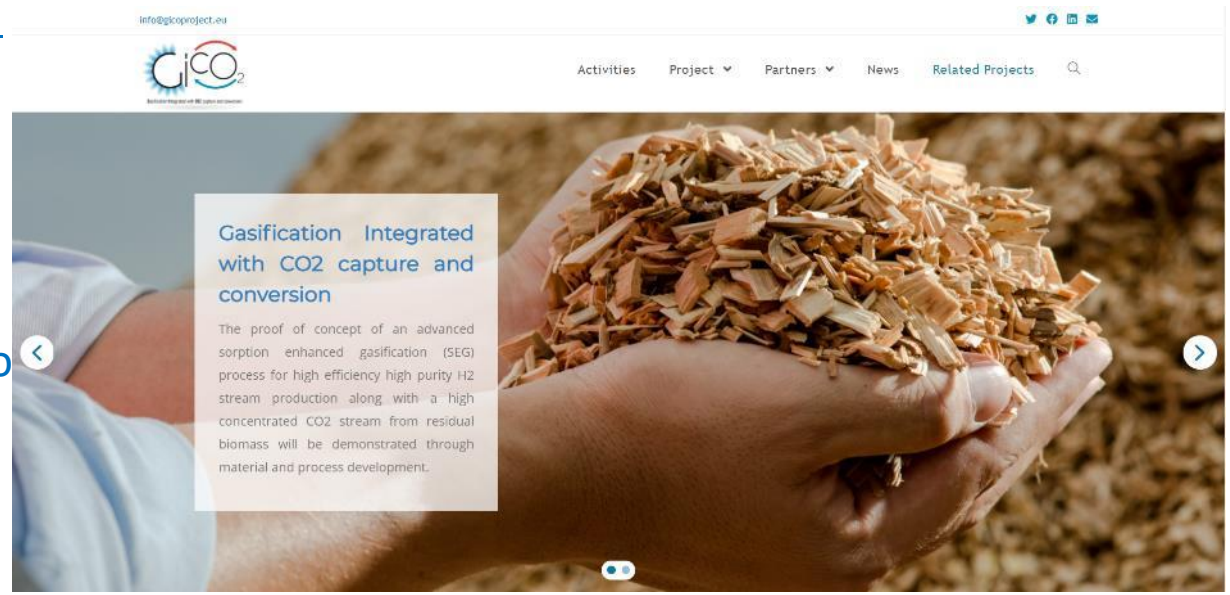
Dissemination/communication activities :

- 6 Conferences presentations: EUBCE, EFC, Biocogen, Turbo Expo, Nano Innovation, SDEWES.
- 12 Publications in scientific journals: 5 in Energies, 3 in IJHE, 2 in Frontiers, 2 in ASME
- The official BLAZE website https://www.blazeproject.eu:
- The official GICO website https://www.gicoproject.eu:
- Platform: www.blazeproject.eu/biocogen-2030/
- BLAZE & GICO social media (Twitter, Linkedin and Facebo
  - Blaze & Gico Project (e.g. @GicoProject) / Twitter
  - Blaze & Project: Overview | LinkedIn
  - Blaze & project | Facebook



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