BioRobur^{Plus} project: Advanced direct biogas fuel processor for robust and decentralized hydrogen production

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Concept and objectives

The BioRobur^{plus} project will develop a pre-commercial oxidative steam reformer (OSR) for green hydrogen production from biogas. The TRL6 demo-plant will deliver at least 50 Nm^3/h (107 kg/day) of H_2 at 99.9% purity and 1.5 bar, starting from a biogas simply desulphurised having a concentration of 60% CH_4 and 40% CO_2.

The concept is based on structured catalysts (Fig. 1), which were successfully developed in the finishing BioRobur FCH JU project.

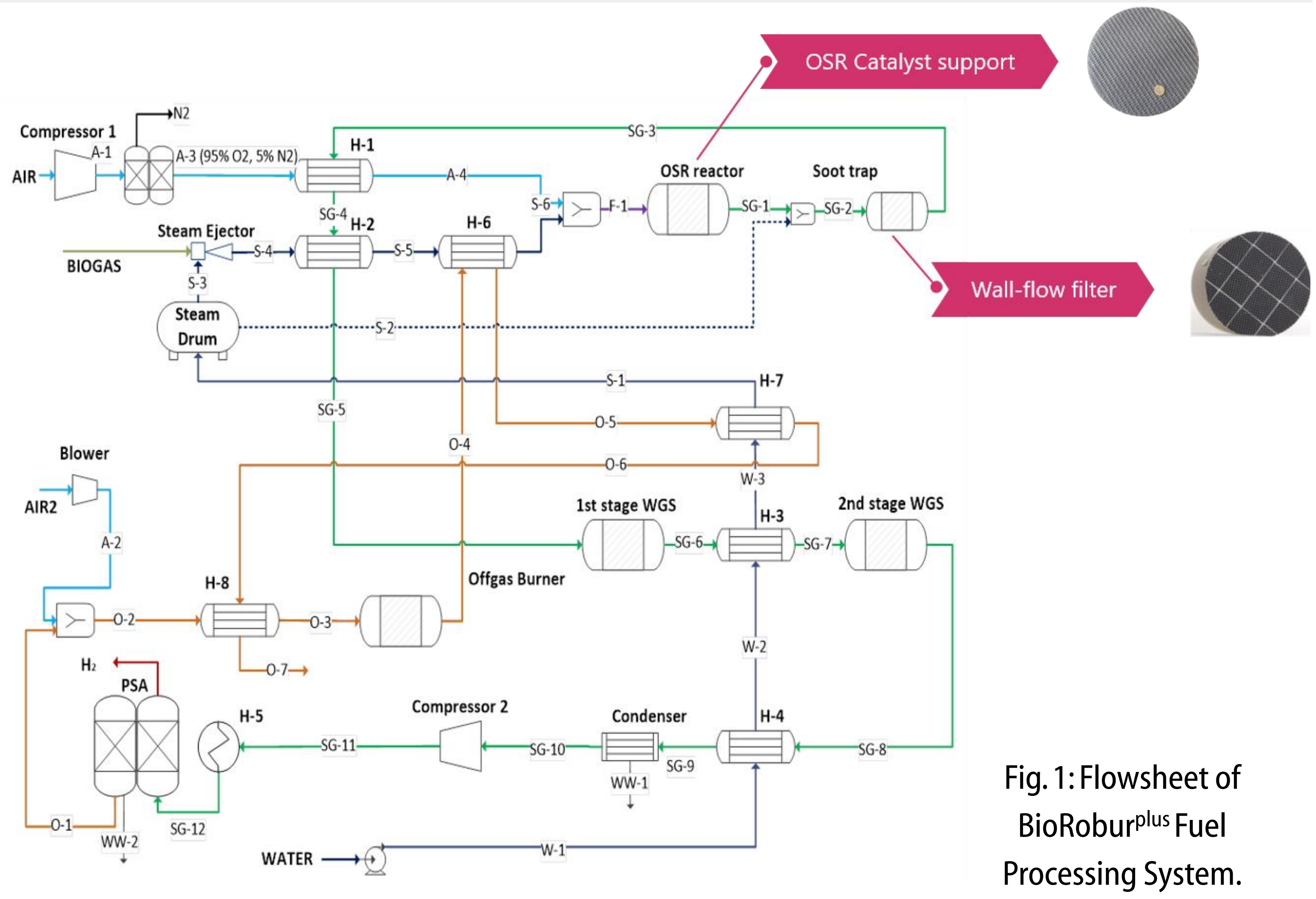

Fig. 1: Flowsheet of BioRobur^{plus} Fuel Processing System.

The BioRobur^{plus} project will exploit this OSR component in the overall fuel processor illustrated in Fig. 1, following new developments and concepts:

01 A tailored purification system to drive H2 separation from CO_2 and N_2 with minimal power consumption and exploitation of low temperature heat recovered from the processor.

02 A recuperative burner based on cellular ceramics capable of exploiting the low enthalpy H_2 purification off-gas to provide a crucial sensible heat input to the feed of the OSR reactor.

03 New OSR catalysts (Fig. 1) designed to match the operating conditions of the reformer (>700°C inlet temperature; reduced air feed; increased S/C ratio) entailed by the above described heat recovery measures.

04 An innovative and effective process architecture enabling high conversion efficiencies (Fig. 1).

Acknowledgments

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BioRobur^{plus} challenges

- Innovative and suitable supports for OSR catalyst.
- Catalysts with low degradation and good coking resistance.
- H_2 production from different biogas types in a cost-effective manner.
- An energy efficiency of 81% on a HHV basis.
- A start-up time after stand-by < 15 min.
- A cold-start up time of no more than 2 h.
- A dedicated TRL6 demo campaign (>4400 h).
- An average life plant of 10 years.
- A CAPEX costs of about 2,000 €/Nm^3/h.
- A materials cost < €250,000.
- Reformer outlet CO concentration below 8% on a dry-basis.
- An overall CO_2 footprint lower than 50%.

Expected Results and Conclusions

A robust biogas OSR plant for the production of 50 Nm^3/h of hydrogen with an energy efficiency of 81% will be developed .

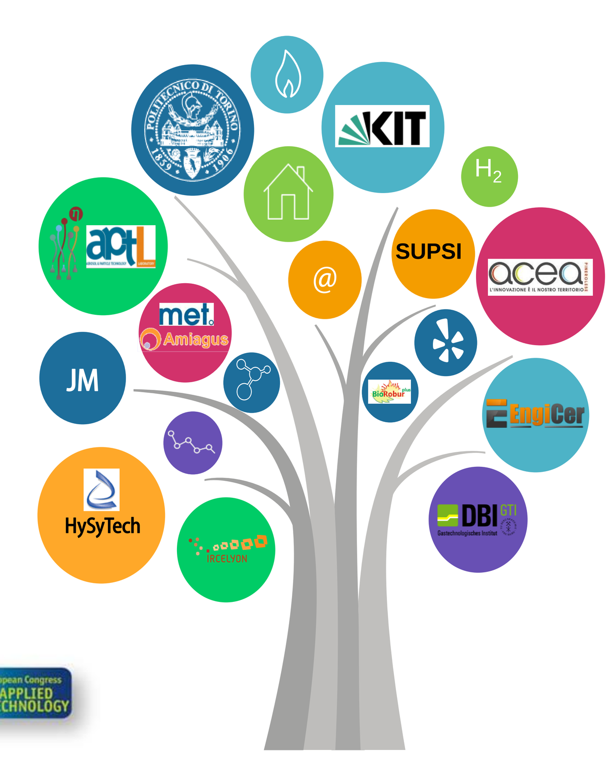
Research and technological development activities are being carried out on materials, catalysts and processes for chemical conversion, as well as their integration and prototyping in an efficient thermally optimized system.

The above innovations and the aforementioned scientific and technical objectives will be achieved by combined modelling and experimental research efforts, driven by combined LCA, HAZOP, REACH and multi-objective analyses on the overall energy system and its components (materials, chemicals, plants, …).

Coordination and Partnership

Prof. Debora Fino, the coordinator of BioRobur^{plus} project, will manage, in an industrially-oriented perspective, the work of 11 partners with complementary expertise:

- 3 universities (POLITO, KIT, SUPSI),
- 3 research centers (IRCE, CPERI, DBI),
- 3 SMEs (ENGICER, HST, MET) and
- 2 large companies (ACEA, JM).



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