Demonstrating hybrid biomethane production from biomass

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CoLAB BIOREF

INDÚSTRIA DE FUTURO
Roteiro para a Introdução dos Gases Renováveis no Setor Industrial Nacional

12.JUL 2023 9H00
Meliá Hotel, Setúbal

HYFUELUP
Hybrid Biomethane Production from Integrated Biomass Conversion

BIOREF
Laboratório Colaborativo para as Biorrefinarias

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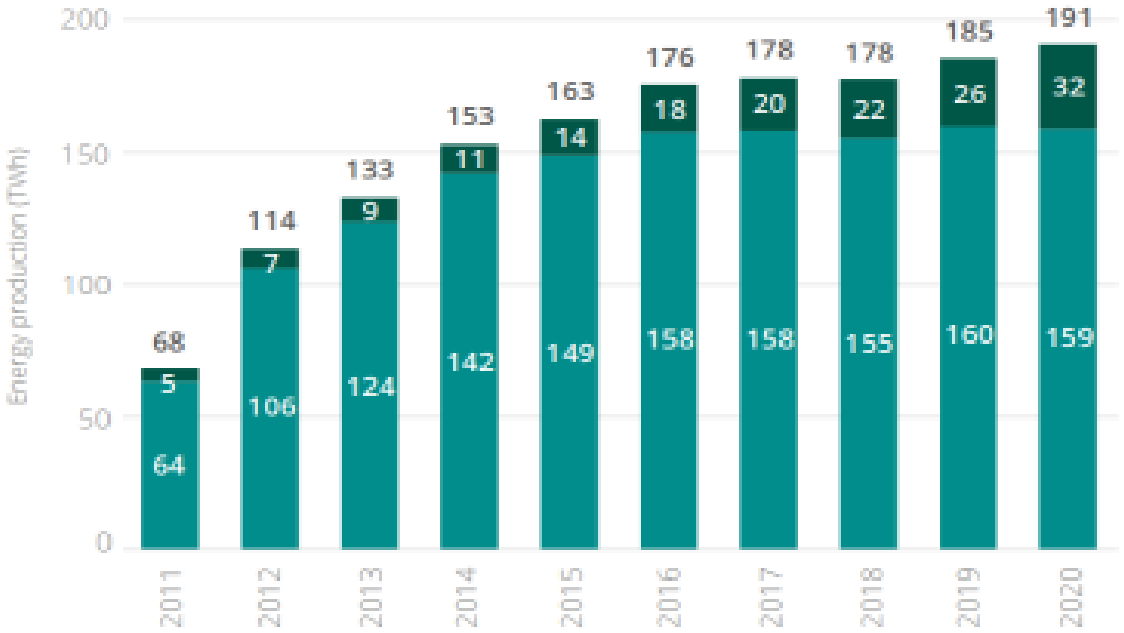
Contents

Biogas for biomethane



In: European Biogas Association. EBA Statistical Report 2021. (2021)

- Biomethane production in the EU (32 TWh or 3 bcm) differs significantly between countries

RePowerEU
Target to reach **35 bcm of biomethane by 2030** in EU, which is **more than 10x** the 2020 values in EU (3 bcm)

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AD vs. Gasification Technologies for Biomethane

- Most production occurs via **AD biogas production and upgrading**, however there are,
  - Operational problems due to process instability
  - Inhibition and feedstock limitations (lignocellulosic feedstocks use is not straightforward)
  - Rigid and complex process operation and in general, CO_2 stream is flared
  - AD leads to low biogas productivity (days instead of hours)

- **Gasification** is an alternative that needs to be widely implemented
  - Sustainable biomass feedstocks are larger
  - Much higher productivity at similar energy efficiency (62-65%)

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Project summary

- **HORIZON-CL5-2021-D3-02-016:** Innovative biomethane production as an energy carrier and a fuel
  - Innovation Action (IA)
  - TRL: Activities are expected to achieve **TRL 6-7** by the end of project

- **Project budget:** 11.6 M€ with an **EU contribution of 10.3 M€**

- **Expected outcome:** **Complete plant validation** and first liquified biomethane offtake, from gasification technology, **expected in 2026**

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Project summary

- **Industrial site:** Tondela (Viseu), Portugal
- **Starting date:** Nov 1st, 2022 (4 years)
- **Coordinator:** BIOREF – Collaborative Laboratory for Biorefineries, Portugal

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Consortium

HYFUELUP

- **11 partners**

BIOREF
Laboratório Colaborativo para as Biorrefinarias

University of Stuttgart
Germany

JM Johnson Matthey
Inspiring science, enhancing life

PAUL SCHERRER INSTITUT
PSI

CIRCLE MOLECULE

ΚΑΠΕ
CRES

Bioplat
BIOMASA PARA LA BIOECONOMÍA

AlphaSYNT
Swiss SynFuels

dourogás
renovável

POLITÉCNICO
DE PORTALEGRE

LNEG

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Budget / Main Role by (National) participant

HYFUELUP

BIOREF Laboratório Colaborativo para as Biorrefinarias	• Project budget: **3.5 M€**	• Main role: **Coordination, Methanation**
CIRCLE MOLECULE	• Project budget: **2.2 M€**	• Main role: **Gasification**
dourogás renovável	• Project budget: **0.7 M€**	• Main role: **Biomethane offtake (bio-LNG)**
POLITÉCNICO DE PORTALEGRE	• Project budget: **1.5 M€**	• Main role: **Electrolysis**
LNEG	• Project budget: **0.5 M€**	• Main role: **Sustainability assessment**

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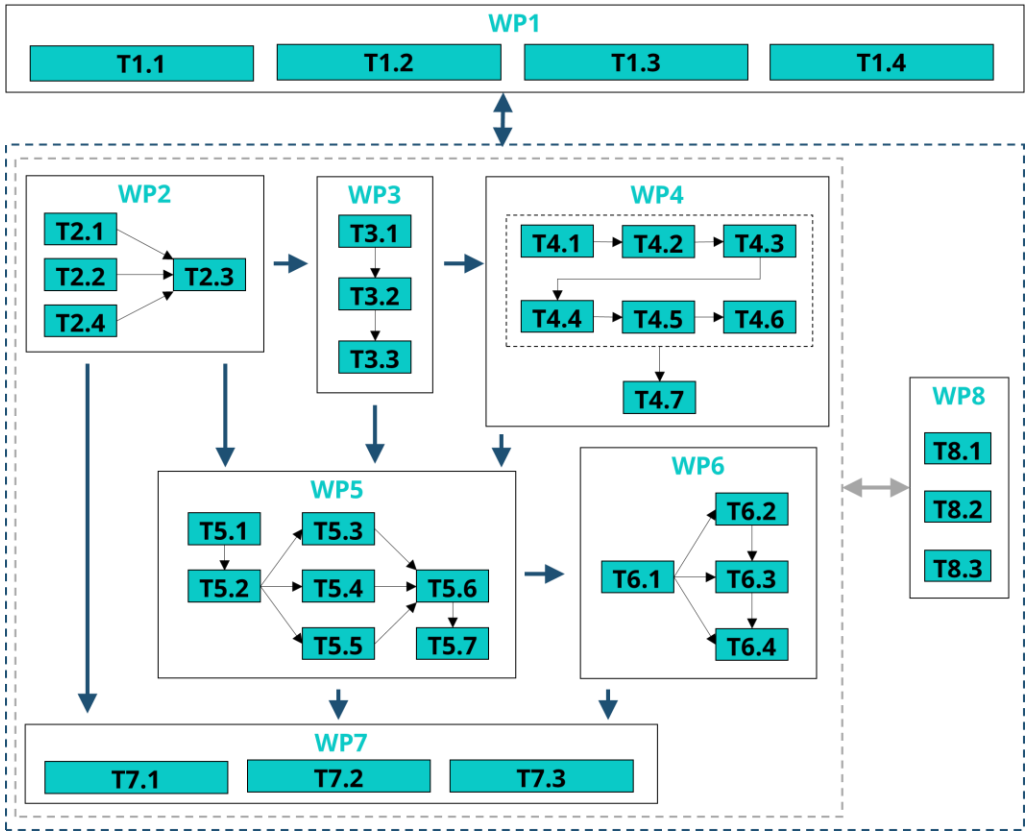
Work plan

- **8 Work packages:**
  - WP1 – Project management
  - WP2 – Feedstock and logistics
  - WP3 – SEG/Oxy-SEG gasification
  - WP4 – Adaptable methanation
  - WP5 – Scaled-up gasification unit
  - WP6 – Biomethane liquefaction
  - WP7 – Sustainability assessment
  - WP8 – C&D&E



Project HYFUELUP

Shaping a Better Tomorrow with Renewable Natural Gas

- The HyFuelUp project will develop an **advanced technology for biomethane production** using gasification and methanation.
- The biomethane produced will then be liquefied and used for the **decarbonization of long-distance road freight transport and in maritime transportation**.

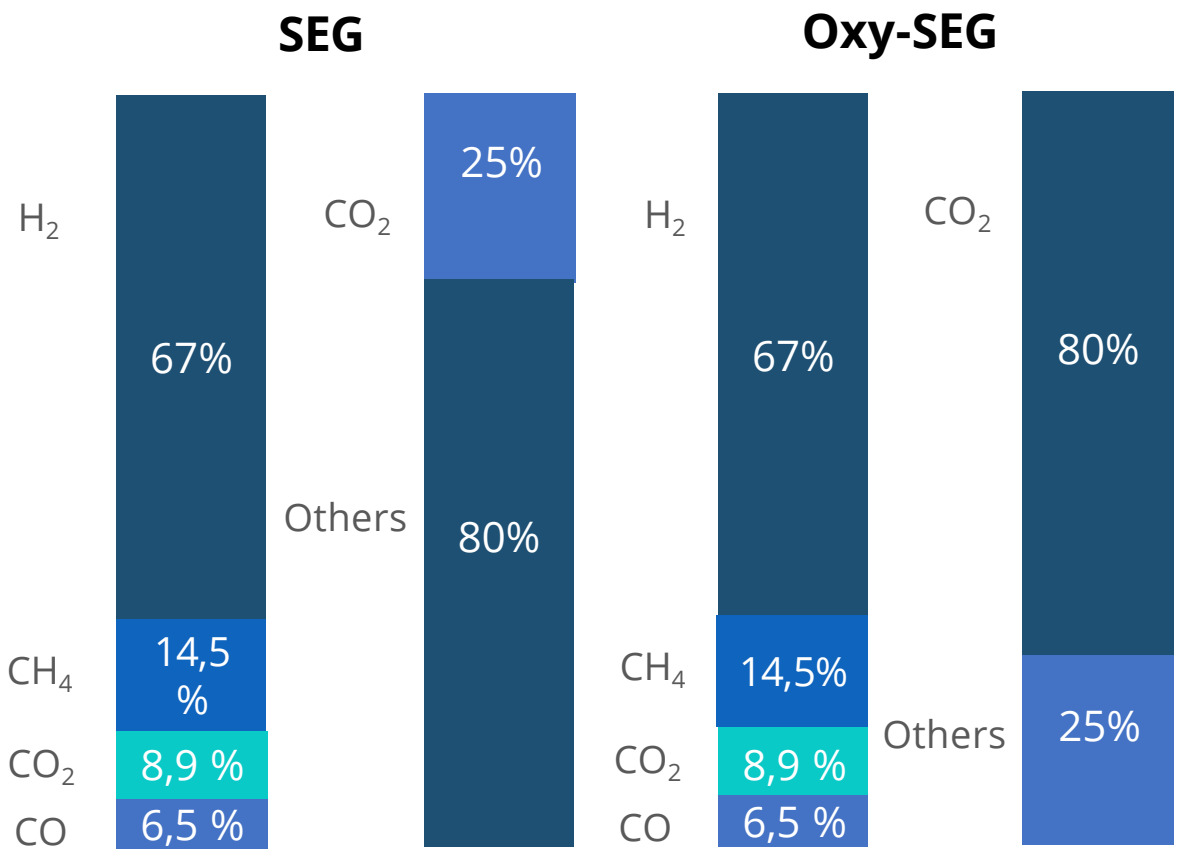
Goals

- Demonstrate an **innovative pathway** for the efficient and cost-effective production of biomethane in industrial environment.
- Deploy a **first-of-its-kind** value chain for **biomethane production** using low-grade biomass residues and sludge digestate from AD plants.

What does HYFUELUP propose to do?

- HYFUELUP integrates a SEG/Oxy-SEG process to turn wastes into **syngas or flue gas.**

- This results in a **syngas with high H_2 content (>65%) and a CO_2-rich flue gas**, making them suitable for catalytic methanation.



No effect in syngas composition from the change in operation mode

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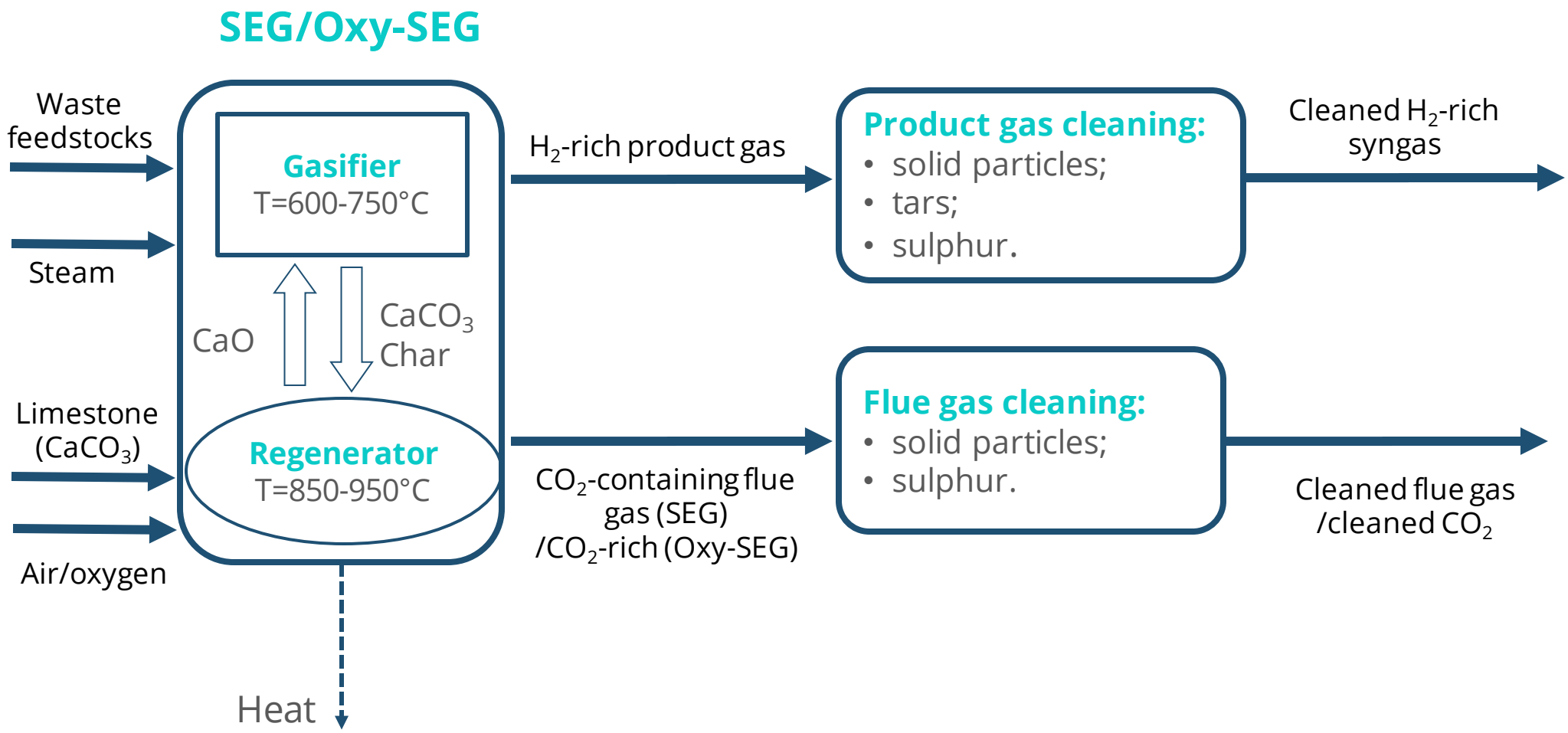
The main demonstration site

Located in Tondela (Viseu) Portugal

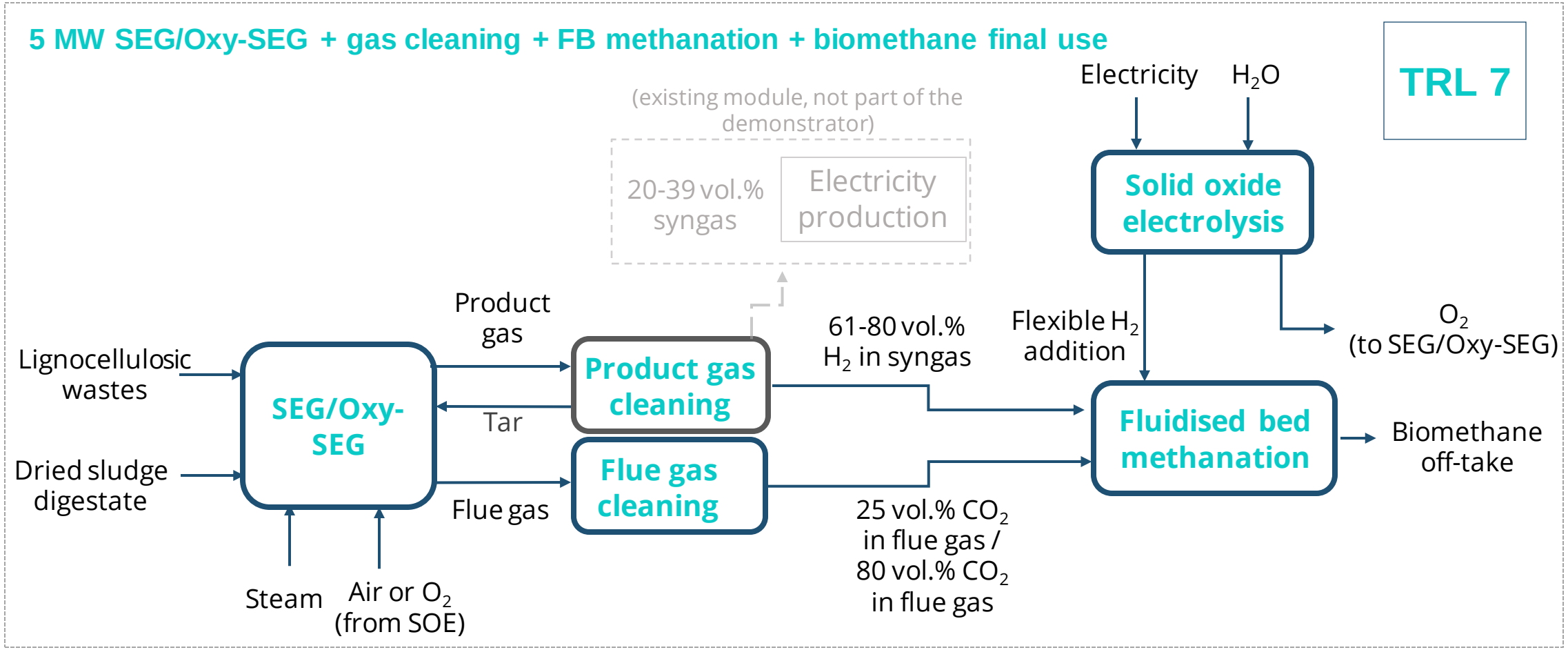
- Retrofitting of an existing CFB gasifier
- Biomethane production capacity: 500 $kW_{th\ LHV}$ or 50 m^3/h or 36 kg/h

CIRCLE MOLECULE

Concept and operation



Basic schematics of the technological demonstrator



Advances and innovations

- Diverse technological concept via **advanced gasification**
- Expanded **lignocellulosic crop supply** for biomethane
- **Diverse feedstocks** using low-grade wastes (digestate)
- **Flexible operation** with fewer steps
- In-situ CO_2 sorption/capture: **enhanced carbon efficiency** (from 65 to >71% as HHV)

Advances and innovations

- **All CO_2 in flue gas** is potentially **converted into CH_4**.
- **Hybrid/adaptable operation mode** in the same reactor (avoids downstream CO_2 separation)
- **Flexible H_2 addition** following availability and needs
- **Complete deployment value chain** will be demonstrated

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Opportunities and outcomes

- Validation of an innovative, competitive, and **clean biomethane production technology** based on **local renewable resources** (crops, wastes, and by-products)
    - Only low cost biogenic wastes are used.
- **Accelerating energy transition in the EU** and increasing sustainability in the transport and energy sector.
    - Replication is expected Europe-wide.

Opportunities and outcomes

- **Reducing GHG emissions** and improving competitive sustainable growth
    - Higher than 90% GHG reduction, compared to use NG.

Contacts

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- **BIOREF's Scientific and technical direction**
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Thank you for your attention

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