

# **HYDROGEN FROM SUPERCRITICAL WATER GASIFICATION OF RESIDUES FROM WINE GRAPES AND GREENHOUSE BIOMASS**

## **PARTNERS**

**BAUER KOMPOST (D)**

**FELUWA PUMPEN (D)**

**SPARQLE (NL)**

**BTG (NL)**

**PROMIKRON (NL)\***

**WIESLOCH WINZERKELLER (D)**

**KOMPOSTERINGSBEDRIJF-ZH (NL)**

**CALLAGHAN ENGINEERING (IRL)**

**FZ KARLRUHE (D)**

**\*PROF.DR.IR.FOPPE DE WALLE**



**BIO-ENERGY  
ENLARGED PERSPECTIVES**

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# **OBJECTIVES**

- **BIOSLURRY FEED PREPARATION**
- **HIGH PRESSURE PUMPING TO 350 BAR**
- **SUPERCRITICAL WATER GASIFICATION OF BIOSLURRY AT 350 BAR AND 600 °C IN 10-30 L/HR BENCH SCALE UNIT (20 kW<sub>th</sub>)**
- **VALIDATION IN 100 L/HR PILOT UNIT**
- **DESIGN OF 1 MW DEMO UNIT**

**OVERALL PURPOSE: CONVERT BIOMASS WASTE TO HYDROGEN FOR ELECTRICITY AND HEAT**

# CONVERSIONS

**GLYCEROL: WATER IS FORMED (1:1,1)**

**HYDROGEN FROM GLYCEROL (1:0,8)**

**GLUCOSE: WATER IS NEEDED (1:3,4)**

**HYDROGEN PRODUCTION (1:7,1)**

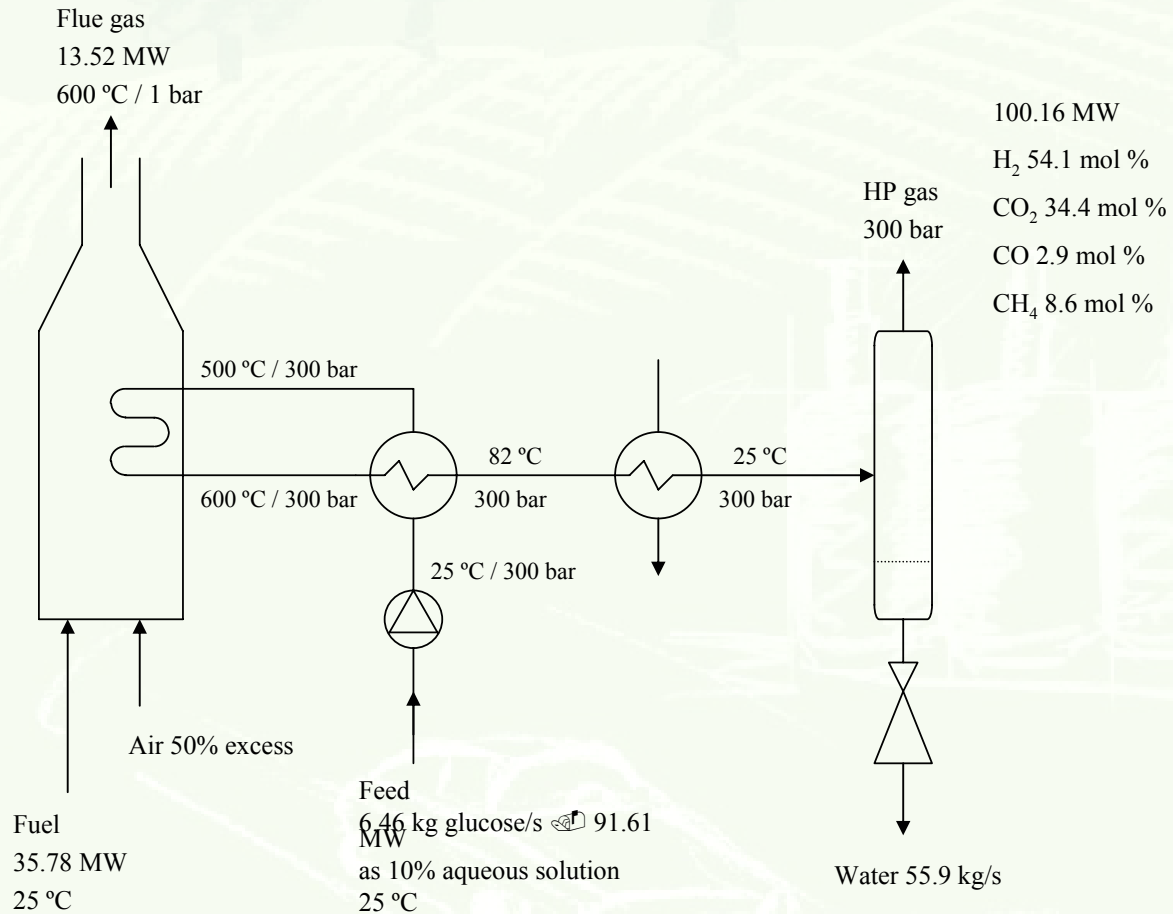
**36% OF H<sub>2</sub> FROM WATER**

**TRESTER: WATER IS NEEDED (1:1,3)**

**HYDROGEN PRODUCTION (1:2,9)**

**17% OF H<sub>2</sub> FROM WATER**

## Conceptual process configuration SWG/SWS process - based on glucose / SCW chemistry



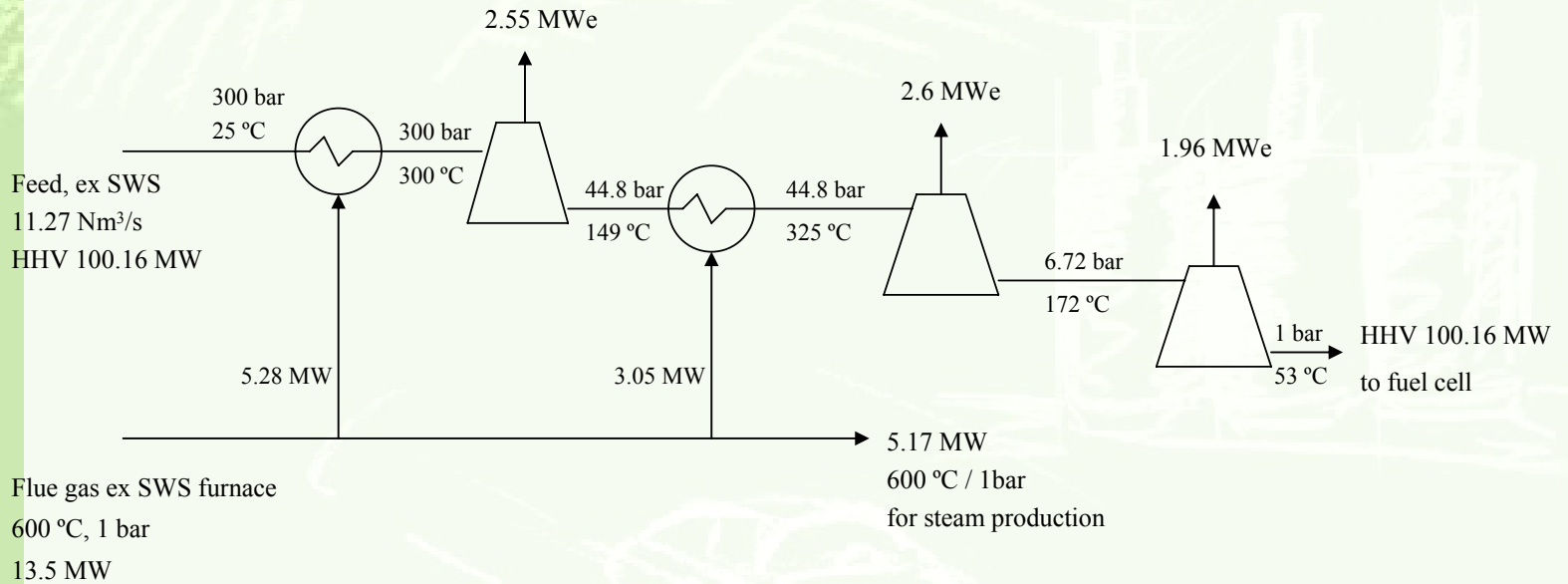
Thermal efficiency  $\eta$  of SWS process - 100.16 MWth product gas / 300 bar

| feed wt % | glucose feed rate | furnace fuel | hp pump*  | $\eta$ |
|-----------|-------------------|--------------|-----------|--------|
| 10        | 91.61 MWth        | 35.78 MWth   | 3.58 MWth | 0.767  |
| 20        | 91.61             | 24.90        | 1.98      | 0.846  |
| 30        | 91.61             | 21.10        | 1.28      | 0.882  |

\* fuel demand for electric power, 50 % efficiency

## Expansion to atmospheric pressure for maximum power

expansion ratio: 6.7       $\eta = 0.72$



## SWS vs. Electrolysis

|                           | SWS           | Electrolysis |
|---------------------------|---------------|--------------|
| Power consumption, MWe    | 14.04 – 24.09 | 162 – 191    |
| Biomass consumption, MWth | 91.61         | zero         |

SWS costs 91.61 MWth of wet biomass

But saves 138 to 177 MW electric power over electrolysis !

*“Power production from wet biomass with thermal efficiency higher than 100 %”*

# CONCLUSIONS

- **BIOSLURRIES UP TO 35% DS PRETREATED**
  - **RAPID CONVERSION AT 300 BAR AND 600 C**
  - **SALT FORMATION TO BE REMOVED BEFORE DURING AND AFTER SCWG**
  - **THERMAL YIELD ABOVE 70%**
- 5. 25 ct/kg H<sub>2</sub> AT EUR -/- 25/TON GATE COST IN 100 MW<sub>th</sub> PLANT USING 190 kT/YR BIOMASS**