CHRISGAS:

Clean Hydrogen-rich Synthesis Gas

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CHRISGAS

BIO-ENERGY
ENLARGED PERSPECTIVES

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The Issue Addressed

Transport Fuel Usage in EU 15

1998	Gas and diesel	244 Mtoe
2010	Gas and diesel (prognosis)	304 Mtoe
1998	Biofuel	0,5 Mtoe
2000	Biofuel	0,7 Mtoe
2010	Biofuel (target 5,75%*)	17,5 Mtoe

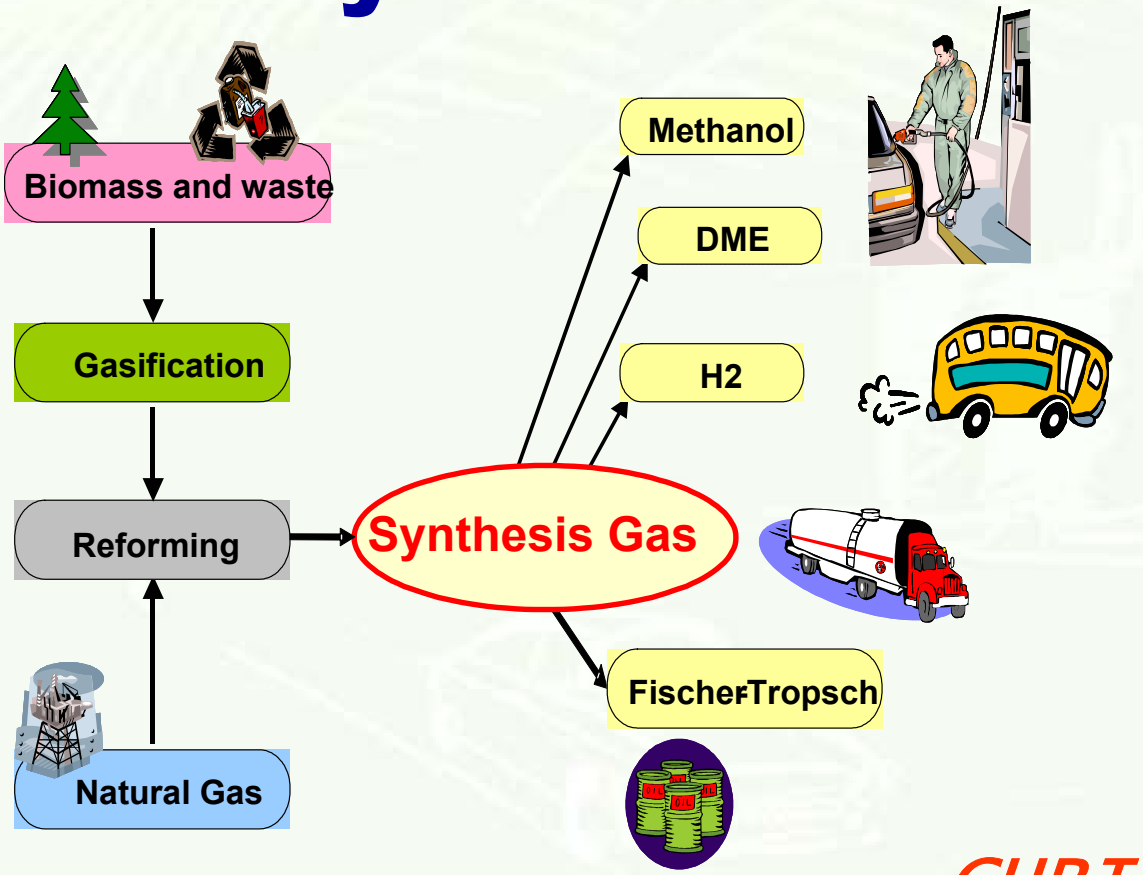
Equivalent to today's consumption of transportation fuels in BENELUX

*Directive on Biofuels for Transport, 2003/30/EC

Comparative costs and energy efficiencies

- Grain or sugar ethanol — 30-50 €/MWh, 30-50%
- Cellulosic ethanol — 70-80 €/MWh, 20%
- RME — 60 €/MWh, 30%
- Methanol/DME — 40-60 €/MWh, 50-60%
- Hydrogen (target 36€/MWh) — ?

CHRISGAS
Clean Hydrogen-rich Synthesis Gas



CHRISGAS Summary

- The hub of the Integrated Project (**IP**) is the existing, unique 20 MW biomass-fuelled pressurised air-blown gasification combined cycle CHP plant at Värnamo
- The Värnamo plant will be refurbished to oxygen gasification to produce a hydrogen-rich gas.
- This **IP** offers already in 2004 gasification RD&D at larger scale at a much lower cost than alternatives
- System studies related to the large-scale use of such plant and its impact on the environment and society at large and Training activities are included in this **IP**

Key Data of Proposal

- 22 Partners
  - 13 IND of which 7 SME
  - 4 HE
  - 3 RES
  - 2 OTHER
- 8 member states: S, DK, GR, D, ES, NL, FI, I
- 4 (5) years duration
- Budget 18.9 MEURO + costs outside project
- 9.5 MEURO EU grant allocated by the EC
- Further projects planned with aims to install a complete GTL facility

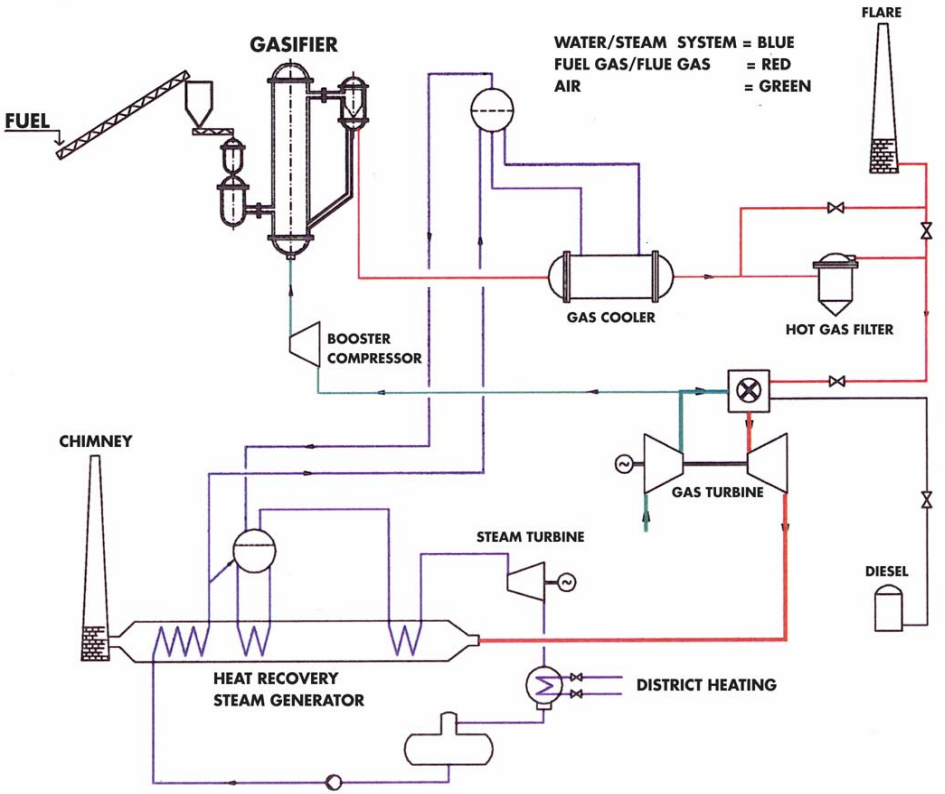
Objectives and Deliverables

Production within 3-4 years of cleaned, hydrogen-rich gas from biomass fuels at the scale of 3 500 Nm^3/hr H_2 equivalents

- RTD Deliverables
  - Catalysts, filters, gas cleaning systems etc. used at Värnamo
  - Tests and operational data at 3-4 tonne fuel/hr
  - Drying and feeder system prototypes tested
  - Fuel availibility & cost, liquid fuel prod. costs at European level
- Training Deliverables
  - Web based educational package
  - Research school for academia

Värnamo Biomass Gasification Center

Sydkraft IGCC Plant, Värnamo



- Op. 1994-2000
- Air blown gasifier, 20 bar for GT
- Typhoon GT
- **18 MW** thermal,
- 4 ton/hr feed
- **8 500** hours op.
- **3 600** hours GT

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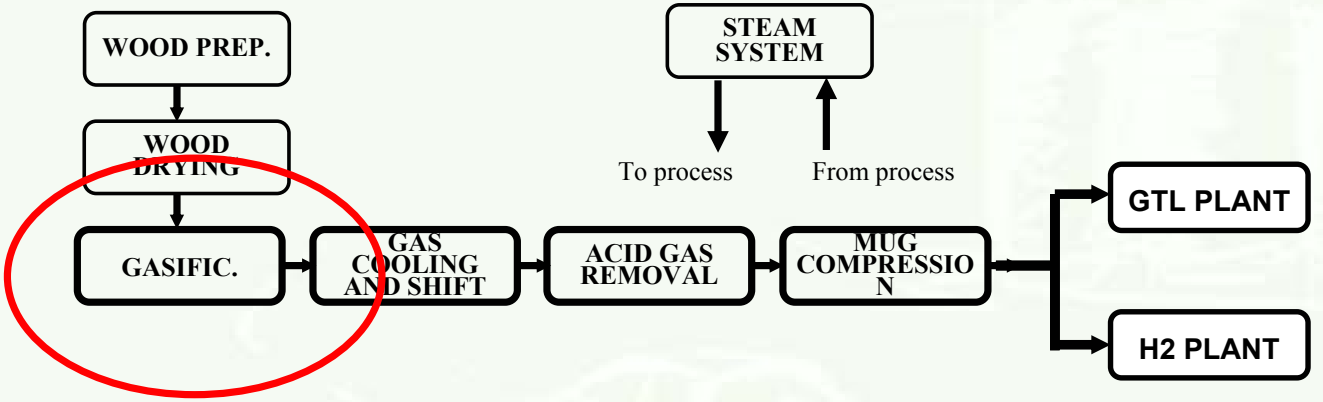
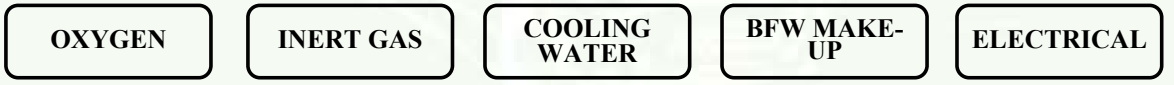
RTD Objectives, Experimental

OBJECTIVE: Gasification of biofuels to a hydrogen rich gas

METHODS: Laboratory and bench-scale work
Modification and operation
of the Värnamo Plant



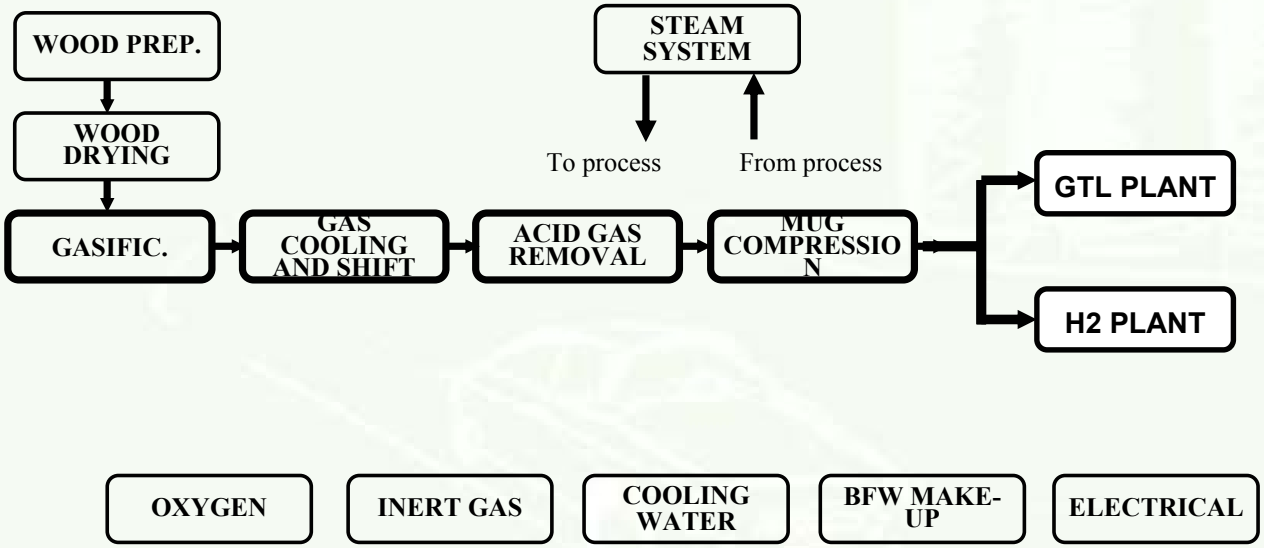


RTD Objectives, Studies

OBJECTIVE: Production system and cost

METHOD: System studies

- Preferred process system
- Fuel availability, cost
- Plant capacity, product cost



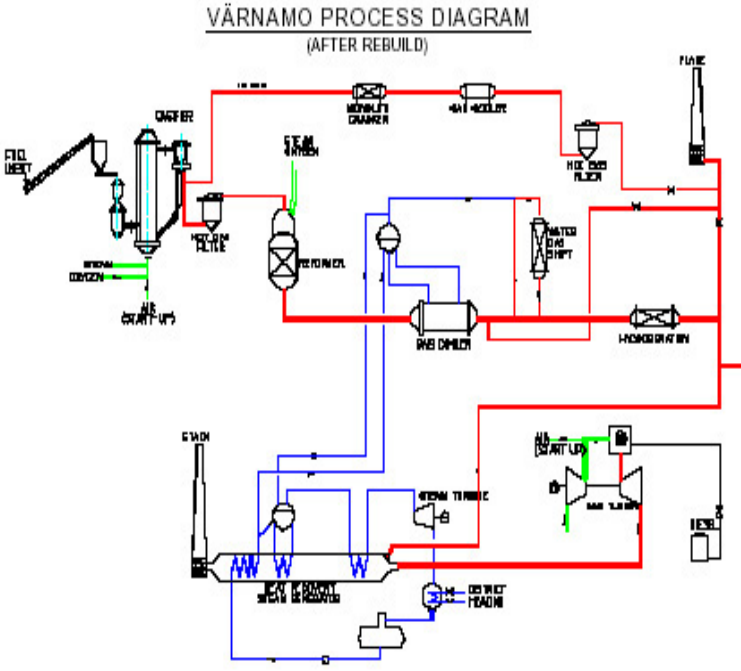
CHRISGAS Status

- 2004-2009
  - Swedish Energy Agency
  - Renewable Fuel Policy emphasis on Biomass-based Synthesis Gas RD&D
  - Other projects
  - Full scale plant in Växjö kommun
  - May-August: Positive evaluation by the EC Environmental Protection and Road Traffic Authority joint
  - September-: Preparation of
    - EPA March 2004
    - DG TREN December 2004
    - Technical Annex and Consortial Agreement
    - Co-financing application

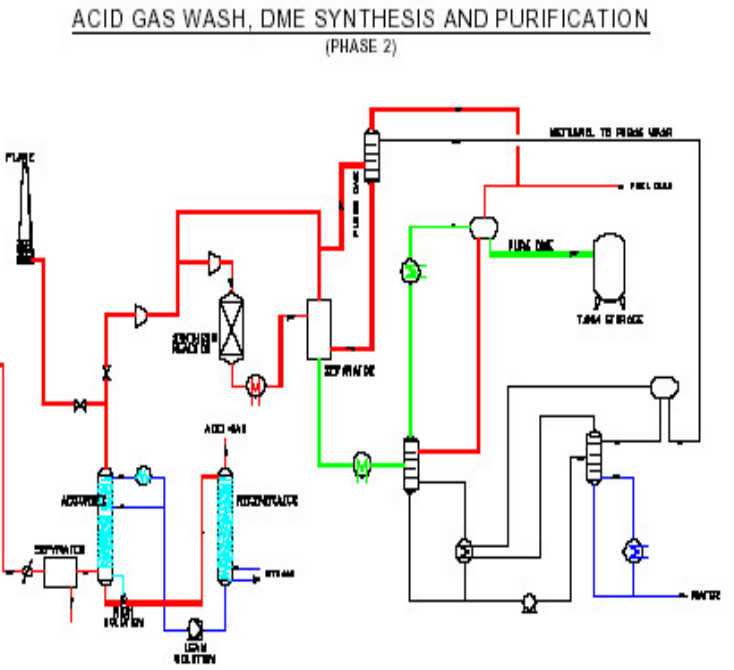
FP6 CHRISGAS

CHRISGAS PHASE II

Hydrogen-rich gas



Automotive fuels



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Exploitation of Results

- **Exploitation of technical results and IPR**
  - Directive 2003/30/EC generates new oportunities
  - Partners, e.g. **Linde**, engaging as technology suppliers/ contractors / owner & operators for liquid biofuel plants
  - Training

- **Exploitation plan for VBGC plant**
  - Syngas production 2003-2008, GTL facility 2005-2010
  - Production of liquid fuels for fleet tests e.g. AFFORHD project 2009-
  - Parallel use of VBGC as platform for training, customer RTD work on gas cleaning, GTL, FC etc. to generate customer values and IPR

CHRISGAS offers

- From the VBGC plant
- **To Europe and Sweden in relation to 2003/30/EC**
  - Establish raw syngas production already in 2005-2006
  - Lower cost as plant already exists
  - Syngas and GTL products 2007-2008 for fleet tests
  - VBGC as platform for
    - a training center
    - customer R&D work on i.e. gas cleaning, liquid fuels, FC:s, H_2
  - A show-case project of Swedish and European Ambitions to acilitate the implementation of the directive
  - Create a center of excellence on an European scale for training and technical know-how in the area of gasification for liquid biofuel