

Direct production of bio-methane through biomass gasification and grid injection

Expert Forum WOC5 -5A

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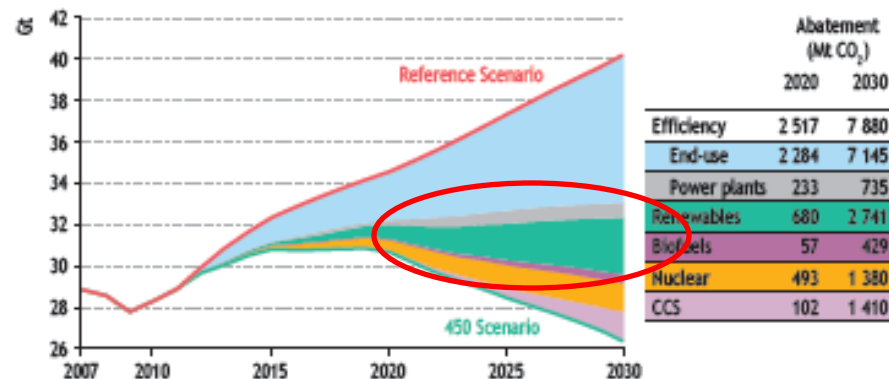
- **Context**
- **Gasification processes to produce Bio-methane**
- **The models for sustainable injection of bio-methane into natural gas grid**
- **Associated business models for NG companies**
- **Conclusions**

Context: Why Bio-methane in the natural gas grid ?

Evolution of customers context

- ❑ Energy and environmental context
 - ✓ Factor 4 – 450 ppm CO₂
 - ✓ European Energy- Climate change targets ex: EU 3 x 20% rules
- ❑ Regulation Context
 - ✓ Energy management standards - ISO 50001
 - ✓ New operating permitting for industrial plants
 - ✓ National quotas CO₂ allocations
- ❑ Profitability of industries or ind. Plate-forms (Steel ind. Chemical ind.)
 - ✓ Energy prices → Reduction of energy consumption
 - ✓ « **Low carbon-foot print** » factories ou Eco-design: → Re-engineering of the energy master plans
- ❑ Strategic context – “Technology boosting”
 - ✓ Advanced technologies in energy (NTE)
 - ✓ Eco-technologies and fighting against Climate Changes

Figure 5.8 • World energy-related CO₂ emission savings by policy measure in the 450 Scenario

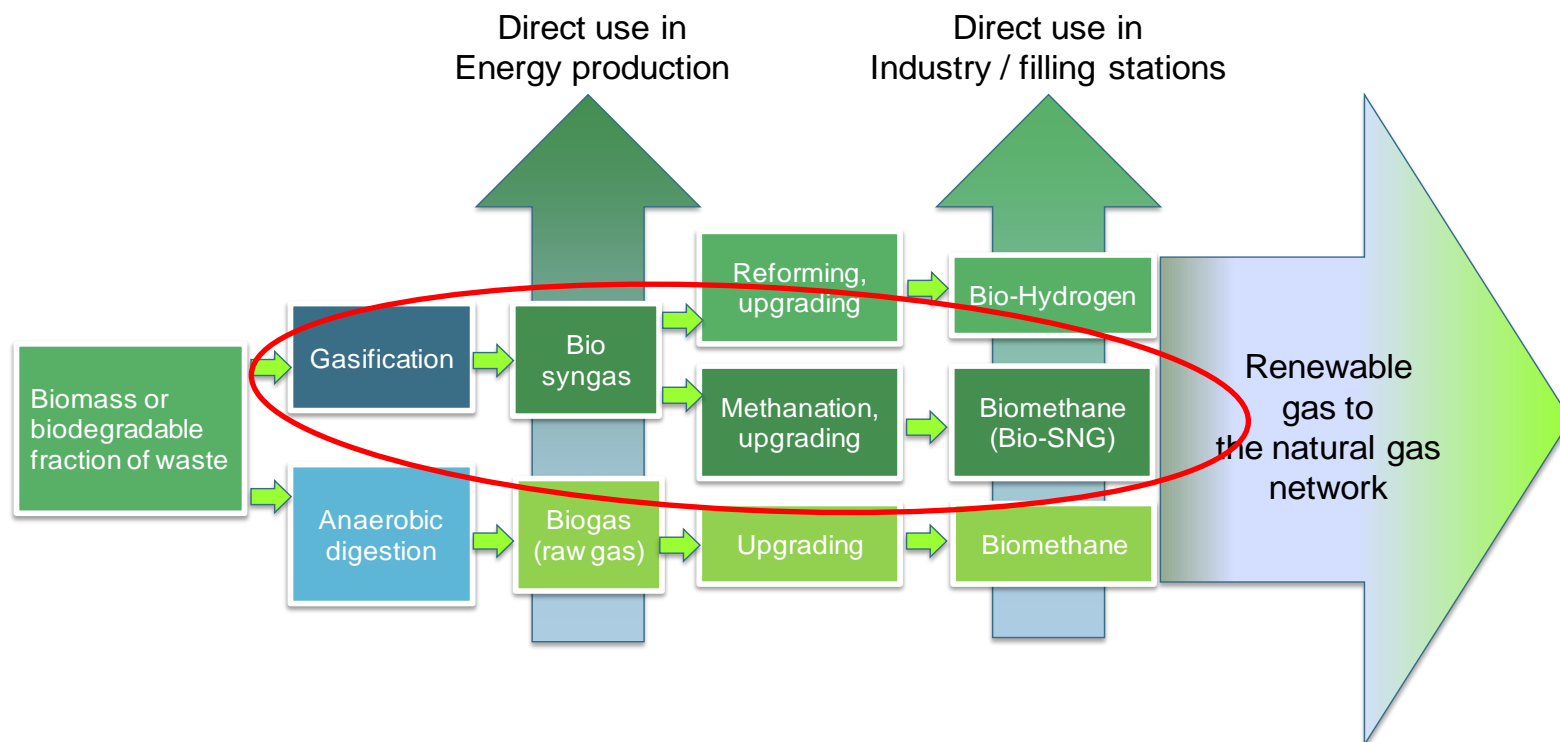


- Implementation of renewable fuel into energy mix of industrial plants will be a priority to reach Climate Change targets
- Even if Natural gas is the lowest carbon contains fuel-gas , it's still a Fossil Fuel
- Our customers will ask us to provide “Green Fuel-gas molecules”
- NG grid is a good opportunity and tools to provide “free CO₂ fuel-gas” to our customers

Gasification processes to produce Bio-methane

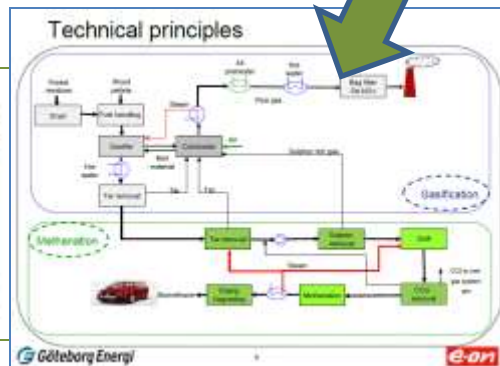
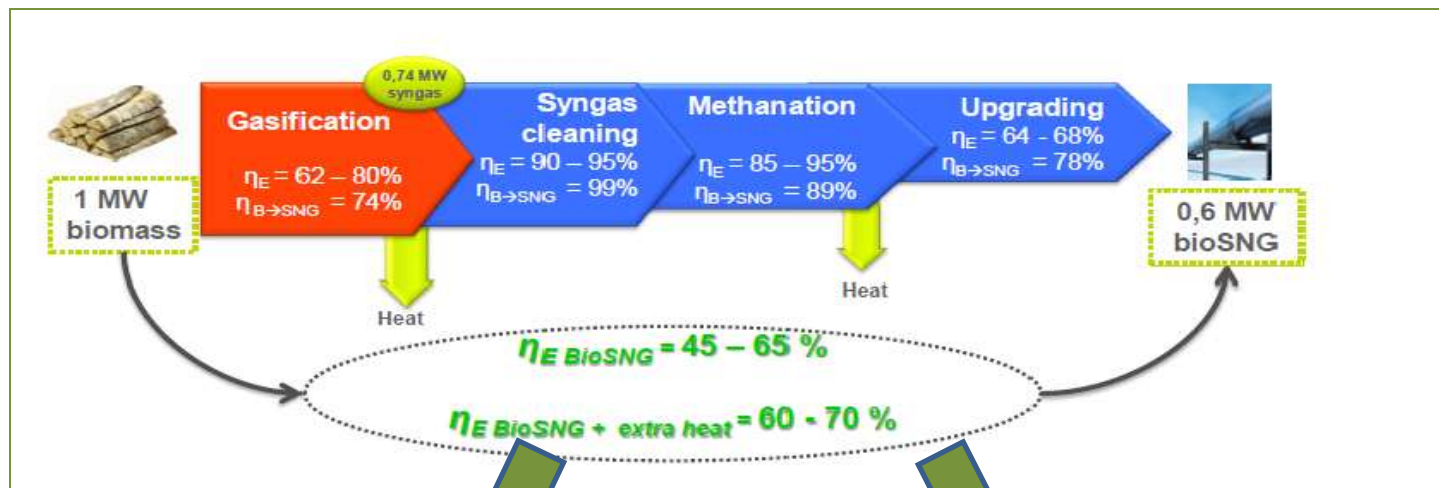
■ Biomass to Energy conversion : Several Processes are available

- Gasification / thermo-chemical process is a sustainable & flexible way for treatment of Dry & Ligneous Biomass



Gasification processes to produce Bio-methane

- Gasification : An efficient thermo-chemical process to produce Bio-methane



1- GoBiGas - Göteborg Energi/Eon project with REPOTEC FICFB gasification process and Haldor Topsoe methanation process



2- Replotec FICFB gasification process – Güssing CHP unit and méthanation pilot plant with CTU process

The models for sustainable injection of bio-methane into natural gas grid

- Two models are under investigation : “Green gas concept”

Mass production similar to Electrical power plant models

- Large plant capacity : 80 to 200 MW bio SNG - 1 600 GWh/yr – ~ 160 MNm³/yr
- 2 or 3 plants per countries/lands
- Use of imported biomass 90 to 220 kT/an
- Bio-methane injection into transmission grid
- Country energy mix strategy
- Ex: GoBiGas project (Sweden)

Göteborg Energi

e-on



Local production similar to Cogeneration plant

- Medium plants : 20 to 60 MW bioSNG – 450 GWh/yr – ~ 50 MNm³/yr
- One plant for industrial Plat-form or site /town with cogeneration biomethane/heat
- Use of local biomass 20 to 60 kT/an
- Bio-methane injection into distribution grid or local grid
- Energy integration Territory approach
- Ex: GAYA project (France)

Gaya

GDF SUEZ



Associated business models for natural gas companies

Biomass trading or energy tolling ✓

Engineering Services to support implementation of plants ✓

Global Services for Mass production of green Fuel gas ✓

Global Services for local production of green Fuel gas ✓

O & M services ✓

Engineering services and plant erection

Design of technologies

- **Opportunities of Business: *For 10% of Renewable methane in Europe 2030***
 - ~ 50 billion m³/year (500 TWh/year) to produce and transport
 - ~55 billion€/year for sales
 - ~60 billion€ for investments

Conclusions

Direct production of bio-methane through biomass gasification and grid injection

- Thermo-chemical biomass to energy conversion is an efficient process
- Technologies are available at preindustrial stage or local production, at industrial stage for large production (coming from coal gasification technologies)
- Several industrial or Pilot demonstrations are undergoing (GoBiGas & GAYA projects in Europe ; GTI project in USA)
- Favorable contexts in term of Environment, Economic & regulatory
- Opportunity for NG companies to be able to provide “FreeCO2 fuel gas”
- Some Models of business are well known by NG & energy services companies, Others need to be invented
- A promising potential of new turn over to be confirmed
- A good transition to Hydrogen or Bio-Hydrogen distribution

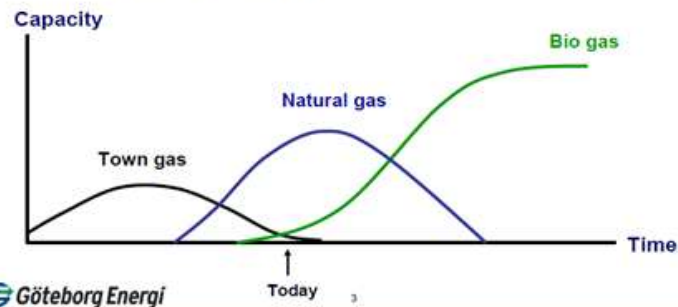
Our vision:

Only renewable gas in the future

Short term target 2020 for Gothenburg > 1 TWh of biomethane

Short term target 2020 for Sweden > 15 TWh of biomethane

Long term target – only renewable energy sources



1 Biomethane vector : 4 generations of technologies SDG 3, 7, 13
Complementary pathways targeting different resources

