2nd Generation Biofuels – the bioliq technology and economic perspectives

IEA Bioenergy, Task 33, Workshop „Liquid Biofuels“
04/11/2014 l Dr. Thomas Wurzel l Air Liquide Global E&C Solutions, Frankfurt, Germany

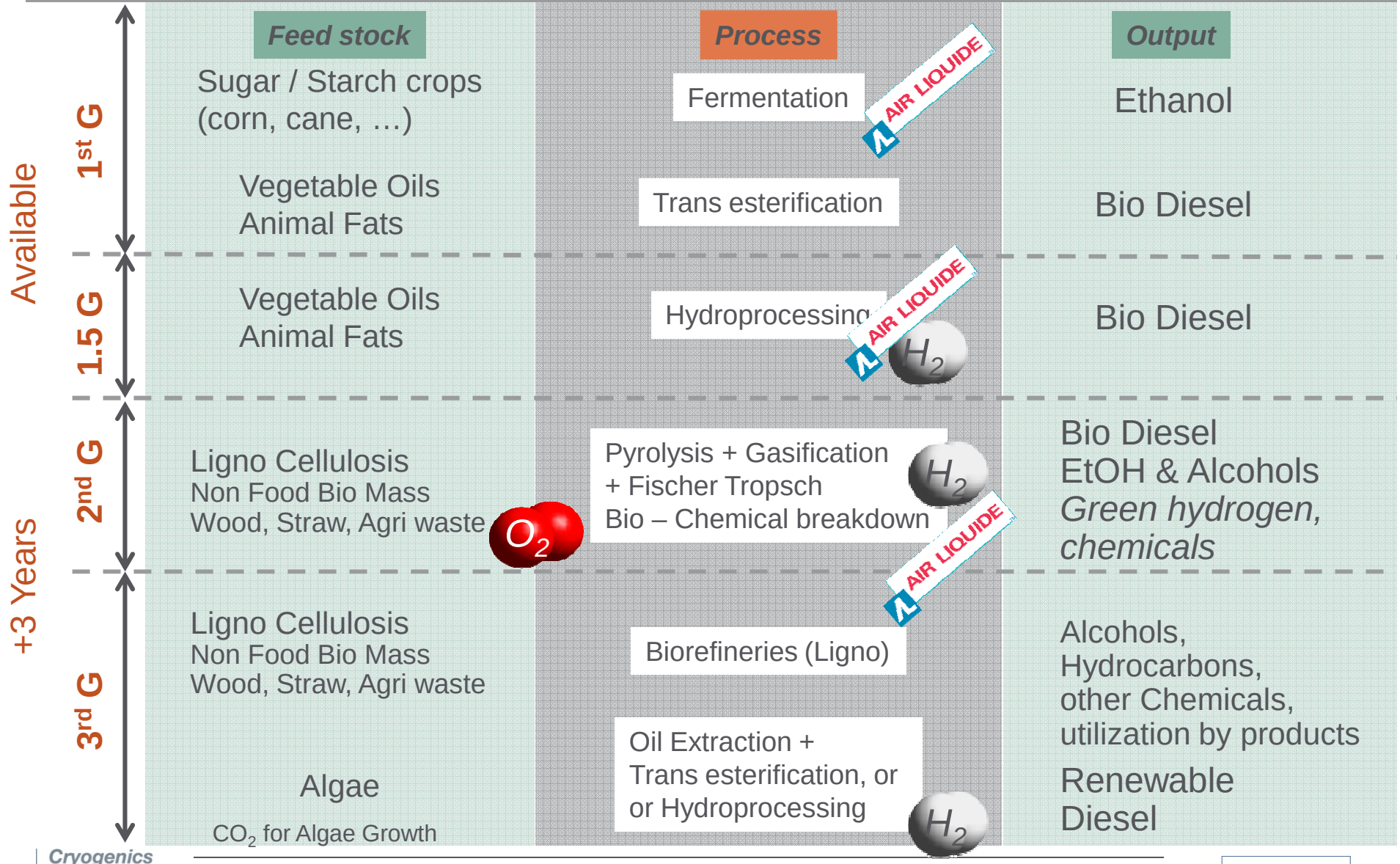
Agenda

- Why to accept the G2 biofuel bet?
- What is at stake?
  - For the society / economy
- What are potential routes for green fuels?
- Where do we stand with bioliq?
- What does is cost?
- What´s next?

Why to accept the G2 biofuel bet?

- Green, sustainable and reliable energy supply is on today´s agenda
  - CO_2 reduction for transportation
  - Contribute to the German energy turn-around (“Energiewende”)
- The potential of biomass as part of the global energy mix beyond G1 fuels is not leveraged as yet due to:
  - Availability of proven technology
  - Economics
- We believe industry & academia have to deliver a solution to this issue

Technology Map: Biofuels and selected Biobased Products



G1 Biofuel - “Biodiesel”

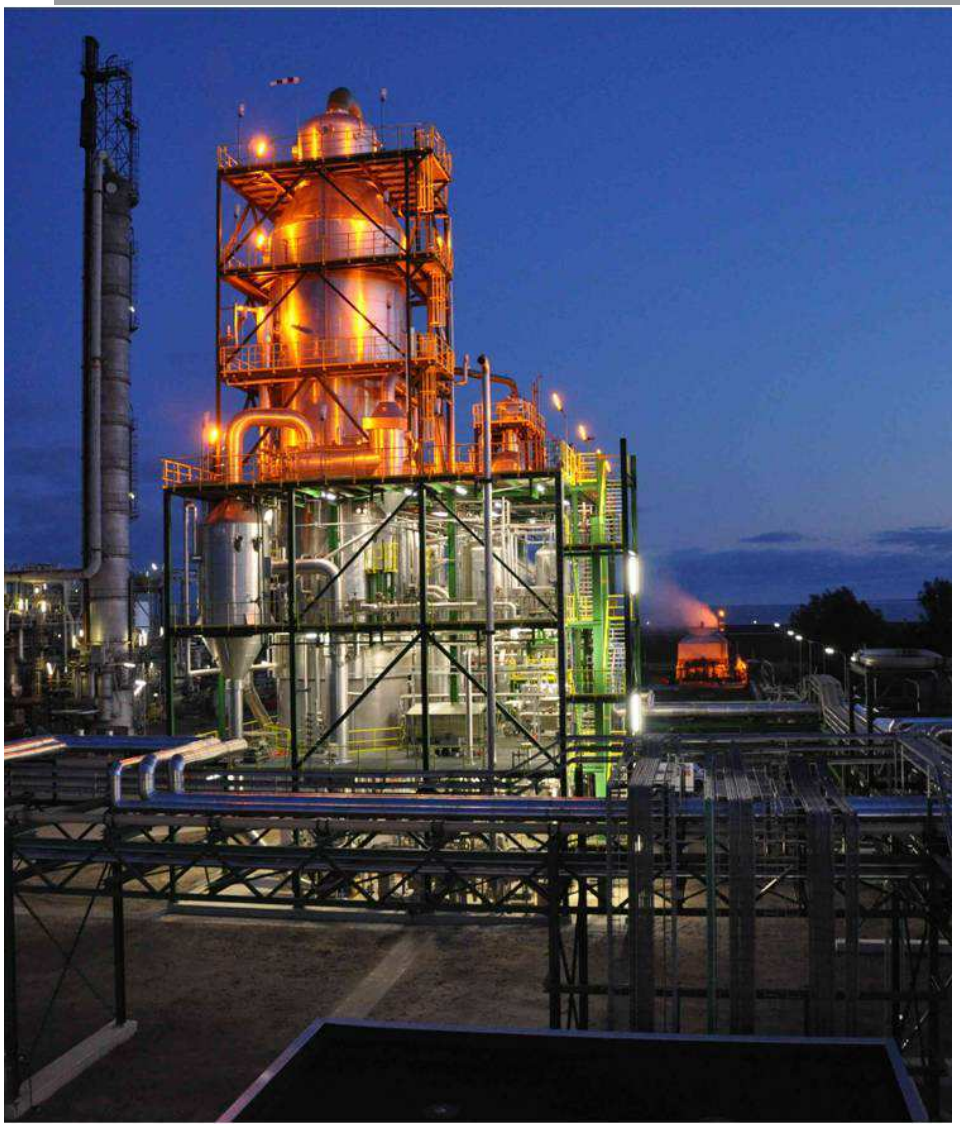
- Biodiesel boom in early 2000s mainly driven by:
  - Political (and tax) tailwind via blending obligations
  - Venture capital available in the market
  - “Easy technology” with good scale-up characteristics
  - Attractive by-product valorisation (glycerine)

- Recent Challenges:
  - Competition with food (“plate vs. tank”)
  - Reduced sustainability level
  - Over capacity

- Conclusion:
  - G1 biodiesel boom is over


Biodiesel Reference Plant
Natural Energy West (NEW), Marl

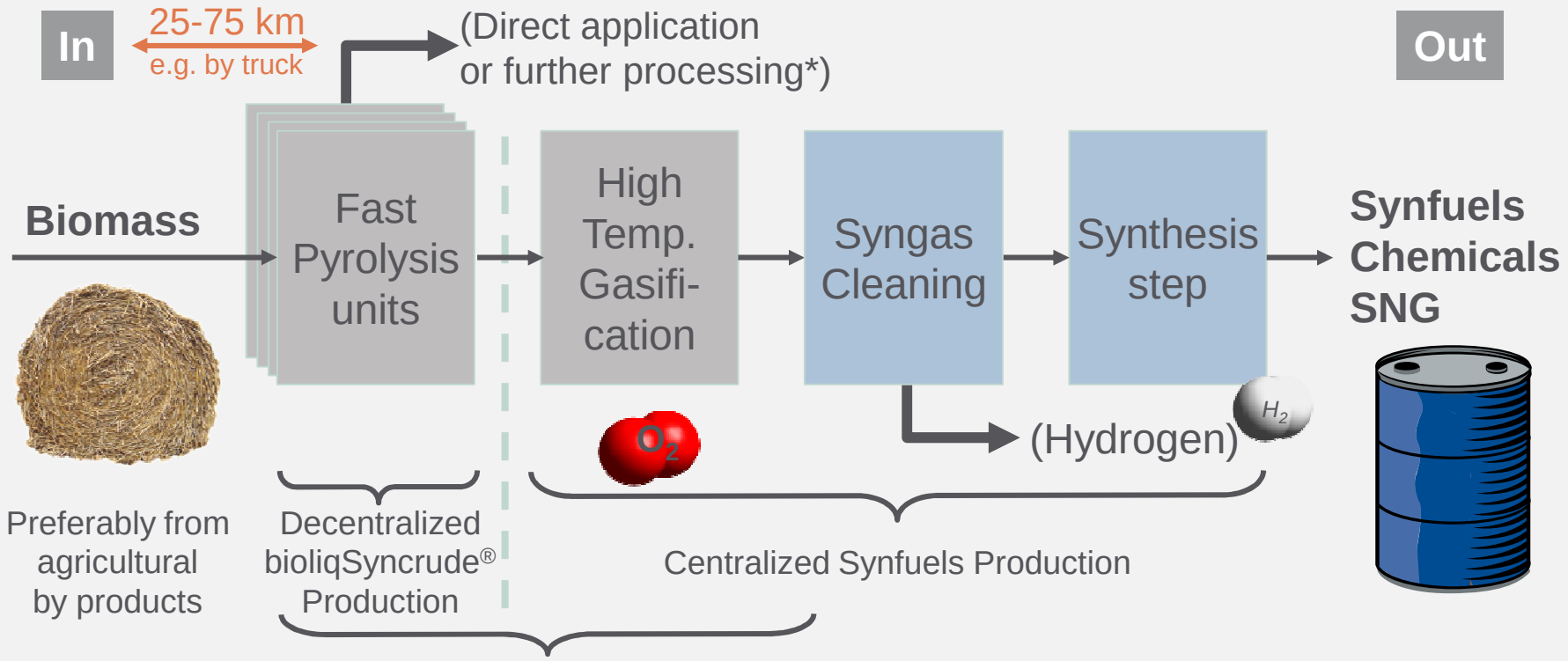
G1 Biodiesel triggered renewable MeOH production



- World largest glycerine distillation (200 kta) delivered by AL E&C in 2008
- Qualitfied as green product : Crude glycerin as by-product from Biodiesel production
- Customer BioMCN produces BioMethanol from purified glycerin

Development with KIT - 2nd G biofuel Bioliq®: “The thermo-chemical route”

- Focus: Demonstration of pyrolysis and gasification of bio-mass



Joint Development by Air Liquide & KIT*; sponsored by FNR**

* KIT Karlsruhe Insitute of Technology
** FNR: Fachagentur für Nachwachsende Rohstoffe

bioliq I - Plant Information

Photos courtesy of
Cryogenics
Lurgi
Zimmer

bioliq®
AIR LIQUIDE GLOBAL E&C SOLUTIONS

bioliq I - Plant Information

- **Plant data**
  - Pyrolysis of 500 kg/h of biomass (air dry) at approx. 500 °C via hot sand employed as heat carrier medium
  - Hot sand is heated and circulated via natural/(product gas combustion)
  - Staged condensation of liquid pyrolysis products: Biotar & Aqueous Condensate
  - Feed for bioliq II: bioliqSyncrude® (1 t/h)
  - Suspension of liquid pyrolysis products (Biotar + Aqueous Condensate) + Char
- **Achievements**
  - Routine campaigns to prolong operation and prepare for commercialisation
  - 1600 h of heat carrier loop operation (incl. test operations for heat carrier system only)
  - 290 h of biomass feed → 53 tons of pyrolysis products:
  - 18 tons of Biotar , 20 tons of Aqueous Condensate and 15 tons of Char
- **AIR LIQUIDE R&D Topics**
  - Pyrolysis Product Condensation System - Simulation in Aspen Plus
  - Test trials with different feedstock types, product yield & characteristics
  - Optimization (e. g. heat carrier/biomass ratio, operation parameters) for stable operation together with KIT, Air Liquide R&D and Air Liquide Global E&C Solution
  - Preparation for upscaling

bioliq® II – EF gasification

- Plant data
  - Pressurized EF (entrained flow) slagging gasifier with full quench
  - Temperature up to 1200 °C
  - 5 MW / ~1,000 kg/h nominal feed
    900 kg/h O2
  - Up to 80 bar gasif pressure
  - Production of green syngas for synthesis of biofuels or green chemicals
- Project data
  - First successful gasification with liquid feedstock 40 bar October 2012
  - Operation with synthetic slurry in 2013 at 80 bar
  - Operation with bio-based feedstock in 2014
  - Integration with bioliq 3&4 delivering first fuel

bioliq®

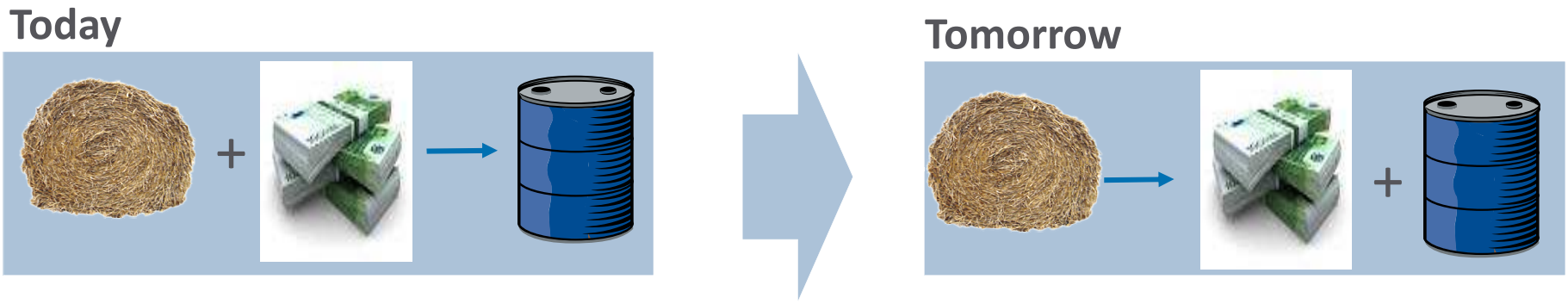
bioliq® – technical challenges

- Variety of green feed-stock material
  - Pyrolysis to unify and to condense
- “New” feedstock in gasification (bioslurry)
  - Detailed characterisation effort
    - values of feedstock properties
    - 13-25 MJ/kg, < 0.9 % Cl, < 40 % solids
  - Proper burner design and temperature management

- This development is a “high risk” development requiring:
  - Demonstration at substantial scale
  - Cooperation with academia to address fundamental research topics
  - A long-term commitment from both partners to make it happen

bioliq® – commercial challenges

- Only few customers cover the whole scope from feed-stock to product which makes it also difficult to define *a priori* the “best” down-stream product
- Diesel price for G2 Diesel still > 1 €/l (w/o tax)
  - Tax holidays or other subsidies are not considered to be an option
- We will need a first reference and such a “first of its kind” project will need an unconventional financing approach (e. g. governmental support)



Outlook and conclusion

- CO_2 reduction targets, sustainable energy supply needs and our strong background in syngas generation and conversion technologies were the main reasons to enter the 2G biofuels development program
- The joint development work carried out by KIT and Air Liquide is a cornerstone in our ability to serve the market with 2G syngas/biofuels
- The processes are well demonstrated and at the edge of commercialisation. Main challenge will remain the project implementation (guarantees and liabilities)
- There is and there will be a need for G2 biofuels. When will this need be strong enough to close the economic gap observed today?

Questions?