

An integrated network on thermal biomass conversion for power, heat and transport fuels

ThermalNet Final Report

Work Package: 2G

WP Title: Transport fuels

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Objectives

- Define rules-of-thumb and guidelines for selection of biofuel production systems based on the location, available biomass, preferred biofuel to be produced, and scale AND create consensus among the experts about these rules-of-thumb and guidelines. The so-called "Biofuel Vision".

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Work Programme

- Topics covered in workshop
 - Kick-off meeting
 - Optimum scale of stand-alone Fischer-Tropsch fuel production
 - Prospects of systems co-producing Fischer-Tropsch fuels, heat and electricity
 - Use of flash pyrolysis in liquid fuel production
 - General issues
 - How to meet the challenge to start the transition from 1st to 2nd generation liquid biofuels

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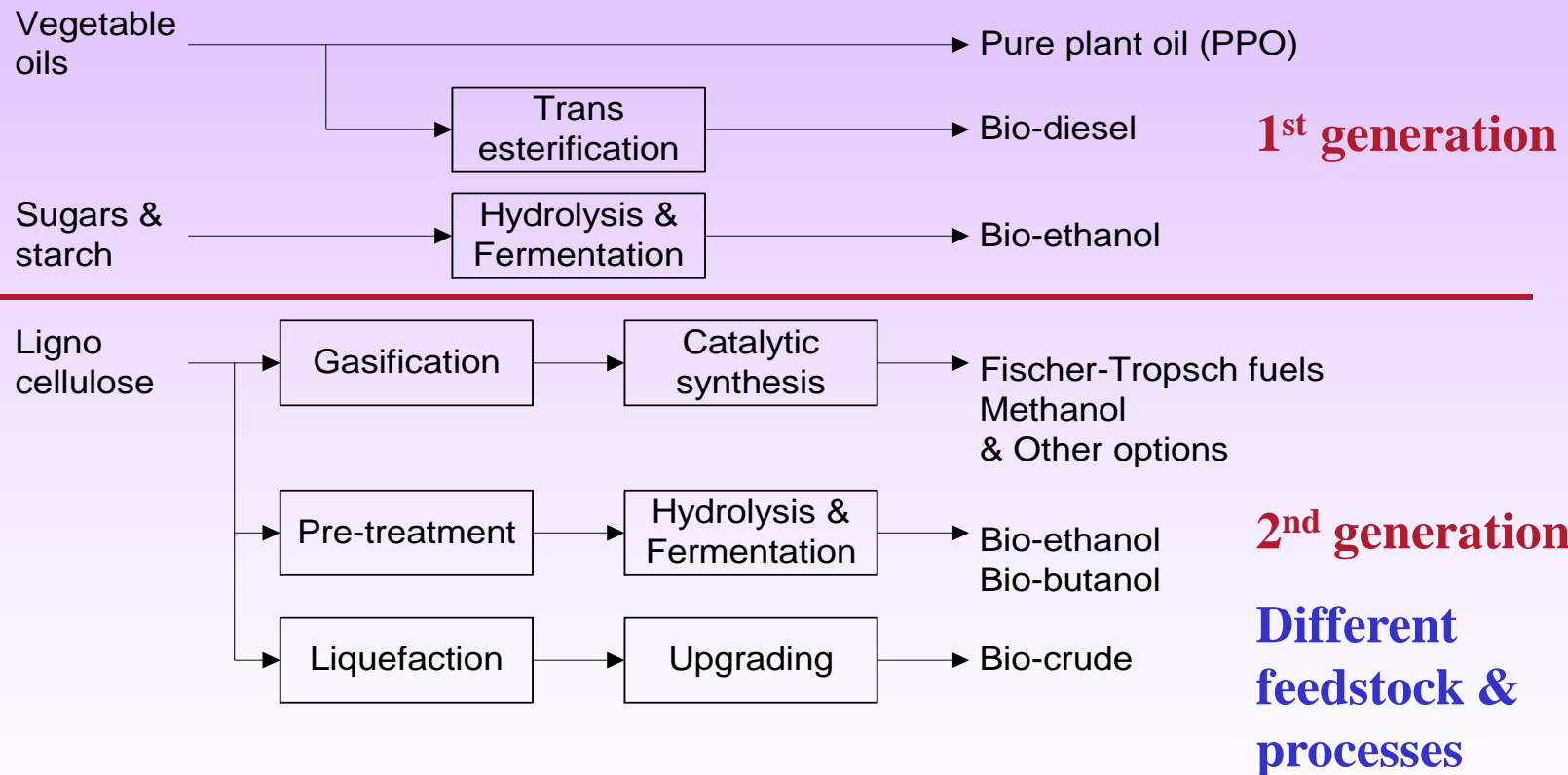
State of the Art

- Motivation for biofuels:
 - Global warming: reduction of GHG emissions
 - Security of supply: decrease dependency on oil
 - Agricultural development: new markets for agricultural products
- EU targets for use of biofuels for transport
 - 2005 2%
 - 2010 5.75%
 - 2020 (proposed) 10%
(With minimum requirements on sustainability)
- Actual use in the EU:
 - 2003 ~0.5%
 - 2005 ~1%
 - 2006 ~1.8%

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State of the Art

- Options for biofuel production:



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Results

- Feedstock issues

Resource type	Biomass consumption, 2003 (Mtoe)	Potential, 2010 (Mtoe)	Potential, 2020 (Mtoe)	Potential, 2030 (Mtoe)
Wood direct from forest (increment and residues)		43	39-45	39-72
Organic wastes, wood industry residues, agricultural and food processing residues, manure	67	100	100	102
Energy crops from agriculture	2	43-46	76-94	102-142
TOTAL	69	186-189	215-239	243-316

Source: Final report of the BIOFRAC

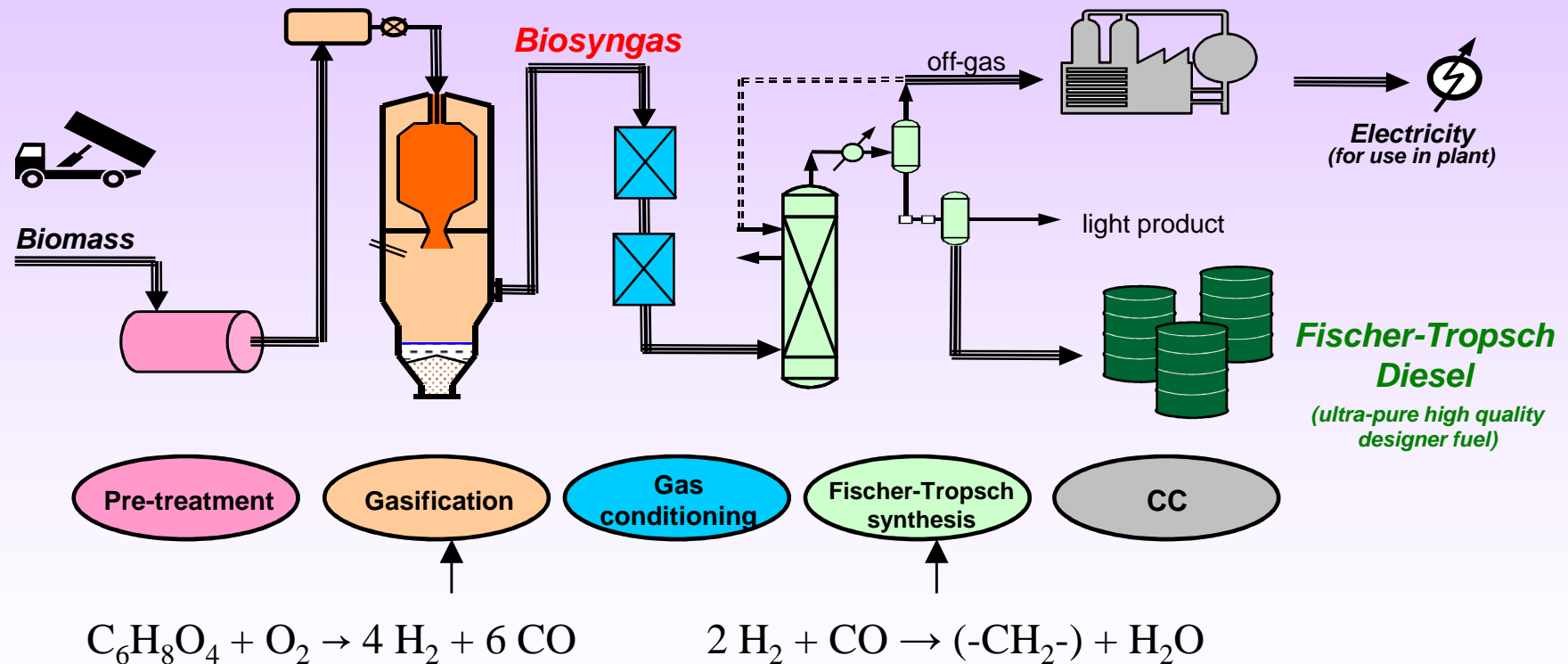
- Transportation fuels for road transport in EU in 2030 : 360 Mtoe
- Biomass availability in EU enough to cover considerable part of transportation fuel demand in 2030
 - Short-term: waste & residues important as feedstock
 - Long-term: important role for energy crops

- Feedstock issues:
 - In the long-term important role for energy crops.
 - Challenge is to turn potential of energy crop cultivation into reality.
 - Major barrier: the risk for farmers to change to cultivation of lignocellulosic energy crops:
 - Alternative outlets for lignocellulosic crops are limited
 - Strategies must be developed to reduce the risk for farmers to stimulate, e.g. co-conversion of coal and biomass

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Results

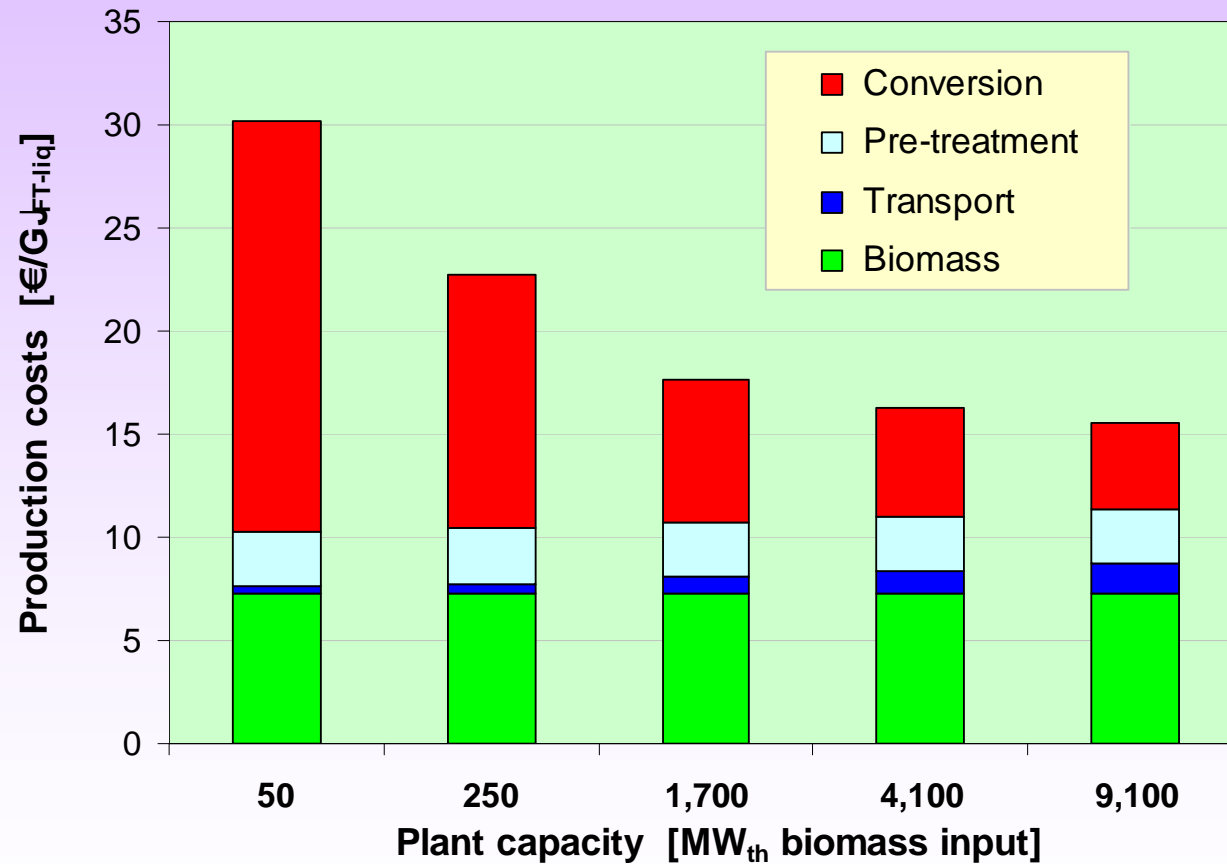
- Synthetic fuel production: general scheme



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Results

- High temperature gasification and stand alone Fischer-Tropsch



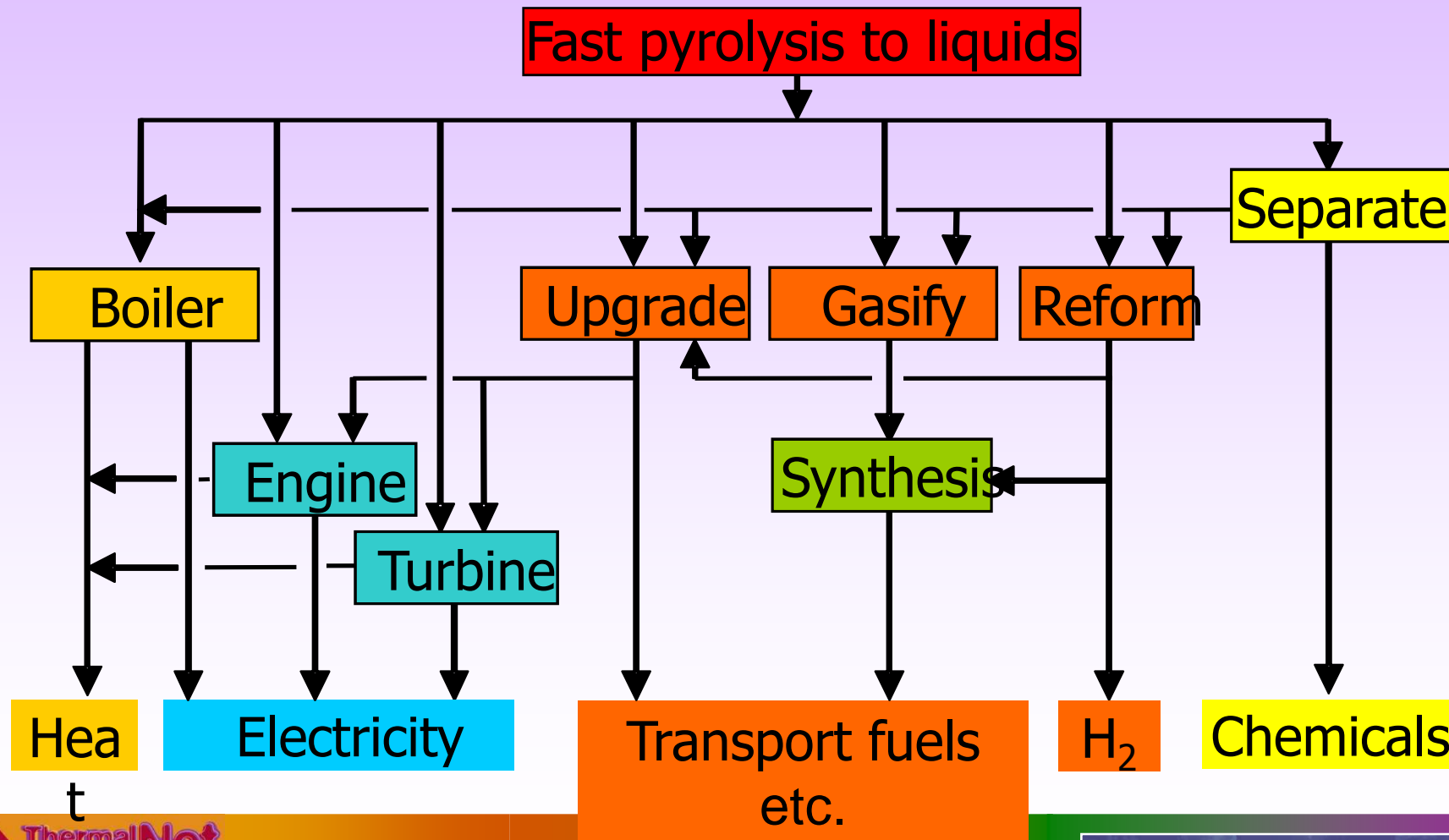
- Low-temperature gasification and co-productio

Scenario		I	IIa	IIb
Thermal input	kW	50 000	50 000	50 000
Net electricity production	kW	5 200	0	2 000
Net electric efficiency	%	10.4	0.0	4.0
Fuel production	t/a	7 900	16 000	14 000
Fuel efficiency	%	27.0	54.0	47.0
Thermal power	kW	18 000	11 800	12 835
Thermal efficiency	%	36.0	23.6	25.7
Total net efficiency	%	73.4	77.6	76.7
Production costs	€ct/l	~0.95	Slightly below 0.95	

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Results

- Role of flash pyrolysis

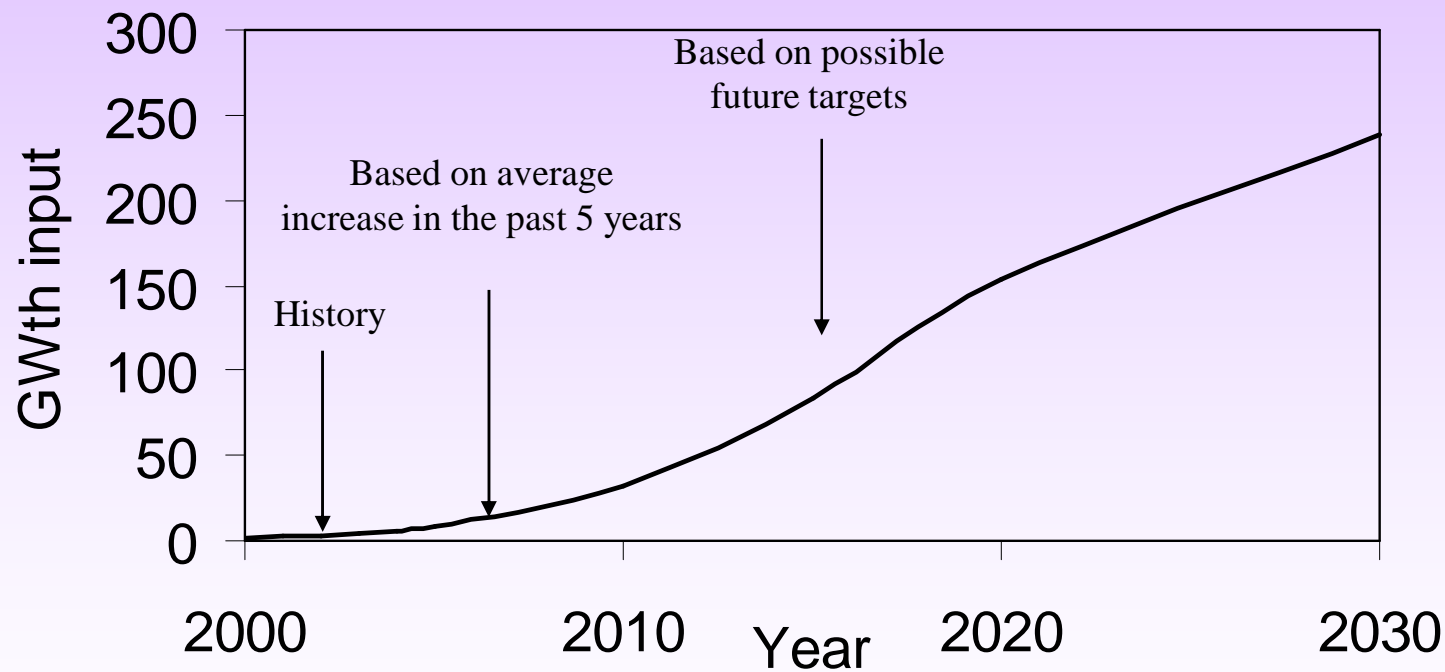


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Results

- Product issues:
 - A number of different transportation fuels can be produced from biomass: new options pop up regularly
 - Requirements from perspective of automotive industry:
 - High energy density
 - Improve the combustion performance in the engine
 - Reliability
 - Also gaseous fuels have to be considered like DME and SNG
 - Important market for the future can be aviation fuels

- Market development:



WP 2G Achievements / Deliverables

- Achievements:
 - 5 workshops on liquid biofuels (Heidelberg, Innsbruck, Lille, Glasgow, Salzburg)
 - Contributions to Thermalnet newsletter
- Deliverables:
 - 2G-1 Report on economy of Biomass-to-Liquids (BTL) plants; An engineering assessment
 - 2G-2 Report on status of and developments in production of 2nd generation liquid biofuels via thermochemical conversion
Incorporated in final report

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Conclusions

- Feedstock issues
 - Future biomass feedstock availability in Europe enough to cover substantial part of transportation fuel consumption
 - Short term waste and residues important
 - Long term energy crops important contribution
 - Important to start transition to energy crop cultivation
 - Major barrier risk for farmers
 - Can be circumvented by co-conversion with coal

- Biofuel production
 - For biomass-to-liquids via synthesis gas different routes under development:
 - Stand alone fuel & high temperature gasification scale
 - Going from 50 MW to 9000 MW capacity reduces production costs by factor 2
 - Co-production system (CHP +fuel) & low temperature
 - Good prospects in the short-term
 - Fast/flash pyrolysis
 - Direct upgrading high H₂ consumption
 - Upgrading of pyrolysis oil fraction interesting new development
 - Use of pyrolysis oil(&char) as feedstock for gasification

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Conclusions

- Product & market issues:
 - New options come up, among them gaseous fuels like synthetic natural gas
 - Requirements of automotive industry crucial:
 - High energy density
 - Performance in the engine
 - Reliability
 - Biofuel market is expected from relative small scale market into a large scale market

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Recommendations

- Instead of debating on the potential of biomass the challenge is to turn the potential into reality
 - Development should focus on maximizing the yield of biomass feedstock
 - Remove the risk barrier for farmers for lignocellulosic energy crops by stimulation and developing alternative outlets for the crops
- The area of liquid fuels from biomass is developing
 - This results in continuous changes in the landscape (market size, type of biomass used, production technologies, new fuel options)
 - The RD&D programm in Europe should take these changes into account.