



# Aktueller Entwicklungsstand und Perspektiven der bioCRACK Pilotanlage in der Raffinerie Schwechat

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# BDI at a glance



Austrian based, highly professional plant engineering and construction company

Tailor-made turn-key solutions

Own biodiesel & biogas technologies  
“from waste to value“

More than 40 reference plants  
on 4 continents, since 1991

Strong in-house r & d  
(5 – 10% of annual revenue)

## Key figures 2013:

Staff: 113 employees

Turnover: € 36 Mio

Equity ratio: 67%

Stock market listed in Frankfurt



# bioCRACK - Concept

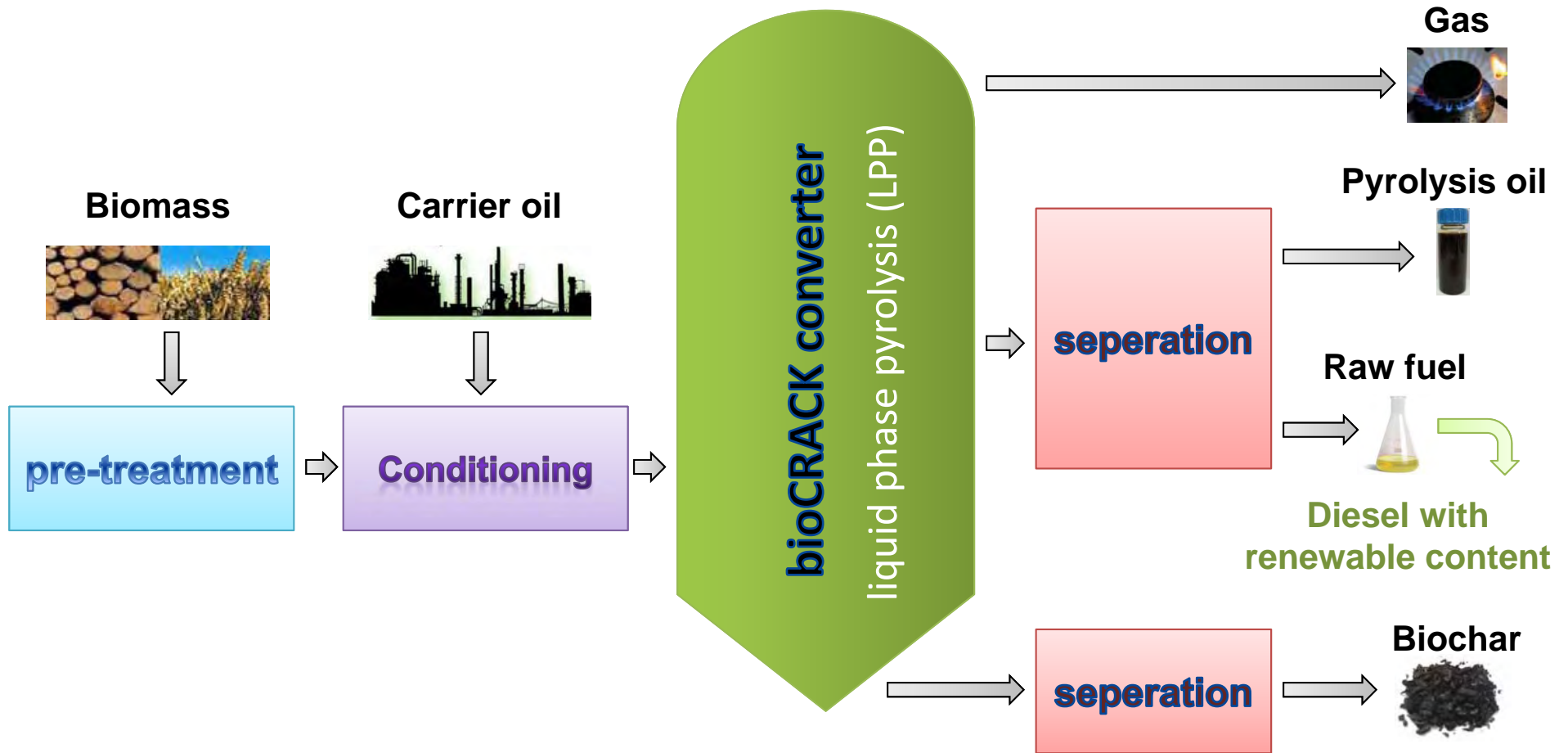


In liquid phase pyrolysis (LPP) a hot liquid is used as heat carrier

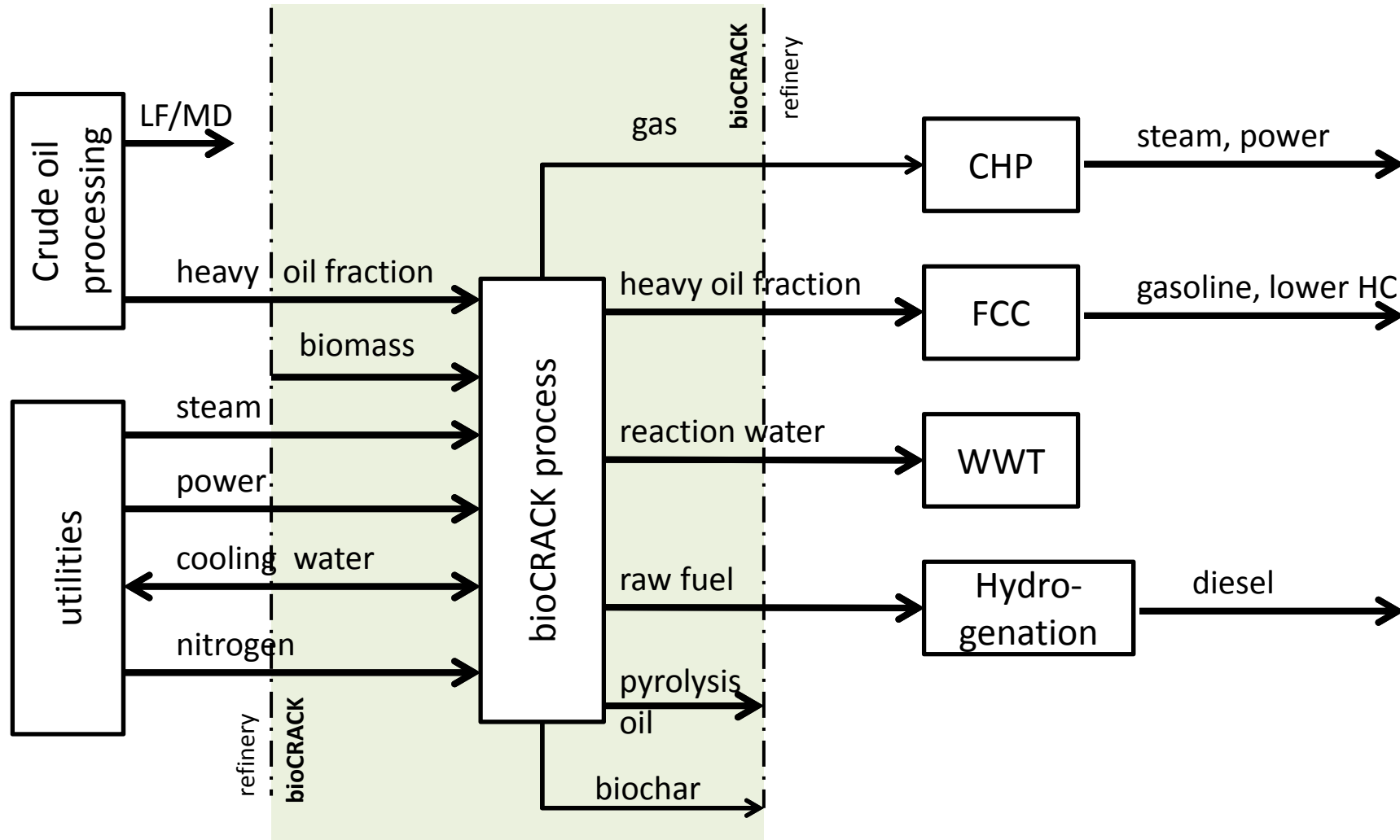
<p><b>Pro:</b></p> <ul style="list-style-type: none"><li>• Moderate process conditions (ambient pressure, temperature &lt;450°C)</li><li>• Compared to other technologies simple concept</li><li>• Heat recovery possible</li><li>• Usage of standard industrial equipment</li><li>• Time to market short</li><li>• Direct conversion from solid biomass to liquid hydrocarbon</li></ul>	<p><b>Contra:</b></p> <ul style="list-style-type: none"><li>• Limitation in maximum temperature</li><li>• Limited conversion from solid to fuel</li><li>• Challenging separation task solid/liquid</li><li>• Utilisation of by-products necessary</li><li>• Cracking of the heat carrier oil</li></ul> <p>↓</p> <p>→ Chance for integrated process in standard refinery</p>
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**To succeed with LPP one need to use a heat carrier oil where cracking is desired!**

# bioCRACK - Process Scheme



# bioCRACK - Refinery Integration

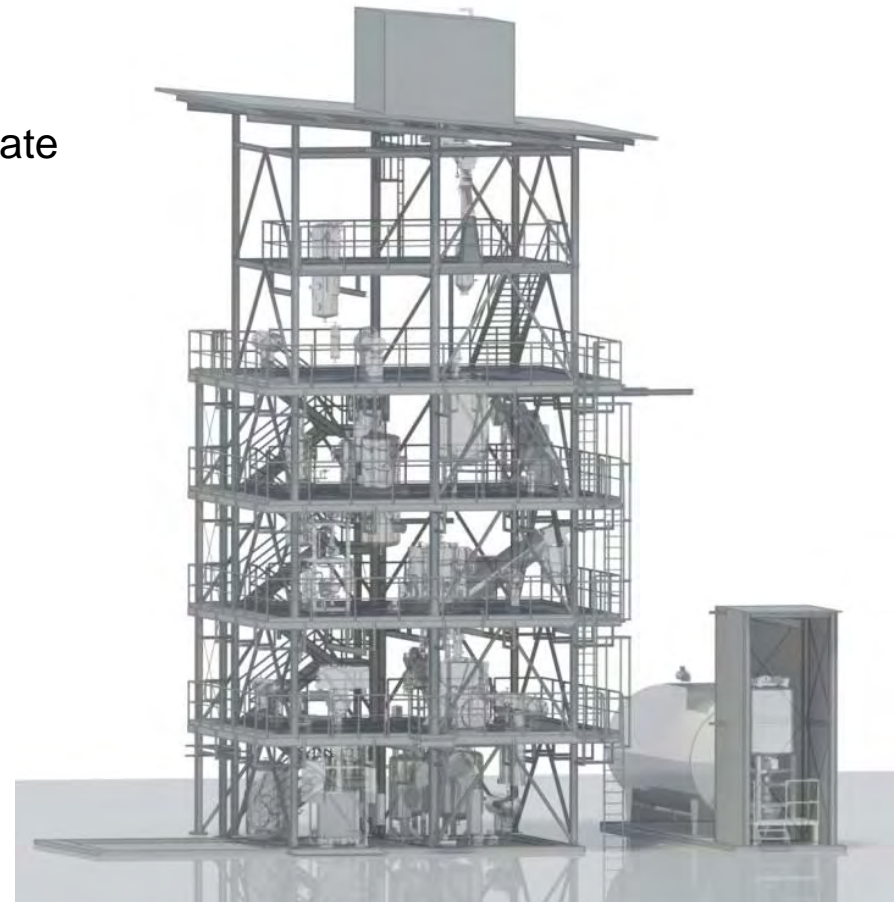


# bioCRACK Pilot Plant



## Facts and figures

- Project duration: April 2010 - 2014
- Project cost: € 7 Mio (Grand by Austrian Climate and Energy Fund: €2,0 Mio.)
- Dimensions: basis: 7,5x7m, height: 21,5m
- Steelwork: 60 tons
- Pipes: >2.000 m
- I/O: > 700
- Engineering demand: ~ 17.000 hours
- Feed capacity: 100 kg/h biomass and 1000 kg/h heavy oil
- Pressure: atmospheric
- Temperature: up to 400°C



# bioCRACK Pilot Plant



Integrated pilot plant at the OMV refinery Schwechat/Austria



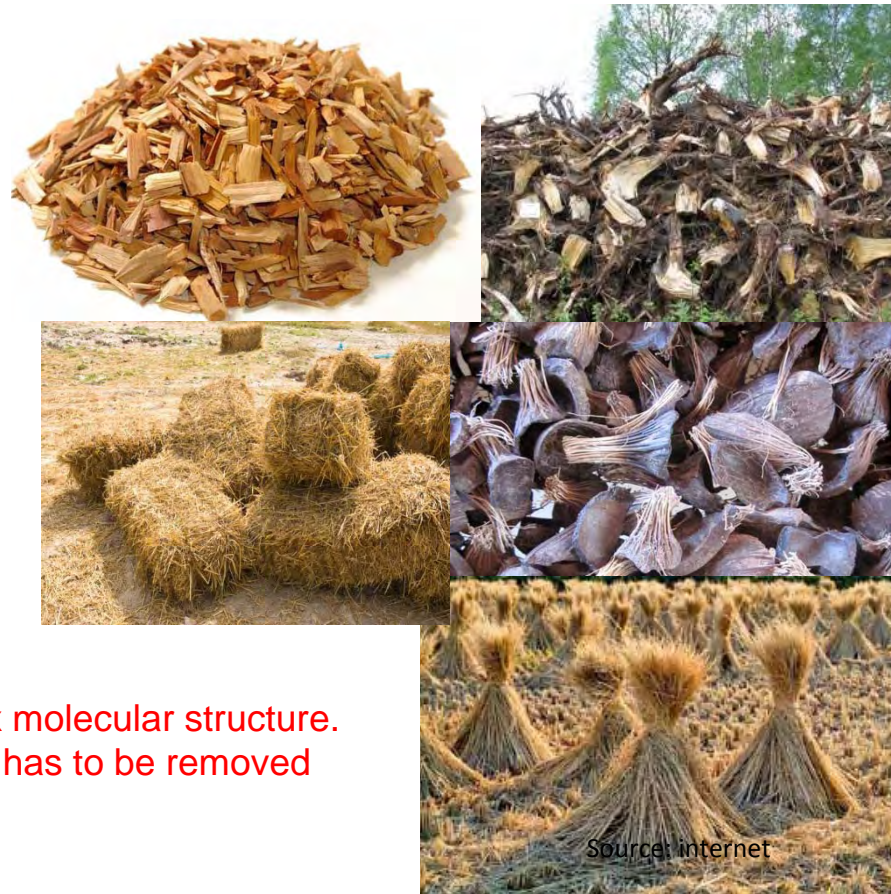
# bioCRACK - Feedstock

## Ideal biomass for bioCRACK is renewable lignocelluloses

- + Low water content
- + Low nitrogen, chlorine, toxics
- + Fine particle size (<5mm) possible

### Examples:

- Wood chips (soft and hard wood)
- Forestry residues
- Chopped straw/agricultural residue
- .....



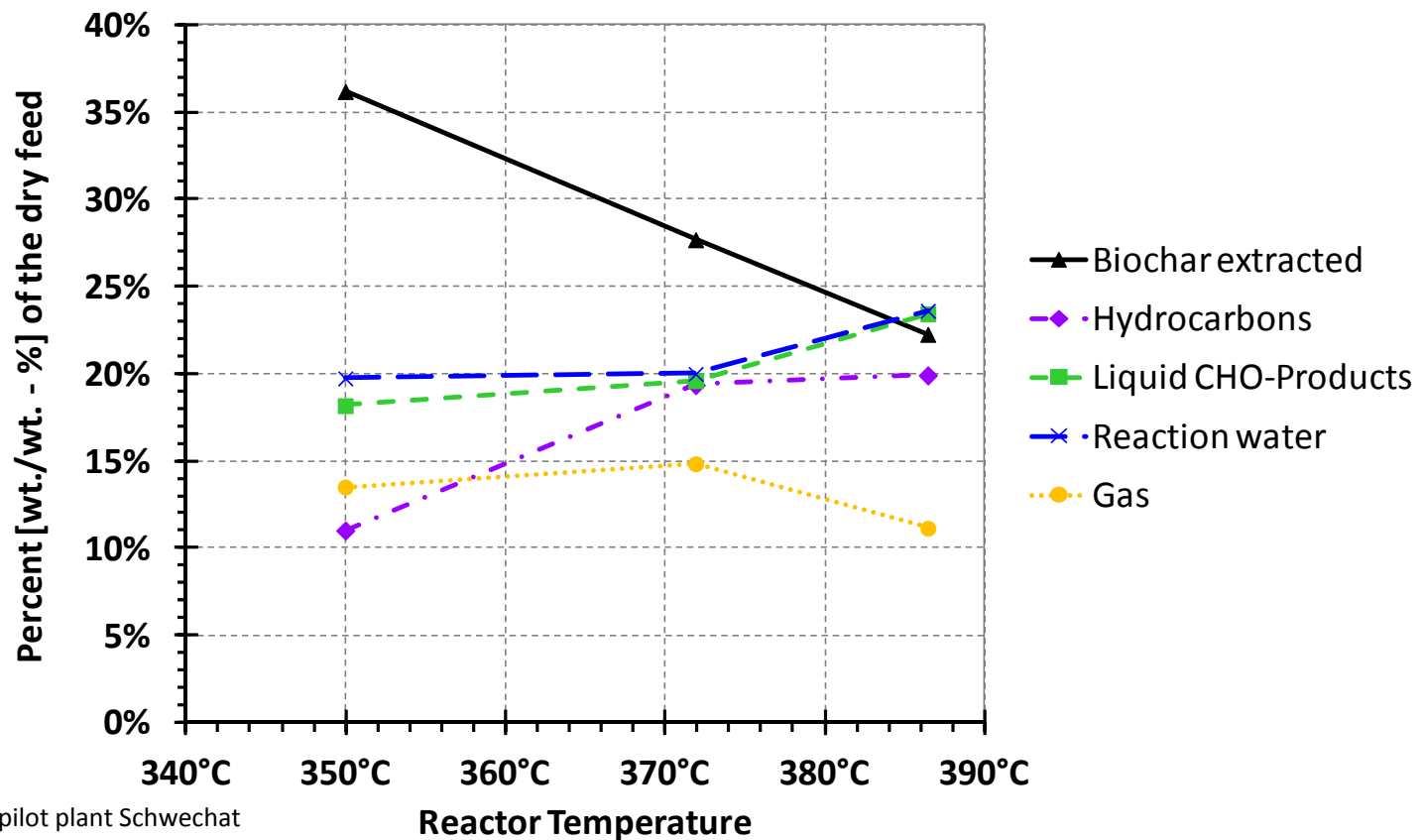
Biomass contains up to 50% oxygen in complex molecular structure. Oxygen is unwanted element in liquid fuels and has to be removed to reach requested fuel quality!



# bioCRACK - Biomass Conversion



## Mass-conversion of biomass vs. temperature



Results from bioCRACK pilot plant Schwechat  
Feedstock: spruce

# bioCRACK - Diesel Fuel



## Upgrading of raw diesel to EN590 quality is possible

Parameter	Untreated raw diesel	After hydro treatment	EN 590
Density (15°C)	868 kg/m <sup>3</sup>	833 kg/m <sup>3</sup>	820 - 845 kg/m <sup>3</sup>
Viscosity (40°C)	2,53 mm <sup>2</sup> /s	n.a.	2 - 4,5 mm <sup>2</sup> /s
Cetan	44	53	> 51
C/H/O	85/13/2 wt.%	86/14/0 wt.%	n.a.
Volatile <350°C	83 wt.%	86 wt.%	> 85 % (v/v)
Sulfur	177 mg/kg	3 mg/kg	< 10 mg/kg

Results from bioCRACK pilot plant and hydrogenation at OMV/Schwechat  
Feedstock: spruce

# bioCRACK - Biochar



## Analysis of biomass (spruce) and biochar

		Biomass (spruce)	Biochar
Carbon	[wt.%]	50	81
Hydrogen	[wt.%]	6.3	5.4
Nitrogen	[wt.%]	0.0	0.3
Rest (Oxygen + Ash)	[wt.%]	44.2	13.4



- Utilisation:
- ✓ Renewable solid fuel for combustion
  - ✓ Additive in steel industry, construction material,....
  - ✓ Fertilizer and carbon sink
  - ✓ Further upgrading to transportation fuel

# bioCRACK - Pyrolysis Oil



## Dehydration of bioCRACK pyrolysis oil is possible

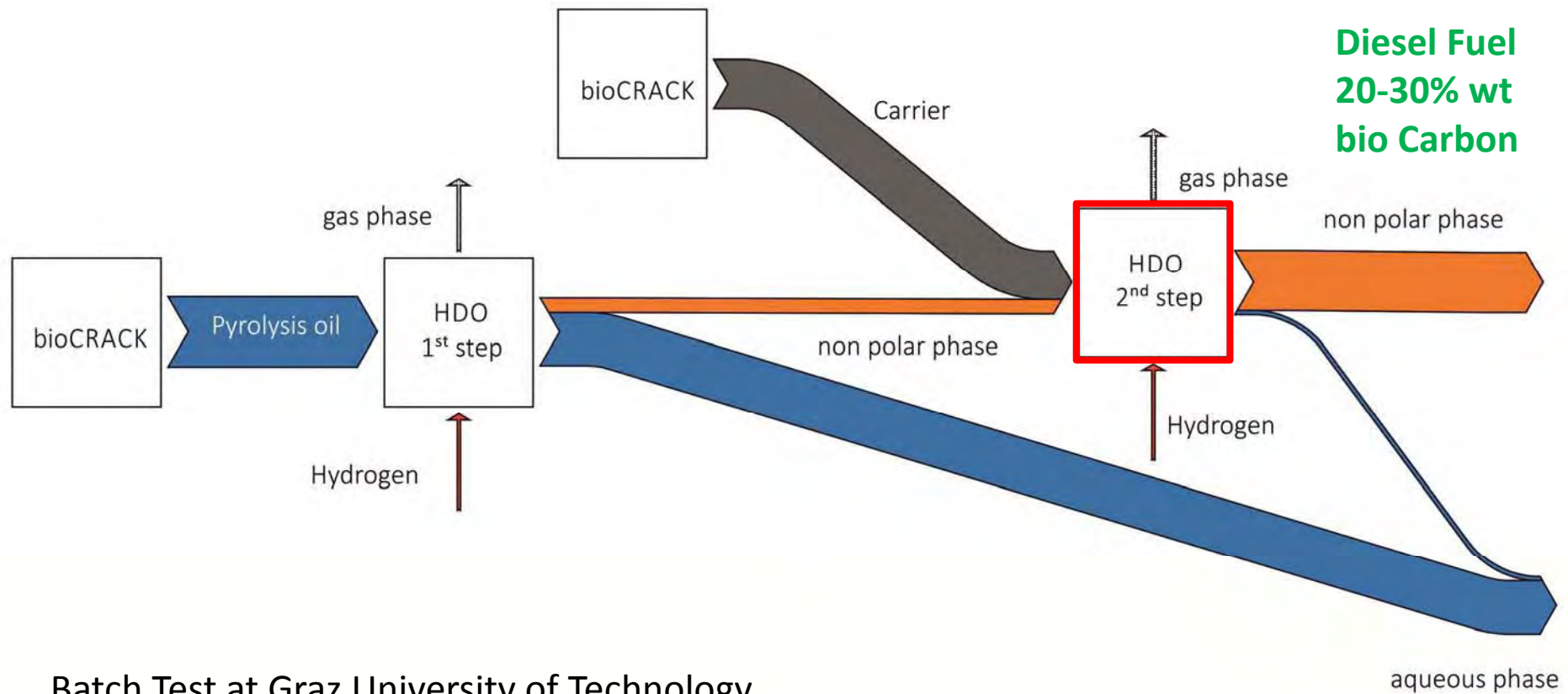
		Pyrolysis Oil	Pyrolysis Oil dehydrated	Crude Oil <sup>1</sup>
Water Content	[wt.%]	50	8	0.1
Lower Calorific Value	[kJ/kg]	8700	29000	43100
Carbon	[wt.%]	22	72	83 - 86
Hydrogen	[wt.%]	10	9	11 - 14
Oxygen	[wt.%]	68	19	<1
Nitrogen	[wt.%]	<1	<1	<1

- Utilisation:
- ✓ Renewable liquid fuel for combustion
  - ✓ Source for chemicals
  - ✓ Further upgrading to transportation fuel

<sup>1</sup>Mortensen et al., Applied Catalysis A: General, 407 (2011)

# R&D – HDO of Pyrolysis Oil

## bioBOOST Hydro-Deoxygenation of bioCRACK pyrolysis oil



Batch Test at Graz University of Technology

# R&D – Properties HDO Pyrolysis Oil

	unit	Feed	HDO 1 <sup>st</sup> step	HDO 2 <sup>nd</sup> step	Diesel
Water content	[wt.%]	50	11	0.2	0.02
LHV	[MJ/kg]	8.7	26.4	41.2	42.5
Density	[kg/m <sup>3</sup> ]	1070	1100	870	845
Viscosity	[mPa s]	4	163	4.5	4.5
Carbon content	[wt.%]	25.6	62.5	85.5	85.9
C14 content	[wt.%]	100	100	28	<7
Hydrogen	[wt.%]	9.2	8.3	12.1	13.3
Oxygen	[wt.%]	64.9	28.7	1.9	<1
Nitrogen	[wt.%]	<1	<1	<1	<1

# bioCRACK Status and Outlook

## Ongoing FFG Project ScaleUp:

- Completion of test phase in Sept 2014
- Ongoing engineering for Up-scaling to demonstration plant
- Elaboration of the GHG-saving potential (Joanneum Research)
- Economic assessment in cooperation with OMV
- Continued Research Project „bioBOOST“:HDO of bioCRACK pyrolysis oil in cooperation with TUG



# bioCRACK Partners



BDI – BioEnergy International AG



OMV Refining and Marketing GmbH



Institute of Chemical Engineering and Environmental  
Technology

Prof. Dr. M. Siebenhofer



Austrian Climate & Energy Fund  
“New Energies 2020”



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# from waste energy

