

DAIMLERCHRYSLER

Experiences with the Use of Synthetic Fuels

2nd International BTL Congress 2006, 12-13 October 2006, Berlin
Dr. Stefan Keppeler

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Content

- Challenges for Future Propulsion Systems
- Recent Improvements in Diesel Engine Technology
- Contribution of Synthetic Fuels for low CO₂ and emission reduction
- Synthetic Fuels Roadmap
- Conclusions

Content



- **Challenges for Future Propulsion Systems**
- **Recent Improvements in Diesel Engine Technology**
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- **Synthetic Fuels Roadmap**
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Requirements for Future Propulsion Technology



Customer Demand and Regulations

Legislation

Environmental Compatibility

- Emissions
- Fuel Consumption
- Noise and Recycling

Customer Demand

Sportive

- Power and Torque
- Vehicle Response





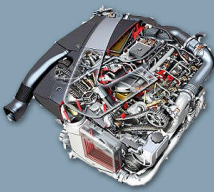

High Quality

- Durability
- Reliability
- Smoothness

Economic

- Purchase price
- Maintenance cost
- Long service interval

Continuous improvement of conventional combustion engines

	Diesel Engines	Gasoline Engines
Consumption		
Emissions		
		
GOAL	Petrol cars - as efficient as diesels Diesel cars - as clean as petrol cars	

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Three steps towards the cleanest diesel in the world



Reduction of nitrogen oxide levels up to 80 percent

optimization of the engines and combustion processes, clean fuels



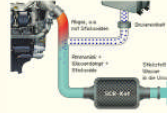
minimize untreated emissions

oxidizing catalytic converter, particulate filter



minimize emissions of carbon monoxide, unburned hydrocarbons and particulate matter

BLUETEC technology

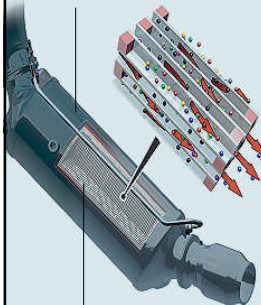


reduces nitrogen oxide levels up to 80 percent

BLUETEC – Diesel Technology: AdBlue injection

Modular Concept BLUETEC

Oxidising catalytic converter



Particulate filter

BLUETEC

AdBlue metering valve

SCR catalytic converter



Actros



Vision GL 320 BLUETEC

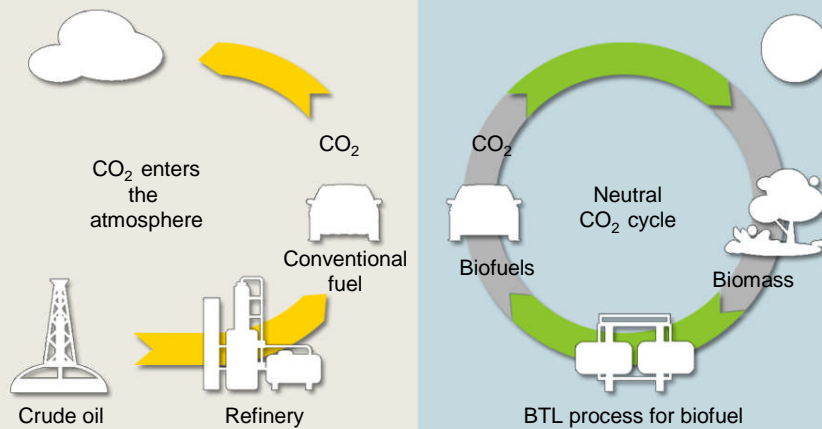
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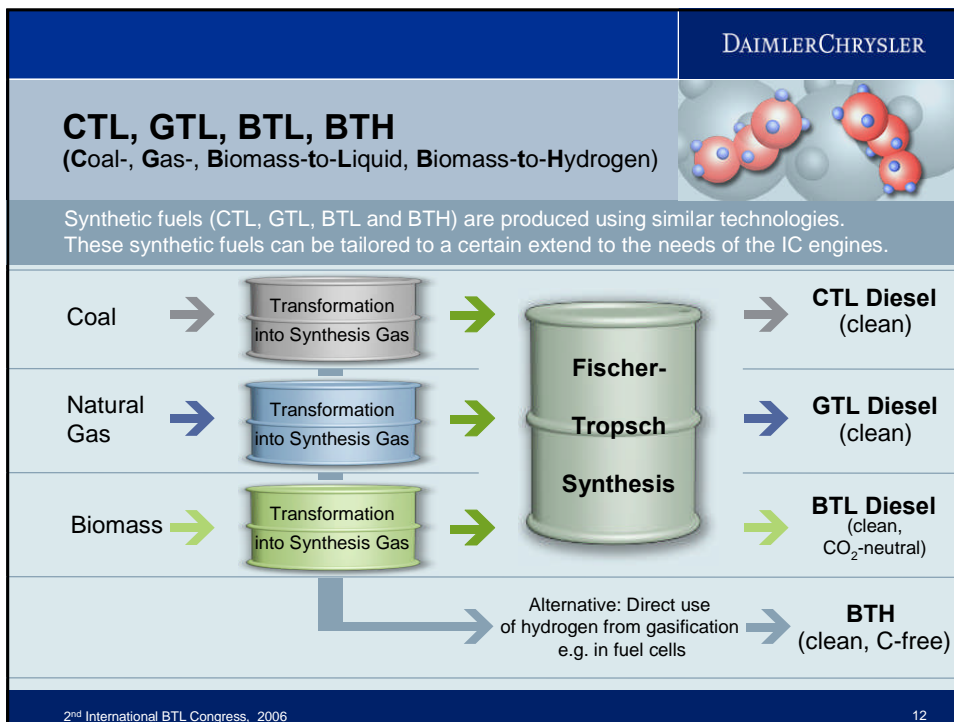
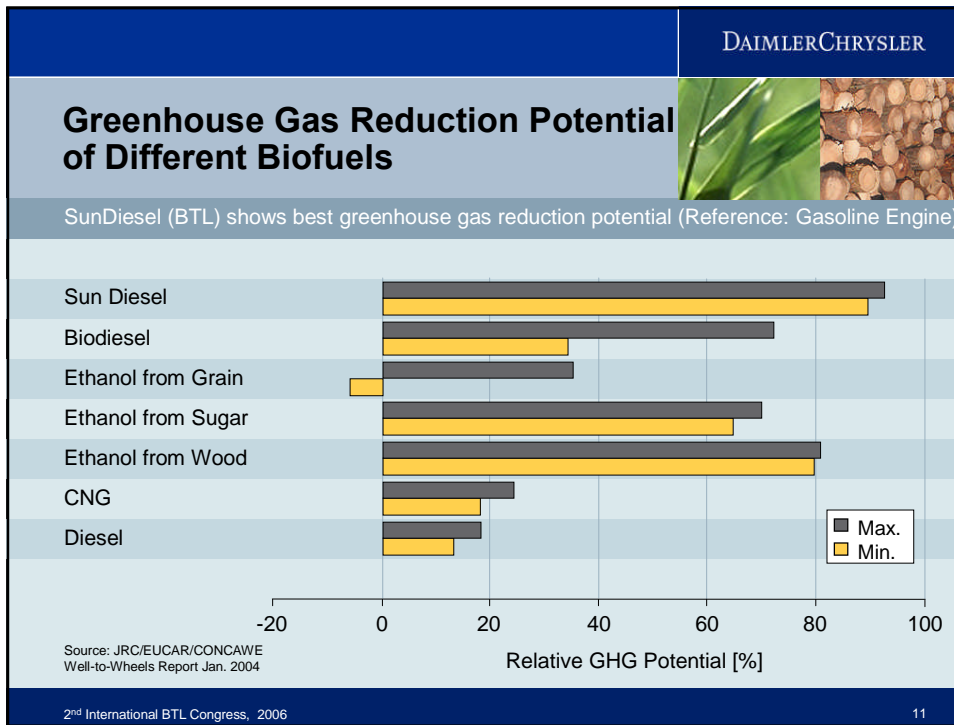
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Fuels from Renewable Resources GHG Balance

Fossil Fuel

Fuel from Renewable Resources





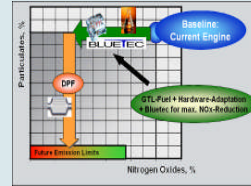
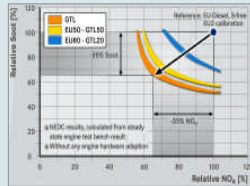
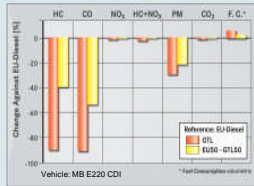
Diesel Passenger Car GTL Utilization Scenarios



w/o Engine Modifications

Only Softwareadaptation

Software- and
Hardware-Adaptation

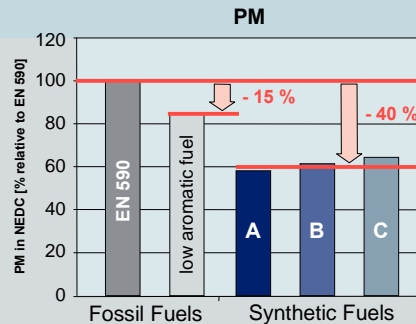
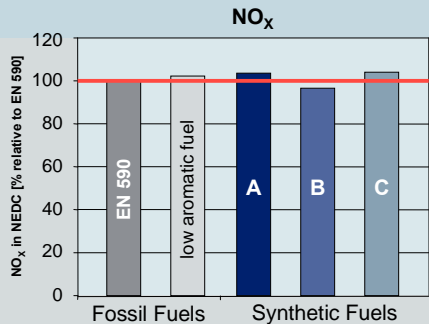


+	<ul style="list-style-type: none"> HC ↓ CO ↓ PM ↓ 	<ul style="list-style-type: none"> HC, CO ↓ NO_x ↓ PM ↓ 	<ul style="list-style-type: none"> HC, CO, NO_x, PM ↓ No power loss Lower cost (Aftertreatment)
-	<ul style="list-style-type: none"> Limited NO_x-reduction Reduced Power Higher vol. FC 	<ul style="list-style-type: none"> Emission limits still be fulfilled with fossil Diesel Higher vol. FC 	<ul style="list-style-type: none"> Dedicated engine Requires new standard to utilize full potential

NEDC Vehicle Testing applying Synthetic Diesel Fuels



Vehicle: E class 220 CDI (Euro4) → no changes in software of ECU
 Engine: OM 646, 4 cyl., 2.2 L, CR → no changes of engine hardware
 EGA: Oxidation Catalyst → DPF removed for measuring PM raw emission



similar NO_x emission for all fuels

significant reduction of PM raw emission when using synthetic fuels

Impact of GTL Diesel on Engine Performance and Emissions



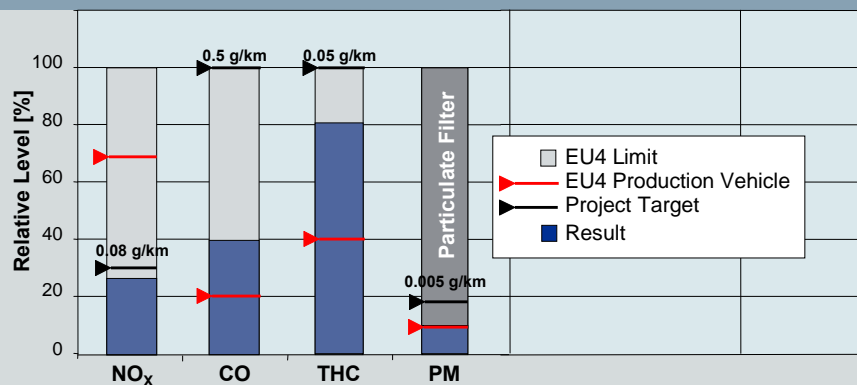
Vehicle Data:

Designation	Mercedes-Benz E 320 CDI
Engine	Mercedes-Benz OM 642
Model Year	2005
Gearbox	7-speed automatic transmission
Emission status	EU 4 (baseline)
Emission test cycle	New European Driving Cycle NEDC 2000
Vehicle Weight Class	4000 lbs

Impact of GTL Diesel on Engine Performance and Emissions: Test Results



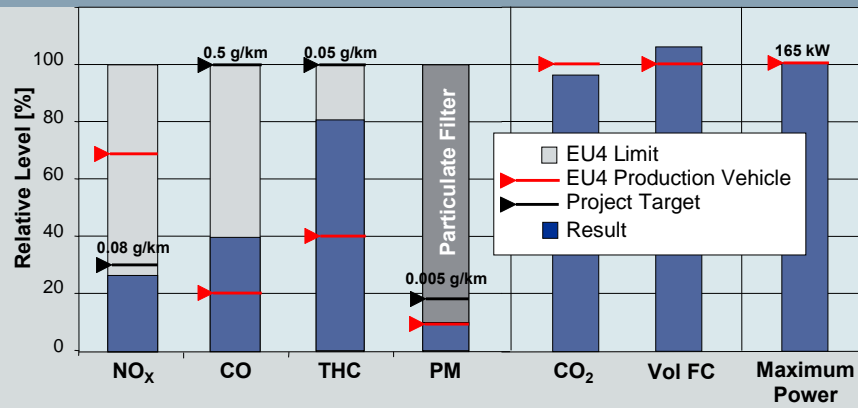
Exhaust Emissions



Impact of GTL Diesel on Engine Performance and Emissions: Test Results



Exhaust Emissions Fuel Consumption

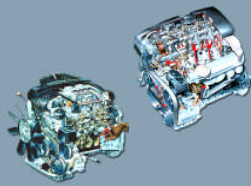
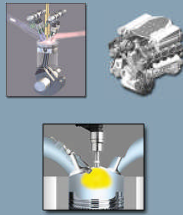
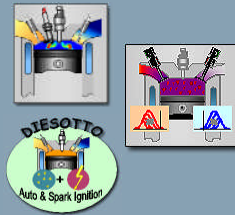


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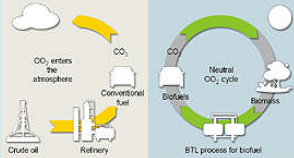



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Future Engine Concepts Require Adapted Fuels

Today	Tomorrow (2010)	Future (2015 ... 2020)
<p>Gasoline and Diesel Engines</p> 	<p>Advanced Gasoline and Diesel Engines</p> 	<p>New Engine Concepts</p> 
<p>Clean Conventional Fuels (Required for Particulate- and NO_x-Aftertreatment Systems)</p>	<p>Blends With Synthetic Fuels (Limited effect on in-cylinder emission reduction)</p>	<p>Dedicated Synthetic Fuels (Potential enabler for new engine concepts)</p>

Advantages of Synthetic Fuels

<p>1</p> <p>Potential reduction of local air quality in unmodified engines (short term option)</p> <p>➤ Utilization in fleet application (e.g. City fuel)</p>	
<p>2</p> <p>Reduction potential of global CO₂ emissions, if biomass is used as feedstock for synthetic fuel (BTL)</p> <p>➤ Reduction potential proportional to blending ratio</p>	
<p>3</p> <p>Reduction potential of local air quality in dedicated engines (long term option)</p> <p>➤ Depends on widespread availability and price of synthetic fuels</p>	

Conclusions

Synthetic fuels represent a promising alternative for future mobility

Based upon natural gas (or coal), synthetic fuels can reduce local emissions. Additional developments are necessary to further reduce WTW-Greenhouse-gas-emissions

If based upon biomass, they offer highest CO₂-reduction potential combined with low local emissions

Synthetic fuels will initially be used as blending components



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21

