

BTL – High Yield, Low CO₂, Second Generation Biofuel

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Disclaimer



Certain statements that are included in this presentation are forward-looking in nature.

There are associated risks and uncertainties inherent in such statements and actual results may differ materially from those expressed or implied by the forward-looking statements.

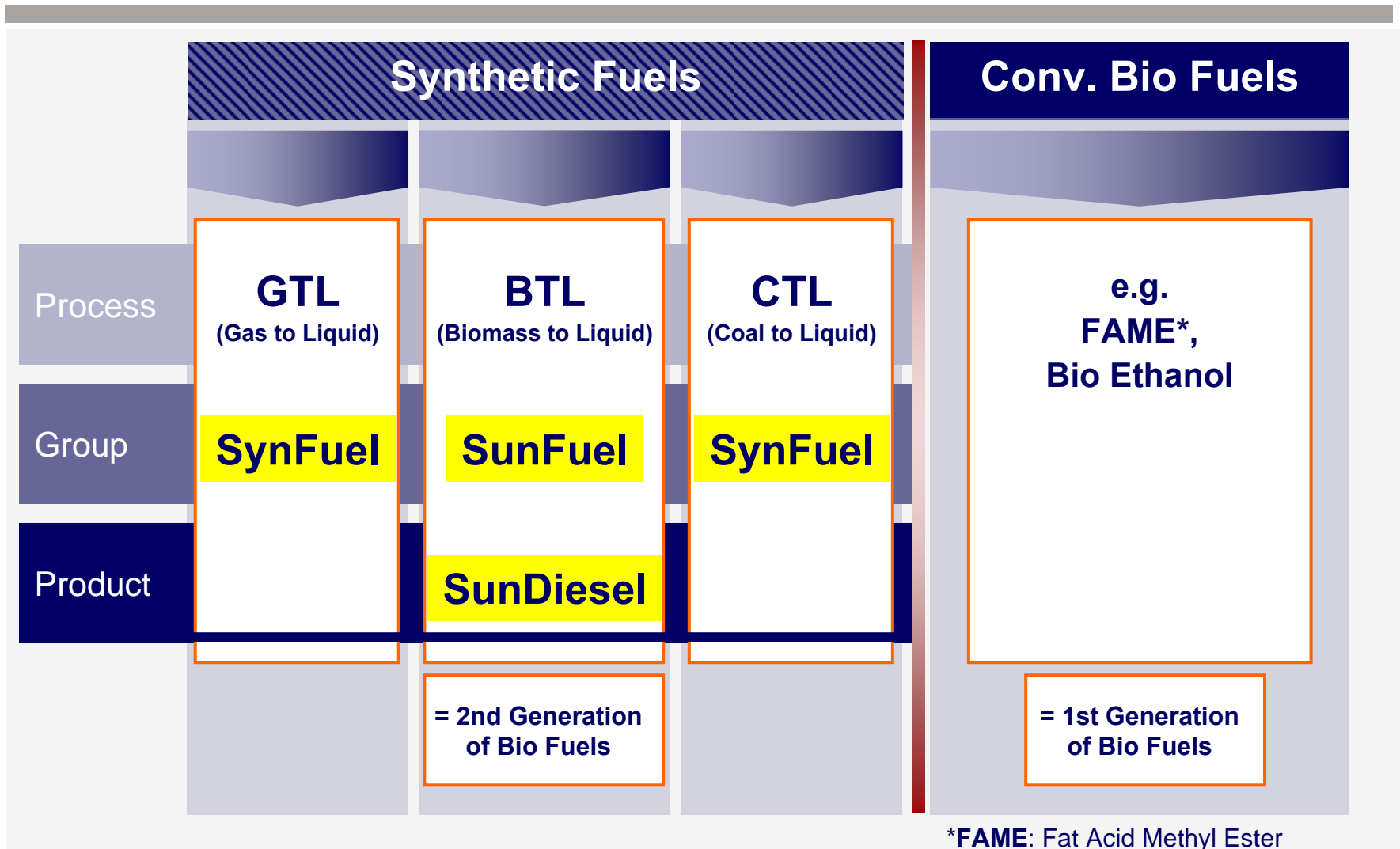
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Biofuels contribution to different targets

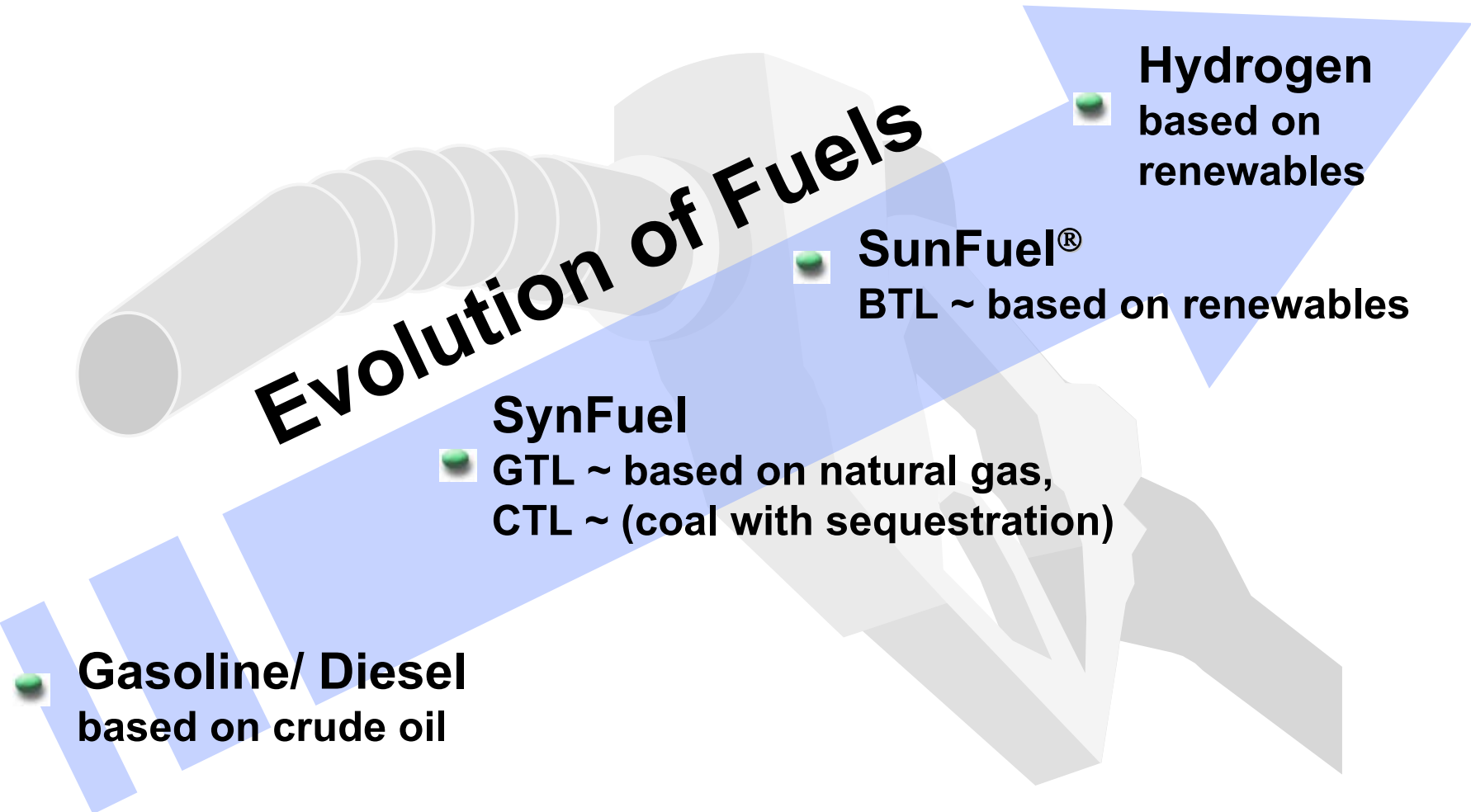


Biofuel	CO ₂ -Reduction	Energy Security	Agricultural Benefits	Target fuel / blend	Fuel Performance	Substitution Potential >10%
Plant Oil	☹️	☹️	☹️	Diesel	☹️	☹️
FAME	☹️	☹️	☹️	Diesel	☹️	☹️
Conv. Ethanol	☹️	☹️	☹️	Gasoline	☹️	☹️
Bioethanol (2°)	😊	😊	😊	Gasoline	☹️	😊
BTL (2°)	😊	😊	😊	Diesel	😊	😊

2nd Generation Bio Fuels



*FAME: Fat Acid Methyl Ester



Evolution of Fuels

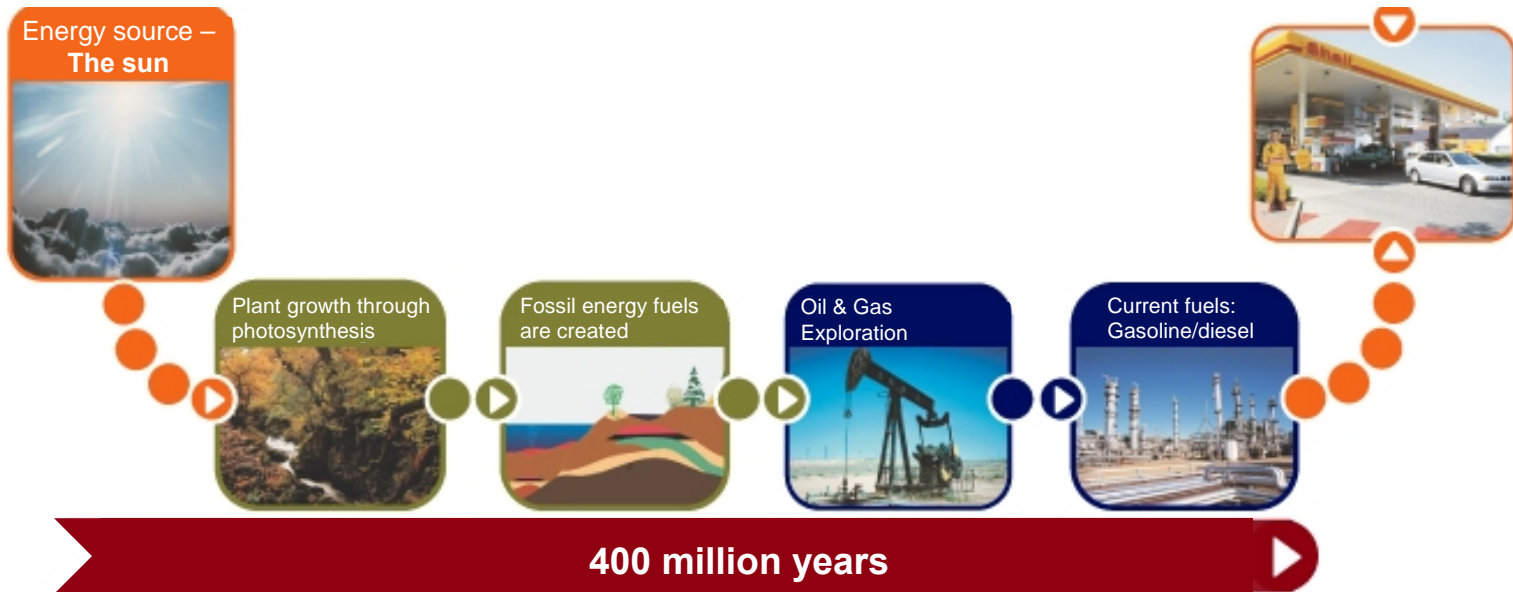
■ **Gasoline/ Diesel**
based on crude oil

■ **SynFuel**
GTL ~ based on natural gas,
CTL ~ (coal with sequestration)

■ **SunFuel®**
BTL ~ based on renewables

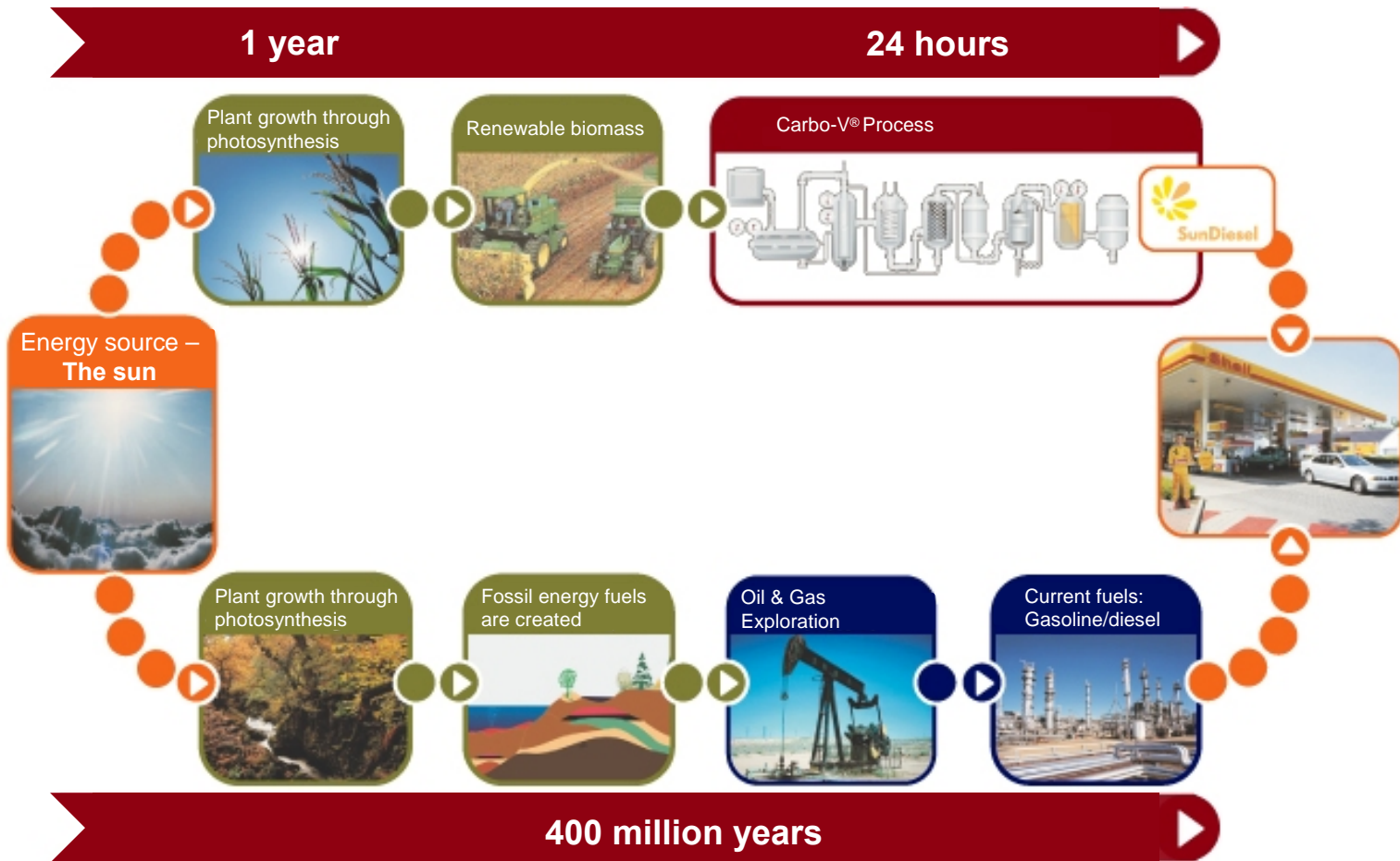
■ **Hydrogen**
based on
renewables

Comparison of Energy Cycles



Comparison of Energy Cycles

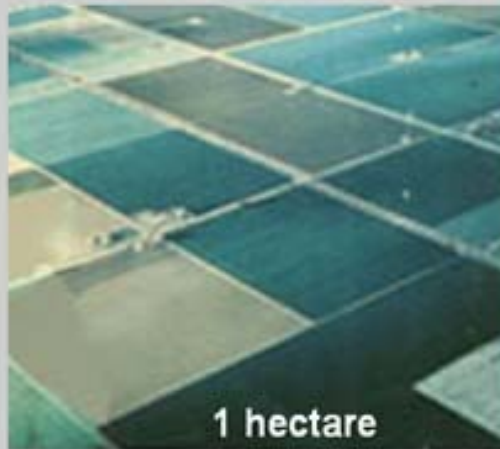
Following Nature's example – but much faster!



Liquid Biofuels

Already today, SunFuel has highest per acre yield (3x with 6x potential)

litres per year and hectare



2,500 l/ (ha/a) diesel equivalent



4,046 l/ (ha/a) diesel equivalent



1,300 l/ (ha/a) diesel equivalent



1,300 l/ (ha/a) diesel equivalent

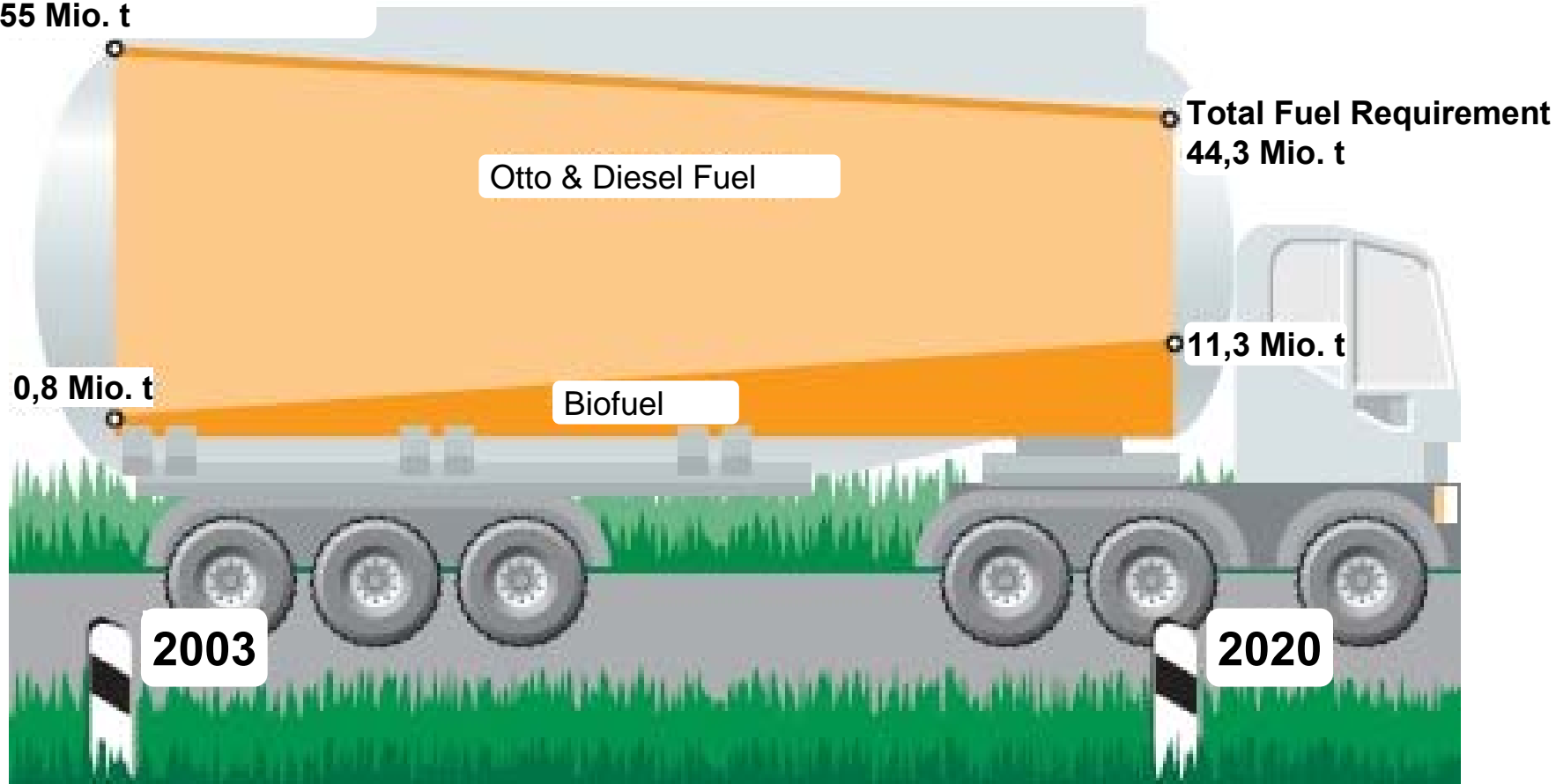
Source: FNR (Fachagentur Nachwachsende Rohstoffe, Germany)

Biofuel Potential in Germany

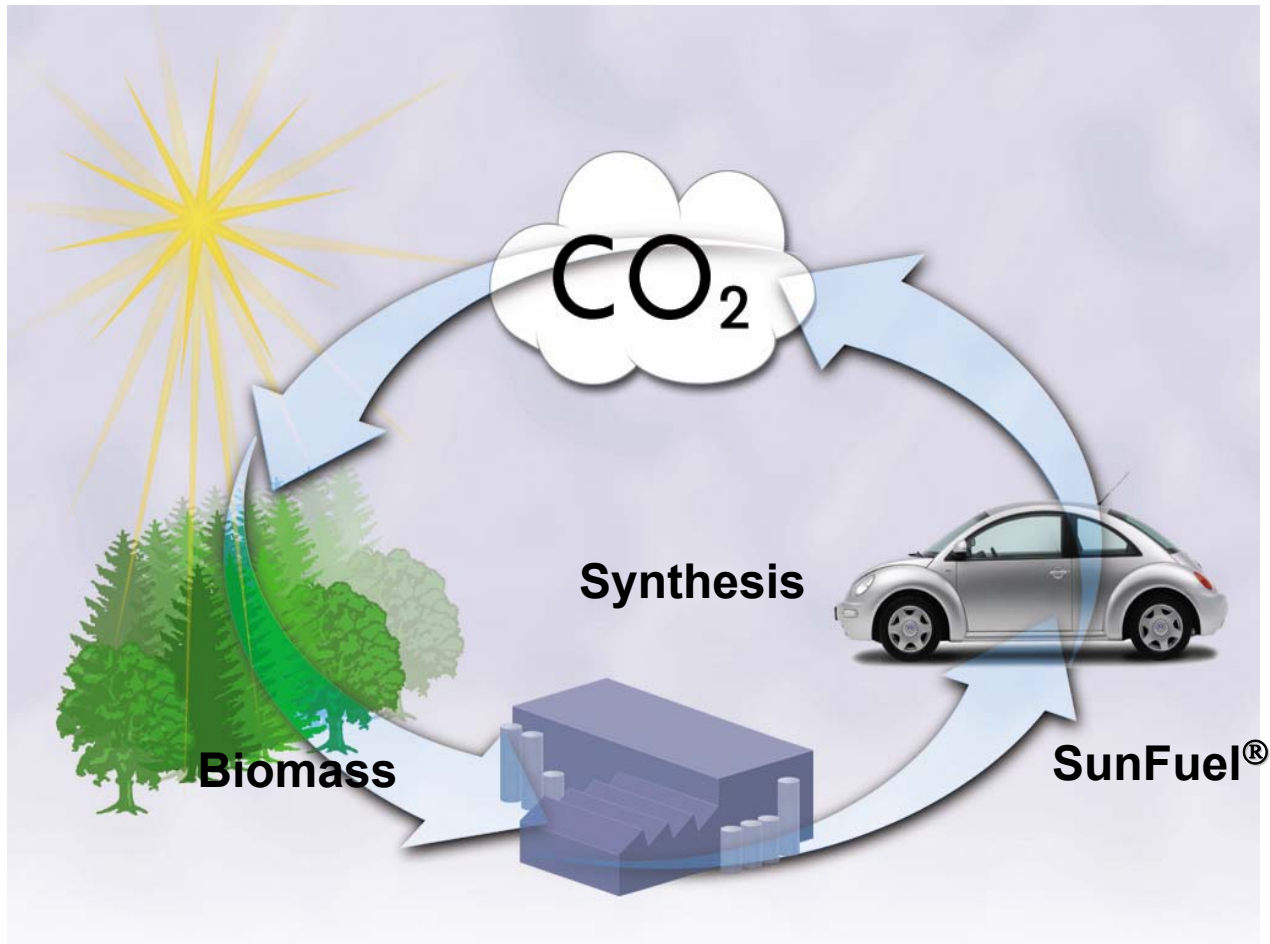
Biofuel Content in the Years 2003 and 2020

Total Fuel Requirement

55 Mio. t



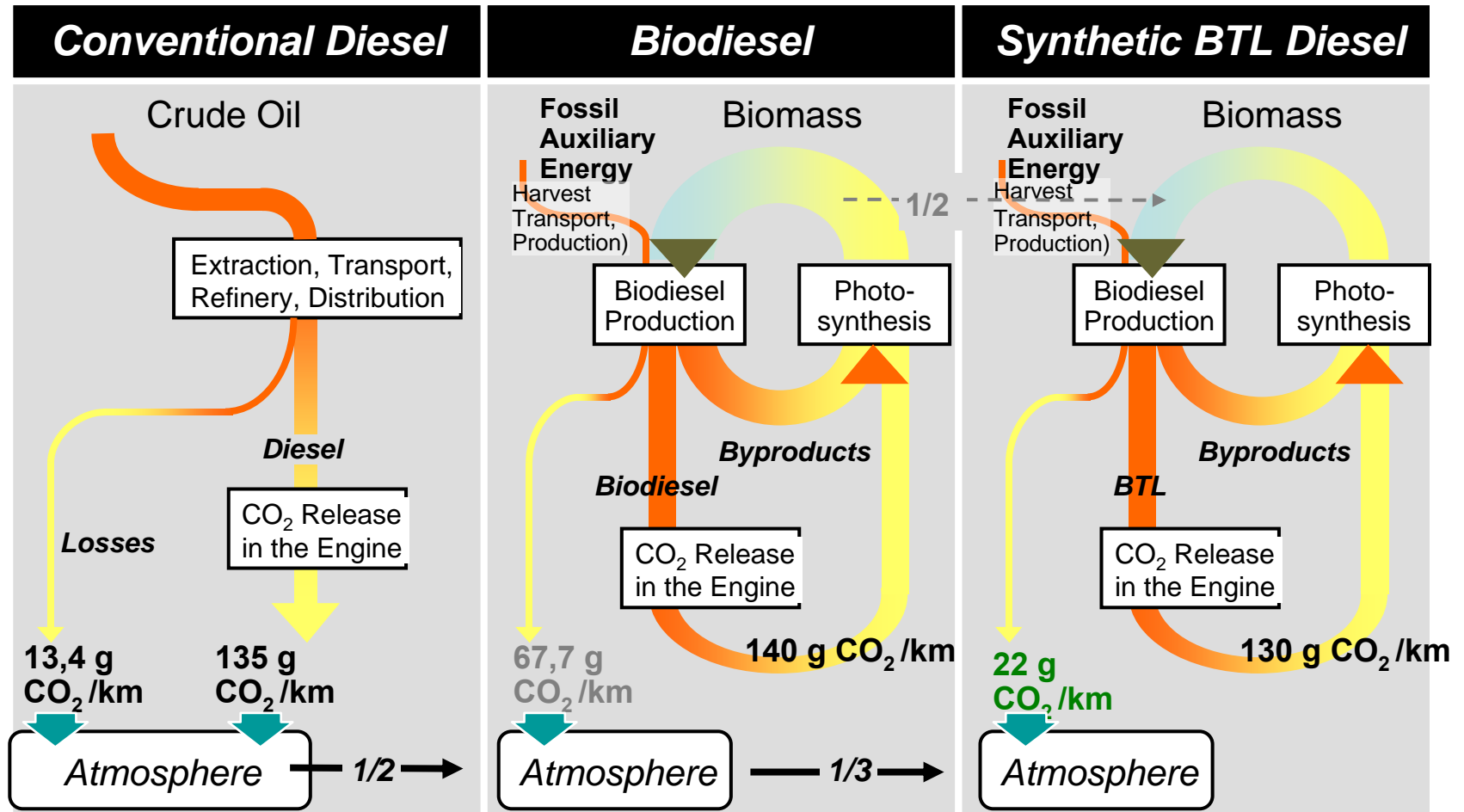
CO₂ cycle with SunFuel®



CO₂ cycle with SunFuel®



CO₂ Emissions, Compact Car, 1.9 L, NEDC



Source: R.R. Maly, DC & H. Heinrich, VW: View on Biofuels as Road Fuels; DOE Combustion and Fuels Meeting; Washington, March 17, 2004; DC Krahl Mobil oil

“Environmentally Friendly Fuel”



Molecular Structures

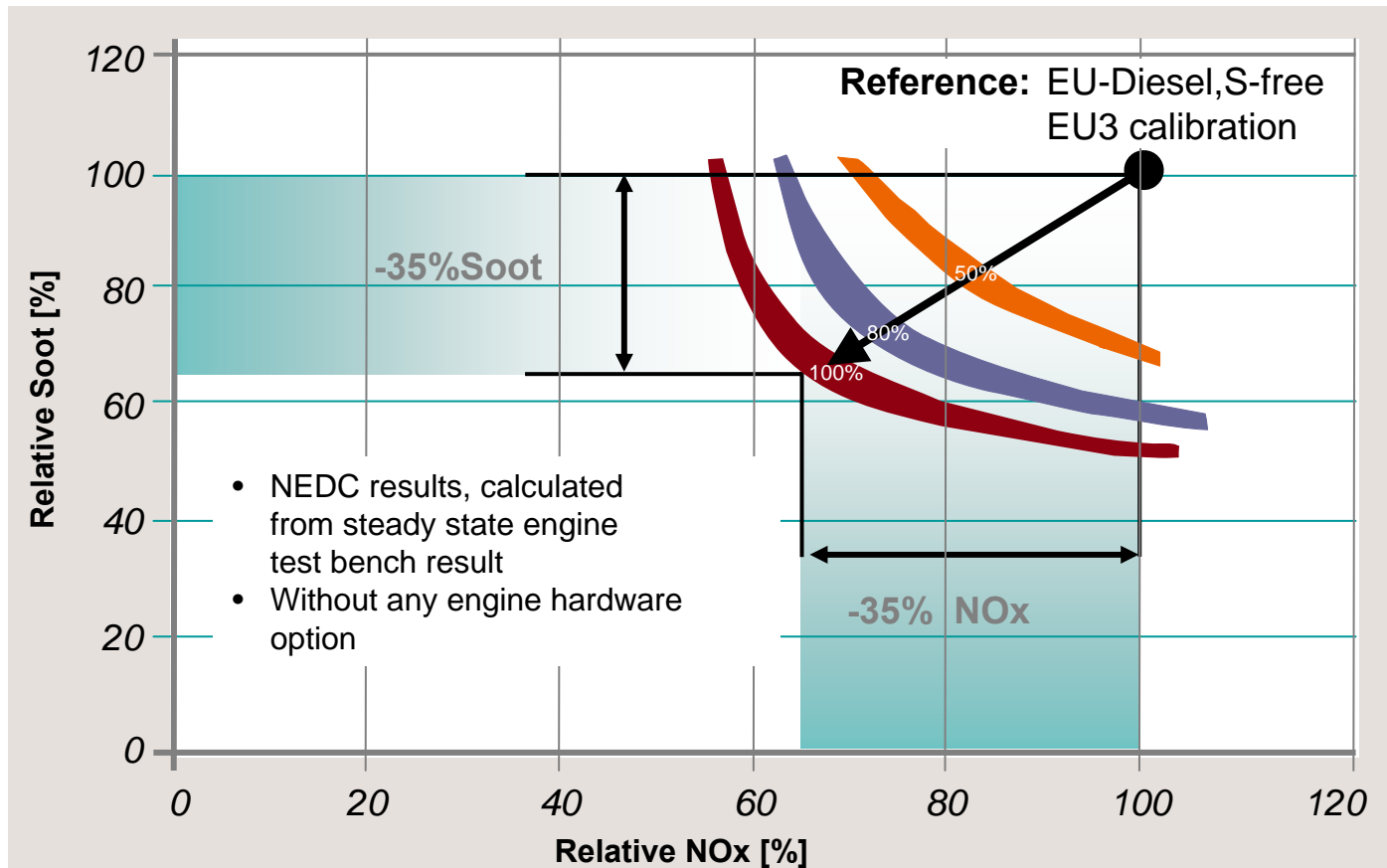


Distilled (150°C – 270°C) & without hydro-treatment

	SunDiesel®
N - paraffins, % wt	77.3
Iso paraffins, % wt	6.9
Olefins, % wt	12.9
Naphthenes, % wt	0
Mono Aromatics, % wt	0.1
Di Aromatics, % wt	0
Poly Aromatics, % wt	0
Alcohols C4-C16, terminal, % wt	2.1
Alcohols C5-C17, branched, % wt	0.4
Aldehydes C5-C17, % wt	0.1
Ketones C5-C17, % wt	0.3

NO_x- Soot Trade-Off

GTL (BTL) blending effects



Source: DaimlerChrysler

EU80-GTL20

EU50-GTL50

GTL

SunDiesel® ~ Clean Combustion

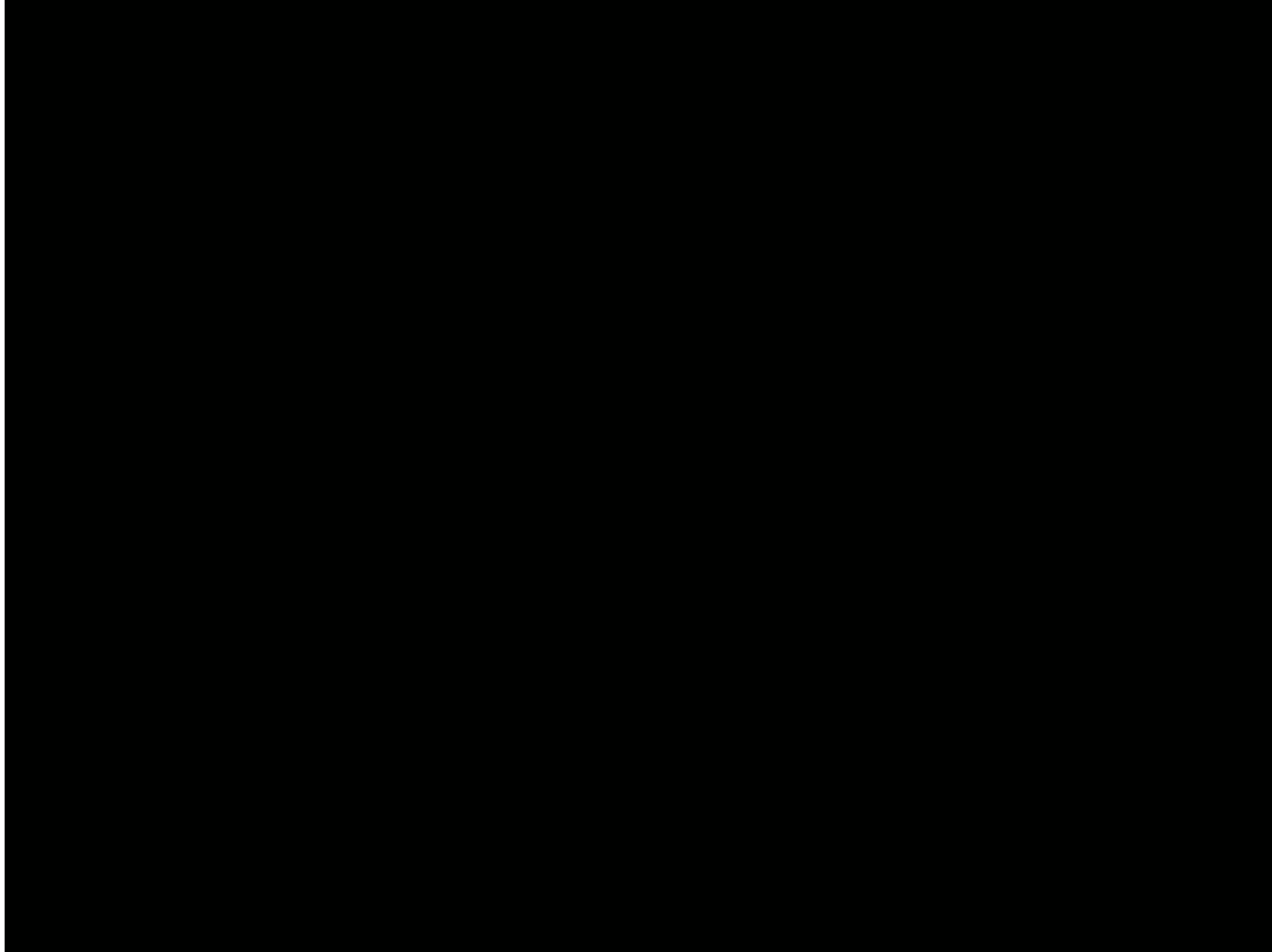


Conventional Diesel



SunDiesel
made by CHOREN

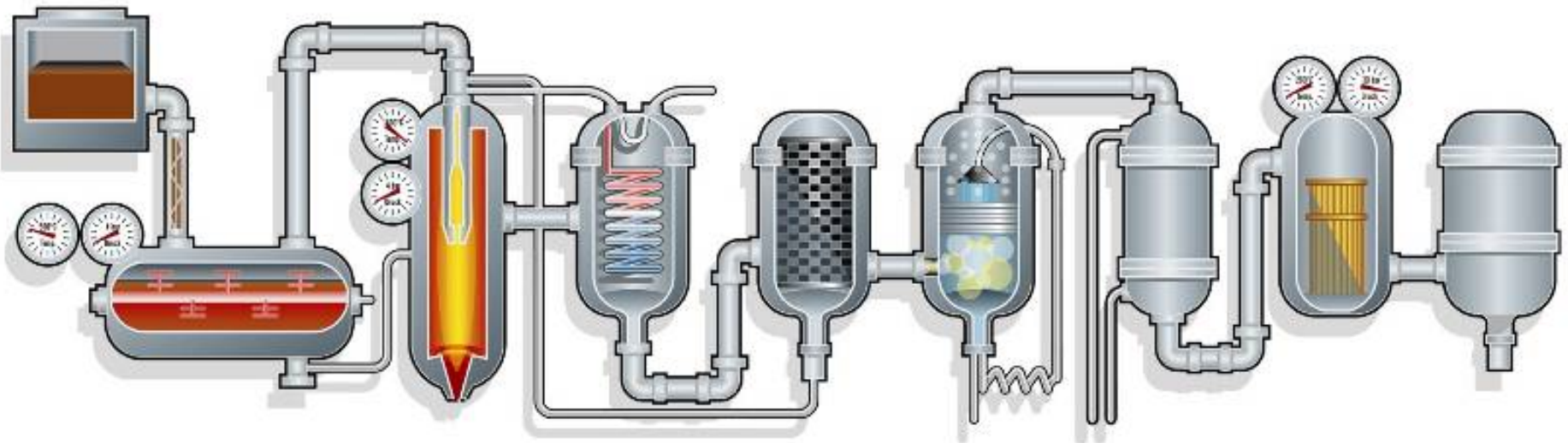
SunDiesel® – made by CHOREN



Prof. Dr. Herbert Kohler - DaimlerChrysler AG

- ▶ **SunDiesel is the cleanest possible combustion fuel**
 - ▶ No aromatic content, therefore very low particle emissions
 - ▶ No sulfur, therefore no acidity / acid rain
 - ▶ Significant CO₂ emissions reduction
- ▶ **Fits any diesel engine, therefore no costly infrastructure changes (Premium Fuel blend / No additional Pumps)**
- ▶ **High yield per hectare, therefore able to make a real difference**
- ▶ **Creates jobs at home and provides opportunity for farmers**
- ▶ **Energy security**

The Carbo-V[®] - Process



**Three Phase
Gasification**

Gas Treatment

**Fischer-Tropsch &
Hydrocracking**

CHOREN's Plans

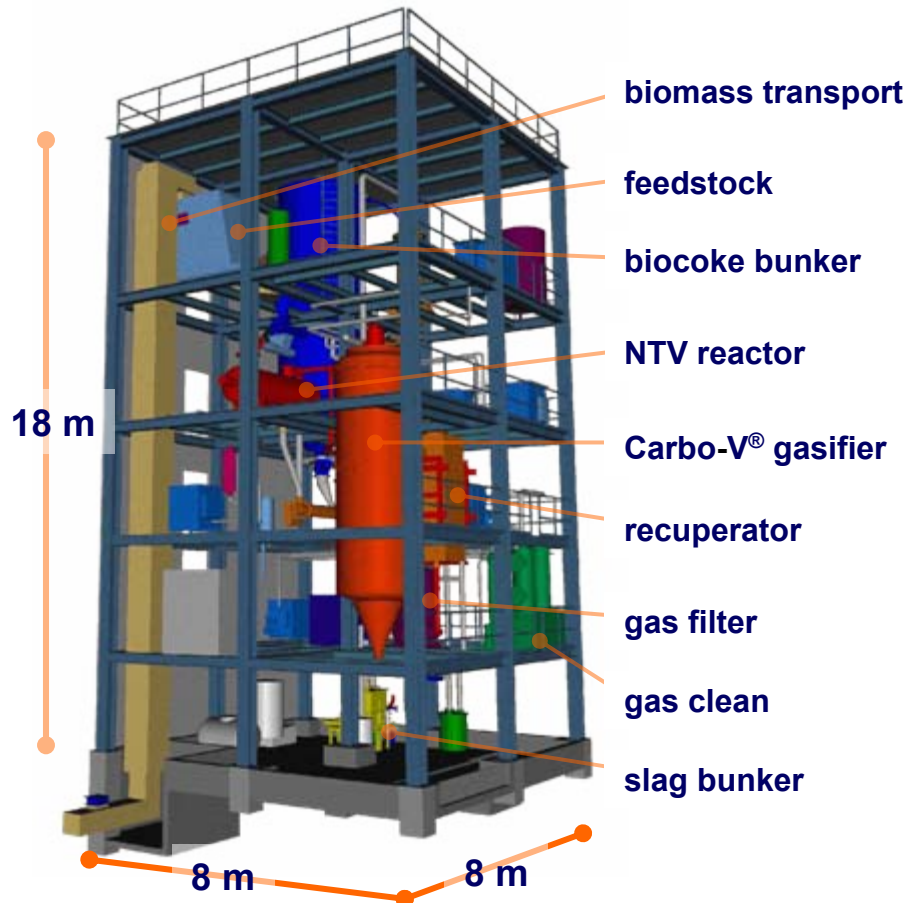


- ▶ 2003 – Pilot plant completed
- ▶ 2006 – First industrial facility (15,000 t pa)
- ▶ 2009 – First domestic large scale facility (200,000 t pa)
- ▶ 2010 – First international facility
- ▶ 2012 – 1,000,000 t pa SunFuel (Germany)



Alpha-Plant

Production of SunDiesel® since 10 / 2003



1 MW thermal

200 tpa SunDiesel

1,000 tpa biomass

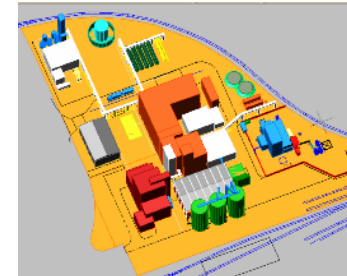
Beta Plant – Completion: 2006 / 2007



▶ 45 MW Thermal

▶ 75.000 t/a Biomass

▶ 16.5 mio. l SunFuel



Beta Plant – Completion: 2006 / 2007



▶ 45 MW Thermal

▶ 75.000 t/a Biomass

▶ 16.5 mio. l SunFuel



CHOREN Locations - Germany



- ◇ Potential Production Facilities
- Office Locations
- ◆ Pilot and Scale-Up Facilities
- 🛢️ Shell Rheinland Refinery

Economic & Social Benefits



Per 200,000 tpa Full Scale Commercial Facility

▶ Economic benefits:

Imported Oil reduction (\$60/barrell)	> €100 million / year
Local value added - purchase of biomass	> €60 million / year

▶ Employment:

Direct employment	150 jobs
Indirect employment ~ local agriculture etc.	~ 700 jobs
	<hr/>
	~ 850 jobs

▶ Environmental

Reduction of Green-House-Gases	650,000 t / year
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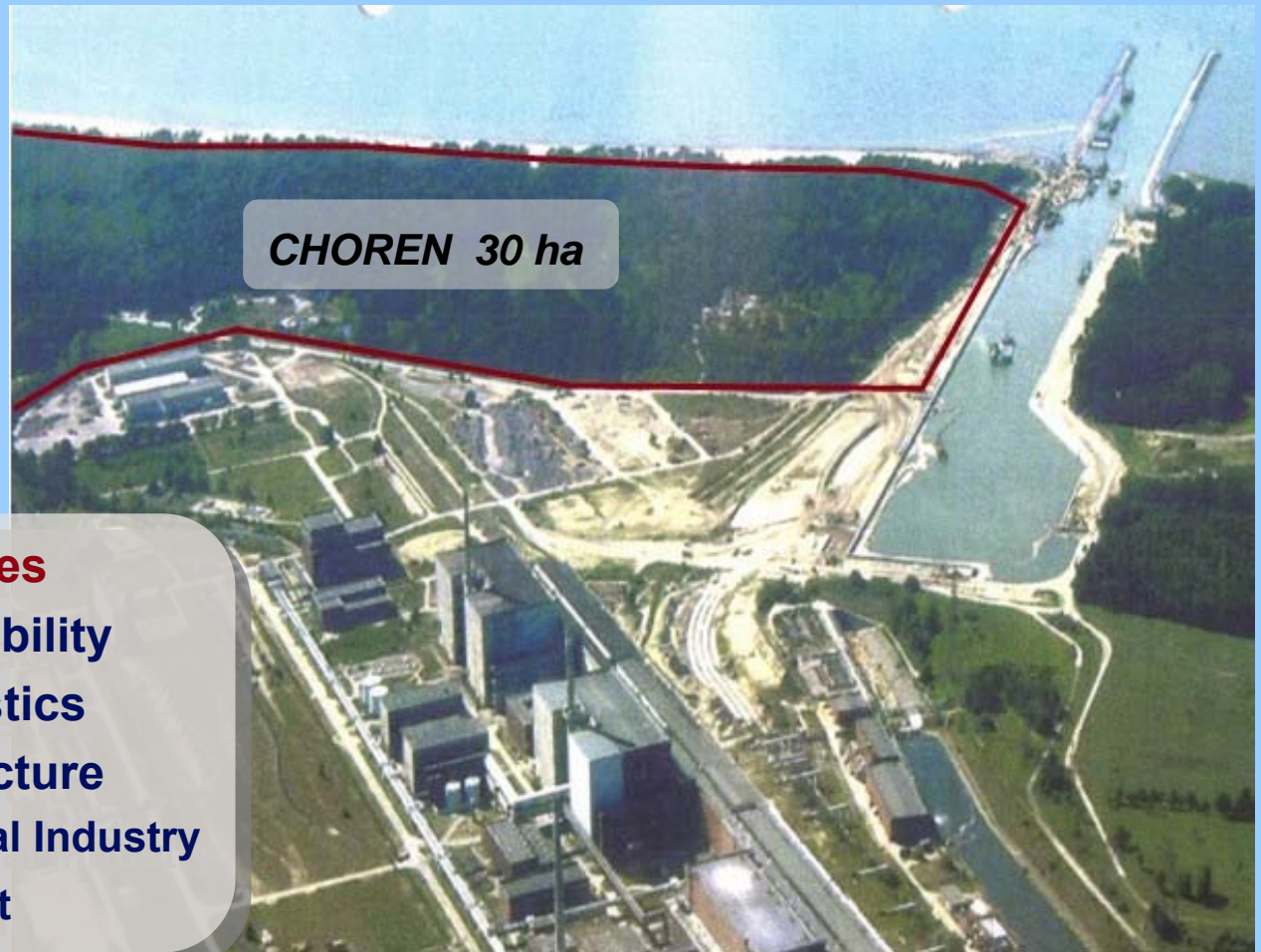
Σ Plant Lubmin – Completion: 2008 / 2009



▶ 600 MW Thermal

▶ 1,000,000 t/a Biomass

▶ 4,500 BOPD SunFuel



Location Attributes

▶ Biomass availability

▶ Transport logistics

▶ Local Infrastructure

- Synergy with local Industry

- Financial Support

Σ Plant Dormagen (BAYER Chemie Park)



▶ 600 MW Thermal

▶ 1,000,000 t/a Biomass

▶ 4,500 BOPD SunFuel

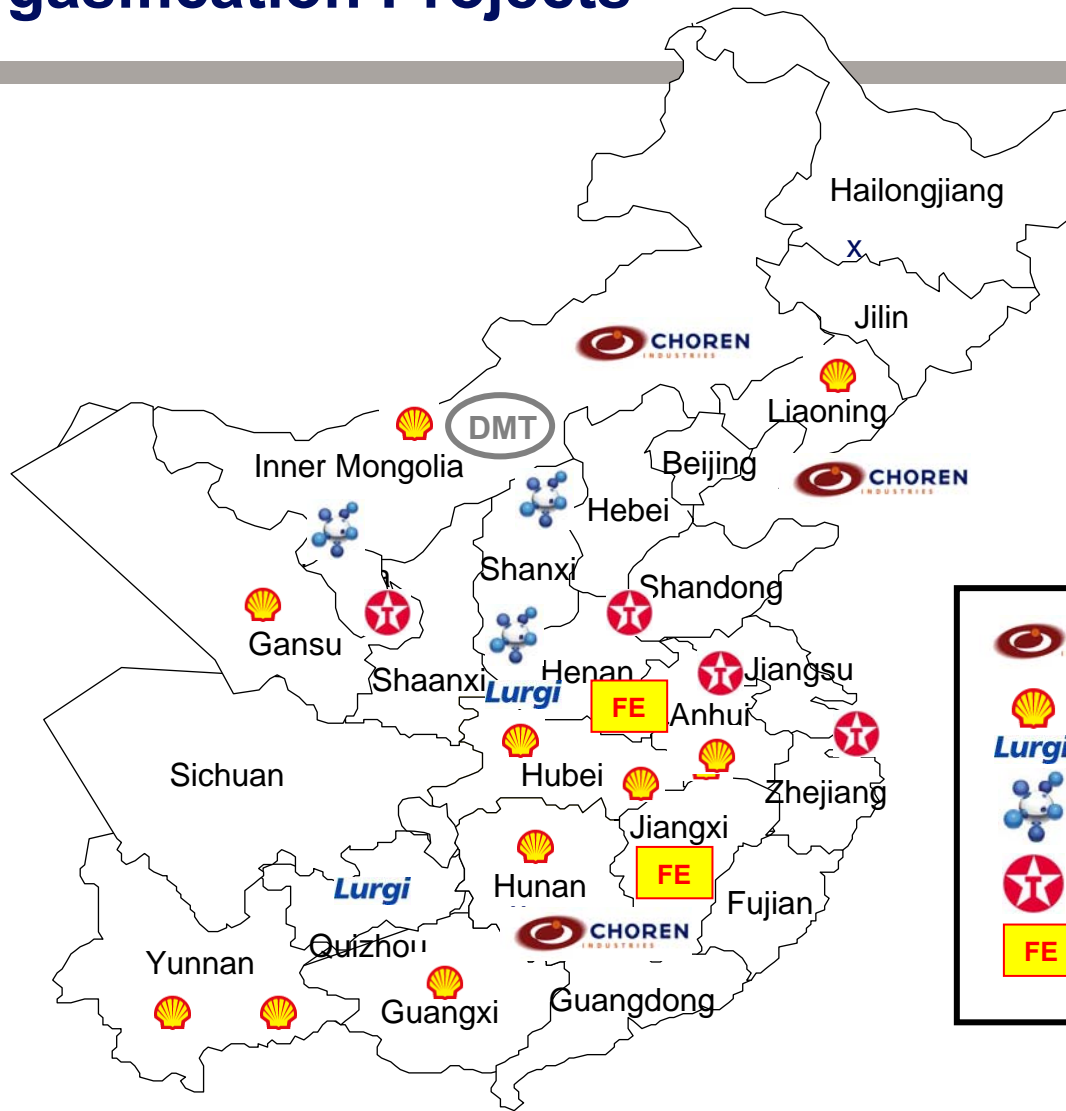








Location Attributes

- ▶ Infrastructure / Synergy
- ▶ Logistics
- ▶ Biomass

International Opportunities

Active gasification Projects

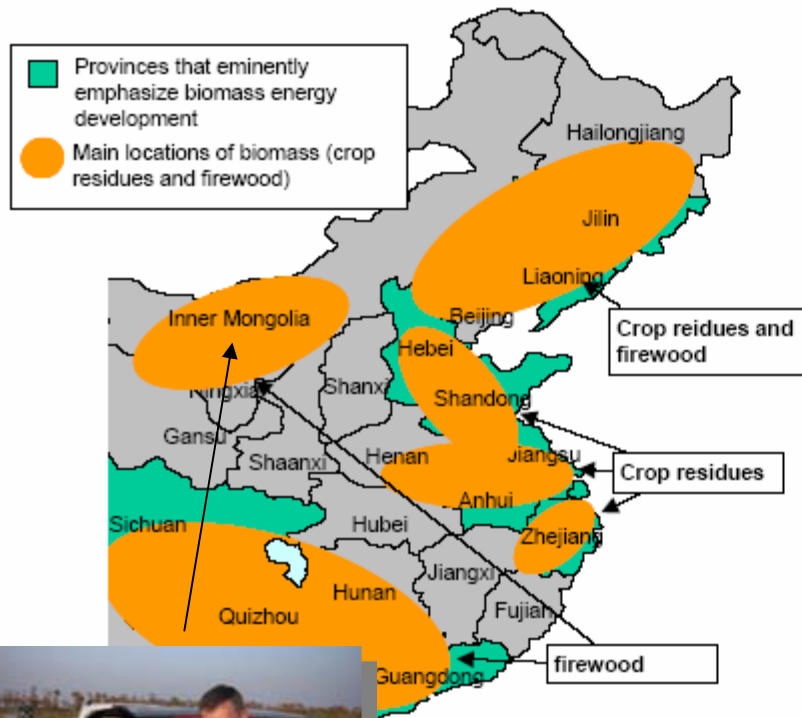


	CHOREN
	SHELL
	Lurgi
	SASOL
	TEXACO
	Future Energy

BTL Opportunity

Crop residues in the north- east and lower Yangtse area, fire wood and forest residues in the north- east, south and south- west area

Sources of biomass in China



	Area	Remarks
Rice	South China, Yangtse Area, Yunnan- Guizhou Plateau	In 2000: 190 mio. tons
Wheat	Henan, Shandong, Anhui, Shanxi, Jiangsu, Hubei & Sichuan	In 2000: 99 mio. tons
Corn	North-, Northeast- & Southeast- China	-
Rape- seed	Central China, Yangtse Area	China largest producer of rape seeds. Also largest importer of rapeseed & 2nd largest importer of rapeseed oil
Wood	Xinjiang, Inner Mongolia, Jilin, Hebei and Southern Qinghai	Logging ban on 57% of all forests as reaction to flooding and erosion. Fuelwood acreage: 5,40 mio. ha



Opportunities – United States



Alaska / Kenai

- ▶ Beetle killed Trees
- ▶ Synergy ~ Agrum
- ▶ AIDA Support

Kentucky / Mid West

- ▶ Agricultural biomass waste
- ▶ Logistics
- ▶ Local Infrastructure

East Coast

- ▶ Waste Wood availability
- ▶ Hurricane damage wood
- ▶ Synergy with Industry

California

- ▶ Clean fuel initiatives
- ▶ Waste wood availability
- ▶ West Coast Lumber Industry

Arkansas

- ▶ Mississippi Logistics
- ▶ Pulp and paper
- ▶ Huge biomass potential

Hawaii

- ▶ Energy plants
- ▶ BtL vs 'Imports'
- ▶ Synergy with Paper Industry

New Orleans

- ▶ Mississippi Logistics
- ▶ Petrochem Industry synergy
- ▶ Local Infrastructure



A technology whose time has come



- ▶ **Awareness that fossil fuels are finite (Peak Production)**
 - ▶ **Global energy demand continues to climb (China, India ...)**
 - ▶ **Rising energy costs (Demand >> Supply)**
 - ▶ **Environmental concerns and awareness**
 - CO₂ levels and global warming
 - Demand for sustainable clean fuels
 - ▶ **New opportunities for agriculture (energy farming)**
 - ▶ **Confluence of interests: Economic, Political, Environmental and Consumers**
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