

# BIOGORIVA



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## **Fosilna goriva / Fossil Fuels**

- Benzin / Gasoline
- Dieselsko gorivo / Diesel
- UNP / LPG
- Sintetska goriva / Synfuels - CTL & GTL
- Prirodni plin, SPP, UPP / Natural Gas, CNG, LNG

## **Obnovljiva goriva / Renewable Fuels**

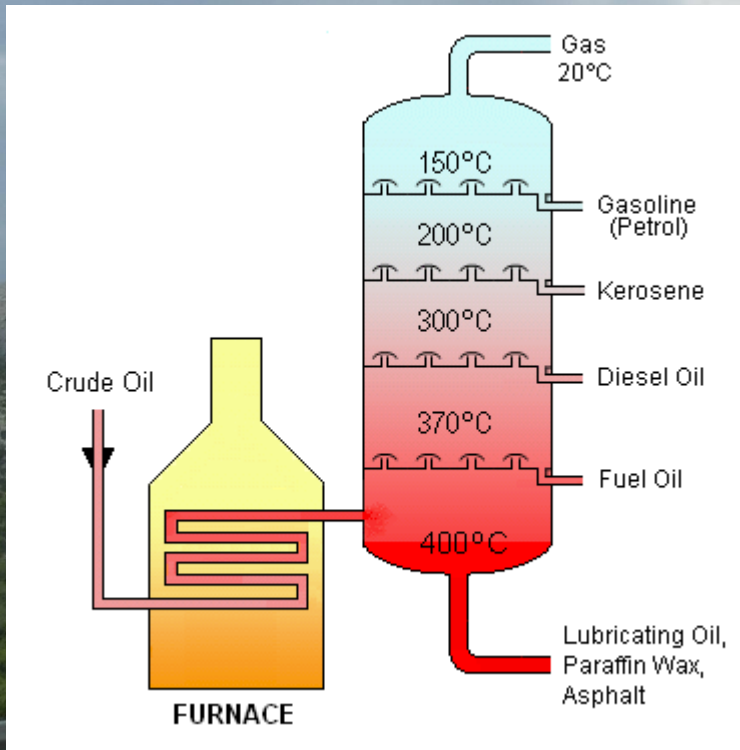
- Biodizel / Biodiesel (FAME)
- Obnovljivi (HO) dizel / Renewable (HT) Diesel
- Sintetska BTL goriva / Synthetic Fuel - BTL
- Bioetanol / Bioethanol
- Celulozni etanol / Cellulosic Ethanol
- Bio ETBE
- Bio MeOH & Bio DME
- Biobutanol
- Bioplin – biometan / Biogas
- BioVodik / BioHydrogen

# Gasoline, Diesel, and LPG Technologies

In this section we will be describing the different refining technologies relating to Gasoline, Diesel and LPG. Although these are labeled as conventional technologies, refineries today have become increasingly more efficient and efforts across the globe are being made to invest in better performing technologies and processes that save energy and decrease each refineries environmental impact whilst meeting increasingly more stringent fuel product specifications.

As can be seen below a basic refinery typically produces a variety of products including: LPG; petrochemicals; gasoline; jet fuel; paraffin for lighting and heating; lubricating oils, waxes and polishes; heavy fuel oil, and bitumen for roads and roofing.

## Products Produced by Refineries



## Different Refining Configurations Related To Automotive Fuel Qualities

A refinery's configuration refers to the type, size, number of process technologies and facilities employed, and the flow sequence.

Refinery configurations depend on what crude oil quality, product mix and quality, and environmental, safety, economic or other constraints were specified with its design. No two refineries are exactly alike, but refineries can be characterized into generic groups defined by the availability of the technologies.

A refinery's complexity is typically referred to within four configurations.

These configurations are listed in the table below together with their available process technologies and their yields.

## Refining Configurations and Their Yields

Configuration Group & Process Technologies	Product & Yield (vol %)				Comments
	Gas	Gasoline	Diesel	Fuel Oil	
<b>Topping</b> <ul style="list-style-type: none"> <li>• Crude Distillation</li> </ul>	2	32	30	37	<ul style="list-style-type: none"> <li>• Product quality and volume is dependent on crude oil source.</li> <li>• Distillate contains lots of heavy products.</li> <li>• Gasoline has low octane value.</li> </ul>
<b>Hydroskimming</b> <ul style="list-style-type: none"> <li>• Crude distillation</li> <li>• Hydrotreating</li> <li>• Reforming</li> </ul>	3	28	30	37	<ul style="list-style-type: none"> <li>• Product quality and volume is dependent on crude oil source. It allows refiners to adjust product slate (gasoline instead of naphtha).</li> <li>• Provides new possibilities to improve fuel quality, especially for gasoline.</li> <li>• Sulphur removal.</li> </ul>
<b>Conversion</b> <ul style="list-style-type: none"> <li>• Crude distillation</li> <li>• Hydrotreating</li> <li>• Reforming</li> <li>• FCC</li> <li>• Some upgrade units</li> </ul>	3	49	30	17	<ul style="list-style-type: none"> <li>• Flexibility in final production.</li> <li>• High quality products.</li> </ul>
<b>Deep Conv/Complex</b> <ul style="list-style-type: none"> <li>• Crude distillation</li> <li>• Hydrotreating</li> <li>• Reforming</li> <li>• FCC</li> <li>• Many upgrade units</li> </ul>	3	47	43	4	<ul style="list-style-type: none"> <li>• Addition of coking allows minimal production of low valued fuel oil.</li> </ul>

Refineries are comprised of a number of individual technology based processing facilities with varying objectives, and integrated as necessary to meet product targets.

The types, size, number and flow sequence of a specific refinery (i.e., refinery configuration) will vary depending on crude oil quality, required product mix and quality, and environmental, safety, economic or other constraints.

The major refinery processing steps or technologies can be categorized into six functional areas: separation, conversion or cracking, combination, reformulation, treating and other specialty or support operations

All these steps and technologies are included in the figure below that illustrates a complex refinery configuration.



Ubrzani razvoj svjetskog gospodarstva prati stalan porast potrošnje goriva i petrokemijskih sirovina, što za krajnju posljedicu ima ubrzan iscrpак fosilnih goriva i povećanu emisiju stakleničkih plinova.

(Uzrok je to sve veće nestabilnosti i izraženog porasta cijene nafte na svjetskom tržištu.)

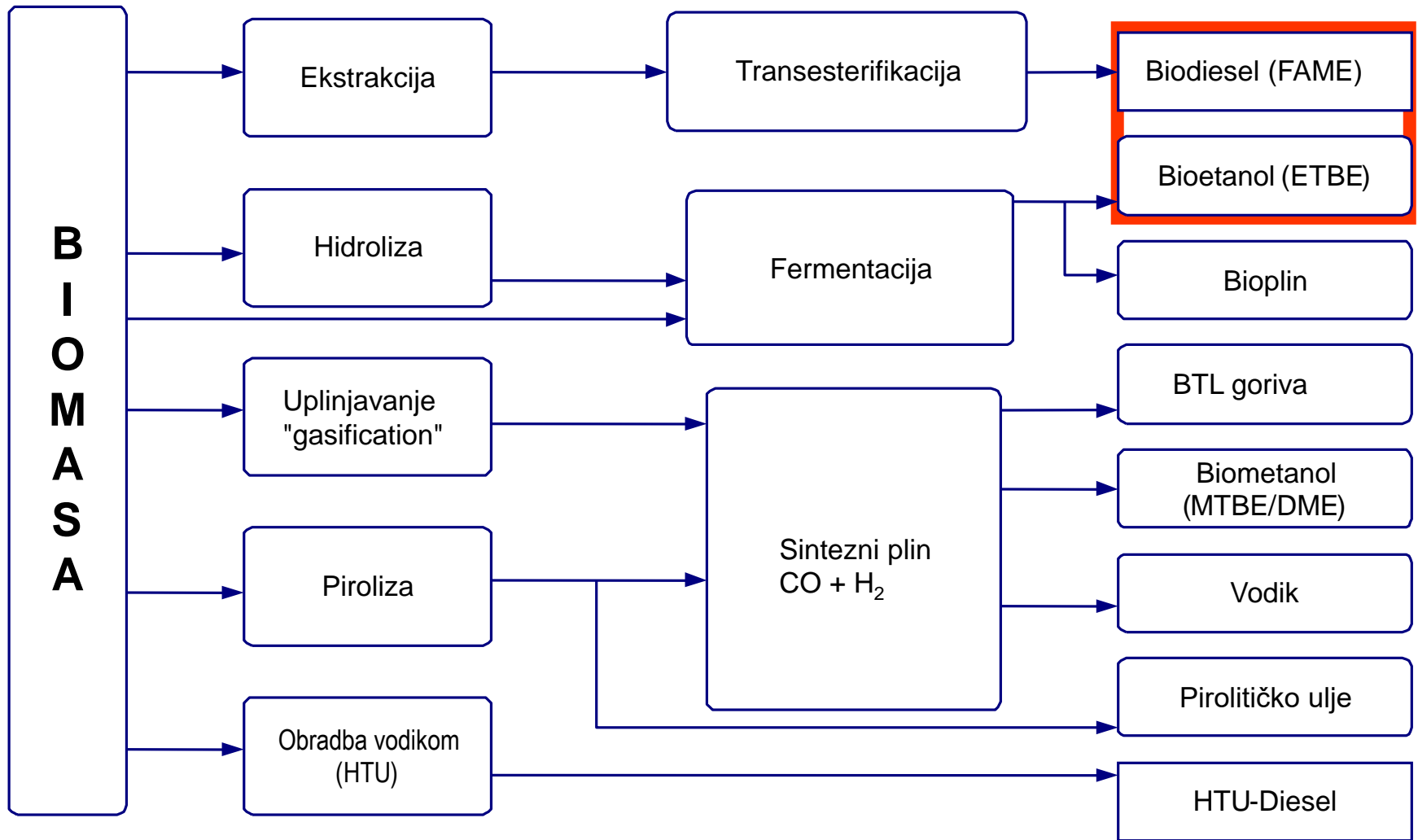
Kao jedno od mogućih i prihvatljivih rješenja primjena je biogoriva zajedno s drugim alternativnim izvorima energije.

Biogorivo se najvećim dijelom upotrebljava kao gorivo za transport, a dobiva se iz mnogih agrokulturnih izvora. Dolazi u kapljevitom stanju kao **bioetanol** ili **biodiesel** ili plinovitom obliku kao **bioplin (metan)** ili **vodik**. Izravna su zamjena za postojeća benzinska i dieselska goriva, te se mogu koristiti u obliku smjesa s konvencionalnim mineralnim gorivima ili u čistom obliku za pokretanje automobilskih motora.

Biogoriva mogu “preskočiti” zapreke njihovom ulasku na tržište jer su kompatibilna s konvencionalnim motorima i lako se namještavaju s fosilnim gorivima (?!).

Nadalje, njihove su dobre karakteristike da korištenje u većem ili manjem udjelu dovodi do  smanjene emisije štetnih plinova: CO, CO<sub>2</sub>, NO<sub>x</sub>, kao i krutih ugljikovih čestica, te se izbjegavaju problemi onečišćenja tla i vode koji se inače javljaju upotrebom MTBE-a.

Također, u širem kontekstu primjena biogoriva omogućava dodatno upošljavanje radne snage i povećanje iskorištenja u poljoprivredno ekstenzivnijim područjima, a na taj način smanjuje se ovisnost o promjenljivom globalnom tržištu nafte.



Tehnologije dobivanja biogoriva

## **Prednosti uporabe biogoriva največim su dijelom strateške i ekološke:**

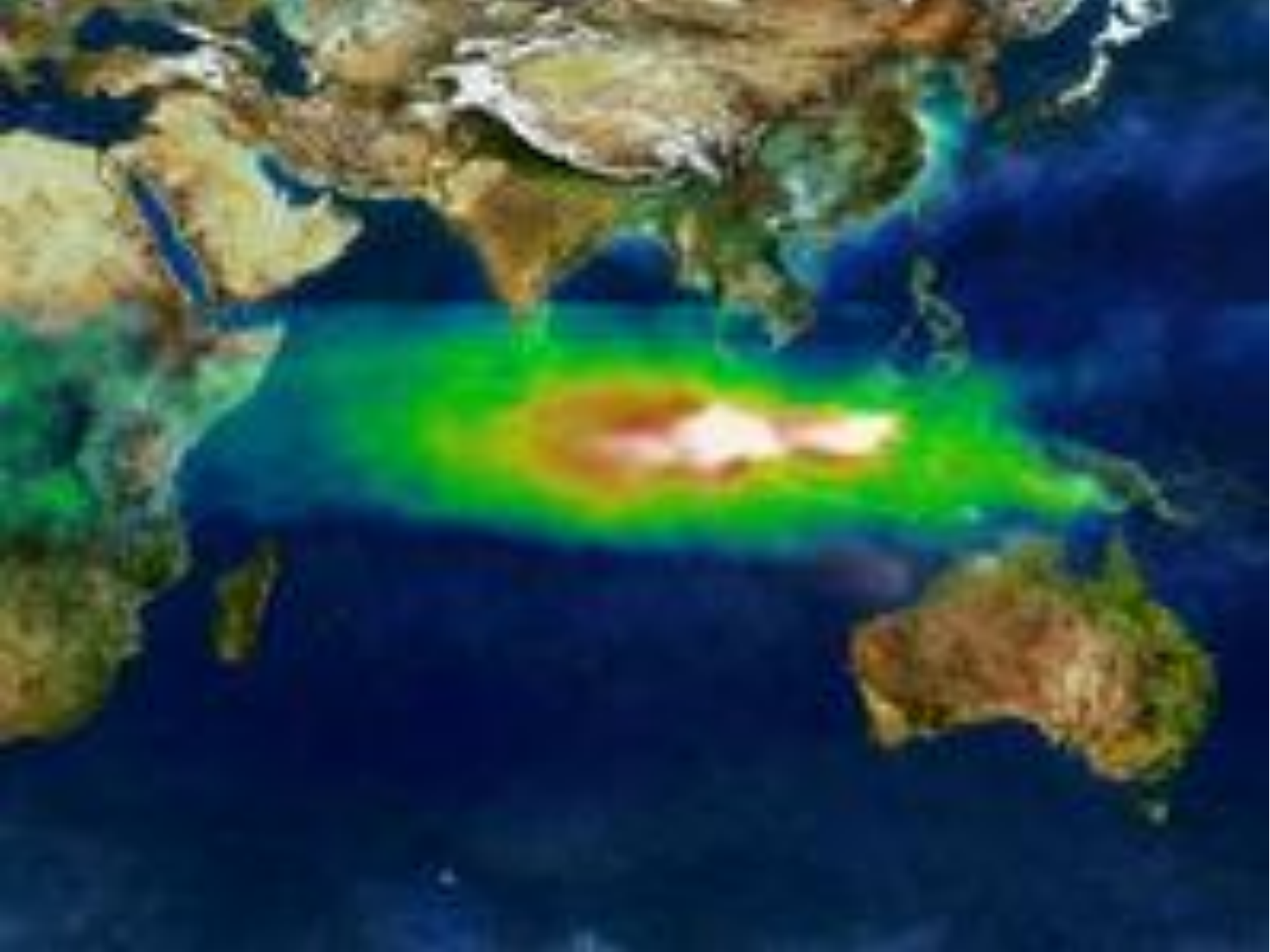
1. smanjuju ovisnost o fosilnim gorivima
2. ekološki pogodni jer ne sadrže sumporove spojeve niti postojeane aromatske ugljikovodike (benzen) izrazito štetne po okoliš
3. stvaraju znatno manje CO<sub>2</sub> i drugih stakleničkih plinova (biodiesel 40-60 %, etanol iz saharida do 55 %, iz celuloze do 80 %)
4. biorazgradljivost
5. visoka kvaliteta goriva (oktanski broj > 105, cetanski broj > 55)
6. mogu se odmah primijeniti jer nisu potrebne značajnije promjene na (standardnom motoru) niti na postojećoj distributivnoj infrastrukturi
7. značajnija uloga biogoriva na tržištu, potakla bi razvoj ruralnih sredina
8. moguće je provesti i decentraliziranu proizvodnju biogoriva na farmama i poljoprivrednim gospodarstvima

Potencijalne pogodnosti koje decentralizirana proizvodnja donosi samim korisnicima uključuju niže troškove, veću neovisnost, poboljšanu kvalitetu, racionalnije gospodarenje energijom, i doprinosi smanjenju potrošnje plina i električne energije.

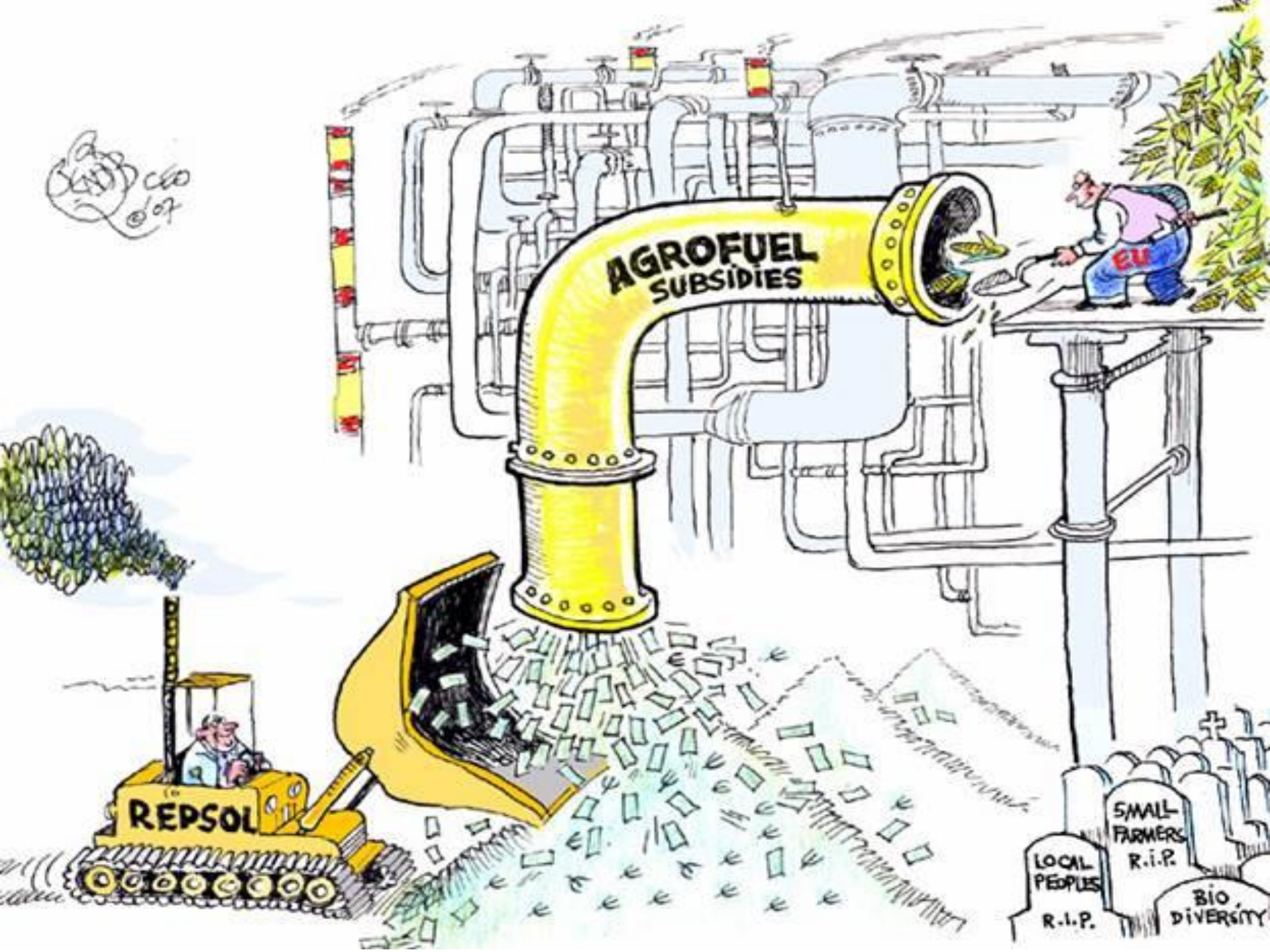
## **Nedostatci:**

1. nastajanje monokultura / smanjenje biološke raznolikosti
2. prenamjena postojećih polja i površina pod šumama u svrhu sađenja onih kultura od kojih se proizvodi biogorivo
3. za konvencionalna biogoriva kao što su biodiesel i bioetanol, cijena proizvodnje znatno varira ovisno o vrsti sirovine
4. upotreba jestivih agrikultura za masovnu proizvodnju mogla bi imati negativan utjecaj na prehrambenu i poljoprivrednu industriju - cijenu hrane
5. povećanje upotrebe genetički modificiranih biljaka
6. zagađenost tla i voda uzrokovana intenzivnim uzgojem

(primjeri: SAD – Ohio, Brazil – Amazonija, Indonezija)



© 07



AGROFUEL  
SUBSIDIES

SMALL  
FARMERS  
R.I.P.

LOCAL  
PEOPLES  
R.I.P.

BIO  
DIVERSITY

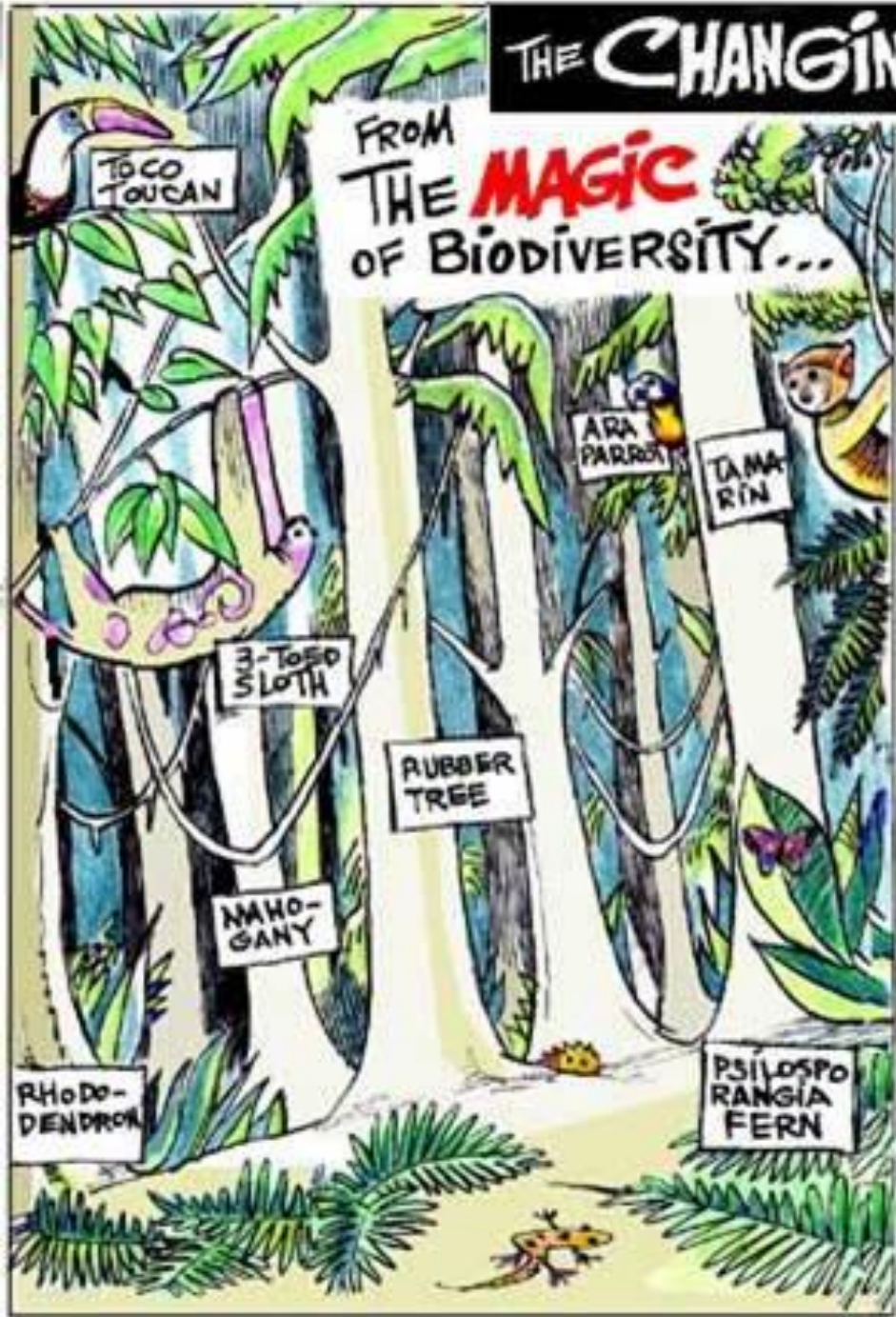
REPSOL

# THE CHANGING AMAZON

WARR-CORP-WATCH.ORG  


FROM THE **MAGIC** OF BIODIVERSITY...

...TO THE MONOCULTURE OF **MAGGI!**



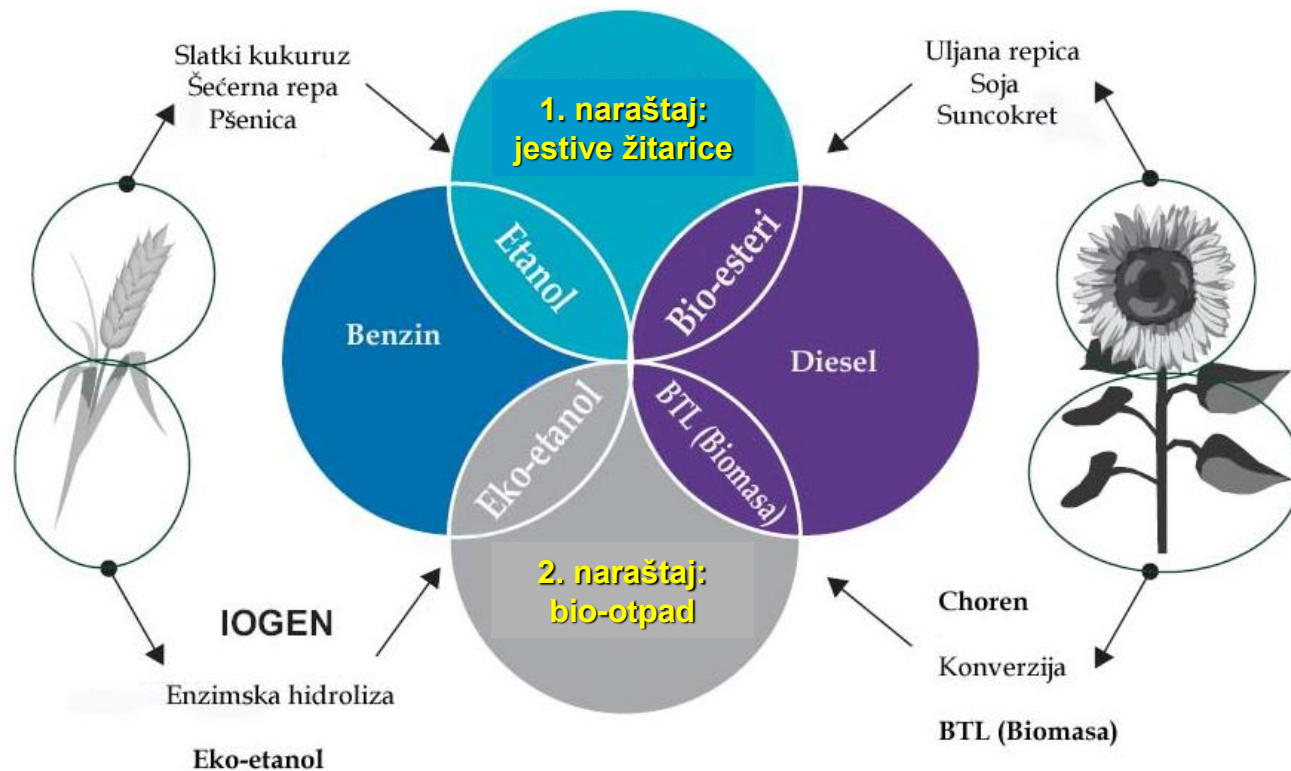
Biogoriva 1. naraštaja



Biogoriva 2. naraštaja

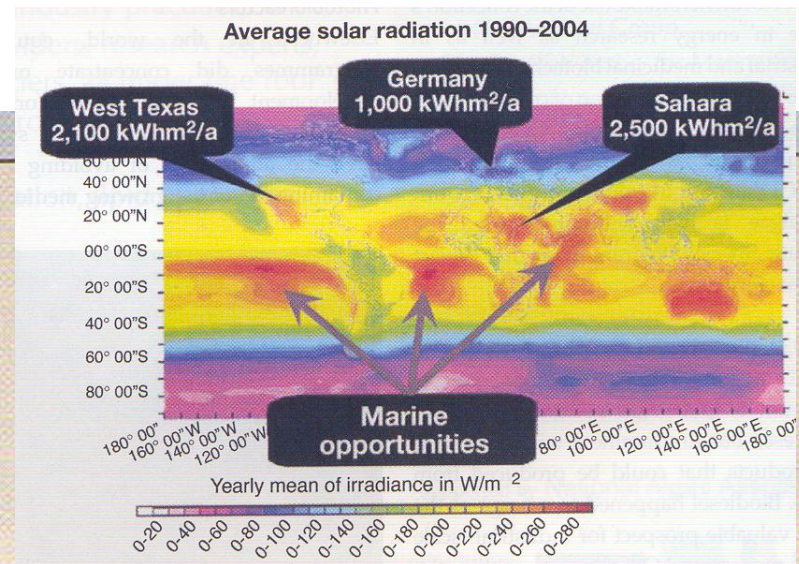
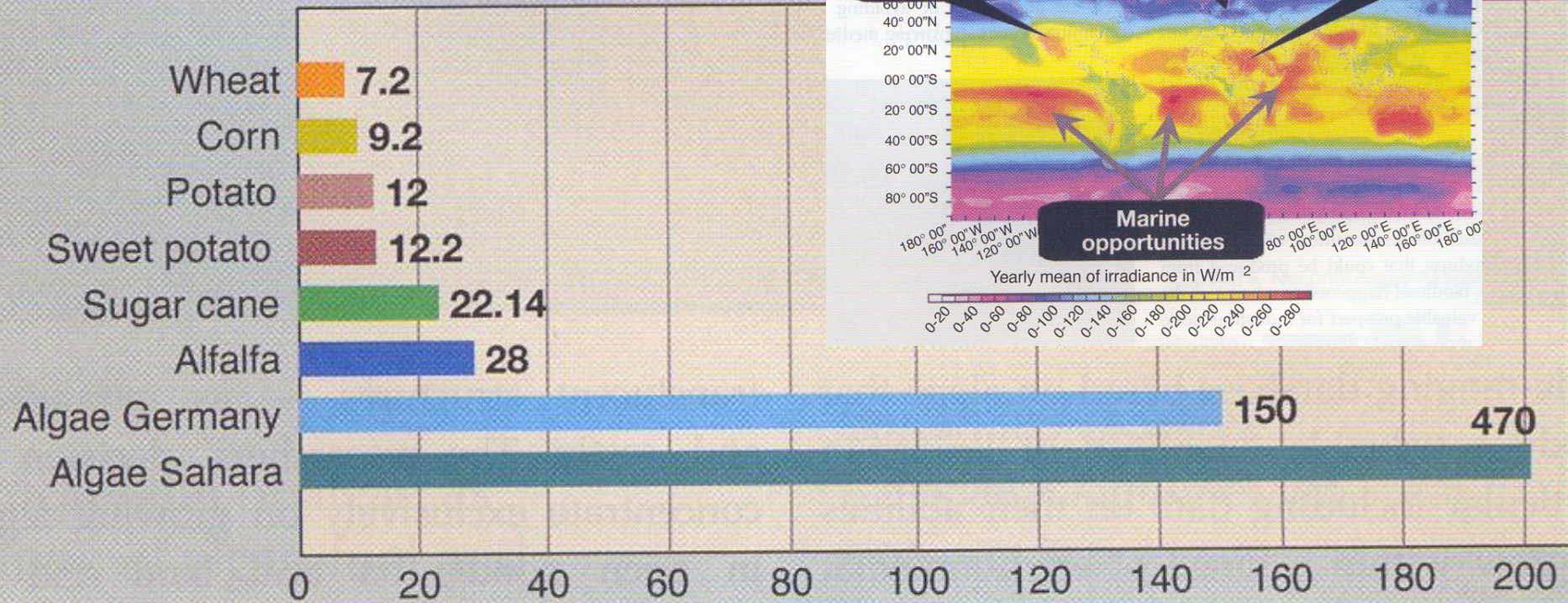


Alternativni postupci proizvodnje visoko kvalitetnih sintetskih goriva iz biomase = Fischer-Tropschova sinteza i biotehnološki postupci.

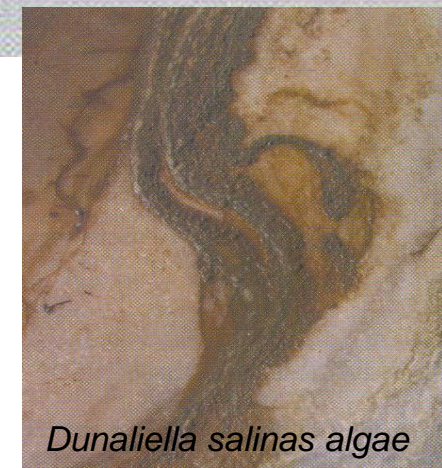


Stoga proizvodnja biodiesela, kao i sintetskog benzina iz biomase ima najveći potencijal jer kao osnovnu sirovinu koristi obnovljive izvore energije kao što su drveni otpad, otpad žitarica i bilo koji drugi otpad biološkog porijekla, pa čak i otpadni mulj. Te sirovine reagiraju s vodenom parom u prisutnosti katalizatora pri čemu nastaje sintezni plin, ugljikov monoksid i vodik, iz kojih se zatim dobivaju čisti kapljeviti CH, odnosno sintetska goriva i voda.

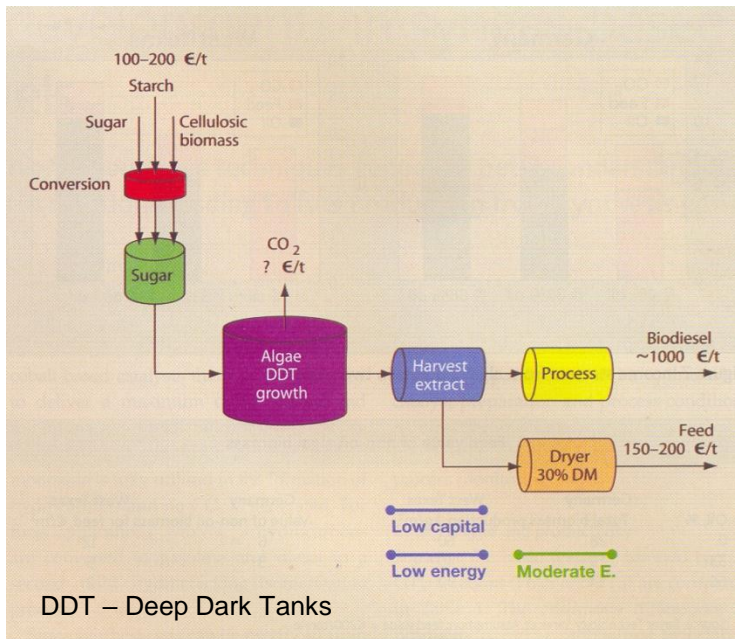
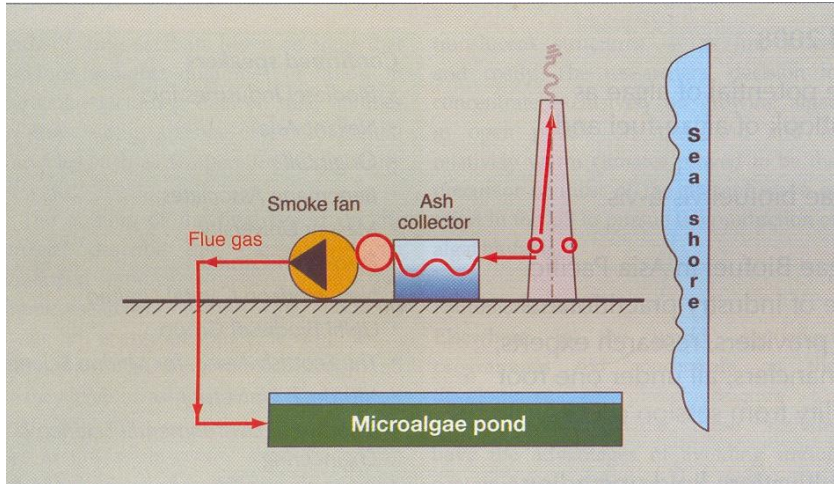
# Biomasa iz proizvodnje algi



Iskrpak suhe biomase agrokulturnih usjeva (tona/hektar)



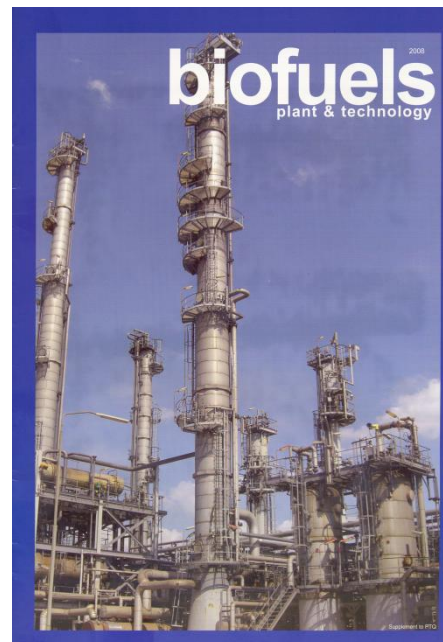
# Tehnolojske sheme proizvodnje algi sa i bez sunčevog svjetla

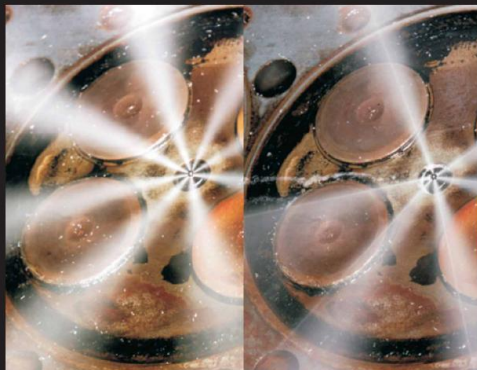


### Economic comparison of various first- and second-generation biofuels process routes, including catalytic pyrolysis of biomass

	\$/Boe	\$/GJ
<b>Crude Oil</b>	60	10
<b>Ethanol</b>		
Sugarcane (Energy = biowaste)	54	9
Sugarcane (Energy = fossil)	90	15
Cellulose	120	20
<b>Diesel</b>		
Biodiesel from Jatropha	156	26
BTL via GTL	110	18
<b>Bio-Crude (via direct BTL)</b>		
Pyrolysis or Hydrothermal (HTU)	72	12
Catalytic Pyrolysis	60	10

Boe: Barrel of Oil equivalents      GJ: Giga Joules





## 49. međunarodni simpozij Hrvatskog društva za goriva i maziva

# FUELS

19.-21.10.2016., Šibenik



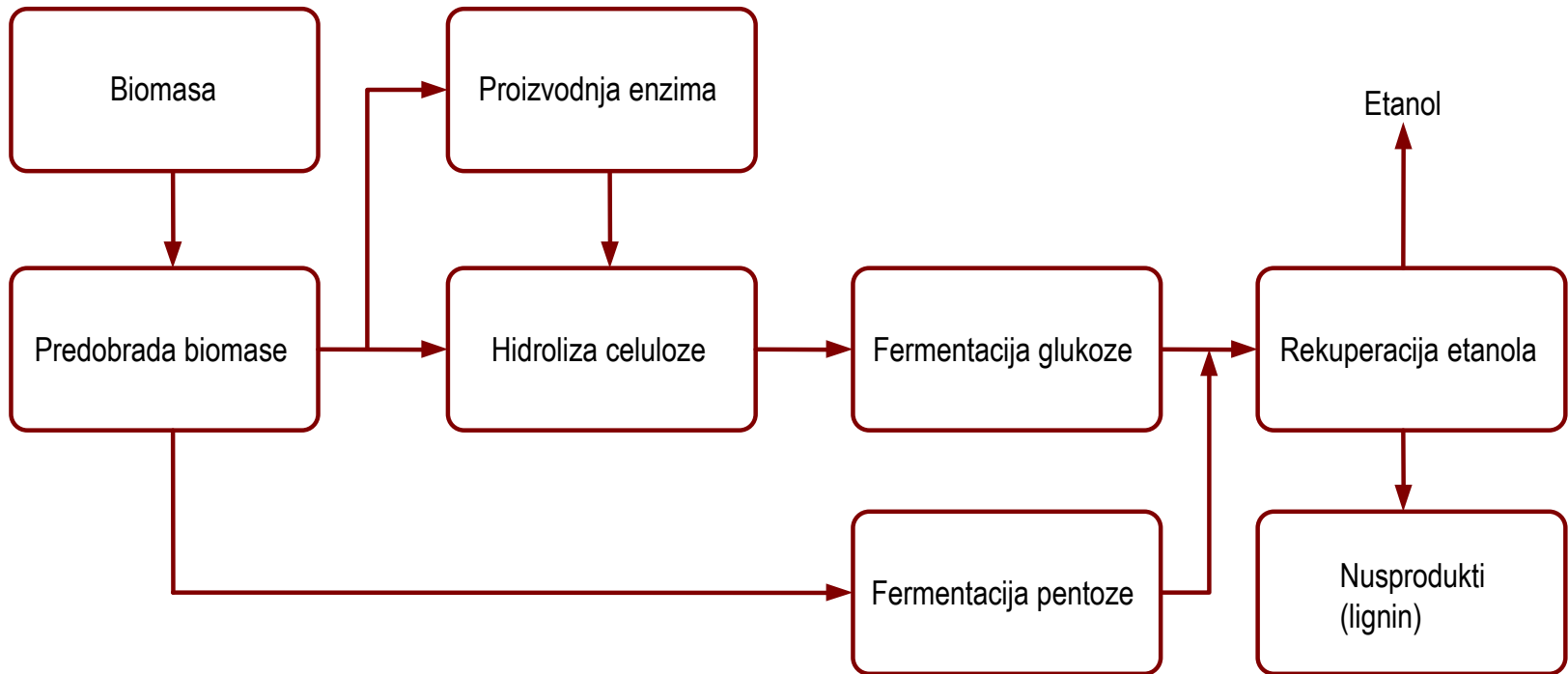
# GOMA

Hrvatsko društvo za goriva i maziva  
Berislavićeva 6, HR-10000 Zagreb

tel: +385 (0)1 4873 549 - fax: +385 (0)1 4872 503  
e-mail: [goma@goma.hr](mailto:goma@goma.hr) - [www.goma.hr](http://www.goma.hr)

**Etanol** je biogorivo koje se danas najviše upotrebljava (3 % od ukupne svjetske upotrebe transportnih goriva) s tim da se 10 % rabi za namješavanje s klasičnim gorivom zbog povećanja oktanskog broja benzina.

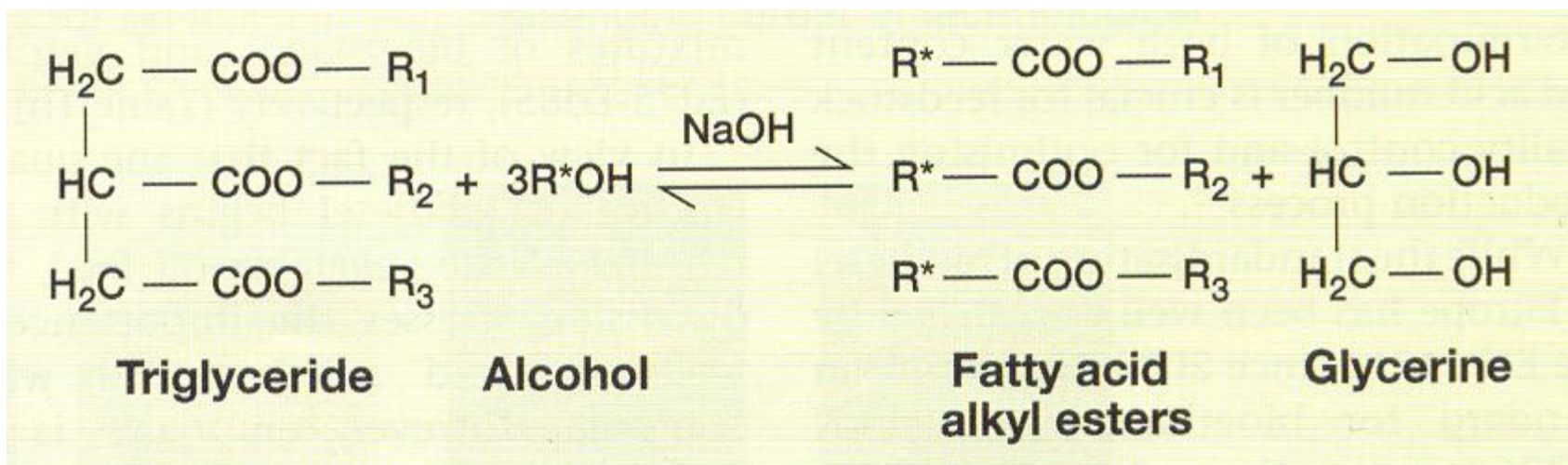
Konvencionalna proizvodnja etanola iz kukuruza i šećerne melase dobro je poznata i razvijena tehnologija. Bioetanol se može proizvesti i iz ostataka žetve, konverzijom celuloze u šećer te procesom fermentacije u alkohol. Upotrebom celuloznih sirovina kao što su slama, drveni otpad, itd., proizvodnja bioetanola nema utjecaja na proizvodnju hrane, ali je proces u razvitku i traže se rješenja za ubrzavanje reakcije hidrolize i zbrinjavanje nepoželjnih sporednih produkata.



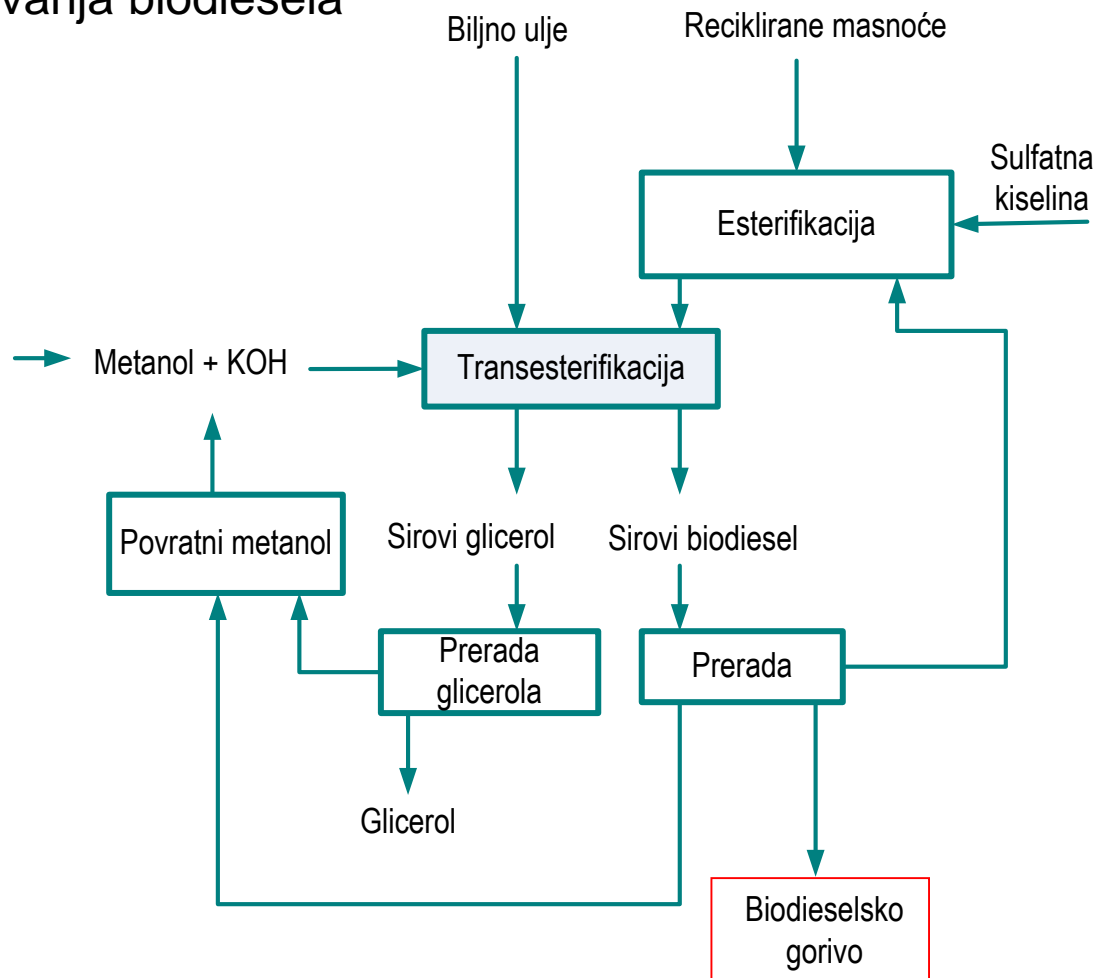
Dobivanja bioetanola procesom fermentacije

**Biodiesel** (alkilni esteri viših masnih kiselina) je čišće i ekološki povoljnije gorivo koje može zamijeniti klasično dieselsko gorivo za pokretanje motora automobila.

Može se proizvesti iz prirodnih obnovljivih izvora kao što su biljna ulja i životinjske masti. Masti i ulja kemijski reagiraju s alkoholom (uglavnom metanolom) da bi se proizveli metilni esteri viših masnih kiselina, poznati kao biodiesel, pri čemu se kao koproizvod u procesu dobiva glicerol.



# Proces dobivanja biodiesela



Biodiesel se može upotrebljavati u čistom obliku u minimalno modificiranom dieselskom sustavu s kompresijskim paljenjem, ali najviše se još uvijek upotrebljava u smjesi s klasičnim dieselskim gorivom. Gotovo 80 % od svjetske proizvodnje biodiesela je u Europi. Proizvodnja biodiesela zahtjeva pet puta više obradivih površina po jedinici energije nego za proizvodnju bioetanola.

Godine 2005. proizvedeno je 30 miliona tona bioetanola u svijetu, a samo 4 miliona tona biodiesela.

# Biogas / Bioplin (metan)

Biogas can be extracted from sewage treatment plants, refuse dumps and other sources of biologically degradable material. The fuel can also be produced by biomass gasification. A variety of process schemes have been developed.

Biogas is a gas mixture: approximately 40-75% CH<sub>4</sub>, 25-60% CO<sub>2</sub>, 2% of other gases (hydrogen, hydrogen sulphide and carbon monoxide).

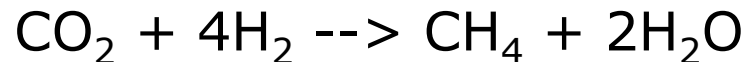
Biogas develops through anaerobic fermentation.

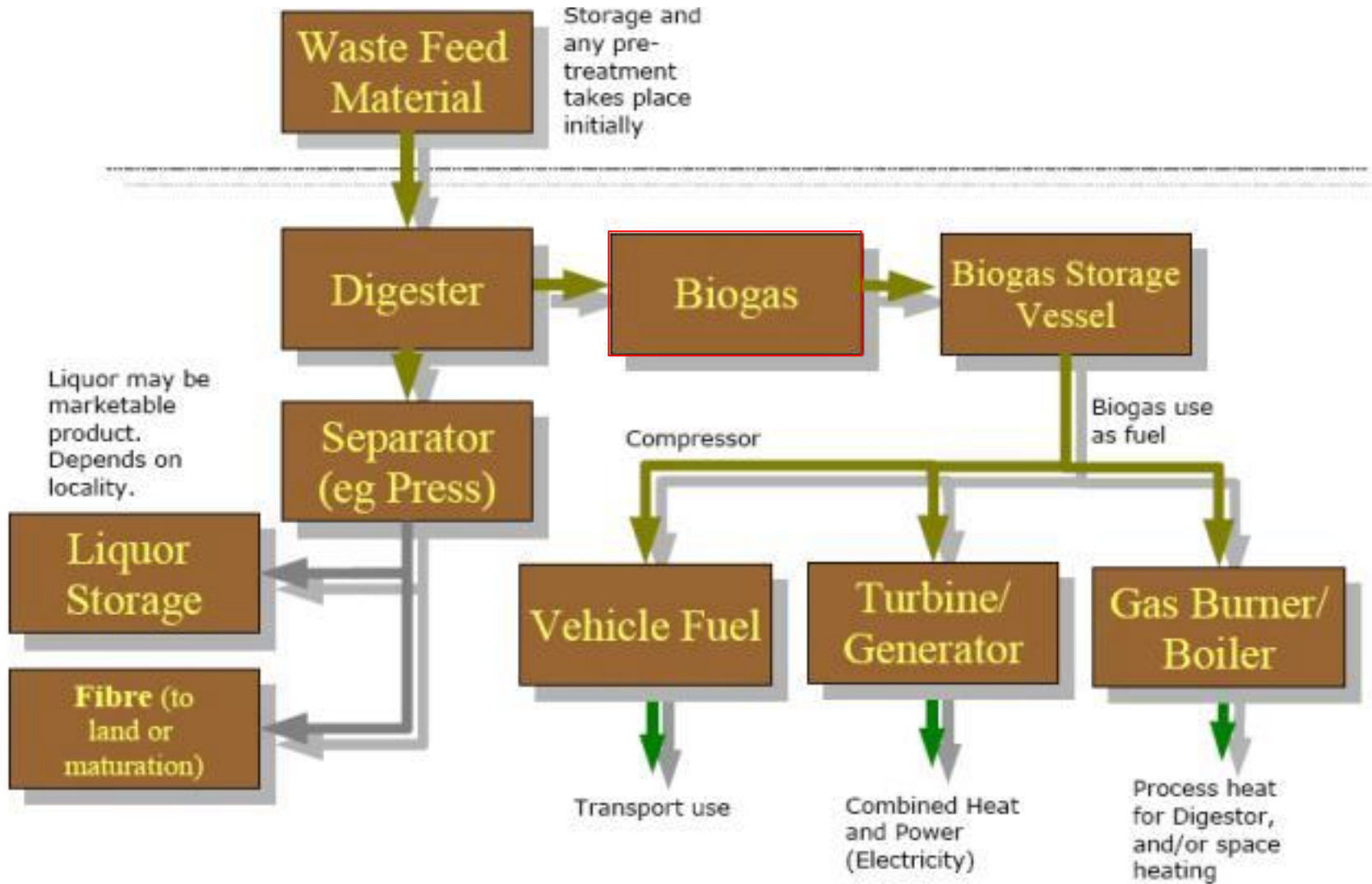
During this process, organic substances are decomposed by micro-organisms.

The substances added to the system produce the biogas in an **oxygen-free environment**.

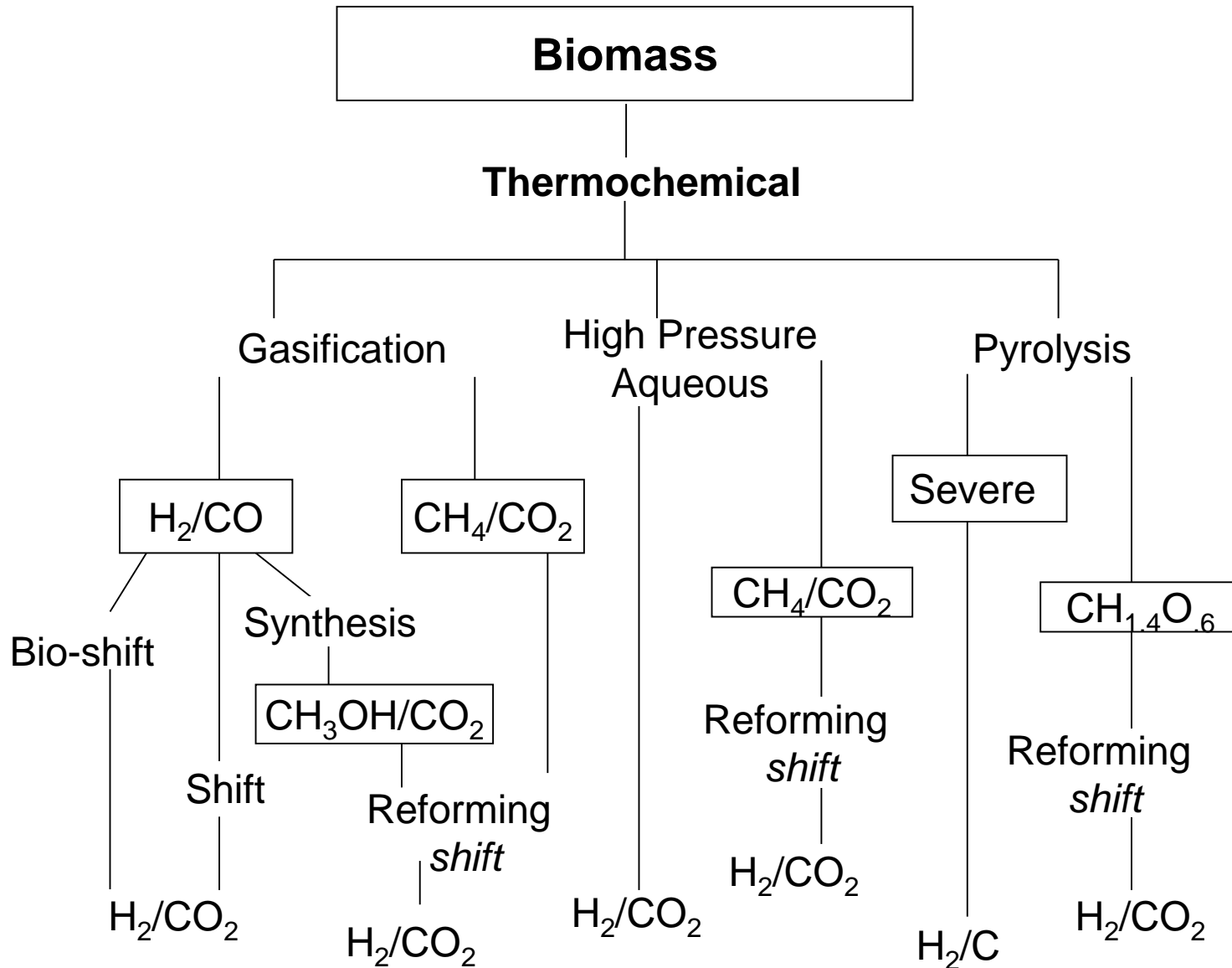
In the first step, the organic substances are divided into molecular components (sugar, amino acids, glycerine and fatty acids).

Microorganisms convert these intermediate products into hydrogen and carbon dioxide, which are then transformed into methane and water according to the equation:

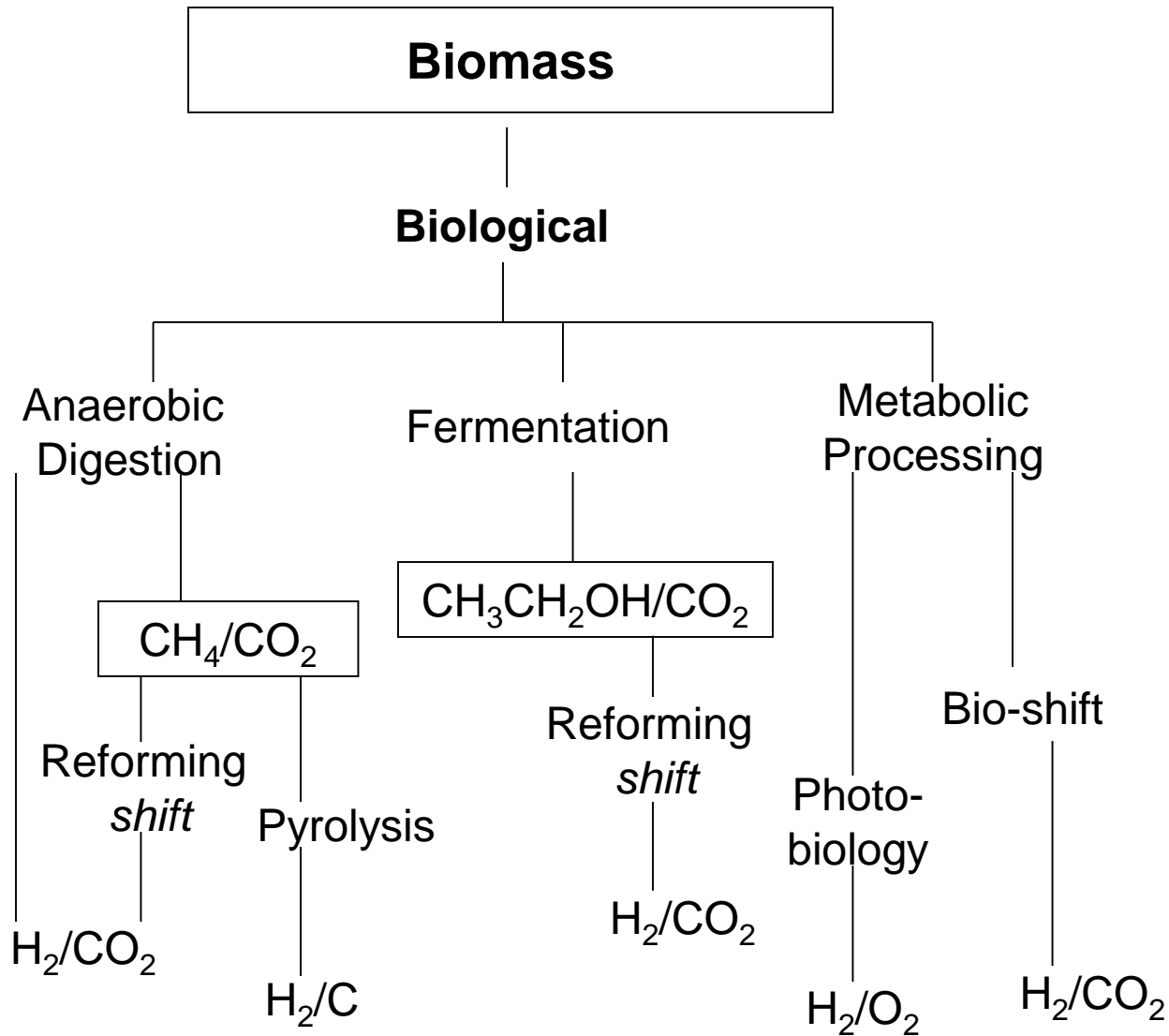




# Dobivanje vodika iz biomase

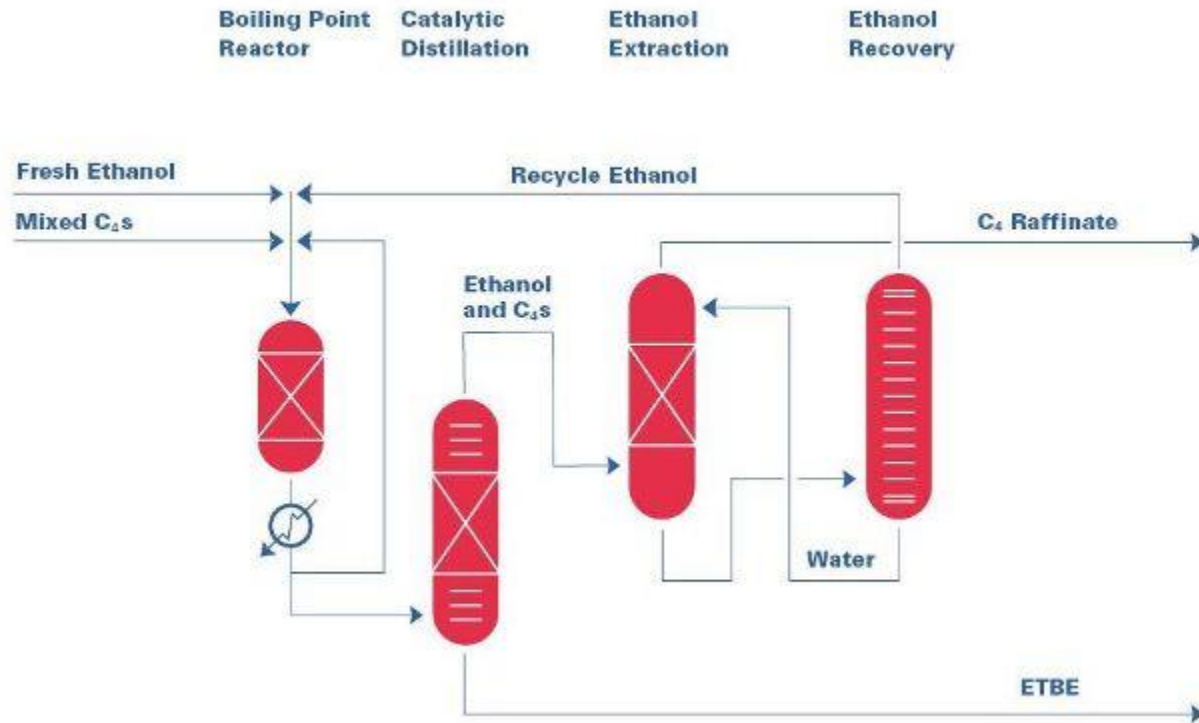


# Dobivanje vodika iz biomase



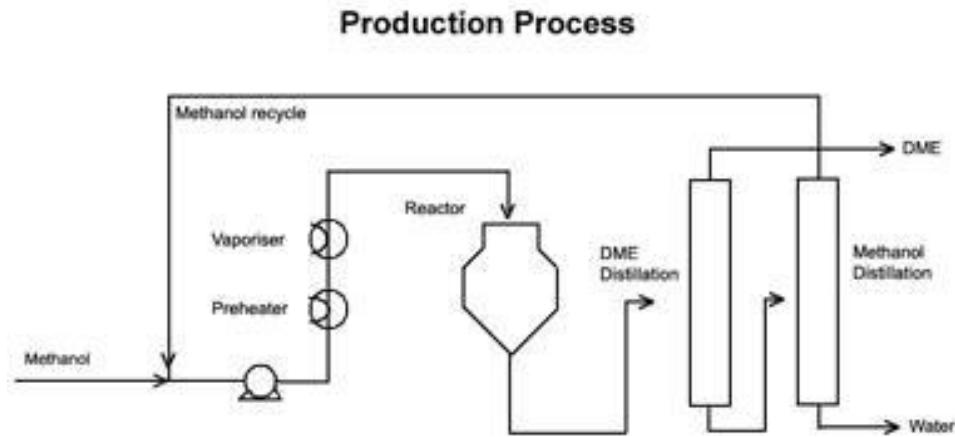
**Bio-ETBE** is produced by mixing bio-ethanol (47%v) and isobutylene (53%v) in the presence of a catalyst. Isobutylene can be isolated from refinery streams by reaction with sulfuric acid or by catalytic dehydration of isobutene.

**Etherification**



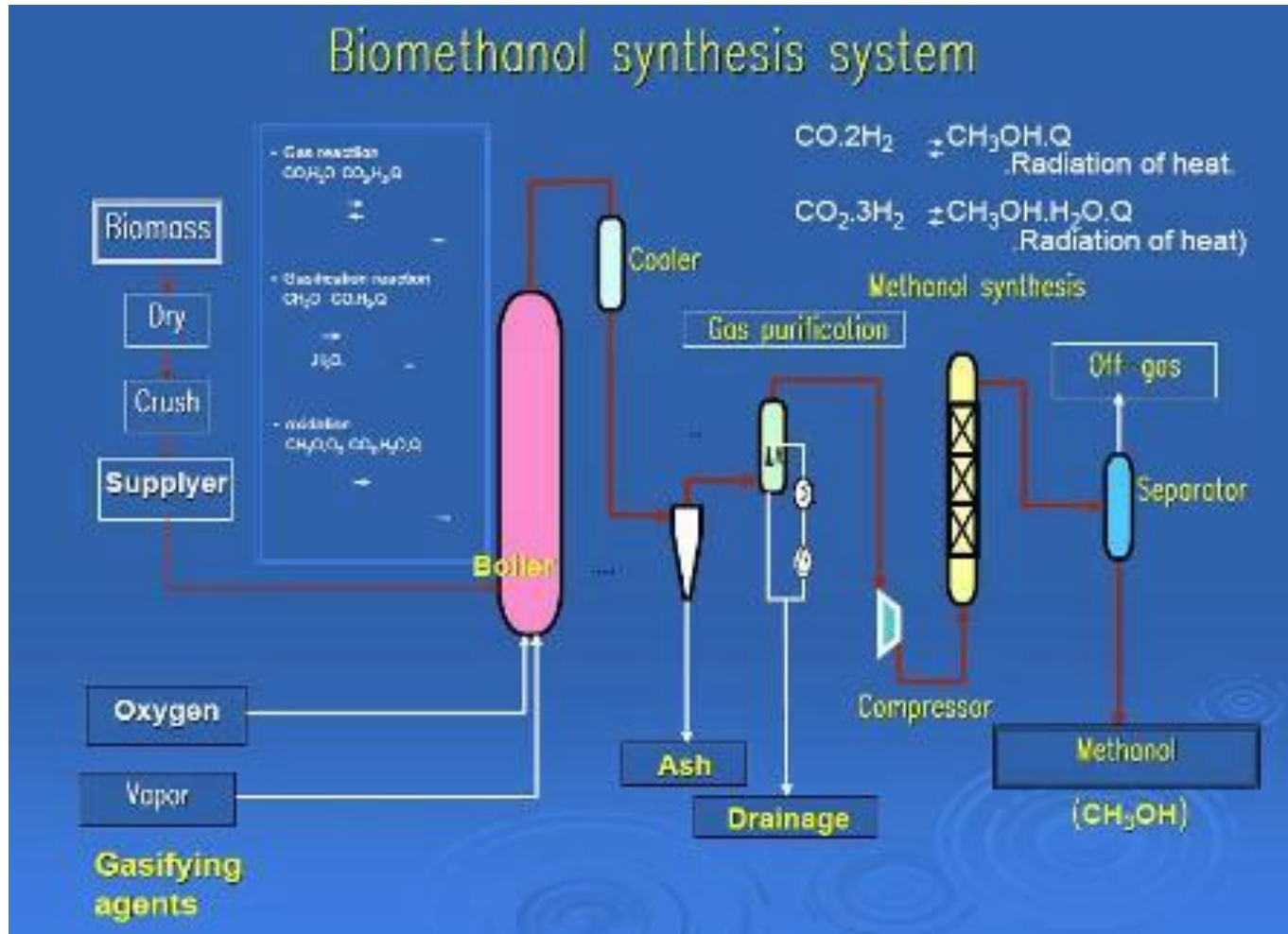
**Bio-DME** ( $C_2H_6O$ ) is a colourless, gaseous ether that can be used in diesel and gasoline engines and in gas turbines. It works particularly well in diesel engines because of its high cetane number.

DME can be processed and produced from natural gas, coal and biomass. Currently there are two ways to produce DME: one is methanol dehydration and the other is DME synthesis from syngas. With the catalytic dehydration method, DME is produced from two methanol molecules in the presence of a catalyst, which produces one DME molecule and water.

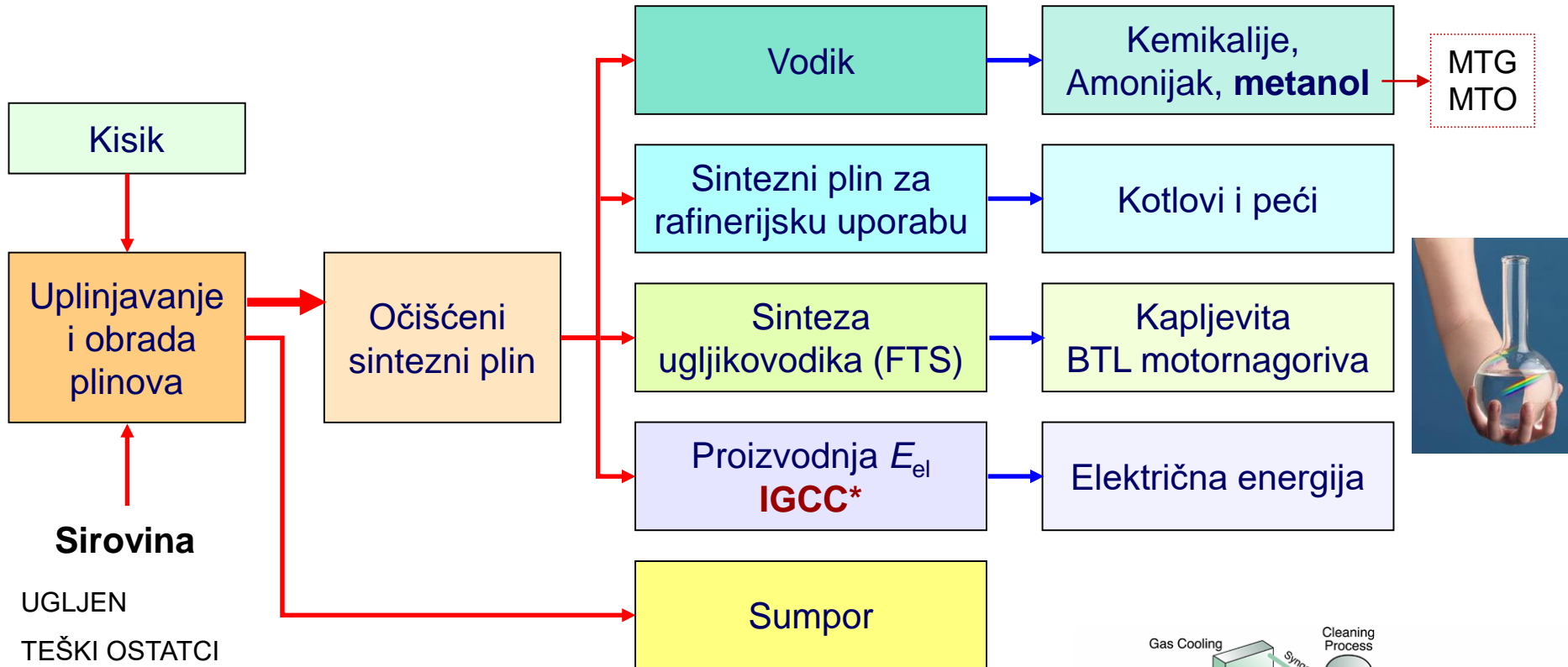


**Bio-methanol** ( $\text{CH}_3\text{OH}$ ) is an alcohol that can be used in a blend with conventional (fossil) gasoline as a substitute for gasoline.

Bio-methanol can be produced naturally by the anaerobic metabolism of many types of bacteria. Methanol can also be produced synthetically by using natural gas. Natural gas and steam are reformed to produce  $\text{CO}$  and  $\text{H}_2$  in a furnace and the two then react to an added catalyst and produce methanol.



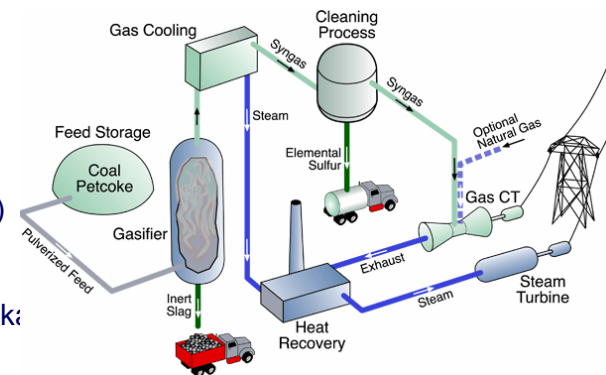
Objedinjavanje preradbe nafte, petrokemijske proizvodnje i proizvodnje energije u modernim rafinerijama na temelju procesa uplinjavanja sintezni plin ( $H_2+CO$ ), petrokemikalije ( $CH_3OH, NH_3, \dots$ ), sintetički benzin i dieselsko gorivo, toplinska (para) i električna energija



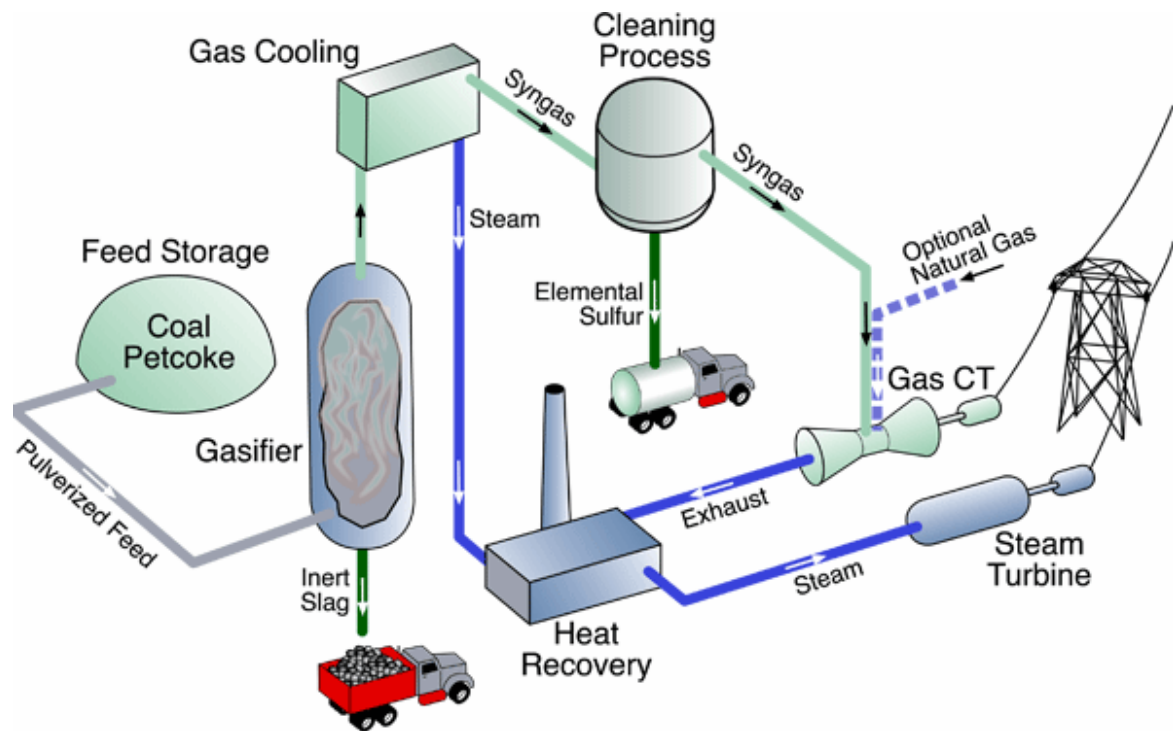
- UGLJEN
- TEŠKI OSTATCI PRERADBE NAFTE
- PRIRODNI PLIN
- BIOMASA

**\*IGCC**

- zrelost tehnologije nije postignuta (komercijalna postrojenja od 1990-tih)
- visoka početna ulaganja
- nepouzdanost - neispunjena očekivanja učinkovitosti i ekonomičnosti
- standardizacija dizajna postrojenja; sirovina, poligeneracija:  $H_2$ ,  $E$ , kemik;
- zbrinjavanje  $CO_2$
- 2015. - 2025. drugi naraštaj IGCC; > 500 MW<sub>e</sub> (iz koksa)



Objedinjavanje preradbe nafte, petrokemijske proizvodnje i proizvodnje energije u modernim rafinerijama na temelju procesa uplinjavanja  
 sintezni plin ( $H_2+CO$ ), petrokemikalije ( $CH_3OH, NH_3, \dots$ ),  
sintetički benzin i dieselsko gorivo, toplinska (para) i električna energija



UGLJEN  
 TEŠKI OSTATCI  
 PRERADBE NAFTE  
 PRIRODNI PLIN  
 BIOMASA

**\*IGCC**

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- zbrinjavanje  $CO_2$
- 2015. - 2025. drugi naraštaj IGCC; > 500 MW<sub>e</sub> (iz koksa)

**PRIRODNI PLIN**

(natural gas)

**UGLJEN**

(coal)

**BIOMASA**

(biomass)

**PROIZVODNJA  
SINTEZNOG  
PLINA, CO + H<sub>2</sub>**

reformiranje  
djelomična oksidacija  
uplinjavanje

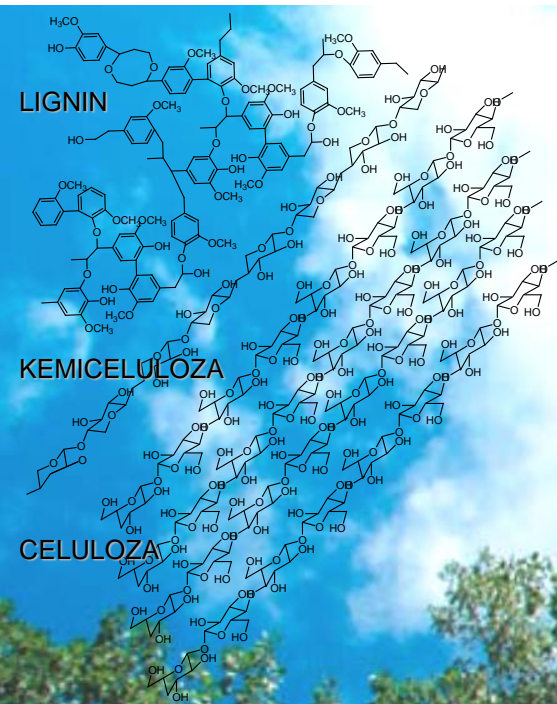
**FISCHER-  
TROPSCHOVA  
SINTEZA**

oligo/polimerizacija  
(-CH<sub>2</sub>-)<sub>n</sub>

**NADOGRADNJA  
PRODUKTA**

**GTL**  
(gas-to-liquid/plin-u-kapljevinu)  
**CTL**  
(coal-to-liquid/ugljen-u-kapljevinu)  
**BTL**  
(biomass-to-liquid/biomasa-u-kapljevinu)

**sintetska goriva**

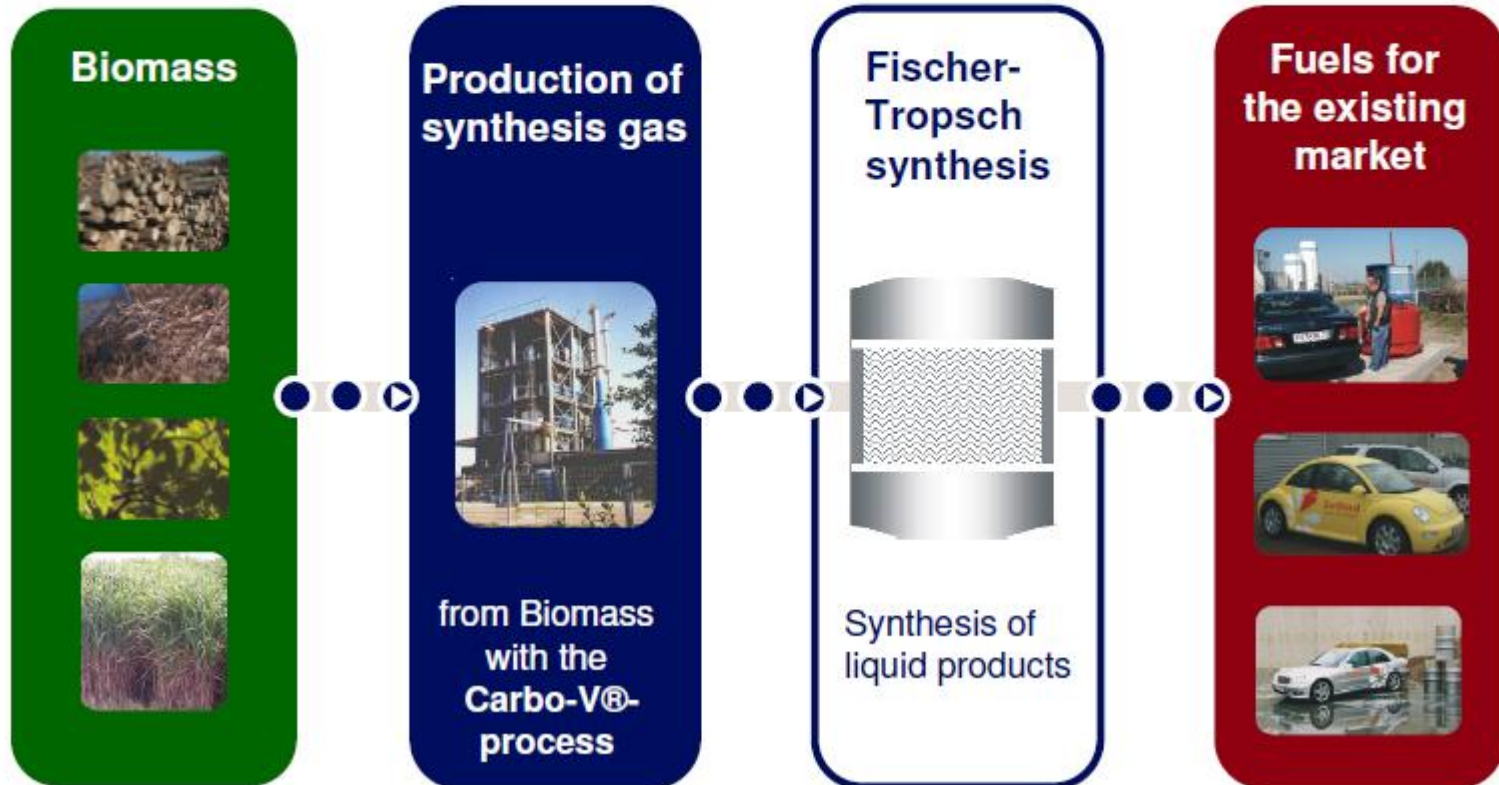


- ▶ reduces dependence on imported oil;
- ▶ is renewable and largely CO<sub>2</sub>-neutral;
- ▶ can be produced and consumed locally and therefore creates a future for rural regions;
- ▶ can be directly fed into the infrastructure of existing distribution channels and is suitable for long-distance transportation and storage;
- ▶ can be used in existing engines, but can also be further developed for more sophisticated engines;
- ▶ has a high energy density (40 MJ per liter);
- ▶ is an extremely clean automotive fuel: no sulfur and no aromatic hydrocarbons;
- ▶ causes significantly fewer exhaust gas emissions than traditional fossil fuels;
- ▶ can be manufactured from a very broad range of feed materials;
- ▶ has a high yield/ha

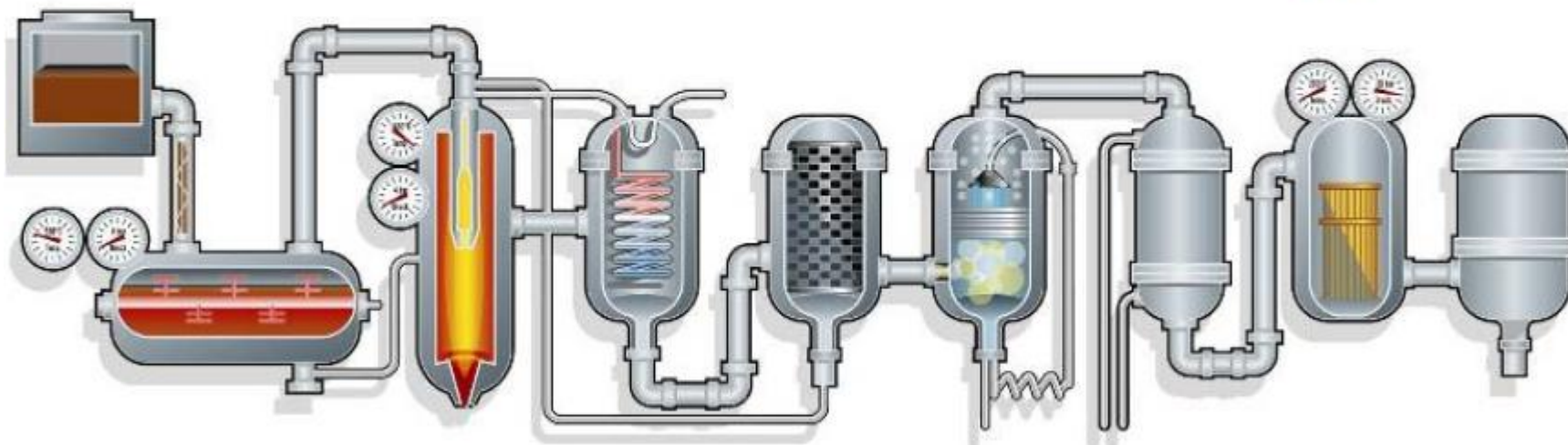
# What is SunDiesel?



## Production process



# The BTL process



Three Phase  
Gasification

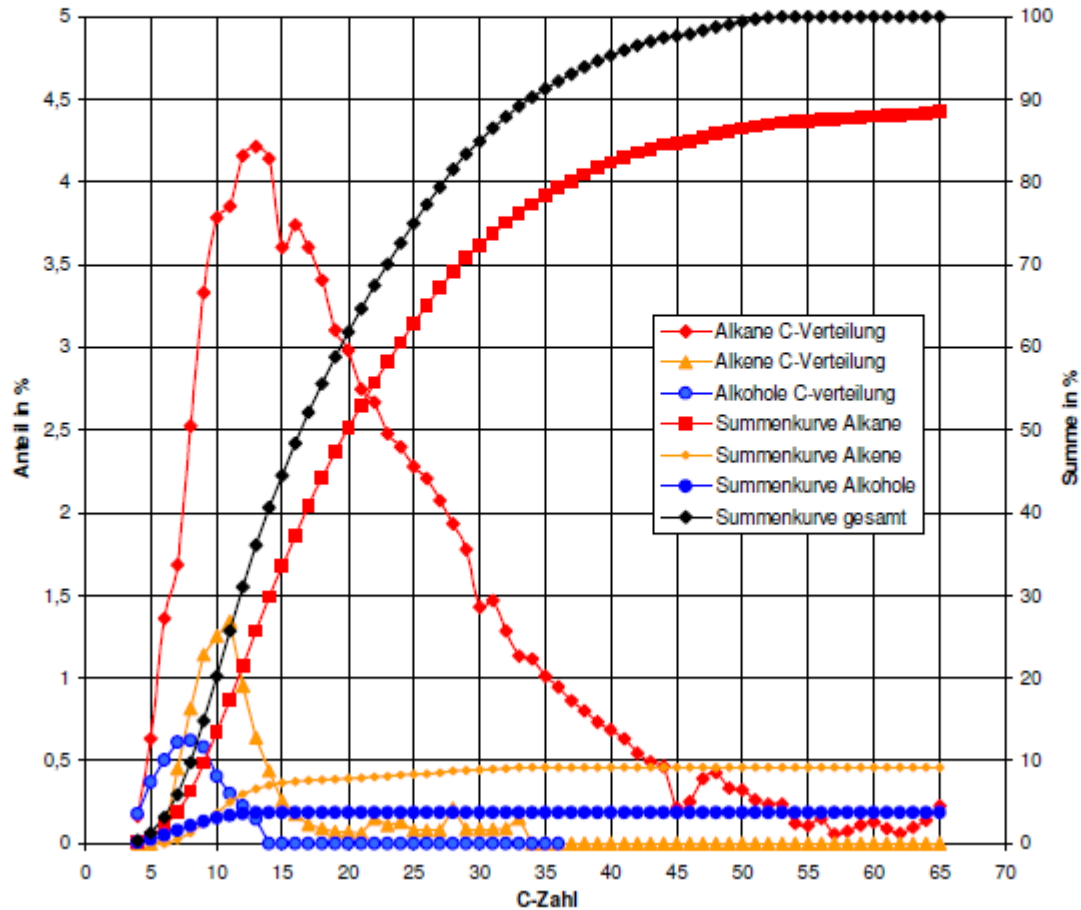
Gas Treatment

Fischer-Tropsch &  
Hydrocracking

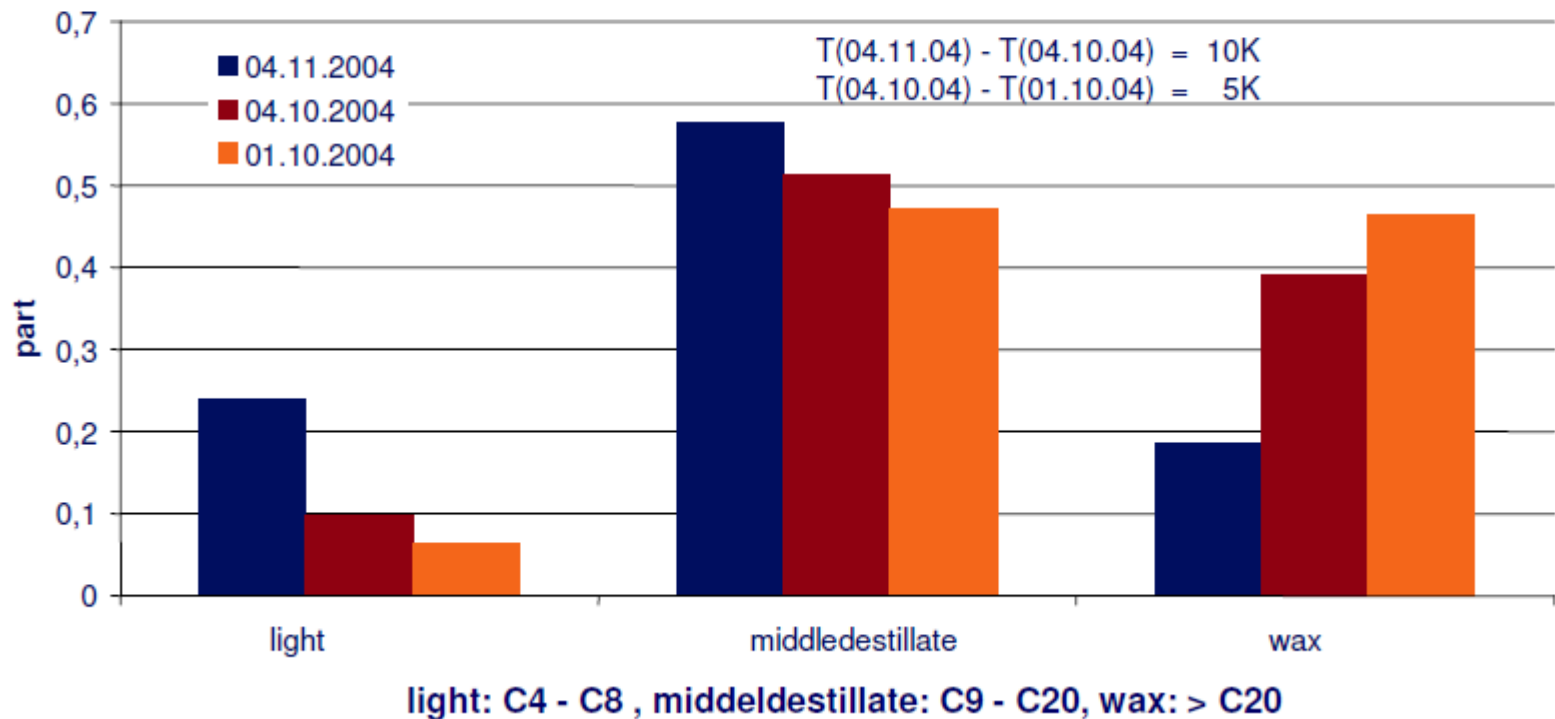
# CHOREN FT- raw product (example)



FT-Rohprodukt - C-Verteilung  
Probenahme 04.10.2004



# FT raw product = f (temperature)



## General

- ▶ Sulphur: zero ( $\ll 10$  ppm)
- ▶ Low aromates
- ▶ High H/C-ratio
- ▶ Low density

## Diesel

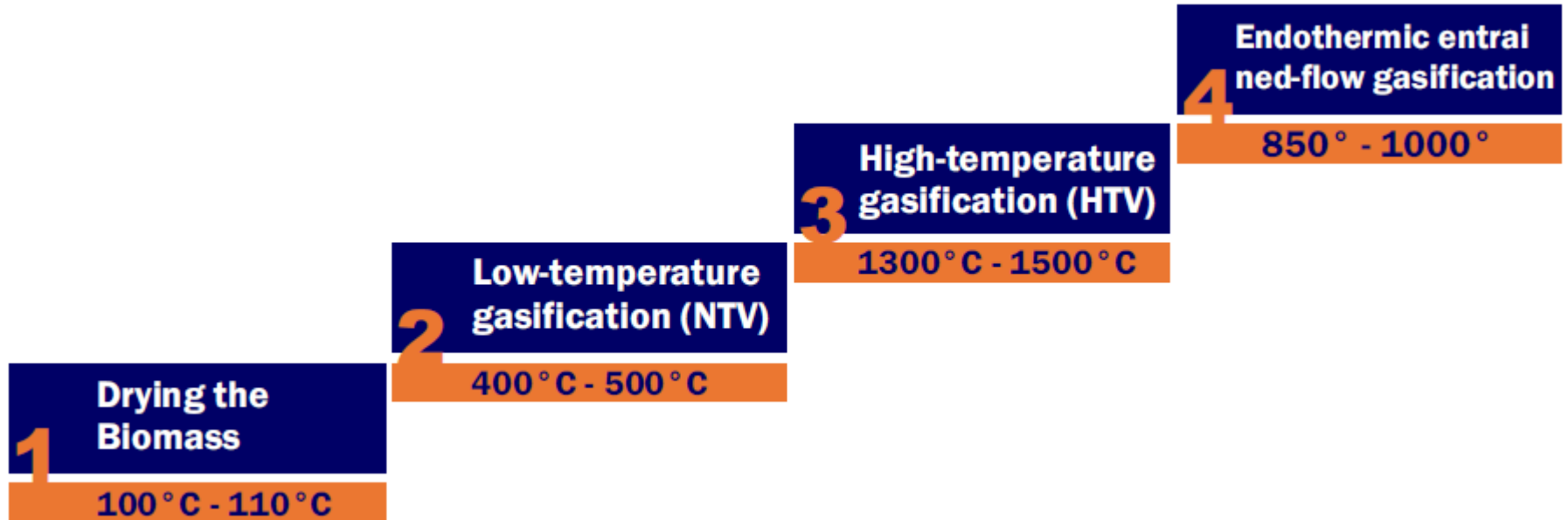
- ▶ High Cetane No.:  $> 60$

## Naphtha

- ▶ Diesel-like Cetan No. at low boiling range:  
=> good opportunities for HCCI/CCS-systems

The **Carbo-V<sup>®</sup> Process** is a **multi-stage gasification process** involving the following

**PROCESS STEPS:**

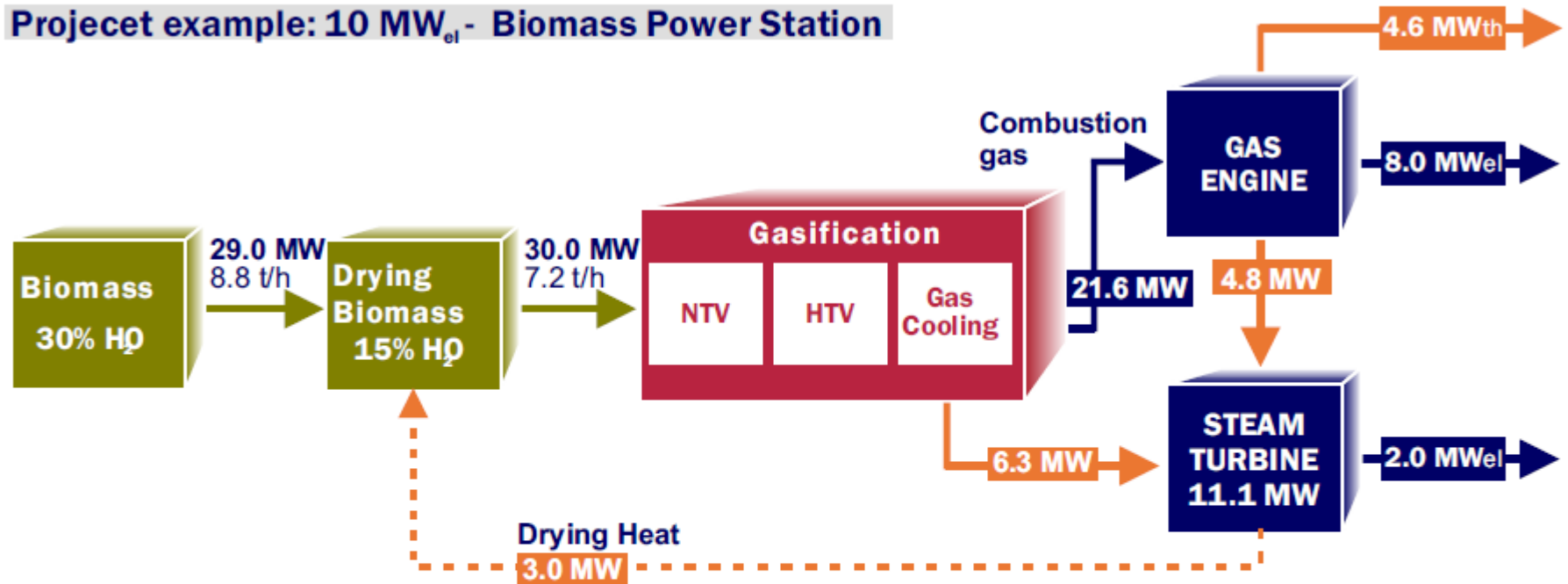


**Start-up of the first commercial  
BTL production facility**

CHORENs BETA-Plant Freiberg

# ENERGY STATEMENT AND DEGREES OF EFFICIENCY

Project example: 10 MW<sub>el</sub> - Biomass Power Station



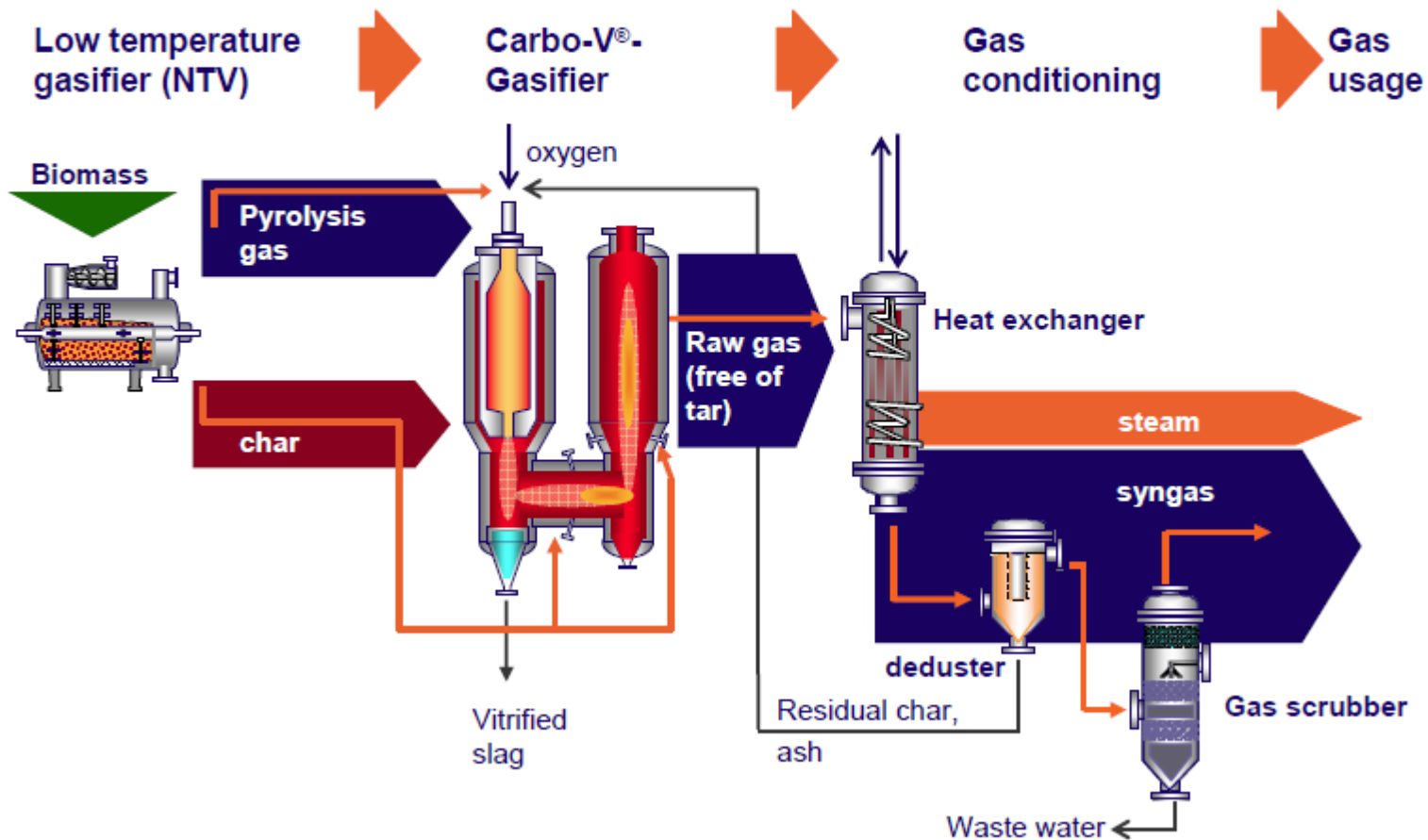
## Input - Output

Biomass	=	29.0 MW
Other fuels	=	0.2 MW
Electricity required	=	0.8 MW
<b>Total input</b>	=	<b>30.0 MW</b>
Electricity output	=	10.0 MW
Heat output	=	4.6 MW

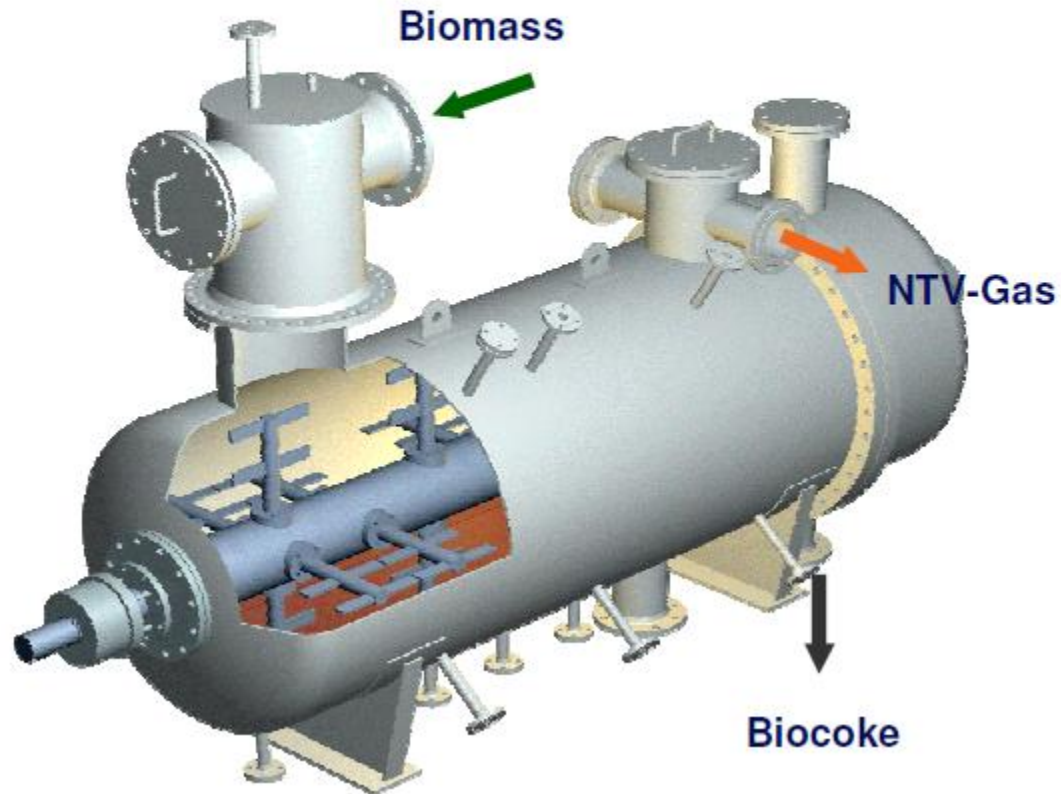
## Net Degree of Efficiency

Cold gas	=	72.0%
Electrical	=	33.3%
Thermal	=	15.3%
<b>Total</b>	=	<b>48.7%</b>

# The Carbo-V<sup>®</sup> Process



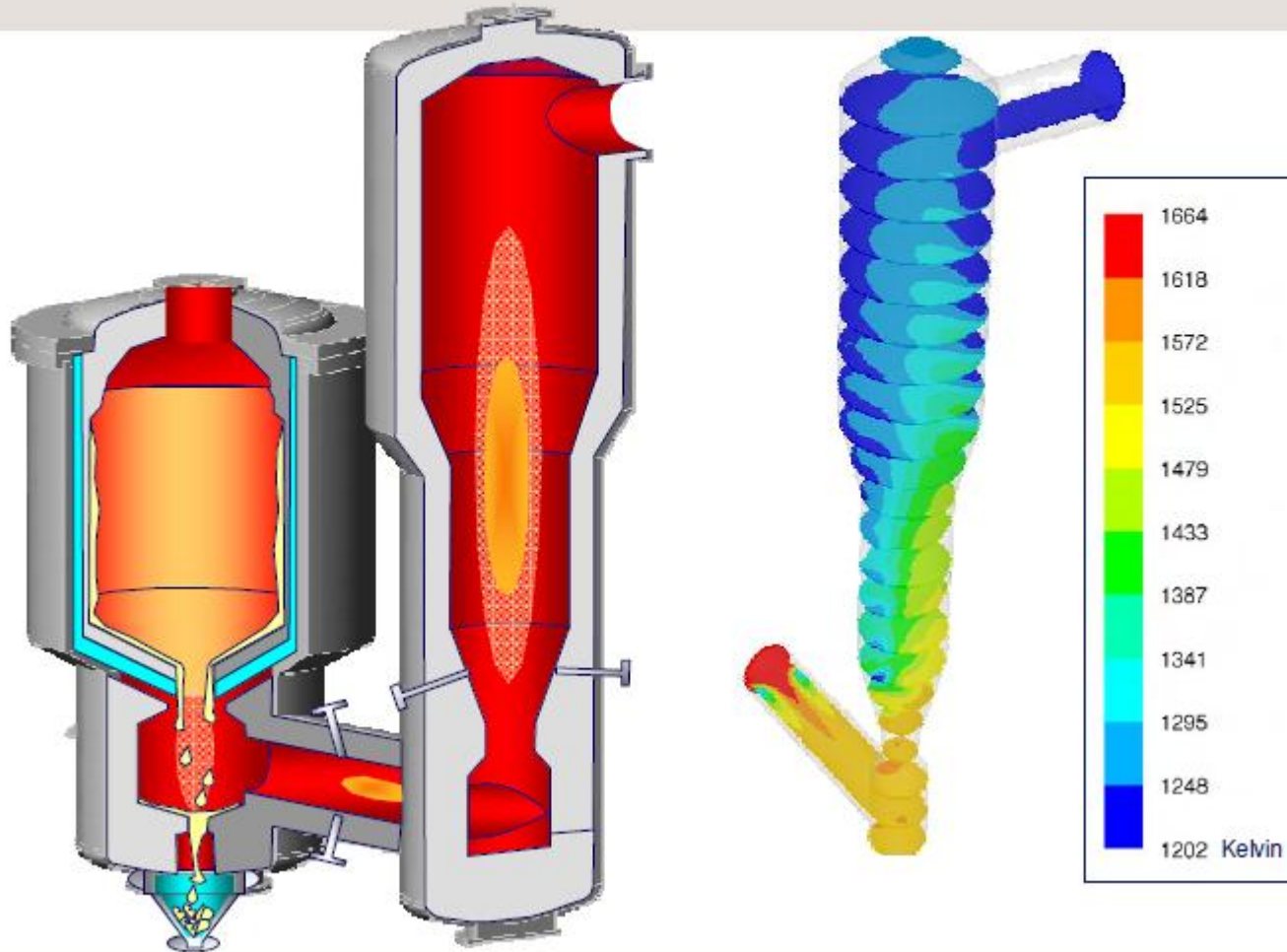
# Low Temperature Gasification (NTV) Pyrolysis



# Low Temperature Gasification (NTV) Pyrolysis



# High Temperature Gasification (HTV) Tar Oxidation and endothermic quench

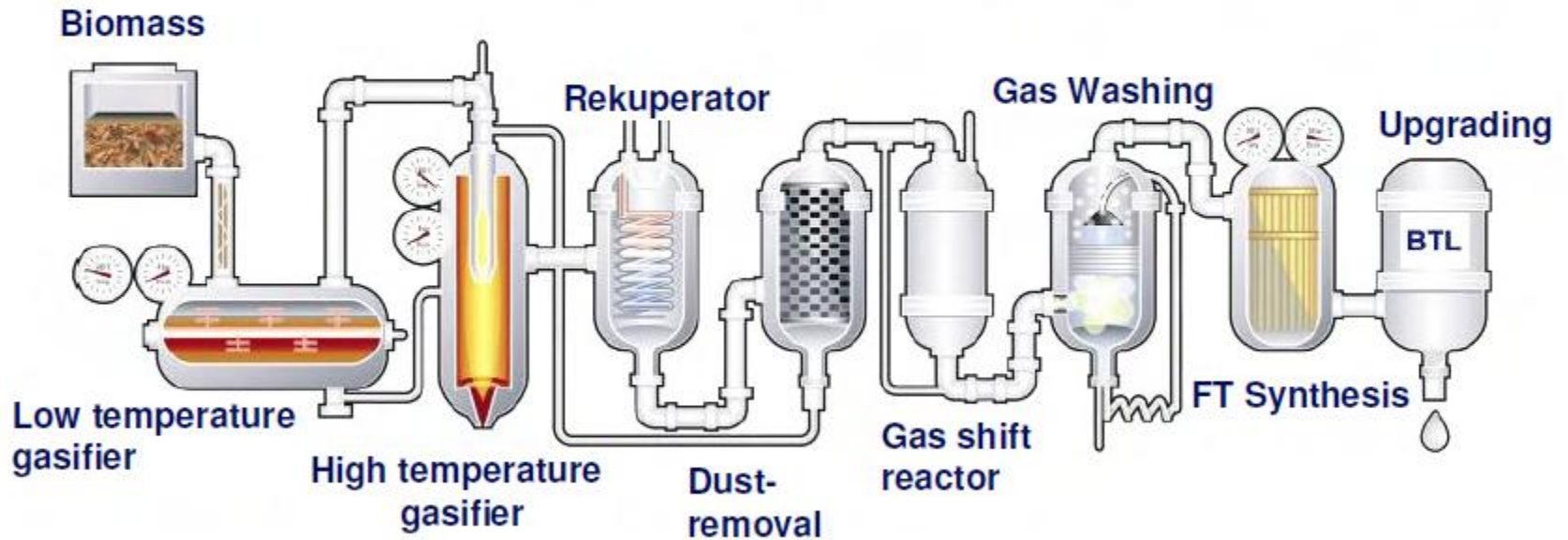


# High Temperature Gasification (HTV) Tar Oxidation and endothermic quench



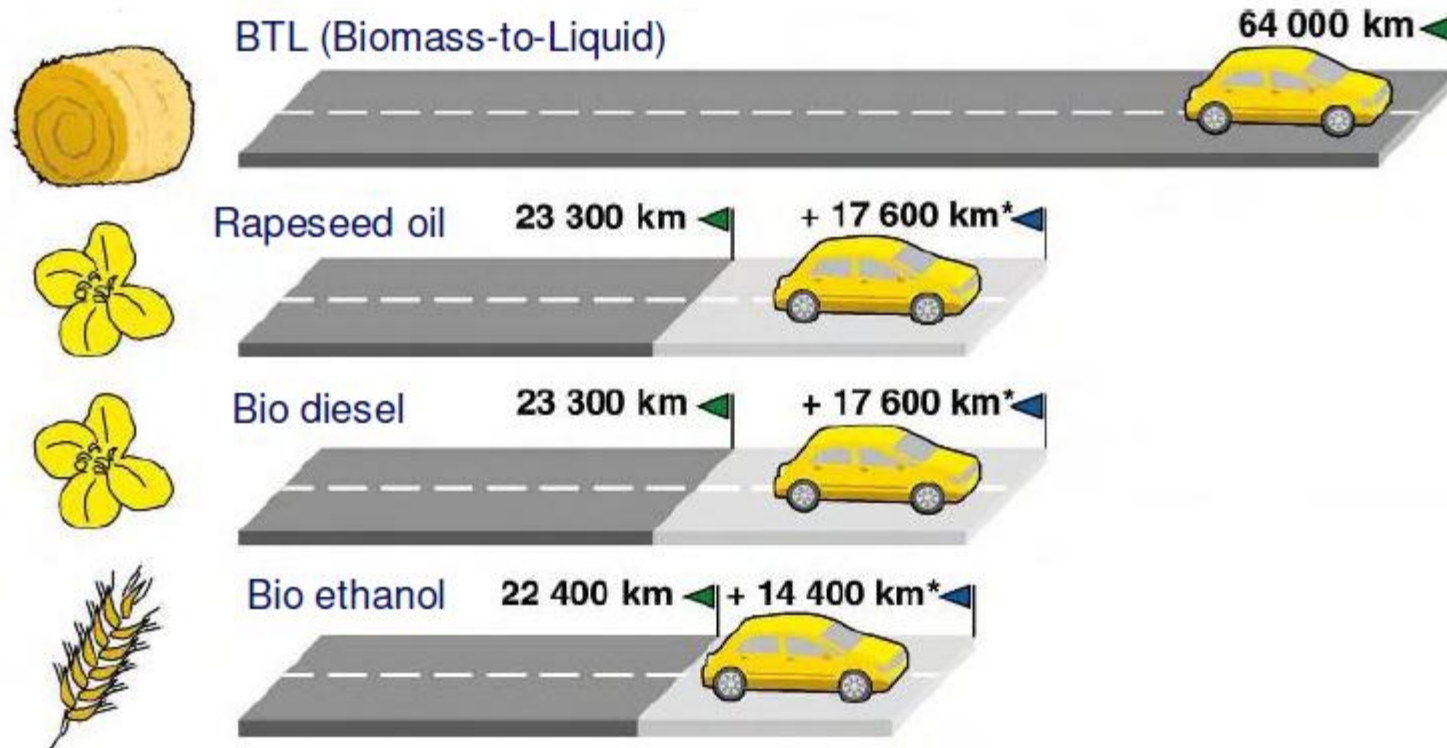
# BTL production

## From Biomass to BTL



# Comparison of Bio Fuels

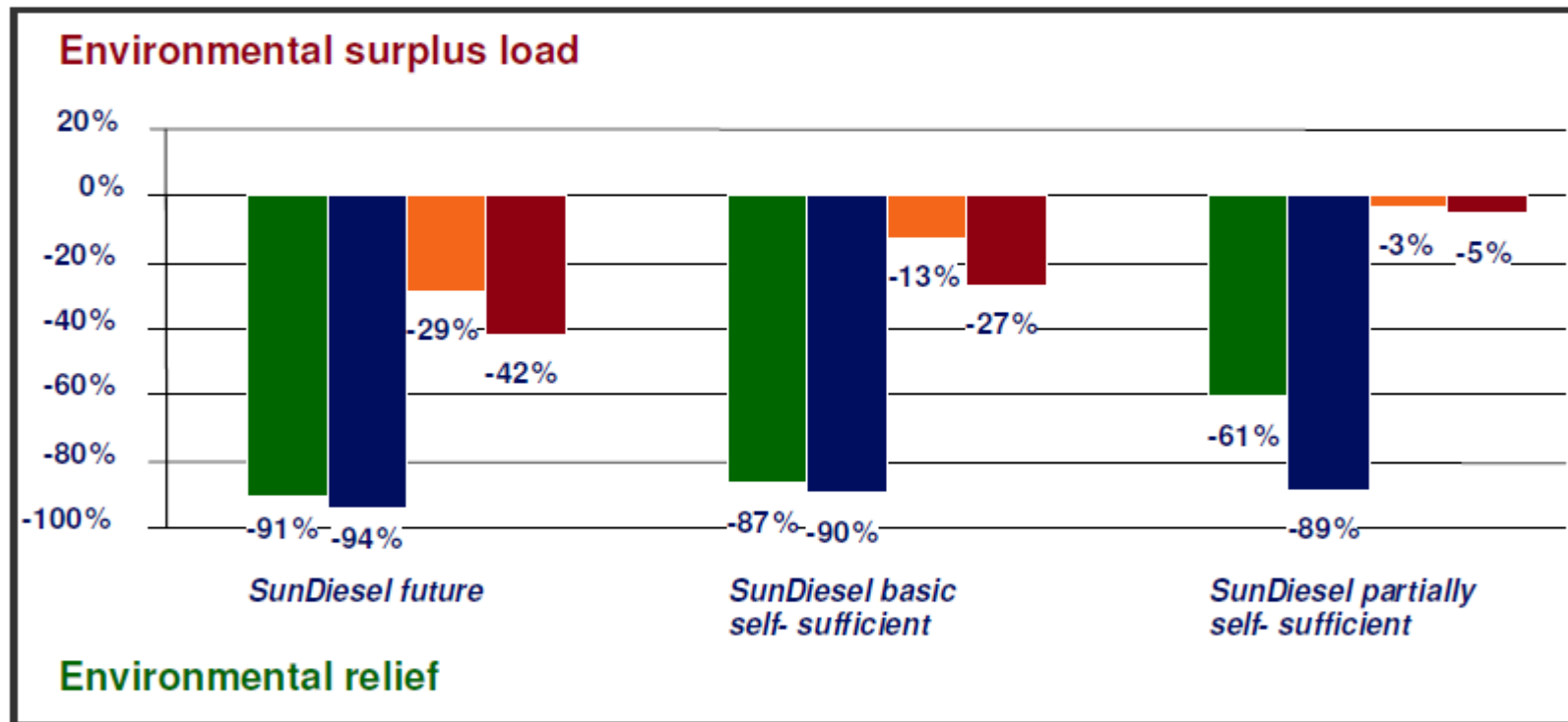
The Distance a car can reach filled with Bio Fuels from 1 ha acreage



Automotive Fuel Consumption: Otto 7.4 l / 100km, Diesel 6.1 l/100km

# Effects on the environment

## Using BTL instead of fossil diesel



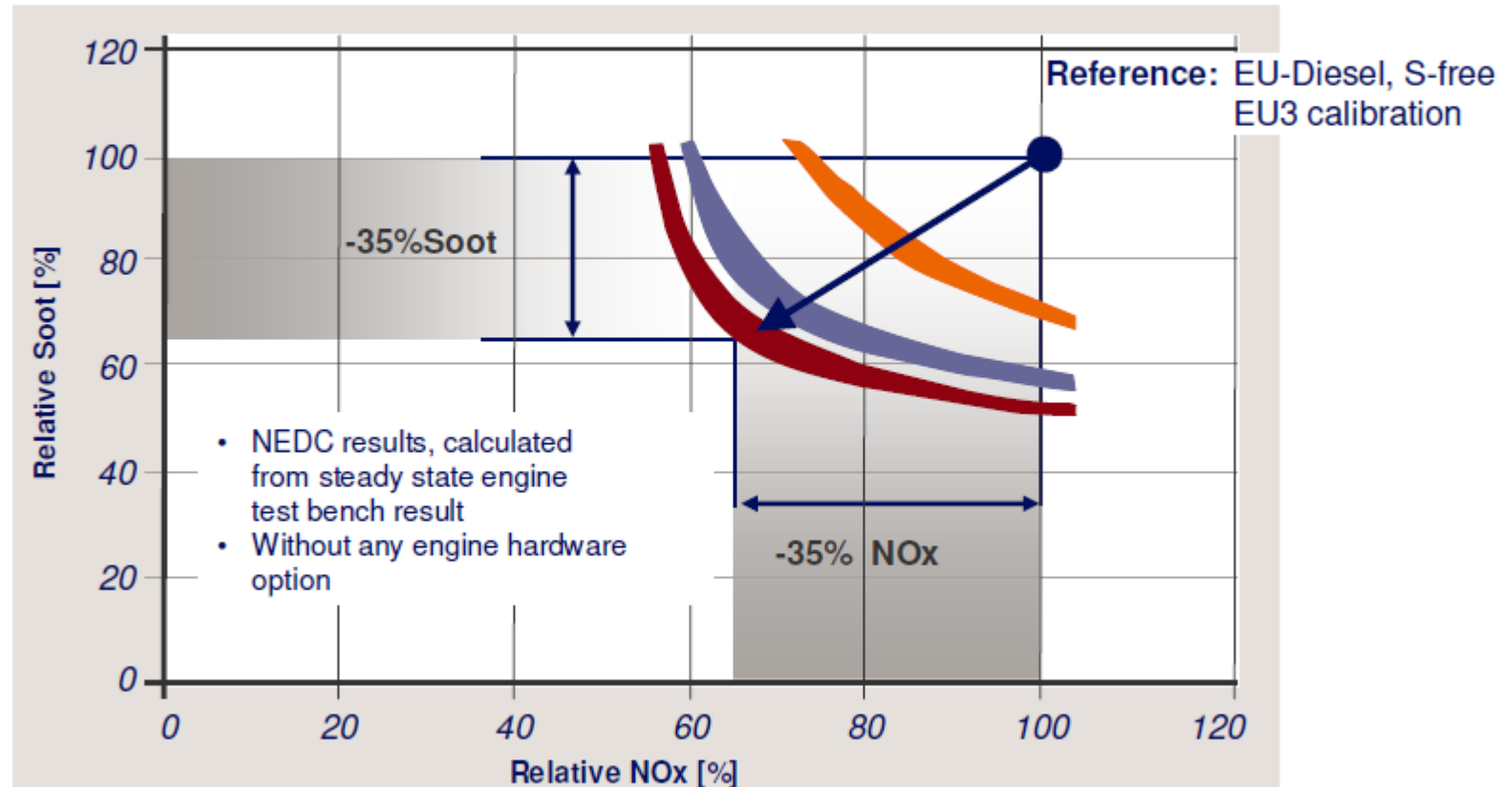
■ greenhouse gases potential [kg CO<sub>2</sub>-equivalent]  
■ photo-oxidations potential [kg ethene-equivalent]

■ eutrophication potential [kg phosphate-equivalent]  
■ over-acidic potential [kg SO<sub>2</sub>-equivalent]

# NO<sub>x</sub>-Soot Trade-Off



## GTL blending effects



Source: DaimlerChrysler, P. 11, Fig. 8

■ GTL

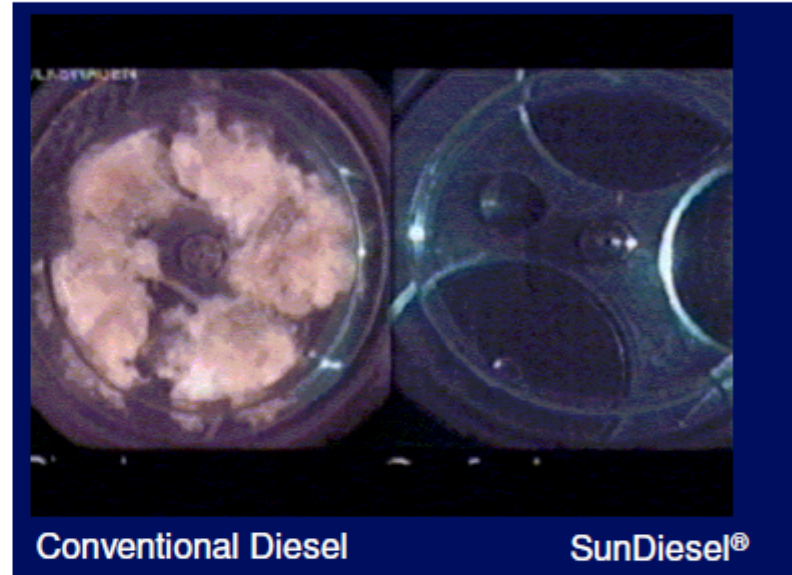
■ EU50-GTL50

■ EU80-GTL20

# SunDiesel® – made by CHOREN



- ▶ can be directly fed into the existing infrastructure
- ▶ can be used in existing engines, but also in more sophisticated engines
- ▶ is renewable and largely CO<sub>2</sub>-neutral
- ▶ is extremely clean: no sulphur and no aromatic hydrocarbons
- ▶ has a high cetane number
- ▶ causes significantly fewer exhaust gas emissions than traditional fossil fuels
- ▶ has a high yield/ha
- ▶ has a high energy density (40 MJ per litre)



**Trademark information:** Trademarks SUNDIESEL® and SUNDIESEL®-Logo are registered trademarks by Volkswagen Aktiengesellschaft in the European Community and additional Countries and are used under license of Volkswagen Aktiengesellschaft.

# Beta-Plant Freiberg: BTL Production in Industrial Scale



1 Biomass conditioning

2 Biomass storage

3 Biomass dryer

4 Carbo-V® gasifier

5 Power station

6 Gas conditioning & Fischer-Tropsch synthesis

7 Compressor building

8 Storage for offsite & utility gases



Višestupnjeviti proces:

1. Sušenje biomase
2. Niskotemperaturno uplinjavanje, 400-500 °C
3. Visokotemperaturno uplinjavanje, 1300-1500 °C
4. Endotermno uplinjavanje, 850-1000 °C

◉ 45 MW thermal

◉ 65,000 t<sub>DM</sub>/a feedstock

◉ 18 Million Liter BTL

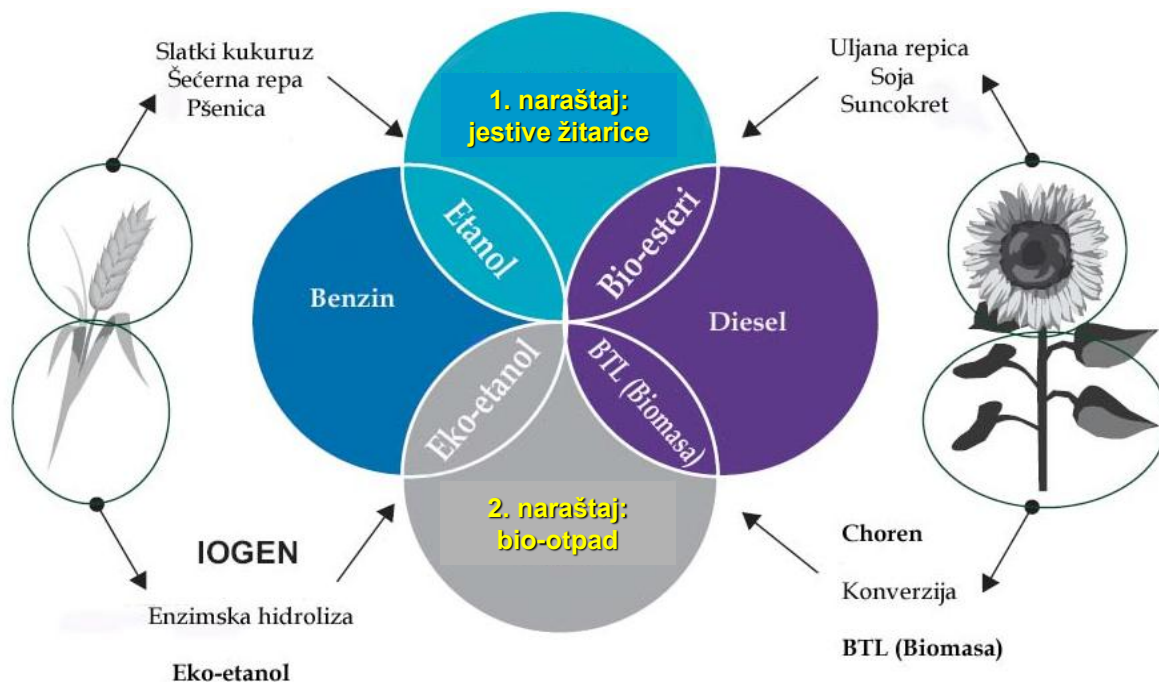
# Obnovljivi diesel (Renewable Diesel)

Proizvodnja dieselskog goriva vrhunske kvalitete iz obnovljive bio-sirovine.

“**Biodiesel (FAME)**” = transesterifikacija biljnih ulja i masti.

“**Zeleni diesel**” = katalitička hidrokonverzija smjese dieselskih frakcija i biljnih ulja u rektoru za hidroobradbu pri visokim temperaturama i visokom tlaku vodika. Trigliceridi iz biljnih ulja ili životinjskih masti prevode se u linearne ugljikovodike koji čine dieselsko gorivo upotrebljivo u nepreinačenim motorima s unutarnjim izgaranjem.

“**BTL-diesel**” = proizvodi se postupkom “biomasa-u-kapljevinu” (Biomass-to-Liquid), višestupnjevitim procesom: uplinjavanje / Fischer-Tropschova sinteza / hidroobradba.



Svojstvo goriva	Biodiesel: FAME	Zeleni Diesel	BTL-Diesel	Mineralni / Fosilni Diesel (EN 590)
Gustoća pri 15 °C (kg/m <sup>3</sup> )	885	775 - 785	770 - 785	835
Viskoznost pri 40 °C (mm <sup>2</sup> /s)	4.5	2.9 - 3.5	3.2 - 4.5	3.5
Cetanski broj	51	84 - 99	73 - 81	53
Destilacija 10 vol. % (°C)	340	260 - 270	260	200
Destilacija 90 vol. % (°C)	355	295 - 300	325 - 330	350
Točka zamućenja (°C)	-5	- 5 to -30	0 to -25	-5
Niža ogrjevna vrijednost (MJ/kg)	38	44	43	43
Niža ogrjevna vrijednost (MJ/l)	34	34	34	36
Poliaromati (mas. %)	0	0	0	8
Kisik (mas. %)	11	0	0	0
Sumpor (ppm)	<10	0	<10	<10

**SIROVINA:**

**Biljna ulja**

**Biljna ulja**

**Biomasa  
(otpadna)**

**PROCES:**

**Esterifikacija**

**Hidroobradska**

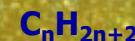
**Uplinjavanje  
F-T sinteza  
Hidroizomerizacija**

**PROIZVOD:**

**FAME  
Biodiesel**

**Zeleni diesel**

**BTL-diesel**



**Esteri**

**Parafini**

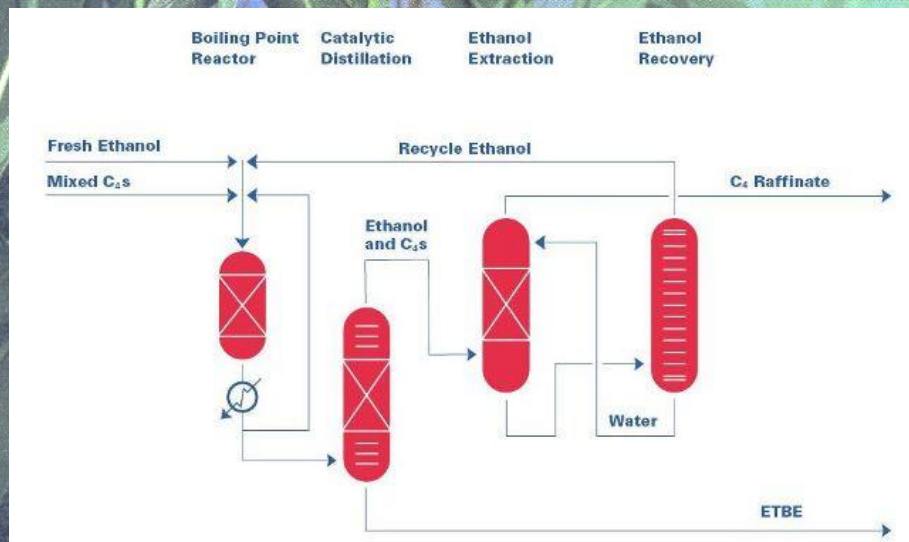
**Parafini**

# Bio-oksigenati motornih benzina

Proizvodnja Bio-ETBE, sastavnice i poboljšavala oktanskog broja motornih benzina.

Bio-ETBE ( $C_6H_{14}O$ ) = katalitička esterifikacija bio-etanola (47 vol. %) i izobutilena (53 vol. %). Izobutilen se može izdvojiti iz rafinerijskih tokova i dodatno proizvesti katalitičkom dehidrogenacijom izobutana.

Bio-ETBE, za razliku od etanola, nije mješljiv s vodom.



# ZAKLJUČNO

- široki raspon zamjenskih obnovljivih goriva prema kemijskom sastavu, svojstvima, tehnologijama proizvodnje
- nužan stručno usmjeren i interdisciplinarnan pristup u kreiranju energijskih strategija u skladu s postojećim resursima  
(zalihe fosilne i bio sirovine, postojeća industrija, infrastruktura...)  
i obvezujućim / nametnutim ? / zakonodavstvom (CO<sub>2</sub>, obnovljivi izvori...)





Hvala na pažnji !