ENERGIJA VETRA

ENERGIJA VODE

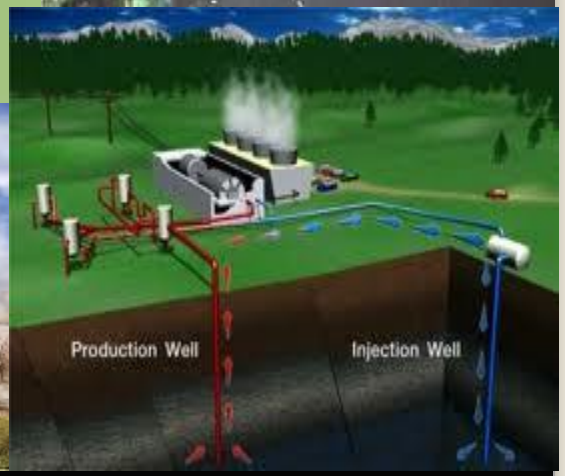
GEOTERMALNA ENERGIJA

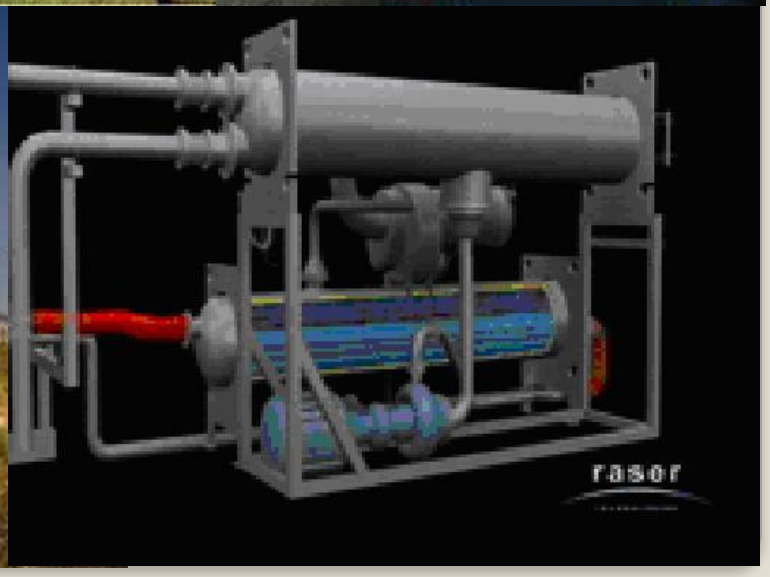
BIO ENERGIJA

ENERGIJA SUNCA

Obnovljivi izvori energije

Intake
Canal
Forebay
Penstock
Powerhouse


Production Well
Injection Well


rasor

Obnovljivi izvori energije

Izborni predmet – V semestar – 2+2+1 – 5 kredita (2OEU5C03)

Modul US - 2018/19.

Izborni predmet – V semestar – 2+2+1 – 5 kredita (2OEE5A05)

Modul E - 2018/19.

Izborni predmet – V semestar – 2+2+1 – 5 kredita (2OEM5A04)

Modul EKM - 2018/19.

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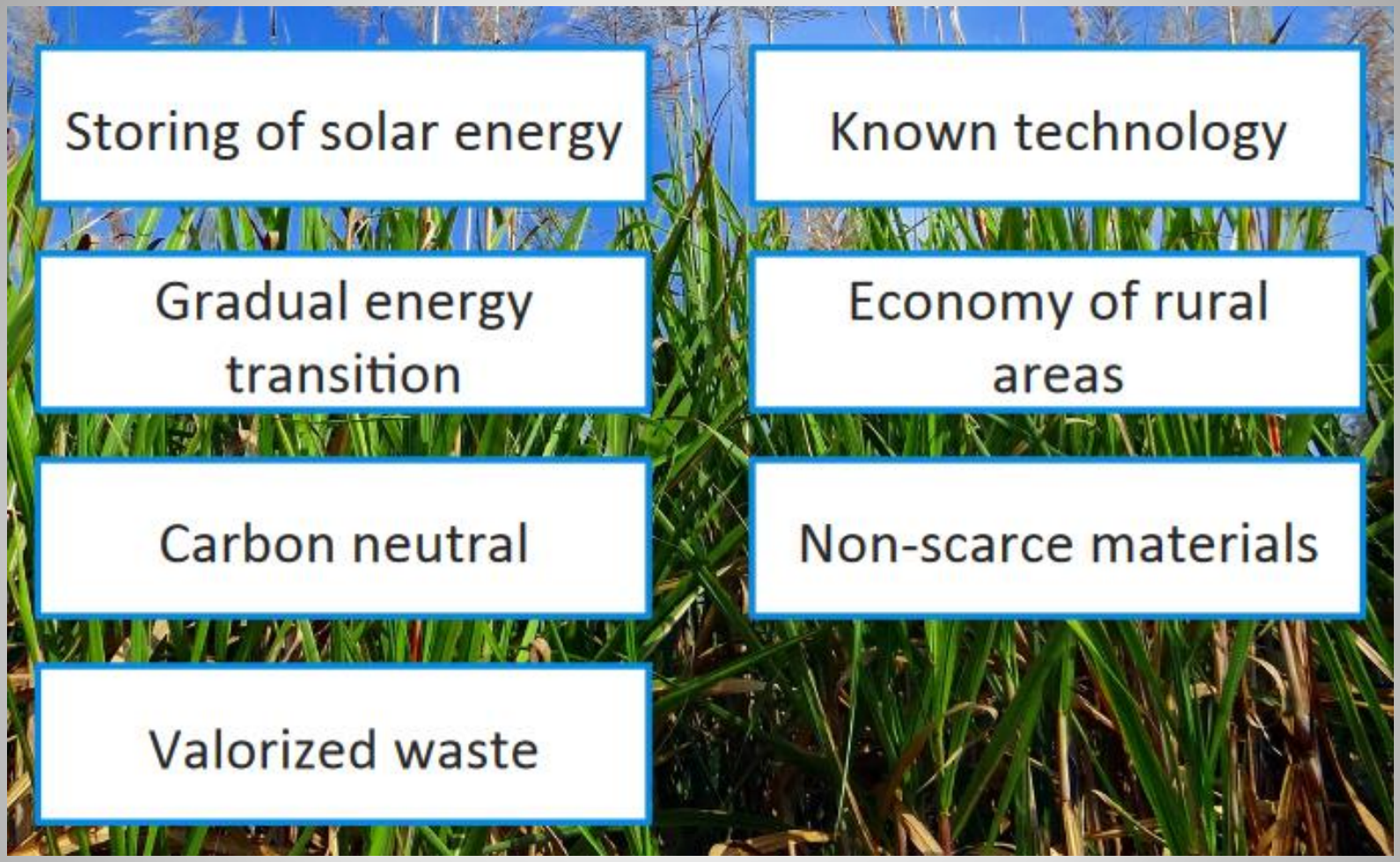
Prof. dr Dragan Mančić, M2-4, dragan.mancic@elfak.ni.ac.rs

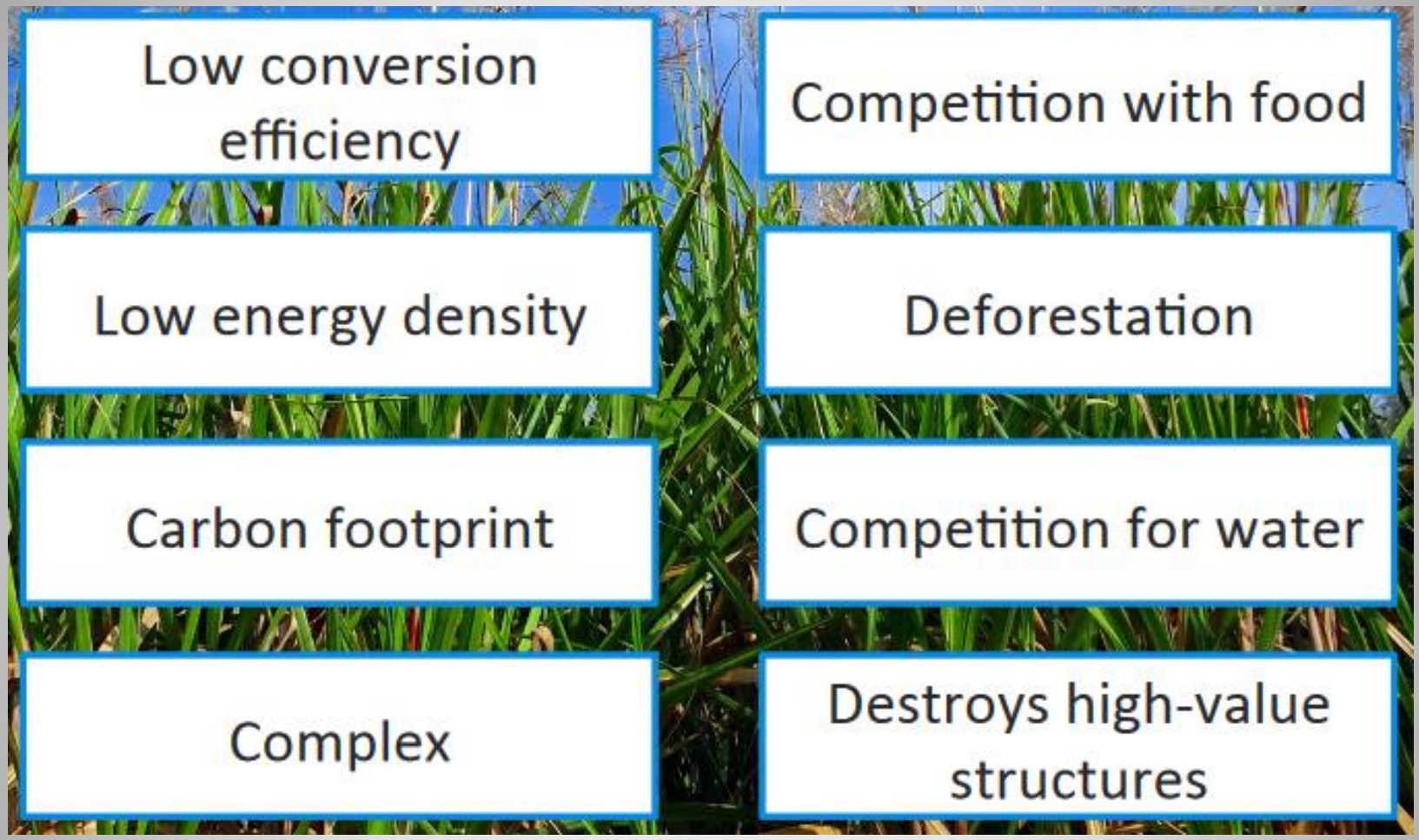
Energija biomase

Šta je biomasa?

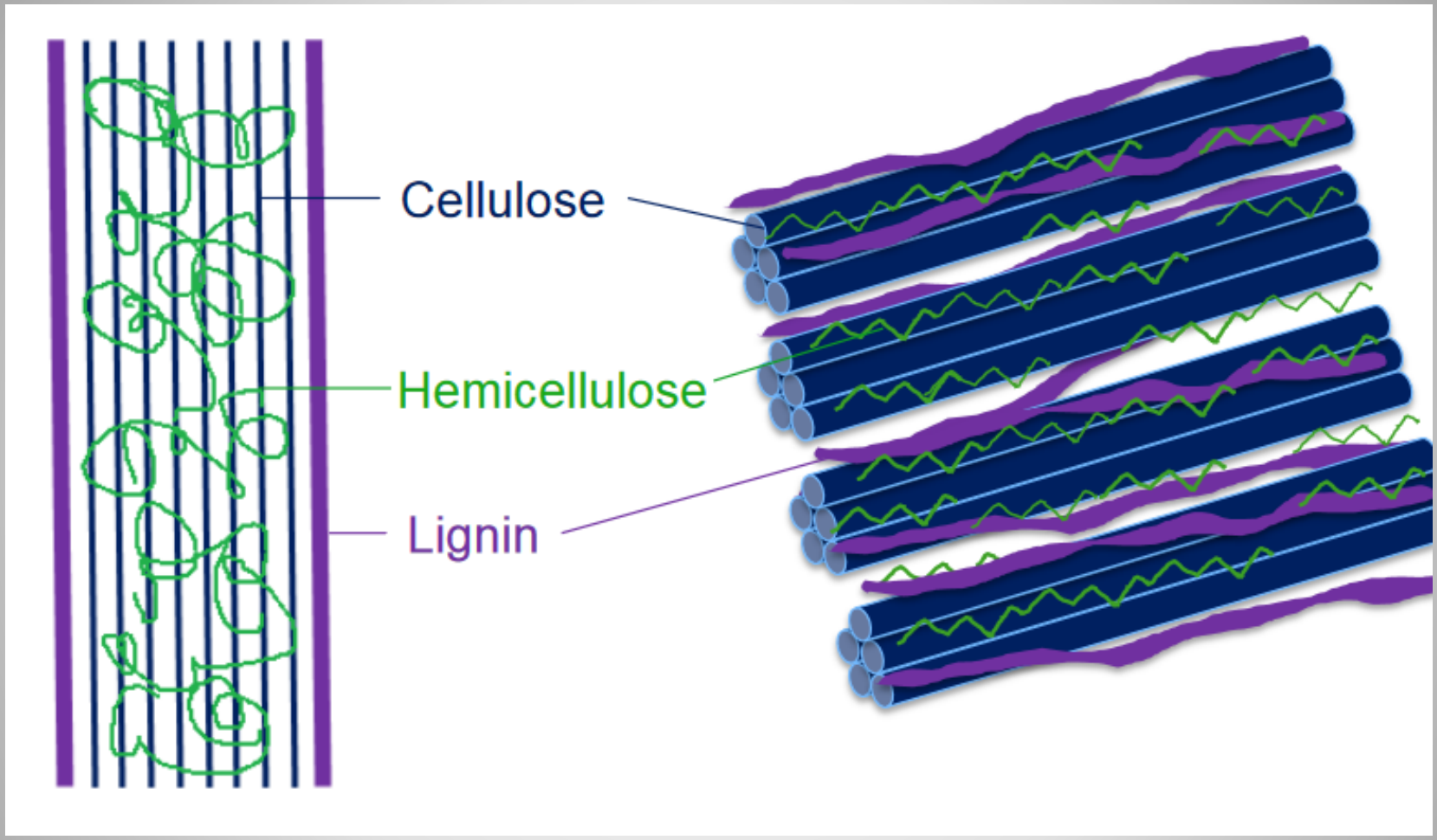
- Predstavlja prvobitni izvor energije
- Organski materijali koji imaju energetsku vrednost koja se može pretvoriti u gorivo ili direktno u toplotnu energiju
- I danas se još uvek dominantno koristi na tradicionalan način (direktno sagorevanje, a ne prerada u tečno ili gasovito gorivo)
- Biomasa se može koristiti kao:
  - Čvrsto gorivo: drvo, pelet
  - Tečno gorivo: bioetanol, biodizel, bioulja
  - Gasovito gorivo: biogas, vodonik



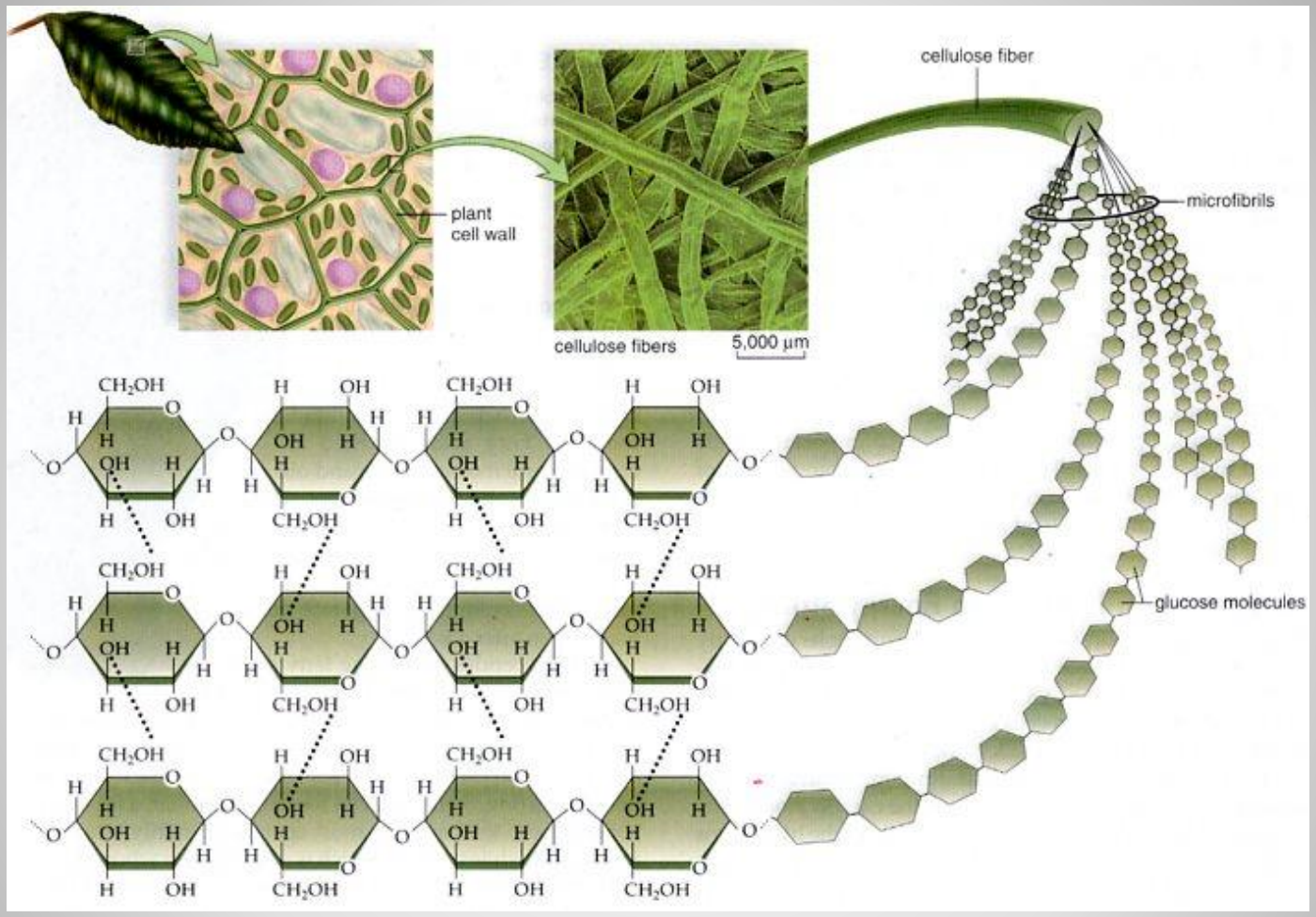
Prednosti biomase



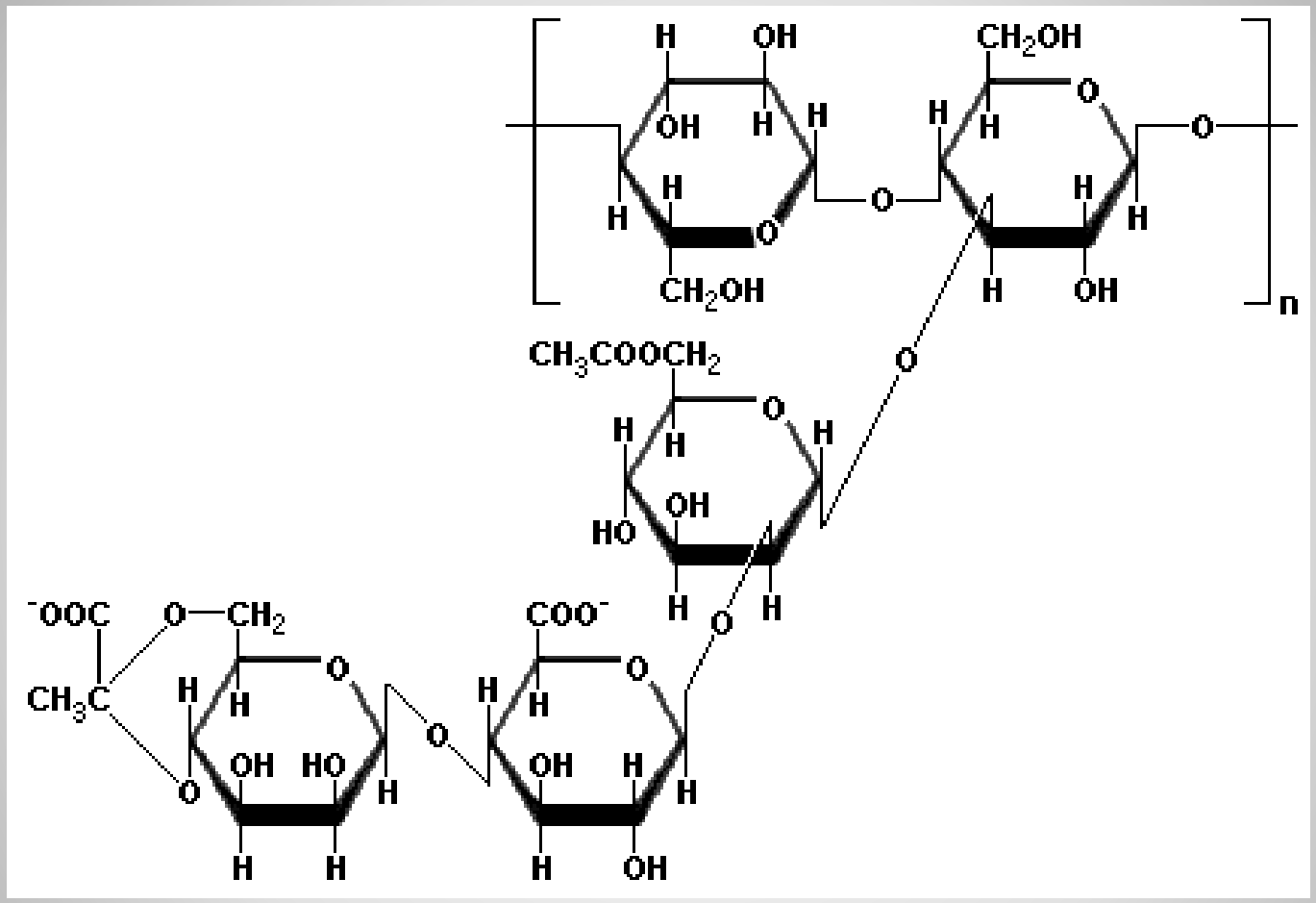
Nedostaci biomase



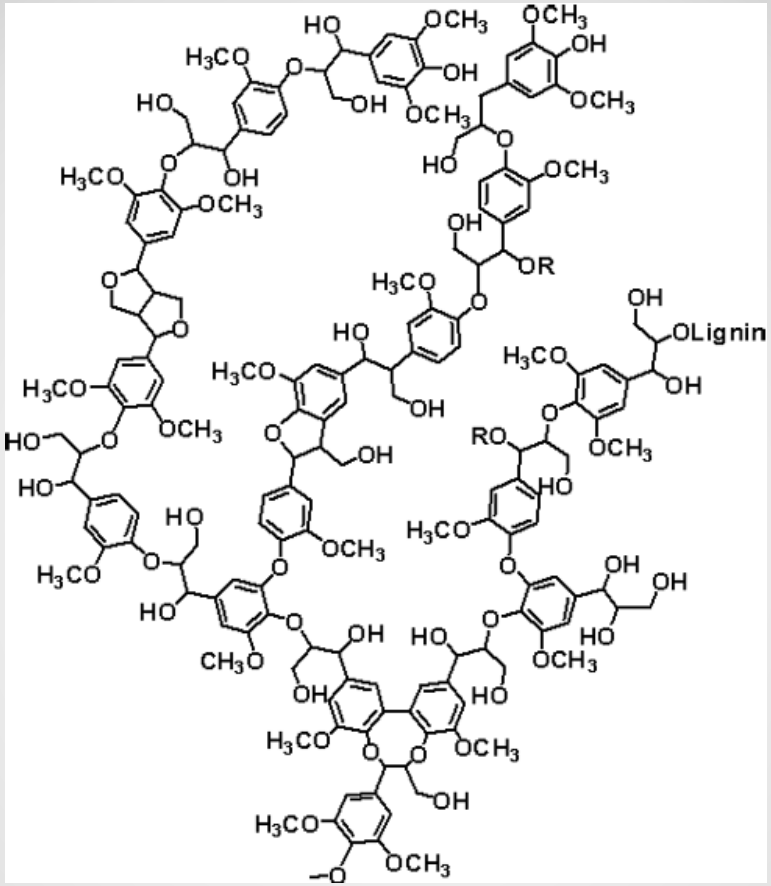
Sastav biomase


plant
cell wall
cellulose fibers
5,000 µm
cellulose fiber
microfibrils
glucose molecules

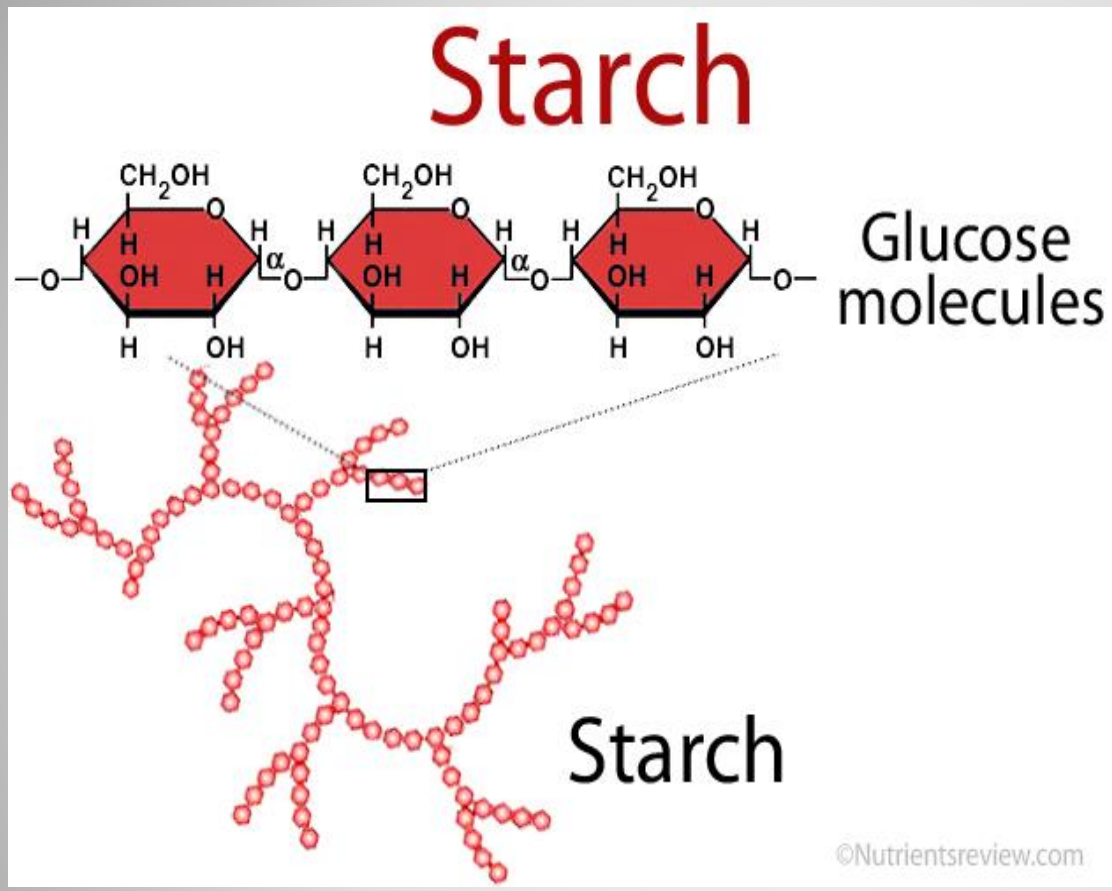
Celuloza



Hemiceluloza



Lignin



Skrob

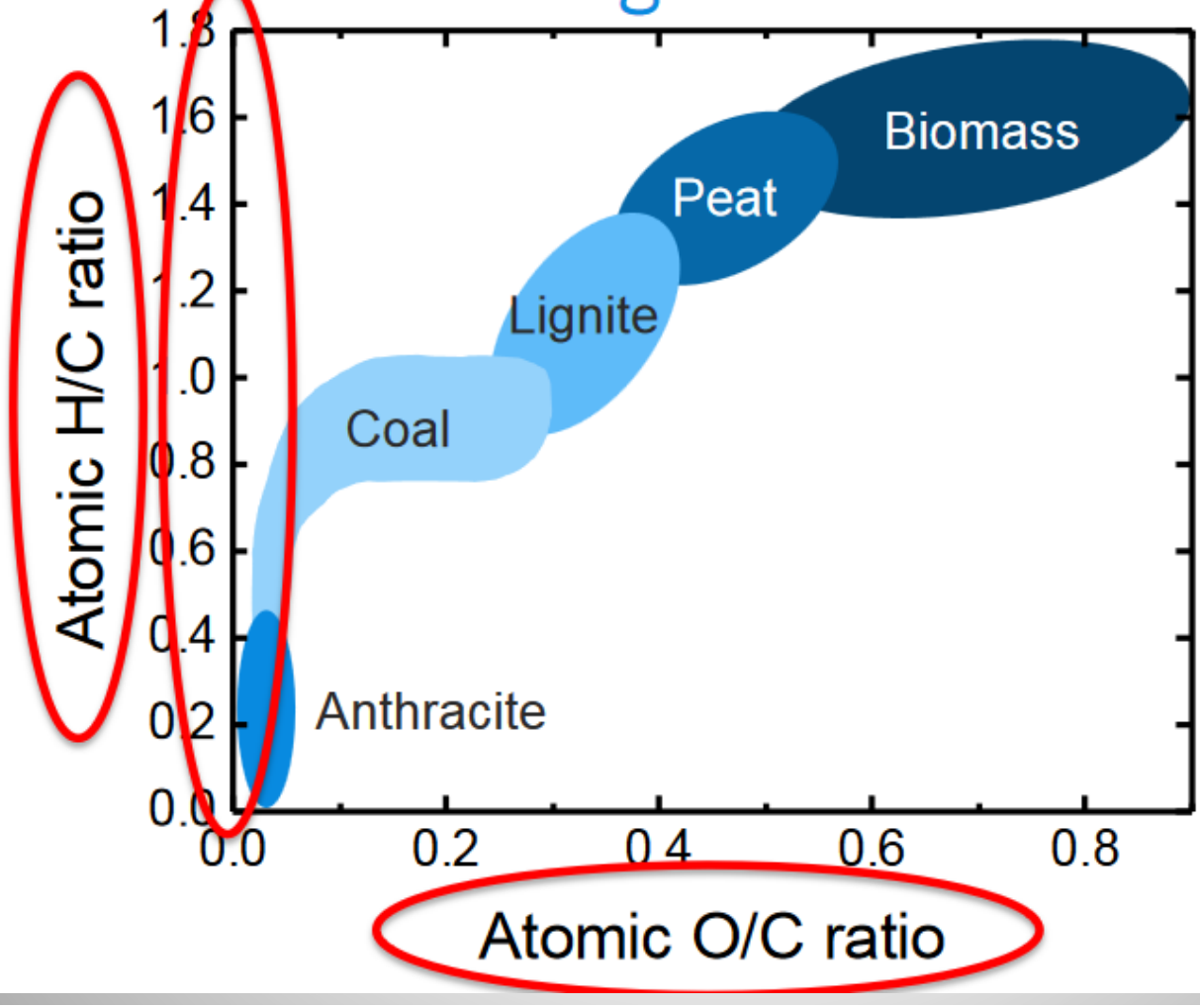
First Generation

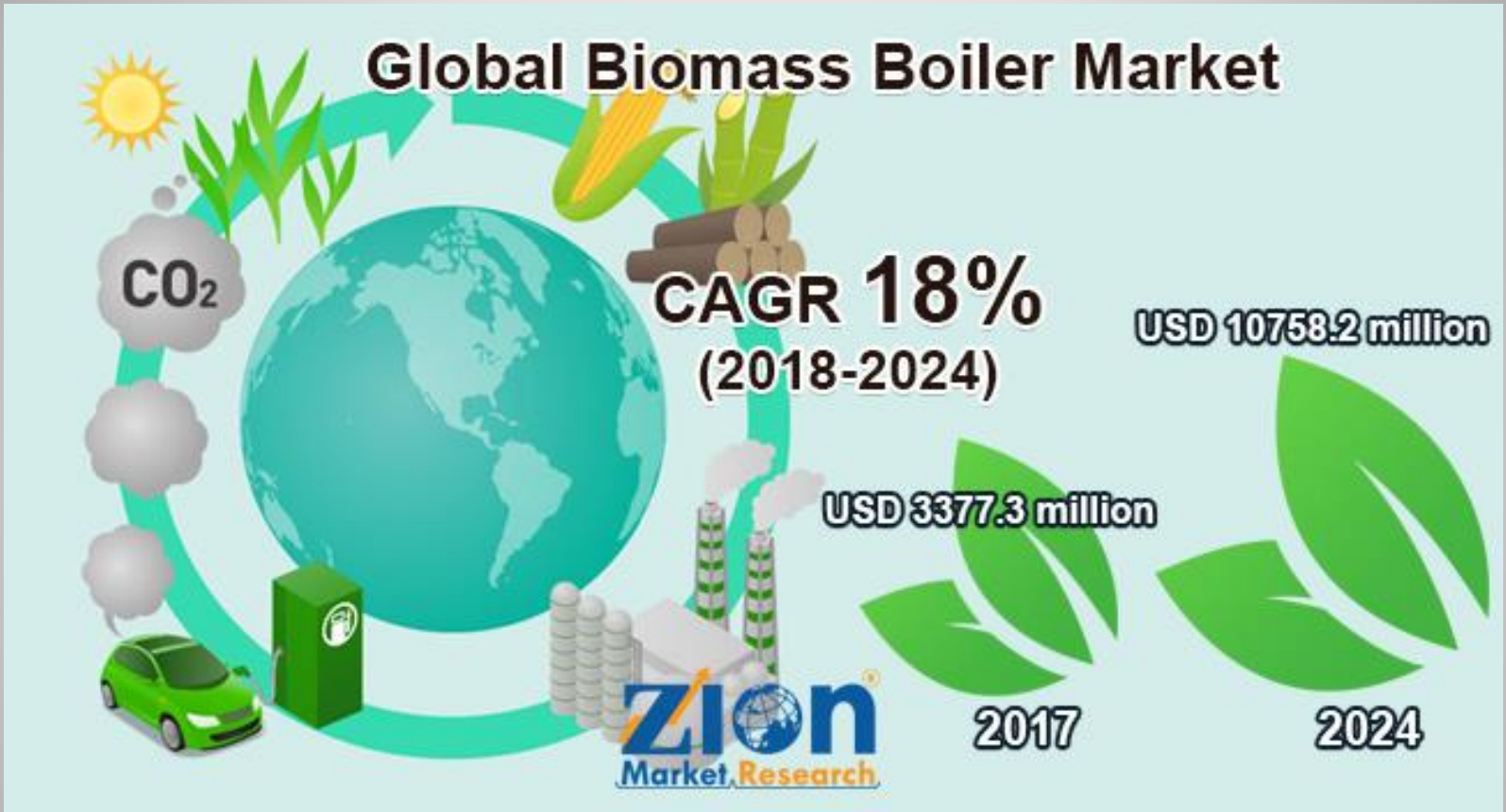
Second Generation

Third Generation

Tipovi biogoriva

Van Krevelen diagram





Globalno tržište biomase

Heat (and light) generation

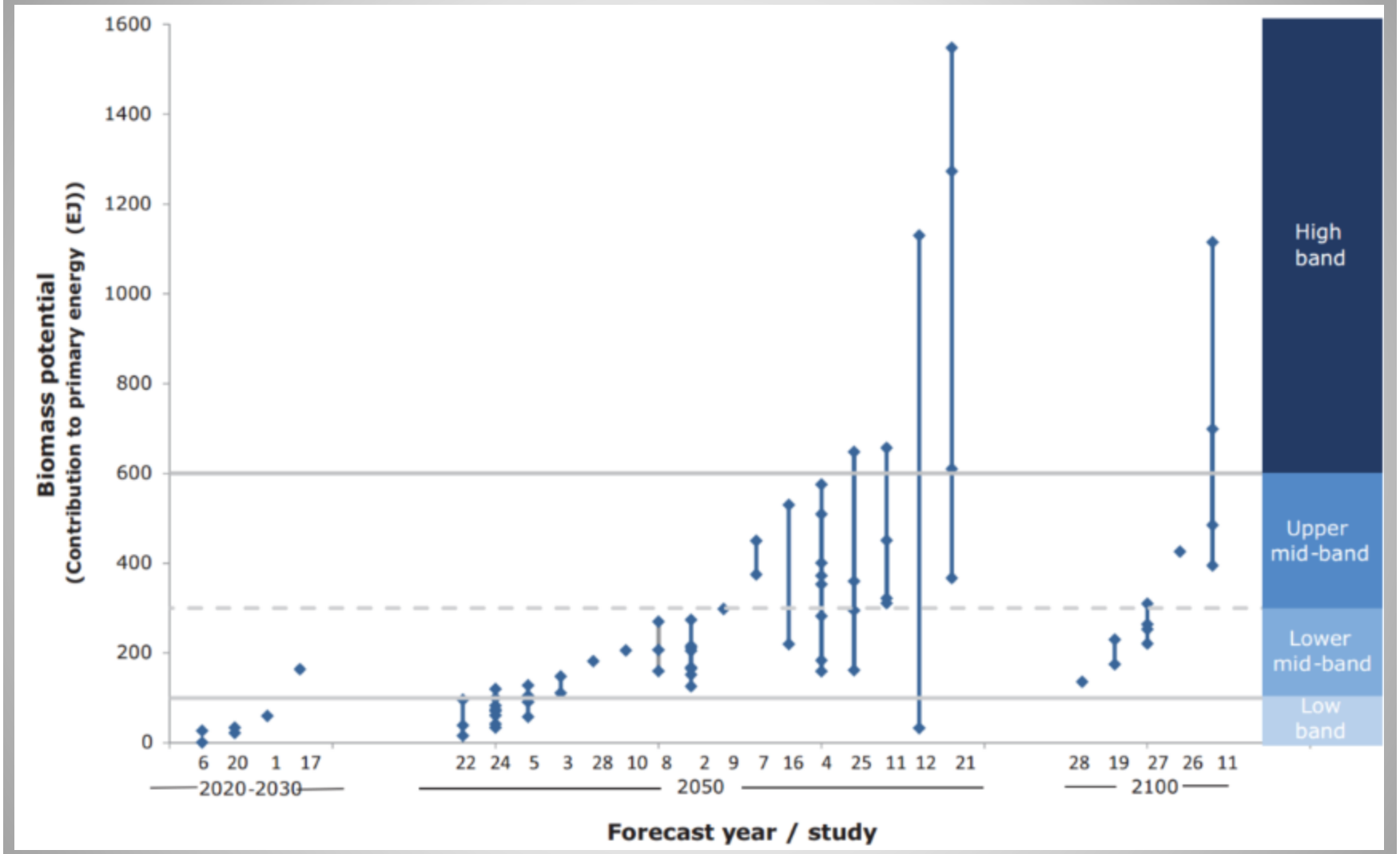
Bulk chemicals

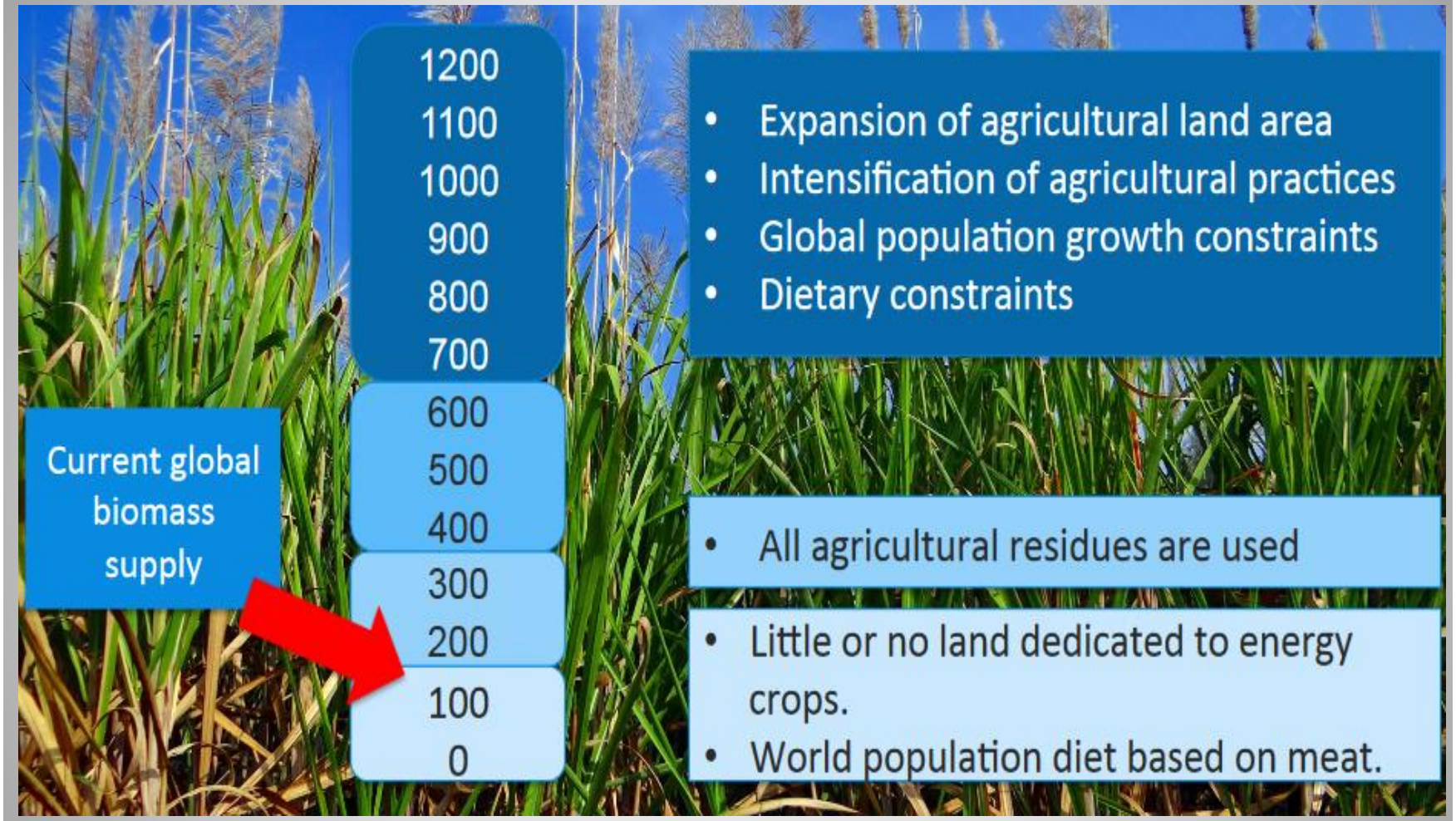
Power (and heat) generation

Specialty chemicals

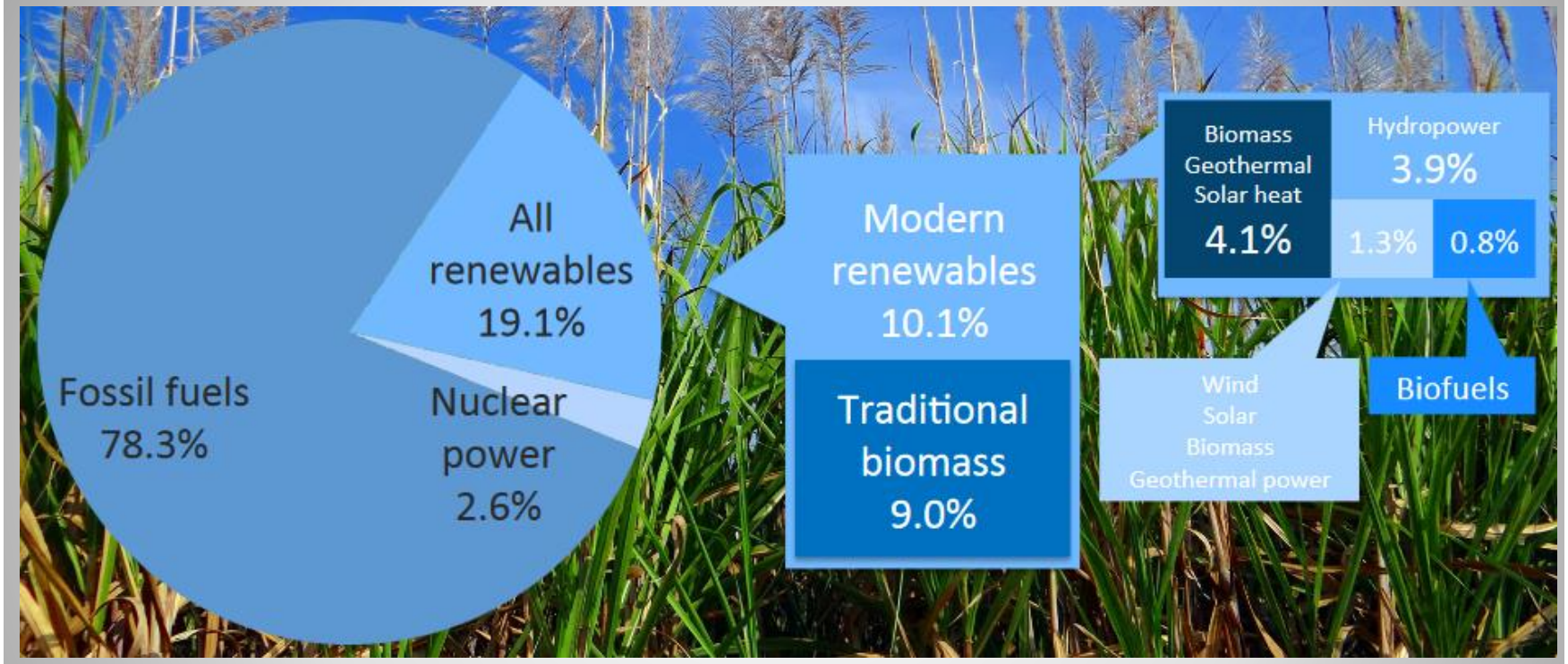
Transportation fuels

Materials


Biomass potential
(Contribution to primary energy (EJ))
1600
1400
1200
1000
800
600
400
200
0
High band
Upper mid-band
Lower mid-band
Low band
6 20 1 17
22 24 5 3 28 10 8 2 9 7 16 4 25 11 12 21
28 19 27 26 11
2020-2030
2050
2100
Forecast year / study



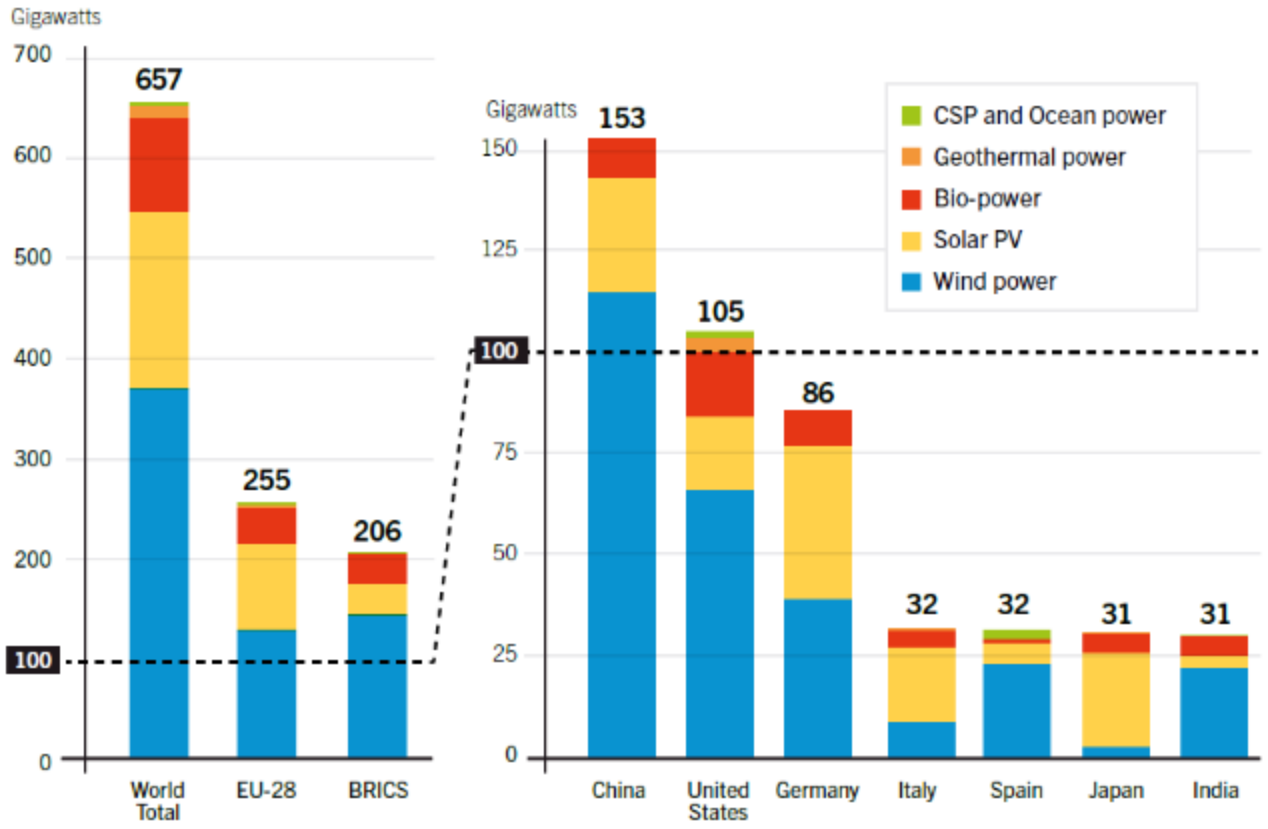
Globalni potencijal biomase (EJ)



Trenutno iskorišćenje biomase za dobijanje energije

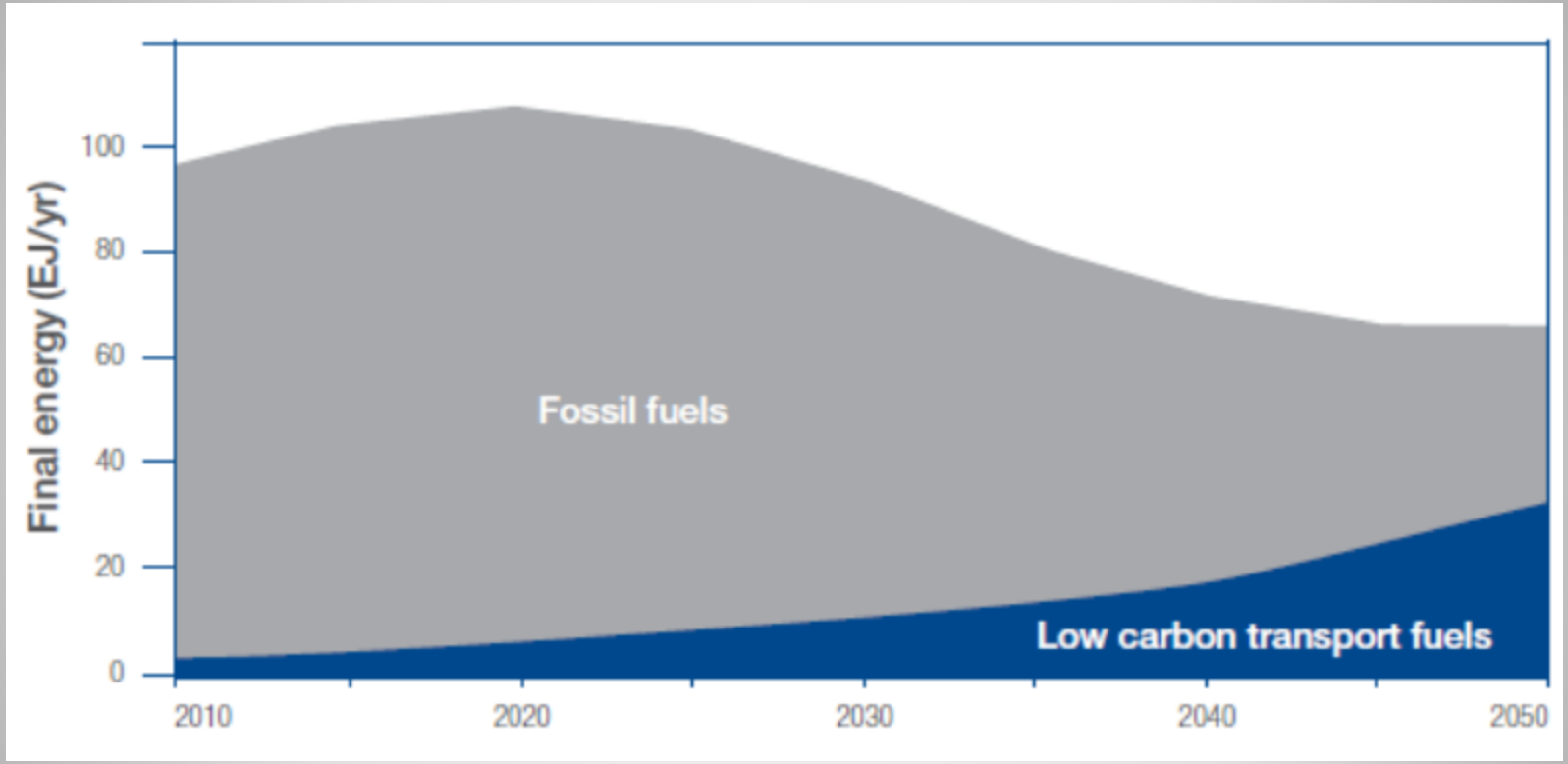
Renewable power generation

Renewable Power Capacities* in World, EU-28, BRICS, and Top Seven Countries, 2014

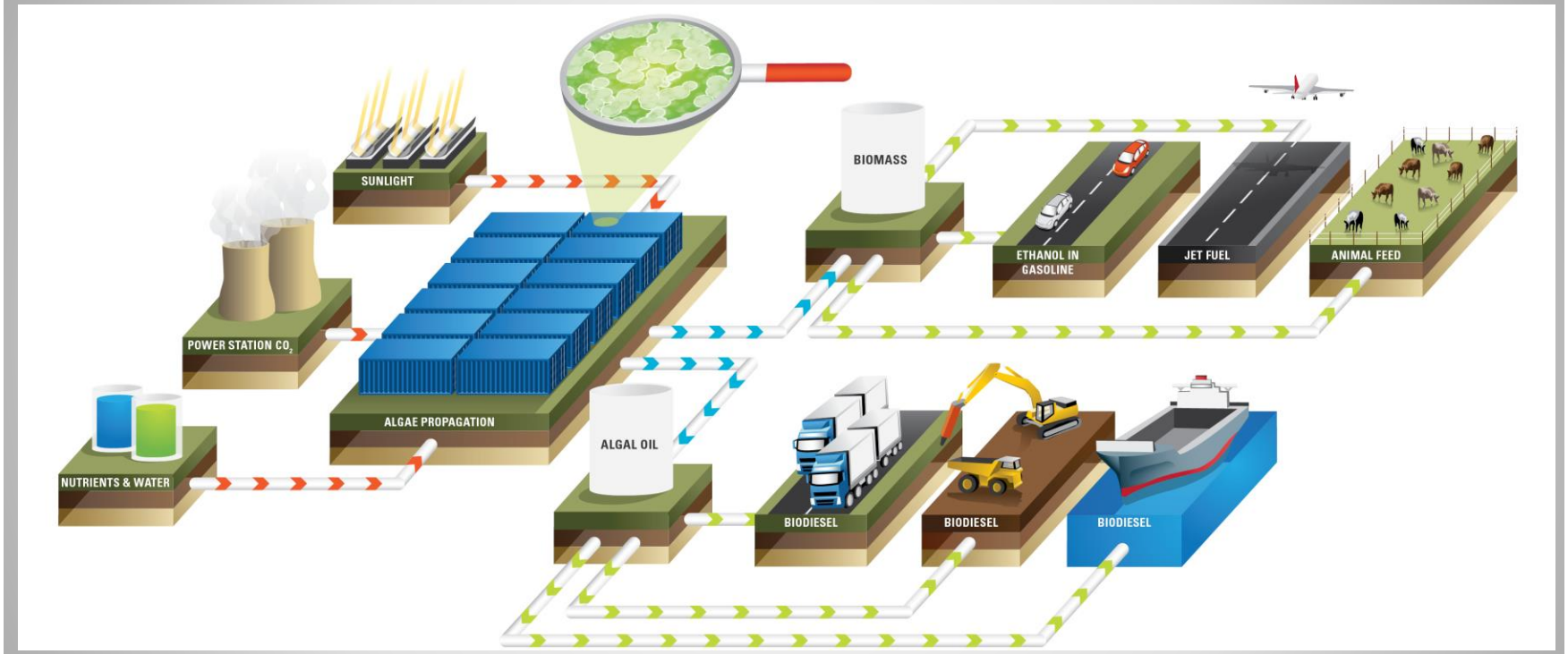


REN21

* not including hydropower.

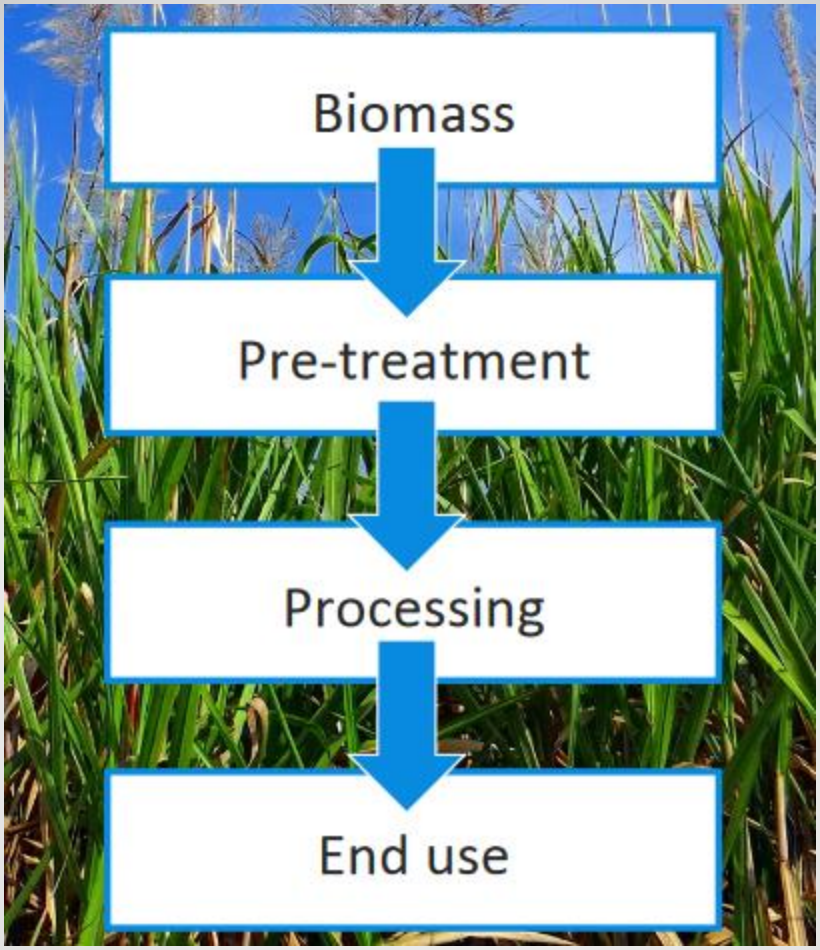


Proizvodnja goriva iz biomase

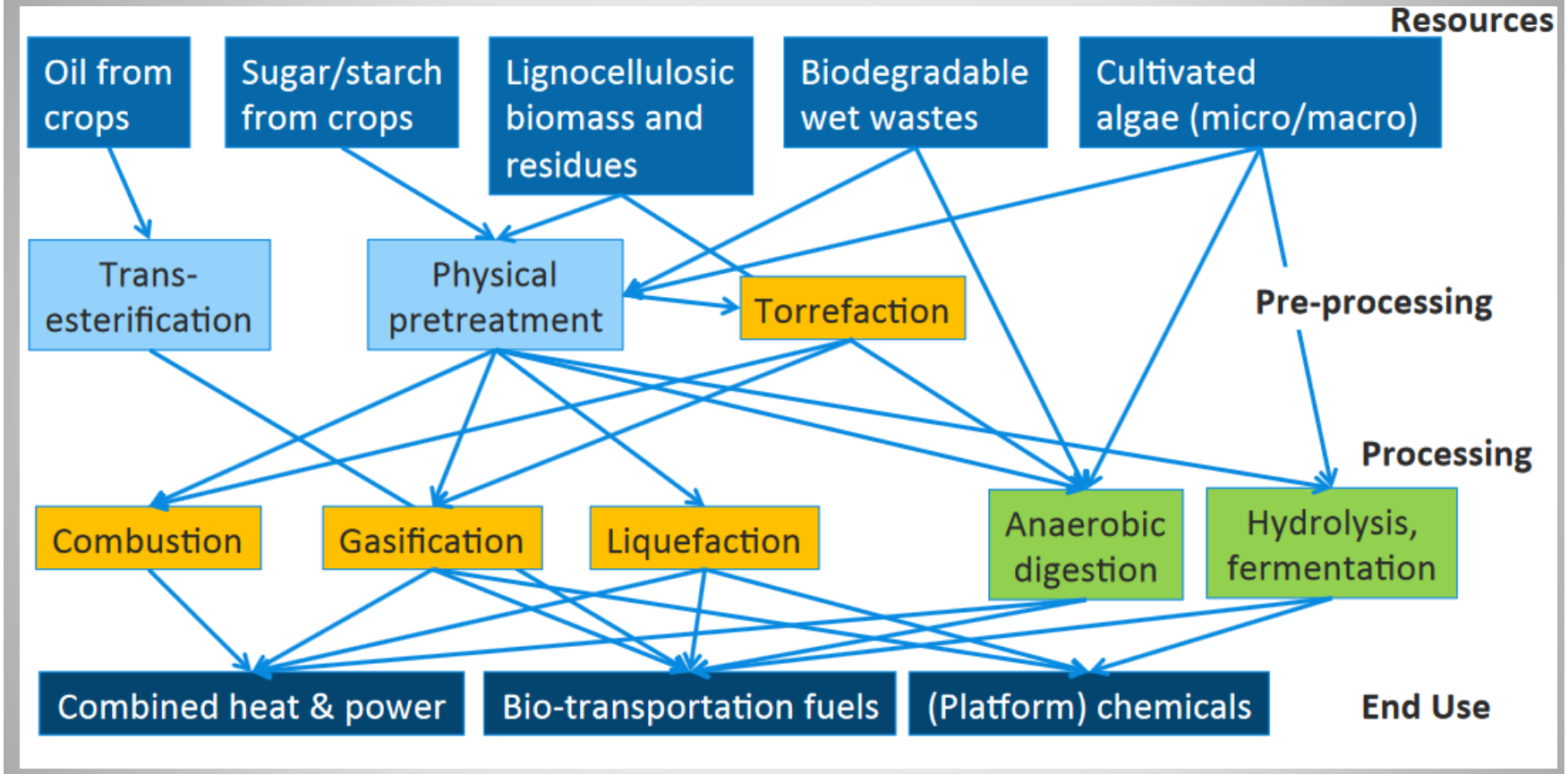


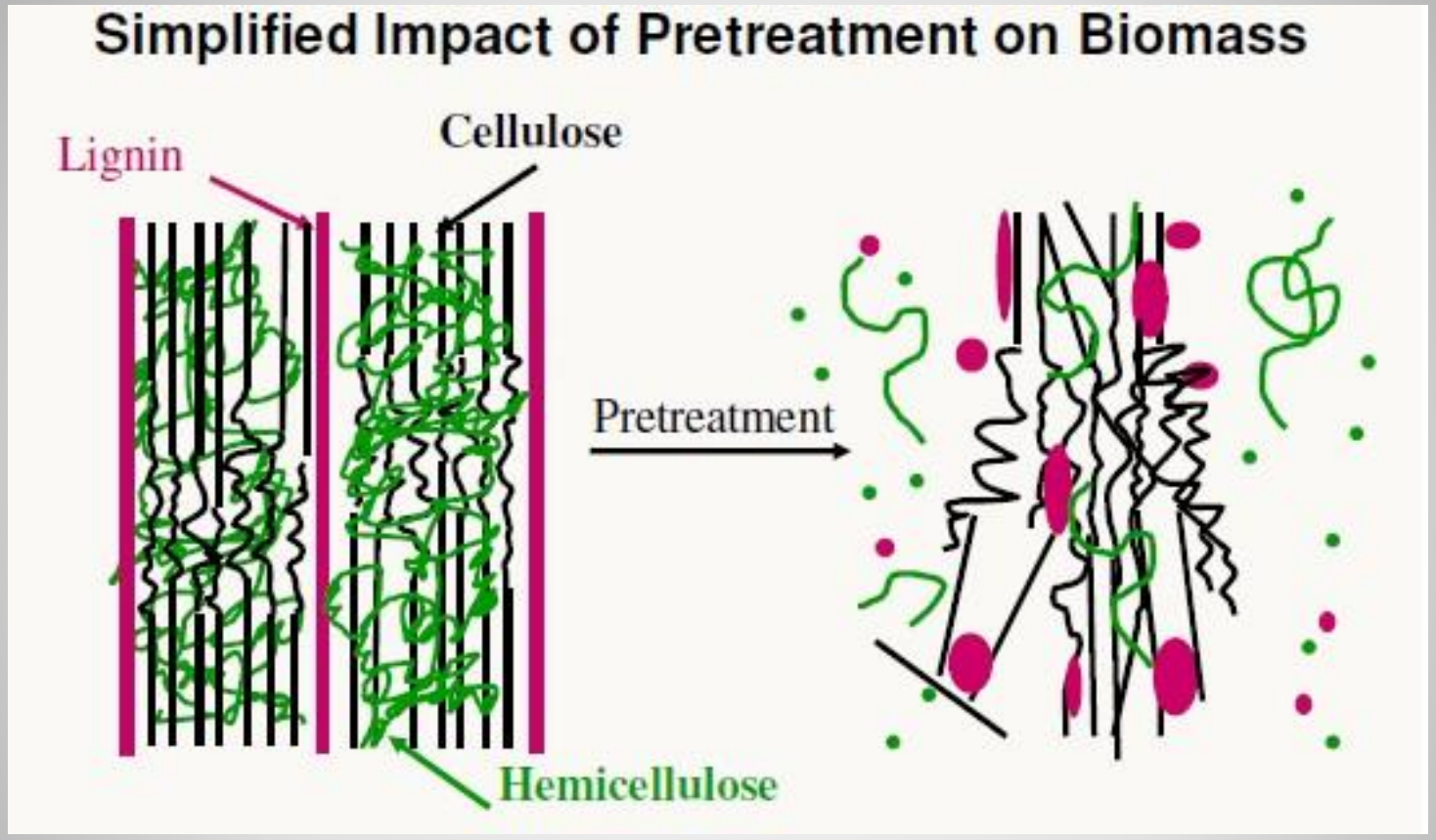
Tehnologije korišćenja biomase

Procesni koraci



Tehnološki lanac


Resources
Oil from crops
Sugar/starch from crops
Lignocellulosic biomass and residues
Biodegradable wet wastes
Cultivated algae (micro/macro)
Trans-esterification
Physical pretreatment
Torrefaction
Pre-processing
Processing
Combustion
Gasification
Liquefaction
Anaerobic digestion
Hydrolysis, fermentation
Combined heat & power
Bio-transportation fuels
(Platform) chemicals
End Use



Priprema biomase

Oil crops

Manure
Sludges
Biodegradables

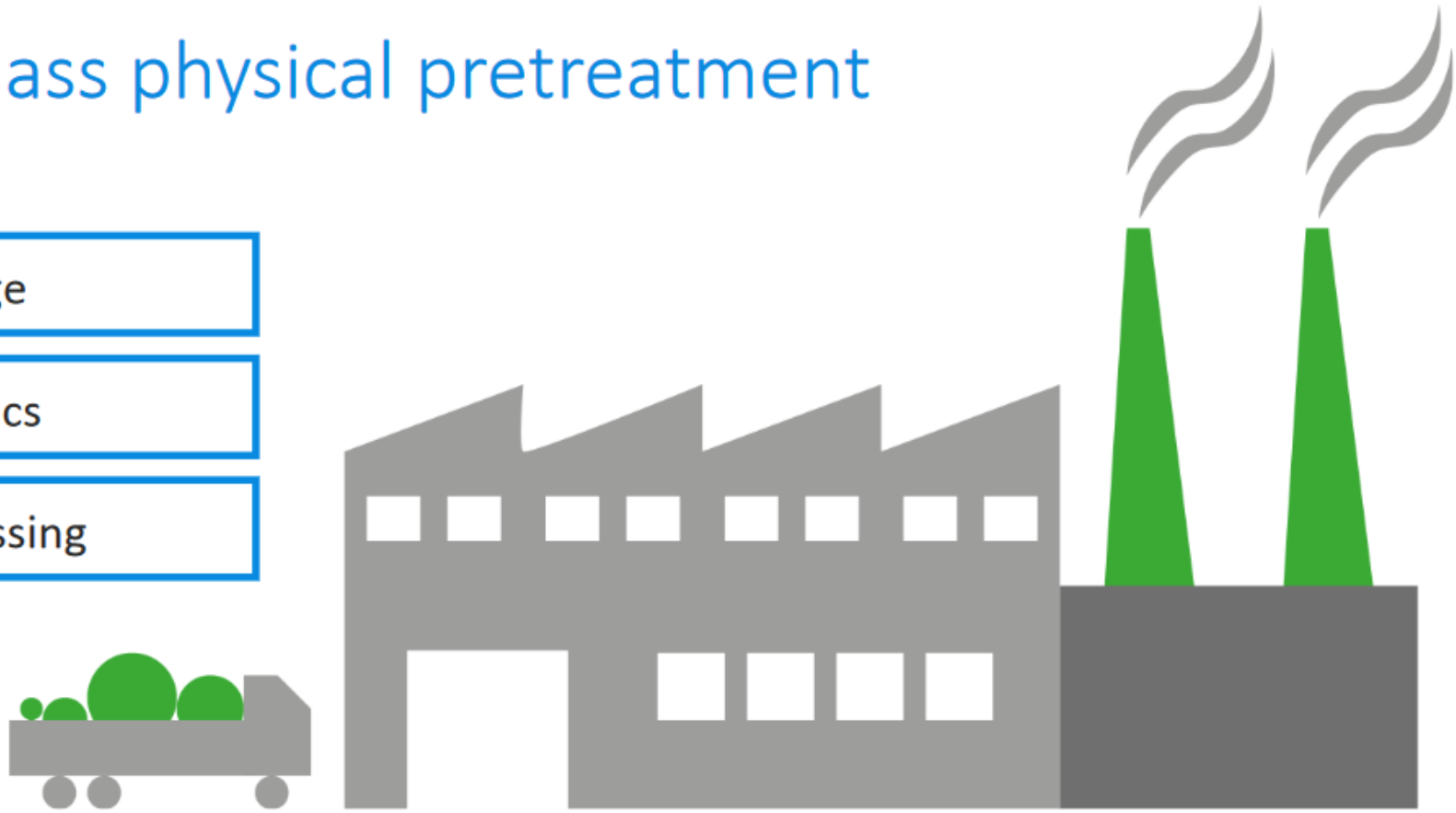
Sugar and starch crops

Photosynthetic micro-organisms

Lignocellulosic biomass

Biomass physical pretreatment

- Storage
- Logistics
- Processing



Fizička predobrada

- Skladištenje
- Smanjenje sadržaja materijalaštetnih za dalju obradu (uklanjanje kamenja, prosejavanje ili pranje)
- Smanjenje veličine
- Smanjenje sadržaja vlage
- Povećanje gustine energije – presovanje
- Homogenizacija sirovine ili pametno mešanje sirovina – stabilniji kvalitet

Health & safety:

- Moisture → fire
- Dust → explosions
- Smell
- Greenhouse gasses

Pretreatment

- Drying
- Microbial
- Fungi
- Demixing

Skladištenje

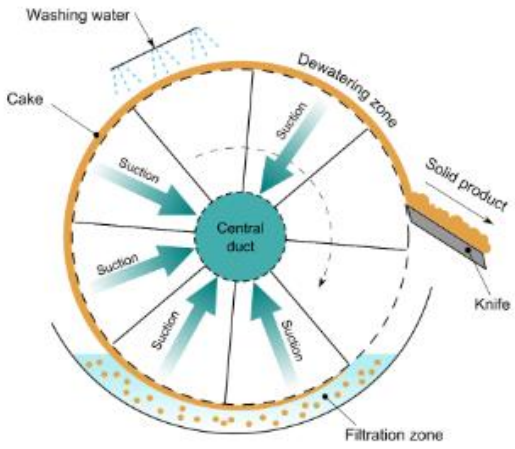
Chunks

Crushing

Chipping & Shredding

Milling

Smanjivanje dimenzija



Natural Drying	Mechanical drying Dewatering	Thermal drying

Smanjivanje vlage

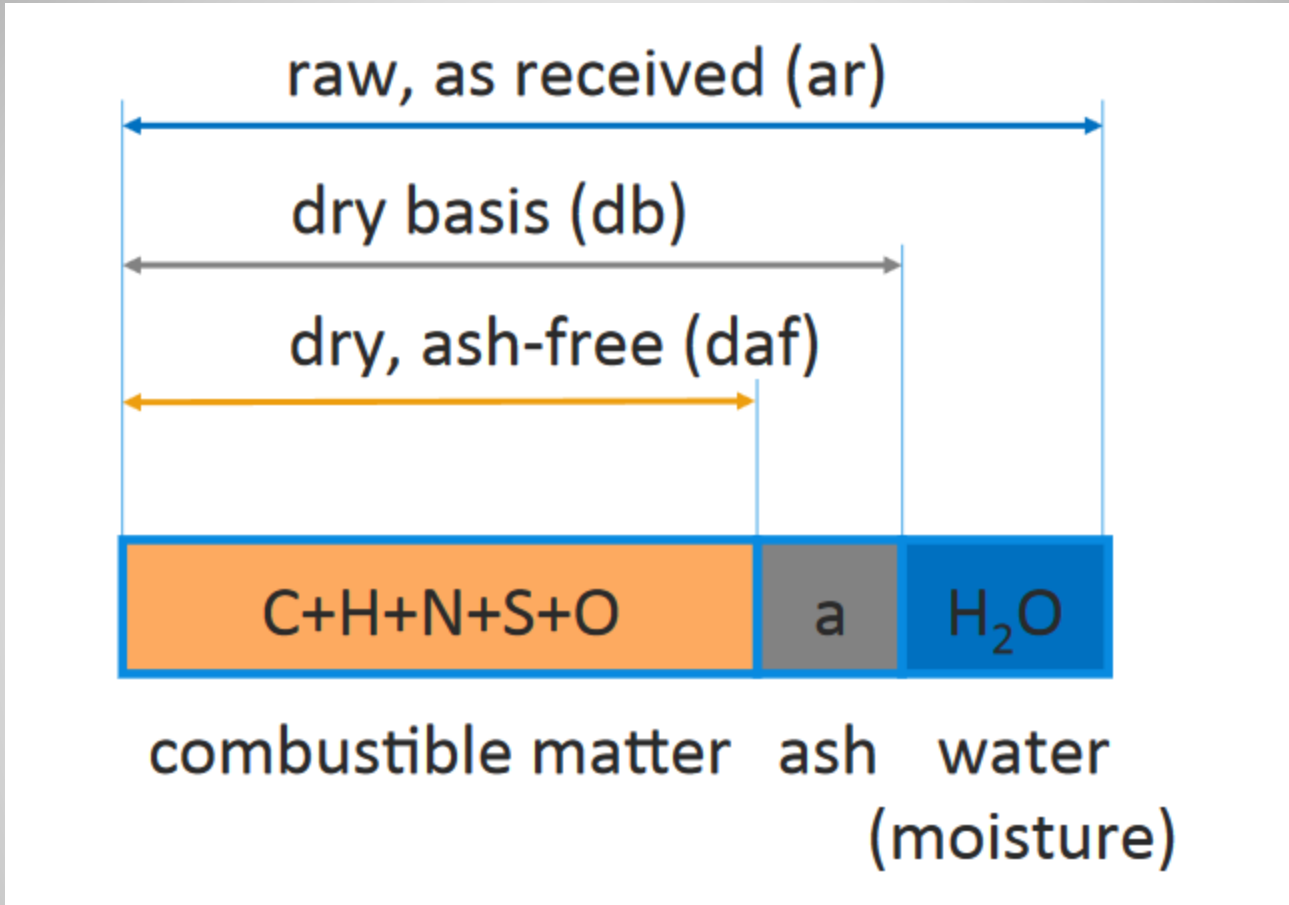
Baling

Briquetting

Pelletization

Presovanje - zbijanje

Combustion & Gasification



Sastav biomase

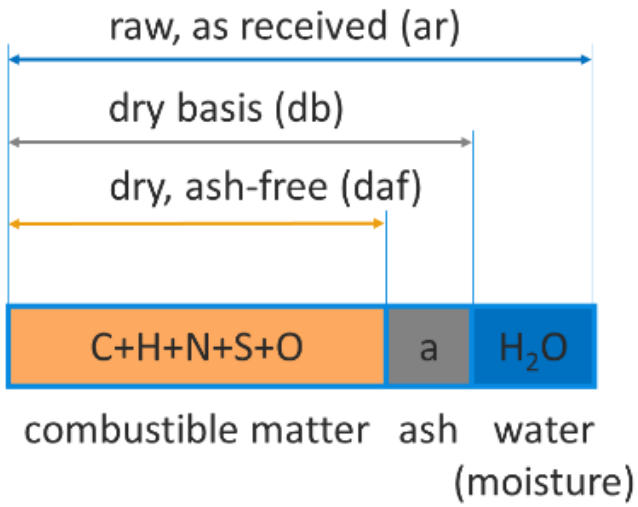
Sastav biomase

$$m_{i,daf} \cdot \mathbf{m}_{daf} = m_{i,ar} \cdot \mathbf{m}_{ar}$$

$$m_{i,daf} = m_{i,ar} \cdot \frac{\mathbf{m}_{ar}}{\mathbf{m}_{daf}}$$

$$m_{i,daf} = m_{i,ar} \cdot \frac{\mathbf{m}_{ar}}{\mathbf{m}_{ar} - \mathbf{m}_{ash,ar} - \mathbf{m}_{M,ar}}$$

$$m_{i,daf} = m_{i,ar} \cdot \frac{1}{1 - Y_{ash,ar} - Y_{M,ar}}$$



$$\lambda = \frac{\left(\frac{A}{F}\right)}{\left(\frac{A}{F}\right)_{stoic}}$$

Where

λ is the air factor

A is the air mass

F is the fuel mass

AIR faktor (Faktor vazduha)

Faktor vazduha

$$\lambda = \frac{\left(\frac{A}{F}\right)}{\left(\frac{A}{F}\right)_{stoic}}$$

$\lambda = 1$	stoichiometric combustion
$\lambda > 1$	fuel lean combustion
$\lambda < 1$	fuel rich combustion
$\lambda << 1$	gasification

$$C_xH_yO_z + a \cdot \lambda \cdot \{O_2 + {}^{79}/_{21}\, N_2\} \longrightarrow$$

$$CO_2 + ({}^{y}/_{2}) \cdot H_2O + ({}^{79}/_{21}) \cdot a \cdot \lambda \cdot N_2 + a \cdot (\lambda - 1) \cdot O_2$$

With

Stoichiometric factor $a = x + ({}^{y}/_{4}) - ({}^{z}/_{2})$

Air factor $\lambda = 1$

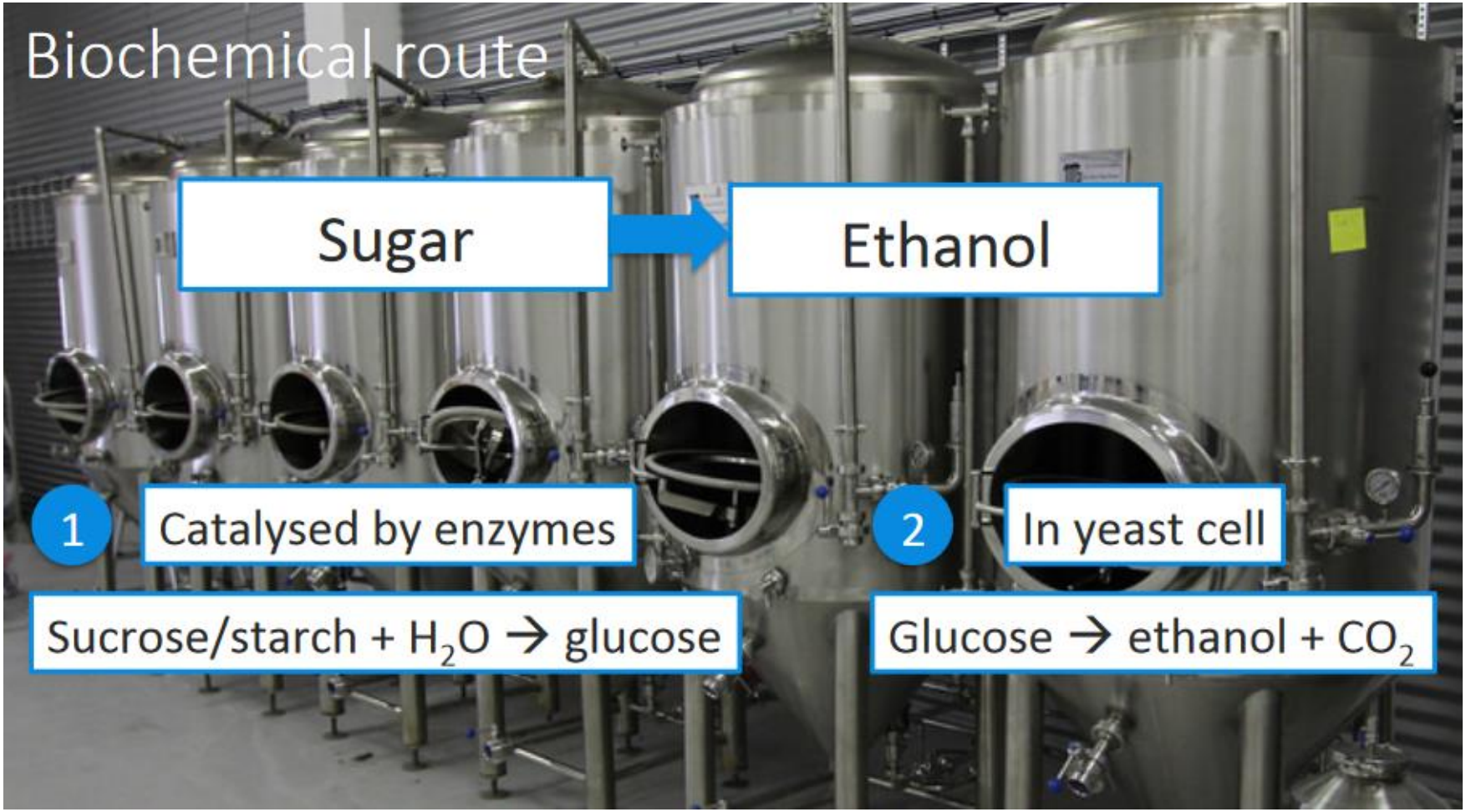
Idealized dry air:
vol% N_2 = 79 %
vol% O_2 = 21 %)

Reakcija sagorevanja u idealno suvom vazduhu

Proizvodnja goriva

CAR 2GO
electric drive
5-ZFG-86
↓ Energy density
New infrastructure

Biochemical route
Thermochemical route
GAZOLE
Super
DIESEL
Maximum
by
wynn's


Biochemical route
Sugar
Ethanol
1
Catalysed by enzymes
Sucrose/starch + H_2O → glucose
2
In yeast cell
Glucose → ethanol + CO_2

Sugar cane

- Brazil
- India

Corn

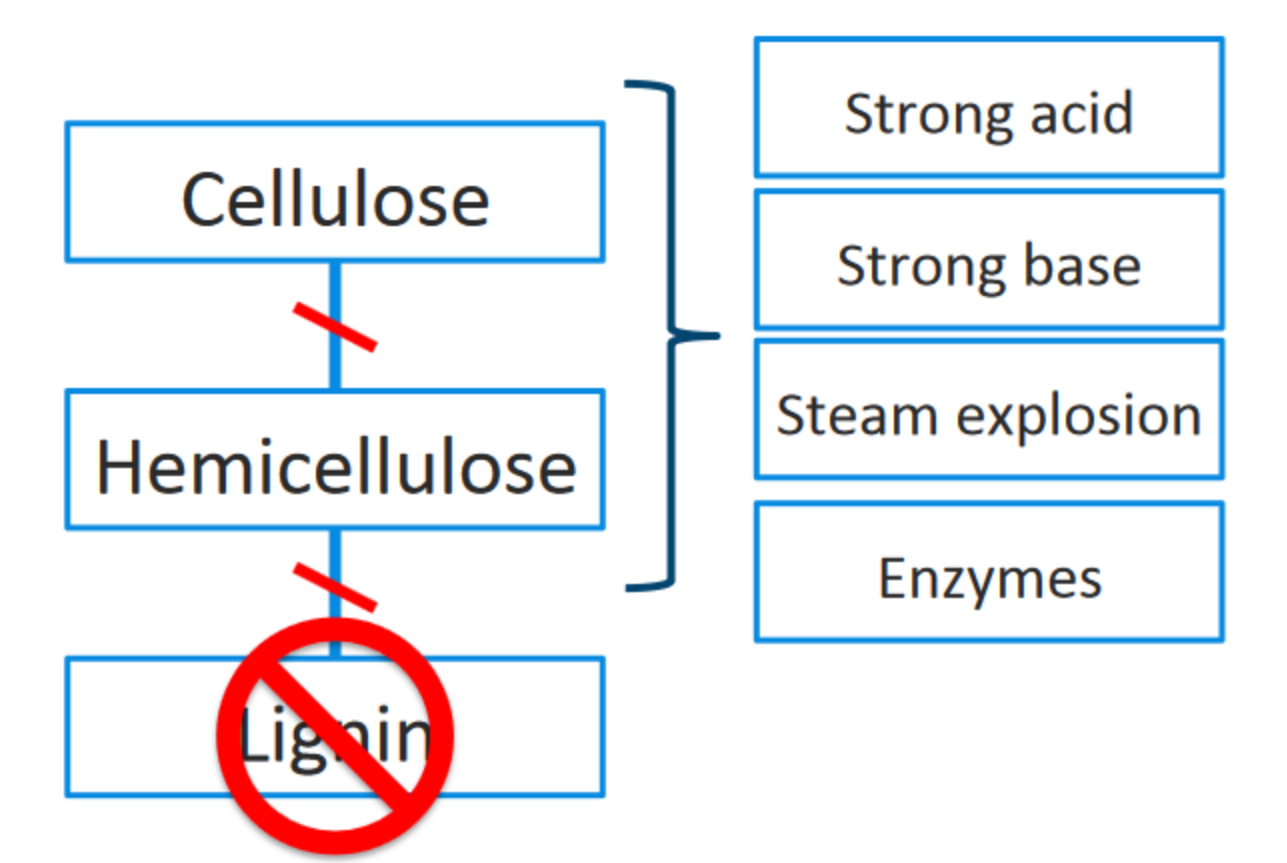
- USA
- China

Sugar beet

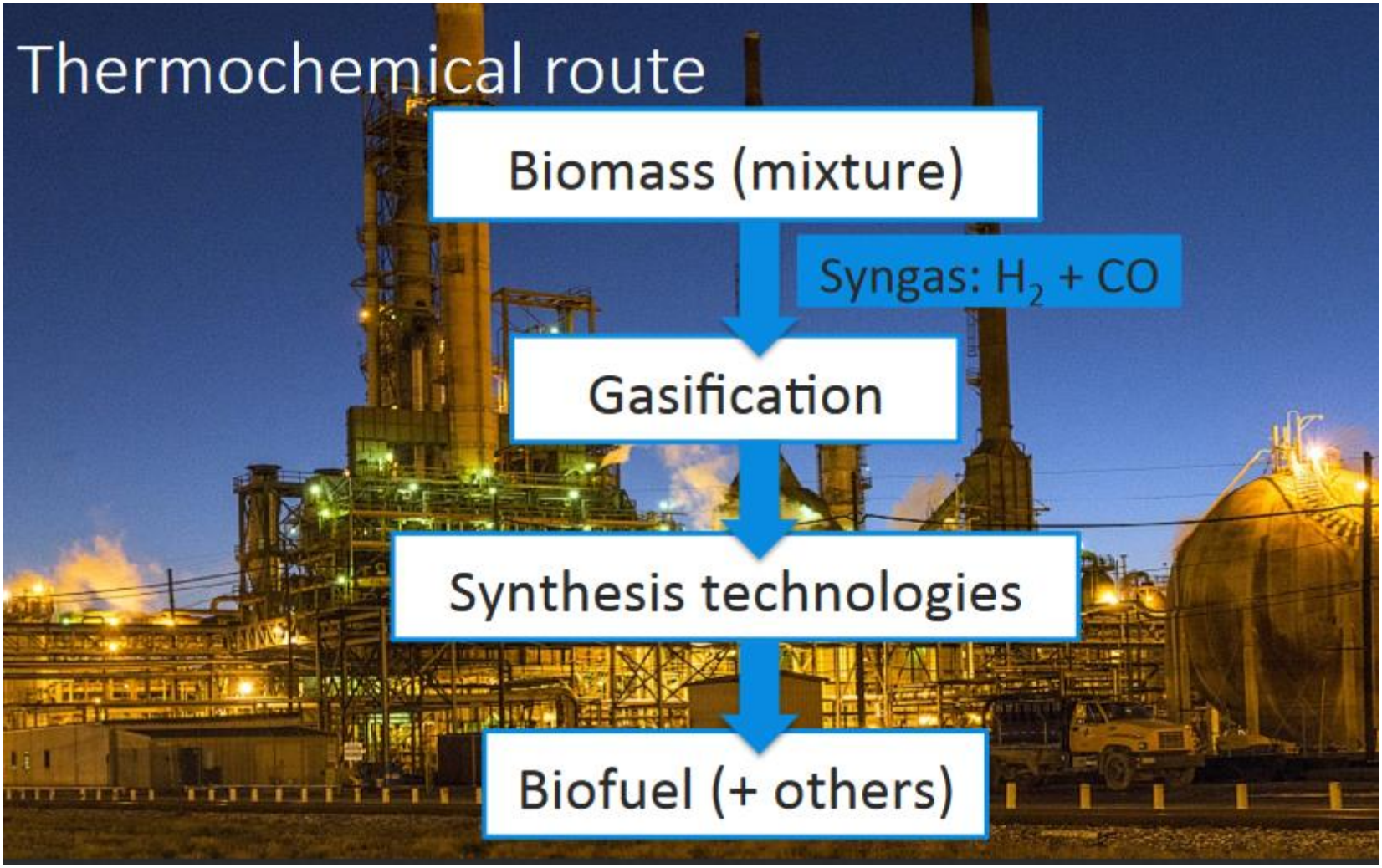
- Europe

Wheat

- Europe



Druga generacija etanola

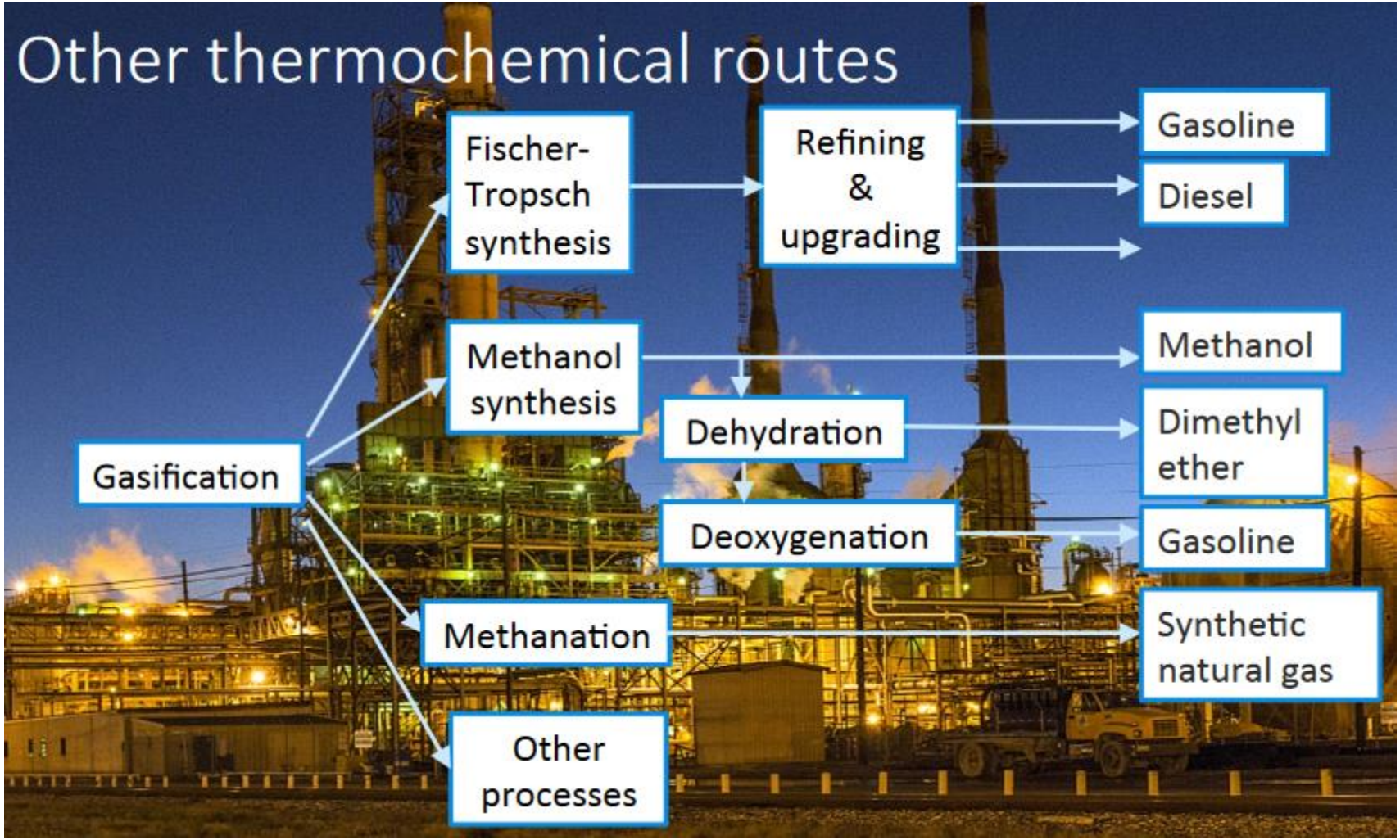

Thermochemical route
Biomass (mixture)
Syngas: H_2 + CO
Gasification
Synthesis technologies
Biofuel (+ others)

Fischer Tropsch

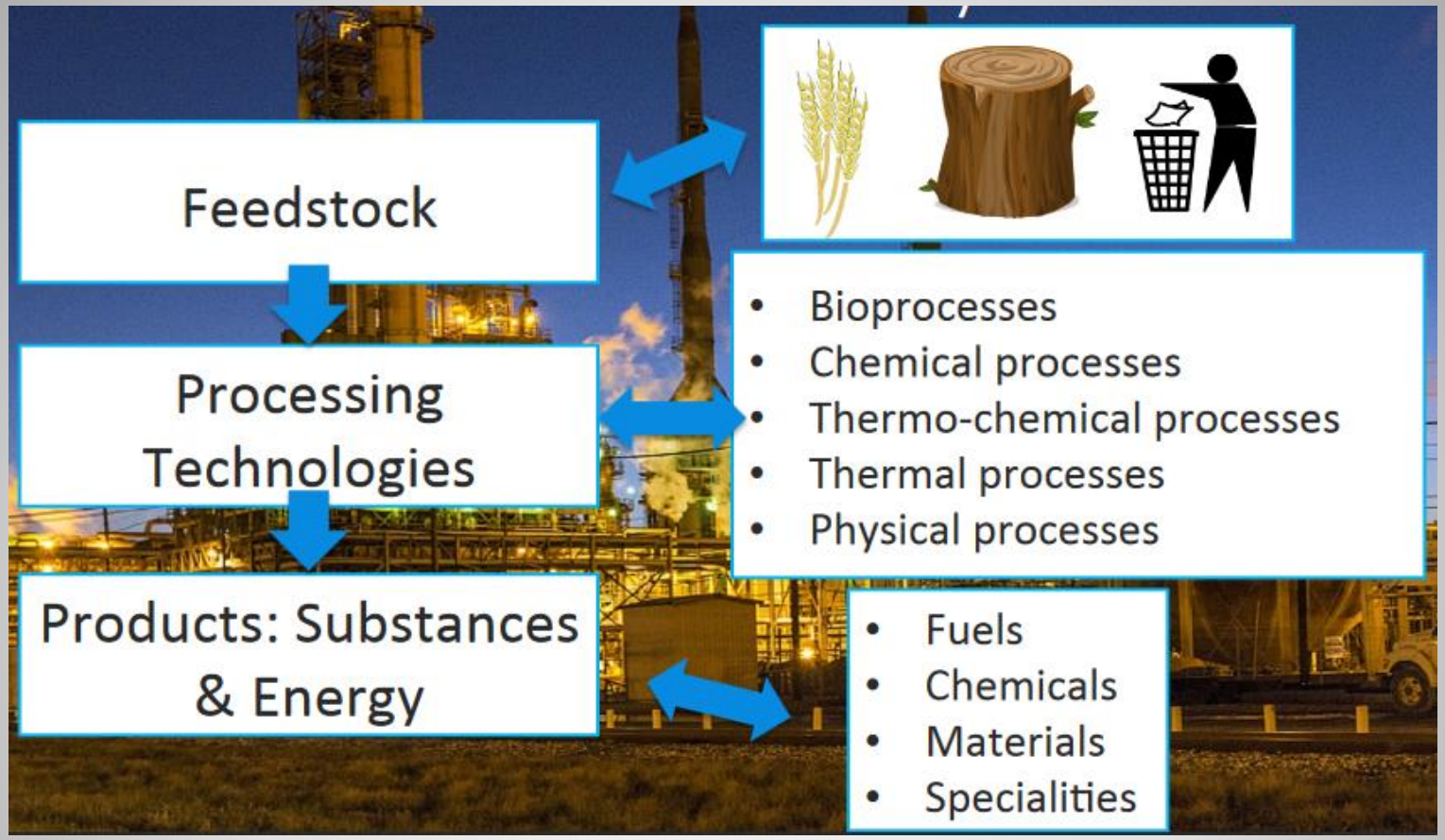
Gasification → $CO + H_2$ → Fischer Tropsch → Hydrocarbons → Product separation and upgrading

$$CO + H_2 \rightarrow C_nH_{2n+2} + H_2O + \text{heat}$$

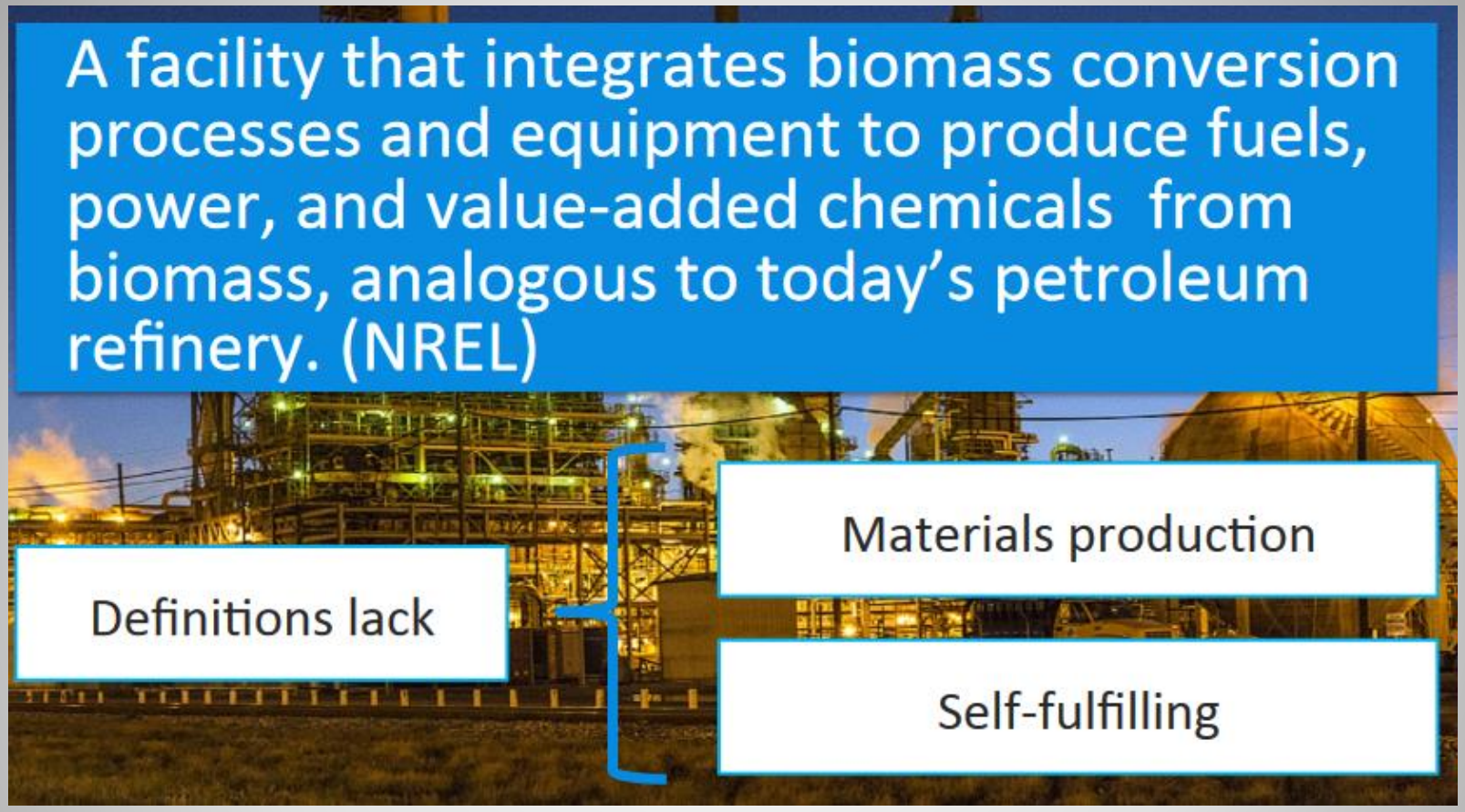
- 200-300°C
- 20 bar


Other thermochemical routes
Fischer-Tropsch synthesis
Refining & upgrading
Gasoline
Diesel
Methanol synthesis
Methanol
Dehydration
Dimethyl ether
Gasification
Deoxygenation
Gasoline
Methanation
Synthetic natural gas
Other processes

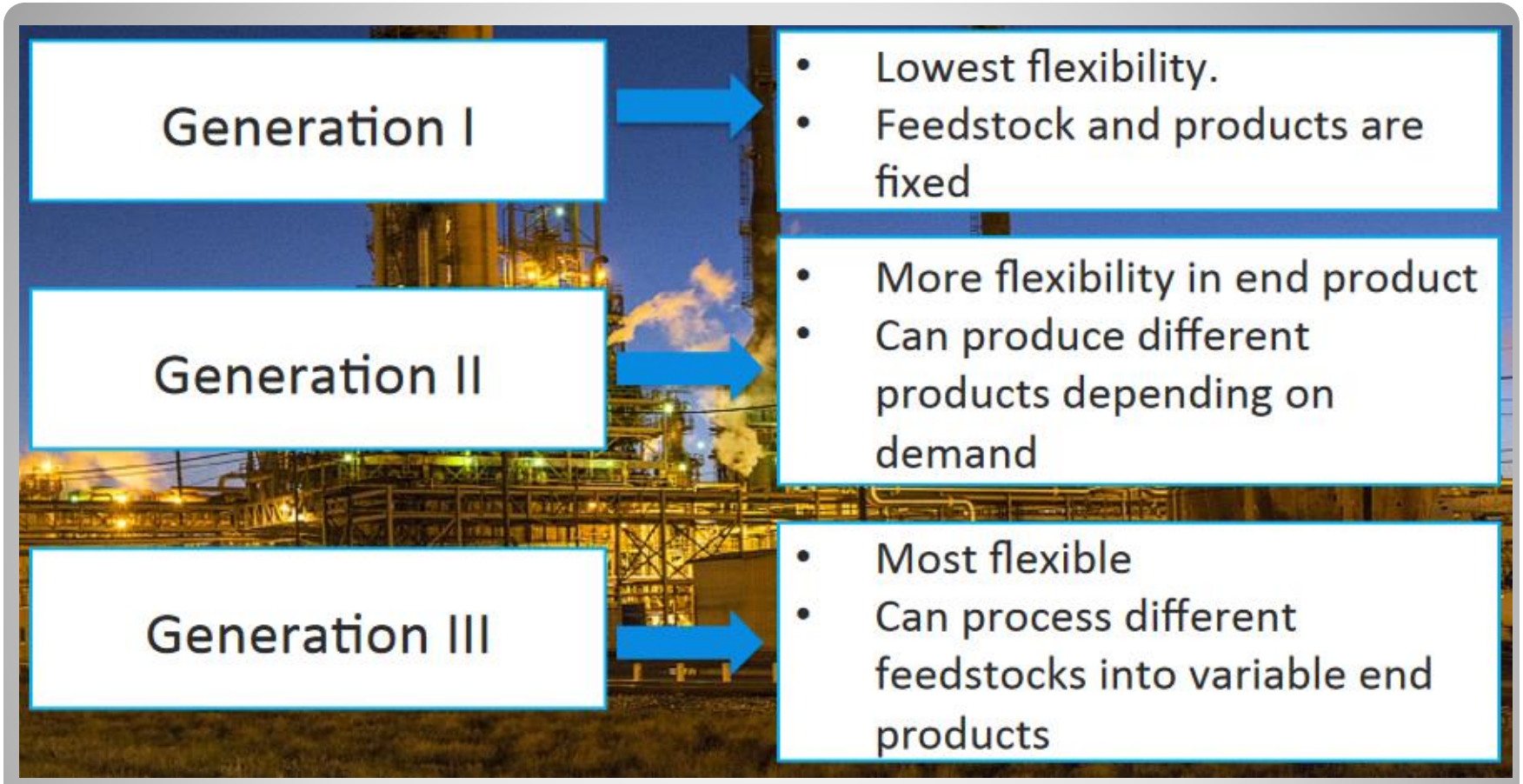
Biorafinerije



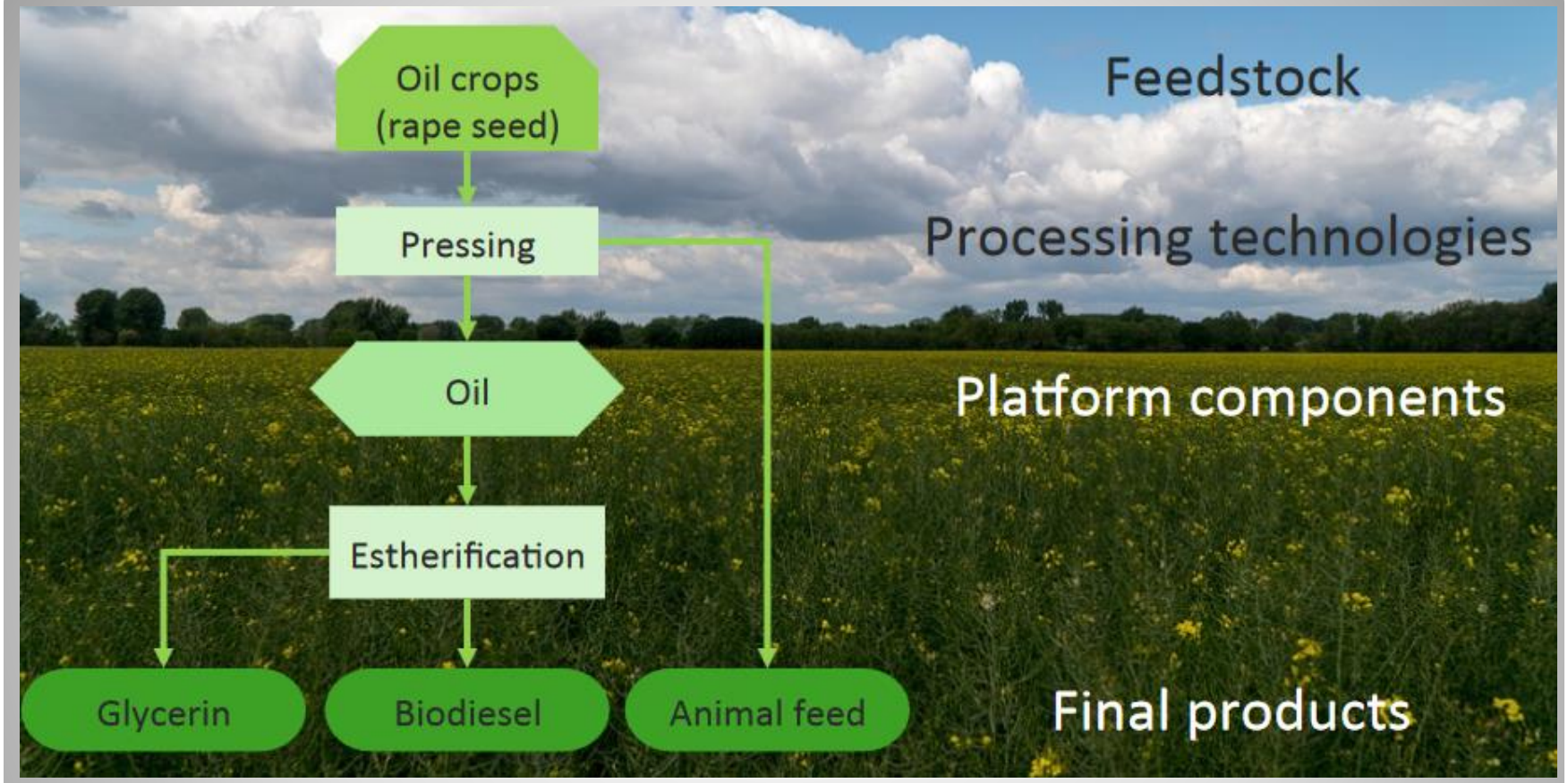
Šta su biorafinerije?



Biorafinerija



Kategorije biorafinerija


Oil crops
(rape seed)
Pressing
Oil
Estherification
Glycerin
Biodiesel
Animal feed
Feedstock
Processing technologies
Platform components
Final products

Ideas
potential
vision
knowledge
motivation
research
creativity
inspiration
development
imagination