ROHETULEVIKU OLULISIMAD TEHNOLOOGIAD: TRENDID JA MÄÄRAMATUSED

Prof Allan Niidu (TalTechi rakendusliku keemia professor)

Arenguseire rohekonverents 14.06.2023

SUUNDUMUSED

1. Liha alternatiivne tootmine
2. Biorafineerimine
3. Rakutüvede digitaliseeritud arendamine
4. Tehisintellekt ja masinõpe
5. Sardsüsteemid ja kiibitehnoloogiad
6. Vesinikutehnoloogiad

Biotehnoloogiad

Kiibid ja arvutustehnoloogia

Keemiatööstuse ja energeetika alternatiiv

TAL TECH

RINGMAJANDUS EESTIS

TAL TECH

https://keskkonnaportaal.ee/et/ringmajandus/ringmajandus-eestis#Ringmajandusevimekusetstmine
https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits

BIOTEHNOLOOGIAD

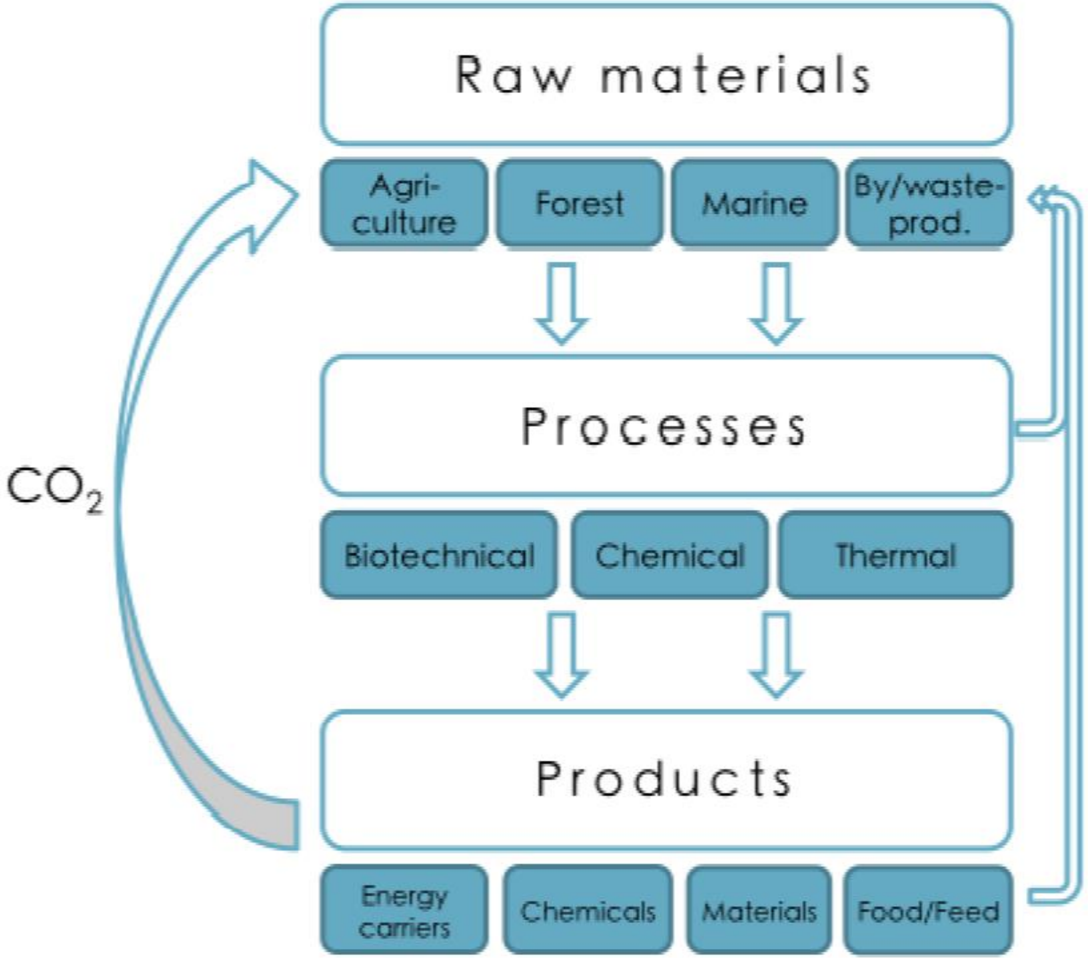
Lignotselluloosilise biomassi biorafineerimise tehnoloogiad jagunevad:

keemilisteks biorafineerimise protsessideks (Krafti protsess),

ensümaatiliseks hüdrolüüsi tehnoloogiaks,

pürolüüs kombineeritud gaasfermentatsiooni tehnoloogiaks ja

biomassi anaeroobse kääritamise protsessiks.



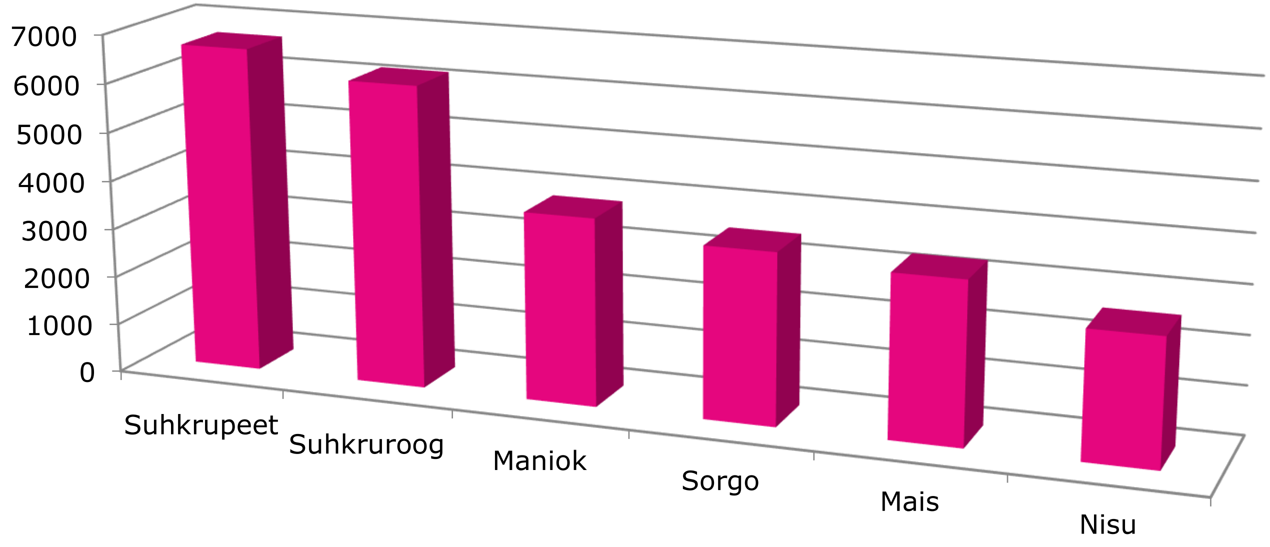
Rakutüvede digitaalne arendamine tähistab kõrgeläbilaskvusega (automatiseeritud) rakkude ja ensüümide inseneerimist, kus kasutatakse sünteetilise ja süsteemide bioloogia tööriistu, et disainida ja konstrueerida parendatud või täiesti uute funktsionaalustega elavaid rakke.

TAL TECH

Javier A. Linares-Pasten, Maria Andersson and Eva N. Karlsson. Current Biotechnology, Vol. 3, Issue 1, 2014, 26 – 44.
DOI: 10.2174/22115501113026660041

BIORAFINEERIMINE: BIOETANOOL

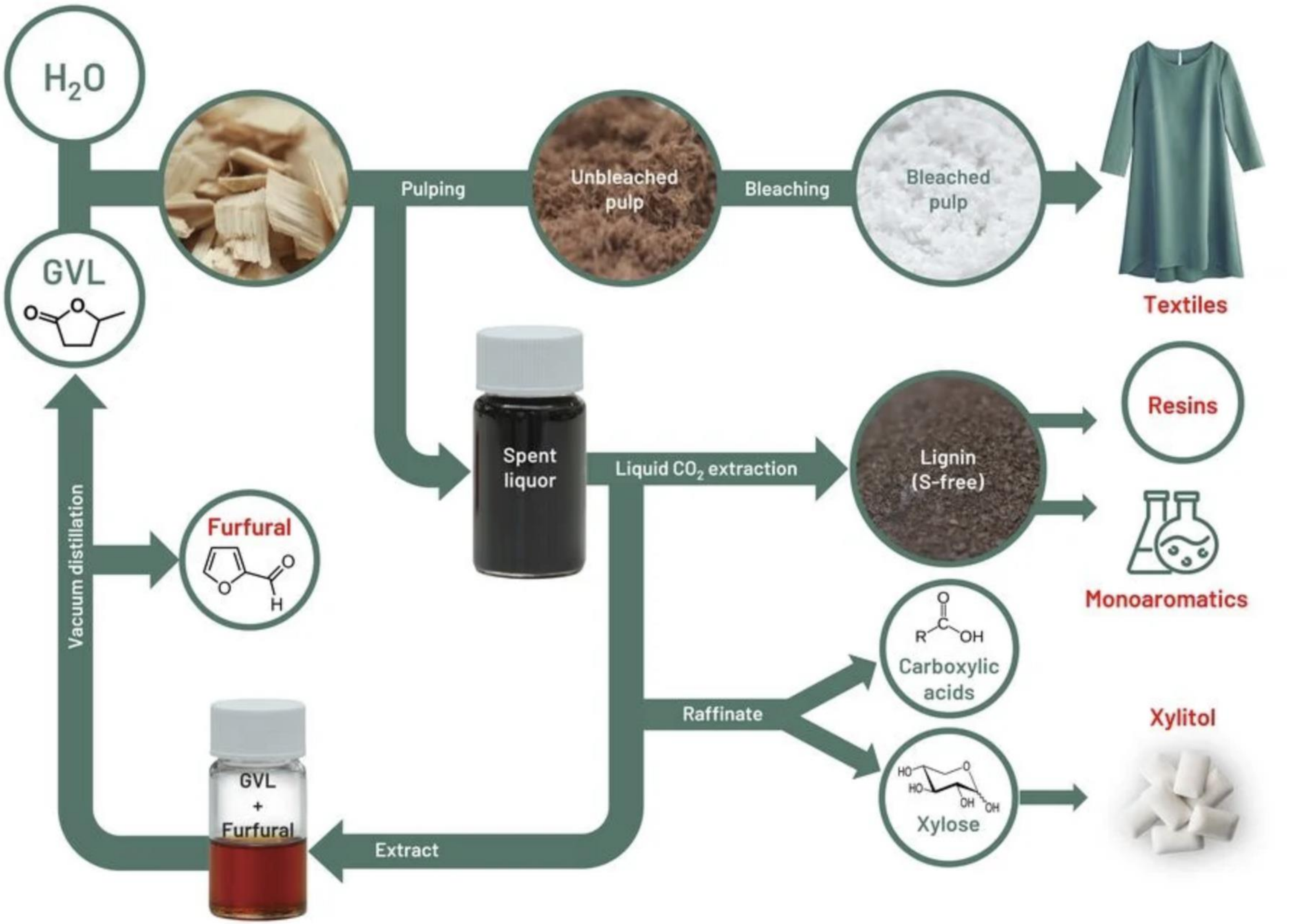
NB! 1 bbl = 159 l



Ligikaudne etanooli saagis liikide lõikes l/(ha*a).

- I põlvkond
  - Pärm ja suhkrurikkad toiduained
- II põlvkond
  - Ensüümid ja tselluloos

AALTO KONTSEPTSIOON



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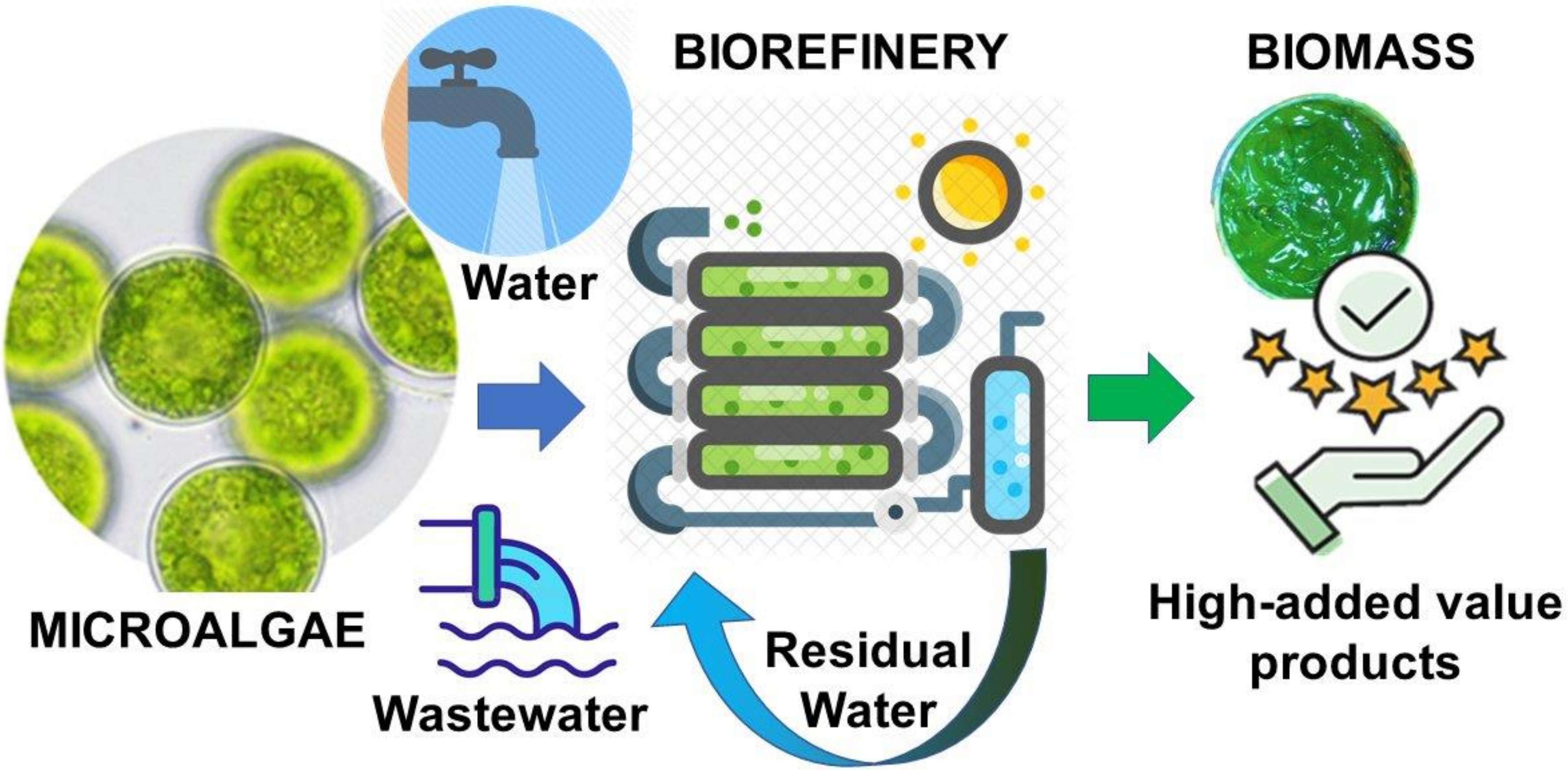
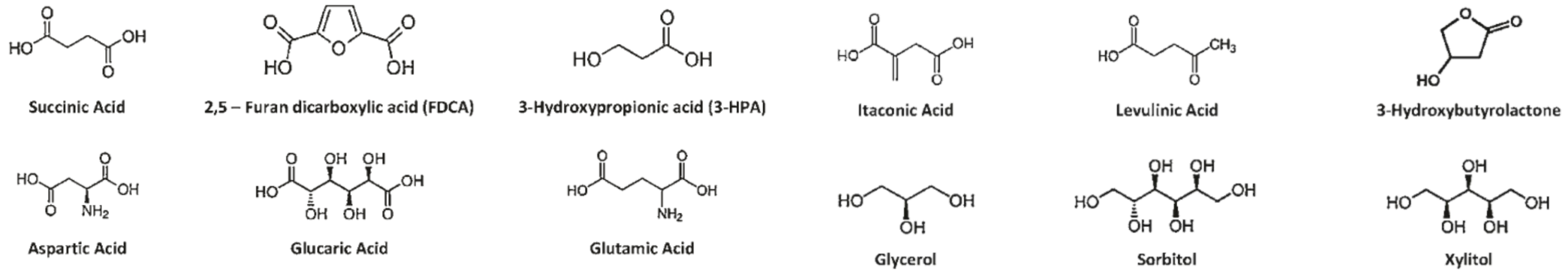
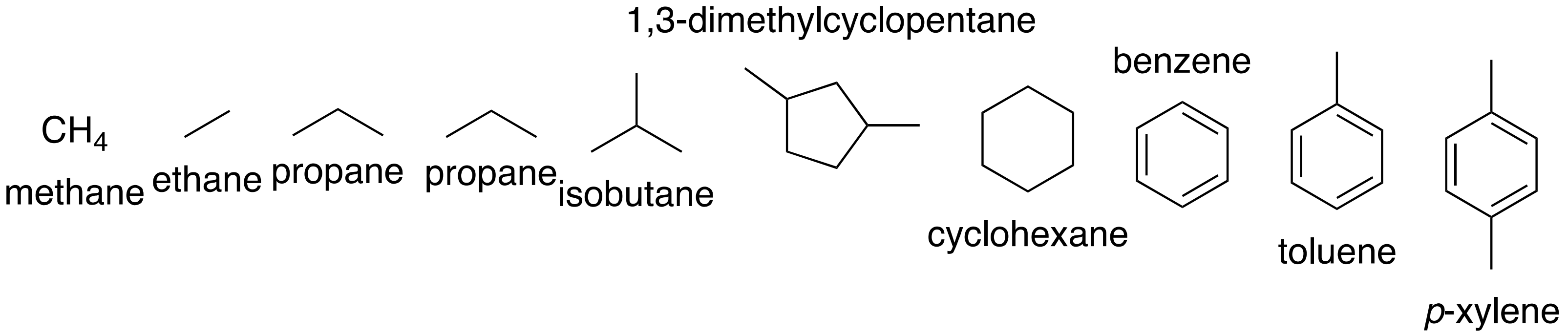
KOLMAS PÕLVKOND



Olguín, E.J.; Sánchez-Galván, G.; Arias-Olguín, I.I.; Melo, F.J.; González-Portela, R.E.; Cruz, L.; De Philippis, R.; Adessi, A. Microalgae-Based Biorefineries: Challenges and Future Trends to Produce Carbohydrate Enriched Biomass, High-Added Value Products and Bioactive Compounds. *Biology* **2022**, *11*, 1146. https://doi.org/10.3390/biology11081146

PLATVORMKEMIKAALID





Loomse valgu tootmine kasutab 80% kogu põllumajandusmaast, ent toodab 30% inimeste tarbitavast valgust.

KUST TULEB LIHA?

1) **Kultiveeritud liha -** tervete loomsete tüvirakkude kasvatamine laboratoorsetel tingimustel. Kui rakkude kogus on piisavalt suur, eraldatakse need üksteisest ning pannakse spetsiaalsesse keskkonda, kus neid saab diferentseerida lihasrakkudeks.
2) **Mikroobne liha** - mikroorganismide rakkudest (nt bakterid, pärm või seenerakud). Ka mikroobse liha valmistamise protsess hõlmab tavaliselt mikroobide kasvatamist spetsiaalselt loodud bioreaktorites.
3) **Taimsed lihaalternatiivid** - taimsete valguallikate, nagu soja, herned, nisu, kaunviljad, kartulid ja riis kasutamine. Tootmisprotsess hõlmab taimsete valkude eraldamist, töötlemist ja nende koostisosade kombineerimist, et saavutada liha sarnane tekstuur ja maitse. Taimseid valke saab töödelda ekstrusiooni (taimsed valgud segatakse õlide, maitseainete ja toiduvärvidega ning kuumutatakse), kõrgsurveprotsesside või fermenteerimise abil. Eri meetodite eesmärk on parandada valkude maitset, tekstuuri ja seeduvust.
4) **Putukatest valmistatud alternatiivid** põhinevad putukate kasutamisel toiduvalguallikana. Tootmiseks kasvatatakse putukaid (kriketid, söödavaks mõeldud ussid, herilased ja kärbsed) spetsiaalses keskkonnas. Seni on putuka valgu kätte saamiseks kasutusel ainult putukate otsene tarbimine või nende pulbriks tegemine ja olemasolevatesse toodetesse lisamine.

TAL TECH

A Hydrogen Economy

The medium of energy transport from an atomic reactor to sites at which energy is required should not be electricity, but hydrogen. The term "hydrogen economy" applies to the energetic, ecological, and economic aspects of this concept.

The concept envisages atomic reactors held on platforms floating on water. They are in water sufficiently deep to make heat dissipation easy. The electricity they make would be converted on site to hydrogen and oxygen by electrolysis. The hydrogen would be piped to distribution stations and thereafter sent to factory and home. Reconversion to electricity would take place in on-site fuel cells, the only side product being pure water. Some advantages of the concept are:

1) A considerable increase in our energy supply will be needed in coming decades, and we must avoid air and heat pollution in its creation. This method avoids both. It does not imply a pollutional limit on growth. Its efficiency would be about 36 percent (if one assumes conservatively a 60 percent efficiency in both the use of energy to produce hydrogen and its reconversion at the fuel cell). Conversely, direct current would be generated. (In a transition period, alternators would consume another 1 to 2 percent of energy.)

2) The electricity supplied thus would be cheaper than that sent by overhead cables at distances greater than about 400 km from the reactor source (*1*). At 1600 km, the cost would thereby be halved.

3) The hydrogen economy would produce about 14 liters of pure fresh water per household per day, at the present level of the use of electricity. By A.D. 2000, the average household in the United States is likely (*2*) to consume ten times more electrical energy than at present. In this situation, the drinking water needed for a household would be a by-product of its electrical energy source.

4) Energy needs are cyclical; atomic reactors work continuously. Cryogenic hydrogen storage would be possible.

5) The hydrogen would run trucks, cars, ships, and trains, by means of fuel cell–battery combinations and electric motors. Transportation would be not only nonpolluting but also silent and cheaper in running costs (because of the greater efficiency of energy conversion). The performance of vehicles

6) Fusion reactors will need deuterium. Deuterium is a by-product of water electrolysis.

The main difficulties which we would face in getting started toward a hydrogen economy are (i) conservatism; (ii) the absence of education or training in electrochemical engineering; and (iii) the public's fear of hydrogen. This is outmoded; railway cars containing liquid hydrogen pass casually through our cities and tunnels.

The prospect is for abundant energy and as affluent an economy (if the population growth can be limited) as we want in the future without the ecological difficulties which we now foresee in obtaining the first and maintaining and spreading the other.

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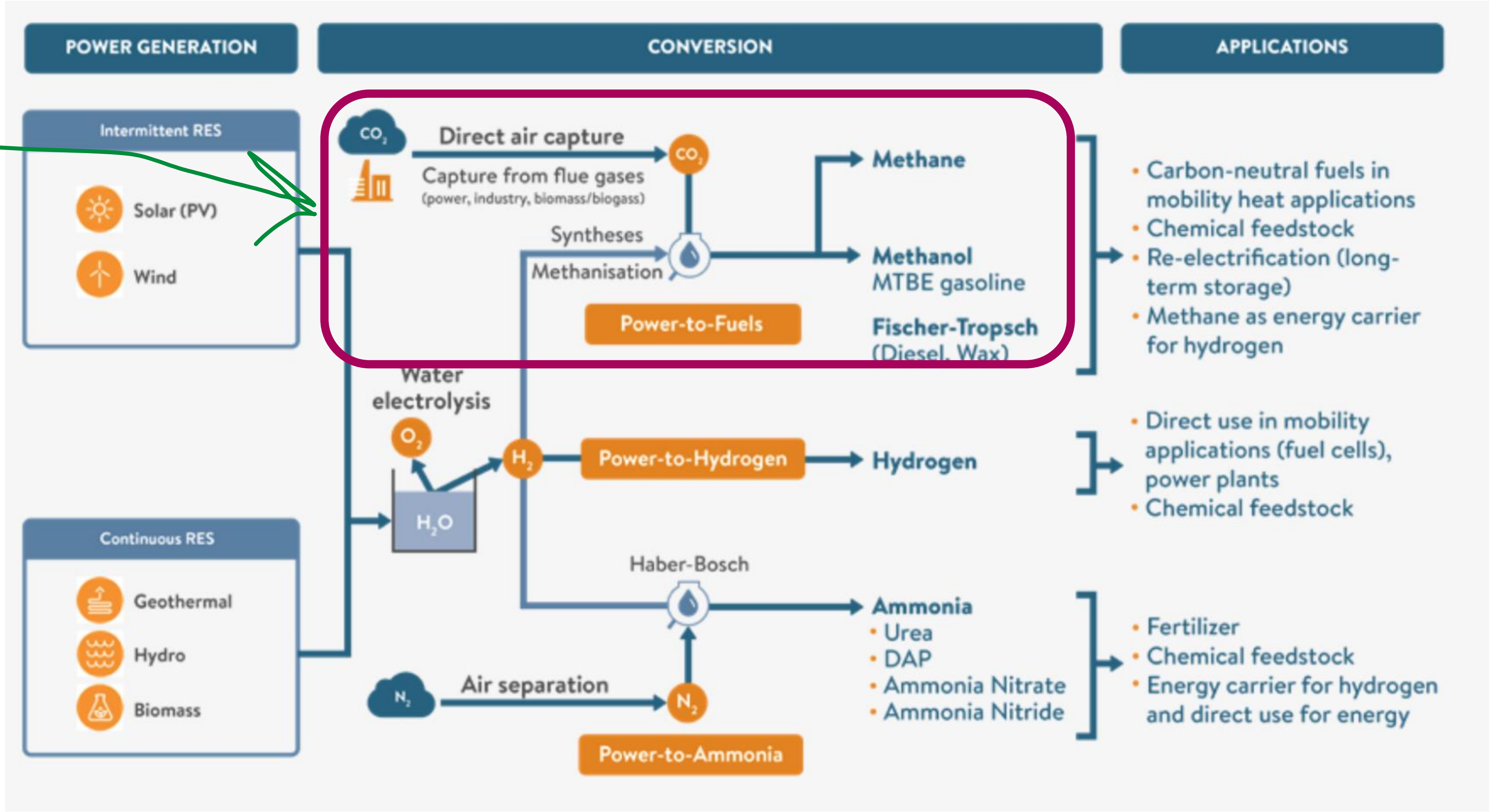
References and Notes

1. D. Gregory and D. Ng, in *The Electrochemistry of Cleaner Environments*, J. O'M. Bockris, Ed. (Plenum Press, New York, 1972), chap. 8, p. 226.
2. R. P. Hammond, in *ibid.*, chap. 7, p. 207.
3. I acknowledge discussion with F. T. Bacon of Energy Conversion, Cambridge CB2 5ES, England; with R. Henderson and N. Triner of the General Motors Technical Center, Warren, Mich.; with D. Gregory and D. Ng of the Institute of Gas Technology, 3424 South State Street, Chicago, Ill.; and with J. Appleby of the Centre Nationale de la Recherche Scientifique, Paris.

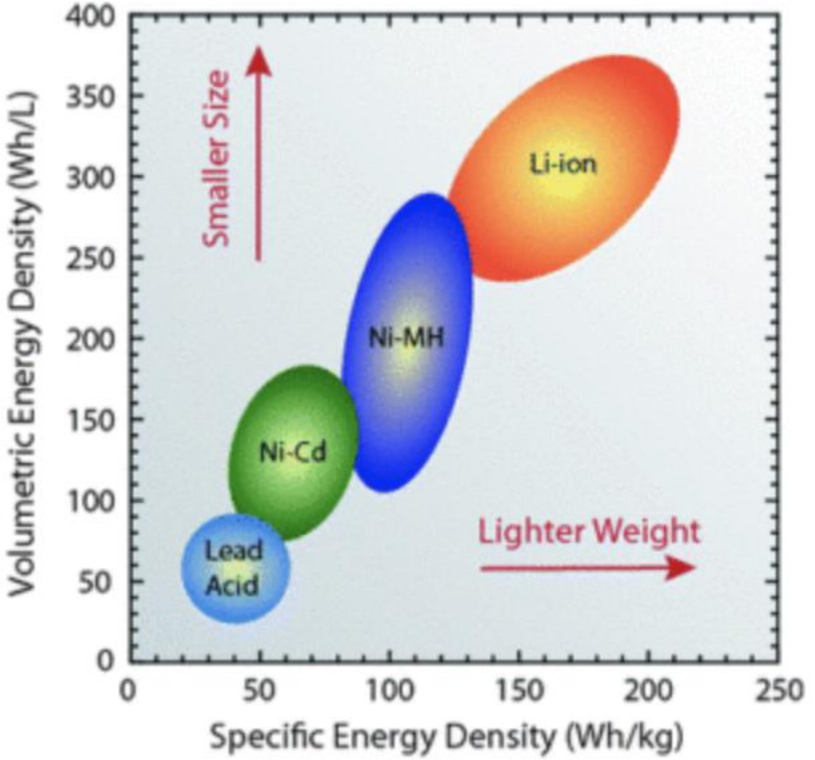
30 August 1971; revised 18 April 1972

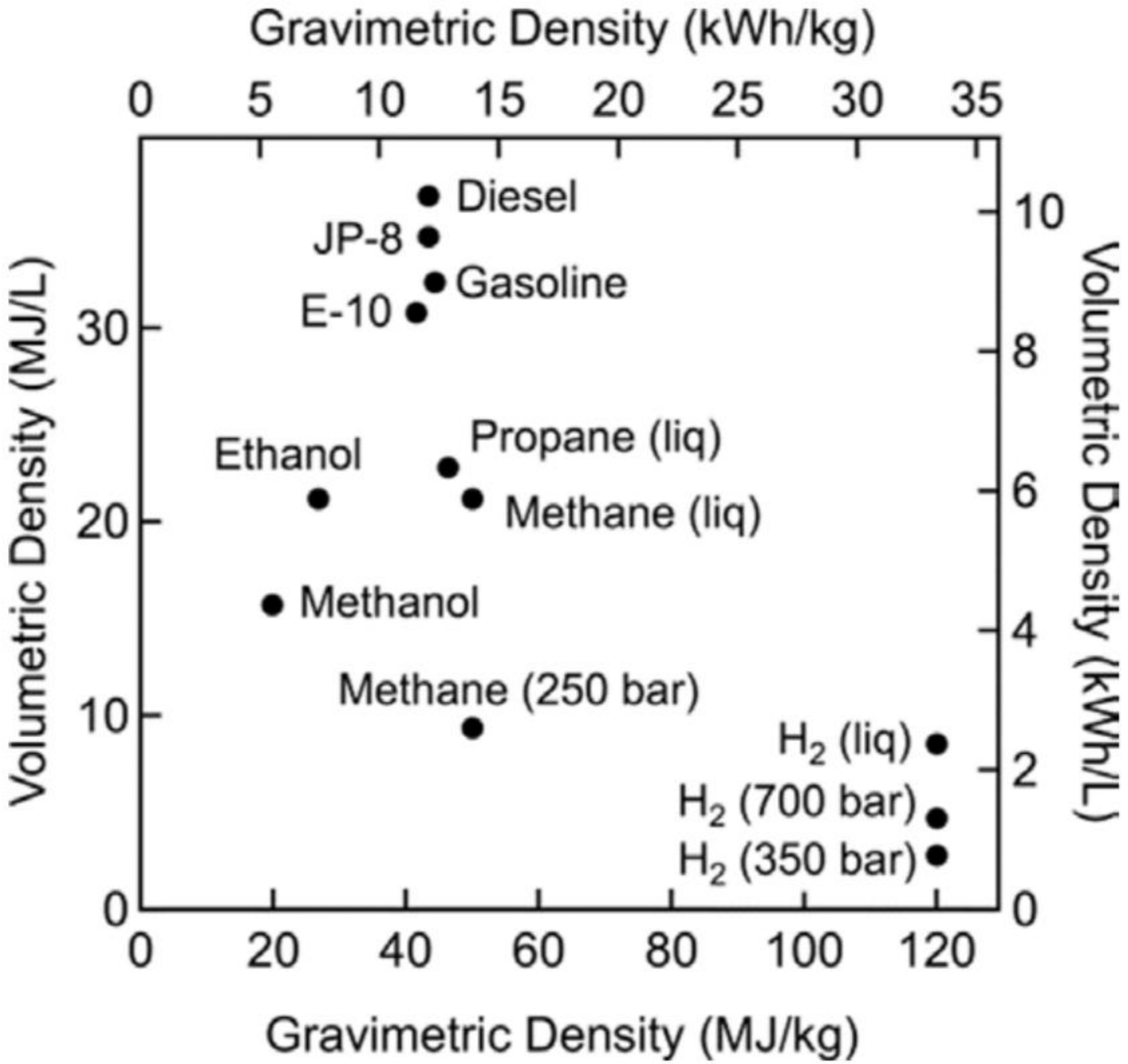
VESINIK JA METANOOL SAAVAD KOKKU

H_2 ja MeOH saavad kokku



AKUD JA VESINIK (DOE 2017)





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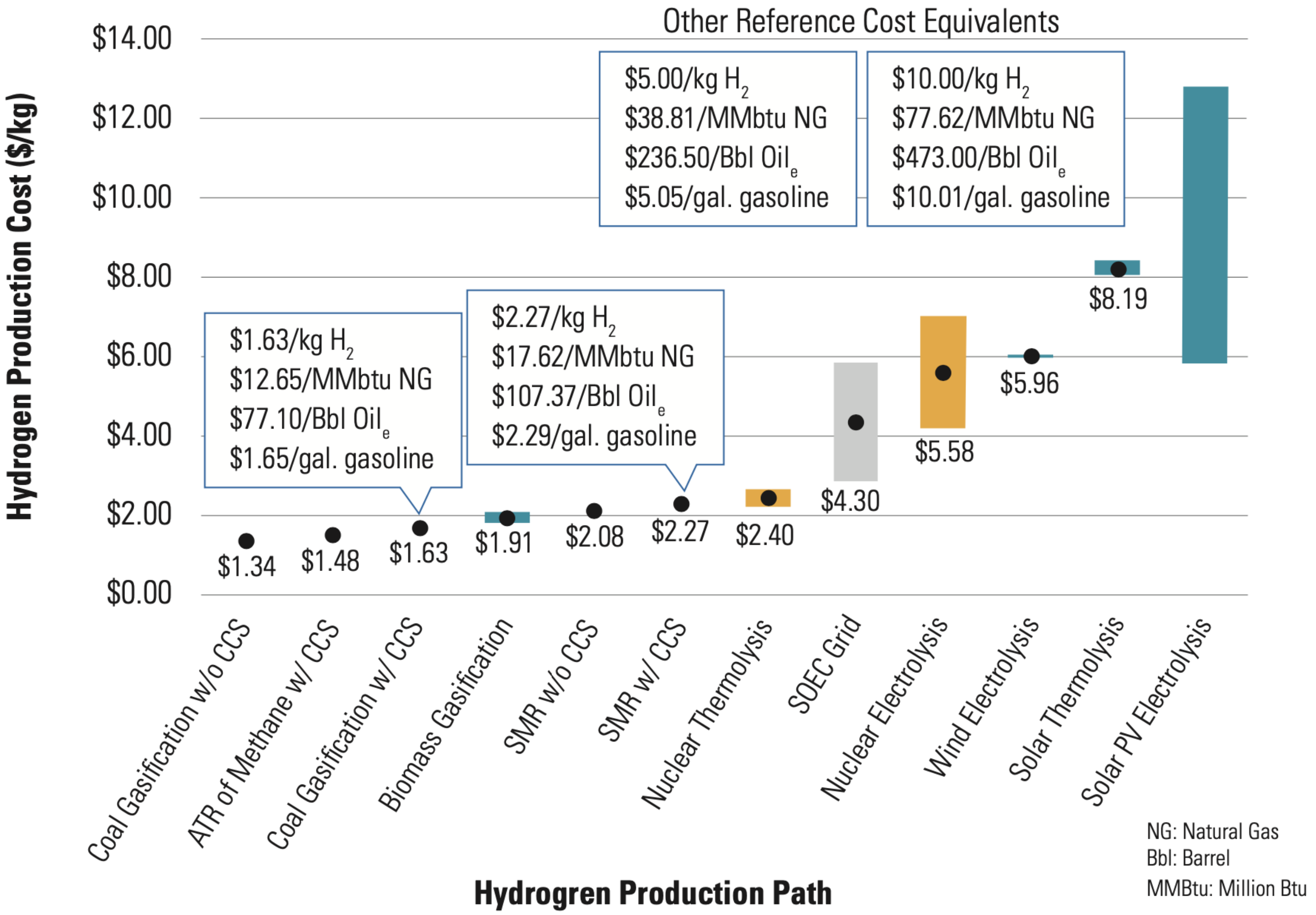
https://www.cei.washington.edu/education/science-of-solar/battery-technology/

VEINIKU HIND

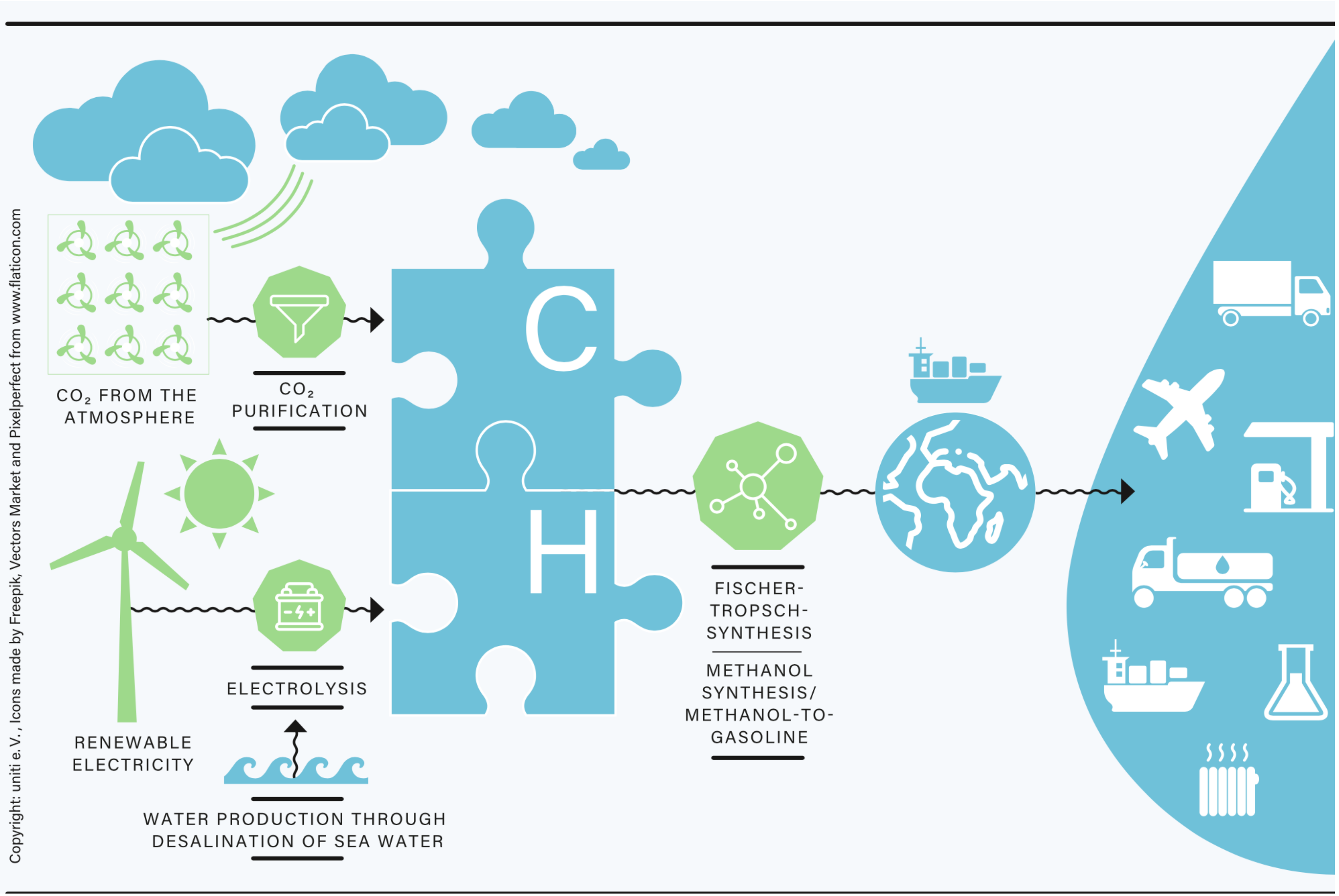


Hydrogen Strategy. Enabling a Low-carbon Economy. Office of Fossil Energy US DOE, 2020

E-KÜTUSED

Definitsiooni kohaselt on e-kütused taastuvenergiast toodetud kütused, kus vesinik on toodetu elektrolüüsil ja kasutatakse tüüpiliselt CO_2 väärindamiseks süsivesinikeks.

Tänapäeval vaadeldakse kütustena ka ammoniaaki ja metanooli.



https://www.efuel-alliance.eu/efuels/what-are-efuels

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EIT Raw Materialsi võrgustikku TalTechi siseselt esindab alates 2023 aastast RMTL

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https://taltech.ee/ringmajandus

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