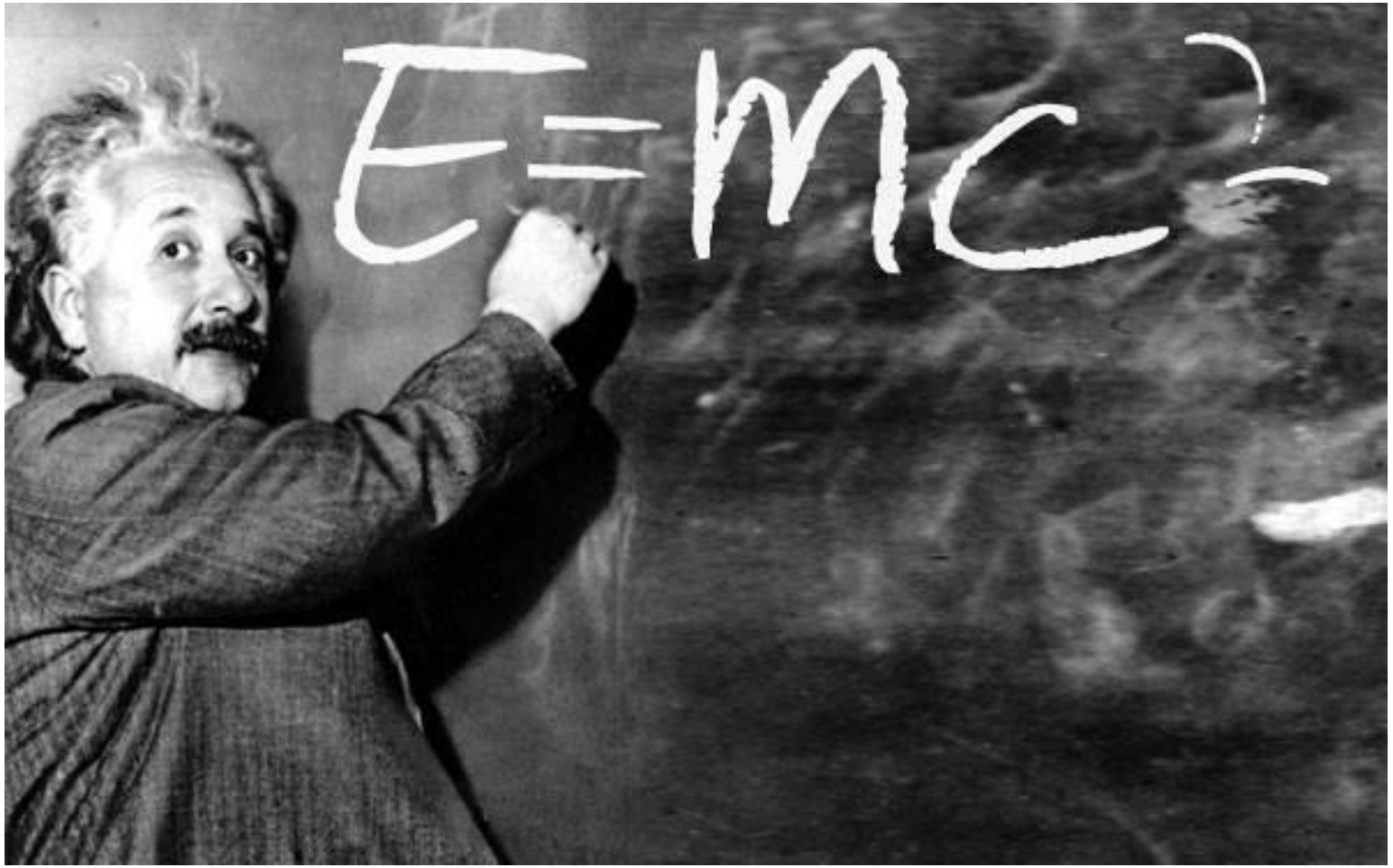
Energy Business Scenarios

Gonçalo Amarante Guimarães Pereira

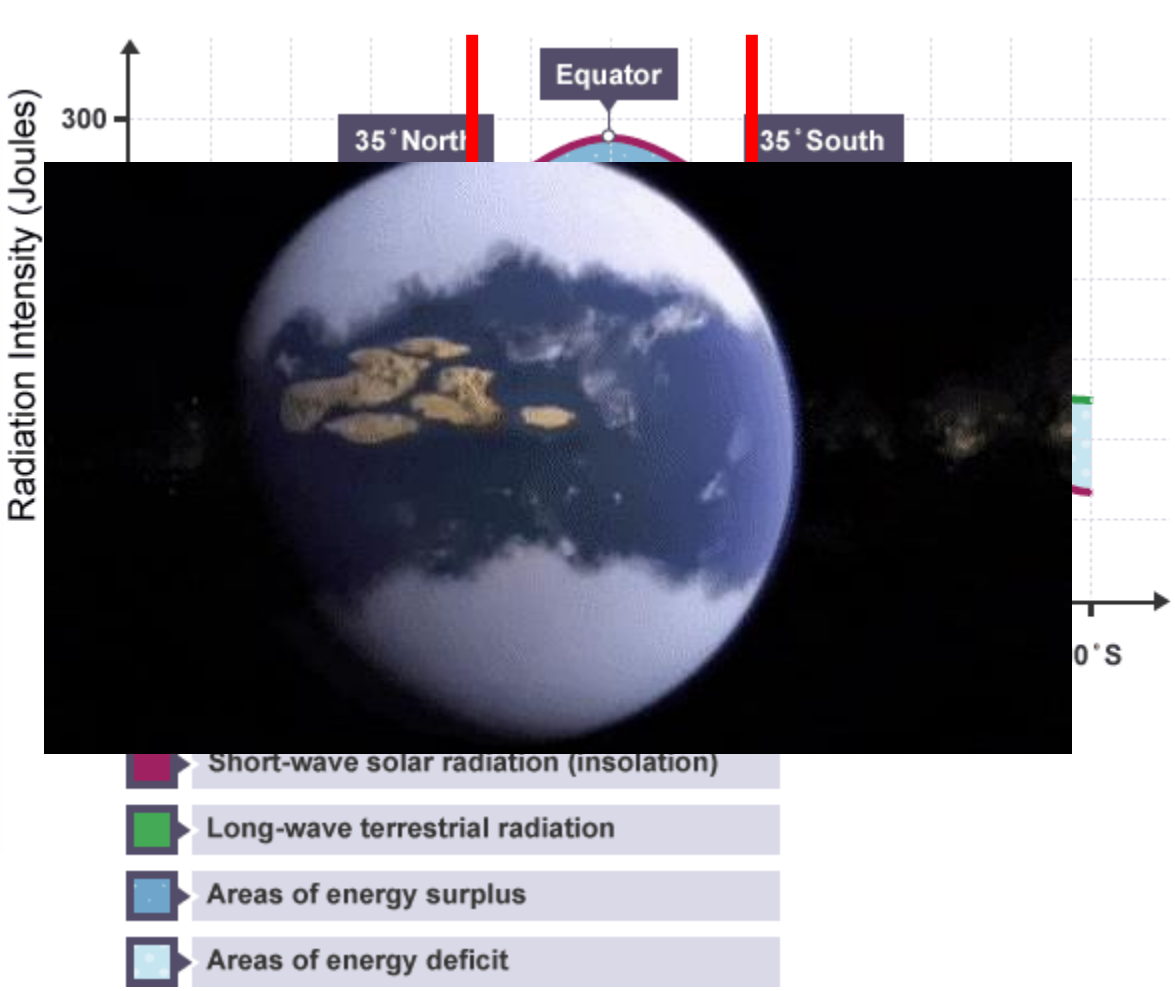
27/03/2023

Follow the Energy…



Gç

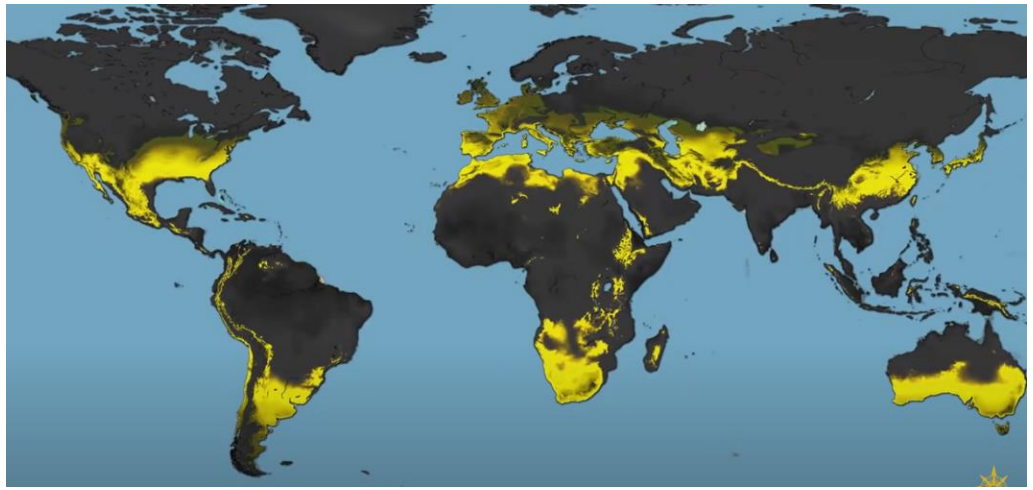
The Global Energy Scenario



Gç

Why this Paradox?

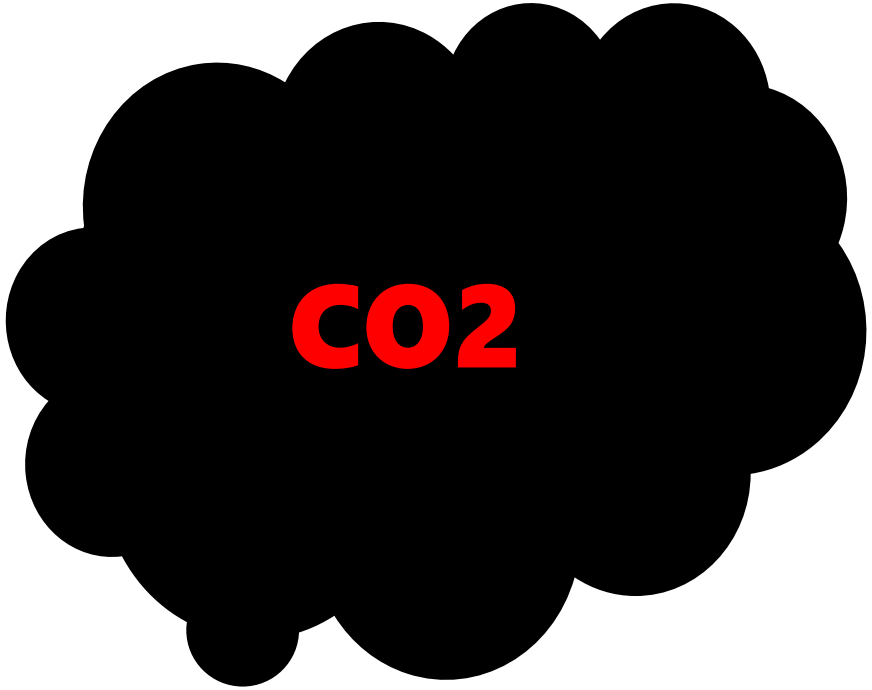
21 – 23 ºC



How to Solve?

Gç

Side Effect



Gç

CO2 is The Global Problem

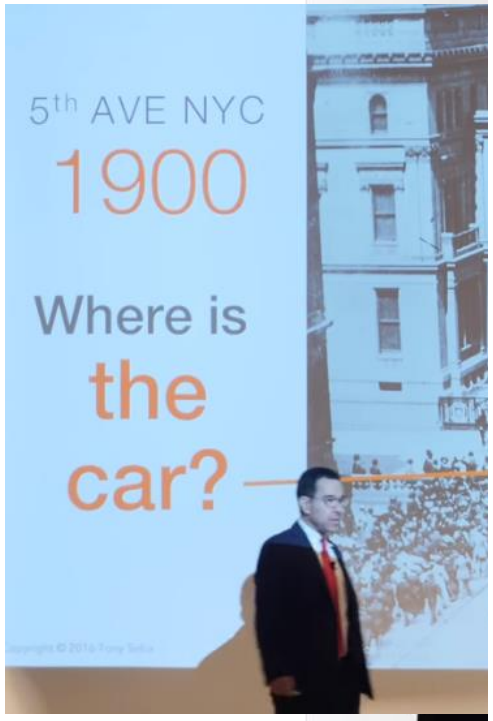
Thesis

35%

90%

Gç

The Future....Eletric Cars in 5 Years (from 2016)....

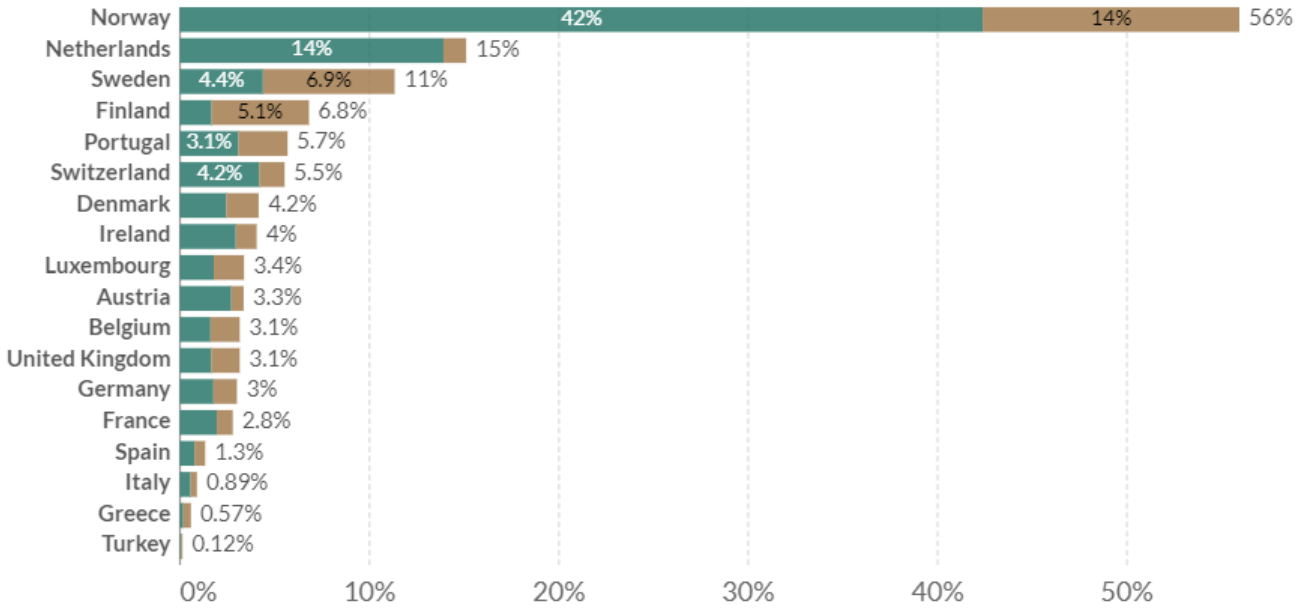


Share of new passenger vehicles that are electric or plug-in hybrid, 2019

Our World in Data

Add country

Battery electric Plug-in hybrid



Source: International Council on Clean Transport (ICCT) and European Environment Agency
Note: Based on new passenger vehicle registrations.

OurWorldInData.org/transport • CC BY

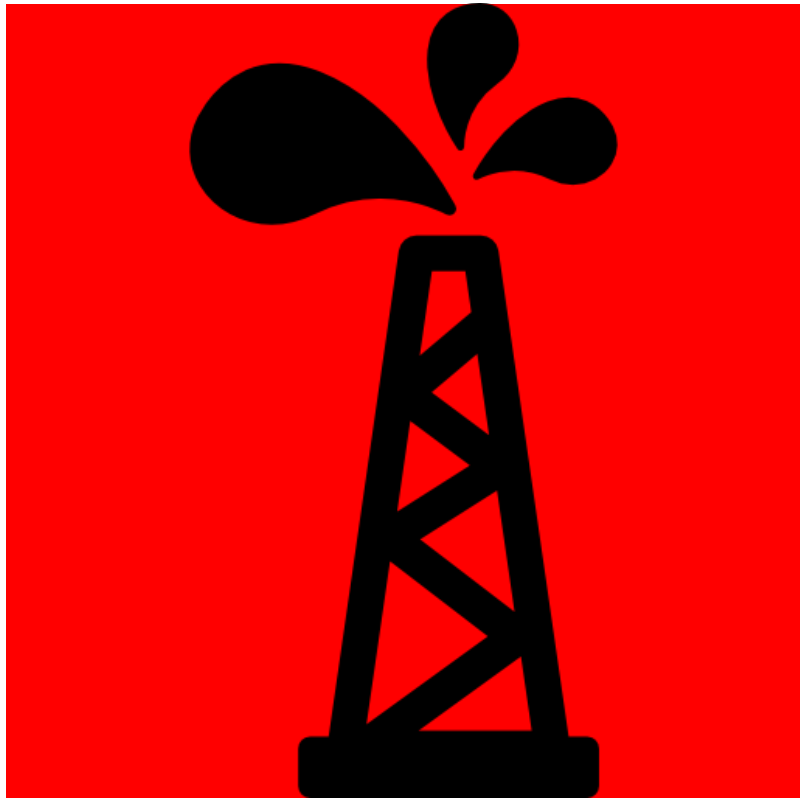
2001 2019

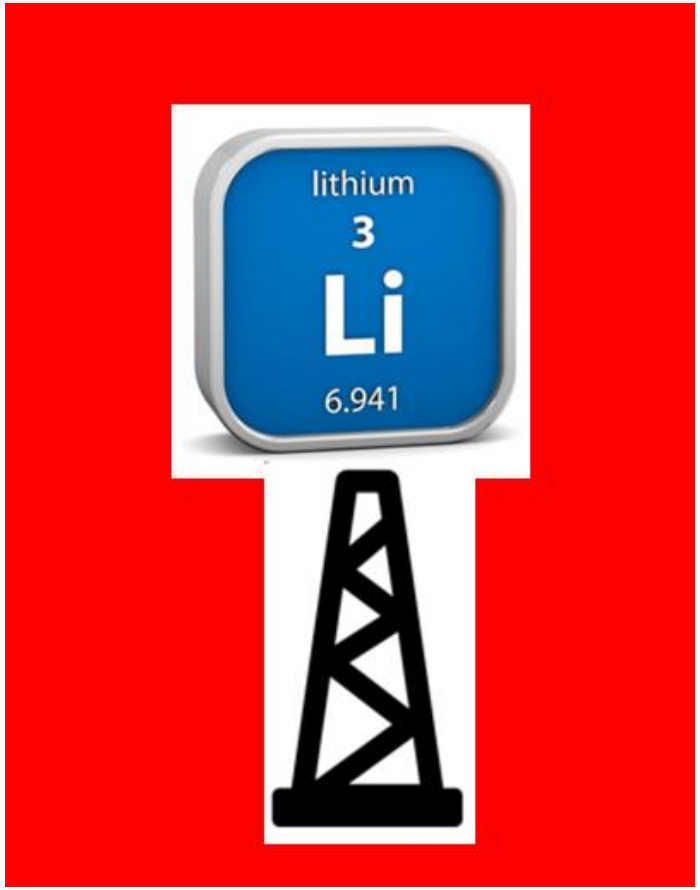
Gç

Countries 'Classification

Flashlight on PassCar/LDV Regional Trends						
Categories/Regions	Europe	China	US	Japan	Brazil	ROW
LCA	Tank to Well CO2	Sincere	Political dependent	Well to Wheel	Well to Wheel	
Electification	Push to BEV	BEV and HEV	BEV, H2, HEV	Most effective	Fashion	
Tendency	ICE Sales stop in 2035	H2 and Methanol ICE	BEV with boundaries	Most effective	Flex and HEV	
Backdoor	CO2 neutral fuel - X and Biofuel	No need	No need	Most effective	Biofuel	
Consequences of electrification	Jobs destruction	Jobs creation	Inflation Reduction Act	Energy Supply	Lobbies	Energy Supply, Price, Infrastructure
Electrification Phylosophy	Dogmatic	Pragmatic	Opportunistic	Fact Based	Unnecessary	None - Lobby dependent

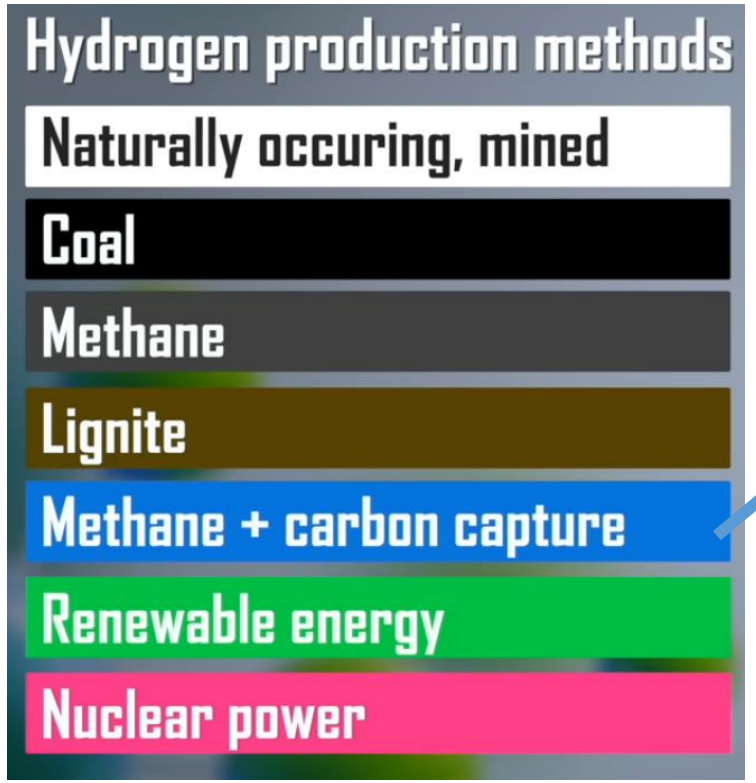
Antithesis 1 - Metals

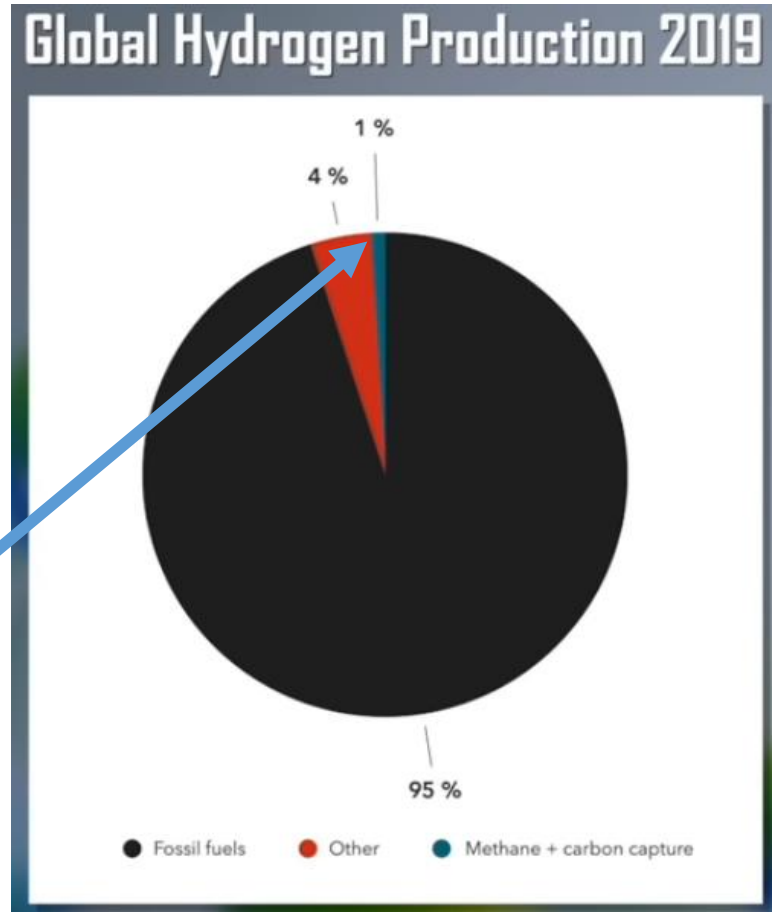


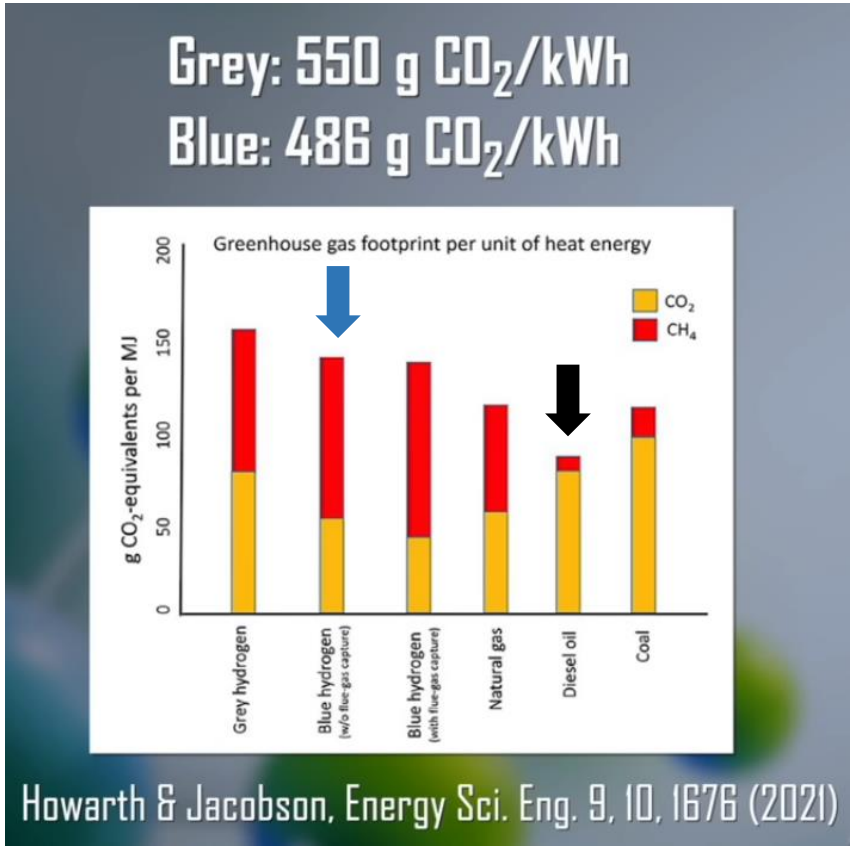


Gç

The Strange Rainbow of Hydrogen



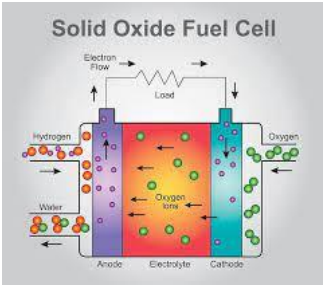




Gç

Decision-Making

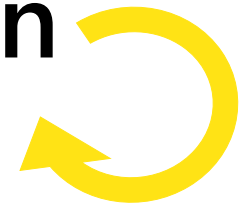
Action ?????



Desires

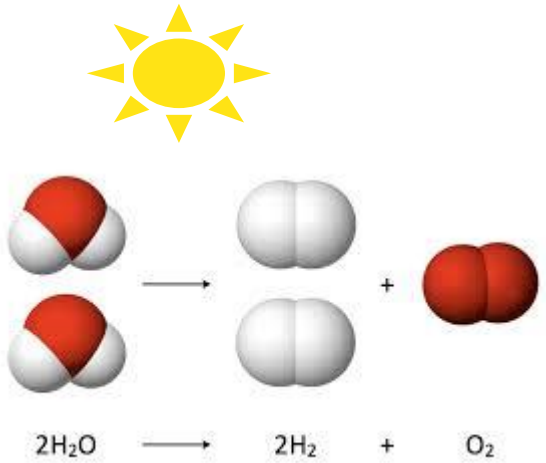
Believes

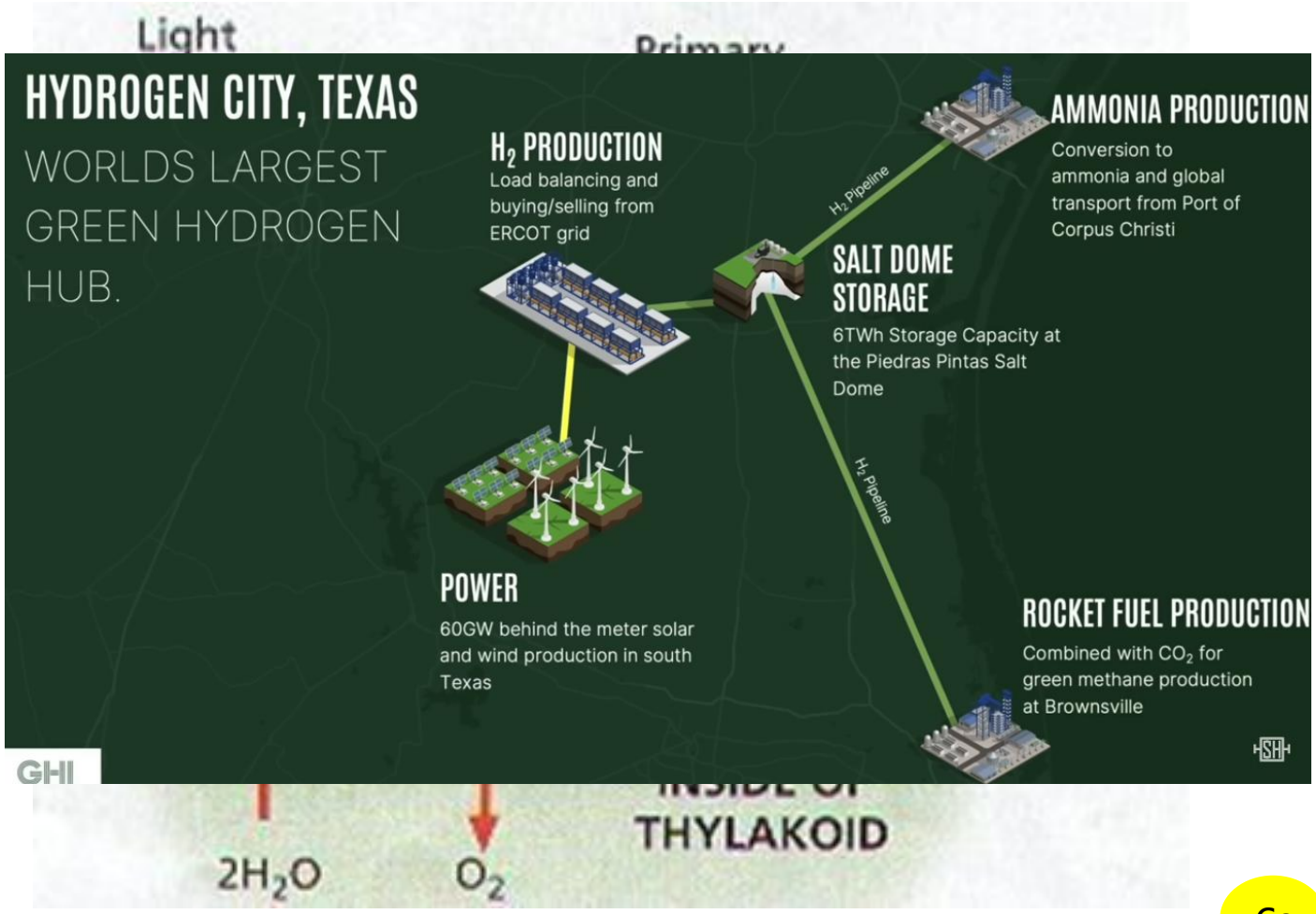
Information



Gç

(Photo)Synthesis





Gç

Reality Check

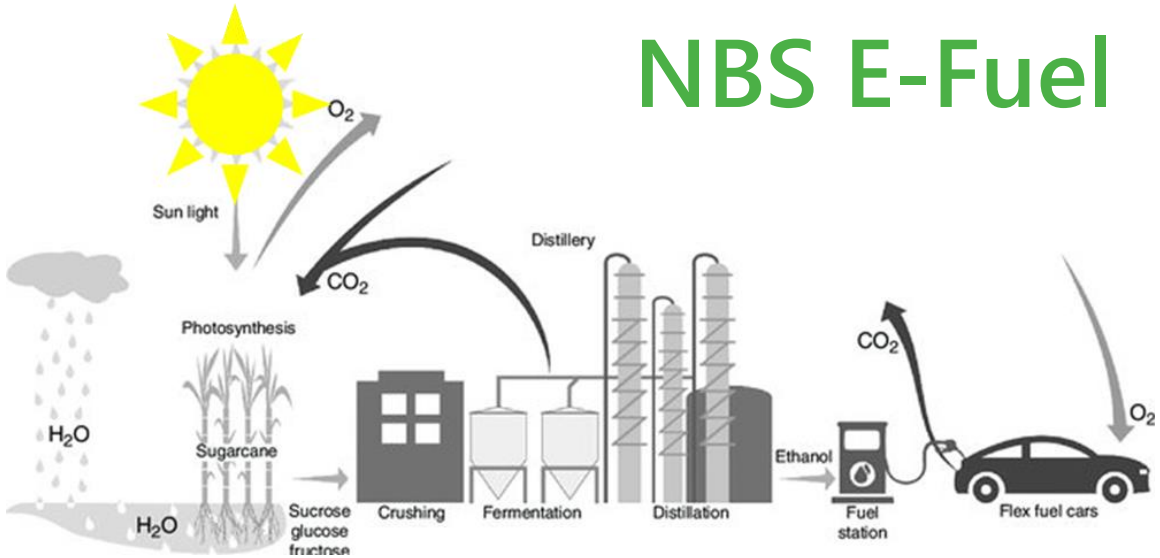
REUTERS®

Exclusive: EU drafts plan to allow e-fuel combustion engine cars

By Markus Wacket

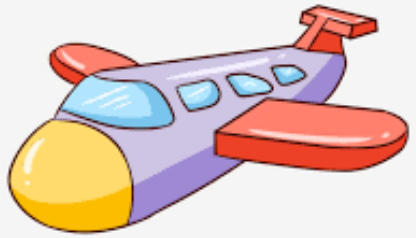
BERLIN/BRUSSELS, March 21 (Reuters) - The European Commission has drafted a plan to allow sales of new cars with internal combustion engines after 2035 **if they run only on climate neutral e-fuels**,

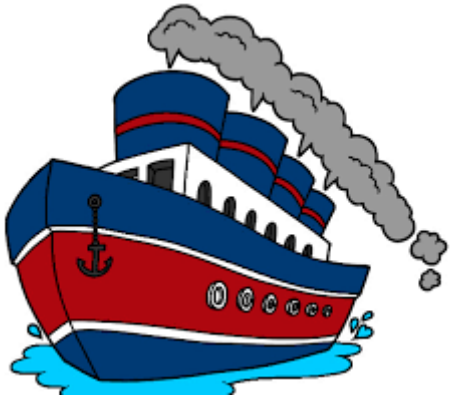
NBS E-Fuel



Gç

So What?





SAF	Bunker Fuel	Green Diesel	Light
HEFA	Methanol	HVO	Ethanol
ATJ	Ammonia	Biodiesel	Ethanol
		DME	Ethanol
		Methane	.....

Gç

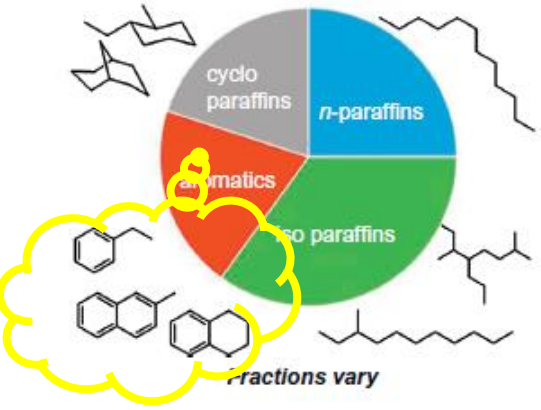
SAF – *Sustainable Aviation Fuel* (min 80% less CO2)

Jet fuel specifications

ASTM 1655-15d

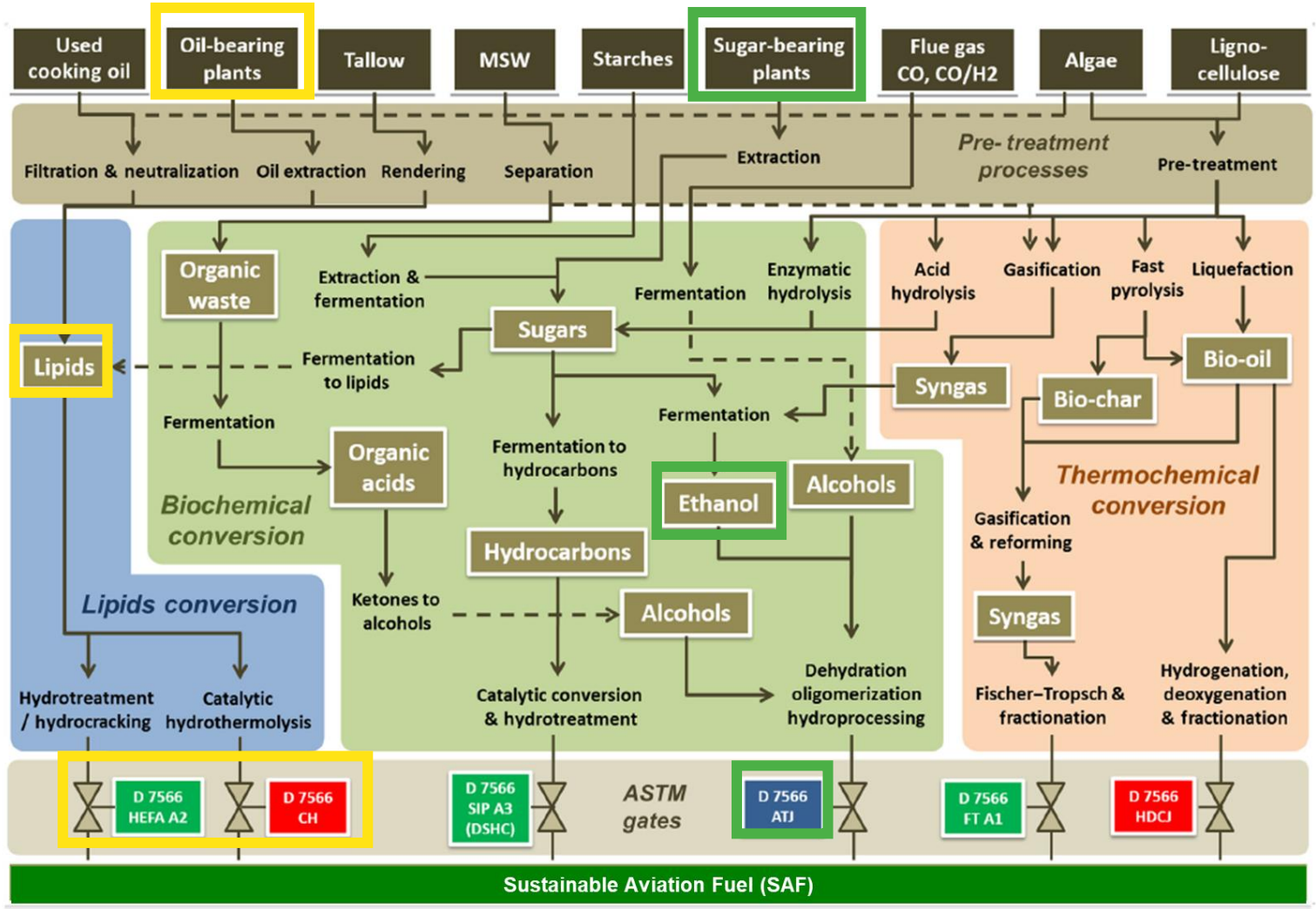
	Criteria	Explanation	Jet A-1 specification
	Flash point	The temperature at which the fuel ignites in the engine	38° minimum

Ideal carbon length C8–C16



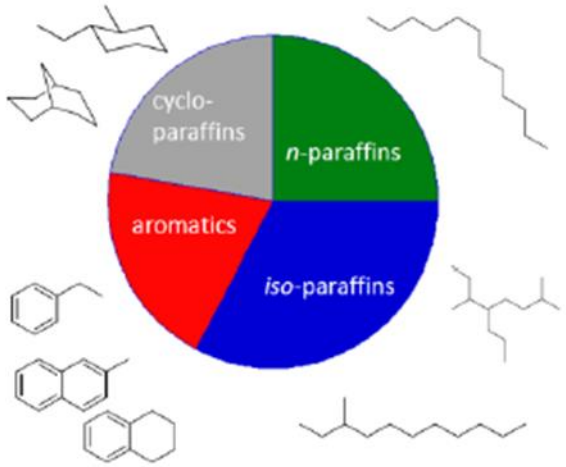
- Paraffins (70–85%) (iso, normal, and cyclic, provide Btu content)
- Aromatics (less than 25%) (poor combustion; some) needed to ensure seal swell)
- Olefins (<1%) (gum formation)
- S, N, O containing (limited allowance)

S	Sulphur content	The amount of sulphur in the fuel (parts per million)	0.30
	Density	How heavy the fuel is per litre (kg/m³)	775-840

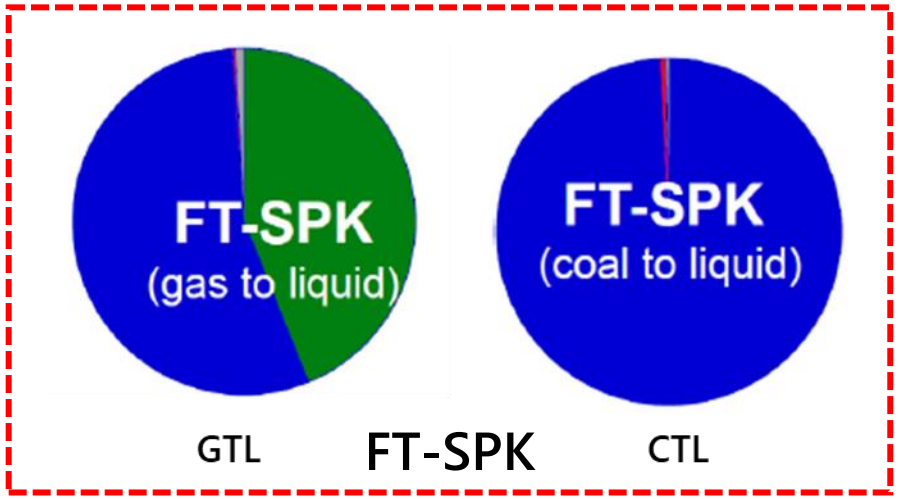


Adapted from: L.A.B. Cortez, F.E.B. Nigro, A.M. Nassar, H. Cantarella, L.A. H. Nogueira, M.A.F.D. Moraes, et al., Roadmap for Sustainable Aviation Biofuels for Brazil, Blucher, São Paulo, 2014, 272 p

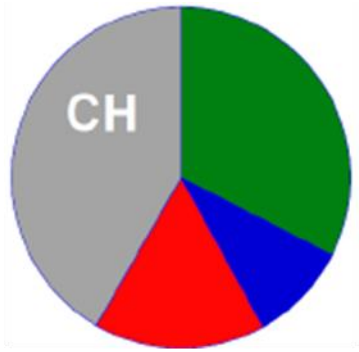
Aromatic Issue



Typical composition of Jet-A1

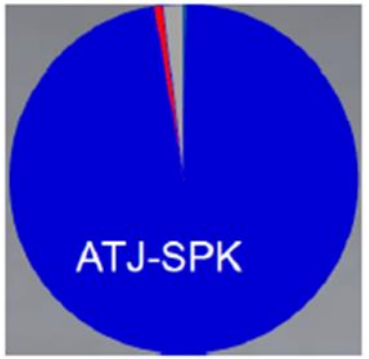


GTL FT-SPK CTL



Catalytic Hidrothermolysis - CH

HEFA - SPK



ATJ - SPK

Gç

New elastomer seals. The properties of fluorocarbon and fluorosilicon rubbers are far less sensitive to fuel composition changes than nitrile rubber. However, is that all existing aircraft fuel systems would have to be suitably upgraded prior to introduction of low-aromatic fuel blends.

Pratt & Whitney and Embraer Complete 100% SAF Flight Testing of GTF-powered E195-E2 Aircraft

SAF Approved Process

Different Internationally Approved Process Through Which SAF Can				
Pathways and process	***Feedstock options***	***Producers using the pathway***	***Date of approval***	***Current blending limit***
Fischer-Tropsch Synthetic Paraffinic Kerosene (FT-SPK)	Biomass (forestry residues, grasses, municipal solid waste)		2009	Up to 50%
Hydroprocessed Esters and Fatty Acids (HEFA-SPK)	Algae, jatropha, camelina	Alt Air	2011	Up to 50%
Hydroprocessed Fermented Sugars to Synthetic Isoparaffins (HFS-SIP)	Microbial conversion of sugars to hydrocarbon	Amyris	2014	Up to 10%
FT-SPK with aromatics (FT-SPK/A)	Renewable biomass such as municipal solid wastes and forestry residues, wood and energy crops		2015	Up to 50%
Alcohol-to-Jet Synthetic Paraffinic Kerosene (ATJ-SPK) (Isobutanol)	Agricultural waste products (stover, grasses, forestry slash, crop straws)	Gevo	2016	Up to 30%
Alcohol-to-Jet Synthetic Paraffinic Kerosene (ATJ-SPK) (Ethanol)	Agricultural waste products (stover, grasses, forestry slash, crop straws)	LanzaTech	2018	Up to 50%
Catalytic hydrothermolysis synthetic jet fuel (CHJ)	Triglyceride-based feedstock (plant oils, waste oils, alga oils, soybean oil, jatropha oil, camelina oil, carinata oil and tung oil)	ARA and Euglena	2020	Up to 50%
High Hydrogen Content Synthetic Paraffinic Kerosene (HHC-SPK)	Biologically derived hydrocarbons such as algae	IHI World	2020	Up to 10%

https://aviationbenefits.org/environmental-efficiency/climate-action/sustainable-aviation-fuel/producing-sustainable-aviation-fuel/

Gç

Some Figures and Believes.....

- Market Perspective: Air Bus reported that there are approximately *15.750 aircraft in the world (2022),* and it is projected to reach *32.000 by 2028;*

- Price Challenge: Nowadays the *fuel consumption is around 3-4 liters/(passenger. 100km),* which makes fuel the *1°cost for an airline (30% of total costs)*;

- Safety and Entrance Barrier: To be approved by international standards *(ASTM D4054 – Qualification Procedure)*;

  - ASTM qualification *is a long and costly process*;

  - It requires a large quantity of jet fuel, from about *38 to 380 m^3*, several years, e.g. *2 to more than 5 years*, with a *cost* that *can overpass US$10 million*.

  - The construction, and operation for a few years, of a *big size pilot plant* or *demo plant*, to demonstrate the process and to be able to scale it up, with *costs typically in the range of US$ 100 to a few hundred millions*.

- The SAF cost is not competitive compared to petroleum-based Jet fuel. SAF is 2-2,5 times more expensive than fossil Jet fuel; (WHERE AND WHY?)

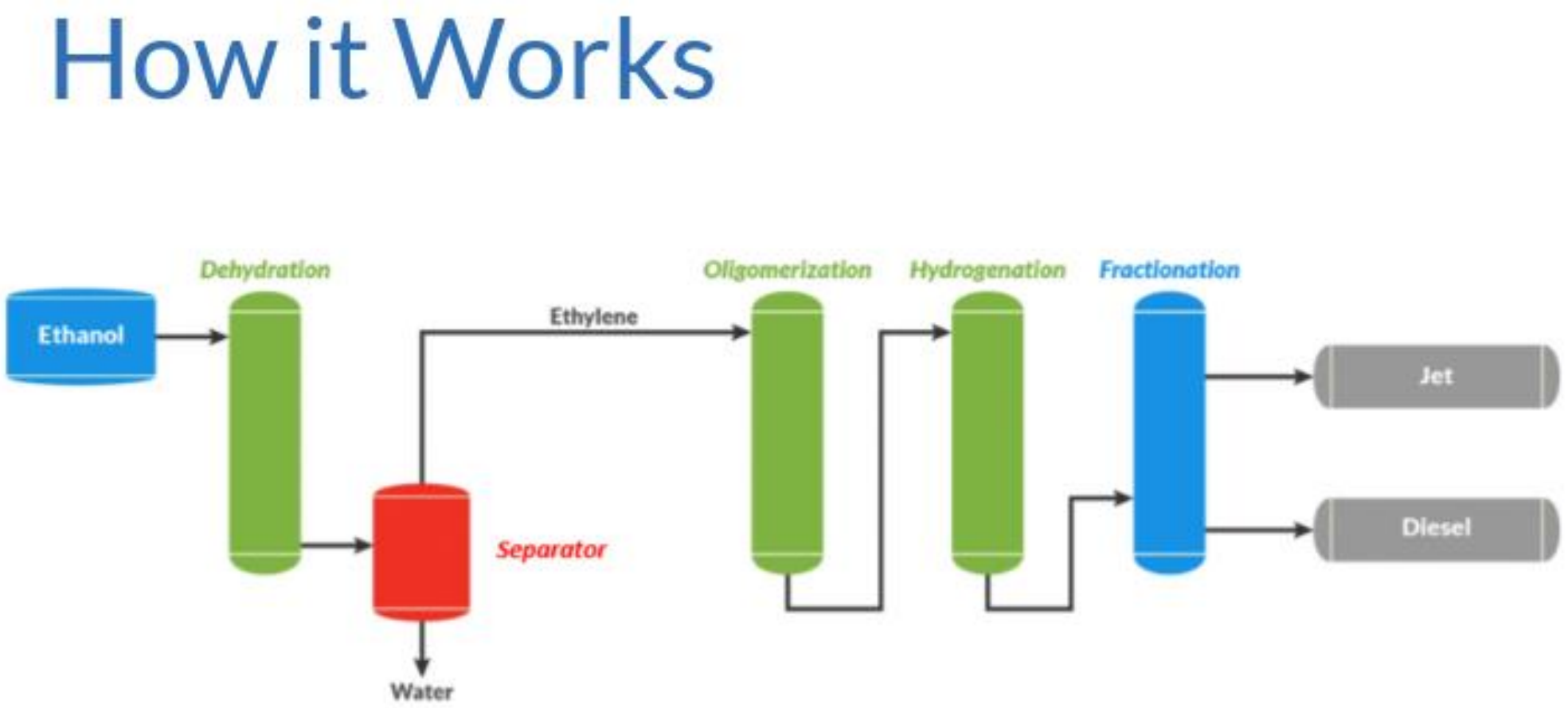
Gç

Biomass Price is the Key (obviously)

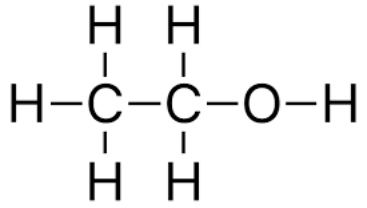
Energy-cane I Sugarcane Energy-cane II

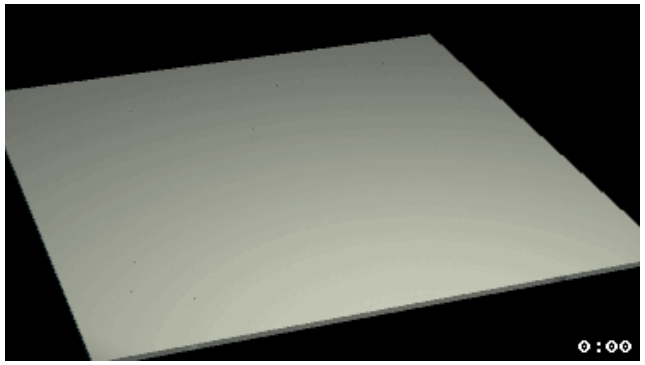
Gç

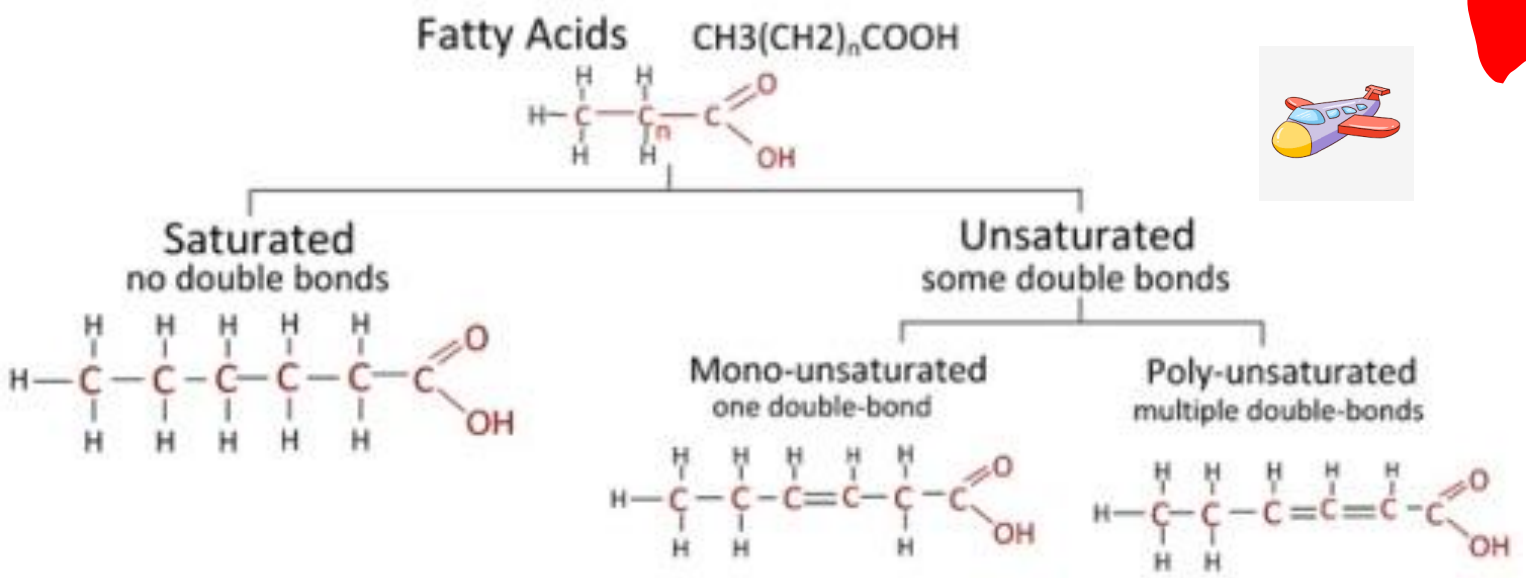
Raizen, Shell and LanzaJet

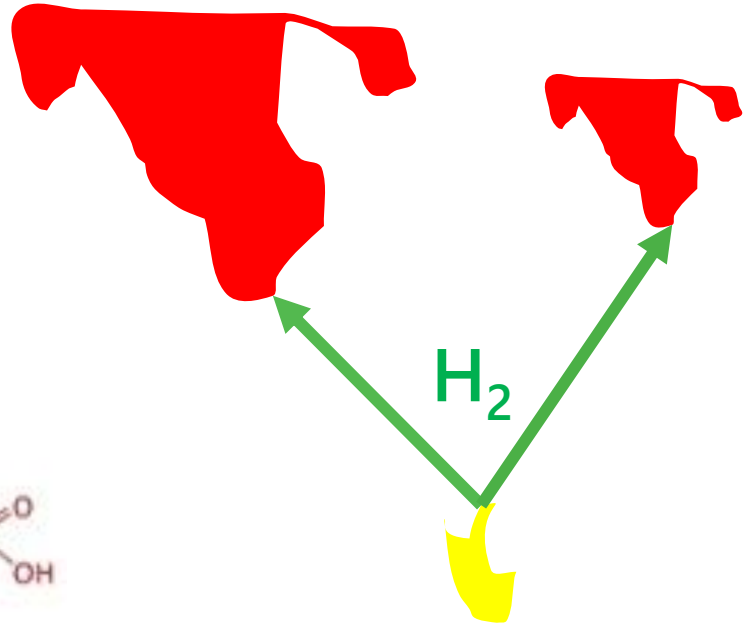


The Beauty of the (Bio)Oil





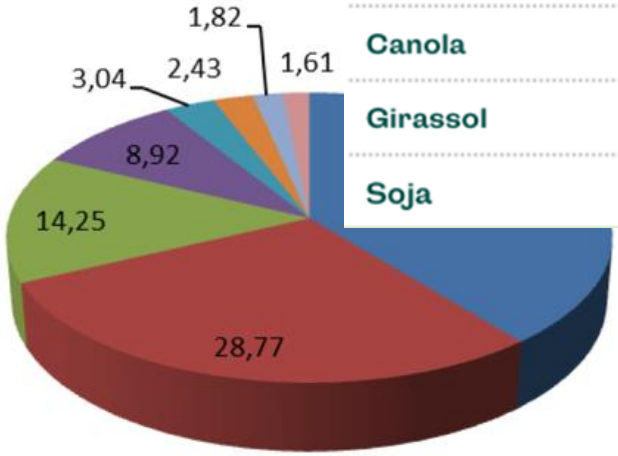




Gç

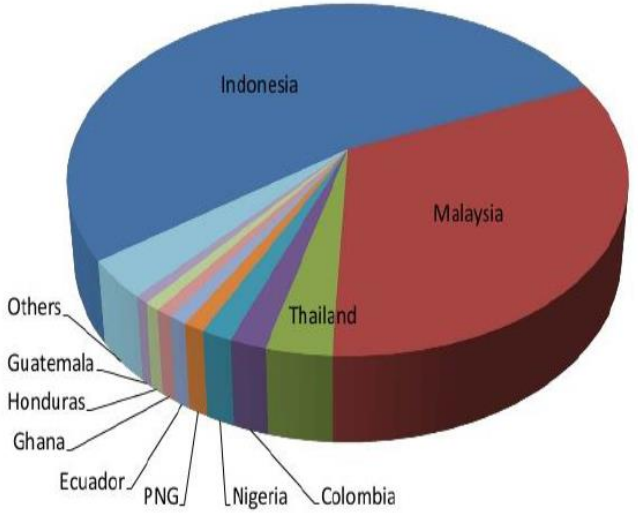
The Biooil Issue

	Toneladas/ha
Palma Africana	3,8
Canola	0,8
Girassol	0,7
Soja	0,6



Oil Palm (CPO PKO)

Soybean



Gç

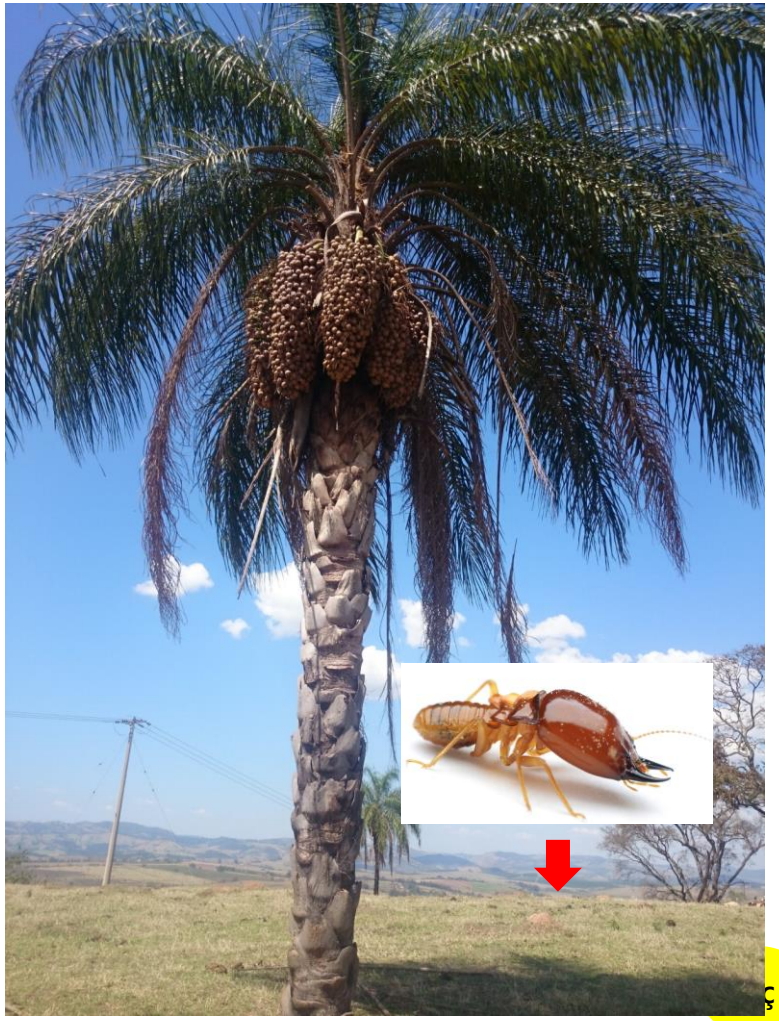
Brazilian Palm Option

Elaeis guineensis

2000mm

Acrocomia aculeata

1000mm



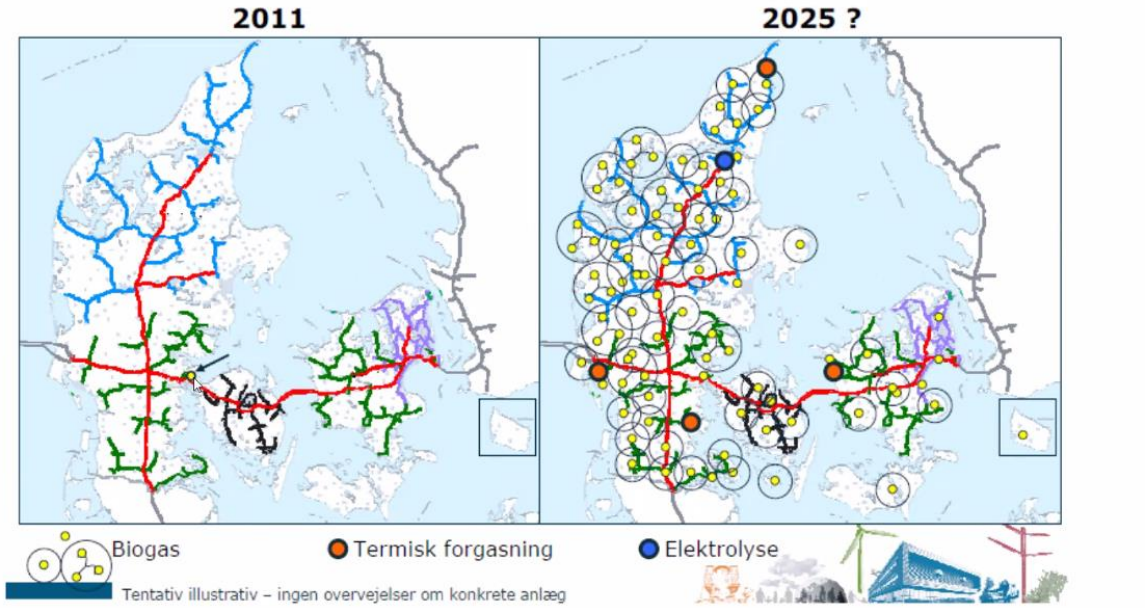
Massive Natural Occurrence

Biogas

AALBORG UNIVERSITY
AALBORG ESBJERG COPENHAGEN

Future gassector?

Interreg
Deutschland - Danmark
Large Scale Bioenergy Lab 2



38

Shell conclui aquisição de maior produtor de biometano da Europa

Petroleira adquiriu 100% das ações da Nature Energy Biogas; empresa possui 14 usinas em operação e um pipeline de cerca de 30 novos projetos de fábricas na Europa e na América do Norte

epbr — 27 de fevereiro de 2023

Em **Biocombustíveis**, **Internacional**, **Mercado de gás**, **Transição energética**

AA

Utilizando resíduos agrícolas, industriais e domésticos, a Nature Energy possui 14 usinas em operação (Foto: Divulgação/Nature Energy)

Gç

A Cane for the Semiarid

Gç

Ethanol Production Potential

Journal of Cleaner Production 261 (2020) 121283

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Agave: A promising feedstock for biofuels in the water-energy-food-environment (WEFE) nexus

Xiaoyu Yan [a, b, *, 1], Kendall R. Corbin [c, 1, 2], Rachel A. Burton [c], Daniel K.Y. Tan [d]

[a] Environment and Sustainability Institute, University of Exeter, UK
[b] College of Engineering, Mathematics and Physical Sciences, University of Exeter, UK
[c] ARC Centre of Excellence in Plant Cell Walls, University of Adelaide, Australia
[d] The University of Sydney, Sydney Institute of Agriculture, School of Life and Environmental Sciences, Faculty of Science, Sydney, NSW, 2006, Australia

28 MM Ha

Ha	Litros
1	7.414
1.000	7.414.000
1.000.000	7.414.000.000
10.000.000	74.140.000.000

3,3 MM ha – 30 Bi Litros

Sugar Cane 

4,5 MM ha – 30 Bi Litros

Gç

The Opportunity…

BRAVE Program

LGE
Genômica e bioEnergia

What about NOW?

SINDIFIBRAS
SINDICATO DAS INDÚSTRIAS DE FIBRAS VEGETAIS NO ESTADO DA BAHIA

November, 2021

Sisal	2017	2018	2019	2020	2021 (jan/jun)	2021 (estimated)
Total Exported (US$ 1,000)	**75,973**	**84,538**	**85,321**	**77,999**	**39,764**	**79,528**
Fiber	31,761	40,032	44,003	37,597	20,110	40,220
Manufactured	44,212	44,506	41,318	40,402	19,654	39,308
Total Exported (ton 1,000)	**49,523**	**49,563**	**57,988**	**59,381**	**30,123**	**60,246**
Fiber	23,224	29,539	36,149	34,432	17,001	34,002
Manufactured	26,299	20,024	21,839	24,949	13,122	26,244
Average (US$/ton)	**1,534**	**1,706**	**1,471**	**1,314**	**1,320**	**1,320**
Fiber	1,368	1,355	1,217	1,092	1,183	1,183
Manufactured	1,681	2,223	1,892	1,619	1,498	1,498
Production (ton 1,000)	**70,7**	**70,4**	**82,8**	**84,8**		**86,1**

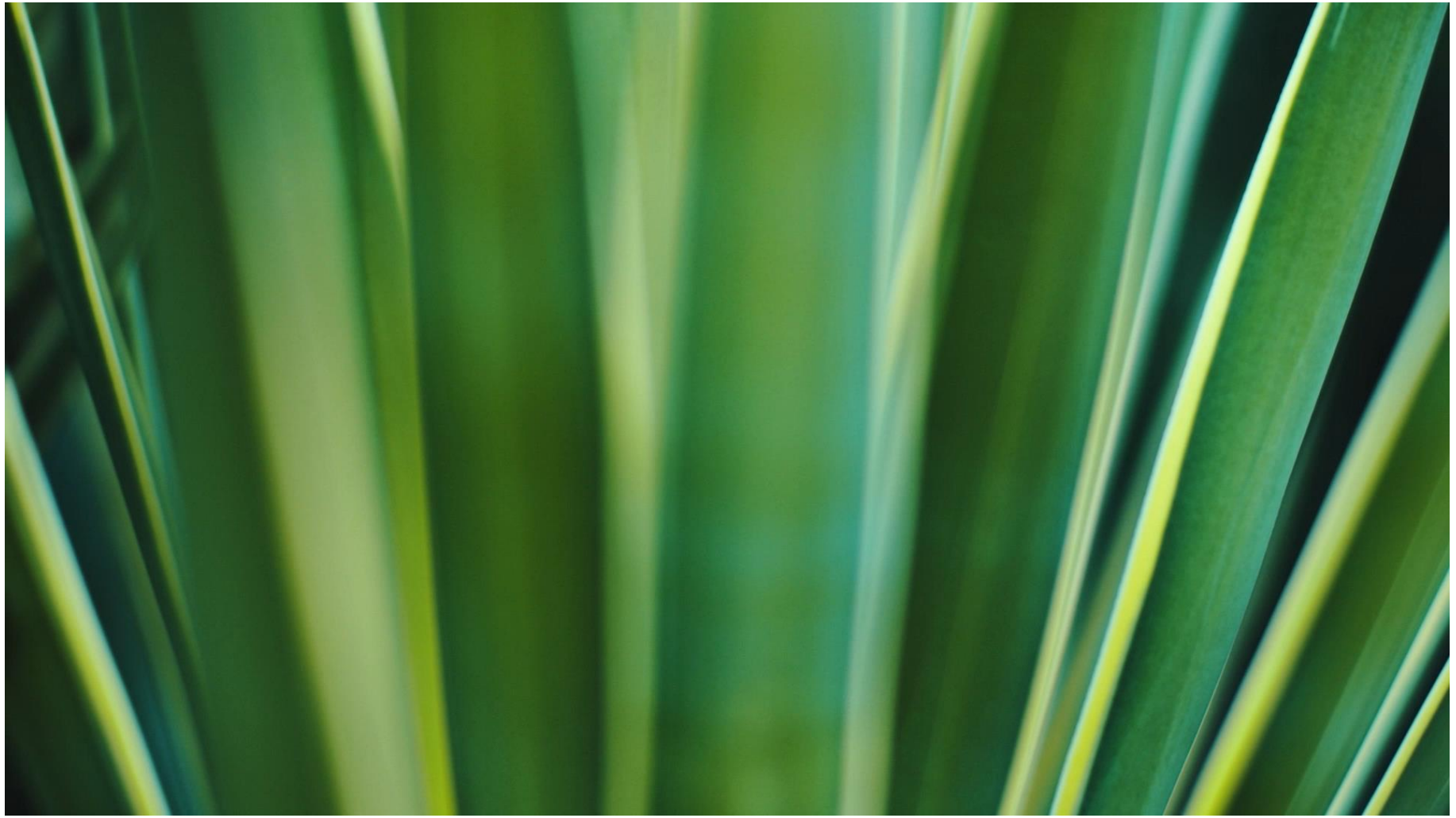
4%

Biogas Obvious Opportunity

14 BOE/ha

	Fibra seca/há	Peso das Folhas	No de folhas	Pot. Biomet. M³/há.ano	Faturamento/há.ano	BOE
HB 11648	4.000	100.000	250.000	2294,67	R$18.884,00	13,87355467

A bright Summary

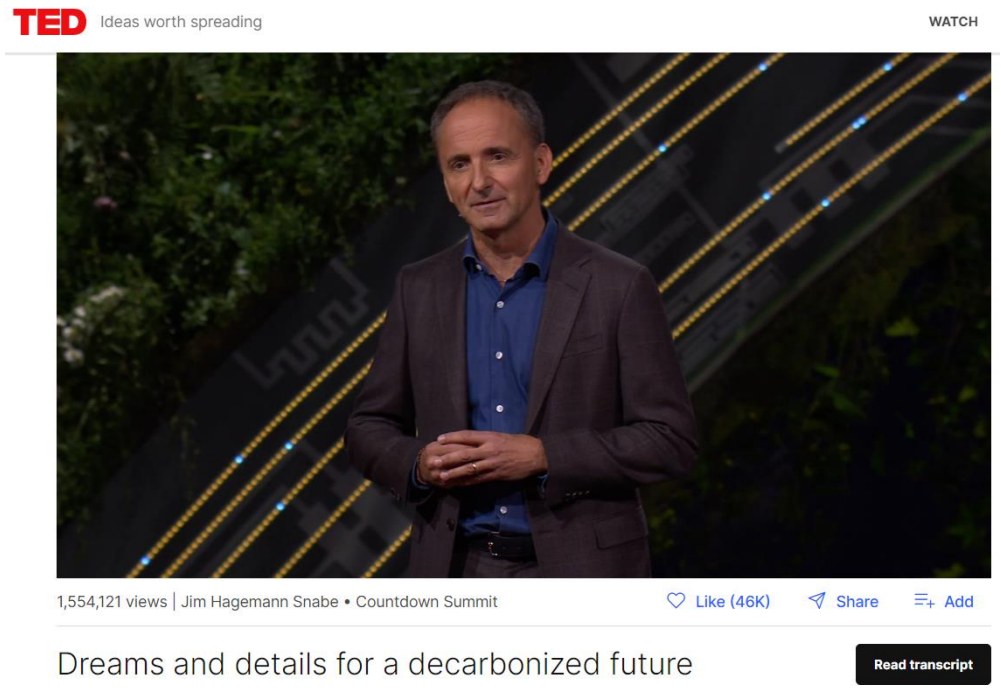


Gç

The final Comment

Gç

E-Bunker Fuel



"How much green electricity do we need to fuel all of our 750 vessels with green fuel?" Our fleet today consumes 10 million tonnes of bunker oil. To replace that with green fuel, we estimate that we need 220,000 gigawatt-hours of green electricity. That is the equivalent of 10 percent of the installed base of solar and wind in 2019. And Maersk is 20 percent of the cargo shipping industry. So, to fuel the cargo shipping industry alone would consume 50 percent of the entire installed base of green electricity. And that's just cargo shipping. In other words, **we need a dramatic, exponential scale of installations of solar, of wind, of hydrogen production, of green fuel production, to solve this problem**. We estimate that the total investment will be in the neighborhood of **two trillion dollars, which, granted, is a lot of money**. But actually, it is the equivalent of **four years of capital expenditure in the oil and gas industry today.**

Baker's Account...

Transporte de Carga no Mundo segundo Maersk			
Item	Unidade	Número Maersk	Números Mundo
Navios	n	750,00	3.750,00
Consumo Bunker Fuel	t	10.000.000,00	50.000.000,00
Eletricidade equivalente	Gwh	220.000,00	1.100.000,00
Petróleo Equivalente	BOE	129.448.000,00	647.240.000,00
Equiv. Energia Verde Instalada	%	10,00	50,00
Investimento necessário	U$ Trillion	0,60	3,00
Investimento necessário	Anos de gasto de petróleo	0,80	4,00

Biogás no Sertão	**14 BOE/hectare**	**9.246.285,71**	**46.231.428,57**

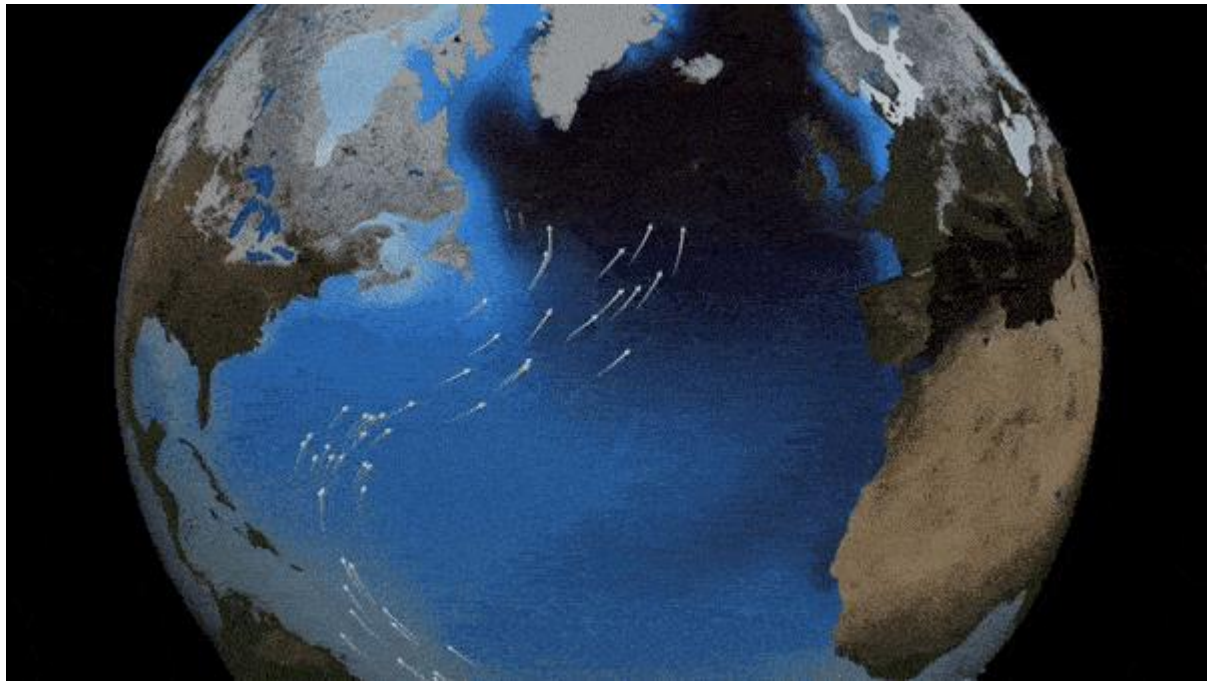
Sertão = 105 MM hectars

Gç

Compensating the Nature

What's The Best Temperature for Civilization?

Atlas Pro
1,11 mi de inscritos



Forbes

FORBES > FORBES MAGAZINE > FORBES ASIA

Biggest Invention: The Transistor, The Internet....Or The Air-Conditioner? (Hint) None Of The Above

Eamonn Fingleton Contributor ⓘ
A sharp eye on media bias, official propaganda, and globaloney.

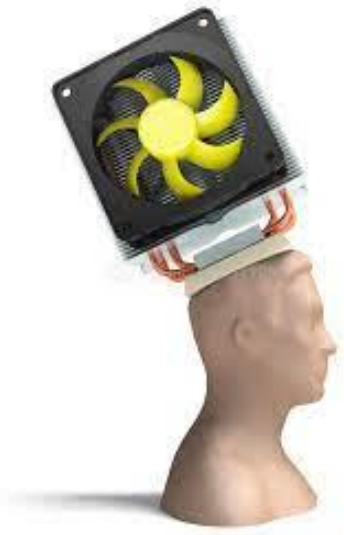
Follow

Jul 5, 2015, 11:21am EDT

When Lee Kuan Yew, the late Singaporean patriarch, was asked to name the twentieth century's most consequential invention, he gave a characteristically counterintuitive answer. Not for him anything so obvious as television, antibiotics, the transistor, or the internet.

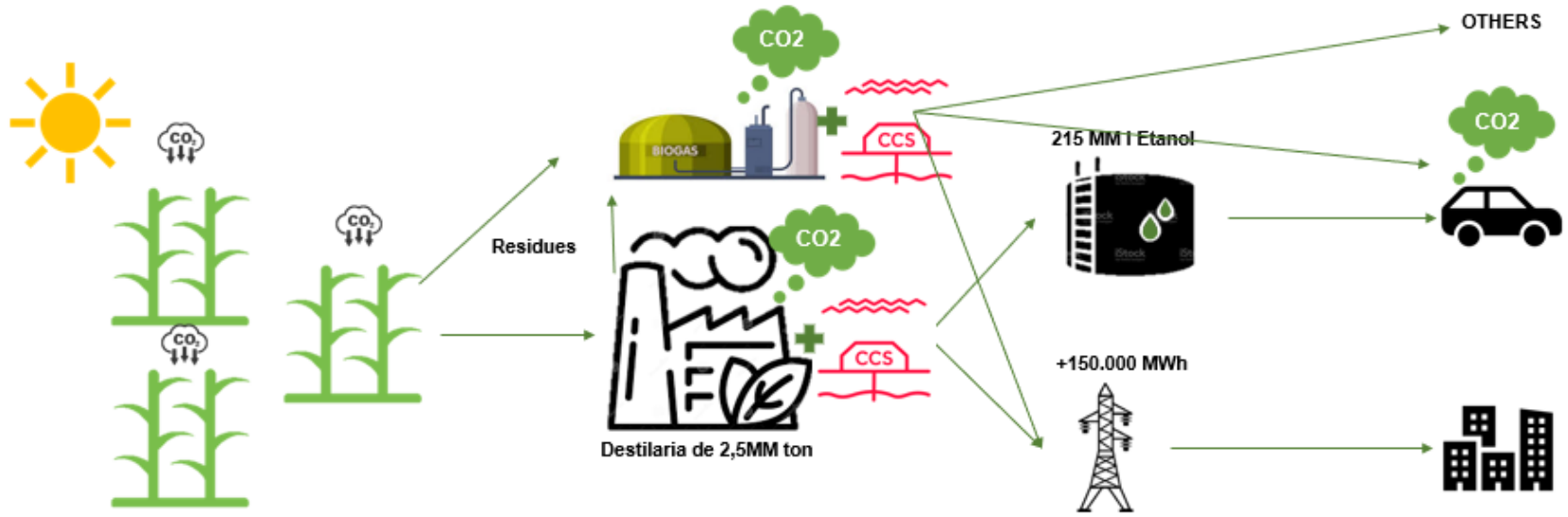
Gç

The Bioeconomy Equation



Light at the end of the CO_2 Tunnel

Caminho do CO_2 no setor sucroenergético – Potencial BECCS



em CO_2 eq	Cana de açúcar	Industrialização	Consumo	Balanço
Emissões Processo	Captura Fotossíntese - 952k ton	Fermentação : +31kton (Δ124kt*) Cogeração: +98k ton (Δ390kt*) Total: +129k ton	Emissões combustão etanol: +309k ton	-514k ton -376 k ton
Emissões "Manejo"	Emissões Manejo + 121k ton	Emissões Industria: + 6k ton	Emissões transporte e uso: +11k ton	+138 k ton

Tomaz Pereira

Gç

bioFuel for Food

Gç

A Real Future