

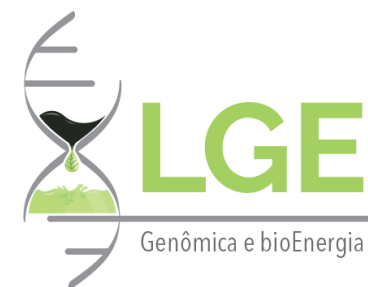


BioElectrification: A vector of sustainable development for Brazil and the world

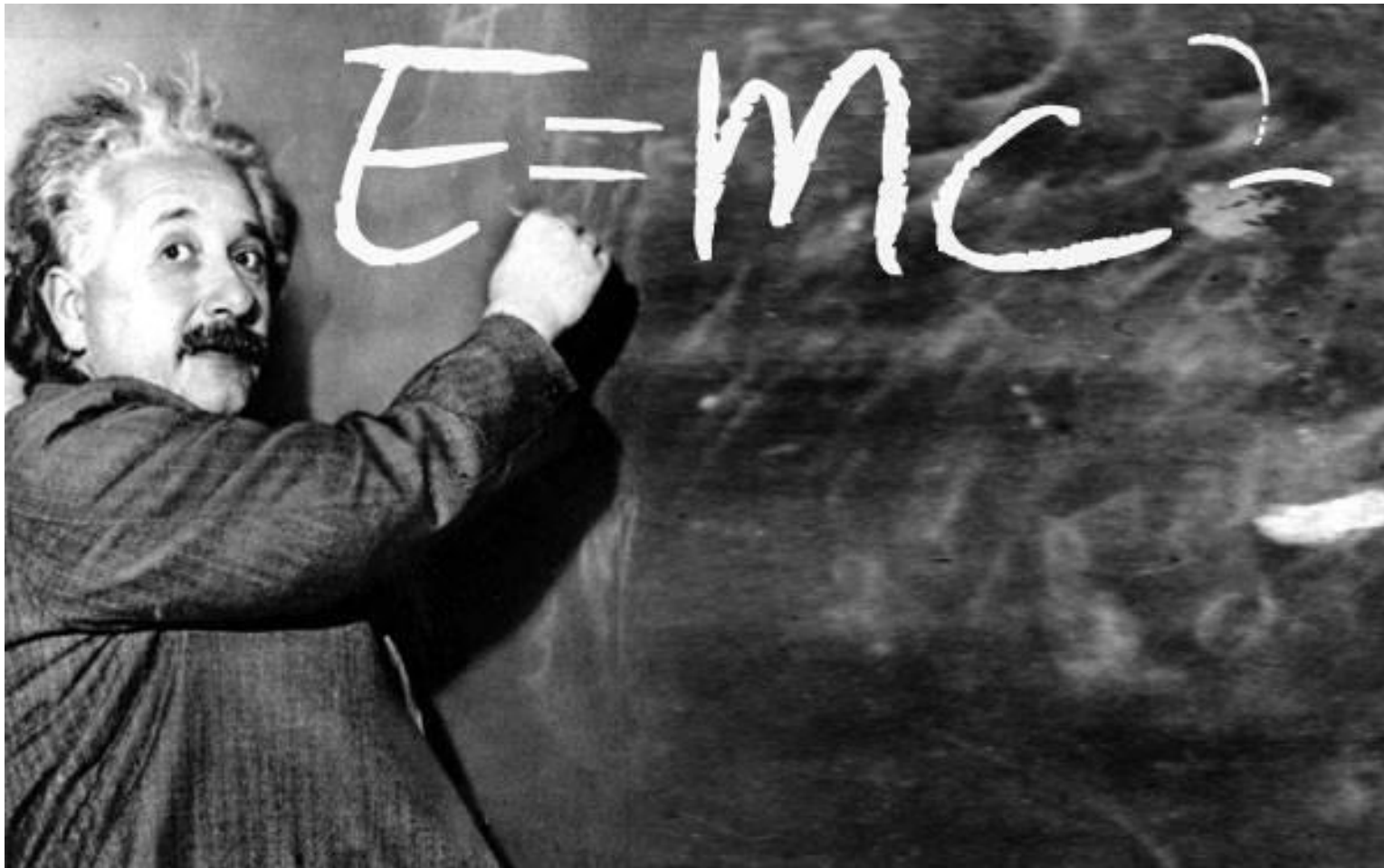
Gonçalo Pereira
Cali, via Zoom, 01/09/2022



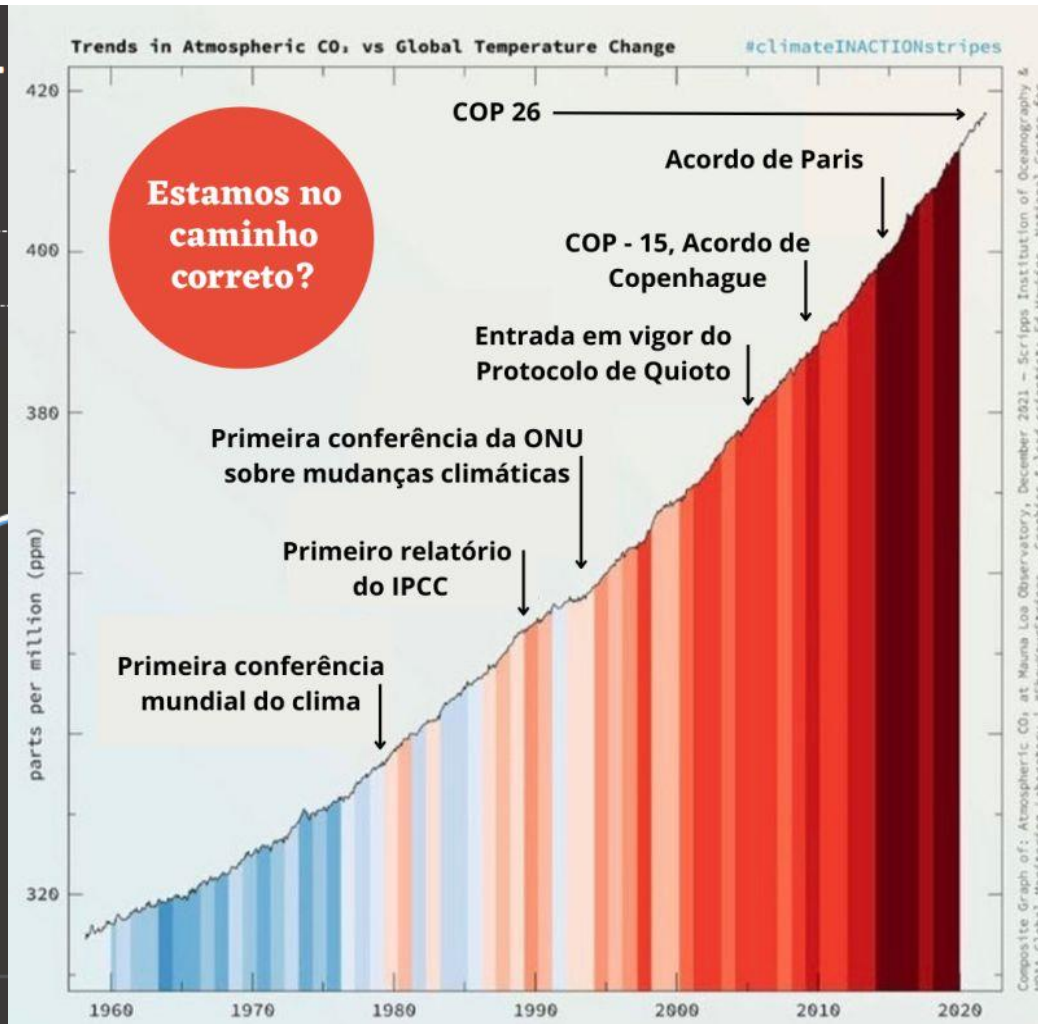
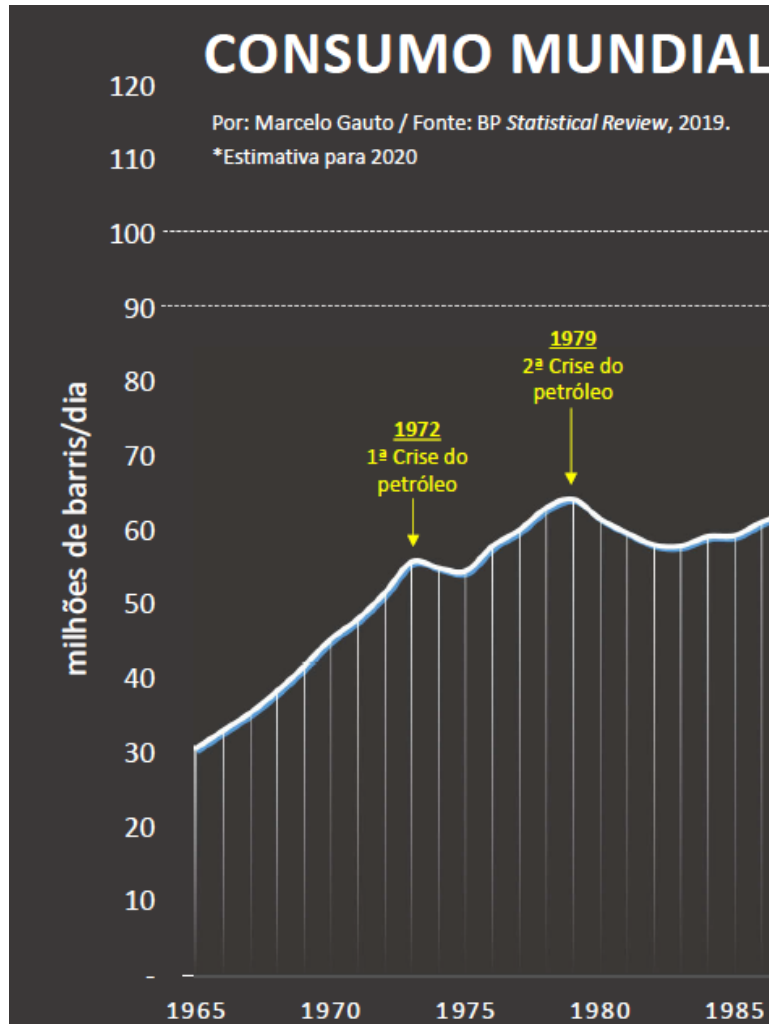
linkedin.com/in/goncalopereiraunicamp



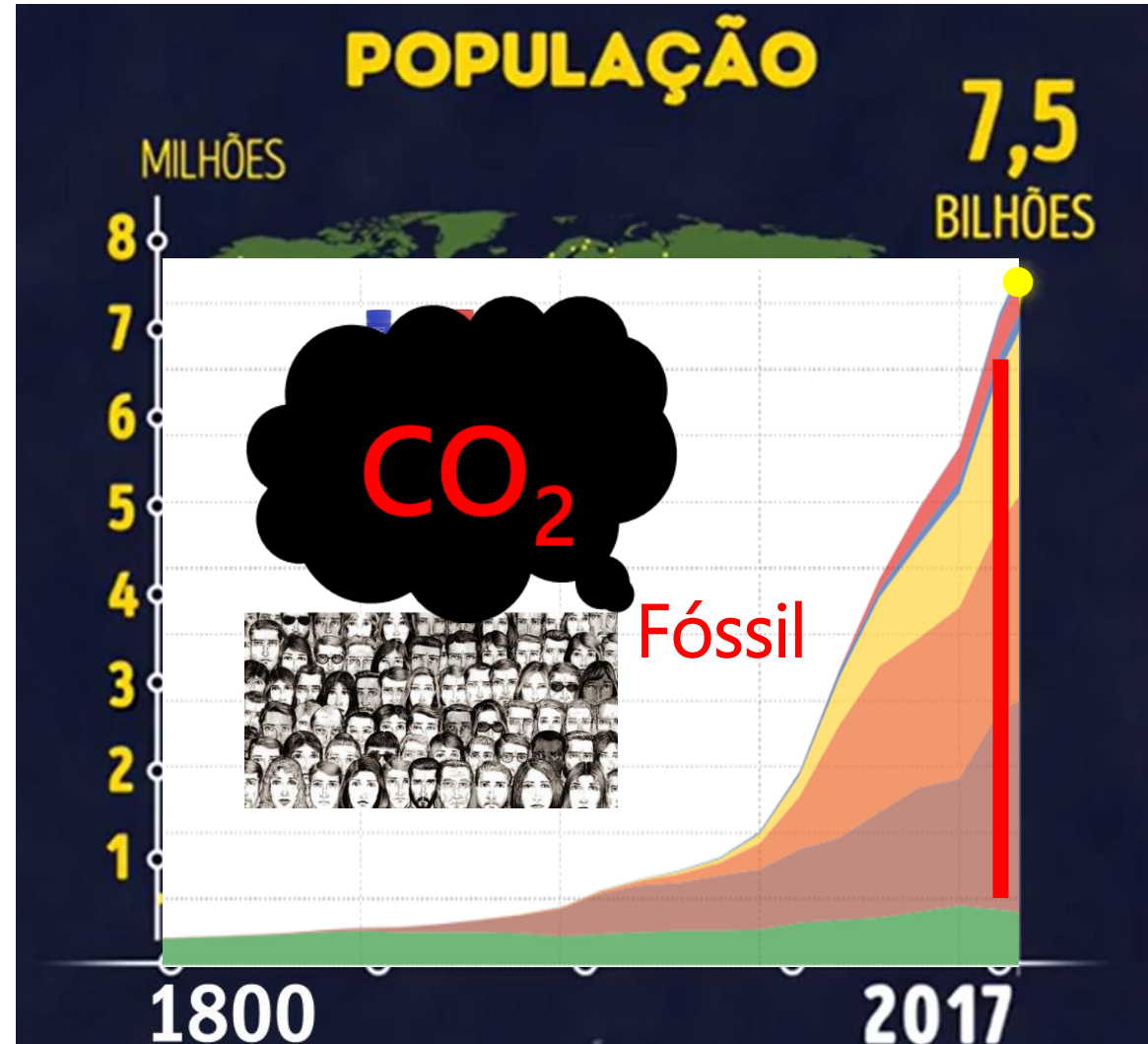
Rationale



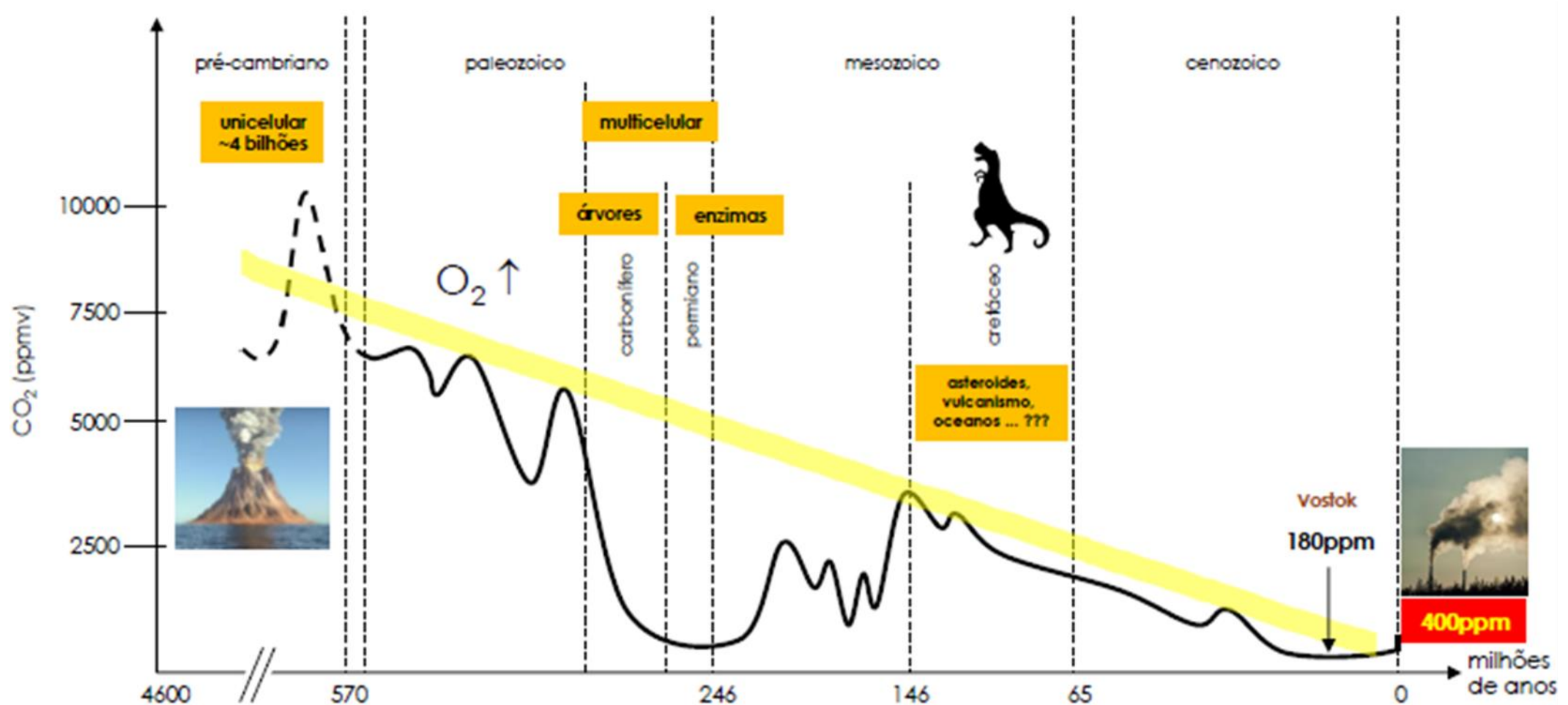
Energies



Energy Conversion

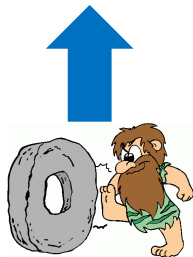
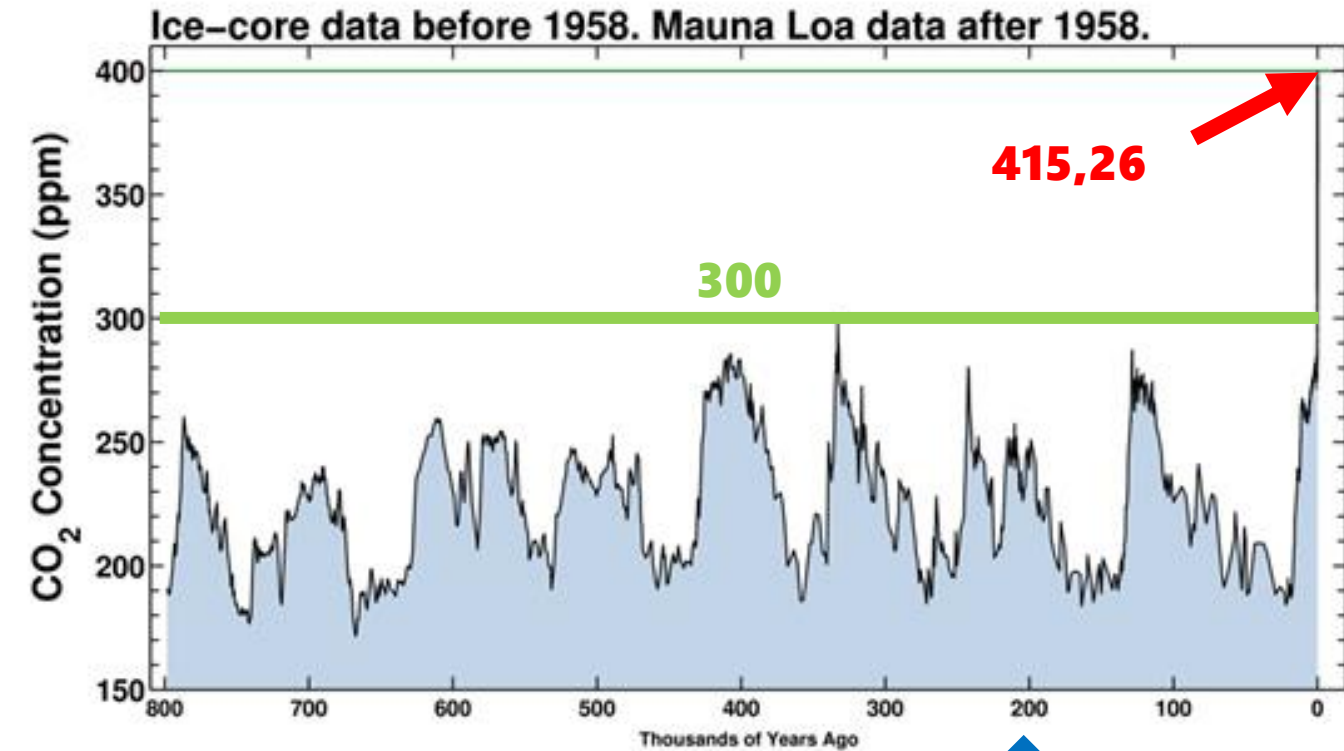


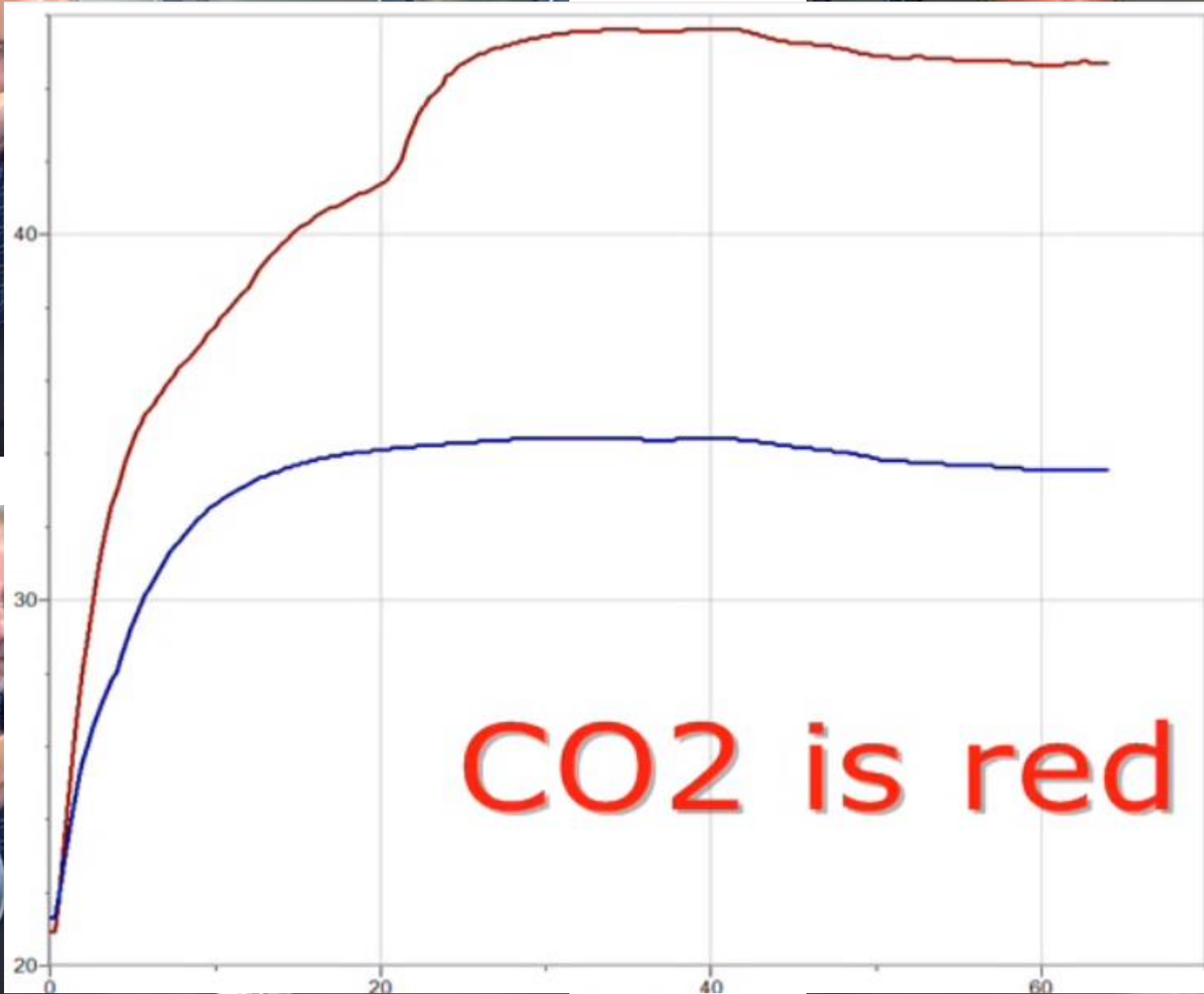
CO₂ on the Planet



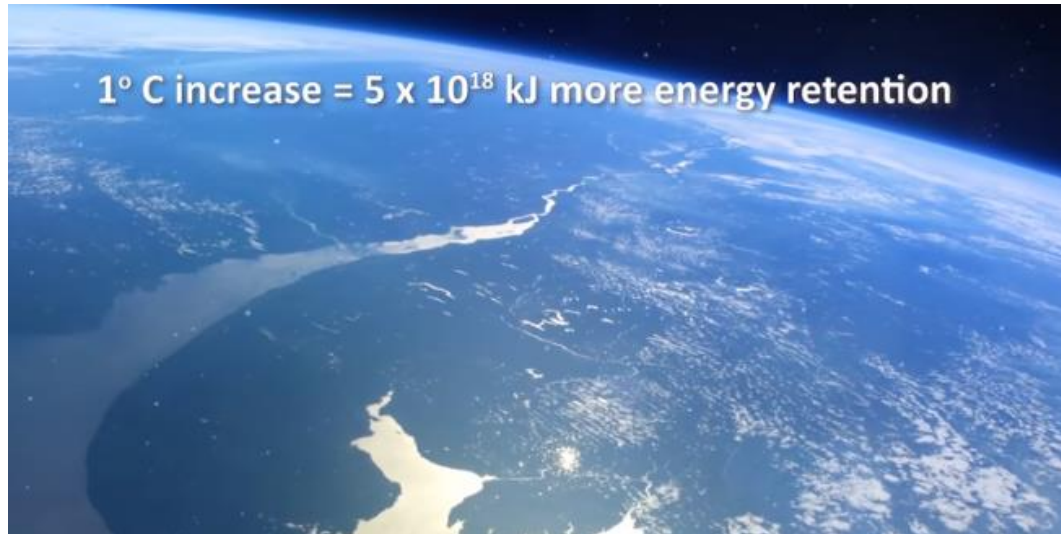
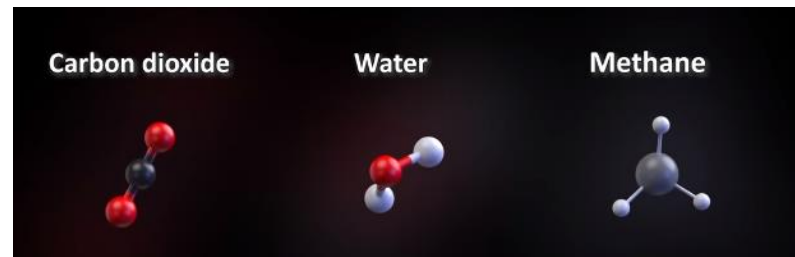
Prof. Paulo Seleglim

What would be the problem then?





Atmospheric Battery



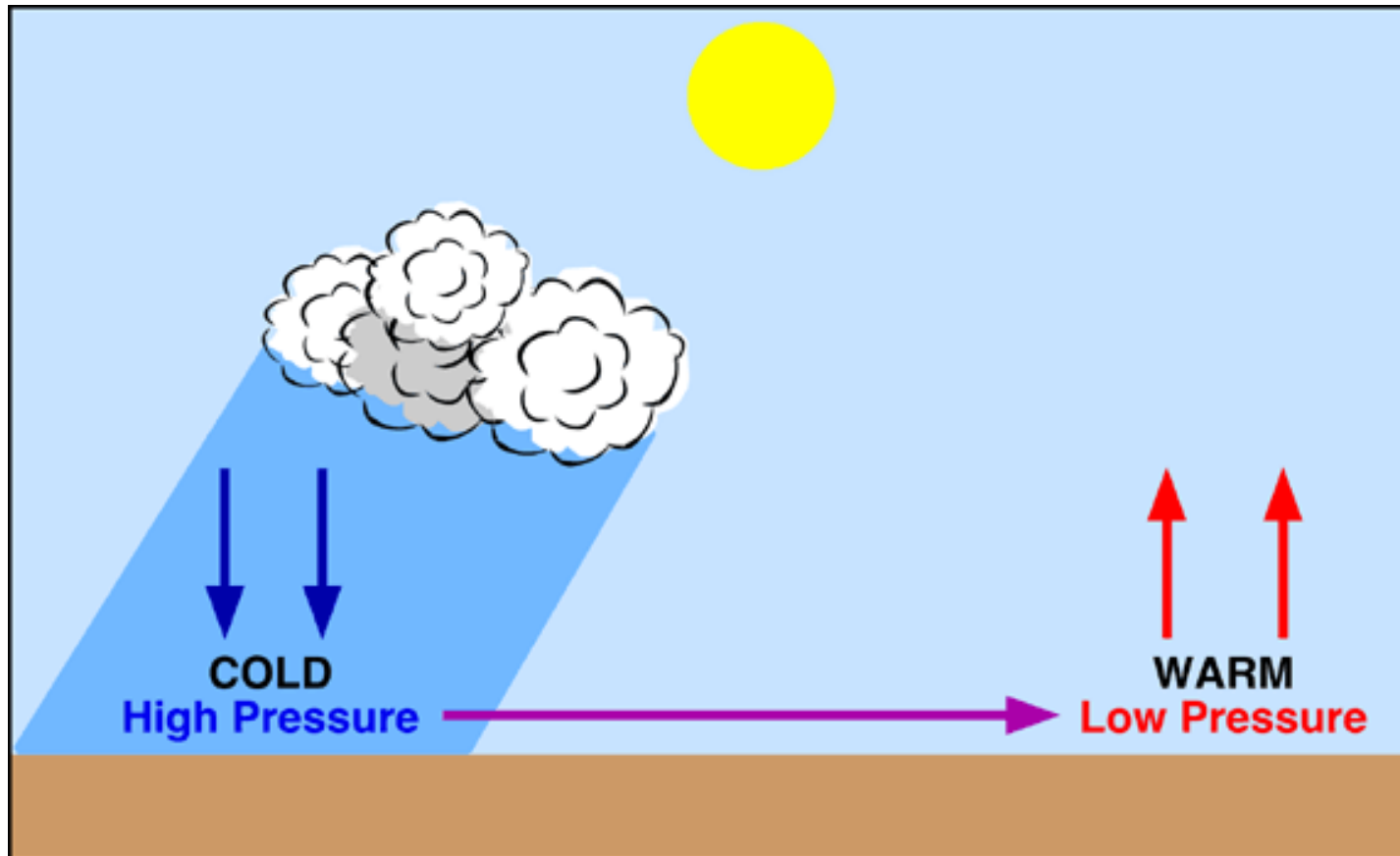
Work

Change in kinetic energy

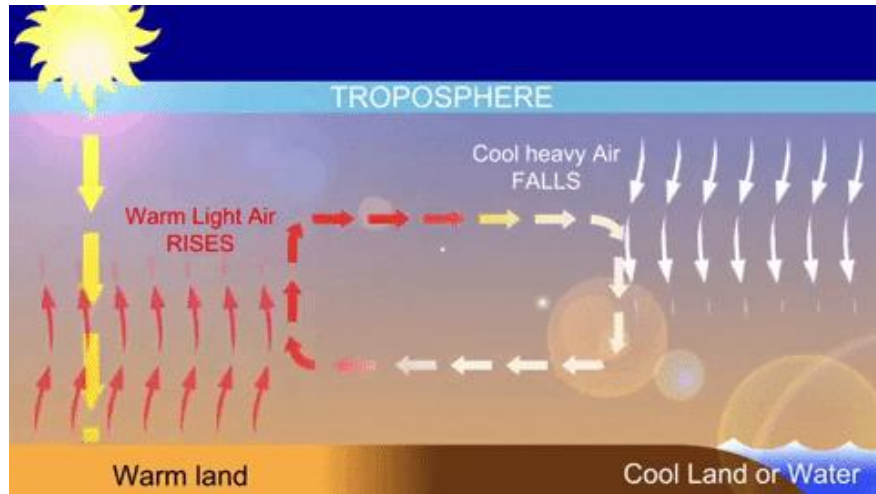
$$W = \Delta E_{kin}$$

<https://www.youtube.com/watch?v=-skE4jCuf-w>

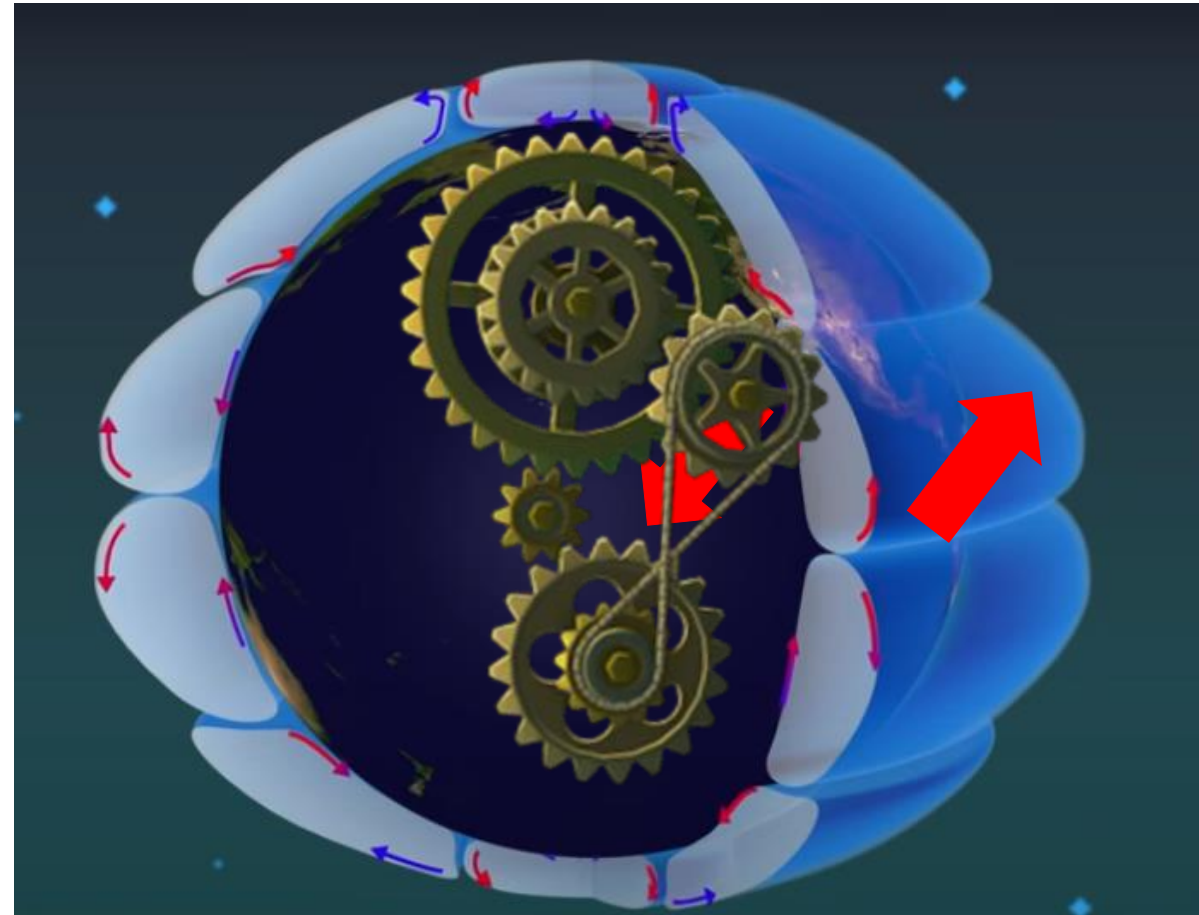
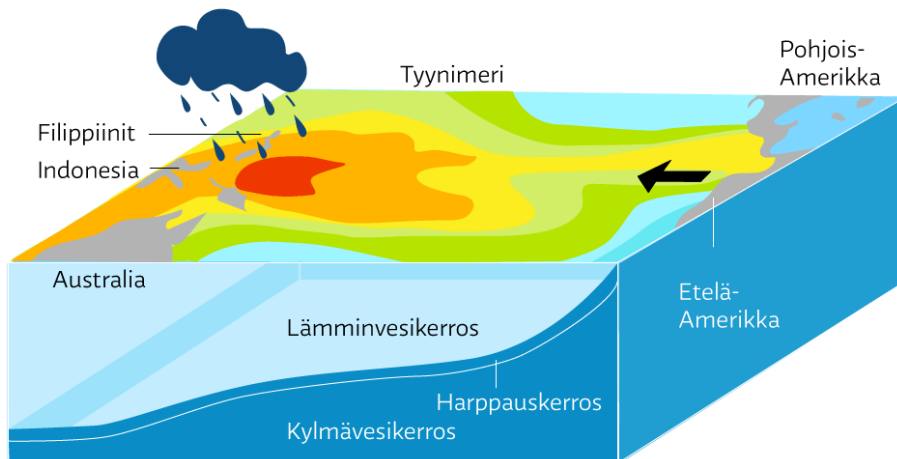
And then it's as simple as that....



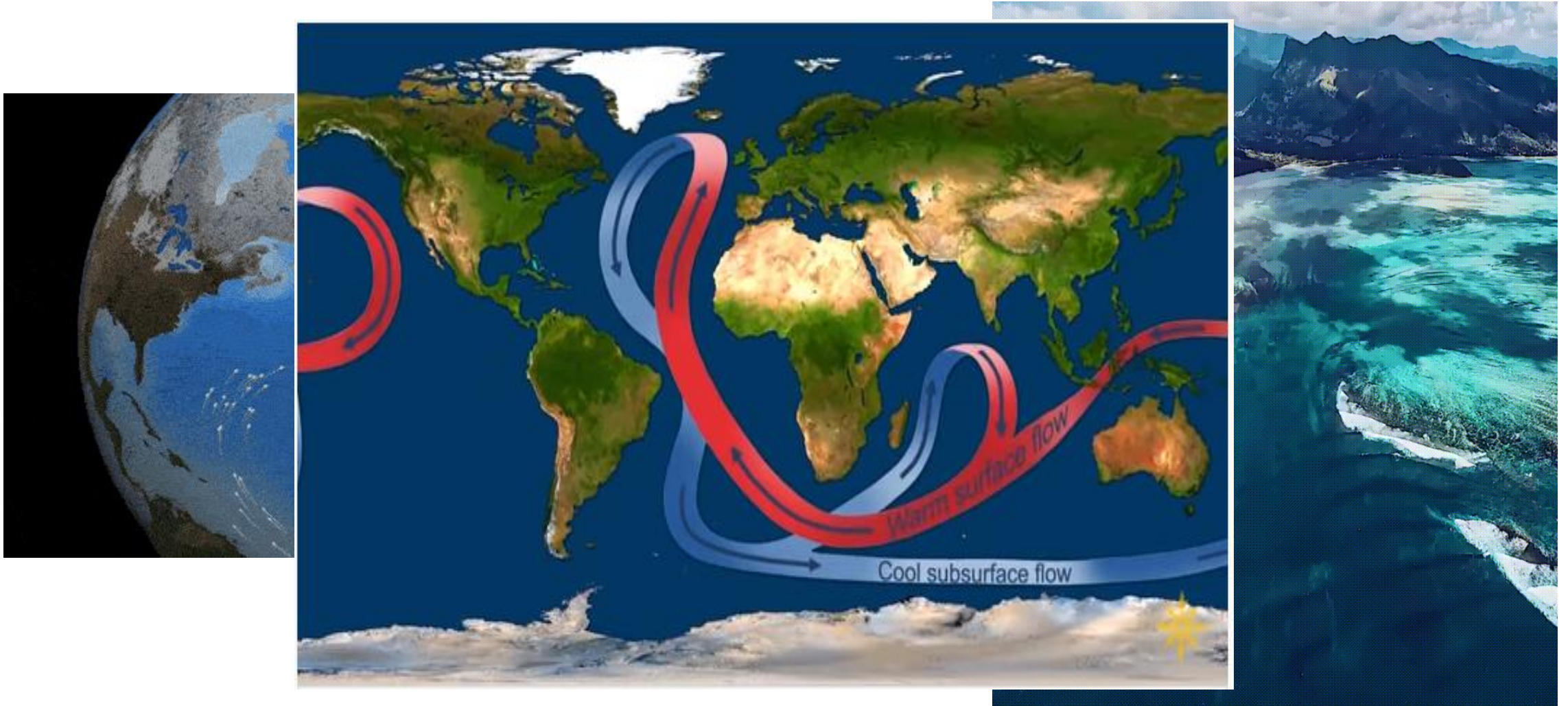
Weather Gears



Normaaliolosuhteet



Global Circulation



Simply put...



And the Renewables with that????

THE WALL STREET JOURNAL.

Home World U.S. Politics Economy Business Tech **Markets** Opinion Books & Arts Real Estate Life & Work WSJ. Magazine

Energy Prices in Europe Hit Records After Wind Stops Blowing

Heavy reliance on wind power, coupled with a shortage of natural gas, has led to a spike in energy prices

By [Joe Wallace](#)

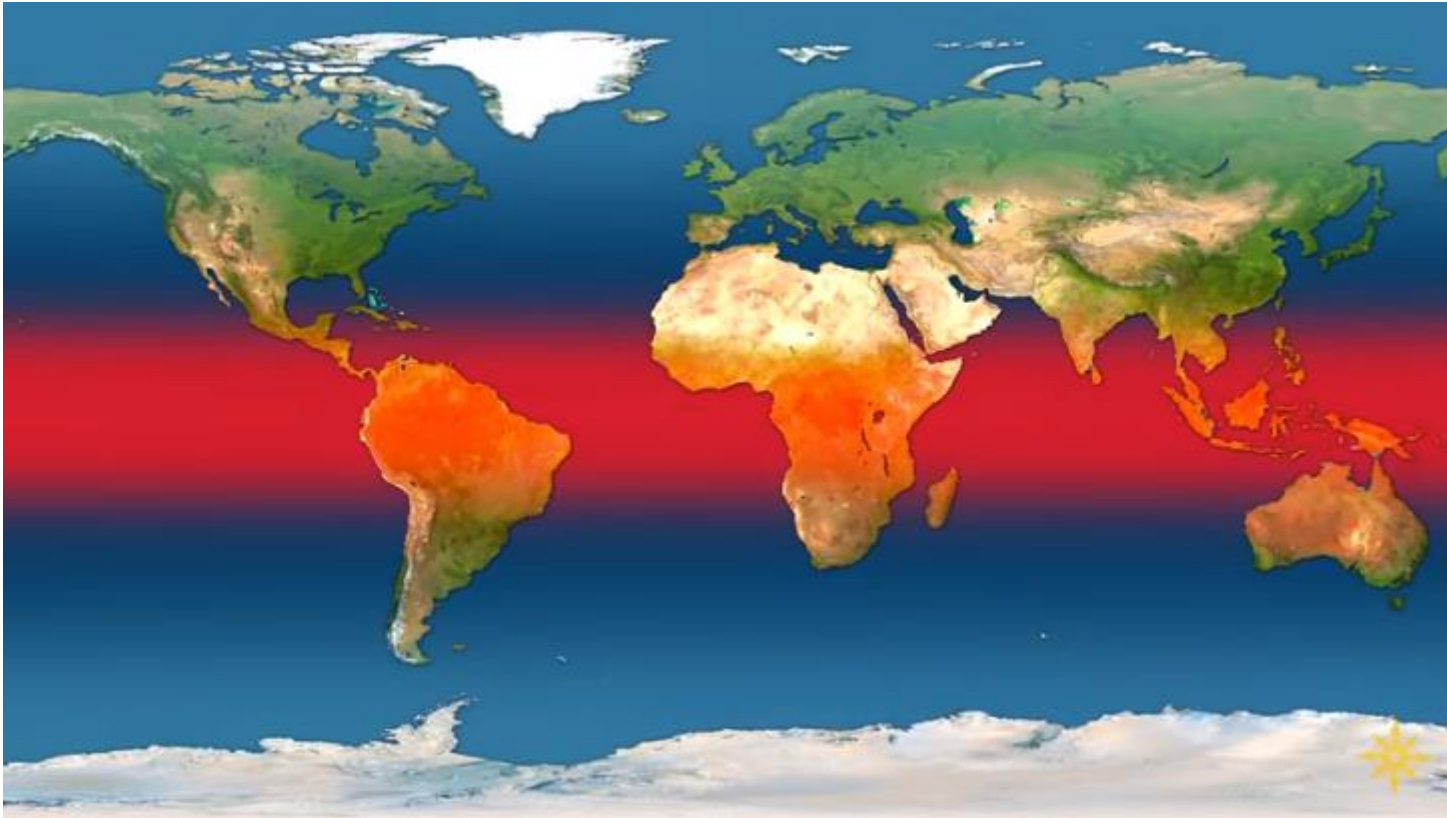
Sept. 13, 2021 6:17 am ET

Why Small Towns Are Fighting Renewable Energy Development

Property owners in the windy and sunny parts of the U.S. are pushing back against large-scale renewable energy development, opposition that researchers say could slow the transition to a cleaner economy. Photo: Aaron Yoder/WSJ



Climatic zoning



Migration and Geopolitical Tension

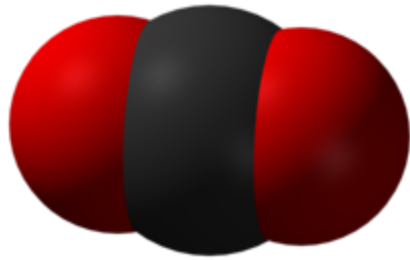
CLIMATE
REFUGEES



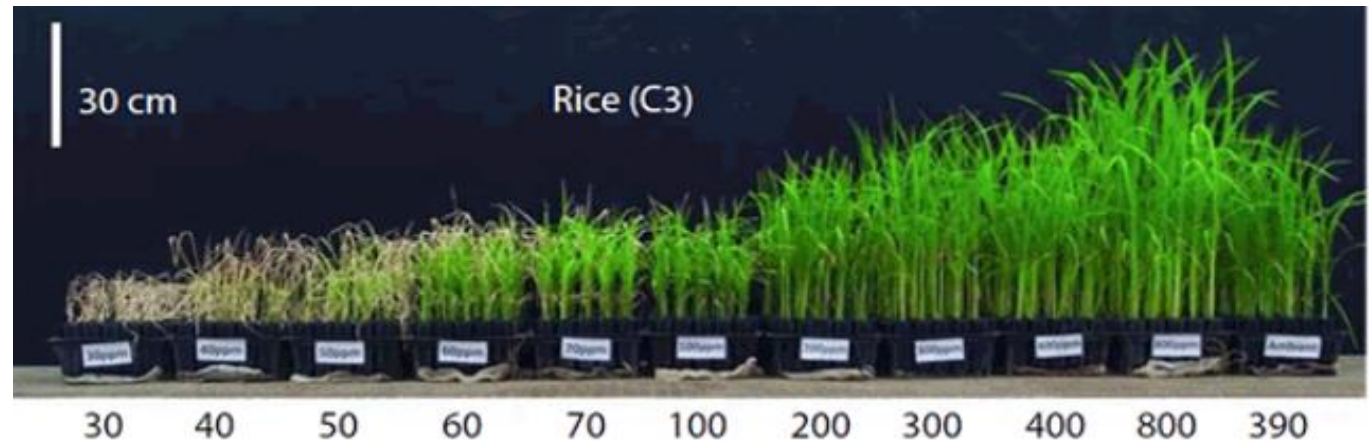
Message

CO₂ Is a Global Problem

However, CO₂ IS NOT A LOCAL PROBLEM

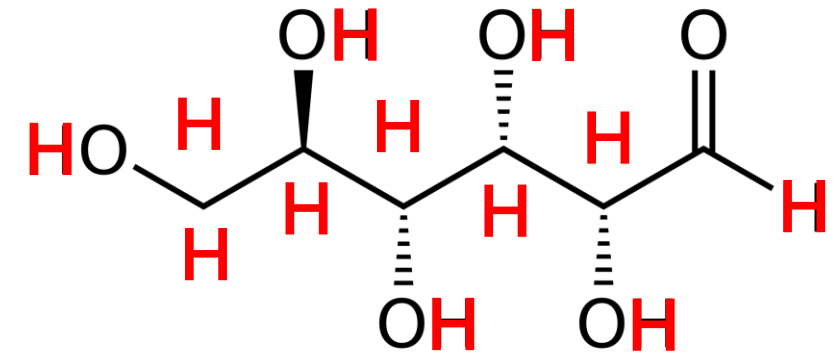
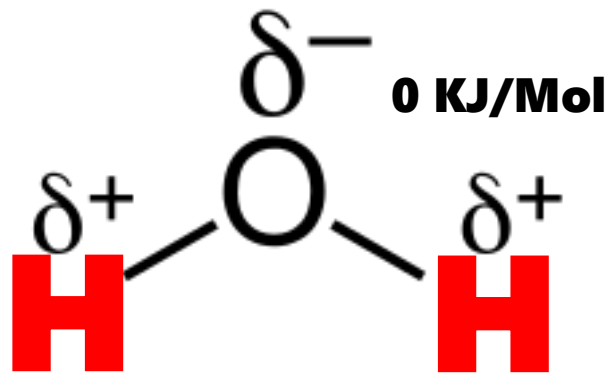


NON TOXIC $\neq$ SO₂, NOX, O₃, PM
Fertilizer for Plants

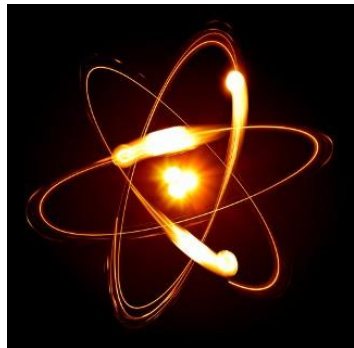


High Efficiency Natural Battery

How to charge a CO₂ Battery

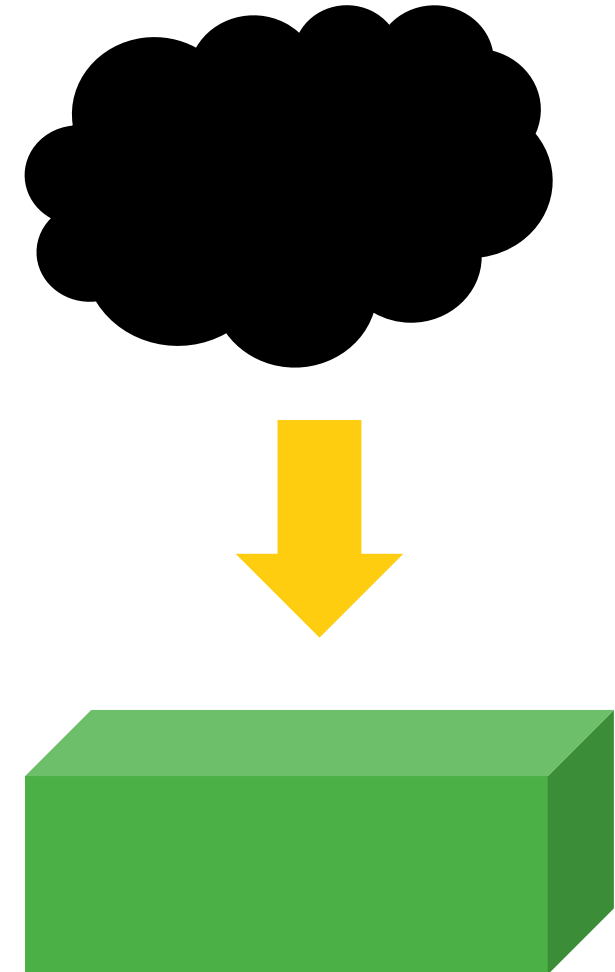
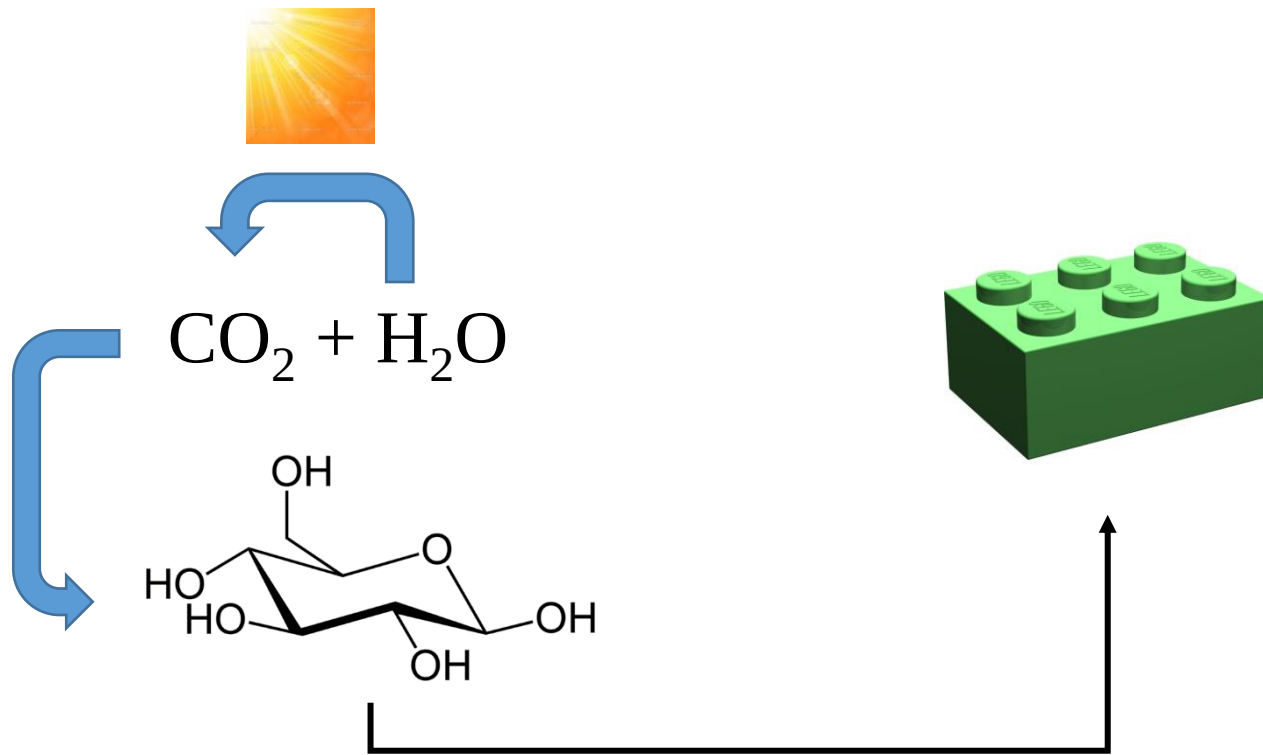


2540 KJ/Mol



0 KJ/Mol

Phase Change



Convertible into Liquid Battery



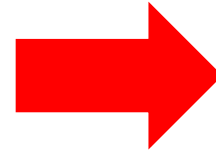
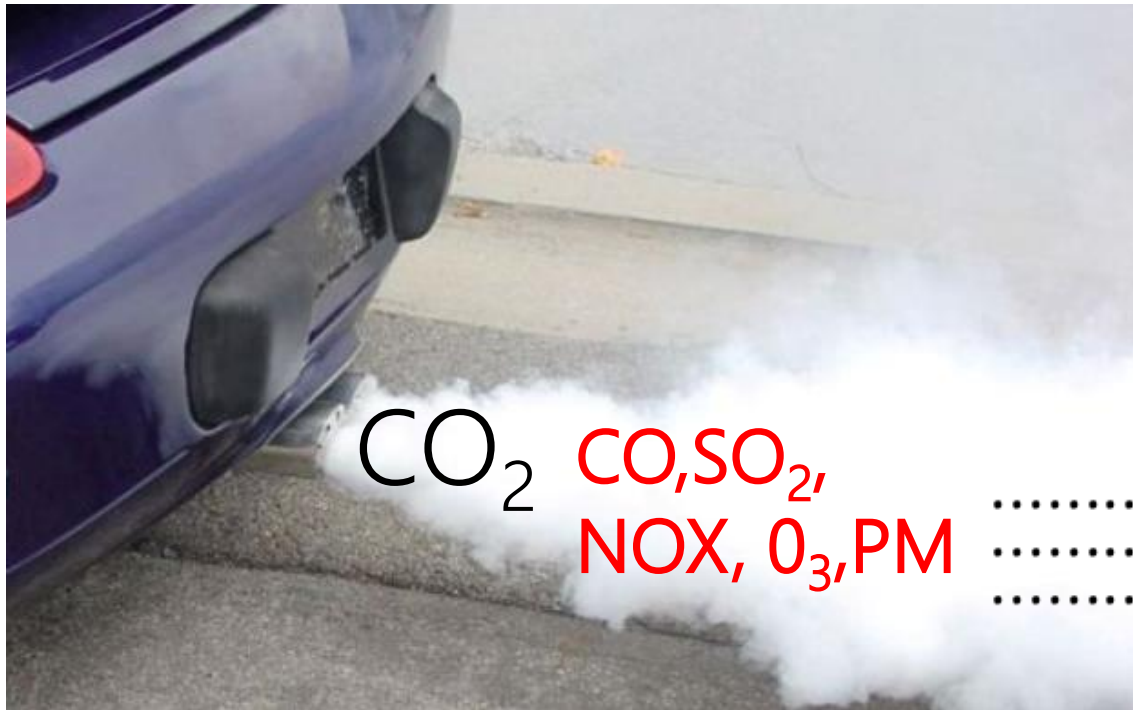
Or gassy



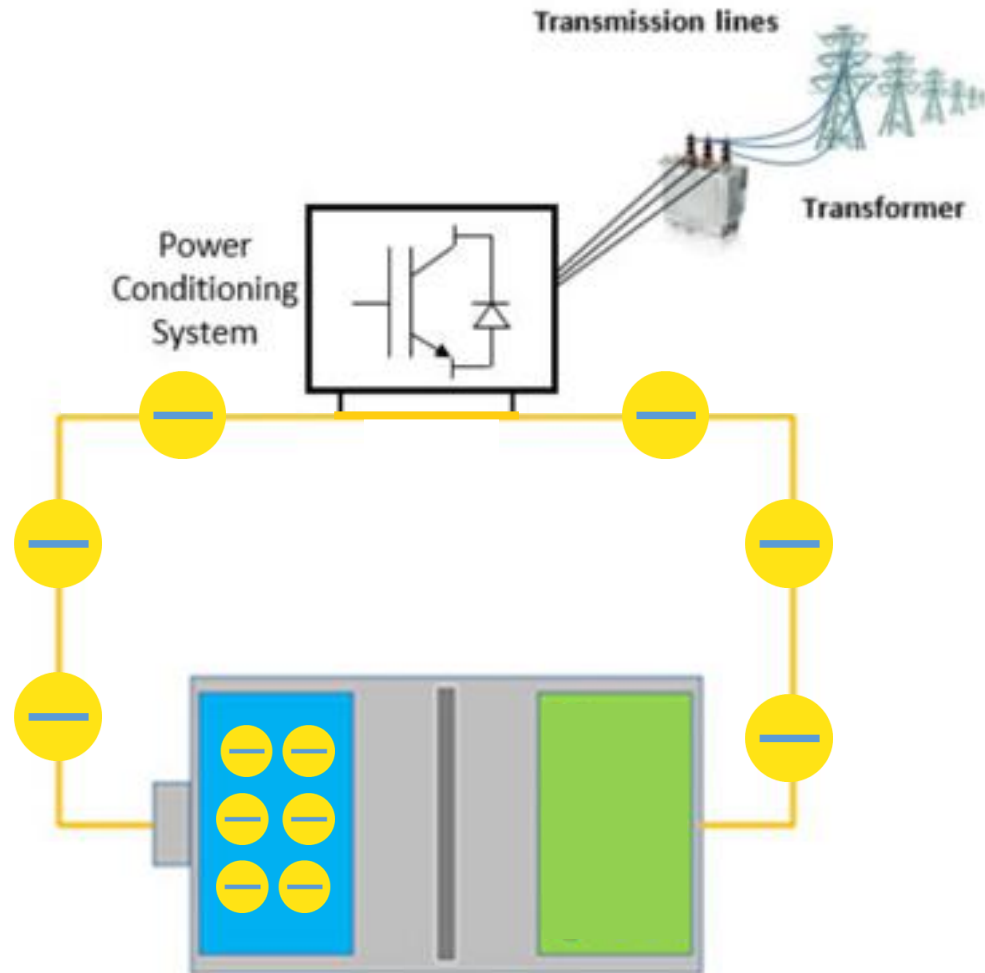
This is Circular Economy



Fallacy



Battery Recharging



Local X Global

Global Emission



Local Emission



Life Cycle Analysis



All cats are gray in the dark.....



FORSCHUNGSERGEBNISSE

*Christoph Buchal, Hans-Dieter Karl und Hans-Werner Sinn**

Kohlemotoren, Windmotoren und Dieselmotoren: Was zeigt die CO₂-Bilanz?

ifo Schnelldienst 8/2019 72. Jahrgang 25. April 2019 43

Emissões de CO₂ são mais altas nos elétricos que nos carros a diesel

Segundo o estudo [apresentado](#) pelo Centro de Estudos Económicos da Alemanha, os veículos elétricos não são uma panaceia para as mudanças climáticas.

Assim, considerando o atual *mix* de energia na Alemanha e a quantidade de energia usada na produção de baterias, as emissões de CO₂ dos carros elétricos a bateria são, na melhor das hipóteses, ligeiramente superiores às de um motor a diesel, e são muito maiores.

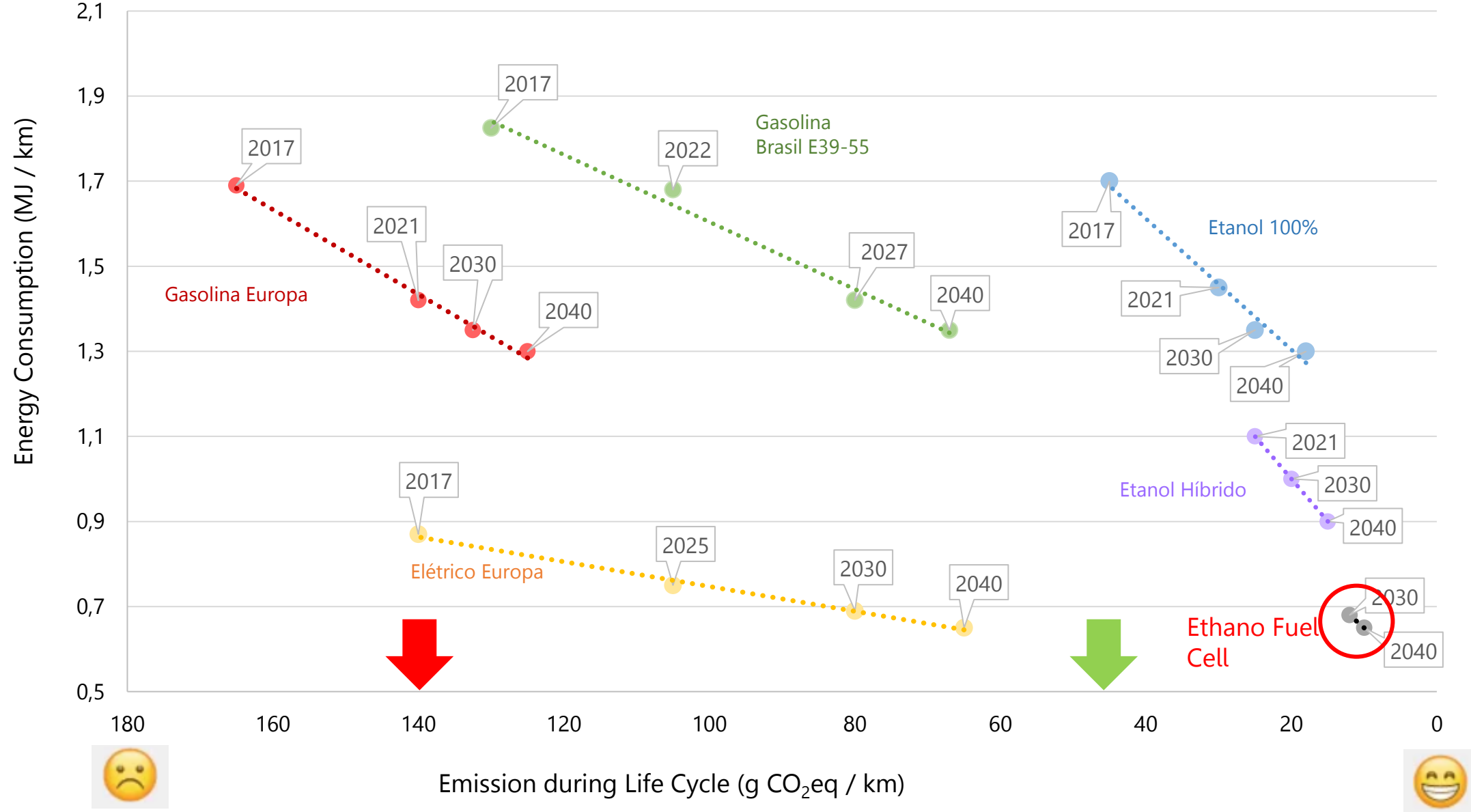
Quem afirma isto são alguns especialistas em energia do Instituto de Pesquisa Económico (Ifo), docentes de física da Universidade de Colónia e da Universidade de Munique.



Weird Wedding



Life Cycle Analysis

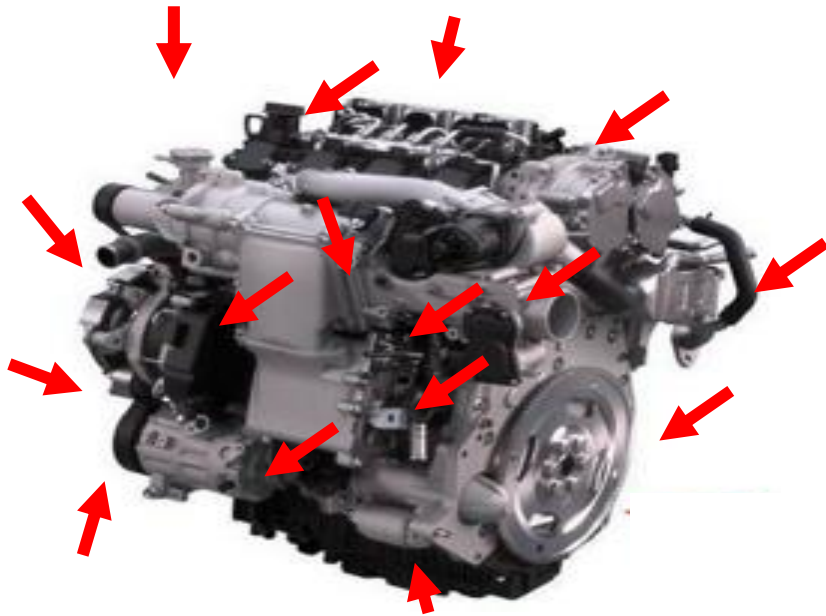


Combustion is no Problem



FUEL can be a problem

Engine Efficiency



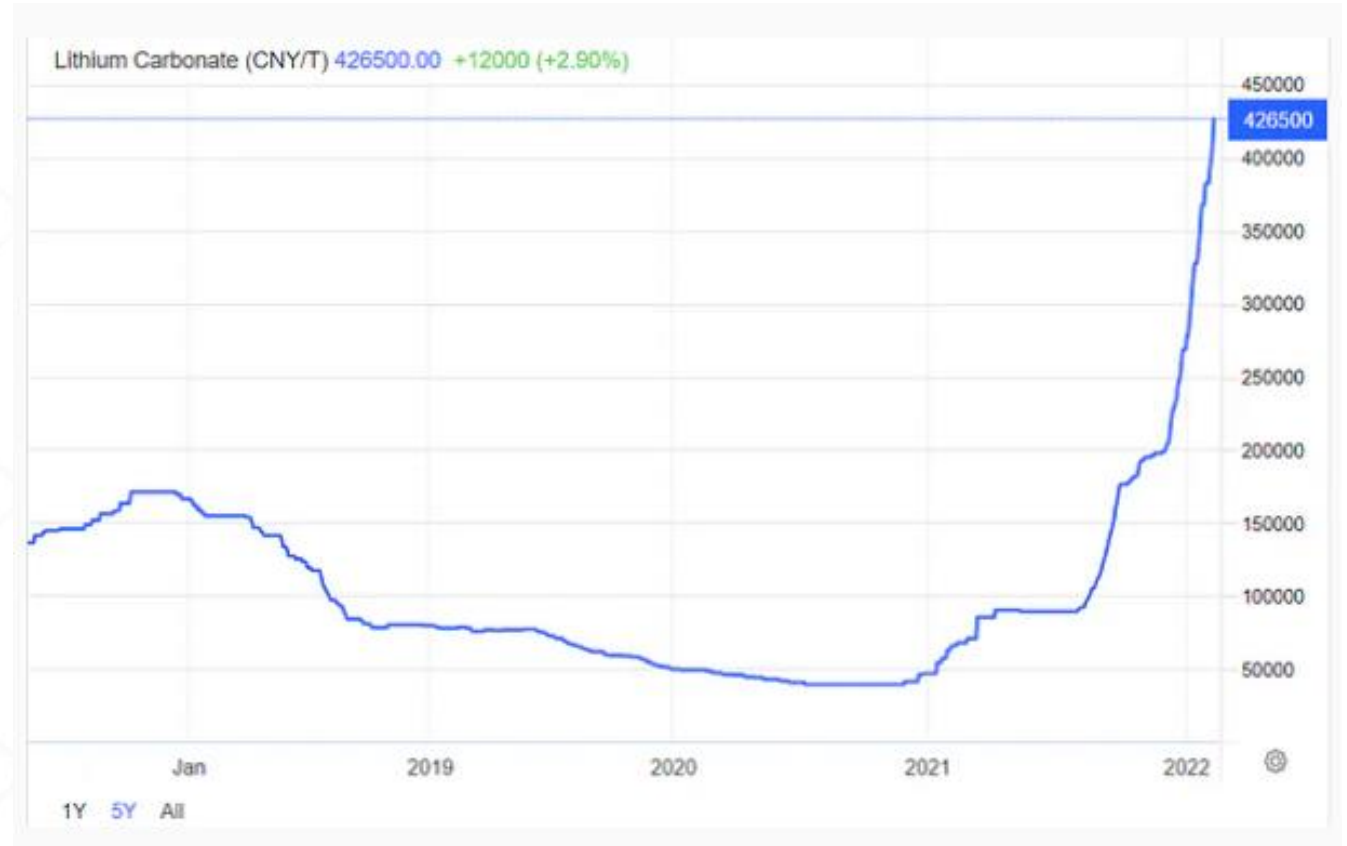
35%

Jobs

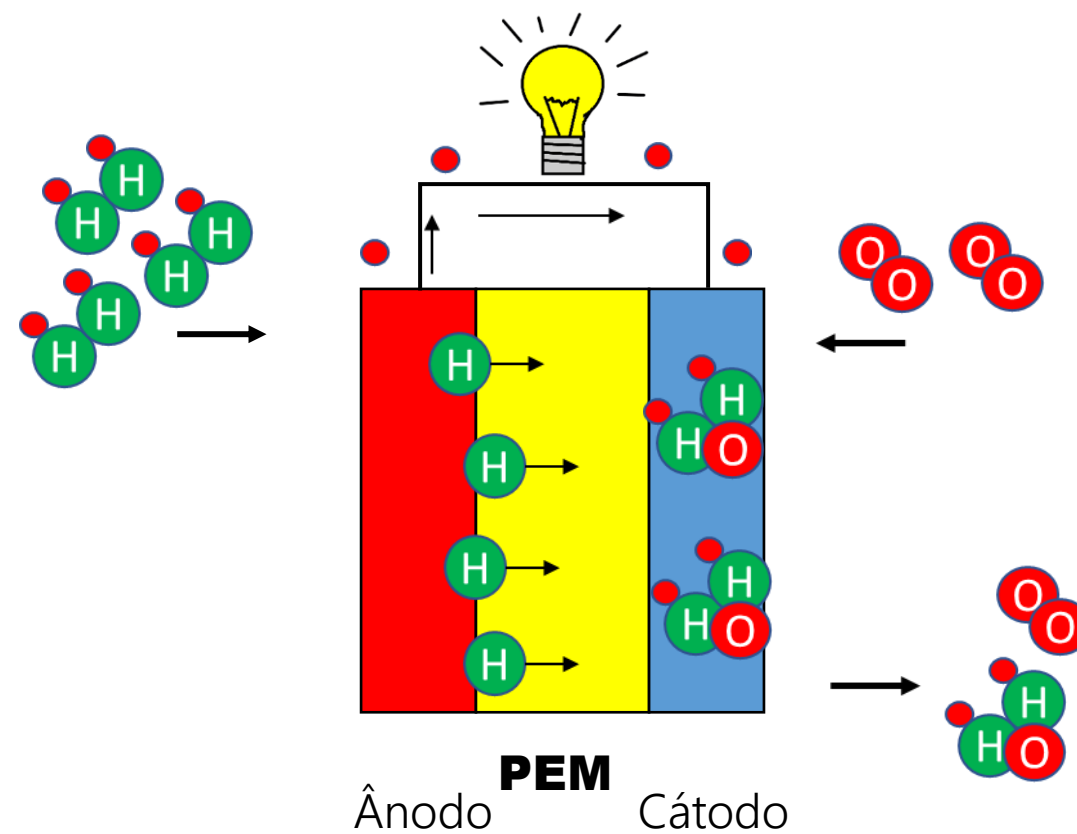


90%

Electric Car is NOT Synonymous with Metallic Battery



Hydrogen Battery



Gamble

HYDROGEN AND FUEL CELL TECHNOLOGIES OFFICE



Hydrogen Production: Natural Gas Reforming

ENERGY.GOV



Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

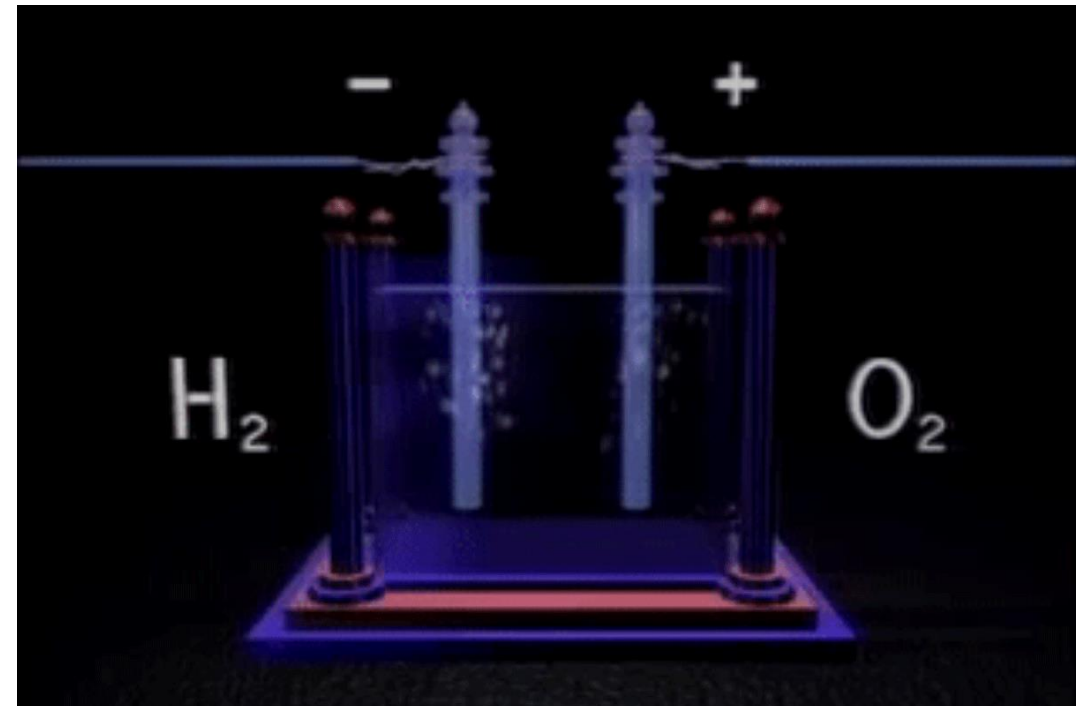
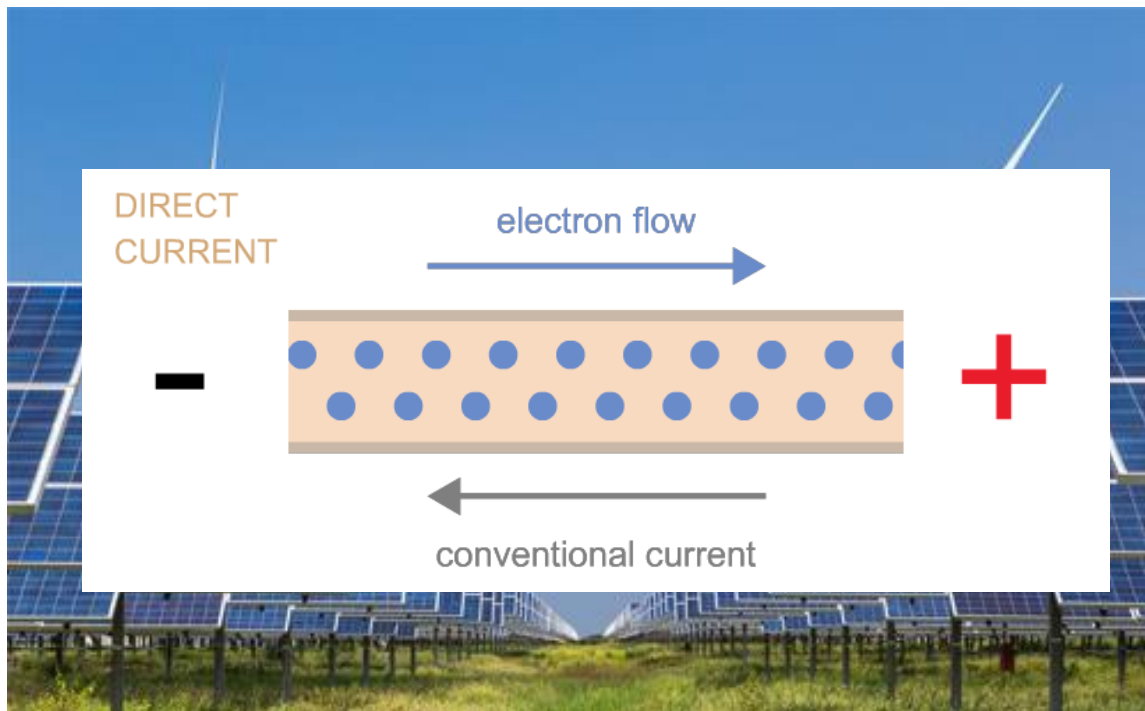
[Home](#) » [Hydrogen Production](#) » [Processes](#) » Hydrogen Production: Natural Gas Reforming

Natural gas reforming is an advanced and mature production process that builds upon the existing natural gas pipeline delivery infrastructure. Today, 95% of the hydrogen produced in the United States is made by natural gas reforming in large central plants. This is an important technology pathway for near-term hydrogen production.



As well as aiming to increase our charging points from 7,500 today to more than 70,000 in 2030, we are also

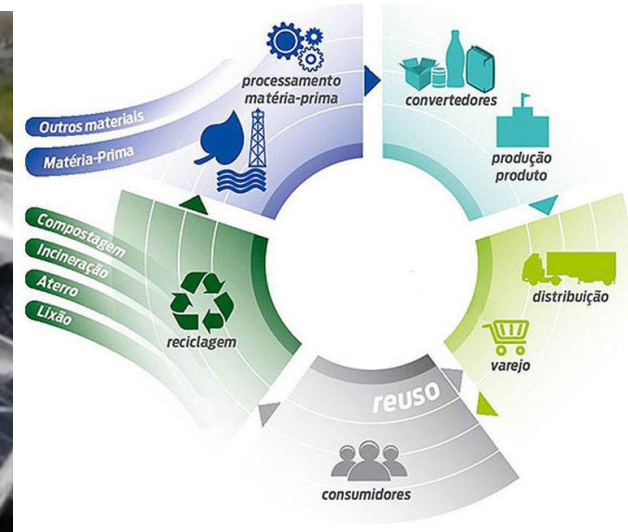
Hydrogen, Alright....



But, Green (????)



Solar panels are starting to become a toxic garbage problem



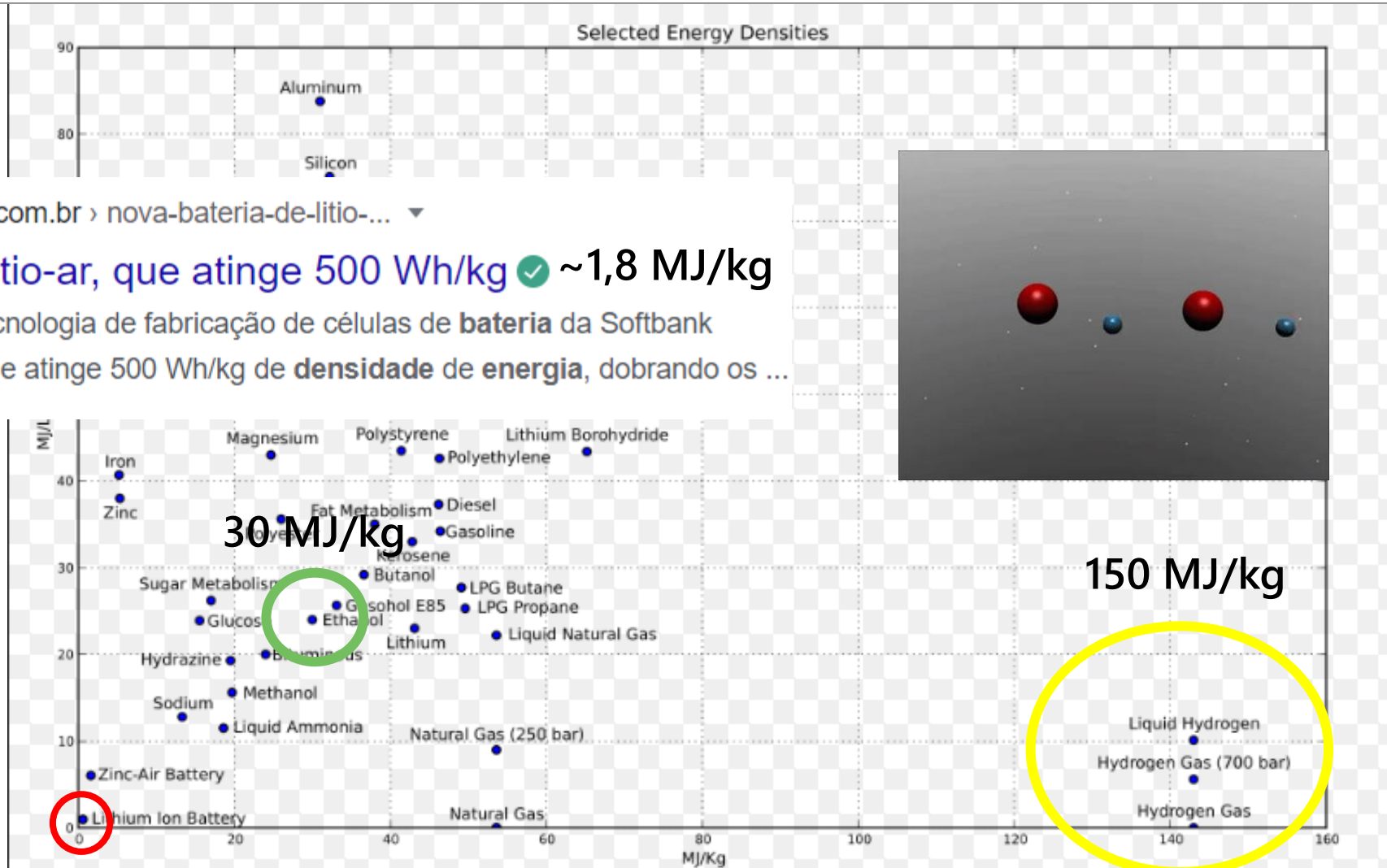
**Bloomberg
Green**

**Wind Turbine Blades
Can't Be Recycled,
So They're Piling Up
in Landfills**

Companies are searching for ways to deal with the tens of thousands of blades that have reached the end of their lives.

By Chris Martin

The Hydrogen



<https://clickpetroleoegas.com.br> > nova-bateria-de-litio-...

Nova bateria de lítio-ar, que atinge 500 Wh/kg ✓ ~1,8 MJ/kg

9 de fev. de 2022 — A tecnologia de fabricação de células de **bateria** da Softbank alcançou um protótipo que atinge 500 Wh/kg de **densidade de energia**, dobrando os ...

The Other Side of Excess Energy



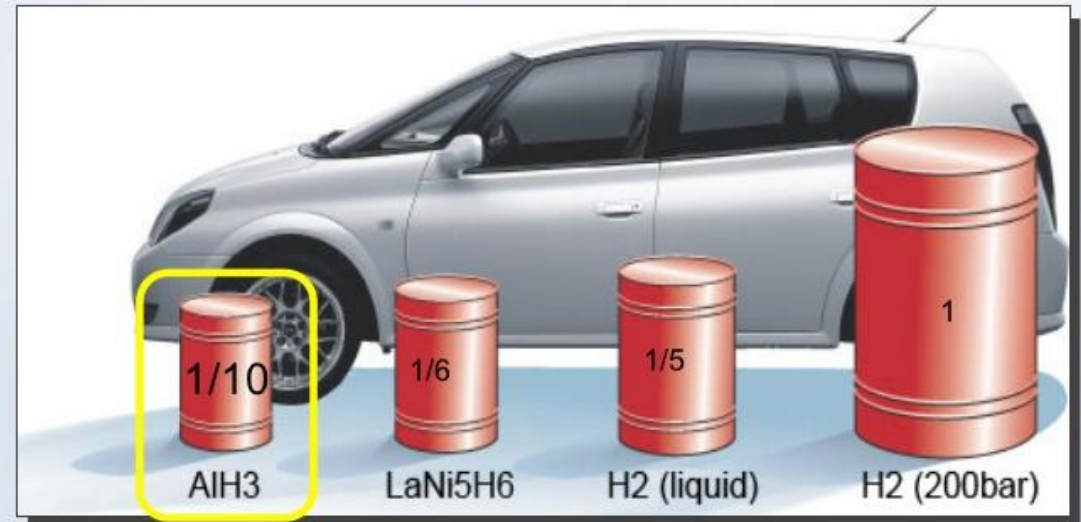
Taming Hydrogen - Backbone



Hydrogen Storage



What is the most compact way to store hydrogen?



Volume of 4 kg of hydrogen (~200 mile driving range) in different storage media

Solid-state hydrogen storage provides a much greater volumetric capacity than gaseous or liquid H_2

6

BROOKHAVEN NATIONAL LABORATORY

eFuel (I've seen this somewhere.....)

E-Gasoline Test Shows Carbon Is the Least of Combustion Engines' Problems

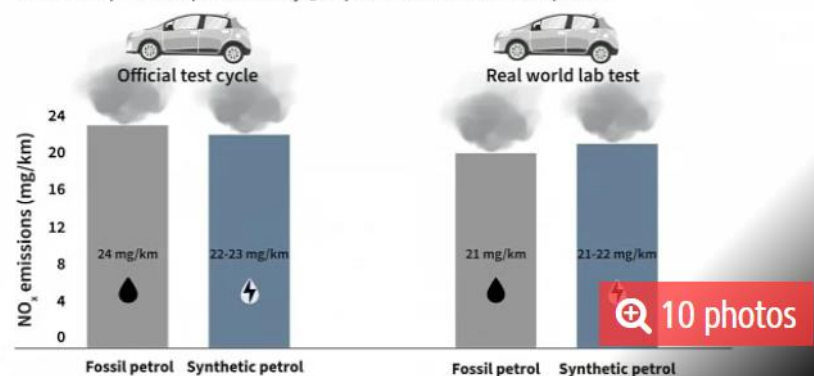
Home > News > Safety

6 Dec 2021, 20:40 UTC · by Gustavo Henrique Ruffo

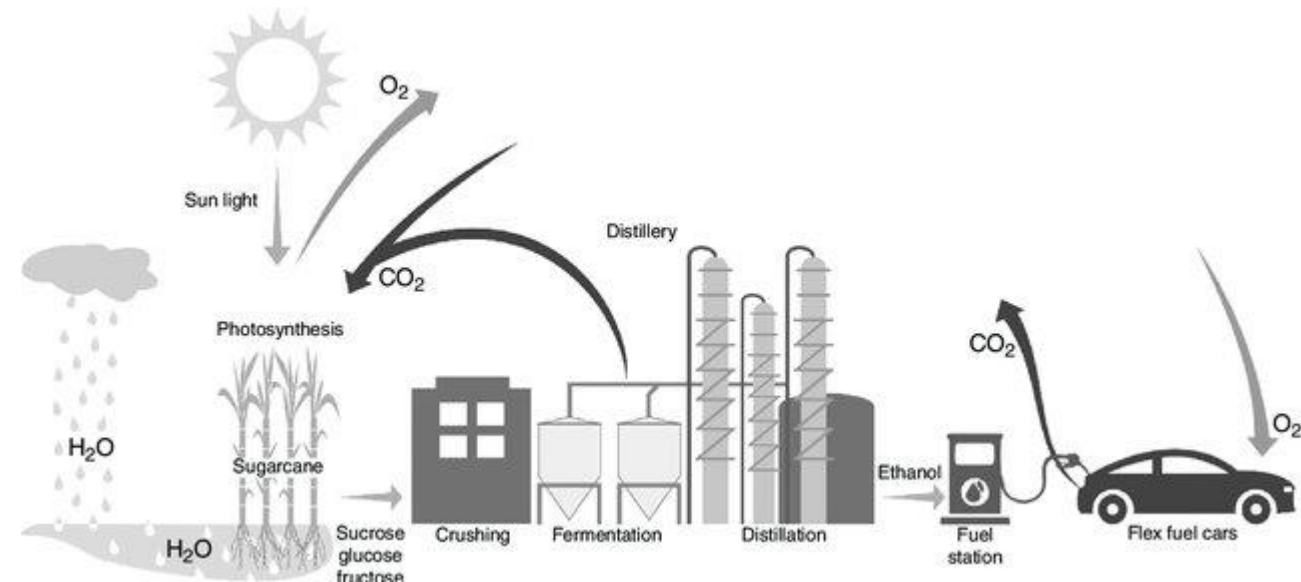


CLEPA proposed this December 6 that renewable fuels can make combustion engines live longer and save jobs. Volkswagen thinks ethanol can deliver a carbon-neutral future in developing countries. These are hopes that do not stand a simple reality check like *T&E (Transport & Environment)* has performed with e-gasoline. Synthetic or not, renewable or not, the issue with burning stuff goes beyond carbon dioxide.

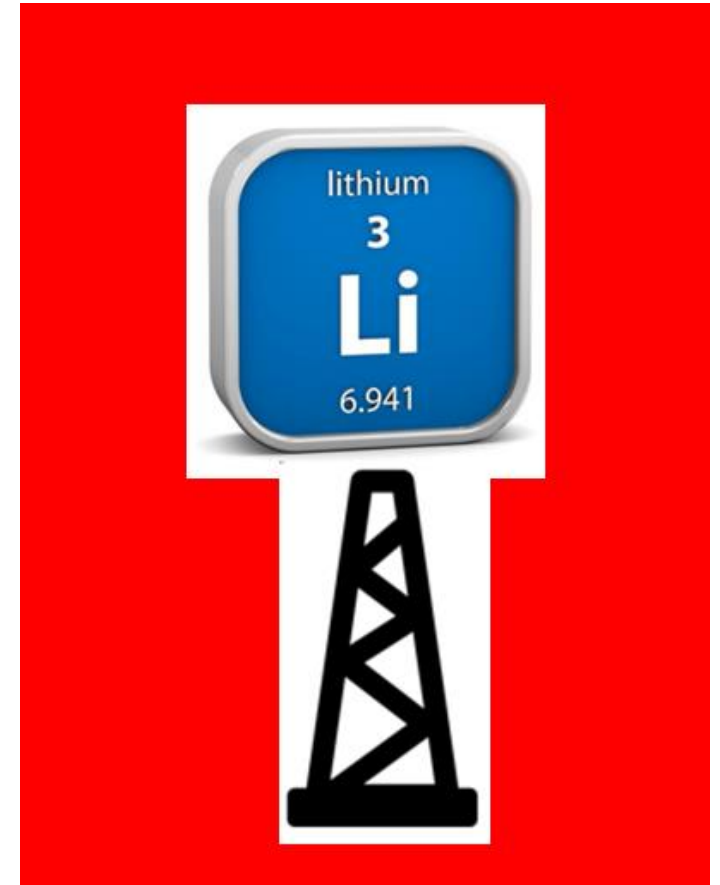
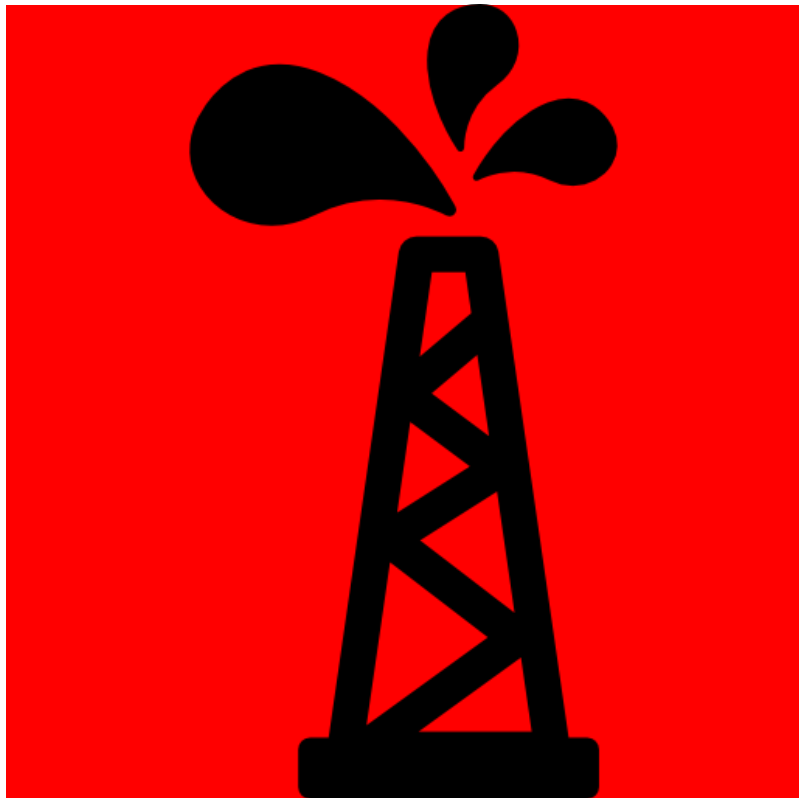
Tests compare car powered by 3 e-petrol blends to fossil petrol



Etanol = eFuel



Energy Makeup !!!



CO₂ Battery: Ethanol



500 a 840

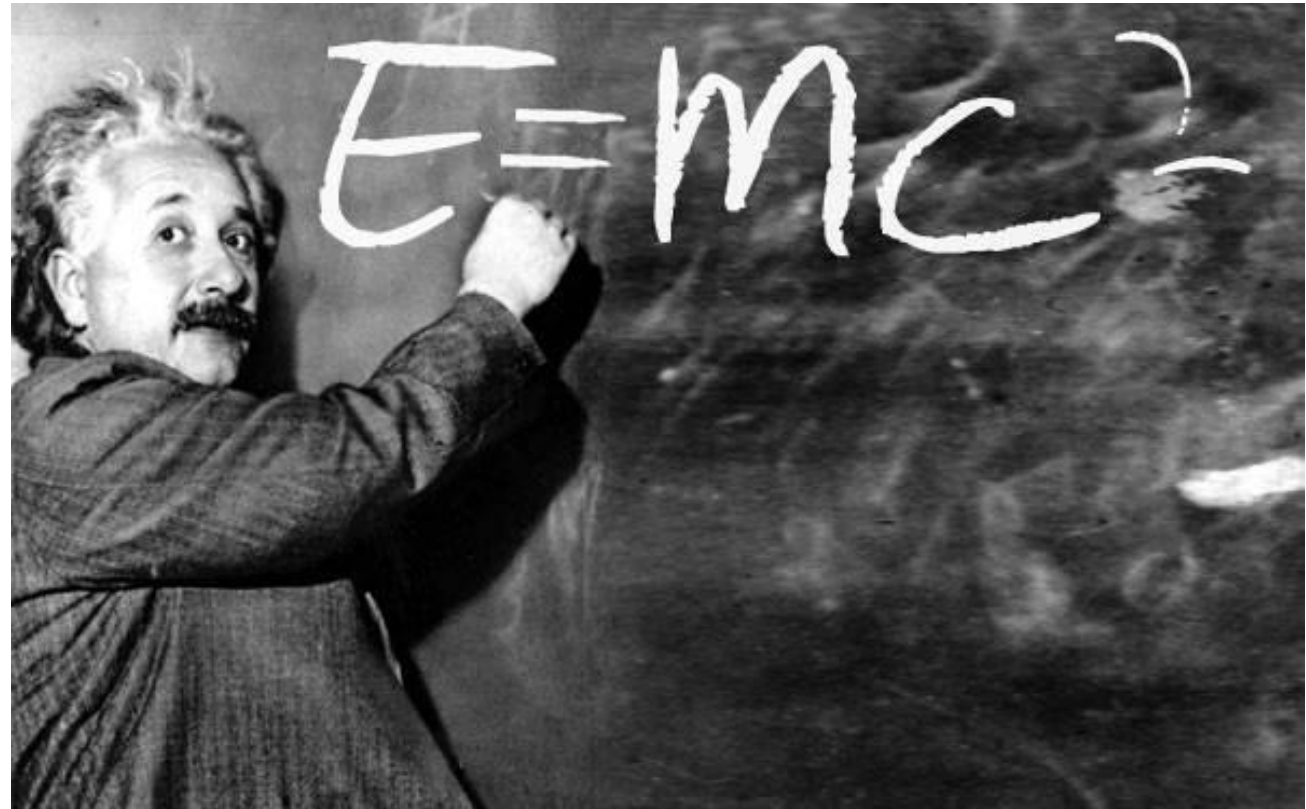
How to Discharge a CO₂ Battery



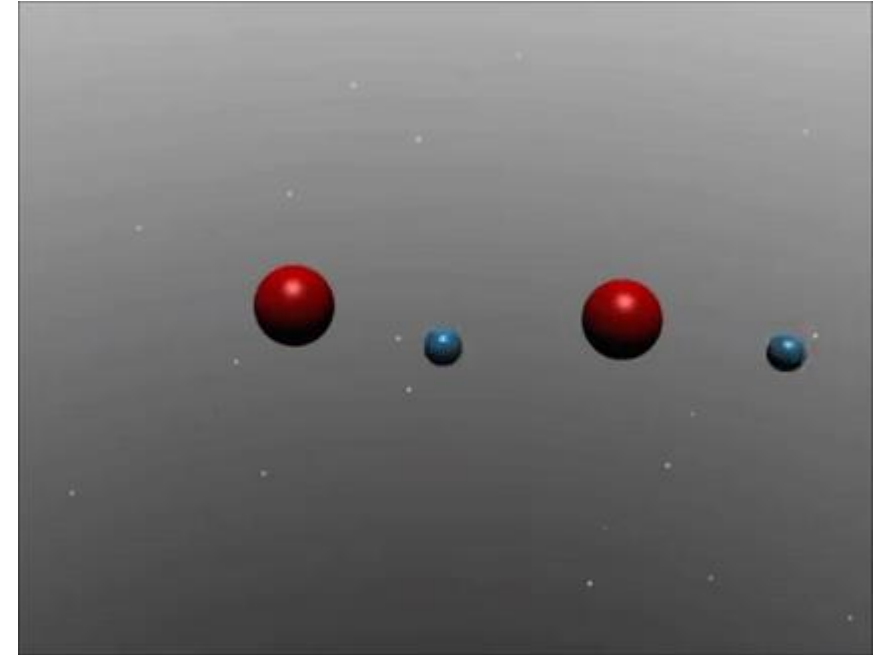
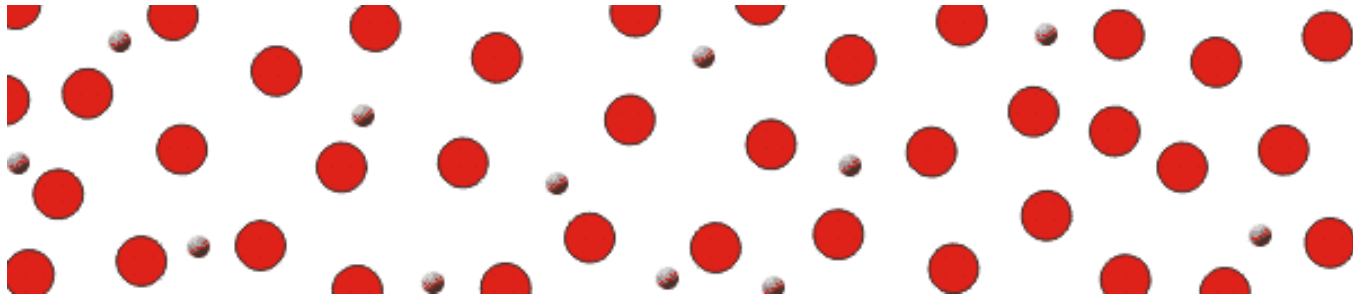
But Full Electric is Sexy...



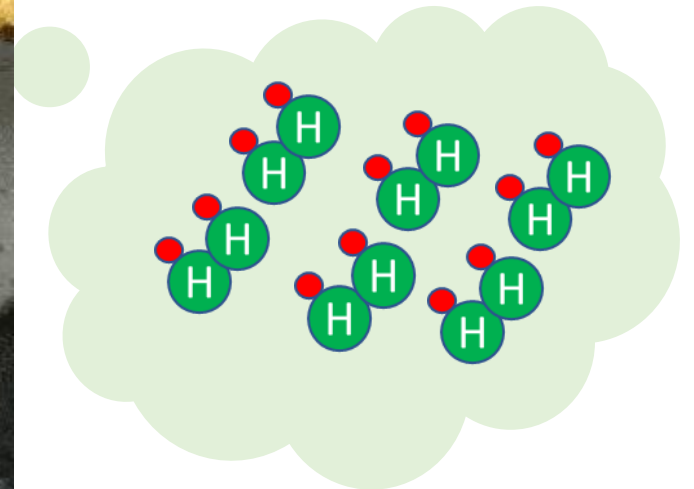
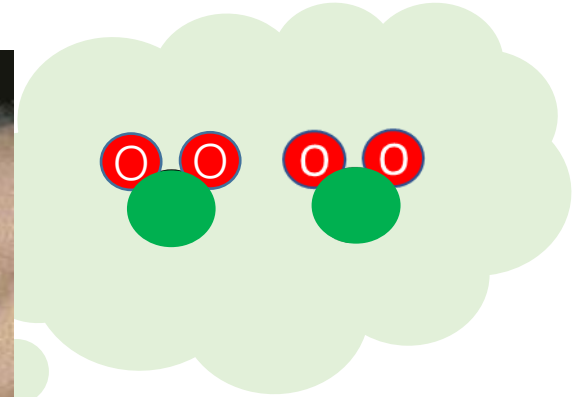
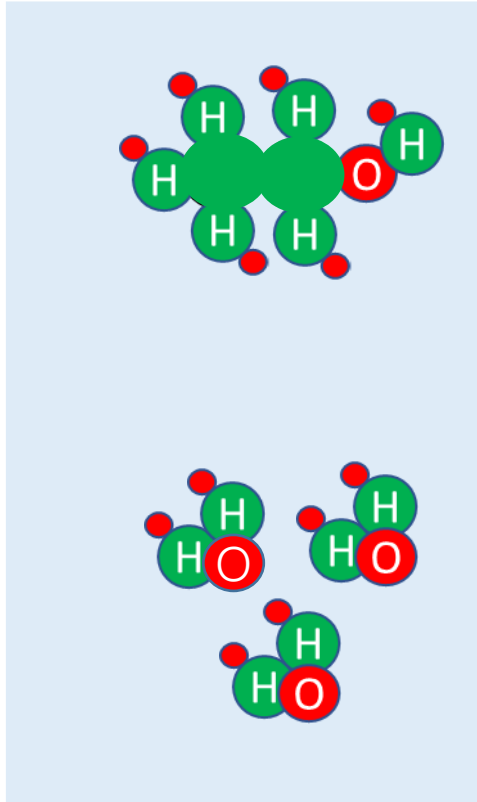
Electricity



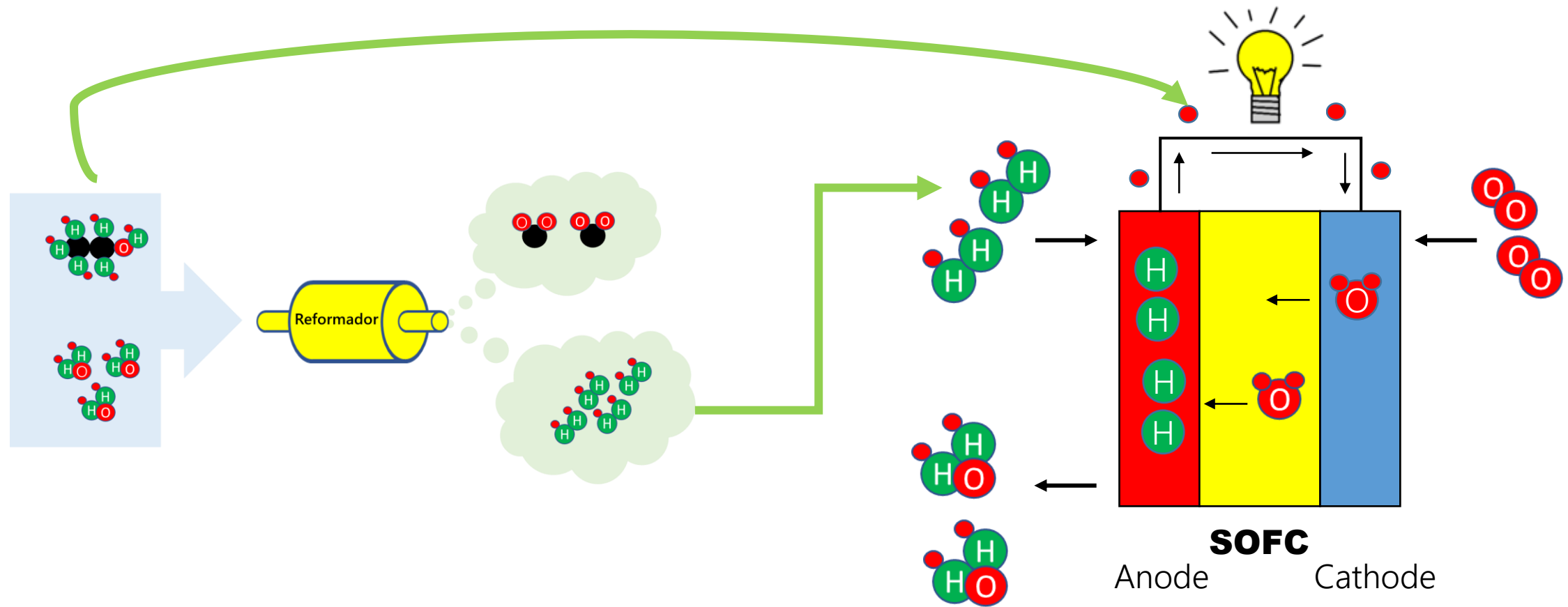
Electric Current



Green “Electricity”



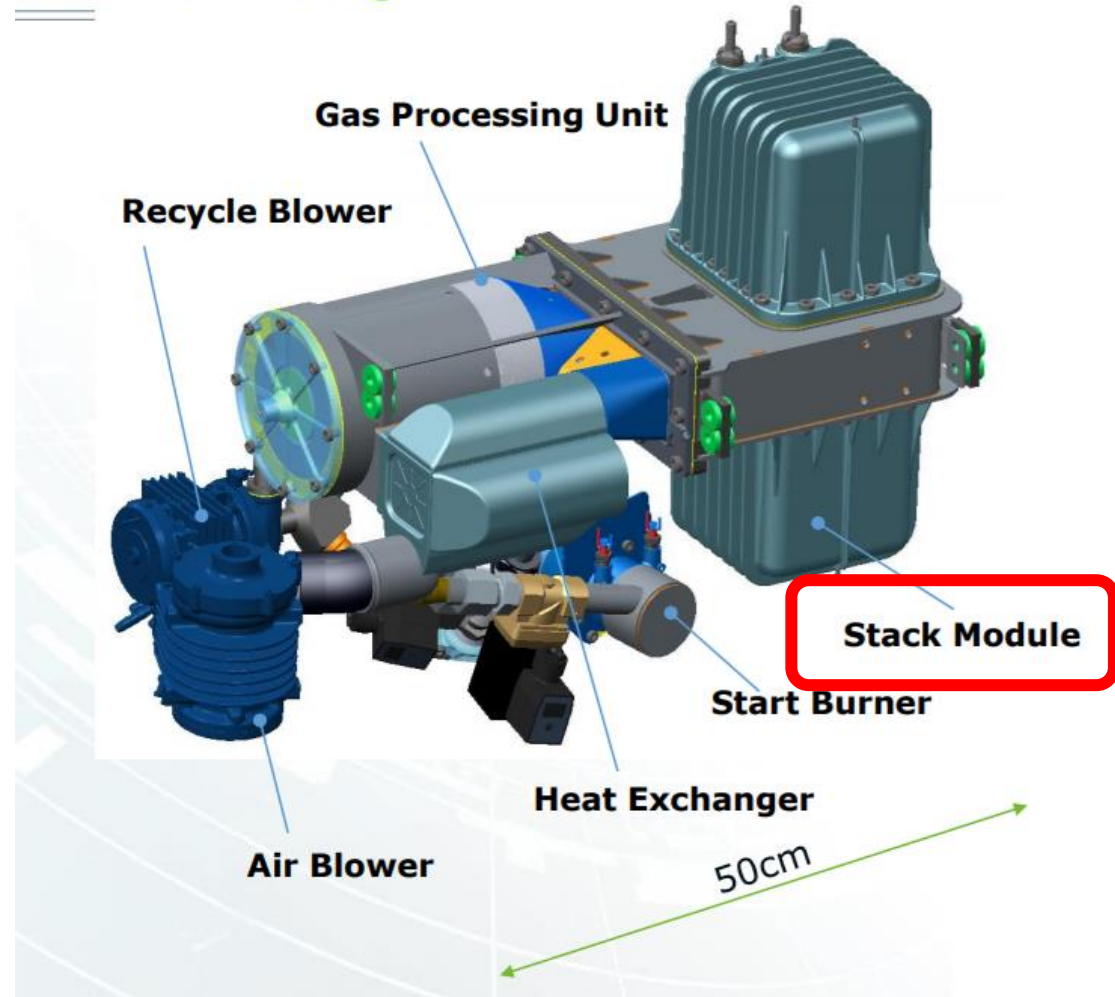
SOFC Fuel Cell



The new Engines



SOFC Design





Solid Oxide Fuel Cell

News

Ceres and Bosch Scale up for Mass Solid Oxide Fuel Cell (SOFC) Production

By FuelCellsWorks | December 7, 2020 | 4 min read (785 words)



  1920 x 1080

  1200 x 1200

SHARE 

COPY EMBED HTML 

26 km/l

Decrease and Board....



Climate-friendly:
Getting real with
green energy

Efficient: The
front-runner in the
efficiency stakes

Decentralized: An
independent, local
source of energy

**Connected and
scalable:** Sized to
fit your needs

Brazilian Development in Partnership



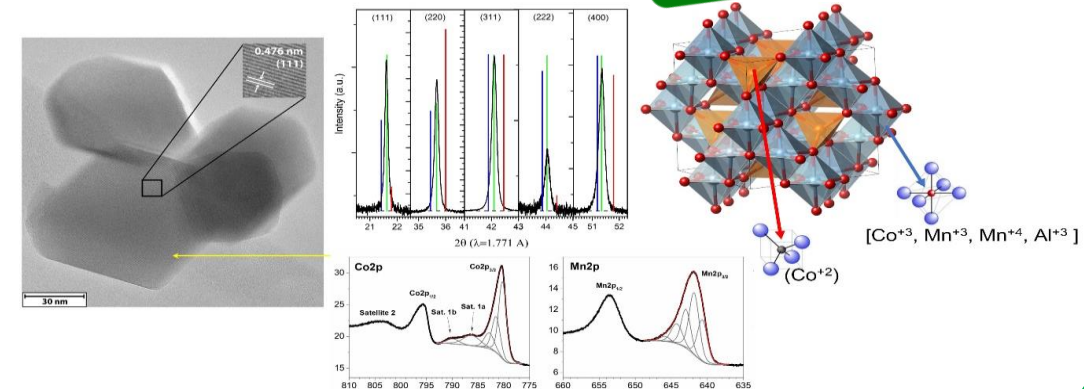
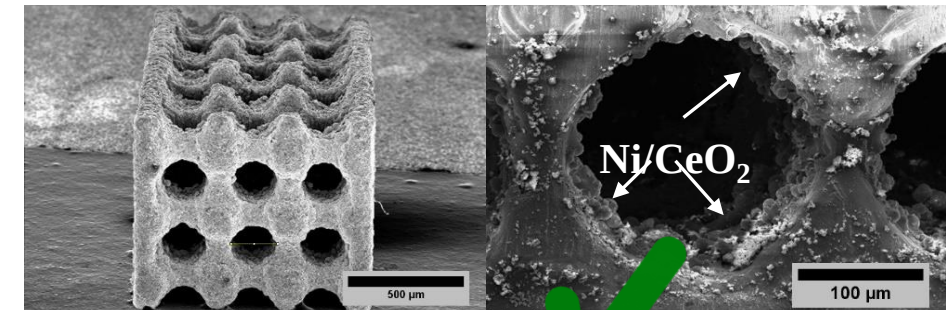
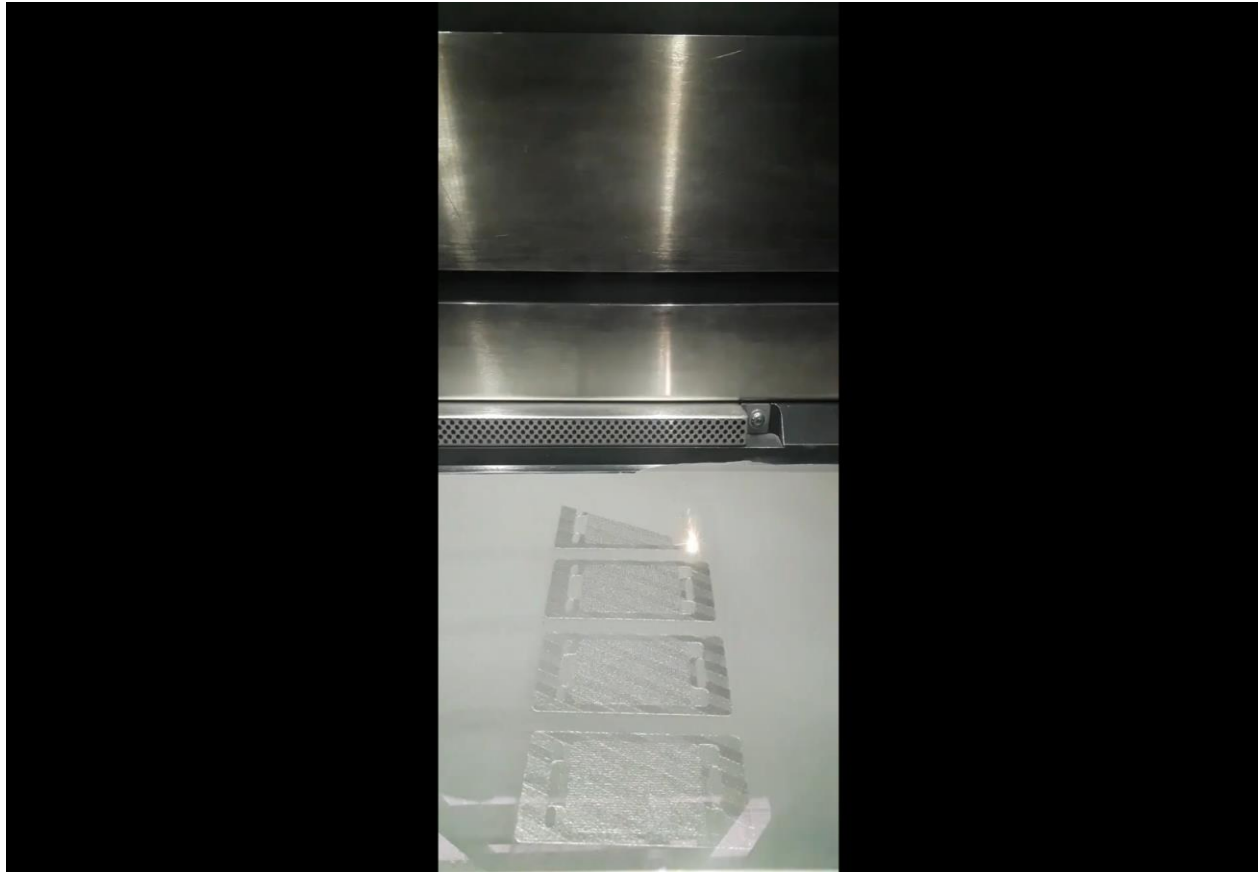
Coordenadores: Gustavo Doubek & Hudson Zanin – UNICAMP

doubek@unicamp.br ; hzanin@unicamp.br ; <https://www.brenergies.org/>

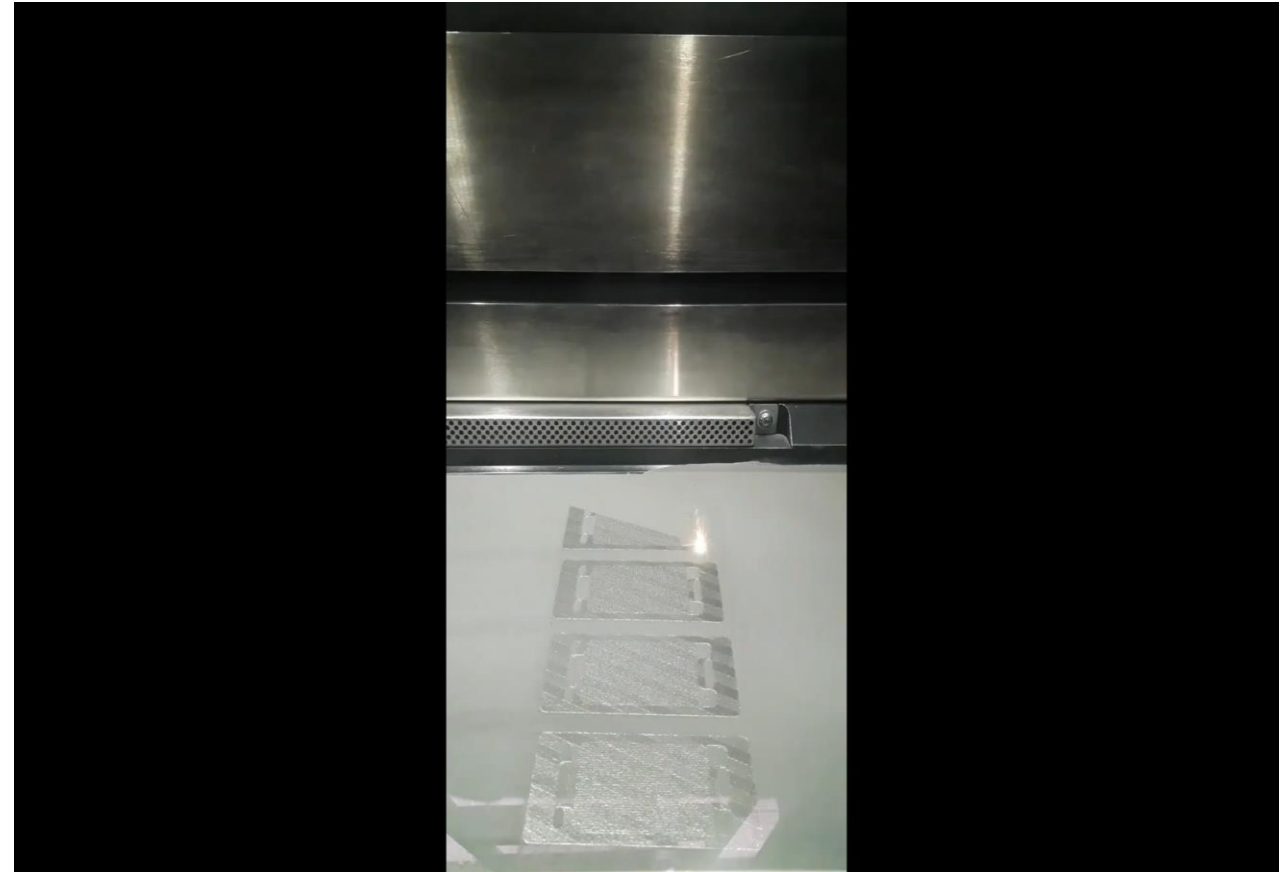
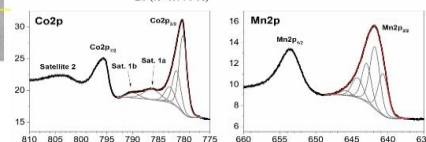
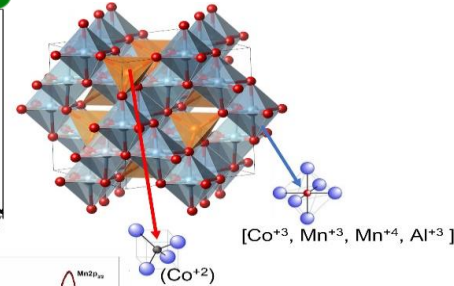
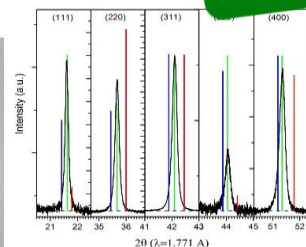
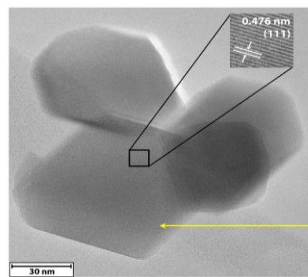
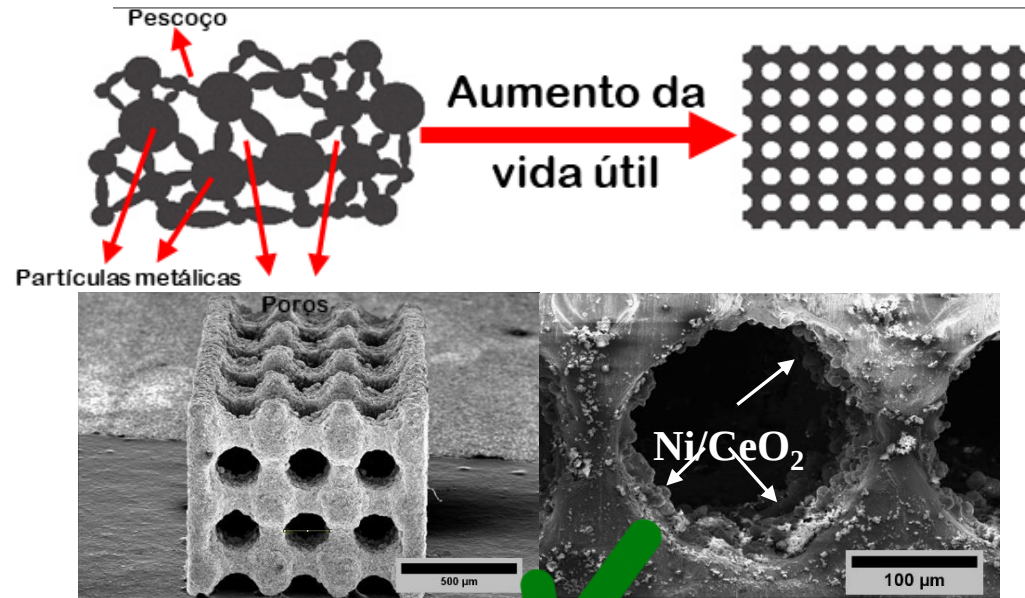
Equipe: Fábio Antunes; Rubens M. Filho; André Jardini; Tarcio dos Santos Barros (UNICAMP); Leonardo Moraes da Silva (UFVJM); Renato Freitas Sobrinho (UFMT)



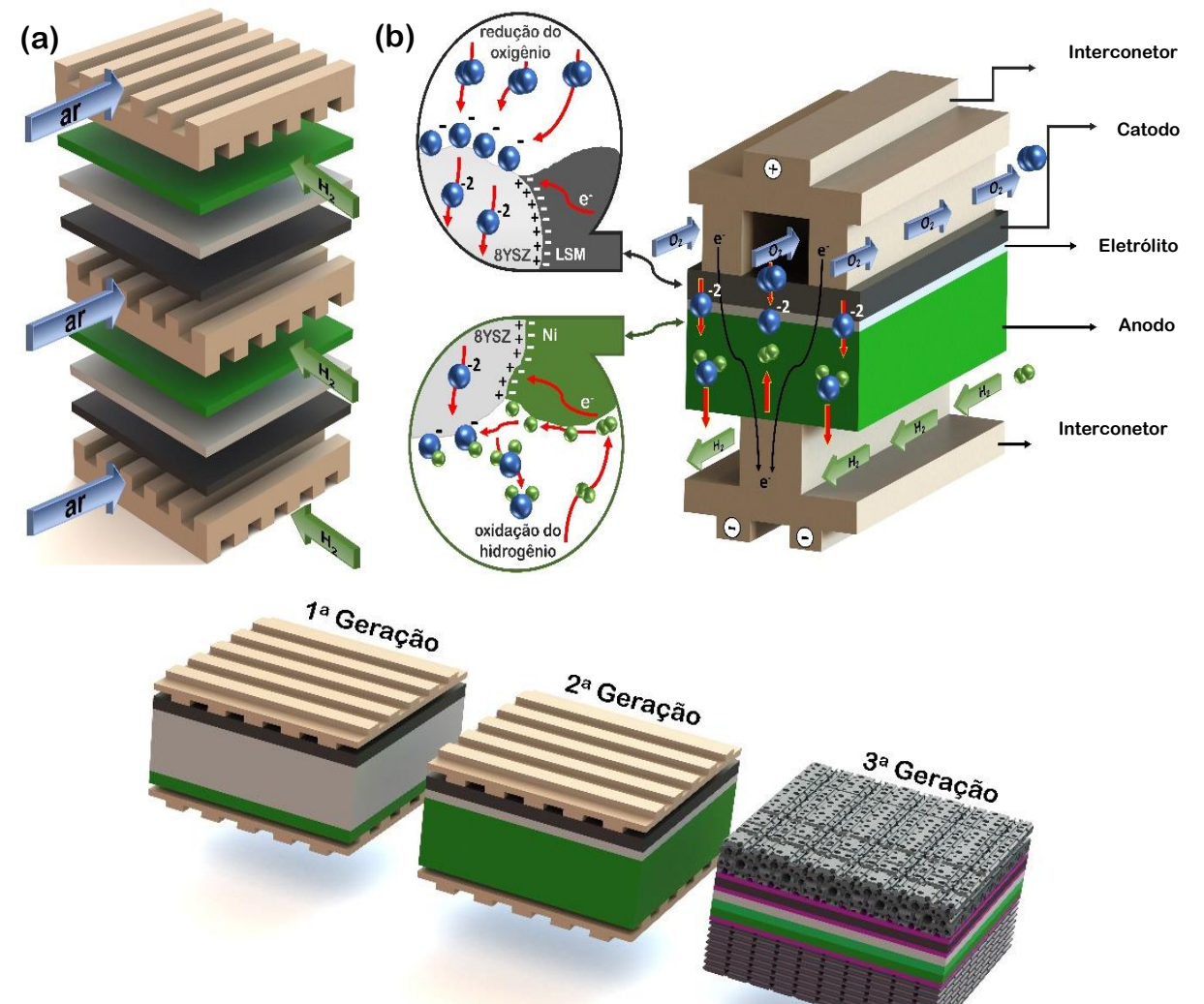
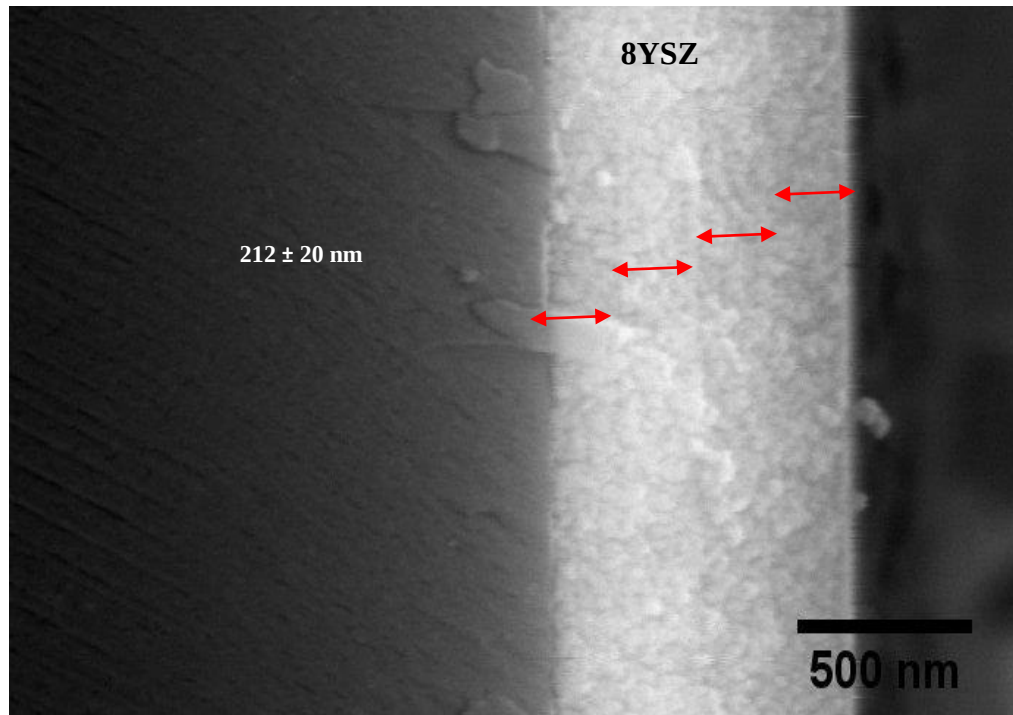
Prototyping of metallic supports and Micro Reformers



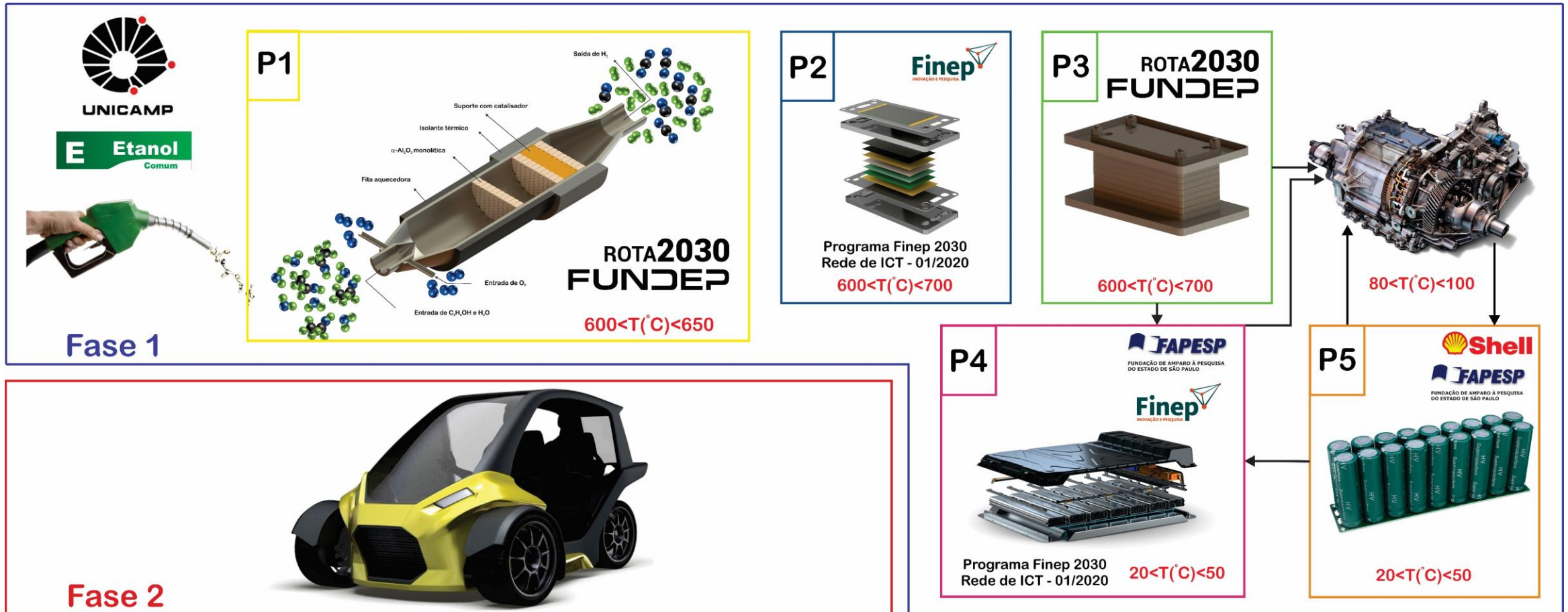
Prototyping of metallic supports and Micro Reformers



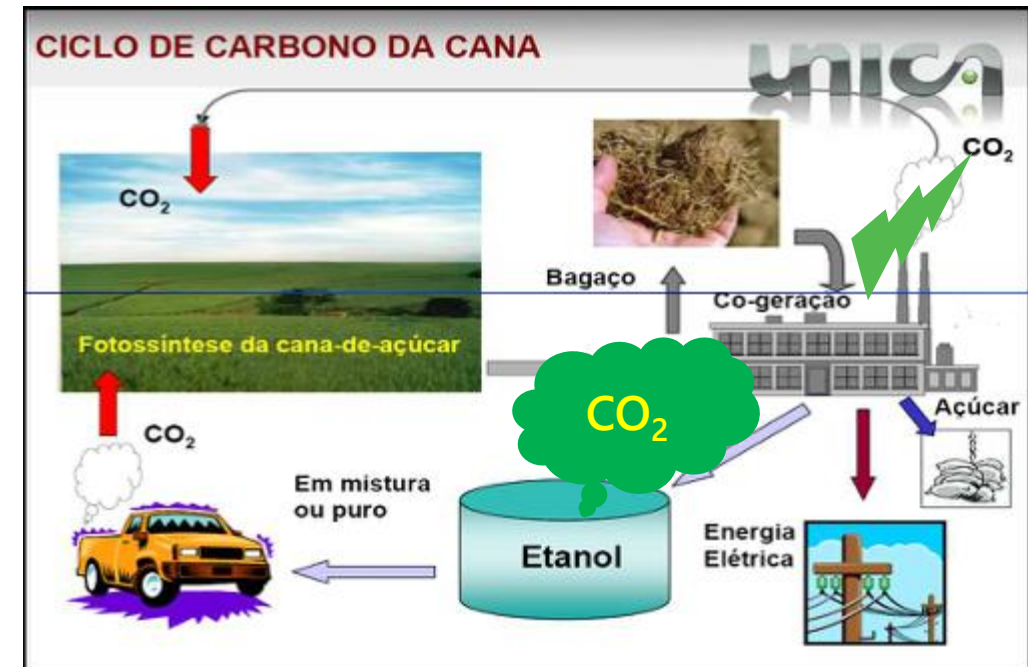
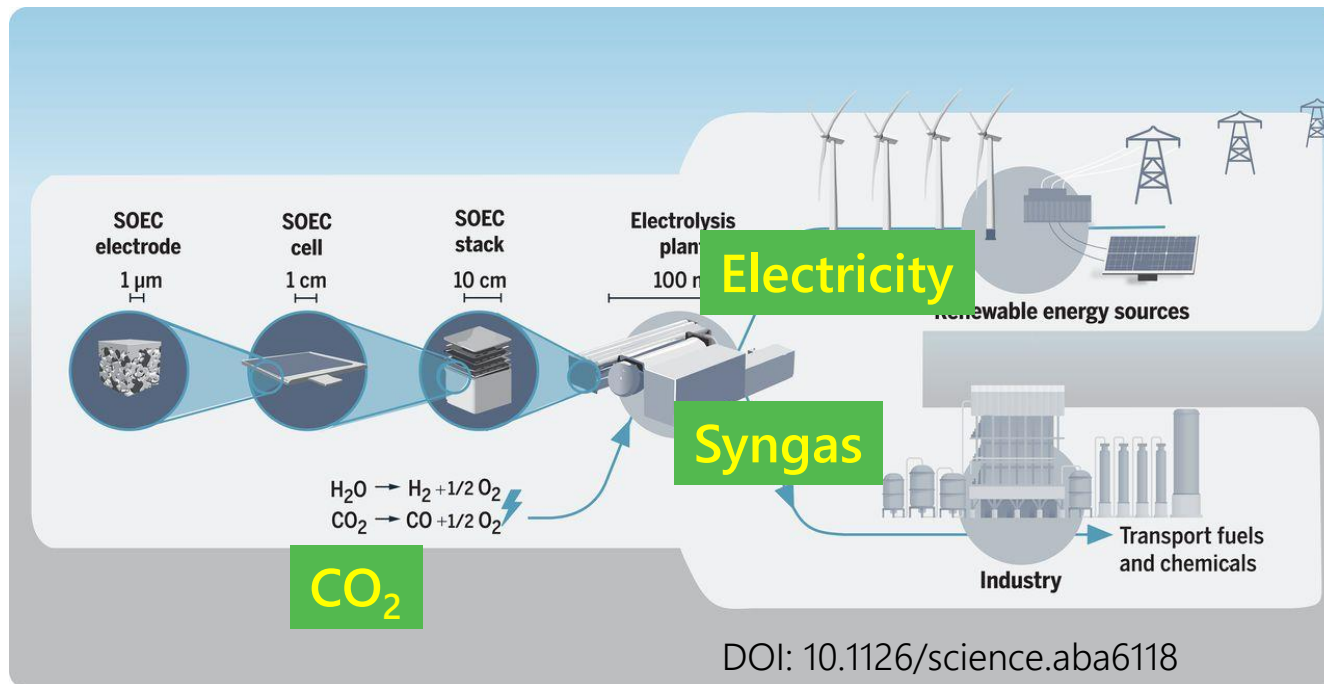
3rd Generation SOFC construction



The Goal



On the other hand: Solid Oxide Electrolysis Cell (SOEC)



Still in mobility, no less than that....



seminário
bioenergia

**BRASIL, A HORA DE SER
PROTAGONISTA NA
ENERGIA RENOVÁVEL**

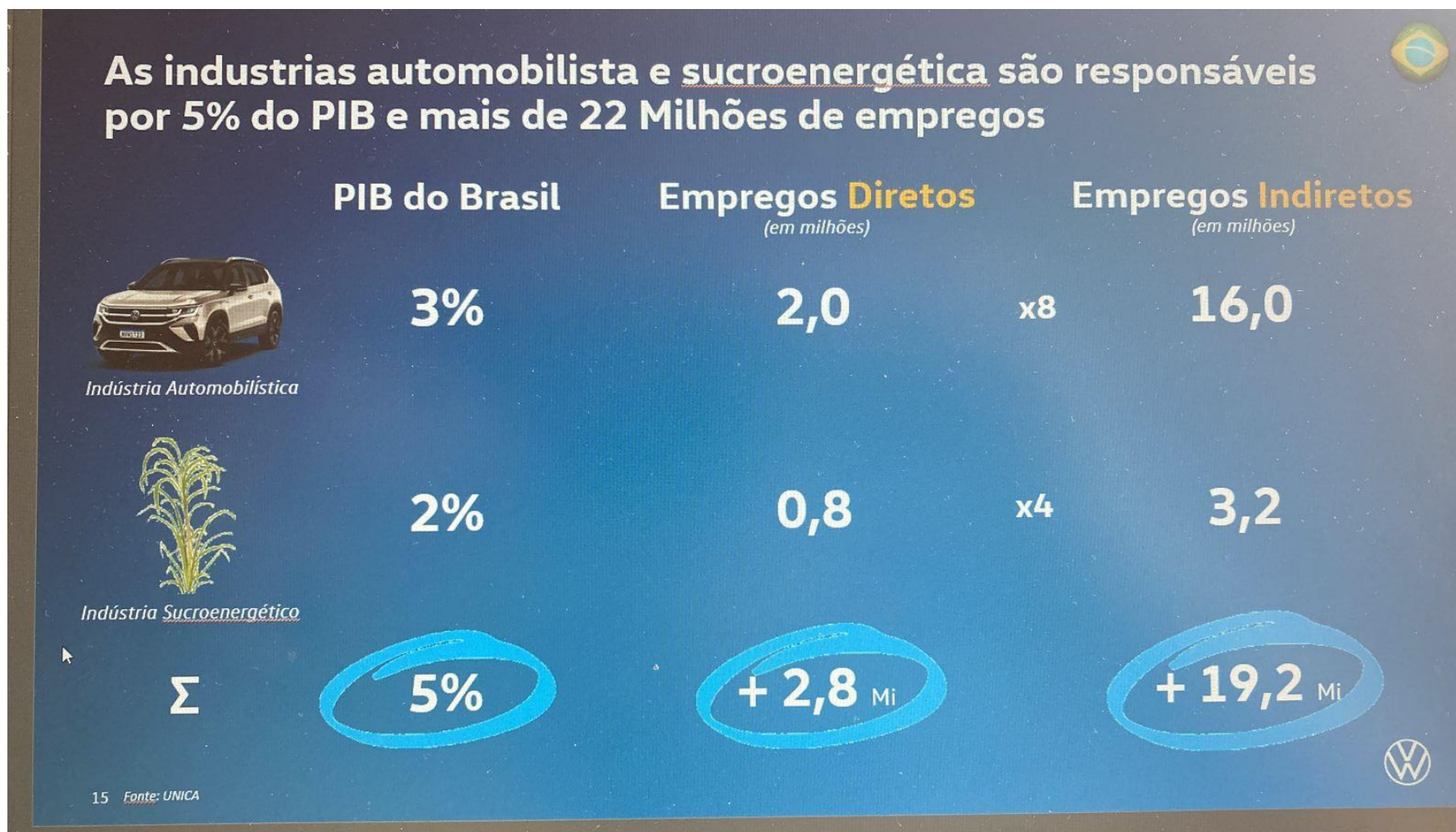
Pablo Di SI



25 DE NOVEMBRO DE 2021 | 13H |
CANAL NO YOUTUBE: BIOENERGIA UNICAMP

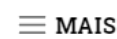


Arguments



Think Globally and Act Locally

NOVACANA



ASSINE JÁ



INVESTIMENTO

Volkswagen anuncia investimento R\$ 7 bi na América Latina, maior parte no Brasil

Valor, que engloba aportes até 2026, é igual ao ciclo iniciado em 2017 e será aplicado em novos veículos, desenvolvimento de negócios digitais e pesquisas sobre biocombustíveis

Sobre o centro de pesquisa e desenvolvimento de biocombustíveis, disse que o bioetanol é “um significativo complemento regional à nossa estratégia elétrica, porque reduz as emissões de carbono em até 90% comparado à gasolina. É um excelente exemplo de pense globalmente e aja localmente”.

Jaboticaba Effect....

'Em 2025, vamos concluir os testes da célula a etanol', diz presidente da Nissan no Brasil

Sistema será instalado em fábrica no Japão neste ano e poderá ser utilizado em qualquer veículo



Tião Oliveira

24 jan 2022 05h10

[ver comentários](#)

Cousseau diz que Brasil deve liderar exportação da nova tecnologia

Foto: Nissan/Divulgação / Estadão



Cousseau diz que Brasil deve liderar exportação da nova tecnologia

Foto: Nissan/Divulgação / Estadão

Freeing up Genetics



Zé UNIT

Planting Hydrogen

471 t/ha



Energy-cane

Sugarcane

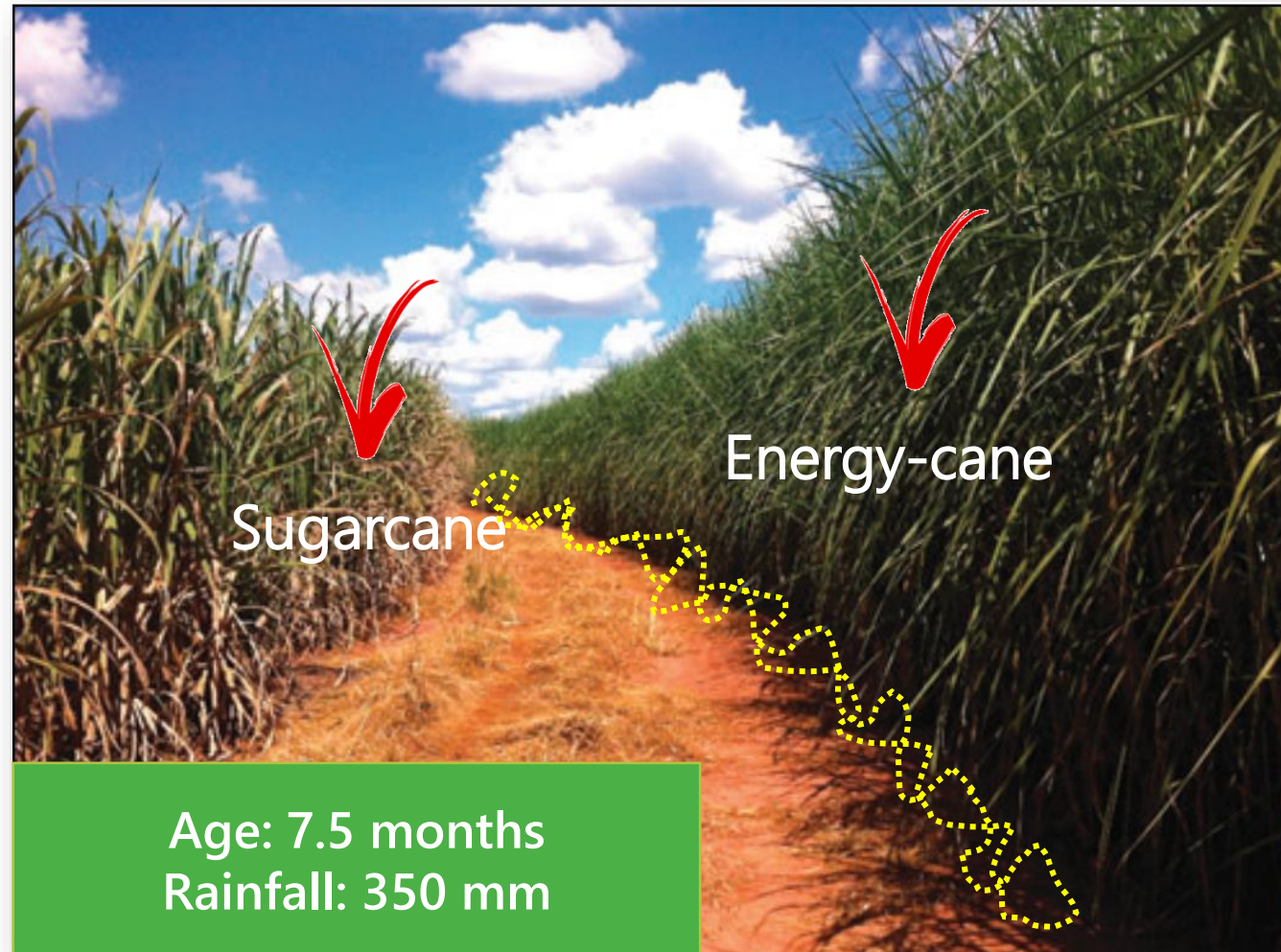
Energy-cane

Corte 2							Corte 3				
Epoca 1	Epoca 2	Epoca 3	Epoca 4	Epoca 5	Média		Epoca 1	Epoca 2	Epoca 3	Epoca 4	Epoca 5
361	308	334	310	274	317		471	255			
376	258	271	262	309	296		366	181			
350	298	271	241	237	280		304	205			
349	259	267	240	247	272		300	228			
304	256	290	244	223	263		209	218			
276	223	224	210	184	223		283	218			
346	265	276	254	262	281		334	209			

Ensaio Irrigado Vertix - Rosário BA (Terceiro corte em andamento)

11:54

Endurance, Productivity and Natural Fertility



Root System

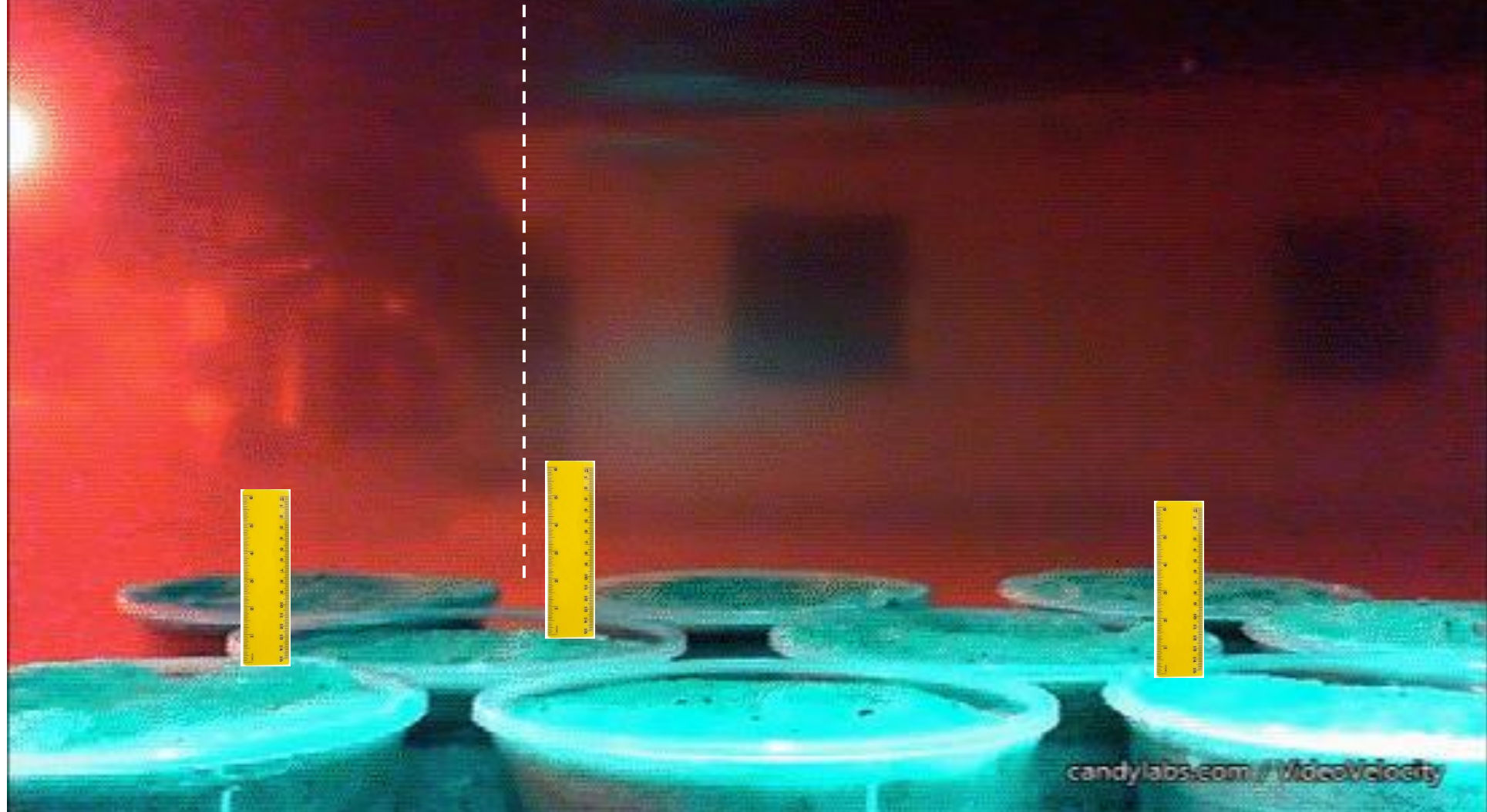


Sugarcane

Energy Cane

Sugarcane

Energy Cane



2th Generation

Sugar Cane – Typical Composition

1 Ton Sugar Cane

>> 140 kg Sugar

>> 140 kg Bagasse (FIBER)

>> 140 kg Straw and Tip (FIBER)



1 ha Sugar Cane

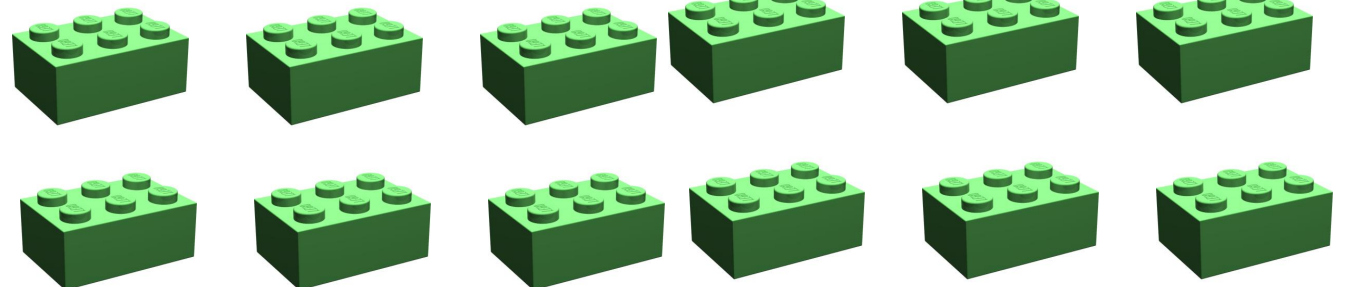
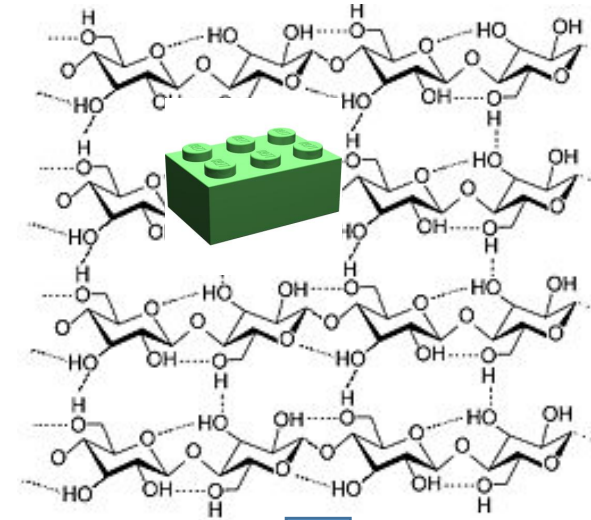
80



Per Year

1 ha Energy Cane

240



Put Price in Value

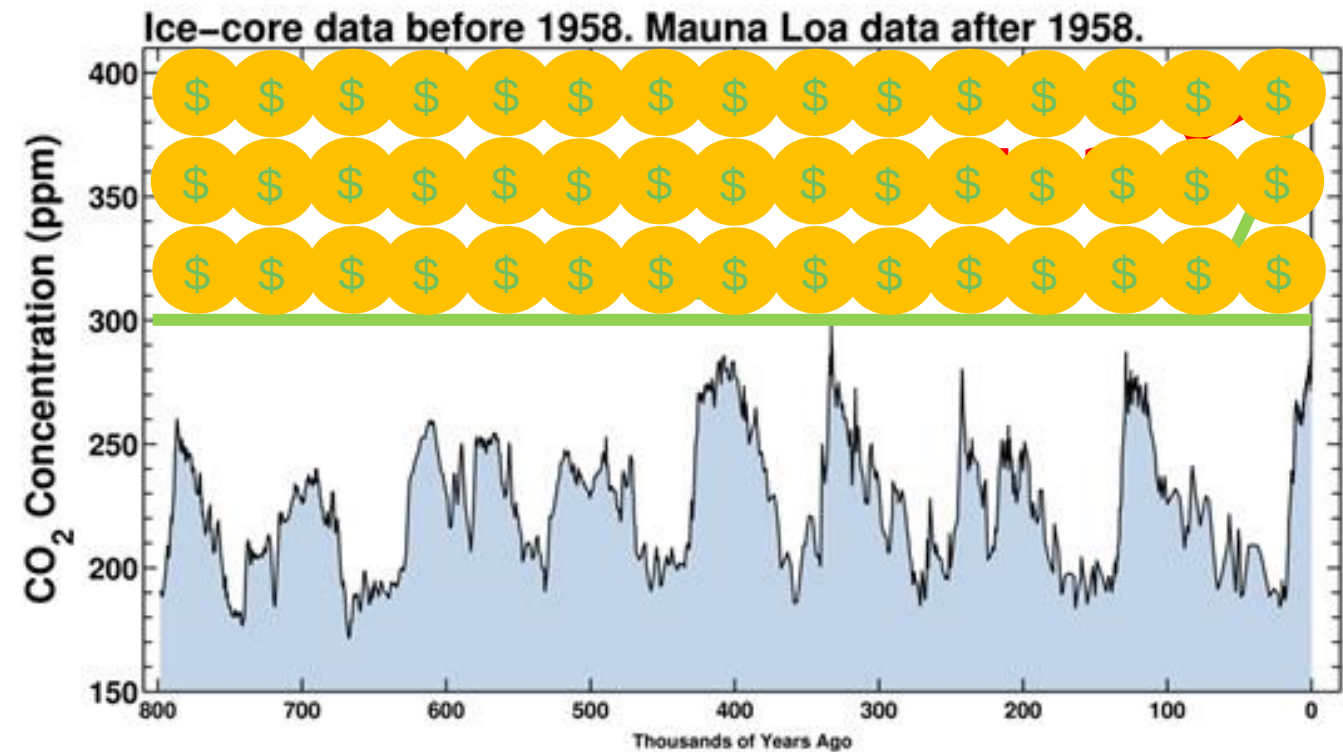
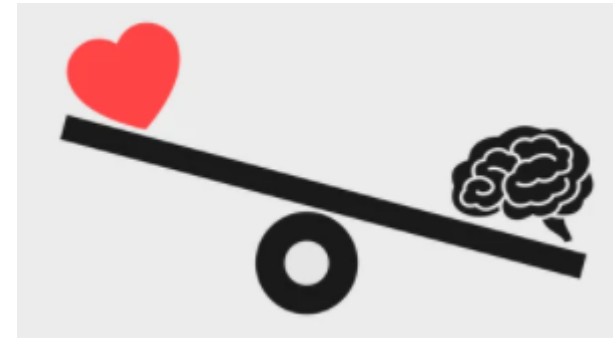
Green Car Congress

Energy, technologies, issues and policies for sustainable mobility

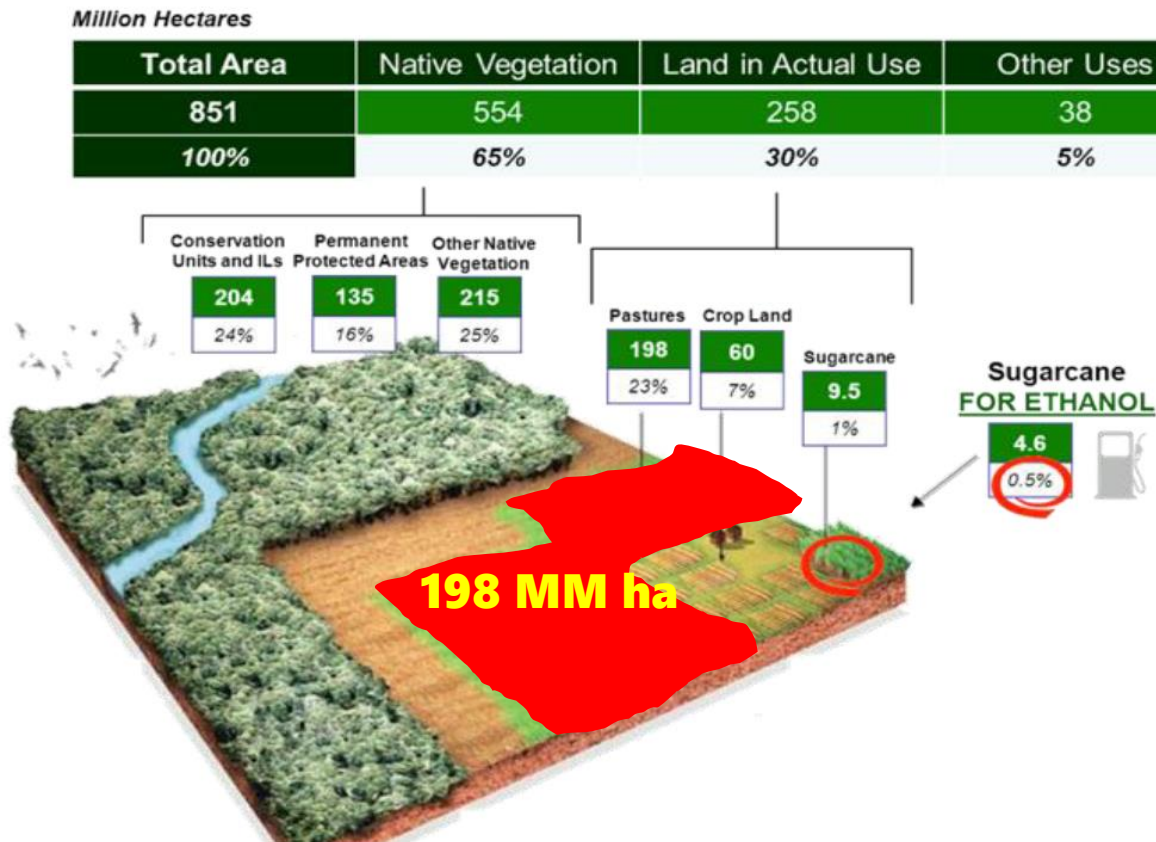
Study finds limiting warming to 2 °C would require at least a \$200/t carbon tax globally

06 May 2022

CO₂ Financialisation



Brazil just starts Agriculture....



VISITA FELINA

Onça-parda é vista em todos os biomas do Brasil

Onça-parda ou suçuarana
(*Puma concolor*)

9 anos
é a estimativa de vida*

É o 2º maior felino das Américas, atrás apenas da onça-pintada

Vive só e anda em par apenas em época de acasalamento

Durante a vida, transita por uma área média de 75 quilômetros quadrados

Suas presas têm em média até 15 kg. Exemplos: capivara, paca e tatu

Não tem predadores naturais

O risco de atacar humanos é considerado baixo



CIDADES ONDE APARECERAM ONÇAS-PARDAS

- 1 Loanda (PR)
- 2 Brasília (DF)
- 3 Belo Horizonte (MG)
- 4 Erechim (RS)
- 5 Hidrolândia (GO)
- 6 Campina da Lagoa (PR)
- 7 Ribeirão Preto (SP)
- 8 Jaú (SP)
- 9 Campinas (SP)
- 10 Mococa (SP)

RAIO-X

Peso*: macho 56 kg, fêmea 37 kg



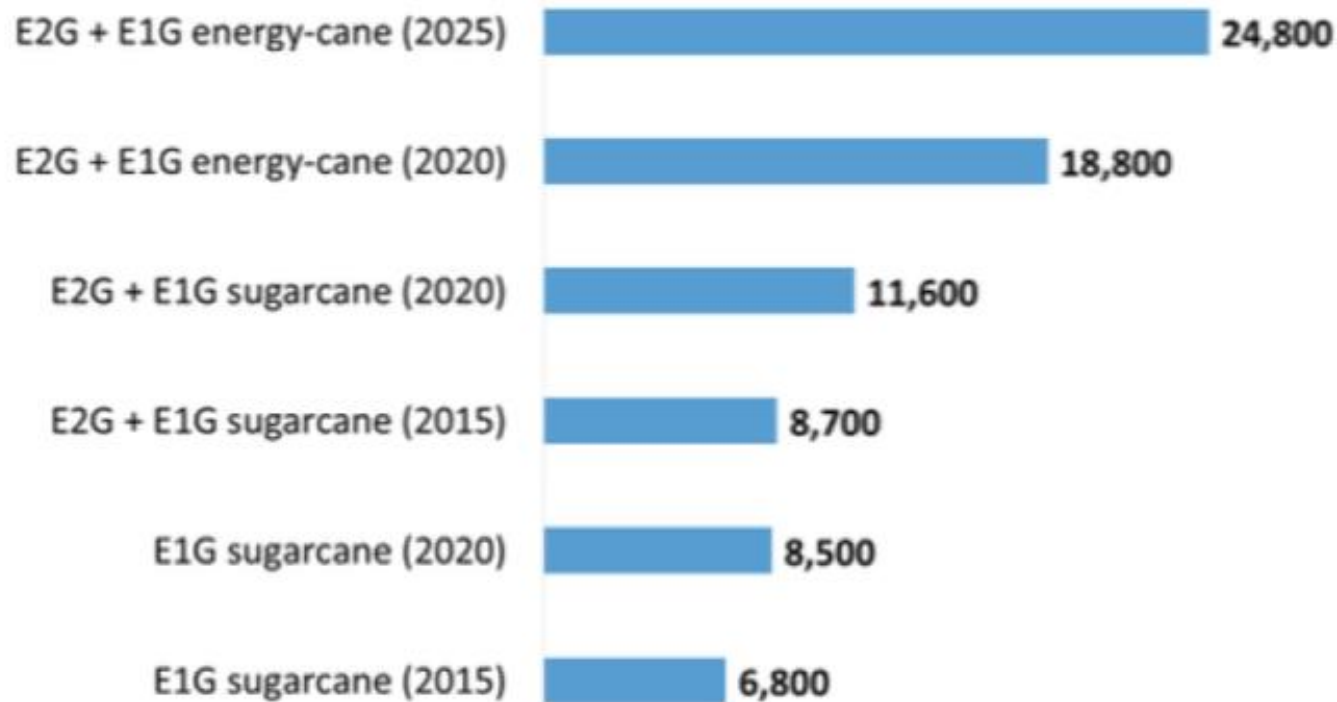
1,71 m de comprimento* (cabeça e corpo)

* médias
Fonte: CENAP (Centro Nacional de Pesquisa e Conservação de Mamíferos e Carnívoros)

Imagem Fotolia

Smooth Energy Transition

Ethanol productivity (liters/ha)



Area Requirement Analysis

Global Gasoline Consumption	1,3tri liters/year
EtOH Equivalent	1,86 tri liters/year
Required Area E2G + E1G Energy Cane (2020)	100MM hectares
Required Area E2G + E1G Energy Cane (2025)	75MM hectares

50% dos Pastos = Consumo Mundial de Gasolina (Combustão)

Most Populated Countries in 2100

Rank	Country	Population (2017)	Rank	Country	Population (2100E)
#1	 China	1.4B	#1	 India	1.09B
#2	 India	1.38B	#2	 Nigeria	791M
#3	 U.S.	325M	#3	 China	732M
#4	 Indonesia	258M	#4	 U.S.	336M
#5	 Pakistan	214M	#5	 Pakistan	248M
#6	 Brazil	212M	#6	 DR Congo	246M
#7	 Nigeria	206M	#7	 Indonesia	229M
#8	 Bangladesh	157M	#8	 Ethiopia	223M
#9	 Russia	146M	#9	 Egypt	199M
#10	 Japan	128M	#10	 Tanzania	186M

Africa

BIODIVERSITY AREAS

550 MM ha

5.5 mil km²

REMAIN LAND POTENTIALLY
AVAILABLE FOR BIOFUEL
PRODUCTION



	million km ²
	24.3
	-2.4
	-1.0
	-6.9
	-2.9
	-5.1
	-0.5
STOCK	5.5

This tragedy must be avoided





bioFuel for Food (and development)

Petroleum

69,000 Employees

\$300 billion in Revenue

= U\$ 4,350 MM/Employee

Ethanol

4500 Employees

\$400 million in revenue

= U\$ 89,000/Employee

50X mais Empregos



UNICAMP

A maior startup do Brasil

A segunda geração do Etanol, feita com os restos da cana, começou a ser produzida na novata Bioflex, da GranBio. É uma revolução, que pode elevar em 50% a produtividade do setor

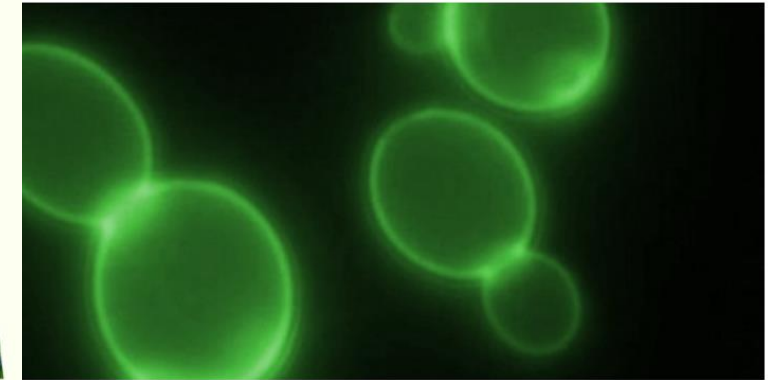
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A BIOFLEX, USINA NO INTERIOR DE ALAGOAS, COMEÇOU A FABRICAR O ETANOL DE SEGUNDA GERAÇÃO EM SETEMBRO, MAS O ALVO DA EMPRESA É TRANSFORMAR O AÇÚCAR EM UMA ALTERNATIVA AO PETRÓLEO (FOTO: GUILHERME ZAUITH)



Startups founded by Students



Exame, baseado em reação entre microrganismo e o novo coronavírus, permitirá determinar rapidamente a presença do SARS-CoV-2 em amostras de saliva e estará disponível no primeiro semestre de 2021 (Imagem: BIOinFOOD)

Startup desenvolve teste de diagnóstico de COVID-19 a partir de levedura

15 de dezembro de 2020



Cientistas usam levedura modificada para produzir o adoçante xilitol a partir da palha da cana

24 de agosto de 2022



Julia Moioli | Agência FAPESP – A palha da cana-de-açúcar,

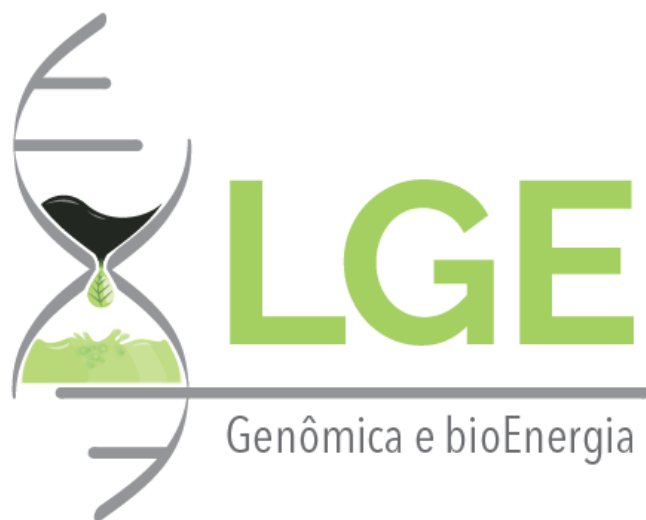


APEXzymes

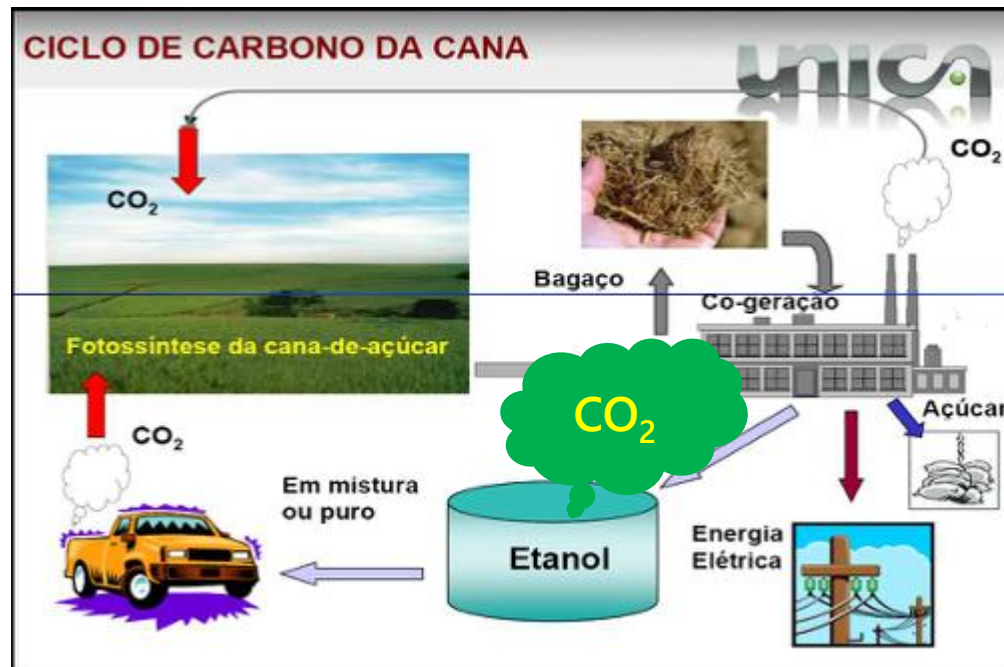


Micro Forge

Laboratório de Genômica e bioEnergia



On the other hand: Solid Oxide Electrolysis Cell (SOEC)



H₂ + CO

Stack Module



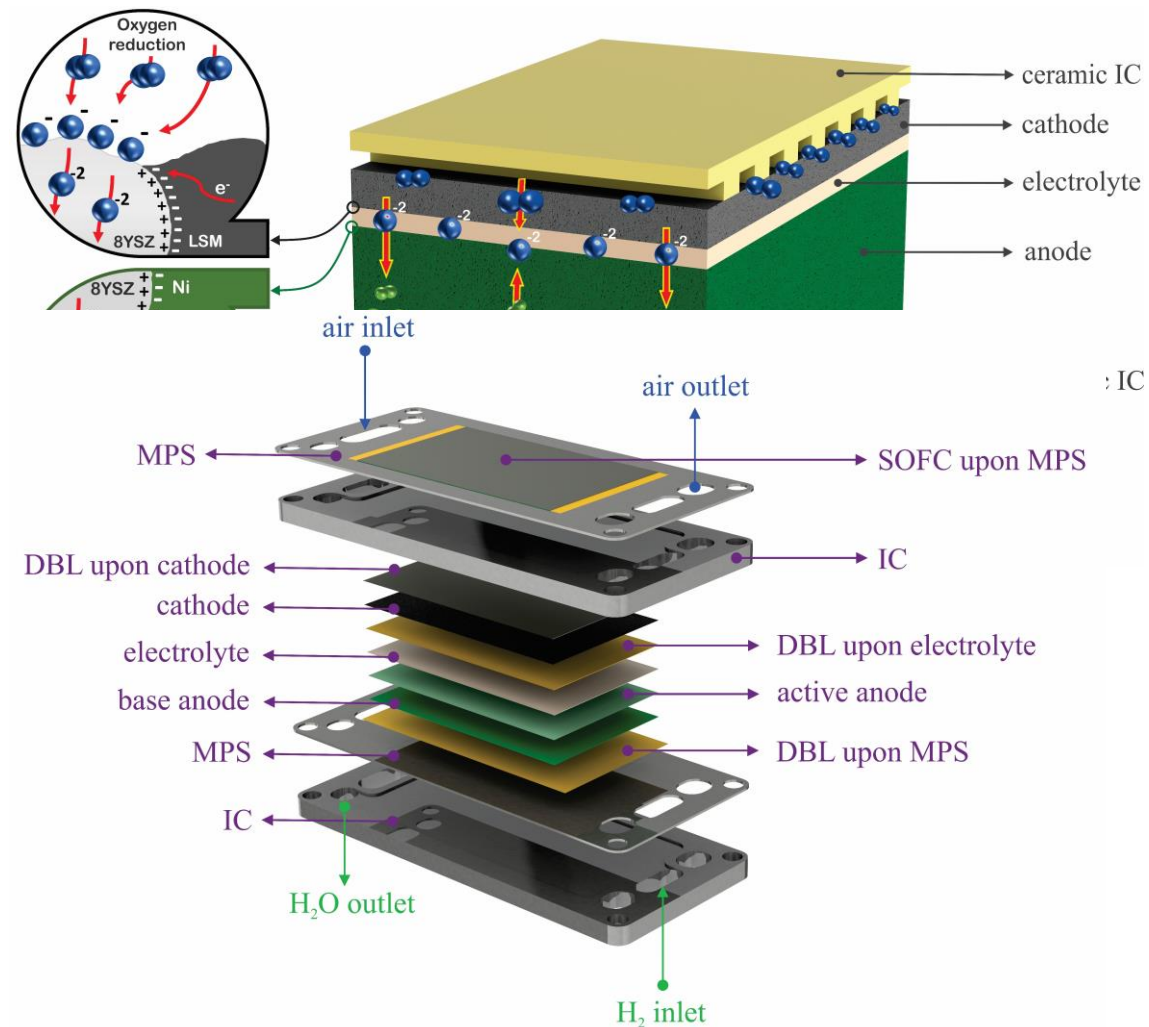
Prof. Hudson Zanin



Prof. Gustavo Doubek



Post Doc Fábio Antunes



The Progress



Materials

FSS or ASS stainless steel
FSS or ASS stainless steel
CoO _x
Ni/8YSZ or Ni-Cu/8YSZ
Ni/10GDC or Ni-Cu/10GDC
8YSZ or 10GDC
10GDC
LSM or LSC or LSCF

Components

Interconnectors and micro porous support
Micro reformers
DBLs upon porous support and interconnectors
Base anode layer
Active anode layer
Dense electrolyte layer
DBL upon electrolyte
Cathode layer