

Asian Clean Energy Forum ACEF 2023

# Hydrogen – Between Reality and “Hopium”

By Hans-Henning Judek, J.E. Access Ltd.

# Hydrogen will play an important role in the defossilization drive

- Hydrogen is definitely part of the solution to get to net zero
- Hydrogen production with the HaberBosch process is well-known since the first decade of the 20<sup>th</sup> century
- Why is the use of hydrogen still limited to a few applications?
- Main uses are fertilizer (urea), desulfurization of fossil fuels and **AdBlue<sup>®</sup>**
- Energy requirements - Combined with the energy needed to produce hydrogen and purified atmospheric nitrogen, hydrogen and ammonia production is energy-intensive, accounting for 1% to 2% of global energy consumption, 3% of global carbon emissions (equal to the whole maritime industry), and 3% to 5% of natural gas consumption



*Before I ask the question, can anyone anticipate the answer?*

*Hydrogen!!*

ALGEBRA



**The Solution!!  
Green Hydrogen**

**Dr. Robert Habeck, Minister of Economics and Climate**

**BUT**

**Germany will have to import 70%  
of the green hydrogen it consumes**

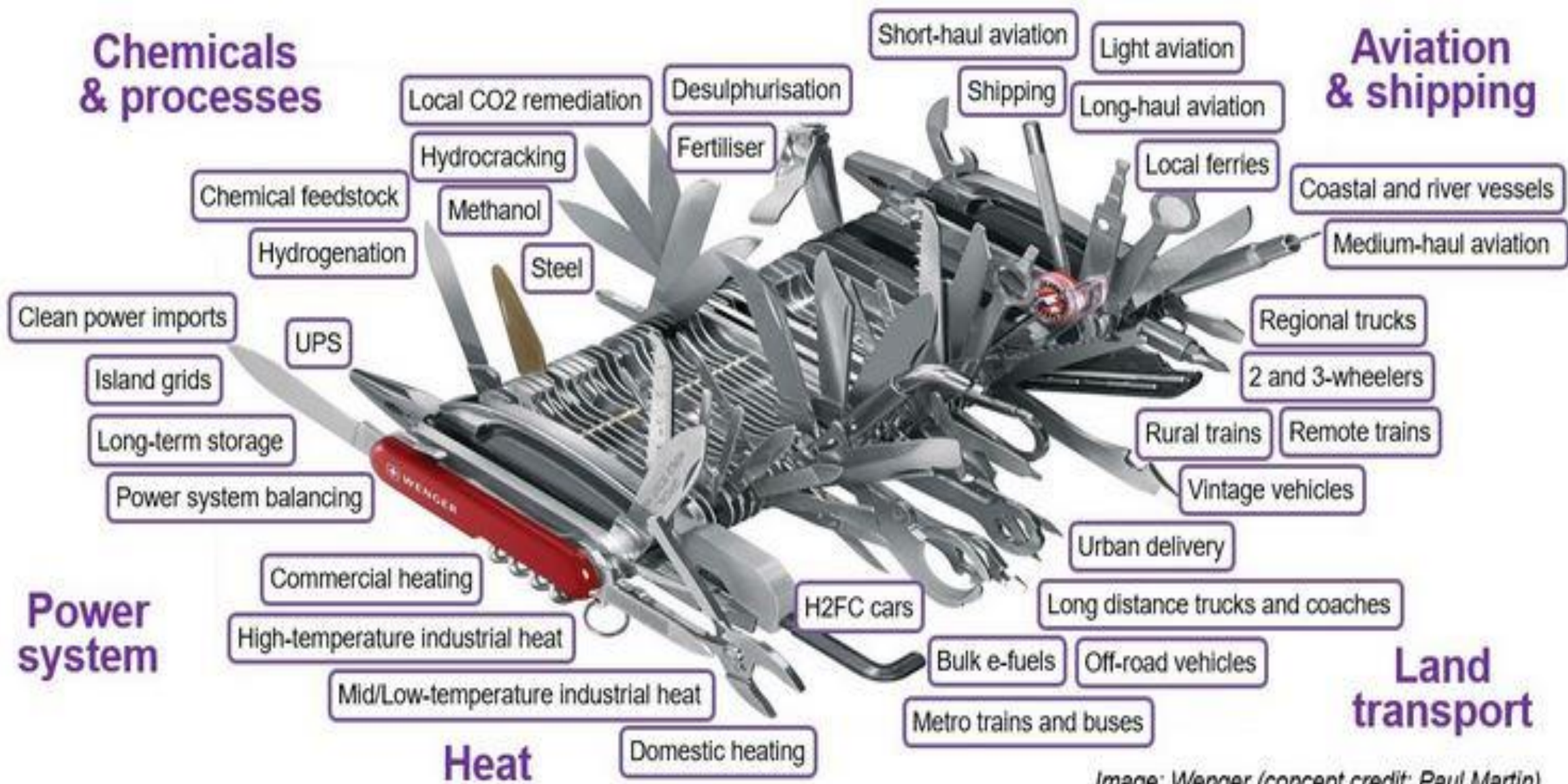
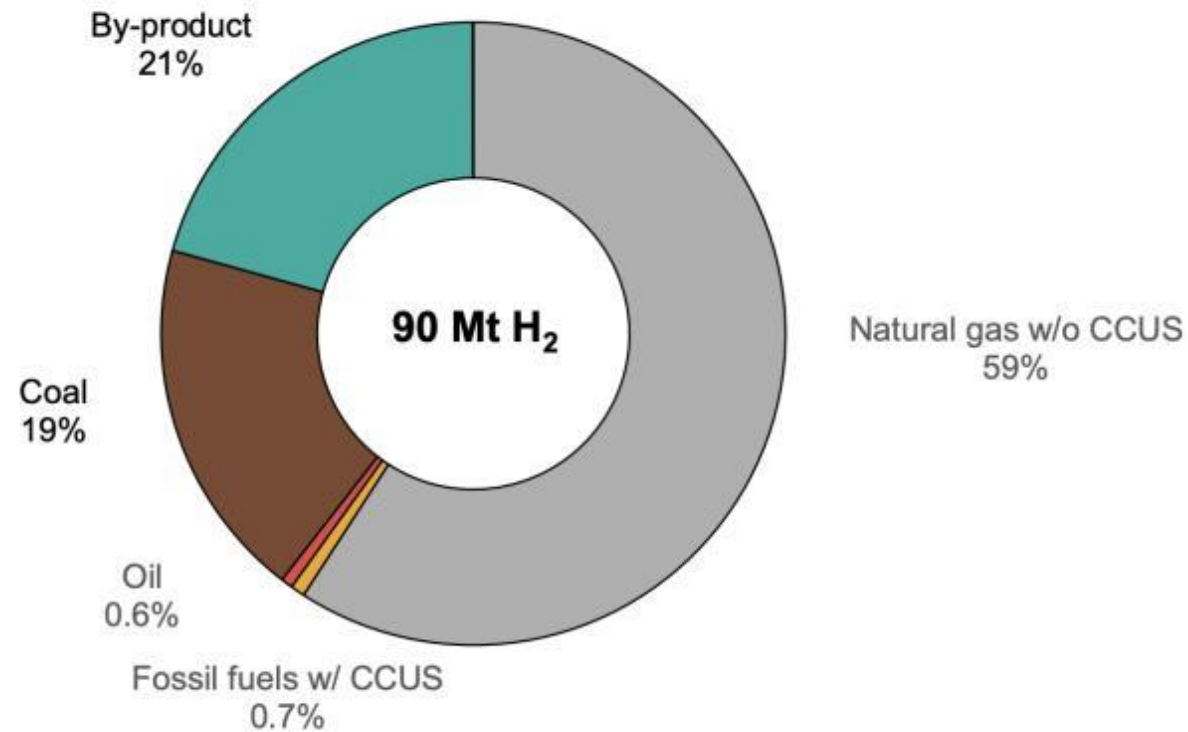


Image: Wenger (concept credit: Paul Martin)

# Sources of Hydrogen Production

Sources of hydrogen production, 2020



IEA. All rights reserved.

Note: CCUS = carbon capture, utilisation and storage.

# Green Hydrogen - The Reality Check

- Only about **1%** of it is Green Hydrogen. **99%** of the currently used hydrogen is of fossil origin from coal and natural gas (black, brown, grey, blue hydrogen and some bruise colors)
- “Fossil hydrogen” has a 1.2-times larger CO<sub>2</sub> footprint than the source material coal or natural gas
- Getting to net zero requires **Green Hydrogen**
- So still 90 million tons would have to be produced with green electricity. Is it feasible?

# So let's make 90 Mt GREEN!!

- A very efficient electrolyzer consumes 50 MWh of electricity to produce one ton of hydrogen
- 90 Mt require **4500 TWh of green electricity**
- This is **all** of the green electricity in the world from solar and wind in 2023 and more than half of the predicted capacity in 2025
- Competing with EVs, households, maritime and aviation industries, and other industrial sectors like steel and coal for which **at current levels no green electricity would be left.**





**The Solution!!  
Green Hydrogen**

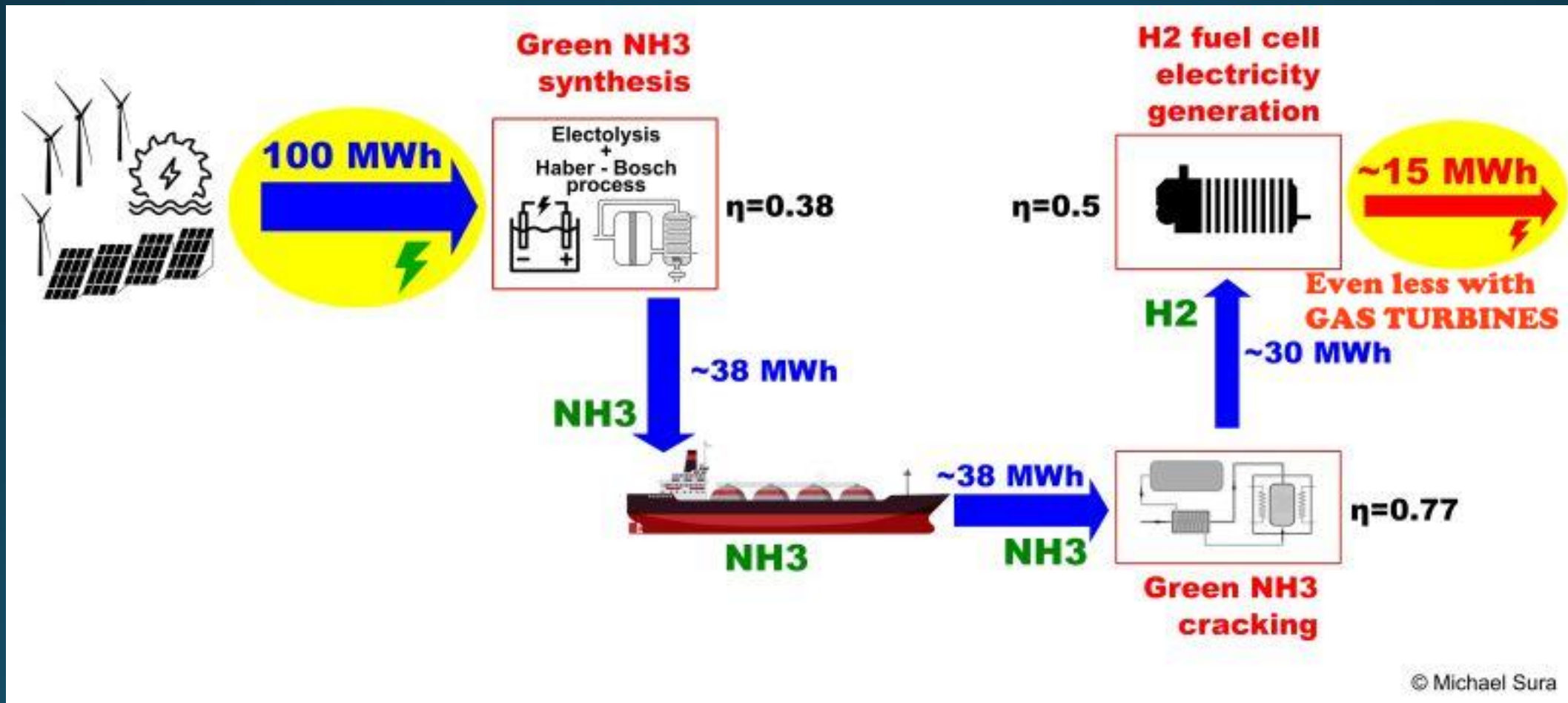
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# How to Transport 70% Hydrogen?

„Of course, in form of ammonia“ Really?



# How about CCS and CCUS

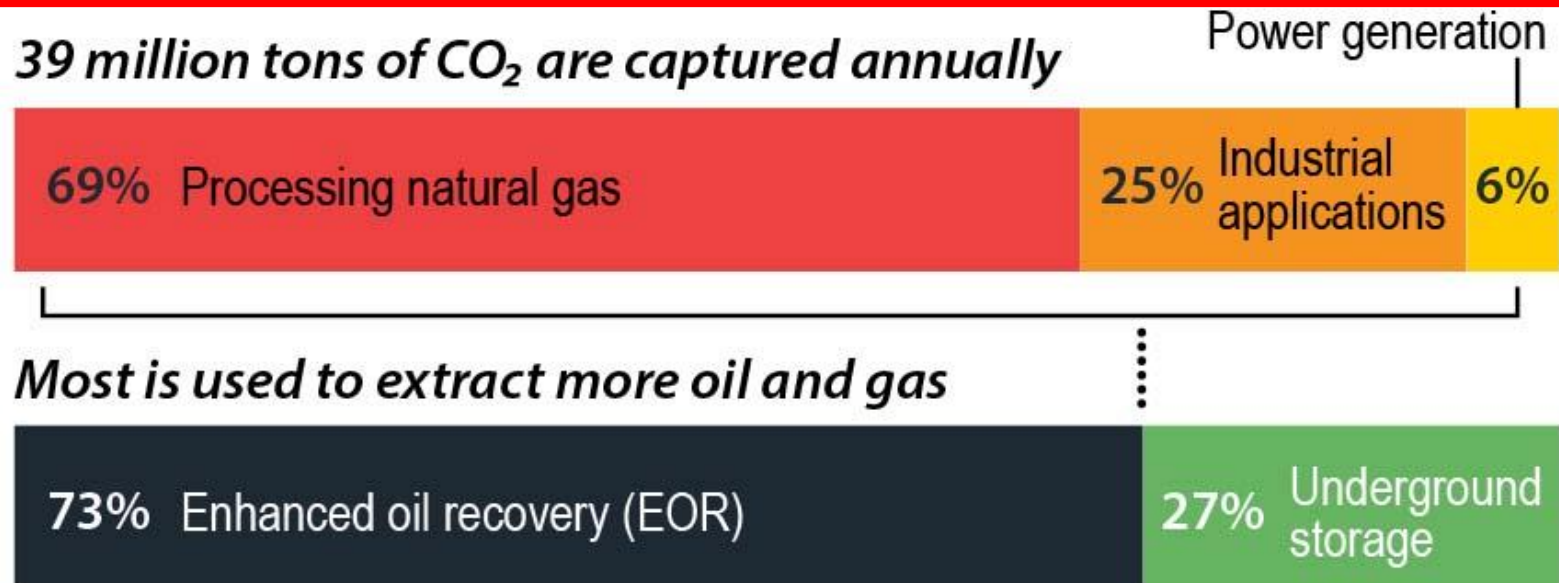
The fossil fuel industry proposes CCS and CCUS as a solution.

- Key Findings
- Despite 50 years of development, the technology is not working as advertised – instead of 5 billion tons stored as predicted in the “Clean Coal” drive in the 1990s and 2000s, today only 39 million tons are captured
- 10 of 13 ‘Flagship’ CCS Projects Failed to Deliver (Institute for Energy Economics and Financial Analysis (IEEFA))
- Captured carbon has mostly been used for enhanced oil recovery (EOR): enhancing oil production is not a climate solution.
- Successful CCUS exceptions mainly exist in the natural gas processing sector serving the fossil fuel industry to extract more oil and gas, leading to further emissions.

# The Reality of CCS and CCUS

## Carbon Capture Efforts Are in Service to Big Oil

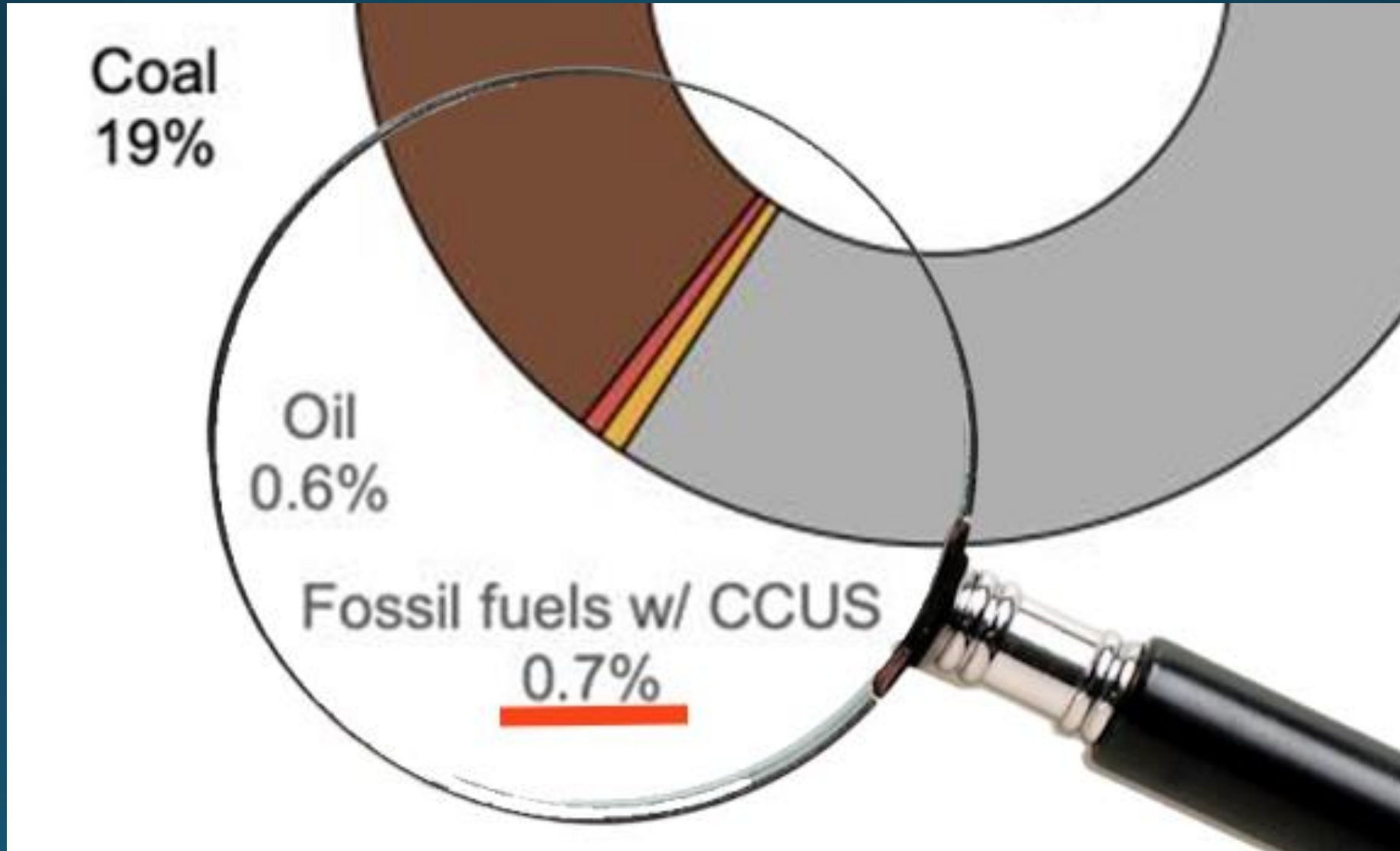
Nearly three quarters of CO<sub>2</sub> captured annually is reinjected into oil fields to push more oil and gas out of the ground



Sources: Global CCS Institute, IEEFA analysis

IEEFA

# Hydrogen from Fossil sources with CCUS is Miniscule! No Solution





# Over 500 Organizations Call on Policymakers to Reject Carbon Capture and Storage as a False Solution

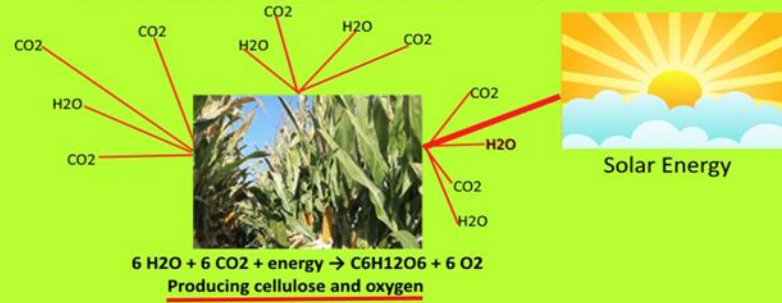
Over 500 organizations across the United States and Canada expressed deep concerns about the US and Canadian governments' support for carbon capture and storage (CCS) and carbon capture, utilization, and storage (CCUS) technologies in an open letter to policymakers in the United States and Canada.

Despite occupying center stage in the "net-zero" climate plans trumpeted by the United States and Canada at the Leaders' Summit on Climate, government spending programs, and bills pending before Congress and Parliament, carbon capture is not a climate solution. On the contrary, investing in carbon capture delays the needed transition away from fossil fuels

We have to add other options

Carbon-**NEGATIVE**  
(climate-positive) biofuels

The most powerful CCS in the world is working for us  
Mother Nature's CO2 to biomass conversion



Processing results in carbon-neutral products



Avoidance counts in our LCA!

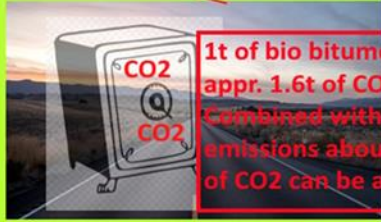
Ca. 50%\* converted into carbon-neutral MGO (marine gas oil)



50%\* converted into bio bitumen stored in the asphalt of sustainable roads.

The PERFECT CCS

\* estimated depending on feedstock



1t of bio bitumen stores appr. 1.6t of CO2  
Combined with avoided emissions about 3.5t of CO2 can be avoided

**CAMBIO FUEL is carbon-NEGATIVE - Ships using it, create CARBON CREDITS**

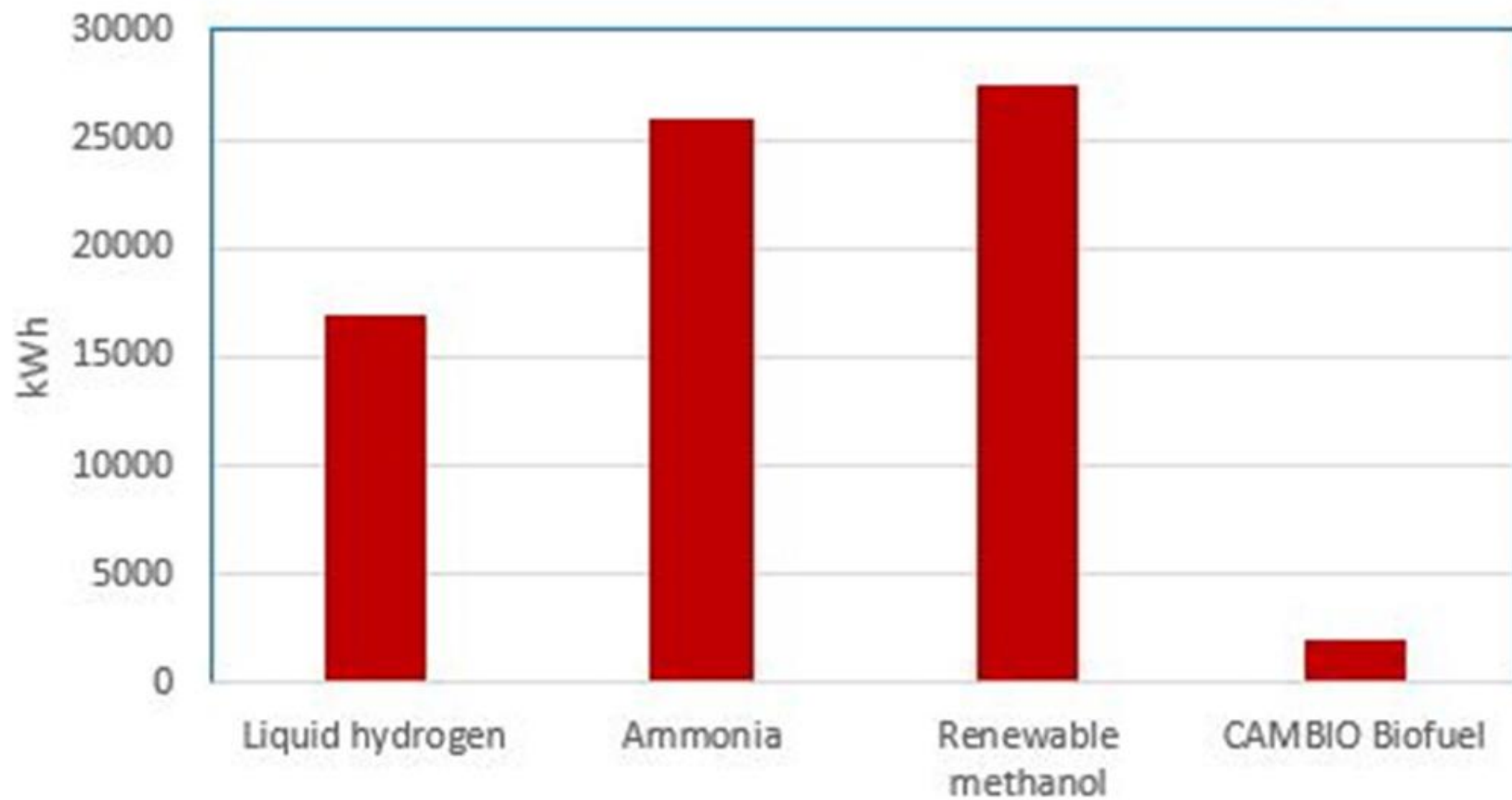
Drop-in fuel, no change to engines and infra-structure required  
Mixes in any ratio with fossil diesel

In their LCA, ships using CAMBIO Fuel, remove more CO2 from the environment than leaves the stack. Better than ammonia.





## Green electricity consumption in kWh/toe



# Thank you for the opportunity

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