

TURNING CARBON DIOXIDE INTO FUEL

**EMERGING
TECHNOLOGIES
FOR
GLOBAL WARMING
MITIGATION**



CLIMATE CHANGE ON INDIA

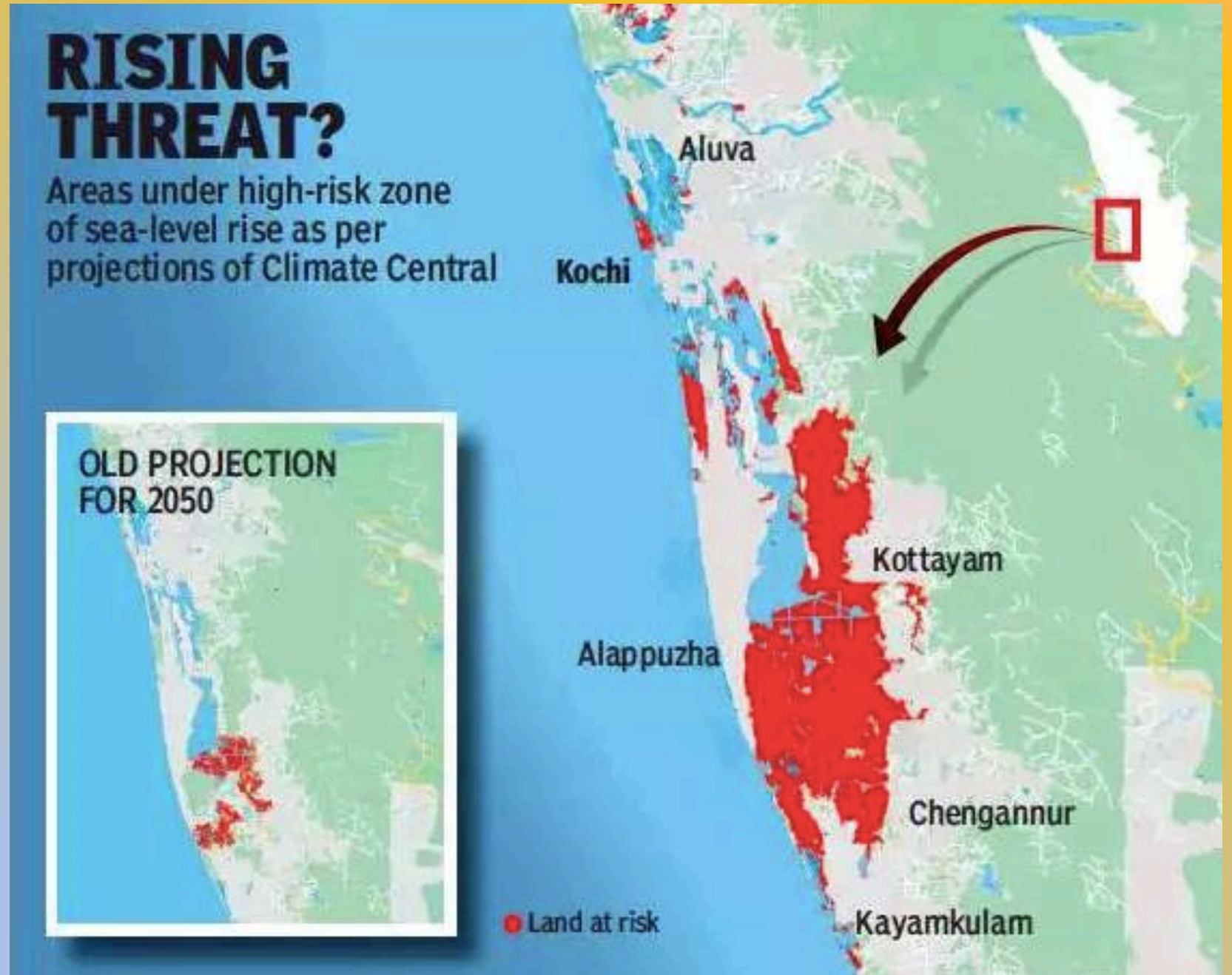
- Extreme climatic events
- Adverse effect on agriculture, health, forestry
- Temp rise by 3° C to 4°C by end of 21st century
- Reduction in wheat and rice yields
- Rainfall patterns
- 70% of vegetation vulnerable to change
- Adverse impact on biological species



IMPACT OF CLIMATE CHANGE: INDIA

COASTAL INUNDATION

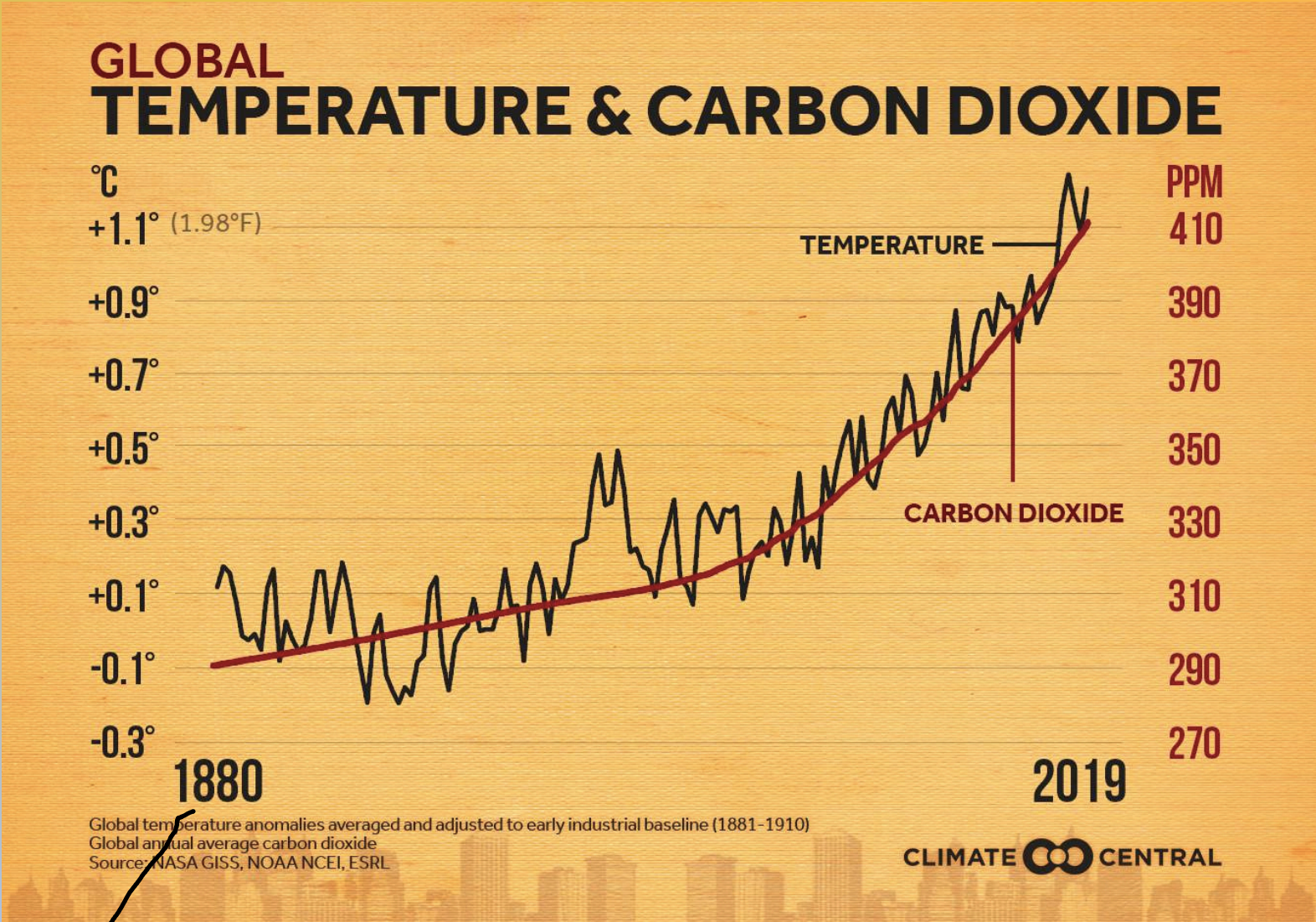
Mumbai
Calcutta
Cochin





2018: power sector emitted 14 billion tons of CO2

3 Trillion Tons already in the atmosphere



Industrial Revolution

The Greenhouse Effect



CO2
Blanket

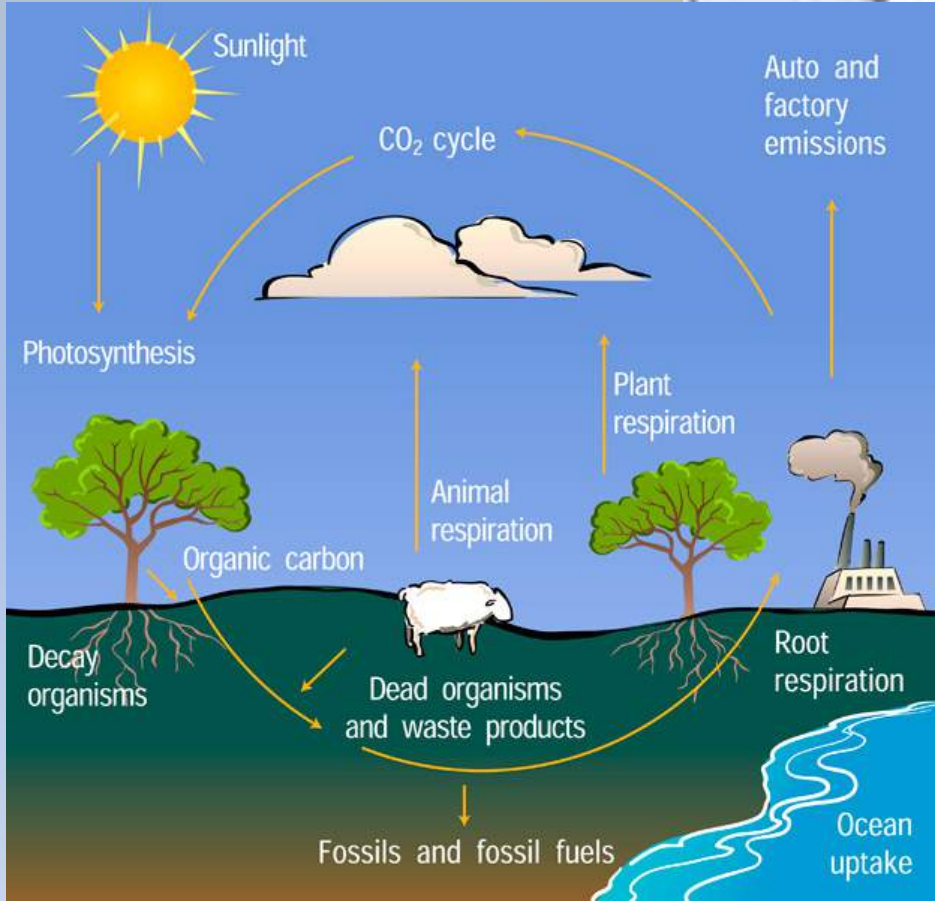
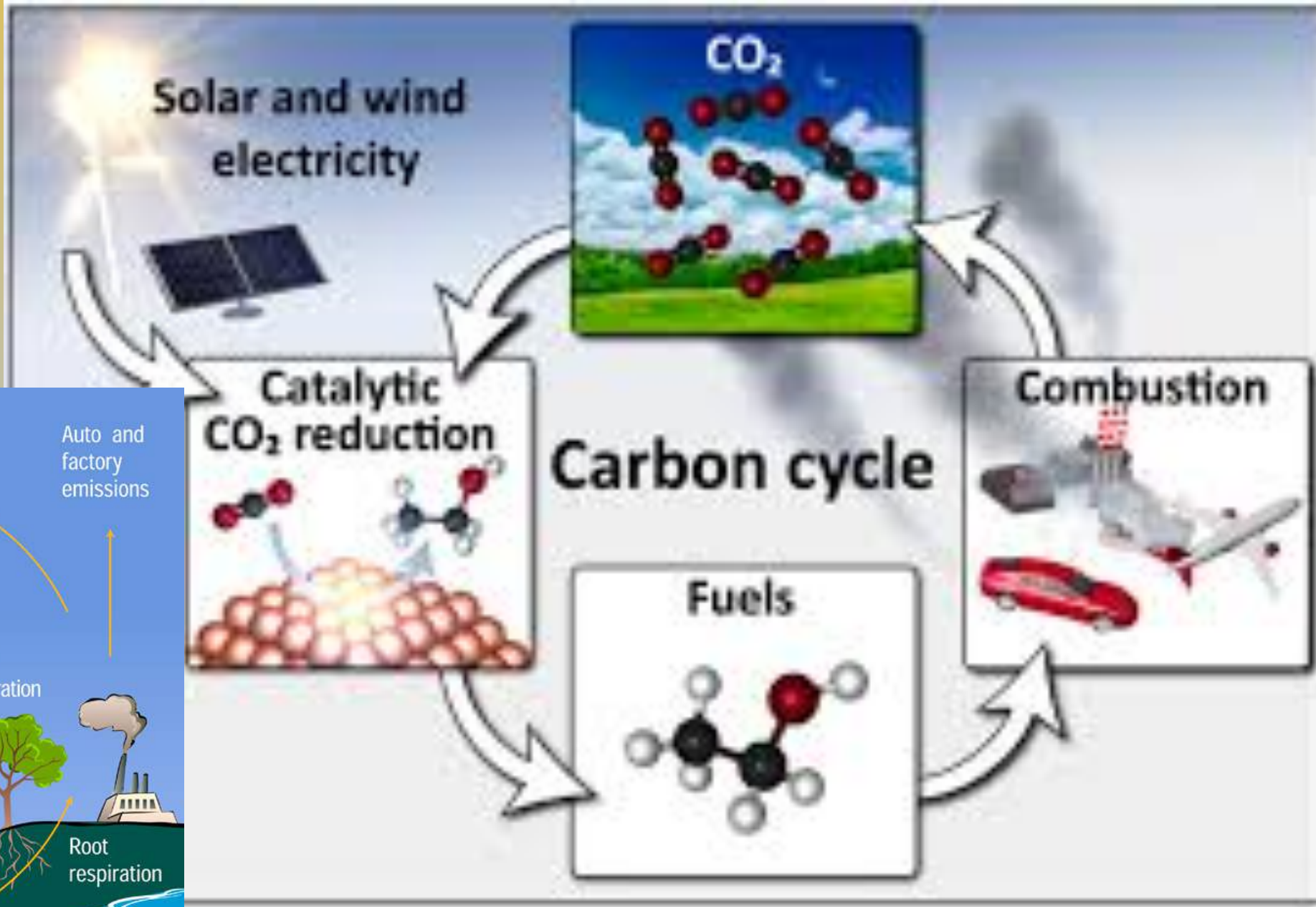
Global Warming of 1.5°C

2018 October: 1.5 degree limit

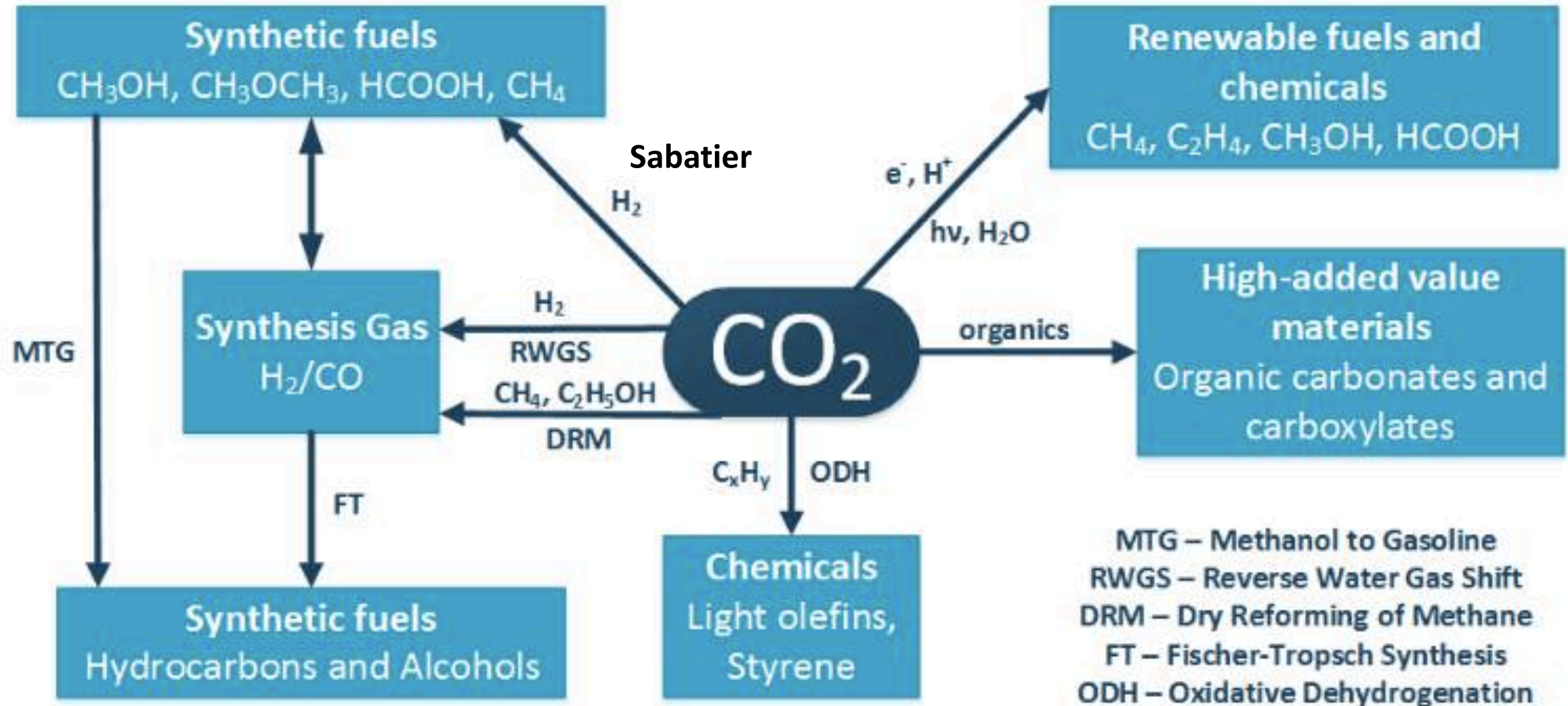
Beyond 1.5 deg C, risks of extreme climatic events would be too high

CO₂ emissions should be cut by half by 2030 and brought down to zero by 2055.

SUSTAINABLE CARBON CYCLE

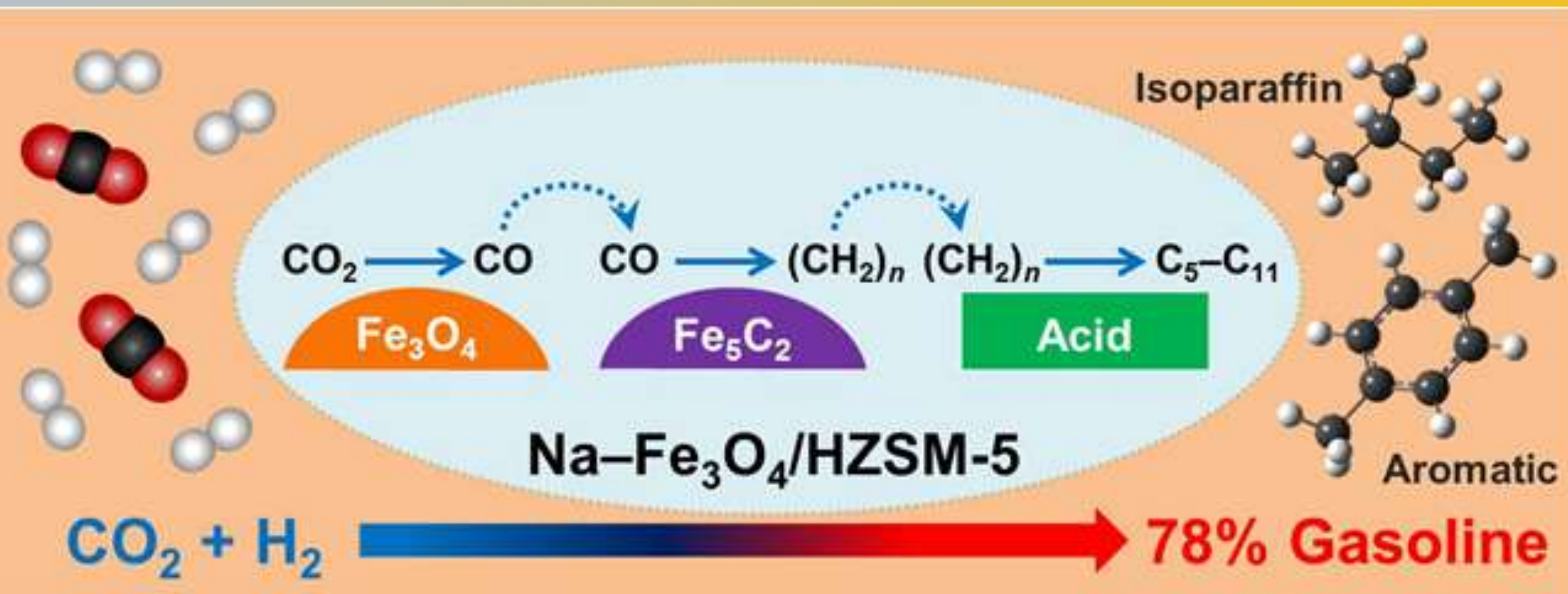


Step 1: CONVERT CO₂ INTO CO

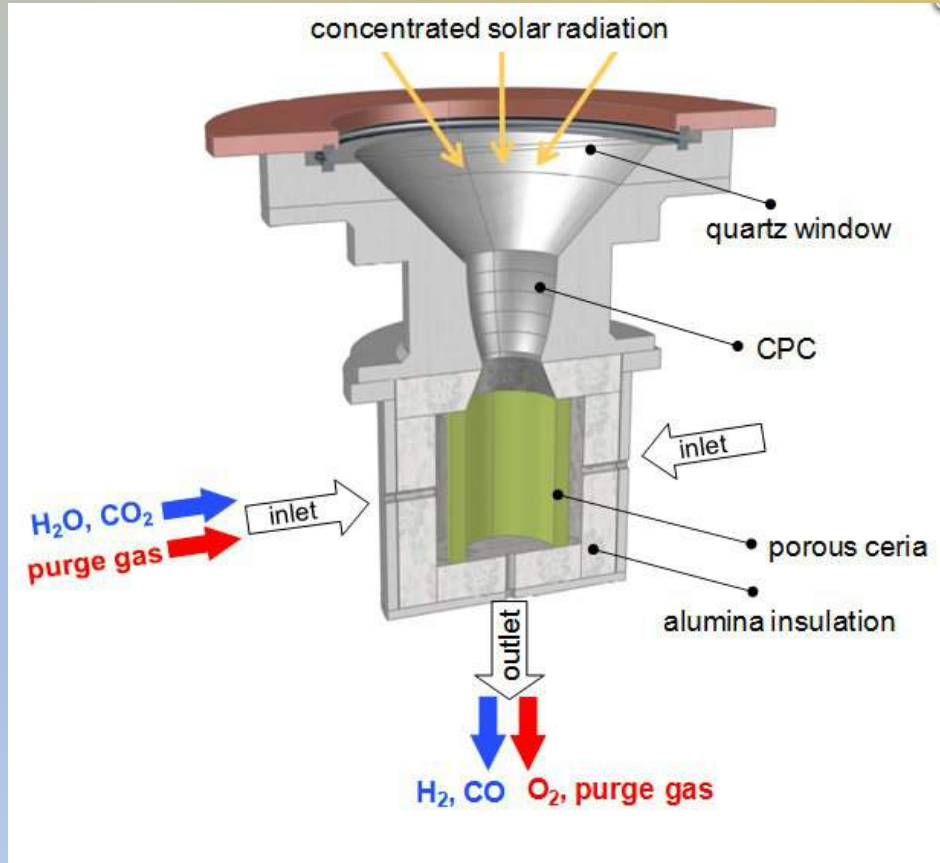


Catalysts can lower the temperature

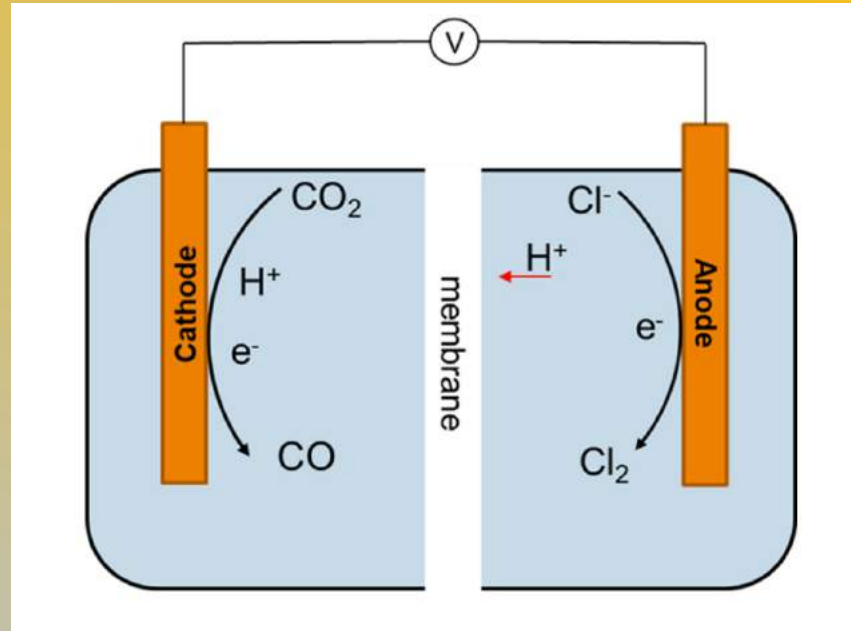
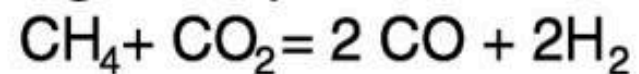
Louisa Rui Lin Ting, Oriol Piqué, Si Ying Lim, Mohammad Tanhaei, Federico Calle-Vallejo, and Boon Siang Yeo
ACS Catalysis **2020** 10 (7), 4059-4069



NEW TECHNOLOGIES



High temperatures

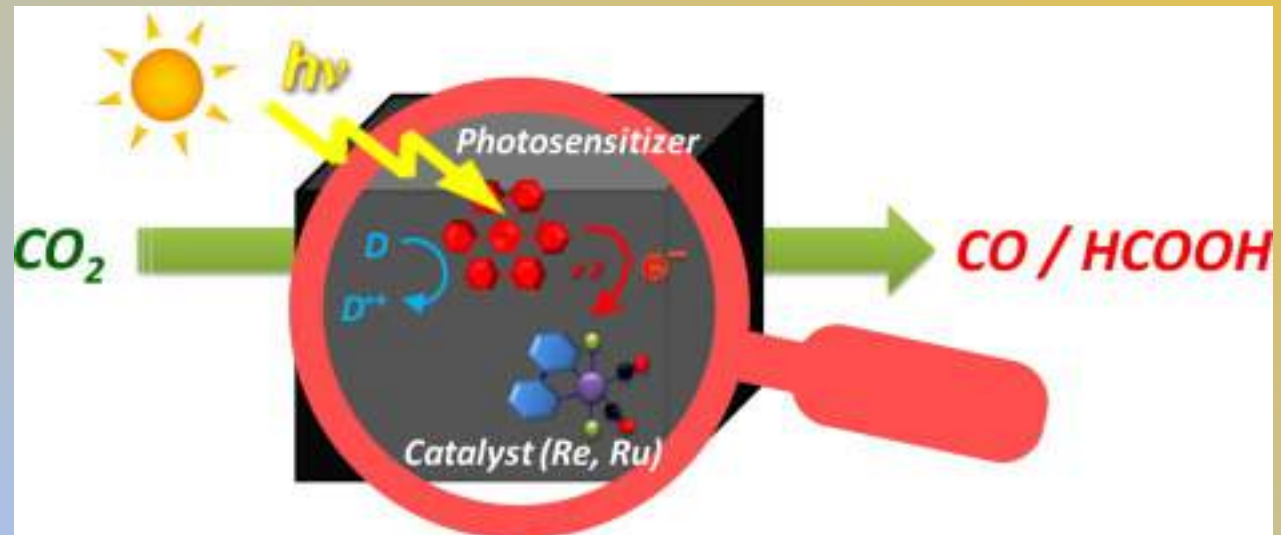


Electrochemical reaction

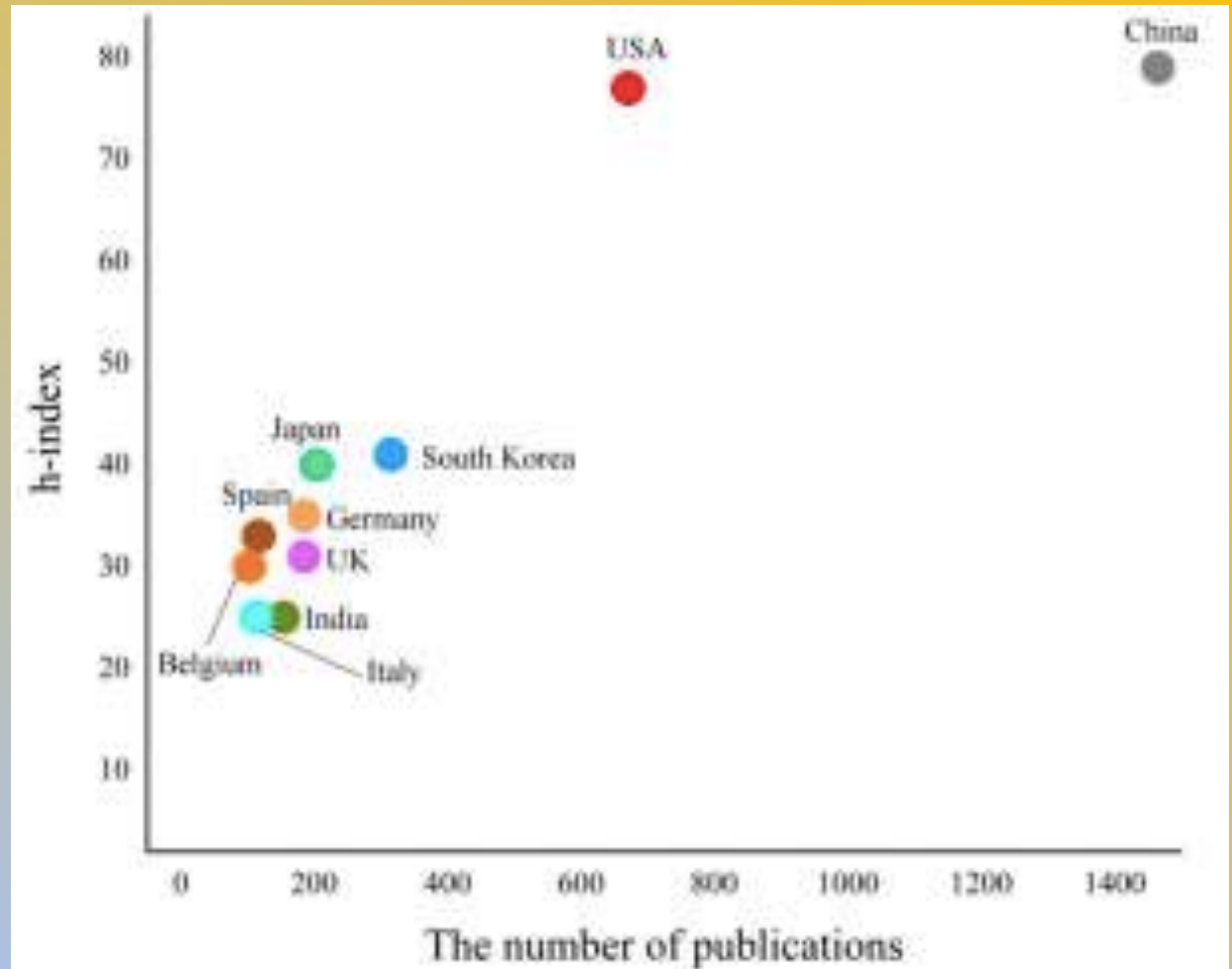
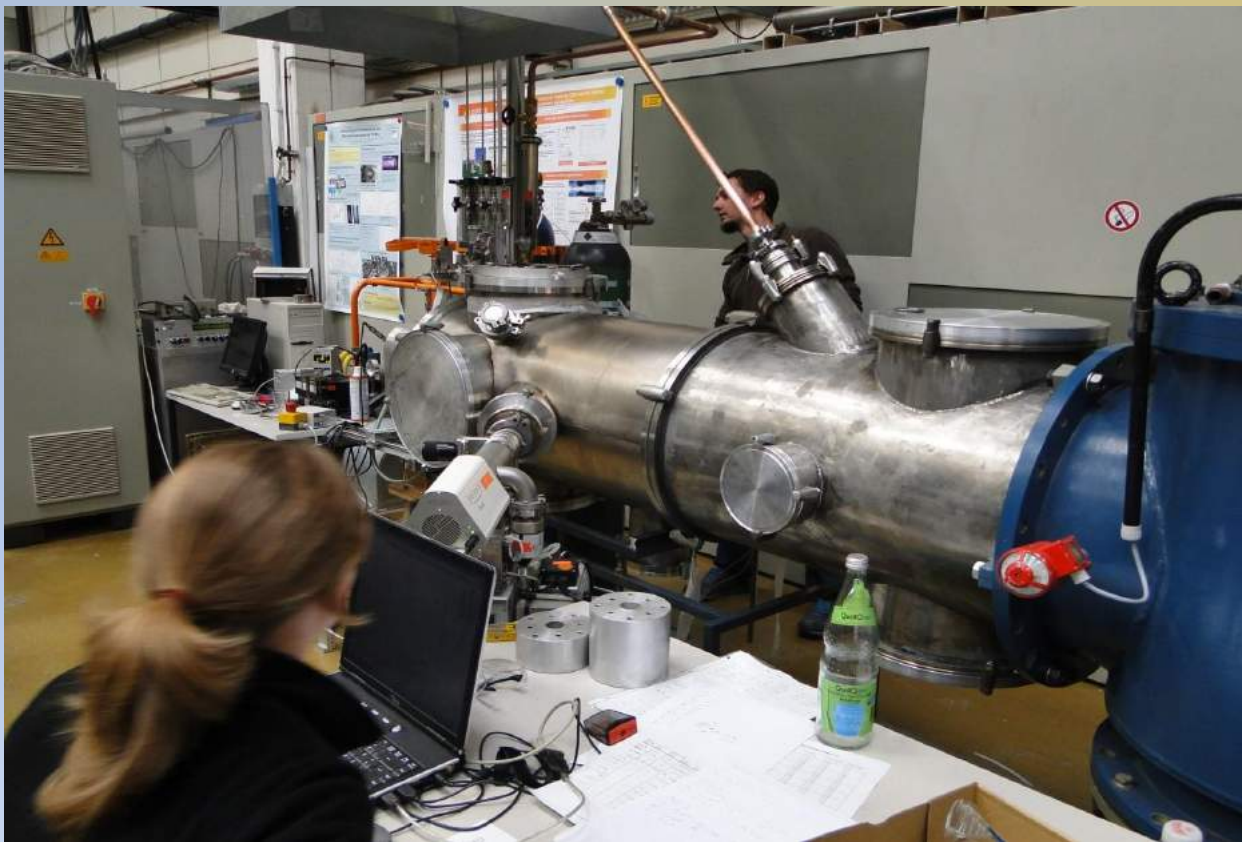
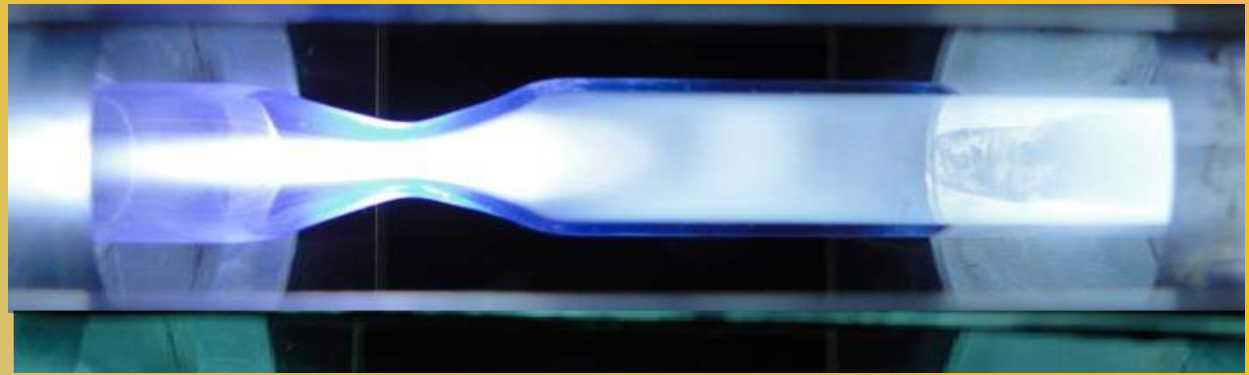
$$\text{CO}_2 + 8\text{e}^- + 8 \text{H}^+ = \text{CH}_4 + 2\text{H}_2\text{O}$$

Photochemical reaction

$$\text{CO}_2 + 2\text{e}^- + 2\text{H}^+ = \text{CO} + \text{H}_2\text{O}$$

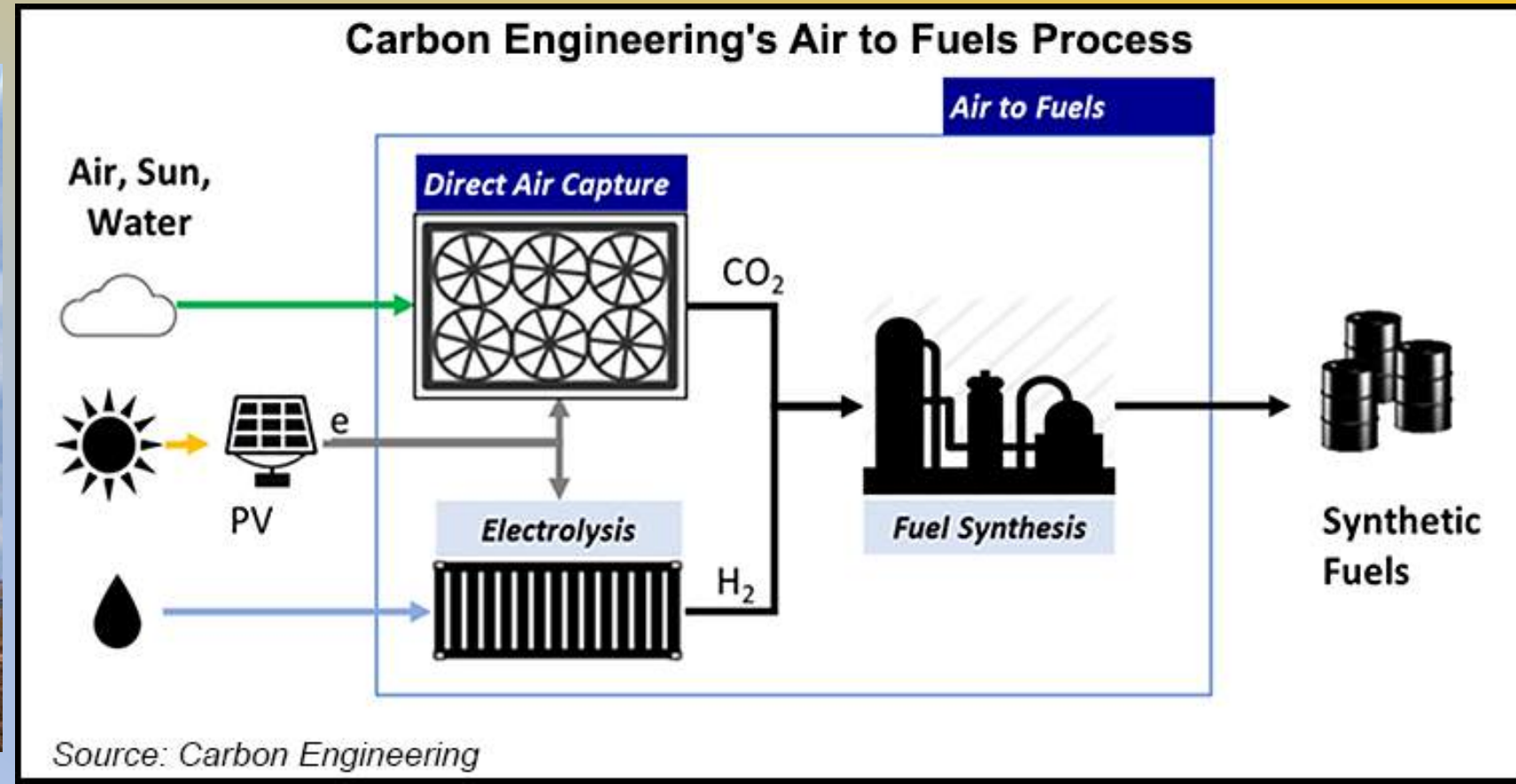
$$\text{CO}_2 = \text{CO} + \frac{1}{2} \text{O}_2$$


PLASMA CHEMICAL CONVERSION





Carbon Engineering



CO₂ Value Europe

The new industry association
dedicated to Carbon Capture & Utilization (CCU)

- A new Industrial Revolution based on Circular concepts in waste to value is emerging.
- Europe is the epicentre
- Intellectual fervour and entrepreneurial effervescence.
- Many Startups: including one from India

 **CCU... the time is now !**

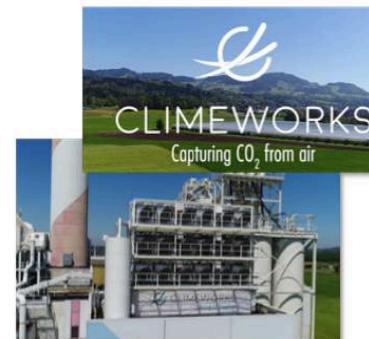


Greenhouse Gas Emissions
Accounting for CO₂
Capture and Utilisation
(CCU) Technologies
Characterising CCU Technologies, Policy
Support, Regulation and Emissions
Accounting
IEAGHG Technical Review
2018-TR01
March 2018



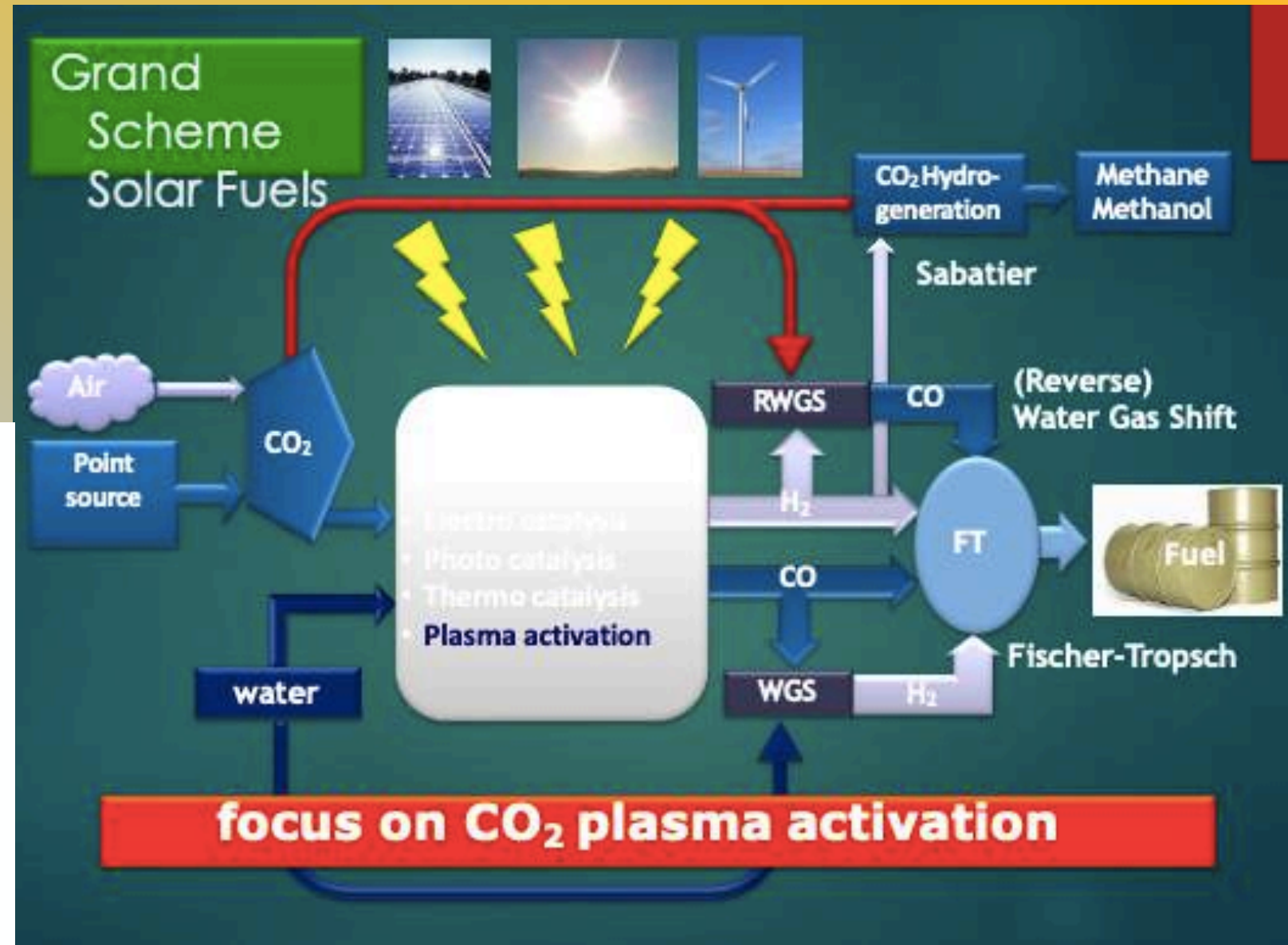
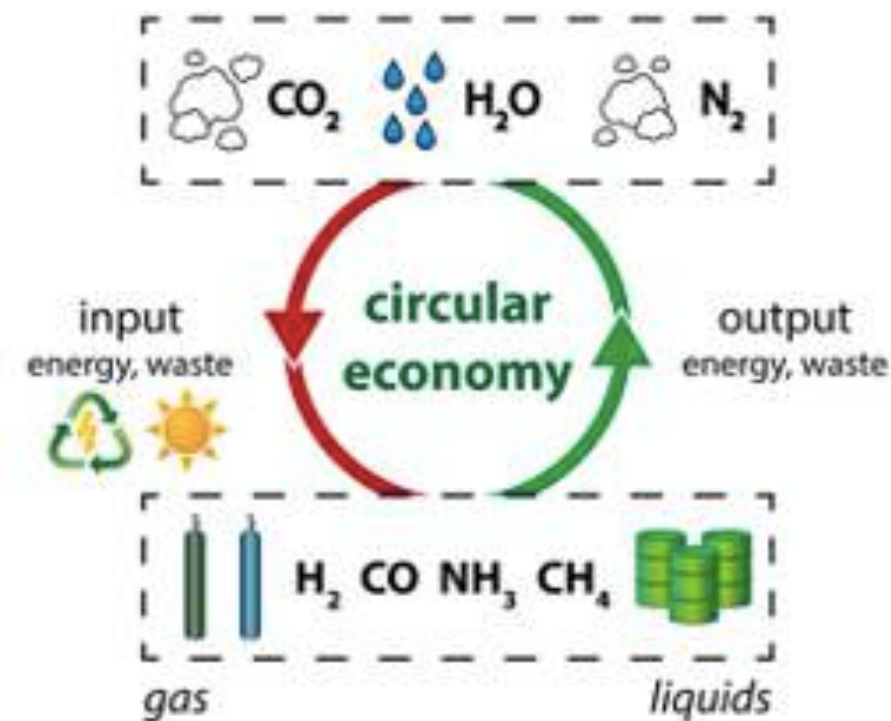
 **CCU... the time is now !**

Covestro begins delivery of first CO₂-based product
Debut of carbon dioxide as raw material
Climate gas in foam component for mattresses



- CO₂ recycling with solar energy
- Storing electricity as chemical energy in gas grids

CO₂-Neutral Fuels.



CONCLUSIONS

New ideas of using plasma processes to convert CO₂ into fuels enable a sustainable fuel cycle.

It will allow us to continue using the abundant Hydrocarbon resources.

Unexplored possibilities like Plasma Catalysis may further increase the energy efficiency and through put of the Plasma Process.

