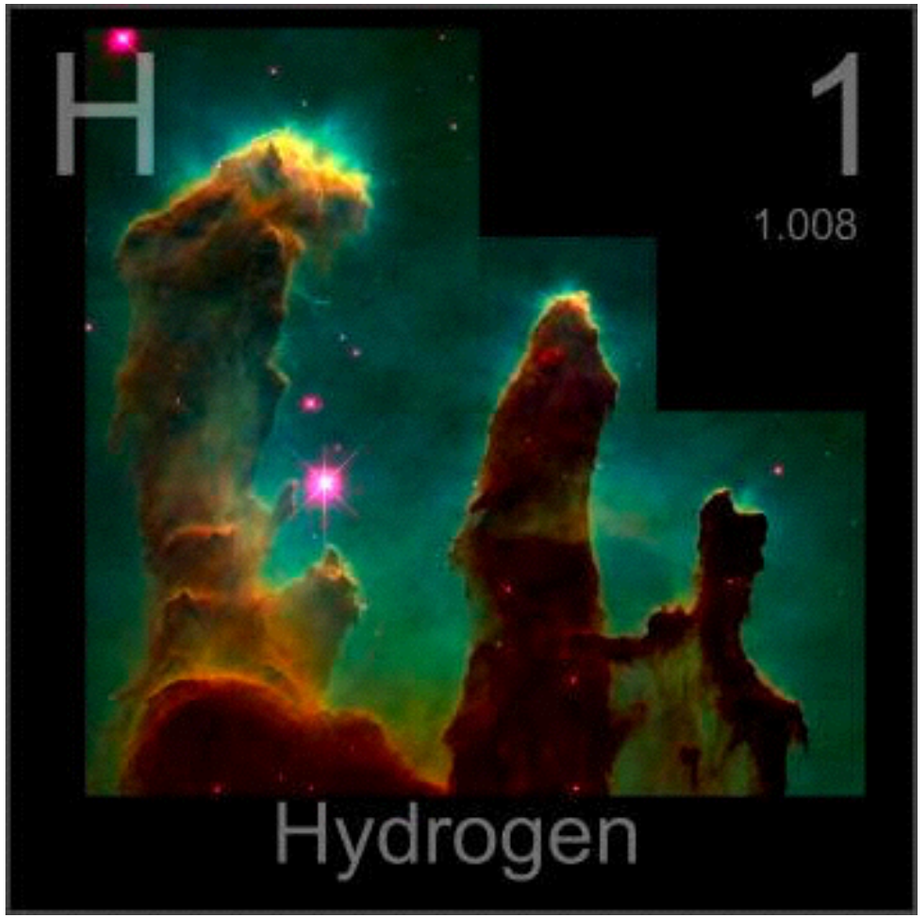
Township of Huron-Kinloss Special Council Meeting

Presentation On Hydrogen Energy & Sustainable Agriculture

Presenter: D. Haberman, Hydrogen Subject Matter Expert

Meeting Time & Date: 7pm on Monday, April 25, 2022

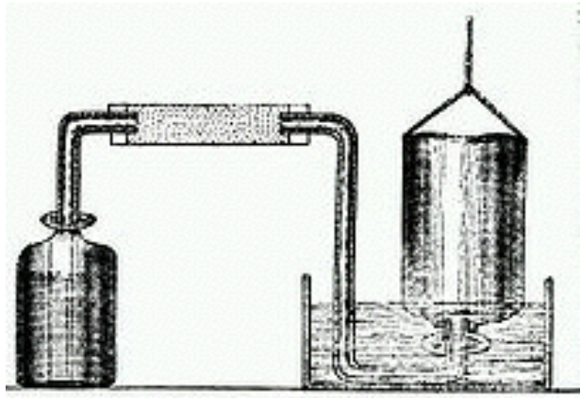
Zoom: https://zoom.us/



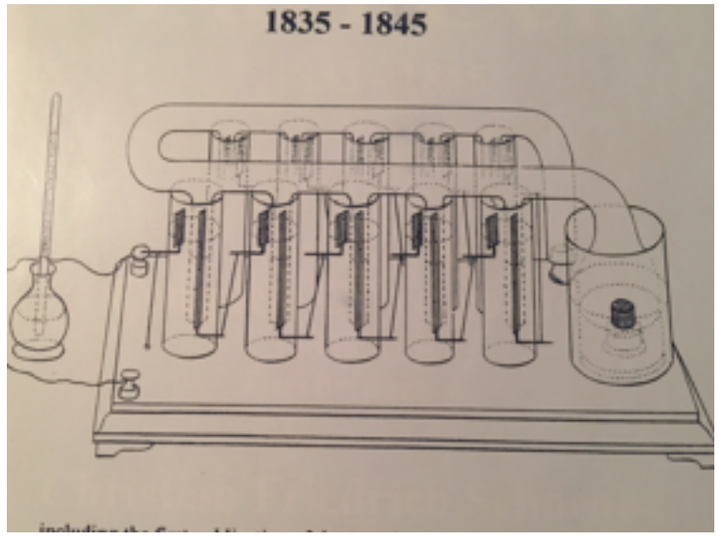
Informational References:

h2gta.ca
FuelCellsWorks.com
h2-view.com
https://carlsun.com
nifa.usda.gov
www.attra.ncat.org
nrcan.gc.ca
ontario.ca

Hydrogen Energy History & Uses



Cavendish Discovers Hydrogen 1786



Grove & Schoenbein Invent Fuel Cells

Marshal Plan Needed H2 For NH3 For Fertilizer After WWII

Refining Petroleum, Alloying Metal, Glass, Food Oil, Semiconductors, Cooling Generators

Nuclear Hydrogen?

Fuel Cells Fit Requirements Of Submarines & Spacecraft

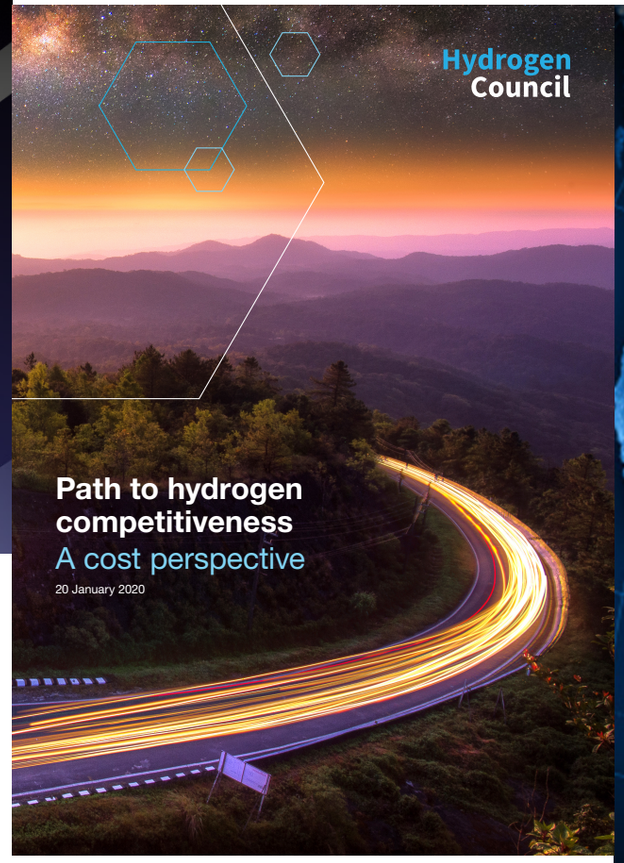
Hydrogen Safety

- Not Explosive In Open Air
- Not Decomposing
- Not Self-Igniting
- Not Oxidizing
- Not Toxic
- Not Corrosive
- Not Polluting
- Not Cancer Causing

WORLD ECONOMIC FORUM

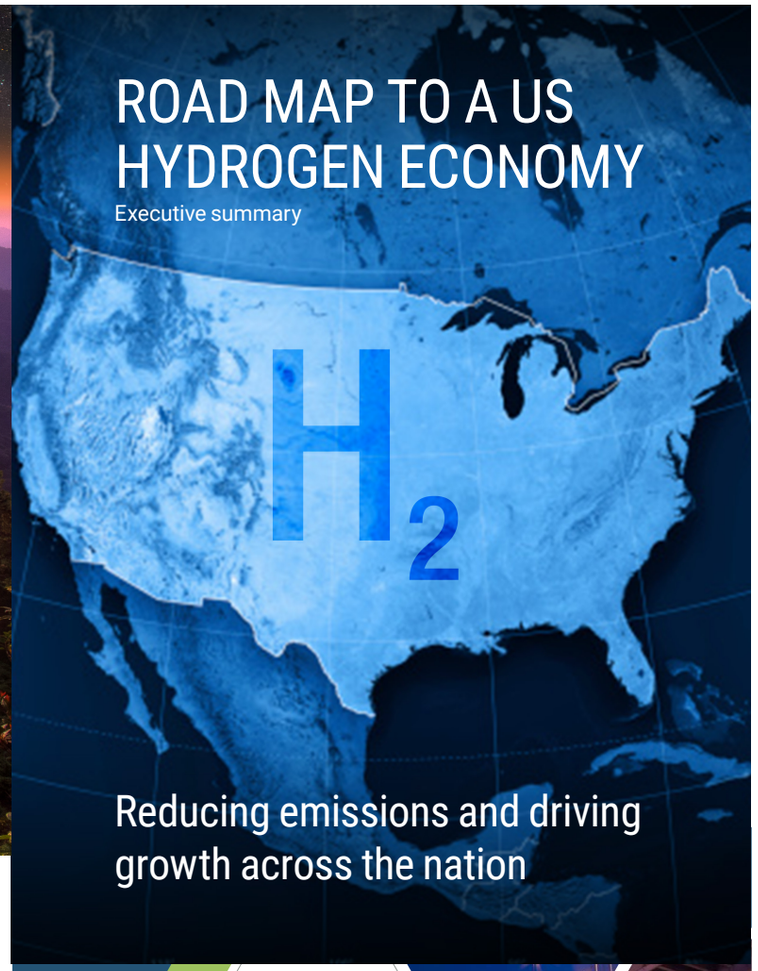
Top 10 Emerging Technologies of 2020

SPECIAL REPORT
NOVEMBER 2020



ROAD MAP TO A US HYDROGEN ECONOMY

Executive summary



Reducing emissions and driving growth across the nation

ENERGY

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Green Hydrogen

Zero-carbon energy to supplement wind and solar

The Future of Hydrogen

Seizing today's opportunities

Report prepared by the IEA for the G20, Japan

Hydrogen scaling up

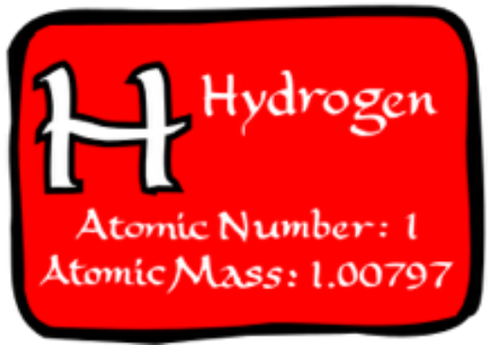
A sustainable pathway for the global energy transition

Hydrogen Council November 2017

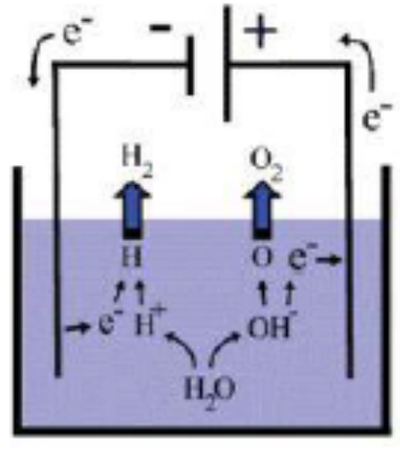
CTC Produces Hydrogen Fuel From Water

Power (Multiple Sources)

Water



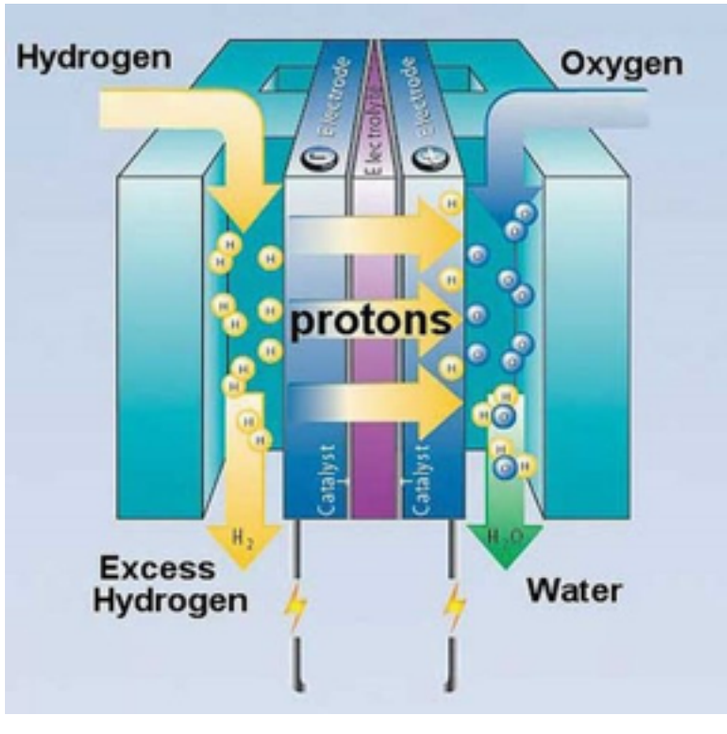
Clean Fuel



H_2 Production At Bolton & AJB Using Automated Electrolyzers

Fuelcell Power Installed Into AGVs In Bolton & AJB Will Achieve Significant Power Efficiency Improvement

Fuelcells Replace Batteries In Material Handling Vehicle Fleet

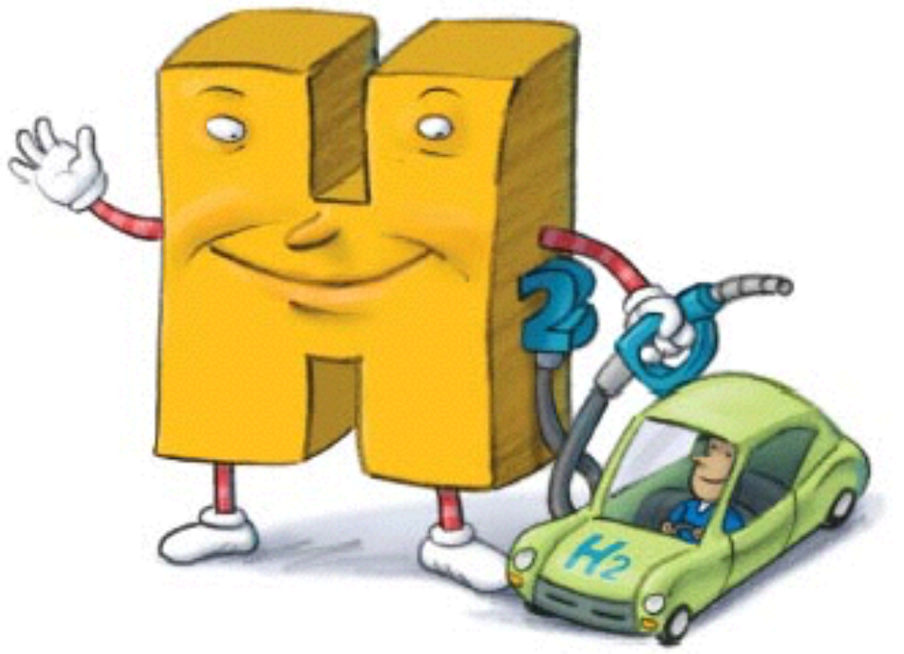


Fuelcells Replace Batteries & Use H_2 To Generate Power

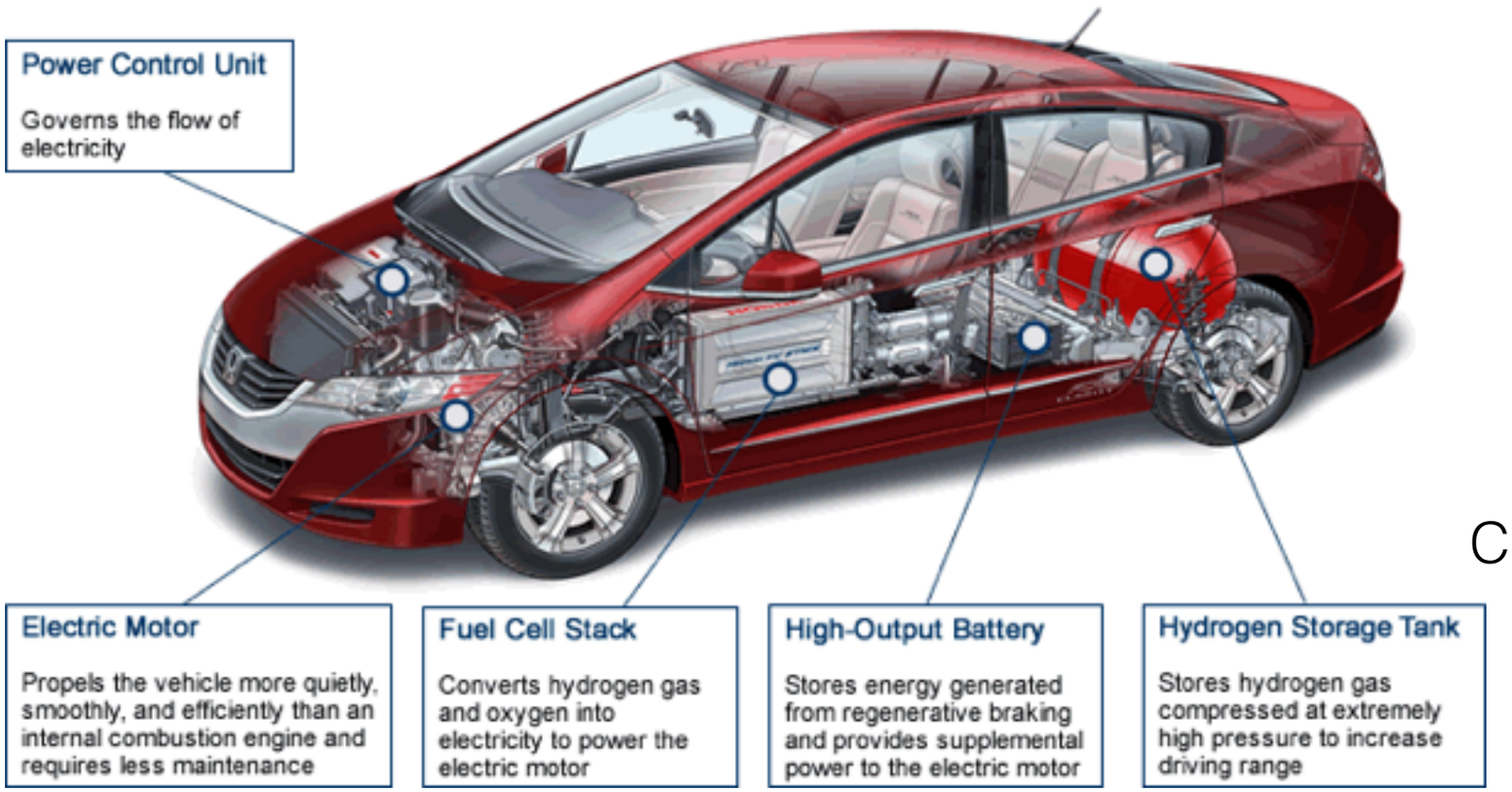
Transition Of Ground Transportation To
Zero Emission Electric Vehicles/Trucks/Buses
H_2 Fuelcells Engines (No Combustion Emissions)

Terminal Tractors: Immediate Use

H_2 Fueled
Class 8 Truck
Replacements
For Diesel Combustion =
Carbon Burden Reduction

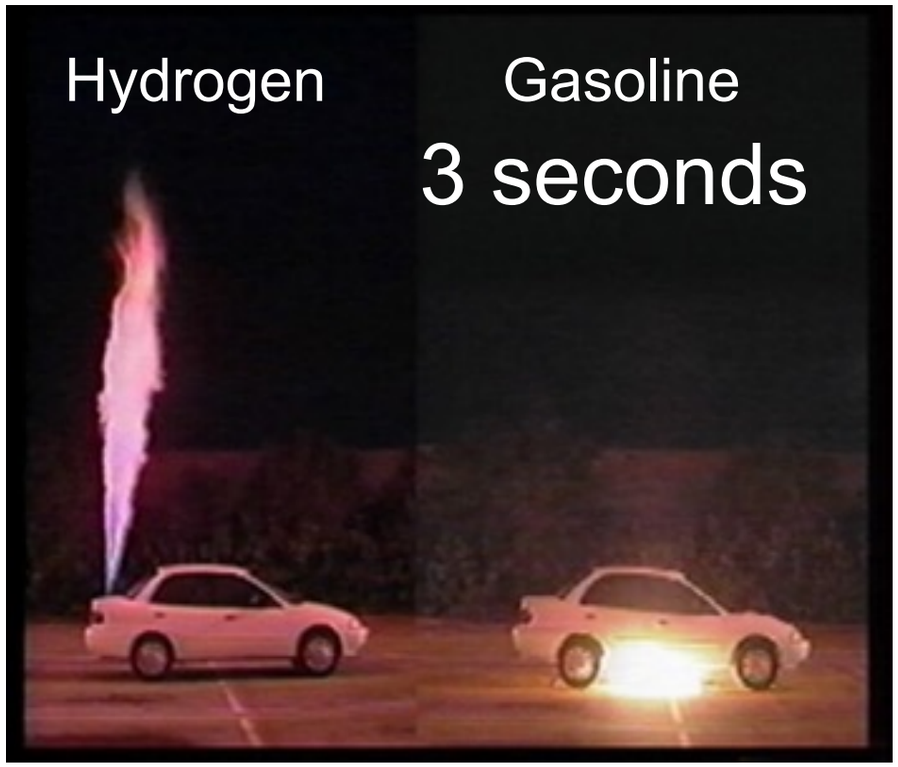


Providing H_2 Fuel To A New
Generation Of Ground Transportation



H_2 Fueling Is
Complementary To
Electric Vehicle
Charging
Infrastructure

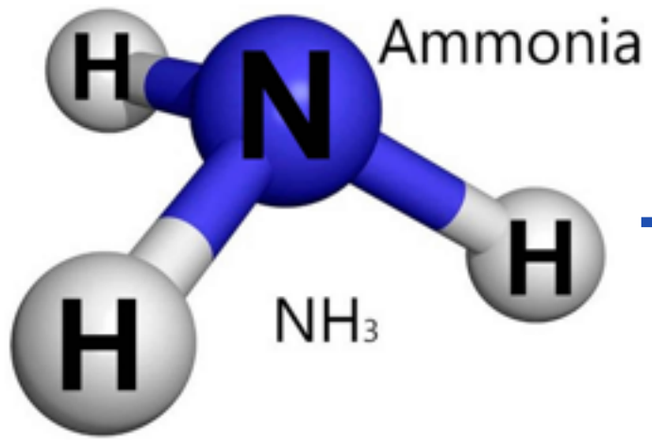
Hydrogen Safety

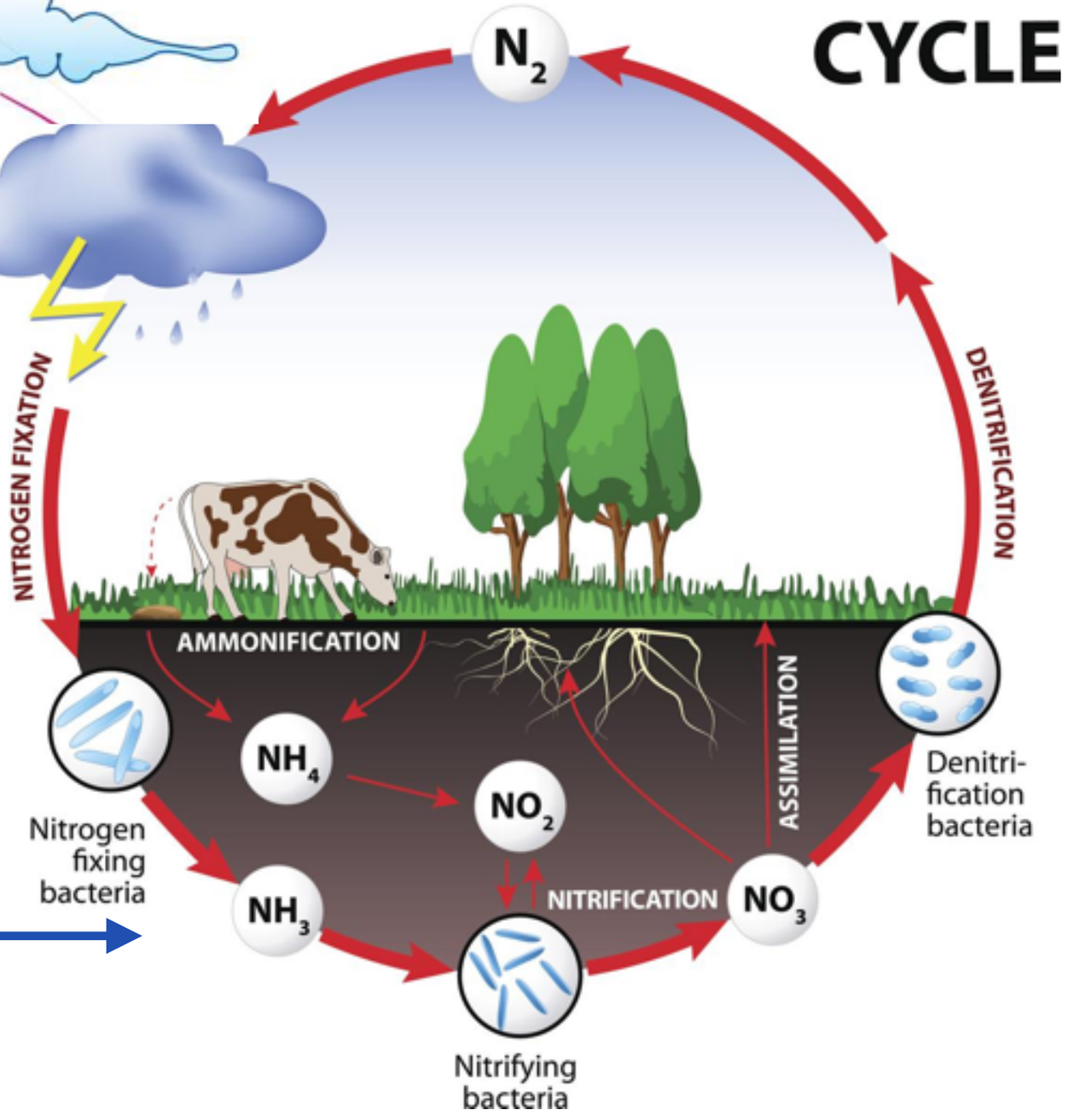


- Fuel leak simulation
  - Hydrogen on left
  - Gasoline on right
  - Equivalent energy release
- Single-mode failure assessment

Which car would you rather be in?

Today Hydrogen Will Be Used To Produce Green Ammonia For Fertilizer





	Anaerobic	Aerobic
Reactants	Glucose	Glucose and oxygen
Combustion	Incomplete	Complete
Energy Yield	Low (2 ATP)	High (36 – 38 ATP)
Products	**Animals:** Lactic acid **Yeast:** Ethanol + CO_2	CO_2 and H_2O
Location	Cytoplasm	Cytoplasm and mitochondrion
Stages	Glycolysis Fermentation	Glycolysis Link reaction Krebs cycle Electron transport chain

Aerobic HOT compost	Anaerobic COOL compost
e.g. 3-Bay System	e.g. black council bin
Fueled by OXYGEN & moisture	Fueled by BACTERIA & moisture
Turned weekly	Not turned
Large (at least 1 cubic metre)	Small (less than 1 cubic metre)
Quick Ready in 6 weeks	Slow Ready after 6 months
Kills pathogens & weeds	Can spread pathogens & weeds

Difference between aerobic and anaerobic biodegradation

AEROBIC	ANAEROBIC
Most rapid and fast degradation .	Time consuming and slow
No pungent gas produced .	Pungent gas produced.
More expensive	Less expensive
Large disposable waste generated.	Less waste is generated
Microbes are *Xanthomonas,Comamonas*	*Clostridia ,Eubacteria etc.*

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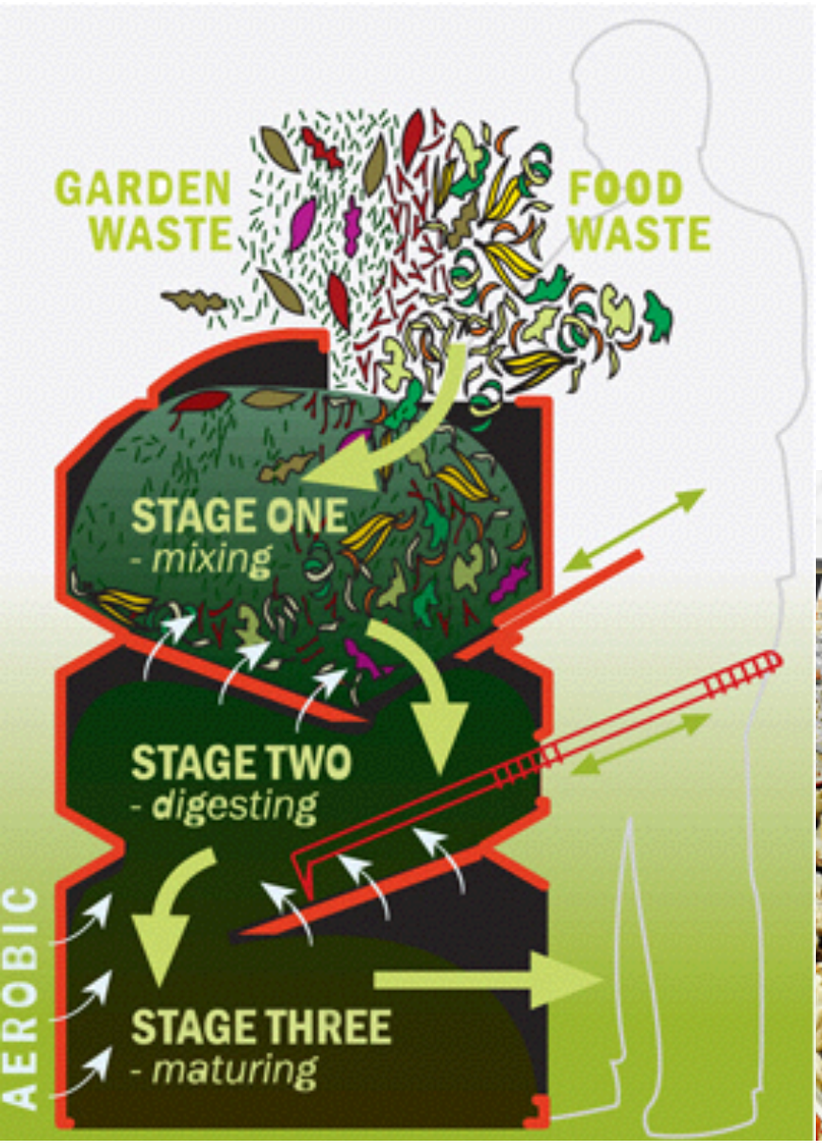
Aerobic Catabolism

$$OM + O_2 \rightarrow CO_2 + H_2O + Cells + Heat$$

Oxygen Demand

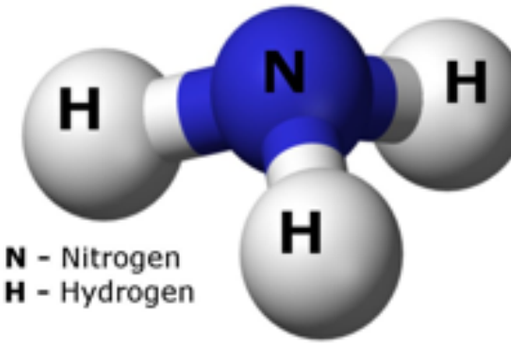
Hydrogen Energy Agricultural Initiative



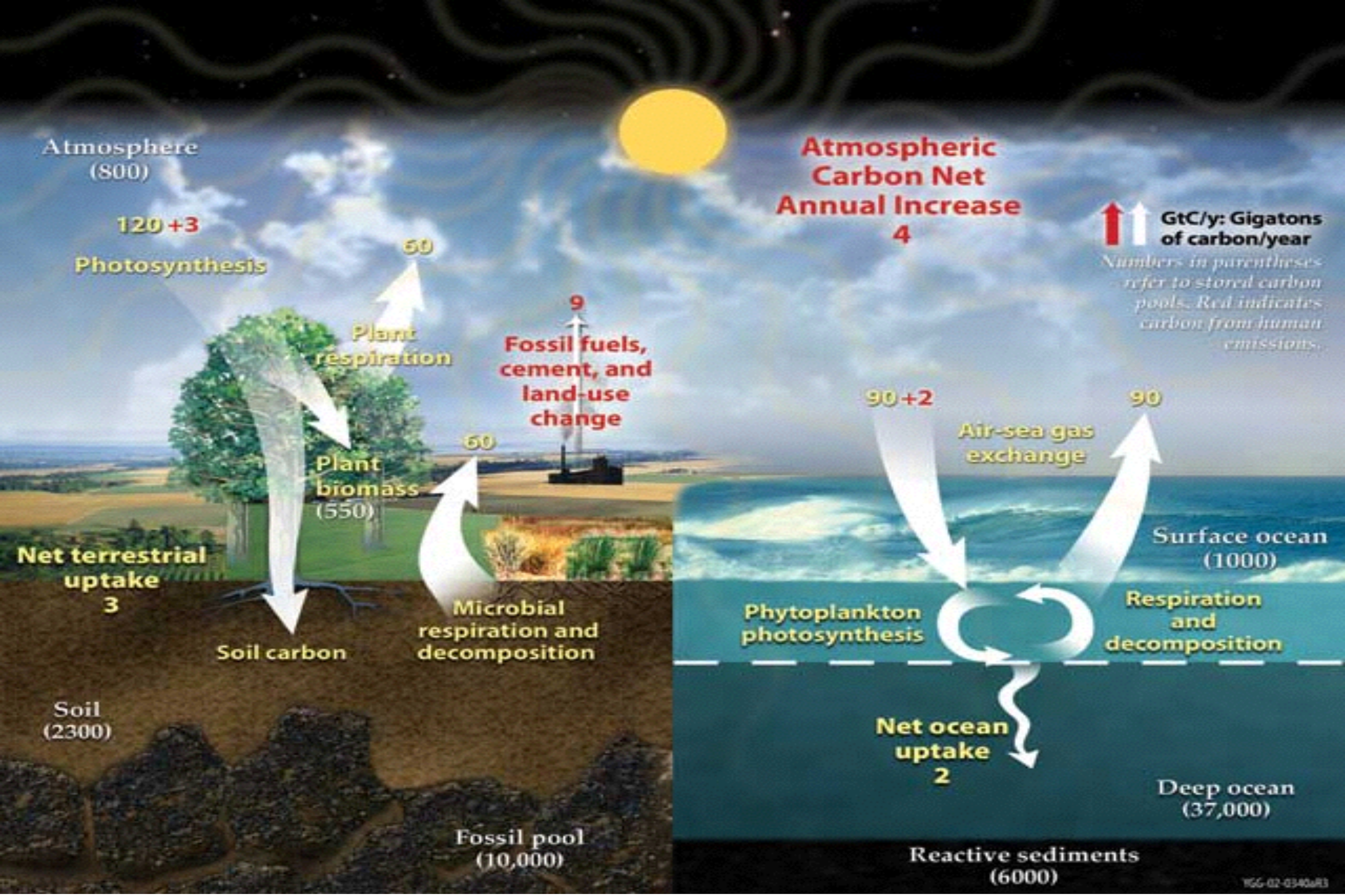
Oxygen Accelerated Decomposition & Nutrient Recovery

BRUCE INNOVATES

Bruce County Federation of Agriculture



Fertilizer



Carbon Cycle Does Not Pause & Does Not Negotiate

∑ Cumulative Effects Of Climate Change

Changing Lake & Ocean Chemistry

Food Chain Impacts

Changing The Boundaries Of Ecosystems

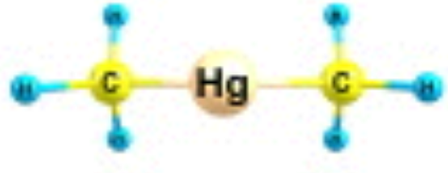
Loss Of Land From Flooding

Loss Of Water Resources & Desertification

Natural Gas (CH_4) Release From Ice

Mercury (Hg) Release From Ice

Harm To Human Health & Death



Unimaginable Economic Losses

Sustainability Is The Necessary Checklist To Apply To Energy Decisions

- Situational Awareness is understanding the “truth on the ground” and using reality as a basis for weighing alternatives to the status quo
- Efficiency is measured both technically and economically using analytical methods that address the full scope of the application
- Resource Stewardship is a set of objectives which place a future value on resources and the preservation of options for future use of those resources – thus an imperative of avoiding waste
- Protection Of People & Environment is a requirement for any sustainable action and it depends upon a comprehensive risk analysis and the strict avoidance of the pretense of knowledge
- Innovation & Contribution To Knowledge Base assigns a value to applying technical and process advances which realize improvements to the status quo and the documentation & sharing of lessons learned which is essential to the continuity and growth of sustainability