

The logo features the word "ethacell" in a white, lowercase, sans-serif font. A small green leaf icon is positioned above the letter 'a'. The text is centered within a large, vibrant green circle that has a textured, brush-stroke-like appearance. A thick, diagonal green line passes through the circle from the bottom-left to the top-right.

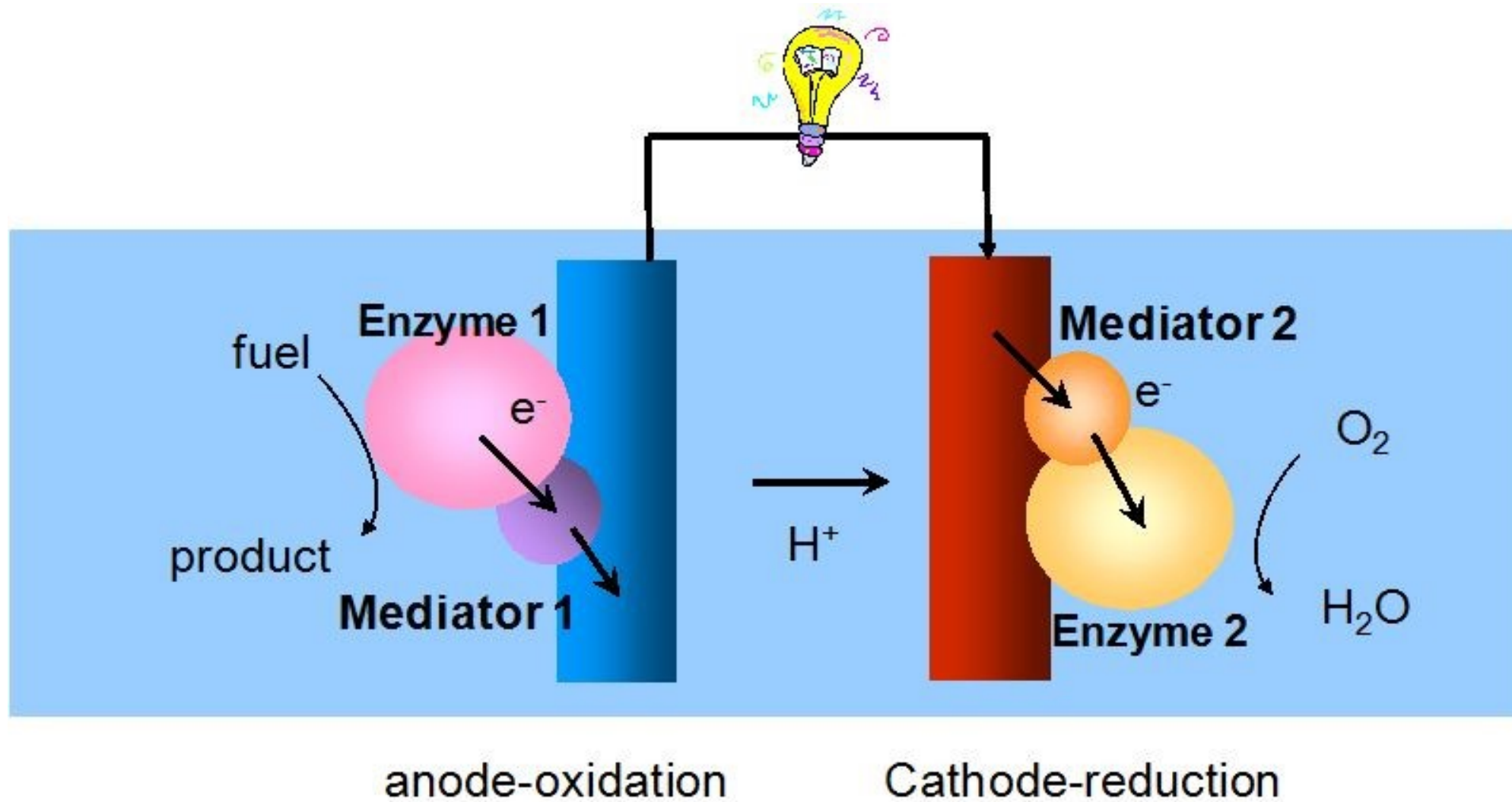
ethacell

Eniek, Omer, Rima, and Yana





Enzymatic Fuel Cell

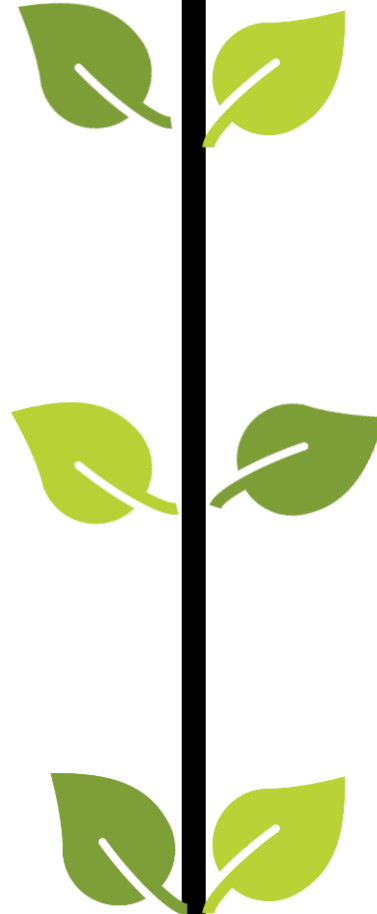


Problem

Cannot fully oxidize fuels

Solution

Encapsulate enzymes in **cell-membrane-like coating** to elongate lifespan.

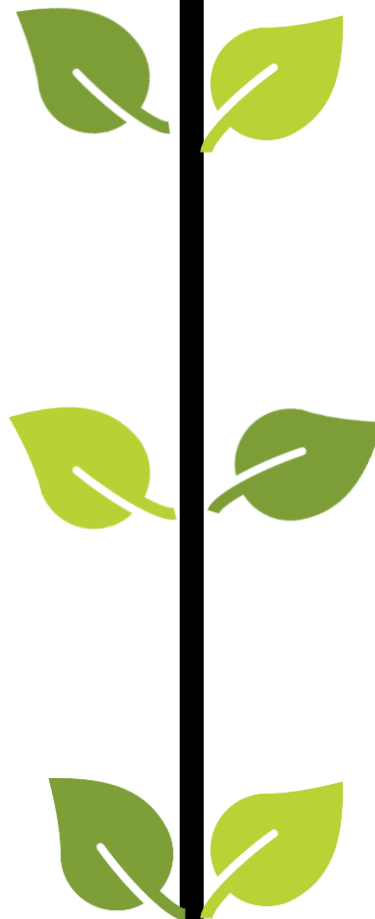


Problem

Limited voltage output

Solution

Energy stored in **algae cellulose batteries**, not used directly to power the vehicle.

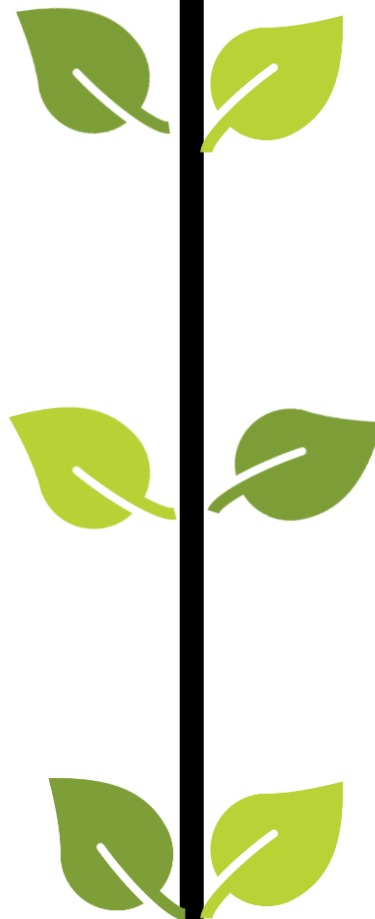


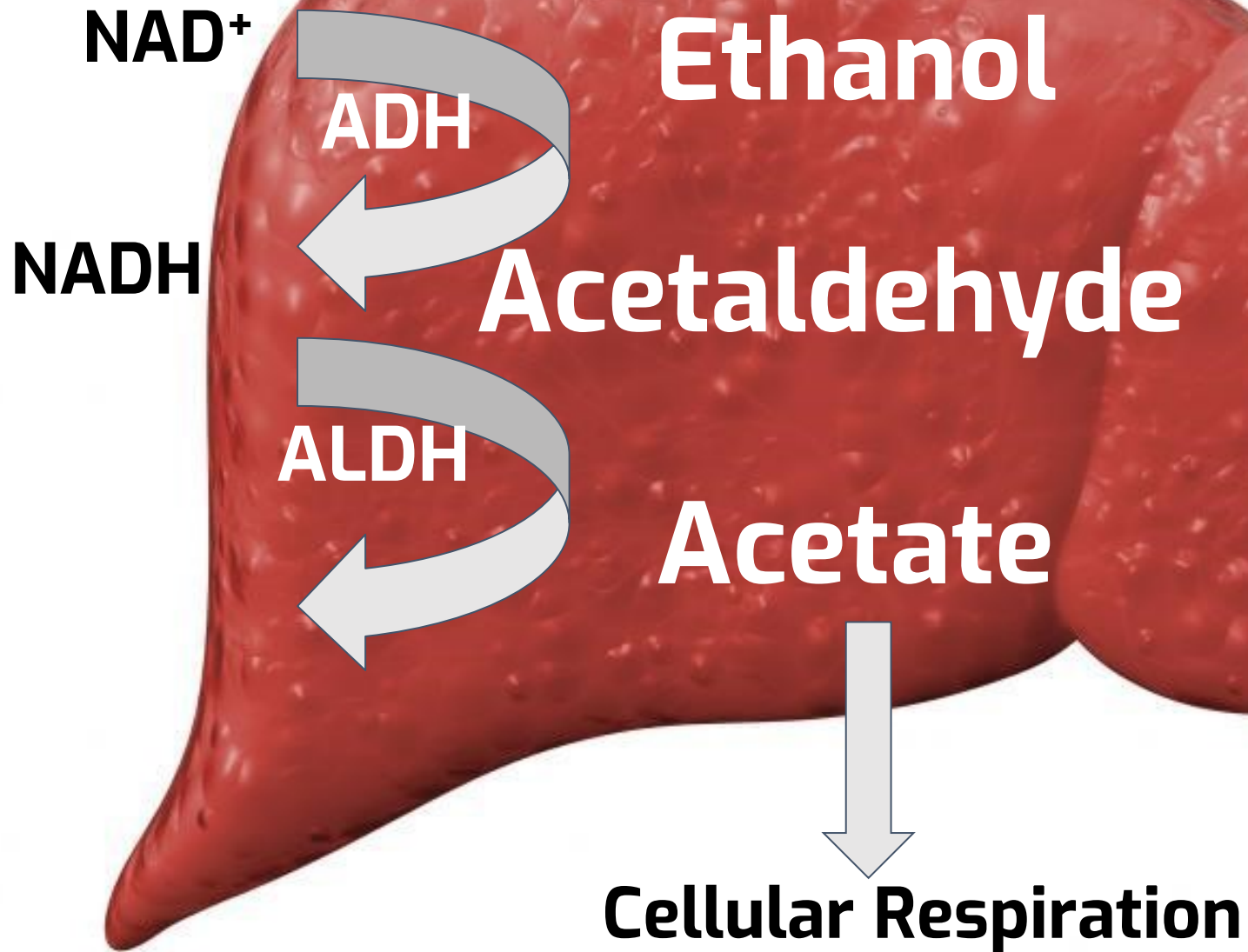
Problem

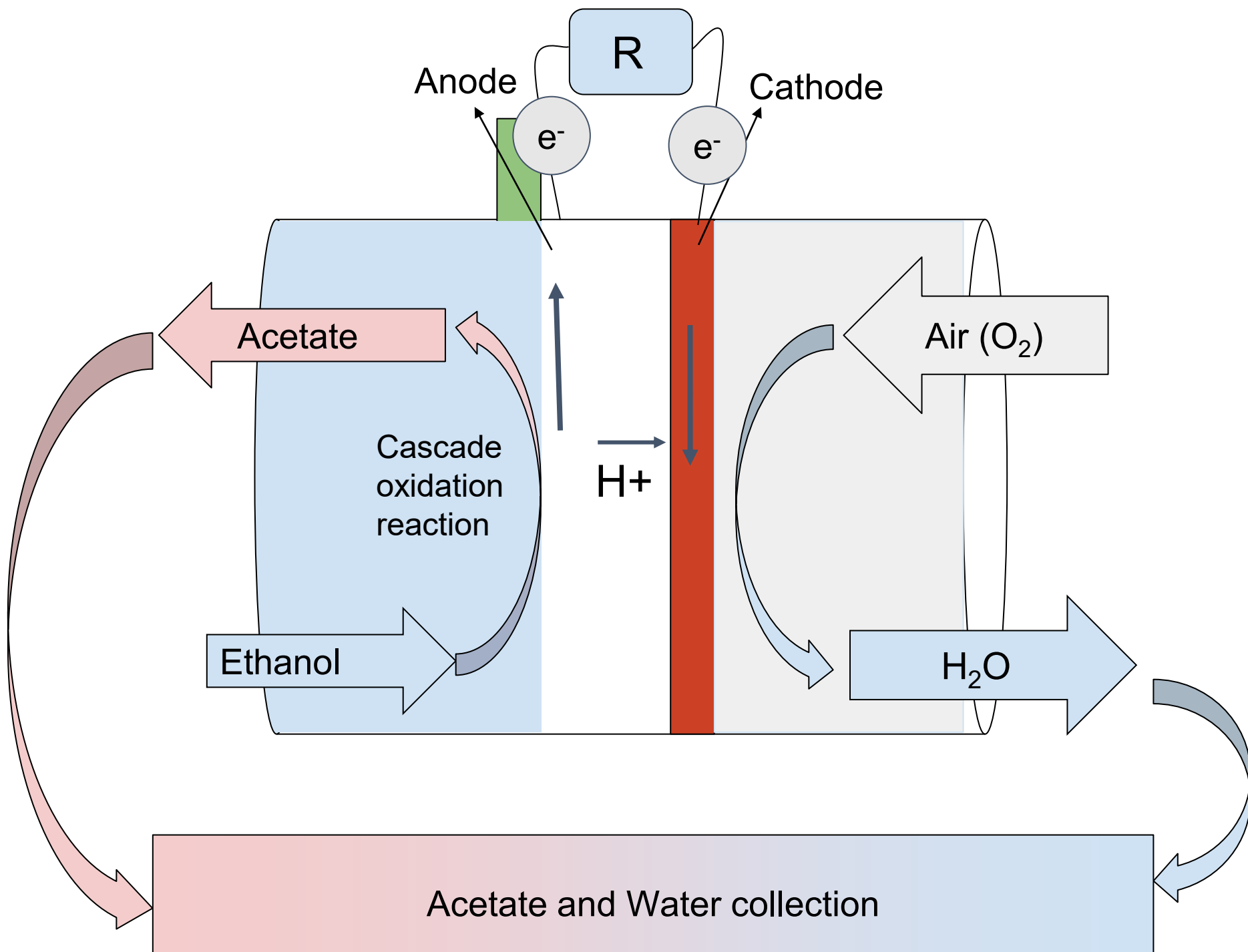
Low power density

Solution

Enable enzyme cascade.
Increase surface area of
electrodes.









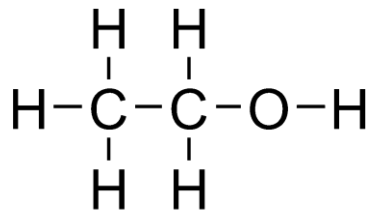
Ethanol is put into the cell.

Ethanol broken down into Acetaldehyde by ADH.

Acetaldehyde is broken down into Acetate by AldDH.

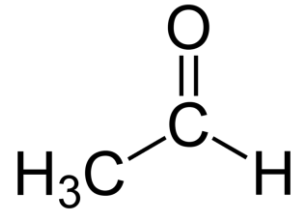
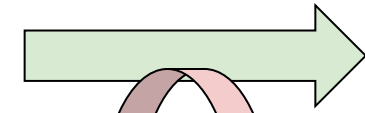
The Process





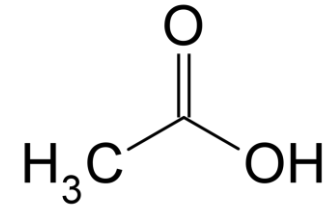
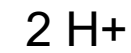
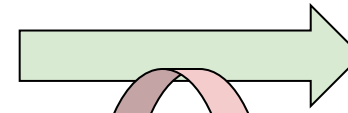
Ethanol

ADH



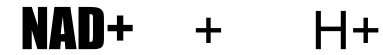
Acetaldehyde

AldDH



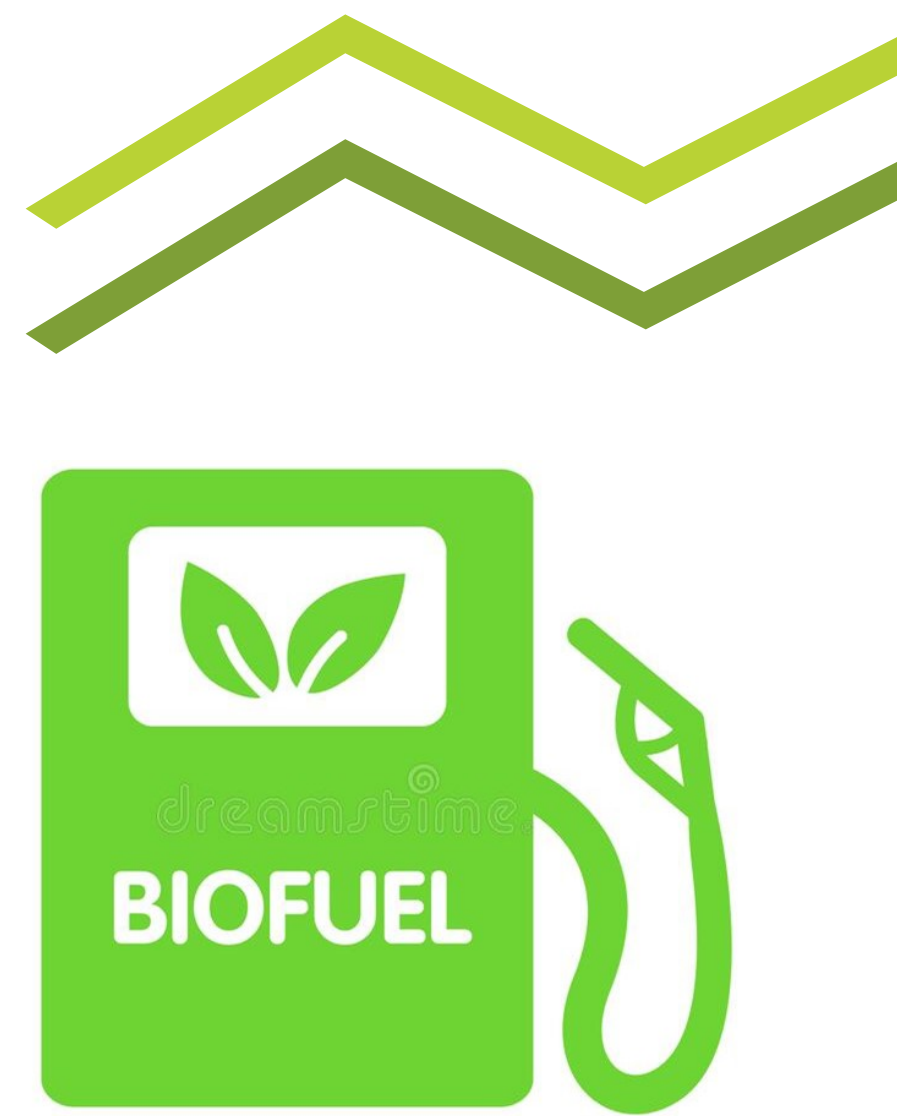
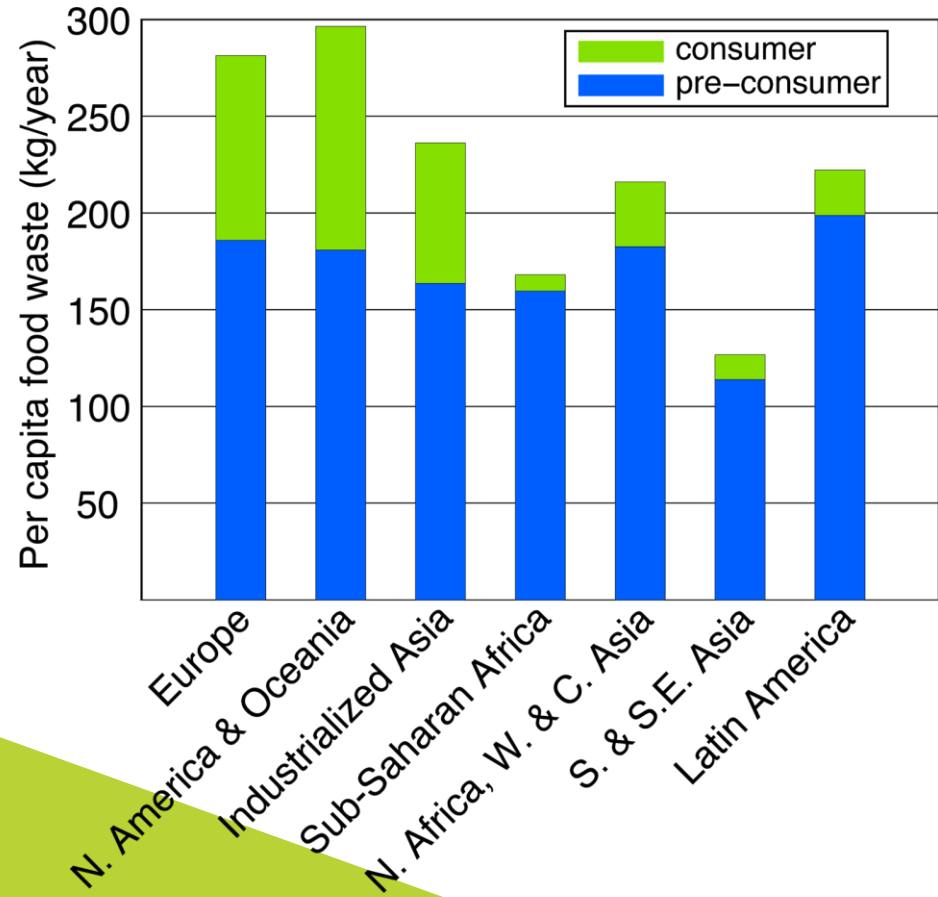
Acetate
(Acetic acid)

REDOX
Mediator



(At anode)

Annual food waste per capita



The Fuel

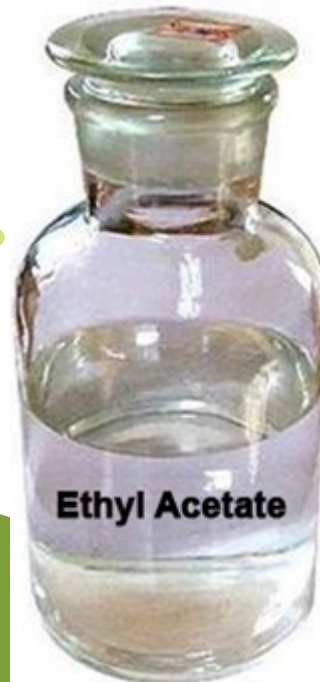


The Fuel Waste

Medical

Industrial

Commercial



Algae Cellulose Battery

- **Cost: 10\$ - 20\$ per piece**
- **Efficiency per battery:**
 - Specific Energy: **38-50 Wh/kg**
 - Charging Speed: **10s for 80%**
- **Parameters:**
 - lightweight
 - non-toxic
 - 100x surface area of electrodes
= increase of power,
capacitance

Li-Ion Battery

- **Cost: 30-70\$ per piece**
- **Efficiency per battery:**
 - Specific Energy: **100-160 Wh/kg**
 - Charging Speed: **180min for 100%**
- **Parameters:**
 - very heavy
 - toxic: need protective steel layer
 - greater energy output

Infrastructure Changes



Ethanol
Production
Plants



Ethanol
refuel
stations



New acetate
storage tank



Thank you!

Questions?





Wallet Check

Price of Bioethanol	0.81 \$/L // 0.75€/L
Energy output of ethacell	1.3 V/s
Energy density of ethanol	8 kWh/L ; 60% efficiency
Energy density of gasoline	12 kWh/L; 40% efficiency
Algae Cellulose Battery Stack	12 000 (\$24 000, max)
Algae Cellulose Battery Storage	50 Wh/kg
Li-Ion Battery Stack	6 381 (\$49 000, max)
Li-Ion Battery Storage	100 Wh/kg



Sources

- Franco, Jefferson & Minter, Shelley & De Andrade, Adalgisa. (2018). Product Analysis of Operating an Ethanol/O₂ Biofuel Cell Shows the Synergy between Enzymes within an Enzymatic Cascade. *Journal of The Electrochemical Society*. 165. H575-H579. 10.1149/2.0931809jes
- Smith, AJ. "Http://Archives.pdx.edu/Ds/Psu/12597." *The Electrochemical Society*, vol. 6, no. 1, 2014, pp. 111–136., doi:10.1.1.977.7178.
- Team, AskNature. "Polymer-Cellulosic Batteries." *AskNature*, 1 Oct. 2016, asknature.org/idea/polymer-cellulosic-batteries/#.Xk54do4vNoM.
- https://en.wikipedia.org/wiki/Energy_content_of_biofuel#cite_ref-8
- Nyström Gustav, et al. "Ultrafast All-Polymer Paper-Based Batteries." *Nano Letters*, vol. 9, no. 10, 2009, pp. 3635–3639., doi:10.1021/nl901852h.
- Chambers, Nick. "Algae-Based, Non-Metallic Batteries Could Revolutionize Energy Storage Industry." *Enrg.io*, Enrg.io, 1 Aug. 2019, enrg.io/algae-based-non-metallic-batteries-could-revolutionize-energy-storage-industry/.
- Xiao, Xinxin. "Tackling the Challenges of Enzymatic (Bio)Fuel Cells." *Chemical Reviews*, American Chemical Society, 25 June 2019, pubs.acs.org/doi/10.1021/acs.chemrev.9b00115.
- Sprenger, Mona. "Energy from Algae Coming Your Way." *Norwegian SciTech News*, 1 June 2019, norwegianstechnews.com/2019/06/energy-from-algae-coming-your-way/.

