

KANBAR COLLEGE OF DESIGN, ENGINEERING & COMMERCE

Hemp-Derived Hybrid Materials

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Jefferson
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Today's Discussion

Hybrid Materials (Composites)



Hemp-Derived Hybrid Materials



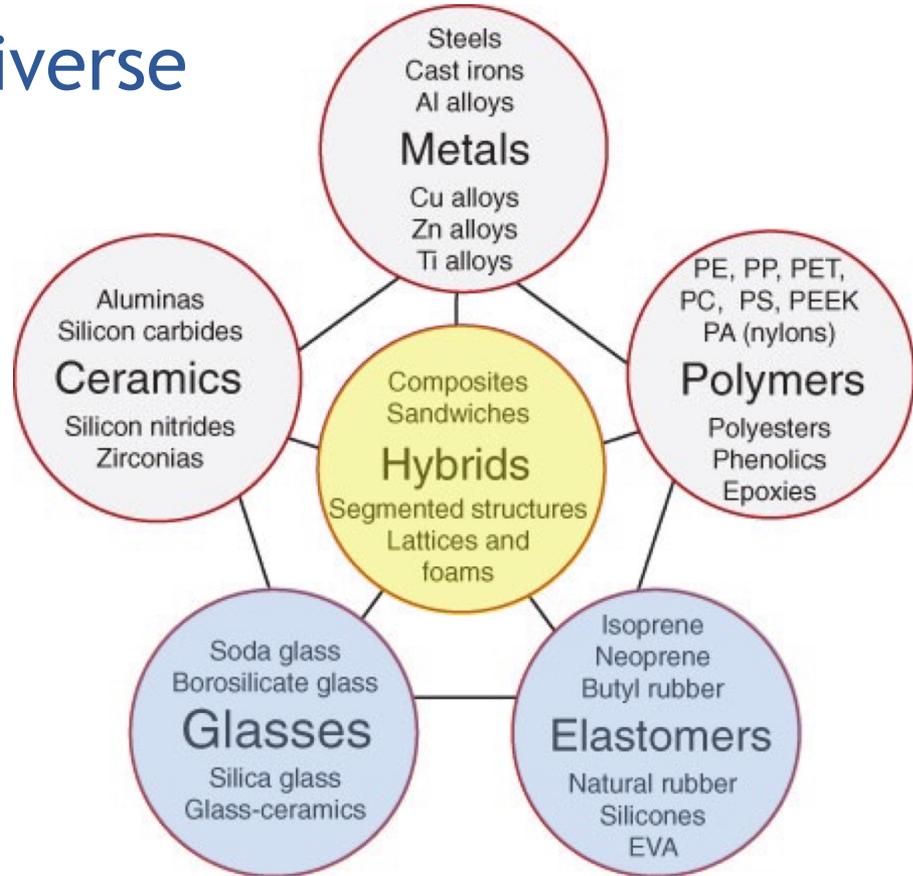
Jefferson Research Examples



What's Next?

Material Science Universe

Metals
Ceramics
Polymers
(Glasses)
(Elastomers)
Hybrids



Examples of Hybrid Materials

“Traditional” Composites (metal, ceramic, polymer)

- Matrix material typically reinforced with fabrics, fibers, or particles

Fibers, Yarns & Fabrics

- Fabrics are typically constructed from woven, knit, or non-woven yarns or fibers

Natural Materials

- Plant fibers, animal skins, wood, paper, cardboard, etc.

Hybrid Structures

- Sandwich panels, foams, lattices, etc.

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Hemp-Derived Hybrid Materials



Recent Research Examples



What's Next?

Hemp-Derived Hybrid Materials



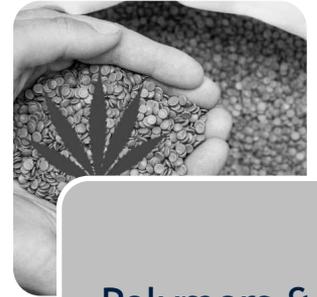
Natural
Hybrid
Material



Fibers,
Yarns, &
Fabrics



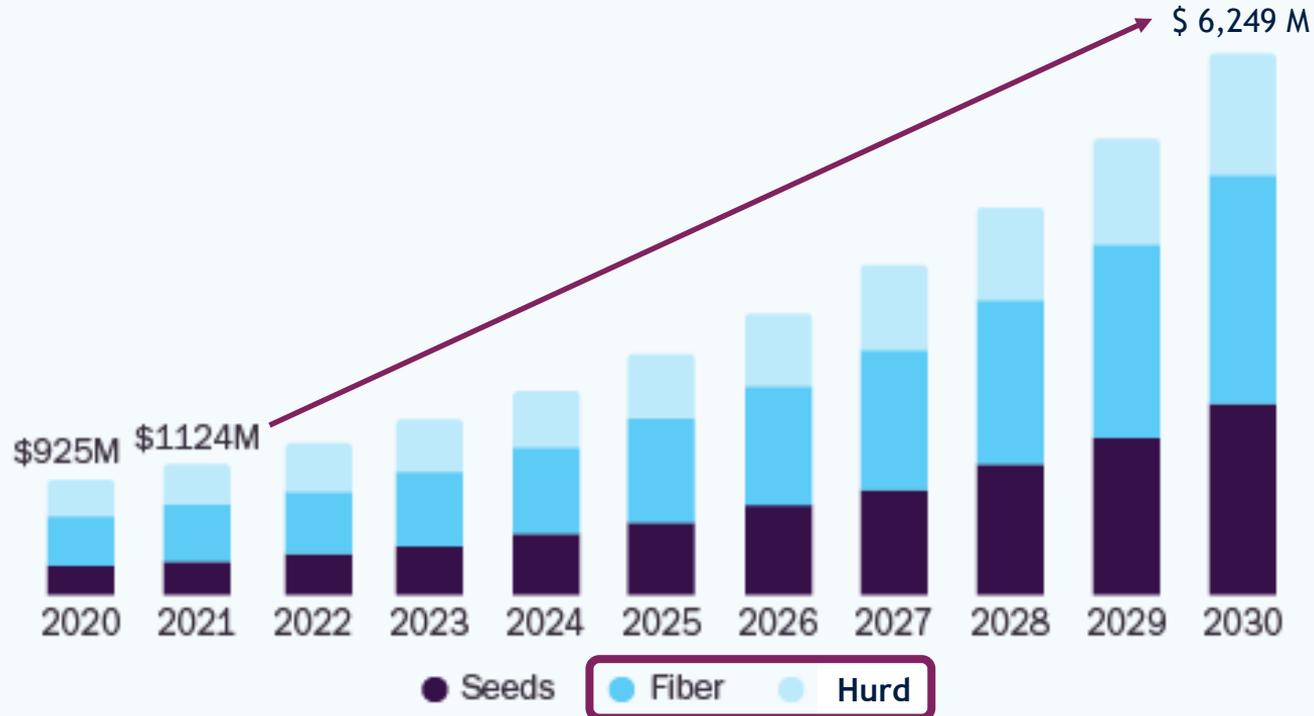
Composites,
Paper, &
Cardboard



Polymers &
Chemicals

U.S. Industrial Hemp Market

size, by product, 2020 - 2030 (USD Million)



21.0%

U.S. Market CAGR,
2022 - 2030

Source:
www.grandviewresearch.com

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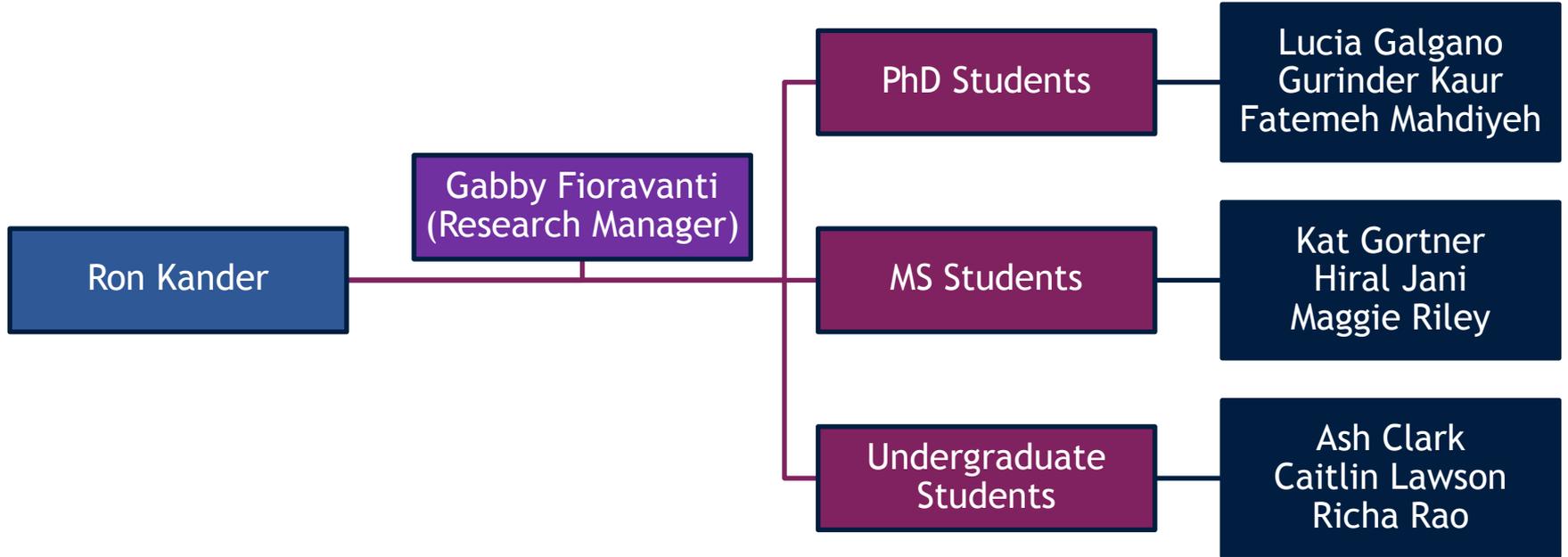


Jefferson Research Examples



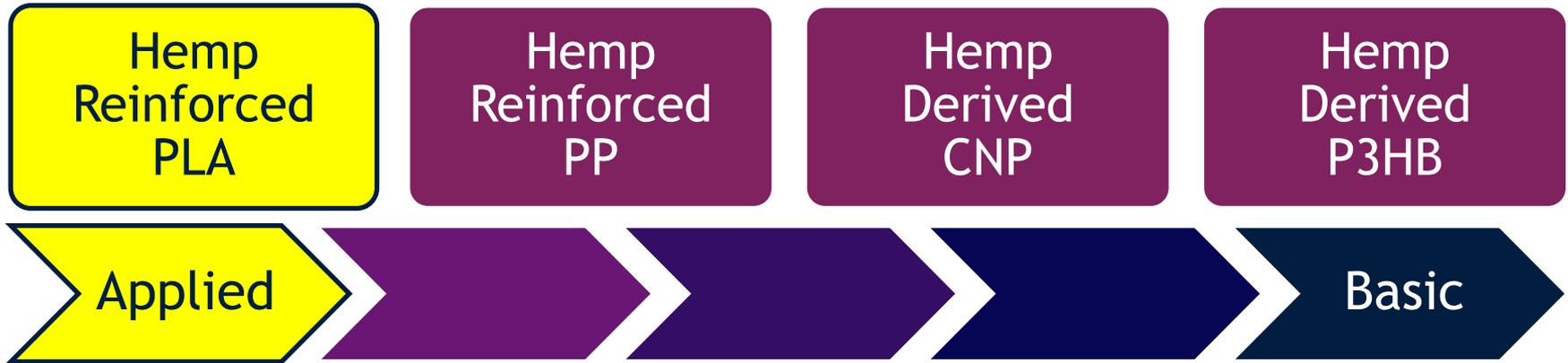
What's Next?

Kander Research Group



Current Hemp Project Map

Hemp Biomass Utilization





Residue

Hurd

Bast Fiber



**POCONO
ORGANICS**
— EST. 2015 —
MOUNTAIN FRESH



**POCONO
MOUNTAINS™**

Hemp-Reinforced PLA

Hemp Waste

- Pocono Organics

Cryo-Grinding

- Jefferson → Air Products

Compounding

- Jefferson → Addisperse

Molding

- Jefferson → Echo Molding

Testing

- Pocono Organics → Jefferson

Composting

- Pocono Organics → UNSAM

10% Hemp Reinforced PLA



Current Hemp Project Map

Hemp Biomass Utilization

Hemp
Reinforced
PLA

Hemp
Reinforced
PP

Hemp
Derived
CNP

Hemp
Derived
P3HB

Applied

Basic

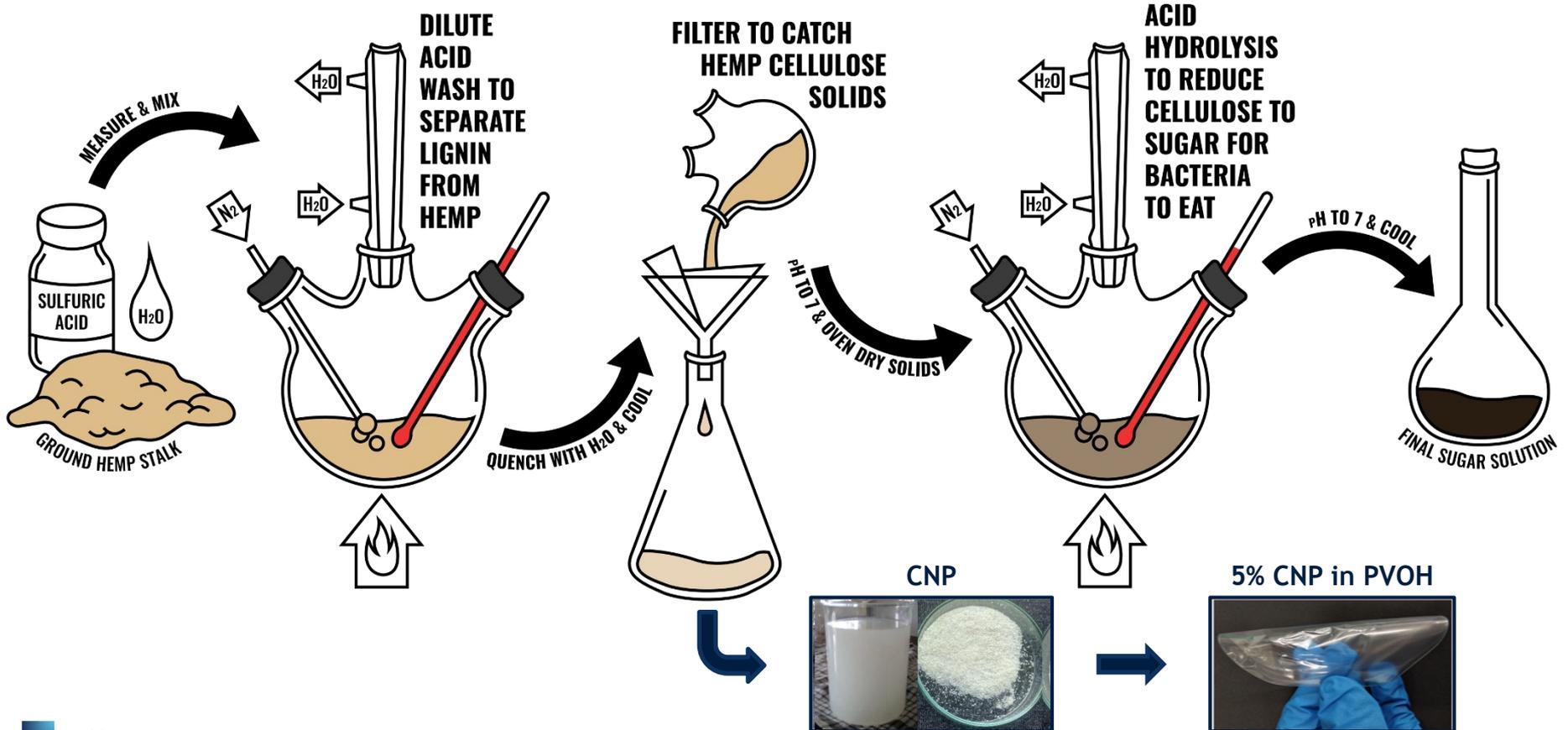


Residue

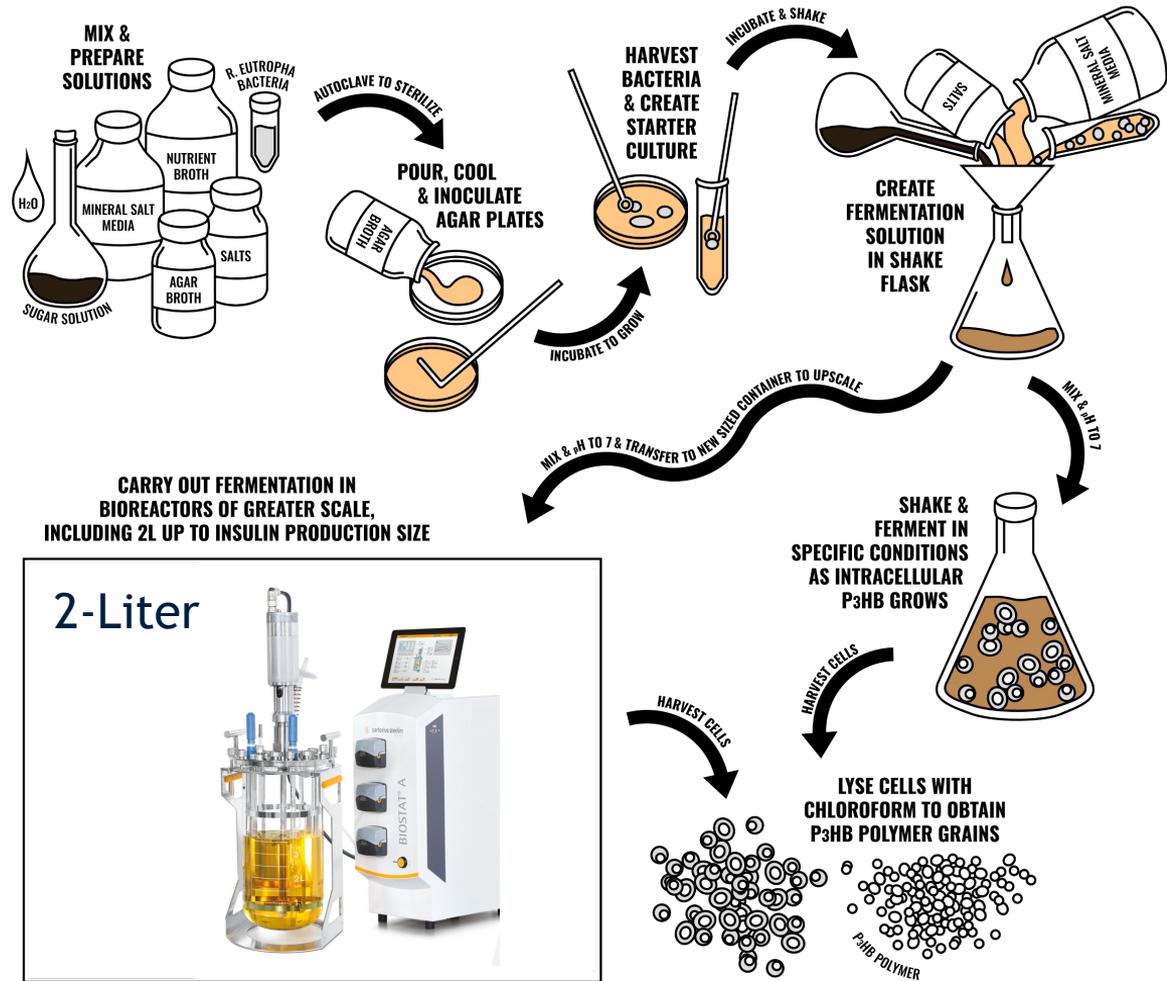
Hurd

Bast Fiber

Acid Hydrolysis of Hemp



P3HB Production



Process Scalability



2-Liter



200-Liter



250,000-Liter

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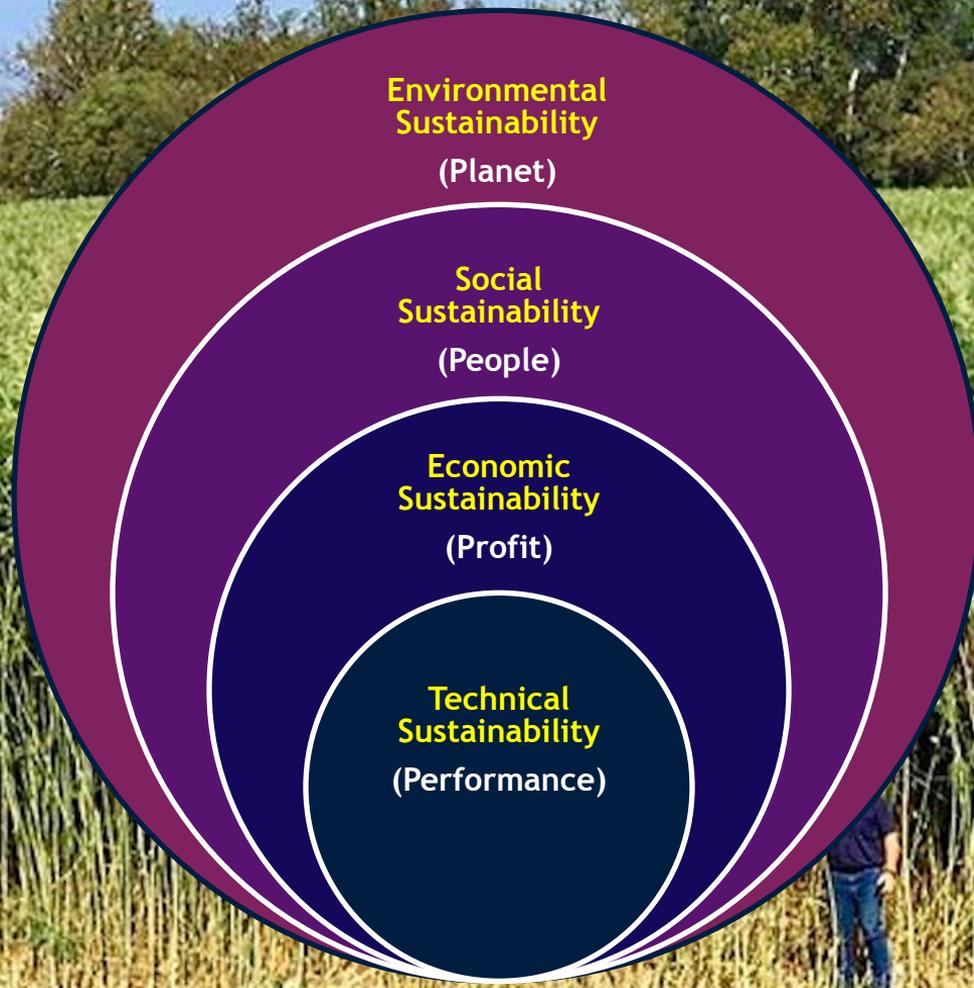
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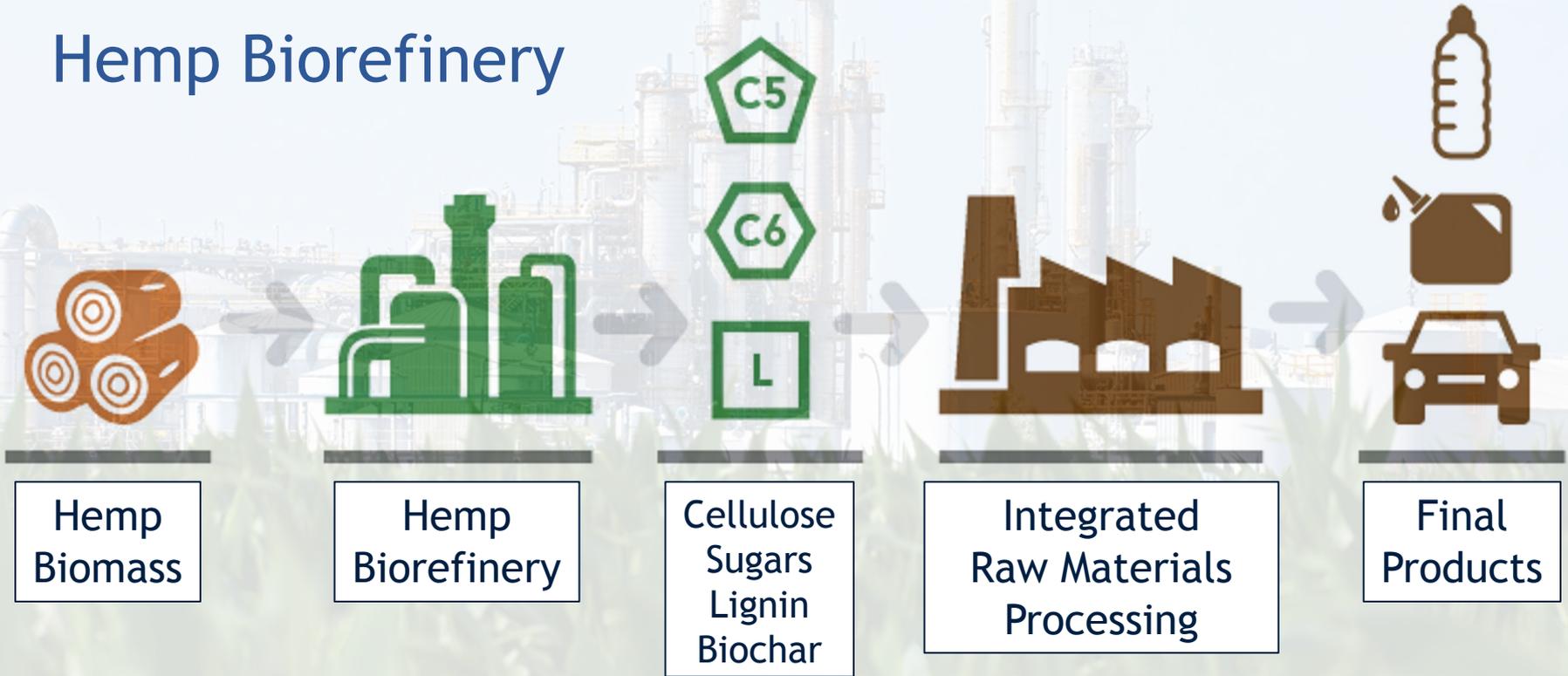
Jefferson Research Examples



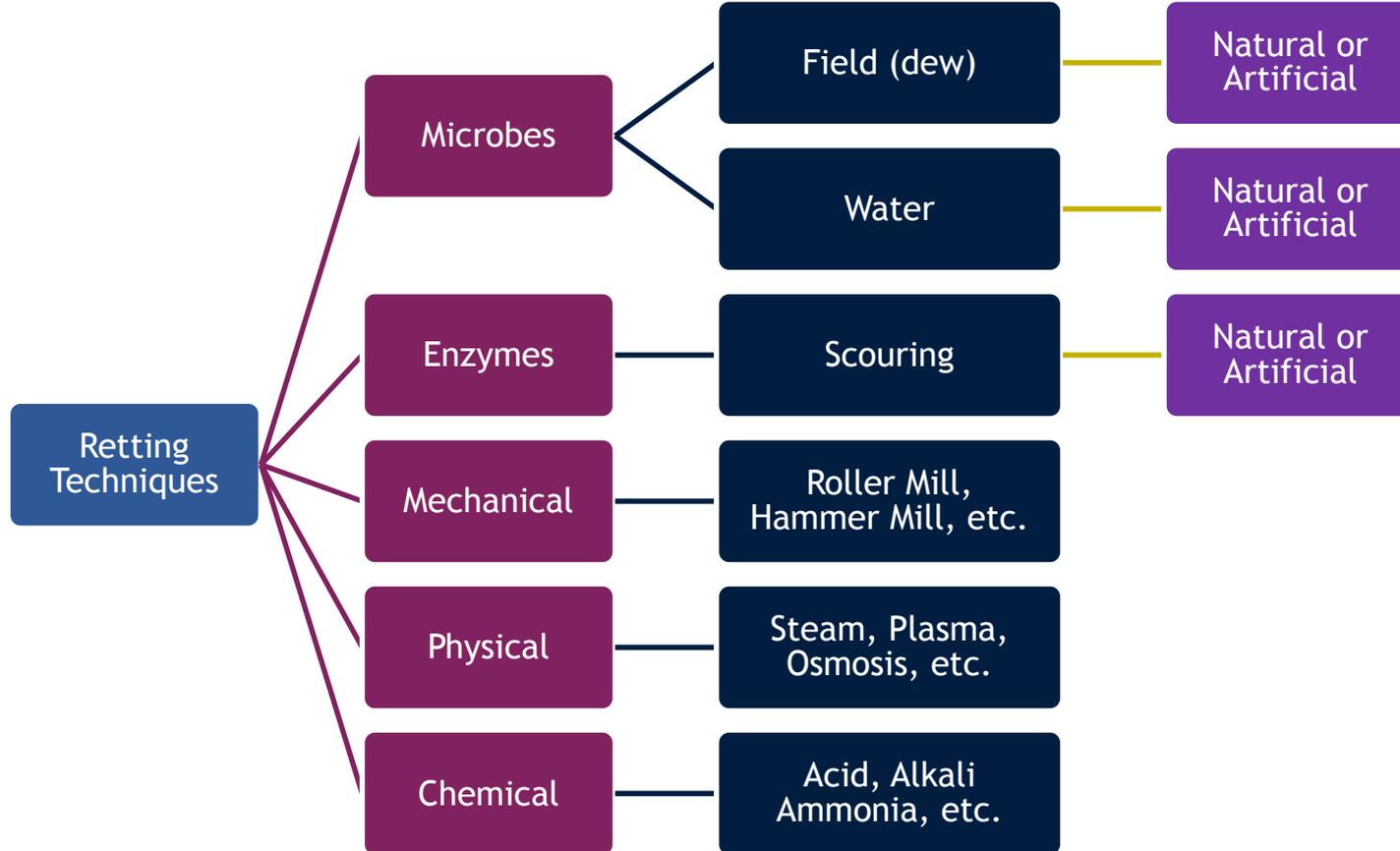
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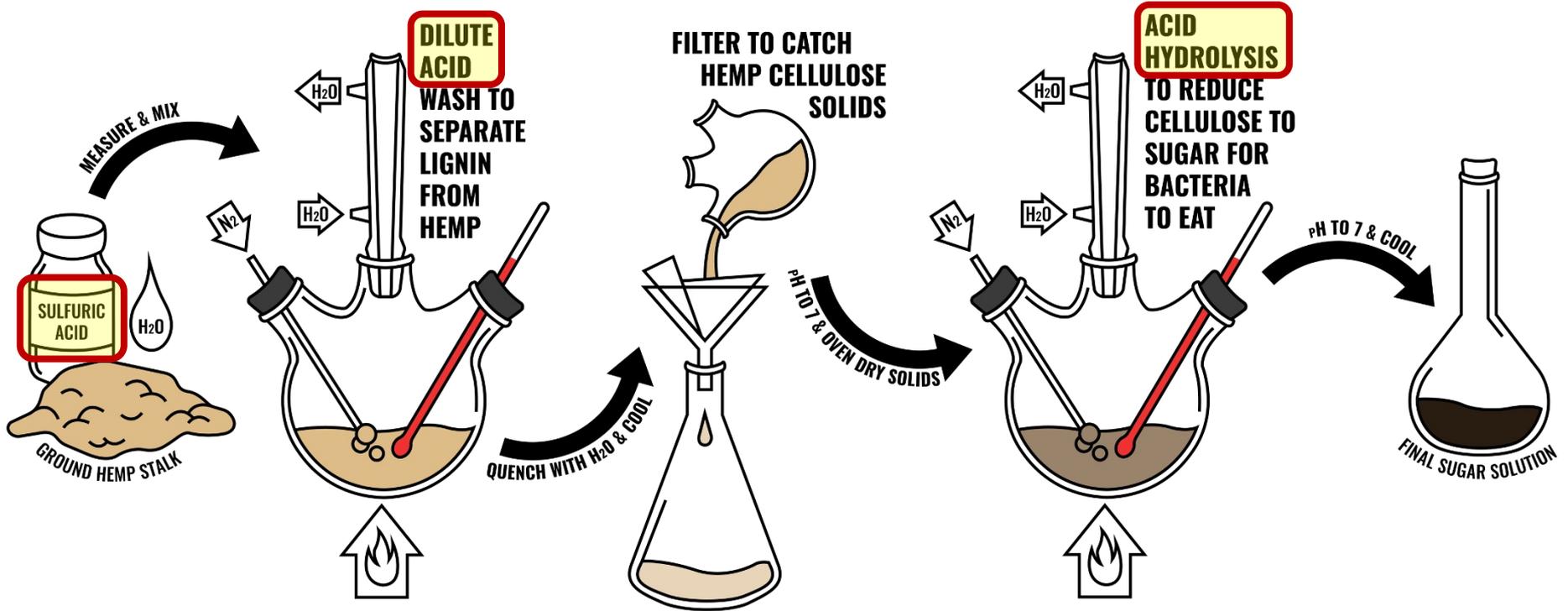
Hemp Biorefinery



Alternate Retting Processes



Alternate Acid Hydrolysis Processes



Sulfuric Acid

Organic Acid

No Acid

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Jefferson Research Examples



What's Next?

