New Opportunities in the Bioeconomy that Target Zero Waste Agriculture

William Orts
USDA-Agricultural Research Service
Western Regional Research Center
Albany, CA

Our USDA Research Mission:

Add value to agricultural products to help the rural economy

Agricultural Research Service

USDA's chief scientific research agency

1,800 PhD-level scientists

100+ research locations

"The nine most terrifying words in the English language are: I'm from the Government, and I'm here to help. " -- Ronald Reagan, 1986

…….our visit to Illinois, especially this morning at the State fair, was to **bring a special message to America's farmers, one of concern and hope.** Amid general prosperity that has brought record employment, rising incomes, and the lowest inflation in more than 20 years, some sectors of our farm economy are hurting, and their anguish is a concern to all Americans.

Wheat:

We only use the seed for flour…..

Which represents less than 25% of the crop.

What do we do with the rest?

Zero Waste Agriculture - Drivers

Adding value to agricultural products.

- Improve the rural economy.

Biodegradability. Compostability.

- Reduce litter. Reduce ocean plastics/microplastics.

Regulatory.

- Prevent negative health & environmental impacts.
- The USDA's BioPreferred Program.

Recycling and Landfill Diversion.

- Closing the circular economy. Capturing methane releases.

Greenhouse gas reduction.

- **To create the best product!**

USDA

Summary

Biobased & bioinspired materials are profitable options

Zero Waste Agriculture is achievable.

USDA ARS Agricultural Research Service

ARS is the in-house research arm of the USDA.

The BioPreferred Program

http://www.biopreferred.gov/

The BioPreferred program gives venders a significant advantage in filling federal contractors. This can be HUGE when filling military contracts, etc.

Biobased content is readily measured (ASTM D6866; ratio of C-14 to C-12)

Partnerships: Single use items from straw

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WORLD CENTRIC
For a better world

Single use items from corn

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CORUMAT
BETTER MATERIALS


green works
99% naturally derived
compostable*
cleaning wipes
CLOROX

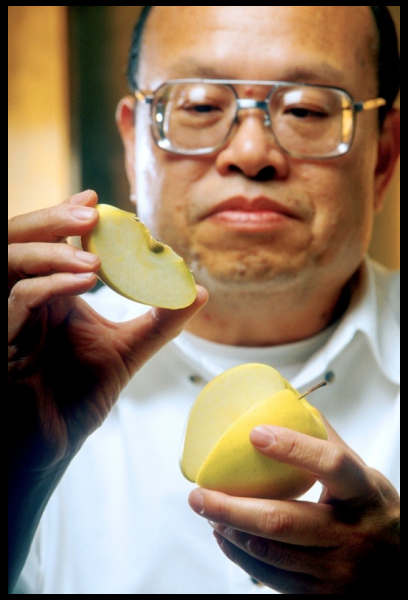

KINGSFORD


method
FRAGRANCE
BOOSTERS
REHAUSSEURS DE PARFUM
spring garden
jardin de printemps
ADDS A BURST OF SCENT
KEEPS FABRIC FRESH FOR 12 WEEKS*
480g (17 OZ)


method
fresh currant
naturally derived hand wash
groseilles
savon à mains d'origine naturelle
354mL (12 FL OZ)


ecover
Get nature on your side.
Dish Soap
Liquide à Vaisselle
Powerfully cuts through grease
Dissout efficacement la graisse
Lime Zest
Zeste de Lime

Mantrose-Haeuser Co., Inc.



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McDonald's sells 65 million lbs/yr of apples in the U.S.
USDA continues to collect royalties

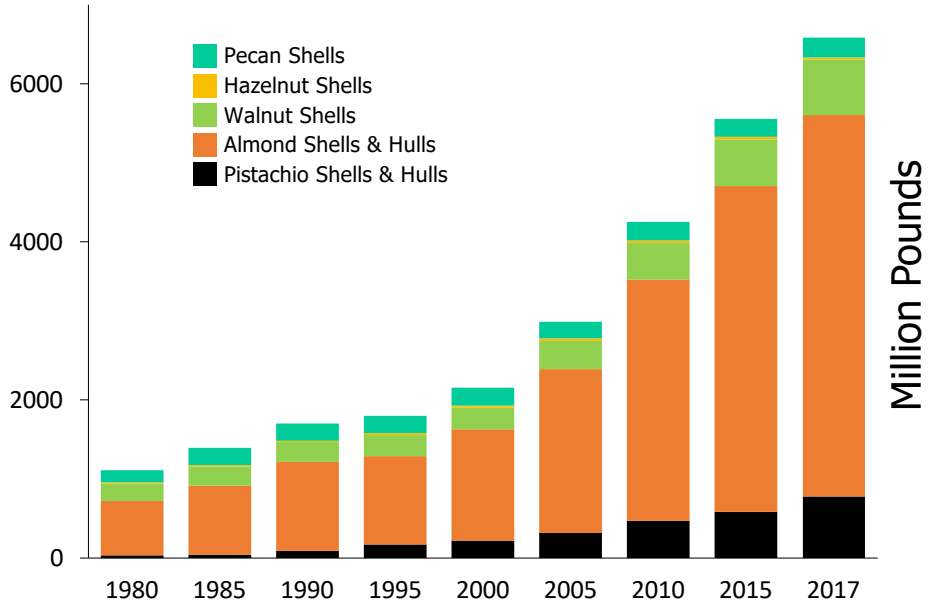
Almond Trees Produce Three Co-products

Strategic Driver: Agricultural Coproducts & Residues

California produces 82% of the world's almonds, resulting in nearly 0.95 million tonnes of shells annually and 1.1 million tonnes of hulls.

New markets for almond shells and other agricultural byproducts are needed.

US Tree Nut Biomass Production

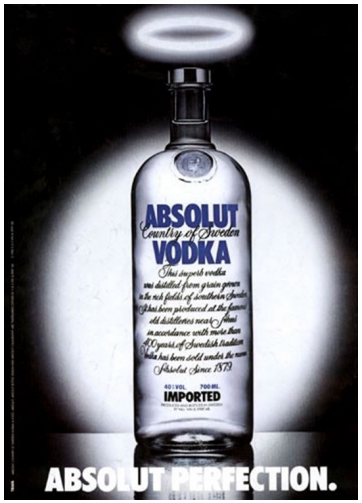


California's cows happily eat almond co-products

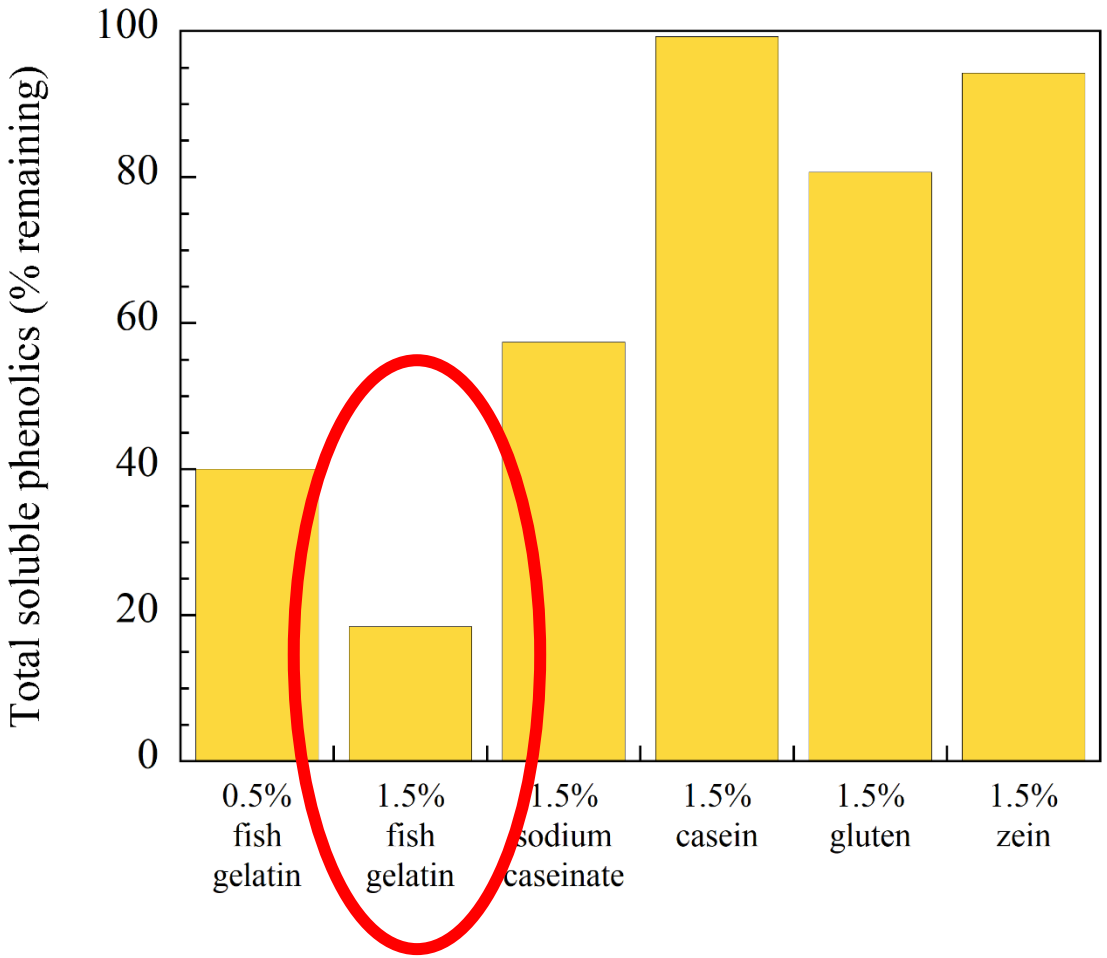
But lately, due to drought, change in markets, land costs, etc.

There are fewer cows and lots more almonds….

Can we make fuel ethanol from almond hull sugars?



Hull Sugars: Removal of bitter phenolics using proteins



Bor-Sen Chiou

Trung Cao

– **Mix in shaker for 1 hour and then filter**

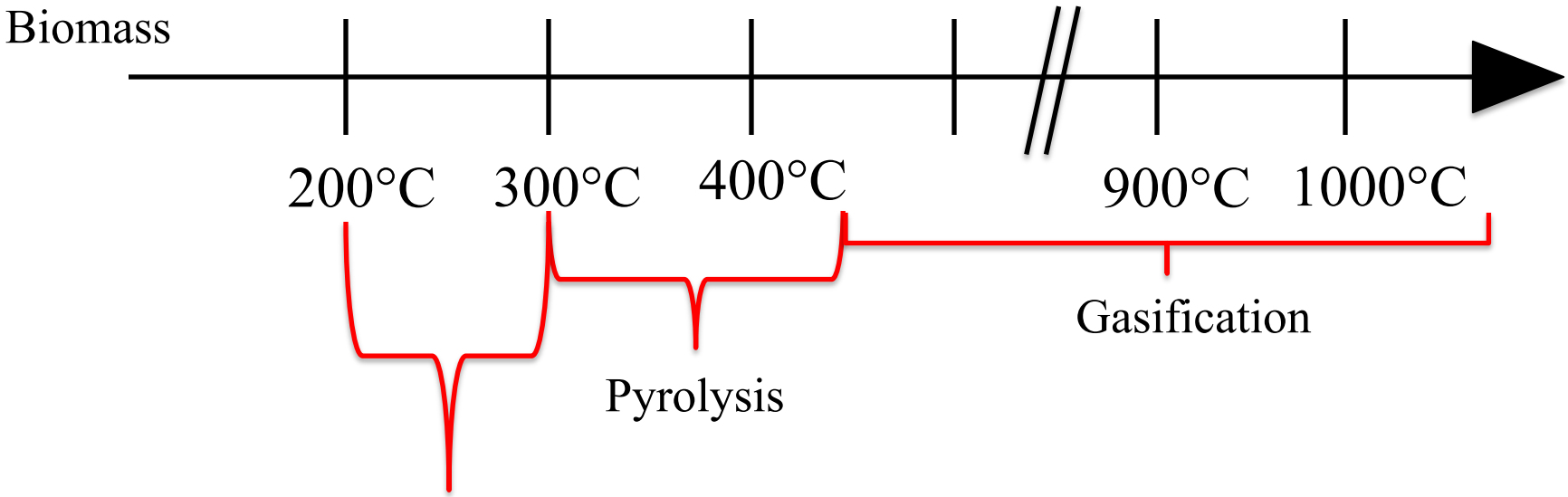
The market is calling for natural sugars

Hull sugars in bee diets

Gloria DeGrandi-Hoffman

What to do with almond shells?

Torrefaction: Making charcoal



Torrefaction

Densifies the biomass

Removes moisture and volatiles

TORREFIED SHELLS: ADDING VALUE

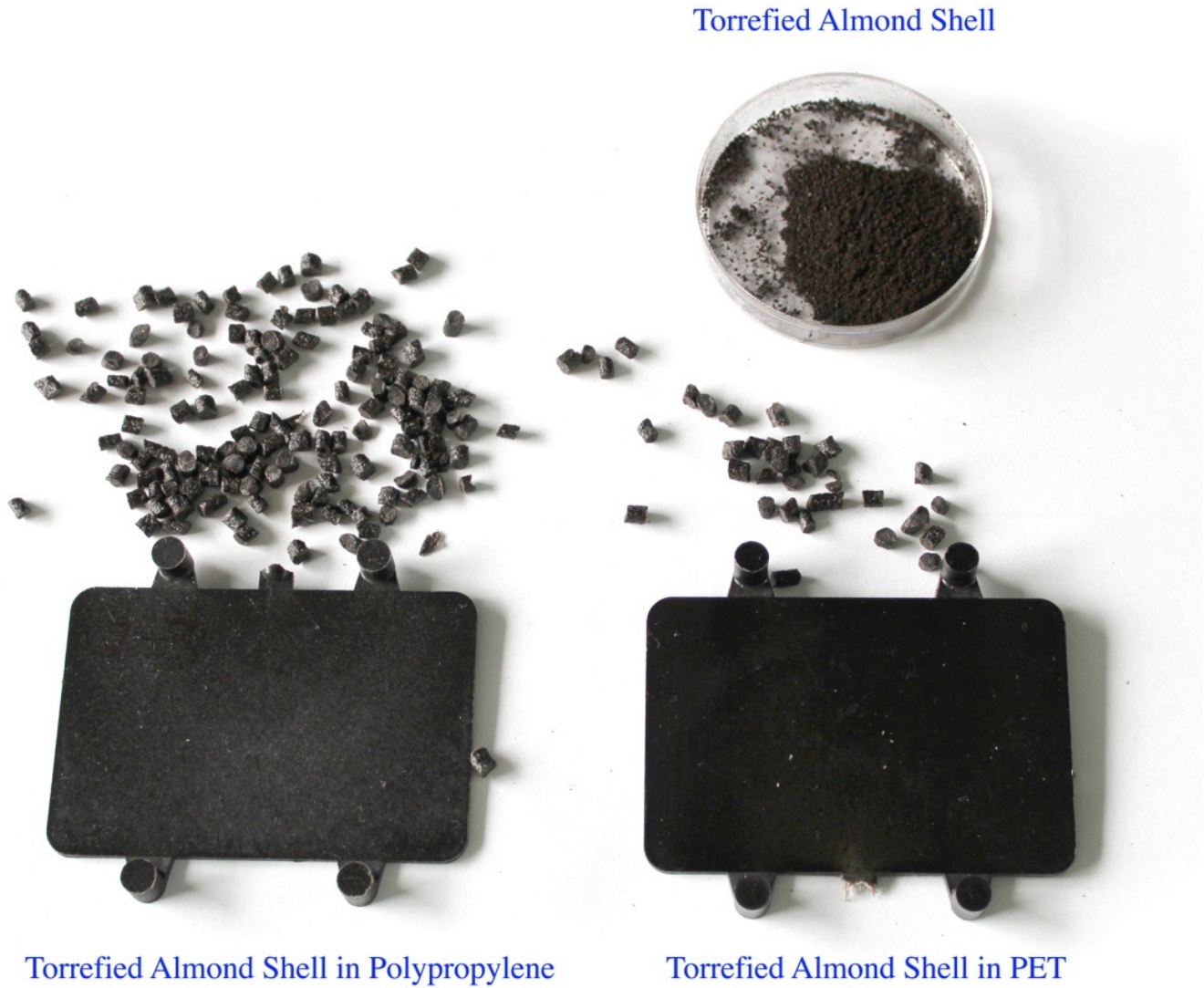
THE EFFECTS OF TORREFIED FILLERS ON THERMAL AND MECHANICAL PROPERTIES OF PLASTICS

Bor-Sen Chiou

Zach McCaffrey

Allison Flynn
Lennard Torres

Torrefied Almond Shell Composites

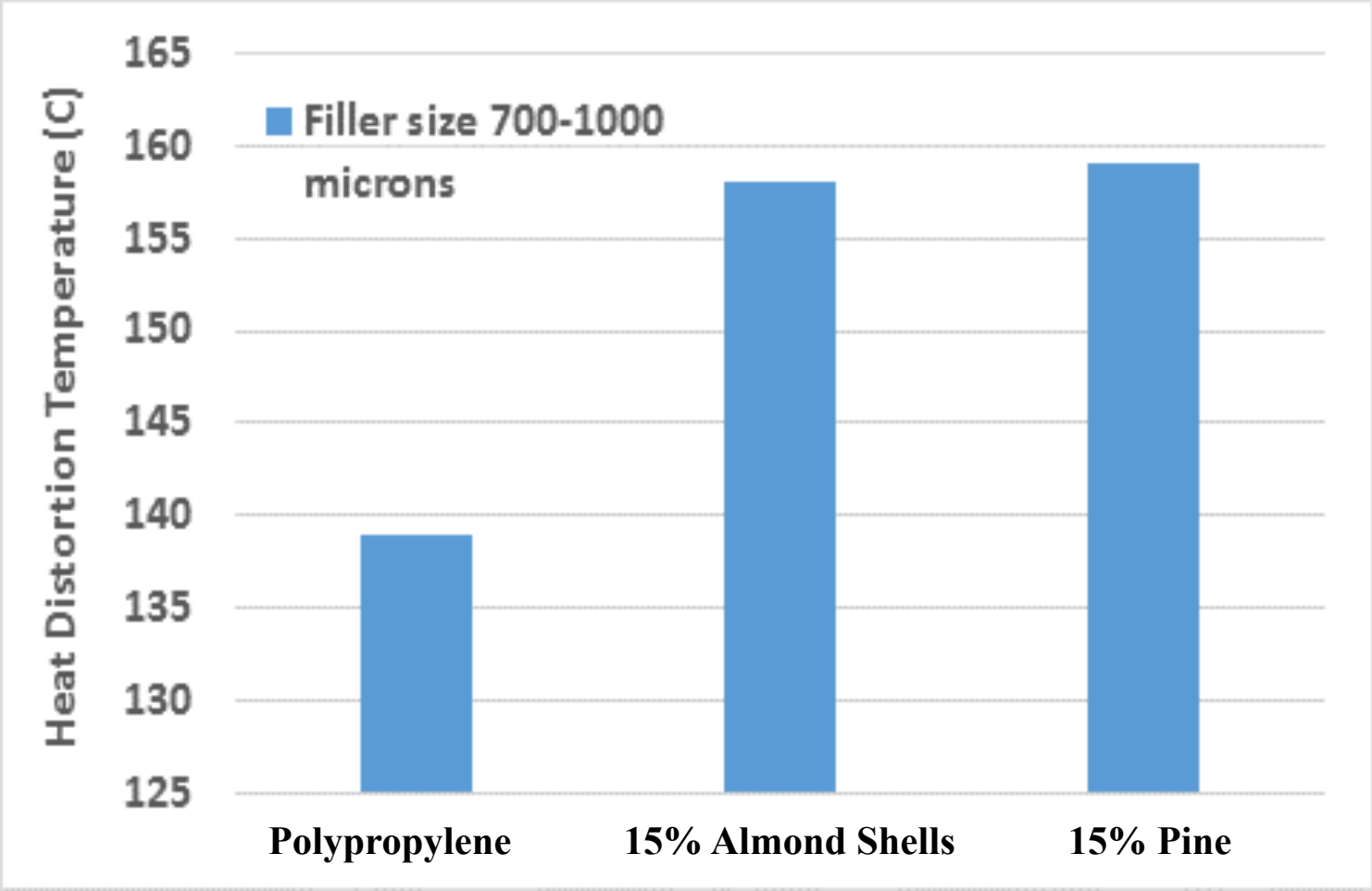


– Alternative to wood-polymer composites

Heat Deflection Temperature

Temperature at which material deforms under specific load

The softening point of plastics is improved by adding shells



Torrefied Biomass in Plastics

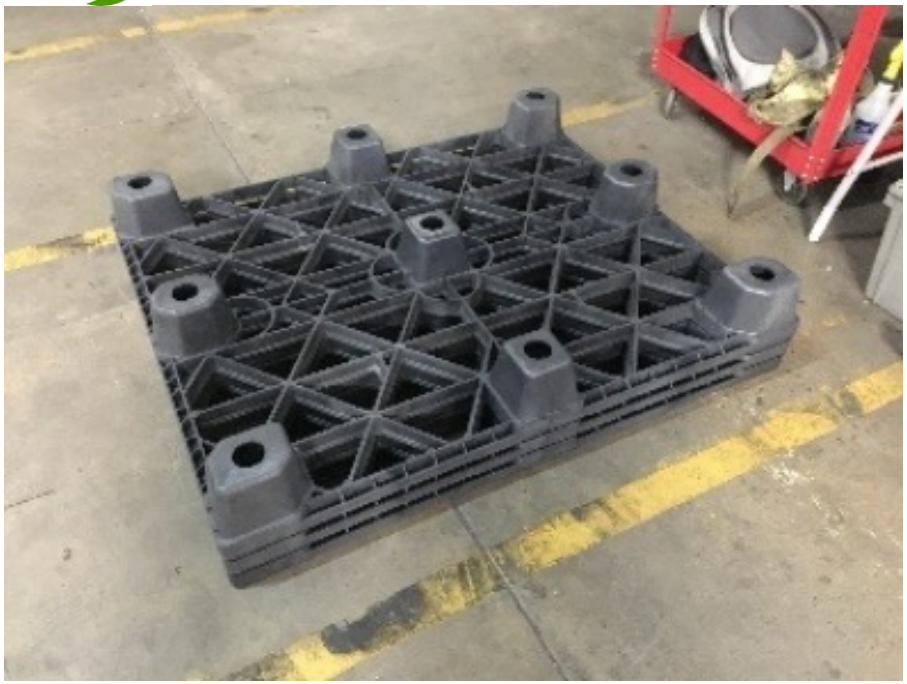
Funded By CalRecycle

TRANPAK

F-D-S Manufacturing Co. Since 1950

RPAC LLC
ALMOND GROWER & PROCESSOR

USDA



Torrefied Biomass in Rubber Compounds

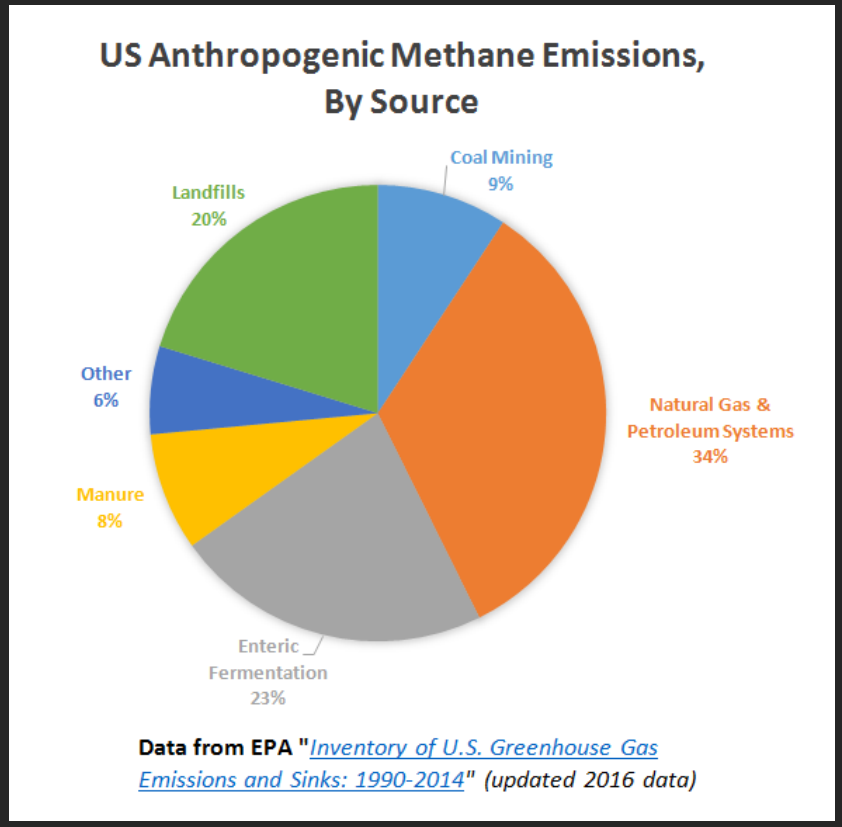
Prototype shaker heads produced in 2020-2021

Connor Wagner (Almond Board) with Delilah Wood, Zach McCaffery, Lennard Torres and Colleen McMahan

Torres, L. F., McCaffery, Z. Washington, W., Williams, T. G., Wood D. F., Orts, W. J. McMahan, C. M. Torrefied agro-industrial residue as filler in natural rubber compounds. (2021) Journal of Applied Polymer Science 138 (28), 50684

New infrastructure for food waste & ag-residues

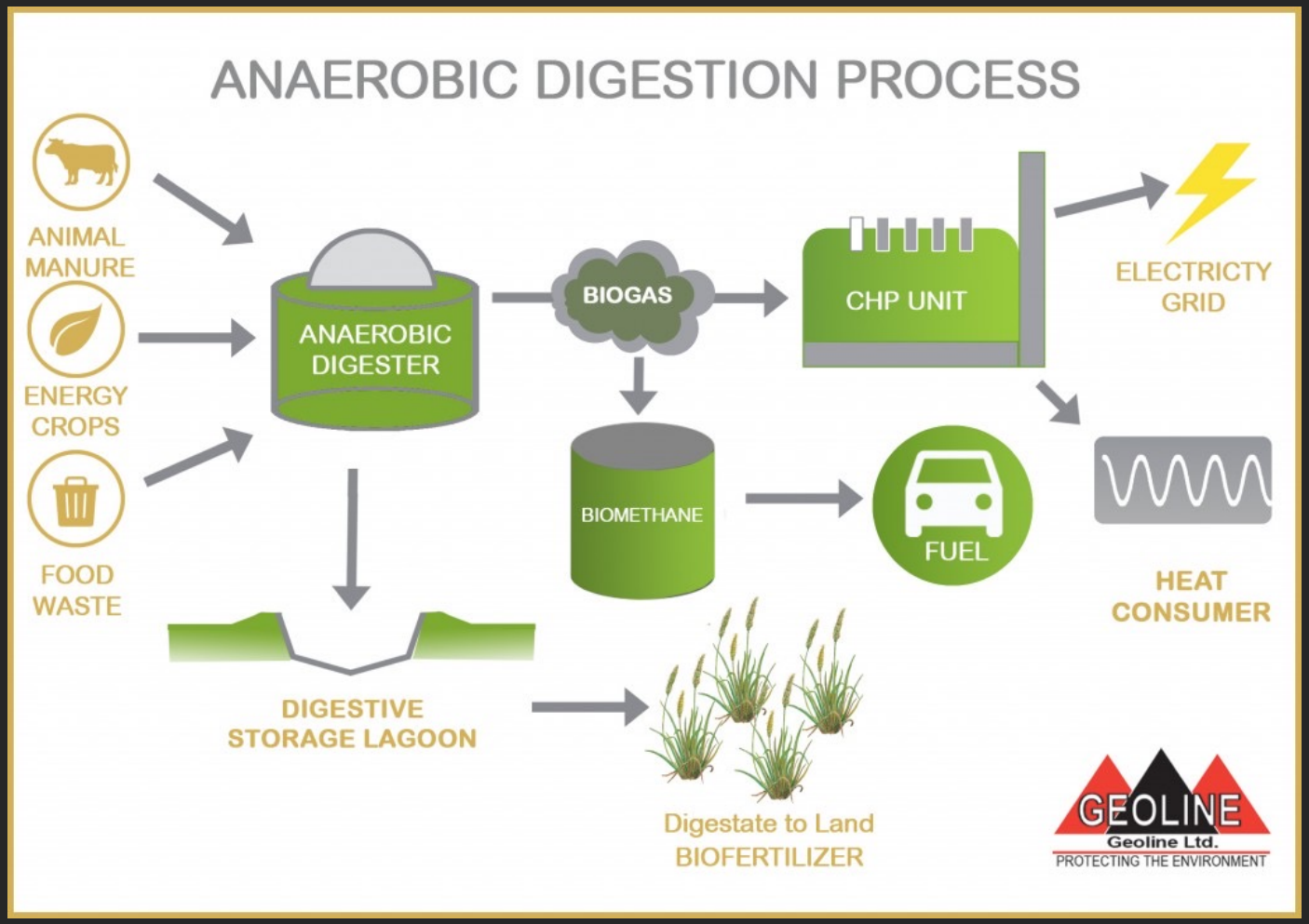
Methane: Potent greenhouse gas!!



EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

https://www.edf.org/climate/methanemaps/leaks-problem

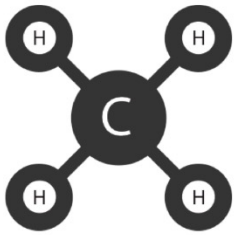
Digestion:


ANAEROBIC DIGESTION PROCESS
ANIMAL MANURE
ENERGY CROPS
FOOD WASTE
ANAEROBIC DIGESTER
BIOGAS
CHP UNIT
ELECTRICTY GRID
BIOMETHANE
FUEL
HEAT CONSUMER
DIGESTIVE STORAGE LAGOON
Digestate to Land
BIOFERTILIZER
GEOLINE
Geoline Ltd.
PROTECTING THE ENVIRONMENT

Salinas Crazy Horse Landfill – Bioenergy Park

SALINAS VALLEY
SOLID WASTE AUTHORITY
Promoting the Environmental Health of the Salinas Valley

Waste facility

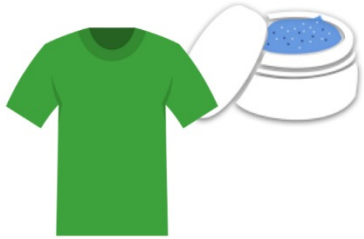


Methane gas emissions

Microbial process

MANGOMATERIALS™

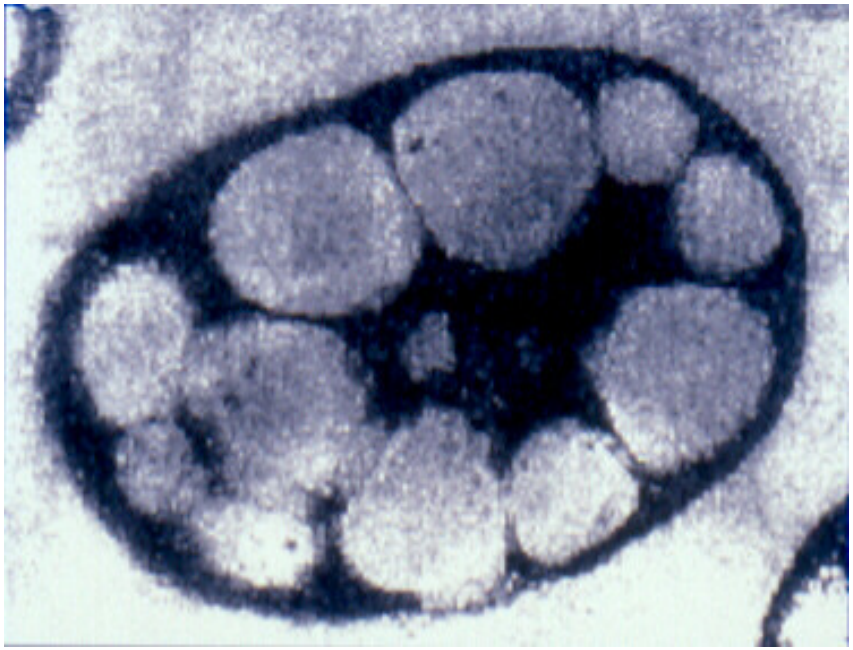
PHA biopolymer

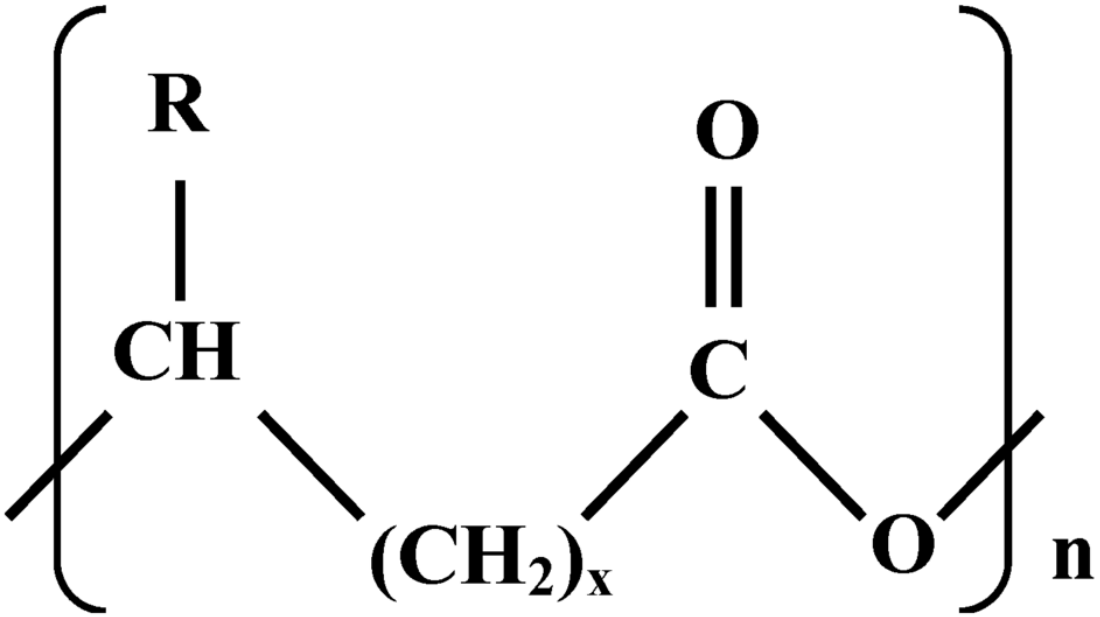


Biodegradable products

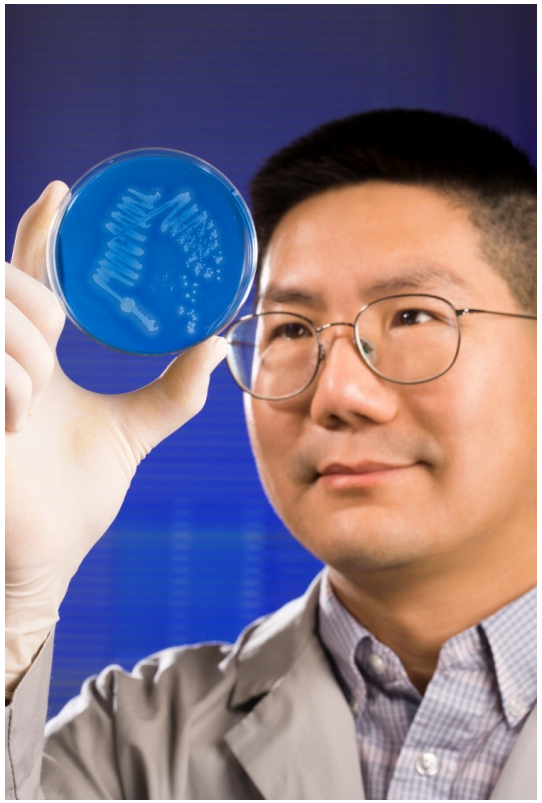
PHA Biorefineries:
PolyHydroxyAlkanoates

properties similar to polypropylene





MANGO MATERIALS



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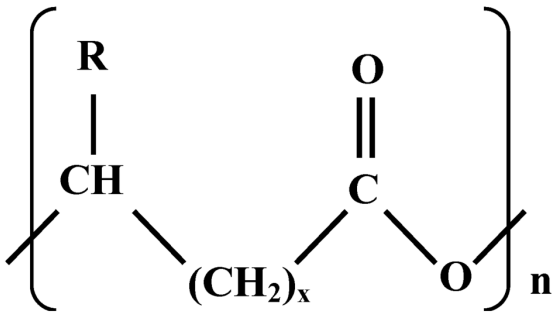
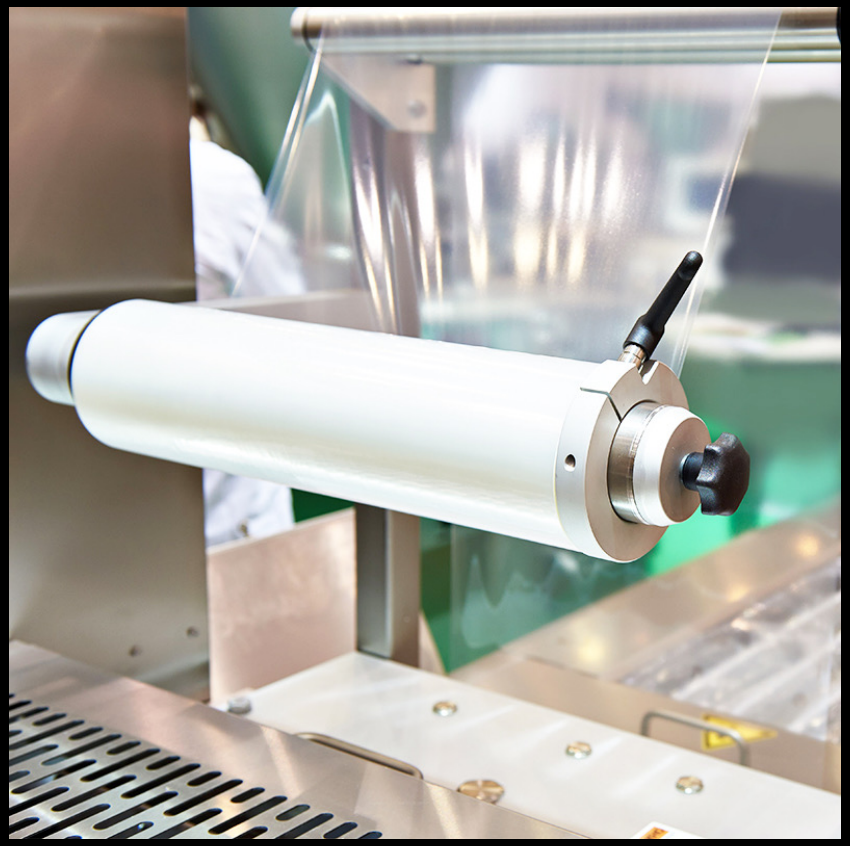


PHA fibers from Ag-Wastes

Methane-derived bioplastics act as excellent natural barriers and degradable food films.



Danimer Scientific and PSI to develop home-compostable films for foodservice.

Bioproducts:

Wood, paper, cotton, silk, wool, leather, linen.....

Summary

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USDA Agricultural Research Service

ARS is the in-house research arm of the USDA.

Partnerships: Industrial Collaborators

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WORLD CENTRIC
For a better world

YULEX

Sylvatex

method

FULL CYCLE
Bioplastics for the Circular Economy

COOPERTIRES

california almonds

CALIFORNIA Walnuts
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F-D-S Manufacturing Co.
Since 1950

MANGO MATERIALS

Researchers: Zero Waste Agriculture

USDA Team

De Wood
Bor-Sen Chiou
Zach McCaffrey
Mark Wechsler
Lennard Torres
Charles Lee
Andrew Cal
Allison Flynn
Trung Cao
Artur Klamczynski
William Hart-Cooper
Gregory Glenn
Colleen McMahan
Grace Chen
William Orts

Bill.Orts@USDA.gov