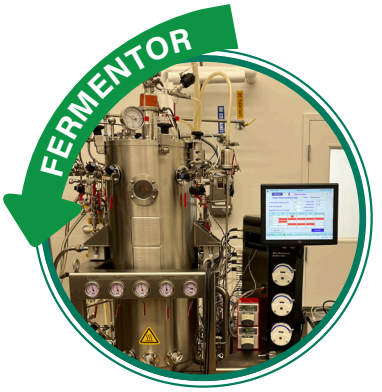
CDR & the DAIRY BIOECONOMY

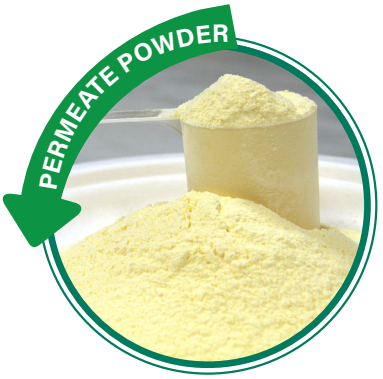
Center for Dairy Research and its partners are powering the bioeconomy

The bioeconomy has a direct impact of over $400 billion on the U.S. economy, and the Federal government has promoted the bioeconomy as a central theme for its climate goals. The U.S. Department of Energy (DOE) projects that the United States produces more than 1.3 billion tons of biomass a year and renewable dairy feedstocks could play a significant role in this transformational change in the U.S. economy.

Current DAIRY INDUSTRY Themes

- Historically, dairying has been a key pillar of the Wisconsin economy.
- Dairying has an annual economic impact of $45 billion.
- Dairy farms and cheese plants are a key part of the **RURAL** economy.
- The dairy industry has successfully developed many innovations.
- Dairy industry is being challenged to innovate on sustainability & reduce greenhouse gas emissions.
- The dairy industry produces significant volumes of co-and by-products of low value.
- Dairy waste streams are often spread on fields, hauled to landfills.
- Low milk prices and dumping of milk.
- Current uses of the dairy waste streams provide challenges, are costly and provide minimal returns to the farmers and processors.





Approaches to power the BIOECONOMY through renewable dairy feedstocks

CENTER FOR DAIRY RESEARCH
CDR
UW
& PARTNERS

- Create a scientific, translational and commercialization accelerator.
- Focus on dairy and the circular bioeconomy.
- Utilize the world-class $72M CDR pilot facilities to the fullest.
- Leverage campus research expertise and industry partnerships.
- Focus research on bioconversion and biofermentation of waste streams to food ingredients and green chemicals.
- Scaleup prototypes and new innovations including TEA (techno-economic analysis).
- Train workforce supporting startups and commercialization.
- Accelerate the decarbonization of the plastic and chemical sectors that are currently fossil-fuel derived.

Dairy Waste Streams for Biofermentation Scaleups

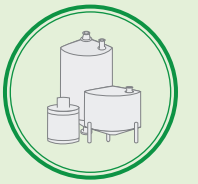
Annually, **31B lbs** of liquid milk from dairy farms in WI produce → **3.4B lbs** of cheese, creating → **28B lbs** of whey containing → **1B lbs** of lactose.

FEEDSTOCKS/ RENEWABLES

- The cheese and Greek yogurt industry produces large amounts of renewable feedstocks.
- Dairy feedstocks are simple and easily fermentable.
- Dairy feedstocks have a consistent composition and provide all nutrients for fermentation.
- The U.S. produces 600,000 lb of dry permeate annually (usually exported as animal feed or low value).

TARGETED GREEN CHEMICALS

- Organic acids (e.g. lactic acid)
- Fatty acids
- Biodegradable bio-plastics and bio polymers (e.g. polyhydroxybutyrate, (PHB)
- Replace petro-based chemicals
- Food ingredients or supplements



CDR PILOT PLANT SCALEUP CAPABILITIES

- $72 M state-of-the-art facility
- Large bioreactors
- Centrifugation
- Evaporation
- Membrane filtration
- Spray drying
- Aseptic liquid processing
- Pasteurization
- Ion exchange/electrodialysis

USDA Agricultural Marketing Service

DBIA Dairy Business Innovation Alliance Funded by USDA-AMS

Center for Dairy Research CDR UW

Dairy Farmers of Wisconsin

Wisconsin Cheese Makers Association

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CDR → Training → Product Development → Applied Dairy Research → Entrepreneurship

Current CDR Industry Partners

Agri-Mark, agropur, Ajinomoto, ALCE, amcor, ampi, Applied Biomimetic, Arthur Schuman, bel, Bluegrass Ingredients, Cargill, Chobani, CHR. Hansen, Campbell's, Coca-Cola, Cheese Merchants, DFA Dairy Farmers of America, Danone, Daisy Brand, DSM Bright Science. Brighter Living., Ellsworth Cooperative Creamery, fairlife, Foremost Farms USA, glanbia, GPC, Grande Cheese Company, Great Lakes Cheese, Hilmar Cheese Company, Hydrite Chemical Co., iff, Kerry, Kraft Heinz, Lactalis, Land O'Lakes, Masters Gallery, MilkSpecialties Global, Organic Valley, OSI, Prairie Farms, Saputo, Sargento, Sartori, Schreiber, Synder Filtration, Tillamook, Tetra Pak Protects What's Good, Wisconsin Cheese Group