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Membrane Process & Controls

Presented to:

Dairy Products 301 Filtration of Milk & Dairy Products

Fresno State University, Jordan Agricultural Research Center, Fresno, CA

September 11, 2025

Agenda (45 min)

- Welcome & Introduction
- Who We Are
- Real-World Pilots
- Why Piloting in critical in our world
- Lessons Learned & Final Thoughts

Kurtis Koskey

MP&C

10 years of experience in membrane filtration and separation

Expertise in dairy and protein processing applications

Work closely with all major membrane manufacturers to stay ahead of industry trends

Focused on optimizing system performance and reducing operational costs

Founded and privately owned by Joel Stencil in Edgar, WI.
We have built a foundation of integrity and quality for more than 30 years that is backed by a name and personal guarantee.

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ABOUT US

- Since our start in 1992, we have become a whole lot more than a world-class developer of membrane filtration technologies. We have a worldwide footprint with our hands in industries spanning from wastewater treatment to highly regulated water for the pharmaceutical industry.
- We believe in conducting business with trust and integrity, where your success is our success. We value the long-term partnerships we've built and nurtured over time.
- Vertically integrated to support design-build projects.

OVER 250 YEARS OF COMBINED FABRICATION EXPERIENCE!

CAMPUS·

80+ TEAM MEMBERS

- Membrane Specialists: 5
- Process, Automation, & Electrical Engineers: 7
- Project Managers: 5
- Tank Fabricators: 8
- Skid Fabricators: 7
- Panel/Automation Specialists: 10
- Install Team Members: 6

- (3) Operational Buildings
- 50,000ft^2 of climate-controlled Manufacturing
- 6,500ft^2 R&D Test Center
- 700,000 hours without a recordable incident! Over 3 Years!

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EQUIPMENT OFFERINGS

- Membrane Filtration Skids
- Process Skids
- Sanitary Tanks & Pressure Vessels
- Specialty Silos
- Piping & Equipment Installation Services
- Design Build Process Offerings

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INDUSTRIES OF FOCUS

- Dairy
- Water
- Food
- Beverage
- Chemical
- Biotech

MP&C 6,500 sq ft R&D Facility

- Built to serve innovation and customer support
- Includes UF, RO, NF, MF systems and CIP setup
- Used for trials, validation, and development of new applications

Membrane Skids in Pilot Plants

USED BY ACADEMIC, STARTUP, AND LARGE DAIRY CLIENTS

FLEXIBLE, MODULAR DESIGNS FOR RAPID TESTING AND SCALING

SUPPORTS PRODUCT INNOVATION WITH LOW INVESTMENT RISK

Pilot Testing – Key Considerations

Pilot Testing – Key Considerations

Define the **goal**: product quality, yield, or water reuse

Match **feed stream** (composition, temperature, variability) to real conditions

Select correct **membrane type & configuration** (UF, RO, NF, MF)

Monitor **flux, fouling, and cleaning requirements**

Test for **scalability** – how results translate to full plant size

Collect **data on operating costs**: energy, chemicals, water use

Ensure **sample collection & analysis** for proteins, solids, salts, etc.

Design Considerations

Raw stream variability and pretreatment needs

CIP and cleanability design

Membrane selection by application

System expandability and integration with existing processes

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WATER REUSE IMPORTANT FOR COST SAVINGS AND SUSTAINABILITY

SPECIALTY INGREDIENTS LIKE PERMEATE GAINING VALUE

MORE DEMAND FOR HIGH-PROTEIN PRODUCTS (MPC, MPI WPC, WPI)

GROWTH IN LACTOSE-FREE AND REDUCED-LACTOSE PRODUCTS

Industry Trends

Pilot plants are driving new product development

Real-World Applications & Case Studies for Dairy and Pilot Plants

Kurtis Koskey

MP&C Membrane Process & Controls

Water Scarcity Challenge – Kansas Pilot

Initial ask: Clean evaporator water for reuse

- Customer wanted to expand capacity
- Water quality & regulations were key concerns
- Started with evaporator… transitioned through pilot work

FROM INITIAL IDEAS TO SMARTER SOLUTIONS

Customer Initial Idea

Customer initially proposed piloting a reverse osmosis system to expand production capacity.

Consultative Engagement

Consultative approach uncovered broader goals and operational challenges through targeted questions.

Pilot Testing Benefits

Pilot testing enabled exploration of alternative solutions in a low-risk, data-driven manner.

Ultrafiltration Advantages

Ultrafiltration systems offer energy efficiency, operational flexibility, and easy integration.

Key Differences: UF vs Evaporators

UF Membrane System:

- Separates proteins, lactose, and water
- Creates multiple saleable products
- Energy efficient
- Reusable water (cow water)

Evaporator:

- Only reduces water (volume reduction)
- Primarily intermediate step to drying
- Energy intensive (steam)
- Waste steam

Case Study: XYZ Family Farms – New vision

1

LARGE DAIRY OPERATION WITH A FOCUS ON SUSTAINABILITY AND QUALITY

2

PARTNERED WITH MP&C TO ENHANCE PROCESS CAPABILITIES

3

OBJECTIVE: IMPROVE PROTEIN PROCESSING AND REDUCE ENVIRONMENTAL IMPACT

Agreement to Execution: Piloting UF Technology

1

Validating performance

2

Testing scalability

3

Capturing key learnings

Our first Pilot was to resolve the silica in the well water

RO & Polisher Testing Setup

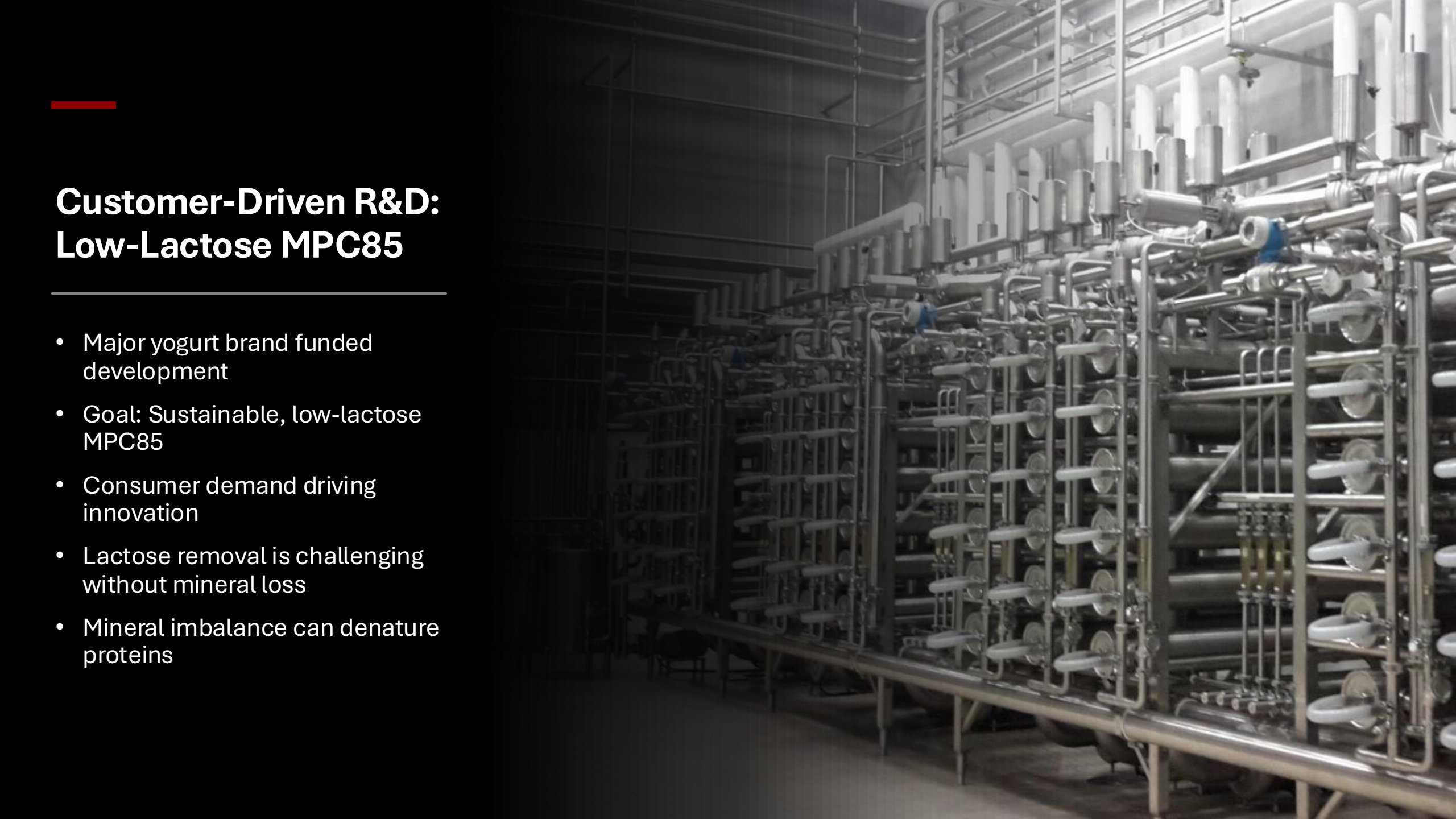
- Conductivity, PPM, TDS, Organic Solids
- Polisher trial for regulatory compliance
- Evaluating need for chemical or UV treatment

Silica Challenge & Chemical Dosing

- High silica levels detected in water samples
- Proposed RO system with industrial fiberglass membranes
- Piloting revealed chemical dosing prevents silica attachment
- Precise temperature control required to avoid membrane blinding

Customer-Driven R&D: Low-Lactose MPC85

- Major yogurt brand funded development
- Goal: Sustainable, low-lactose MPC85
- Consumer demand driving innovation
- Lactose removal is challenging without mineral loss
- Mineral imbalance can denature proteins

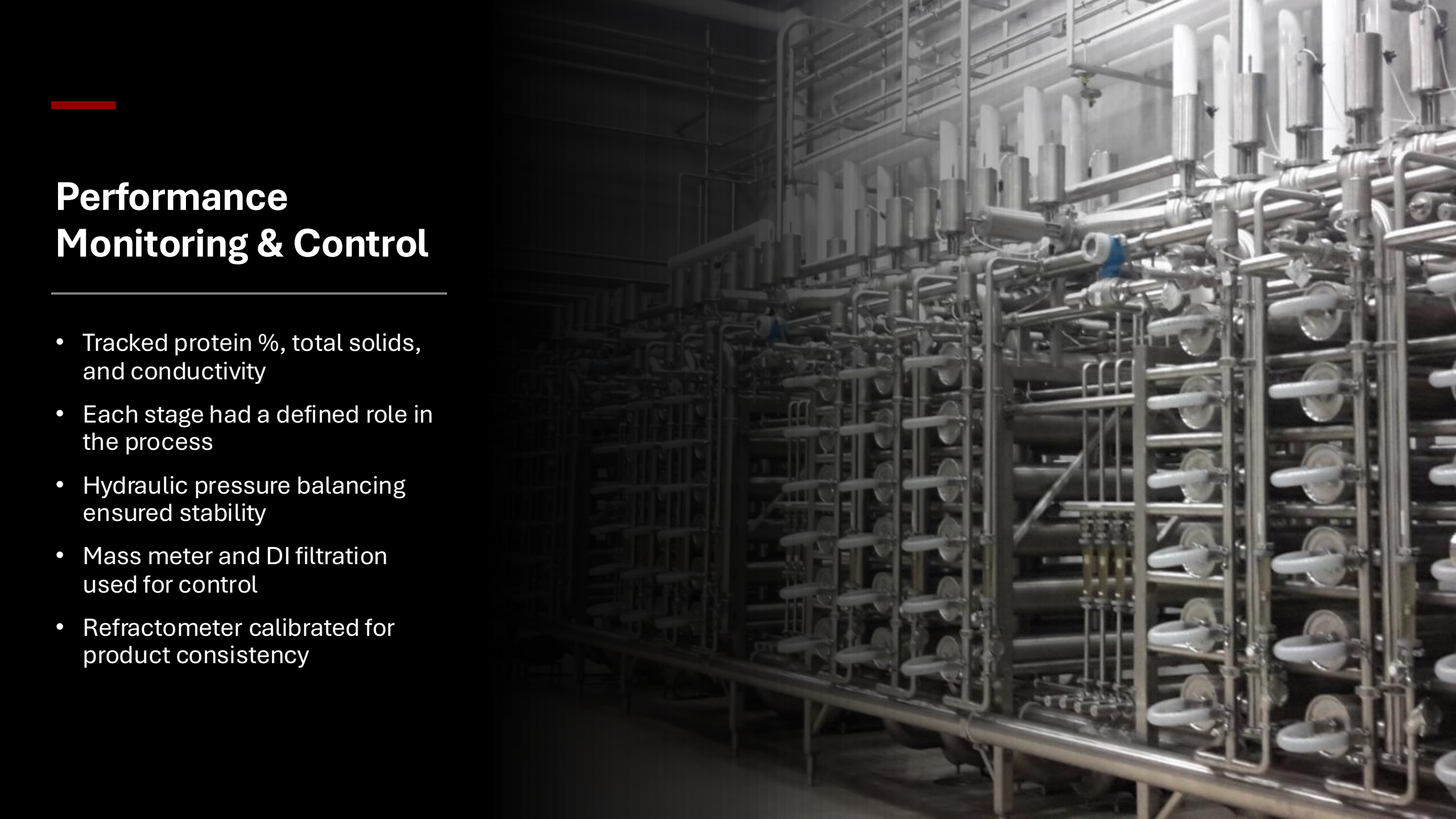


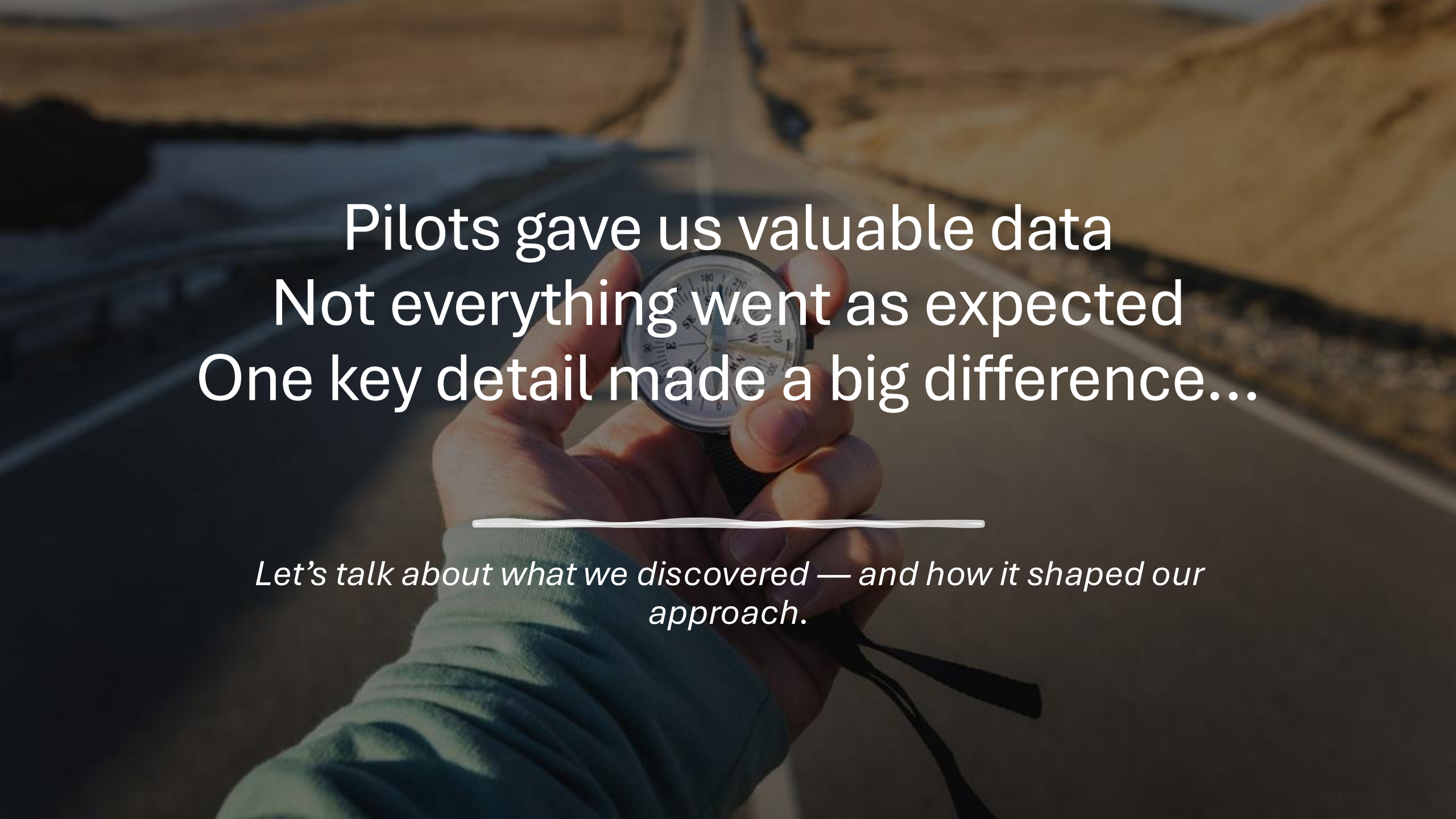
Multi-Stage Pilot Design

- Designed to monitor lactose & mineral removal
- Focused on protein concentration in final product
- 5-stage setup: concentrate milk, wash minerals, maintain solids
- Conductivity dropped ~300 µS per stage

Performance Monitoring & Control

- Tracked protein %, total solids, and conductivity
- Each stage had a defined role in the process
- Hydraulic pressure balancing ensured stability
- Mass meter and DI filtration used for control
- Refractometer calibrated for product consistency





Pilots gave us valuable data
Not everything went as expected
One key detail made a big difference...

Let's talk about what we discovered — and how it shaped our approach.

Pilot Testing – Lessons Learned

- Challenge: Reduce lactose below 8% without losing minerals
- Fresh milk proved too stable, making separation much more difficult than when using slightly aged milk during pilot testing.
- Future pilots should use fresh milk for better results again real-world conditions
- DI water usage must reflect real separation behavior
- Reminder: Pilots must simulate real-life conditions to be effective

Case Study: XYZ Family Farms – Overview

Initial Customer Plan

- Add second evaporator
- Focus: Capacity through infrastructure

Our Pivot

- Validated smarter alternative (no 2nd evaporator)
- Introduced processing flexibility
- Aligned with sustainability goals

Outcomes

- Improved protein recovery
- Reduced environmental impact
- New sellable products from side streams

“Rather than simply scaling up, we helped the customer scale smarter.”

Final Thoughts

Partnership and planning are key to membrane success

Pilot trials reduce risks and validate performance

Membranes are reshaping dairy processing capabilities

Q&A – Please Come see me after this presentation

- Open discussion with students and farmers

- Practical examples and real-world applications

- Brainstorm potential use in your facilities

Thank you!
Questions?

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