



June 7, 2014

Are breweries ready for membranes?

A New Belgium Case Study

**Anaerobic Membranes for
Process Waste Treatment**

Presented by: Tim Rynders, P.E., CDM Smith



Co-Author: Brandon Weaver, New Belgium Brewing



Presentation Overview

NBB Fort Collins Process Water Treatment Plant Overview and History

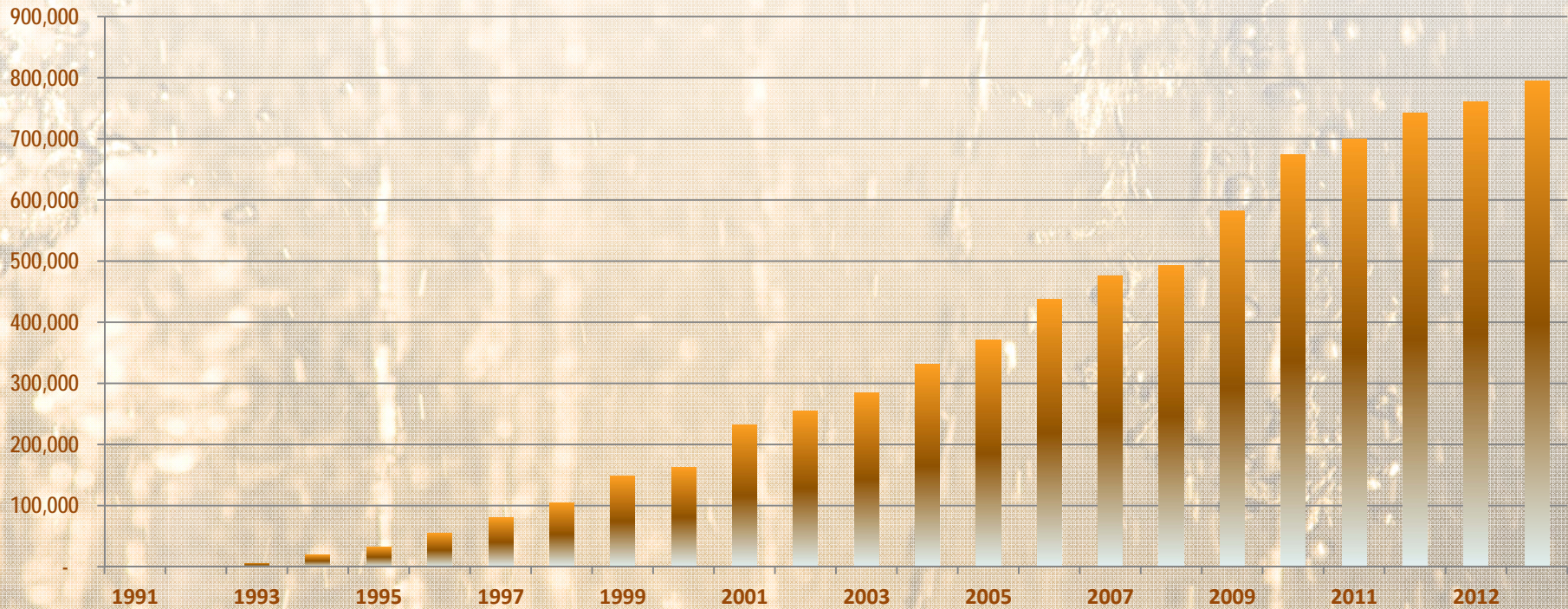
NBB Asheville Brewery Plans

Bright Idea Evaluation of Anaerobic Membrane Technology

2014 AnMBR Pilot Testing in Fort Collins

NBB Fort Collins PWTP

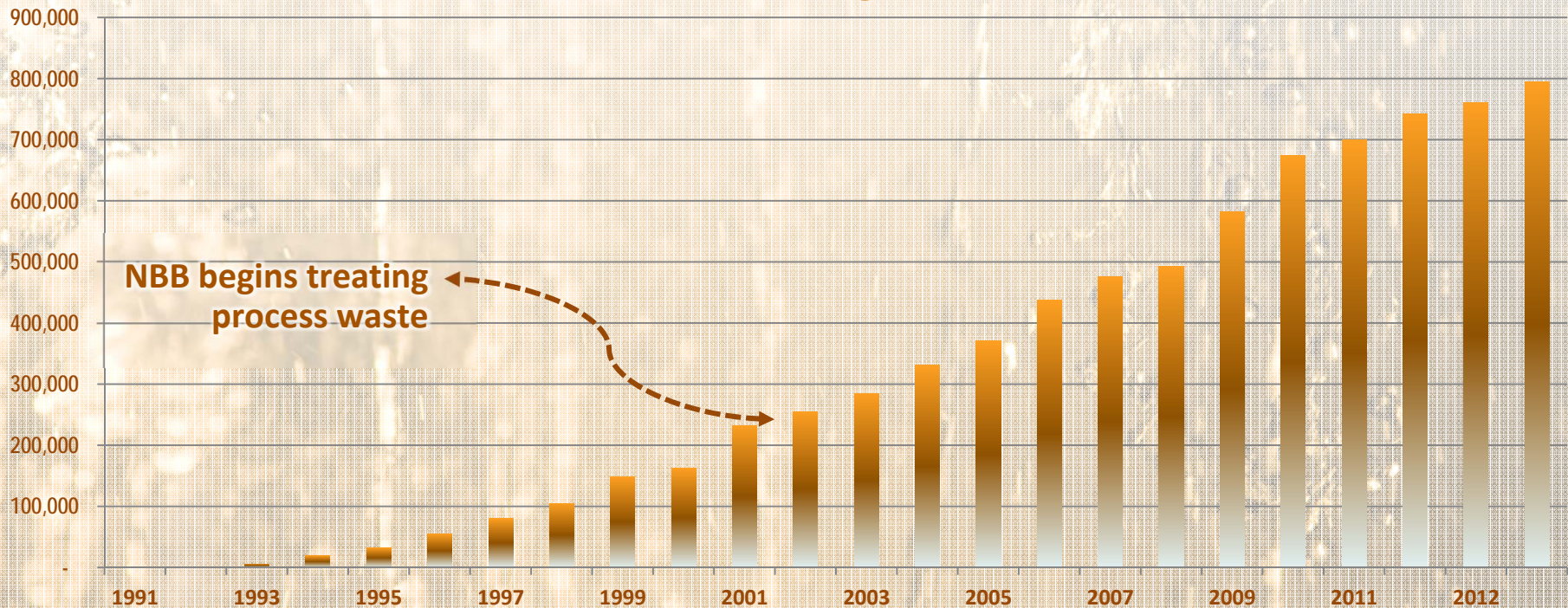
Barrelage



NBB Fort Collins Process Water Treatment Plant
Overview and History

NBB Fort Collins PWTP

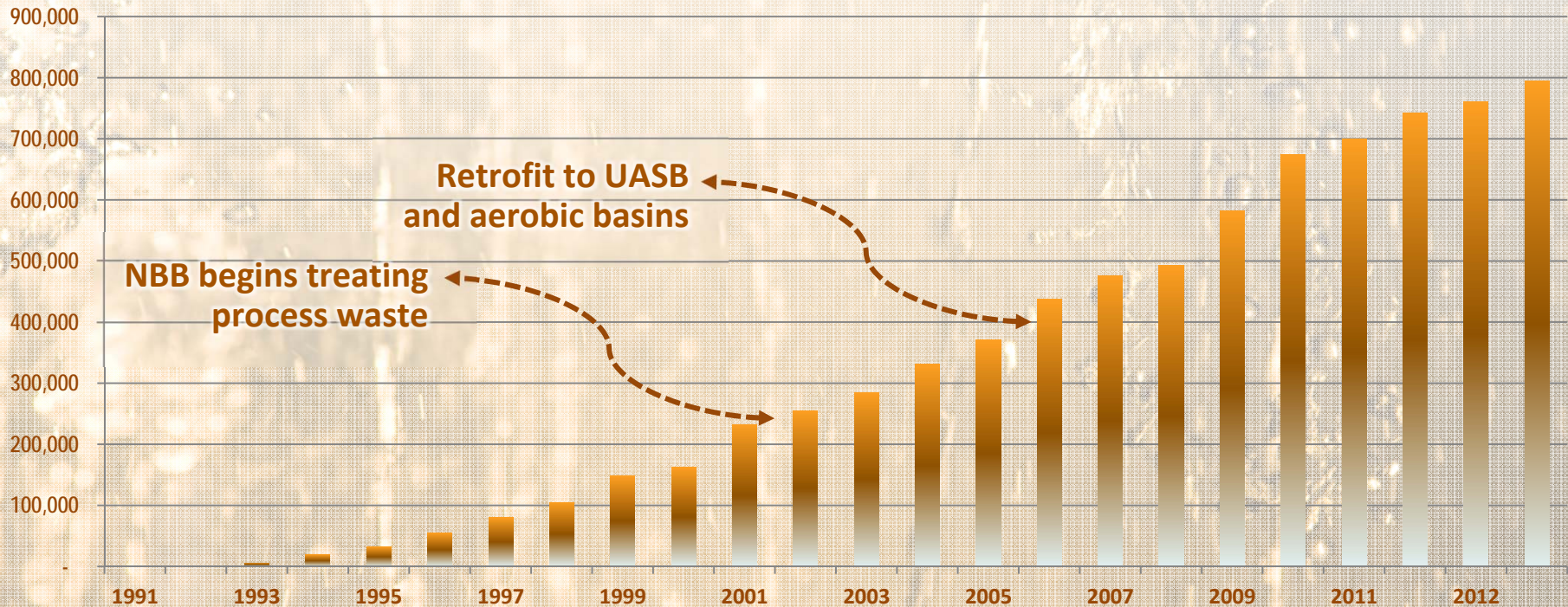
Barrelage



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NBB Fort Collins PWTP

Barrelage



NBB Fort Collins Process Water Treatment Plant
Overview and History

NBB Fort Collins PWTP

- First Anaerobic System installed in 2002–2006 (Von Nordenskjold Two-Stage system)
- Second Anaerobic System 2006–Current
 - Sanotec/GW&E Upflow Anaerobic Sludge Blanket followed by aerobic basins>solids handling
- CHP installed in 2002 & 2006 with biogas
 - 500 kw for CHP at PWTP
 - 292 kW for peak shaving from brewery demands

Modern Lingo

OLD WORDS	NEW WORDS
Light Beer	

NBB Fort Collins Process Water Treatment Plant
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OLD WORDS	NEW WORDS
Light Beer	Session Beer

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Wastewater treatment	
Wastewater treatment plant	

NBB Fort Collins Process Water Treatment Plant
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Wastewater treatment	Water Reclamation
Wastewater treatment plant	Resource Recovery Center

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Modern Lingo

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Wastewater treatment	Water Reclamation
Wastewater treatment plant	Resource Recovery Center
Sludge (or Spent Grain)	
Waste Gas	
Waste Heat	
Pollution	

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Modern Lingo

OLD WORDS	NEW WORDS
Light Beer	Session Beer
Wastewater treatment	Water Reclamation
Wastewater treatment plant	Resource Recovery Center
Sludge (or Spent Grain)	Fertilizer, Feed Stock, Nutrients
Waste Gas	Biogas
Waste Heat	Heat Recovery
Pollution	Misplaced Resource

NBB Fort Collins Process Water Treatment Plant
Overview and History

NBB Fort Collins PWTP

- Typical NBB Process Waste Water

Constituent	Average Value
Biological Oxygen Demand (BOD)	6,900 - 9,400 mg/L
Total Suspended Solids (TSS)	1,300 - 2,900 mg/L
pH:	1-14
Temperature:	25-60 degrees C
Daily flow:	~160,000 gallons/day

- UASB typically removes 80-85% BOD
 - Operational challenges: loss of biomass, system upsets, aerobic blowers are energy intensive, requires significant footprint

NBB Asheville Brewery Plans

- Brownfield Site, limited space 500,000+ bbl/yr capacity



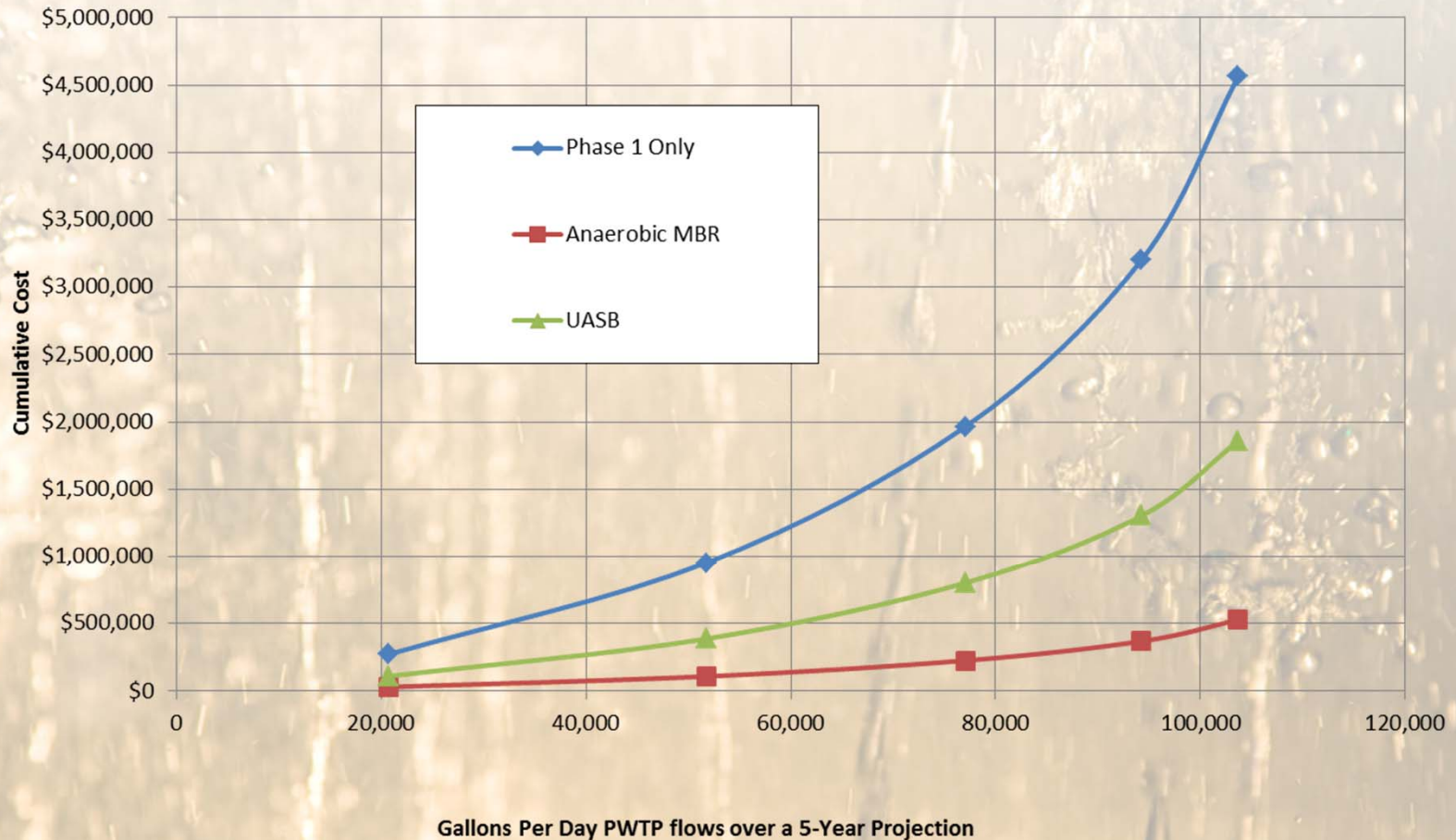
NBB Asheville Brewery Plans

- At projected buildout of 500,000 bbl/yr production = surcharges of \$1-1.3M/yr with no treatment installed

PWTP Flow (gpm)	Daily Flow (gal)	BOD \$/month	TSS \$/month	Flow \$/month	Cost per Year \$
14 gpm	20,000	\$16,432	\$3,760	\$2,469	\$271,932
35 gpm	50,000	\$41,081	\$9,401	\$6,172	\$680,000
70 gpm	100,000	\$82,341	\$18,842	\$12,372	\$1,362,660

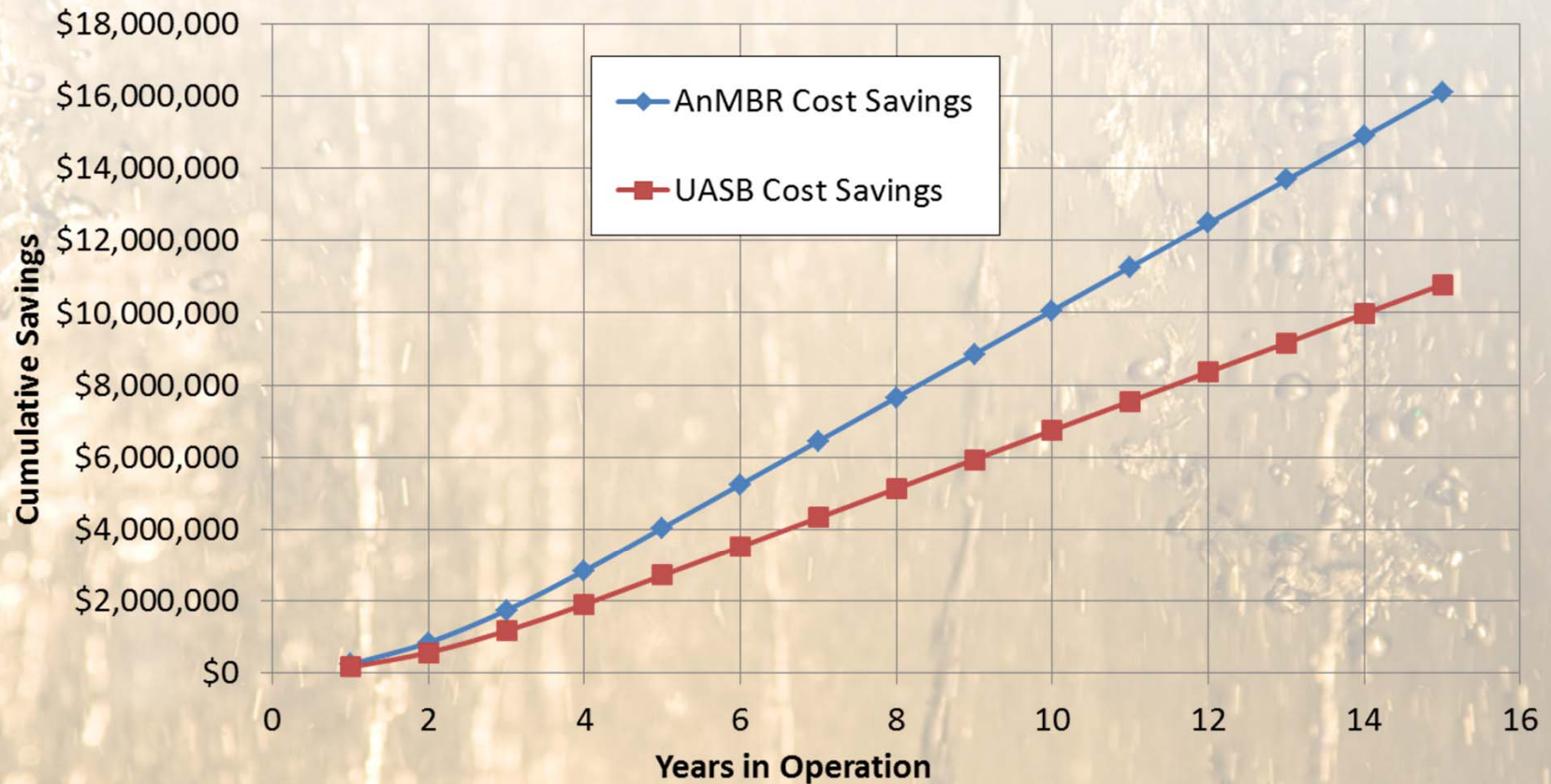
NBB Asheville Brewery Plans

Preparing for Surcharge Costs during brewery Ramp-up



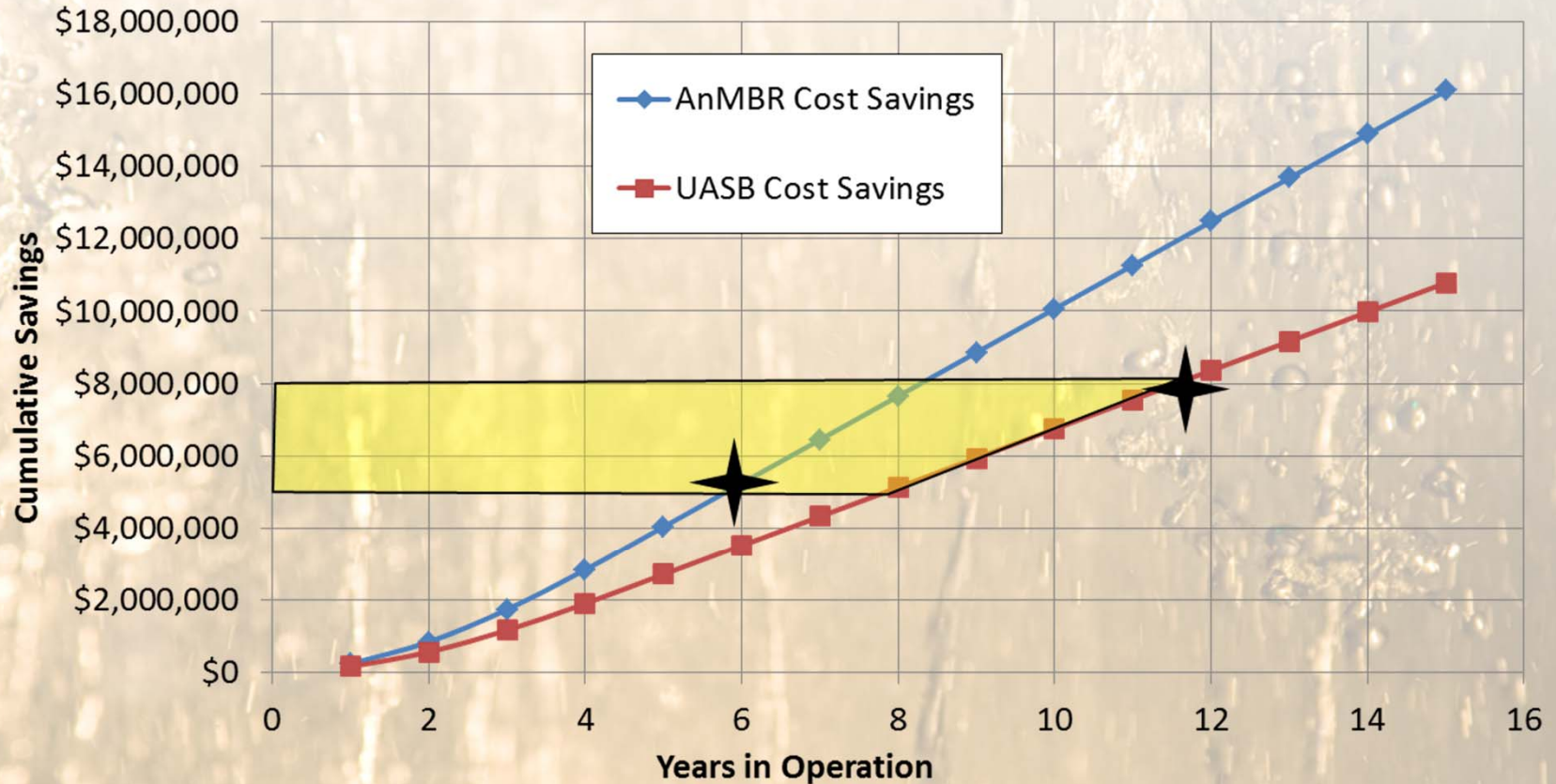
NBB Asheville Brewery Plans

Cumulative Cost Savings



NBB Asheville Brewery Plans

Cumulative Cost Savings



NBB Asheville Constraints

- 4,250 square feet available footprint
- Available space for PWTP is highly visible and close to streets and neighbors



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AnMBR Pilot Testing

- Request for Proposals sent to nine equipment vendors: ADI, Avanti, Biothane, Cambrian, GE, HTI, GW&E, Purpose Energy, Sumitomo
- Up to two technologies are expected to be tested at the operating Fort Collins PWTP in 2014
- Testing to start end of June into Fall

What is AnMBR?

AnMBR = Anaerobic Membrane BioReactor



TANK

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AnMBR = Anaerobic Membrane BioReactor



TANK



Courtesy of ADI Systems, Inc.

MEMBRANE TANK

Why Membranes in Breweries, Now?

- Membrane technology in high solids applications has greatly improved
- High quality of filtrate typically exceeds all surcharge limits
- Separation of HRT from SRT allows for smaller footprint/high removal systems
- Breweries understand filtration!
- Breweries REALLY understand anaerobic digestion!

AnMBR Pilot Goals

- Determine:
 - Operation requirements
 - Design Criteria (to allow competitive bidding)
 - Ability of digester to handle various solids
 - Quantity and quality of biogas
 - Quality of filtrate
 - Best technology for Asheville needs

AnMBR Pilot Equipment

- Enclosed trailer from GE using submerged membranes
- Fully automated

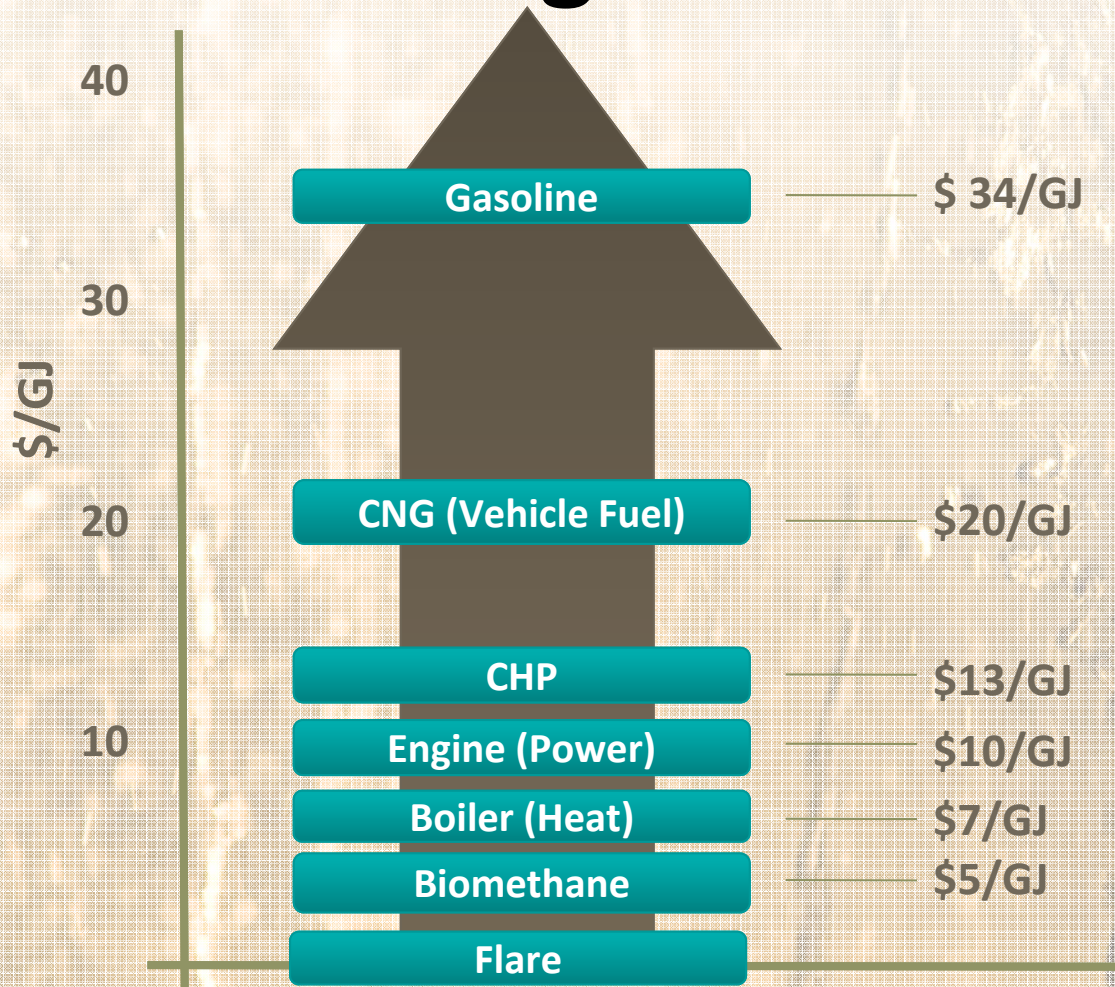


2014 AnMBR Pilot Testing in Fort Collins

AnMBR Implementation

- Every brewery has unique elements to consider
 - Water cost, availability
 - Process waste disposal cost, availability
 - Energy needs
 - Property needs/requirements
 - Over usage of the term “*Turn key*”
- Owner involvement is key to determine preferences for a successful project

Asheville PWTP Looking Forward – Biogas Value



Assumptions:

- Gasoline @ \$4/gallon
- CNG @ \$2.30/GGE
- Electricity @ \$0.10/kWh
- CHP @ 35% electric efficiency
- CHP @ 40% heat efficiency
- Boiler @ 85% efficiency

2014 AnMBR Pilot Testing in Fort Collins

Asheville PWTP Looking Forward

- Maximize production of biogas
 - Consider sweetening biogas for use in vehicles



Courtesy of Greenlane Biogas

2014 AnMBR Pilot Testing in Fort Collins

Thank you! Questions?



Tim Rynders | CDM Smith | rynderst@cdmsmith.com | 303.383.2325