Welcome!

Sustainable Future:

Efficiency in Resource Use and Competitive Positioning For Craft Beverage Producers

Contains portions of some materials initially prepared with support of the New York State Department of Environmental Conservation

New York State
Pollution Prevention Institute

8:30 – 9:00 am	**Check-In / Breakfast**
9:00 – 9:15 am	**Welcome**
	Rajiv Ramchandra- NYS Pollution Prevention Institute Gregory Back - Carey Institute for Global Good (Helderberg Brewshed) - Current state of distilleries and breweries in NY
9:15 - 9:30am	**Sustainability Opportunities in the Craft Beverage Industry**
	Shawn Reidy- Anheuser-Busch- drivers for sustainability, corporate goals and key target areas
9:30 - 10:00 am	**Water and Wastewater: Reduce, Recycle, Reuse**
	Gene Park- best practices for water reduction, recycling and reuse Jim Kuhr- FX Matt Brewing- on site anaerobic digestion for wastewater
10:00-10:30 am	**Energy: Reduction and Efficiency**
	Garry Sperrick-Abandon Brewing Co. & Martin Schooping-NYSP2I- energy assessment & improvements Brian Lee- Tuthilltown Spirits Distillery- waste heat reuse, solar panels, energy efficiency
10:30- 10:45 am	**Break**

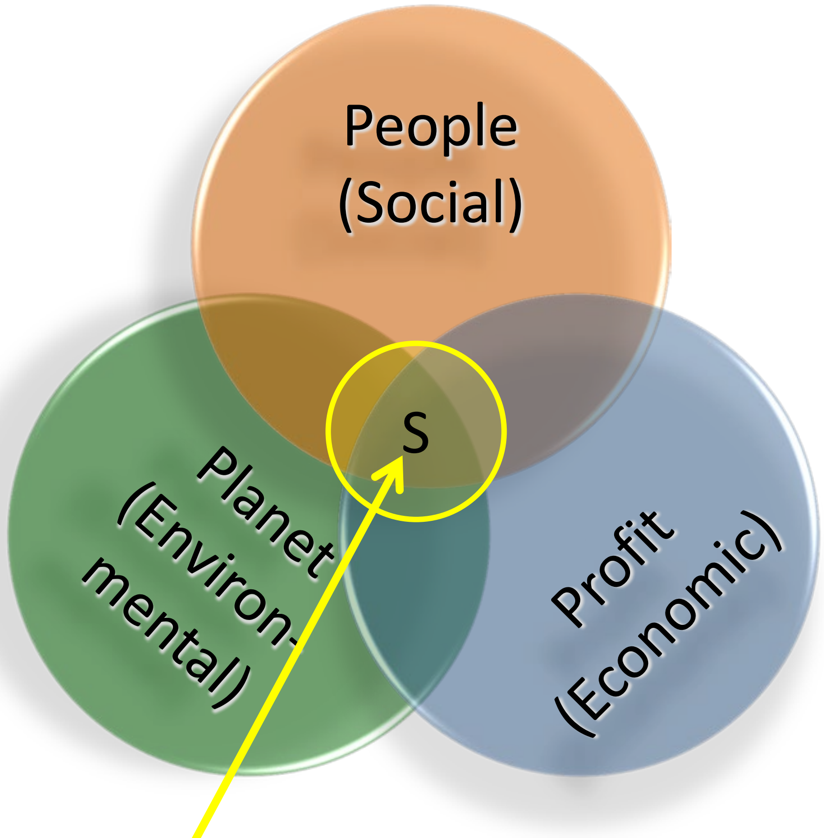
10:45- 11:15 am	**Solid Wastes: Opportunities for Reduction, Alternative Uses**
	Mike Haselkorn- RIT/ F.X. Matt Brewing Co. project- spent grain secondary use - organic wastes from Brooklyn Breweries & anaerobic digestion
11:15-11:-35 pm	**Sustainable Supply Chain** Trish Donohue- NYSP2I/ Rohrbach Brewing Co. project – how tracking sustainability helped business Shawn Reidy – Anheuser-Busch's Smart Barley
11:35- 12:30 pm	**Q&A and Roundtable**
	Small group roundtable discussions on presented topics
12:30-1:30 pm	**Tasting/ Networking (optional)**

Sustainability – Defined
Many Phrases for the Same Concept

Many terms for addressing social, environmental and economic initiatives:

- "3Ps" – People, Planet, Profit
- Social, Economic, Environmental
- "Corporate Social Responsibility"
- "Corporate Citizenship"
- "Sustainable Growth"

Each company or organization should define how they address "sustainability".



Sustainability is actualized

New York State
Pollution Prevention Institute

New York State Pollution Prevention Institute (NYSP2I)

Vision & Mission

Vision:

The vision of the NYS P2I is to foster the transformation and development of sustainable businesses and organizations in New York State in a collaborative program committed to making the State a leader in environmental stewardship.

Mission:

The mission of the Institute is to provide a high-impact, comprehensive and integrated program of technology research development and diffusion, outreach, training and education aimed at making New York State more sustainable for workers, the public, the environment and the economy through:

- reductions in toxic chemical use
- reductions in emissions to the environment and waste generation
- the efficient use of raw materials, energy and water

The Helderberg Brewshed

HELDERBERG BREWSHED

An Initiative of the Carey Institute for Global Good

CAREY INSTITUTE
FOR GLOBAL GOOD

The Farm Brewery Legislation

This legislation, enacted in 2013, establishes a dedicated license for breweries that pledge to use New York-grown ingredients in their products.

		
2013-2017 20% NYS Hops and Small Grains	2018-2023 60% NYS Hops and Small Grain	2024 90% NYS Hops and Small Grains

The license also allows for the creation of "branch offices" which are becoming vibrant taprooms and one-stop shops for local craft beverages and other locally-sourced goods.

Farm Brewery Impacts

- The legislation has more than doubled the number of craft breweries in the state between 2012 and early 2015
- In the same period, farm distilleries, under a similar law, have increased 700%
- Additionally, the bill has brought about a broad-based interest in developing a state-based small grains and hops agricultural sector.
- Prohibition and diseases wiped out hops and brewing grains in the first half of the 20th century, requiring a restoration of the fledgling industry

Moving Forward

- The Carey Institute believes the farm brewery and farm distillery bills present a unique and much needed opportunity for agricultural economic development that directly supports sustainable community food systems.
- Alone, however, the farm brewery legislation is not enough
- The new demand for locally grown hops and small grains creates new opportunities for farmers and processors
- To foster a more robust farm-to-glass partnership, the Helderberg Brewery Initiative has three core objectives: education/capacity building, research/development, and local/regional market development

Education and Capacity Building

- The Brewshed has developed a Farm-to-Glass Workshop series that brings together New York State's farmers and craft beverage producers
- The Brewshed will provide technical assistance and experiential learning opportunities in brewing, brewery start up and business management
- We are also a physical brewery, crafting beer for our local market and educating consumers about NYS beer and the farm-to-glass supply chain

Research & Advocacy

- We are advocating for the inclusion of malting barley in 2015 USDA Non-Insured Crop Disaster Assistance Program
- We called for the inclusion of a grain hub in New York State's Food Hub Feasibility Study in Cobleskill
- We have published both a malt house and farm brewery Feasibility Study

Local & Regional Market Development

- Launching regional discussion of Brewer & Distiller Supported Agriculture mode
- Conducting needs assessment for regional breweries
- Developing small grains marketing & mapping tool to streamline supply chain


The Craft Beverage Industry In
New York State
May 2015

Industry Vital Stats (Craft Beer)

- The number of craft breweries has more than doubled from 2012 to 2015
- 95 breweries in 2012
- 207 in January of 2015
- Craft beer production is up 54 percent from 2011 to 2013
- 859,535 barrels of beer produced in 2013
- Total retail value of $500 million
- This, however, is only a small fraction of the entire craft beer market.
- 3.66 million brewery related tourism visits last year

Industry Vital Stats (Craft Spirits)

- 71 farm distilling licenses
- 10 in 2011 (700% increase)
- Farm distilleries purchase 1,000 tons of grain from New York farms
- Farm distilleries hosted over a half million visitors last year
- About half of New York's 63 counties are home to at least one distillery
- Five million bottles of Empire State spirits have been made to date.

Jobs Created

- The craft beverage industry accounts for 6,552 direct jobs
- The industry supports another 4,814 jobs in related industries
- Craft beverages represent $2.9 billion in direct and indirect revenue within the state
- Another $554 million in direct and indirect wages
- Nearly $3.5 billion in total economic impact on the state.

Infrastructure Investments

- The state has announced the creation of a $350,000 fund to support research into hops and malting barley
- A Federal barley crop insurance plan has also been proposed.
- Hops and barley are essential to the growth of our in-state craft beverage industry.
- The farm brewery law mandates that breweries source 20% of their ingredients from within the state
- Percentages will increase incrementally
- Farm distilleries must source 75% of their ingredients from NYS
- Hops acreage has increased from just 15 acres in 2010 to 250 acres in 2014 with more on the way
- Barley acreage has increased to 2,000 acres from 500 in 2012

In Summation

- The craft beverage industry in New York State is experiencing undeniable growth
- This is thanks in part to changing state policy, an innovative mindset amongst individuals opening breweries and distilleries, and larger market trends
- Continued growth will be sustained through further infrastructure improvements, supply chain streamlining, and industry self-regulation, as well as public education about craft beverages

Energy Usage

Brian Lee, Co-Founder

Tuthilltown Spirits

200+ Year Old Site

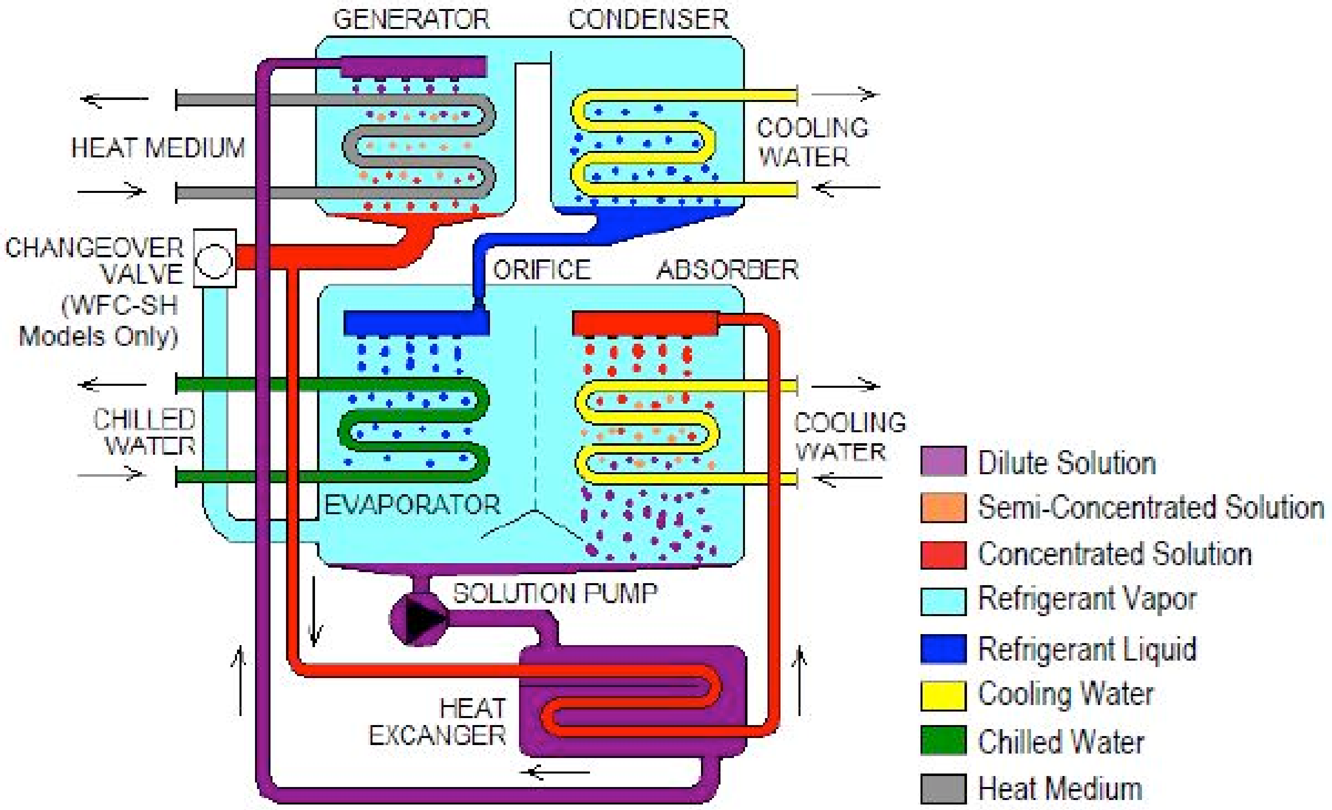
Series of Production Buildings

Grain as Input

Fermentation 4-5 Days

Alcohol Removed in Stills

Yakazi Adsorption Chiller



Four Modern Stills on Site

Barrel Aging Begins

Bottling in Glass

Store at the Distillery

Product Lineup

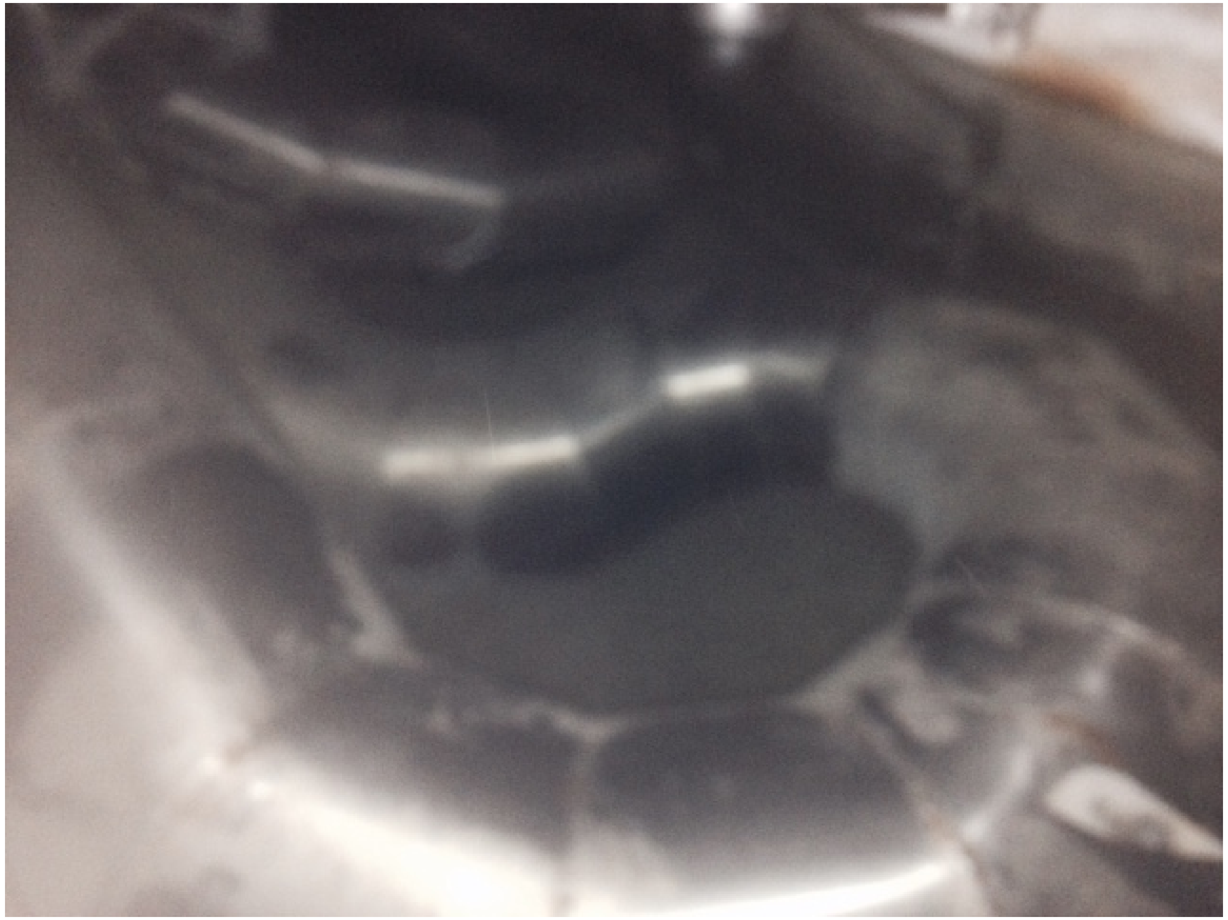
Goods Packaged for Retail

Solid Waste Stream

Biomass Boiler

Liquid Waste Stream

Direct Evaporation of Waste Liquid



Evaporator Boiler System

50KW Solar Array

French Still Product “Parrott”

“1867” Charente Still

Rochester Institute of Technology (RIT)

Dr. Michael Haselkorn
April 30th, 2015

"You can observe a lot by just watching." Yogi Berra

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Problem

- According to Gunter Pauli of the Zero Waste Research Institute 92% of brewing ingredients are wasted.
- Most of the waste is spent grain that still has lots of useful protein and fiber.
- Spent grain is potential revenue that most brewers are either giving away or paying to have removed as refuse.

Why let that grain go down the drain when that mushy malt can be turned into money?

Uses for Spent Brewers Grain

Number 1 use for spent brewers grain is Animal Feed

- It is either sold at a nominal cost or given away for free
- Offsets waste disposal fees
- Transportation costs an issue – farms need to be relatively close

Use spent Brewers grain to feed beef sold in restaurant or pub

Uses for Spent Brewers Grain
Foam to Flora

- Schlafly Beer (St. Louis) used a grant from Missouri Dept. of Natural Resources to research various uses for spent brewers grain
  - Best use was compositing
  - Spent brewers grain greatest ability is to provide food to a community

- Milwaukee Brewing Company partnered with Growing Power
- Brewery 85 (South Carolina) partnered with Generous Garden
- Grow food for local food banks and local churches

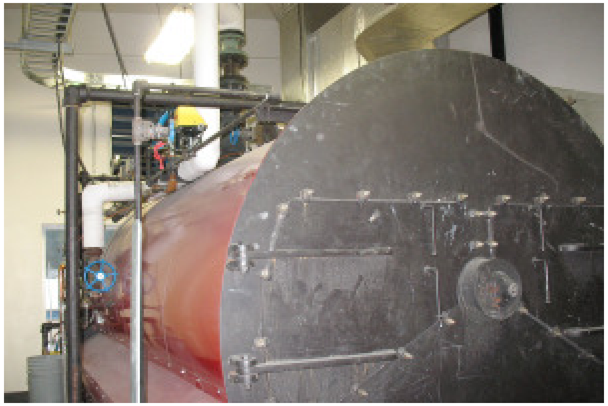
Uses for Spent Brewers Grain
Foam to Plate

- Using the spent grain for bread products
- The historic Frankenmuth Brewery in Michigan serves their chili in a spent grain "bread bowl".
- Granite Restaurant and Brewery in Toronto matches jalapeno spent grain bread with their Best Bitter as part of a prix fixe beer dinner menu.
- The bruschetta served at Hales Ales in Seattle is spent grain crostini topped with fresh mozzarella, vine-ripe tomatoes, and fresh basil, drizzled with balsamic reduction vinegar.
- Mixing with Peanut butter and making dog biscuits

Uses for Spent Brewers Grain

- Spent grain compost can also be used as a growing medium for mushrooms.
- Schlafly is hoping to use another grant to renovate storage areas at their Bottleworks to create incubation and fruiting rooms that will use spent grains and spent yeast to grow oyster mushrooms they will serve at their two restaurants.
- Great Lakes Brewing Co. in Cleveland provides spent grain and scrap paper to their partners at Killbuck Farms to grow organic shitake and oyster mushrooms that are used in entrees at their pub restaurant.

Uses for Spent Brewers Grain
Create Energy



Alaskan Brewing Company

- Biomass Steam Boiler
- Eliminate need to purchase energy to dry grains
- Reduced energy costs by ½ for steam creation for brewing process

The Matt Brewing Co., Inc. On Site Anaerobic Digestion

Sustainable Future:

Efficiency in Resource Use and Competitive Positioning for Craft Beverage Producers

Thursday, May 14th, 2015

Carey Institute for Global Good, Rensselaerville, NY

Overview

- Wastewater pre-digester
- Anaerobic Digestion 101
- Why did we do this?
- Start up
- What do we treat?
- Impact
- Future

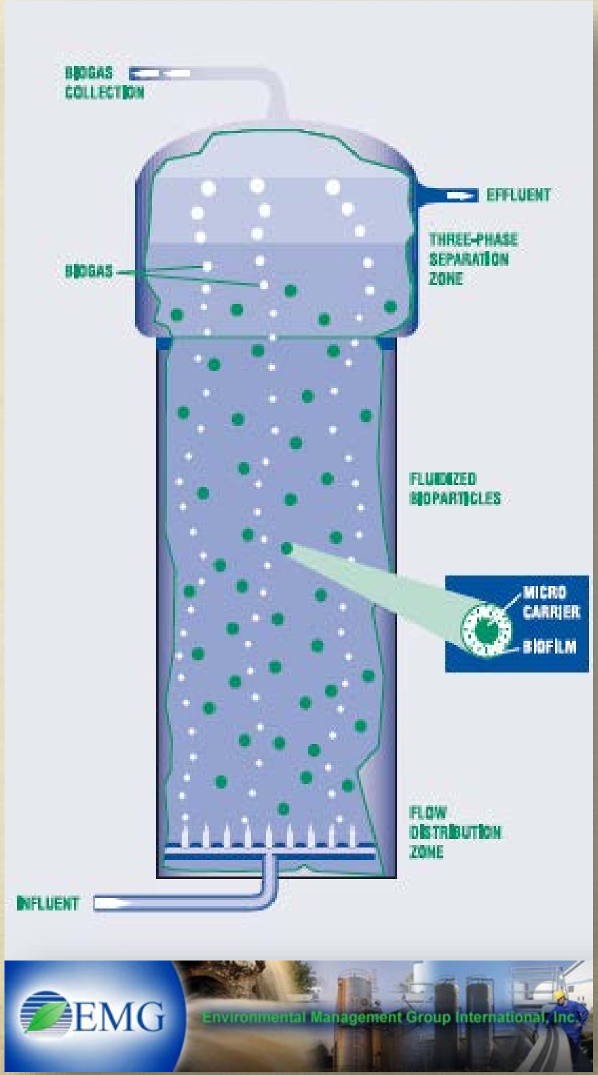
Wastewater Pre-digester

Anaerobic Digestion 101

Per the EPA…

- Anaerobic digestion is a biological process that occurs when organic matter (in liquid or slurry form) is decomposed by bacteria in the absence of oxygen (i.e., anaerobic).
- As the bacteria "work," biogas is released, which consists of approximately 60% methane and 40% carbon dioxide.

http://www.epa.gov/methane/agstar/anaerobic/ad101/index.html



Why Did We Do This?

- Energy Production
  - First considered boiler feed
  - Electricity generation
- Incentives were right
  - NYSERDA grant
  - Federal tax credits
- Not because we had to
  - No pressure from local sewer authority

Start Up

- Feed
  - Capturing high strength wastewater
- Seeding
  - Sources
- Solids removal
  - Hops!
- Ramp Up
  - Turtle v Hare

What Do We Treat?

- Process wastewater only
  - 33,000 to 55,000 gallons per day (average 40,000 gpd)
- High load waste water only
  - Characterization study importance
- C.O.D.
  - Influent: 15,000
  - Effluent: 5,000
  - Removal: 67%
- B.O.D.
  - Influent: 8,200
  - Effluent: 2,200
  - Removal: 73%

Impact

- Cost of operation
  - Caustic and other chemicals
  - Utilities
  - Manpower
  - Sewer bill
- Energy Production
  - Biogas
  - Electricity
- Staffing

Future

- Challenges
  - Digestion efficiency
    - Need to get it up to the design specs – getting there
  - Engine efficiency
    - Not running at spec nor is it user friendly
  - Operational input reduction
    - Main concern is caustic cost
  - Outside sources of feed
    - Whey: ~63,000 COD
    - Soft Drink Waste: As high as 120,000 COD
- Options
  - Separate generator to run on NG only.

Thank You

Contact

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Director of Brewery Operations

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Water and Wastewater: Reduce, Recycle, Reuse

NYS Pollution Prevention Institute

Eugene Park, PhD

Asst. Director Technical Programs

May 14, 2014

Contains portions of some materials initially prepared with support of the New York State Department of Environmental Conservation

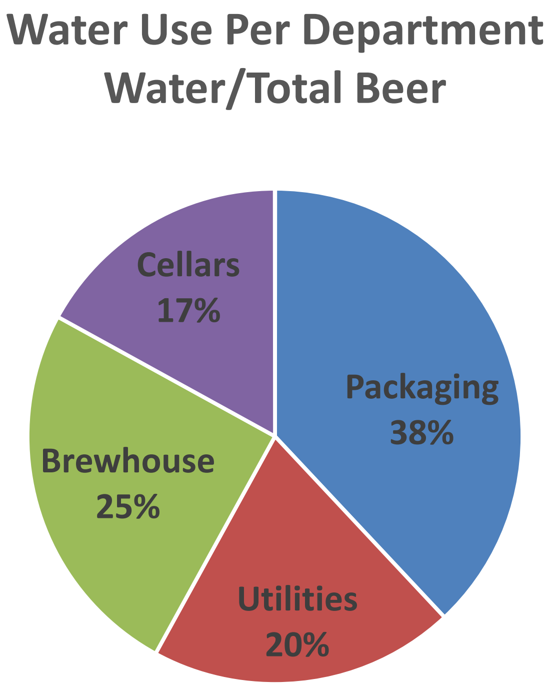
Brewery Wastewater Concerns

- Most breweries discharge 70% of incoming water as effluent[1]
- Brewery wastewater[2]:
  - sugar, alcohol, solids, high temperature, acidic
  - high BOD and corrosive properties
- A recent study showed[1]:
  - Few breweries have onsite wastewater generation
  - Some operations have high strength waste
  - 50% of breweries had no pre-treatment installed to treat effluent prior to municipal discharge
  - 1/3 of breweries paid a surcharge based on BOD and TSS

1. Brewers Association Water and Wastewater Reduction Manual https://www.brewersassociation.org/attachments/0001/1517/Sustainability_-_Water_Wastewater.pdf
2. Brewery Wastewater 101 http://brewerywastewater.com/the-nature-of-brewery-wastewater/brewery-wastewater-101-introduction/

Wastewater Generation and Water Use Areas

- Four main areas of water use in breweries
  - Packaging
  - Utilities
  - Cellars
  - Brewhouse
- Reducing water use will reduce effluent load and lead to wastewater reduction



Water Reduction Benefits

- Potential savings include lower costs for process water as well as effluent treatment and discharge
- Secondary savings can be achieved such as
  - Increased beer production (less product rejection, so less water used)
  - Greater recovery of materials for sale as animal feedstock
- Although the cost of water seems cheap, it is important to consider the full cost of water (i.e. from incoming water to water treatment to effluent surcharges)

Full Cost of Water

Cost Associated with water use = Price of Incoming water + Sewer Service Charge + Cost of energy and chemicals needed to process water + Labor and other costs associated with water processing and treatment

The “price on the water bill”

- The <u>cost</u> of water use at a facility can be much greater than the amount on the water bill.

Best Practices – Leak Detection

- Comprehensive monitoring system in main process areas allows for rapid leak identification and minimum water losses
- Perform a water balance using water and sewer bills with sub-metering data to create a leak-detection checklist

Problem Area	Estimated Potential Costs (U.S.$/Hour)
Hose left on	14.00
Bottle Pasteurizer rinse jets left switched on	14.00
Bottle rinser left switched on	6.10
Leaking float valve on the cooling tower	4.10
Leaking ball valve on the bottle pasteurizer	2.00
Leaking ball valve in the keg plant	1.90
Pasteurizer header tank top-up valve jammed	1.65

Leak Detection Checklist

- Restrooms and shower facilities (in-tank-type toilets, conduct dye tests to locate hidden leaks)
- Kitchens, dishwashing facilities and food preparation areas
- Wash-down areas and janitor closets
- Water fountains
- Water lines and water delivery devices
- Process plumbing, including tank overflow valves
- Landscape irrigation systems

Best Practices - Brewing

- Closed loop system for fermenters – minimizes water flow and energy use
- Yeast dewatering using a filter press or centrifuge to recover beer then sell solids as animal feedstock
- Cross-flow filtration to filter beer uses less water, more efficient
- Chase water – use a 'pigging' system for fairly straight pipes
- Clean-in-place (CIP) system – maximized efficiency in cleaning process as well as fewer labor costs
  - A water tank can be installed to recycle the final rinse stage to use for the initial rinse stage to further save water

Water Saving Measure	Possible Application	Typical Reduction in Process Use (%)
Closed loop recycle	Fermenter cooking	>90
Cleaning-in-place (CIP)	New CIP set	60
Re-use of wash water	Cask Washer	50
Countercurrent rinsing	CIP set	40
Good housekeeping	Hose pipes	30
Cleaning-in-place	Optimization of CIP Set	30
Spray/jet upgrades	Cask Washer	20
Brushes/squeegees	Fermenter Cleaning	20

Best Practices – Packaging

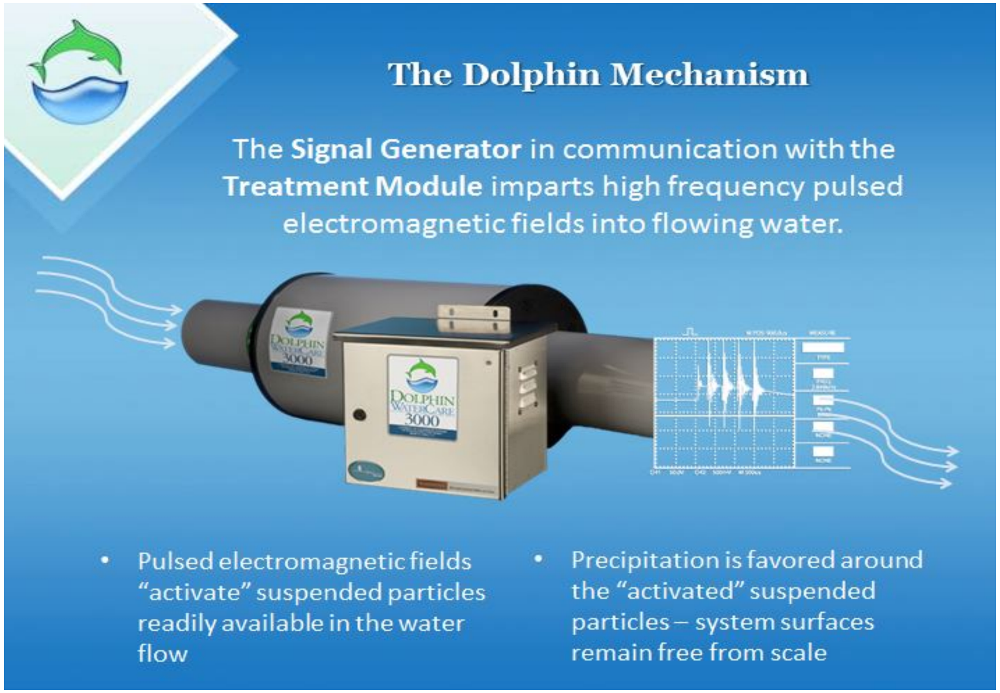
- Switch to dry-lube system on conveyers to reduce water
- Utilize solenoid valves to restrict flows when conveyors are switched off
- Keg/cask washing – dispose of spent beer before washing to minimize BOD and use high-efficiency spray nozzles (high pressure, low volume); final rinse water can also be reused for other tasks or pre-rinsing
- Bottle washing – optimize caustic dosing to allow for minimum water use

Best Practices - Utilities

- Cooling towers – a key parameter for evaluating operation is 'cycles of concentration'
  – Ratio of conductivity in blowdown water compared to make-up water
  – Maximizing cycles will reduce water use (increasing from 3 to 6 will reduce make-up water by 20% and blowdown by 50%)
- Steam generation – properly insulate steam and condensate pipes and recover condensate for re-use to reduce water use
- Compressors – consider a closed-loop system with a cooling tower or integrate compressors with another chilled water loop
  – If closed-loop is not possible, potential for water re-use for washing operations exists

Electro Pulse Systems

- Applies electrical current to treat and flocculate contaminants without adding chemicals
- Neutralizes particulates by forming agglomerates which separate out from the water



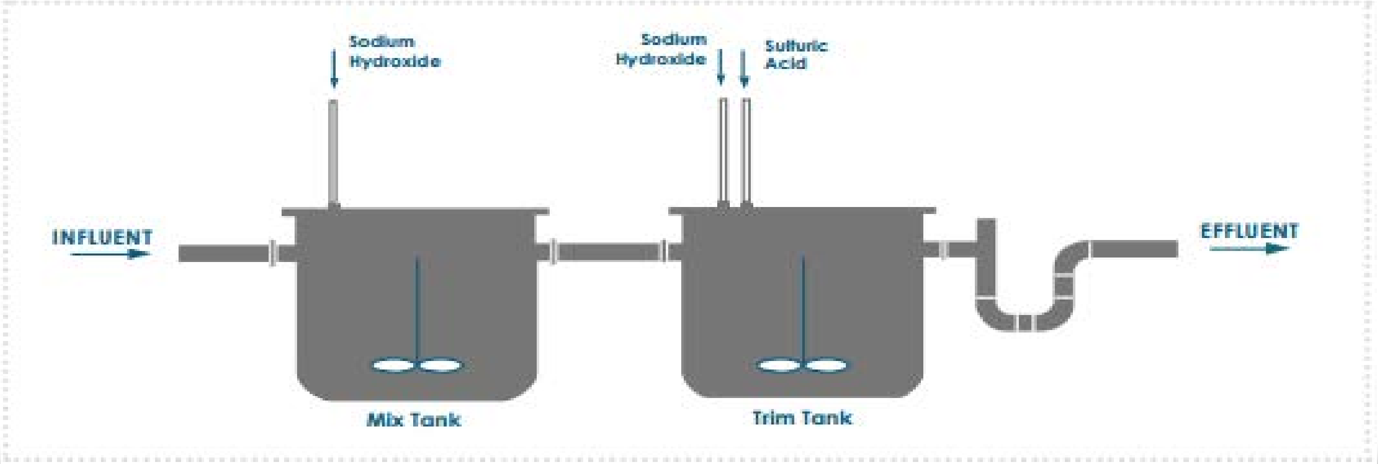
Onsite Wastewater Treatment

- In order to further reduce wastewater cost, onsite pretreatment measures can be installed
- Generally, advanced systems do not have economic payback unless volumes of wastewater large
  - Usually when annual sewer discharge costs are close to $250,000, or approximately 150,000-300,000 bbl/yr (based on flows of 2-4 bbl wastewater/bbl beer and surcharge rates of $0.30/lb BOD, TSS)
- 3 primary pretreatment processes used at breweries
  - pH neutralization
  - Solids removal
  - Biological treatment

pH Neutralization

- Good pH neutralization requires proper mixing, tank configuration, and instrument control
- Flow equalization consolidates effluent in holding tanks for ‘equalizing’ temperature and pH
- Chemical adjustment of pH and flocculation of solids are common in breweries.

Typical pH Neutralization



Solids Removal

- Screening is the first step to remove glass, labels, and bottle caps or floating plastic and spent grains
- Wastewater then flows into a grit chamber for sand, grit, and small stones to settle
- Suspended solids still exist at this stage; these can be removed with further treatment like sedimentation or chemical flocculation

Fixed-film Biological System

- Uses fixed-film media that allows for robust bacterial growth and retention. Bacteria grow on the media as well as inside the liquid
- Ideal for applications where wastewater flow is variable
- Does not require sludge management or time consuming maintenance
- A self-regulating process which adapts to low flow scenarios

Ref: Fixed-Film Biological System

http://www.wwdmag.com/channel/casestudies/recreating-responsibly?eid=286062671&bid=1058236

Conclusion

- Water reductions are possible to save money and reduce wastewater impacts
- Process modifications can be affordable
- End-of-pipe wastewater treatment costs can vary from low to high depending on sophistication of system
- Anaerobic digestion of wastewater also possible
- Less use of chemicals can result because of good water management

SmartBarley

GLOBAL INSIGHTS, LOCAL RESULTS

delivered by Anheuser-Busch InBev

A collaboration with our global barley growers to improve barley quality and farm level performance, leveraging our expertise, industry leadership, and technology to deliver transformative value to our growers and AB InBev

SmartBarley
GLOBAL INSIGHTS, LOCAL RESULTS
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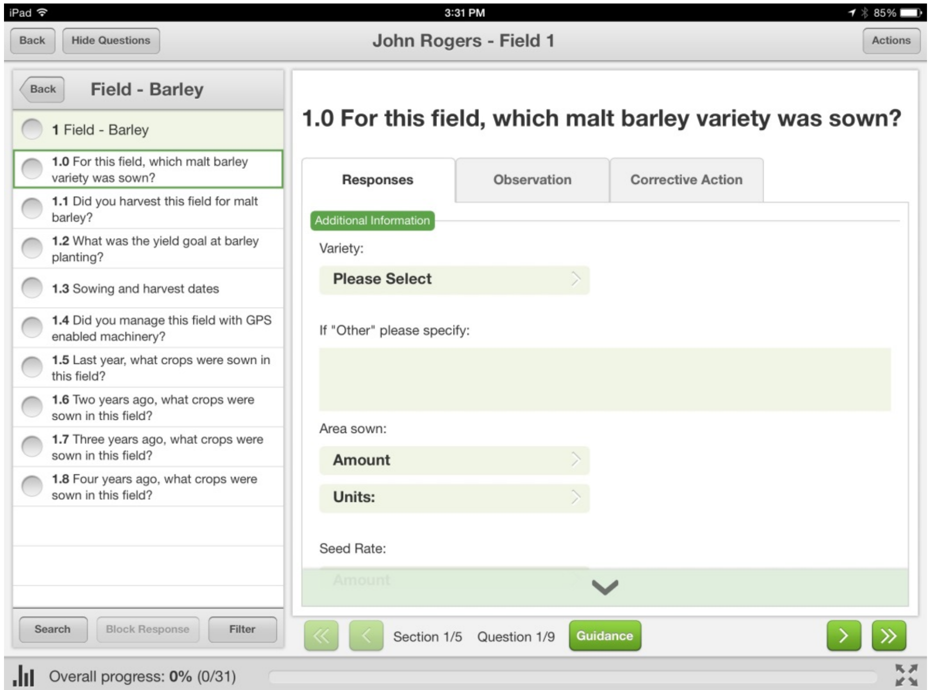
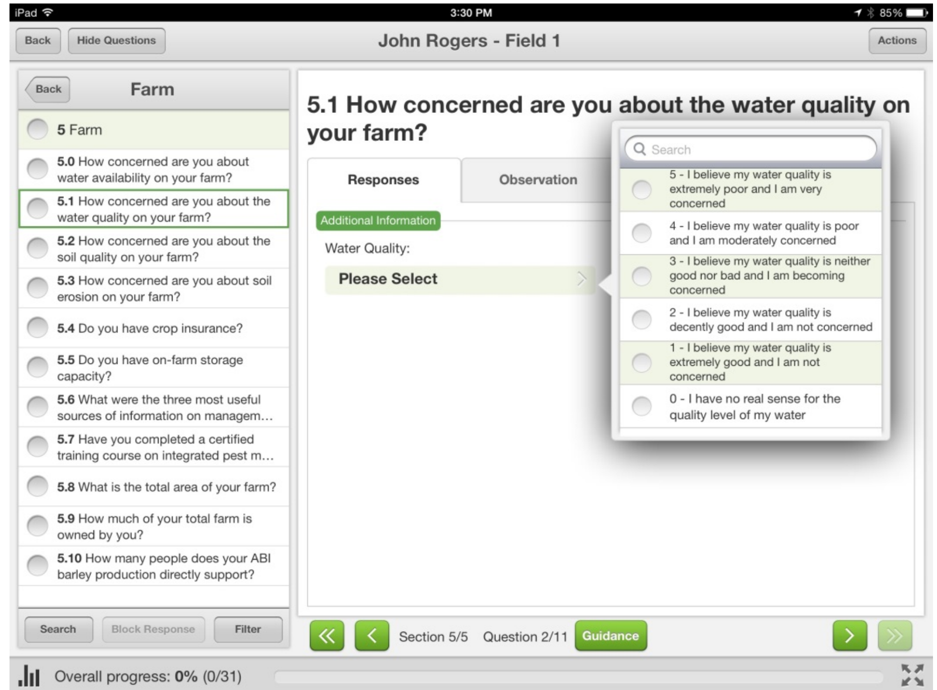
ABInBev

Grower to Grower Benchmarking

Capturing a conversation between our agronomists and barley growers





Field Level – Production Practices to KPIs

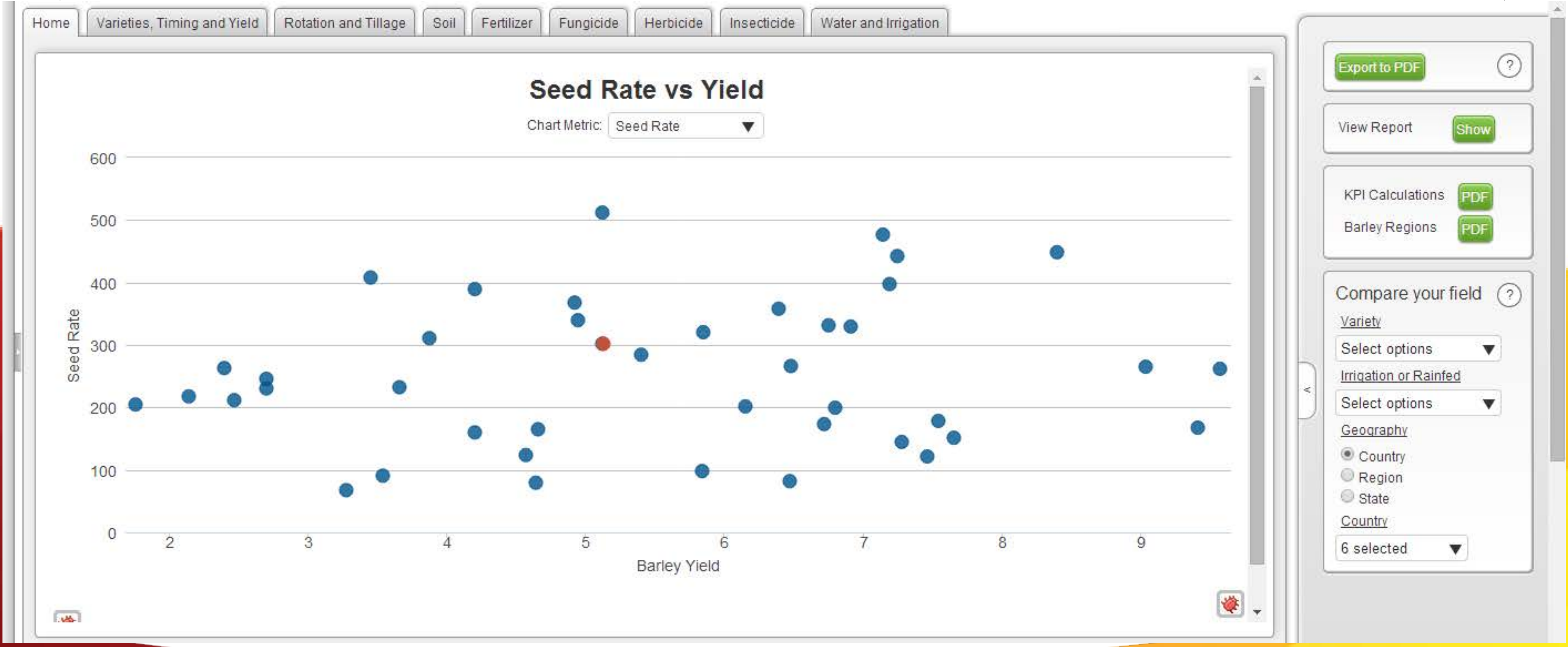
- Review of individual grower fields with barley
- Specific varieties, rotations and crop performance
- Capture inputs and management practices

Farm Level – Better World Indicators

- Assess concern regarding water and soil risks
- Ability to address and manage weather risk
- Economic contribution of producing barley for ABI

Growers, upon completing their field review, receive an email with their unique login

- Access to 40+ KPIs providing productivity and environmental insights for their production
- Ability to benchmark against growers around the world; filter by location and production characteristics



Insights to Action – Best Practices & Technology

AgriMet

Partnering with government and academia to improve irrigation management in Idaho and Montana

Country: United States

Local Stakeholders: Caribou Soil District, USDA, University of Idaho

2014 Targets:
- 6 climate stations
- 3 AgriMet field trials
- 25 participating growers
- 1000 educated about AgriMet

Irrigation Optimization

Improving irrigation practices in the Gansu province that reduce water use and improve drought management

Country: China

Local Stakeholders: GAAS, State Owned Huangyanghe Farm

2014 Targets:
- Irrigation optimization trial
- Ganpi drought tolerance report
- Ganpi malt quality report
- 30 grower demonstration

Conservation Agriculture

Enhancing soil health and moisture retention through conservation agriculture in the Bajio and Altiplano

Country: Mexico

Local Stakeholders: MasAgro, FIRA, SAGARPA

2014 Targets:
- 900 demonstration participants
- 2000 committed ha for 2015
- 4 qualified trials in Bajio

Handheld NDVI Sensors

Improving nitrogen use efficiency to increase yields, grow profits and enhance water quality in the Bajio

Country: Mexico

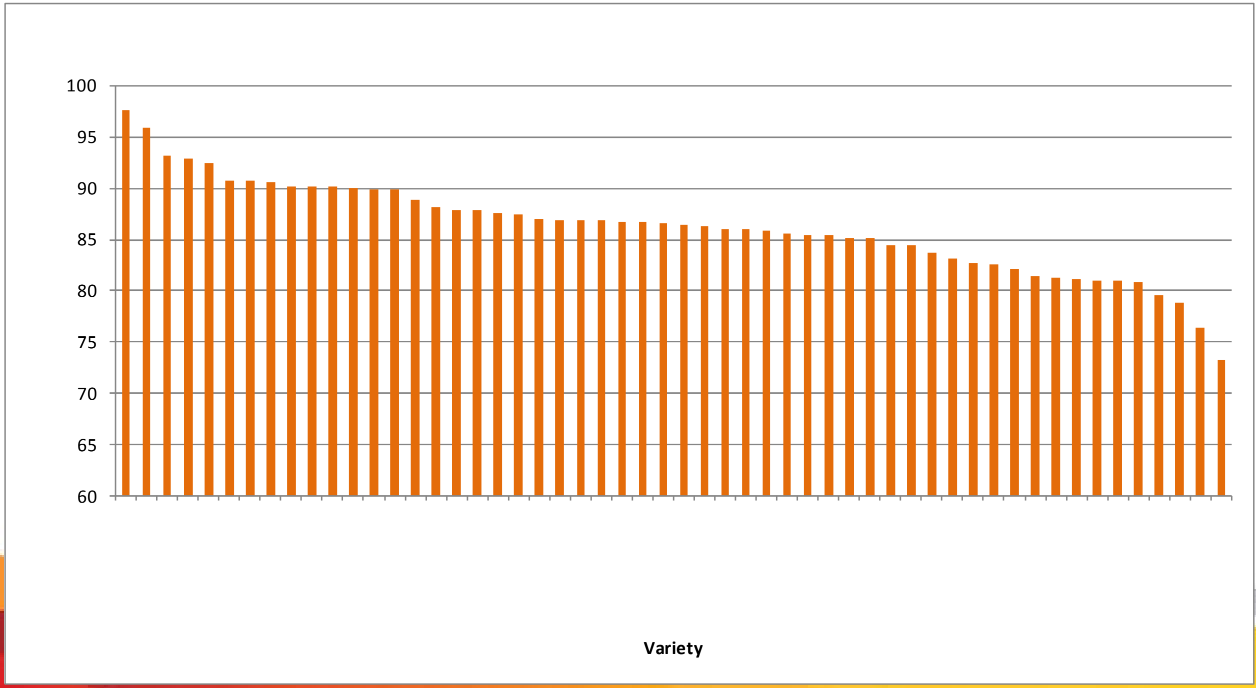
Local Stakeholders: MasAgro, FIRA, SAGARPA

2014 Targets:
- Summer promotion program
- 14 demonstrations
- Implementation of grower rewards system for giveaways

Improved barley varieties

Global research strategy to breed, evaluate and introduce drought resistant varieties that maintain yield and quality, while requiring less water

- Test new and existing varieties under normal and stressed conditions to determine top performers
- Focus on varieties that maintain at least 70% yield with 60% less water



Sustainable Future Meeting

Shawn Reidy – Sustainability at the Baldwinsville Brewery

Thursday, May 14, 2015

Drivers For Sustainability

- It's the right thing to do
- Reputation – we're expected to use natural resources wisely
  - We have a long history of environmental stewardship
  - Investors are very interested as we find more ways to reduce costs
  - Consumers increasingly basing purchasing choices on how a company reflects their personal values.
- Business Case – water, effluent treatment, energy, agricultural ingredients, and packaging materials are expensive

AB InBev Global Environmental Goals

- Across value chain, 3 goals address water
- Involve internal and external partnerships
- Cascaded across the company and owned by groups and individuals that have the greatest impact on them
- Linked to variable compensation
- Quarterly reporting to Steering Committee (3 Chiefs)

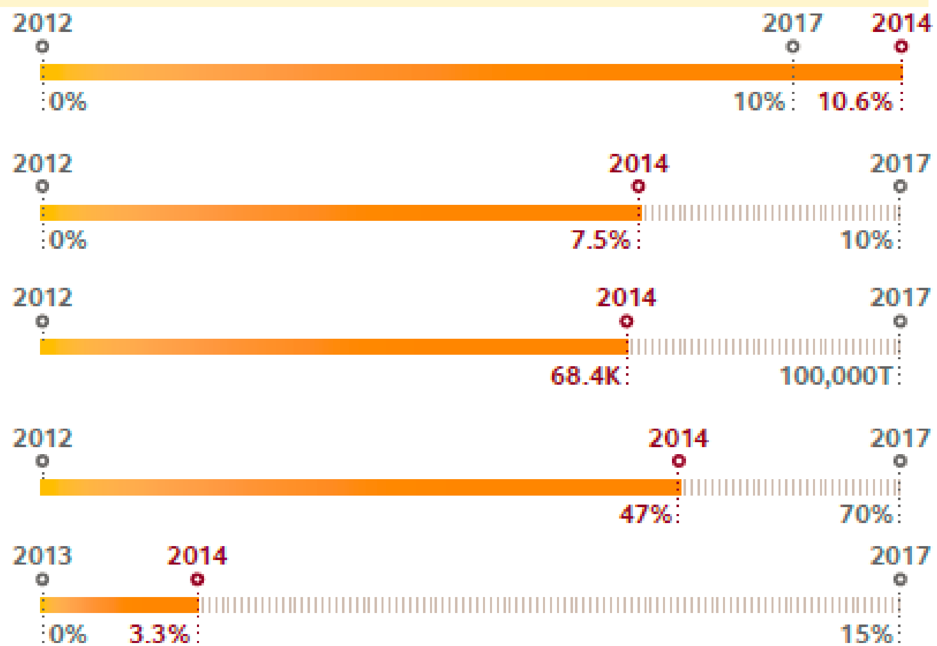
Reduce global greenhouse gas emissions per hectoliter of production by 10%, including a 15% reduction per hectoliter in China°

Reduce global energy usage per hectoliter of production° by 10%

Reduce packaging materials by 100,000 tons

Reach a 70% global average of eco-friendly cooler purchases annually

Reduce greenhouse gas emissions in logistics operations by 15% per hectoliter sold from our 2013 baseline°°



A-B Brewery Performance Indicators

- All parameters are tracked either daily/monthly/quarterly and reported to zone and global
- Assigned to an individual(s) who can have the greatest impact on them.
    - Water usage
    - Energy usage
    - Renewable energy
    - Packaging Material Reductions
    - Recycling Rates/Revenues
    - Watershed protection measures in stressed areas

Other indicators assigned to Zone and Global employees

ABInBev

About the Baldwinsville Brewery

- Over 5.5 million barrels packaged annually
- Over 70 brands and over 300 package combinations
- 2014 Water use ratio = 3.73 hL/hL beer
- Winner of Numerous Awards
    - 2015 NYEL Leadership Tier Member

Baldwinsville Brewery Highlights

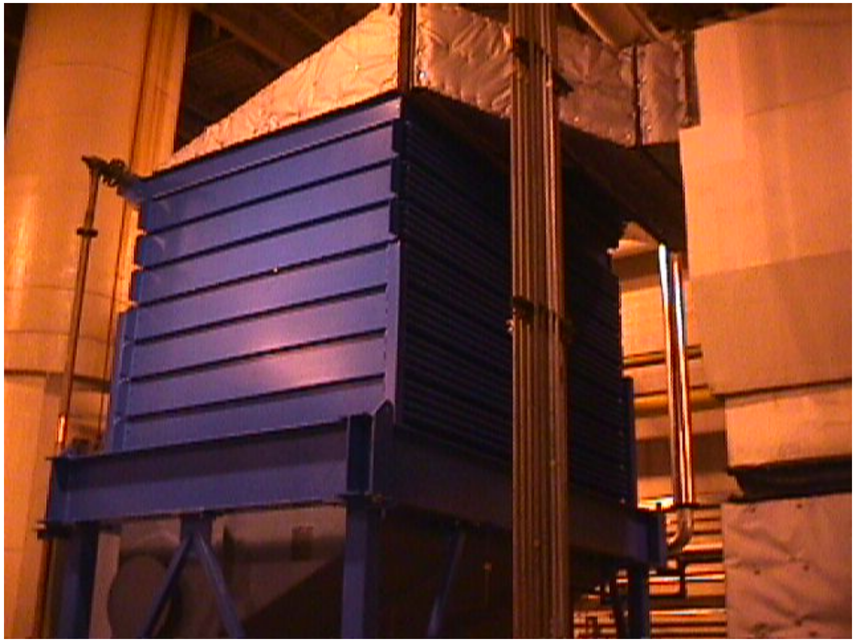
- Direct discharge with aerobic and anaerobic treatment
  - Effluent Returned to Water Source
- 20% of fuel used at the brewery is from methane recovery
  - 500,000 CF/day
  - 10 of 12 US breweries have methane recovery
  - 2 other breweries have land application of effluent to produce high value agricultural products
- 100% solid waste recovery rate with a revenue >$2.5 million
- Condensing Heat Exchanger reclaims 16 million BTU/hour from the boiler exhaust flue gas to make hot water
- CO_2 purification and recovery – 10,000 pounds/hour and reduces oxygen content from 2000 ppm to 1 ppm.

ABInBev

Baldwinsville Brewery Highlights

CO2 Advanced Purification System

Condensing Heat Exchanger



Wastewater Treatment Plant

Final Thoughts

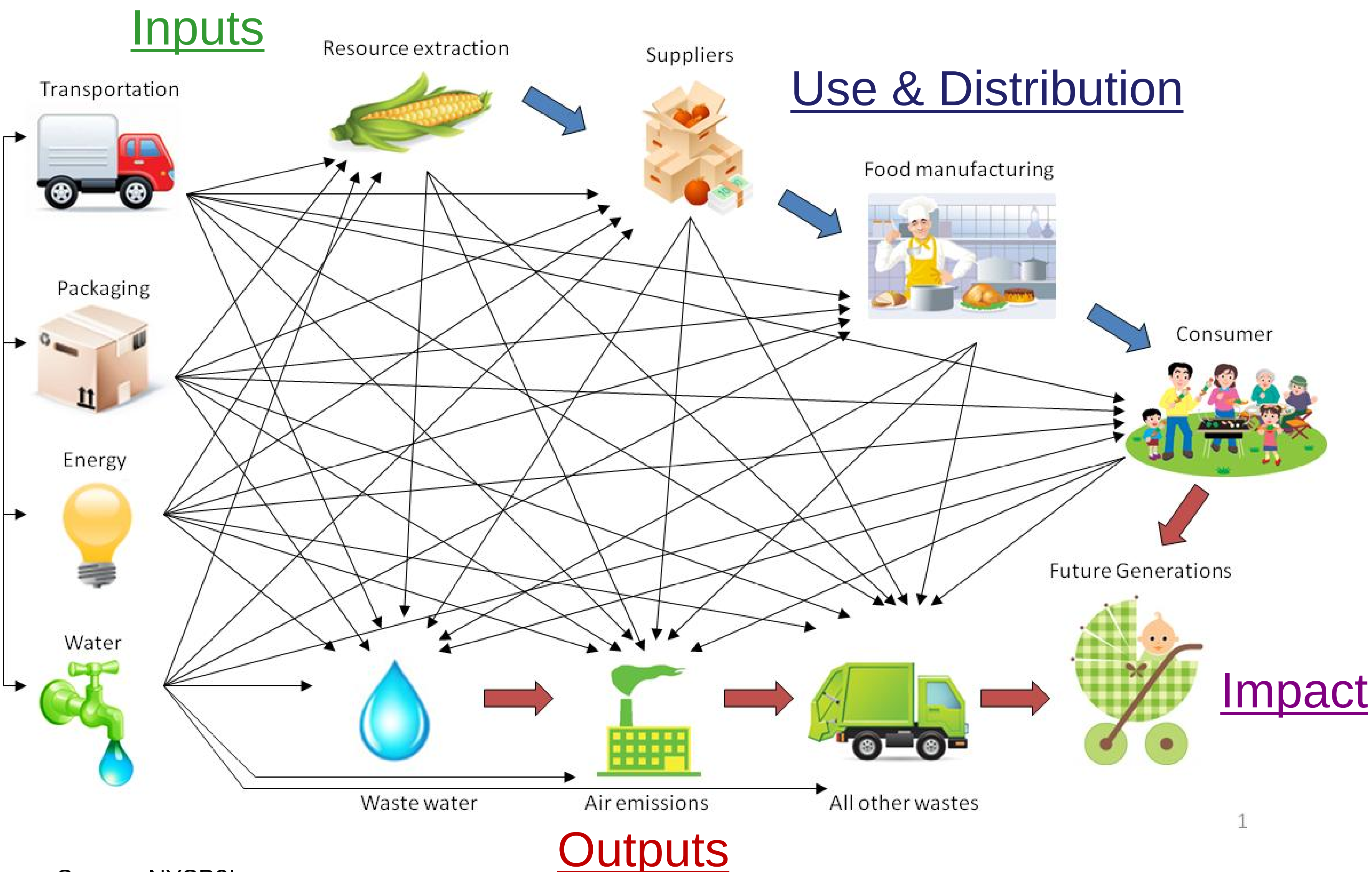
- We’re learning all the time, improving all the time
- We’re driven by a strong company culture that:
  - Promotes dreaming big
  - Holds us accountable through shared targets
  - Focuses on execution, results and practicality
- Sustainability is treated like any other aspect of our business and owned by many
- We look forward to the future and more opportunities to help people, planet and profits

NYSP2I's

Sustainable Supply Chain Program

New York State Pollution Prevention Institute

Supply Chain Relationships



Source: NYSP2I

"Supply Chain Sustainability" – A Definition

The United Nations Global Compact defines **supply chain sustainability** as *"the management of **environmental, social and economic** impacts, and the encouragement of good governance practices, throughout the lifecycles of goods and services"*

*"The objective of supply chain sustainability is to create, protect and grow long-term environmental, social and economic **value** for all stakeholders involved in bringing products and services to market."*

http://unglobalcompact.org/docs/issues_doc/supply_chain/SupplyChainRep_spread.pdf

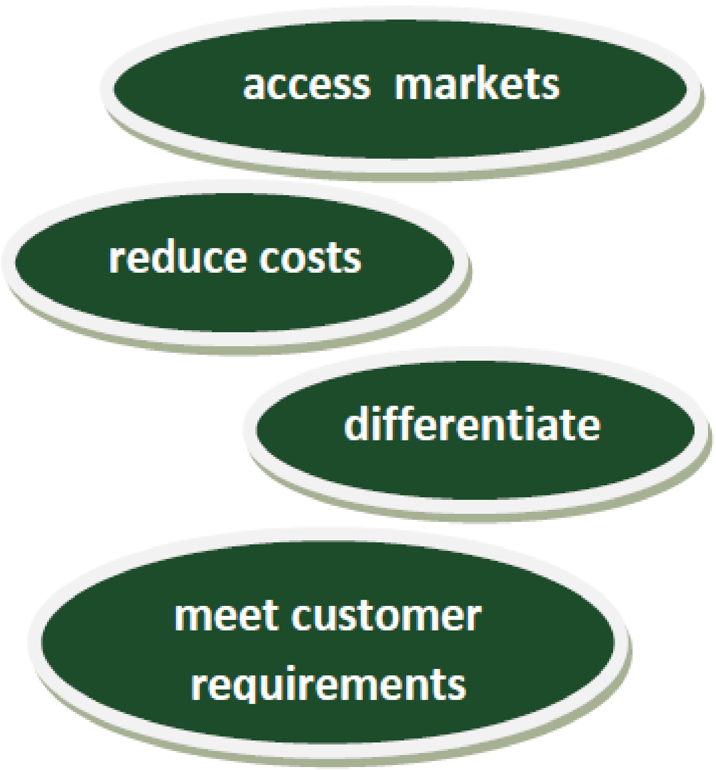
Funding Provided by NYS Department of Environmental Conservation

Sustainable Supply Chains - Benefits

- Ensures compliance with **laws and regulations**
- Enables company to meet **customer requirements**
- Differentiates company from their **competition**
- Adheres to and supports international principles for sustainable **business conduct**
- Improves social, economic and environmental **impacts**
- **Acts** in the company's own interests, the interests of their stakeholders, and the interests of society at large

http://unglobalcompact.org/docs/issues_doc/supply_chain/SupplyChainRep_spread.pdf

Becoming a Sustainable Supplier - Benefits



Cost Reduction

- Identify opportunities for efficiency improvements leading to reduction in total cost of ownership

Risk Reduction

- Mitigate business and brand risk by understanding environmental impacts of self and suppliers

Revenue Growth

- Seen as a leader verses competition
- Viewed as a trustworthy and respectable company
- Become a supplier of choice

Funding Provided by NYS Department of Environmental Conservation

Supply Chain Sustainability Assessment at a Small Craft Brewery

Rohrbach Brewing Company

Rohrbach's is a craft brewery in downtown Rochester, NY. Their ales, lagers, and sodas are sold mainly in western New York. Some products are sold direct to customers through their restaurant and brewery/tasting room but the majority of products are distributed to restaurants, bars and retail outlets.

Opportunity Areas

- The demand for sustainability-minded brewers exists, especially with "millennial-generation" consumers.
- Rohrbach's would like to be able to communicate their commitments to sustainability and strive for continuous improvement to gain and retain customers and be the brand of choice.

ROHRBACH BREWING COMPANY ROCHESTER SINCE 1991 N.Y.

Work Performed

NYSP2I's supply chain sustainability assessment tool was used to inquire about various common components of internationally accepted guidelines, standards, and protocols.

Results

Opportunities identified include:

- informing procurement personnel of sustainable purchasing alternatives;
- measuring impacts to set objectives and targets and to track performance;
- adding policy, objectives and targets, performance and action plans to marketing and communications material.

Rohrbach's anticipates a 10% increase in customer demand due to communicating its sustainability commitment and performance, resulting in retaining 13 jobs and creating two new jobs.

NYS P2I
New York State
Pollution Prevention Institute

Rochester Institute of Technology
Funding Provided by NYS Department of Environmental Conservation

Abandon Brewing Company

Brewery Energy Mapping and Analysis

NYS P2I New York State Pollution Prevention Institute

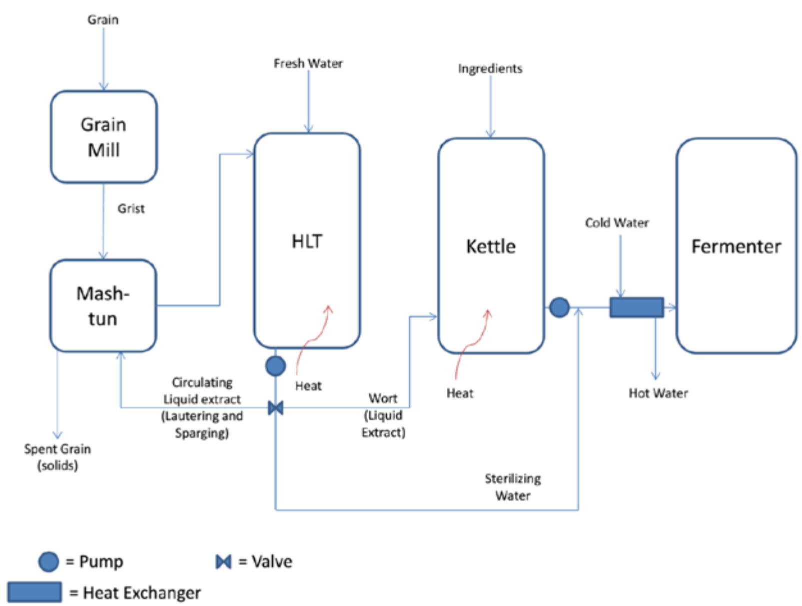
Project Introduction

- Intro to Abandon Brewery – Garry Sperrick
  - How he got involved with P2I
    - Prior history with RIT
  - Motivation to work with P2I
    - Due to his location and lack of production utilities, efficiency was a top priority
- Project details – Marty Schooping
- Implementation and results - Garry

Project Objectives

- Use measured energy consumption in Abandon Brewing Company's pilot brewery to model energy use in the full scale brewery (3 bbl system).
- This model will be used to provide recommendations for reducing the brewery's energy costs.
- The main pieces of equipment that were analyzed were:
  - Heating Lautering Tun (HLT)
  - Kettle
  - Associated Pumps throughout the process

Process Understanding



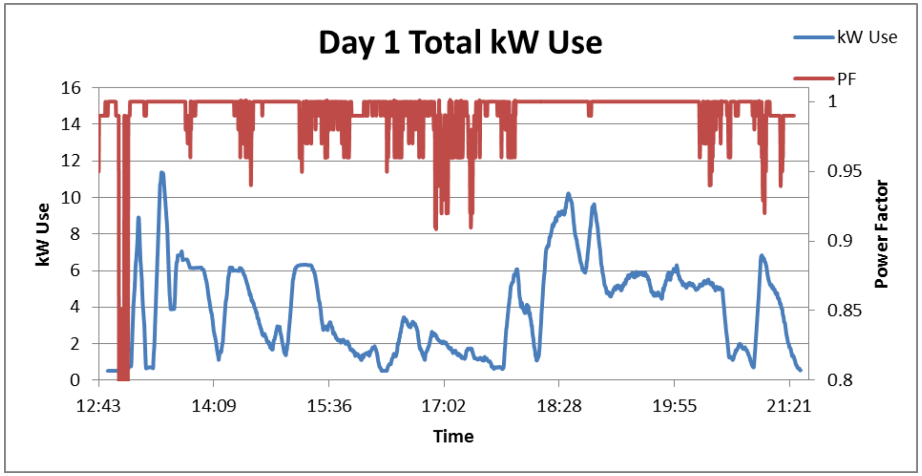
- Steps Analyzed
  1. Crushing of the grain to make the grist
  2. Adding hot water to the grist to dissolve the sugars to be fermented
  3. Separate the wort from the mash
  4. Boiling the wort with hops and recipe ingredients
  5. Cooling the wort to be sent to the fermenter

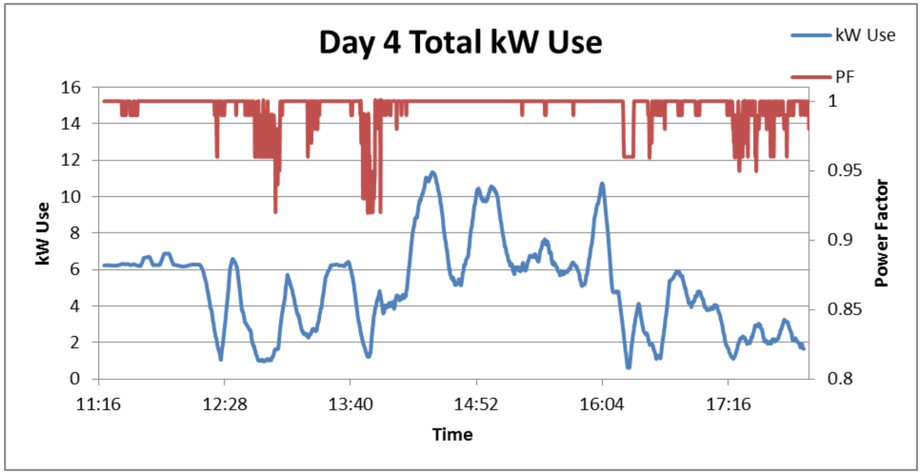
Project Tasks

- Task 1:
  - Monitor Current Energy use for Abandon Brewing Company's Electric Brewery
- Task 2:
  - Construct Energy Map of the Proposed Brewery
- Task 3:
  - Develop Time — Energy Plots of SEU and Sources

Task 1: Pilot Brewery Evaluation

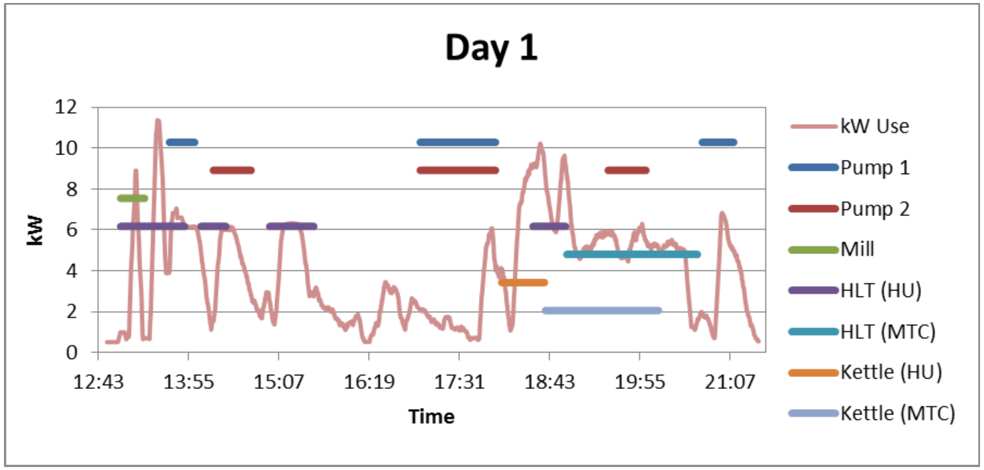
- A meter was installed on site for four days. On ‘Day 1’ and ‘Day 4’ energy use during a single brew was measured.
- The energy used by isolated equipment was also measured during a second site visit

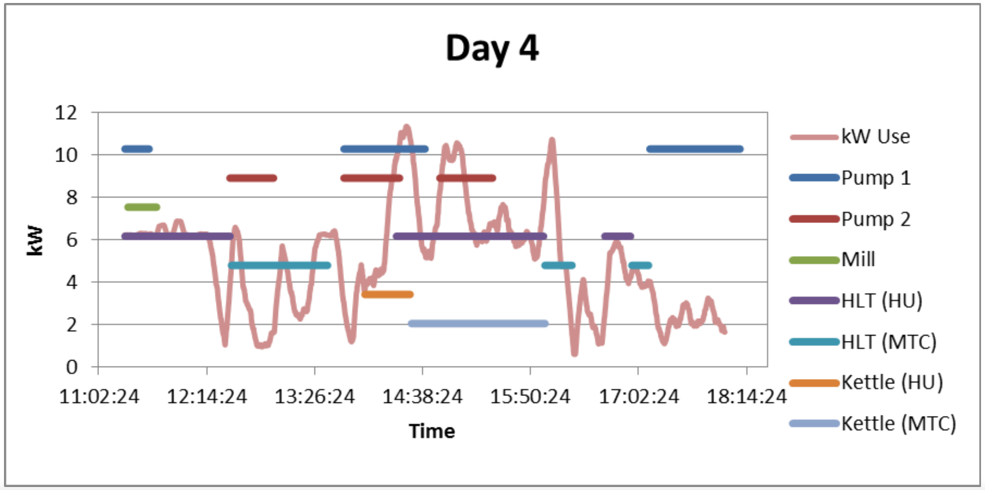




Task 1: Pilot Brewery Evaluation

- Using the notes provided by the brew master and individual equipment power uses, the equipment run times were separated.
- The extracted run times along with the measured power use were used for the analysis of the full scale brewery.





Task 2: Energy Map of Full Scale Brewery

Estimated Times for a Brew	Time (min)	kJ	kWh	Step
Time Required To Fully Heat HLT_1 to 175	142	140580	39.0	Recipe Water Heat-up
Time Holding HLT_1	60	16938	4.7	Lautering and Sparging
Time Required To Fully Heat HLT_2 to 175	118	116820	32.4	Hot Rinse Water Heat-up
Time Holding HLT_2	60	18296	5.1	Waiting for Hot Rinse
Time Required To Heat Kettle to Boil	106	69960	19.4	Getting to Boil
Time Holding Kettle at Boil	90	27532	7.6	Boil Water
	Totals	390126	108.4	

Pump Uses		Time (min)	kJ	kWh
Filling HLT1		10.0	0.81	0.000225
HLT1 to Mash-Tun (L+S)		60.0	4.87	0.001352
HLT1 to Kettle		10.0	0.81	0.000225
Filling HLT2		8.0	0.65	0.000180
HLT to Line (Hot Rinse)		8.0	0.65	0.000180
Kettle to Fermenter		9.7	0.79	0.000218
	Totals	105.7	8.58	0.002382

- Shown is the calculated energy use for each step of the brewing process as well as the energy used by the pump between/during steps
- Calculated using the pilot scale information and the extracted running times

Task 3: Significant Energy Uses

- Energy use is at its peak when the kettle is being brought to a boil and when the sterilization water is heating up. During these process steps, both heaters are running and one or more pumps are circulating water through the piping.

Recommendations

1. Insulation of HLT and Kettle
   - The most energy intense part of the brewing process is the heating up and maintaining of the recipe water.
   - Insulating the HLT, Kettle, and exposed pipes, will reduce not only the cost of heating but the time required for heating as well.
   - Assumptions made by the calculator as well as additional assumptions made by P2I are listed in the report.

Results							
Thickness (inches)	Surface Temp (°F)	Heat Loss (Btu/h)	Cost of Fuel ($/yr)	Installed Cost ($)	Payback (months)	Annual Return	CO_2 Emissions (MT/yr)
0	174.9	7272	$418.14	$0.00	NA	NA	1.85
0.5	NA	NA	NA	NA	NA	NA	NA
0.75	NA	NA	NA	NA	NA	NA	NA
1	91.6	788	$45.31	$758.40	24.4	48%	0.2
1.5	84.2	566	$32.57	$768.64	23.9	49%	0.14
2	79.9	443	$25.46	$778.88	23.8	50%	0.11
2.5	76.9	364	$20.92	$789.76	23.9	49%	0.09
3	74.8	309	$17.76	$799.68	24	49%	0.08
3.5	73.2	268	$15.43	$840.00	25	47%	0.07
4	72	237	$13.65	$850.24	25.2	47%	0.06

Insulation Savings for the HLT

Results							
Thickness (inches)	Surface Temp (°F)	Heat Loss (Btu/h)	Cost of Fuel ($/yr)	Installed Cost ($)	Payback (months)	Annual Return	CO_2 Emissions (MT/yr)
0	211.8	10475	$301.13	$0.00	NA	NA	1.33
0.5	NA	NA	NA	NA	NA	NA	NA
0.75	NA	NA	NA	NA	NA	NA	NA
1	101.4	1106	$31.80	$758.40	33.8	34%	0.14
1.5	91.8	793	$22.79	$768.64	33.1	34%	0.1
2	86	619	$17.78	$778.88	33	35%	0.08
2.5	82.2	508	$14.59	$789.76	33.1	34%	0.06
3	79.4	431	$12.38	$799.68	33.2	34%	0.05
3.5	77.3	374	$10.75	$840.00	34.7	32%	0.05
4	75.7	331	$9.50	$850.24	35	32%	0.04

Insulation Savings for the Kettle

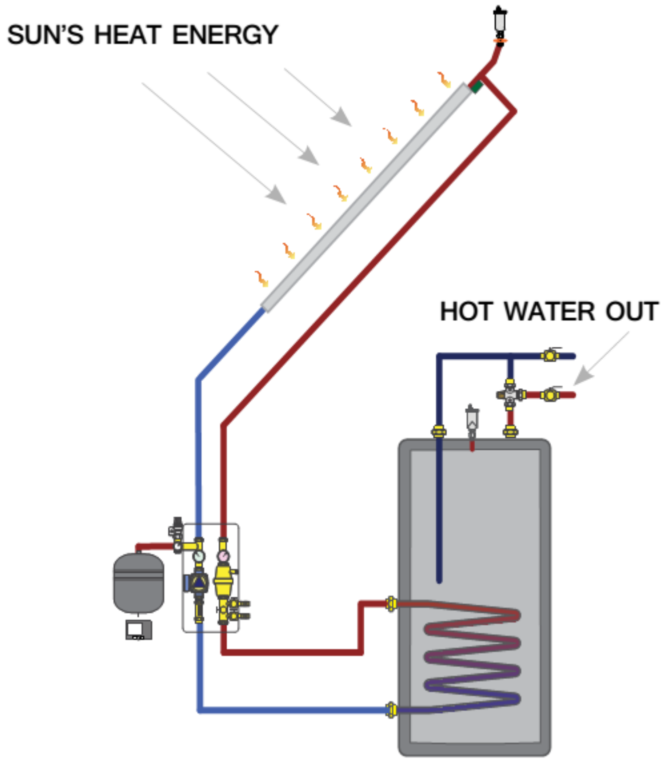
Recommendations

2. Heat Recovery from existing Heat Exchanger
   - The energy from the hot sterilization water and the hot recipe water from the kettle both go unused at the end of the step.
   - Using the existing heat exchanger to recover the heat from these two steps as opposed to just using cold tap water would reduce the amount of energy/time needed to heat as well as cut back on water use.
   - The table displays cost savings as a function of coolant temperature and flow rate. Appendix C of the report contains the full summary of the optimization implications.

	Cost Savings/yr ($)		Coolant Exit Temp (°F)								
	gpm	lb/hour	160	150	140	130	120	110	100	90	80
Cold Water Flow (Coolant/ Water)	2	1,001	196.6	196.6	196.6	196.6	196.6	177.3	138.8	100.2	61.7
	4	2,003	393.2	393.2	393.2	393.2	393.2	354.7	277.6	200.5	123.4
	6	3,004	589.8	589.8	589.8	589.8	589.8	532.0	416.3	300.7	185.0
	8	4,006	786.4	786.4	786.4	786.4	786.4	709.3	555.1	400.9	246.7
	10	5,007	983.0	983.0	983.0	983.0	983.0	886.6	693.9	501.1	308.4
	15	7,511	1,474.5	1,474.5	1,474.5	1,474.5	1,474.5	1,330.0	1,040.8	751.7	462.6
	20	10,014	1,966.0	1,966.0	1,966.0	1,966.0	1,966.0	1,773.3	1,387.8	1,002.3	616.8

Recommendations

3. Solar Water Heating
   - Using the sun's energy to heat glycol/water which then is used to transfer the heat to the recipe water stored in a holding tank
   - This design would reduce the money spent on heating the recipe water
   - The quote from Free Hot Water for the 3 bbl. production system projects a an annual savings of $3, 319 with a payback period of 3.9 years.
   - Appendix B shows the vendors full quote.



Recommendations

- Wind Power
  - The payback period was estimated to be approximately 16 years. Per Sustainable Energy Developments, the payback period is extended beyond an acceptable window for return on investment largely because the wind at the site is marginal.

Implementation

- What systems were implemented?
  - Tank insulation
  - Recapture of heat from process cooling
  - Geothermal instead of Solar Hot Water
- What were the results?
  - Tank insulation reduced heat energy required
  - Recapture and Geothermal combined pre-heat process water to 90°F

Brewery and Distillery Waste Reduction by Anaerobic Digestion

Jacqueline Ebner and Thomas Trabold

Rochester Institute of Technology (RIT)

May 14th , 2015

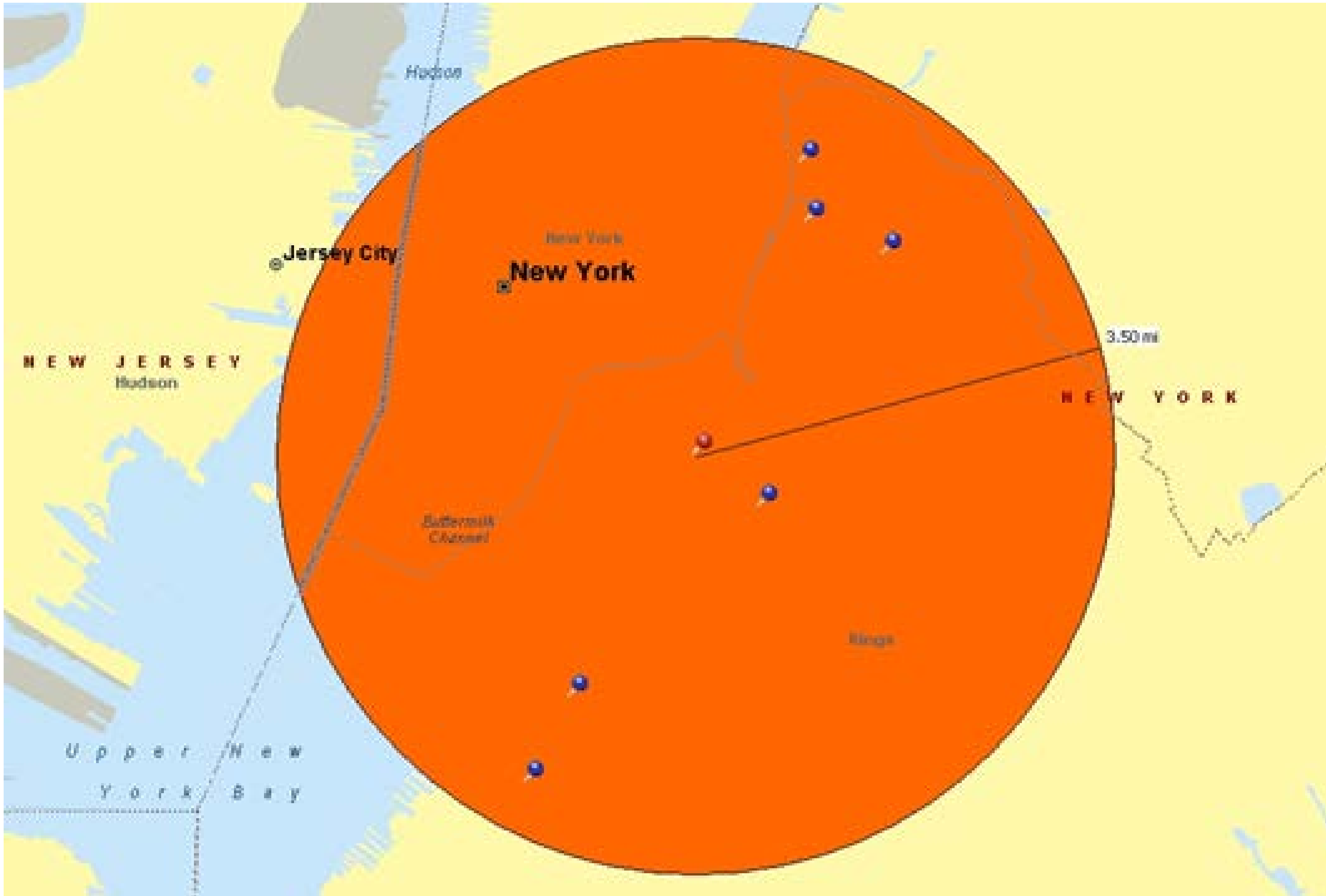
New York State Pollution Prevention Institute

The problem: NYC pays over $250/ton for waste disposal, among the highest in the country

- **76 percent** of the city's **residential trash** is **sent to landfills** (in states like Pennsylvania, Ohio, Virginia and South Carolina), **14 percent is recycled**, and **10 percent is converted to energy.**

- **Over thirty percent** of the city's residential waste stream is **organic material** that can be composted (food scraps, paper towels and napkins, yard waste, etc.). [NYC.gov: Organics Collections & Drop-Offs]

What's the opportunity in the brewery & distillery sector?



Known brewery and distillery facilities located within a 3.5 mile radius of the Brooklyn Navy Yard

Table 1 - Published biomethane potential (BMP) values of food wastes

Waste material	Biomethane potential (BMP) [m^3/metric ton]	Reference
Brewer's grain	129	M. Effenberger (2006); cited by Gooch and Scott (2006)
Tomato skins and seed	70	Dinuccio *et al.* (2010)
Fish waste	150	Salam *et al.* (2009)
Flour/bread	572	Used average of values quoted for "waste bread" and "baking wastes" by M. Effenberger (2006); cited by Gooch and Scott (2006)
Meat	390	To be conservative, used the lower end of the range for slaughterhouse waste cited by Pitk *et al.* (2012), who reported data in m^3 CH_4/MT volatile solids
Mixed food waste	220	M. Effenberger (2006); cited by Gooch and Scott (2006)

Table 2 – CH_4 production potential of identified food waste resources

Waste Material	BMP factor [m^3/MT]	Quantity [MT/year]	Estimated CH_4 production [m^3/year]
Grain	129	1470	190,000
Grain	129	3918	505,000
Grain	129	1470	190,000
Wort	129	136	17,500
Ethanol & wort	129	<1	0
Ethanol & wort	129	<1	0
Ethanol & wort	129	<1	0
Tomatoes	70	163	11,400
Fish waste	150	590	88,500
Fish waste	150	590	88,500
Flour/bread	572	408	233,000
Meat	390	590	230,000
Mixed food	220	73	16,000
Flour/bread	572	45	25,700
Flour/bread	572	35	20,000
Mixed food	220	1630	359,000
Flour/bread	572	11	6,300
	Total	**11,290**	**1,981,000**

Table 3 – Potential benefits of an anaerobic digestion system in Brooklyn, NY

Total waste identified (MT/year)	11,290		
CH_4 production potential (m^3/year)	1,981,000		
Gas engine size (kW)[1]	400		
	Annual production potential (MWh)	Annual income ($)	Annual GHG reduction (MT CO_2 equivalent)
Electricity	3500	500,000	990
Natural Gas[2]	2300	72,000	410
Total	5800	572,000	1400

[1] Assuming full-scale biomethane production in a co-digestion system is 50% of that estimated from laboratory-scale measurements of biomethane potential of individual brewery and food waste materials.

[2] Displaced by engine waste heat, assuming 50% is available after heating anaerobic digestion system.

Anaerobic digesters in the brewery sector:

1. Why would you consider AD → waste reduction, renewable electricity, heat, or a combination?
2. What is the volume of waste at your facility, and can it be combined with other reliable waste resources in close proximity?
3. Based on the available waste resources, where would an AD plant best be located? Close to the brewery operation may enable use of waste heat.
4. What to do with the digestate?

Thanks for your interest and attention!

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