

BREWING SUSTAINABILITY

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About the Alliance and its internship program

Since its organization in 2003, the Alliance has focused on sustainability at the community level, and this commitment goes beyond environmental concerns and looks at the many inter-related aspects of sustainability as they apply to communities here in the Lehigh Valley.

This project on sustainability in the brewing industry was prompted by the ever-increasing number of small craft breweries and brewpubs in the Lehigh Valley and by the realization that brewing is an energy-intensive process. This project is part of the Alliance's ongoing efforts to promote more sustainable business practices. The Alliance thanks Olivia Barz (Lehigh University '19) for researching sustainable practices in the craft brewing industry and for preparing this report.

We welcome suggestions for future projects.

For more information about past projects or about the Alliance's internship programs, contact Peter Crownfield [peter@sustainlv.org]

If you have any questions about this report, please contact us by email at brewing@sustainlv.org.

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INTRODUCTION

The craft brewing industry has more than tripled in the past three decades¹. While it's a small percentage of the total, brewing is an energy-intensive business and contributes more than you might expect to greenhouse gas emissions and climate change. Businesses, institutions, and individuals all contribute to the problem, of course, and everyone needs to be part of the solution. Climate change is a threat to living organisms from every corner of the world, including humans.

We are already experiencing more frequent and severe illnesses, heat waves, hurricanes, floods, rising sea levels, droughts, decreased availability of food, and loss of habitable and productive land. These are all symptoms of the underlying problem: An unsustainable system that functions on greenhouse gases is pushing the planet to a tipping point that will make it nearly uninhabitable for most living things.² This means we must move away from business as usual and begin to implement sustainability measures and the triple bottom line — managing for people, planet, and profit — in order to maintain the growth of the brewing industry, while simultaneously maintaining the health of the environment and all living things.

Climate change and environmental degradation affect our ability to produce quality products, especially in the agricultural sector.³ For the brewing industry, this could mean shortages and price increases for crucial resources such as barley and hops as they become harder to grow in the changing climate.⁴ Organizations, individuals, and businesses—including breweries—all have a responsibility to do what they can to reduce their impact on global warming and climate change. Fortunately, there are many things that can be done to greatly reduce a business's impact on the environment and the climate.

"The greater the amount of energy consumed..., the greater the release of toxic wastes to the environment, causing damage which may put human lives at risk of other diseases and death."

—Corporate Wellness Magazine

In the brewing business, sustainability measures also often reduce costs by making energy and water use more efficient and by reducing waste (and wastewater). Environmental sustainability is also becoming very marketable, so sustainability initiatives also lend themselves to new marketing strategies and customer groups.

This report outlines ways to enhance sustainability in breweries, while at the same time creating opportunities to save money and even increase sales. Incorporating sustainability into a business plan allows a business to implement the triple bottom line approach. Companies using the triple bottom line approach are dedicated to environmental and social sustainability in addition to profit. This report introduces some actions a brewery can take to begin improving its triple bottom line.

Appointing a person to coordinate sustainability efforts is an important first step towards making meaningful changes. Having a lead person responsible for sustainability helps ensure attention to incorporating sustainability in every possible aspect of the business while helping it improve their triple bottom line.

Another critical step to implement sustainability is gathering and analyzing data that will let management identify wasted energy and water. Monitoring and understanding the brewery's energy and water usage allows management to develop realistic goals for reducing future usage; making problem areas more visible also encourages everyone to work harder to solve the problems. Once the first steps are taken to introduce sustainable thinking and the triple bottom line, the brewery can begin implementing the action items discussed in this report.

If you have any questions about this report, please contact us by email at brewing@sustainlv.org.

ENERGY EFFICIENCY & GREENHOUSE GAS EMISSIONS

U.S. breweries spend over \$200 million in energy costs every year.⁵ The Brewer’s Association places combined electricity and natural gas usage at 50-66 kilowatt-hours [kWh] per barrel⁶, a cost of \$3.75-\$5.00 per barrel. For a company brewing 10,000 barrels per year, that means total energy costs of \$37,500–\$50,000 per year. (Breweries running solely on electricity will be at the higher end of this cost.) Electricity costs fluctuate and are expected to increase by 3% in 2019.⁷ Breweries can reduce costs by using more energy-efficient equipment, often with a payback period of only about two years—after that, the savings continue year after year.

Brewers should also be concerned with effects that greenhouse gas emissions will have on their business in the future. We can already see climate change affecting the availability and location of crops. Because brewers rely on quality ingredients such as hops and barley — crops that can be greatly affected by increased temperatures and changes in precipitation — a changing climate can greatly impact the ability to brew good beer.⁸ Breweries need to take responsibility for their emissions in order to sustainably maintain their own existence. By using energy more efficiently, more product can be produced using less energy, and therefore producing lower emissions.

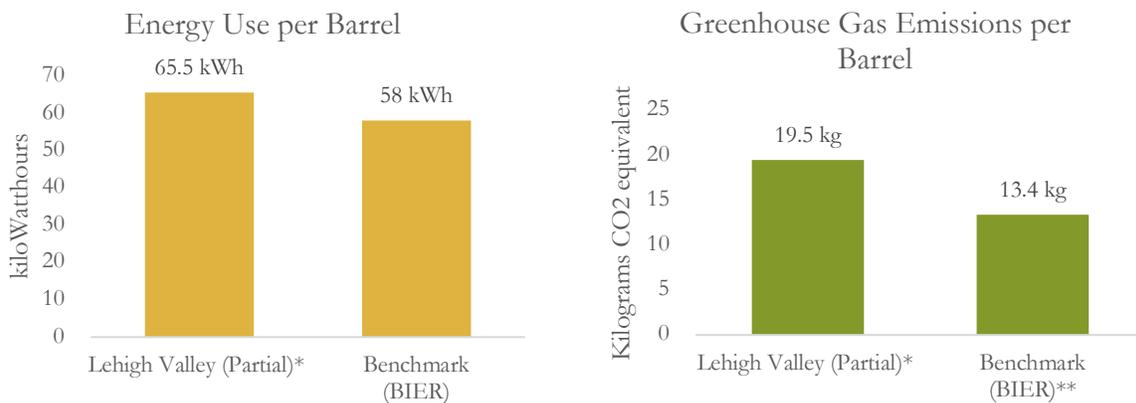
One excellent way to reduce emissions — and costs — is recovering heat from both heating and cooling processes. Taking the time to identify what areas of brewing are wasting the most energy will allow the greatest savings.

To reduce emissions even further, use renewable energy generated from sources such as solar and wind energy. Renewable energy can be purchased from electric utilities, but on-site installations will result in much lower operating costs.⁹ For breweries, on-site generation of electricity and hot water are both viable — and there are tax credits, grants, and low interest loans available. After factoring in these incentives, on-site renewable energy infrastructure can have a payback period as short as 7.5 years. (see Attachment D)

Sierra Nevada Brewing

- Heat recovery units on boilers, microturbines, and brew kettles
- Variable speed drives on large motors and pumps conserve energy by automatically adjusting to demand.
- Water is used as efficiently as possible and closely monitored for leaks, as lost water is lost energy.
- Ambient light sensors adjust lighting based on the amount of natural light coming through the windows.
- Motion sensors and timers on lights ensure energy savings.
- Chico, CA location has a 20-megawatt solar array on-site, providing about 20% of electricity; microturbines and solar provide 90% of electricity needs.

www.cdn.sierranevada.com/sites/www.sierranevada.com/files/content/sustainability/reports/SustainabilityReport2015.pdf



*Lehigh Valley (Partial) values are based on limited data and may not represent the average of all Lehigh Valley breweries.

**The benchmark for greenhouse gas emissions is based on the BIER Energy benchmark, with GHG based on industry average for ratio of electricity and natural gas; it does not include CO₂ released to the atmosphere in the fermentation process, refrigerants used in cooling systems, or emissions from transportation.

Sample Action Items:

- Recapture heat during heating processes like mashing, wort boiling, fermentation, and pasteurization, and from all cooling processes. This heat can be captured from steam, hot water, and evaporation and reused to heat more water.
- Install solar PV panels or solar water heaters, or purchase offsets for energy that is used, or purchase energy from renewable sources.
- Look for ways to analyze the system as a whole, rather than as multiple separate parts; this can improve overall efficiency as streams are or can be connected.
- Recover carbon dioxide from fermentation for later use to save money on carbon dioxide purchases and reduce greenhouse gas emissions to the atmosphere.

For a more complete list of action items, see Attachments A and B.

Resources

- Brewers Association
- Energy Star
- Industrial Assessment Center (Lehigh University) *Eligibility requirements apply*

For a list of resources, with links and descriptions, see Attachment C

WATER EFFICIENCY & WASTEWATER

Water is an essential resource that is being depleted in many areas and is a significant cost in the brewing industry. According to the Beverage Industry Environmental Roundtable (BIER), the average brewer uses 4.28 gallons of water per gallon of beer. This ratio includes the brewhouse, packaging, cellars, and utilities in the brewery.¹⁰ This average includes very large breweries that tend to have more efficient water use than smaller breweries.

In 2011, the average cost of water in Pennsylvania was \$6.50 per 1000 gallons.¹¹ Here in the Lehigh Valley, rates tend to be a little lower, but wastewater costs usually more than double the initial cost. Reducing the amount of water used, and reusing water whenever possible, greatly decreases annual costs without compromising the quality of the beer.

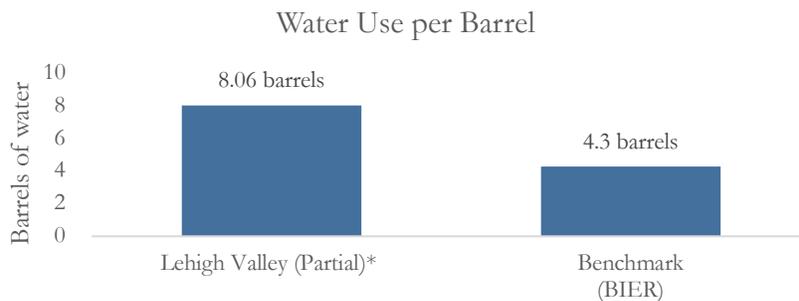
In addition, wastewater treatment centers usually require a certain quality of water; wastewater with higher levels of contamination can result in higher costs or even fines. More efficient use of water not only reduces the initial cost of the water, it also decreases the volume of wastewater produced, decreasing costs two-fold.

For some breweries, onsite wastewater treatment can not only mitigate costs but can also produce energy for the brewery. This benefits both the brewery and the environment, as the process not only produces clean water but generates energy for the brewery.

Victory Brewing

- Heat recovery throughout the brewing process
- 100% renewable energy or renewable energy credits offset electricity used in their brewery and brewpubs
- Sky tubes bring more natural daylight into the building.
- Ambient light sensors adjust lighting based on the amount of natural light coming; motion sensors and timers on lights minimize energy use.
- Composts all brewpub food waste

www.victorybeer.com/about/victory-for-the-environment



* Lehigh Valley (Partial) values are based on limited data and may not represent the average of all Lehigh Valley breweries.

Sample Action Items

- Monitor the amount of water used for each process to identify areas for improvement.
- Collect and reuse wastewater from various steps in the brewing process for use in cleaning and other non-critical areas
- Consider onsite wastewater treatment if volume warrants.
- Use low-flow spray valves, faucets, and bathroom facilities. High-efficiency dual flush toilets and no-flush urinals save even more water.

For a more complete list of action items, see Attachments A and B

Resources

- Brewers Association

For a list of resources, with links and descriptions, see Attachment C.

SOLID WASTE REDUCTION

The amount of resources being used and disposed of in the United States increases demand for raw materials and for disposal sites — and single-use and short-lived items such as packaging, disposable cups, and containers are among the worst contributors to the problem. Spent grains are often sent to farms as animal feed, which is far better than simply sending them to the landfill, but generally does not decrease greenhouse gas emissions because many animals produce large amounts of greenhouse gas emissions and many farms are not sustainably run.

Bayern Brewing

- Uses 100% reused / reusable glass for bottling
- Buys back 6-pack holders and gives credit for beer or merchandise in the Tasting Room.
- Participants can use a 'Bayern Ecopack' to recycle their glass and get a refund for bottles (12 oz brown glass, no twist off lids, no embossing, and removable paper labels)
- A percentage of all Dancing Trout merchandise and beer sales goes Montana Trout Unlimited and their efforts to conserve and restore Montana's watersheds.
- Buys materials for brewing and packaging beer from nearby sources
- Joined Bicycle Benefits, a program providing discounts to participants who bike to the brewery

www.bayernbrewery.com/sustainability-1

One of the main concepts to keep in mind is “Reduce, Reuse, Recycle”: Reduce the amount of materials being used, reuse the materials you have whenever possible, and recycle what cannot be reduced or reused. Bringing less material into the location also reduces waste, and as the price of resources increases, finding and developing ways to use less will reduce costs and contribute to the triple bottom line.

One of the largest sources of waste from breweries comes ‘downstream’, when the consumer disposes of the bottle or can. One way to reduce post-consumer waste is to implement a return-and-reuse bottle program, which will also save on costs of new bottles. An incentive to return the bottles (such as a small discount) helps ensure that enough bottles are returned to maintain the program. The bottle-reuse program can span several local breweries, making more bottles, return locations, and cost-sharing opportunities available. Also make recycling instructions and messaging clear on the bottle or can, to strongly urge the consumer to dispose of it properly, rather than just throwing it away or improperly recycling it.

Sample Action Items:

- Conduct regular waste audits to identify the largest sources of waste.
- Follow the three R's: Reduce how much you use, reuse what you can, and recycle what can't be reused.
- Push for increased keg and growler use among customers.
- Work with other local brewers & brewpubs to implement programs for reusable bottles.
- If flexibles (such as shrink wraps) are used, make sure there is a system for recycling all used or leftover material.
- For non-returnable containers, make a strong effort to encourage customers to recycle them properly

For a more complete list of action items, see Attachments A and B.

Resources

- Brewers Association resources
- EPA resources

For a list of resources, with links and descriptions, see Attachment C.

TRANSPORTATION

Delivery of raw materials to the brewery and shipping final products can be a large cost. Inefficient transportation, such as not filling the truck completely or taking multiple trips where one trip would be possible, is not only bad for the budget, but it emits more greenhouse gases and other pollutants linked to public health concerns. While changing transportation methods will not have as large an impact as reducing energy and water use, it can still have a significant positive economic and environmental impact.

Sample Action Items:

- Purchase local materials when possible to cut back on miles travelled. This boosts the local economy while decreasing costs and miles travelled by materials.
- Select carriers that have sustainable practices (including intermodal transportation)
- Combine trips whenever possible: deliver shipments and pick up shipments on the trip back.
- Encourage alternative transportation for employees and guests (walking, bicycling, using public transit, carpooling)

For a more complete list of action items, see Attachments A and B.

Resources:

- Sierra Nevada Brewing
- EPA

For a list of resources with links and descriptions, see Attachment C

Sustainable management decisions are key to creating a more sustainable business with lower costs. Many of the other changes such as energy and water use efficiency, waste reduction, and changes in transportation start with management. Making a real commitment to sustainability and the triple bottom line — coupled with leadership by the management is essential. Creating a team of employees, along with one person who is responsible for the focus on sustainability, can help ensure that each step in the brewing and management process is as efficient and sustainable as possible.

Purchasing sustainable inputs (brewing ingredients, electricity, fuel, office supplies, or furniture) is key for sustainability. Conserving energy and water are key to making your operation more sustainable and reducing GHG emissions.

Since a significant public push is now developing for more sustainable products, creating a more sustainable operation can help you make your product more attractive to these customers. Management leadership can help the entire production and sales team see how sustainability efforts are vital keys to tomorrow’s success.

If you have any questions about this report, please contact us by email at brewing@sustainlv.org.

New Belgium Brewing

New Belgium Brewing has a mission to prove that business can be a force for good. In their annual Sustainability Report, they report on their current energy, water, waste, and greenhouse gas emissions, and set goals for the future. They base their goals off what they believe they can accomplish in the time frame, as well as the standards set by the Brewers Association and the Beverage Industry Environmental Roundtable.

Goals (per Barrel of Beer)

2017 Data	2020 Goal
51.91 kWh/barrel	35.65 kWh/barrel
4.62 barrels water/barrel beer	3.5 barrels water/barrel beer
79.7g waste to landfill/barrel	70.37g waste to landfill/barrel
20.8kg CO2 equivalent/barrel	18.6 kg CO2 equivalent/barrel

<https://www.newbelgium.com/globalassets/sustainability/force-for-good-digital-report.pdf>

Sample Action Items:

- Create a team of employees from every area of production, management, packaging, and shipping; make one person responsible for maintaining a focus on sustainability throughout the entire brewery
- Purchase local products to support local economy and community, and to reduce miles travelled; purchase recycled, recyclable or reusable products whenever possible.
- Create a line of beer that promotes sustainability and some portion of the profits go towards an environmental or sustainability organization (Like last Weyerbacher Last Chance IPA).
- Market environmental and sustainability improvements to customers.
- Advocate and raise funds for local environmental based organizations and groups.

For a more complete list of action items, see Attachments A and B.

Resources

- New Belgium Brewing Sustainability Report
- Sierra Nevada Brewing Sustainability Report

For a list of resources, links, and descriptions, see Attachment C

ATTACHMENT A: ACTION ITEMS, SORTED BY CATEGORY

Section	Action Items	Suggested Timing
Energy	Use energy efficient lighting and appliances.	Getting Started
Energy	Utilize natural light when possible.	Getting Started
Energy	Think of and analyze connections among different stages of the process and look at the system as a whole rather than just separate parts; this can improve overall efficiency as streams are or can be connected.	Getting Started
Energy	Match motor, pump, and compressor sizes to the load; use variable speed drives when possible.	Intermediate
Energy	Replace regular parts, systems, or items with high efficiency versions.	Intermediate
Energy	Use automated control systems when possible.	Intermediate
Energy	Consider on-site renewable energy generation; in the meantime, purchase energy from renewable sources or purchase carbon offsets for energy used.	Intermediate
Energy	Use a compression filter rather than a plate filter during mashing process.	Intermediate
Energy	Recover carbon dioxide from fermentation for later use. New technology makes CO ₂ recovery feasible for small brewers	Intermediate
Energy	Install a green roof.	Intermediate
Energy	Add heat exchangers to recover heat from processes where material is heated or cooled, from mashing, to pasteurization. The captured heat is reused to reduce the energy demand for other steps in the production.	Intermediate
Energy	Install solar panels to generate electricity or preheat water.	Long Term
Energy	If wastewater is treated onsite, capture methane for an energy source.	Long Term
Energy	Install modern, energy-efficient brewing systems and machinery, such as Steinecker Merlin systems.	Long Term
Energy	Use flash pasteurization to reduce energy used.	Long Term
Energy	If bottles are collected and reused, use efficient cleaning systems to conserve energy and water.	Long Term
General	Conduct regular maintenance and monitoring of all systems and pipes and replace old parts and insulation to optimize energy use.	Getting Started
General	Make sure all staff understand the importance of, and know how to do, sustainable practices such as efficient water and energy use, recycling, and waste reduction.	Getting Started
General	Install sub-meters to monitor energy and water use in individual processes.	Intermediate
Management	Make recycling available at your location and use only recyclable products.	Getting Started

Section	Action Items	Suggested Timing
Management	Make sure guests are aware of proper recycling at location.	Getting Started
Management	Educate about the importance of recycling and sustainability to customers.	Getting Started
Management	Create a team of employees from every area of production, management, packaging, and shipping; make one person responsible for maintaining a focus on sustainability throughout the entire brewery	Getting Started
Management	Purchase local products to support local economy and community, and to reduce miles travelled.	Getting Started
Management	Purchase recycled, recyclable or reusable products whenever possible.	Getting Started
Management	Purchase Fair Trade and organic products when possible.	Intermediate
Management	Make sustainability a factor in choosing suppliers.	Intermediate
Management	Produce and publish an annual sustainability report.	Intermediate
Management	Advocate for and support local environmental organizations and groups.	Long Term
Marketing	Create a line of beer that promotes sustainability by committing some portion of the profits go towards an environmental or sustainability cause (As Weyerbacher did with Last Chance IPA).	Intermediate
Marketing	Develop marketing strategies based on environmental and sustainability improvements.	Intermediate
Transportation	To the extent possible, combine trips: deliver shipments and pick up shipments on the trip back.	Getting Started
Transportation	To the extent possible, make sure all shipments completely fill the truck.	Getting Started
Transportation	Encourage alternative transportation for employees and guests (walking, bicycling, using public transit, carpooling)	Getting Started
Transportation	Purchase local materials when possible to cut back on miles travelled. This boosts the local economy while decreasing costs and miles travelled by materials.	Getting Started
Transportation	Ship by rail or intermodal carriers for long hauls.	Intermediate
Transportation	Use biodiesel in delivery vehicles.	Intermediate
Transportation	Install electric vehicle charging ports and bike racks to encourage alternative transportation by employees and guests.	Intermediate
Waste	Conduct regular waste audits to identify the largest sources of waste.	Getting Started
Waste	Follow the three R's: Reduce how much you use, reuse what you can, and recycle what can't be reused.	Getting Started
Waste	Contact your local recycling center or county waste management coordinator to figure out the best way to recycle shipping and packaging materials.	Getting Started

Attachment A: Action Items, Sorted by Category

Section	Action Items	Suggested Timing
Waste	Reuse spent grain by sending it to local farms as feed or bake it into products like dog treats; Compost spent grain and yeast if it is unable to be reused.	Getting Started
Waste	Push for increased keg and growler use among customers.	Getting Started
Waste	Purchase cases, carriers, and other products made from recycled material when possible.	Getting Started
Waste	Recycle all cardboard when possible.	Getting Started
Waste	Reduce the number of pallets needed; repair damaged pallets when possible.	Getting Started
Waste	Reduce the use of "flexibles" (Plastic bags, plastic straps, plastic wrap, and plastic sacks) by using reusable materials for tying down and shipping; make sure there is a system for recycling all used or leftover material.	Getting Started
Waste	Recycle all diatomaceous earth (DE) as a pesticide or in construction materials.	Intermediate
Waste	Switch to reusable and returnable bottles.	Intermediate
Waste	Use reusable 6 pack containers that get returned to the brewer rather than discarded.	Intermediate
Waste	Implement onsite composting, shredding, and baling.	Intermediate
Waste	Install on-site waste-to-energy processes.	Long Term
Water	Repair all leaks.	Getting Started
Water	Audit amount of water used for each process identify areas for improvement.	Getting Started
Water	Brush or rake systems to clean them instead of using water. Put mesh over the floor drains so any solid waste does not enter the water stream.	Getting Started
Water	Use low-flow spray valves, faucets, and bathroom facilities. High-efficiency dual flush toilets and no-flush urinals save even more water.	Getting Started
Water	Reuse surplus wort from previous batches.	Getting Started
Water	Filter yeast to recover residual beer and then recycle spent yeast by donating it to local farms or bakers.	Getting Started
Water	Pay attention conveyor system maintenance.	Getting Started
Water	Use a solenoid valve to stop water flow whenever the conveyor is stopped.	Getting Started
Water	Make sure nozzle jet streams for spraying are releasing an appropriate amount of water and use high efficiency nozzles.	Getting Started
Water	Make overflow points visible to employees so water isn't wasted by over-filling.	Getting Started
Water	Collect and reuse water from various steps in the brewing process for use in cleaning or other process that do not require pure water.	Intermediate
Water	Use float operated valves.	Intermediate

Attachment A: Action Items, Sorted by Category

Section	Action Items	Suggested Timing
Water	Use efficient systems to clean pipes and tanks, to minimize use of water.	Intermediate
Water	Insulate steam pipes to maintain temperature and decrease the amount of steam needed to be produced.	Intermediate
Water	If feasible, implement onsite wastewater treatment. Capture methane from anaerobic digestion for as energy elsewhere in the brewing process.	Long Term
Water	Implement cross-flow or membrane filtration.	Long Term

ATTACHMENT B: ACTION ITEMS, SORTED BY RECOMMENDED TIMING

Section	Action Items	Suggested Timing
Energy	Use energy efficient lighting and appliances.	Getting Started
Energy	Utilize natural light when possible.	Getting Started
Energy	Think of and analyze connections among different stages of the process and look at the system as a whole rather than just separate parts; this can improve overall efficiency as streams are or can be connected.	Getting Started
General	Conduct regular maintenance and monitoring of all systems and pipes and replace old parts and insulation to optimize energy use.	Getting Started
General	Make sure all staff understand the importance of, and know how to do, sustainable practices such as efficient water and energy use, recycling, and waste reduction.	Getting Started
Management	Make recycling available at your location and use only recyclable products.	Getting Started
Management	Make sure guests are aware of proper recycling at location.	Getting Started
Management	Educate about the importance of recycling and sustainability to customers.	Getting Started
Management	Create a team of employees from every area of production, management, packaging, and shipping; make one person responsible for maintaining a focus on sustainability throughout the entire brewery	Getting Started
Management	Purchase local products to support local economy and community, and to reduce miles travelled.	Getting Started
Management	Purchase recycled, recyclable or reusable products whenever possible.	Getting Started
Transportation	To the extent possible, combine trips: deliver shipments and pick up shipments on the trip back.	Getting Started
Transportation	To the extent possible, make sure all shipments completely fill the truck.	Getting Started
Transportation	Encourage alternative transportation for employees and guests (walking, bicycling, using public transit, carpooling)	Getting Started
Transportation	Purchase local materials when possible to cut back on miles travelled. This boosts the local economy while decreasing costs and miles travelled by materials.	Getting Started
Waste	Conduct regular waste audits to identify the largest sources of waste.	Getting Started
Waste	Follow the three R's: Reduce how much you use, reuse what you can, and recycle what can't be reused.	Getting Started
Waste	Contact your local recycling center or county waste management coordinator to figure out the best way to recycle shipping and packaging materials.	Getting Started

Attachment B: Action Items, Sorted by Recommended Timing

Section	Action Items	Suggested Timing
Waste	Reuse spent grain by sending it to local farms as feed or bake it into products like dog treats; Compost spent grain and yeast if it is unable to be reused.	Getting Started
Waste	Push for increased keg and growler use among customers.	Getting Started
Waste	Purchase cases, carriers, and other products made from recycled material when possible.	Getting Started
Waste	Recycle all cardboard when possible.	Getting Started
Waste	Reduce the number of pallets needed; repair damaged pallets when possible.	Getting Started
Waste	Reduce the use of "flexibles" (Plastic bags, plastic straps, plastic wrap, and plastic sacks) by using reusable materials for tying down and shipping; make sure there is a system for recycling all used or leftover material.	Getting Started
Water	Repair all leaks.	Getting Started
Water	Audit amount of water used for each process identify areas for improvement.	Getting Started
Water	Brush or rake systems to clean them instead of using water. Put mesh over the floor drains so any solid waste does not enter the water stream.	Getting Started
Water	Use low-flow spray valves, faucets, and bathroom facilities. High-efficiency dual flush toilets and no-flush urinals save even more water.	Getting Started
Water	Reuse surplus wort from previous batches.	Getting Started
Water	Filter yeast to recover residual beer and then recycle spent yeast by donating it to local farms or bakers.	Getting Started
Water	Pay attention conveyor system maintenance.	Getting Started
Water	Use a solenoid valve to stop water flow whenever the conveyor is stopped.	Getting Started
Water	Make sure nozzle jet streams for spraying are releasing an appropriate amount of water and use high efficiency nozzles.	Getting Started
Water	Make overflow points visible to employees so water isn't wasted by over-filling.	Getting Started
Energy	Match motor, pump, and compressor sizes to the load; use variable speed drives when possible.	Intermediate
Energy	Replace regular parts, systems, or items with high efficiency versions.	Intermediate
Energy	Use automated control systems when possible.	Intermediate
Energy	Consider on-site renewable energy generation; in the meantime, purchase energy from renewable sources or purchase carbon offsets for energy used.	Intermediate
Energy	Use a compression filter rather than a plate filter during mashing process.	Intermediate
Energy	Recover carbon dioxide from fermentation for later use. New technology makes CO ₂ recovery feasible for small brewers	Intermediate

Attachment B: Action Items, Sorted by Recommended Timing

Section	Action Items	Suggested Timing
Energy	Install a green roof.	Intermediate
Energy	Add heat exchangers to recover heat from processes where material is heated or cooled, from mashing, to pasteurization. The captured heat is reused to reduce the energy demand for other steps in the production.	Intermediate
General	Install sub-meters to monitor energy and water use in individual processes.	Intermediate
Management	Purchase Fair Trade and organic products when possible.	Intermediate
Management	Make sustainability a factor in choosing suppliers.	Intermediate
Management	Produce and publish an annual sustainability report.	Intermediate
Marketing	Create a line of beer that promotes sustainability by committing some portion of the profits go towards an environmental or sustainability cause (As Weyerbacher did with Last Chance IPA).	Intermediate
Marketing	Develop marketing strategies based on environmental and sustainability improvements.	Intermediate
Transportation	Ship by rail or intermodal carriers for long hauls.	Intermediate
Transportation	Use biodiesel in delivery vehicles.	Intermediate
Transportation	Install electric vehicle charging ports and bike racks to encourage alternative transportation by employees and guests.	Intermediate
Waste	Recycle all diatomaceous earth (DE) as a pesticide or in construction materials.	Intermediate
Waste	Switch to reusable and returnable bottles.	Intermediate
Waste	Use reusable 6 pack containers that get returned to the brewer rather than discarded.	Intermediate
Waste	Implement onsite composting, shredding, and baling.	Intermediate
Water	Collect and reuse water from various steps in the brewing process for use in cleaning or other process that do not require pure water.	Intermediate
Water	Use float operated valves.	Intermediate
Water	Use efficient systems to clean pipes and tanks, to minimize use of water.	Intermediate
Water	Insulate steam pipes to maintain temperature and decrease the amount of steam needed to be produced.	Intermediate
Energy	Install solar panels to generate electricity or preheat water.	Long Term
Energy	If wastewater is treated onsite, capture methane for an energy source.	Long Term
Energy	Install modern, energy-efficient brewing systems and machinery, such as Steinecker Merlin systems.	Long Term
Energy	Use flash pasteurization to reduce energy used.	Long Term

Attachment B: Action Items, Sorted by Recommended Timing

Section	Action Items	Suggested Timing
Energy	If bottles are collected and reused, use efficient cleaning systems to conserve energy and water.	Long Term
Management	Advocate for and support local environmental organizations and groups.	Long Term
Waste	Install on-site waste-to-energy processes.	Long Term
Water	If feasible, implement onsite wastewater treatment. Capture methane from anaerobic digestion for as energy elsewhere in the brewing process.	Long Term
Water	Implement cross-flow or membrane filtration.	Long Term

ATTACHMENT C: INFORMATION RESOURCES

Section	Resource Link	Description
Energy	Brewers Association Energy Management Handout	One-page handout describing industry standards for and some quick tips on how to increase energy efficiency.
Energy	Brewers Association Energy Manual	A more detailed manual on energy-efficient practices in the brewing industry and how to implement them.
Energy	Brewers Association Energy Set Points	Guide on what settings are the most energy efficient for various machines, utilities and appliances.
Energy	Brewers Association Employee Engagement	Guide on engaging employees in sustainable thinking.
Energy	Brewers Association Insulation	Guide on best insulation practices for energy efficiency.
Energy	Brewers Association Lighting	Guide on best lighting practices for energy efficiency.
Energy	Brewers Association Energy Audit Sheet	Spreadsheet for auditing brewery energy use.
Energy	Brewers Association Future Design Tips Sheet	Guide on implementing new techniques and methods during future design and renovation.
Energy	Brewers Association Energy/GHG Data Collection Spreadsheet	Spreadsheet to aid in collecting energy and greenhouse gas emission data.
Energy	Energy Star Energy Efficiency Improvement and Cost Saving Opportunities for Breweries	Detailed manual for more energy-efficient processes and equipment in the brewing industry.
Energy	Industrial Assessment Center	Sponsored by U.S. Department of Energy, the center provides no-cost assessments of energy use in industrial settings. Eligibility requirements are based on size and energy used.
Water	Brewers Association Water and Wastewater Treatment/Volume Reduction Manual	Detailed manual on the most water-efficient practices in the brewing industry and how to implement them.
Water	Brewers Association Water Management Handout	One-page handout describing industry standards for water use and some quick tips on how to increase water efficiency.
Water	Brewers Association Sanitary Water Usage	Guide for how much water should be used in sanitary practices for employees regularly.
Water	Brewers Association Water Losses from Leaks	Visual guide on how much water is lost from various types and sizes of leaks.
Water	Brewers Association Water Efficiency Opportunity Checklist	Detailed checklist of water efficiency opportunities for breweries.
Water	Brewers Association Water Audit Collection	Spreadsheet to aid in water audits.
Water	Brewers Association Full Cost of Water Spreadsheet	Detailed spreadsheet for calculating and understanding water use costs.

Section	Resource Link	Description
Water	Brewers Association Pre-treatment Cost Spreadsheet	Spreadsheet to aid in costs and cost savings of pre-treatment of water on site.
Waste	Brewers Association Solid Waste Reduction Manual	More detailed manual on waste reduction practices in the brewing industry and how to implement them.
Waste	Brewers Association Solid Waste Management Handout	One-page handout describing industry standards for waste production and reduction and some quick tips on how to decrease waste production.
Waste	Brewers Association Workplace Recycling Program	Guide on how to implement a recycling program.
Waste	Brewers Association Onsite Composting Feasibility	Checklist that shows the feasibility of composting on site.
Waste	Brewers Association Onsite Solid Waste Analysis	Spreadsheet that aids in analyzing the amount, type, and source of solid waste.
Waste	EPA Pallet Alternatives Cost Calculator	Spreadsheet to aid in the costs of pallet alternatives.
Transportation	Sierra Nevada Brewing Company Transportation Efforts	A list of efforts by Sierra Nevada Brewing Company to make transportation more sustainable.
Transportation	EPA Fact Sheet on Sustainable Transport	Methods of more sustainable delivery methods by the EPA.
Management	New Belgium Brewing Sustainable Sourcing Questionnaire	New Belgium Brewing's guide to sustainable sourcing.
Management	New Belgium Brewing Barley and Malt Sourcing	New Belgium Brewing's guide to sustainable sourcing of barley and malt.
Management	New Belgium Brewing 2018 Sustainability Report	The 2018 Sustainability Report from New Belgium Brewing.
Management	Sierra Nevada Brewing Company 2015 Sustainability Report	The 2015 Sustainability Report from Sierra Nevada Brewing Company.
General	Sierra Nevada Sustainability Map	An interactive map of sustainability implementation at Sierra Nevada Brewing Company.
General	Fourth National Climate Assessment Summary	The <i>Fourth National Climate Assessment</i> prepared by U.S. Global Change Research Program (National Oceanic & Atmospheric Administration) demonstrates the urgent need for major changes to reduce impact of climate change.

ATTACHMENT D: GRANTS, TAX CREDITS, LOANS, AND OTHER INCENTIVES

Initial investments for many sustainability measures can be expensive. There are many tax credits, grants and loans available to businesses to help implement sustainability. Many of them have to do with energy, which can also have the largest payback to the company. There are also some resources available for equipment and building upgrades to improve efficiency and pollution reduction.

ENERGY

- **Alternative and Clean Energy Program (STATE)** - The Alternative and Clean Energy Program provides funding to suitable applicants for the construction and application of alternative energy utilities. Loans of up to \$5 million, or 50% of the total project cost, are offered. Amortizations are structured to begin after 25 years and take place over a 10–year term, with current interest rates located through the program link. Grants of up to \$2 million are another option.
- **Alternative Fuels Incentive Grant (AFIG)** (STATE) - AFIG promotes markets for alternative energy technologies in hopes of creating opportunities to better manage Pennsylvania’s fuel resources, while also achieving triple bottom line results. An estimated \$10 million in grants will be available to multiple eligible applicants, including organizations, nonprofit agencies, for-profit companies, and more. Check out AFIG link for current application dates!
- **Pennsylvania Energy Development Authority (PEDA)** (STATE) - PEDA is an independent public financing authority whose mission is to finance clean, advanced energy projects in Pennsylvania. Pennsylvania projects that could potentially qualify for funding from the authority include solar energy, wind, low-impact hydropower, geothermal, biomass, landfill gas, fuel cells, integrated gasification combined cycle, waste coal, coal-mine methane, and demand management measures. The authority presently can award grants, loans, and loan guarantees. For more information, visit PEDA.
- **Energy Efficient Tax Credits for Commercial Buildings** (FEDERAL) - Businesses that own or lease an energy-efficient building can apply for this tax credit. Most buildings need to show a 50% energy reduction to qualify for the full credit. Businesses that show energy reductions of at least 16.7% can receive a partial tax credit. This tax credit is worth \$1.80 per square foot of office or retail space.
- **Small Business Advantage Grant Program** (STATE) - Small businesses can apply for up to \$9,500 for energy efficiency improvements. A business that receives a grant needs to match the funding they receive. Also, eligible projects need to save the business at least \$500 per year. Pennsylvania's Department of Environmental Protection offers this grant annually. They'll accept applications on a rolling basis until funding runs out. Who is eligible: Small Businesses with 100 or fewer full-time employees located within Pennsylvania.
- **Solar Energy Program** (STATE) - Businesses can use the funding in many ways. Along with construction costs, grants can fund feasibility studies, planning and research. Businesses usually receive grants based on the number of kilowatt hours generated. The maximum grant amount is \$1 million. Like other energy efficiency grants from the state of Pennsylvania, small businesses will need to match the funding they receive.
- **Pennsylvania Green Energy Loan Fund** (STATE) - Offers loans for energy-efficient remodels and retrofitting. Businesses, nonprofits and government are all able to apply. Loans pay for energy-efficient equipment as well as for construction costs. Most loans go to businesses that are remodeling or upgrading equipment. To qualify for a loan, businesses will need to show that the project will reduce their energy use by 25%. If a business needs help proving this, they can contact PA Green Energy Loan Fund. The fund gives businesses technical help with energy analysis. Loans range from \$100,000 to \$2.5 million. Most loans have an interest rate between 4 and 5%, and the length of the loan can be up to 15 years.

NEW OR UPGRADED EQUIPMENT

- **Business Energy Investment Tax Credit** (Federal) - A 30% tax credit for businesses that install clean energy equipment. Businesses that use solar, fuel cells, ground source (geothermal) heat pumps, and small wind power are all eligible. The maximum credit is \$1,500 per 0.5 kWh for fuel cells or \$200 per kWh for microturbines.
- **Machinery and Equipment Loan Fund (MELF)** (State) - Provides low-interest financing for the acquisition or upgrading of new or used machinery and equipment. Loans of up to \$5 million or 50% of project costs are offered through this program, with current interest rates available on the fund's webpage.
- **Rebates for Energy Star® Products** (Federal) - To encourage customers to buy energy efficient products, ENERGY STAR® partners occasionally with sponsors to provide special offers, such as sales tax exemptions, credits, or rebates on Energy Star certified products. Visit Energy Star and enter your zip code to see what offers may be available in your area.

BUILDINGS

- **High Performance Building Incentives Program** (State) - Offers grants and loans to help businesses build high-efficiency buildings or renovate existing buildings. Grants can be used to cover a wide range of improvements including purchasing energy efficient appliances or installing energy efficient insulation and weatherization. Businesses can also use loans for design costs. The maximum grant is \$500,000 or 10% of the project cost. As with other grant programs, businesses need to match the grant amount they receive. Loans from the High-Performance Building Program can be up to \$2 million.

POLLUTION/WASTE

- **Pollution Prevention Assistance Account Loan Program** (State) - To reduce waste, recycle or implement other pollution prevention programs. Loans through the Pollution Prevention program have a maximum interest rate of 2%. The maximum loan is \$100,000, or up to 75% of the total eligible project cost. These loans have a 10-year repayment period — one of the longest available for clean energy loans

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