Brewers Association

Solid Waste Reduction Manual

BREWERS ASSOCIATION

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acknowledgements

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introduction

Craft brewers are an innovative segment of the greater brewing industry. Subsequently, it is no surprise that many craft brewers have found innovative solutions for waste management. These solutions reach beyond a simple reduction of waste to landfill and office recycling. They lead to operating cost reductions, new sources of revenue, and new community and image building initiatives.

The traditional disposal option for solid waste (i.e., hauling 'garbage' to landfills) has become more expensive in recent years. Old landfills have filled up and closed, and the few new landfills that are permitted to open are located further away from populated areas, thereby leading to an increase in transportation costs to the final disposal area. Breweries, like many businesses, are finding that reducing the amount of waste generated can lead to significantly reduced operating costs. In addition, keeping recyclable materials out of the landfills can create a significant source of revenue.

This manual is a consolidated resource for effective solid waste management solutions in the craft brewers segment. Solutions offered can apply to all breweries, regardless of location and operational size. Guidance is provided for brewers that are just beginning to explore solid waste reduction programs, as well as for brewers that are looking to improve a well-established program.

There are checklists, resource information, and other visual tools throughout the manual and in Appendix A to help breweries make educated solid waste management decisions.

Disclaimer: the following information provided constitute suggestions that may or may not fit the need of each brewery specifically. Brewers should proceed with caution when implementing any new programs. It is not guaranteed that operating under the guidance of this manual will lead to any particular outcome or result.

The information is structured as a pathway to effective and sustainable solid waste management from start to finish, and is organized into five sections:

1. **Segment Profile:** A discussion of solid waste generation and recycling trends, where to find information on regulatory drivers, examples of non-regulatory drivers, and risks and opportunities for cost savings.
2. **Data Management:** A guide to identifying the components of brewery waste streams, establishing key performance indicators and goals, managing solid waste data, and benchmarking waste reduction progress toward goals.
3. **Best Practices:** Guidance on best practices to reduce, reuse and recycle waste within the craft brewers segment with a focus on opportunities in the brewing process, packaging, warehousing, utilities, and food service/events.
4. **Onsite Waste Treatment:** An overview of drivers for onsite waste treatment and example projects.
5. **Case Studies**: Examples of successful waste management and waste treatment programs used by craft brewers.

section one

Segment Profile: Solid Wastes Generated by Craft Brewers

There are four general solid waste streams produced within the craft brewers segment: brewing process wastes, packaging wastes, food service wastes, and wastes generated during special events, such as concerts or festivals. Throughout the manual, components of these waste streams will be discussed, as well as how to effectively quantify waste generation and disposal. This manual will also present best practices for waste reduction.

Four Main Solid Waste Generation Processes in Breweries

BREWING	PACKAGING	FOOD SERVICE	CONCERTS/ EVENTS
Spent Grains	Cardboard/Paper	Food	Food
Spend DE	Wood Pallets	Cardboard	Cardboard
Spent Yeast	Aluminum/Metal	Aluminum/Metal	Aluminum/Metal
Spent Trub	Glass	Glass	Glass
	Plastic	Plastic	Plastic

Before evaluating brewery-specific waste streams, this section will review some basic trends associated with waste stream components. Understanding these trends will enable brewers to make well informed decisions.

It will also review regulatory drivers for solid waste management, such as mandatory recycling laws. Several non-regulatory drivers will also be highlighted, including recognition of excellence in solid waste management, which strengthens public image, consumer opinion, community ties, and employee morale.

Section 1 concludes with a brief overview of the risks and opportunities in solid waste management.

1.1 Overview of Current Solid Waste Performance and Trends in the United States and Europe

In 2010, the United States Environmental Protection Agency (U.S. EPA) published an annual Municipal Solid Waste (MSW) Report. This report outlines current waste disposal quantities and trends throughout the United States, and provides insight into some brewery-specific waste streams that demonstrate a national movement of improved recycling habits. Highlights from the report are shown below.

U.S. EPA MSW Report Highlights (2010)

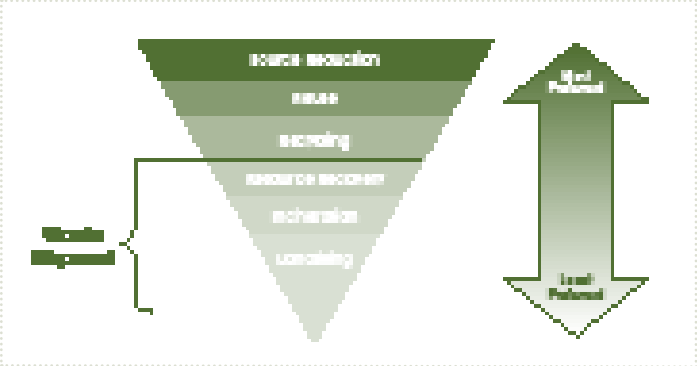
- *Over 250 million tons of waste was generated in the United States: 34.1% was recycled, up from 28.6% in 2000.*
- *13.9% of the municipal solid waste stream consisted of food scraps.*

- *49.6% of generated aluminum beer and soda cans were recovered.*
- *41.4% of generated glass beer and soft drink bottles were recovered.*
- *71.3% of paper and paperboard used for packaging was recovered.*

Americans are taking advantage of recycling programs and are more conscious of their waste disposal, as compared to just a decade ago. In 2010, 71% of the U.S. was served by at least one recycling program, diverting over 85 million tons of waste from landfills – resources to be repurposed for another use.

The preferred method of dealing with waste is reducing its volume from the start. It is also important to understand the type and amount of waste generated, rather than just the volume or weight going to landfill. After reducing the amount of waste generated, avenues for material reuse, such as recycling, should be investigated. After these options are exhausted, waste disposal options should be considered. Best practices for reducing, reusing, and recycling waste streams are discussed in Section 3.

Solid Waste Management Hierarchy



In their May 2012 report, The Environmental Performance of the European Brewing Sector, the Brewers of Europe present key solid waste performance information and trends in the European beverage segment. They also cite the success of utilizing potential wastes from the brewing process as secondary products.

The report also provides insight into packaging trends at European breweries that support waste minimization. Some common trends include:

REDUCE: In coordination with the Waste and Resource Action Programme (WRAP), UK breweries have worked toward more environmentally friendly packaging. Using lighter weight materials and boosting the amount of recycled materials in packaging are just some ways breweries are improving their waste management processes.

REUSE: In 2010, 24.5% of packaging in their segment was returnable bottles and 20.7% was kegs. Returnable glass bottles and metal kegs can be reused and require less reliance on new manufactured materials. Returnable bottles are a negligible part of the beer industry in the U.S. today, and it would take significant retailer and distributor agreement to resuscitate this practice.

RECYCLE: In 2010, 24.7% of their packaging was metal (aluminum or steel) cans. Using highly recyclable materials like aluminum or steel helps maximize recycling opportunities.

1.2 Regulatory Drivers

In the United States, the availability of recycling programs varies by jurisdiction. Typically, there are no enforceable laws for companies or households who choose not to recycle.

In recent years, local and regional regulations have established mandatory recycling and/or waste minimization requirements. These measures have created opportunities for households, businesses, and communities, such as reducing the energy and costs for hauling solid waste, creating jobs at community recycling centers, and extending the lifespan of existing landfills.

Two Examples Of Regional Mandatory Recycling Laws

California AB 341

In January 2012, California adopted a statewide mandatory commercial recycling program with the goal of "reducing greenhouse gas emissions by diverting commercial solid waste to recycling efforts" and to "expand the opportunity for additional recycling services and facilities in California." Under the new program, businesses are required to subscribe to a recycling service and arrange pickups for recyclable materials. In addition, local government is required to implement a commercial solid waste recycling program that includes education and outreach, monitoring, and annual reporting.

European Commission Directive 94/62/EC

In 1992, the European Commission initiated a directive aimed to "harmonize national measures…to prevent or reduce the impact of packaging and packaging waste" on both the environment and on the Internal Market. Revised in 2004 and 2005, the directive includes provisions for waste prevention, packaging reuse, and recovery and recycling of packaging wastes. The directive also includes recycling and recovery targets for member states.

There are a number of resources available to assist in the development of a solid waste management program. A few are listed below:

Links For More Information

- *Campaign for Recycling: Local laws and campaigns in the United States http://www.campaignforrecycling.org/states*
- *Earth 911.com: Locate recycling centers and review reduce, reuse, recycling guidance: http://www.earth911.com*
- *U.S. EPA recycling information by region: visit the regional office directory and select Solid Waste or Recycling links to identify local initiatives: http://www.epa.gov/epahome/whereyoulive.htm*
- *Recycling Info in the UK: Guidelines for waste sorting/recycling and localized information: http://www.recycle-more.co.uk*

1.3 Non-Regulatory Drivers – Image/brand, Community Ties

Craft breweries traditionally have a good reputation, a positive brand, and a strong tie to the community. Breweries that share their commitments to sustainability and report their success stories build trust among customers, the surrounding community, and the local and regional government.

Sustainability recognition through communicating efforts, innovating initiatives, certifications, and achievement awards support a brewery's commitment to solid waste reduction at both a facility and community level.

Communication: Contact local waste authorities, environmental offices, state offices, or public interest groups to identify opportunities to report solid waste reduction efforts, including recovery statistics and initiatives. Communicating this information will highlight a brewery's commitment to community waste initiatives and share a brewery's efforts to minimize local impact.

Certifications/Awards: As the waste management program matures, report successes and innovations to local, national or international organizations. Sharing achievements strengthens a brewery's image and also inspires other breweries to adopt similar processes for their own success.

California Waste Reduction Awards Program (Wrap) Recognition For Sierra Nevada

Sierra Nevada received California's WRAP recognition every year from 2001 to 2011. The state applauded their commitment to creative recycling and reduction efforts, impressive landfill diversion statistics, and unique composting solutions such as the Hot Rot system.

Community ties give craft breweries the unique opportunity to communicate reuse and recycling opportunities beyond their own facility. Through facility tours, information sessions, communicating progress and goals, and supporting community initiatives, breweries can support and influence a community-wide adoption of responsible waste management.

Boulevard Brewing Company's Ripple Glass Solution

Boulevard Brewing Company was alarmed that Kansas City, Missouri was sending millions of pounds of glass to the landfill each year due to a lack of glass recycling facilities in the area. Subsequently, the brewery was instrumental in establishing the Ripple Glass Program. They built a processing plant, found a resource to convert recycled glass into fiberglass, and distributed collection receptacles throughout the city. The program has since expanded to Jefferson City, with other cities on the radar.

1.4 Risks and Opportunities – Waste Reduction and Recycling

There are risks in both the costs and opportunities associated with waste management in the craft brewers segment. The most obvious and immediate cost is the time and resources invested in training and educating staff in proper waste

management. A brewery may not see an immediate return on time and effort spent for this program. For example, the annual billings for waste disposal may not justify the expenses needed to implement programs. Additionally, depending on the level of recycling materials, sufficient storage space will be needed to stage diverted material before pick up. Many craft brewers are limited in their footprint and may be unable to create dedicated staging areas.

Also, it should be noted that some waste reduction programs might increase the use of energy or water. For example, brewpub operations reducing the use of disposable tableware may increase the use of hot water used to wash tableware, or installing hand dryers in restrooms may reduce the quantity of waste generated, but the dryer will increase energy use. Most waste reduction efforts are straightforward and can be implemented with little increase in water and energy use, but it is important to fully understand the costs and benefits before proceeding with any program.

Waste Reduction Opportunities and Risks

OPPORTUNITIES	RISKS
Lower cost for new materials	Reduction of certain materials may affect product quality
Lower cost for shipping/ receiving	Time invested to sort material for reuse or recycling
Lower monthly payments to waste haulers	Investment into alternative materials that may be more expensive than traditional
Potential revenue from reusable items (e.g. spent grain for feed or compost)	Some waste reduction initiatives may increase energy or water use
Potential revenue for recycled scrap metal and aluminum, glass, plastic, etc.	If operating in-house waste reduction systems, capital investments in onsite equipment
	Increasing use of warehouse or other space for staging and interim storage of wastes

section two

Data Management

Effective management of information is more than just a component of a solid waste management program; it is essential for success. As discussed previously, there are both costs and opportunities in solid waste management. Making informed business decisions to minimize risk and maximize opportunity requires effective data management.

Process Flow of Effective Data Management

The next section covers best practices for managing information:

- Data collection
- Ensuring accuracy
- Creating key performance indicators
- Setting goals

2.1 Data Collection

Data management is a process often guided by the implementation of a sustainability program, and it is typically composed of three parts: collecting the data, verifying data is accurate, and arranging the information into useful indicators of performance.

As previously mentioned, waste is generated from craft breweries during four main activities: brewing, packaging, food service, and during concerts and events. Within each activity, there are common wastes that have specific disposal and recycling methods. Conducting a basic waste audit to characterize generated wastes can help identify which area to address first.

Conducting a Waste Audit

- *Meet your waste stream*
- *Gather resources*
- *Identify opportunities for improvement*

Understanding the waste streams at your facility may require you to get your hands dirty – literally! The best way to learn about solid waste is to meet it face to face. Here are some simple steps to get started:

Meet Your Waste Stream

Determine the best time to conduct a waste audit and schedule for when the waste accumulation is at its peak (e.g., before waste contractors are scheduled to collect). If appropriate, separate audits can be scheduled for different waste streams.

During the audit, use a simple checklist and walk through the facility to begin characterization. Start with the big dumpsters (often in the warehouse or loading bay) and move throughout other areas in the facility. Sort through storage bins, pails, and dumpsters to identify the following:

- General types of waste (e.g., plastic bottles, filtration sheets)
- Source of the waste streams (e.g., packaging process, brewing)
- Waste staging and storage areas (e.g., barrels of spent grain in west warehouse)
- Quantity of waste in each storage area – use a scale, reference vendor records, or provide an estimate, citing your estimation process (e.g., "weight of one aluminum can multiplied by 500 in the bin", etc.)
- Frequency of pickup by waste collectors

For example, label pre-weighed large plastic drums with the words food, recyclable metals, recyclable non-metals, general trash, etc. Wearing proper personal protection equipment, pull materials from the dumpster and place in the appropriate plastic drum. When the dumpster is empty, weigh each drum and record the weight and volume of material categorized. Try repeating the process several times to get a general average.

Gather Resources

Once the walk-through audit is complete, reach out to vendors, community resources, or the local government or solid waste management district for additional assistance. There may be ample free services available to small businesses to implement waste reduction programs.

A waste hauler or vendor will manage the treatment or ultimate disposal of some portion of the overall waste stream. These vendors are a great source of information for efficient sorting methods, disposal opportunities, and waste quantification.

Vendors can only accept materials which they are authorized to treat or dispose, which makes following vendor instructions for waste sorting and storage essential for a successful pickup. For example, cardboard haulers may require that materials be baled, or that certain types of cardboard (e.g., wax-coated cardboard boxes) be omitted. Failure to adhere to instructions may result in additional disposal fees or outright rejection of the load.

As the price of the 'tipping fees' into landfills has increased in recent years, waste haulers have focused on identifying new opportunities to recycle or find other 'resource recovery' possibilities, making local waste haulers a suitable source of guidance on additional waste disposal opportunities.

If an onsite glass reuse or recycling program appears feasible, reach out to the local waste management district or other community resources to inquire about additional information. The waste hauler may also be able to recommend someone who can help.

In addition to the quantity estimates generated during a waste audit, waste vendor invoices are typically weight or quantity based. They can serve as a valuable validation or substitution for breweries that do not want to conduct a waste audit. Review these monthly waste invoices to identify how the brewery waste is quantified. Some invoices will list exact tonnage while some vendors charge a flat fee based on dumpster size. For invoices based on the number of dumpsters, size and frequency of pick-up, independent weighing may still be required. The day before pickup, observe the dumpster and approximate the percentage of filled capacity. Track this for a few weeks to determine variability. If necessary, contact the vendor directly for more information to help accurately quantify the waste generated.

Identify Opportunities to Improve

Whether a brewery is just beginning a solid waste program or a well-established program is already in place, there is always an opportunity to improve through waste audits. Take notes on potential areas for improvement and opportunities, such as:

- Sorting and storing wastes for onsite or offsite treatment and/or disposal
- Labeling and categorizing wastes
- Organizing or reducing space needed to sort, store and stage waste
- Optimizing opportunities for onsite management strategies such as purchasing a cardboard baler, establishing a compost bin, or reusing wood pallets.
- Training personnel to best manage waste streams, sorting, staging and storage methodologies, and recycling awareness.

- Disposing of recyclable or compostable materials in non-recyclable or non-compostable bags.
- Continuously identify new material from supplier packaging or product packaging that comes through the brewery which can be reused or recycled instead of directly sent to landfills after its use.

Spotlight On U.S. Epa Waste Wise Program Tools

The U.S. EPA Waste Wise online resource (www.epa.gov/wastewise) provides several downloadable tools to help quantify waste generation and continuously measure progress to help reach waste reduction goals. The Waste Reduction and Buy Recycled Tracking Sheet help breweries identify different components among waste streams, quantify total waste, and view potential revenues and cost savings. In addition to providing a technical tool for volume-to-weight conversions, there are user-friendly tools to quantify waste reduction, estimate disposal costs, and quantify monetary savings from waste reduction.

2.2 Ensuring Accuracy

After waste streams are identified and quantified, the information should be reviewed for accuracy. Without reliable data, especially as a baseline, it may be difficult to track progress. Having accurate initial data is also important for the monitoring for any new wastes generated, identifying mid-point goal and milestones as well as calculating cost savings. To verify the data, three main questions should be answered:

- Does the volume of generated waste appear reasonable based on the amount of beer produced?
- Is the volume of waste consistent with historical volumes (e.g., last month and the same time last year)?
- Is there any missing data that should be included (e.g. new waste stream, or one-time disposal due to construction)?

After the data is verified and approved, the information should be shared with team members, such as brewery employees and management. For breweries which are conducting the waste audit for the first time, the report may just outline the specific waste streams and total waste generated. Breweries which have collected information for several years can report progress toward waste reduction goals and overall cost savings. For breweries new to waste reduction programs and those who are operating well-established programs, it is always important to communicate the starting point goals as well as final goals and targets.

2.3 Creating Key Performance Indicators (KPIs)

Key Performance Indicators (KPIs) are specific identifiers that measure the effectiveness of a waste management program over time. KPIs provide a standard point of reference to give insight into a program's performance over time. These measurements can be on an absolute or normalized basis. To be comparable across breweries of differing size and scale, KPIs are usually measured as a rate or ratio rather than a quantitative total, such as 'tons of waste generated per barrel of beer produced' and not 'total waste generated'. Typical KPIs for solid waste include:

Key Performance Indicators (KPIs)

Total Diversion Rate: How much of the overall waste was not brought to, or 'diverted' from, a landfill (also referred to as "recovery rate" or "recycling rate")

Total Diversion Rate Excluding Spent Grain and Yeast: Due to the high volume and reuse in spent grain and yeast, total diversion rates often appear very high (very near 100%), potentially masking the diversion of other waste materials. Therefore, craft breweries have established a separate diversion rate that excludes spent grain and yeast.

Waste Generation Rate: This measures the amount of waste generated per quantity of beer produced – which is a measure of efficiency (also referred to as "total waste ratio"). Typically, this unit is metric tons of waste per barrel of beer (or per hectoliter of beer) produced.

Waste Recycling Rate: Usually presented as a percentage of total waste generated. For example, 70% of all waste generated is recycled.

There are many terms used to track waste management KPI's. Many terms are also used interchangeably (100% recyclable vs. 100% compostable) – sometimes accurately and sometimes incorrectly. To add to the confusion, "zero waste" can refer to different metrics altogether: zero waste generated versus zero waste to landfill. In another example, some consider heat recovery from incinerating waste as

recycling, while others do not. These differences make it difficult to compare waste programs across breweries. As standards and terminology for sustainable waste management continue to evolve, craft brewers should define common KPIs to drive further progress within the sector.

As discussed, the total quantity of waste generated is an important metric that provides insight on total costs and impacts. This should be used in conjunction with a normalized ratio based on production volume.

By using a ratio instead of the total, the KPI will be less influenced from fluctuations in production volume, as illustrated in the table below.

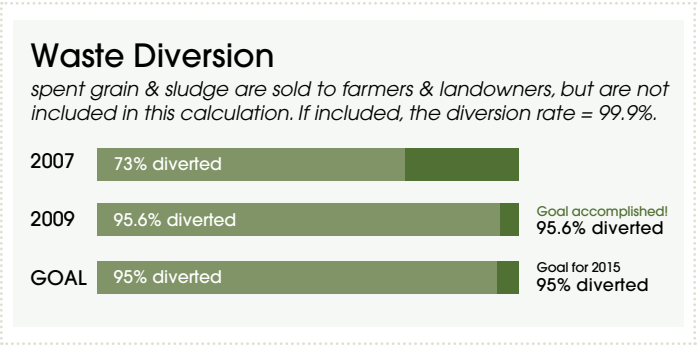
KPIs – Relative Waste vs. Total Waste

	2011	2012
Waste Generated	8,900 US tons	6,800 US tons
Beer Production	64,000 bbl of beer	48,000 bbl of beer
Total Waste Ratio	0.14 US tons/bbl	0.14 US tons/bbl

In the table above, total waste generated in 2012 was down from 2011. However, total beer production also decreased in 2012. Focusing on waste generation without accounting for production can lead to assuming less waste was generated due to improved waste reduction strategies. By using a ratio, both waste generation and beer production is accounted for – providing a more accurate assessment of facility performance.

The key is to be transparent as to what is included and what is not.

New Belgium Brewery Total Waste Diversion



KPIs are often used internally to manage a waste program by encouraging comparison over time. Initially, breweries may only have one or two KPIs that focus on basic waste streams. As the waste reduction program evolves, KPIs may change or new ones may be followed to encourage continuous improvement, particularly in less obvious areas in specific processes or waste streams.

Once KPIs are defined, establish an annual internal benchmarking plan to see how the brewery's waste management program is progressing. Assign data management roles to brewery personnel so that a data set can be built throughout the year. Repeat the benchmarking plan each year and report progress on goals internally. When a level of confidence in the accuracy of the data is achieved, consider communicating the results with customers, the community and peers. Communicating this information could be as simple as mentioning it during a brewery tour, outlining the information on the brewery website or social media outlets through blogs or Twitter feeds, or as sophisticated as publishing a sustainability report. Connect with a public relations/marketing coordinator to explore positive public messaging opportunities regarding waste reduction initiatives.

Benchmarking the brewery to peer companies, segment standards, and the craft brewer's segment average will help gauge the effectiveness of the waste management program. Internal benchmarking is an essential element of each brewer's sustainability journey. Unfortunately, there is no single standard for benchmarking and thus, best-in-class designations and research results may vary.

These manuals are not intended to function as a sole third party compliance check against all available best practices. There are many additional sources of published information; some are identified in the Reference and Web Link Sections.

One of the most effective ways to benchmark KPIs is through member-to-member comparison. Sharing this information with other Brewers Association members may encourage an ad hoc benchmarking process to develop.

2.4 Setting Goals

Establishing appropriate goals and objectives will drive continuous improvement in a waste management program. Several important things to consider when defining objectives and setting goals are:

- Prioritize opportunities: What is most important for the brewery in the near future? What opportunities are beneficial but could wait a few more years for implementation? Which opportunities are the 'lowest hanging fruit'?

- Set meaningful targets and align goals with philosophies: Make sure goals are meaningful and realistic. Also, incorporating the brewery's philosophy into solid waste reduction and overall sustainability goals will boost interest and enthusiasm for the program. Set interim attainable performance targets to ensure your brewery is effectively working towards its goals.
- Establish a benchmarking plan: As previously discussed, a brewery benchmarking plan will ensure continuous improvement over time. Plans will vary based on brewery size and program maturity.
- Look at the big picture: Think beyond the primary goal to larger objectives (e.g., employee engagement in waste management or encouraging solid waste reduction within other parts of the brewery).

Setting Goals and Targets Effectively

Targets are designed to be more objective and specific than goals. Often, targets are set in response to goals. For example, a brewery may set a goal of sending zero waste to landfill by 2020, and a target for 20% waste to landfill reduction every two years. Goals typically align with brewery philosophies, are further in the horizon and are more subjective; targets are measurable, realistic, near-term and attainable. A brewery can reevaluate a goal that was not achieved, but missing a set target can potentially demonstrate poor performance.

Both goals and targets are valuable in implementing an effective waste reduction program to ensure the program continues to improve over time. The table below summarizes some differences between targets and goals.

Goals vs. Targets

GOALS	TARGETS
Are longer term in nature (e.g., 5-year goal or 2020 goal)	Shorter time frame for achievement (e.g., 2013 target)
May be more aspirational (20% reduction by 2020)	Breaks down goals into annual, achievable measurable units
May be tied to overall company strategy	May be tasked to individual employees or departments
	Can be evaluated and enhanced or adjusted after each target is achieved or not achieved

In the early years of implementing a waste minimization program, setting ambitious yet achievable targets may appear difficult if a brewery is not fully familiar with the composition and quantity of what is in the waste stream. As brewery personnel gain familiarity with the tools available to reduce the waste stream, targets and goals will become easier to establish. While the goals may be lofty, it is always a good idea to be realistic in terms of expectations for individual targets, allowing the brewery to build upon initial success and create positive waste reduction culture and participation in the brewery's sustainability efforts.

section three

Reduce, Reuse, Recycle Best Practices

Craft brewers are often featured in the media for the innovative ways they have reduced waste through material reuse and recycling. In fact, many craft breweries have built efficiency and waste reduction into their core business culture through tactics such as working with local farmers to reuse spent grain, communicating with customers about sustainable waste management practices, and sourcing repurposed materials for building construction/interior decorating. Even top line revenue can be supported by waste reduction practices by marketing recycled products to customers. The craft brewers segment offers many opportunities to minimize waste generation, regardless of the size of the brewery or maturity of the brewery's waste management program.

Section 3 presents best practices in solid waste management. Sub-sections are organized by brewery processes and designed to follow the preferred hierarchy of sustainable waste management:

- Reduce the amount of materials used and waste generated
- Reuse materials in its original form where possible
- Recycle materials that have no further purpose at the brewery

Reduce, Reuse, Recycle

This section also discusses the importance of building a waste reduction culture at breweries. By keeping employees informed, enthusiastic and engaged, a brewery can ensure

the waste reduction program is a success. In addition, sharing practices and enthusiasm with customers demonstrates a brewery's dedication to the sustainability and the local community.

Best Practices

Many of the following efficiency improvements are independent of brewery size and there is little to distinguish between small, local craft brewers with the larger regional breweries.

3.1 Brewing

For the purposes of this manual, brewing is defined as the physical and chemical processes of producing beer. These processes are: mashing, lautering, boiling, fermenting, conditioning, and filtering.

Best Practices - Spent Grains

Spent grains are byproducts of the malting and lautering processes and the largest source of waste for most brewery operations. Although spent grains cannot be repurposed in the brewing process, they are still rich in protein, fiber and other nutrients and are a valuable resource that can be reused in many areas. Fortunately for brewers, there are many businesses and groups who are also willing to pay for and remove this 'waste' from the brewery.

Animal feed is one of the most popular ways breweries reuse spent grains. Breweries donate or sell spent grains to local farmers and livestock owners, which results in less waste to landfill, less virgin grain that needs to be grown or delivered to farmers, and more support for local agricultural business.

Spent Grain Pickup For Reuse[1]

The recent increase of ethanol plants in the United States has saturated the market with spent grain "suppliers". In addition, the consolidation of cattle to select geographic regions has eliminated many reuse opportunities for brewers. The cost and potential spoilage associated with transporting spent grains long distances is a limiting factor for many brewers. Regardless, small businesses and the local agricultural movement have continued to provide new uses and markets for spent grain.

Bakers can use spent grain as a main ingredient. Breads, cookies, and even dog biscuits can prove to be popular among the brewery's existing customers as well as introduce the brewery to new customers. In addition to creating a new revenue opportunity for breweries, a component of the waste stream is recycled within the premises.

Composting is another option for reusing spent grain. An onsite compost system can be used for spent grain, food wastes, paper wastes and other organics. Local farmers may also be interested in using spent grain in their own farms. Section 4.0 has more information on composting as a treatment option.

Some Craft Brewers Who Reuse Grain

- *Victory Brewing Company in Pennsylvania sends all spent grain to local dairy farmers, while one of these farmers provides beef to the brewery restaurant.*
- *Brooklyn Brewery in New York offers spent grain in a self-serve barrel at the front of the store on a first come, first serve basis. They post availability notices on their Twitter and Facebook feeds.*
- *Frankenmuth Brewery in Michigan uses spent grain to bake bread bowls that hold their famous chili.*
- *Reuben's Brews in Washington sends spent grain to an offsite composting group that uses compost to harvest mushrooms.*
- *Brewery Terra Firma in Michigan grows all of its ingredients needed for the brewery on its farms. The brewery wastes are composted onsite and returned back into the ground to help grow next season's ingredients.*

Spent-grain-to-fuel is a higher capital intensive solution for spent grain disposal. Though fuel-to-energy processes may appear innovative, the technology is well established. Fuel-to-energy processes converts spent grain into biogas that can be used to supplement energy used in-house or sold back to the electrical grid. Anaerobic digesters are a common type of fuel-to-energy process and can use any type of organic waste – including food waste from restaurants – providing opportunities to collaborate with the local community. If installing an in-house anaerobic digester is not feasible, a brewery can also investigate whether a nearby business has an existing unit that could incorporate the brewery's spent grain as fuel.

Best Practices – Diatomaceous Earth

Diatomaceous earth (DE) is a naturally occurring siliceous sedimentary rock that is used during the filtration process of brewing to clarify beer and remove particulates. If a brewery uses a significant amount of DE, disposal of the material can become problematic if not managed well.

Filtering of cold conditioned beer is usually done with a plate-and-frame filter. Plate and frame filter presses are dewatering machines that utilize pressure to remove the liquid from slurry. Beer is mixed with a filter aid such as DE or perlite. The solids remain in the void between the plates, until the plates discharge the filtered solids. At the end of filtration, the solid filter cake is removed and typically disposed in a landfill. There are some reuse opportunities for this material as listed below.

REDUCE

- *Optimize the use of DE when preparing a filter to mitigate waste. This requires knowledge of the particle sizes of potential impurities and expectations for clarity of the beer. Work closely with the brewing team to identify ways to reduce the amount of DE without impacting beer quality.*
- *For larger regional breweries, explore alternatives to DE filtration such as cross-flow filtration technology (where product passes across a filter to remove impurities - filter tends to last longer than DE filters), centrifuges, or alternative filtration media (e.g. BASF's Crosspure beer filtration aid, used at some breweries in Germany and China).*

REUSE

- *According to a 1997 University of Western Australia study, small DE particle size makes it easier to store or add to compost bins, and has the added benefit of pest control. Coarse DE affects the skin of soft-bodied pests like slugs or aphids, and decreases the need for additional chemical pesticides.*
- *Spent DE can be used as an additive to certain construction masonry materials such as concrete, cement, and brick. Contact local construction companies and identify opportunities to donate or sell spent DE. Or if onsite construction activities are planned, identify any opportunities to add spent DE to required masonry materials.*

Regardless of reuse method, it is extremely important to maintain DE in a wet condition to avoid the dangers associated with airborne dust.

Best Practices - Spent Yeast

Yeast is added during the fermentation process of brewing to catalyze the chemical conversion of sugars from wort into carbon dioxide and alcohol. Most brewers, if not all, have excess yeast from the brewing operations. Effective management of yeast can reduce costs and increase revenue, without compromising the quality of the final product.

REDUCE

- *Save and reuse yeast*
- *Spent yeast diversion from disposal; reven generating system for high value byproduct to feed or vitamin supplements*
- *Spent yeast and trub are materials that add bulk to an onsite or offsite composting system*

- *Spent yeast, like spent grain, can be used as animal feed. Be mindful of the state of the yeast culture if using spent yeast for animal feed.*

A common practice in both breweries and bakeries is to save and reuse yeast to reduce the amount of new yeast that must be purchased from a vendor, and can improve yeast qualities from generation to generation. Note that techniques of yeast storage will vary by brewery process and size.

When reusing yeast, brewers should be mindful of two important factors: temperature and time. Included below are tips to optimize the number of generations sourced from reusable yeast.

White Labs Yeast Reuse Best Practices

- *Collect yeast shortly after fermentation is complete, and keep it at 10 – 15 degrees Fahrenheit below beer temperature.*
- *Although many brewers use conical bottom fermenters, higher quality yeast is collected from top cropping. This prevents good yeast from mixing with bacteria, waste product and dead yeast at the bottom of the fermenter.*
- *Store yeast in an airtight container – many brewers use stainless steel soda-type kegs or high-quality food-grade plastic containers or buckets.*
- *Avoid pressure and carbon dioxide build up – shake and vent pressure at least once a day.*
- *Use storage containers only for yeast to prevent cross-contamination of other components and bacteria.*
- *Use reused yeast ideally within 1 – 3 days of harvest in order to preserve viability. Any amount of time beyond two weeks significantly increases the risk of losing yeast viability.*
- *Test yeast regularly for issues with viability and purity before adding to a brew.*
- *Once the yeast tests clean, add some wort prior to its use.*

Yeast contains over 40% protein and can be suitable as an animal feed supplement. Check with local authorities and animal nutritionists before mixing spent yeast with spent grain. Although in many instances it is acceptable, some jurisdictions require the yeast to be inactive and many spent grain contracts limit the percentage of yeast that can be added.

Brewery Yeast Reuse

Standing Stone Brewery adds materials leftover from the fermentation process such as spent yeast, trub and hop leftovers to the compost mix used at their farm. Farm-raised chickens are given the task of picking and scratching through the compost beds, mixing the materials and subsequently forming a nutrient rich soil used to grow fruits and vegetables for the Brewery restaurant.

In summary, the main component of most breweries' solid waste stream is from the spent ingredients used during the brewing process. There are ample opportunities to reduce and recover this valuable 'waste' stream using the checklist below:

Activity Checklist

SPENT GRAIN

- *Quantify the amount of spent grain your brewing process regularly produces. Establish a formal spent grain staging area to hold spent grain waste prior to reuse.*
- *Reach out to local farmers/livestock owners and let them know your brewery has spent grain available for pickup. It's at your discretion to sell or donate the grain.*
- *Use posters/flyers, social media feeds, and email lists to reach the customer base and inform them of spent grain availability.*
- *Connect with local gardening co-ops, garden clubs, farmers, schools, etc. to identify interest in spent grain for offsite composting.*
- *If your brewery has an associated restaurant, investigate ways to incorporate spent grain into recipes for goods that can be sold at the bakery.*
- *Connect with local bakeries and restaurants to gauge interest in baking goods with spent grain.*
- *Connect with local soil and water districts, environmental conservation departments, farm bureaus, or universities to identify the need for spent grain in grant work or other scientific studies.*

DE

- *Quantify the amount of DE your brewing process regularly produces. Establish a formal DE staging area so this waste can be segregated from other streams prior to reuse. Don't forget: Always keep it wet.*

- *Meet with the brewing team to discuss the amount of DE being used for a single run of the process. Determine if there are opportunities to minimize the amount of necessary DE without affecting product quality.*
- *Meet with filter vendors and process managers to identify potential cost-effective alternatives to DE filtration that would result in less solid waste generation at the facility.*
- *Evaluate opportunities for adding spent DE to cement, concrete, or other construction materials being used onsite.*
- *If your facility produces a substantial amount of spent DE, connect with local masonry supply businesses to determine if there are opportunities to sell or donate for use as an additive.*

SPENT YEAST

- *Evaluate opportunities to reuse yeast at the brewery.*
- *Evaluate yeast storage processes – meet with process managers and purchasing department to identify improvements that can be made to yeast storage to maximize viability.*
- *Consider mixing spent yeast with spent grain. Check with local authorities and the end user to understand restrictions.*

3.2 Packaging

For the purposes of this manual, packaging is defined as the process of bottling/canning finished product and preparing it for distribution to the consumer. Packaging materials offer some of the best opportunities for waste reduction, material reuse, and recycling. Because packaging costs can account for 30% to 50% of total finished goods costs, a reduction in the amount of packaging can directly impact the bottom line.

Many breweries already have some type of recycling program in place for glass, paper, and metal products. One of the greatest challenges of establishing a recycling program at a brewery is the availability of local recycling programs or availability of local waste vendors/recycling centers. If recycling is not available in the area, there are other opportunities to reuse and reduce total waste that will be discussed throughout this section.

Though not yet available all across the U.S., there are some local recyclers that can assist with recycling a significant portion of packaging materials. Check with your local waste hauler or solid waste management district to identify what packaging material recycling options there for your brewery.

Optimizing packaging materials for reuse and recycling relies heavily on the brewery's ability to effectively sort and separate the items. Different types of glass, paper, metals, and plastics have different qualities and availability of recycling programs for each may vary. For example, some vendors may only accept clear glass, or may have stringent requirements for how cardboard must be organized, bound and flattened in order to be accepted for pickup. There may also be an economic benefit in taking the extra effort to recycle some materials. Before developing packaging waste management programs, evaluate the brewery's capacity for an organized sorting system. Be sure to involve personnel from across the brewery (process managers, warehouse employees, brewing team, etc.) and consider each perspective. This participation builds accountability and strengthens the recycling culture at the brewery.

Best Practices - Corrugated Cardboard

Corrugated cardboard finds its way to the brewery through shipments from vendors and suppliers. It is primarily used for product packaging (e.g., six-packs, cases) and other offsite shipments (e.g., equipment for repair, merchandise from gift shop, etc.).

REDUCE

Find alternatives for corrugated cardboard when packaging final product. Use reusable plastic cases or crates that can be returned to the brewery.

Consider product extensions beyond bottled beer and promote large-pack products, such as growlers or kegs that do not require additional paperboard packaging to keep bottles together.

Use responsible cardboard products when corrugated cardboard is necessary. Select cardboard that is high in post-consumer content to reduce reliance on virgin materials. Look for cardboard with the "Corrugated Recycles" logo to maximize opportunities for consumer recycling. Avoid cardboard with wax coatings, as these are difficult to recycle.

Repurpose cardboard - there are countless opportunities for repurposing cardboard at breweries. Employees and members of the community are a great resource for ideas on how to reuse cardboard. These individuals have creative solutions specific to the facility and community. Some examples include:

- Shipping items such as merchandise or parts in need of repair.
- Composting cardboard that is wet, waxed, or soiled (depending on the material that has soiled the cardboard).
- Shredding cardboard to use as packing material to protect fragile items during shipment.

Cardboard Baler[2]

After reviewing options to reduce and reuse cardboard at the brewery, recycling the waste is the next best option. Contract a waste vendor for pickup or delivery of recycled materials to a cardboard recycling facility. Recycling opportunities and requirements will vary by location. A few simple rules of thumb for preparing materials are outlined below.

RECYCLE: Recycling rules

- *Ensure cardboard is clean and meets recycling requirements (e.g., no wax, additional packaging materials removed, etc.).*
- *Break down cardboard boxes so they are flat and easily stackable.*
- *If required, use approved straps to bind cardboard so it can be easily transported (e.g., plastic straps, rope, etc.).*
- *Store cardboard in a dry, cool place.*
- *Use a "cardboard only" waste container that is weather-proof and can be locked to prevent disposal of non-cardboard wastes.*

Best Practices - Wood Pallets

Wood pallets are used in staging operations in the brewery for holding equipment and barrels on the brewery floor, packages of finished product, or empty packaging materials being moved to the filling area.

Some jurisdictions have special requirements for how wooden pallets should be disposed or recycled when they are beyond repair. Contact local waste management authority to inquire about any special regulations for wooden pallet disposal.

Reusable Plastic Pallets[3]

REDUCE

- *Use wooden pallets responsibly: Seek pallets that are durable, made from good quality materials, and/or constructed from recycled pallet materials. Repair broken pallets onsite or identify a local vendor who can provide repairs. Consider entering into a pallet leasing program to share pallets with other local businesses – a particularly attractive option for smaller scale breweries.*
- *Find alternatives to using wooden pallets. Some options include:*
  - *Recyclable/reusable plastic pallets that are as durable as wooden pallets and last longer.*
  - *Recyclable plastic slip sheets which are lightweight and compact.*
  - *Recyclable/reusable cardboard/fiber pallets and wrapping that are lightweight.*

REUSE

Repurpose pallets that are broken beyond repair. Wooden pallets can be chipped or ground and the wood used for pellet stoves, landscaping, composting, spill cleanup or animal bedding for local husbandry. Broken down pallets can even be repurposed for building material, art and furniture.

Architects, decorators and local artists who use pallets also seek wooden pallets. Similarly, pallets could be reused at the brewery for décor or small improvement projects.

Recycled Wooden Pallets[4]
Wood chips made from ground up recycled pallets and colored are destined for the landscaping market.

RECYCLE
Recycle pallets that are broken beyond repair or no longer needed for brewery operations. Selling used pallets can provide an additional revenue stream for the brewery.

There are many local and national markets where vendors buy and sell used pallets. Many of these vendors also take broken pallets or pallets that are no longer needed. Note that some used pallet vendors may require a large number of pallets in order to be picked up.

Wooden Pallets Checklist

- *Conduct a cost benefit analysis for using wooden pallets at the brewery. Reference the U.S. EPA's Pallet Cost Calculator as a guide through the quantification process.*
- *Identify opportunities to reduce sourcing of new wooden pallets – are used pallets available? Is there room in the budget to purchase pallets made from recycled plastic? Are there local pallet share networks that can be joined for a reasonable cost?*
- *Consider investing in equipment needed to repair broken pallets onsite or identify local vendors that will repair and/or recycle broken pallets.*
- *Evaluate opportunities to sell or donate used or broken pallets to local artists or schools.*
- *Chip or grind non-repairable pallets for onsite wood/pellet stoves, landscaping, compost, or small brewery improvement projects (e.g., decorations, garden boxes, etc.).*

Best Practices - Flexibles: Shrink Wrap, Bags, Sacks

Flexibles are plastic packaging used for the staging and transport of finished product to distributors or consumers. Plastic shrink wrap stabilizes finished product loads during transportation. Plastic bags or sacks are used to package products purchased by customers. Certain brewery supplies may also be shipped in plastic bags (e.g., packing material, shrink wrap from bottle delivery, ingredient additives).

Effective Recycling of Plastic Strapping

Plastic strapping is typically made of either polypropylene or polyester. Polypropylene can be used for lighter applications and polyester is better for heavy duty applications and both types of strapping are recyclable if the appropriate facilities exist locally. Check with the recycling vendor to see if they accept the type of strapping you receive with your supplies. And, remember to cut the strapping down to manageable lengths when recycling them.

Investigate whether steel straps or reusable webbing can be used instead of plastic straps to secure kegs for shipping.

The most effective way to reduce waste in this area is simply use flexibles only when necessary. Request suppliers to reduce the amount of unnecessary plastic wrapping used in their supplies. Make adjustments to the way brewery staff packages products for customers. Staff can try to avoid double packaging, and instead of automatically placing product in a plastic bag, ask if the customer needs a bag. Monitor the average amount of shrink wrap used on stacked pallets and evaluate ways to wrap them more efficiently. The key is to find an optimal balance between protecting the product to ensure a saleable product and minimizing the use of flexibles.

Use recyclable flexibles to prevent additional waste that needs to be disposed of or use flexibles made from recycled materials that prevent sourcing of new materials. For plastic straps used for shipping, many companies offer these in both (new) recyclable plastic and recycled plastic forms.

Pallet Wrap Reusable Mesh Reduces The Need For Plastic Shrink Wrap[5]

Use alternatives to plastic bags/sacks. Much research and comparison has been done about the environmental attributes between paper and plastic bags. The jury is still out on this issue but one aspect is undisputed: reusable bags trumps both paper and plastic. Many businesses offer reusable cloth or post-consumer plastic shopping bags to customers for purchase or as a marketing give-away. This is a great way to promote a brewery. Offering reusable shopping bags at a brewery presents several opportunities: reduction in sourced new plastic materials, brand recognition (via customers reusing the bag within the community), and supporting the brewery's waste reduction culture. Encourage customers to return with their shopping bag each time they visit the brewery (a "bring your own bag" program) for a promotional item or other incentive.

Look for opportunities to reuse bags inside a brewery. If there is no recycling program for plastic bags available in the area, try to avoid using them in the first place in favor of alternatives. Consider offering customers a small incentive if they bring their own bags in for their purchase or decline using a new bag.

REDUCE

Use alternatives to shrink wrap packaging. Reusable packaging such as "Pallet Wrapz" mesh pallet wrappers or cardboard containment reduce the amount of sourced plastic and potential waste.

REUSE

Plastic bags used for shipping ingredients or other additives can be reused to collect non-reusable, non-recyclable waste to landfill instead of purchasing 'garbage' bags.

RECYCLE

Recycle flexibles: proper sorting of plastics and keeping out contaminant plastics will ensure the material is properly recycled.

Recycling opportunities will vary depending on brewery location. The first step in successful plastic recycling is sorting plastics according to plastic type.

There are seven different types of plastic classified according to their material content. Some plastics cannot be recycled because their chemical composition prevents them from being reformed into another product. With this in mind, breweries must properly segregate plastics.

Breweries should then reach out to local recycling authorities and identify which plastics are accepted in the area. The most commonly accepted plastics are #1 (Polyethylene Terephthalate), #2 (High Density Polyethylene) and #4 (Low-Density Polyethylene). Recyclable shrink wraps are typically #4 plastics, while most plastic shopping bags/sacks are #2 or #4.

Seven types of plastic

Best Practices - Aluminum Cans

Aluminum cans are highly recyclable and one of the primary vessels for packaging finished product. Many breweries prefer to use aluminum cans because they are opaque and prevent oxidation. They are easy to carry without risk of breakage, and their lightweight properties make them easier to ship and package.

LIfe Cycle Of A Recycled Aluminum Can[6]

Aluminum, like glass, can be infinitely recycled - meaning the material does not deteriorate the more it is recycled. According to the Aluminum Association, aluminum cans are typically recycled, turned into new cans and placed back on the shelf within 60 days.

RECYCLE

Collect aluminum cans that were rejected during the quality process or are leftover from a tasting at the brewery and send them to a vendor for recycling. Aluminum cans can also be collected and returned to raise profits for local community organizations (e.g., high school sports teams, river keepers or environmental groups).

While cans tend to be thought of as "one-size-fits-all" and that little can be done to affect the size and quality of the aluminum can, many suppliers are able to produce cans to meet the specifications requested by the brewery. With this, cans may be designed that reduce the thickness and composition, yet have no effect on the quality of the beer.

Tallgrass Brewing Company "Canifesto"

The Tallgrass Brewing Company in Kansas worked with their supplier to create a unique can for the company. The new size, containing one full pint, was created. This effort was born, in part, by wanting to make it as easy as possible for their customers to recycle their Tallgrass Beer containers.

Aluminum Can Facts

- *Aluminum cans on average, have about 68% recycled content.*
- *In the U.S., over 100,000 aluminum cans are recycled each minute. That amounts to 53 billion cans recycled in 2010.*
- *Cans are approximately 12x lighter than bottles, thus requiring less energy to transport*
- *The U.S. recycling rate for aluminum beverage cans reached 58.1% in 2010- a rate that is more than double that of any other beverage container.*
- *Twenty recycled cans can be made with the energy needed to produce one can using virgin ore.*
- *The amount of energy saved just from recycling cans in 2010 is equal to the energy equivalent of 17 million barrels of crude oil, or nearly two days of all U.S. oil imports.*
- *Recycling one aluminum can saves enough energy to run your television for three hours.*

Source: U.S. EPA, Container Recycling Institute, Can Manufacturing Institute

Best Practices - Glass Bottles

Glass bottles are the iconic packaging of craft brewers. Beer is typically bottled in brown, green, or clear glass; however, tinted glass is preferred for its opacity, which preserves beer quality. Although glass is 100% recyclable, the availability of recycling programs will vary based on brewery location.

Glass Bottles[7]

REDUCE

Source locally. Craft breweries typically cannot produce their own glass bottles onsite. Consequently, glass must be sourced from offsite locations. Contracting with a local glass producer will reduce the amount of energy needed to transport glass to and from the brewery.

REUSE

See if a recycled glass supplier is available in your area, and seek opportunities to reuse certain glass containers.

- *If a recycled glass supplier is available, although a little farther, consider selecting that supplier. According to the Glass Packaging Institute, transportation accounts for under10 percent of the energy used to move bottles from the recycling facility to the final consumer and back to make a new bottle. And, the energy saved from using recycled glass in the manufacturing process can offsets the energy used to transport glass containers across the country.*
- *Refillable bottles: Due to U.S. regulations, small pack bottles cannot be refilled. In some countries like Canada, this is a widely accepted process and an efficient collection and distribution network is well established. Growlers, or 64-ounce refillable glass containers, are becoming more popular at craft breweries. Indeed, many breweries promote the use of growlers (e.g., "Growler Hours" at East End Brewery in Pennsylvania). Growlers provide the customer with a fresh product in a container that can be refilled at the brewery. Purchase of one growler prevents the filling of multiple 12-ounce glass bottles, strengthens brand loyalty and provides the customer with a unique experience.*

RECYCLE

Sort and divert--Although glass is highly recyclable, it must be properly sorted to meet processing requirements.

Develop a recycling area and label bins to segregate glass waste (e.g. "brown glass", "clear glass", etc.). Provide training to brewery personnel to ensure they are properly disposing of glass waste (e.g., glass is clean, sorted accordingly, etc.) and make sure they understand what materials can be recycled and what must be sent to landfill. Note that other 'glass' materials such as Pyrex, window glass, and dishware cannot be recycled and will contaminate the load if included.

Boulevard Brewing Company

In 2009, the Boulevard Brewing Company in Missouri realized that almost 10 million empty Boulevard bottles were being thrown away into local landfills. The brewery found that, while there were plenty of businesses that were using recycled glass, most of this glass was sourced from outside the area. The reason? There was no local system in place to collect glass for recycling and no nearby facility to process it, even if it was collected. Subsequently, in collaboration with other local companies and the community, Ripple Glass was born.

Ripple Glass now has a state-of-the-art processing plant and there are dedicated glass recycling containers throughout the metro area, including Jefferson City and Branson. Ripple's facility is processing glass from all over the region, helping other communities keep glass out of their landfills and saving significant amounts of energy.

Glass Bottle Facts

- *Glass bottles have gotten 50% lighter in weight between 1970 and 2000.*
- *Glass bottles are 100% recyclable and can be recycled endlessly without loss of quality.*
- *In 2010, over 41% of beer and soft drink bottles were recovered for recycling, a higher percentage than liquor and jars. In total, 33.4% of all glass containers were recycled.*
- *An estimated 80% of recovered glass containers are made into new glass bottles, and it can happen quickly. A glass container can go from a recycling bin to a store shelf in as little as 30 days.*
- *States with container deposit legislation have an average glass container recycling rate of over 63%.*
- *Recycling just one glass bottle saves enough energy to light a 100-watt light bulb for four hours, power a computer for 30 minutes, or a television for 20 minutes.*
- *•There are 48 glass manufacturing plants operating in 22 states, and approximately 76 recycled glass (cullet) processors in 31 states.*
- *Ceramics, porcelain, Pyrex, and dishware are the most destructive contaminants for glass recycling. Make sure they don't get mixed in with your recycled glass bottles.*

Source: U.S. EPA, Container Recycling Institute, Glass Packaging Institute

3.3 Warehousing

For the purposes of this manual, warehousing refers to operations within the brewery's main storage area where finished product, supplies, extra equipment, maintenance supplies, etc. are staged.

A brewery warehouse is a common space to organize waste reduction activities. Some opportunities include:

- Cardboard baler: investing in an onsite cardboard baler offers several advantages. Baled cardboard takes up less space than loose cardboard. Even if there are no cardboard recycling options in the area, compressed baled waste leaves room in disposal bins for other solid waste. Some cardboard recyclers require all cardboard to be bailed before they will accept it.
- Shrink wrap or plastic baler: similar benefits to using cardboard balers – optimizing storage space needed for waste plastic. There are many hand-operated plastic balers in the market, eliminating the need for a nearby electrical outlet.
- Waste stream sorting: Use warehouse space as a central location for waste sorting and storage. A central location with clearly labeled waste bins will help employees sort wastes consistently (e.g., each department sorting and storing recyclable plastics the same way). Scheduling waste pickup will also be easier if all brewery waste streams are accounted for and organized.

REUSE

Refurbished or used fixtures are a good investment for expanding a warehouse area. Find ways to purchase used fixtures and equipment (e.g., light fixtures, shelving units, powered industrial trucks, balers, etc.) through internet resources and local business bureaus or construction/architecture firms.

3.4 Support Systems (Utilities)

Support systems refer to utilities, physical space, site management, and office space. These are the 'back-of-house' operations that keep the company and brewery processes running smoothly.

Building a culture based on sustainability and efficiency among brewery employees is critical for a successful waste reduction program. Even the lower profile areas such as administrative space should be included in any waste reduction program.

REDUCE

Begin with employee awareness campaigns – provide training on waste sorting, explain waste reduction goals and targets, and seek employee input for unique ways to reduce solid waste. Celebrate waste reduction achievements and share good news with customers and the community. Employee support for waste reduction programs will be evident – customers will appreciate the genuine efforts the brewery takes in being sustainable.

Establishing a "Green Team"

A great way to build a sustainability culture is to establish a "Green Team" – a group of employees from all levels (e.g. management, operators, engineers, marketing, retail, etc.). The team can work together to brainstorm and implement sustainable practices at the brewery and importantly, get buy-

in from all across the organization. Members of the Green Team can be responsible for collecting metrics, hold information sessions, and identify unique ways of supporting the culture. For suggestions on how to establish a Green Team, see Section 4.

Consider implement a green procurement process for all office and facilities purchases. Identify suppliers who carry environmentally sensitive inventory or, if they don't, request them. In order for recycling programs to work, a robust market for the recycled materials needs to be in place. By purchasing recycled equipment where available, a brewery can increase the demand for such products in the market and thereby increase the incentives for recycling programs.

New Belgium Brewery Employee Empowerment and "Sustainabillies"[8]

At New Belgium Brewery, the "Sustainabillies' (the brewery's version of a Green Team) are empowered to promote sustainability by conducting department visits and explore how to incorporate waste, water and energy reduction within the company. These visits help identify barriers to achieving it and uncover innovative approaches to incorporating sustainable practices through all routine tasks. Even for a company where environmental stewardship is a major part of the company's history, the Sustainabillies continually work to keep it front of mind. New Belgium is now embarking on a new era of employee engagement where all employees feel empowered to drive sustainability into their daily activities.

When expanding or renovating, consider reusing materials from local businesses that are closing down, repurpose old brewery materials for the new areas, or purchase recycled building materials.

Breweries that Build with Recycled Materials

Reuben's Brews in Washington purchased tables and benches constructed from "new wood" – a material made from 99.9% post-consumer waste.

SKA Brewery in Colorado used leftover wood from local bowling alleys to build a bar and tables in their new brewery.

Yards Brewery in Pennsylvania uses all reclaimed fixtures, furniture and equipment. Floors are made from recycled concrete and coated in a SoyCrete sustainable compound. They also use wood from a bowling alley and materials from an old skate park.

3.5 Food Service

For the purposes of this manual, food service refers to operations within brewery restaurant or pub areas, as well as break rooms within a brewery. A simple way to reduce overall waste is to reduce or eliminate the use of individually packaged items, such as creamers, condiments, and straws. Care must be taken to ensure a sanitary environment can support these efforts to reduce overall waste.

Even if a brewery does not have a brewpub or associated food operation, most will have an employee break room or cafeteria. An effective waste reduction strategy for the break room is to post sustainability information and recycling reminders – both to encourage participation as well as to reinforce the sustainability culture the brewery is fostering. Many of the following best practices can be used in this area of the brewery.

The National Restaurant Association has developed the Conserve Sustainability Education Program. It is an excellent online resource to help restaurants reduce operating expenses and leave a lighter footprint on the environment. Many of the ideas presented in this section are from the Conserve program.

Best Practices – Cardboard and Paper

Cardboard and paper products are used in restaurants for food preparation and serving supplies, take-out containers, serving wares, kitchen operations, maintenance and housekeeping, and sanitary services. A common misconception is that soiled cardboard or paper products can be recycled; however, cardboard or paper that comes into contact with oil or grease cannot be recycled. For example, pizza boxes with grease stains from melted cheese cannot be recycled.

Cardboard and paper recycling services will vary based on a brewery's geographic location. Regardless of location, all brewery restaurants can find ways to reduce paper waste.

Control napkin use by substituting cloth napkins at serving tables. Cloth can be reused and sanitized with water-efficient and chemical-efficient practices. If cloth napkins are not practical, control the number of paper napkins that are provided to customers. This practice can be implemented by giving one napkin per customer unless more are requested, or removing napkin dispensers. There are new dispensers on the market that also effectively reduce the number of napkins dispensed at any one time. If paper products are used, consider purchasing products that are biodegradable or made from post-consumer materials.

Standing Stone Brewery in Oregon uses plant-based materials on all to-go ware, including straws. These materials can be composted.

REDUCE

- *Install air dryers in restrooms as an easy and efficient way to minimize paper towel waste. Over time, hand air dryers are also more economical due to the continued expense of restocking paper towels. Air dryers reduce waste to landfill as paper towels may contain potential biohazards that should not be included in compost or recycling systems.*
- *Buy bulk products at superstores or from restaurant suppliers to minimize the amount of individually packaged items. Avoid products that are individually packaged and then repackaged in a larger box or plastic casing.*

REUSE

Compost clean paper products such as paper towels used to sop up water, used paper plates, or non-recyclable cardboard containers (waxed cardboard, egg cartons). Always segregate paper products that have been soiled with chemicals or grease/oil to avoid contaminating the compost bin.

RECYCLE

Use recyclable or compostable containers for take-out or pre-made orders. Have restaurant staff remind patrons that the containers can be recycled or composted, noting that only cardboard containers that are clean can be recycled and composted. If take out containers come into contact with grease or oil, it cannot be recycled.

Best Practices - Plastic

Plastics are used for food storage and preparation, packaging, serving ware, bottled water, and other non-alcoholic beverages.

REDUCE

Use alternatives to plastic utensils by sourcing compostable plant-based utensils or offering metal flatware. If there alternatives to plastic are not feasible, select utensils made with post-consumer plastic.

REUSE

- *Avoid wasting plastic wraps and bags by using reusable plastic or glass storage tubs for food preparation, freezing, etc. Wrap sandwiches or bakery items in recyclable or biodegradable paper. Encourage the use of reusable totes when sending out to-go orders.*
- *Reuse plastic tubs – some ingredients are shipped in large plastic barrels or tubs (typically #3 or #7 plastic). There are countless ways to reuse these tubs – as planters in the brewery garden, waste sorting buckets, or storage for nuts and bolts, etc. If there is no further use for them within the brewery, identify possibilities for reuse by employees or customers.*

RECYCLE

As a final resort, recycle plastic. Sort plastics appropriately: Typical plastics encountered in restaurants include #1, #2, #4 and #5 (Polypropylene, or PP, typically used for dairy products such as butter tubs and yogurt). If there are no recycling facilities

available in the area, encourage other businesses and the community to work together and investigate how to develop a new facility.

Tips for Sorting Restaurant Plastics

Sorting – Set up a kitchen plastics sorting area. Label bins to collect different plastics according to number.

Training – Train employees on proper plastic recycling practices, such as cleaning out plastic bottles and tubs prior to placing them in the recycling bin, and recognizing plastic types according to number.

Customer Participation – At self-serve restaurant establishments or events, provide an area for customers to separate plastic wastes from other waste. Place a clearly labeled bin for recyclable/compostable plastics and/or plastic bottles near the main trash receptacle. Use posters or tri-folds on tables to encourage customers to recycle plastic materials.

Bottle Recycling – If your restaurant sells plastic bottles to customers, use Earth911.com or other resources to identify the availability of bottle recycling for returnable deposit. Funds from bottle recycling can be donated to local community organizations.

Best Practices - Glass

Glass use in brewery restaurants varies depending on the services offered. Some restaurants serve beer on tap using glass pint glasses or other glassware, while others serve beer in bottles. Glass is also used in kitchen areas for ingredient and food storage.

REDUCE

Increase the use of tanks or kegs to serve beer instead of individual bottles to reduce glass waste. Avoiding the use of plastics by using glass pint glasses or compostable biodegradable plastic cups will also avoid waste generation.

RECYCLE

Sort glass for recycling: Glass is highly recyclable but must be properly sorted for recycling. Local recyclers may only accept specific types and colors of glass and following these instructions reduces contamination of the recycler's stock.

Best Practices - Aluminum and Steel

Aluminum and steel use in brewery restaurants is similar to glass usage. Beer is served to customers in aluminum cans and kitchen operations use aluminum and steel cans for food preparation.

Recycling Glass, Steel and Aluminum in the Brewery Restaurant

- *Identify glass, aluminum and steel recycling operations in the area through online resources, local jurisdiction waste offices, or waste management companies.*
- *Monitor the amount of glass, aluminum and steel waste that is generated weekly - schedule pickups according to typical customer flow.*
- *Ask recycling vendors about revenue from aluminum and steel return – and evaluate whether it will reduce the cost of recycling (e.g. pick up, storage).*
- *Develop a well-organized recycling storage space in the kitchen area. Label and color-code bins to segregate wastes (e.g., returnable aluminum beer cans, brown glass bottles, clear glass jars, etc.).*
- *In self-serve restaurants, provide a similar waste sorting system for customers to deposit their empty bottles and/or cans as they exit the restaurant. Ask restaurant employees for suggestions on the most effective placement for the recycling bin.*
- *Let customers know the brewery restaurant recycles – post signage. Include references during tours, etc. Share brewery recycling efforts with customers to strengthen the sustainability culture.*
- *Provide training to restaurant personnel to ensure they are properly disposing of glass, aluminum and steel waste (e.g., vessels must be cleaned with no food waste, paper wrapping removed, etc.) and understand what materials can be recycled and what must be sent to landfill.*

RECYCLE

Sort and recycle: Aluminum and steel are both highly recyclable materials and if a brewery has a large enough volume, there may be an opportunity to recoup some revenue for recycling this material.

Best Practices - Food Waste

One way to reduce operational costs in a brewery restaurant is to reduce the amount of food that goes to waste. As food costs have risen significantly in recent years, reducing food waste has become a greater area of focus for all food service operations.

Food Waste[9]

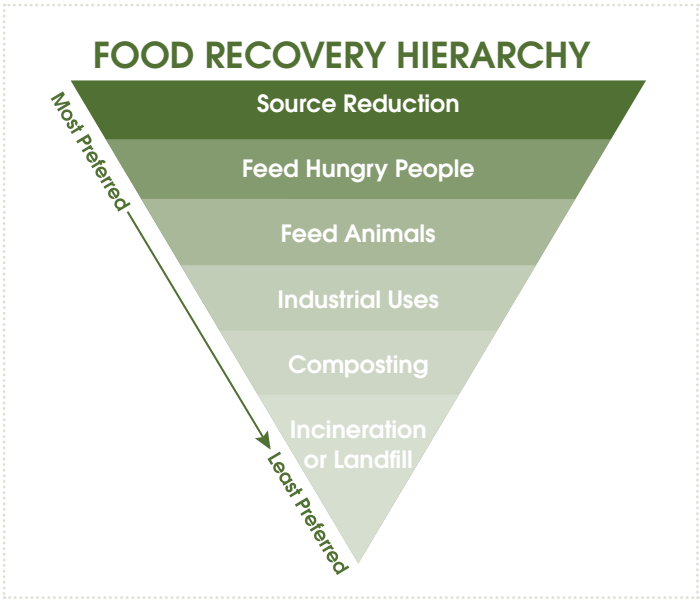
All food service operations produce food waste. According to the U.S. EPA, 25% of the food prepared in the U.S. ends up as solid waste in landfills. When food decomposes, the natural composition produces methane, a potent greenhouse gas, which is often released directly into the atmosphere.

Spoiled or stale food, surplus food that will not fit in cold storage areas, and unfinished portions left by customers must be disposed. Byproducts of food preparation, such as oils and greases from fryer operations or fat and bones from prepared meats, also add to the generation of food waste.

The U.S. EPA established a Food Waste Hierarchy, a way to identify how to divert food waste from landfill disposal which follows the preferred order for waste reduction: Reduce, Reuse and Recycle. The website also provides tools and guidance documents for those interested in minimizing food waste.

Sourcing local ingredients for menu items and purchasing local products reduces the cost of shipping and transportation, provides customers with fresher food, and supports community business. Preparing cooked meats and fried goods generates fats, oils and greases. Proper management of fats, oils and greases reduces waste generation and prevents equipment malfunctions due to buildup. It also keeps restaurants in compliance with wastewater regulations.

U.S. EPA Food Waste Hierarchy[10]



Source: U.S. EPA

REDUCE

Advance planning: Regularly monitor customer demand for menu items and plan meals accordingly. Prepare only what is needed, and when possible cook meals to order instead of preparing surplus dishes. Carefully managing production prevents wasted food and money.

Reduce the amount of used fryer oil that is disposed: Keep the fryer oil in optimal condition by daily filtering and consistently removing excess food pieces from the oil. Also, keep the heat below 355°F when in use, and either off or no more than 250°F when not in use. Following these best practices will unlikely impact the quality of the prepared food.

Checklist For Managing Fats, Oils And Greases

- *Collect and render grease – keep it out of drains*
- *Scrape grease from cookware/serving platters before washing*
- *Use drain screens on sinks and piping to collect grease that makes it through to cleaning cycles*
- *Regularly inspect and clear grease control*

devices (e.g., screens, grease traps)
- *Wipe up grease spills before adding water to avoid creating slippery surfaces*
- *Limit garbage disposal use to non-greasy food materials to prevent grease buildup and equipment malfunction*
- *Train employees in proper grease management practices*

REUSE

Fryer oil to biodiesel: Breweries can donate or sell used fryer oil to companies and individuals for use as biodiesel to fuel vehicles:
- *Inquire with other local restaurants to identify sources who accept used fryer oil*
- *Post availability of fryer oil using social media outlets or your website*
- *Seek guidance from the local waste authority or the brewery waste vendor*
- *Connect with companies and organizations that specialize in buying and selling fryer oil for biodiesel, such as the Alternative Fuel Foundation*

Bull City Brewery Biodiesel

As part of a cooperative that contributes to the biodiesel supply at the Bull City Biodiesel, the Bull City Brewery in North Carolina recycles its fryer oil from the restaurant operations to power vehicles.

If a brewery's spent grains are already destined for a local composter, inquire if the compost can also accommodate food wastes. Certain food scraps can be composted onsite, provided to an offsite composting facility, or transported to an offsite anaerobic digester.

REUSE

Surplus food donations are accepted in most communities to feed those in need. Check with local food banks, community centers, churches, shelters, and soup kitchens. The Food Donation Connection, in partnership with the National Restaurant Association, matches donated food from restaurants with regional and local recipient groups. And finally, the EPA offers additional guidance on their "Food Donation: Feed People, Not Landfills" website.

If the brewery has onsite livestock or partners with a local farm, food scraps can be reused to feed animals. Discuss dietary restrictions with a veterinarian or partner farmers, and work with kitchen personnel to sort scraps that can be provided as feed.

Onsite Composting at Sierra Nevada Brewery

Sierra Nevada Brewery, no stranger to sustainable brewing practices, continues to develop best practices for managing wastes and invested in a new "HotRot" composting system. The HotRot is a large, enclosed system that composts waste from the brewing process and discarded food scraps from the restaurant. Sierra Nevada invested in this state-of-the-art composting system due to a lack of composting options in the region. In addition, filter pads from the filtration process and spent hops from the dry hopping process can also be composted.

3.6 Concerts and Events

Craft breweries are known for hosting and supporting community events, such concerts and festivals, or hosting a booth at local community gatherings. Although these events are held for fun and entertainment, they are also an opportunity to promote responsible waste reduction practices and share sustainability culture with customers and the community.

There are numerous ways to reduce waste at concerts and events. Collecting and sorting recyclables may appear to be labor-intensive but an added bonus of implementing a waste minimization program at concerts and events are the countless volunteers that can be relied upon to assist in reaching goals.

Sort the waste by setting up a waste sorting system in the main gathering area of the event. Provide clearly labeled bins for each type of waste that can be recycled or composted. Recruit the brewery Green Team or other volunteers to sort through the materials after the event and ensure they are properly disposed, recycled or composted.

Work with a local commercial composter to ensure all food waste is composted after the event. Identify a commercial or industrial composter that can accommodate corn-based or compostable utensils. Encourage food vendors to use compostable utensils and plastic ware to streamline the composting feedstock.

Prominent Recycling Signage is Important[11]

Use smaller containers at buffets or food service stations to reduce the amount of spoiled food that will be discarded. In addition, serve smaller portions and encourage guests to return for seconds to reduce over serving guests and leading to food waste.

Avoid plastic water bottles: Encourage patrons to bring their own reusable cups or bottles to the event to minimize waste generation. Provide water stations and offer a small discount or other incentive to those who bring their own vessel. Offer reusable bottles for a small fee or give them away as a marketing tool. If bottled water is unavoidable, select a supplier who uses a compostable plastic bottle to streamline the post-event recycling efforts. These bottles can be added to the food waste stream to be composted after the event.

For events in the Denver area, the local utility, Denver Water has a water truck for use for community events and concerts.

Compostable biodegradable serving ware at events, like GreenWare used at the Bell's Brewery Eccentric Café in Kalamazoo, Michigan.

Offer recycled souvenirs/merchandise: Offer merchandise that is made from post-consumer materials or sourced locally. For example, Reuben's Brews in Seattle, Washington sells baseball caps made from recycled plastic bottles and tee shirts made from organic cotton and supplied by a local company.

Breweries have the unique opportunity to provide sustainability outreach information and awareness at events. Set up a table or booth to showcase the brewery's waste reduction achievements, and engage the community so they can take the message home.

Implementing a waste minimization and recycling program at concerts and events is also an excellent way to rally volunteers and the community. Due to the vast number of people attending an event in a short period of time, the greater the number of volunteers and staff able to help with the proper collecting and sorting, the greater the success the waste management program will be.

The North American Organic Brewers Festival

Through concerted effort and collaboration with the event organizers and volunteers, the NAOBF was able to divert 87% of the almost one ton of waste generated at the event from landfill. The majority of the diverted waste was composted.

section four

Onsite Waste Treatment

Evaluate the waste stream as a potential resource for another process. Is there something that can be used for another company or another industry? With a little bit of effort, waste can be diverted and used as a valuable input for a different process.

This section presents selected onsite waste treatment opportunities for craft breweries. Reducing the generation of waste should always be the first step, while installing onsite solid waste treatment may be economical at some point.

4.1 Economic, Regulatory, and Image Drivers

Most craft brewers are interested in finding ways to reduce hauling and waste removal costs. As prices for disposing waste continue to increase, alternative solutions become more attractive. The primary considerations are the cost-benefit tradeoffs. Will the brewery benefit more from paying a contractor to bale and recycle cardboard packaging, or is it worth investing in an onsite baler to get the job done in house? If the budget can't accommodate a new baler, could it support purchasing a smaller, used baler instead?

Some craft breweries may move to invest in onsite waste treatment to more easily comply with new and changing regulations. If a craft brewer seeks to invest in onsite solid waste treatment, regulatory requirements for permitting, installation and processing need to be considered. Reach out to the local waste management district to understand the appropriate regulations within the town, the surrounding region, and the state.

Additional Resources on the Regulation Environment:

- *US EPA Regional Offices: Visit the EPA website to review region-specific waste regulations and locate contact information for specialists who can provide further insight into requirements*
- *State/regional environmental departments: Seek more localized information by contacting the state/regional environmental department (e.g. New York State Department of Environmental Conservation). Most states have contact information and regulatory resources available online*
- *City/town waste manager or Department of public works: Connect with a city or town official to discuss local recycling initiatives or waste reduction protocols.*
- *Non-Governmental Resources: There are several*

organizations that can point in the right direction toward waste reduction solutions. Notably, Earth911.com is a frequently cited resource that provides zip code specific waste reduction opportunities

- *Waste Vendors: They can provide information regarding regulatory requirements*

If pursuing an onsite waste treatment program, it is prudent to schedule a meeting with the local planning board to discuss requirements associated with onsite waste treatment. Some jurisdictions may follow statewide requirements, while others may have local specifications that need to be met (e.g., protecting the local watershed). Permits may be required for certain projects, like onsite composting or waste-to-energy systems.

Craft brewers aim to have a positive reputation, especially when it concerns dedication to the environment. Installing an in-house waste reduction program not only may be cost efficient, but also:

- Demonstrates awareness about sustainability issues and commitment to reducing community impact. By taking a little effort and time, the brewery can send less waste to local landfills and treatment facilities.
- Provides a good story to tell during brewery tours. Incorporating the brewery's sustainability practices into the tours demonstrates a brewery's dedication to waste reduction and commitment to being a responsible local business.

4.2 Simplified Onsite Composting

Composted material can be used for onsite landscaping and gardens or provided to local co-ops to support community compost programs. To get started:

- Quantify the compostable material including food waste, such as fruits, vegetables, eggshells, stale breads and non-food waste, such as spent grains.
- Connect with local resources (compost co-ops, restaurants, farmers) that have experience composting. Ask for suggestions on which equipment to use, space needed for composting, local costing of equipment, etc.
- Identify which commercially available compost equipment would best fit the brewery's needs. An enclosed compost unit is likely the best fit for most craft breweries. Enclosed compost bins mitigate odors, and are less attractive to pests and wild animals.
- Visit a local hardware store or farm supply shop to identify options. The best solutions are usually dependent upon local conditions - there isn't an optimum solution that fits all breweries.

On average, commercial-sized compost bins range from the low hundreds to several thousand dollars, depending on the type of composting unit and capacity:

- Worm Composters (Vermiculture): compost bins that use worms to assist with organic material breakdown.
- Compost Bins: metal, plastic or wooden bins that hold compost and require manual turning to keep the process active.
- Compost Turners: enclosed bins that are turned using a wheel or lever.

What Goes In (and Stays Out) of Compost

TYPICAL COMPOSTS	SOME COMMERCIAL OR INDUSTRIAL COMPOSTS	DO NOT ADD TO ANY COMPOST
• Animal manure • Cardboard rolls • Clean paper • Coffee grounds and filters • Cotton rags • Dryer and vacuum cleaner lint • Eggshells • Fireplace ashes • Fruits and vegetables • Grass clippings • Hair and fur • Hay and straw • Houseplants • Leaves • Nut shells • Sawdust • Shredded newspaper • Tea bags • Wood chips • Wool rags • Yard trimmings	• Black walnut tree leaves or twigs • Coal or charcoal ash • Dairy products • Eggs • Fats, grease, lard, or oils • Meat or fish bones and scraps • Pet wastes • Yard trimmings treated with chemical pesticides	• Plastic • Glass • Metal

4.3 Advanced Onsite Composting

Larger scale composting projects require careful review of waste streams, equipment capacity, and employee engagement. Items to consider when evaluating the brewery' ability to implement a composting program include:

- Identify the waste stream: Evaluate the brewery's waste streams by process. Quantify waste generation over time (e.g., pounds of DE per month) to determine which waste streams should be included in compost.
- Evaluate brewery capacity for a large-scale composting system. Reach out to composting equipment companies to determine what type of system will best match the brewery's needs.
- Determine if it will be an outdoor or indoor composting system.
- Check state and local regulations to clarify what can and cannot be composted in the brewery jurisdiction.
- Present a compost system plan to local building departments or other officials to ensure compliance with any permit requirements.
- Work with equipment companies to ensure the system is properly installed and that system maintenance and management requirements are understood.
- Identify where compost mix will be used, such as onsite to grow fruits and vegetables for the brewery, or donated to a local farm or co-op.

4.4 Balers

In some locations, cardboard recyclers will require cardboard waste to be pre-baled for pickup. Investing in an onsite baler could save a brewery both time and money. Similarly, purchasing a cardboard shredding unit may also have long term waste reduction benefits, producing a media that can be used for shipping or sent to compost.

CASE STUDY

Higher recycling revenue from baled cardboard

By baling cardboard over a period of time and delivering a full truck load directly to the recycling facility, Sierra Nevada is able to receive higher revenue directly from the facility than from a recycling hauler.

Shredding Units Or Balers Can Be Purchased New Or Used From Vendors Across The Country[13]

Baled Flexible Plastics For Recycling[14]

There are countless balers of various sizes, costs, and applications that can be used at a brewery. Some of the smaller balers are even hand operated, eliminating the need for a nearby electrical source. Some balers can be placed on casters, allowing the unit to be moved periodically.

4.5 Waste-to-Energy Projects

Waste-to-energy or waste-to-fuel systems include incineration, anaerobic digestion, gasification, and pyrolysis, among others. The most common waste-to-energy system for craft breweries to use is anaerobic digestion. Anaerobic digestion systems capture the methane gas produced when organic material breaks down. The methane is then combusted to produce heat or energy to power other brewery processes.

Installing an anaerobic digester creates a closed-loop system that provides methane from a waste product. Although it may be a good long-term investment, this solution is not for everyone. Investments in this type of project require some amount of capital as well as technical know-how to keep the operation running smoothly, which may not be feasible for smaller breweries. Similarly, small breweries may not produce the quantity of waste needed to make the waste-to-energy system a cost-neutral or positive investment.

More information on waste-to-energy systems can be found in the Brewers Association Energy Best Practices Manual.

section five

Brewery Case Studies

Reduce, Reuse, Recycle

Bell's Brewery – Kalamazoo, Michigan

Between 2008 and 2011, Bell's Brewery went from a 50% landfill diversion rate to a 93% diversion rate. Garbage collection has been reduced at the brewery from three pick-ups per week to one as a result of their recycling efforts.

Some of their efforts completed to achieve this improvement include:

- Recycling all cardboard, paper, stretch wrap, green plastic banding, keg caps, wood, electronics, batteries, copper, stainless steel and black iron from the brewery production process.
- Using GreenWare cups at Bell's Eccentric Cafe (which are manufactured by a local company), made from a plant starch-based polymer resin and that can be composted with other yard waste from the city of Kalamazoo.
- Composting food waste from the Eccentric Café's kitchen with sawdust from carpentry contractors and spent grain from the original brewery in downtown Kalamazoo.

The brewery views sustainability as the capacity for the business to thrive in future generations through the practices of environmental stewardship, economic robustness and social integrity.

Great Lakes Brewing Company – Cleveland, Ohio

In 2001, the Great Lakes Brewing Company launched their Zero Waste Initiative to minimize energy and resource use and maximize materials reuse. Some of the efforts include:

- The Bio-Diesel Fueled Shuttle uses a diesel fuel made from the brewery's discarded fryer grease used in the restaurant, which runs 30 percent cleaner than conventional diesel fuel.
- Spent Grain is used as a growing medium for gourmet mushrooms, ingredient in bread and pretzels and feed for dairy and beef cattle; it is also being tested as a soil amendment by local vegetable growers.
- Cardboard, Glass, Paper—recycling of these materials has reduced trash removal fees by 40%.

McMenamins Pubs & Breweries – Portland, Oregon

A number of initiatives are in place, including:

- Recycling scrap paper, office paper, newspaper, magazines, cardboard, aseptic containers (milk cartons and drink boxes), plastic bottles and jugs, plastic tubs and buckets, plastic bags and shrink wrap, metals (including tin, aluminum, aerosol cans and any other metals), colored glass jars and bottles, block Styrofoam packaging, wine bottle cork (donated to SCRAP, a Portland nonprofit that teaches art programs in the city's public schools), electronic and computer equipment, oil from fryers and grains left over from the brewing process

(which go to a local hog farmer). They also provide resources for people who are interested in recycling materials from an event held at McMenamins' properties.
- The oil used in Edgefield's Black Rabbit Restaurant is already a recycled product; it's derived from rice bran, a by-product of milling rice.
- Edgefield wine bottles and packaging peanuts are reused.
- Copy paper with the highest post-consumer recycled content is used; menus are printed on paper with 30% post-consumer waste.
- Recovery of food items (kitchen trimmings, plate scrapings, meat, bones, fish, dairy products and baked goods) and uncoated foil-soiled paper (paper towels, napkins, waxed cardboard, pizza boxes, coffee grounds and filters). The materials are composted at a facility in Cedar Grove, WA. The product is then sold as compost and soil amendments at retailers such as Home Depot.
- Divert organic-matter waste at the following locations - Portland: Edgefield, Kennedy School, Bagdad, White Eagle, McMenamins Tavern & Pool, the Chapel Pub, Fulton Pub, Hillsdale Brewery & Public House; and Seattle: McMenamins Queen Anne.
- A portion of brewery hops and debris generated from the gardens is used in the Edgefield Gardens, which are grown using organic methods.
- In 2009, grape pumice (a by-product of Edgefield Winery's crush), was donated to the Oregon Food Bank Farm Production Program.
- Chipped wood used for walking trails at Edgefield is donated by local arborists.

New Belgium Brewing Company – Fort Collins, Colorado

In 2011, New Belgium Brewery diverted 94.38% of its waste from landfills, excluding spent grains, yeast, DE and wastewater treatment sludge. Some of the ways that New Belgium worked to improve its waste systems included:
- Eliminating two trash dumpsters at its Process Water Treatment Plant and Malt building and replacing them with recycling containers for super sacks, plastic bags and Mylar bags.
- Adding compost collection to New Belgium's offsite warehouse.
- Diverting plastic bags, super sacks, Mylar bags, chip bags and compost discs out of landfills. Additionally, the brewery improved systems to collect more Styrofoam and paper packaging than in previous years.

Ongoing waste reduction initiatives the brewery is pursuing include:
- Working to identify waste opportunities where New Belgium can eliminate waste before it enters the brewery.
- Eradicating or reducing waste that New Belgium sends to the landfill.
- Activating projects that will work to increase New Belgium's waste diversion rate.

Sierra Nevada Brewing Company – Chico, California

In 2010, Sierra Nevada reported 99.6% of solid waste was diverted from landfill disposal (92.9% if spent grain and yeast are excluded from the total).

Sierra Nevada works with suppliers to limit the amount of wasteful product that enters the facility, like individual plastic packaging for key chains and pens. The brewery continuously seeks opportunities to eliminate process waste, such as modifying filtration processes to eliminate filter waste, and to reduce packaging through methods such as reducing the amount of cardboard needed for secondary packaging and increasing the amount of recycled content in bottles.

Sierra Nevada stresses the importance of materials reuse. Examples of reuse opportunities include: repairing and reusing broken pallets, reusing incoming packing materials for off-site shipments, and donating large grain sacks to landscaping companies and local bee keepers. In addition, they have identified creative reuses for product packaging, such as converting old labels into notepads and old bottle caps into magnets. They also reuse spent grain: 100% of spent grain and yeast is recovered and sent to local cattle and dairy lots as supplemental feed.

Sierra Nevada has a well-organized recycling program that includes collection of cardboard, shrink wrap, glass, scrap metal, wood, paper, and plastic strapping. Their sustainability department conducts regular audits of trash, recycling and compost areas.

Stone Brewing Company – Escondido, California

Stone Brewing Company's approach is to reduce the use of materials in the first place, then reuse, compost and recycle what's left. The company offers numerous house-made products that involve less packaging, and stores the dry ingredients in reusable and washable glass jars. Their chickens are fed with restaurant and brewery byproducts, including spent grain, hops and vegetable scraps. For recycling, the company tries to keep every resource that

comes in to the facility within the brewing operation until the very end of its useful life. Stone Brewing's newest projects are all about completing the resource circle by converting items that are normally trashed into resources.

Onsite Treatment

Magic Hat Brewing Company (North American Breweries) – Burlington, Vermont

Most operations dispose of their spent grain by selling it — or giving it away — to farmers, for use as cattle or animal feed. At the Magic Hat Brewing Company, this waste is being converted into natural gas by using an anaerobic digester.

The 42-foot tall structure, which cost about $4 million to build, sits in the back parking lot of Magic Hat's brewery, about 100 feet from the main complex. The anaerobic methane digester extracts energy from the spent hops, barley and yeast left over from the brewing process — and it processes the plant's wastewater. That saves the brewer on waste disposal, wastewater treatment costs and natural gas purchasing.

Having an anaerobic methane digester onsite can save breweries up to $2 per barrel in costs, a considerable savings for even a medium-sized operation like Magic Hat.

Sierra Nevada Brewing Company – Chico, California

Sierra Nevada developed their well-known HotRot composting system in response to a lack of large-scale composting programs in the area. The in-vessel system composts waste from the brewing process and onsite food services, such as paper towels from the break room, spent grain skimmed from water treatment, filter pads, and food (including bones) and paper waste from the restaurant and concert venue. The investment paid off- HotRot can accept up to 5,000 pounds of compostable waste daily, using discarded organics for a nutrient-rich soil supplement for the hop field, restaurant garden and employee garden.

appendix a

Tool Box

Guidance and Checklists

- Guidance - How to Create a Workplace Recycling Program (Earth 911)
- Checklist – Feasibility of onsite Composting (USEPA)

On-Line Excel-Based Tools

- Calculating the Costs & Benefits of Onsite Waste Management

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- CalRecycle, www.calrecycle.ca.gov
- Carbon Dioxide Recovery (Brewery), https://union.dk/
- Compost Regulations, www.recycle.cc/compostregs.htm
- Construction Junction, www.constructionjunction.org
- CrossPure, www.basf.com/group/corporate/en/brand/CROSSPURE
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- RippleGlass, www.rippleglass.com
- City of Ashland, www.ashland.or.us/Page.asp?NavID=12023
- National Restaurant Association (ConsSERVE), conserve.restaurant.org/
- The Brewers' Handbook, www.beer-brewing.com/default.htm
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