Winery
SUSTAINABILITY WORKBOOK

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Cornell CALS
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NYS P2I | New York State Pollution Prevention Institute

Introduction

Sustainability for the wine industry

Sustainability supports economic growth, the environment, and social progress. To promote sustainability in the winery industry, the New York State Pollution Prevention Institute (NYSP2I) at Rochester Institute of Technology (RIT) and the Cornell Craft Beverage Institute at Cornell University partnered to launch a sector-based pollution prevention (P2) initiative. Through this work, **key sustainability best management practices (BMPs)** for wineries have been identified that can lower production costs, reduce environmental impacts, save natural resources, and demonstrate social responsibility.

How to use this workbook

The goal of this workbook is to provide BMPs that wineries can implement to reduce environmental impacts associated with utilization of water, energy, and chemicals, such as minimizing the use of toxic cleaning chemicals and generation of wastewater and solid waste.

This workbook is designed to provide step-by-step guidance for using the **Best Management Practices (BMPs) for Wineries Checklist**, which is found at the end of this document. It is organized throughout into four key focus areas:

- water use and wastewater generation
- energy use
- chemicals and materials management
- waste management

The preliminary sections (pp. 3–15) provide additional background information and recommendations corresponding to the numbered self-assessment questions in the checklist. Refer to these as you develop your answers. And remember: Even small steps can lead to big results over time.

The primary focus of this initiative is Central and Western New York; however, this workbook can be used to help wineries across all of New York State and beyond.

Water Use and Wastewater Generation

Best Management Practices

Although water is readily available and relatively inexpensive in many parts of the United States, excess water consumption can have an impact on costs and energy use, since energy is needed to move water. Overuse also leads to increased amounts of wastewater, which must be dealt with according to applicable regulations. Reducing water use can potentially save costs for a winery on the process side (lower fees if purchased or less pretreatment and pumping if from a well) as well as on the wastewater side (reduced disposal and pretreatment costs for chemicals and energy).

Understanding water usage for each area of the winery, as well as wastewater pollutant concentrations, can help identify priorities for decreasing water usage and wastewater generation. For example, winery wastewater generated from washing operations during harvesting, pressing, fermentation, washing equipment and bottles, bathroom, and restaurant usage can be examined for potential reduction opportunities. Source-reduction measures, like modifying operations to reduce potential contaminants entering the wastewater, may lower disposal costs and help ensure compliance with wastewater-discharge regulations.

1. Are you aware of the total amount of water used in the winery?

Understanding water use is the first step in prioritizing strategies to reduce water use and wastewater generation. Methods to measure water use include analysis of water bills and reading of water meters. If well water is used, meters can be set up at the well or at the water's point of entrance into the facility. The volume of water you are currently using can serve as a baseline for measuring other BMPs, especially if specific operations are metered.. Any unusual or unexpected changes in water use can signal hidden problems, like a pipe leaking or a running hose left unattended for significant periods of time.

2. Do you measure water use in specific areas where water use is significant? Are sub-meters in place?

Where are you using the most water? The second step in water-use reduction is identifying areas with high water use.

Processes to track include the following:

- general cleaning (cleaning transfer lines, floors, walls, and ceiling)
- barrel cleaning
- barrel hydration
- tank cleaning
- press or crusher cleaning
- filter cleaning
- bottling

Sub-meters located in areas with high water use will provide the data needed to compare usage from month to month, and can help identify areas for improvement or maintenance, including leaks, faulty equipment, or unnecessary equipment running.

3. Do you use dry methods instead of using water when cleaning, such as sweeping and collecting debris?

Pre-cleaning equipment, tanks, and floors using brushes, brooms, shovels, or squeegees can help prevent winemaking solids and juice from entering the wastewater. The use of dry methods can reduce the quantity of water needed to clean, as well as the volume and contamination level of wastewater that needs to be treated or hauled away. Soft-bristle brushes can be used for scrubbing to avoid damaging stainless steel coatings. Note: No one should ever enter a tank without proper training and enclosed space protocols in place.

4. Do you use flow-control devices?

Various methods to reduce water use without sacrificing satisfactory results are available, some of which involve special equipment. Trials can be run to see which devices make the most sense for a particular operation. Common types of control devices include the following:

- **timers** – Where sporadic rinsing needs exist, timed rinses that correlate with actual need can help eliminate excessive water use.
- **flow restrictors** – Flow restrictors are inline fittings designed for a maximum flow rate, such as one or two gallons per minute, regardless of back pressure. These restrictors can be used while still meeting cleaning requirements.
- **low-flow hose nozzles** – High-pressure, low-flow nozzles for cleaning and barrel washing reduce water flow significantly compared to conventional flow nozzles. Cleaning with high pressure is most effective when the spray is at an angle to the surface. Either cold or warm water can be used for initial rinsing; however, warm water may reduce the rinsing time.

Other water-reduction methodologies include switching to waterless sanitation through the use of ultraviolet (UV) light and monitoring and fixing leaks throughout the facility.

5. Do you use a high-pressure cleaning system on the crush pad?

High-pressure cleaning typically requires less water than conventional pressure cleaning to achieve acceptable results.

> *Bedell Cellars on Long Island is now using a high-pressure washer, which uses 25% less water. Read the case study **here**.*

Other strategies that can help to reduce water use on the crush pad include the following:

- installation of shading to prevent sunlight from drying solids and juice on equipment
- removal of as many solids as possible by hand (to keep them from entering wastewater)
- scheduling as much crushing as possible between cleanings

6. Do you reuse relatively clean water, such as final rinses, in other areas of operation?

In many cleaning applications, rinsing with clean water is required, sometimes more than once. Oftentimes, the rinse water from tank or fermenter cleaning, bottle cleaning, barrel cleaning, cooler flushing, filter backwashing, and sterilizing is discharged after use. Water from final rinses may be adequate for reuse in facility cleaning, initial rinses, filter backflush, caustic dilution, boiler makeup, refrigeration equipment defrost, and irrigation of the vineyard or landscaping (if allowed). The result is less water being used and less wastewater generated. Rinse water can be filtered and/or disinfected if necessary. Note: Testing should be performed to determine where rinse water could be used.

7. Do you have a dedicated barrel-cleaning system?

Special barrel-cleaning nozzles—either high-pressure or low-flow—can increase water efficiency. Also, using a small amount of hot water and steam instead of soaking barrels can reduce water use.

8. Do you use a predetermined amount of water in sanitation operations, including rinses?

Predetermining and limiting the amount of water used in repetitive cleaning operations can reduce dependence on monitoring requirements, which, if not diligently followed, can result in excess water use and unnecessary waste.

9. Have you installed any pretreatment equipment to manage wastewater leaving the facility?

Regardless of how much water is conserved and/or reused, wastewater will always be created. Depending on where the winery is located, discharge of wastewater may be regulated by either the state or local municipality. If a municipal sewer line is used for discharging wastewater, the winery may need to make sure that a proper permit is in place. If discharging into a leach field or directly onto the ground, state regulations typically apply and are disclosed in a permit. These discharge permits typically impose limits on the amounts of solids and organic matter that can be sent to the sewer or the ground, usually measured as total suspended solids (TSS) and biological oxygen demand (BOD). Pretreatment may be necessary to ensure that TSS and BOD levels are within permit limits. Any winery in New York State considering development of a wastewater discharge program will need to contact either the local municipality (sewer) or the New York Department of Environmental Conservation (direct discharge) to determine if a permit is required and, if so, the limits that would be applicable to the winery.

Below are three specific questions to consider regarding wastewater management.

- What is the cost of connecting to a municipal system to dispose of wastewater compared to on-site treatment?
- If wastewater is treated on-site, what will your maximum capacity be? Will this be adequate at all times? Note: Storage tanks can be used to equalize flow into the treatment plant.
- How will high-strength wastes be segregated for compost or transport to existing municipal anaerobic digesters to avoid overloading an on-site treatment system?

> *For more information on wastewater issues, a guidance document has been prepared and can be found **here**.*

10. Are you aware of all regulations related to water use and wastewater discharge?

Since regulations can vary by location, it is important to understand which regulations and permits apply to a particular winery. Besides discharge to sewer or ground, other regulations may be relevant. In many locations, rinse water can be recycled for irrigation or landscaping if free of chemical, organics, and solids.

Energy Use

Wineries typically use significant amounts of energy since refrigeration and other machinery are needed in production. Reducing energy saves money and can lower maintenance needs, improve equipment performance, and cut down on the use of fossil fuels (and in turn, greenhouse gas emissions). An awareness of existing energy use can serve as a baseline for comparing alternatives and measuring savings.

1. Are you aware of high-energy use operations within your facility and how they affect demand charges?

Most commercial entities have two main charges on their electric bill: consumption and demand. Consumption is the total amount of energy (kWh) used during a billing period and demand is the peak usage or maximum amount of power (kW) drawn at any 15-minute interval during the same billing period. The unit cost of demand is typically much higher than the unit cost of use. Reducing overall electric usage will lower consumption costs and lowering peak demand can result in significant savings.

Consider the following strategies:

- To avoid large demand charges, shift or stagger some electric loads to make your power use more consistent over time.
- The New York Independent System Operator (NYISO) offers **demand response programs**, providing incentives to reduce energy peaks. Users can enroll in these programs through their local utility company and, if certain conditions are met, receive payments for reducing their electric usage from the grid during periods of high energy demand.

2. Do you track energy use in high-consumption areas, like refrigeration?

Refrigeration is usually the largest energy user in a winery and therefore has great potential for energy savings.

Consider the following strategies:

- Investigate methods, such as use of tank and pipe insulation, to reduce refrigeration requirements. (See Checklist Question 3.)
- A chiller uses excess energy when its large compressors run at full-rated constant speed. Additionally, frequent start-and-stop cycles waste energy and reduce the service life of motors and compressors. Operating compressors at lower speeds can reduce power requirements and eliminate cycling. If compatible, sizing and/or retrofitting a chiller with a variable frequency drive (VFD) to run at part-load can cut electric costs by up to 30 percent and reduce peak power demand. It is important to ensure that the motors used in the chiller are VFD-compatible; premature equipment failure can result , if they are not.
- Many refrigeration systems operate at unnecessarily high head pressure. The use of floating head-pressure controls will lower a system's compressor head pressure based on outdoor environmental conditions and can result in significant energy savings.
- If a cooling fluid, such as propylene glycol is used, maintain the fluid at the percentage of dilution recommended by the manufacturer for optimum heat transfer.
- In refrigeration systems, condensers are the components that reject heat from the system. Condensers affect energy use differently, depending on the type used. Air-cooled condensers reject heat to the outside air and must be hotter than the dry-bulb temperature of the air. Evaporative condensers also reject heat to the air but only need to run hotter than

the wet-bulb temperature. Liquid-cooled condensers need to run hotter than their cooling mediums, whether that medium is cooled by a cooling tower or a geothermal well. Lower condenser temperatures allow the compressor to run at a lower pressure, which saves energy. When specifying condensers, consider their operating temperature and impact on energy use.

3. Have you insulated all piping connected to refrigeration and hot water?

Energy is lost from exposed piping when the fluid temperature inside is much lower or much higher than the surrounding ambient temperature. For colder pipes, excess condensation and frost are indications that energy is being lost. Depending on several factors, insulation on piping and tanks can provide significant energy savings.

Consider the following strategies:

- Use reflective or light-colored, outdoor-rated piping, tanks, and insulation where pipes are exposed to sunlight.
- If possible, locate all tanks inside an air-conditioned space or, if outdoors, under a shaded and ventilated area.

Bedell Cellars insulated outdoor chiller pipes that were exposed to sunlight and energy loss. By implementing this BMP, the winery realized a 4% reduction in electric costs. Read the case study ***here****.*

4. Are cold-stabilization tanks insulated?

Many wineries use uninsulated cold-stabilization tanks in their processing rooms. Insulating chilled or heated tanks can reduce energy consumption and improve both product and environmental conditions.

Key advantages to using insulation include the following:

- Less energy use puts a smaller demand on existing heating and cooling equipment. Longer term, it allows for the purchase of smaller, lower capacity models.
- Insulation can reduce noise levels from equipment.
- Insulation can prevent condensation that may lead to corrosion on cold piping, valves, fittings, and chillers; moisture damage to other building materials; and mold and mildew growth. A vapor-retardant system may be recommended to keep the insulation dry and effective. Aluminum or light-colored insulation is best for tanks installed outdoors.
- Some wineries cool their cold-stabilization rooms with uninsulated, chilled tanks. This slows the wine-cooling process, creates high humidity from condensate, and makes temperature control in the space difficult or impossible. Insulating the tanks and chilled water piping and adding proper evaporators with condensate drains can improve wine-chilling performance and provide better environmental control of the space.
- According to the National Insulation Association, proper insulation can increase process efficiency by as much as 95 percent.

5. Do you use electrodialysis (ED) instead of cold stabilization to remove tartrates?

Tartaric acid is naturally occurring in all wines and can precipitate as salts. During fermentation and barrel aging, some of the tartaric acid settles out as tartrates but the majority remains soluble in the wine. However, when wine is chilled below 40°F, it will bind with potassium, which is also naturally occurring in wine and will form potassium bitartrate crystals (KHT) or tartrates.

Tartrates are harmless but may be visually unappealing to customers. They are commonly removed through cold-stabilization, where the fermented wine is cooled close to its freezing point (as low as 28°F) for up to three weeks. Cold-stabilization is time-consuming and costly due to refrigeration costs. Some wineries will take advantage of a cold winter climate to perform cold-stabilization only during colder weather and thus avoid high energy use, but this approach can place a constraint on production scheduling.

ED is already used extensively in California and in other countries to eliminate tartrates from wine. It is deemed a proven membrane-based technology that can reduce acidity and thus prevent tartrate formation. The ED process is also much faster than

cold-stabilization and and demands 66–99 percent less energy. Since significant capital investment is needed to implement ED, wineries would need to produce enough wine to realize a reasonable return on this expenditure. Water is used and some wastewater is generated. More details on ED and its application to wineries can be found **here**.

> *A NYSP2I study at Glenora Wine Cellars in Dundee, New York, found that switching to an ED system could save the winery $46,000 annually and reduce energy costs associated with cold-stabilization by 96 percent. Read the case study **here**.*

6. Do you use a tartrate precipitation inhibitor [e.g., carboxymethylcellulose (CMC) or Zenith™]?

Besides cold-stabilization and ED, removal of tartrates can be accomplished through the use of crystal inhibitors such as CMC, Zenith™, and metatartaric acid (AMT). Zenith™ is made with potassium polyaspartate (KPA). CMC, meanwhile, may cause filtering issues. These products prevent precipitation when the wine is chilled and have been widely adopted in areas where cooling costs are high. This technique is more cost-effective but may have limitations for certain wines due to the effects they have on color and taste. . Simple tests can be performed to determine applicability for each wine produced. Some known features for these inhibitors are summarized below.

Tartrate Inhibitor	Long-Term Stabilization?	Affects Wine Color?
CMC	Yes	Yes
Zenith	Yes	No
AMT	Reduced effect long-term	No

7. Do you have a preventative-maintenance protocol for your refrigeration system?

Replacing air filters and cleaning condenser coils periodically enables more efficient operation and less chance of equipment damage. It is normal for dirt to settle on coils and accumulate on filters. Clogged filters reduce airflow, which can cause coils to freeze and lead to overheating, and possibly damage the motor. Dirty coils cannot release heat easily; the unit must work harder, making it less efficient.

Also, check the system for refrigerant leaks, since operating at low charges can damage equipment. Refrigerants emitted into the atmosphere can degrade the ozone layer and also have a very high impact on global warming, often hundreds to thousands of times greater than carbon dioxide. In addition, check for oil leaks, which may mean parts are not being lubricated properly. Leaking oil is also a good indication that refrigerant may also be leaking.

8. Is the area around cooling devices free of items to allow for unrestricted airflow?

Maintaining airflow around equipment increases energy efficiency and the lifespan of your equipment. Confirm manufacturer-recommended clearances to ensure optimal layout.

9. Do you use programmable HVAC (heating, ventilation, and air-conditioning) thermostats?

If a consistent schedule is in place for building space and rooms, turning on heating and cooling systems only when space is occupied can reduce energy use. As opposed to manual control, a programmable thermostat to adjust temperatures as needed would help ensure systems are turned on only when space is occupied. Discount programmable thermostats are available through many electric-utility companies.

10. Have you switched to energy-efficient lighting like LED (light-emitting diodes) in more than 50 percent of your facility?

Per the U.S. Department of Energy, LED lighting can reduce energy consumption by 72–80 percent, compared to traditional incandescent or halogen lighting, and last significantly longer than traditional bulbs. In addition to immediate energy savings, many local electric utilities offer rebates or incentives for the replacement of existing lighting with qualified Energy Star or DesignLights Consortium (DLC) products. Longer lighting life necessarily results in reduced maintenance costs, especially when replacing lighting in difficult-to-reach areas. Switching to LEDs will help reduce energy costs and greenhouse gas emissions.

> *Channing Daughters on Long Island replaced all fluorescent lighting in their hospitality room with LED lighting, saving over $400 in electric costs per year. Read the case study* ***here****.*

11. Do you use timers and/or motion sensors to turn lights off when not needed?

Energy is wasted when lights are left on in unoccupied rooms. Energy research has determined that indoor occupancy sensors have a high potential for energy savings, particularly if energy-efficient lighting has not been implemented. Local electric utilities typically offer rebates or incentives for the installation of new lighting controls.

Use lighting controls to dim or turn off electric lighting when sufficient natural light is available (i.e., daylighting). Certain designs can be incorporated into new buildings pre-construction, and daylighting can be achieved post-construction with skylights and tubular lights. In either case, experts should be consulted to help determine locations and spacing, balance heat gains and losses, reduce glare, and determine economic payback. Daylighting has also been shown to improve mental health and morale, performance, and productivity while reducing eye strain, headaches, and fatigue.

12. Do you regularly maintain the air-compressor system?

Compressed air is an inherently inefficient system where only 10–15 percent of the input energy is delivered as compressed air. The remaining 85–90 percent of the energy is lost as heat. This hot exhaust air reduces the unit's efficiency, so it should be exhausted away from the compressor. Proper air circulation with cool air will improve compressor efficiency.

Compressors are intended to support pneumatic components of process equipment. Using compressed air to clean floors or equipment is highly inefficient–use brooms or other dry clean-up methods, if available. Also, regularly check for, locate, and fix any air leaks to reduce compressor demand. Leak-detection methods, including estimation of the amount of leakage, can be found on **the U.S. Office of Energy Efficiency and Renewable Energy's website**.

13. Do you use variable frequency drives (VFDs) to optimize motor energy use in equipment?

VFDs can reduce energy use by adjusting a motor to load requirements. The use of VFDs can reduce stress on a motor and extend its life, improve efficiency, and provide significant electrical energy savings. Not all equipment is compatible with VFDs, so it is important that manufacturers be consulted to confirm that VFDs can be used. If incompatible, motors and control components could be

damaged. If compatible, VFDs can be applied to chillers, fans, pumps, conveyor systems, HVAC units, and compressors where lowering motor speed would result in energy savings. A winery may be eligible for a rebate from the local electric-utility company toward VFD implementations.

14. Have you installed any renewable-energy technologies, like solar, wind, or geothermal?

Renewable energy is generated from sources that are naturally replenishing and are considered "clean." In some cases, renewable energy may be a good fit for a winery. Details and examples of renewable energy are provided below.

- **Solar:** Two types of solar energy systems that wineries could evaluate include use of photovoltaic (PV) panels that convert solar energy into electricity and systems that use sunlight to heat or preheat water. Wineries typically have sufficient roof area for either. New York State incentive payments programs, local utility net-metering programs, and New York State and federal tax credits can significantly reduce the capital cost of commercial solar energy.

- **Wind:** Wind power may be viable in many parts of New York where windy conditions exist. Wind speeds for a given location can be obtained from the **National Renewable Energy Laboratory (NREL)** to determine if sufficient wind speeds are available. Another option is to participate in commercial wind projects through a program like **New York State Electric and Gas Corporation's (NYSEG) Wind Energy program**, in which 5–100 percent of the power needs can be purchased as energy from wind turbines. A certificate documenting ownership of carbon-reduction credits may be available, which can enhance a winery's public image.
- **Geothermal:** Geothermal systems involve loops of buried piping and a heat pump to provide heating or cooling. Heat pumps are reversible refrigeration systems and can provide cooling like a typical chiller but can also heat a space or medium by extracting heat from the outdoor air or geothermal loop and pumping it into the space. Heat pumps do not create heat; they only move it from one medium to another and can move more heat than the energy they consume. Therefore, heat pumps can be more efficient for heating than burning fossil fuels.

  Heating and cooling can be supplied to a building as heated or chilled air or liquid. Through the use of multiple heat pumps, both heating and cooling can be supplied at the same time, for example, to heat a building while also cooling tanks. Alternatively, a single heat pump can move heat from the chilled tanks to a heated space. In addition, rather than relying on large heat pumps, multiple smaller heat pumps can be used when a full load is not required.

  In addition to federal tax incentives, rebates for installing geothermal systems are available through many New York State utility companies. Although the initial installation cost is higher than the cost of more conventional HVAC systems, operating costs for geothermal systems are much lower—approximately one-third of what would be spent on conventional systems. The U.S. Department of Agriculture (USDA) has a grant and loan program called the Rural Energy for America Program (REAP), which is available for solar, geothermal, and wind projects for agricultural producers. These funds may also be used for other energy-efficiency improvements.

> *A solar-energy assessment of Shadow Springs Vineyard and Windsor Run Cellars in North Carolina showed that installing solar panels could save more than $260,000 in annual electricity costs, depending on the type of system used. Read the case study **here**.*

Chemicals and Materials Management

Materials used in a winery, including cleaning chemicals and product bottles, can be managed to minimize waste and reduce environmental effects.

1. Do you use test strips to measure concentrations of detergents or sanitizers?

Insufficient detergent or sanitizer concentrations may result in extended cleaning times with potential effects on product quality. Conversely, using higher-than-recommended concentrations means more chemicals being used unnecessarily and may incur additional water use for proper rinsing. Improperly cleaned equipment and high detergent concentrations may cause permanent damage to equipment. Test strips or titrations help ensure that correct concentrations are used.

2. Do you rotate chemical use to ensure maximum effectiveness?

No one detergent or sanitizer is ideal to control every microbe. Over time, bacteria can develop a resistance to a specific cleaner or disinfectant, rendering it less effective. Alternating cleaners and sanitizers can help to assure effectiveness and minimize chemical use in the long run. Ideally, the everyday detergent or sanitizer should be replaced with a material that has a different mode of action once every 5–10 uses. For example, if caustic soda is the usual detergent, try an acid-based detergent once every two weeks or so.

3. Do you use caustic soda or acid for cleaning detergent?

While caustic soda (sodium hydroxide, or NaOH) is effective as a cleaner, excessively high NaOH concentrations pose risks to workers and the environment and can damage equipment if not used properly. Caustic soda is very effective at removing cells and biofilms from plastic and metal surfaces, but it cannot be used on oak barrels.

While potash (potassium hydroxide or KOH) is another strong alkali, it is better for rinsing than caustic soda because less water is needed. Soda ash or sodium carbonate (Na2CO3), a milder inorganic alkaline cleaner, also is better for rinsing than caustic soda. Trisodium phosphate (TSP) is another mild alkali that can be used.

Acid-based cleaners, which include phosphoric and citric acid, are used for scale and mineral-deposit removal and prevention. Acid cleaning has typically been used as part of a cleaning sequence with the following steps:

caustic➔rinse➔acid➔rinse

A cleaning product called Destainex was recently developed to shorten this cleaning sequence by eliminating the acid cleaning and rinse steps, thus saving water and time.

4. Do you have a written protocol to follow regarding concentrations of detergents and sanitizers?

Employee training in the methods of preparing cleaners and ensuring that the correct concentrations are used is critical. Cleaning chemicals, if used in higher-than-recommended concentrations, not only result in more chemicals being used and higher operating costs, but they also can corrode and damage equipment. The Food Safety Modernization Act requires all food- and beverage-processing facilities to document sanitary processes.

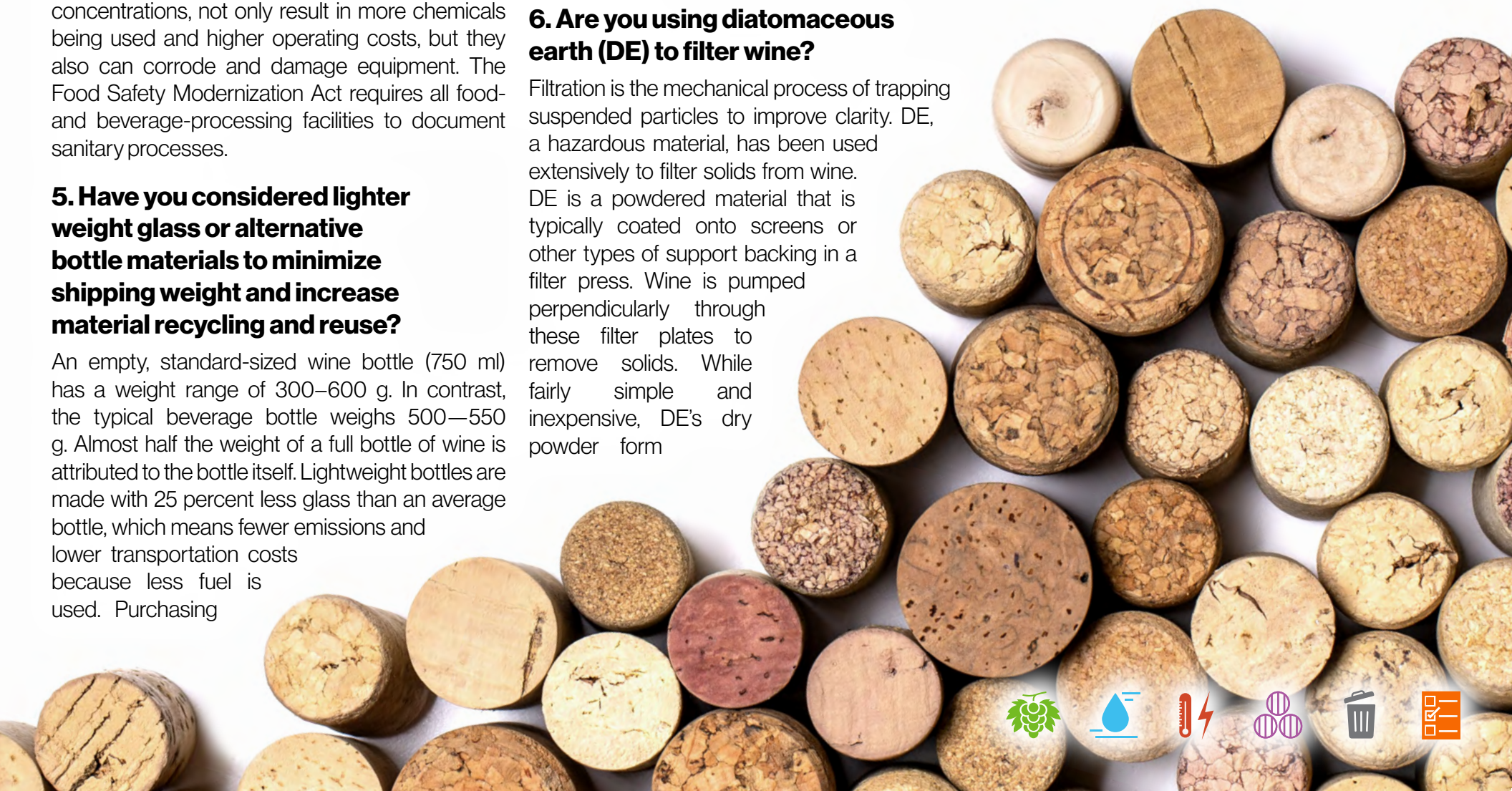
5. Have you considered lighter weight glass or alternative bottle materials to minimize shipping weight and increase material recycling and reuse?

An empty, standard-sized wine bottle (750 ml) has a weight range of 300–600 g. In contrast, the typical beverage bottle weighs 500—550 g. Almost half the weight of a full bottle of wine is attributed to the bottle itself. Lightweight bottles are made with 25 percent less glass than an average bottle, which means fewer emissions and lower transportation costs because less fuel is used. Purchasing glass by weight will also lower bottle costs.

Bottle material alternatives like plastic and aluminum are also available and are a consideration for both environmental sustainability and brand differentiation. In the tasting room or restaurant, offering keg wine is a good alternative to glass, when possible.

6. Are you using diatomaceous earth (DE) to filter wine?

Filtration is the mechanical process of trapping suspended particles to improve clarity. DE, a hazardous material, has been used extensively to filter solids from wine. DE is a powdered material that is typically coated onto screens or other types of support backing in a filter press. Wine is pumped perpendicularly through these filter plates to remove solids. While fairly simple and inexpensive, DE's dry powder form is considered a respiratory risk to humans and requires the use of personal protective equipment (PPE) when handled. Other filtration methods that pose fewer risks include paper pads and cross-flow filtration, though paper pads are not very efficient and can require more labor. A comparison of DE to cross-flow filtration is provided next.



7. Are you using cross-flow filtration to filter wine?

One alternative to the perpendicular-flow filtration using DE or filter pads is cross-flow filtration. Instead of forcing fluid through the filter media straight on, fluid is moving in parallel or tangentially to the filtration surface. Back-pressure applied to the fluid forces solid-free liquid to permeate the filter medium and is then collected as product.

*Glenora Wine Cellars installed a cross-flow filtration system to reduce use of diatomaceous earth and recover more product.. Read the case study **here**.*

The table below provides a comparison between DE filtration and cross-flow filtration:

Wine-Filtration Method	Pros	Cons
Perpendicular- Flow with Diatomaceous Earth	> Method is less expensive than cross-flow filtration.	> DE can be a health hazard when handled. > Process allows oxygen to penetrate wine, thereby degrading wine quality. > Large amounts of DE are needed, which increases waste disposal. > Process can lead to relatively high wine loss. > Process may be labor-intensive.
Cross-Flow Filtration	> Method avoids clogging issues. > It can be used to recover juice or wine from lees before or after fermentation, increasing yields and reducing loss. > It is generally accomplished in a single pass while multiple passes (and additional filter media) will be required with traditional filters. > It uses less water and generates less waste. > It is more energy efficient > It allows small volumes to be filtered immediately through batch operating. > It minimizes oxygen exposure as a closed system.	> Initial capital costs are higher.* > Cross-flow filter replacement can be costly. 

*The larger the size of an operation, the better return on investment. For smaller operations, outside mobile services may offer an affordable option.

Waste Management

Cutting down on waste and wastewater can lower treatment and disposal costs. Also, purchasing ingredients in bulk containers with locally sourced ingredients to the greatest extent possible can help to reduce waste.

1. Do you divert pomace to high value-added recovery routes, besides land-spreading or off-site disposal?

At least 20–30 percent of grapes, by weight, that are used in winemaking end up as pomace, which includes the grapes' pulp, skin, stems, and seeds left behind after pressing. Besides simple land-spreading or disposal, different pomace-valorization methods have been developed and put into practice. Some uses of pomace include the following:

- fertilizer and compost
- liquor distillation (grappa)
- animal feed
- grapeseed oil
- bioactive compounds (polyphenols) [extracted for pharmaceuticals; dental hygiene products; or anti-inflammatory, anti-oxidant, or anti-cancer properties]
- food preservatives, natural dyes, and food-coloring
- feed for anaerobic digesters to produce methane gas
- biochar for soil conditioners

2. Do you recycle bottles?

Recycling materials not only reduces waste and disposal costs, but can also lower purchasing costs. For bottles, consider the following:

- Reuse your own bottles, plus those from other wineries, that have been sterilized.
- If not reused on-site, send bottles off-site for recycling and buy bottles made out of recycled glass, which can use up to 70 percent recycled material. Ground recycled glass requires less energy to melt and has a lower environmental impact.
- Make glass bottles easier to recycle. The foil capsule covering the cork must be removed to recycle the bottle. If you need to cover a cork, wax seals can be used as a substitute or screw caps used instead of corks.
- Glass bottles are one-hundred-percent recyclable; however, color can create challenges depending on the recycling processes available in a particular location. Using clear glass avoids this issue.
- Consider bottle material alternatives like recyclable plastic and aluminum.
- Start a refillable bottle program: Consumers can bring their own growlers to fill up or use reusable bottles with reusable closures.

3. Do you recycle cardboard and packing materials?

Recycling materials reduces waste and disposal costs, and lowers purchasing costs. In terms of environmental impacts, recycling cardboard reduces logging. Recycled cardboard can be used to make chipboard, paperboard, paper, and more cardboard. Cardboard made from recycled materials requires 30-percent or less new wood, 25-percent less energy, and 99-percent less water. For cardboard and packing materials, consider the following:

- Separate cardboard and packing material from your regular trash to lower waste-disposal costs. The material may even be sellable to a recycling company.
- Check with your suppliers of cardboard packaging to see if they can take it back for reuse.
- Use shredded or perforated cardboard as packing material.
- Purchase cardboard made from recycled material to further lower your environmental impact.

4. Do you compost or divert post-fermentation solid waste (e.g., tartrate crystals, tank sludge, or lees) from entering the drain with rinse water?

To reduce the strength of the wastewater that will need to be treated or disposed of post-fermentation, remove solid wastes so they do not enter the drain with the rinse water. The diverted solid waste can used for the following:

- Windrow composting: Large volumes of food waste can be combined with a bulking agent, such as wood chips, and formed into long narrow piles to allow exposure to air. The piles are periodically turned to ensure oxygen flow through the pile. Wine lees are rich in nutrients—some are beneficial but others are harmful if in too high a concentration. An adjustment of pH levels may be required.
- Antioxidants: Polyphenols in wine lees have an antioxidant effect. Food and pharmaceutical industries can extract these from waste. A **Cornell-led food science study** provides more info on potential benefits.

Find the right best practices for your winery.

Every winery faces challenges—and opportunities—when it comes to sustainability. The **Best Management Practices Checklist** is a tool for translating your winery's unique barriers and advantages into BMPs that make business sense.

The checklist covers four key areas—water use and wastewater generation, energy use, chemicals and materials management, and waste management—that broadly describe how wineries work in New York State and beyond. But it is intended only as a starting point; you may find some areas more practical than others as avenues for moving forward on sustainability.

Ready to fill out the checklist and find opportunities for making your winery operation more sustainable and proudly display your certificate?

Click here to go to the checklist

However your sustainability journey unfolds, we encourage you to reach out to our team of specialists with any questions or to share your BMPs with us. Our goal is to develop knowledge and strategies that not only help individual wineries meet their business and sustainability goals, but that support the New York State winery industry as a whole in becoming more sustainable and profitable.

Contact us: nysp2i.rit.edu/contact

This workbook was created by:

New York State Pollution Prevention Institute

The New York State Pollution Prevention Institute (NYSP2I) is led by the Golisano Institute for Sustainability at Rochester Institute of Technology (RIT) and is a partnership between RIT, Clarkson University, Rensselaer Polytechnic Institute, SUNY Binghamton, Cornell University, and the New York State Manufacturing Extension Partnership.

NYSP2I is a trusted resource for organizations across the state seeking cost-effective strategies for realizing new levels of efficiency and minimizing their impacts on the environment. Its team of engineers and researchers collaborate with decision-makers—small-business owners, manufacturers, community leaders, and municipalities—working to make New York State a national model for sustainability, waste reduction, and pollution prevention.

For more information, visit: *nysp2i.rit.edu*

Cornell Craft Beverage Institute

The Cornell Craft Beverage Institute (CCBI), located at Cornell AgriTech at Cornell University, works with the wine industry to create educational programs that support the growth and improved quality of premium wines. Facilities at CCBI include the Vinification & Brewing Technology Lab, where fermentations are conducted in collaboration with research projects and applied trials; and the Cornell Craft Beverage Analytical Lab, where products may be submitted for troubleshooting, routine analysis, or sensory appraisal.

For additional information, visit:

cals.cornell.edu/cornell-craft-beverage-institute

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