



Sustainable Winemaking: A Liquid Revolution

This paper provides an overview on how small- to medium-sized **wineries** or **vineyards** can take steps towards becoming a sustainable business. It will help you understand the steps that must be taken in order to make **sustainability** a part of your business model. Resources and examples will be provided throughout the paper so that you will understand how to incorporate sustainability into your winery and vineyard. This paper will include the following information:

- Sustainable agriculture
- Sustainable architecture
- Greening the supply chain
- Environmental impacts of winemaking
- Ways to communicate sustainable progress
- Case studies

© 2010 Strategic Sustainability Consulting
Doug Sharo





Contents

EXECUTIVE SUMMARY.....	1
WHY SHOULD YOUR WINERY BECOME SUSTAINABLE?.....	2
Historical Vineyard Management	2
Current Trends.....	3
The Triple Bottom Line	8
A SUSTAINABILITY PLAN FOR WINERIES	10
Sustainable Agriculture.....	10
Sustainable Architecture	14
Supply Chain	17
Measuring and Reducing your Environmental Impacts.....	18
Communicating Progress.....	27
SWOT ANALYSIS.....	29
CASE STUDIES.....	30
California Case Study: Frog’s Leap Winery	30
Virginia Case Study: Barrel Oak Winery.....	32
CONCLUSION.....	34
GLOSSARY.....	35
REFERENCES.....	38



Executive Summary

The objective of this paper is to help you, the small- to medium-sized winery take advantage of the benefits that sustainability has to offer your business. In order to thrive, businesses need three types of resources: environmental or natural resources, social resources (employees, customers, societal goodwill), and economic resources. These three factors have been driving business decisions since our species has been conducting business. While many business decision-makers think sustainability runs counter to maximizing profits; the opposite is true. Creating a sustainable business model is the key to long-term success because you are increasing short- and long-term profitability by holistically managing environmental resources, social resources, and economic resources to mitigate risks and increase opportunities.

This white paper answers several questions. The first question is why should you adopt a sustainability plan? This question will be answered by examining the history of vineyard management, an evaluation of current trends in the wine world, an evaluation of how sustainability and competitive advantage co-exist, and an examination of the Triple Bottom Line as it applies to wineries. The second question is how can you implement a sustainability plan for your winery? This question will be answered by evaluating specific areas of improvement for wineries. Areas evaluated include:

- Sustainable agriculture
- Sustainable architecture
- Supply chain
- Environmental impacts of wineries and vineyards
- Ways to communicate progress

The third question is what are the positives and negatives of becoming a sustainable business? This question will be answered by conducting a SWOT (strengths, weaknesses, opportunities, threats) analysis. The SWOT analysis will be supplemented by two case studies of wineries that have incorporated sustainability efforts into their businesses. By answering these questions, you will see why business-as-usual for a winery can be counter-productive to your overall business goals.

This white paper is useful for you, the winery and/or vineyard owner, by providing an idea of what a sustainability plan will look like and what it will accomplish. By adopting a sustainable business model, you will be able to gain a competitive advantage over others in your industry by having a positive impact on the community, engaging employees, reducing costs, and increasing profits. Already, many winemakers are beginning to implement sustainable winemaking practices that translate into better wines and tangible savings for their business. The basic question is, if others can do it, why not you?



Why Should Your Winery Become Sustainable?

HISTORICAL VINEYARD MANAGEMENT PRACTICES

Two decades ago, a vineyard was supposed to look as pristine as possible. If your vineyard had weeds, a blade of grass out of place, or insect and bird life, then you had a problem. The only sign of life was supposed to be your vines sticking up out of the soil. The only way to achieve this desired look was by littering the soil with rodent poison to kill moles and gophers, spraying herbicides to kill unwanted plant life, and spraying insecticides to eliminate unwanted insects (Slinkard). The use of chemicals in growing grapes impacts health by indirectly disrupting your surrounding vineyard ecosystems and the community at large. Compounds from chemical use leach into groundwater or runoff into streams or lakes, harming wildlife and people that live near your vineyard (Levin). There are two issues with managing your vineyard in such a way: it is extremely costly and it is unsustainable.

INEFFICIENCIES AND DISCONNECTION FROM THE LAND

Growing grapes with the use of rodent poison, herbicides, and insecticides minimizes the benefits of soil because the spraying inadvertently kills beneficial microbes. Essentially, you are killing the living relationship that a vine has with the soil. The soil is unable to provide nutrients and the structure necessary to retain moisture, so growers must compensate with fertilizer and irrigation (Frog's Leap: Organics 101, 2010). Though the initial result of dripping fertilizer and water may show impressive results, the long-term results will be less than

impressive. A poorly nourished vine will most likely have health problems because it will be less resistant to pests, bacteria, mildew, disease, and black rot. A vineyard built around the use of chemicals results in weakened vines, lower yields, and less-nutritious fruit. Artificial fertilization looks impressive at first because growth is accelerated by swelling the grapes with more water, leaving it with a lower concentration of nutrients (Levin).

Interested in Calculating your Winery or Vineyard's Carbon Emissions?

Check out the Wine Institute's easy to use International Wine Carbon Calculator here <http://www.wineinstitute.org/ghgprotocol>

Using chemicals increases costs, and as a result is less efficient. By using poisons, herbicides, and insecticides the grower is disconnecting himself and his product from the land. Instead of creating a natural relationship with the soil and the crop, the grower is making the crop dependant on unnatural chemicals. Reducing the use of chemicals will make your business model more compatible with the natural environment. The soil will be more fertile and the resulting crop yield will be of higher quality (Frog's Leap, 2010). Making your crop dependant on unnatural chemicals alters its natural processes. For example, before the use of anti-fungals a bottle of red wine contained 30 to 40 milligrams (mg) of **resveratrol** (see page 4 for the health benefits associated with resveratrol). Today, many growers spray anti-fungals on their crop, and resveratrol has dropped to 2 to 3 mg per bottle because the plants

lower their resveratrol production (Wine Library TV, 2009). A grower should try to connect his crop to the land because it will help maintain a healthy relationship between the vines and the soil, promote biodiversity, and yield a higher quality fruit (Levin).

EXTERNALITIES

Externalities associated with the wine industry include:

- *GHG emissions* – emissions from winemaking are associated with power use, machinery use, packaging, product transport, and waste generation.
- *Solid waste production* – wineries produce solid waste from the vineyard (stems, seeds, skins) and from the winery production facility (barrels, bottles, cardboard, paper, food, corks, pallets, etc).
- *Water pollution* – run off from chemical use pollutes streams, lakes, and groundwater. Winemaking also produces large quantities of wastewater that need to be treated before it can be reintroduced to the land.
- *Sedimentation* – wineries and vineyards that are located near streams, lakes, and rivers can create sedimentation problems (mainly through construction and building processes).
- *Destruction of wildlife habitat* – wineries and vineyards are land intensive and wineries that are building new facilities or expanding existing facilities will have an impact on wildlife habitat.

A sustainable winery will find ways to reduce their externalities and this will make for better wine and a better business model. The section A Sustainability Plan for Wineries starting on page 9 will discuss ways in which wineries can reduce or eliminate externalities.

CURRENT TRENDS

LINK TO NATURE

Everything in and on your winery or vineyard is interconnected. If you have a stream that flows behind your winery it is not a drainage ditch, it is a critical part of the ecosystem that surrounds your business. Trees located on your property provide habitat to a number of different creatures that are all affected by your actions. The grapes you produce are not affected just by you and your business' actions, but by numerous other factors that you cannot completely control including:

- Sunlight
- Rainfall
- Drought
- Pests
- Soil
- **Mineral cycle**
- **Bioregion**
- Disease

For example, the soil you plant your vines in affects the taste of your grapes and ultimately, the wine you make. “What is reflected in the ground is reflected in the plant, also reflected in the taste of the wine (Overstreet, 2007, VideoJug).” Since these factors affect the taste of your wine they have to affect your business. If people like the taste of your wines then your sales are likely to increase, so your connection to the land is directly linked to the profitability of your business.

The vineyard itself is a whole ecosystem. When it is healthy and balanced, you can see firsthand how interconnected everything is. You realize you are not solely working with the soil, but insects that pollinate

the plants and prey on harmful pests. Birds that are natural predators for many harmful insects also help eliminate the rodent population. A prime example of a vineyard that has linked their business model to nature is Fetzer Vineyards. They have committed to doing business in alignment with nature and see this as a requirement for a sustainable business. This decision came about simply because their winemaker realized one day that their 20-acre stand of organic grapes tasted vastly different from their other grapes. Fetzer Vineyard realized that organic grapes would make better wine and their sustainable business model grew from there (Dolan, 2003).



Figure 1: Vineyard Ecosystem

THE HEALTH BENEFITS OF WINE: ORGANIC WINE VERSUS STANDARD WINE

ANTI-INFLAMMATORY

Heart disease, cancer, diabetes, and aging are all related to low-grade inflammations. Red wine's biggest health benefit is that it contains antioxidants which are natural anti-inflammatories. One example is resveratrol, which is a natural anti-fungal that grape vines produce. Many years ago a bottle of red wine contained about 30-40 mg of resveratrol, but today a bottle of red wine only contains 2 to 3 mg because growers spray anti-fungals on their vines, which causes the plant to reduce production of the chemical (Wine Library TV, 2009). As a result,

organic wines will naturally have more resveratrol, 30 to 40 mg, and this amount can have health benefits (Wine Library TV, 2009). The health benefits come from how red wine affects gene expression, red wine has a positive effect because it can down regulate genes that are pro-cancerous and up regulate protective genes (Wine Library TV, 2009).

STROKE RESISTANCE

Researchers at Johns Hopkins found that resveratrol has the ability to provide neuroprotection against **ischemic attack**. They found that it protects the brain by increasing levels of the enzyme **heme oxygenase**, which is known for its ability to protect the brain (Mitchell, 2010). If the enzyme levels are elevated then the brain is prepared for strokes. As a result, resveratrol can potentially build brain resistance to **ischemic stroke**, the most common type of stroke, and researchers believe even a small amount may be sufficient to build resistance. Even more important for the wine world and red wine drinkers, the researchers discovered that the alcohol in wine may be necessary to concentrate the amounts of antioxidants to provide the benefits. Essentially, although resveratrol is found in red grapes, alone they may not be sufficient to provide the benefits (Mitchell, 2010).

FLAVOR

Organic wines of the late 1980s and early 90s were considered by many wine critics to be undrinkable, but organic winemaking was in its infancy then. Today things have changed due to advances in winemaking technology and grape quality (Levin). Organic wines have flavors that are cleaner, clearer, more intense, have better texture, and have bolder profiles than standard wines (Organic Authority, 2010). Since the vines and soil are not coated with chemicals, the vines are encouraged to defend

themselves naturally. This leads to grapes with smaller berries and thicker skins, which leads to more concentrated flavors and brighter color respectively (Organic Authority, 2010). Brighter colors will always mean more antioxidants, making organic a win-win situation. Organic wines have also been heralded because they display a more distinct **terroir** than non-organic wines (Levin).

SULFITES

Sulfites are salts or sulfurous acids that occur naturally in many wines. Winemakers also add sulfites for preservation of wines, so it is very rare to find a wine that does not have them (Hewitt, 2006). Many people are allergic to sulfites and cannot drink wine because of this. Allergic reactions can range from headaches and abdominal pain to difficulty breathing. However, 100 percent organic wines do not contain any added sulfites and are drinkable for people that are allergic (Levin). The less sulfites in a wine, the healthier it is for people that have adverse reactions to them (Hewitt, 2006).

OTHER HEALTH BENEFITS

Some health benefits associated with both standard and organic wines include:

- Improved lung function
- Increased cardiac output
- Increased arterial elasticity
- Reduced risk of senility or Alzheimer’s disease
- Eradicating bacteria that causes peptic ulcers
- Lowering cholesterol (Organic Authority, 2010)

Even though there are health benefits associated with standard wines, because organic grape growing abstains from using chemicals it provides a more wholesome fruit, making it a healthier option (Levin).

SUSTAINABILITY

A survey of 73 winery and vineyard representatives found that many of them plan to introduce new lightweight and recycled packaging. Roughly, 40 percent said they are using fewer chemicals in order to help mitigate increased vineyard costs. According to the survey, 10 percent stated that they were turning to solar energy, and roughly 23 percent said they are reducing or limiting employee travel. Roughly 80 percent stated that they are at least farming a portion of their acreage sustainably (Greenbiz.com, 2008). This survey shows that the industry is beginning to trend towards sustainable practices. Many wineries are working toward sustainability in a number of ways, but to be effective at becoming a sustainable business, the initiatives cannot stand alone. The organization as a whole must be transformed, and this takes hard work by individuals and coordinated group efforts throughout every segment of your business. The hard work put in by many wineries that have chosen to green their efforts is paying off in wine sales. From 2008 to 2009 the sale of green wine grew by 122 percent (Osborn, 2009).

Reason	2007 Response	2009 Response
Sustainable products are better for the earth/environment.	49%	59%
Sustainable products are better for me and my family.	47%	47%
I’m influencing society and the economy by purchasing sustainable products	22%	33%
Sustainable wines taste better	17%	14%
I am making a statement about my values when purchasing sustainable products.	16%	30%
It’s my way of offsetting things that I do that are bad for the environment.	14%	19%
Other	9%	21%

Table 1. Reasons for Purchasing Organic or Sustainable Wine (Full Glass Research, 2009)

WHAT DOES SUSTAINABILITY MEAN FOR WINERIES AND WHY IT IS IMPORTANT

Any winery that is interested in becoming a sustainable business will face three main challenges. The first is defining what sustainability will mean for your business, the second is implementing the changes you wish to make, and the third is measuring your impact and your progress. Small to medium-sized wineries that fail to change the way they and their supply chain operate are potentially putting their entire business at risk. Wineries have more dollars tied up in assets (vineyard, equipment, inventory, buildings) per dollar of turnover than most other industries (Croser, 2005). The nature of the wine business requires long-term and expensive assets, this makes sustaining a competitive advantage even more important because if you do not sustain that advantage then you will not use your capital efficiently (Croser, 2005). Wineries that are a part of big companies have significant **economies of scale** and large distribution power, this allows them to continue to compete strongly in down markets when profit margins are shrinking and costs are increasing (Croser, 2005). This is exactly why small to medium-sized wineries should be looking at sustainability as a competitive advantage. For example, if you reduce water use, become more energy efficient, or cut down on your waste, you can cut costs and increase your profit margins. It should be understood that there is also more at risk than just the financial aspect. A business can lose its social mandate to conduct business, and then it faces as much risk as if it were struggling financially. If people do not like the actions of your business in this **Web 2.0** world, then one person can quickly turn into many and affect the operations of your business.

A sustainable winery is not just about the grapes, every part of the business will be affected. Every aspect of sustainability should have a positive impact on the bottom line of the business. Sustainability can also help a business stay ahead of the regulatory curve; for example, efficient building may become common practice over the next decade but it could also be mandated by law. This could have a big impact on a lot of wineries because of the large amount of energy expended keeping barrel storage areas cool.

Many wineries are not moving their business model towards sustainability because they believe they cannot afford it. However, the negative effects associated with the use of pesticides and herbicides on soil quality and crop quality means that it may not be cost-effective to not be sustainable. This is the stance that Frog's Leap Winery has taken. They believe that the use of pesticides and herbicides leads to under-nourished vines. They believe a well-nourished vine will be more flavorful, better balanced, and longer lived (Frog's Leap, 2010). This in turn leads to more flavorful fruit and wines that reflect their beliefs and efforts (their wines have received consistently high scores from wine critic Wilfred Wong).

An important concern is the negative health impacts that spraying will have on your employees and the surrounding community. Harmful compounds from spraying can be dangerous to workers, bystanders, and people in the community. The compounds can seep into streams, lakes, and groundwater which will impact your winery's reputation and create potentially costly liability situations. It is clear that many wineries are facing these problems, but they are unaware that sustainability can help them solve

these problems and at the same time continue to have a profitable business.

COMPETITIVE ADVANTAGE

Proving that it is possible to have a successful business while being a good steward of the environment and your community, and that it is the only way for your business to remain successful in the long run, is a difficult proposition (Rodriguez, Ricart, & Sanchez, 2002). Sustainability is not always easy to achieve, but that is one reason why it provides a competitive advantage for your business. Sustainability initiatives can be hard for other businesses to mimic which makes it harder for them to compete with you. Your winery will develop competitive advantages by creating value. The activities proposed throughout this paper will be valuable because they will distinguish your business model from that of your competitors. Sustainability also creates value because our society is increasingly demanding that businesses account for their environmental and societal impacts and implement more sustainable initiatives (Rodriguez, Ricart, & Sanchez, 2002).

Two clear cut sources of continual competitive advantage are innovation and reputation (Rodriguez, Ricart, & Sanchez, 2002). This is why it is so important to get your company to start talking about sustainability. The best way for your business to constantly innovate is for everyone in the company to feel like they are a part of the conservation. This will allow them to openly generate and contribute ideas that they have which are specific to their areas or duties. Next, your winery needs to understand the reputation it has with stakeholders. You need to understand who is buying your products and why. Retailers and consumers are increasingly buying products based on sustainability factors, so you want to know how large that group is, how fast it is growing, revenue generation potential, and how you can gain shares of the market through market penetration. This will help you understand your reputation and how to improve it (Rice, 2009).

The wine business is one of the most competitive global industries in the world. There is constant jockeying for position in terms of shelf space in

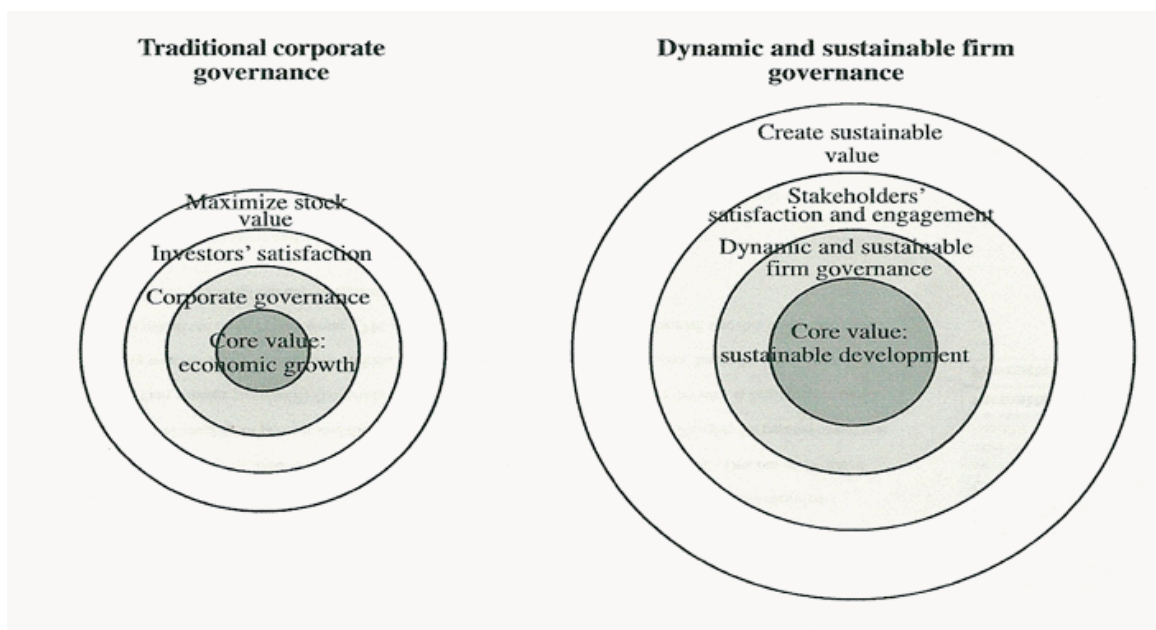


Figure 2. Corporate Governance Strategies (Rodriguez, Ricart, & Sanchez, 2002)

stores, spots on restaurant wine lists, time with wholesalers, retailers, wine critics, and space at public events (Dolan, 2003). Every winery that is looking for a competitive edge against their competitors should be considering making sustainability a part of their business model. The possibilities are endless; you can cut costs and increase profits through a number of different sustainability initiatives including:

- Sustainable agriculture
- Sustainable architecture
- Creating an efficient supply chain
- Measuring and reducing your impacts
- Communicating with your stakeholders

All of these initiatives will be further explored in the following sections.

THE TRIPLE BOTTOM LINE

The topics most often described in a company are likely to include products, sales growth, costs of goods sold, **gross margin**, and branding. These are things that all businesses must discuss in order to remain a profitable business and continually meet their goals. However, the **triple bottom line** (TBL) aligns business goals with environmental and social obligations. A TBL company sees opportunities in their environmental and social obligations and develops strategies that create better products, increase sales growth, reduce costs of goods sold, increase gross margin, and strengthen their brands. Sustainability must be talked about right along with maximizing profits. This seems simple enough, but many business leaders would consider this to be a radical approach. TBL stands for people, profit, and planet, but in terms of winemaking it can be understood as environmentally sound (reducing CO₂ emissions), socially equitable (community

investments), and economically viable (producing great wines that are profitable). Businesses have the option of inserting sustainability into the conversation about maximizing profits. What many businesses find difficult is integrating the two concepts until they have become the same conversation. This is the foundation of the TBL concept, creating a business where the environment and social equity are provided the same level of commitment as the goal of maximizing profits. For example, Fetzer Vineyards uses the TBL approach as their business model. Since the early 1990s, they have worked to improve the quality of life of their workers by providing healthcare and education to their workers (Dolan, 2003). They have enhanced their community by creating community gardens and asking for citizen input on winery projects. They have reduced their environmental impact by growing organic grapes and reducing their waste stream (Dolan, 2003). As they made the transition to a sustainable business, they managed to increase their earnings an average of 15 percent a year throughout the 1990s, all while making sure environmental and social responsibilities were top priorities (Dolan, 2003).



Figure 3. A community garden

The conversation about sustainability needs to take place throughout your business; there is not a single aspect of your business where discussing sustainability is inappropriate. The boardroom, the factory floor, sales meeting, investor presentations, this is all fair game for a conversation about sustainability. It has to be able to take place anywhere, anytime and should be a comfortable subject for everyone in your business because everyone has something to contribute. There is no instruction manual for making your business sustainable; this makes conversation even more paramount because it is guaranteed to produce new ideas.



A Sustainability Plan for Wineries

SUSTAINABLE AGRICULTURE

Sustainable agriculture and organic agriculture have been around for almost a century, but they have only recently gained in popularity and importance over the last two decades (Lodi Winegrape Commission, 2010). Organic agriculture focuses on the use of inputs such as pesticides, herbicides, and fertilizers. Organic growers must follow specific practices in order to become certified, based on USDA regulations. Sustainable agriculture can be something entirely different. Unlike organic agriculture, sustainable agriculture is not codified at a national level and it addresses other important issues besides chemical use. These issues include water use, air quality, energy use, greenhouse gas (GHG) emissions, wildlife habitat, employee health, and the health of the citizens in your community.

There is no universally accepted definition of sustainable agriculture. However, in 2001 the California Association of Winegrape Growers (CAWG) and the Wine Institute formed a joint committee to develop a program that could be used for winegrape growers across the state (Ohmart, 2008). Their definition of sustainable agriculture is “growing and winemaking practices that are sensitive to the environment, responsible to the needs and interests of society at large and economically feasible to implement and maintain (Ohmart, 2008).”

There are three different types of sustainable farming standards; the first is process-based. Process-based standards involve a grower implementing a cycle of self improvement by setting sustainable goals for the farm (Ohmart, 2008). The grower then conducts a

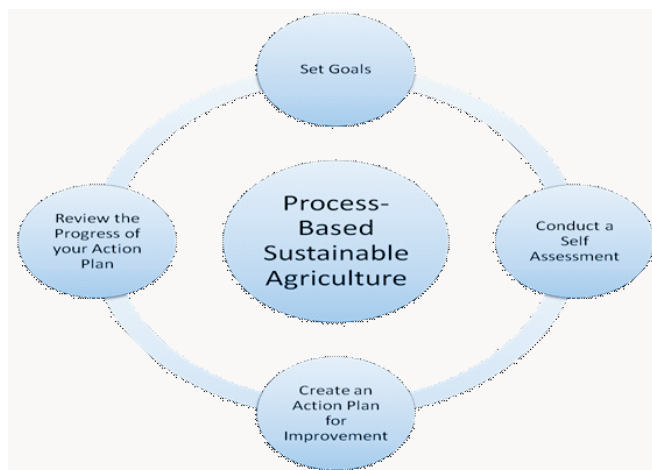


Figure 4. Process-based Sustainable Agriculture

self-assessment of their operation using a tool such as the *Lodi Winegrower’s Workbook* (www.lodiworkbook.com), the *Positive Point System* (www.vineyardteam.org/pps/), or the *Code of Sustainable Winegrowing Practices Workbook* (www.sustainablewinegrowing.org). Growers then create a plan to improve in areas where their practices are not sustainable according to the self-assessment. The plan is re-viewed after a certain period of time (six months to one year) to make note of the progress that has been made. The cycle repeats itself as targets are reached and new goals are made (Ohmart, 2008). The second type of sustainable farming standards is practice-based standards, which require the farmer to implement specific practices or prohibit specific practices. The *Lodi Winegrower’s Workbook* is an example of practice-based standards (The Lodi Rules are expanded on in the next section). The third type of sustainable farming standard is performance-based, meaning that a grower must obtain or comply with a certain level of performance (Ohmart, 2008). This can apply to things like water use, electricity use, pesticide use, or fuel consumption. Though this is not very common

in today's wine world, it could be an important part of sustainable wine growing in the future.

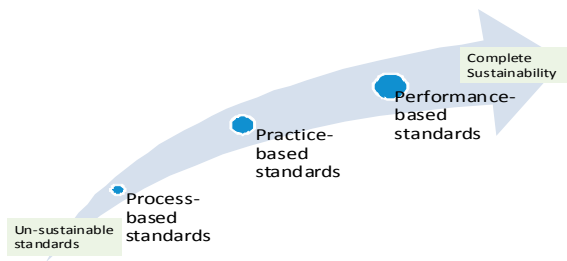


Figure 5. Sustainability Continuum

If you think of sustainable farming as existing on a continuum you can see how these three types of standards differ. On one end you are not acting sustainably and at the opposite end you are completely sustainable. As you move along the continuum, the level of sustainable farming increases. The process-based set of standards has a farmer moving along the continuum increasing their level of sustainable practices over time (Ohmart, 2008). The negative aspect of process-based standards is that they can be at any point along the continuum and still be in compliance with the standards. This is because there is not a particular level of sustainability that is stipulated. A farmer could be at the very bottom end of the continuum and as long as they are improving and meeting their goals they would be in compliance with the program. The practice-based and performance-based standards are different because they stipulate a particular level of sustainability. The farmer must be at or past a particular point along the sustainability continuum to be in compliance with the standards. An ideal situation would involve a practice-based program requiring the farmer to be at a high level of sustainability, near the complete sustainability end of the continuum (Ohmart, 2008).

The California Association of Winegrape Growers and the Wine Institute Joint Committee

The committee identified 105 issues and categorized them into seven chapters: viticulture, soil management, water management, pest management, habitat, human resources, and wine quality (Ohmart, 2008).

Worksheets were created for each issue listing farming practices available to wine-grape growers to address them. Each practice influences one or more of the three E's of sustainability, either positively or negatively. (Ohmart, 2008).

After the practices were listed for each issue they were arranged into four categories on each worksheet, with category 1 for least-sustainable practices, categories 2 and 3 progressively more sustainable and ending with the most-sustainable practices in category 4. Decisions on what practices to list and the level of sustainability for each were based on research results, as well as on the knowledge and experience of the committee members. (Ohmart, 2008).

This is just one example of a set of standards to give you an idea on how to begin farming sustainably.

Many in the California wine industry have adopted the definition set forth by the CAWG and the Wine Institute, but growers also need tools to help in adopting sustainable winegrowing practices and track their progress (Ohmart, 2008). For example, **Farm*A*Syst** was established in 1991 as a partnership

between government agencies and businesses to prevent pollution on farms. It is a national program supported by the U.S. Cooperative State Research, Education, and Extension Service, Natural Resources Conservation Service, and U.S. Environmental Protection Agency (EPA). Farm*A*Syst's approach is a standard process in which the farmer develops goals, implements them, measures their success, and makes further improvements (Ohmart, 2008). The Lodi Winegrower's workbook helps growers identify farming practices that are beneficial to the environment and those that are having harmful effects. It allows the growers to create succinct action plans with timetables that help them meet their target goals. Once the plan is defined, the growers must implement sustainable viticulture into their day-to-day farming practices. Growers will then measure the impact the sustainable practices have had on their operations. This includes grape quality, wine quality, farming costs, ecosystem quality, and human resources (Lodi Winegrape Commission, 2002). The intended result is to put the growers on path of continual improvement towards their sustainability goals.

Certification is an important part of adopting sustainable farming standards. It is important because many consumers, environmental groups, and government regulators do not trust the farmer to comply with the standards on his own. Surveys show that consumers are willing to trust certification programs, especially if it is a third-party certification because there is not a conflict of interest (Ohmart, 2008). What kind of certification you will get, if you get one at all, will depend on what state you are in because there is not a national certification program for sustainable wines. For example, Oregon and California both have sustainability certifications for their wines, the Oregon Certified Sustainable Wine program and the California Sustainable Winegrowing Alliance, respectively. However, two large wine producing states, Washington and Virginia, both do not have sustainability certification programs.

ENHANCE ENVIRONMENTAL QUALITY/ STEWARDSHIP OF THE LAND

Stewardship of the land means you must account for everything in your vineyard. You should be proactive in your approach to restoring and conserving your vineyards. This means eliminating as many chemicals as you can from your practice because the chemicals will degrade your soils. You should plan out ahead of time where you want to lay out new vineyards and where you will allow vehicles on your land because certain areas of your property may be more pesticide ecologically sensitive than others. It is also important to commit to conserving and restoring **riparian buffers** that are on your property. Taking care of your wastewater is important because wineries generate wastewater that is high in **biological oxygen demand (BOD)** because of the sugar content in the winemaking process. As a result, wineries face

ACTION PLAN				
Workbook section	Issue Number	Issue and Area of concern	Plan of action	Timetable for action
Pest Mgt: Insect and mite management	6.1 on page 201	Vineyard monitoring for insect, mite, disease, weed and vertebrate pests Category 1: My PCA and/or I monitor the vineyard for insect, mite, disease, weed and vertebrate pests at least a month during the growing season	Monitor every two weeks.	Next growing season
Pest Mgt: Pesticide safety	6.39 on page 267	Pesticide emergency response plan: I follow minimum legal requirements for emergency response plans.	Contact Ag Commissioner's office for information on what a typical emergency response plan looks like; figure out how to make work on my ranch; train both tractor drivers; test plan by the sprayer fill-up.	Immediately.

Figure 6. Lodi Winegrower's Workbook sample action plan for pest management.

increasingly stringent regulations for wastewater discharge. Wineries that choose to be proactive will save money from fines and costly equipment purchases that may be required in the future (Firstenfeld, 2003). The more wastewater you recycle and reuse the less money you will have to spend on treatment equipment and everyday water use. For example, wastewater from the **crush** period can be recycled, then treated and reused for landscaping.

USE NATURAL RESOURCES THAT YOUR VINEYARD DEPENDS ON

Winemakers have an abundance of natural resources around them on their vineyards. A winery can become a more sustainable business by taking advantage of these resources. For example, during the crush period many wineries simply throw away skins, seeds, and other wastes from wine production. This does not need to be the case because the skins, stems, seeds, and any other natural component of the grapes can be recycled by composting it and then using it to fertilize the fields. If you set aside an area for composting, all the skins, seeds, and stems from a harvest can be mixed with manure and turned into a fertilizer throughout the year.

If you want to increase the effectiveness of your fertilizer, one cost-effective way is to grow cover crops in between the rows of your vines. You can till these cover crops into the soil and create an even more effective fertilizer if it is applied in conjunction with other composted materials. Shafer Vineyards says that their vineyard used to have a “pool-table look,” because the vineyard had no wild plants growing, just rows upon rows of vines (Slinkard). Today they let clover, vetch, and oats grow along with their vines and enrich the soil. A byproduct of the cover crops is the creation of habitat for natural predators like spiders

and ladybugs which prey on vineyard blighting insects (Slinkard).

Another natural resource that wineries can take advantage of is natural predators for vineyard pests. These predators include owls, hawks, bats, and birds. Shafer Vineyards has been doing this since the late 1980s (Slinkard). Previously, Shafer used rodent poison to stop the spread of gophers and moles which ate through young vines roots. However, they wanted to eliminate using rodent poison in their soil, so they decided to erect nesting boxes for owls and perch poles for hawks. Between the hawks and owls they have day and night rodent control because hawks feed during the day and owls feed at night (Slinkard). As a result, Shafer Vineyard’s rodent problem is now under control without the use of rodent poisons in their soil. This method has been so effective for them they even named their Chardonnay vineyard Red Shoulder Ranch in honor of the Red Shouldered Hawk



Figure 7. Shafer’s Red Shoulder Ranch Chardonnay

(Slinkard). Shafer Vineyards also uses this method for insect pests such as Bluegreen Sharpshooters and Leafhoppers. They have erected a bat roost that is designed to hold 400 to 1,000 bats, and they have designed it to be a maternity colony where the bats can breed and raise their young (Slinkard). To combat insect pests during the daytime, they erected songbird houses for cavity-dwelling species like Swallows and Bluebirds throughout their vineyards (Slinkard).

As you can see, your winery and vineyard is surrounded, supported, and connected to all the

living things on your property. It makes good business sense to run your business in agreement with the living things around you rather than against them. The same concept applies to reducing potable water usage. Fetzer Vineyards collects their wash-down water and filters it and adjusts the PH level so it can be re-used to irrigate their landscape (Dolan, 2003). Using the natural resources of your vineyard is not only good for your crops, but it makes good business sense because it will save you money. For example, if you use the natural fertilizer your vineyard has to offer you will not have to purchase it and if you use natural predators you will spend less money on pesticides.



Figure 8. A bat house

SUSTAINABLE ARCHITECTURE

Sustainable architecture and green building is a new trend for many contractors, but there are many that have been conscious of energy-saving methods, conserving natural resources, and minimizing waste. The first step is to find an architect and a contractor that is familiar with environmentally friendly building methods. It is always important to check references and make sure that they have a

reputation for keeping projects within budget. When deciding on a contractor or architect, the key is to find someone who can put things in terms that are easily understood for the layman. Find someone who can give you examples of some everyday techniques that will save you energy and resources, and makes concrete suggestions for improving your plans. The following paragraphs will provide examples of how sustainable architecture can apply to wineries.

ARCHITECTURE

Whether you are building a new winery or remodeling existing facilities, sustainable winery design is an important step that can lead your business towards sustainability. Building sustainably will help reduce the impact your business has on the environment. Sustainable design will not only have a positive impact on your community at large, but also the bottom line of your business. Wine is getting more and more expensive to produce, and an important aspect of this is the increasing costs of rising energy and material prices (Chauncey, 2007). Wineries that follow sustainable design principles will see reduced costs and greater profits because operating costs will be lower and energy bills will decrease. Sustainable architecture relies on balancing all aspects of the design to reduce energy consumption and reduce the use of natural resources while improving facilities. For example, Barrel Oak Winery built their barrel storage area into the side of a hill to reduce cooling costs (see pictorial on page 33). They also installed a geothermal HVAC unit that they estimate saves them roughly \$3,000-\$5,000 a month (Gumino, 2008).

Sustainable architecture begins with reducing heat gain and heat loss, the following paragraphs

describe different ways your winery can do this. One way to make your facilities less susceptible to heat gain and loss is by increasing the quantity or type of insulation (Chauncey, 2007). Placing portions of your buildings underground will help provide a constant temperature. Barrel storage areas are perfectly suited to this, if your storage area is in contact with the earth's soil then you will not need to artificially cool the area as much, or at all (As mentioned above, Barrel Oak Winery is a perfect example, see the Case Study on page 32).

Increasing your buildings **shading coefficient** is another aspect of sustainable architecture. Any way you can block sunlight will reduce the need for cooling and help reduce costs. Planting trees along the south and west faces of your winery will help reduce the need for cooling during the summer months. Another option is installing a wall trellis system to grow vines that will help shade your building.



Figure 9. An example of a wall trellis

Even installing a sunscreen that shades your building and ventilates heat away from its surface may be a cost effective option (Chauncey, 2007).

Increasing day lighting levels will help as well. Allow your design to have additional windows or skylights, and you will reduce the need for artificial light. This

will reduce your electricity bill and save you money, day lit wineries can reduce lighting watts by roughly 66 percent (Chauncey, 2007). An added benefit is that these small designs may even benefit your employee's attitudes and efficiency by increasing the views to the outdoors.



Figure 10. Winery tasting room.

Designing or remodeling your winery with increased natural ventilation is a good option. Placing windows at or near the floor level will bring in cool night air. Installing a louver in the upper part of your winery is another option. Hot air that has been accumulated during the day can be exhausted through the louver. The hot air that leaves the winery will pull in cooler night air creating a passive ventilation system. This can be done without the use of mechanical equipment (Chauncey, 2007).

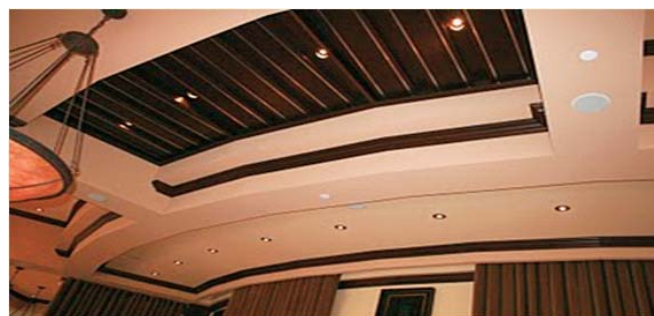


Figure 11. Ceiling louver.

The type of paint materials used will also have an important impact. There are many types and colors of paints that reflect pigments. If you paint your roof with a paint that reflects pigment, it will reduce the amount of heat absorbing light and create a cool roof. This can help immensely when it comes to reducing your cooling costs (Chauncey, 2007). The Department of Energy (DOE) maintains the DOE Cool Roof Calculator which is meant to help small to medium-sized enterprises calculate their cool roof annual savings. To calculate your annual savings go to <http://www.ornl.gov/sci/roofs+walls/facts/CoolCalcEnergy.htm>.

If you can create a building with mass instead of a building with thin walls made out of metal with poor insulation, then heat and cold will not penetrate your walls as quickly. Buildings made out of concrete, masonry, or stone with insulation in between will be much more efficient at blocking out the heat and the cold (Chauncey, 2007). For example, brick wall buildings absorb heat all day, and then release it at night with little effect on the interior temperature of the building. If you have limited capital for construction, since mass walls are more expensive than thin wall systems, you can utilize mass solely for barrel storage areas. You can use a mass wall to create a **chai**, an aboveground structure used for wine storage and aging, if you do not want to build an underground storage area.



Figure 12. A Chai in Bordeaux

Finally, if you have an existing building that you are considering tearing down and replacing, consider adapting it for a new use. Remodeling it will give it a second life; you could use it as storage for cases, equipment, or documents. Any facilities on your property that can be saved from the landfill and remodeled will help you in your goal towards becoming a sustainable business.



Figure 13. A prime example of a winery building ready to be efficiently remodeled.

Green building is about more than just using new technology and engineering. It is about making the most of what you have. Green building maximizes the space of your facilities, recycles and reuses materials, uses natural materials, minimizes waste, and reduces energy and water usage (Heyns, 2009). Leadership in Energy and Environmental Design (LEED) is a green building rating system developed by the U.S. Green Building Council (USGBC). LEED helps define green building through common standards of measurement. LEED provides a framework for assessing building performance and meeting goals of sustainable buildings. Following LEED's framework can be a great option for the facilities of a winery because it emphasizes strategies that save water, conserve energy, conserve materials, and provide quality indoor environments. The certification itself is free, but achieving it will

require the help of a consultant. The upfront costs are expensive, so LEED certification may not be practical for every winery. Some wineries that have embraced LEED certification are Frog's Leap Winery, Stratus Vineyards, and Stoller Vineyards.

If you do not want to commit to becoming LEED certified, that does not mean you are out of options. If you are building or remodeling facilities, you can use materials that are reclaimed or recycled. Fetzer Vineyards has a 10,000-square-foot administration building that is made almost entirely from recycled materials (Fetzer Vineyards, 2010). Flooring can be made "green" with the use of recyclable or renewable resources, but it is important to do research because some green flooring products are not durable enough for your intended use and they will have to be replaced more often (Heyns, 2009). Bamboo is a good example of an environmentally friendly flooring choice because it is recyclable, reusable, and it is an easily replenished natural resource (Heyns, 2009).

If you plan on remodeling any of your facilities, you can reuse a lot of the materials from your existing facilities. This includes old pieces of furniture, cabinetry, flooring, studs, siding, and countless other materials. This will save you a lot of money and it is environmentally friendly because it will reduce what you send to the landfill. Old bricks can be reused to create walkways or patio surfaces. Even if you are planning on demolishing an existing facility you can still remove reusable or recyclable materials from the facility beforehand. Organizations such as Second Chance (<http://www.secondchanceinc.org/>) have teams that are specially trained to remove materials that can be reused or recycled.

What Should You Do with Unwanted Materials?

There are charitable organizations that encourage building material donation so that they can perform new construction, renovations, and remodels for those less fortunate. The Building Materials Reuse Associate (BMRA) is one organization where anyone can donate reclaimed building materials (www.buildingreuse.org). Habitat for Humanity also welcomes donations of used and unused building materials, appliances, and cabinetry (www.habitat.org).

SUPPLY CHAIN

A winery's supply chain is a crucial aspect of its sustainability. The supply chain will vary depending on whether or not the winery also has a vineyard, but a typical supply chain for a winery with a vineyard will include the following products and services:

- Farming equipment
- Fuel for equipment
- **Fermentation tanks**
- Barrels
- Bottles
- Corks
- Labels
- Cases and crates
- Transportation of wine
- Office supplies

All these various aspects of the supply chain need to be monitored and evaluated for their environmental impacts. For example, Fetzer Vineyards determined that they were purchasing bottles and cases that

did not align with their sustainability initiatives. They decided to only purchase bottles and cases that were made with the maximum amount of post-consumer/recycled materials available (Dolan, 2003). Once Fetzer Vineyards accomplished this, they realized they could have a positive influence on the environmental practices of their suppliers by using a vendor evaluation system. They already had a vendor evaluation system in place that graded and compared vendors on quality, cost, and service, but they decided to add an environmental component. For example, they gave vendors positive points for delivering materials in reusable containers, developing their own environmental friendly processes, and reducing their own waste (Dolan, 2003). Fetzer Vineyards wanted to give their vendors an incentive to look at their environmental impacts and compare them to their competitors.

Many vendors may think that you are trying to impose your values on them, but this does not matter in our free market economy. Vendors can choose to do business with other wineries and vice versa. This is important because if you do have vendors that align their own interests with your sustainability interests, you are creating a stronger partnership than you previously had. You know that your business can depend on them to supply you with products that can help you achieve your sustainability goals, and they know they have a customer that is willing to pay for advances they make in terms of environmental friendly products. For example, a vendor will be more likely to conduct research and development into new papers or inks if they know they already have a client that is willing to pay for and wants those products (Dolan, 2003).

The largest impact your supply chain has will be

its climate change impact. The greatest impact will be transportation and the creation of glass bottles. Transportation accounts for roughly 20 percent of the CO₂ production in the winemaking process, and glass manufacturing accounts for roughly 45 percent (Lodi Wine, 2010). GHG emissions will vary depending on how your wine is packaged, shipped, and for how many miles. While climate change is an important impact from your supply chain, it is only a part of the complete sustainability picture. Fetzer Vineyards provides another good example in regards to the way they handled their purchasing of corks. They were the first winery to buy corks directly from the source in Portugal and ship them in large containers, eliminating the need for packaging (Dolan, 2003).

Some Tips That Will Help You Reduce Your Impacts

- Start an employee commuter program.
- Place recycling bins throughout your office.
- Purchase energy star products for your office.
- Create cases from recycled cardboard.
- Purchase corks that have not been washed with chemicals.
- Purchase natural cork.

MEASURING AND REDUCING YOUR ENVIRONMENTAL IMPACTS

LAND DEVELOPMENT

The success that wineries and vineyards have had over the past couple of decades has become increasingly unpalatable to environmentalists, and many winemakers and growers have gotten the message (Carlton, 2002).

The main concern is that winemakers are wasting

natural resources and converting natural landscapes as wineries and vineyards continue to increase in numbers. Developing land for use in your vineyards will impact the surrounding ecosystem and affect the community you operate in. Habitat loss is a given if you develop forested areas, but this could also anger many people in the community who do not want that land converted, impacting your reputation. There has been a lot of bad press for the wine industry in the past decade, so there is concern that the public pressure will result in increased government oversight (Carlton, 2002). You may want to take matters into your own hands so you will not be burdened by possible regulations, or just to make sure you stay ahead of the regulatory curve. If you are looking to expand or buy new land, try to make a commitment that you will not develop pristine natural landscapes into vineyards. Look for agricultural land and convert it to your intended use, rather than converting forested areas. This will go a long way in preventing habitat loss and GHG emissions. Forested areas are natural buffers, so avoiding forest conversion will also prevent water pollution and sedimentation. Awareness of your potential impacts and taking actions to reduce them will have a positive impact on your business's reputation and a positive impact on your surrounding environment.

MATERIAL USE

Material use is a good place to start if you are looking to reduce your impacts. One of the leaders in the wine industry in material use reduction is Fetzer Vineyards. Their bottles are made from 35 percent post-consumer recycled glass and their case partitions use 100 percent recycled materials (Fetzer Vineyards, 2010). They also use recycled paper and soy-based inks for their wine labels (Dolan, 2003). Fetzer has also developed a light-

weighting initiative, which will reduce the carbon footprint of their packaging throughout their value chain, from bottle production to shipping to home consumption. The study evaluated all **Scope 1** and **Scope 3 emissions** related to Fetzer's supply chain (Fetzer Vineyards, 2010).

Sustainability Initiative	Total Average Weight Reduction	Carbon Footprint Reduction	Glass Usage Reduction	GHG Emission Reduction (Supply Chain)
Lightweight Bottles	14%	14%	16% (2,100 tons) annually	14% (3,000 tons of CO _{2e})

Table 2. Fetzer's Light-weighting Initiative



Figure 14. Lightweight Bottle (left) vs. Standard Bottle (right) (Fetzer Vineyards, 2010)

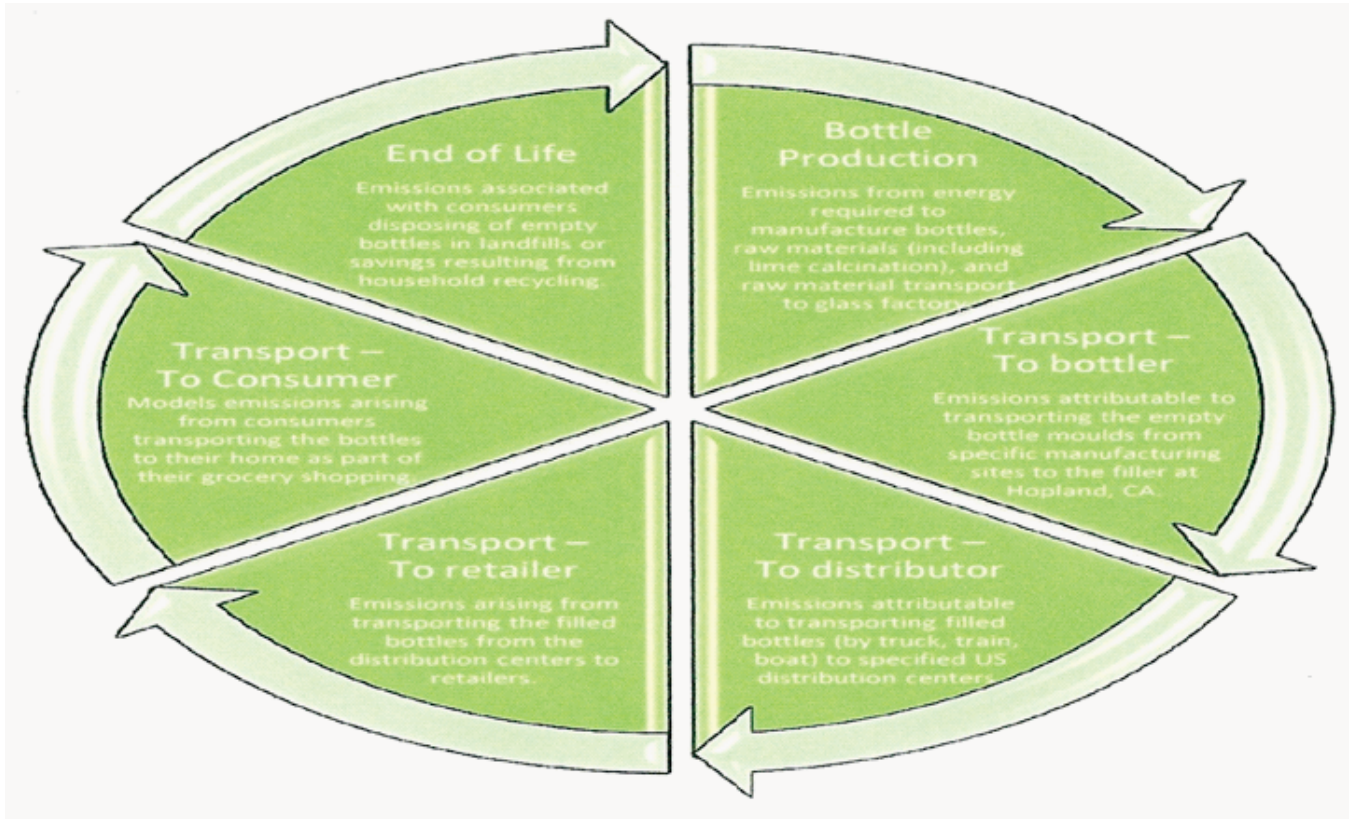


Figure 15. Fetzer's Life Cycle Methodology for the Light-weight bottle study (Fetzer Vineyards, 2010)

If you are willing to switch from glass bottles to bag-in-box (BIB) wine packaging you will be able to significantly reduce your material use impacts. Switching to a BIB packaging will result in a 55 percent smaller carbon footprint and 85 percent less landfill waste (Better Wines Better World, 2010). The BIB packaging will reduce **cork taint** which spoils between 3-5 percent of wines sealed with a natural cork. U.S. wine drinkers throw out wine from cork taint that is equivalent to filling 43.56 Olympic-sized swimming pools. It is estimated that if all glass bottling from the U.S. wine industry switched to BIB packages the savings in the U.S. would amount to roughly \$5 billion (Better Wines Better World, 2010). A number of wineries from around the world have switched to BIB packaging including Alamaden (California), Foxhorn (Australia), Casarsa (Italy), J.P. Chenet (France), and Zimmermann (Germany) (Better Wines Better

World, 2010). Switching to BIB packaging could result in significant savings for your winery if you are willing to switch from glass bottles.

Another option that eliminates cork taint is using screw caps instead of corks. Loring Wine Company uses screw caps for all their wines. This has cut costs for them because the screw caps only cost 15 cents per bottle whereas corks cost them a dollar per bottle (Wine Library TV, 2010). However, screw caps are not the more sustainable option, natural cork is. Natural cork is harvested from the cork oak tree. Cork is stripped from the trunks every nine years after the trees reach about 25 years old (Steeman, 2010). The process does not harm the tree because the cork grows back, making it a renewable resource. A typical tree can be harvested for 200 years (Warren, 2010). Cork is sustainably harvested from the trees and cork is biodegradable and recyclable,



Figure 16. A stripped Cork Oak tree

making it a more sustainable option than screw caps (World Wildlife Fund, 2006). Many cork oak forests in Spain, Portugal, and Italy have achieved the Forest Stewardship Council (FSC) certification, which is achieved by managing and conducting operations to international social and environmental standards (Steeman, 2010).

Interested in finding out more information about natural cork? Check out this report from the World Wildlife Fund: <http://www.wwf.org.uk/filelibrary/pdf/corkscrewed.pdf>

Natural cork is also more environmentally friendly because the cork oak trees conserve soil by providing protection against wind erosion, preventing **desertification**. The trees are also effective at preventing sedimentation. The cork oak trees act as a natural buffer to streams and rivers preventing the flow of sediments and pollution into these water bodies. Like all living plants, the cork oak trees sequester CO₂. A unique aspect of cork oak trees is that they store CO₂ in order to regenerate after harvesting. As a result, cork oak trees that are harvested absorb 3 to 5 times more CO₂ than ones that are not harvested (World Wildlife Fund, 2006).

It is also important to be aware of the deep psychological fascination with corks and wine bottles in the wine world. The “pop” that comes with opening a bottle of wine is a part of tradition and nostalgia that many consumers are not willing to give up. One survey found that in wines priced over \$15, consumers prefer natural corks, and the closure type was more important to them than price, varietal, or the region of origin (Penn, 2007). Many consumers will view other closure and bottling options as a sign of a lower quality product.

Barrels are one of the most, if not the most important material a winemaker uses. Barrels are very expensive, ranging in price from anywhere to \$200-\$600 per barrel depending on the vendor (Oak Barrel Winecraft, 2006). As a result, they represent a great way to conserve materials and reduce costs if you can repair, restore, and recycle them. Fetzter Vineyards was able to do this exact thing, they hired a **barrel cooper** to repair and restore barrels (Dolan, 2003). This reduced their barrel costs and postponed their need for new barrels. The barrel cooper fixed anything on a barrel that was broken or worn out, and scraped out old charred wood in the barrels to expose new wood, and then re-toasted it to the specifications of the winemaker. This effort gave Fetzter the equivalent of a new oak barrel at a fraction of the cost (Dolan, 2003). This saved the vineyard money and was in line with their sustainability goals.

ENERGY USE

When people think of energy they think of electricity. However, energy is much more than that; it includes vehicle use, air travel, natural gas use, propane, and diesel. This is the total energy consumed by your winery when you produce wine (Garn, 2005). Most

managers only want to see the dollar amount when talking about energy, but you also need to understand kilowatts and **BTUs**. You need to know these numbers in order to determine the monetary cost it takes to produce each case of wine per year (Garn, 2005). An energy audit is a great way to understand how much energy your facilities use and ways to become more energy efficient.

Interested in Conducting Your Own Self Energy Audit?

Answering some of these starter questions will help you generate ideas and point you in the right direction:

- What is your total energy use?
- What is your total electricity use? Natural gas? Propane? Fuels?
- What is your total wine production (in gallons or cases)?
- What is your energy intensity per gallon or case?
- Is there a regular maintenance cycle for your HVAC unit?
- What is the efficiency of your HVAC unit?
- Is there a policy to turn off lights and machinery when not in use?
- Are you using natural light effectively?
- Are hot water pipes insulated?
- Are tanks insulated?
- When was the last time the compressed-air system was checked for leaks?
- How old is your refrigeration equipment, air compressor(s), and boiler(s)?
- Are wastewater aerators operated around the clock, or regulated by timers?
- Is office equipment Energy Star-certified?

Knowing your energy baseline is extremely valuable because if you know your current energy use, you can determine where you want to go with your energy efficiency measures and determine future cost savings. Your utility company is one of your most valuable resources for determining your total kilowatts and BTUs (Garn, 2005). They will be able to assist you by providing historical data for your operations, all you have to do is contact them and most likely perform a simple registration to obtain your data.

Interested in an environmental Audit?

Check out SSC's Green Audit at <http://www.sustainabilityconsulting.com/greenaudit>.

The best way to start reducing your energy use is to pick the “low-hanging fruit” or energy hogs. Low hanging fruit is often things like your lighting, refrigeration systems, boilers, and compressors. One area that is often overlooked is water systems. Water can be a big part of your energy use because there so many different areas of your winery that use water. You have pumps that extract water out of the ground for general everyday use, to irrigate vines, to landscape your property, and to make wine. You also use a lot of energy heating water, treating water, and disposing of it. One of your biggest energy guzzlers for water use is aerators if you use wastewater ponds, because many wineries run them around the clock (Garn, 2005).

There are numerous wineries that are implementing energy efficiency measures that you can replicate. For example, connect dissolved oxygen monitors to your wastewater pond aerators so that they are not constantly running (Garn, 2005). Honig

Vineyard and Winery provides a great example. They installed monitors to measure the moisture level in grapes leaves, so that they could cut down on water consumption to only what is required. As a result, Honig has saved \$1,500 year in electrical costs from not having to pump as much water from wells (Carlton, 2002).

ENERGY EFFICIENCY

A good example of a winery picking some of their low hanging fruit is Kendall-Jackson Winery. They developed an energy efficiency program that will save them \$100,000 annually in energy and maintenance costs. The program features innovative fluorescent lighting from GE Consumer and Industrial (Business Wire, 2009). The winery installed GE's T5 Watt- Miser[®] system with shatter-resistant covRguard[®] technology in active areas of the winery such as bottling and blending, and GE's Ecolux[®] T8 fluorescent lamps in case goods and barrel storage areas. The winery selected GE's NEMA Premium[®] UltraStart™ high-efficiency ballasts throughout all of winery (Business Wire, 2009). As a result, Kendall-Jackson now has energy efficient lighting that is segmented to each area of its winery according to use and need. The combined package the winery received allowed them to cut energy costs and GE was able to reduce packaging, material waste, weight, floor space requirements, and installation times (Business Wire, 2009).

SOLAR ENERGY

Another option to cut energy costs and reduce environmental impacts that many wineries have embraced is solar energy. The threat of climate change and rising fuel prices is making solar power an attractive option. The technology is improving

and tax breaks are still available, so if you have the capital for the initial investment, now is a good time to turn to renewable energy. Federal government, states, and utilities are all working together to make solar economically feasible for many business owners (Firstenfeld, 2007). Besides the reduced environmental impact solar power provides, there is a 30 percent federal tax credit and the option to depreciate your investment over just five years, which is another good incentive to invest in solar power. For example, Ballentine Vineyards constructed an 87-kilowatt system in July, 2007. The system is expected to last from 20 to 30 years, coming with a 25-year guarantee. On their first statement from the utility company the power cost was zero for the 11,000 case winery and 16-acre vineyard. The initial investment was \$600,000 with a \$200,000 rebate from PG&E, with energy savings, tax credits, and accelerated depreciation, the winery expects to pay off the system in only six years (Firstenfeld, 2007).

Honig Vineyard and Winery is another example of a winery that has embraced solar power. They installed 819 Sanyo 200-watt modules mounted on the ground, generating power for the winery, and for cooling and bottling (Clark, 2009). Honig's solar power system will prevent 7.5 million pounds of carbon dioxide emissions over the systems life, this is equivalent to planting 34 acres of trees (Clark, 2009). The solar system cost Honig \$1.2 million, but they only had to pay a third of that because of credits and tax breaks. Honig treats the system as one of its most important investments. The owner Michael Honig states that "The costs we incur now are more like investments. We are applying the same money we spend on electricity to paying off the bank loan to pay for the solar panels. After ten

years we will own our system, enabling us to save over \$42,000 a year in electric bills,” says Michael. “We used to rent our power. Now we’re on our way to owning it (Clark, 2009).” The winery believes they will be able to pay off their investment within 10 years, so with a 25-year warranty, they should be able to enjoy 15 years of cost free solar powered energy (Clark, 2009). So, depending on the size of your winery, your power use, and the size of your installation, using solar power can reduce or eliminate your electricity bill.

For an interesting example of how Honig Vineyard and Winery displays their energy usage, go to http://www.honigwine.com/solar_calc.aspx.

INFORMATION TECHNOLOGY

Another way to green operations and decrease the costs of energy usage is through information technology (IT). Many wineries that have adopted sustainability initiatives have yet to do anything about greening their IT processes. One winery that is on the cutting edge of greening their operations through IT is Monte Vibiano. The company is known for its fine wines and olive oils but two years ago they set out to become a carbon neutral winery. In February 2010 they achieved their goal and became one of the first wineries in the world to have 0 GHG emissions, in accordance with the international standard **ISO 14064** (Monte Vibiano, 2010). They achieved their goal by focusing their efforts on technology by extending an already existing partnership with Microsoft.

Using Microsoft’s Hypervisor virtualization platform, the company reduced the number of servers they used from four to two and cut the energy use of the

remaining two servers from 1,95KwH to 1,2KwH, a 38 percent reduction (Monte Vibiano, 2010). Monte Vibiano lowered their CO₂ emissions from 287 tons of CO_{2e} in 2004 to -764 tons of CO_{2e} in 2008 (Monte Vibiano, 2010). Though they are a small company, Monte Vibiano incurs large amounts of travel related costs due to the nature of their work (i.e. tastings and meetings with customers). In order to reduce their travel related emissions and costs, the company now conducts more meetings over the internet rather than face to face. As a result, Monte Vibiano has reduced their greenhouse gas emissions and cut its travel costs by \$35,500, since the projects inception in October 2008. Monte Vibiano is a great example of how sustainability can have a positive impact on a small winery’s bottom line.

WATER

Water is one of the most precious resources for winemaking because it is essential for growing the grapes and producing the wine. In order to conserve water a winery must first analyze where they are using their water, and second develop ways to conserve or recycle it. A prime example of a winery that has made water conservation a part of their sustainability goals is J. Lohr Vineyards and Wines. When they decided to expand their winery, they had to increase the capacity of their wastewater treatment facility or reduce their consumption in order to achieve their conservation goals. They started their conservation plan by purchasing portable flow meters and took measurements of their water use (Zucker). Then they created a spreadsheet that allowed them to predict their water use from all aspects of their business.

The first thing they did was install low flow/high pressure nozzles on the hoses in the winery, this

reduced the flow on each hose from 20 gallons per minute to 7 gallons per minute (Zucker). Their next step was to put specific time lengths on all activities that involved using water and they placed clocks at all of their washing stations so people could keep track. They believed that their most important thing they did was change the culture of the winery into one where conserving water was an important part of doing business (Zucker). The table below shows the results of their efforts with 2003 as their baseline year.

	2003	2004	2005	2006	2007
Gallons Water/ Gallons Wine	3.5	2.2	1.2	1.6	1.2
Percent decrease v. 2003		38%	67%	53%	66%

Table 3. J. Lohr. Water Used to Produce a Gallon of Wine

One way for your winery to calculate your water footprint is by using the World Business Council for Sustainable Development’s Global Water Tool (<http://www.wbcsd.org>). The tool is used so that organizations can comprehensively evaluate their water risks and impacts throughout their operations (including supply chain). The tool provides the following data:

- Compares your organization’s water uses (including staff, industrial use, and supply chain) with key external water-related data
- Creates key water Global Reporting Indicators (GRI), inventories, risk and performance metrics, and geographic mapping
- Establishes relative water risks in your

organization’s portfolio to prioritize action

- Enables effective communication with internal and external stakeholders on your organization’s water issues
- Allows calculation of water consumption and efficiency

The Wine Institute provides a tool that measures the electricity costs of winery water use. Interested? Go to <http://www.wineinstitute.org/winerywaterguide>

WASTEWATER

Wineries generate large amounts of wastewater because winemaking is a water intensive process and the wastewater is high in BOD because of the sugar content of the grapes. As a result, wineries face increasingly stringent regulations for wastewater discharge. Wineries that choose to be proactive will save money from fines and costly equipment purchases that may be required in the future (Firstenfeld, 2003). However, since it is a strong organic waste, this also means that it is suitable for biological treatment systems, which means it will be easier to recycle and reuse (Moore). The more wastewater you recycle and reuse the less money you will have to spend on treatment equipment and everyday water use. For example, wastewater from the crush period can be recycled, then treated and reused for landscaping.

Winemaking operations that generate wastewater include cleaning of the crusher, presses, fermentation tanks, washing of storage tanks, and bottling equipment (Moore). Your winery will also generate wastewater from employees and visitors. There are a number of different wastewater treatment processes

for wineries including **activated sludge**, **leachfields**, **sequencing batch reactors**, **artificial wetlands**, and **aerated lagoons** or **ponds** (the most common). Each one of these methods is capable of producing effluent that is suitable for spray irrigation of vineyards, woodlands, or landscaping (Moore).

Leachfields should be avoided because they have little to no treatment, which will result in high strength discharge to groundwater (Moore). The rest of the biological treatment systems are economical and effectively remove BOD and **total suspended solids** (TSS). Aerated ponds are the most common biological treatment system and they are reliable and perform well. They are low maintenance, simple, and capable of handling surges in hydraulic and organic loadings (harvest and crush). When they are operated properly there is a low risk of odor problems and groundwater and surface water contamination problems (Moore).

The most important thing your winery can do to reduce its environmental impact is to reuse your effluent. Although the wastewater you reuse will be low in BOD and TSS, it will still have some residual macronutrients and many micronutrients that can enhance plant growth. Nutrients will include iron, manganese, zinc, boron, copper, and molybdenum (Moore). You can also build earthen trenches to prevent runoff when you reapply effluent back to the land, this will make sure that it is not discharged into surrounding water bodies (Moore).

SOLID WASTE

The five main materials that comprise a winery's solid waste stream are paper, plastic, metals, glass, and wood. Paper is the largest part of the waste stream with roughly 50 percent ending up in the

landfill (California Wine Community Sustainability Report 2009). In order to reduce your winery's waste stream you should work with suppliers to reduce the amount of packaging that comes with the materials you order, or encourage them to supply you with materials that come with recycled packaging. This encourages suppliers to develop systems for reusable containers, recyclable packaging, or reprocess waste material (California Wine Community Sustainability Report 2009).

The key factor for reducing your waste stream and increasing recycling is your employees. You should invest time and money to educate and train all employees to identify, separate, and recycle materials. This is something that every employee can relate to because many of them already recycle at home, and it will mean money back in your pocket (California Wine Community Sustainability Report 2009).

Before you start to invest resources to reduce your waste stream, you need to assess the amount and understand how your winery generates solid waste. This will allow you to strategically plan and invest in the parts of your operation that will yield the greatest benefit (California Wine Community Sustainability Report 2009). For example, Fetzer Vineyards worked with their suppliers to find ways to limit the amount of waste they sent to landfills. They were able to reduce their solid waste from 1,724 cubic yards in 1990, to 60 cubic yards today, a 96 percent reduction (Fetzer Vineyards, 2010). Fetzer was able to double their wine production during this time period. The following table provides ways to reduce your solid waste stream.

Types of Solid Waste	Reduction Strategies
Cooperage	<ul style="list-style-type: none"> Track conditions of your barrels to reduce leakage Make sure the wood you purchase for your barrels is certified sustainably forested Sell or recycle used barrels
Cardboard	<ul style="list-style-type: none"> Reuse cardboard for shipping Work with your supplier to take it back Recycle cardboard Track what is recycled and what is disposed of
Paper	<ul style="list-style-type: none"> Recycle all paper products Know what you are recycling and what is being discarded Use scrap paper for notes Use two sided copying as a standard practice E-mail reports and newsletters instead of making copies
Cork	<ul style="list-style-type: none"> Buy natural corks Provide containers in the tasting room to recycled cork Provide containers in the bottling room to recycle cork
Pallets and bins	<ul style="list-style-type: none"> Reuse and repair all wood pallets and bins Recycle them once they have reached their useful life Try to convince suppliers to take back used pallets Store unused pallets for vendors
Packaging	<ul style="list-style-type: none"> Know what is coming in and what is coming out Use alternative packaging material Recycle packaging material when possible and track what you cannot recycle Know the major sources of plastic coming to your facility Find vendors that specialize in recycling packaging material Try to convince suppliers to take back packaging material
Landscape	<ul style="list-style-type: none"> Let organic material from landscaping naturally decompose on your property Create a compost area

Table 4. Solid Waste Production at Wineries

COMMUNICATING PROGRESS

INFORM STAKEHOLDERS

When adopting and implement a sustainable business model it is important to communicate your efforts to your key **stakeholders**. This group includes:

- Consumers
- Suppliers
- Wholesalers
- Buyers
- Employees
- Neighbors
- Community

You have an obligation as a business to tell people why you are doing this because the parties that purchase your products could feel like they are being deceived or tricked if you do not communicate what your plans and goals are. This is the reality of sustainability in the marketplace for all businesses, especially for wineries because there are so many wineries capitalizing on green efforts. As a result, many people will be skeptical about your efforts because they will think you are simply trying to increase your profit margin.

Decision makers and managers are particularly important in generating the sustainability conversation. It is their responsibility to get the conversation started so that everyone in the organization can join and not have to create the conversation themselves. It is easier for people to join in on the conversation when it is already ongoing, so if you want to keep people focused on sustainability help them to get started by talking about it. If you

are effective in communicating your plans and goals you will gain the trust of your key stakeholders and grow your **brand**.

STRENGTHEN YOUR BRAND

One aspect of becoming a sustainable winery is marketing your wine in a way that tells the story about how you produced it using sustainable practices. This is important because you can use sustainability as a competitive advantage to increase sales. For example, Honig Vineyard and Winery states on their blog (<http://www.honigwine.com/honig-blog>) that their wine label tells a story, makes an impression on the buyer, and creates a



Figure 17. Honig's wine label

brand image. Honig is a sustainable winery and they communicate this on the back of their wine label. You should market your sustainable wine based on facts and resist the urge to embellish your sustainable strategies. However, since sustainability is all encompassing, it can be difficult to develop a simple, yet meaningful message to help market your product. Your winery should develop a mission statement that

enhances your business mission and communicates your goals. It should allow people to see that you are placing environmental and social goals at the same level as your economic goals. Rather than focusing on just one aspect of your sustainability initiatives, such as your wine production, your overall broader marketing plan should focus on all of your efforts. If you have a website, put information about what you

are doing in regards to your vineyards, winemaking, facilities, and community outreach to name a few. You can even start a blog that details some of your sustainability efforts. You want your customers to have great experiences not just with your wines, but with your brand. This is a good way to avoid greenwashing claims because loyal customers who have experienced your brand will help build your credibility. A press release on the CO2 emissions you cut with your new solar panels does not do much for you if you are not demonstrating sustainability in your day to day interactions with customers. This also applies to the wholesalers and retailers you conduct business with because they have a direct impact on your customer experience (Rice, 2009). The key is to be open and honest to all stakeholders about what your goals are and how you are planning on achieving them. For example, Fetzer Vineyards and Frog's Leap Winery (see case study on page 30) do a great job accomplishing everything described in this paragraph.



Figure 18. Fetzer's Sustainability Wheel



SWOT Analysis

A SWOT analysis is a planning tool used to evaluate the strengths, weaknesses, opportunities, and threats involved in a project. The analysis involves specifying the objective of a project and identifying the internal and external factors that are favorable and unfavorable to achieving that objective. The SWOT analyses carried out for this study was used to evaluate the positives and negatives associated with becoming a sustainable winery.

Sustainability	Winery and Vineyard
Strengths	<ul style="list-style-type: none"> • Improvement in your outdoor and indoor environment • Creation of a healthy work environment for employees • A reduction in operating costs • A reduction in operating costs means a higher gross margin • Sustainable agriculture does not require up-front investments • Changing farming practices can affect the taste of your grapes (for the better) • Decreased chemical costs • Decreased electricity costs • Decreased solid waste generation • Reduced water usage • Ability to reuse your wastewater • Organic wines have greater health benefits (antioxidants, resveratrol) • Organic wines have bolder more concentrated flavors • Creation of stronger relationships with your suppliers • Smaller impact on climate change • Increased competitive advantage
Weaknesses	<ul style="list-style-type: none"> • Remodeling buildings to become “green” can be expensive • Solar panel retro-fits will require large capital costs, and it can take many years for the investment to pay off • Loyal customers may not like your changes • Changing farming practices can affect the taste of your grapes (for the worse) • Loyal customers may not like or be skeptical of your new brand image • 100 percent organic wines are more perishable because they cannot contain sulfites • Vendors may not be receptive to new philosophies

Sustainability	Winery and Vineyard
Opportunities	<ul style="list-style-type: none"> • Increased gross profit gives you the ability decrease your price point, potentially attracting new customers • Your sustainability initiatives could attract new customers interested in green wines • Many retailers and wholesalers are interested in green wines • Sustainability provides your business with new marketing opportunities • You could grab a portion of the market share for green wines • You could grab a portion of the market share for people that are allergic to sulfites • Potential of greater relationships with consumers and suppliers
Threats	<ul style="list-style-type: none"> • Some consumers will see green efforts as greenwashing • Initial investments could put cash flows at risk • Many loyal customers may abandon your products • More scrutiny from environmentalist and new customers (are you really sustainable, are you truly making the efforts you say you are?) • Attempting to penetrate new markets could result in the loss of previous market share

Table 5. SWOT analysis for wineries.



Case Studies

CALIFORNIA CASE STUDY: FROG'S LEAP WINERY

Frog's Leap Winery is located in Rutherford, CA, the heart of California's Napa Valley. Frog's Leap is a perfect example of what a sustainable winery should be. Their mission statement sums up who they are as a sustainable business.

"Frog's Leap will make a difference. We will produce wines that deeply reflect the thoughtfully chose soils and climates from which they emanate. We will respect our surroundings, maintain good stewardship of the land, uphold our commitment to the principles of sustainable farming and seek a deeper understanding of the natural living system around us... We will succeed as a business, measuring our success with unique criteria. We will both respect and challenge conventional wisdom, growing our company the way we grow our vines. We will enhance the quality of our lives and the lives of those who work with us, never forsaking our belief that wine is a wonderful part of life, not life itself. Frog's Leap will leave a legacy." (Frog's Leap, 2010)

Frog's Leap's sustainability efforts begin with photovoltaic energy. The winery maintains an on-site solar panel array that it considers to be a thoughtful ecological decision and a good business decision. In February, 2005 the winery became 100 percent solar powered and now captures more electric power than it needs to conduct everyday business. Frog's Leap sells the excess electricity back to the power company for credit, essentially becoming an energy provider (Frog's Leap, 2010).

Their system consists of 1,020 photovoltaic panels on a half acre of vineyard space which faces south-east at a 5-degree angle. The initial cost of the project was \$1.2 million with a 50 percent rebate from Pacific Gas and Electric Company (PG&E) (\$600,000). They expect the system to fully pay for itself in six years and have a lifetime of 30 years. The system averages an output of 168 kw/day, the winery only uses 65 kw/day, and provides roughly 450,000 kw hours electricity/yr. All the excess electricity is fed back into PG&E's grid. As a result of this effort, Frog's Leap estimates that they have reduced their CO₂ emissions by 1,600 tons, equivalent to planting 450 acres of trees or not driving 4 million miles (Frog's Leap, 2010).



Figure 19. Solar panel array.

Frog's Leap also reduces its energy use through the utilization of geothermal heating and cooling. When the winery decided to develop a new Hospitality Center and Administrative Office, they decided

that they wanted to use geothermal energy to complement their existing solar array. The winery uses an underground loop system, and with the geothermal temperature remaining a consistent 56-58 degrees, it allows for an efficient exchange of energy between the building and the soil below (Frog's Leap, 2010). During the winter months, water circulating in the underground loop system absorbs heat from the soil and distributes it to the geothermal unit where it is compressed to a higher temperature to provide heat to the building. During the summer months, the system expels heat from the building to the cooler soil via the loop system, allowing for a comfortable climate within the building.

Their geothermal system consists of a geothermal bore field with 20 wells, 250 ft deep on a continuous loop. The cooling/heating capacity of each well is 1 ton or 12,000 BTUs, this energy output is equivalent to the energy usage of 8-10 homes (Frog's Leap, 2010). The winery expects this investment to pay for itself within six years. Another important aspect of this system was that it did not have an aesthetic impact on the winery, the system was installed underneath the winery's parking lot.

A cornerstone of Frog's Leap's sustainability efforts is its organic farming practices. They believe that anything less than organically grown grapes is a compromise of both taste and affordability. Through the use of cover crops and composting, the soil remains alive with a complex system of microbes that provides nutrients for the plant and the soil. Ultimately, Frog's leap believes that organic farming produces a healthy soil which produces a healthy vine which in turn is resistant to diseases and pests. They till the soil with cover crops such as Purple

Vetch, oats, Austrian Winter Pea, and Mustard, this provides a balanced diet to the vines which leads to balanced growth. They plant cover crops every winter and litter the soil with organic matter like humus, nitrogen, and other nutrients. This improves soil structure and root growth symbiosis with beneficial soil bacteria, fungi, and earthworms. Cover crops also provide a habitat for beneficial insects (ladybugs, spiders) and birds (bluebirds, owls) that will eat vineyard pests. Cover crops are one of their premiere investments because they beautify and diversify their vineyard. Frog's Leap believes that if the environment around the vine is not healthy, it will be difficult to maintain a healthy productive vineyard. This is their concept of sustainable farming, reduce, reuse, recycle, renew, retain, and reverse (Frog's Leap, 2010).



Figure 20. An example of cover crops in the vineyard.

Frog's Leap also engages in dry farming. They believe that deeply rooted vines produce grapes with greater balanced flavors and are more reflective of their native landscape. A secondary benefit that falls in line with their sustainable business model is that dry farming reduces the wineries water usage

(Frog's Leap, 2010). Dry farming goes hand in hand with planting of cover crops and tillage; together they all promote an environment that increases the soils capacity to hold water and at the same time encourages a healthy, balanced, and complex biological life in the soil's structure. Limiting the amount of water encourages deeply rooted vines, which will become stronger and more disease resistant.

Frog's Leap Winery believes that all farmers are caretakers of the soil, air, water, and all living organisms associated with their business. That means that they are responsible for not just their role in farming, but how their role affects everything their work touches. All of Frog's Leap's sustainability efforts work together and benefit their business, their people, and their surrounding environment.

VIRGINIA CASE STUDY: BARREL OAK WINERY

An example of a Virginia winery pursuing sustainability efforts is Barrel Oak Winery located in Delaplane, Virginia. Though winemaking and sustainability go hand in hand in California nowadays, east coast wine makers have not adopted sustainability on the mass scale that California has. Barrel Oak Winery is one exception.

Barrel Oak's decision to green its business was a practical one, rather than motivated strictly by environmental responsibility. Co-founders, Brian and Sharon Roeder, realized that energy prices were soaring and one way to keep Barrel Oak's future costs down was to build the winery sustainably. The winery's sustainability efforts started with material conservation. A majority of the rock used to the construct the winery was obtained on-site during

construction and the building's flooring is made strictly from recycled wood. Barrel Oak maximized its use of recycled materials by insulating the entire winery with recycled construction materials (Wine with Dinner, 2008).

Barrel Oak takes full advantage of their natural surroundings and climate conditions. When building the winery, the Roeders knew that the hills on their property had more than just aesthetic value. Though the tasting room on the upper floor is open to the air on all sides, the cellar and production areas on the lower floors were built into the hill, and are only open to air on one side. In doing so, Barrel Oak will minimize the amount of power needed to cool the cellar and production areas, reducing operating costs. The winery is able to take advantage of the natural climate because they installed large glass doors and state of the art windows which are strategically positioned so that they can be opened on hot summer afternoons and allow the breezes from the ridge to cool the winery (Wine With Dinner, 2008).

One of Barrel Oak's most important sustainability efforts was the installation of \$180,000 geothermal HVAC system (Gumino, 2008). The system consists of a large heat pump that uses the ambient temperature of the surrounding soil (approximately 58 degrees) to heat or cool the winery (Wine with Dinner, 2008). This saves the winery a significant amount of power because as the seasons change the soil temperature does not change as significantly as the outside temperature. This means that the winery can achieve its desired temperature with minimal energy use, which decreases greenhouse gas emissions and saves Barrel Oak money on their energy bills. The winery estimates that they have electricity savings of \$3,000 to \$5,000 per month, and they

expect to break even on their investment in roughly five years (Gumino, 2008).

Although Barrel Oak does not incorporate organic farming practices into their vineyards they do try to limit the amount of spraying they do. The winery tries not to waste any resources, all fruit skins and stems that are leftover after crush are composted and later re-incorporated into the vineyard. Finally, Barrel Oak recycles all of their bottles and any cardboard that is used for operations.

Barrel Oak is standing out among Virginia wineries because of their leadership in sustainability. The winery's actions do not just have a positive impact on the environment, they have positive impacts for its business goals as well. By acting as smart businessmen, Brian and Sharon Roeder discovered what sustainability initiatives worked for their winery and implemented them.



Figure 21. Construction of the winery into the hill side. (Photo Courtesy of Barrel Oak Winery)

“While the farmer holds the title to the land, actually it belongs to all the people because civilization itself rests upon the soil.”

– Thomas Jefferson



Conclusion

In the wine industry there is an incredible amount of competition in terms of shelf space in stores, spots on restaurant wine lists, time with retailers, wine critics, and space at public events. For this reason, it is important find a way to gain an edge on your competitors. Sustainability offers such an edge by having a positive impact on the community, engaging employees, reducing costs, and increasing profits. Adopting sustainable principles and making changes to become a sustainable business means that you must constantly be looking for new ways to improve your environmental and social performance. Once all the low-hanging fruit has been picked, driving your business towards sustainability gets more challenging. However, with hard work,

determination, and a business environment that allows for an open flow of ideas, you will always be able to discover something you can improve upon. Though it is impossible to grow grapes and make wine without leaving an environmental footprint, the goal is continual improvement. Take the ideas that you think will work for your business and make them a part of your sustainability initiatives. You will begin to see that you are making a difference for the environment, your employees, and the community. Once you notice this shift you will have business goals that are as socially responsible as they are fiscally responsible.



Glossary

Activated Sludge – Atmospheric air or pure oxygen is introduced to a mixture of primary treated or screened sewage (or industrial wastewater) combined with organisms which reduces the organic content of the sewage.

Aerated Ponds – A holding and/or treatment pond provided with artificial aeration to promote the biological oxidation of wastewaters.

Artificial Wetlands – An artificial marsh or swamp, created for anthropogenic discharge such as wastewater, stormwater runoff or sewage treatment.

Barrel Cooper – One that makes or repairs wooden barrels and tubs.

Biological Oxygen Demand (BOD) – A chemical procedure for determining the uptake rate of dissolved oxygen by the biological organisms in a body of water. It is not a precise quantitative test, although it is widely used as an indication of the quality of water.

Bioregion – The unique physical, biological and climatic characteristics of a particular area.

Brand – Name, term, design, symbol, or any other features that distinguish a seller's good or service from those of other sellers.

British Thermal Unit (BTU) – A basic measure of thermal (heat) energy. One BTU is the amount of energy needed to heat one pound of water one degree Fahrenheit, measured at its heaviest point.

Chai – An aboveground structure used for wine storage and aging.

CO_{2e} – A measurement for describing how much global warming potential a given type and amount of greenhouse gas may cause.

Cork Taint – A wine fault characterized by a set of undesirable smells or tastes found in a bottle of wine, especially spoilage that can only be detected after bottling, aging, and opening.

Crush – After stems are removed, breaking the grape skins prior to pressing and fermentation. The term can also be applied to the season of the year (during harvest) when this occurs.

Desertification – The transformation of arable or habitable land to desert, through changes in climate or destructive land use.

Economies of Scale – The cost advantages that a business obtains due to expansion. They are factors that cause a producer's average cost per unit to fall as scale is increased.

Externalities – The idea that the benefits or costs of activities spill over and affect third parties who pay the costs or reap the benefits.

Farm*A*Syst – A partnership established in 1991 between government agencies and businesses to prevent pollution on farms.

Fermentation Tanks – A tank in which fermentations are carried out.

Greenhouse Gases (GHG) – Gases in the atmosphere that absorb and emit radiation within the thermal infrared range.

Greenwashing – The practice of companies disingenuously marketing their products and policies as environmentally friendly.

Gross Margin – A company's total sales revenue minus its cost of goods sold.

Heme Oxygenase – An enzyme that catalyzes the degradation of heme, producing biliverdin, iron, and carbon monoxide.

Ischemic Attack – A change in the blood supply to a particular area of the brain, resulting in brief neurologic dysfunction persisting less than 24 hours.

Ischemic Stroke – A change in the blood supply to a particular area of the brain, resulting in brief neurologic dysfunction persisting longer than 24 hours.

ISO 14064 – A standard that provides governments, businesses, regions and other organizations with an integrated set of tools for programs aimed at measuring, quantifying, and reducing greenhouse gas emissions.

Leachfields – Porous soil area, through which septic tank leach lines run, emptying the treated waste.

Mineral Cycle – The cycle of moving key elements such as nitrogen, phosphorous and potassium through the soil

Resveratrol – A natural anti-fungal produced by grape vines. It is also a natural anti-inflammatory found in red wine.

Riparian Buffers – A vegetated area near a stream, usually forested, which helps shade and partially protect a stream from the impact of adjacent land uses.

Scope 1 Emissions – Emissions from onsite operations or from sources that the company owns or controls.

Scope 2 Emissions – Emissions that are generated from the use of electricity or other energy sources.

Scope 3 Emissions – All indirect emissions, especially those emissions associated with supply chains.

Sequencing Batch Reactors – Industrial processing tanks for the treatment of wastewater in which oxygen is bubbled through the waste water to reduce biochemical oxygen demand (BOD) and chemical oxygen demand (COD) to make suitable for discharge into sewers or for use on land.

Shading Coefficient – This is the ratio of solar heat gain admitted through glass. It can also refer to how glass is thermally insulating the interior of a building when there is direct sunlight on a window.

Stakeholders – A person or organization that has a legitimate interest in a project or entity.

Sustainability – Meeting the needs of the present without compromising the ability of future generations to meet their needs.

Terroir – A group of vineyards (or vines) from the same region that share the same type of soil, weather conditions, geography, and grapes which contribute to give its specific personality to the wine.

Total Suspended Solids (TSS) – A water quality measurement.

Triple Bottom Line – The idea that businesses should operate so that social, environmental, and economic bottom lines are interdependent.

Vineyard – A plantation of grape-bearing vines, grown mainly for winemaking.

Winery – A business involved in the production of wine.

Web 2.0 – The second generation of the World Wide Web, especially the movement away from static webpages to dynamic and shareable content and social networking.



References

- Better Wines Better World (2010). Better World. Retrieved February 18, 2010, from <http://www.betterwinesbetterworld.com/>
- Business Wire (2009). Kendall-Jackson Winery Taps GE for Energy Efficiency. Retrieved on March 20, 2010, from http://www.businesswire.com/portal/site/home/email/headlines/?ndmViewId=news_view&newsLang=en&div=-564504432&newsId=20090710005051
- California Sustainable Winegrowing Alliance (2009). Sustainability Report 2009. Retrieved February 22, 2010 from <http://www.sustainablewinegrowing.org/2009sustainabilityreport.php>
- Carlton, J (2002). Wall Street Journal. *Conservationists Try to Stem California's Vineyard Sprawl: State's Wine Industry, Criticized For Wasting Resources, Establishes Guidelines to Protect Environment*. New York, N.Y: Oct 23, 2002, pg B.1.
- Chauncey, J (2007). AllBusiness.com. Sustainable Winery Architecture: Nine Ways to Save Money and the Planet. Retrieved February 22, 2010, from <http://www.allbusiness.com/wholesale-trade/merchant-wholesalers-nondurable-goods/3904843-1.html>
- Clark, A (2009). Green Wineries Embrace Innovation from the Fields to the Bottle. Retrieved March 12, 2010, from <http://www.greenbiz.com/blog/2009/07/27/green-wineries-embrace-innovation-fields-bottle>
- Croser, B (2005). The Idea of Quality: Creating Sustainable Competitive Advantage. Retrieved April 2, 2010, from http://www.finewinepress.com/modules.php?op=modload&name=PagEd&file=index&topic_id=32&page_id=161
- Dolan, P (2003). True To Our Roots: Fermenting a Business Revolution. Princeton: Bloomberg Press.
- Fetzer Vineyards (2010). Greening Business. Retrieved March 17, 2010, from http://www.fetzer.com/greening_business.aspx
- Firstenfeld, J (2003). It's your Wastewater: Treat it Right. Retrieved March 19, 2010, from http://findarticles.com/p/articles/mi_m3488/is_3_84/ai_99197152/?tag=content;coll
- Firstendfeld, J (2007). Wines and Vines. Why Solar Makes Sense: boutique wineries take advantage of incentives. Retrieved March 28, 2010, from <http://www.allbusiness.com/energy-utilities/renewable-energy-solar/5525244-1.html>
- Frog's Leap (2010). Dry Farming. Retrieved March 17, 2010, from http://www.frogleap.com/html/beinggreen_dryfarming.html
- Frog's Leap (2010). Geothermal Energy. Retrieved March 17, 2010, from http://www.frogleap.com/html/beinggreen_geothermal.html

- Frog's Leap (2010). LEED Certification. Retrieved March 17, 2010, from http://www.frogsleap.com/html/beinggreen_LEED.html
- Frog's Leap (2010). Organics 101. Retrieved March 17, 2010, from <http://www.frogsleap.com/html/organics101.html>
- Frog's Leap (2010). Photovoltaic Energy. Retrieved March 17, 2010, from <http://www.frogsleap.com/html/beinggreen.html>
- Full Glass Research (2009). Consumer Perspectives on Organic/Sustainable: An Update. Retrieved on March 17, 2010, from <http://www.greenwinesummit.com/presentations.html>
- Garn, J (2005). Benefits of Energy Auditing for your Winery. Retrieved March 20, 2010, from <http://www.practicalwinery.com/mayjune05/mayjune05p6.htm>
- Greenbiz.com (2008). Wineries Embrace Green Business Practices but Hesitate Telling Customers. Retrieved March 4, 2010, from <http://www.greenbiz.com/news/2008/09/28/wineries-embrace-green-business-practices-hesitate-telling-customers>
- Gumino, J (2008). Fauquier Times-Democrat: Crying the Blues Leads to Nurturing the Green. Retrieved March 2, 2010, from <http://www.fauquier.com/news/2008/jul/01/crying-blues-leads-nurturing-green/>
- Hewitt, J (2006). Top 3 Reasons Why You Should Drink Organic Wine. Retrieved April 20, 2010, from http://www.associatedcontent.com/article/78181/top_3_reasons_why_you_should_drink.html?cat=22
- Heyns, J (2009). The Piedmont Virginian: *Green Building: Forget the Real Estate Blues*. Retrieved February 20, 2010, from http://www.piedmontvirginian.com/articles/1/green_building_forget_the_real_estate_blues-22.html
- Levin, R. Is Organic Wine Better for You? Eco-Message in a bottle. Retrieved April 19, 2010, from http://www.novusvinum.com/features/organicwine_health.html
- Lodi Winegrape Commission (2002). Sustainable Viticulture. Retrieved February 22, 2010, from <http://www.lodiwine.com/sustainableviticulture1.shtml>
- Mitchell, D (2010). Red Wine, Resveratrol May Build Brain Resistance to Stroke. Retrieved April 28, 2010, from <http://www.emaxhealth.com/1275/red-wine-resveratrol-may-build-brain-resistance-stroke.html>
- Monte Vibiano (2010). A 360 Green Revolution. Retrieved March 6, 2010, from <http://www.360green.it/>
- Moore, L. Improve Wastewater Treatment at Hess Collection Winery. Retrieved April 1, 2010, from http://www.airoflo.com/reports/hess_paper.pdf
- Oak Barrel Winecraft (2006). Winemaking. Retrieved April 10, 2010, from http://www.oakbarrel.com/winemaking/french_oak.shtml

- Ohmart, C. Vineyard View: Rough Start of National Standards. Retrieved March 16, 2010, from http://www.lodiwine.com/A_National_Sustainable_Agriculture_Standard.pdf
- Ohmart, C. Vineyard View: Marketing Sustainability: Can wine be green without greenwashing? Retrieved March 16, 2010, from http://www.lodiwine.com/Marketing_Sustainability.pdf
- OrganicAuthority.com (2010). Organic Vines for Better Wines. Retrieved April 20, 2010, from <http://www.organicauthority.com/organic-food/organic-food-articles/organic-vines-for-better-wines.html>
- Overstreet, D (2007). VideoJug: Soil and Wine. Accessed April, 20, 2010, from <http://www.videojug.com/interview/soil-and-wine-2>
- Penn, C (2007). Independent Consumer Research on Closures. Retrieved April 22, 2010, from <http://www.winebusiness.com/wbm/?go=getArticle&dataId=47416>
- Rice, J (2009). Creating Competitive Advantage Through Sustainability. Retrieved April 19, 2010, from <http://www.fruitfulstrategy.com/blog/2009/07/creating-competitive-advantage-through-sustainability/>
- Rodriguez, M, Ricart, J, & Sanchez P. University of Navarra (2002). *Sustainable Development and Sustainability of Competitive Advantage: A Dynamic and Sustainable View of the Firm*. Retrieved April 14, 2010, from <http://www.iese.edu/research/pdfs/DI-0462-E.pdf>
- Slinkard, S. Bugs, Birds, Bats and Beyond: Sustainable Farming at Shafer Vineyards and other California Wineries. Retrieved March 3, 2010, from <http://wine.about.com/od/wineries/a/shaferag.htm>
- Steeman, A (2010). Wine Bottle Closures: Natural Cork versus Alu Screw Cap. Retrieved on April 18, 2010, from <http://bestinpackaging.wordpress.com/2010/05/05/wine-bottle-closures-natural-cork-versus-alu-screw-cap-part-2/>
- Vaynerchuk, G (Producer), (2009). *Wine Library TV: Episode #784 Wine with Dr. Perricone* (Video Blog). Retrieved on April 20, 2010, from <http://tv.winelibrary.com/2009/12/11/wine-with-dr-perriocone-episode-784/>
- Vaynerchuk, G (Producer), (2010). *Wine Library TV: Episode #850-51 Brian Loring of Loring Wine Company* (Video Blog). Retrieved April 18, 2010, from <http://tv.winelibrary.com/2010/04/22/brian-loring-of-loring-wine-company-part-1-episode-850/>
- Warren, S (2010). The Great Cork Debate: Natural vs. Synthetic vs. Screw Cap. Retrieved April 21, 2010, from <http://blog.vintagecellars.com/2010/01/the-great-cork-debate-natural-vs-synthetic-vs-screw-cap/>
- Wheeland, M (2009). Red Wine and Green IT: A Perfect Pairing. Retrieved April 2, 2010, from <http://www.greenercomputing.com/blog/2009/07/22/red-wine-and-green-it-perfect-pairing>

Wine With Dinner (2008). Barrel Oak Winery: “Green” Wine is Good Business. Retrieved March 2, 2010, from <http://winewithdinner.wordpress.com/2008/05/06/barrel-oak-winery-green-wine-is-good-business/>

World Wildlife Fund (2006). *Cork Screwed? Environmental and Economic Impacts of the Cork Stoppers Market*. Retrieved April 15, 2010, from <http://www.wwf.org.uk/filelibrary/pdf/corkscrewed.pdf>

Zucker, J. Water Conservation and Sustainability: An Interview with Jeff Zucker. Accessed March 13, 2010, from http://www.jlohr.com/water_conservation.html