

LEED CERTIFICATION PROPOSAL FOR NEW CONSTRUCTION

HUDSON WINERY

AMADOR COUNTY, CALIFORNIA

A Thesis

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Amy Chesarek

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College of Business Administration

Abstract
of
LEED CERTIFICATION PROPOSAL FOR NEW CONSTRUCTION
HUDSON WINERY AMADOR COUNTY, CALIFORNIA

by
Amy Chesarek

The State of California recently experienced one of its driest years in 2013 since it became a state in 1850. This not only influences modern day construction practices, but some counties enforce mandatory conservatory practices. Amador County, California is an agricultural community 40 miles east of Sacramento that is experiencing significant growth in wine and viticulture. The Hudson Winery is opening its doors in Amador County and is setting the standard locally for a LEED Certified tasting room. The Winery spent months researching the best materials, construction methods, and operating practices through books, articles, and interviews with local businesses. The most utilized source was the Guide to LEED AP text which detailed the categories and how to achieve a LEED rating. The Hudson Winery was awarded the Silver LEED rating for its innovation in construction materials and sustainable operating practices. It is the first winery in Amador County to be awarded a LEED rating, but hopefully many more businesses will follow the same path to sustainability.

_____, Committee Chair
Professor Sudhir Thakur

Date

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Chapter 1: Introduction

The state of California experienced one of the driest years in 2013 since it became a state in 1850 (Ross, 2014). This has caused a significant amount of pressure on farming industries and construction practices statewide.

Hudson Winery is looking to expand their passion for sustainability by building one of the first LEED certified wineries in Amador County, California. The purpose of this thesis is to illustrate the process for the Hudson Winery to become LEED certified. This paper will guide the Hudson Winery through each of the LEED Categories to help determine which credits the development can earn.

LEED is the commonly used acronym that means Leadership in Energy and Environmental Design. It is a certification program for buildings that concentrate in LEED's five main areas: energy efficiency, indoor environmental quality, materials selection, sustainable site development, and water savings. The U.S. Green Building Council primarily runs the program, but they work closely with other certification bodies to supplement information for regional credits or to provide additional expertise. In order to achieve LEED Certification, the project team needed to research the project requirements, fiscal implications, and the certification process. Each LEED category for credits focuses on the different aspects of the design, construction, and operations of the project. Therefore, the project team determined the best location for the winery, how the winery should be constructed/oriented on the land, materials that should be used, operating procedures, and how to address regionally sensitive issues.

Supply of water has become a critical issue for farming and viticulture and now sustainable practices are being required in construction. Hudson Winery has taken measures in making sure the grapes they grow or purchase are farmed sustainably and they would like to continue that practice through the construction of their tasting room.

The Hudson Winery project team performed extensive research through texts, regional publications, and interviews with local businesses to help determine how the project could meet the LEED requirements for certification. This thesis will outline every category in which credits can be earned for LEED certification.

Chapter 2: Sustainable Sites

The Sustainable Sites Category is the second largest category to earn points for a project seeking LEED Certification. A sustainable site refers to the project's location, design, construction, and maintenance of the site while considering the effects on the environment, community, and economics. The selected location of a site is extremely important because it needs to take into account the characteristics of the existing land, transportation effects on the community and environment, and the effects of the proposed project.

Table 2.1: Summary of Prerequisites and Credits for Sustainable Sites

Credit	Description	Points Possible	Projected Points Earned
Prerequisite 1	Construction Activity Pollution Prevention	Required	Required
Credit 1	Site Selection	1	1
Credit 2	Development Density and Community Connectivity	5	0
Credit 3	Brownfield Redevelopment	1	0
Credit 4.1	Alternative Transportation, Public Transportation Area	6	0
Credit 4.2	Alternative Transportation, Bicycle Storage and Changing Rooms	1	0
Credit 4.3	Alternative Transportation, Low Emitting and Fuel Efficient Vehicles	3	3
Credit 4.4	Alternative Transportation, Parking Capacity	2	0
Credit 5.1	Site Development, Protection of Restored Habitat	1	1
Credit 5.2	Site Development, Maximize Open Space	1	1
Credit 6.1	Stormwater Design, Quantity Control	1	1
Credit 6.2	Stormwater Design, Quality Control	1	1
Credit 7.1	Heat Island Effect, Non-Roof	1	1
Credit 7.2	Heat Island Effect, Roof	1	1
Credit 8	Light Pollution Reduction	1	1
Total Points Possible		26	11

Location and Transportation

Amador County is located in Central California about 60 miles southeast of the City of Sacramento. Wineries in Amador County are spread out, but tend to become more frequent along

highways. The Hudson Winery would follow the same pattern and be developed along Highway 16, which connects Highway 49 and the City of Plymouth. Grouping the wineries together allows for shorter drive times between stops, and in some instances, allows the visitors to walk. There are scheduled wine tours offered through private companies who frequent the wineries along the highways. This makes the location ideal not only for sustainability purposes but also for business profitability.

Site Selection

In order for Hudson Winery to be LEED compliant, it is encouraged that site selection for green buildings be developed next to existing buildings in order to avoid sprawl. This is especially important in Amador County because the majority of the land is undeveloped and used for grazing or agriculture. The second part to selecting a site from an environmental perspective is to find the precise location that has no primary habitats for plants and animals that would threaten their well-being if built upon. If there are any natural habitats that would be affected, they should be accommodated somewhere on site so they are not completely disrupted.

In order to earn points for the SS Credit 1: Site Selection, the following land types must be avoided:

- Prime Farmland
- Floodplains/Flood Prone Areas
- Habitats for Species on the Endangered or Critical Species Lists
- Land Within 100 feet of Wetlands
- Previously Undeveloped Land within 50 feet of a Body of Water – this is in accordance to the Clean Water Act
- Public Parkland

Prime farmland as defined by the U.S. Department of Agriculture is land having the soil quality, growing season, and moisture supply to sustainably produce high yields of crops. See Appendix A displaying the important farmland in Amador County as of 2010. There is prime farmland in the Shenandoah Valley where the majority of the grapes are grown for the Amador County wineries. Hudson Winery would utilize the prime farmland for growing grapes, but the tasting room will avoid the prime farmland, unique farmland, and farm land with either statewide or local importance. There are no known floodplains or wetlands in the Shenandoah Valley. In order to identify if there are any critical or endangered species near the site, an environmental scientist would need to come survey the area. By following these guidelines, the winery would qualify for the SS Credit 1.

Unfortunately, because the location of Hudson Winery is along the agricultural low-density land, the project will not earn any points for the SS Credit 2: Development Density and Community Connectivity which requires that the site is developed within an area of at least 60,000 square feet per net acre or within a half mile of a residential land use with at least 10 units per acre. The project will also not be eligible for the SS Credit 3: Brownfield Redevelopment because there are no known brownfields in the City of Plymouth.

Transportation

The transportation credits are difficult for the Hudson Winery to earn since it is located outside of the developed downtown and residential neighborhoods. The first credit that the project can earn is the SS Credit 4.3: Low-Emitting and Fuel-Efficient Vehicles. This credit is worth 3 points if at least 5% of the parking lot is reserved for fuel-efficient vehicles. SS Credit 4.4: Parking Capacity is worth two points and can be earned by supplying 25% less parking spaces than estimated by the Institute of Transportation Engineers "Parking Generation" guide. Due to the lack of alternative transportation, Hudson Winery will not be able to limit their parking to

visitors because it would negatively impact the business, but 5% of the parking will only be available to low-emitting or fuel-efficient cars.

The LEED program encourages project teams to not only think about the final product and operations of the building, but also the planning and construction in the beginning stages of the project. The prerequisite for this category addresses LEED's guidelines that construction techniques should be closely monitored in order to avoid disturbing the existing environment through sedimentation or eutrophication. Sedimentation occurs when the erosion from the land gets into the waterways and pollutes the streams and the larger bodies of water. Eutrophication occurs when excess nutrients such as nitrogen and phosphorus leave the construction site and are dispersed through the waterways. These nutrients promote the growth of weeds and algae blooms which can be harmful to the native plants and animals. To meet the SS Prerequisite 1: Construction Activity Pollution Prevention, the project team must include a civil engineer that will produce an erosion and sedimentation control plan for the contractor to follow throughout the construction phases.

Since the project's site is undeveloped, the building will need to be designed using setbacks in order to limit disturbing the surrounding, existing environment. Therefore, in order to earn points for the SS Credit 5.1: Site Development, Protect or Restore Habitat, the setbacks for the design should be as follows:

- 40 feet from the perimeter
- 10 feet from hardscape
- 15 feet from roads
- 25 feet from pervious surfaces

In addition to adhering to the suggested setbacks, the project should also preserve as much of the existing native plants as possible. To be considered native, a plant needs to be a

species that is naturally occurring and was not planted previously or considered an invasive species. The only other plants that LEED approves are adaptive plants, which refer to species that can adapt to their new environment with little human interaction. This is an important characteristic because it means that the plants will not need as much water to thrive and maintenance costs will be lower.

The City of Plymouth or Amador County do not have any open space requirements in their zoning law, so in order to earn points for the SS Credit 5.2: Site Development, Maximize Open Space, 20% of the site will need to remain as open space. Since the design of the Winery is meant to blend in with the existing environment, the tasting room and parking lot will be the only space on the site that is developed. This will also make the project eligible for an Exemplary Performance point for this category which only requires that at least 40% of the site's total space is left as open space.

The next two credits discuss the design of the building and site creating a "heat island effect" in the area. This is more important for denser, developed areas but the techniques can still be utilized in Amador County's wine country, because temperatures can be very high for several months of the year. SS Credit 7.1: Heat Island Effect, Non-roof requires that at least 50% of the hardscapes for the site be shaded, have a solar reflective index greater than 29; otherwise open grid pavers should be used. Hudson Winery will use open grid pavers for the parking lots because they allow storm water to sink back into the water table, they enable vegetation, and reduce the effects of erosion. The second part to the heat island effect is SS Credit 7.2: Heat Island Effect: Roof, which prescribes what type of roof materials are the best for resisting heat. There are three options in order to earn points for this credit. The first is to cover 75% of the roof with a material that has at a solar reflective index of at least 78, not including the space covered by solar panels. The second option would be to cover the roof with at least 50% vegetation. The third option

would be a combination of the first two options. Since the roof for Hudson Winery is going to be significantly covered with solar panels, to cover 75% of the exposed roofing material would not be significant enough to make a difference. Planting vegetation around the panels would also not be viable because it would create too many issues for the maintenance and operation of the panels. Therefore, the best way to earn this credit would be to use a high solar reflective index for the entire roof surface. Cool metal roofing was selected because it is efficient in reducing the heat island effect as well as cost effective. Depending on the model metal roofing selected, the SRI ratings range from 30-70 and will qualify the winery for this credit.

The last two credits for the Site Selection category focus on the stormwater management of the site. The LEED Certification criteria emphasize the importance of preserving the natural ecological systems through stormwater management because it promotes biodiversity so that unique ecosystems can continue to thrive post development. There are two ways to earn points for SS Credit 6.1: Stormwater Design, Quantity Control. The options can be determined by hiring a civil engineer to conduct a study to determine the existing imperviousness of the site. The first option is if the site has less than 50% of impervious ground, then the site design cannot add more impervious surfaces and decrease the overall percentage. The second option is if the site has over 50% impervious surfaces, then the site design would need to decrease the overall area of impervious surfaces by at least 25%. The site's location is undeveloped so the Hudson Winery project team will pursue the first option of making sure that the site never has more than 50% of impervious surfaces. This should not be a difficult task since most of the impervious surfaces in development come from parking lots and sidewalks. As mentioned above, Hudson Winery will use open grid pavers in order to let runoff through to the water table. The roof will still create a significant amount of run off during the rainy season, so a bioswale will be placed underneath the edge of the roof which will lead to open space at the perimeter of the property. In order to earn

points for the SS Credit 6.2 Stormwater Design, Quality Control, the project team will need to prove that at least 90% of rainfall is captured and filtered by the installed stormwater management systems which include the open grid paver parking lot and vegetated bioswale.

Chapter 3: Materials and Resources

Construction practices and materials used is one of the most significant causes of greenhouse gas emissions in our country. San Mateo published a Sustainability Guide and claimed that the United States consumes 25% of all the wood that is harvested, 40% of raw stone, gravel and sand. In addition to generating greenhouse gases and using natural resources, the country also generates an extreme amount of waste. The Environmental Protection Agency (EPA) published their findings in 1996 that 76 million tons of debris was generated as a result of commercial construction (EPA, 2016). The LEED program encourages builders to develop buildings in a more environmentally conscious manner in what materials they choose, how much waste is generated, and how many GHGs will be emitted during construction.

Table 3.1 Summary of Prerequisites and Credits for Materials and Resources

Credit	Description	Points Possible	Projected Points Earned
Prerequisite 1	Storage and Collection of Recyclables	Required	Required
Credit 1.1	Building Reuse, Maintain Existing Walls, Floors, and Roof	1 – 3	0
Credit 1.2	Building Reuse, Maintain 50% of Interior Non-Structural Elements	1	0
Credit 2	Construction Waste Management	1 - 2	2
Credit 3	Materials Reuse	1 - 2	2
Credit 4	Recycled Content	1 - 2	1
Credit 5	Regional Materials	1 - 2	2
Credit 6	Rapidly Renewable Materials	1	0
Credit 7	Certified Wood	1	1
Total Points Possible		14	8

Material Selection

If the location where the building is to be developed has an existing structure, the best practice would be to preserve anything salvageable and reuse it in the project. The site where Hudson Winey is to be developed is empty, but there was recently the demolition of the

Downtown Plaza building where the concrete and steel could be reused. Reusing the steel and concrete from the demolition would reduce the use of raw materials and the manufacturing resources that it would take to make them usable. Recycled barn wood and crate wood will be used as decorative pieces on the inside of the tasting room. Several barns in Placer County and Amador County have aged and been unused that can be collected and restored. This will also add a special local element to the tasting room which will hopefully become an attraction to the winery. The boards will be marked with their origins as well as to help display the appreciation for the local environment and community. The adaptive reuse of the concrete and steel from the Downtown Plaza demolition and the wood from the barns would qualify the project for the MR Credit 3: Materials Reuse. Hudson Winery did not qualify for the first two credits, because they required the building materials to be found on-site from an existing development.

The second part of selecting building materials is to select sustainable ones. This can be done by performing a life-cycle assessment which will evaluate how long the material will last, also known as the “cradle to grave” cycle.

The Life-Cycle Assessment includes:

- How were the materials harvested?
- Where were the materials were harvested ?
- Process in which the raw materials were manufactured
- Where were the materials were manufactured?
- Impact on construction workers and building occupants
- Expectancy term of use during operations
- Disposal options

LEED also supplies a list of materials that are acceptable and will qualify the project for credits.

MR Credit 4: Recycled Materials is a credit granted for using at recycled materials in the construction materials that account for at least 10% of the materials cost. If the total cost is 20% then the project can earn two credits and 30% of costs will earn three credits. Some examples of materials with recycled content include concrete, carpet, tile, rubber flooring, metal, etc. There are also two types of waste that count as a recycled material: preconsumer waste and postconsumer waste. Preconsumer waste is material that is generated from the processing of a material that can be reused in another manufacturing process. This can include sawdust, walnut shells, sunflower seed hulls, shavings, and trimmings. Postconsumer wastes are manufactured products which have already been used for their intended purpose. This can include any products that have already been used such as paper, plastics, glass, or cardboard.

The floors of Hudson winery alone will qualify the project for one credit in the MR Credit 4 category. The floor will be made of 100% recycled materials and will be a blend of broken glass (old wine bottles) and concrete. Since the glass is from old wine bottles, the colors of the glass fragments will mostly shades of green with some translucent.

MR Credit 5: Regional Materials refers to the purchasing of materials from local vendors. In order to be considered a regional material according to LEED standards, the product must be extracted, processed, and manufactured within 500 miles of the project site. If 10% of the total materials cost is purchased regionally it will earn the project one credit, 20% will earn 2 credits, and 30% would be considered “Exemplary Performance” and would earn 3 points. The two locally sourced companies that Hudson Winery will buy products from are H.C. Muddox of Sacramento who manufactures their own brick and Gladding McBean of Lincoln who makes ground pavers.

MR Credit 7: Certified Wood means that the wood purchased for the project is certified by the Forest Stewardship Council (FSC). In order to qualify for this credit, at least 50% of new

wood purchased as a part of the permanent structure must be certified by the FSC. FSC only certifies wood that is purchased from companies who are compliant with responsible forest management policies, the preservation of materials for the future, and help to maintain biodiversity. To prove that wood purchased is certified by FSC, the Chain of Custody Certificate must be provided to LEED.

Waste Management

As mentioned at the beginning of this Chapter, waste from construction and building operations is a major contributor to total waste generated in landfills. LEED buildings should be exemplary in their techniques and policies for minimizing waste and environmental impacts throughout their construction phases as well as the operation of the building after construction is complete. There are two ways to deal with waste produced. The first is to sort the waste on site to make sure that recyclable items are extracted and recycled in the correct bins. The second is to have the waste sorted offsite. LEED certification requires that at least one of these options are selected in order to be compliant with LEED's goals of reducing green house gases created from landfills.

MR Prerequisite 1: Storage and Collection of Recyclables means that project teams are required to offer recycling programs as a part of the buildings daily operations. LEED requires, at a minimum, that there are recycling containers for the following materials: paper, corrugated cardboard, glass, plastics, and metals. Hudson Winery by nature will generate a significant amount of glass (wine bottles) and cardboard (wine boxes) but all of it will have clearly marked bins for recycling. Most of this will be able to be controlled by winery workers to ensure the maximum amount of product is recycled. Hudson Winery will have a recyclable wine carrier program. If visitors bring any reusable bag for the wine they buy, they will receive 5% off their

entire purchase. This should encourage visitors to help the winery reduce waste and the amount of products needing to be recycled on site.

MR Credit 2: Construction Waste Management requires that the project team create a Construction Waste Management Plan to be implemented by the contractor during the construction phase. The plan should aim to keep nonhazardous materials out of landfills or incineration facilities in order to reduce GHG emissions. The first credit is earned by diverting 50% of waste and a second credit can be earned by diverting 75% of waste. Hudson Winery's project team will create the Waste Management Plan to meet the criteria listed above.

Chapter 4: Energy and Atmosphere

The Energy and Atmosphere category for LEED Certification discusses the production and consumption of energy for the operations of the building. The Energy and Atmosphere category is the most emphasized in the LEED Accreditation because of the effect that the production of electricity has on the environment. The category is split into four areas of emphasis: energy efficiency, tracking energy consumption, managing refrigerants, and renewable energy.

LEED suggests that project managers use energy modeling and simulation software to determine synergistic opportunities for their building. They suggest using computer software because it is very difficult to determine how all of the components of a building will work simultaneously and not just individually. The software also makes it easier to determine life-cycle cost assessments of the building, which determine upfront costs versus long term savings.

Table 4.1 Summary of Prerequisites and Credits for Energy and Atmosphere

Credit	Description	Points Possible	Projected Points Earned
Prerequisite 1	Fundamental Commissioning of Building Energy Systems	Required	Required
Prerequisite 2	Minimum Energy Performance	Required	Required
Prerequisite 3	Fundamental Refrigerant Management	Required	Required
Credit 1	Optimize Energy Performance	1 – 19	4
Credit 2	On-Site Renewable Energy	1 - 7	7
Credit 3	Enhanced Commissioning	2	2
Credit 4	Enhanced Refrigerant Management	2	2
Credit 5	Measurement and Verification	3	3
Credit 6	Green Power	2	0
Total Points Possible		35	18

There are three prerequisites in the Energy and Atmosphere Category. The first is the Fundamental Commissioning of Building Energy Systems. This means that the building needs to be commissioned by a commissioning agent, who would preferably be a member of the design team. The commissioning agent would coordinate communications between the design team and

the contractor. The commissioning agent cannot be the engineer for the project and must have experience commissioning at least two other projects. The agent would be responsible in making sure that all equipment is installed, calibrated, and operating correctly. Then at the end of the construction phase, the agent would put together a report that summarizes the design, planning, and implementation throughout the construction process. If this prerequisite is met, then the project can be eligible for EA Credit 3: Enhanced Commissioning. This credit will be awarded to a project if the commissioning agent takes on the additional tasks of reviewing the plans for design flaws, ensuring that energy use reduction strategies are included, and that the design and strategies are consistent with OPR and BOD requirements. The agent also needs to review the construction submittals for commissioning. The final item the agent is responsible for before the building becomes occupied is writing Operations and Maintenance Manuals to help inform the facility team members. The final requirement for the credit states that the commissioning agent must return to the building 10 months after it has been occupied to ensure that all of the systems and maintenance are running in accordance with the manuals. If any errors or inconsistencies are found, they are responsible to coordinate the solution.

The second prerequisite is a Minimum Energy Performance which represents the LEED Certification's policy that a project must perform to a minimum energy standard. Hudson Winery would meet this prerequisite with the performance based approach through an energy simulation software, as mentioned above. To earn points for EA Credit 1: Optimize Energy Performance, the energy simulation software would need to show that the project will be at least 12% better than the baseline performance rating according to the ASHRAE 90.1-2004 standards. With every 2% savings in energy cost, an extra point would be earned for a maximum of 10 points or 42% over baseline. This must include all of the energy costs of the project, meaning both process and regulated energy. Process energy refers to office equipment, dishwashers, refrigerators, laundry

equipment, etc. Regulated energy refers to internal lighting, HVAC systems, and service water heaters.

The third prerequisite is the Fundamental Refrigerant Management. In order to meet this prerequisite, the project cannot use chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs) because they have the greatest negative impact on the ozone's depletion. A project team can refer to the Montreal Protocol bans if they need more information on harmful refrigerants and the phase out of these substances. The Montreal Protocol was passed in 1987 with the goal of phasing out production of substances that lead to the depletion of the ozone layer. Since the treaty has passed, the hole in the ozone above Antarctica has slowly been recovering. Climate projections say that the ozone hole should return to its 1980 level between 2050-2070. Negative impacts to the earth's atmosphere are very difficult to recover and take tens to hundreds of years to remedy, which is why these credits hold a strong emphasis in the LEED certification process. In order to earn the EA Credit 4: Enhanced Refrigerant, the project cannot use any halons and HCFCs for fire suppression. Halons have a very high ozone-depletion potential so they have been banned since 1994. Refrigeration is a very important requirement for a winery because the wine has to keep a consistent, cool climate in order to protect the integrity and aging of the wine. In determining what refrigerants to use for Hudson Winery so as to meet the EA Prerequisite 3 and earn the EA Credit 4, I referenced the list released by the EPA for suggested alternatives to CHCs (see Appendix B). The R-047C is a viable alternative for CFCs.

Renewable energy will be heavily utilized on-site through photovoltaic panels on the roof. Hudson Winery is aiming to offset no less than 80% of the electrical usage of the building. The roof of the building will be one plane, which allows for maximum roof space to be used for panel installation, tilted 18 degrees with a 180 degree azimuth. The 18 degree tilt and 180 degree azimuth were selected because that is the optimum position for the solar panels to produce

electricity. Based on the energy simulation model results, the project's kilowatt hour usage on a monthly basis would average to 3082 and cost roughly \$900 for electricity. In order to determine the system size and price, I used solar financing software created by Clean Power Finance, a company based in San Francisco, California. The software uses the average monthly electrical bill (in this case I used the \$900 estimate), roof size, historical utility price increases, equipment, and labor costs. The suggested system size is a 19 kilowatt system that would offset roughly 85% of the usage. The leased system would cost approximately \$346 a month and the leftover utility costs would be \$113, totaling \$459 in electricity costs. Leasing the system would save roughly 49% in energy costs qualifying the project to earn the maximum number of seven points for the EA Credit 2: On-Site Renewable Energy. The next credit EA Credit 6: Green Power would not be possible to earn in the first few years of the completion of the project since 85% of the energy usage is estimated to be offset onsite by the photovoltaic system. If electricity usage increases in time, then the additional electricity will be purchased from a Green-E Certified provider.

The final credit available for New Construction in the Energy and Atmosphere category is EA Credit 5: Measurement and Verification. To earn points for this credit, the project team will need to create a measure and verification plan that is consistent with the International Performance Measure & Verification Protocol Volume III. This document narrates several methods to earning points for this credit. This project will use Option B which mostly compares post construction energy usage versus projected baseline energy usage. Since a significant amount of the electricity will be generated on-site, the project needs to have a monitoring meter in order to accurately track the system's production to make sure that it is fully operational. The data from the monitoring meter needs to be summarized in a report that includes hours of operation, kilowatt hour production, and imposed equipment loads. The first year of building operational procedures should be included in the plans, as well as solutions in case

operations/equipment does not work as they are intended. For the first year of operation, the Tasting Room Manager will carry out this responsibility under the advisement of the Project Manager.

Chapter 5: Indoor Environmental Quality

The previous chapters have discussed protecting and preserving the quality of the outdoor environment, but promoting high indoor environmental quality is important in the LEED Certification process as well. The Environmental Protection Agency released a study that said Americans spend about 90% of their time indoors (EPA, 2016). Therefore, if you can establish a beneficial indoor environment, then the end user will have a better experience from it. Indoor air quality also promotes a safe environment for people to live, work, and visit. Buildings that have toxins in the air from building materials or poor ventilation can be harmful for the visitors and the environment. There are several different ways to address the quality of the indoor environment, but in order to earn LEED credits this chapter will focus on indoor air quality, thermal comfort, lighting, and acoustics.

Table 5.1 Summary of Prerequisites and Credits for the Indoor Environmental Quality

Credit	Description	Points Possible	Projected Points Earned
Prerequisite 1	Minimum Indoor Air Quality Performance	Required	Required
Prerequisite 2	Environmental Tobacco Smoke Control	Required	Required
Credit 1	Outdoor Air Delivery Monitoring	1	1
Credit 2	Increased Ventilation	1	1
Credit 3.1	Construction IAQ Management Plan – During Construction	1	1
Credit 3.2	Construction IAQ Management Plan – Before Occupancy	1	1
Credit 4.1	Low-Emitting Materials, Adhesive and Sealants	1	1
Credit 4.2	Low-Emitting Materials, Paints and Coatings	1	1
Credit 4.3	Low-Emitting Materials, Flooring Systems	1	1
Credit 4.4	Low-Emitting Materials, Composite Wood & Agrifiber Products	1	1
Credit 5	Indoor Chemical & Pollutant Source Control	1	1
Credit 6.1	Controllability of Systems, Lighting	1	1
Credit 6.2	Controllability of Systems, Thermal Control	1	1
Credit 7.1	Thermal Comfort, Design	1	1

Credit 7.2	Thermal Comfort, Verification	1	1
Credit 8.1	Daylight & Views, Daylight	1	1
Credit 8.2	Daylight & Views, Views	1	1
Total		15	15

The first part of the Indoor Air Quality category is the EQ Prerequisite 1: Minimum Indoor Air Quality Performance, which requires that the project meet the minimum air quality performance as prescribed by ASHRAE 62.1-2007. Some things that ASHRAE 62.1-2007 addresses include that occupied areas need to be within 25' of operable windows and that windows must have an operable opening of at least 4% of the floor area. This means that if the occupied area of the Hudson Winery is 2500 square feet, then there needs to be at least 100 square feet of operable window space that allows natural ventilation. Hudson Winery will have two horizontal windows on the east and north sides of the building that will allow ventilation through the building in order to maintain air quality and to regulate the climate. Therefore, Hudson Winery will meet the standards listed by ASHRAE 62.1-2007 while also meeting the EQ Prerequisite 1.

After meeting Prerequisite 1, the project is eligible to earn points for EQ Credit 1: Outdoor Air Delivery Monitoring and EQ Credit 2: Increased Ventilation. In order to meet the criteria for EQ Credit 1, LEED asks that a mechanical engineer create a system that includes monitoring for carbon dioxide. Visitors and occupants will have a better indoor air quality experience if CO₂ is maintained at the suggested level. If levels vary out of the 10% tolerance, then an alarm should sound, notifying the occupants. The easiest way to balance the levels of carbon dioxide inside the building is to open the windows and doors for natural ventilation. EQ Credit 2 builds off the Prerequisite and states that if the project can increase natural ventilation by at least 30% over the required amount determined from the prerequisite. Once the tasting room has determined how to increase ventilation, the mechanical engineer will need to provide a diagram and calculations illustrating the chosen strategy for the project.

The next set of credits focus on the construction phases and practices for the project. There are guidelines written by different organizations detailing better construction practices or the workers, end-users, and the environment. The first example would be the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) who, for LEED's purposes, focus on eliminating contaminants from being used for mechanical systems inside of buildings. Some examples of contaminants include carbon dioxide, particulates, volatile organic compounds, or tobacco smoke. These types of contaminants can be found in anything such as paints, furniture, and carpets, so it is very important that the project team pays close attention and avoid any materials containing contaminants when selecting indoor fixtures. EQ Credit 3.1: Construction IAQ Management Plan – During Construction asks that the project team provide a plan showing how the project will meet the standards created by SMACNA focusing on heating, ventilation, HVAC system, housekeeping, and scheduling. The EQ Credit 3.2: Construction IAQ Management Plan- Before Occupancy sounds similar to the previous credit, but actually refers to air quality testing. Before the building is to be occupied and weather permitting, an air quality test can be conducted to see if contaminant levels meet the EPA Compendium of Methods for the Determination of Air Pollutants. Test results should be submitted with the LEED Application and a pass for the test will earn the point for this credit.

The next four credits for Indoor Air Quality focus on the materials selected for the project such as adhesives and sealants, paints and coatings, flooring systems, and composite wood and agrifiber products. The requirements for each credit are very specific and list the corresponding policy in which selected materials should be in compliance with. The table below lists the standards for each credit.

Table 5.2 Summary of EQ Credit 4 Standards and Requirements

EQ Credit 4.1: Low-Emitting Materials – Adhesives and Sealants	All adhesives, sealants, and sealant primers used on the project must be in compliance with SCAQMD Rule 1168. Any aerosol sprays that will be used during construction or post occupancy must meet Green Seal Standard for Commercial Adhesives, GS-36.
EQ Credit 4.2: Low-Emitting Materials – Paints and Coatings	All paints and coatings must be in compliance with Green Seal Standard, GS-11. Anticorrosive/antirust paints must be in compliance with Green Seal Standard, GS-3. Wood finishes, floor coatings, stains, primers, and shellacs used on the interior of the building must meet SCAQMD Rule 1113.
EQ Credit 4.3: Low-Emitting Materials – Flooring Systems	All Carpet must be in compliance with the Rug and Carpet Institute Green Label Plus Program. All wood flooring systems must be in compliance with the FloorScore Program and SCAQMD Rule 1113.
EQ Credit 4.4: Low-Emitting Materials – Composite Wood and Agrifiber Products	Any composite wood or agrifiber products used must not contain any urea-formaldehyde resins.

Source: Guide to the LEED AP BD+C, Michelle Cottrell

The second prerequisite for the Indoor Air Quality category is EQ Prerequisite 2: Environmental Tobacco Smoke Control. Since tobacco smoke is not conducive to wine tasting it will be very limited on-site. Smoking will not be allowed within 25 feet of any entrance to the building or 25 feet within the outdoor patio. In addition, if a guest is 25 feet away from either an entrance or the patio and is negatively affecting the experience of others, the smoker may be asked to restrain from smoking while on the property.

The next credit, EQ Credit 5: Indoor Chemical and Pollutant Source Control is similar to Prerequisite 2 and aims to reduce the amount of pollutants that make it into the building. The main entryway should have at least 10 feet of paved ground in order to help remove any contaminants from shoes that may be tracked inside. If contaminants do make it into the building, the mechanical engineer needs to make sure that the installed HVAC system has a MERV 13 filter or better. Lastly, if there are any hazardous materials on site, they need to be properly

contained and disposed of. The only hazardous material on-site for Hudson Winery will be the refrigerant for the wine cellar, but the management and disposal of these materials are addressed in Chapter 3.

The temperature of the inside of the building is extremely important for customer satisfaction when visiting the winery. If visitors are more focused on the temperature of the building being too warm or too cold, they will not be focusing on tasting the wine which would be harmful to business. Therefore, Hudson Winery will take extra caution in maintaining the thermal comfort of the tasting room in order to ensure customer satisfaction. Cottrell defines thermal comfort as “the temperature, humidity, and airflow ranges within which the majority of people are most comfortable, as determined by ASHRAE Standard 55-2004.” In order to earn the point for EQ Credit 6.2, at least 50% of the occupied space must have control of one over one of the characteristics of thermal control. Hudson Winery will have the temperature set to 70 degrees in the summer and 67 degrees in the winter, but if the temperature does not feel comfortable to the staff or visitors, then it can easily be changed through the digital thermostat. The next credit, EQ Credit 7.1: Thermal Comfort, Design relies on the mechanical engineer to make sure that the HVAC system is in compliance with ASHRAE 55-2004 which has detailed what range of conditions are deemed acceptable to occupants of a building.

Lighting also plays a critical role in the quality of the indoor environment. Day lighting is the most preferable source for lighting, but when that does not provide enough light, fixtures will need to be ready. To earn EQ Credit 6.1: Controllability of Systems, Lighting, the indoor lighting needs to be able to be controlled in at least 90% of the occupied space. All of the lighting in Hudson Winery will be able to be controlled manually by the tasting room staff. The next credit, EQ Credit 8.1: Daylight and Views, Daylight is more appropriate for Hudson Winery because having the interior of the building lit by the natural light provides a better wine tasting

experience. The credit requires that at least 75% of occupied space can be lit with daylight. Since the tasting room is mainly one large space with surrounding windows, this credit is easily achieved. The second credit that is similar is EQ Credit 8.2: Daylight and Views, Views focuses on how much wall space is appropriated for views. Amador County is a scenic area, so it would be unfortunate to not have views from the inside of the tasting room. Visitors should be able to connect with the natural environment they are visiting, and allowing sight of that from within a building is an important concept for Hudson Winery. To earn this credit, the winery must have views in at least 90% of its occupied space. The preferred method of installing viewing areas is “vision glazing” which means that windows are between 30 inches to 90 inches above the floor. See image below for how Hudson Winery will install vision glazing in the tasting room.

Figure 5.1 Vision Glazing Guidelines

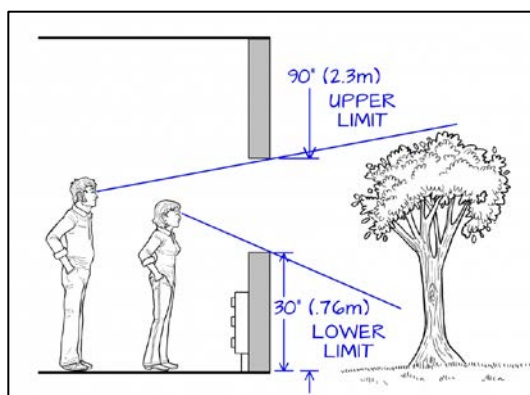


Figure 5.2 Vision Glazing Example



Chapter 6: Water Efficiency

The State of California is dealing with one of the greatest droughts in its history. It has been estimated that it will last for several more years and that the water table levels may never fully recover. Therefore Hudson Winery's water conservation practices may be more aggressive than other tasting rooms in the area. LEED explains that water efficiency is not only about using less potable water that is delivered from the utility company, but also by minimizing the amount of wastewater that is released from the site. The water efficiency category credits emphasize three major themes: indoor water use, outdoor water use for regulation, and processed water.

Table 6.1 Summary of Prerequisites and Credits for Water Efficiency

Credit	Description	Points Possible	Projected Points Earned
Prerequisite 1	Water Use Reduction	Required	Required
Credit 1	Water- Efficient Landscaping	2-4	2
Credit 2	Innovative Wastewater Technologies	2	0
Credit 3	Water Use Reduction	2-4	2
Total		10	4

Indoor water use encompasses almost all uses of water within the interior of the building including appliances in the kitchen, bathrooms, laundry rooms, etc. Flush appliances water usage are measured by the gallon per flush and flow appliances are measured by the gallons per minute. The Energy Policy Act of 1992 issued a table of standards that were adopted into law for how much water an appliance could use. In order to meet the WE Prerequisite 1: Water use Reduction, Hudson Winery will need to demand at least 20% less potable water than a conventional building of the same use. In order to determine how much water the building will require, the project team needs to calculate the baseline for water consumption. Once the baseline is determined, the project team can compare the consumption for each fixture against the baselines determined for a conventional building to determine whether or not it would be 20% less (calculations are

completed on a LEED Online template). WE Credit 3: Water Use Reduction awards up to four points if the project can reduce consumption by up to 40% for indoor water use.

The WE Credit 2: Innovative Wastewater Technologies covers the issue of high usage for bathrooms in projects looking for LEED Certification. In order to earn points for the credit, wastewater consumption needs to be cut by 50% by using water efficient features or graywater for flushing. This credit will be difficult for the tasting room to earn since most visitors may use the restroom more frequently than other conventional uses due to alcohol consumption. Also, cleanliness and image of a bathroom are also important in the overall customer experience, therefore composting toilets that use 0.8 gpf would not be an option.

To earn points for WE Credit 1: Water-Efficient Landscaping, the landscape will need to use 50% less potable water for irrigation than conventional landscaping. This can be achieved through drought tolerant plants as well as installing irrigation systems that have moisture sensors. The project team should follow the detailed calculations required for LEED Certification in order to prove the 50% reduction and earn points for this credit.

Chapter 7: Innovation in Design and Regional Priority

The innovation and design chapter is a way for projects to earn exemplary points for LEED Certification. Unfortunately, due to the location and budget constraints, the Hudson Winery will not be eligible for any points for the Innovation and Design category of this chapter. The innovation and design of the project means being able to take the requirements of LEED Certification of the other categories one step further and making them exemplary.

Table 7.1: Summary of Innovation in Design Credits

Credit	Description	Points Possible	Projected Points Earned
Credit 1.1	Innovation or Exemplary Performance	1	0
Credit 1.2	Innovation or Exemplary Performance	1	0
Credit 1.3	Innovation or Exemplary Performance	1	0
Credit 1.4	Innovation	1	0
Credit 1.5	Innovation	1	0
Credit 2	LEED Accredited Professional	1	0
Total		6	0

The second part of this chapter details the credits that are awarded for Regional Priority. In order to figure out how to earn extra points for regional priority, the project team visits the USGBC's website to find what credits are available based on the project's location. For Amador County, Hudson Winery can earn extra points for renewable energy production, optimizing energy performance, minimizing parking square footage, rainwater management, outdoor water use management, and indoor water use management.

Table 7.2: Summary of Regional Priority Credits

Credit	Description	Points Possible	Projected Points Earned
Credit 1.1	Regional Priority: Renewable Energy	3	3
Credit 1.2	Regional Priority: Optimizing Energy Performance	6	0

Credit 1.3	Regional Priority: Minimizing Parking Square Footage	1	0
Credit 1.4	Regional Priority: Outdoor Water Use Management	2	1
Credit 1.5	Regional Priority: Indoor Water Use Management	6	0
Total		18	4

The Hudson Winery will earn three credits for the renewable energy production credit because its renewable energy percentage is greater than 10%. In order to calculate the percentage of renewable energy, divide the equivalent cost of renewable energy that is produced by the solar panels by the total annual energy costs for the project. The estimated post-solar cost, as projected by the Clean Power Finance Tool, would be \$459 (\$346 lease payment, \$113 PG&E). Therefore, \$459 divided by \$900 would be 51% which would qualify the project for the three points. The Hudson Winery wants to be an exemplary project for renewable energy, because it is located in a low density, agricultural area which means that the transportation of the fossil fuel energy would be costly and would take even more energy to maintain the piping. Therefore it was important to the project team that as much of the energy from fossil fuels was offset by the solar system. Hudson Winery is unfortunately not eligible for the second credit category for regional priority because it is new construction and it did not select Option 2 in the EA Prerequisite Minimum Energy Performance. Hudson Winery will also not be eligible for Credit 1.3: Minimizing Parking Square Footage for the same reason as mentioned in Chapter 2. The location of Hudson Winery makes it difficult for visitors to use alternative transportation methods without affecting the vitality of the business.

The final two credits for the Regional Priority Category deal with the Outdoor and Indoor Water Use Reduction. In order to earn a point for outdoor water usage, Hudson Winery's landscaping would need to reduce its water usage by at least 50% compared to baseline usage during peak watering months (June – September). If the project were to reduce its consumption by 100%

during peak watering months, then it could earn the maximum of two points. This can mainly be accomplished by choosing plant species that do not require irrigation or much maintenance.

Hudson Winery will focus on drought tolerant plants because Amador County's environment can become very dry during the summer months. Also taking into consideration the lowering water tables in California, water for irrigation should be reduced where it is not necessary to produce crops. Earning points for the last category of Regional Priority: Indoor Water Use Management would also be difficult for Hudson Winery to achieve since wine tasting developments typically require a significant amount of water usage. Hudson Winery will install low-flow fixtures throughout the project, but it will unfortunately not be enough to earn any points.

Chapter 8: LEED Certification Projected Results

In order for Hudson Winery to become a LEED Certified project, it will need to apply and be awarded. One of Hudson Winery's members will become the LEED Project Administrator and will submit all of the necessary information to the Green Building Certification Institute (GBCI). The Project Administrator will verify that the project meets all of the LEED program requirements and then register Hudson Winery in the LEED-Online software. LEED-Online is the program that manages the individual projects through the approval process. All of the required documentation can be uploaded to LEED-Online and will be available to GBCI and other certification bodies. After the Project Administrator registers Hudson Winery, LEED-Online will show the project's Scorecard, Credit Interpretation Requests (CIRs) and Rulings, LEED Submittal Templates, and the Certification Timeline. After the Project Administrator completes the Design Phase by uploading the required documentation, receiving responses to CIRs, and paying applicable fees they can submit an application for Construction Review. The Certification Body has 25 days to issue an 'Anticipated' or 'Denied' status. Then the project team has 25 days to respond to any issue clarification requests and resubmit for certification. Therefore, the certification process can range from 25 days to 130 days depending on how many appeals there are.

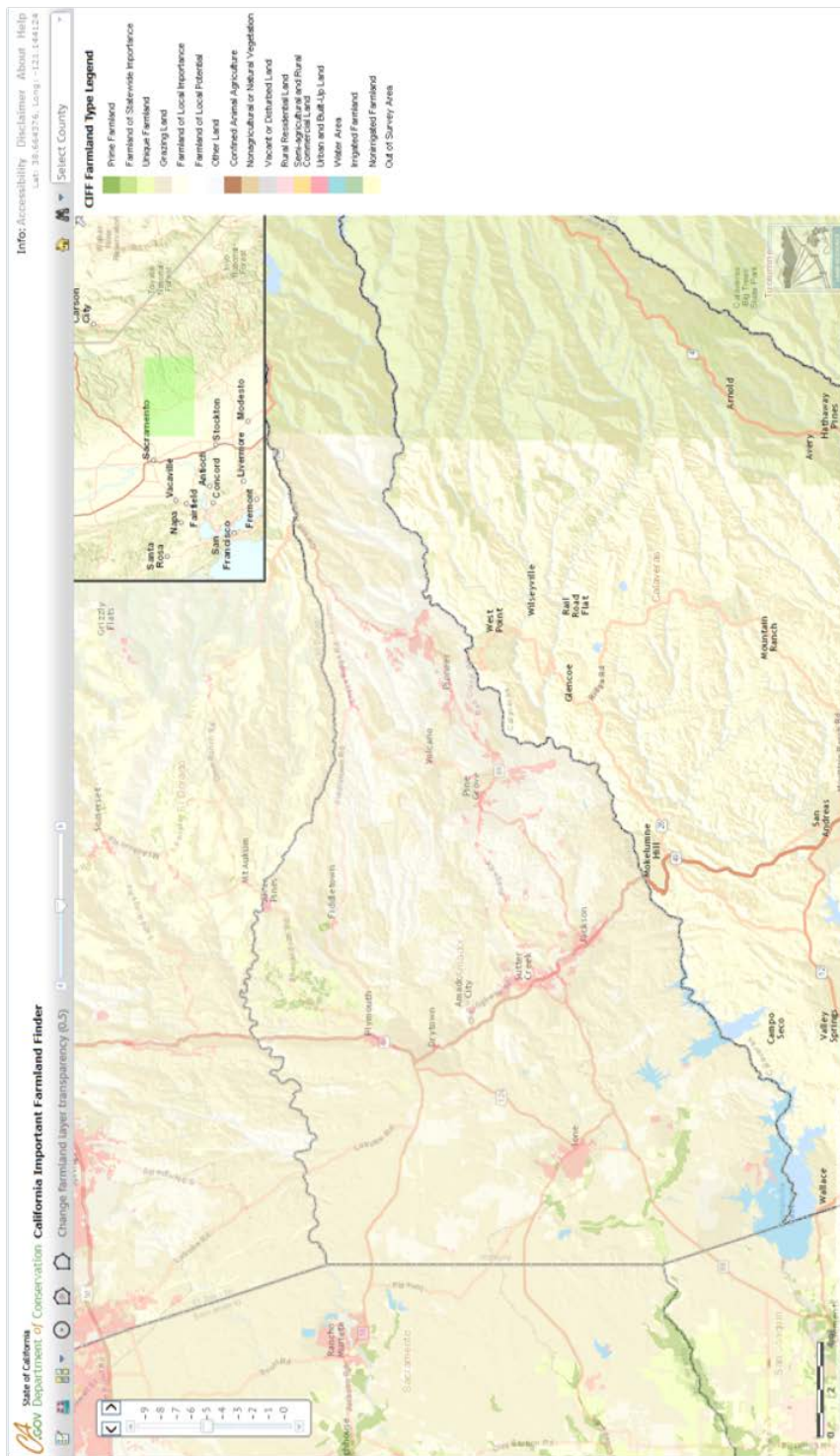
In order for a project to receive a LEED Certification, it must earn at minimum 40 points. For a project to be 'Certified' it needs to receive 40-49 points, 'Silver' 50-59 points, 'Gold' 60-79 points, and 'Platinum' over 80 points. The Hudson Winery has exhibited their passion for constructing the winery in a sustainable, locally responsible manner and therefore the project is anticipating to be awarded the Silver LEED rating at minimum. The total anticipated points is 60, which earns a 'Gold' rating. The anticipated points is the best case scenario, so the 'Silver' rating

is what the Hudson Winery project team is expecting. Summary Table 8.1 below shows the anticipated credits for each category.

Table 8.1 Summary of Projected Credits Earned

Credit	Points Possible	Projected Points Earned
Sustainable Sites	26	11
Materials and Resources	14	8
Energy and Atmosphere	35	18
Indoor Environmental Quality	15	15
Water Efficiency	10	4
Innovation in Design	6	0
Regional Priority	18	4
Total	124	60

APPENDIX A: Prime Farmland Amador County, CA



Source: California Department of Conservation, 2016

APPENDIX B: Acceptable Substitutes for CFCs (class I ODS) in Household & Light Commercial AC

Substitute (Name Used in the Federal Register)	Trade Name	Refrigerant Being Replaced	Retrofit/ New
Evaporative/Desiccant Cooling		all CFCs	N
R-407C	Suva 407C, Klea 407C	502	R, N
R-422C	ICOR XLT1	502	R, N
KDD6	KDD6	12	R, N
Hot Shot 2	Hot Shot 2	12, 502	R

Key: R = Retrofit Uses, N = New Uses

Source: EPA 2016

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