Developing Energy Benchmarks for the Ontario Wine Industry

Prepared for: Wine Council of Ontario and Natural Resources Canada

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The following wineries participated in the project:

Cave Spring Cellars Ltd.
Creekside Estate Winery Ltd.
Colio Estate Wines
Coyote's Run Estate Winery
EastDell Estates Winery
Flat Rock Cellars
Henry of Pelham Family Estate Winery
Hillebrand Estates Winery
Inniskillin Wines
Jackson-Triggs Niagara Estate Winery
Lakeview Cellars Estate Winery
Pelee Island Winery Inc.
Pillitteri Estate Winery
Reif Estate Winery Inc.
The Grange of Prince Edward Inc.
Vincor International Inc.
Vineland Estates Winery

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DEFINITIONS

Benchmark	Benchmarking can be defined as "a systematic process for securing continual improvement through comparison with relevant and achievable internal and external norms and standards." Benchmarking implies comparison, which may be internal comparisons with previous performance or future targets, or external comparisons of performance against similar businesses.
Best Practices	Documented strategies employed to improve energy use conservation. The qualifier "best" adds a value judgement and assumes the practical implementation of the strategy is well proven and comparably better than other strategies employed within the same context.
Energy intensity	The energy intensity indicator measures the total energy consumed per unit of production or service delivery. For example, a higher energy intensity value indicates that more energy is used to produce a product by a winery when compared to another winery with a lower energy intensity value.
Performance indicator	The tools that are used for rating performance are known as indicators, or performance measures.
Process step and service	A process step refers to one manufacturing step in an industrial process, e.g. crushing, fermentation or storage. A process service refers to the systems that serve the industrial process, e.g. refrigeration system or steam system, and is categorized in this report as space heating and cooling, process heating and cooling, and lighting.

1. INTRODUCTION

This energy benchmarking report is part of a larger project, referred to as the Energy Benchmarking and Best Practices in the Ontario Wine Industry project. The three components of this project are:

- The development of energy benchmarks, which involved site-specific studies at 17 individual wineries based on a process-step benchmarking approach.

- The preparation of energy best practices.

- The delivery of interactive workshops to share the energy benchmarking data and energy best practices, with the approximately 100 individual wineries in the three main wine growing regions of Ontario.

The Energy Benchmarking component was completed in two phases. The first phase involved the benchmarking of 10 wineries and preparation of an interim report that was reviewed and discussed with the Technical Committee of the Wine Council of Ontario (WCO). Phase Two involved completion of the remaining benchmarking studies and preparation of a final industry-wide benchmarking report. The final report incorporated comments received on the interim report, an analysis of the findings from the energy benchmarking studies at all the participating wineries, and conclusions and lessons learned.

Individual reports were prepared for each participating winery to allow them to compare their energy performance relative to the industry-wide benchmarks and to identify and implement opportunities for energy efficiency.

The goal of the Energy Benchmarking and Best Practices in the Ontario Wine Industry Project is to improve the energy performance, cost competitiveness and production efficiency of the Ontario wine industry. The project is an industry-led initiative by the WCO.

The Project is building on *Sustainable Winemaking Ontario: An Environmental Charter for the Wine Industry*, which is being developed by the WCO. The main goals of *Sustainable Winemaking Ontario* are to improve the environmental performance of the wine industry in Ontario; to enhance the quality of wine growing and wine making in an environmentally responsive manner; and to add value to the Ontario wine industry. A significant feature of *Sustainable Winemaking Ontario* has been its interactive nature to meet the needs of the industry. Technical and Sustainability Committees have been established and workshops conducted to understand the needs and issues facing the industry. *One critical issue that has been identified as a strategic priority for wineries is energy management.*

1.1 OBJECTIVES

The Ontario Centre for Environmental Technology Advancement (OCETA) and ALTECH Environmental Consulting Ltd. (Altech) proposed the following objectives to the WCO.

- The main objective of the project is to improve the long-term sustainability and competitiveness of the Ontario wine industry through energy performance improvements.

- The secondary objectives are to develop benchmarking tools and best practices that can be used for measurement, analysis, feedback and reporting to allow the Ontario wine industry to continuously monitor and reduce its energy intensity.

These objectives closely align with the goals of Sustainable Winemaking Ontario. The outcome of the project would be measured reductions in energy usage and greenhouse gas (GHG) emissions.

1.2 SECTOR PROFILE: ONTARIO WINE INDUSTRY

The Ontario wine industry has undergone a significant transformation over the last 20 years. Today there are over 100 licensed wine properties within the province. Wineries are located in Niagara Peninsula, the Greater Toronto Area, Lake Erie North Shore and Pelee Island, and Prince Edward County. The growth of the Ontario wine industry from 1990 to 2004 is summarized by a number of key indicators in Table 1.1.

In 2004, Ontario wine sales were approximately $394 million; $133 million worth was VQA wine sales. The industry purchased 44,000 tonnes of Ontario grown grapes and employed approximately 6,000 people in wine production and marketing. Winery tourism is a significant business attracting 750,000 visitors per year. Exports of Ontario wines grew 20 percent in value with Ontario wineries exporting more than 740,000 litres of VQA wine valued at more than $11 million.

Table 1.1: Growth in Ontario wine industry from 1990 to 2004 (WCO, June 2005. *The Ontario Wine Industry 2004/2005 year in Review*).

Industry Growth Indicator	1990	2004
Ontario wine sales	$143 million	$394 million
VQA sales	$5 million	$133 million
Grapes purchased	25,000 tonnes	44,000 tonnes
Tourism	Just beginning	750,000 / year
Wineries	20	90+
Value of Niagara Vineyard Land	$10,000 / acre	$40,000 / acre
Employment	Unknown	6,000

2. PARAMETERS AND METHODOLOGY

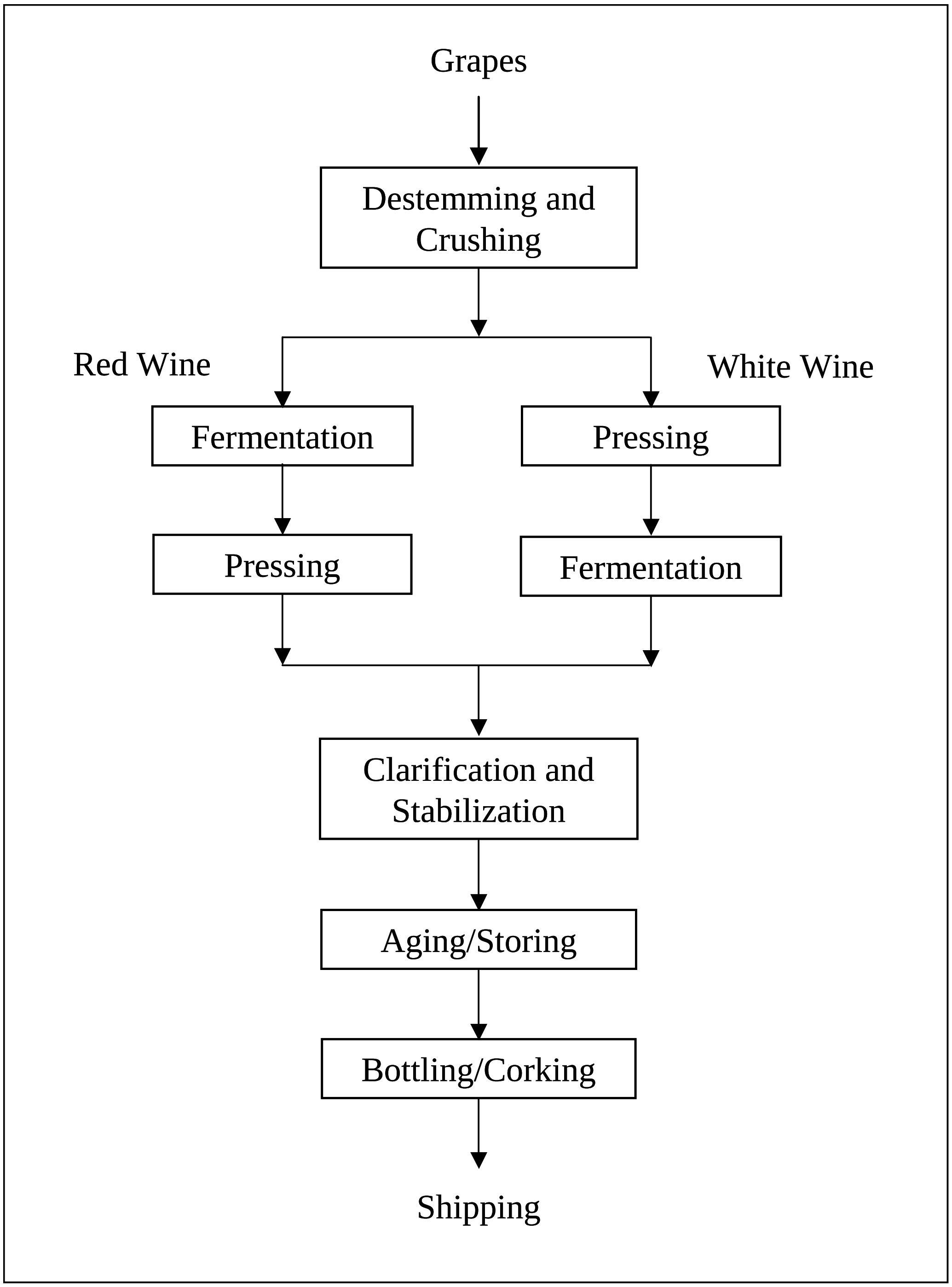
2.1 FOCUS OF THE STUDY AND APPROACH

To maintain consistency with previous energy benchmarking studies performed in the industrial sector, which have been mainly published by Natural Resources Canada (NRCan) through the Canadian Industry Program for Energy Conservation (CIPEC), the energy usage and efficiency of Ontario wineries were studied in the context of the process steps, or value-added chain.

The study focussed on wine manufacturing facilities, and begins with the arrival of input grapes, grape juice or wine at the facility and ends with the output or shipment of wine, in either bottled or bulk loads. The main process steps are presented in Figure 2.1.

Monthly energy usage and production data for the participating wineries were collected and analyzed for the 24-month period from January 2004 to December 2005. For the purposes of developing the energy benchmarks, energy usage was defined as energy produced from carbon-based sources such as electricity, natural gas and other fuels such as diesel and propane. None of the wineries included in the final benchmarks used energy from renewable sources such as wind, solar or geothermal.

Figure 2.1: Main general process steps in winemaking process.



The approach used to develop the energy benchmarking model and the templates to collect the relevant data from wineries involved the following steps:

- With assistance from the WCO, Ontario wineries were requested to participate in the project. The first wineries to respond and commit to participating in the project were included in the study.

- Based on the review of benchmarking studies completed in other jurisdictions such as Australia and California, energy benchmarking studies completed in other industry sectors such as dairy, automotive and pulp and paper, and discussions with individual wineries and the WCO's Technical Committee, a template questionnaire was developed to obtain energy, production and process data in a systematic format. These templates are included in Appendix A.

- The participating wineries completed the template questionnaires and provided the necessary utility and production information. The data included equipment nameplate data and estimated hours of operation.

- A representative from Altech visited each winery. During these site visits the process and facilities were inspected to ensure an understanding of the site specific operation and equipment.

- The data from each winery was assessed and interpreted based on the site visit observations.

- Benchmarks were developed as described in Section 2.5.

2.2 SAMPLE CHARACTERIZATION

The participating wineries in this study were located in the following three main grape growing and wine producing regions of Ontario:

- Niagara Peninsula
- Lake Erie North Shore including Pelee Island
- Prince Edward County

The annual production rate of wineries fluctuates with changes in annual crop yield. The size distribution of the participants based on the 2004 production year is summarised in Table 2.1. One winery is new and only had production data for 2005.

An assessment of the wineries showed low production rates for 2005 and significantly higher production rates during 2004. The 2005 data represented a year with very low crop yields, due to the impact of winter weather. The 2004 production year was found to be more representative of a normal crop yield and production period, with the wineries operating closer to normal capacities. Therefore, data for 2004 was used for all the wineries to assess energy efficiency and to develop the energy benchmarks. The newer winery that had data only for 2005 was excluded from the assessment, due to its non-representative value caused by a production rate significantly lower than its design capacity. The production capacity of this winery was less than 100,000 litres/year.

Table 2.1: Size distribution of participants.

Annual Volume (thousands of litres)	Number of Wineries
< 100	2 (1)
100 - 300	3
300 - 700	5
> 700	6
Total	***16***

(1) One newer winery is excluded in the remaining analysis due to its non-representative value.

Three of the 16 wineries did not have bottling as part of their production during 2004. These wineries ship wine in bulk to other wineries where the bottling and corking are executed.

The product mix of the wineries was assessed and the wines were categorized as “red”, “white - tank fermented”, “white - barrel fermented”, and “ice wine and other”, which includes late harvest and sparkling wine. The product mix is presented in Table 2.2, along with the range of percentages of each product compared to the total wine processed.

Table 2.2: Product mix as percentage of total wine processed at participating wineries.

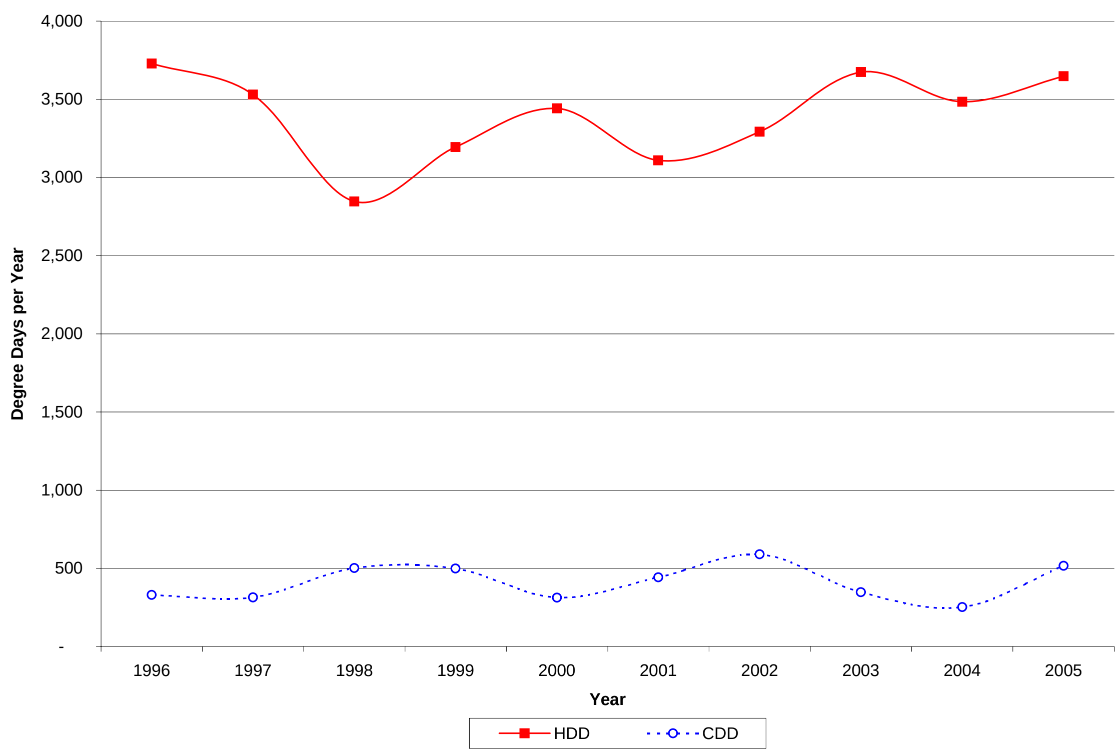
Product	Range of Percentage of Total Wine Processed (%)	Average Percentage (%)
Red wine	29 – 87	54
White wine – tank fermented	3 – 68	37
White wine – barrel fermented	0 – 6	2
Ice wine and other	0 – 13	7

2.3 WEATHER CHARACTERIZATION

The wine making process is very sensitive to temperature settings and controlling production temperatures is a major component of the wine making process. Achieving desired production temperatures generally requires energy for internal cooling and heating and outside ambient temperatures can have a significant influence on the amount of energy required. The annual heating and cooling degree days (HDD and CDD) for 1996 to 2005 were determined from Environment Canada data for Vineland, Ontario and a base temperature of 18ºC.

HDD and CDD are defined as the median temperature difference of a given day with a base temperature. The difference between HDD and CDD is that HDD is calculated for temperatures below the base temperature and CDD is calculated for temperatures higher than the base temperature. The HDD and CDD for one year is the sum of daily HDD and CDD values. The colder a winter season is, the higher the value of HDD for the year, while a warmer summer season will result in higher CDD values.

Figure 2.2: 10-Years annual HDD and CDD for Vineland, Ontario.



The HDD and CDD values for 1996 to 2005 are presented in Figure 2.2. The median annual HDD for the 10-year period is 3,463, compared to 3,484 for the year 2004. The year 2004 is very close to the median in terms of how cold it was during the past 10 years, and is the same as the 55^{th} percentile. One can conclude that 2004 is representative of an "average" year when cold ambient temperature is considered, and energy usage influenced by ambient cold temperature is representative of an "average" year.

The CDD value for 2004 is 252 and is the lowest for the 10-year period. This is indicative of the coldest summer in 10 years. One can expect energy consumption required for cooling during the 2004 summer to represent the best case condition and may result in optimistic energy intensities.

2.4 DATA AND INFORMATION

Detailed information was collected from each of the wineries to determine utility usage and production rates. The utilities include electricity, natural gas and other fuels such as liquefied petroleum gas (LPG), diesel and gasoline. Energy balances were developed for each of the wineries based on equipment energy ratings and hours of usage. The energy balances were calibrated with the actual annual energy usage for 2004 as per utility data.

The results from the energy balances were used to allocate energy usage according to the eight process steps and services shown in Figure 2.1, as follows:

- Destemming, crushing and pressing
- Processing – fermentation
- Processing – clarification and stabilization
- Processing – aging/storage
- Bottling
- Lighting
- Space heating and cooling
- Other

Of particular interest to the wine industry is the allocation and usage of energy for process cooling and heating. In wineries process cooling and heating may be achieved directly with a heating or cooling medium (for example, hot water or a cold water-glycol medium in immersion coils or tank jackets), or indirectly by controlling room temperatures. The results of the energy balance were used to define the energy intensity of direct process cooling and heating, and space (or room) cooling and heating.

The participating wineries used different energy sources, namely electricity, natural gas, propane, diesel and gasoline. To establish energy benchmark targets and enable comparisons between wineries, all the energy was converted to kilowatt-hour (kWh) equivalents. The conversion factors are summarised in Table 2.3.

Table 2.3: Energy conversion factors.

Fuel Type	Unit	kWh Equivalent
Electricity	kWh	1
Natural gas	m^3	10.33
Liquefied Petroleum Gas (LPG)	L	7.39
Diesel	L	10.74
Gasoline	L	10.06

2.5 DETERMINING BENCHMARK TARGETS

To set standards for energy usage, performance indicators were defined and benchmarks were developed for:

- Energy composition
- Total energy usage
- Energy usage by process step and service

A very unique variable in the wine industry is the "art of winemaking." Each winemaker produces wine based on experience and uniquely developed methodologies. These methodolgies have an impact on energy consumption during the winemaking process, for example one winemaker believes in the strict control of temperature and uses mechanical process cooling and heating to achieve this target, while another winemaker allows the temperature to fluctuate more and uses a limited amount of mechanical temperature control. This study did not attempt to quantify the impact of this variable on energy usage.

2.5.1 Performance Indicators

The energy composition is evaluated by assessing each fuel source as a percentage of the total annual energy consumed by a winery.

The performance indicator for total energy usage was defined as the total annual kWh equivalent energy used by each process step (excluding bottling) and service in the specific winery, per annual litres of wine processed. The amount of wine processed in a given year is dependent on the amount of grapes and grape juice received. The rate of bottling is not related to the amount of wine processed in a given year, but is dependent on production during previous years and also the amount of wine received. The total energy usage performance indicator is referred to as the total energy intensity and the unit is kWh/L wine processed.

The performance of energy usage by each process step and process service can be measured by its energy intensity in kWh/L wine processed, or wine bottled in the case of the bottling process step. The following three performance indicators were defined for these process steps and services:

- For the crushing, destemming and pressing step, energy usage depends on the amount of grapes received and not the amount of grape juice received. The performance indicator of this step is therefore defined as the annual kWh equivalent energy used per volume of wine processed from the annual amount of grapes received.

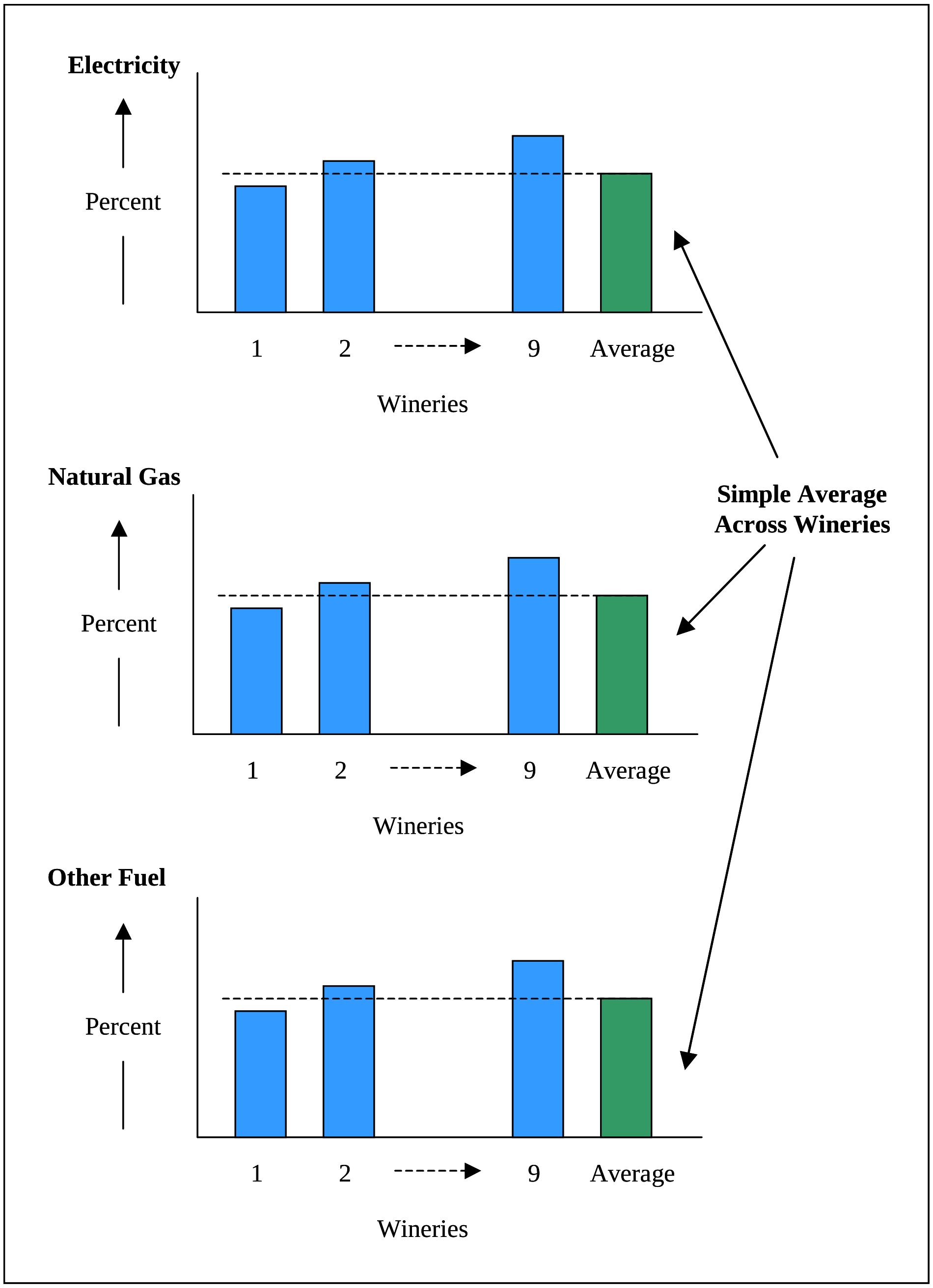
- For the fermentation, clarification and stabilization and aging/storage step, and process services (space heating and cooling, and lighting), the performance indicator is defined as the annual kWh equivalent energy used in each step and service, per annual volume of wine processed.

- For the bottling step, energy intensity is defined as the annual energy usage for bottling per volume of wine bottled, and the unit of the performance indicator is kWh/L wine bottled.

2.5.2 Energy Composition Benchmark

The energy composition of the wine industry was assessed based on the percent usage of each energy source and the benchmark was established as a simple average of the participating wineries. The energy sources were categorized as: electricity, natural gas and other fuels. Figure 2.3 provides an illustration of the concept.

Figure 2.3: Energy composition benchmark as average of percentage use.

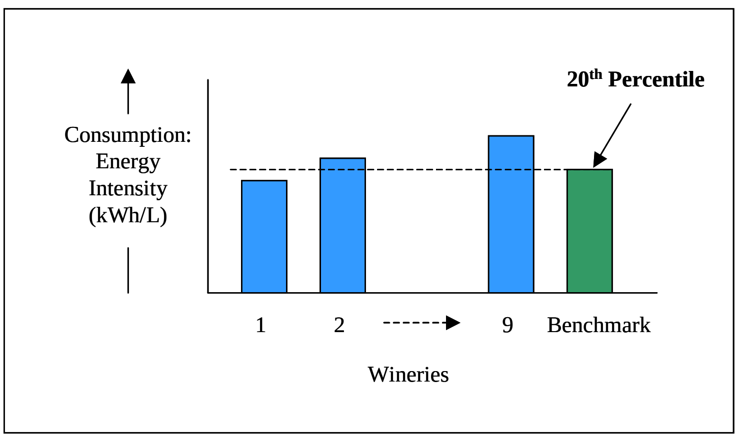


2.5.3 Total Energy Use Benchmark

An energy balance was developed for each winery and the energy intensity for each process step and service was calculated. Using the total energy intensities the benchmark for total energy use was established at the 20th percentile of the plants in the sample, as illustrated in Figure 2.4. The 20th percentile equals the value for which 20% of the wineries have a lower value. It is an indication of the energy intensity that is currently obtained by 20% of the wineries.

Most wineries include offices and other non-production services, like hospitality and retail. These services are generally included in the monthly energy utility invoices. To exclude the energy usage of these areas from the energy benchmarks, the energy consuming equipment within the areas was estimated as a percentage of total energy consumed or accounted for in the overall energy balance. The energy balance was calibrated to the actual invoiced energy consumption. In areas where space heating and cooling were shared between the process and non-process areas, the heating and cooling energy was allocated proportional to the volume of each space.

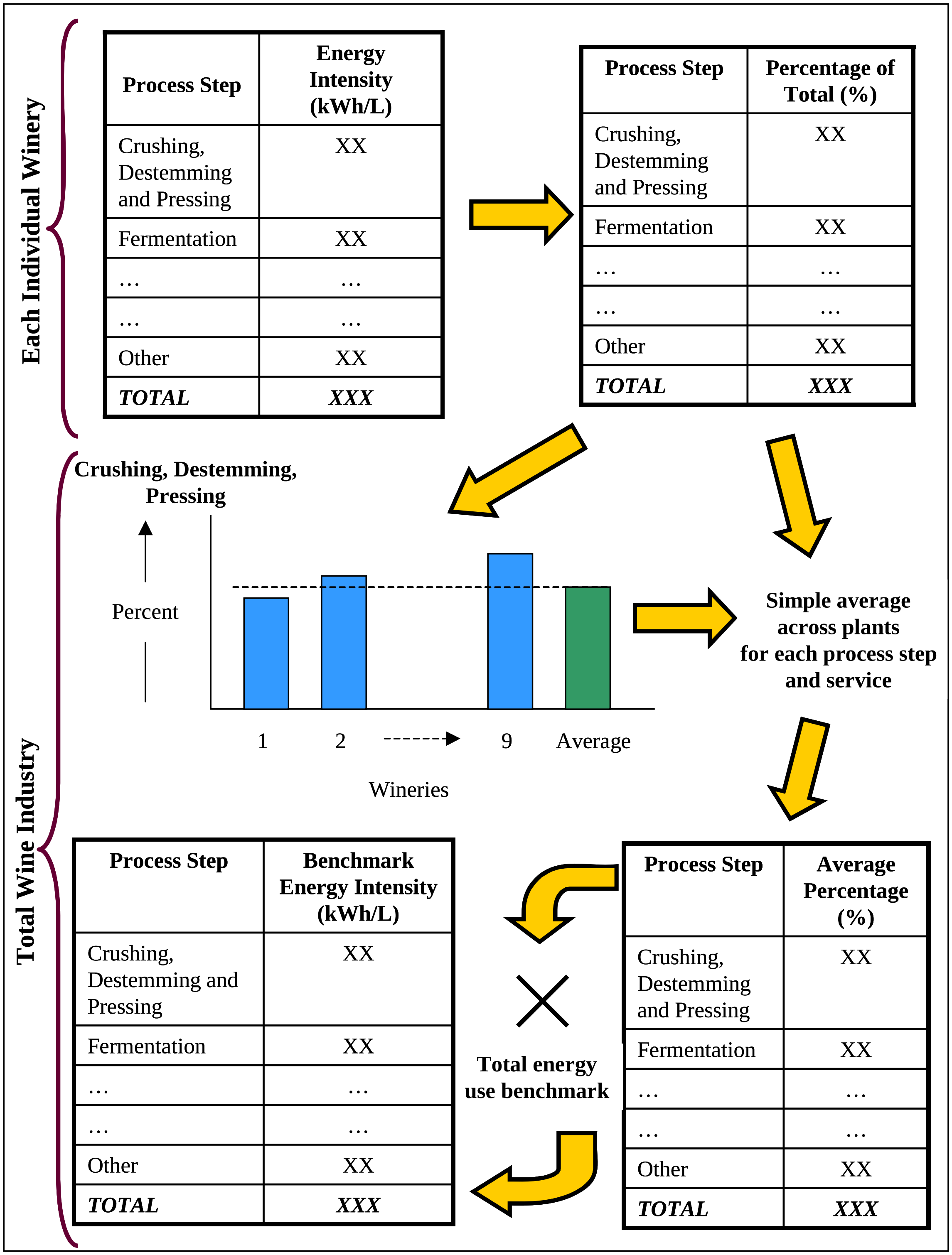
Figure 2.4: Total energy use benchmark as 20th percentile.



2.5.4 Benchmark Energy Use by Process Step and Service

The benchmark for each of the eight process steps and services as described in Section 2.4 was determined by using a bottom-up approach. A simple average across the plants was calculated for the percentage of energy used at each process step and service, based on its energy intensity. This benchmark model was applied to the total energy use benchmark, which was developed as described above.

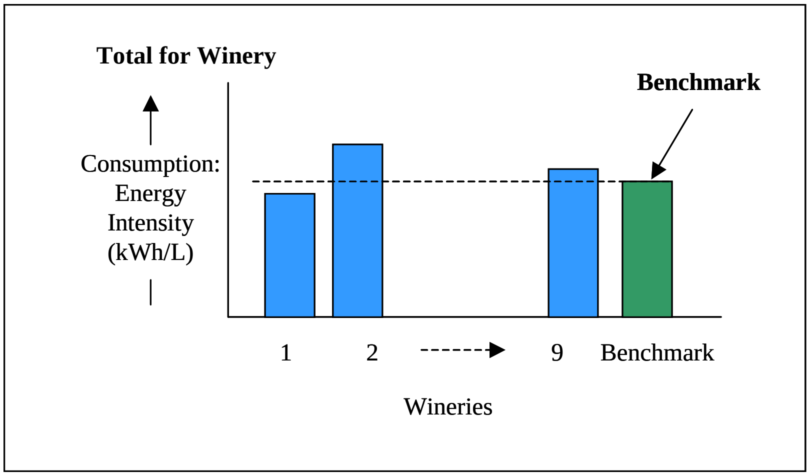
Figure 2.5: Benchmark energy use by process step and service.



2.5.5 Analysis

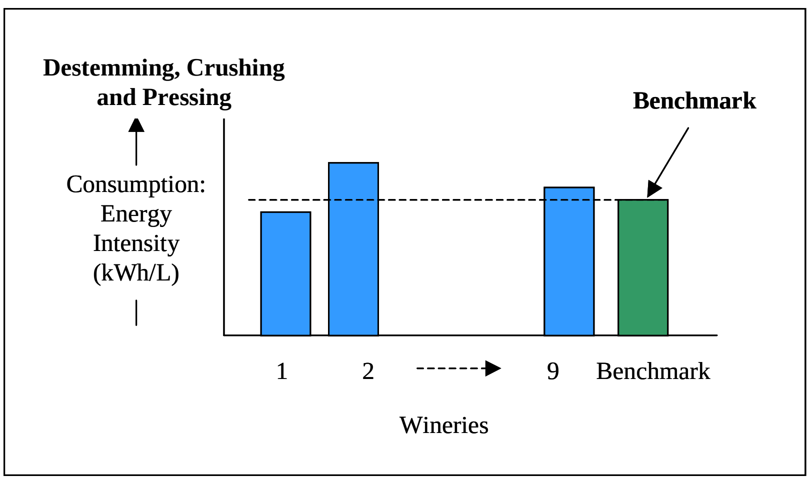
The main analysis at the total plant level involved comparing the total energy usage, expressed as the total energy intensity (kWh/L wine processed), with the benchmark, as shown in Figure 2.6.

Figure 2.6: Analysis of total energy use.



Energy usage, expressed as energy intensity in kWh/L wine processed, within the plant by the eight process steps and services were compared to the benchmark, as shown in Figure 2.7.

Figure 2.7: Analysis of energy use by process step or service.



3. RESULTS AND ANALYSIS

3.1 BENCHMARKING

The labelling of the wineries by numbers in the analysis and figures is associated with the sorted values for the specific analysis and is not specific to one winery, e.g. "winery 1" in Figure 3.1 may not be the same winery as "winery 1" in Figures 3.2 and 3.3.

3.1.1 Energy Composition

Figures 3.1 to 3.3 summarize the analysis of energy composition by fuel source. The benchmark energy composition by fuel source is provided in Figure 3.4 and illustrates that electricity provides 64.5%, natural gas 29.6% and other fuels 5.8% of the total energy used by the 16 wineries. Four wineries did not use natural gas and six wineries did not use other type fuels. None of the 16 wineries used renewable energy sources on site.

Figure 3.1: Electricity use as percentage of total energy use.

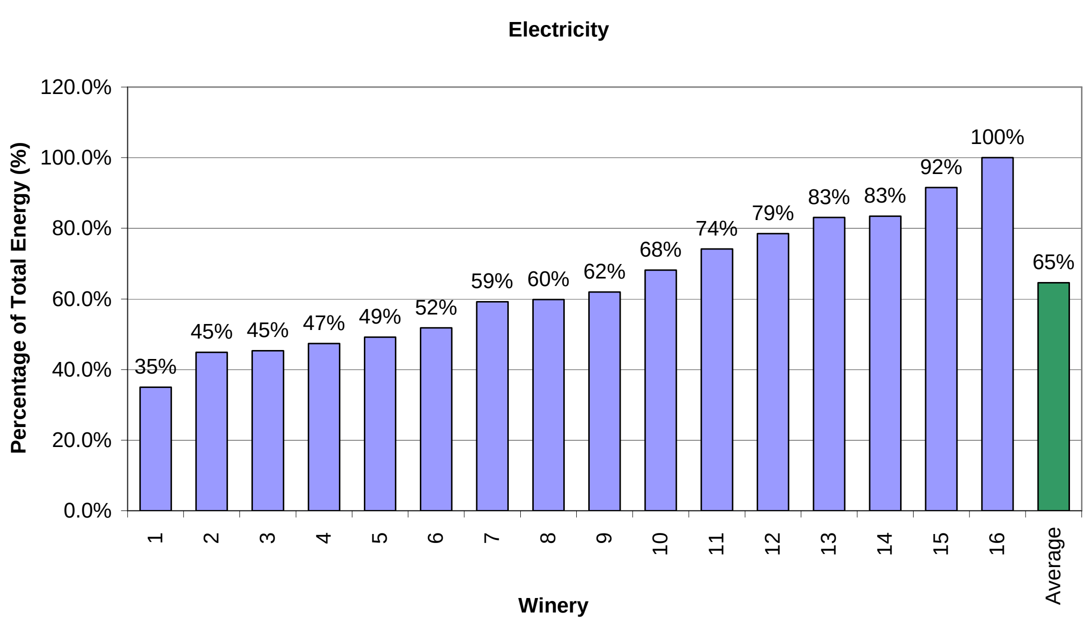


Figure 3.2: Natural gas use as percentage of total energy use.

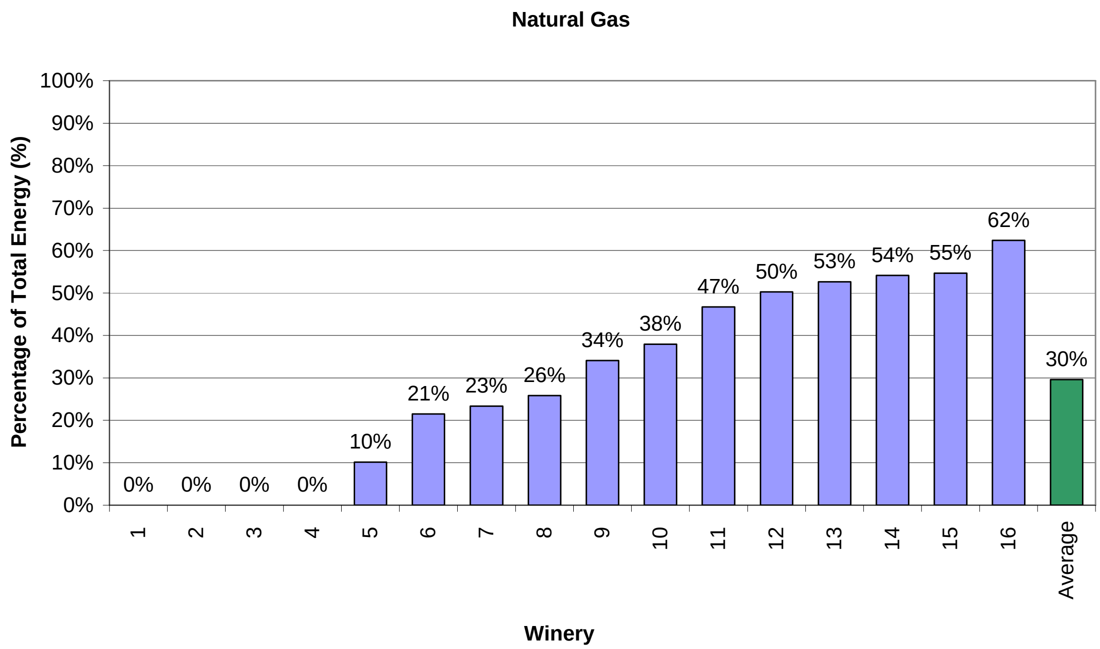


Figure 3.3: Other fuel use as percentage of total energy use.

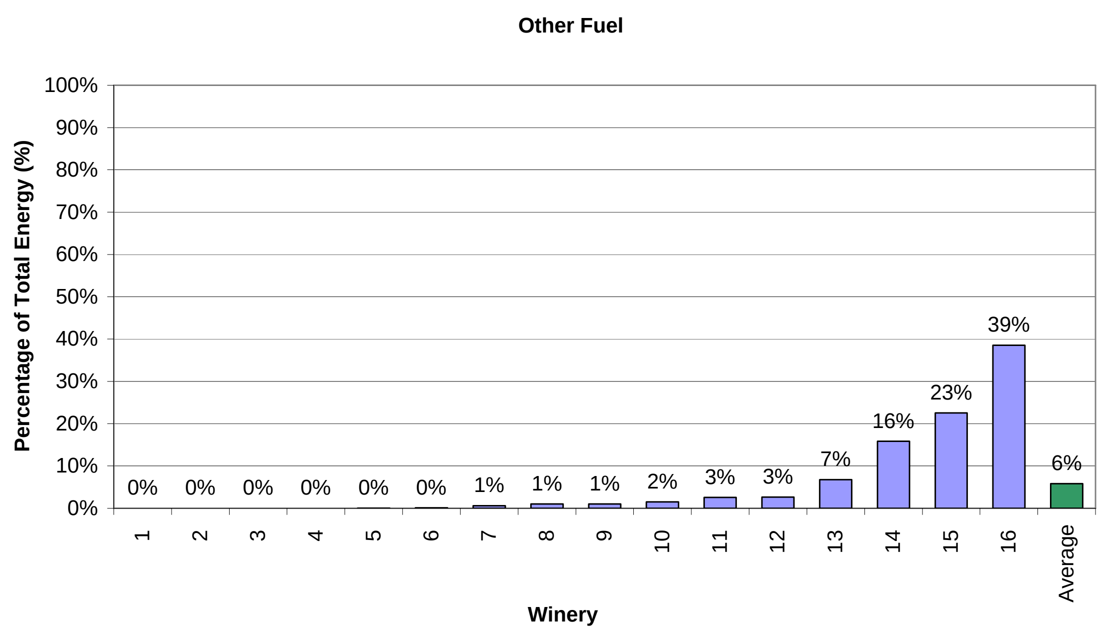
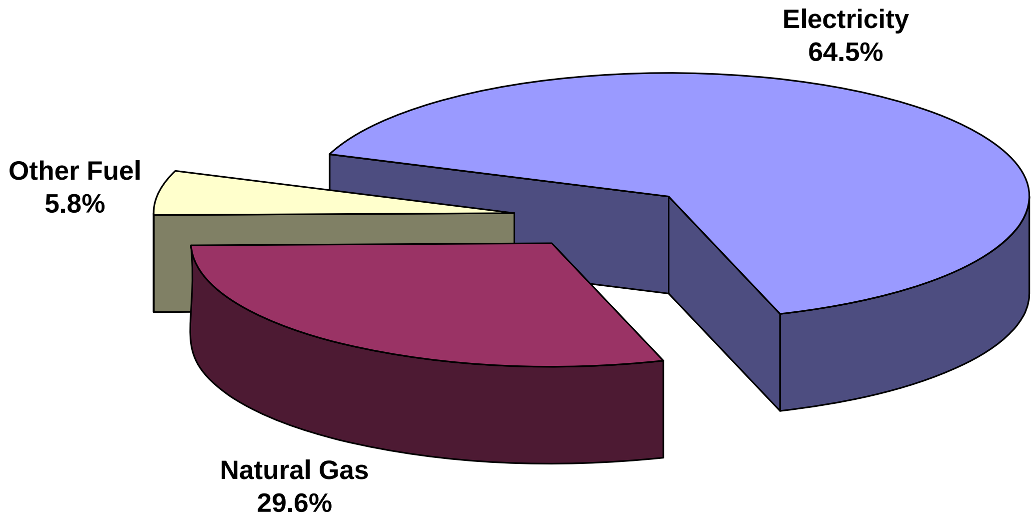


Figure 3.4: Energy composition by fuel source.



3.1.2 Total Winery Energy Use (Excluding Bottling Process Step)

The energy consumption by total winery energy usage was based on the total winery energy intensity (kWh/ L wine processed) excluding the bottling process step. Figure 3.5 compares the total winery energy intensity for the 16 wineries and establishes the benchmark at the 20th percentile as 0.55 kWh/L wine processed.

The energy intensity of each winery was calculated as discussed in Section 2.5.4. With the aid of an energy balance the energy usage by each process step was determined. The energy balance was based on equipment nameplate data and hours of operation. The energy balance was calibrated to the actual 2004 annual energy consumption as per utility invoices. The energy consumption was normalized with the wine production data to obtain the energy intensity per process step for each winery. The total energy intensity is the sum of the energy intensities of a winery's process steps. Comparing the total energy intensities of the 16 wineries, the 20th percentile will be the same as the energy intensity value of the 4th lowest winery, i.e. 20% of the wineries have a lower energy intensity.

It was anticipated that the study would result in an illustration of economies of scale in energy usage. The results of comparing energy intensity with annual wine processing rates are presented in Figure 3.6, and indicate that energy intensity is not influenced by processing capacity, except for wineries that process less than 100,000 L/year. Two wineries produced less than 100,000 L/year and the sample was considered too small to be representative. However, these wineries were still included with the other wineries to develop the energy benchmarks.

An assessment of the product mix and age of the wineries compared to the total energy use indicated that there is no relationship between the product mix, or the age of a winery and energy intensity of the participating wineries.

Figure 3.5: Total winery energy use (excluding bottling process step).

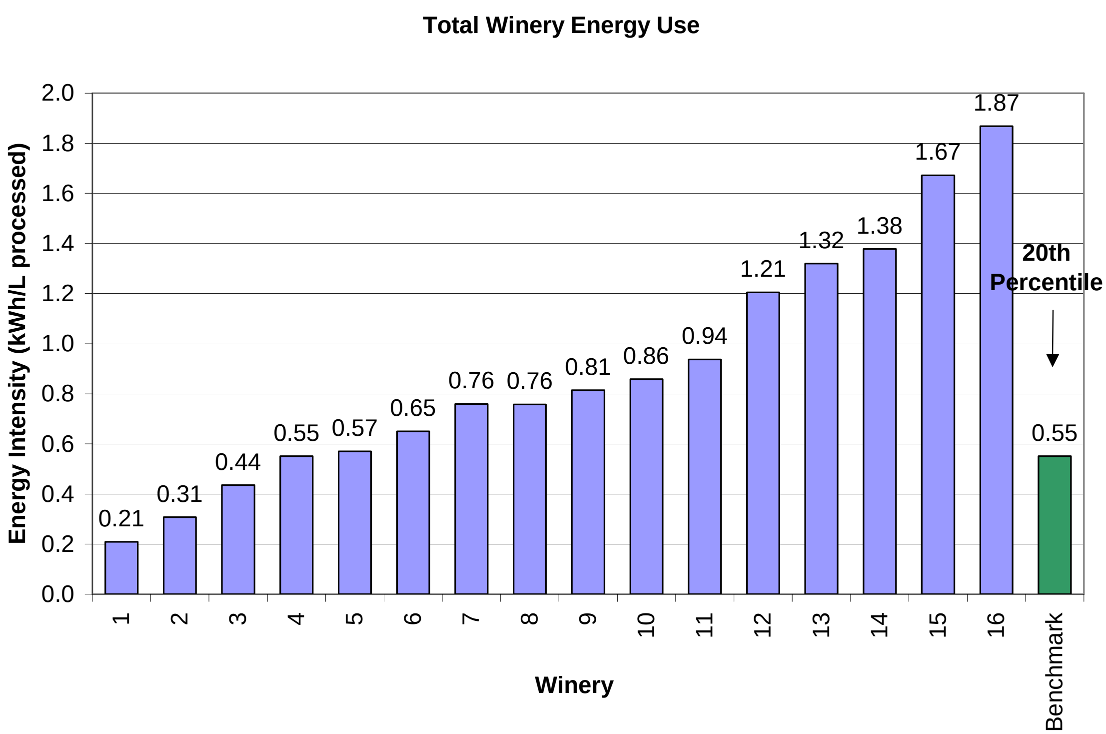
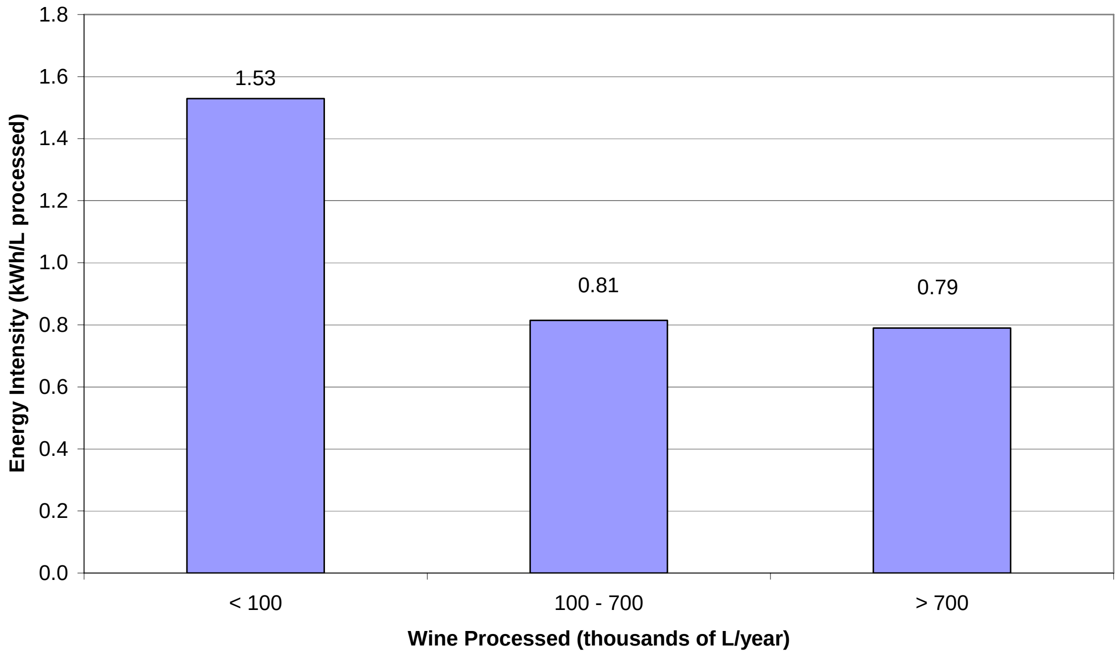


Figure 3.6: Average energy intensity according to annual wine processing rates.



3.1.3 Energy Use by Process Step and Service

The energy use benchmark by process step and service was determined using the total energy use benchmark of 0.55 kWh/L wine processed and applying the model energy use benchmark, as described in Section 2. Figure 3.7 illustrates the energy use benchmarks by process step and service, and Figure 3.8 presents the same data as percentage of total energy use. The energy use benchmark for cooling and heating is presented as a percentage of total energy use in Figure 3.9, while all the other energy used by process equipment is categorized as “other” in the figure.

Figure 3.7: Energy use benchmarks by process step and service (kWh/L processed) (excluding bottling process step).

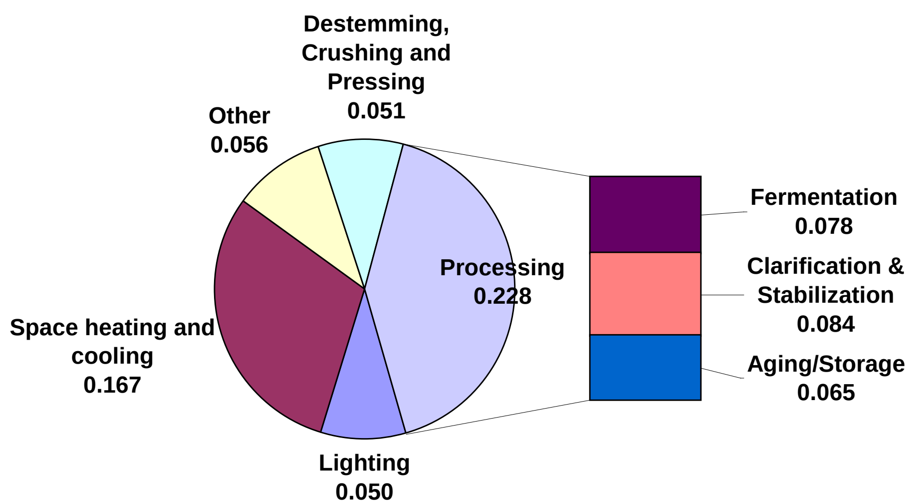


Figure 3.8: Energy use benchmarks by process step and service as percentage of total energy use (excluding bottling process step).

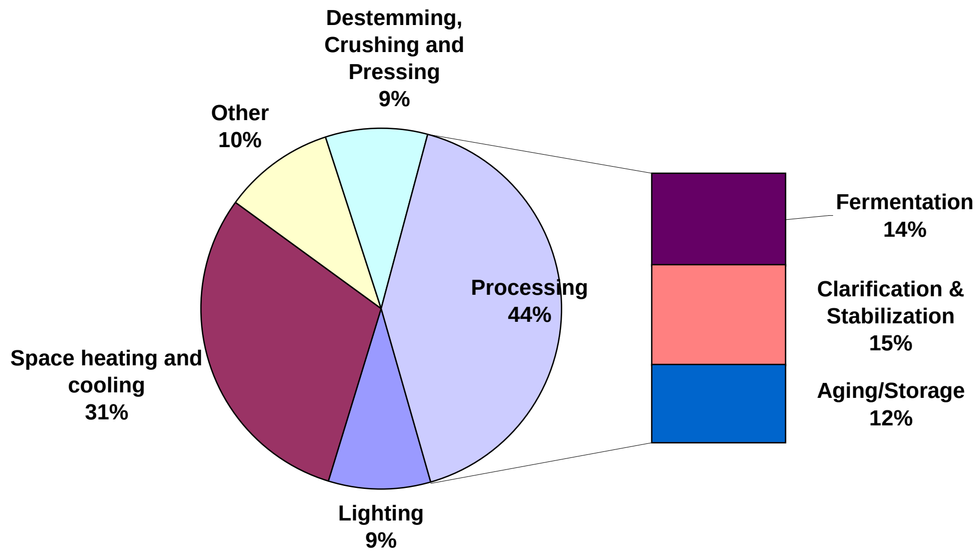
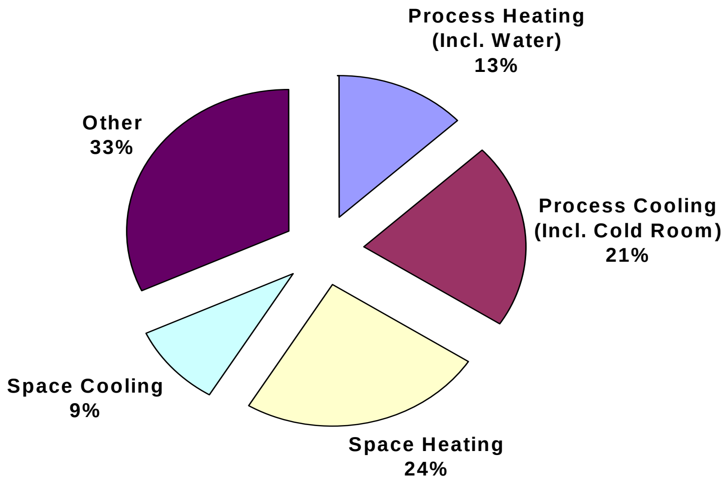


Figure 3.9: Energy use benchmarks for cooling and heating as percentage of total energy use (excluding bottling process step).



3.2 ANALYSIS

Figures 3.10 to 3.23 present the comparisons of each process step across the wineries and the benchmark.

Figure 3.10: Energy use and benchmark for destemming, crushing and pressing process step.

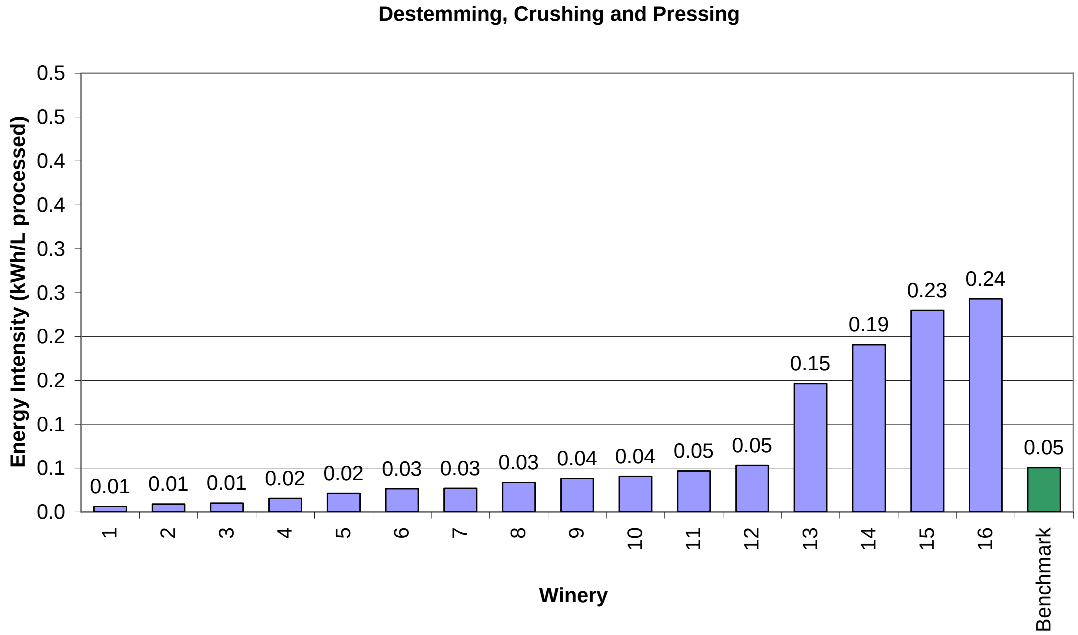


Figure 3.11: Energy use and benchmark for all processing steps.

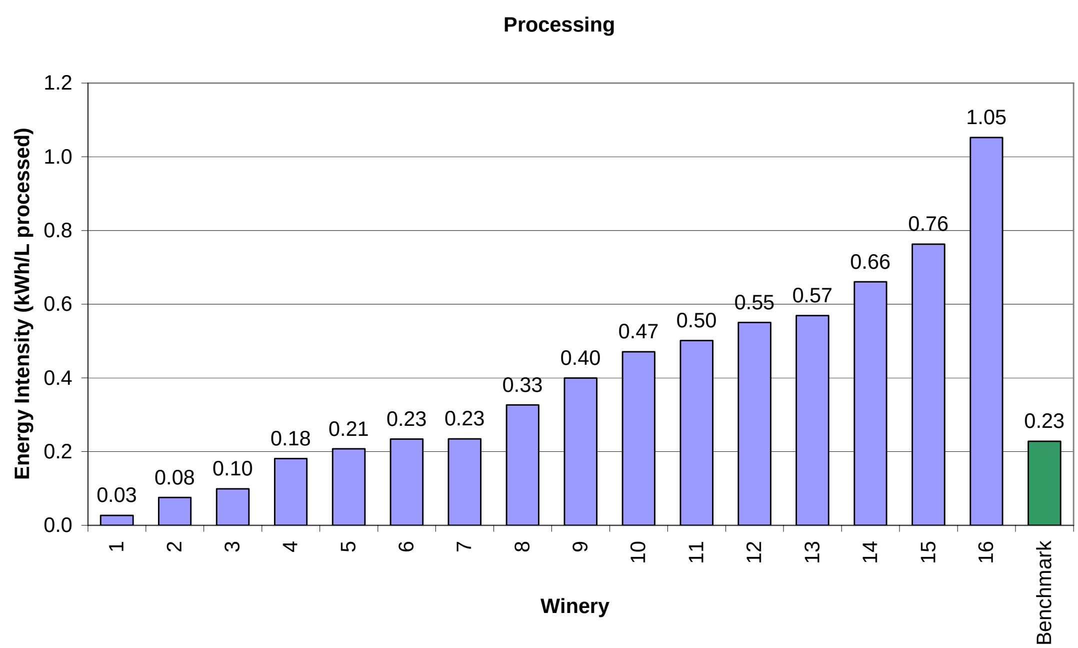


Figure 3.12: Energy use and benchmark for processing (fermentation) process step.

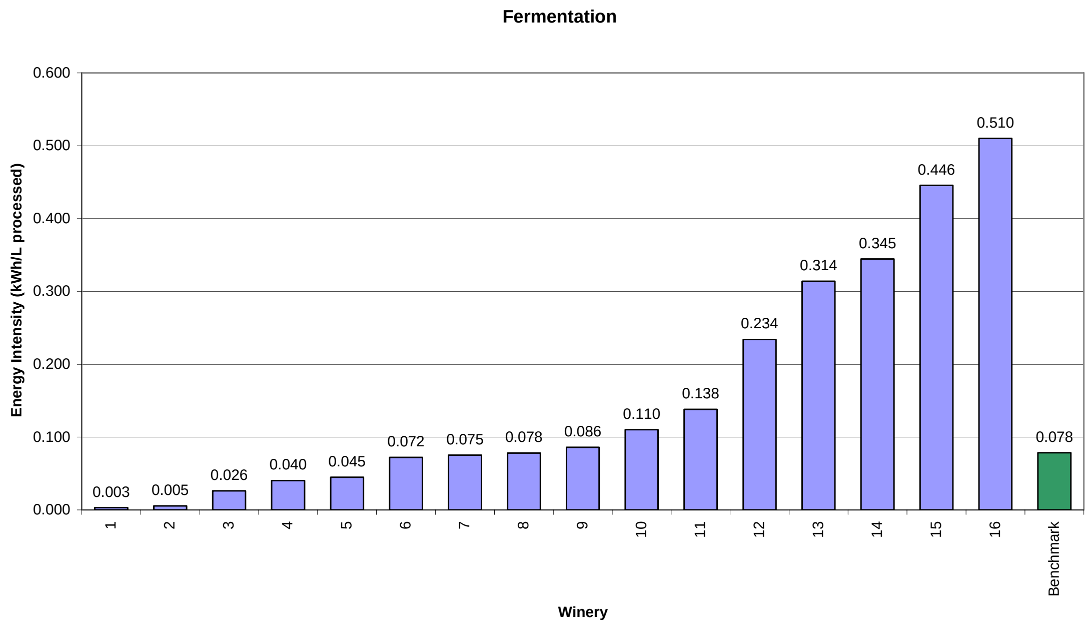


Figure 3.13: Energy use and benchmark for processing (clarification and stabilization) process step.

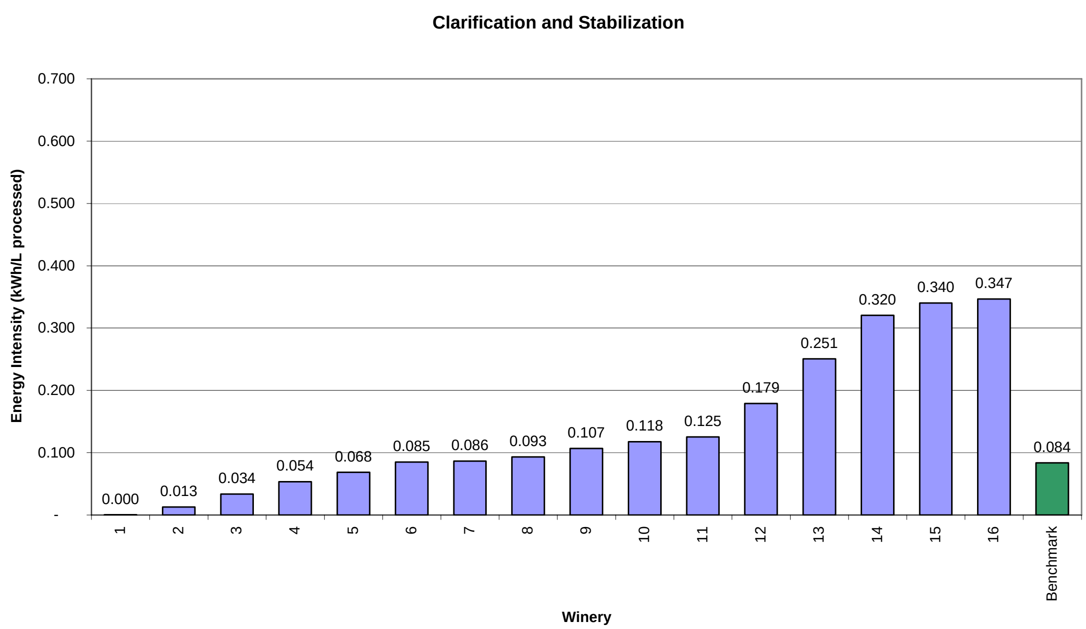


Figure 3.14: Energy use and benchmark for processing (aging/storage) process step.

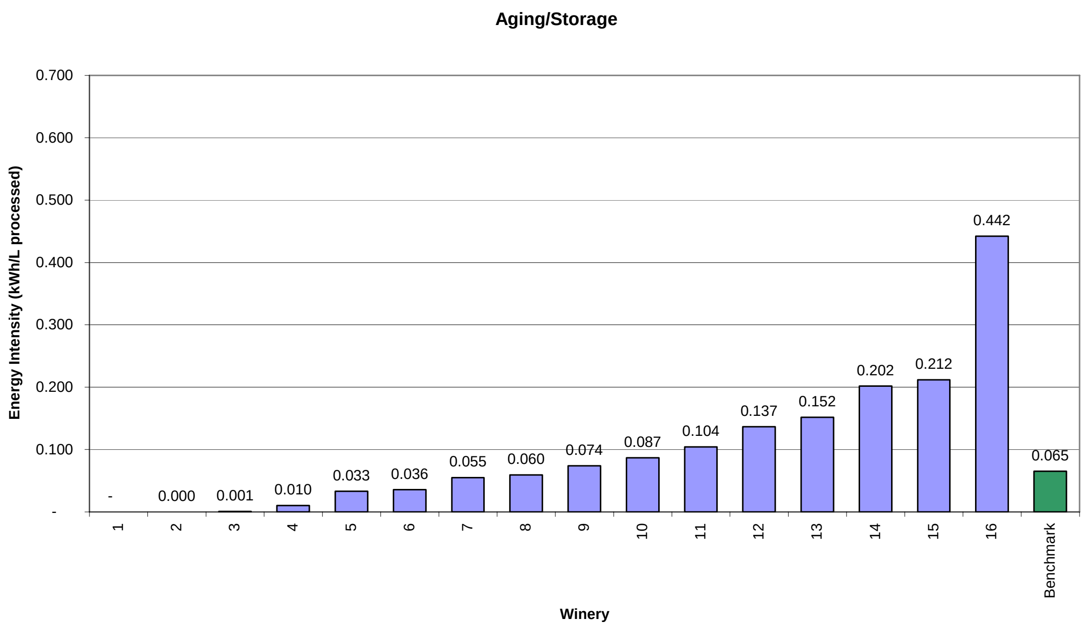


Figure 3.15: Energy use and benchmark for lighting service.

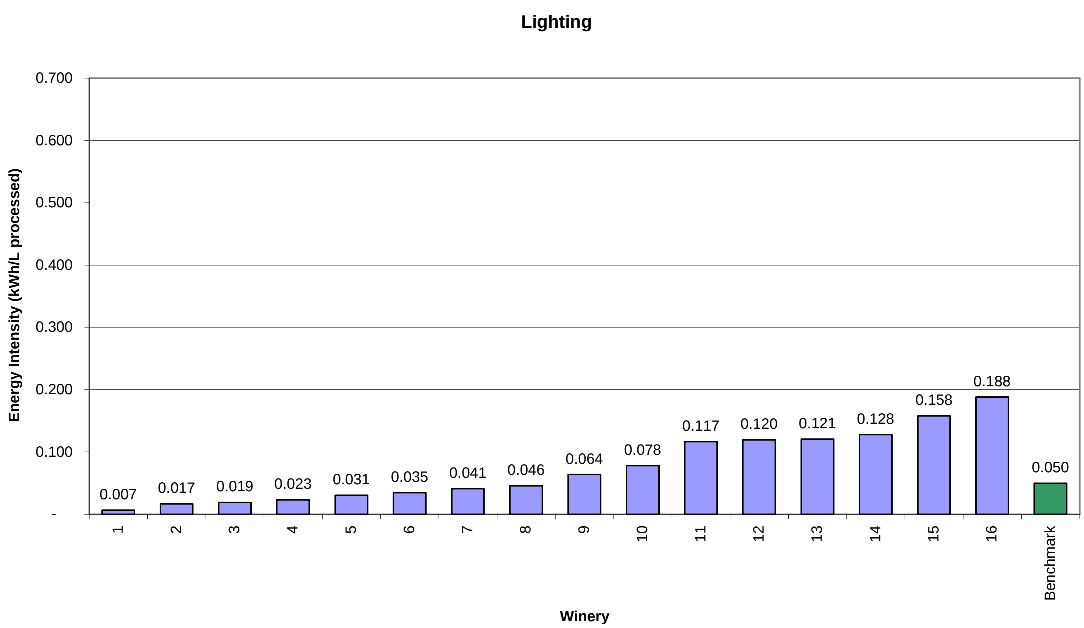


Figure 3.16: Energy use and benchmark for space heating and cooling service.

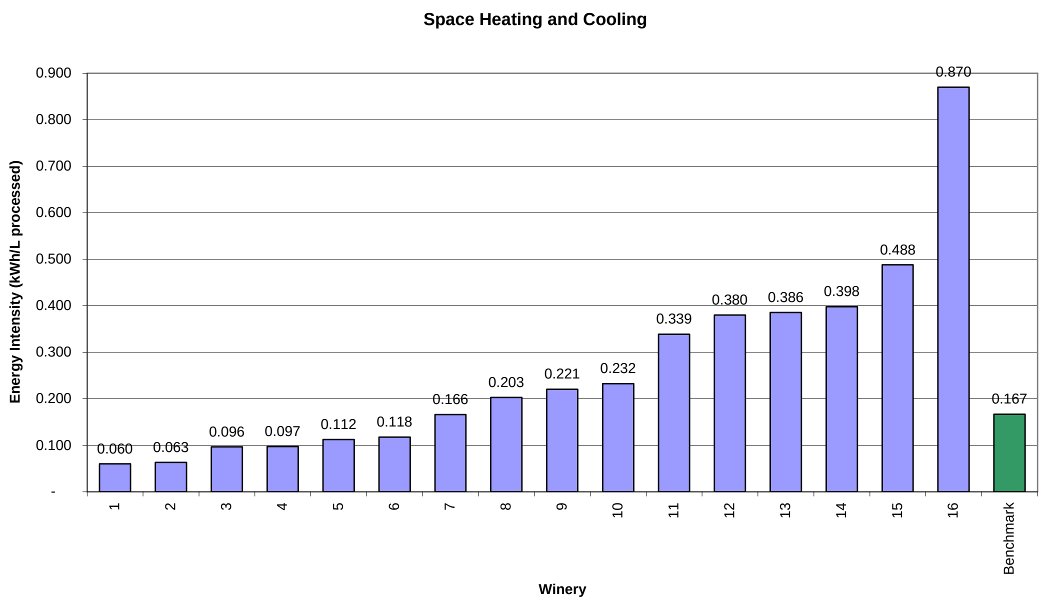


Figure 3.17: Energy use and benchmark for other services.

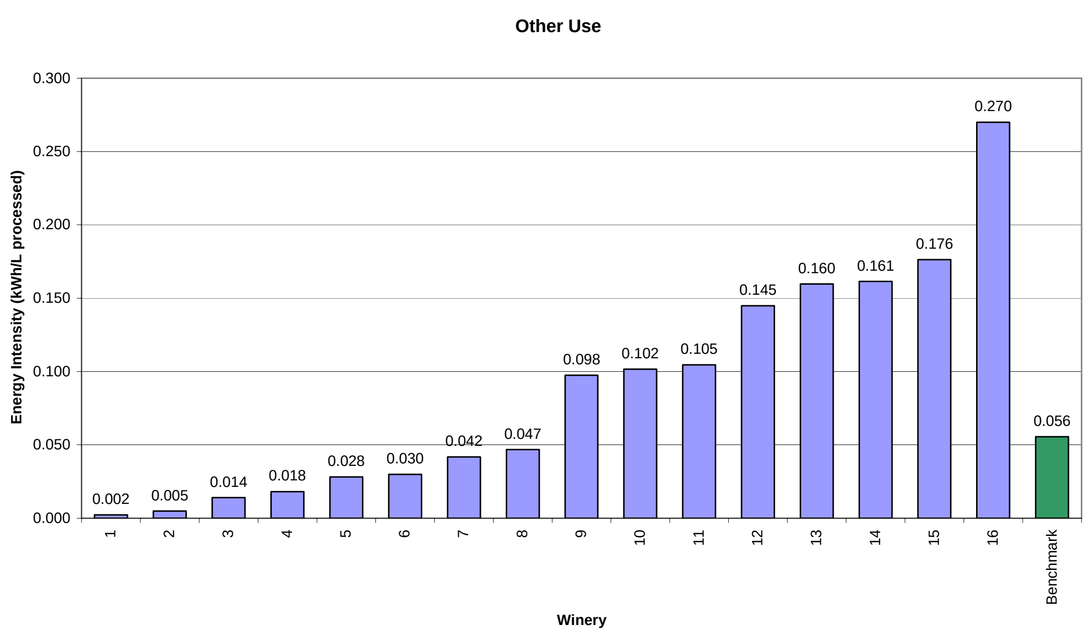


Figure 3.18: Energy use and benchmark for bottling process step.

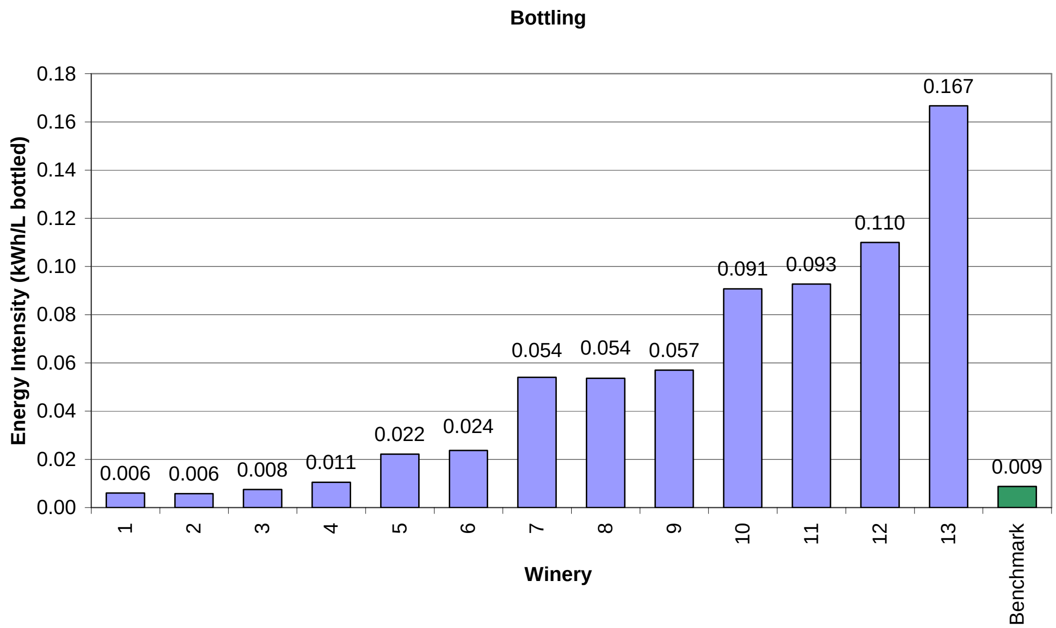


Figure 3.19: Energy use and benchmark for process cooling service.

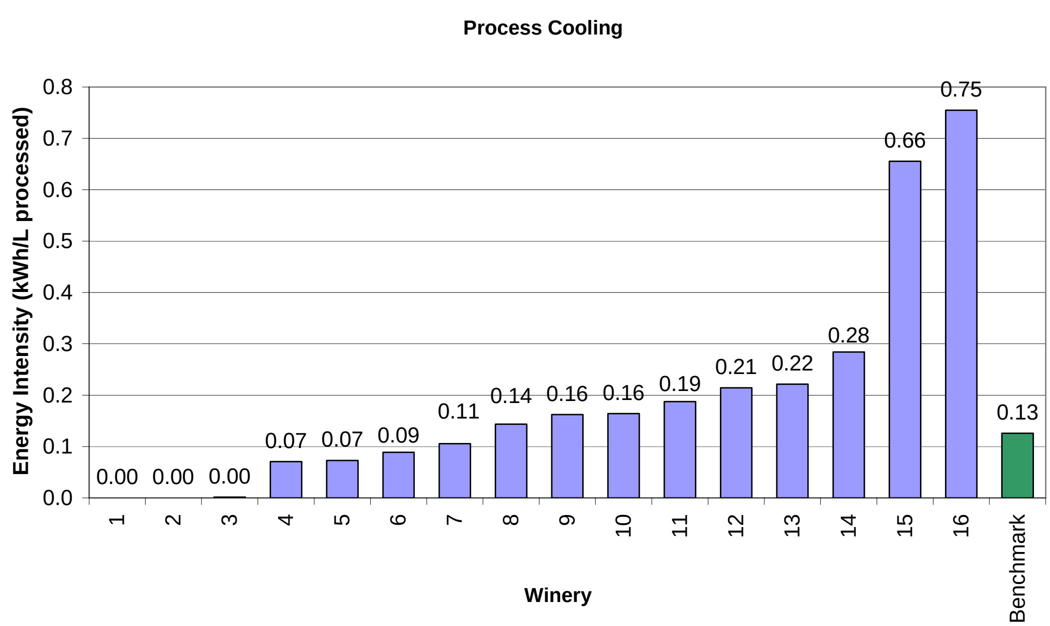


Figure 3.20: Energy use and benchmark for process heating service.

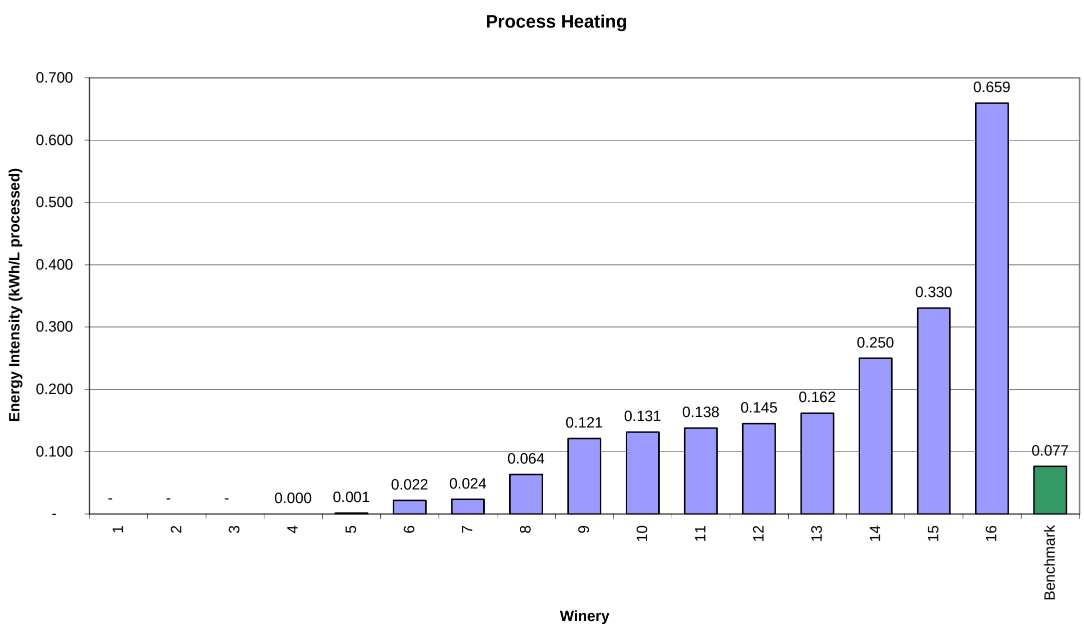


Figure 3.21: Energy use and benchmark for space cooling service.

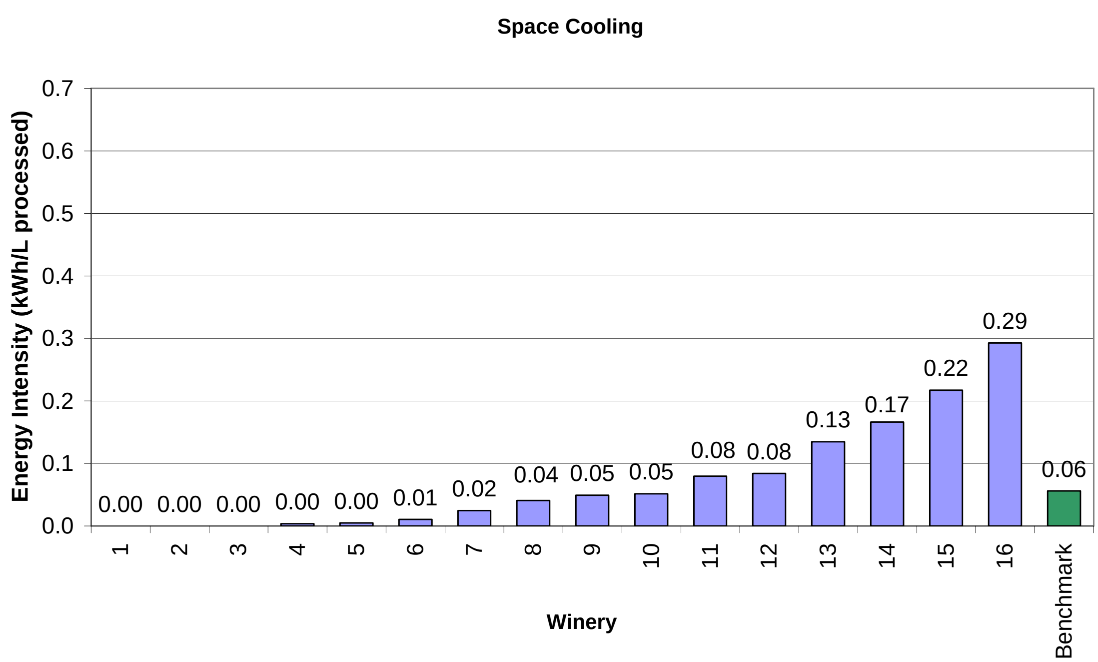


Figure 3.22: Energy use and benchmark for space heating service.

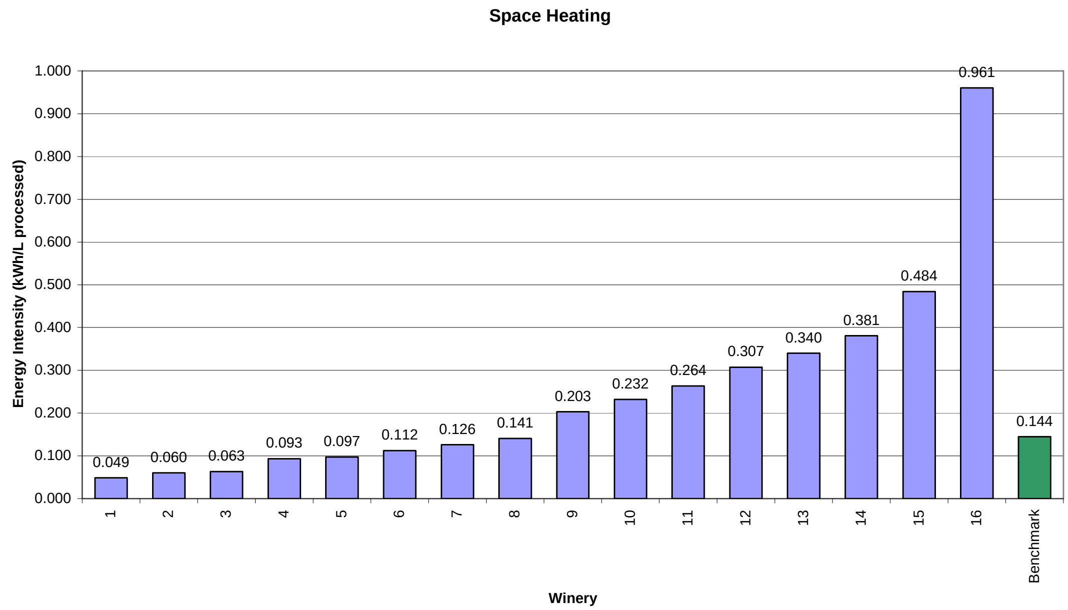
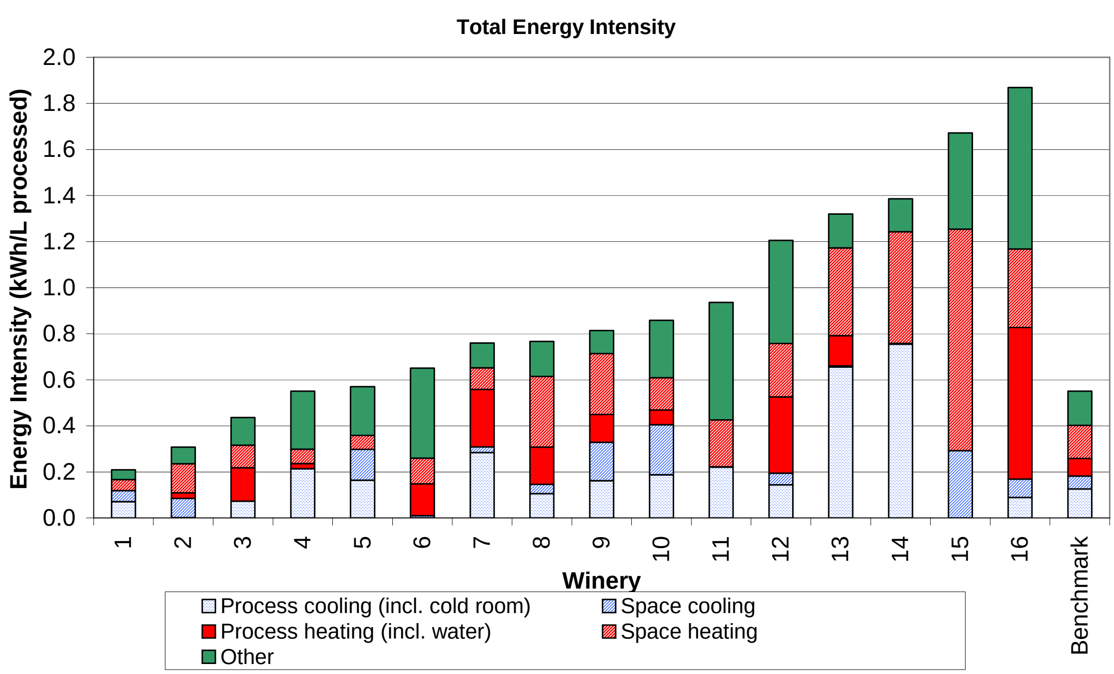


Figure 3.23: Energy intensities by heating and cooling service breakdown.



Based on the assessment of the wineries and their energy intensities the following observations can be made:

- Wineries with an annual production rate of less than 100,000 L/year (labelled as *small wineries*) tend to have high energy intensities when compared with wineries that have higher production rates. This observation is supported by the comparison of average energy intensities indicated in Figure 3.6.

- All the wineries, excluding the small wineries, in the top 25th percentile with electricity as the main energy source (see Figure 3.1), have total energy intensities in the lowest 25th percentile (see Figures 3.5 and 3.23). This correlation implies that wineries where electricity is a significant portion of the energy use mix (close to 80% or more) use energy more conservatively and efficiently than wineries where other fuel sources, especially natural gas, are more predominant in the energy mix. The main driving force for this is believed to be the higher cost of electricity compared to natural gas.

- All the wineries in the top 25th percentile of energy intensity for space heating (see Figure 3.22) have total energy intensities in the highest 25th percentile (see Figures 3.5 and 3.23). This implies that space heating is one of the most significant contributors to a high total energy intensity. Minimizing the amount of space to be heated and optimizing the efficiency and conservation of space heating energy, can be considered as two key strategies that can be used by wineries to reduce energy usage.

- Figure 3.23 highlights specific areas with the highest potential to reduce energy consumption in wineries. This is one of the main benefits of developing energy benchmarks for indivdual wineries. For example, Winery 7 in Figure 3.23 shows a large potential for energy savings related to direct process cooling and direct process heating, while Winery 10 shows high energy savings potential for direct process cooling and space cooling.

- Another advantage of developing energy benchmarks for each winery is that it establishes a baseline against which the winery can evaluate itself in the future. For example, Winery 13 in Figure 3.23 has a total energy intensity of 1.32 kWh/L processed wine for the year 2004. The winery can determine its energy intensity annually and compare it with the 2004 value to assess the impact of implementing energy management strategies.

- The low crop yield in 2005 higlighted the effect of low production rates on energy intensity. Of the participating wineries where sufficient data was available for both 2004 and 2005, ten wineries experienced a decrease in production rate of more than 30% in 2005 compared to 2004. A preliminary assessment of the ten wineries indicated that only one winery reduced its energy usage to the same degree as its decreased production rate. All the other wineries showed increased energy intensities ranging from 60% to 580%, with an average of 260%. The total energy intensity 20th percentile for the nine wineries increased by 93% from 2004 to 2005. This observation emphasizes the need for appropriate energy management strategies during periods of reduced production rates. It also underlines the importance of considering how low production rates can influence the development and interpretation of energy benchmarks.

4. BEST PRACTICES

The site visits conducted during the study provided information to assist in the analysis and interpretation of data. An understanding of the specific wineries and their energy intensities identified areas where wineries with high energy intensities can improve energy efficiency. It also identified ideas and best practices at wineries with low energy intensities, which can be applied to wineries with high energy intensities.

This section provides a summary of these ideas to assist in optimizing energy efficiency. The ideas will be expanded in more detail and incorporated into the companion Energy Best Practices document that is being prepared as a separate deliverable for this project.

Process and Space Heating

- Ensure heated surfaces, including piping and other heat transfer surfaces, are insulated to minimise heat loss.

- Optimizing boiler efficiency which can include air make up flow control, economisers, condensate return, new high-efficiency boilers and appropriate sized boilers.

- Use direct-fired energy instead of a heat transfer medium when possible, e.g. use direct fired natural gas heaters instead of hot water heaters for comfort heating.

- Use radiant heaters instead of convection heaters where possible and applicable.

Process and Space Cooling

- Ensure cooling surfaces are insulated where heat transfer is not desired.

- Make use of free cooling during fall and winter when ambient temperatures are low enough.

- Where possible use underground areas for processes that can benefit from cooler temperatures.

Building Envelope, Lighting and Ventilation

- Minimize window areas to ensure maximum insulation from larger wall areas.

- Minimize the space to be heated or cooled. It is generally more efficient to apply heating and/or cooling directly to insulated tanks (e.g. jacketed tanks) than to control the wine temperature by mechanical room temperature control (e.g. heaters and air conditioning units).

- Keep doors to outside closed when ambient temperature is significantly different from process temperatures.

- Replace inefficient lights with more efficient lights.

- Use controls to automatically turn off lights when not in use.

- Use CO_2 monitors to control exhaust fans for CO_2 removal.

General

- Monitor and track energy usage. Metering energy usage by the winery and by process steps or largest energy consuming equipment will assist in profiling energy usage and identifying energy conservation and efficiency opportunities. Tracking energy consumption will also assist in quantifying energy savings after implementation of energy management strategies.

- Replace motors and equipment, like air conditioning and refrigeration units, at the end of their operating life with more energy efficient motors and equipment. When it is economically feasible, motors and equipment may be replaced earlier with high efficiency versions.

- Use adjustable speed drives (ASDs) or variable speed drives (VSDs) on motors where possible.

- Automate equipment, especially compressors and refrigeration systems, to ensure optimum sequencing and run time.

- Implement a regular maintenance schedule to ensure equipment operates at maximum efficiency.

- Design process flow to follow a logical, energy efficient path from receiving grapes to shipping wine.

- Use gravity to convey liquid and other process material.

- Use equipment that is easy to clean and requires minimum hot water or steam.

- Make use of renewable energy sources when economically and technically feasible.

APPENDIX A: DATA COLLECTION TEMPLATES

WINE COUNCIL OF ONTARIO
ENERGY BENCHMARKING AND BEST PRACTICES IN THE ONTARIO WINE INDUSTRY
DATA REQUEST

This request for data is part of the project to benchmark total energy usage of wineries in Ontario. The project is an initiative of the Wine Council of Ontario (WCO) and is being managed by the Ontario Centre for Environmental Technological Advancement (OCETA).

The steps to obtain the necessary data from participating wineries are as follows:

- Altech Environmental Consulting will contact each winery to explain the project, the types of data required and to arrange for a site visit.
- Altech will forward the data request to each winery approximately one week prior to the site visit.
- The winery can contact Altech directly if they have any questions regarding the data request.
- Altech will visit the winery as arranged. The site visit will be used by Altech to clarify information provided by the winery (where required), to address any information gaps as necessary, and to conduct a walk-through assessment of the winery to identify opportunity areas for energy savings.

To ensure the efficient use of time and human resources, it is requested that the winery provide as much information to Altech in advance of its site visit.

The information required for the benchmarking is indicated in points 1 – 5 below. To facilitate data collection by each winery, a number of tables have been developed to allow each winery to fill in the data. These tables are provided in the attached Excel spreadsheet.

All data provided by the wineries to Altech will be treated as CONFIDENTIAL. Altech can sign confidentiality agreements with each winery.

1. Winery Contact and Location Information

Provide location and contact information on the first page of the spreadsheet.

2. Production data

Please provide the 24 monthly production volumes for the two-year period January 2004 to December 2005 as indicated in Tables 1 – 5 in the spreadsheet.

3. Electricity, natural gas, fuel and water bills

Please provide paper copies of the monthly electricity, natural gas, fuel (e.g. number 2 oil, propane) and water bills for the two-year period 2004 and 2005. If the data is available in electronic format then we would appreciate receiving the electronic copy together with the paper copies of the actual invoices.

If electricity, natural gas and/or water are billed by more than one meter then we require the invoices for all the meters and an indication of which area is monitored by each meter.

4. PROCESS DATA

To determine electricity and natural gas usage by the processes we require the energy rating of the equipment. Please complete Table 6 in the spreadsheet by providing the maximum electricity or natural gas rating of the equipment. This information is available on the nameplate of the equipment, or in the operating and maintenance manuals of the equipment. Use the following terminology when completing the table:

- If a process or equipment is not used at your winery then indicate “N/A” for “not applicable”.
- If a process or equipment is in use at your winery but nameplate data is not available then indicate “U” for “unavailable”.

Table 6 provides separate rows for each piece of equipment. If your winery has more than the indicated number of pieces, or additional process equipment then please add the information at the bottom of the table.

5. OPERATIONAL DATA

To allocate energy usage for room conditioning appropriately we require temperature and dimensional data as indicated in Table 7 in the spreadsheet. Please complete the table with the requested information.

To interpret the energy and water bills correctly, and to classify the energy usage at the winery we require information regarding additional facilities, like wine tasting venues, restaurants, shops and residences, which are included in the invoices. Please complete the table with the relevant information.

Thank you for your assistance and participation. If you have any questions or require clarification, feel free to contact me at 416-467-5555 ext. 230 or e-mail hvanrensburg@altech-group.com.

Henri van Rensburg
Manager – Engineering & Auditing Services
Altech Environmental Consulting Ltd.

Location and Contact Information

Description	Information
Name of Winery	
Wine Region **	
Contact Person	
Address: Street	
City/Town	
Postal Code	
Telephone number	
Fax number	
e-mail	

** (Wine Regions to choose from: Niagara Peninsula, Lake Erie North Shore & Pelee Isl., Prince Edward County or Toronto)

Table 1: Red Wine Production Data

Year	Parameter Unit	Grapes Received Tons	Juice Received Litres	Wine Received Litres	Wine Produced Litres	Wine Bottled Litres	 Cases
2004	January						
	February						
	March						
	April						
	May						
	June						
	July						
	August						
	September						
	October						
	November						
	December						
2005	January						
	February						
	March						
	April						
	May						
	June						
	July						
	August						
	September						
	October						
	November						
	December						

Parameter	2004	2005
Amount fermented (Litres)*		
Wine undergoing malolactic fermentation (Litres)*		
Storage room capacity utilized on average (Liters)		
Wine stored annually (Cases)		
Amount of wine that is cold stabilized annually (Liters)		

*Can also be expressed as % of total amount of juice processed

Table 2: Sweet White Wine Production Data

Year	Parameter	Grapes Received	Juice Received	Wine Received	Wine Produced	Wine Bottled	
	Unit	Tons	Litres	Litres	Litres	Litres	Cases
2004	January						
	February						
	March						
	April						
	May						
	June						
	July						
	August						
	September						
	October						
	November						
	December						
2005	January						
	February						
	March						
	April						
	May						
	June						
	July						
	August						
	September						
	October						
	November						
	December						

Parameter	2004	2005
Amount fermented (Litres)*		
Wine undergoing malolactic fermentation (Litres)*		
Barrel room storage capacity utilized on average (Liters)		
Wine stored in barrels annually (Cases)		
Amount of wine that is cold stabilized annually (Liters)		

*Can also be expressed as % of total amount of juice processed

Table 3: Dry White Wine - Tank Fermented Production Data

Year	Parameter	Grapes Received	Juice Received	Wine Received	Wine Produced	Wine Bottled	
	Unit	Tons	Litres	Litres	Litres	Litres	Cases
2004	January						
	February						
	March						
	April						
	May						
	June						
	July						
	August						
	September						
	October						
	November						
	December						
2005	January						
	February						
	March						
	April						
	May						
	June						
	July						
	August						
	September						
	October						
	November						
	December						

Parameter	2004	2005
Amount of wine fermented (Litres)*		
Amount of wine undergoing malolactic fermentation		
Barrel room storage capacity utilized on average (Liters)		
Wine stored in barrels annually (Cases)		
Amount of wine that is cold stabilized annually (Liters)		

*Can also be expressed as % of total amount of juice processed

Table 4: Dry White Wine - Barrel Fermented Production Data

Year	Parameter	Grapes Received	Juice Received	Wine Received	Wine Produced	Wine Bottled	
	Unit	Tons	Litres	Litres	Litres	Litres	Cases
2004	January						
	February						
	March						
	April						
	May						
	June						
	July						
	August						
	September						
	October						
	November						
	December						
2005	January						
	February						
	March						
	April						
	May						
	June						
	July						
	August						
	September						
	October						
	November						
	December						

Parameter	2004	2005
Amount of wine fermented (Litres)*		
Amount of wine undergoing malolactic fermentation		
Barrel room storage capacity utilized on average (Liters)		
Wine stored in barrels annually (Cases)		
Amount of wine that is cold stabilized annually (Liters)		

*Can also be expressed as % of total amount of juice processed

Table 5: Ice Wine Production Data

Year	Parameter Unit	Grapes Received Tons	Juice Received Litres	Wine Received Litres	Wine Produced Litres	Wine Bottled Litres	 Cases
2004	January						
	February						
	March						
	April						
	May						
	June						
	July						
	August						
	September						
	October						
	November						
	December						
2005	January						
	February						
	March						
	April						
	May						
	June						
	July						
	August						
	September						
	October						
	November						
	December						

Parameter	2004	2005
Amount of wine fermented (Litres)*		
Amount of wine undergoing malolactic fermentation		
Barrel room storage capacity utilized on average (Liters)		
Wine stored in barrels annually (Cases)		
Amount of wine that is cold stabilized annually (Liters)		

*Can also be expressed as % of total amount of juice processed

Table 6: Process Data

#	Process Step	Equipment	Number	Electricity Rating (Provide either kW or HP or V, A and P)					Operation		Natural Gas Rating
				kW	HP	Volt (V)	Ampere (A)	Phase (P)	Total days/year	Average hours/day	BTU/h
1	**Receiving**										
	Unloading	Crane	1								
			2								
	Pumping & Moving	Pump	1								
			2								
			3								
		Conveyor	1								
			2								
			3								
2	**De-stemming and Crushing**										
	Conveyors	Conveyor	1								
			2								
			3								
	Pumping	Pump	1								
			2								
			3								
	De-stemming	De-stemming machine	1								
			2								
	Crushing	Crusher	1								
			2								
			3								
3	**Pressing**										
	Pressing	Press	1								
			2								
	Pumping	Pump	1								
			2								
			3								
4	**Fermentation**										
	Process cooling	Refrigeration system	1								
			2								
			3								
	Mixing in fermentation tank	Mixer	1								
			2								
	Filtering	Filter	1								
			2								
	Cooling of room	Refrigeration system	1								
			2								
			3								
5	**Malolactic Fermentation**										
	Process heating	Hot water or steam system									
	Heating of room	Hot water, steam or direct fired heating system									
6	**Clarification & Stabilization**										
	Process cooling	Refrigeration system	1								
			2								
			3								
	Cooling of room	Refrigeration system	1								
			2								
			3								
	Clarification:										
	Racking	Racking machine	1								
	Cold stabilization	Refrigeration system	1								
	Fining	Fining machine	1								
	Sheet filtration	Filter	1								
	Electrodialysis	Electrodialysis	1								
7	**Storage and Aging**										
	Cooling of room	Refrigeration system	1								
			2								
			3								
	Room humidification	Humidifier	1								
			2								
			3								
	Pumping	Pump	1								
			2								
			3								
	Transport	Forklift	1								
			2								
			3								

Table 6: Process Data (Continued)

#	Process Step	Equipment	Number	Electricity Rating (Provide either kW or HP or V, A and P)					Operation		Natural Gas Rating
				kW	HP	Volt (V)	Ampere (A)	Phase (P)	Total days/year	Average hours/day	BTU/h
8	**Bottling**										
	Filtering	Filter	1								
			2								
			3								
	Pumping	Pump	1								
			2								
			3								
	Bottling	Bottling machine	1								
			2								
			3								
9	**Wastewater Treatment**										
	Aeration	Aerator	1								
	Pumping	Pump	1								
			2								
			3								
	Filtering	Filter									
10	**Other**										
	Lighting	Lights (provide total number of lamps):									
		- Fluorescent									
		- Metal Halide									
		- High Pressure Sodium									
	Space heating	Hot water, steam or direct fired heating system									
	Transport	Forklift	1								
			2								
			3								
11	**Utility**										
	Compressed air system	Compressor	1								
			2								
			3								
	Steam and hot water system	Boiler	1								
			2								
			3								

Table 7: Operational Data

Process Area	Parameter	Red	White			Ice Wine
			Sweet	Dry - Tank fermented	Dry - Barrel fermented	
General production area	Room dimensions - average height (ft)					
	- square footage of area (ft2)					
Fermentation	Room temperature (°C)					
	Fermenting Temperature (ºC)					
Malolactic Fermentation	Room temperature (°C)					
	Fermenting Temperature (ºC)					
Aging and Storage	Room dimensions - average height (ft)					
	- square footage of area (ft2)					
	Room temperature (°C)					
	Average storage period (months/year)					

Are the following facilities included in the energy and water bills? If it is included then provide the applicable data.

Facility	Parameter	Data	Facility is Included in the Following Bills (Answer: Yes / No)		
			Electricity	Natural Gas	Water
Wine tasting	Operation (days/year)				
	Operation (hours/day)				
	Room dimensions - average height (ft)				
	- square footage of area (ft2)				
Restaurant	Operation (days/year)				
	Operation (hours/day)				
	Maximum number of guests that can be accommodated				
	Room dimensions - average height (ft)				
	- square footage (ft2)				
Retail/Shop	Operation (days/year)				
	Operation (hours/day)				
	Room dimensions - average height (ft)				
	- square footage (ft2)				
Residence	Period residence is occupied (days/year)				
	Average number of residence when occupied				
	Dimensions of residence - square footage of area (ft2)				