



Sustainable Winemaking Ontario: An Environmental Charter for the Wine Industry

Sustainable Winemaking Ontario - Energy Best Practice for Wineries

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Energy Best Practice for Wineries

INTRODUCTION

“For many years energy costs for the business have been a flat-line item but now they are rising enormously”

Paul Speck, Henry of Pelham

Energy is integral to the winemaking process. For example, managing temperature during fermentation can use significant amounts of energy. It is both a tool for the winemaker, and a cost of business.

This document is an initiative of the Wine Council of Ontario (WCO). In late 2003 the WCO initiated *Sustainable Winemaking Ontario: An Environmental Charter for the Wine Industry*. The goals of Sustainable Winemaking Ontario are to:

- improve the environmental performance of Ontario’s wine industry
- continually improve the quality of wine growing and winemaking in an environmentally responsive manner
- provide a way to address consumer and resident questions in relation to the environment and the wine industry
- add value to the wine industry in Ontario.

During industry workshops, winery participants identified the reduction of energy consumption, costs and related environmental impacts as one of their priorities. The WCO is very pleased to have received funding from a series of partners to provide wineries with practical information to both reduce their energy costs and their environmental impact.

This document is one of a series that has been developed since October 2004 to support *Sustainable Winemaking Ontario: An Environmental Charter*. Related documents include:

- *Sustainable Winemaking Ontario: An Environmental Charter for the Wine Industry. Eco-Winegrowing 101*
- *Sustainable Winemaking Ontario – Environmental Best Practice for Wineries*
- *Sustainable Winemaking Ontario – Sustainable Viticulture Addendum to the Canada – Ontario Environmental Farm Plan*
- *Sustainable Winemaking Ontario – Environmental Best Practice for Winery Hospitality Services*

- *Sustainable Winemaking Ontario, A Newcomer's Primer: The Environment and the Wine Industry in Ontario*
- *Tracking Sheets for Wineries*. Tracking sheets for consumption and costs of inputs such as electricity, water and cleaning agents for wineries were established and trialed by a number of wineries during Vintage of 2004. These are included as an appendix in this document.

Of these documents, *Sustainable Winemaking Ontario – Environmental Best Practice for Wineries* and *Sustainable Winemaking Ontario – Environmental Best Practice for Winery Hospitality Services* have also been developed as interactive spreadsheets, allowing businesses to instantly receive feedback on their scoring and progress over time.

Energy efficiency is of particular interest to the industry. External funding was obtained for research and workshops related to energy use in wineries. In addition two publicly available documents have subsequently been produced for the Wine Council of Ontario, of which this document is one.

The second document outlines the benchmarking of energy use in Ontario wineries. Undertaken from January to May of 2006, Henri van Rensburg, of Altech Environmental Consulting Ltd., worked with sixteen wineries to identify the benchmarks for the industry in Ontario. The full report, *Developing Energy Benchmarks for the Ontario Wine Industry* is available through the Wine Council of Ontario and Natural Resources Canada. In this document, it is referred to as “the Benchmarking report”. The lessons learnt through that research are reflected in this Best Practice document.

These related energy documents also provide support to the contents of the energy chapter of *Sustainable Winemaking Ontario – Environmental Best Practice for Wineries*.

ACKNOWLEDGEMENTS

Funding for the Energy Project came from a variety of sources including: Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA); the Conservation Bureau division of the Ontario Power Authority; Enbridge Gas Distribution Inc., Agricultural Adaptation Council (AAC), and Natural Resources Canada (NRCan). Additional funding was contributed by the participating wineries, and the Wine Council of Ontario also provided support. Project management was undertaken by Ontario Centre for Environmental Technology Advancement (OCETA) on behalf of Wine Council of Ontario.

The assistance of members of the Technical Committee for the Sustainable Winemaking Ontario is gratefully acknowledged.

The sharing of information and costs by participating wineries is also acknowledged:

Cave Spring Cellars Ltd.
Colio Estates Wines
Coyote's Run Estate Winery
Creekside Estate Winery Ltd.
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
Pele Island Winery Inc.
Pillitteri Estate Winery
Reif Estate Winery Inc.
Stonechurch Vineyards
The Grange of Prince Edward Inc.
Vincor International Inc.
Vineland Estates Winery

Benchmarking for the project was undertaken by ALTECH Environmental Consulting Ltd. (Altech) under the project management of Ontario Centre for Environmental Technology Advancement (OCETA).

CONTEXT: INCREASING COSTS OF ENERGY, VARIABILITY IN COSTS AND ENVIRONMENTAL CONCERNS

The provision of energy in Ontario has moved from being a fairly predictable, highly managed and regulated business to one where there is an increasing number of variables. The regulatory framework continues to change, power provision has been broken up, costs change on an hourly basis and secure supply of power (particularly electricity) is questionable in the long term.

The price of oil continues to rise. Currently trading between US \$55.00 and US \$65.00 a barrel, trend information suggests that the price will remain high rather than returning to the low prices businesses are accustomed to. Increasing demand for energy from China and India adds pressure to the price of oil. At the same time, higher prices for some forms of energy encourage businesses to explore other sources of fuel, such as natural gas. Again, while there may be short-term reductions in price, the trend continues to be higher prices in these alternative fuel sources as well.

The environmental issues associated with energy consumption are also receiving increasing attention. These include poor air quality related to burning of fossil fuels, increasing greenhouse gas emissions and resultant climate changes.

Canadian businesses increasingly identify energy issues and costs as significant concerns. In a survey conducted by the Canadian Manufacturers and Exporters to identify which conditions were better or worse for its member companies, 81 per cent expected energy costs to become more expensive. By far the largest cost squeeze for manufacturers between the first quarter of 2000 and the third quarter of 2005 was energy costs at 72.4 per cent. The availability and cost of energy was identified as a top strategic issue by 41 per cent of companies.¹

Energy Costs are Variable Costs

There is a tendency to consider energy as a fixed cost. It is important to recognize that it is a variable cost, one that can be managed, and one that may be reduced.

A useful way to consider energy in the winery is as a **Strategic Resource**. Some simple questions will help you to consider energy more effectively in your business:

- How much did you spend on energy?
- How much volume did you use?
- Where in the process did you use it?

- What are you doing to manage it?

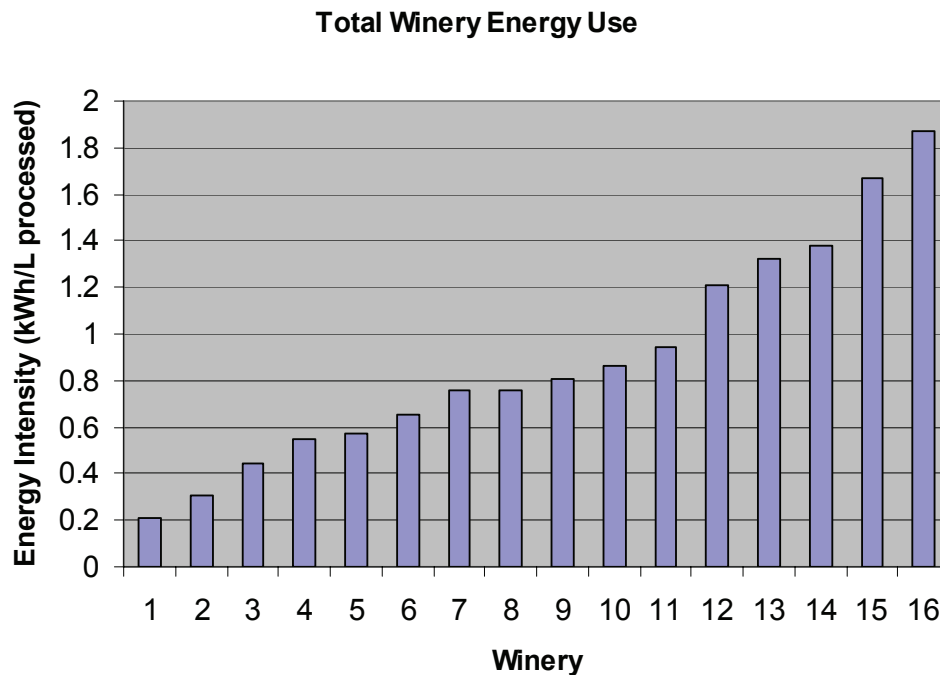
Consistently asking these questions – for example, during quarterly business reviews – helps to increase your ability to manage energy in your business.

To help focus on energy as both a tool and a risk to business, wineries could also ask:

- How much are we prepared to pay for electricity during peak period during Crush?
- What are the costs of a power outage for a few minutes or hours?
- What sort of resilience do we need to build into our production systems and business models? and,
- How can we be proactive in managing our exposure to any increases in energy costs?²

The benchmarking undertaken for Ontario wineries identified a relationship between the size of wineries and energy consumption. The smallest wineries (production of less than 100,000 litres per year) were proportionately less energy efficient than medium or larger wineries. However, there was no relationship between the energy efficiency for different wineries and the age of the operation, or the product mix.³ This means that it cannot be assumed that an older winery is automatically disadvantaged in relation to energy costs. The benchmarking tells part of the story, with efficiencies varying from .21 kWh per litre of wine produced to 1.87 kWh per litre.

Figure 1: Total Winery Energy Use (Excluding Bottling Process Step)

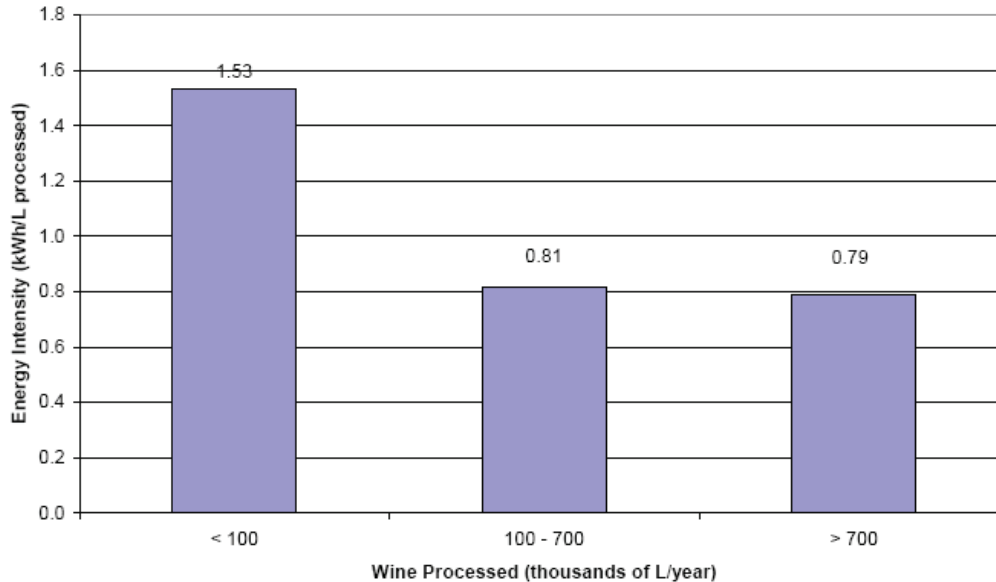


Note: 'Winery' in the above graph refers to the number of wineries that participated, and does not refer to winery size

Source: Altech and OCETA, Developing Energy Benchmarks for the Ontario Wine Industry, 2006, p21.

This range indicates that wineries have considerable variation in the intensity of energy used to produce a litre of wine.

Figure 2: Average Energy Intensity According to Annual Wine Processing Rates



Source: Altech and OCETA, Developing Energy Benchmarks for the Ontario Wine Industry, 2006, pp22.

What does this mean for a business? Every decision in the winery will not revolve around energy. Wine quality, marketing and architectural design all contribute to the positioning of the company relative to its competitors and all are important elements that need to be considered. However, energy efficiency offers an opportunity to improve the finances of a company. The more efficient you can be in energy, the more profit you can make.

HOW BEST PRACTICE HAS BEEN IDENTIFIED

Best Practice is not rocket science. It draws on practical examples with proven results. In Canada, efforts to increase efficiency in industry have been supported by programs funded by a range of organizations, including federal government and industry. For example, work has been undertaken in Ontario, the Fraser Valley in B.C. (for pollution prevention in wineries and breweries), and industries such as brewing, rubber and the

dairy industry. In the wine industry, California and Australia have both undertaken innovative programs to identify different technologies and approaches to reduce the use of energy in processing. An excellent example is BEST Winery Guidebook: Benchmarking and Energy and Water Savings Tool for the Wine Industry (California), which is available on the web.⁴ Details for this resource is included in Further Information.

There is a difference between best *possible* practice and best *existing* practice. Best *existing* practice draws on well established, proven approaches and is the focus of this document. Best *possible* creates stretch goals and encourages people to consider radically different approaches.⁵ A good example of that approach is contained within the Australian document, A Guide to Energy Efficiency Innovation in Australian Wineries, available at <http://www.industry.gov.au/content/itrinternet/cmscontent.cfm?objectID=896D131A-0505-3F44-421B4FFEED12D429> In Ontario, there is considerable scope for improvement in energy efficiency using current, well established approaches and programs.

Other sources of information include the results of programs established by: The Canadian Centre for Pollution Prevention; the Wine Council of Ontario (Sustainable Winemaking Ontario: An Environmental Charter for the Wine Industry); Canadian Industry Program for Energy Conservation (Team up for Energy Savings) and Natural Resources Canada (Energuide for Industry).

While the existing programs and written materials have been reviewed, they do not always apply directly to the Canadian conditions. The outcomes of the energy reviews and results from the Benchmarking component of this project are directly relevant. This Best Practice document therefore builds on both local and international expertise and experience, and has identified specific opportunities for the wine industry in Ontario to improve its energy efficiency.

COMPONENTS OF BEST PRACTICE

Best Practice in any area of a business – whether it's energy efficiency, environmental performance, profitability or service delivery – requires a consistent approach. Best Practice in energy efficiency in wineries involves achieving the desired outcome in terms of quality and quantity of wine, using the least amount of energy at lowest overall cost.⁶

To achieve Best Practice, people must be engaged, processes understood, technologies adapted and results measured. Linked to all of this is accountability, to reinforce the importance of continuously identifying and pursuing better ways of doing business.

People

Best Practice never occurs unless the culture of an organization supports it. People in the organization are both the biggest opportunity and threat in achieving improvements in energy efficiency. There is no point in installing light sensors if people continuously turn them off. Likewise, making sure doors to cool rooms are kept shut, or computers are turned off when not in use or air conditioning requirements in empty areas are reduced all involves individuals making decisions and taking action.

Technologies and Engineering

Dedicated expertise is available in engineering and design for solving specific problems and achieving improvements in energy consumption. There are opportunities for retrofitting elements of the winemaking business. Significant opportunities arise when renovating, extending or commencing a winery.

Processes

Are there ways that the activities in a business can be changed so that there are greater efficiencies? Typically, a review of energy efficiency will examine an activity, such as making wine, and then break it into smaller components. These are then examined and where possible, measured. The document developed as part of this project, Developing Energy Benchmarks for the Ontario Wine Industry, or “the Benchmarking report”, has broken down the processes used in a winery to allow more accurate understanding of energy use, and potential savings.

Wineries can use the results of this work to engage consultants to review their energy performance, or establish in-house expertise to measure and identify potential improvements.

Policies and Procedures

Policies and procedures in an organization can be reviewed to support the development of an energy efficient and environmentally friendly culture.

Where an organization uses structured forms and sign-offs for budgeting and purchasing decisions, amending the forms to include questions on environmental impact and energy performance helps to sharpen attention and consider the implications of decisions.

Reporting regularly at a strategic level, for example at the Executive or Board, on the degree of energy efficiency in the organization, increases transparency and heightens the awareness and accountability about being an energy efficient organization.

REDUCING WASTE

All investments that are made in energy are low risk investments. The returns are not dependent on increasing market access, new product lines or developing new products. In addition to other energy-saving ideas or technologies discussed in this document, by far the simplest, lowest-risk and often ignored approach is to identify waste, and reduce it. Staff is an important resource in reducing waste. Asking them for assistance, as well as making clear that energy is an important aspect of the business which you are determined to manage, will help to identify opportunities to minimize waste.

In terms of a hierarchy of activity, one approach would be to consider the following steps:

1. reduce waste wherever identified
2. invest in the most energy efficient equipment available
3. consider supply alternatives.

If you have limited resources and time, focusing on reducing waste as a first step guarantees you positive returns at no risk, and assists in developing an energy-conscious culture in the organization.

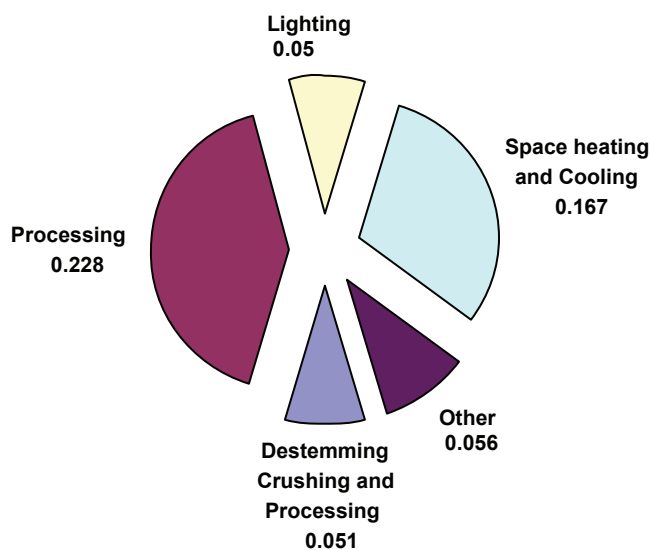
WHERE CAN YOU GET THE BEST SAVINGS?

Benchmarking of the Ontario wineries has identified the energy used by a “benchmark winery.” This was identified as a winery at the 20 per cent consumption mark of all the wineries reviewed in the benchmark study. “The 20th percentile equals the values for which 20 per cent of the wineries have a lower value. It is an indication of the energy intensity that is currently obtained by 20 per cent of the wineries.”⁷⁷ Typically, this will mean that no single winery will have the exact energy profile of the benchmark winery, but it gives wineries a point of reference and comparison.

The energy use benchmark identified was 0.55 kWh/L of wine processed.

Excluding bottling, within the benchmark winery, for each litre of wine processed, 0.55 kWh of energy was consumed (kWh/L processed). Of that 0.55 kWh of energy consumed, the following processes consumed energy:

**Figure 3: Energy Use Benchmarks by Process Step and Service (kWh/L Processed)
(Excluding Bottling Process Step)**



Source: Altech and OCETA, Developing Energy Benchmarks for the Ontario Wine Industry, 2006, p23.

Within the category, “Processing”, energy consumption was further broken down as follows:

Wine Processing	kWh/L Processed
Fermentation	0.078
Clarification and Stabilization	0.084
Aging and Storing	0.065
Total	0.227

This translates to the Processing of Wines (fermentation, clarification and stabilization, and aging and storage) consuming 44 per cent of the energy used in the production of a litre of wine; Space Heating and Cooling consuming 31 per cent; Destemming, Crushing and Pressing 9 per cent; Lighting 9 per cent and “other” 10 per cent.⁸

The energy intensity in the 16 wineries for processing of wines varied from a low of 0.03 kWh/L processed, to 1.05 kWh/L processed.

The actual energy intensity (total energy consumed per unit of production) for the 16 wineries studied varied considerably:

- for **fermentation**, energy intensity ranged from 0.003 kWh/litre processed to 0.510 kWh/litre
- for **clarification and stabilization**, the range was from 0.000 kWh/litre to 0.347 kWh/litre
- for **aging and storage**, the range was from 0.000 kWh/litre to 0.442 kWh/litre.

This range of energy intensity indicates that there is considerable potential for improving energy efficiency in many wineries.

Energy Used in the Winemaking Processes

One of the outcomes of the benchmarking study was recognition that wineries used a mixture of approaches to manage temperature through the winemaking processes. Some wineries did not use tank refrigeration at all to manage their fermentation temperatures but adjusted the ambient temperature of the buildings.

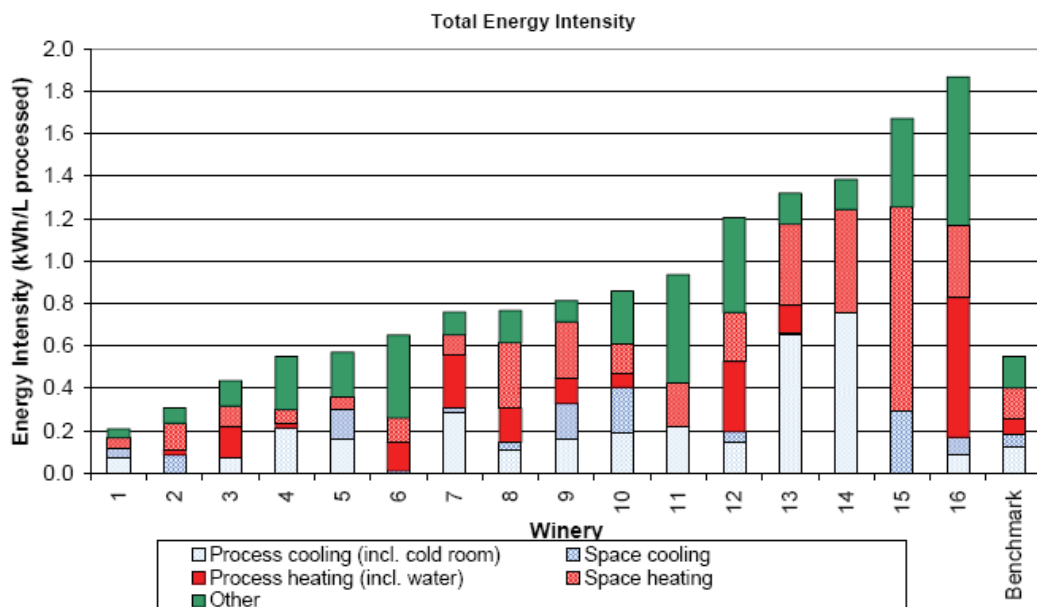
It is important to note that there will be different winemaking philosophies that affect the approaches used. For example, some winemakers will have little temperature control during white wine ferment, others will have very strict parameters to within parts of a degree. These choices reflect differences in winemaking philosophy and approaches to quality.

These variations are reflected in part in Figure 4. Some wineries studied did not use any process cooling (for example, Wineries 2 and 15). Others, including Wineries 5, 11 and 14 did not use process heating.

Figure 4 allows wineries to identify areas that have the highest potential to reduce energy consumption. “For example, Winery 7 ... shows a large potential for energy savings related to direct process cooling and direct process heating, while Winery 10 shows high energy savings for direct process cooling and space cooling”.⁹

Figure 4 is the one of the most important outcomes from the benchmarking work. It shows the range of energy intensity broken into five different areas with a focus on heating and cooling: Process cooling, process heating, space cooling and space heating. For the wineries studied, these four areas comprised 67 per cent of the energy used in the wineries.¹⁰

Figure 4: Energy Intensities



Source: Altech and OCETA, Developing Energy Benchmarks for the Ontario Wine Industry, 2006, p31.

Best Practice is examined in more detail in the following sections. It is arranged to reflect the relative importance of the outcomes of the benchmarking, examining refrigeration and cooling first, then space heating and cooling and then other aspects of the winery energy consumption.

Refrigeration and Cooling

Free Cooling

Winters are a problem for some of us, but they do provide access to free cool air. Wineries can take advantage of this in a number of ways.

Position Tanks Outside

Some wineries have chosen to locate tanks outside of the winery building. This can lead to reduced energy costs in maintaining lower temperatures after fermentation, and during storage of wines. However, there are some potential disadvantages that need to be considered.

From an operational point of view, it may not be possible to access wine stored outside in tanks during winter at different times for bottling or other production. Security may be

an issue, with situations in the past where tanks have been vandalized and product lost. This can be addressed through fencing and other security measures. In addition, architectural and design issues may mean that the winery prefers to maintain all tanks within the building envelope. When new wineries are being established, location of tanks may be a consideration in assisting to obtain planning and building approval.

Manage Access to Cool Air

An alternative to placing tanks outside is to have a controlled access to cool area inside the building envelope. In this case, tanks may be located in an insulated area with good access to outside air. Managing the doorways, for example, can allow the temperature of the winery tanks storage area to be cooled overnight and then kept cooler during the day, without additional energy being required.

Management of this process would include good staff awareness and training, as well as ensuring that the cooler air is maintained where it is wanted and does not lead to expanded heating demands elsewhere in the building.

Refrigeration During Winemaking Processes

Refrigeration during the winemaking process is the approach more often used in wineries. This will inevitably consume energy.

For winery refrigeration systems:

- “Proper maintenance, advanced control systems and operator training are areas that can pay big dividends.
- Small and medium sized winery refrigeration compressors and condensers must be sized for the crush, which lasts only six to eight weeks of the year. Therefore, systems are generally greatly oversized for the balance of the year and efficient operation at reduced capacity is an important area for improvement.
- Because major energy use is of short duration, great care should be expressed in system design. Without great care, energy efficiency measures that pay back quickly in other industries may have extended payback periods for wineries. For example, oversized condensers, variable speed drives (VSDs) on condensers or VSDs on compressors, which are expensive investments, must be evaluated under the annual operating conditions predicted at the winery.”¹¹

It should also be noted that this issue can be exacerbated in periods when there are short crops, due to very cold winters. Wineries should be aware of the significant additional energy costs per unit of production when there is reduced volume being processed. The Benchmarking report noted that:

“Of the ten participating wineries where sufficient data was available for 2004 and 2005, ten wineries experienced a decrease in production rate of more than 30 per cent 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 of the other wineries showed increased energy intensities ranging from 60 per cent to 580 per cent, with an average of 260 per cent This observation emphasizes the need for appropriate energy management strategies during periods of reduced production rates.”¹²

Appendix One includes a detailed examination of approaches to refrigeration and Best Practice considerations in the winemaking process.

Insulation of Tanks

One option for reducing energy costs is to insulate tanks. Insulation has a number of benefits: Cooling is supplied to the tank and not the atmosphere and it provides “thermal insurance” against cooling plant or power failure.¹³

There are three primary forms of tank insulation: Spray-on for large applications, foil over bubble wrap and rigid foam with an outer shell.¹⁴ The “BEST Winery” booklet estimates the energy savings as between 20 and 33 per cent.¹⁵ However, in addition, the ability to more accurately manage the temperature load on the wines can lead to more rapid turnaround in processing. This can lead to increased availability of tanks, reducing the need for additional tanks to be installed.

“Wine Business Monthly” describes tank insulation panel systems as a “no brainer”, arguing that energy savings pay for the cost of the product in a short time.¹⁶ That general statement is not quite good enough for convincing the treasurer.

One estimate of the amount of thermal energy transmitted through the walls of an un-insulated tank is a rate of 1.176 Btuh per square foot of tank wall, per degree Fahrenheit difference in temperature. Standard insulation offered by one producer as a retrofit reduces the rate by 93 per cent.¹⁷

The following is an example of information provided by one producer:

The chart below shows the relative heat gain of a typical 7,000-gallon tank with, and without, insulation.

Such increased efficiency can be extrapolated directly into dollar savings. According to Dove distributor Scott Labs, if this same 7,000-gallon tank is used only

five months a year with a 20 degree Fahrenheit differential, the annual savings in California conservatively calculate to \$980 (see Table One, below). As usage and temperature go up, so do the savings.

Temperature Difference (F)	20	30	40	50
BTUH Savings Per Tank	9,920	14,879	19,839	24,799
Kw/BTUH 3,415	2.905	4.357	5.809	7.262
Cost/Kwh \$0.1882	\$0.55	\$0.82	\$1.09	\$1.37
Hours/day 12	\$6.56	\$9.84	\$13.12	\$16.40
Days 30	\$196.80	\$295.20	\$393.60	\$492.00

Source: <http://www.winebusiness.com/html/MonthlyArticle.cfm?dataid=27895>

Additional benefits of this type of insulation system identified (but not quantified) include:

- reduced maintenance costs
- refrigeration equipment runs less
- improved sanitation: uninsulated tanks can sweat and encourage mould growth and slippery floors, and
- wine quality is assisted by the maintenance of a stable temperature.¹⁸

A practical example of the benefits of insulation was identified at the Niagara Falls plant, Vincor. "Insulation of the cold stabilization tanks had a straight payback period greater than two years based on energy conservation alone. However the insulation would allow the tank contents to reach cold stabilization temperature nine days sooner. The resultant increase in cold stabilization capacity lowered the payback period to 1.5 years."¹⁹

While considering insulation of tanks, insulation of refrigerant lines should also be considered.

It should be emphasized however, that in debate with the treasurer, energy savings are not just about immediate payback. There are ongoing savings for the operation, every year of operation, for the investment made.

Space Heating and Cooling

The Benchmarking report and, particularly, Figure 4 indicates that there are significant opportunities in a number of wineries to improve efficiency in space heating and cooling. Space heating was identified by Altech in their analysis as one of the most significant contributors to high total energy intensity. "Minimizing the 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 use".²⁰

There are opportunities at the design stage to consider the implications of energy use. Construction, for example for renovations or expansion, provides an opportunity to review the building envelope and internal spaces and identify if changes can be made to make the building more energy efficient. The LEED program provides a structured method to consider environmental impacts, including energy impacts, in design and construction.

LEED® Canada for New Construction and Major Renovations version 1.0 is an adaptation of the U.S. Green Building Councils (USGBC) Leadership in Energy and Environmental Design Green Building Rating System (LEED®), tailored specifically for Canadian climates, construction practices and regulations.²¹ Further information is available at http://www.cagbc.org/building_rating_systems/leed_rating_system.php

Stratus is an example of a winery that looked carefully at design and has achieved LEED certification.

Stratus Vineyards Ltd.



"Energy & Atmosphere

Throughout the design and construction of the winery, the design team focused on reducing energy consumption of the building. Starting with the building itself, an east-west orientation was combined with a well insulated envelope to reduce heating and cooling loads. Clearstory windows on the north wall and an interior translucent glazed wall were designed to provide daylighting to both the winemaking areas and the barrel cellars, thus greatly reducing the need for artificial lighting.

Electric lighting was designed to match or have lower lighting power densities than Model National Energy Code (MNECB) allowances, and occupancy sensors were included for further improved energy performance.

In terms of the mechanical systems, a ground source heat pump system was devised to provide heating and cooling for the building and the process. In summary, annual energy consumption has been reduced by an estimated 42 per cent through a combination of process and building system enhancements, including:

- high performance building envelope (windows, walls, and roofs)
- extensive use of daylighting in office and retail areas
- efficient lighting and occupancy sensors
- ground-source heat pump system, and
- high efficiency boilers for tank wash-downs."²²

Source: Canada Green Building Council, LEED Certified building case studies, Stratus Vineyards Ltd., available at http://www.cagbc.org/green_building_projects/leed_certified_buildings.php?id=15&pres=1&draw_column=3:3:2

Other wineries have designed their spaces to be within existing buildings, which might also include heritage buildings. There are options available in existing buildings to increase the energy efficiency of space heating and cooling.

Efficient management of heating, ventilation and air conditioning (HVAC) reduces costs and is outlined in more detail in a later section

The Benchmarking report recommends that wineries improve energy efficiency and energy conservation for space heating and cooling. Recommendations address temperature settings, proper maintenance, upgrading equipment as feasible and identifying the best technologies for different areas.

Temperatures should be set at what is considered optimum for the use of the room. For example, temperatures can be set back when higher temperatures are not required. Likewise, in summer, temperatures can be increased so that space is not over-chilled. Balancing of heating and cooling units should be assessed regularly; if members of staff in summer in some areas are so cold that they are using radiant heaters while the air conditioner is working, then regular evaluation and rebalancing of the air heating and cooling systems is required.

Maintenance of equipment is essential. Significant losses of efficiency can occur with boilers, water heaters and air conditioners. More detailed information is included in the following sections. It should be noted that there are a significant number of opportunities for increased efficiency that do not cost a lot, or are very low cost. Again, these are outlined in more detail in the following sections.

In wineries, as with many other businesses, growth can occur sometimes in an ad hoc way. Time and attention is likely to be focused on production and other issues can be lost. A good example is with equipment that may have been installed for some historical use and later the original use has changed. This can lead to equipment being oversized, and work practices continuing without close analysis. Assessing hot water systems and the use of hot water in the cellar, for example, can provide opportunities to identify both savings and efficiencies. As buildings change, there may be an opportunity to replace older equipment with more efficient units. Any time equipment is due for replacement, it is good practice to seek out the most energy efficient unit and consider ongoing savings.

Finally, it is good practice to identify the best technologies for space heating and cooling. One approach may be to use infra-red heating systems. This can reduce the heating costs by up to 30 per cent.²³ The Office of Energy Efficiency provides information on high efficiency equipment for businesses and commercial operations. Details are provided for air conditioning and refrigeration equipment, boilers and steam distribution systems, as

well as lighting. Further information is available at <http://oee.nrcan.gc.ca/commercial/equipment/index.cfm?attr=20>

Aging and Storage

Wine may be stored in barrels for some time, and finished wine in bottles also needs to be stored at an appropriate temperature to ensure quality is maintained. If air conditioning of these areas is required, then care needs to be put into the design and operation of these systems, as well as ensuring that movement of people and goods into these areas minimizes the loss of chilled air.

In existing buildings, attention to insulation of these areas can assist in reducing energy costs. This may include the addition of extra insulation, paying attention to ease of cleaning of the material applied.

Where there is an expansion of the winery – for example, the barrel cellar– placing the barrel cellar underground can substantially reduce energy costs. In this case, the thermal qualities of the soil keep the temperature uniform. Humidity levels, however, still need to be monitored and managed to ensure that there is not excessive evaporation.

Huff Estates

Huff Estates is a recently opened winery in Prince Edward County. As part of the design and construction, the barrel cellar was established by excavating soil and building it partially underground. The cellar, on completion, was covered with more soils and turf was established.



RENEWABLE ENERGY – OFF THE CARBON

All of the wineries included in the Benchmarking study relied on carbon-based energy: electricity, gas, diesel and/or propane. None used renewable energy. If the Benchmarking is repeated in a number of years, one future benchmark may be to identify the changes in the levels of the use of renewable energy.

For purposes of the Benchmarking study, if a winery had produced energy from local renewable sources such as wind, solar or geothermal energy managed and owned by the winery then energy consumed from these sources would have been excluded²⁴. As the report noted, “These energy sources are considered to provide free energy, in terms of consumption and demand, and have a zero impact on air quality when compared with carbon-based fuel sources.”²⁵ There are, of course capital costs and ongoing maintenance systems that must be considered.

Generation of energy by renewable sources is a component of Best Practice. Wineries in Ontario currently employ geothermal energy and solar energy, as well as incorporating passive solar techniques into the design of the building.

Including renewable energy into your winery business reduces your dependence on external sources of sources of energy. This provides more security of supply when there are potential overloads in the energy grid system, as has been experienced in Ontario.

Renewable energy generation also reduces your ecological footprint, reduces the carbon generated from your business, and can assist in positioning your business as a more environmentally friendly enterprise.

An excellent resource available is the RETScreen International Clean Energy Decision Support Centre. Available at <http://www.etscreen.net/ang/menu.php>, this free, downloadable software tool and accompanying information allows wineries, consultants and others to “evaluate the energy production, life-cycle costs and greenhouse gas emission reductions for various types of proposed energy efficient and renewable energy technologies, compared to conventional energy projects.”²⁶ In addition, there are extensive case studies for a range of technologies, including wind energy, photovoltaic, combined heat and power, biomass heating, solar water heating, passive solar heating and ground source pumps available at http://www.etscreen.net/ang/12_case.php

There are also excellent resources and constantly emerging new technologies. Importantly, the costs of different technologies are also reducing. Additional resources are included in **Further Information**.

Flat Rock Cellars

Flat Rock Cellars demonstrates a number of Best Practices in energy efficiency.

At the design phase, attention was paid to reducing the amount of energy used in moving the wines, through the use of a gravity system. Fruit is delivered at the top of the winery and different winemaking processes are undertaken at lower levels of the winery.

Natural light is also used in the winery, reducing the need for artificial light.



The winery uses geothermal energy for all of its process refrigeration, and space heating and cooling needs.

Building Best Practice

*How do you rate? Check **Appendix Two** from Sustainable Winemaking Ontario – Environmental Best Practice for Wineries.*

Planning and Monitoring

Planning and monitoring includes identifying people to be responsible for energy management in the business, being able to measure and track energy consumption, and have systems in place to review progress.

One way to obtain Best Practice is to incorporate questions on energy efficiency whenever related decisions are made. These include: Changes of process, purchases of equipment, decisions about refurbishment of equipment, renovation and expansion of existing buildings, or construction of new buildings.

Critical decision-making points include: Identification of a need (for example, identified by a winemaker), identification of type of equipment required, costing for submission and sign-off by the person who controls the budget.

In larger organizations, purchasing departments or officers can be key players in making good decisions that incorporate energy efficiency.

The purchase of pumps is an example of the benefits of looking at the larger energy implications. In a winery, pumps may be used for refrigeration systems, water systems and pumping product.

“It is important to note that initial costs are only a fraction of the life-cycle costs of a pump system. Energy costs, and sometimes operations and maintenance costs, are typically much more important in the lifetime costs of a pump system. In general, for a pump system with a lifetime of 20 years, the initial capital costs of the pump and motor make up merely 2.5 per cent of the total costs. Energy costs, however, make up about 95 per cent of the lifetime costs of the pump. Maintenance costs comprise the remaining 2.5 per cent. Hence, the initial choice of a pump system should be highly dependent on energy cost considerations rather than the initial costs.”²⁷

Developing an Energy Culture

- ☑ Identify someone responsible for the energy program. This person can lead the program and help “make it happen”. If it is no-one’s responsibility to check the accounts and take ownership then it is unlikely that energy initiatives will be successful. One mechanism to assist this is to tie the energy program to individual performance objectives.
- ☑ Establish systems to regularly review energy costs and consumption and compare these year to year.
- ☑ Identify and engage a champion: someone at a senior level, for example, the CEO or President, who can enthusiastically support and acknowledge the work that has to be done. The champion can be an important asset in reducing bureaucratic roadblocks that make it “too hard”.
- ☑ Involve your staff: recognize that many good ideas are already in the workplace. This can involve the establishment of an energy team if the organization is large enough, or one or two key personnel if it’s a small organization.
- ☑ Amend forms used in decision making and reporting (for example, equipment investment) to identify initial energy efficiency and ongoing energy requirements.
- ☑ Report back on progress made in a structured way to senior levels of the organization.

For further information on engaging the whole of the organization, refer to Team up! for Energy Savings. A Guide for Building an Energy-Saving Culture in the Workplace available at <http://www.nrcan.gc.ca/industrial>

To **monitor performance**, it is critical to measure and track energy consumption:

- ☑ Collect and review all consumption of energy, both in units and dollar value.
- ☑ If several operations run at the one site – for example, the winery and a hospitality function – then consider installing separate meters for each area to keep more accurate records of energy use.
- ☑ Install meters at different points of the winery so that more detailed tracking and analysis can take place.
- ☑ Analyze the kWh per litre of production.

Additional monitoring can be an important tool in allowing a better understanding of the energy consumption and savings for the business. The increased cost of additional meters is offset by the ability to gain a clearer view of the energy consumption of different areas and focus on areas to reduce waste.

Energy Economics

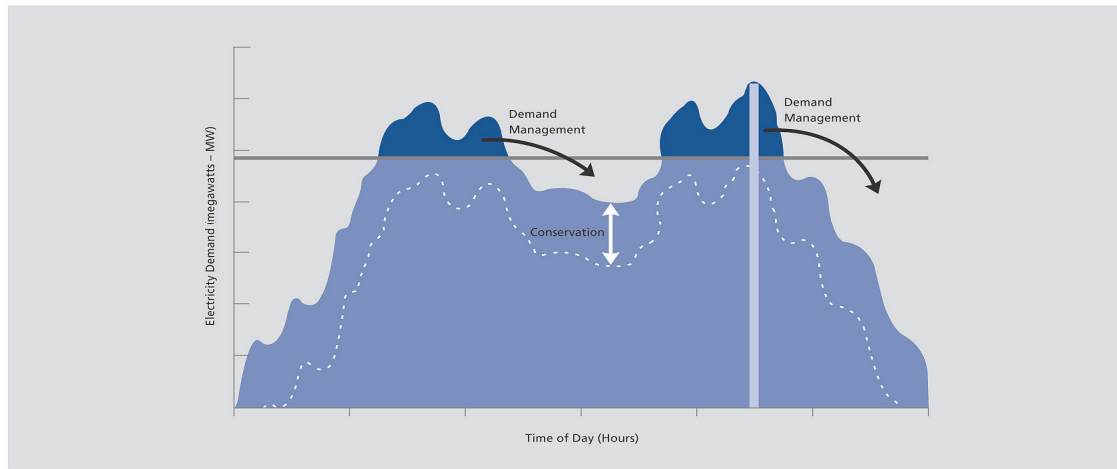
Electricity

In Ontario, market rates apply to all businesses that use over 250,000 kWh per year. Electricity provides 66 per cent of the total energy used by wineries.²⁸ The market price for electricity is different for every hour of the day. For example, on March 14, 2006 the price ranged from 2.8c/kWh at 4:00 a.m. to 8.7 c kWh at around 3:30 p.m.²⁹ From 2002 to 2006, the average weighted hourly price varied from 3.0 c/kWh to 9.97 c/kWh in September of 2005.³⁰

This variation in price can provide opportunities for businesses. Tools to assist this include: interval meters, load shifting, identifying whether a fixed price contract will provide an advantage and energy conservation.

Interval meters measure electricity use and record that usage for each hour of the month. The data provided can assist in determining when, where and how much electricity is being consumed. These meters provide another tool for management, including deciding whether load shifting is appropriate.

Figure 2
Components of Conservation and Demand Management



Source: Conservation Bureau, 2005³

Source: Sean Brady, Director Industrial and Agricultural Program, Conservation Bureau, June 27, 2006.

Load shifting refers to the practice of rescheduling operations to period of the day when the cost of electricity is lower.

Other approaches include the installation of standby generators for “peak lopping” to reduce loads during peak periods where the price of electricity is highest.

Advantages and disadvantages of these methods are available through the Ontario Independent Electricity System Operator (IESO), [The Bottom Line on Energy Management: Making Ontario’s Electricity Market Work for your Business](http://www.ieso.ca/imoweb/pubs/bi/em_bottomLine.pdf), available at http://www.ieso.ca/imoweb/pubs/bi/em_bottomLine.pdf

- ☑ Consider installing interval meters.
- ☑ Identify operations that can take place in off peak (lower cost) periods.
- ☑ Identify activities such as maintenance that requires shut-down of equipment that can occur in high peak periods.

Natural Gas

The price for natural gas for Ontario is determined by a range of factors. Factors that tend to put downward pressure on prices include: New supplies becoming available, new pipe, which increases access; and good quantities of storage being maintainable. Upward

price pressures come from increasing demand; the impact of the weather (including hurricane impacts); the price of oil and the degree of political uncertainty in different parts of the oil-producing and natural-gas-producing world.³¹

Prices for natural gas in Ontario are established by the Ontario Energy Board (OEB), which approves the rates based on market pricing. Two charges are involved: A commodity price, and a delivery price. The prices charged to businesses lag the prices established by the OEB by about six months.

Refrigeration Systems

There are seven Best Practice considerations for energy-efficient refrigeration systems in wineries:

- ☑ Reduce the load as low as possible – cool only that which needs refrigeration. Other options may include pre-cooling using cooling fluids, such as water at ambient temperatures, product-to-product heat exchange, or, where available, cool air.
- ☑ Size condensers and evaporators to reduce temperature lift by maintaining the lowest practical condensing temperature and the highest effective evaporating temperature.
- ☑ Avoid or minimize head pressure control.
- ☑ Determine the most efficient compressor/refrigerant combination for the application.
- ☑ Insulate the suction line.
- ☑ Ensure the system is leak free and contains the right type and amount of refrigerant.
- ☑ Regularly clean condensers and evaporators (air systems only).³²

Appendix One includes information on Best Practices for refrigeration systems.

Compressed Air

Compressed air is identified as, “Probably the most expensive form of energy used in an industrial plant because of its poor efficiency. Typically efficiency from start to end-use is about 10%. Because of this inefficiency, if compressed air is used, it should be of minimum quantity for the shortest possible time, constantly monitored and weighed against alternatives.”³³

Wineries typically used compressed air in bottling lines as well as other parts of the winery. At 100-psi (pounds per square inch) a 10HP (Horsepower) air compressor consumes about \$7,000 worth of hydro per year, working 40 hours per week, based on \$0.09 per kWh. Leaks in these systems cost money:

- 1 mm = 1.0 L/s and \$18 per month
- 3 mm = 10.0 L/s and \$198 per month
- 5 mm = 26.7 L/s and \$540 per month
- 10 mm = 105.0 L/s and \$2124 per month³⁴.

Efficiencies can be obtained through maintenance and management, and the use of control equipment.³⁵

- ☑ Reduce compressed air system use by 20–50% with efficiency improvements.
- ☑ Use cooler intake air for compressors to reduce air-compressed energy use by 1% per 5°C. Payback is usually less than two years.
- ☑ Repair air leaks to reduce compressed air system energy use.
- ☑ Install or adjust unloading controls to reduce compressed air system energy use by about 10%.
- ☑ Recover air compressor waste heat.
- ☑ Purchase an ultrasonic monitor to find air leaks. These monitors cost around \$400.

Best management practices include compressed air management, system management and record keeping.³⁶

- ☑ Replace compressors with the most efficient type available when justified.
- ☑ Generate compressed air at the lowest pressure required.
- ☑ Use intake air from the coolest location, for example by direct ducting of fresh air from outside.
- ☑ Discharge air from air-cooled compressors outdoors during summer.
- ☑ Use waste heat from air-cooled compressors as an indoor heat source during winter.
- ☑ Recover heat from air compressor cooling water.
- ☑ Switch off compressors when production is down.
- ☑ Compress low production periods to avoid stops and starts of large compressors.
- ☑ Use reciprocating compressors and shut down screw compressors if partial loads are needed.
- ☑ Check compressor efficiency regularly and maintain records.

Further detailed information on compressed air used in wineries is available in BEST Winery Guidebook: Benchmarking and Energy and Water Savings Tool for the Wine Industry, pages 29–35, available at http://www.energy.ca.gov/pier/final_project_reports/CEC-500-2005-167.html

Boilers³⁷

There is considerable information available on increasing efficiency of boilers. For example, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) in 2003 produced a document which provided tips for energy savings for boilers, as well as other equipment. A typical boiler has a combustion efficiency of 75 per cent to 80 per cent. Typical losses just in the fuel during operation can come from the boiler envelope (4 per cent), the flue gasses (18 per cent) and the blowdown (3 per cent).

Energy efficiencies can come through maintenance and management, the installation of control equipment and blowdown technology. Best Practice includes boiler management, steam management, stack emissions management and record keeping:

- ☑ Set up a chemical treatment program to reduce scaling and fouling of heating services. This should be closed-loop system to make sure that it does not add to water treatment problems.
- ☑ Establish a maintenance program for de-scaling both sides of the heat transfer interfaces.
- ☑ Set up the boiler to achieve optimum combustion efficiency.
- ☑ Stop extra air moving into the combustion chamber.
- ☑ Reduce boiler blowdown levels and frequency to the minimum.
- ☑ Set up a steam management program.
- ☑ Identify and stop steam and condensate leaks.
- ☑ Insulate steam, hot water and condensate return lines and components.
- ☑ Decommission redundant steam and condensate return pipes.
- ☑ Collect all possible condensate and return to boiler make-up water tanks.
- ☑ Check flue gas, oxygen and carbon monoxide levels regularly with a manual or automatic flue gas analyzer.
- ☑ Evaluate the flue gas heat recovery system for pre-heating of feedwater and/or boiler intake.
- ☑ Keep records by checking boiler efficiency regularly and maintain those records.

Heating, Ventilation and Air Conditioning

As with many of these approaches, good housekeeping approaches, keeping people informed and constantly involved and appropriate maintenance provide opportunities for savings.

Actions that are low or no-cost (change of process, activities with a payback of six months or less)³⁸ include:

- ☑ Lower the heating temperatures to storage areas to as low as possible

- ☑ Install setback timers on thermostats controlling space heating during non-working hours
- ☑ Use de-stratification ceiling fans in areas with high ceilings
- ☑ Ensure outside doors are closed
- ☑ Shut down exhaust or supply fans during non-working times, except when essential for health and safety
- ☑ Review the condition of HVAC equipment, such as the function of louvers, control valves and temperature controllers, and correct as necessary
- ☑ Clean or exchanging intake filters regularly
- ☑ Check the adequacy of ventilation; use the minimum acceptable ventilation
- ☑ Fit blinds or heat-deflecting film on sun-exposed windows
- ☑ Install variable speed drives on HVAC systems

Activities with a medium cost (retrofit of buildings or equipment required; payback period is three years or less) include:

- ☑ Install infrared heating for large open areas to heat people rather than space; these are more efficient than steam or hot water heating radiators, unless waste heat can be used to act as the heat source for the radiators
- ☑ Check the envelope of the building and reduce unwanted infiltration of air for example reseal cracks, repair or replace doors

Actions with a capital cost (new equipment required; payback three years or more) include:

- ☑ Use reflective insulation, or painting flat roofs over refrigerated areas white
- ☑ Evaluate the application of regenerative rooftop heat recovery systems
- ☑ Consider the applicability of green roof installation for reduction of heat loss, additional insulation and stormwater management; if this option is considered, good technical advice will be needed and appropriate engineering required to ensure effectiveness and safety.

Pumps and Motors

In wineries, pumping energy needs can account for a large proportion of energy needs. In the U.S. context, this has been measured as between 10–15 per cent of electricity consumption.³⁹ However, pump efficiencies may vary from 15–90 per cent, which demonstrates potential for efficiency improvement.⁴⁰

Wineries use pumps to move product around, and pumps are found in refrigeration systems and in water systems. Choice of pumps becomes particularly important for product handling. “For example, lobe pumps are suitable for pumping fluids with

suspended solids, (e.g. must and lees), while centrifugal pumps are mostly used for moving wine between tanks and for pumping water.”⁴¹

A number of wineries on Ontario have chosen to reduce the amount of pumping through design elements in the winery that use gravity. Stratus and Flat Rock Cellars are example of wineries that incorporate gravity systems into the winemaking process. This is often a decision allied to the winemaking philosophy, and not necessarily driven by energy considerations.

When more pumps and motors are used in the winemaking process, then decisions at purchase can reduce the ongoing costs to the winery. Information on pumps – hints on purchasing more efficient pumps, sizing and maintenance – is available through Natural Resources Canada at

<http://oee.nrcan.gc.ca/industrial/equipment/pumps/purchasing.cfm?attr=24>

Efficiency of equipment can be improved by:⁴²

- ☑ upgrading to an energy efficient motor; this will save 5 per cent over the operating costs of a standard motor
- ☑ upgrading to a three-phase high efficiency motor to reduce energy and demand costs
- ☑ installing a monitoring and tracking system to identify electrical loads for specific production functions

Best Practice actions include:

- ☑ Identify motors that idle excessively and shut down motors when not needed
- ☑ Replace standard electric motors with high-efficiency types when replacement is necessary
- ☑ Replace motors that operate at less than their optimum rated load with smaller high-efficiency units
- ☑ Install variable speed drives and improved controls
- ☑ Maintain screw compressors at full load when reciprocating compressors and screw compressors are used in parallel; when partial loads are required, use the reciprocating compressor and shut down the screw compressor

Other considerations include: Ensuring maintenance and monitoring, reducing pumping need, developing a control strategy to shut off unneeded pumps or reduce load until needed, ensuring the correct sizing of pumps and pipes, identifying the most efficient pumps for the use required; utilizing precision castings, coatings and polishings that reduce surface roughness, using multiple pumps, trimming impellers, using adjustable speed drives to match the speed of the pump to the load requirement and replace belt drives.⁴³ Further details are available at BEST Winery Guidebook: Benchmarking and

Lighting – Shops and Facilities, Offices and Outdoor

Dust and grease on lighting fixtures can reduce the light that reaches the target area by as much as 30 per cent. Light fittings should be cleaned regularly, at least every two years. More regular cleaning is required if they are located in greasy, dusty or smoking areas and when the heat they generate is part of a heating, ventilating and air-conditioning (HVAC) system⁴⁴.

Switching off lights cuts air conditioning costs and refrigeration loads in coolers and freezers.

Housekeeping tips for reducing electricity use include:

- ☒ Turn off lights in unoccupied areas
- ☒ Clean light fixtures regularly
- ☒ Where available, clean skylights, and keep windows clean.

Low cost (change of process, activities or minor cost with payback of six months or less) activities include:

- ☒ Assess whether all lights are needed; for example, reducing lighting levels
- ☒ Use a lux meter (measuring lighting levels in lumens per m²) to check that lighting in all areas is adequate
- ☒ Eliminate any excessive lighting, for example corridors and storage areas.
- ☒ Remove unnecessary lights, including disconnecting light ballasts (they use electricity even when light bulbs are disconnected)
- ☒ Consider installing timers, photocells and occupancy sensors
- ☒ Replace inefficient bulbs with high efficiency bulbs.

Different lighting technologies continue to be developed. Natural Resources Canada provides substantial information on lighting options, including comparisons of costs of different approaches at their website at <http://oee.nrcan.gc.ca/industrial/equipment/products/index.cfm?attr=24> .

High Bay Lighting

Recently developed fluorescent T5 HO (high output) systems offer a number of benefits, which include: having higher light output per unit of electric power, higher light output as lamps age, better colour rendering, energy-saving switching capability, continued reliability when there is lamp failure (high-bay fluorescent systems usually have between four and six lamps per luminaire versus one for HID systems), fluorescent systems

continue to provide illumination if a single lamp fails, less mercury for equivalent lighting service-years and superior performance at higher temperatures.⁴⁵

High-Intensity Discharge Lighting Systems: High-Efficiency Ballasts⁴⁶

High-intensity discharge (HID) lighting systems may be used where high light levels are desired in large areas. Traditionally magnetic ballast designs were once the only choices available for HID lighting systems, while today, high-efficiency electronic HID ballasts are available that provide improved lighting quality and reduce lighting electricity use by 10 to 30 per cent. Some models also have dimming capabilities, which can provide additional savings.

Improved operating characteristics of electronic HID Ballasts include: Improved light colour and output, 30-per-cent-longer lamp life and lower lumen depreciation, continuous dimming capabilities, reduced energy costs, smaller size and lighter weight, silent operation, flicker free, high power factor and low harmonic distortion.⁴⁷

While electronic ballasts have been successfully used with fluorescent lighting systems for many years, electronic ballasts for HID lighting systems have become available only more recently. Reliable electronic ballasts are now becoming available for use with higher wattages of 320, 350, 400 and even up to 1,000 for metal halide and high-pressure sodium HID lighting systems. Natural Resources Canada provides further technical information on this lighting, including potential savings at

<http://oee.nrcan.gc.ca/industrial/equipment/lighting/savings.cfm?attr=24>

Sustainable Power Sources

The section on Renewable Energy later in this document outlines some examples of the types of renewable energy technologies now in use in wineries, and others that may be considered.

In Ontario, the government of Ontario has announced a standard price that will be available for entrepreneurs and businesses to sell clean power generated from small projects to the grid⁴⁸. Under Ontario's Standard Plan offer program, the Ontario Power Authority will purchase electricity produced by wind, biomass or small hydroelectric at a base price of 11 cents per kilowatt-hour. The fixed price for solar electricity will be 42 cents per kilowatt-hour.⁴⁹ This should be considered by wineries if they are looking to install renewable clean power.

Alternative Vehicle Fuel Sources and Technologies

Wineries use vehicles both around the winery and vineyards, and in marketing. There can be extensive mileage built up, particularly for delivery and marketing vehicles. As decisions are being made about vehicles to purchase or lease, there are opportunities to consider more efficient and less polluting vehicles. In the last few years, hybrid vehicles have become more available. These use a combination of gasoline and electric power. The electric power is generated through capture of waste energy, such as heat from braking, and typically do not require an electric outlet and recharging through external power sources. Toyota and Honda are two of the leaders in this area. The U.S. Environmental Protection Agency (EPA) has some excellent tools that allow comparison of vehicles for their fuel consumption patterns, air pollution levels and greenhouse gas emissions. Further information is available at <http://www.fueleconomy.gov/feg/findacar.htm>

ENERGY SAVINGS AND GREENHOUSE GASES

Greenhouse gases are produced in wineries in three different ways: When carbon based fuels are consumed to produce energy; when material such a pomace, or marc, decomposes; and during the processing of grapes, particularly fermentation.

Reducing energy consumption from carbon based fuels reduces greenhouse gases. Wineries at the very least should be recording their consumption of energy, and also identifying savings in energy consumption that emerge from any of the activities outlined in this Best Practice document, as well as other energy savings approaches.

Different greenhouse gases have different potency for their impact on climate. In general discussion, carbon dioxide is the gas most often discussed. As a greenhouse gas, it has global warming potential (GWP) of 1. Other gases can be more potent:

Gas	Global Warming Potential
Carbon Dioxide CO ₂	1
Methane – CH ₄	21
Nitrous Oxide – N ₂ O	310
Perfluoro-Carbons - C _x F _x	6,500–9,200
Hydrofluorocarbons - HFCs	100–12,000
Sulphur Hexafluoride – SF ₆	23,900

Source: Doug Russell, Managing Director, Natsource, 'Greenhouse Gas Emissions and Carbon Trading' at the [Energy Management Workshop](#), Inn on the Twenty, Cave Spring Cellars, Jordan, June 27 2006.

Most reports translate any savings into CO2 equivalents for consistency and ease of comparison.

There are a number of web-based calculators for greenhouse gas generation. The Canadian Government allows calculations of individual greenhouse gas generation at home at <http://www.climatechange.gc.ca/calculator/english/>

The U.S. Climate Technology Co-operation Gateway provides a Greenhouse Gas Equivalencies Calculator, “designed to enable public and private sector organizations and individuals to quickly and easily translate greenhouse gas (GHG) reductions from units that are typically used to report reductions (e.g., metric tons of carbon dioxide equivalent) into terms that are easier to conceptualize (e.g., equivalent number of cars not driven for one year).”⁵⁰ Further information is available at <http://www.usctcgateway.net/tool/>

Other calculators are available and listed at <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterToolsCalculators.html>

Emissions Trading

While established in other countries, emissions trading has not yet been established in Canada. Emissions trading is created by governments, unlike trading of a commodity like wheat. The price of the trading unit is established by government rules.⁵¹

Appendix Three provides more information on emissions trading. For the wine industry, the most important thing that can be done in the short term is to measure the energy savings undertaken when implementing energy improvements.

A more detailed outline of emissions trading is available from Pollution Probe's [Emissions Trading Primer](http://www.pollutionprobe.org/Publications/emissionstradingprimer.org), available in hard copy or through the web at <http://www.pollutionprobe.org/Publications/emissionstradingprimer.org>

CONVINCING THE TREASURER

While identifying opportunities for investment to reduce energy costs, don't consider the energy savings in isolation. The proposal should also address other aspects of the business: What is the impact for health and safety? Is there an impact on productivity? Will it lead to less wastage? Will it assist in improving quality? If the approach that is proposed has benefits in these and other areas, then they should be captured and included as part of the business case presented for decision-makers.

The U.S. Department of Energy makes a number of suggestions on how to go about presenting an energy efficiency project to management. They note that the “resistance of the chief financial officer and other upper management executives can be a critical barrier to implementing compressed air or other energy efficiency system improvement projects.”⁵² Suggestions to sell the project to management include:

- state the purpose of the presentation
- state the problem to be corrected
- describe the scope of the project being proposed
- state the benefits to be achieved by implementing the project
- clearly state the cost of implementation
- explain the effect the project will have on operations
- present the effect on budget
- provide a co-ordinated implementation plan
- summarize the project and ask for the decision⁵³

Further information is available through the web at

http://www.eere.energy.gov/industry/bestpractices/energymatters/full_issue.cfm/volume=23

There are also some examples of “number crunching” available that can provide good background information for establishing cases. The following example is of a boiler replacement project. This material is extracted from Implementing and Planning Best Management Practices for Utility Efficiency in Food Processing Establishments A Utility Management Guide produced by the Ontario Ministry of Agriculture, Food and Rural Affairs.⁵⁴

WORKED EXAMPLE: BOILER REPLACEMENT PROJECT

Project Payback Calculations

Background: Plant operations want to calculate the potential cost savings on a boiler upgrade

Key data required:

- | | | |
|----|--|-----------------|
| A) | Old boiler efficiency rating | $A = 62\%$ |
| B) | Estimated efficiency of replacement boiler | $B = 90\%$ |
| C) | Current average annual cost of fuel | $C = \$120,000$ |

Calculations using key data shown in 2 steps (sample formulas in ***bold Italics***):

- Step 1. Calculate difference in boiler efficiencies,
 $(B - A) \div A = Y$ (***efficiency improvement factor***)
[[New boiler efficiency – old boiler efficiency] ÷ old boiler efficiency]
or $((90\% - 62\%) \div 62)$ = 0.45
- Step 2. Calculate reduced fuel consumption for current utilization,
 $C \times Y = X$ (***projected fuel consumption decrease***)
[Current fuel cost x difference in boiler efficiencies from Step 1]
or $(\$120,000 \times .45)$ = **\$54,000**

CONCLUSION

Energy is an important component of the business of a winery. It is a variable cost that can be managed and reduced, adding to the profitability and efficiency of a winery business. Best Practice is a combination of old fashioned waste minimization, engagement of people and cultural change, and identifying the most appropriate technologies for each business. All of these approaches must be framed within the other business decisions and parameters such as wine quality and marketing. However the evidence is in, as shown in the related Benchmarking report: The wine industry in Ontario has opportunities to both improve its economic and environmental performance over time, by managing energy.

Energy management and Best Practice is a clear example where good environmental performance is good business.

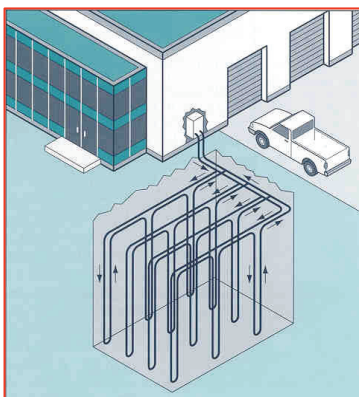
RENEWABLE TECHNOLOGIES

This section outlines some examples of the types of renewable energy technologies that are now in use in wineries, and others that may be considered.

Geothermal Energy

“Geothermal heating and cooling systems (also called earth energy systems, ground-source heat pumps or GeoExchange SM systems) are heat pumps that collect and transfer heat from the earth through a series of fluid-filled, buried pipes running to a building, where the heat is then concentrated for inside use. Ground-source heat pumps do not create heat through combustion – they simply move heat from one place to another. Heat pumps can also operate in reverse to by transferring heat outside of a building where the cooler ground absorbs the excess heat.”⁵⁵

Ground pumps can be in a variety of configurations that use the ground, groundwater or surface water as heat source or sink. In Ontario, Flat Rock Cellars was the first winery to use a geothermal system. It has a closed loop system running through a pond. Stratus has also installed a geothermal system. Stratus uses a vertical heat exchanger with pipes bored into the ground.



Vertical Ground Loop⁵⁶



Horizontal Ground Loop

Further information is available at Natural Resources Canada website. A useful oversight is provided in the document “Commercial Earth Energy Systems: A Buyers Guide” available on the web at

<http://www.canren.gc.ca/app/filerepository/B0126630E3FD4FFD91D2FC21C213724c.pdf>

See also http://www.canren.gc.ca/prod_serv/index.asp?CaId=150&PgId=769 for further background.

Solar Energy

There is a range of technologies available for solar energy that could be used by wineries. A “Solarwall” preheats air and recaptures wall heat loss, even at night. It can replace traditional cladding and integrates with any HVAC system. The technology also reduces greenhouse gas emissions.⁵⁷



The “Solarwall” is an example of a solar air heating system using the sun's energy to warm air that is then used for ventilation and space heating purposes.

“In a typical system, fresh air is drawn across a heat-absorbing south-facing wall or other form of solar collector. The pre-heated air is drawn into a building's primary heating system where it is further heated, then distributed throughout the building. A solar air heating system augments a conventional heating system rather than replacing it.

Any business or industry needing large volumes of fresh air can benefit from a solar air heating system. They are designed primarily to pre-heat ventilation air for commercial and industrial facilities such as factories, warehouses and hangars. Because the air going into the building's primary heating system is already warmer than the outside air, less energy is needed to heat it further.

Solar heated air ventilation incorporated into the design of a new building can take as little as two years to pay back the initial investment. Payback for retrofits may take longer, but they are still generally cost-effective.

A solar air heating system can typically provide up to 30 per cent savings on the fuel costs. There are other less obvious cost savings: Any new building using a solar air heating system eliminates the need for a conventional south wall facade and could require a smaller primary heating system.”⁵⁸

This type of heating system may also be eligible for funding from REDI (the name of this program will change on April 1 2007 to “the ecoENERGY for Renewable Heat Program”) up to a maximum of \$80,000. Further information is available at <http://www2.nrcan.gc.ca/es/erb/erb/english/View.asp?x=692&oid=154>

Solar hot water systems are also well established technologies with uses in commercial settings. Again, they are eligible for funding support. Further information on the technology and funding is available at <http://www2.nrcan.gc.ca/es/erb/erb/english/View.asp?x=692&oid=155>

Generation of solar power using photovoltaics is another option available to wineries looking at reducing energy costs and greenhouse emissions in the long run.

Detailed information on solar systems is available through the website of the Canadian Solar Industries Association at <http://www.cansia.ca/resources.asp>.

POSSIBLE FUNDING SOURCES

Federal Government

Natural Resources Canada – Office of Energy Efficiency

A short-term extension of funding programs for energy efficiency in wineries is available from Natural Resources Canada (NRCan). These are summarized below.

Industrial Energy Audit Incentive Program

This incentive is designed to help defray the cost of hiring a professional energy auditor to conduct an on-site audit at an industrial facility. Funding is available for up to 50 per cent of the cost of an energy audit, to a maximum of \$5,000. This is an exclusive service for companies that are registered as Industrial Energy Innovators. Companies must have their Industrial Energy Audit Incentive applications approved by NRCan before beginning their audit.⁵⁹ Further information is available at <http://oee.nrcan.gc.ca/industrial/financial-assistance/existing/audits/index.cfm?attr=24>

Industrial Building Incentive Program

The Industrial Building Incentive Program (IBIP) encourages the design and construction of new, energy-efficient industrial facilities. IBIP is a demonstration initiative, with funding of up to \$80,000 for eligible organizations based on process and building savings.

Organizations must first join the Industrial Energy Innovators⁶⁰. Further information is available at <http://oee.nrcan.gc.ca/industrial/financial-assistance/new-buildings/index.cfm?attr=0>

Renewable Energy Program

Natural Resources Canada, Renewable and Electrical Energy Division, at <http://www2.nrcan.gc.ca/es/erb/erb/english/view.asp?x=656>

‘REDI’ is the Renewable Energy Deployment Initiative:

“Industry clients are eligible for the ecoENERGY for Renewable Heat Program rebate when they install qualifying solar air or solar water heating systems (25 per cent of project cost to a maximum of \$80,000) for process, space heating or water heating purposes. Solar air heating is very popular for pre-heating ventilation and make-up air in industrial facilities. Industries with high hot water demand are excellent candidates for solar water heating. If you have a consistent wood waste stream available, consider using a biomass combustion system.

Process Heat News – the ecoENERGY for Renewable Heat Program eligibility extends to solar thermal and biomass combustion systems used directly in an industrial process. Previously, such applications were denied eligibility since they were eligible for Capital Cost Allowance 4.3.1. Now the ecoENERGY for Renewable Heat Program allows industrial process heat clients to obtain both the tax relief and the ecoENERGY incentive.

Source: <http://www2.nrcan.gc.ca/es/erb/erb/english/View.asp?x=455&oid=1026>

Environment Canada – Business Air Quality Program (Available only in Southwestern Ontario)

This program from Environment Canada focuses on improving air quality in Southwestern Ontario by addressing specific air pollutants: Nitrogen Oxides, Sulphur Dioxide, particulate matter and Volatile Organic Compounds. The program provides companies with technical support to identify opportunities for improvements through energy efficiency and pollution prevention. Assistance up to \$5,000 per facility may be provided to assist with a Site-Specific Facility Assessment. This funding can also be combined with other sources of funding such as the NRCan Industrial Energy Audit Incentive Program. This program ends on March 31, 2007 and the funding application cut-off date was December 31, 2006.

More information may be obtained from:

Dan Roumbanis,

Sr. Adviser Pollution Prevention and Innovative Technologies

Environment Canada – Ontario Region Phone: 416 739 6864 or email dan.roumbanis@ec.gc.ca

Joanna Hickling, OCETA
Program Coordinator
Phone: 905 822 4133 x 237 or email jhickling@oceta.on.ca

Government of Ontario

Rebates of Provincial Sales Tax

“ The Ontario government provides the following tax incentives for clean, alternative or renewable electricity generation facilities:

- Corporate retail sales tax rebate for building materials
- 100 per cent corporate tax write-offs for the cost of newly acquired assets
- Capital tax exemption for newly acquired assets.

In addition, the Ontario government currently offers rebates of the provincial retail sales tax (RST) on the purchase of residential solar, wind, micro-hydroelectric or geothermal energy systems, or on any expansions or upgrades to existing systems installed in residential premises until November 25, 2007. For detailed information or to claim the sales tax rebate, contact the nearest Ontario Ministry of Finance Tax Office listed under Taxes - Provincial (Retail) Sales Tax in the blue pages of your phone directory, or call the TAX FAX Service at 1-877-482-9329, or visit the Ministry of Finance website at www.trd.fin.gov.on.ca.”

Source: http://www.energy.gov.on.ca/index.cfm?fuseaction=renewable.faqs#question_26

Union Gas

Union Gas has an active program to reduce the use of energy. From the period of 2000 to 2005, through addressing Demand Side Management, Union Gas has reduced customer demand for natural gas by more than 500 million cubic metres.⁶¹ One of the mechanisms they use is to pay people to reduce energy usage. Energy audits and feasibility studies are two examples of actions that may qualify for savings.

Examples of actions for which funding is available (all subject to approval) include:

- **Increasing combustion efficiency by reducing operating losses from steam generation and process systems:** Funding may include up to 2/3 of study cost up to \$6,000 for individual equipment and up to \$20,000 for equipment as part of a complex plant.

- **Reducing steam losses:** Funding may be up to 50per cent of a survey cost up to a maximum of \$6,000.
- **Replacing old equipment or making process changes:** Funding to support engineering feasibility studies, total energy audits and HVAC audits by contributing up to 50per cent of eligible project costs to a maximum of \$10,000.
- **Choosing high-efficiency natural gas equipment:** An incentive of 10per cent up to a maximum of \$30,000 of the installed cost on eligible high-efficiency equipment.
- **Cash incentives for demonstration projects for an eligible new technology:** An incentive of up to 10per cent of the total project costs up to a maximum of \$50,000.
- Union Gas also offer workshops, newsletters, technology and other publications to increase knowledge of energy-saving opportunities.⁶²

More details of the energy efficiency program, including funding application forms are available at <http://www.uniongas.com/business/contractci/EnergyEff/energyeffindex.asp>

To identify opportunities for your winery contact your regional Union Gas representative.

In Prince Edward County, contact: Stacey Galbraith, Channel Account Manager, Commercial Industrial Sales at 613-968 6787 ext. 206, or through email at segalbraith@uniongas.com

For Lake Erie North Shore, contact: Bill Davies, Channel Account Manager – Commercial Industrial Sales, at 519-250 2355, or through email at bdavies@uniongas.com

Enbridge Gas Distribution Inc.

Enbridge provides a range of industrial programs to aid industrial customers to become more energy efficient. Several types of audits are available. The audit report typically “identifies energy savings opportunities and provides recommendations with estimated dollar savings, budget costs and simple payback periods.” Programs include:

- “Steam-Saver” program surveys and audits that can include a boiler plant performance test and audit (half of the cost of a steam plant audit up to a maximum of \$5,000), a steam trap survey (half of the cost of the steam trap survey up to a maximum of \$5,000) and insulation survey (half the cost of a steam system piping insulation survey up to a maximum of \$5,000)
- Industrial HVAC (Heating Ventilation and Air Conditioning) Audit (half the cost up to a maximum of \$5,000)

- special studies that may be designed to identify energy efficiency processes and projects may receive funding on a case by case basis
- audit incentives may also be combined with other incentives provided by other organizations.

In addition to potential assistance with audits, other aspects of the industrial program include incentive grants for project implementation, “Steam Saver” program and forklift conversion program.

- One time incentive grants may also be available for projects that require a capital investment. For example, high efficiency condensing equipment such as boilers, condensing economizers, and direct contact water heaters or direct contact heat exchangers are eligible for an incentive of 10c per cubic metre of gas saved.
- Boiler combustion tune-ups are available for large boilers, and linkageless combustion control may also be eligible for incentives.
- Enbridge will also pay \$250 per forklift towards its conversion or replacement with natural gas.

All of these programs are subject to conditions. Wineries in Niagara Region can contact: Randy Mazzel, Commercial Sales Associate, at 905-641-4868 or through email at randy.mazzei@enbridge.com . Further material is also available at www.enbridge.com/industrial

Please note that funding details change on an irregular basis. While the material above is correct at time of writing, changes do occur and web references may alter.

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RELATED LINKS

- [Office of Energy Research and Development \(OERD\)](http://www2.nrcan.gc.ca/es/oer)
www2.nrcan.gc.ca/es/oer
- [ACEEE Energy Efficiency in Agriculture](#) (American Council for an Energy-Efficient Economy)
- [BC Hydro's Power Smart Buying Guides](#) – Guides offer what you need to know when acquiring energy-using products
- [Energyguide – Canada](#) – Compare the advantages of an energy-efficient equipment and household appliances
- [EnergyStar Canada](#) – Identify products that are the most energy-efficient
- [HydroOne](#)
 - [Energy Efficiency Information](#): Smart energy use in barns and outbuildings
- [Ministry of Energy](#)
- [Net Metering](#)
- [Ontario Power Authority](#)
- [The Office of Energy Efficiency](#) (Natural Resources Canada)
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- [Office of Energy Efficiency](#)
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- [Canadian Renewable Energy Network](#)
www.canren.gc.ca
- [CANMET Energy Technology Branch](#) www.nrcan.gc.ca/es/etb

Appendix One: Best Practice Opportunities for Refrigeration System and Components

Issue or Opportunity	Best Practice Considerations
Refrigeration System	<ul style="list-style-type: none"> ■ Is there enough opportunity for heat recovery from the refrigeration system, such as system de-superheaters, to reduce or avoid the need to import natural gas or LPG for heating? ■ explore refrigeration load leveling; loads can be shifted or avoided to create a (lower) constant demand for cooling, rather than a fluctuating load ■ compare satellite versus centralized plants; each has its strengths and weaknesses for different loads ■ conduct familiarization training for operators of the refrigeration system can make savings ■ utilize heat recovered from refrigeration plant to heat water for cleaning and process operations on site. <p>Research the use of absorption systems that use waste heat for higher temperature process cooling requirements.</p>
Load Scheduling	<p>Load scheduling has two aspects:</p> <ul style="list-style-type: none"> - First: around management of peak daily demand, particularly on hot days when the refrigeration system is at the margin of its performance, and - Second: concerns the overlap of high energy intensity cooling processes during the vintage; in particular, the onset of cold stabilization before the end of filtering and blending.
■ Load	<ul style="list-style-type: none"> ■ the maximum process-cooling load on the refrigeration system determines the size of the refrigeration plant in kW, and therefore, its capital cost ■ cooling loads are determined by the processing parameters that dictate the amount of time in which a specified amount of heat must be removed ■ as a general point, it was noted that end-use efficiency improvements free up capacity, meaning less primary energy would be needed.
Temperature Lift (Fundamental and Essential Concept)	<p>Temperature lift is the difference between the evaporating and condensing temperatures.</p> <ul style="list-style-type: none"> ■ the temperature lift reduces if the condensing temperature is lowered and/or the evaporating temperature is raised ■ a decrease of 1°C on temperature lift can cut energy consumption by 2–4 per cent.

<p>■ General Factors</p>	<ul style="list-style-type: none"> ■ the condenser rating ■ whether condensing temperature is permitted to float with ambient temperature ■ Frost on evaporator equipment ■ amount of refrigerant in the system and presence of leaks – a leaking system consumes more power than is necessary and wastes expensive (sometimes toxic) refrigerant (leakage can push operating costs up by 10–15per cent) ■ insulation on suction lines
<p>Evaporator</p>	<p>The idea is to have the evaporating temperature (the temperature at which the refrigerant evaporates) as high as possible to maintain evaporator efficiency. The size of the evaporator will determine much of this.</p> <p>As well:</p> <ul style="list-style-type: none"> ■ in a direct expansion air cooler, the fin block should be kept clear of dirt and slime and adequately defrosted when necessary ■ the tubes in a shell and tube evaporator should be cleaned to prevent fouling and corrosion (water quality may also be an issue) ■ the flow of the cooling medium should be maintained – pumps and motors must work efficiently ■ the flow of refrigerant through the evaporator should be controlled to ensure full use of its capacity.
<p>Compressor</p>	<p>For applications where there is a large load, it is usually most efficient to split up the load between smaller compressors with a control system that will ensure that capacity and operations are matched to load. If the compressors are different sizes, the degree of control is increased. Take into account any increased frequency in starting and stopping compressors, as this can erode efficiency.</p> <p>Efficiencies include:</p> <ul style="list-style-type: none"> ■ avoiding the use of a single, large compressor ■ selecting a combination of compressor sizes which avoids the need for one or more machines to operate on capacity control ■ where multiple compressors are used, developing a control strategy which minimizes the operation of compressors on part-load (in particular, not allowing two compressors to operate on 50per cent capacity rather than one operating on 100per cent capacity) ■ screw compressors have higher full load efficiency than reciprocating units, but poorer part load efficiency; VSD can be installed to improve part load efficiency of screw compressors ■ compressor cooling – direct injection is less efficient than water-cooling ■ variable volume ratio compressors allow a floating head pressure; so during periods of lower ambient temperature or lower cooling loads, the compressor work can be reduced. ■ Ensure adequate machines to enable flexibility as duty varies. Fully

	<p>loaded compressors are more efficient than partially loaded machines. Compressor scheduling needs to be appropriately controlled to realize this opportunity.</p>
Condenser	<p>There are three types of commonly used condensers, each of which has different performance and efficiency characteristics:</p> <ul style="list-style-type: none"> ■ air cooled – consumes fan power ■ water cooled – consumes circulating pump power and, usually, cooling tower components ■ evaporative – consumes fan and pump power. <p>The more surface area a condenser has, the closer the condensing temperature is to the temperature of the cooling medium, whether air or water. Lower condensing temperatures mean better energy efficiency. The heat transfer of all condenser types is reduced if they are dirty:</p> <ul style="list-style-type: none"> ■ air-cooled condenser fin blocks should be free of dirt and in good condition ■ water-cooled condenser tubes should not be fouled, corroded or scaled. <p>Air in the system will increase the condensing temperature and reduce efficiency. Good installation and commissioning practices can avoid this; however, commissioning is more often a task which comes at the end of a long hard job and can receive less attention than it really warrants. Large systems which work with suction below atmospheric pressure can also draw air in during operation. This should be removed with a refrigerated air purger.</p> <ul style="list-style-type: none"> ■ the condensing pressure should be allowed to float with ambient temperature so as to take advantage of lower ambient temperatures overnight and during winter; this causes the pressure ratio to vary slightly, which may cause problems with some types of expansion valve. Place desuperheaters prior to condensers to generate hot water. ■ To reduce the solar load on condensers, they should be shaded but in a way that does not restrict airflow to inlets and from outlets.
Expansion Device	<p>Refrigerant quantity is critical to capacity and efficiency of the expansion device. With thermostatic expansion valves, the superheat setting has a significant effect on efficiency and reliability.</p> <ul style="list-style-type: none"> ■ if the superheat setting is too low, liquid refrigerant may return to the compressor, causing damage or failure. ■ if the superheat setting is too high, capacity and efficiency are unnecessarily reduced. <p>Thermostatic expansion valves do not work well when there are widely varying pressure differences. In this situation, balanced port or electronic valves should be used.</p> <ul style="list-style-type: none"> ■ Electronic expansion valves (Tx valves) allow improved control and higher efficiency.

Direct Heat Exchange with Ammonia	<ul style="list-style-type: none"> ■ The use of direct heat exchange with ammonia rather than brine allows higher suction pressure, but reduces storage and part load performance. This may be most appropriate for process operations that require continuous cooling, such as fermentation and storage. ■ Where large temperature drops are required in short periods, such as cold stabilization, ammonia systems can be less effective unless the product is cooled by cycling it through an external heat exchanger. Immersion chillers are not recommended for this application. ■ Rationalize refrigeration systems to separate brine and direct expansion ammonia systems. This could allow highest evaporator temperature for each system, reducing the temperature lift that the compressor has to drive.
Thermal Storage and Distribution	<ul style="list-style-type: none"> ■ Quantity of thermal storage should be reviewed and optimized. ■ The wine in storage provides some thermal inertia that can be used to manage daily demand cycles. ■ Decentralized versus central plant or mixture/hybrid: Given the variation in process temperatures, as well as some cooling loads being localized and rapid while others are expansive and slower, it suggests that a "horses for courses" rather than "one size fits all" approach may be optimal. This is a question of detailed design.
Heat Transfer to Product	<ul style="list-style-type: none"> ■ Improve jacket heat exchange by agitating tank contents and increasing brine flow rate and product brine temperature. ■ Must chillers – changes to pipe work and materials selection may improve effectiveness of heat exchange. (Higher surface area and flow rate will improve heat exchange efficiency – this means larger heat exchangers with more material.) ■ At the time of specifying and purchasing, give consideration to the balance of expenditure on heat exchangers and refrigeration plant. ■ Larger heat exchangers save on running costs. Biasing spending towards larger refrigeration plant at the expense of heat exchanger size will lead to higher running costs.
Refrigerant Maintenance	<p>The system needs the correct amount of refrigerant. This is called the 'charge'. Both too much and too little reduce efficiency.</p> <ul style="list-style-type: none"> ■ Insufficient refrigerant (lost through leakage) results in increased superheat of the refrigerant. This reduces suction pressure to the compressor and increases temperature lift, reducing efficiency. ■ Refrigerants may also be less effective through contamination. This may be caused by air trapped in the system during plant replacement, or nitrogen may remain after pressure testing. Gases trapped in the system means the compressors have to use more power because they effectively raise the total condensing pressure. ■ Simple purging systems don't remove all the air and waste refrigerant. Automatic purging systems should be installed on plants greater than

	500kW where a 3-year payback can be expected from more efficient operation.
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Source: Reproduced from Department of Industry, Tourism and Resources, A Guide to Energy Efficiency innovation in Australian Wineries. Energy Efficiency Best Practices., Commonwealth of Australia. Available at <http://www.industry.gov.au/content/itrinternet/cmscontent.cfm?objectID=896D131A-0505-3F44-421B4FFEED12D429> , 2003, Pp33-35

Appendix Two: Checklist for Wineries: Energy Efficiency

Source: Martin, Narelle, Sustainable Winemaking Ontario – Environmental Best Practice for Wineries, 2007, Wine Council of Ontario.

Topic 1		Yes	No
	<i>Planning and Monitoring</i>		
1-1	Have you identified a person or established an energy efficiency team responsible for energy oversight and management?		
1-2	Do you have information on energy use or costs in your winery?		
1-3	Have you undertaken an energy efficiency audit of the whole winery either internally or with consultants?		
1-4	Do you have a formal monitoring and recording system to check energy use for the winery?		
1-5	Do you compare energy consumption year-over-year, per unit of production?		
1-6	Do you have a scheduled plan incorporated into the capital budget to increase energy efficiency per unit of production?		
1-7	Do you keep track of all energy savings?		
1-8	Have you identified how to convert the energy savings to greenhouse gas (CO ₂) savings?		
1-9	Have you identified ways of selling your greenhouse gas savings, if available?		
1-10	Do you consider energy efficiency and Best Practice in new winery design or expansion?		
1-11	Do you implement energy efficiency and Best Practice in new winery design or expansion?		

Topic 2		Yes	No
	<i>Energy Economies</i>		
2-1	Do you understand the tariff system used to charge for energy?		
2-2	Do you keep aware of the changes in the energy market in Ontario?		
2-3	Have you reviewed the rates being charged for energy, and have you negotiated a better price structure?		
2-4	Have you identified opportunities to switch to off-peak power and reduced electricity charges for your business?		
2-5	Have you taken advantage of government grants for audits and to increase energy efficiency?		

Topic 3	<i>Refrigeration Systems, Tanks and Lines</i>	Yes	No
3-1	Have you conducted a refrigeration system energy audit within the last 3 years?		
3-2	Do you include refrigeration system efficiency as part of an overall energy monitoring and conservation plan?		
3-3	Do you have a proactive program for housekeeping? For example, by ensuring regular repair and maintenance of energy using equipment, structured service shut-downs and monitoring energy accounts?		
3-4	Do you identify opportunities for more operations in off-peak, low tariff? For example, using over chilling refrigeration in off-peak-load times?		
3-5	Have you in the past two years reviewed your cooling and refrigeration systems to ensure that the equipment is designed and run for optimal efficiency?		
3-6	Whenever there is an increase in production requiring investment in equipment, do you review the existing and proposed approach to identify opportunities for energy efficiency and reduction in costs?		
3-7	Do you identify ways to reduce the load on the refrigeration system? For example, keeping chiller doors closed?		
3-8	Do you consider fruit temperature at harvest in relation to energy use? For example, night harvesting of fruit?		
3-9	Do you identify new technologies that minimize energy consumption while maintaining or improving wine quality e.g. low energy tank agitators, motors, drives and pumps?		
3-10	Have you undertaken or engaged consultants to undertake an energy audit of tank heating and cooling within two years?		
3-11	Do you locate tanks to reduce heating or cooling needs?		
3-12	Do you identify opportunities for increased energy efficiency of heating and cooling of tanks?		
3-13	Do you have a goal of insulating all of your temperature controlled tanks?		
3-14	Do you ensure that Glycol lines are insulated?		

Topic 4	<i>Lighting – Shops and Facilities, Offices and Outdoor.</i>	Yes	No
4-1	Have you organized a review of lighting within the last three years?		
4-2	Do you organize regular cleaning of all lighting?		

4-3	Have you installed high efficiency lighting: within the offices <ul style="list-style-type: none"> • within the labs • for outside lighting? 		
4-4	Have you investigated automatic lighting technologies? For example motion sensors and timers when appropriate?		
4-5	Have you reviewed the need for all lights, and removed or disconnected unnecessary lights?		
4-6	Do you consistently remind staff to turn off lighting and equipment not in use?		

Topic 5	<i>Heating, Ventilation and Air Conditioning (HVAC)</i>	Yes	No
5-1	Have you had a consultant and or contractor undertake a HVAC system audit in the last 3 years?		
5-2	Do you regularly schedule maintenance for the HVAC system?		
5-3	Do you attend workshops on energy efficiency and/or keep up to date with energy efficiency technologies?		
5-4	Are you aware of government funding programs to assist in increasing HVAC energy efficiency programs?		
5-5	Do you regularly check and maintain the building to reduce heating and cooling losses? For example, ensure that seals on windows are intact, and building cladding is well maintained?		
5-6	Did you incorporate energy efficiency designs such as passive solar energy and geothermal energy into the building design, or renovations wherever possible?		

Topic 6	<i>Sustainable Power Sources</i>	Yes	No
6-1	Do you engage professionals, and or attend workshops or field days, to investigate the feasibility of all alternative sources of power and investigated government grants?		
6-2	Do you consider alternative sources of power when designing expansions or renovations?		
6-3	Do you purchase green power sources available through the electricity grid?		
6-4	Have you investigated alternative sources of power such as solar photovoltaic, passive solar hot water systems and wind power?		

Topic 7	<i>Alternative Vehicle Fuel Sources and Technologies</i>	Yes	No
7-1	Do you know and systematically track the amount of fuel used in the winery and for sales?		
7-2	Do you undertake a systematic review of your fleet, including sales vehicles, of monthly fuel consumption and maintenance?		
7-3	Have you investigated alternative fuel sources and supplements including biodiesel, ethanol, propane, natural gas, methane or hydrogen for the winery?		
7-4	Have you installed alternative fuel sources and supplements including biodiesel, ethanol, propane, natural gas, methane or hydrogen for the winery?		
7-5	Do you purchase and use the most fuel-efficient equipment of its type in vehicles and outside equipment in the wineries? For example, moving towards four-stroke engines when considering replacements?		
7-6	Have you considered hybrid vehicles for use in fleet operations?		

To obtain further information on Sustainable Winemaking Ontario: An Environmental Charter and the Environmental Best Practice documents, contact the Wine Council of Ontario.

Appendix Three: Emissions Trading

The following information is taken from Pollution Probe Emissions Trading Primer, available in hard copy or through the web at <http://www.pollutionprobe.org/Publications/emissionstradingprimer.org>

“Emissions trading is a market-based environmental policy instrument that helps companies meet their emissions reduction requirements more cost-effectively than they would under traditional command-and-control regulatory approaches. Emissions trading involves the transfer of ownership of emission reduction credits, or emission allowances, from one entity to another. It was first proposed in 1968 by Canadian economist John Dales at the University of Toronto, and was first applied in 1977 under the amendments to the *Clean Air Act* in the United States. Similar trading systems have since been used to help manage fish quotas, reduce the content of lead in gasoline and curtail the release of regional airborne pollutants. More recently, emissions trading has been implemented in the province of Ontario to assist in reducing emissions of nitric oxide (NO) and sulphur dioxide (SO₂). It is also emerging globally as one of the primary mechanisms that will be used to lower the cost of reducing GHG emissions, as required by the Kyoto Protocol.

Emissions Trading:

- does not reduce emissions in and of itself — it is a mechanism that facilitates the reduction of emissions in a more cost-effective way
- does not replace regulation — it complements regulation. Emissions trading systems work best when they are supported by strong regulatory frameworks
- is not the only tool available to regulators — other emissions reduction tools that are being used or considered include regulations, sectoral agreements, tax measures, targeted subsidies and direct financial incentives for system improvements.”⁶³

How Does it Work?

Companies that reduce their emissions below the levels required by regulation can sell “excess reductions” to companies that still need to make emissions reductions to meet compliance commitments. The following is a simple description of the most basic form of emissions trading.

1. The process begins with a government regulator setting targets and timelines for the reduction of emissions of specific air pollutants and/or

greenhouse gases. This is usually accompanied by the government creating a rigorous emissions measurement or monitoring system in order to track progress against targets and create confidence in the emissions trading market.

2. The regulator identifies the largest emitters. It establishes an aggregated cap or limit on the total amount of emissions that can be released to the atmosphere in a given year by the large emitters (called *capped emitters*).
3. The total emissions allowed under the cap are divided into units, called *allowances*, with each allowance equal to one *tonne* of emissions. Each capped emitter is allocated a specific number of allowances by the government, which equals the amount of pollutant that the emitter is allowed to release into the atmosphere within a given year.
4. Each capped emitter is required to monitor its actual emissions throughout the year. At the end of the compliance year, the capped emitter must report its total annual emissions to the government and surrender the number of allowances equal to its actual emissions”.

Emission trading is a mechanism to allow producers of greenhouse gases to pay another organization to reduce their greenhouse gases. For example, if a company can reduce 1,000 tons of Carbon Dioxide Equivalent (CO₂E) and can reduce it at \$2 per ton, then they can reduce 1,000 tons for a cost of \$2,000. This becomes attractive to another company that also has to reduce its CO₂E gas of 1,000 tons, but it will cost \$6 per ton, a total cost of \$6,000. Where an emissions trading mechanism has been developed the second company can buy the emissions saved from the first company at a cost, established by the rules set up by the government. Greenhouse gases produced are reduced by 1,000 tons. The first company reduces their greenhouse gases at a cost of \$2,000, and sells the greenhouse equivalent gas on the emissions market (in this example for \$4 per ton), and gains \$2000 profit. Meanwhile, the second company pays for the credit at a total cost of \$4 per ton, therefore they have purchased the ability to reduce the emissions at a reduced total cost (\$4,000 rather than \$6,000).⁶⁴

The recommendations from experts in the field of emissions trading for the wine industry in Ontario is to continue to monitor the federal climate-change plans in the coming period. If a market is likely to develop, there may be opportunities for the wine industry to offset their emissions saved, on an aggregate basis.⁶⁵

Appendix Four: Tracking Sheets

Tracking Sheet – Wineries

1. Introduction

The Wine Council of Ontario is undertaking a proactive program to continuously improve the environmental performance of the wine industry in Ontario.

To assist in developing programs the Technical Committee for Sustainable Winemaking Ontario project agreed that there could be value in tracking quantities of material consumed and produced in the wineries.

Measuring and recording information is a good business tool. It helps to remind people that reducing waste and being more efficient are good both for the environment and for the business.

Further discussion has identified that there are two types of tracking that can occur.

The first is from existing records, for example, billing records. These are easier to obtain on an annual basis.

The second are ongoing measurement, tracking and monitoring. These may be obtained through billing, but more likely through active monitoring and measurement over a particular period.

The following forms are designed to assist in getting a good picture of what is happening at the winery. The charts are an attempt to make it easy to identify and track aspects of the environmental performance of the winery.

These have been broken down into forms both for annual recording, and for crush.

2. Annual Recording

You do not have to complete each input. If preferred, choose one (for example energy or water). Three different forms are provided:

- Annual Production – the amount of product from the winery
- Annual Usage – the quantities and major costs of inputs into the winery
- Annual Wastage – the amount of material that needs to be managed and disposed of through the year.

3. Recording Through Crush

You will note that the forms for crush period are very similar. The reason for focusing on crush is that this is the peak production time and it may provide an opportunity to

review how work is done during this period. There may be opportunities after crush to review the operations and see if there are opportunities for doing some things differently so that, for example, water and energy are saved.

These forms do not address all aspects of the winery operation. Other factors that can be considered are bottling. The amount of cost that is associated with bottling and production and the management of wastage, such as cleaning costs, could also be tracked.

4. Why Collect Information?

The information you collect is useful information *for the company*. It will assist you in benchmarking and identifying environmental performance.

The collection of this information can provide important baseline information on your business operations. It is not practical for detailed study of all of the areas, but you may wish to consider one or two areas – for example, water and or energy – for more detailed study and to assist in identifying ways for reducing waste.

To allow comparisons it is suggested that you may wish to calculate both usage and waste by kilolitre of production. This means that you are able to then benchmark the efficiency and cost of your operation over different years, as there will be fluctuations in production levels. It will also give a quick indicator if some other factor has changed – for example, energy costs.

5. How have These Forms been Developed?

Examples from other countries have been examined and modified. The forms have been drawn from material produced by the Victorian (Australia) Environment Protection Authority¹ and modified in discussion with members of the Technical Committee and individual wineries.

Over Crush 2004, a number of wineries tried out a draft of these worksheets. The outcomes have been discussed at the Technical Committee and are now provided for wider industry use.

All of the forms are in MS Word format using tables, and can be added to as you require.

¹ For more detail see
http://www.epa.vic.gov.au/Business_Sustainability/Wineems/cpp/collect.shtml

Worksheet 1: Annual Production

The unit of production is a measure of output of the business; e.g., kilolitres of red wine produced. You may use one or more units of production.

Unit of Production	No. of Units of Production Produced Annually- From: To:	Source of Data
Kilolitres of Red Wine Produced		
Kilolitres of White Wine Produced		
Kilolitres of Ice Wine Produced		
Number of Customers Served (Restaurant/Hospitality)		

Worksheet 2: Annual Usage Worksheet

Quantities and costs of major process inputs in the winery: January 1 – December 31

	Annual Quantity of Purchases	Costs of Purchases for the Year	Cost per Kilolitre of Production	Source of Data (e.g. invoices, accounts records, internal business report, Manager's estimates, measurement)
Electricity				
Gas				
Diesel				
Other Fuel				
Water				
Cleaning Products (Winery)				
Diatomaceous Earth				
(Etc.)				

Worksheet 3: Annual Wastage

Quantities and costs of the main waste products produced at the winery. Record the source (or method of estimation) of all data in this table.

Waste Material	Quantity of Waste Material Produced From: To:	Cost of Treatment, Transport & Disposal of Waste Material	Cost per Unit of Production	Source of Data (e.g., invoices, accounts records, internal business report, Manager's estimate)
	(1 Year)	(1 Year)		
Wastewater*				
e.g., Washwater from Barrel Washing	3500 ML (calculated from average cleaning time x no. barrels cleaned x 30 L/min)	\$2,560 (Source: Water Bills)		Calculated from Water Metre Readings on Water Bills
E.g., Marc Produced				

* Please indicate if water is piped to a waste treatment plant or treated on site

Worksheet 4: Crush Production

The unit of production is a measure of output of the business; e.g., kilolitres of red wine produced. You may use one or more units of production.

Unit of Production	No. of Units of Production Produced Through Vintage From: To:	Source of Data
Kilolitres of Red Wine Produced		
Kilolitres of White Wine Produced		
Kilolitres of Ice Wine Produced		
Number of Customers Served (Restaurant/Hospitality)		

Worksheet 5: Crush Inputs

Quantities and costs of major process inputs in the winery: September 1 – December 31

	Quantity of Purchases	Costs of Purchases	Cost per Kilolitre of Production	Source of Data (e.g., invoices, accounts records, internal business report, Manager's estimates, measurement)
Electricity				
Gas				
Diesel				
Other Fuel				
Water				
Cleaning Products (Winery)				
Diatomaceous Earth				
(Etc.)				

Worksheet 6: Crush Wastage

During Crush you may wish to focus on one aspect of your winery to get a better sense of the amount of waste produced and opportunities for savings. Two obvious areas that can yield good results are energy usage and water.

Quantities and costs of the main waste products produced at the winery. Please record the source (or method of estimation) of all data in this table.

Waste Material	Quantity of Waste Material Produced From: To:	Cost of Treatment, Transport & Disposal of Waste Material	Cost per Unit of Production	Source of Data (e.g., invoices, accounts records, internal business report, Manager's estimate)
	(1 year)	(1 Year)		
Wastewater*				
e.g., Washwater from Barrel Washing	3,500 ML (calculated from average cleaning time x no. barrels cleaned x 30 L/min)	\$2,560 (Source: Water Bills)		Calculated from Water Metre Readings on Water Bills
E.g., Marc Produced				

* Please indicate if water is piped to a waste treatment plant or treated on site

¹ Myers, Dr. Jason, Canadian Manufacturers and Exporters; "Energy Efficiency Manufacturing Trends and Challenges", at Creating Value Through Energy Efficiency. Energy Forum for Senior Executives, Toronto Board of Trade, March 28, 2006

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- ⁶ Department of Industry, Tourism and Resources; A Guide to Energy Efficiency Innovation in Australian Wineries. Energy Efficiency Best Practices., Commonwealth of Australia. Available at <http://www.industry.gov.au/content/itrinternet/cmscontent.cfm?objectID=896D131A-0505-3F44-421B4FFEED12D429> , 2003, p8
- ⁷ Altech Environmental Consulting Ltd. and Ontario Centre for Environmental Technological Advancement (OCETA); Developing Energy Benchmarks for the Ontario Wine Industry, September 2006, p15
- ⁸ Altech Environmental Consulting Ltd. and Ontario Centre for Environmental Technological Advancement (OCETA); Developing Energy Benchmarks for the Ontario Wine Industry, September 2006, p23
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- ¹¹ Leue, Dave; 2004 quoted in Lawrence Berkeley National Laboratory, BEST Winery Guidebook: Benchmarking and Energy and Water Savings Tool for the Wine Industry, PIER Final Project Report, November 2005, prepared for the California Energy Commission, Public Interest Energy Research Program, p19
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- ¹³ Department of Industry, Tourism and Resources; A Guide to Energy Efficiency Innovation in Australian Wineries. Energy Efficiency Best Practices., Commonwealth of Australia. Available at <http://www.industry.gov.au/content/itrinternet/cmscontent.cfm?objectID=896D131A-0505-3F44-421B4FFEED12D429> , 2003, p27
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- ⁵⁹ Natural Resources Canada; Office of Energy Efficiency at <http://oee.nrcan.gc.ca/industrial/financial-assistance/existing/audits/index.cfm?attr=24>
- ⁶⁰ Natural Resources Canada; Office of Energy Efficiency at <http://oee.nrcan.gc.ca/industrial/financial-assistance/new-buildings/index.cfm?attr=0>
- ⁶¹ Davies, Mr. Bill of Union Gas at the Wine Council of Ontario Workshop Energy Management Workshop: Reducing Energy Costs in Ontario Wineries, Pelee Island Winery, June 22, 2006 (unpublished)
- ⁶² Union Gas, brochure, available as a pdf at <http://www.uniongas.com/business/contractci/EnergyEff/webenergywise.pdf>
- ⁶³ Pollution Probe, Emissions Trading Primer, <http://www.pollutionprobe.org/Publications/emissionstradingprimer.org> pp3–4
- ⁶⁴ Derived from Russell, Doug, "Greenhouse Gas Emissions and Carbon Trading" at Wine Council of Ontario Workshop, Energy Management Workshop: Reducing Energy Costs in Ontario Wineries, Inn on the Twenty, Jordan, June 27 (unpublished)
- ⁶⁵ Russell, Doug; "Greenhouse Gas Emissions and Carbon Trading" at Wine Council of Ontario Workshop, Energy Management Workshop: Reducing Energy Costs in Ontario Wineries, Inn on the Twenty, Jordan, June 27 (unpublished)