



LARGE SAVINGS FOR MAJOR MALTSTER

EEBP's innovative approach has two key elements: Big Energy Projects and Best Practice People and Processes training.

BARRETT BURSTON MALTING INNOVATION AND CAPACITY BUILDING

The Department of Industry, Tourism and Resources' Energy Efficiency Best Practice (EEBP) program is working with the beverage and packaging sector to help companies redefine best practice in energy management, and build their capacity to identify and implement continuous incremental improvements as well as 'big step' innovative advances.

This case study reports on how one of Australia's biggest malt producers, Barrett Burston Malting (BBM), is reaping the rewards of its partnership with EEBP.

'We saw the program as an opportunity to revisit our high energy use areas in detail and really get a handle on where energy is being used and where it is being wasted. It is easy to lose focus on energy issues when there are many other concerns on our management agenda. This program has provided us with a great opportunity to refocus on energy, make savings happen and explore major savings that we can achieve in future.'

Ray Bracchi, National Operation Manager, BBM

RESULTS TO DATE

BBM originally partnered with EEBP to explore opportunities for improving energy management when planning to build a new malting factory. However, the company soon discovered there were many more benefits that could be applied to its existing operations.

As well as identifying opportunities for the longer term, BBM's work with EEBP has resulted in immediate, and in some cases, unexpected benefits, such as:

- ▶ identifying 30 opportunities for savings of up to \$900 000 per year from BBM's major production site at Geelong
- ▶ seeing total energy operational costs bettered budget across all six sites by 10 per cent within nine months
- ▶ savings of more than 13 000 MWh of electrical energy and 20 000 GJ of gas energy and 17 000 tonnes of greenhouse gas emissions, thanks to the efforts of trained and empowered staff
- ▶ achieving savings in excess of 20 per cent in one malthouse
- ▶ achieving electricity savings of eight per cent at one site while testing improved kilning methods
- ▶ achieving moderate gas savings and a 25 per cent reduction in fan energy by fitting variable speed drives onto kiln fans at two sites





- ▶ identifying potential gas consumption savings of up to \$100 000 a year, improving malt quality and increasing product yields, through improved burner control at one site
- ▶ increasing staff awareness of energy issues and the quality benefits that flow from energy efficiency
- ▶ improving productivity.

The positive trend of staff identifying and making energy savings is continuing. BBM is now building on the lessons learnt and experience gained for its proposed new plant, to achieve lower running costs, reduced greenhouse gas emissions and quality product improvements.

The successful outcome also prompted BBM to roll out the key energy saving opportunities identified through Best Practice People and Processes training modules on specific technologies—such as refrigeration and compressed air—across its six Australian plants.

BACKGROUND ON BBM

BBM produces malt for the domestic and export markets. Malt is one of the main ingredients in beer, whiskey and can be used as a food additive. It is made through an energy intensive process that involves germinating and then drying barley.

The company began industrial scale malting in the 1850s, at Richmond in Victoria. The Richmond factory has seen many changes over the years, and is still in operation. BBM now has five other malting plants, one each in Queensland and New South Wales and three others in Victoria.

Malting requires the art and skill of a master maltster (to achieve malt flavours and brewing qualities) combined with industrial scale production capability to achieve economical manufacture. Like many modern industrial processes, malt at BBM's Geelong plant is produced in large batches in excess of 300 tonnes. While such economies of scale make malt more affordable, large-scale production also increases the risks associated with changing production processes. This means that improvements identified through innovation can only be implemented based on a thorough understanding of process fundamentals and a methodical approach.

In a risk-averse environment, traditional approaches are often retained even though new knowledge and technology could offer significant improvement. BBM has broken free of this traditional approach.

'Innovating involves risk, but not innovating is riskier.'

Grant Powell, Vice President, Group Production Services, BBM

BBM'S BIG ENERGY PROJECT

Big Energy Projects are intensive processes in which company staff and outside specialists analyse the fundamentals of an industrial process, then develop strategies to improve energy efficiency and productivity.

BBM initially embarked on a Big Energy Project to develop a strategic perspective on energy management and identify the scope for savings in a potential new plant.

PREPARING THE BACKGROUND PAPER

Project team members visited a key BBM site to research and analyse the way energy flows through a malting plant. They then explored options for reducing energy use, recovering waste heat, minimising energy losses and introducing new technologies and processes that could potentially improve energy efficiency and plant productivity.

The results were presented in a background paper that was reviewed by key BBM staff. This process focused attention on what information was available and what was lacking. It also opened up the agenda by enabling staff to take a step back and explore the fundamental principles that underpin the process of making malt.

RECRUITING EXTERNAL SPECIALISTS

The project team next drew on this improved understanding to select external specialists to participate in the next stage: the innovation workshop.

The specialists had expertise in gas technology/heat pumps, drying (in this case, timber drying), microwave technology, food processing and energy management. A CSIRO representative with expertise in energy modelling of industrial processes also participated.

A key factor in the success of EEBP innovation workshops is that they bring together people with diverse knowledge and encourage fresh perspectives. Each of the specialists had extensive experience in fields relevant to the processes involved, however none had worked in the malting industry.

'The specialists participating in the workshop were able to consider the malting process from a completely fresh angle, generating a host of valuable creative ideas for future plant designs and many solutions for retrofitting existing plants...I heard more innovative ideas about how we can improve our process during this workshop than I've heard in the last 30 years.'

Grant Powell, Vice President, Group Production Services, BBM

HOLDING THE BIG ENERGY PROJECT WORKSHOP

The external specialists joined BBM management, engineering and operational staff for the three-day workshop. BBM staff came from right across the company and included a senior manager (vice president), the operations manager and national engineering/energy manager. This mix ensured that the perspectives of different groups were explored and the outcomes of the workshop process were 'owned' by the entire company, not just one group.

After a tour of the Geelong Maltings plant and an explanation of the malting processes, workshop participants were presented with an overview of greenhouse issues, energy pricing and potential development opportunities. The presentation highlighted the benefits of adopting a longer-term, strategic perspective and a more proactive approach to energy and greenhouse issues. It also demonstrated how energy market and greenhouse risks could be better managed.

Building on discussions about the whole malting process during the site visit, the workshop group developed a shared understanding of energy flows through the plant and identified areas with potential for energy savings.

In the 'safe' environment of the workshop, participants were encouraged to ask any questions, no matter how basic, to come to terms with underlying principles and to challenge assumptions. The resulting discussions led to new insights for participants.

The second day began with a session in which participants shared their overnight thoughts on what they had learnt the previous day and, in some cases, further research and analysis they had conducted. This led to more ideas for improved efficiency.

Participants formed four smaller breakout groups to discuss specific issues and/or options, with a focus on the practicalities of applying them to the BBM site, including:

1. application of heat pumps and/or desiccant wheels: these could cut gas consumption by recovering heat from water vapour and air in the kiln exhaust stream, using it to pre-heat incoming air.
2. use of microwave technology to supplement hot air generated by gas furnaces in the kiln: microwaves penetrate the product, potentially increasing the rate at which bound-up moisture can be removed.
3. recovery of heat from germination and refrigeration.
4. optimisation of the processes through sensors to monitor conditions against 'ideal' system parameters.



The groups reached conclusions on many issues and, where necessary, identified key questions that needed further exploration and resolution outside the workshop. Each breakout group then shared the outcomes of their session with the other participants.

A half-day session on the third day was used to develop action plans for those options with the greatest chance of being applied.

Potential savings were identified for most parts of the malting process, along with available technologies with the potential to help achieve the savings. In addition, the following opportunities and technologies were identified as requiring further investigation or research and development: heat recovery from grain respiration and kiln exhaust; cogeneration; heat pumping; and microwave-assisted kilning.

One of the significant BBM resolutions arising from the workshop was to conduct an in-depth analysis of energy, mass and water flows in the malting process. For example, since more than half of the process heat is used to evaporate water, and there are many techniques for recovering and re-using this heat, participants suggested this was an avenue worth pursuing.

The workshop also convinced BBM management of the value of strengthening the energy management agenda across the entire company. This led BBM to decide to undergo the Best Practice People and Processes training.

FOLLOW-UP ACTION

To maintain the momentum of the workshop, BBM and EEBP jointly sponsored a more detailed study project to address the key workshop resolutions, namely:

- ▶ conducting a ‘whole-of-system’ in-depth analysis of energy, mass and water flows in malting
- ▶ undertaking an energy audit of BBM’s largest site, Geelong Maltings, to identify opportunities to reduce energy and water use at this site. Because other BBM maltings are similar in equipment, systems and operational practices, albeit on a smaller scale, it was expected that many of the opportunities identified at Geelong should also be viable at the company’s other sites.
- ▶ developing and analysing the costs and benefits of existing technologies opportunities identified during the workshop, particularly in relation to a greenfield site (new plant).

A supplementary aim was to further the company’s commitment to energy efficiency and greenhouse gas reductions by raising awareness and understanding among more BBM staff.

Consultants from a Melbourne energy engineering company, who participated in the workshop, conducted the study project. For Geelong Maltings, this involved:

- ▶ gathering information from BBM staff and service providers
- ▶ surveying equipment
- ▶ reviewing data from electricity and gas ‘smart meters’ and the plant’s extensive automation system.

Using this information, the consultant engineers analysed the malting process and developed a detailed picture of the energy, mass and water flows at Geelong. Once the malting process was analysed, energy savings plans were readily evaluated. The results of the analysis highlighted many more opportunities. In addition, opportunities identified in the workshop were evaluated both for existing and new maltings plants.

The study project involved close cooperation between the consultant engineers and BBM staff. Assistance with reporting and training mechanisms was also provided to help BBM apply the knowledge gained through the study project to its operations.

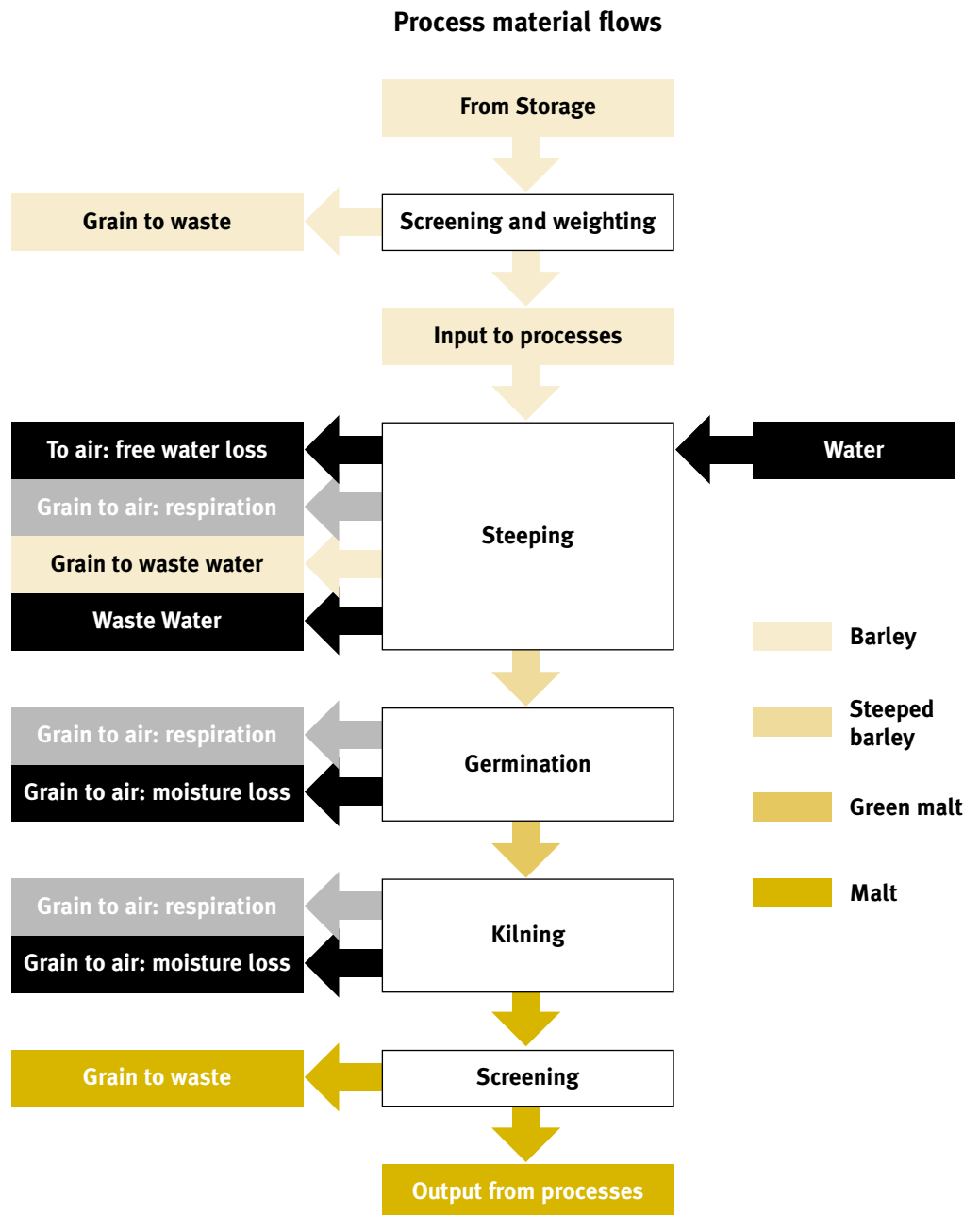


STUDY PROJECT OUTCOMES

Whole-of-system analysis

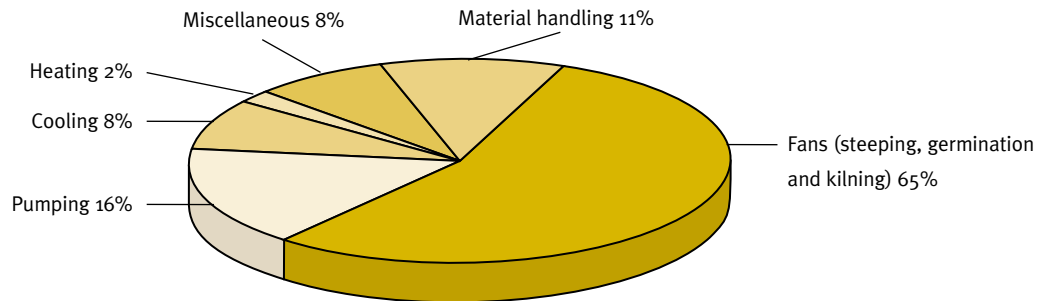
Outcomes from the whole-of-systems analysis were the creation of diagrams illustrating the mass balance and energy balance based on the malting process at Geelong Maltings. The mass balance diagram shows the flow of grain through the processing stages, from input at the top (as barley) to output at the bottom (as malt). Various inputs and outputs are shown at the sides of the diagram. Actual mass data for Geelong Maltings have been omitted for commercial reasons. The process flow is typical of all of BBM's maltings.

Figure 1: main process material flow diagram



The study revealed that at Geelong Maltings the largest end-uses of electricity were: fans (steeping, germination and kilning) at 55 per cent; pumping (mostly chilled water) at 16 per cent; materials handling at 11 per cent; and refrigeration plant (cooling) at eight per cent.

Figure 2: Electricity end use, by equipment type



For gas, the largest end use is in the kiln for drying, at 97 per cent. While such information is specific to Geelong Maltings, other BBM sites are technically and operationally similar and should have similar energy end-use patterns.

Energy audit

The main opportunities identified in the Geelong Maltings energy audit were:

- Cogeneration sized for the plant's electrical requirements with waste heat used in the kilns. This would also improve security of electricity supply, minimising the risk of reduced product quality due to power failures.
- Better control over the site's electrical demand and improved metering and monitoring of utilities (electricity, gas and water).
- In the germination boxes: fit variable speed drives to the spray pumps, repair the spill air arrangements and upgrade systems to better monitor and control temperature (both air and grain) and air moisture.
- In the kilns: upgrade systems to include monitoring of all parameters of intake and exhaust air to assist and improve control in this process, and convert the smaller kiln fan to direct drive with a high-efficiency motor.
- In the refrigeration plant: upgrade instrumentation and control systems and optimise operation, including using head pressure reduction controls, variable speed secondary pumping and automatic chilled water temperature control.
- In the ancillary services area: improve the operation of the compressed air system and better control the wastewater pond aeration pumps.

Areas for further investigation included:

- Apparent flow mismatch between the primary and secondary chilled water circuits, which potentially leads to energy waste through excessive chilling.
- Potential benefits of microwaves or radio frequency drying techniques to assist drying and improve product yield.
- The use of direct grain moisture measurement as a control parameter.

Overall, there is potential to reduce energy use and costs at this facility by up to 36 per cent and to reduce greenhouse gas emissions by up to 43 per cent. The cogeneration opportunity contributes around half of the identified improvement. Many of these findings are also applicable to other BBM sites.

BBM has begun implementing improvements, beginning with low-cost, high-return actions.



BIG ENERGY PROJECT WORKSHOP OPPORTUNITIES

When the opportunities identified during the workshop were developed and analysed in relation to a 'greenfield' site, it was found that:

- ▶ On-site cogeneration of electricity and waste heat would provide large savings in energy costs and reduce annual greenhouse gases by around 25 per cent.
- ▶ Heat pumps to transfer low-grade heat from germination boxes to kilns and from kiln exhaust to kiln intake are not yet a financially viable option, even when the input power is provided from cogeneration.
- ▶ Kiln waste heat exchangers are a viable option and can recover more than one-third of the water added to grain in upstream process steps, as well as saving energy.
- ▶ Heat exchangers to pre-cool germination box intake air on warmer days can greatly reduce the required capacity (and cost) of refrigeration plant, but even so are not financially viable at present.
- ▶ There is major potential to reduce fan energy through lower height grain beds with larger surface areas in both germinating and kilning vessels. By introducing a relatively modest 20 per cent depth reduction (and 25 per cent increase in area, or 11 per cent increase in linear dimensions), fan energy is reduced by nearly half.

Overall, for a new plant, energy costs could be at least 40 per cent lower and greenhouse gas emissions at least 43 per cent less than a comparable existing plant of the same production capacity. Further significant reductions in energy use and greenhouse gas emissions could be achieved by reducing the thickness of the beds of grain at the expense of larger size kilns and germination boxes.

TESTING IDEAS

The BBM Burnley Maltings in Melbourne is being used as a 'test bed' for some of the proposed upgrading of kiln instrumentation and controls identified for Geelong (and possibly at other BBM sites). The work is expected to improve overall understanding and reveal other opportunities. One early and interesting outcome is a larger than expected amount of heat generated by grain respiration in the kiln. Such heat is beneficial to the drying process but comes at a cost of lower product yield. This interesting finding highlights an area worthy of further study — to identify if it is possible to reduce respiration and produce more malt and, if so, how much of a trade-off would be required to generate additional heat from gas.

The outcomes of the study project highlight the value of EEBP and BBM co-funding energy experts to continue working with a company over an extended period of time — taking measurements, asking questions and evaluating options through trials and analysis. In most cases, external consultants are only engaged to undertake studies over a limited time. This means they do not often have sufficient time to form a close enough relationship with a company to come to terms with the unique issues at each site and the subtle but often important aspects of the industrial processes involved. This project study greatly benefited from the guidance of the Big Energy Project workshop and the enthusiasm and help of BBM staff.

BEST PRACTICE PEOPLE AND PROCESSES TRAINING

Best Practice People and Processes training is an organisational development program that builds in-house capability and empowers staff to develop and implement ongoing energy efficiency improvement strategies.

This is achieved through on-site seminars, workshops and training modules, with a focus on forming a multi-disciplinary energy team and gaining company-wide support for ongoing improvements.

‘Staff got an understanding of the ‘black box’ that was the refrigeration room. This led to an efficiency project that has seen \$180,000 approved for a new control and monitoring system integrated into the Central Process Control System’
Kevin Mitchell,
Plant Manager, BBM

The training is also effective in supporting further exploration and implementation of opportunities identified during Big Energy Projects.

BBM has also rolled out training modules across several of its plants, focusing on refrigeration, compressed air and monitoring of energy use.

Like the Big Energy Project, the training is also delivering early, tangible results for BBM:

- ▶ As part of the training, the findings of the energy flow analysis and the Geelong Maltings energy audit were presented to BBM staff at Geelong and Richmond. This contributed to a better understanding of the energy use in malting amongst BBM staff and stimulated discussions that uncovered further opportunities to reduce energy consumption.
- ▶ At the Geelong training session, plant operators commented that their smaller kiln was difficult to control during warmer weather. Speculation that this could cause excessive gas consumption was subsequently confirmed by meter readings and further analysis. BBM is now working with the engineers who undertook the study project and a combustion specialist to improve burner control. Anticipated benefits from this measure alone include gas consumption savings of up to \$100 000 a year, improved malt quality, and higher product yields.
- ▶ An example of an energy-saving opportunity implemented as a result of skills and knowledge obtained during the Best Practice People and Processes training at Burnley Maltings, is the fitting of variable speed drives onto the kiln fans and use of EEBP’s Motor Solutions On-line to test and refine some of the proposed kilning control improvements. Early indications show a 25 per cent reduction in fan energy and a modest reduction in gas energy. The payback is expected to be well under two years, and is already being duplicated at Richmond Maltings.

‘Building on the innovative solutions generated from the Big Energy Project, we have utilised the training program nationally to improve understanding and application of energy use within our production process.’

Ray Bracchi, National Operation Manager, BBM

CONCLUSION

As a result of its partnership with EEBP, BBM is making major improvements to its operations that are paying off through bottom line savings and reduced greenhouse emissions.

Some opportunities have already been implemented and others are underway, including several that will take time to complete. Still others will be implemented when the timing is appropriate, such during refurbishments or when building a new plant.

BBM is enthusiastic about the achievements so far:

‘Participating in this project with EEBP has brought new emphasis to energy conservation within all our production facilities and achieved results not previously thought possible.’

Ray Bracchi, National Operation Manager, BBM

ITR 2002/136

ENERGY EFFICIENCY BEST PRACTICE

Energy and Environment Division, Department of Industry, Tourism and Resources

GPO Box 9839, Canberra City ACT 2601

Telephone: 02 6213 7878 Facsimile: 02 6213 7900 Email: energy.bestpractice@industry.gov.au

Web site: www.industry.gov.au/energybestpractice