



The Queensland food eco-efficiency project: reducing risk and improving competitiveness

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Accepted 21 June 2006

Abstract

For the past several years, cleaner production, or what is now commonly referred to as eco-efficiency by the business sector, has been promoted widely, *but in a relatively ad-hoc manner*. As a consequence, the advantages to industry and society stemming from the uptake of eco-efficiency have been difficult to quantify and assess. This paper details how the Queensland Food Processing Eco-Efficiency Project has attempted to overcome some of these barriers by implementing a two year project focused on: involving and gaining the support of as much of the industry sector as possible; using external expertise, providing the support and technical advice essential to the successful uptake of eco-efficiency by businesses; establishing the key environmental concerns for the industry; identifying realistic eco-efficiency opportunities through site assessments and visits; developing case studies based on quantifiable outcomes; developing tools and resources to enable businesses to successfully implement their own eco-efficiency initiatives; the wide and free distribution of these resources and tools to the entire Queensland industry; follow up workshops and awareness briefings together with the eventual development of a forum to allow effective industry networking to continue.

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Keywords: Eco-efficiency improvements; Australian food industry; Environmental concerns; Quality assurance

1. Introduction

The paper begins with an introduction to the Queensland food processing industry and briefly outlines some of the industry's environmental impacts and concerns, clearly demonstrating the need for and value of eco-efficiency. The project's implementation, from the preliminary stages of stakeholder collaboration, to the distribution of resources and tools and follow up workshops is then described in some detail along with some project case-studies demonstrating the competitive edge that eco-efficiency can provide. The paper concludes with a discussion on where eco-efficiency

gains for the industry can be achieved and how ongoing implementation can be encouraged.

2. Overview of the Queensland food industry

Queensland has the third largest food processing industry in Australia, both in terms of turnover and employment generated. During 1999/2000 the industry employed 35,100 people with AU\$9.93 billion in turnover including AU\$2.34 billion of value added component [1]. During 2001/2002 it contributed approximately AU\$5.3 billion or 23% of Queensland's exports [2]. Food production in Queensland includes very large meat and sugar processing, dairy processing, bakery products, beverages, oils and fruit and vegetable processing, among others.

Environmental impacts of food processing include the consumption of non-renewable energy sources and the generation

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of greenhouse gases, while water scarcity and supply are becoming critical for many food processors. The Queensland food industry consumes an estimated 56 GL¹ of water per year and 84 PJ of energy generating 2.2 million tonnes of CO₂ gas,² which is the equivalent of that produced by 638,000 cars annually. Resources consumed in the production of packaging and the generation of packaging waste is another issue for the sector, together with the increasing costs of disposal of solid and liquid wastes.

3. Environmental challenges and drivers for eco-efficiency

Food processors face many demands during the day to day operations of their businesses. They must be flexible in order to meet customer needs; they must have good manufacturing and hygiene practices to meet requirements for safety, product quality, food regulations and environmental licences. Food companies must also respond to intense competition, sometimes coupled with low profit margins. Increasingly, the sector is subject to globalisation and the competition from lower-priced imports. The premise of eco-efficiency is that it improves profitability while improving environmental performance and lowering the risk of causing environmental harm, which is being increasingly driven by public expectations.

3.1. Compliance and legislation

Environmental legislation that regulates Queensland food processing facilities is administrated by authorities such as the state's Environmental Protection Agency [3]. The Qld EPA issues licences that generally include quantitative and qualitative requirements for emissions to air and surface waters as well as the disposal of solid and liquid wastes. The disposal of wastewater to the sewerage system is regulated by local councils.

Regulatory authorities are encouraging industries to play a more proactive role in improving their environmental performance through the use of tools such as industry codes of practice, environmental management systems (EMS) and waste minimisation plans. To encourage business to achieve more than basic compliance, government authorities are now more focused on building partnerships with business and industry groups to encourage the uptake of eco-efficiency and use other tools.

3.2. Water supply and pricing

Of all the manufacturing industries, food processing has the highest level of water use in Australia, accounting for just over 30% or 241,706 ML per year [4]. Within the food processing

industry there is great variation in water use, due to the diversity of operations taking place.

As increasing pressure is placed on limited water reserves, government bodies and water authorities are actively seeking to promote greater water efficiency and encouraging water conservation strategies and incentives.

Food processors are also becoming aware of the escalating cost of water. For example, since 1997 water supply costs in the Brisbane City Council region have risen from AU\$0.60/kL to AU\$1.13/kL. Many water authorities are progressively introducing a user-pays charging system to recover the full cost of supplying water to the consumer, in order to encourage water conservation and to cut costs.

3.3. Wastewater discharge costs

Wastewater discharge costs vary according to the region, and according to whether the waste is being discharged to land, surface water or the sewerage system. Plants discharging treated wastewater to municipal sewerage systems face the highest costs. Most water authorities currently charge on the basis of the organic loads (BOD/COD), suspended solids and volumes. However, some authorities have introduced additional charges for nutrient loads (nitrogen and phosphorus). Full cost recovery charging has not been applied to sewer discharges to date; but this situation is changing, and local authorities and water boards, especially those in metropolitan areas, are in the process of formulating charging systems that will progressively increase wastewater discharge fees on a user-pays basis until something approaching full cost recovery is achieved. For example, the Gold Coast City Council is more than doubling its volumetric discharge fee, from AU\$1/kL to AU\$2.18/kL, with additional incremental rises in mass load charges. This is in line with the Australian National Competition Policy which calls for full cost recovery of water/wastewater services.

3.4. Energy and energy supply costs

Australia's per capita demand for energy is high by world standards and as much of the energy used depends on non-renewable fossil fuels, the current consumption rate can be considered to be unsustainable in the long term. Australia's overall energy consumption per unit of gross domestic product (GDP) has improved only slightly since 1970, whereas some other OECD countries have achieved improvements of more than 30% [5].

The low cost of energy and the lack of mechanisms to control demand in Australia are seen as among the main factors inhibiting the adoption of more energy-efficiency practices. Nevertheless, a growing awareness of the environmental impact of combusting fossil fuels (in particular increasing greenhouse gas emissions), has driven the development of alternative "cleaner" energy sources. Sources of "green" energy in Queensland include solar, wind, biomass and biogas. Despite greenhouse abatement initiatives such as the Greenhouse Challenge and the Australian Renewable Energy

¹ ABS Water Account [4], Figure 2.4: 4711 GL of water consumed in Queensland, approximately 4% of this is manufacturing and 30% is attributed to the food sector.

² Calculated using ABARE [10]. Queensland energy consumption figures and CO₂ emission factors from the Australian Greenhouse Office [14].

Certificate scheme, it does not appear that the food sector has significantly adopted alternative energy sources, with exceptions such as the sugar industry, which has always been fuelled by biomass and is now widely adopting cogeneration schemes.

3.5. Packaging

Food manufacturers face increasing pressure to develop and use packaging that reduces resource use, enables reuse or recycling and minimises landfill disposal. A 2001 survey by the Australian Food and Grocery Council identified packaging as the most significant environmental issue for their members during the preceding five years; 80% felt it would remain the most significant issue for the next five years, and this has been confirmed in the 2003 survey [6]. The importance placed on packaging may have resulted from the strong increase in awareness as a result of the National Packaging Covenant (NPC), which encourages voluntary actions by signatory companies to reduce packaging waste, and is underpinned by regulation to capture non-signatories. This approach differs from other regulatory approaches, such as in Europe and Japan, where efforts to reduce packaging waste are through increasingly stringent regulations that make manufacturers responsible for packaging, from production through to responsible disposal by the consumer. In some cases packaging initiatives are driven by the legislative requirements of export customers.

3.6. Solid waste management

Solid waste recycling or reuse rates for most food and grocery sectors are about 80%, with an average of 4% sent to landfill [6]. The remainder is organic waste, which may be used as animal feed, composted or digested to produce biogas. Food processing plants in city areas are well serviced by waste disposal and recycling companies, so it is usually more profitable for a company to segregate and recycle than to dispose of waste to landfill. Processing plants in regional areas may experience some difficulties until waste services are developed and expanded. A recent development in some city areas is the collection of organic materials such as food waste for composting, and in the case of Sydney, for power generation (biogas).

From a manufacturer's perspective, challenges include storage of organic waste, frequency of recycling services, and management of odour and other nuisances. Contamination of solid wastes (particularly plastic packaging) by food and food ingredients can be a barrier to recycling, so companies may need to identify ways to remove or minimise the source of contamination. Solid waste disposal costs can be a relatively minor component of total operating costs but it can be an area where employees at all levels can contribute and immediately see results.

3.7. Improving raw material efficiency and product yield

The food industry has the most potential for savings through improving raw material efficiency and product yield. A waste minimisation project carried out in East Anglia,

UK, noted that the equivalent saving in reduced offsite disposal was less than 1% of the savings achieved in reduced raw material cost [7]. The main source of raw material loss is during preparation and cleaning processes and these losses often end up in the wastewater stream. Thus minimising raw material losses provides double savings by conserving resources and minimising treatment and/or disposal costs.

4. The eco-efficiency in the Queensland Food Processing Industry Project

An alliance formed in 2003 between the industry contact body, the stakeholders from funding organisations and the project implementing organisation was essential to the project's success (see Table 1).

These organisations all played an active role on the steering committee together with representatives from the food processing industry who had either been involved in previous eco-efficiency assessments or who showed a strong commitment and interest in eco-efficiency (see Table 2).

The steering committee identified the need to develop strong networks within the industry to encourage involvement and to enhance information sharing and problem solving. A database of all food processing companies in Queensland was developed to assist in the distribution of information about the project to both small and large businesses and to seek expressions of interests in participating in an eco-efficiency assessment or hosting a site visit. The entire sector was able to follow the progress of the project on a specifically designed web site that was regularly updated (http://www.geosp.uq.edu.au/emc/cp/Food_Project/).

The case study implementation stage of the project involved representatives from the UNEP Working Group for Cleaner Production conducting eco-efficiency assessments for the volunteer companies that would form the basis for illustrative local case studies. An eco-efficiency assessment followed the traditional methodology (see for example [15,8]) and typically involved preliminary site visits, developing a process flow chart and identifying the inputs and outputs of the process. Walk through inspections were undertaken to confirm preliminary data, suggest issues and highlight areas for potential improvement. Quantified input and output figures

Table 1
Organisations involved in the project

Role	Organisation
Industry contact	Australian Industry Group – Queensland (AiG)
Funding	Queensland Department of State Development and Innovation (DSDI) The Queensland Environmental Protection Agency (QEPA) Australian Government Department of Agriculture, Fisheries and Forestry (DAFF) Brisbane City Council (BCC) Australian Water Association (AWA)
Project implementation	UNEP Working Group for Cleaner Production in the Food Industry

Table 2
Businesses that conducted an eco-efficiency assessment for case studies

Company	Type of processing
Bundaberg Brewed Drinks Ltd	Beverage
Buderim Ginger Ltd	Ginger
Golden Circle Ltd	Beverage and vegetable
Stahmann Farms Ltd	Macadamia and pecan nut
Goodman Fielders Ltd	Industrial bakery
Mrs Crocket's Kitchen	Salads and vegetables
Previous detailed industry assessments that provided valuable input for the project	
Capilano Honey	Honey
Food Spectrum	Syrups, toppings, blends and mixes
Harvest Fresh Cuts	Salads and vegetables

provided a basis for setting targets and suggesting key performance indicators. Conducting detailed assessments of water, waste and energy use then enabled areas of unexplained loss to be identified and highlighted those operations or activities consuming significant resources or generating waste. Eco-efficiency opportunities were then identified and ranged from simple housekeeping improvements and minor process refinements through to major process changes. Once identified, each opportunity underwent an evaluation process to determine its feasibility and practicality. A few of the eco-efficiency opportunities identified are presented later in this paper. Company personnel involved were required to commit time for meetings and provide data however no other costs to the companies were involved. As well as for assessments, some ten other companies were also visited to promote the aims of the project, discuss eco-efficiency and environmental management needs and obtain feedback as to the perceived value of the project.

Organising such a project from a diverse group of stakeholders and companies with totally different needs can be demanding and difficult. However in this case, operations proceeded smoothly and finding companies to participate was not too difficult as some quickly recognized the benefits of participation and the steering committee provided a wealth of contacts. However, data availability and the need for confidentiality were two barriers that merit further discussion.

Data availability is always a major issue in eco-efficiency assessments, regardless of size. Necessary data tends to be housed with different “gatekeepers” throughout the plant, who are often unwilling to share the information, making data collection a time consuming and tedious process. Companies often regard much of their information as highly sensitive. In this project, all data were treated with the utmost confidentiality with senior staff signing off on any reports or case studies before release. A common approach was to prepare two sets of case study material: one for marketing or similar purposes and a more detailed report that remained confidential.

A comprehensive Eco-efficiency Toolkit for the industry was developed concomitantly and in the light of the assessments’ findings, and included an eco-efficiency manual with an accompanying CD ROM. The manual lists potential opportunities for food processing companies to reduce resource

consumption and waste generation and is supported with many recent and locally relevant case studies, with clearly quantifiable savings and payback periods. The steering committee and a number of other external reviewers provided valuable input into the contents of the toolkit (see Table 3). After the toolkit was developed a series of workshops and stakeholder seminars were held around the state to promote the use of the resources. Hard copies were distributed at seminars and to other interested parties, and downloads could be obtained from the project website http://www.geosp.uq.edu.au/emc/CP/Food_Project/default.htm.

5. Eco-efficiency opportunities

Table 4 summarises how five Queensland companies were able to quantifiably demonstrate an increase in competitiveness through eco-efficiency initiatives. The types of eco-efficiency opportunities identified are then described in more detail.

5.1. Harvest Fresh Cuts

Harvest Fresh Cuts manufactures chilled salads and pre-prepared light meals and is the largest of this sector in the country. This company realised the potential for eco-efficiency in many areas of its operations.

Table 3
Eco-efficiency toolkit for the Queensland food processing industry

Chapter	Content
Chapter 1: Introduction	Outline of the environmental challenges and issue faced by food processors
Chapter 2: Eco-efficiency self assessment guide	Self assessment guide that outlines the steps in an assessment and includes pro-forma worksheets
Chapter 3: Water and wastewater	Opportunities to reduce water use in processing, cleaning, utilities and auxiliaries and to reduce wastewater volume. Examines recovery, recycling and reuse options
Chapter 4: Energy	Opportunities to reduce the demand for steam and the efficient operation of refrigeration systems, compressed air systems, motors, lighting and air conditioning/heating systems. Heat recovery, alternative sources of energy and co-generation are also discussed
Chapter 5: Packaging	Opportunities to avoid reduce, reuse and recycle packaging
Chapter 6: Solid waste	Opportunities to reduce, reuse and recycle solid waste, including product recovery and value adding
Chapter 7: Chemicals	Optimising chemical use during cleaning and the operation of boilers and cooling towers. Water quality and chemical effectiveness, alternatives to chemical use and the supply and handling of chemicals are discussed
Resources CD ROM	Includes a list of useful web links and references Generic eco-efficiency training presentation Calculators: (1) true cost of water; (2) energy sources and greenhouse gas emissions; (3) trade water costs; (4) compressed air Summary tables of eco-efficiency opportunities

Table 4
Demonstrating the benefits of eco-efficiency

Company	Water savings (AUD\$)	Energy savings (AUD\$)	Waste savings (AUD\$)	Chemical savings (AUD\$)
Harvest Fresh Cuts	11000	10000		45000
Food Spectrum	17500	19600	3500	
Golden Circle	65700			
Butter Producers		30000		
Buderim Ginger		50000		

Rationalisation of energy use has resulted in annualised savings of AU\$10,000 from:

- Removal of five split system air conditioners replaced with ducted air;
- Reduction in air temperature in the plant room through improved ventilation;
- Installation of a new variable speed drive air compressor, resulting in additional compressed air capacity and reduced electricity costs by AU\$5000 per annum.

Future initiatives include the introduction of heat exchangers on a processing line utilising wastewater to pre-chill/maintain chilled water temperatures, saving AU\$18,000 per annum with a capital cost of AU\$50,000.

Since the original eco-efficiency assessment, total water consumption on the site has reduced by 15.7% despite production increasing sharply. This represents a saving of AU\$11,000 per annum. Water-saving initiatives included:

- Installation of a second flume washer, enabling the reuse of sanitiser water as “top up” water to the wash tank. This resulted in a reduction of water used on one production line by 28%.
- Introduction of auto-cut off nozzles for hoses used in cleaning has reduced water for washing by 5%.

Future initiatives include the introduction of a system to ensure accurate chemical and water usage during cleaning. This should result in savings in cleaning chemicals (40%) and water (10%) for a capital cost of equipment of \$21,000. An interesting aspect of the work was discovering the true cost of water on site. It was estimated that substantial quantities of cold water were being discharged that represented a cost of almost triple the purchase price. A saving of AU\$45,000 in sanitiser costs was also made with the introduction of the second flume and additional control systems on the Turrati line, enabling sanitiser concentrations to be reduced by 30%, without loss of efficiency in microbial kill [9].

5.2. Food Spectrum

Food Spectrum produces over 100 types and flavours of syrups, toppings, fruit blends, dry blends and pre-mixes that are used in the production of ice cream, cake mixes, yoghurts

and other foodstuffs. The company had operations on a number of sites and was in the process of moving when the preliminary assessment was undertaken, however some substantial potential savings were still found. For example, improvements to the thawing operations for some ingredients could result in estimated savings of AU\$108,000, with a payback in just over 1 year. Other savings included:

- Installation of a Clean In Place system for a capital cost of AU\$50,000 and saving of AU\$17,800/year;
- Turning off air-conditioning when not required to save AU\$5900/year in electricity costs;
- A preventative maintenance program for compressed air leaks, and reducing operating pressure of the compressed air system to save AU\$2400/year;
- The recovery of heat from a hot water stream to pre-heat kettle feed water and save AU\$11,300/year for a capital outlay of AU\$20,000; and
- The review of waste disposal practises for a potential saving of AU\$3500 in reduced waste disposal costs.

5.3. Golden Circle

Golden Circle is Australia's largest grower-owned and Australian-owned fruit and vegetable processor. The company manufactures more than 600 products including shelf stable fruit and vegetables (cans, glass, plastic packaging), fruit juices, cordials, soft drinks, jams and preserves, and a range of pre-processed fresh fruit. An eco-efficiency assessment was carried out for the beverage plant which produces more than 42 million litres of fruit juice and drinks each year. The company has a target for 2004 to reduce water use per unit of production to 20% below 2002 levels. Savings identified by Golden Circle include:

- Optimise cordial line clean-in-place system by eliminating a second rinse step reducing water usage and saving 1700 kL and AU\$4000 per year;
- Prevention of overflowing water on the cordial hot fill line saving 6.7 ML/year and AU\$34,000 in water supply, treatment and discharge costs for an outlay of AU\$400;
- Modifications to the effluent pH control system which saved 5 ML and AU\$12,000 of water per year for an outlay of AU\$200; and
- Reduced the flow on rotary screen spray water to save 6.5 ML and AU\$15,700 per year for no capital cost.

Other potential savings include further optimisation of the beverage plant Clean-In-Place system, recirculation of pump seal water and segregation of wastewater streams to optimise treatment processes for reuse or disposal to sewer [16].

5.4. Butter Producers Federation Cooperative

The Butter Producers Federation Cooperative (BDFC) produces ghee (clarified butter) of which over 80% is exported.

BDFC's Engineering Manager, Darryl Markwell, identified energy savings worth over \$30,000 per annum by:

- Reducing the load on the refrigeration system from adjusting room temperatures, repairing door seals, optimising the control system. Darryl saved AU\$10,800/year in condenser cooling water and AU\$8000/year in gas.
- Installing jacketed pipes to recover heat from the butter to heat hot water. Cost of installation AU\$4000. The boiler was no longer required every day saving AU\$8000 in energy costs.

In 3 years, the company managed to reduce annual water and energy costs by 33%. As Darryl says, "Energy usage reduction is a process of continual improvement and is never finished."

5.5. Buderim Ginger

Buderim Ginger has the capacity to process over 5000 tonnes of ginger per annum, employs over 200 people world-wide and exports to more than 17 countries. The company produces dried, candied, syruped, glaze and crystallised ginger as well as selling a variety of jams, syrups, toppings and beverages. Some eco-efficiency opportunities identified included:

- Installing a computer controlled system for the ginger crystallising air conditioning system expansion valve reducing operating costs by 15%;
- Installing a recuperative heat exchanger on the dehumidifier to heat incoming air saving approximately AU\$14,000 per year in gas costs;
- Installing electronic control valves on the air conditioning saving an estimated 10–20% of operating costs; and
- Replacing 2×2.5 MW steam generators (64% efficiency) with a more efficient 6 MW boiler with an economiser (84% efficiency). This saved 2000 litres/day in gas consumption and reduced maintenance costs by AU\$35,000/year.

Other potential savings identified include AU\$44,000/year in gas costs through the installation of a solar hot water system for pre-heating water for an installation cost of AU\$120,000. Significant savings in waste treatment costs in the order of AU\$120,000 are also being investigated.

6. Where can eco-efficiency gains be achieved?

As shown by the previous examples, there are significant savings available to food processing companies in reducing the consumption of resources and the generation of wastes. The following discussion explores possible savings across the entire Australian food manufacturing industry through the uptake of eco-efficiency initiatives.

For example, an industry-wide 5% decrease in water consumption through the adoption of an eco-efficiency program is perfectly feasible. In 2000–2001, total water use in

Australian manufacturing industries was 866,061 ML or 3.5% of total water use in Australia over this period. The food, beverage and tobacco industries were the highest users of water within the manufacturing industry at 241,509 ML (28%) [4]. A 5% reduction in water use for the food, beverage and tobacco industries would save around 12,075 ML per year which is the equivalent of \$13.6 million based on Brisbane Water supply prices of \$1.13/kL.

Similarly, the Australian food, beverage and tobacco industries consume 142 PJ (1 PJ = 10^{15} joules) of energy [10]. Thus a nationwide 5% decrease in energy consumption would save 7.1 PJ equating to over \$90 million dollars in energy costs³ and a significant reduction in greenhouse gas emissions.

There are numerous opportunities available to the food industry through improving supply chain management. Where there has been industry recognition in the past for integrated supply chain management and the "paddock to plate" philosophy to ensure the integrity of food products, there is now more consumer-driven demand for food safety, better quality and to reduce the environmental impacts of food production [11]. The Australian National Food Industry Strategy (NFIS) has been set up to develop Innovation, Market Development, Business Environment and Environmental Sustainability within the Australian food industry [12]. Improvements in supply chain management inevitably lead to gains in eco-efficiency. For example, Harvest FreshCuts has the potential to save \$110,000 per year by replacing cardboard boxes with reusable plastic crates for distribution of their products. The company has been actively investigating this with retailers (supermarket chains).

There is also potential to further develop markets for the servicing of recyclable wastes and the collection and processing of organic waste into more value-added products such as compost and fertilisers. In 2002, Queensland generated 598,159 tonnes, or 165 kg per person, of commercial and industrial wastes of which 45% was organic comprising food (10%), timber (11%) and cardboard/paper (24%), not including other green wastes.

7. Encouraging implementation

Two questions are continually posed, locally and internationally: "If eco-efficiency is so good why isn't every company doing it?" and "If companies profit from eco-efficiency, why should governments pay for it?" These are difficult questions to answer.

It was found during this project that the identification of eco-efficiency opportunities that meet company criteria for return on investment is still not always sufficient to encourage implementation. In many instances the consequences of not undertaking eco-efficiency are relatively insignificant (apart from a loss of potential savings) or are associated with an "acceptable level of risk". This is noted by Danihelka [13] who

³ Assumes 50% of saving is electricity at AU\$0.05/kWh and 50% is natural gas at AU\$12/GJ.

concludes that “Cleaner Production treats risks which are perceived as acceptable and this is why the motivation to utilise it is not sufficient and that managers of enterprises are concerned more with risks that are perceived to have low acceptability”.

There are a number of questions to be addressed in encouraging ongoing implementation of eco-efficiency:

- How do we ensure implementation and uptake?
- What additional resources are required?
- Are additional stakeholders required to be included?
- What can we do to stimulate continuous improvement?
- How can we work with company teams to ensure survival of the concept?

There are complex reasons why companies do not implement what would appear to be viable opportunities for reducing costs. Some of these are detailed below along with how this particular project or other government initiatives have attempted to address the problem of encouraging uptake of eco-efficiency.

7.1. Where opportunities are identified by “third party” consultants or advisors, there are questions as to the validity of the potential savings presented

For large companies, the facilitation of teams and in-house projects is considered to be more likely to lead to greater uptake as teams are more likely to have a greater level of ownership over ideas and solutions. In this case, experienced advisors could lend their expertise in facilitating such teams. This particular project hoped to encourage implementation by producing a comprehensive manual, with a user friendly step-by-step self-assessment guide, checklists and locally relevant case-studies that enables companies to generate their own eco-efficiency ideas. We believe that once those people in a company who can effect change see the benefits, then the uptake of the strategy will be immediate and continuous. Feedback to date on the Eco-efficiency Toolkit has been extremely positive with comments such as “the manual is one of the most practical resources of its type around”.

Small to medium enterprises (SME) are possibly more time and resource poor than large companies and require more support in implementing eco-efficiency. Although the content of the Eco-efficiency toolkit is equally applicable to SMEs, the format is not. That is, it comprises a 200 page document that cannot be readily absorbed by a company with only a small number of employees. The development of more user-friendly one to two page relevant fact sheets, could be a more appropriate means of providing information to SMEs. This should then be followed up with external support.

7.2. The relatively low cost of essential resources (water and energy) compared with other operating costs such as labour and raw materials

The expenditure on resources such as water or energy can be a relatively small percentage of total operating costs and the identified savings may not be large enough to warrant attention when

more pressing projects or issues need to be addressed, such as ensuring daily factory throughput or addressing safety issues.

A strong focus of the project was to draw attention to the true costs involved in consuming these resources such as water and energy and generating waste. For example water costs can also include heating, cooling, pumping, treatment and final disposal expenses. The project also highlighted the increase in new charging arrangements by local governments to recover costs and the implications for resource consumption. Much of this information had been disregarded until actively pointed out in assessments or workshops, after which it was recognised as an important issue.

7.3. Lack of funds and insufficient technical knowledge and support to implement initiatives once they have been identified

Food companies, as with other manufacturing companies, have different levels of awareness, interest and adoption of eco-efficiency. For more integrated uptake of eco-efficiency, programs should also be designed so that companies have access to resources, support and funding when there is a need or desire to access it, to stimulate activity. Lack of funding and insufficient technical knowledge and support is frequently stated as the overriding reason for not adopting eco-efficiency initiatives. The Queensland Environmental Protection Agency, Sustainable Industries Division, recently launched an “EcoBiz” program in an attempt to address some of these issues (see http://www.epa.qld.gov.au/environmental_management/sustainability/industry/ecobiz/). The department works in partnership with individual businesses to initially conduct a baseline assessment (status quo) and from this develop an action plan for implementation. To encourage implementation, businesses who have completed their action plan are then eligible for a rebate ranging from \$1000 to \$150,000 (a maximum of 30% of the project) on completion of activities identified in their plan, thus providing increased economic support for eco-efficiency.

One of the strengths of this project was its strong links with industry and the creation of networks. The project organisers suggested that enhanced value would be obtained through the formation of an industry forum or industry clusters that could provide the opportunity for companies to support each other by swapping ideas or discussing common issues, at the moment lacking in Queensland. This would also provide an opportunity to discuss technical issues - successes and failures. This could be facilitated by relevant industry associations and possibly state or local governments. In Victoria, the sectoral strategy for the food industry revolves around a number of eco-efficiency activities, including providing structures where ideas can be exchanged, conducting regular meetings and cross-industry partnering.

7.4. Relatively low public pressure to improve coupled with minimal regulatory pressure

Despite relatively low public pressure (in Australia) consumers are becoming increasingly more aware of the

environmental impacts of food production and food products and are starting to ask for change. The project found many examples where businesses are recognising these market demands by improving their environmental impacts and resource efficiency, as discussed previously.

From a regulatory viewpoint, the adoption of eco-efficiency should result in a more compliant organisation that is willing and able to work in partnership with the regulator to improve environmental outcomes, instead of being a “combatant”. An example of such partnering activity is where the Brisbane City Council, recently introduced a voluntary scheme for providing rebates to large users of water that develop and implement water management plans to minimise water use. Such schemes can be quite effective in changing attitudes and bringing mutual benefits. However there are generally low regulatory pressures to improve environmental performance. Most companies tend to operate at compliance levels and there are few programmes designed to improve their performance, although for example new packaging regulations is one area that impacts the food industry significantly and will result in significant changes.

8. Conclusions and recommendations

The Queensland Food Eco-Efficiency Project demonstrated that many food companies in different sectors can identify and profit from eco-efficiency opportunities in a variety of areas of resource efficiency, with profitable opportunities typically arising in the areas of reducing waste and increasing yield, minimising energy and water consumption.

Most of the typical barriers to uptake of eco-efficiency were encountered during this project, but many were overcome by gaining industry “buy-in” at an early stage of the project and using a genuinely collaborative approach between industry associations, individual companies, government and external consultants. We believe that the combination of the implementation process and resources produced as a result of this project have provided a platform to overcome many of the barriers associated with the uptake of eco-efficiency. However difficult issues still remain, such as that the building in of continuous improvement and continuous uptake of eco-efficiency at the outset of a project is difficult with all stakeholders trying to meet pressing performance deadlines. Many are simply too busy to allocate too much time to a project that they may be conducting in their “spare time”. External resources to support eco-efficiency assessments or partially fund projects can be an important driver to support such on-going activity especially in companies that are only partially convinced of the benefits, hence the success of “EcoBiz” type programs.

While the project clearly highlighted that eco-efficiency is a powerful strategy to reduce risk and improve competitiveness it also demonstrated that no matter how convincing and useful the case studies and tools, or how collaborative the project process, follow up for businesses interested to implement eco-efficiency is crucial. We believe that effective support and advice that is ongoing and long term may ultimately make the difference between simply staying with the status quo or deciding to make that change - the vital first step towards continuous, industry led improvement.

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