Faculty of Education

Benchmarking to Trigger and Sustain the Introduction of Cleaner Production in Small to Medium Sized Enterprises

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Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

Signature: ……………………………………………

Date: ………………………...

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Abstract

This thesis investigates benchmarking (and associated capacity building activities) as a trigger for the diffusion and implementation of Cleaner Production. The critical success factors for the environmental benchmarking process are:

- The identification of gaps in environmental performance in areas important to the long-term future of the businesses
- Providing and/or promoting the drivers to close the performance gaps
- Ensuring business managers possess the ability and tools to close the performance gap.

A program was developed implementing these factors and delivered to the drycleaning industry in Western Australia. This program identified large performance gaps for the different Eco-Efficiency indicators. The participants accepted the benchmarks (which are amended for ‘economies of scale’ if required) as suitable targets and committed their businesses to achieving these in their action plans. Economic benefits, managing environmental risk and maintaining their licence to operate were found to be important drivers. Participants on average reduced hazardous waste generation by 48%, improved their chemical efficiency by 30% and their energy efficiency by 9%, while individual business manager’s levels of Eco-Efficiency improvements varied widely. The businesses with the higher levels of productivity and the greatest experience in the industry obtained the greatest improvements in Eco-Efficiency from the program. Furthermore, the business managers involved in the program had a significantly higher uptake of Cleaner Production in comparison with control groups, both inside the drycleaning sector as well as in 3 other sectors dominated by small to medium-sized enterprises.

This research indicates that benchmarking for small businesses needs to be part of an on-going industry specific capacity building program with the opportunity to network in a supportive atmosphere. When this is the case, improved environmental accounting practices and benchmarking can trigger and sustain the uptake of Cleaner Production to improve the Eco-Efficiency of small businesses.

Executive Summary

Cleaner Production aims to change the behaviour of organisations towards the environment. Changing existing behaviour can be very difficult. For example: why is it so difficult for organisations to change their behaviour despite demonstrated economic and environmental benefits? What are the principal enablers for change and why do apparently similar organisations differ so vastly in their Eco-Efficiency? Put at its most basic for Cleaner Production programs to be successful it is necessary to attract the attention of business managers, then somehow retain this attention while the Cleaner Production technical skills and business cultures are being developed until the full benefits of any business improvement tool can be realised. The aim of this research is to promote benchmarking to help trigger and sustain the desired change in environmental behaviour of small and micro businesses.

The literature review for this research concludes that Cleaner Production is a strategy well suited to small business processes, due to its practical three step approach: source inventory, cause diagnosis and option generation. Cleaner Production also focuses on the economic and environmental benefits of improved Eco-Efficiency while constantly working towards and finalising actionable solutions. To be successful, programs need to consider both the technical and cultural requirements and integrate these into the program's design. Benchmarks are the performance levels. Benchmarking is a continuous improvement tool or process, which looks at the practices which lead to that standard of performance and investigates how they can be transferred. Benchmarking should be seen as 'value adding' to environmental monitoring programs.

There are three critical success factors for benchmarking: the identification of performance gaps in issues important to long-term competitiveness; the promotion and cultivation of drivers to improve performance; and ensuring business managers have the skills and tools to close the performance gap. These success factors complement and enhance the innovative SME model (see Figure 1) with its three sub-networks: regulatory, business and

knowledge. The amalgamation of these models can facilitate the establishment of benchmarking to create innovative small businesses and provides a synergy for improving Eco-Efficiency.

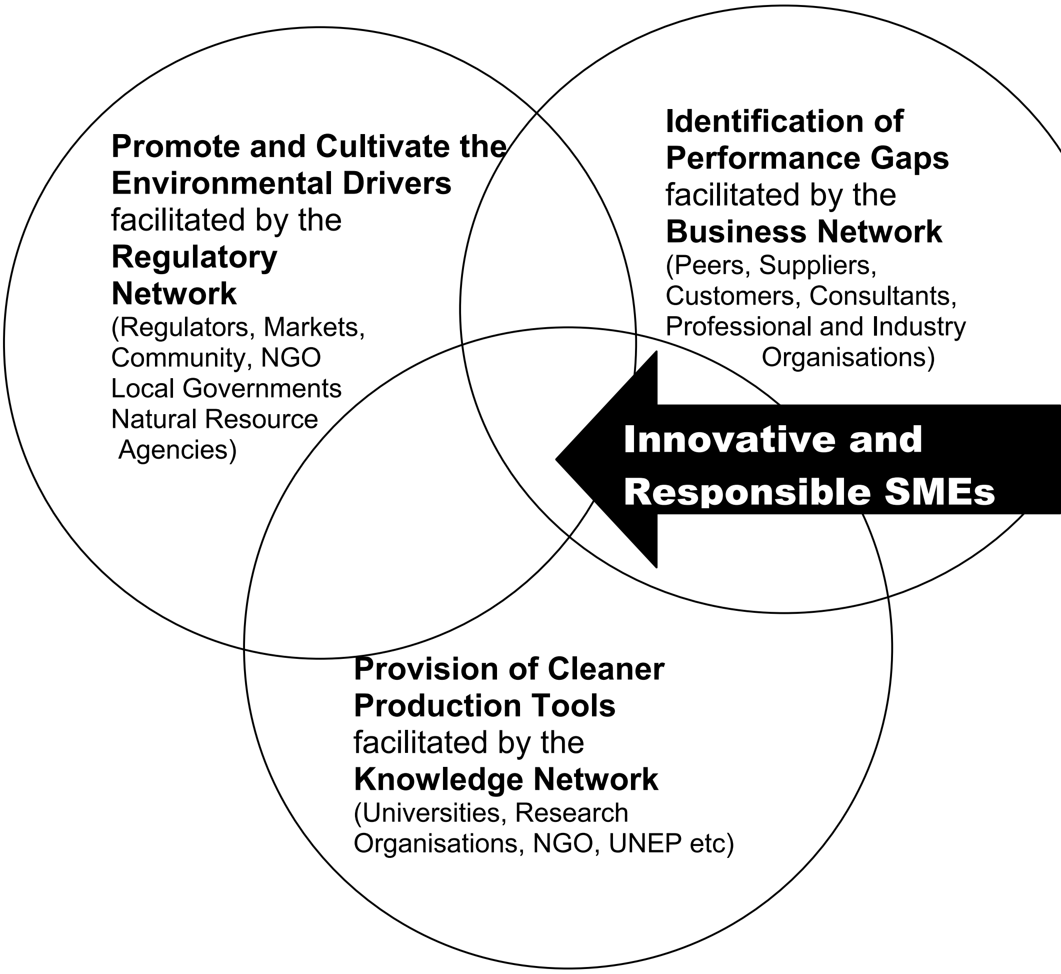

Figure 1: The linking of the innovative SME model and benchmarking's 3 critical success factors

This research project designed and implemented an applied Cleaner Production capacity building program that integrated the critical success factors for benchmarking. It also addressed small businesses' demands and barriers in relation to Cleaner Production and sought to incorporate mechanisms that encourage continuous improvement by instilling an innovative and learning business culture. This research was based on the hypothesis that businesses that participate in benchmarking and capacity building will outperform businesses that do not participate in any of those activities. A pilot program covering benchmarking and capacity building in conjunction and in isolation was implemented by the Centre of Excellence in Cleaner Production, situated at Curtin University of Technology and evaluated in detail for this thesis.

A key to success of any industry program for small businesses is gaining the trust of participants through consistent collaboration. The program's success was measured quantitatively on Eco-Efficiency performance and qualitatively with a Cleaner Production Monitor. The drycleaning industry was selected as the pilot industry sector due to the dominance of small businesses in this sector, its significant environmental aspects and limited past exposure to Cleaner Production. Four groups were established using as a base the level of resources business managers were prepared to commit to improving their Eco-Efficiency: the Drycleaners Cleaner Production Club, Benchmarking Only group, drycleaning control and non-drycleaning control groups. A balanced scorecard was developed that included leading and lagging, management and performance indicators. These covered major environmental impact categories such as: energy efficiency, water efficiency, material efficiency and waste generation including emissions, together with level of education and training, and the number of environmental incidents to have occurred within the monitoring period. A novel approach was developed and successfully applied for calculating size adjusted performance targets to generate more realistic and achievable targets for each participating business. The selection of performance data and a calculation of indicators highlighted the problem of compounding errors in accurately calculating performance standards.

The triggers for the introduction of Cleaner Production (and many other improvement programs) are often generated outside the business through its network (both formal and informal) of stakeholders. This premise is supported by a positive attitude to the business opportunities arising from improvements in Eco-Efficiency. Business managers should not see environmental issues as a threat to their businesses. The development and promotion of case studies and demonstration projects, and the selection of industry leaders as role models or mentors can act as a support mechanism for change.

The results of this research project showed that the Cleaner Production uptake in research program participants (with an average score of 175 out of a possible 300) was significantly higher than the Cleaner Production uptake in the drycleaning control (average score of 82), which was similar to non-drycleaning control (average score of 81). Participants in the research program on average reduced hazardous waste generation by 48% improved their perchloroethylene efficiency by 30% (perc mileage) and energy efficiency by 9%. However, business managers' at times managed by habit perpetuating inefficiencies. These inefficiencies showed up in falling Eco-Efficiency performance in periods of lower physical output as indicated by the results from the different rounds of data.

The reported levels of Eco-Efficiency improvement were not uniform. The businesses with the highest productivity (measured as number of garments cleaned per employee) or the longest experience in the industry improved their performance more than the average, regardless of which program they participated in.

Small businesses face a number of barriers to Cleaner Production and benchmarking. These barriers include: identifying key performance indicators; collection and analysis of data; selecting benchmarking partners; creating networking opportunities with all stakeholders (not only competitors but supply chain, regulators, NGO's etc), and developing and implementing Action Plans. Because of these barriers, benchmarking and Cleaner Production programs for SMEs need to be facilitated by a third party and implemented as a sector-specific network in collaboration with other active stakeholders.

This research project has identified the potential of a two-tier program (club and benchmarking only) to maximise capacity building while obtaining the best use of limited resources. The initial establishment of benchmarking only programs which selected KPIs, established benchmarks, and distribution of printed material together with short site visits can start business managers on the road to Cleaner Production. This is particularly the case in industry sectors with a limited history of Cleaner Production or with major variations in Eco-Efficiency and poor environmental management accounting practices (evident in many small businesses). As more good housekeeping practices are implemented by small businesses and practices are changed to pick-up these opportunities the demand for more comprehensive Cleaner Production capacity building programs will increase. From this research it appears that 'what did get measured does get managed' particularly when there is a local reference point such as peers' benchmarks.

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Definitions

Business managers	Small business owners, managers and operators; referring specifically to the person running the business with the responsibility of business success or failure.
Benchmark	Performance level currently achievable: can be specified as average performance, best performance etc and is differentiated from a target (see below).
Benchmarking	A process of continually searching for best methods, practices and processes for conducting a task and adopting or adapting features to suit the aims of the organisations. Benchmarking can be conducted with peers or across industry sectors.
Small Business	Employs less than 20 employees (covers small and micro businesses) (Australian Bureau of Statistics 1999a), and major policy decisions are taken by one or two people who according to Clarke, 1973, usually own, manage and risk their own money in the business.
Cleaner Production	Cleaner Production means the continuous application of an integrated preventative environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment.
Design for the Environment	Design for the Environment (or life cycle design) is the continuous application of environmental improvement strategies to the design of products and their production, distribution, consumption and disposal systems, with a view to minimise the net environmental burden caused in all stages of the product life cycle.
Eco-Efficiency	Eco-efficiency is reached by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resources intensity throughout the life cycle, to a level at least in line with the earth's estimated carrying capacity.
Industry Ecology	Industrial ecology (and industrial metabolism) are studies of industrial systems and economic activities, and their links to fundamental natural systems. The aim is to imitate the material recycling aspect of an ecosystem – a material flow management is the crucial aspect of these approaches.
Measurement	Measurement is a single recording.
Micro Business	Employs five or less employees.
Monitoring	Monitoring is a continuous system of recording and interpretation of measurements as required for Cleaner Production and benchmarking.
Pollution Control	Pollution control is an after-the-event, 'react and treat' approach.
Pollution Prevention	Pollution prevention means not generating waste in the first place by reducing it at the source.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (World Commission on Environment and Development 1987)
Target	Futuristic performance level involving a time dimension.
Technology	Includes both soft technology (management practices and procedures) and hard technology (plant and equipment).
Toxics Use Reduction	Toxics Use Reduction protects the environment by promoting cleaner, safer industrial production and processing techniques.
Waste Minimisation	In this concept, waste prevention approach and its techniques are defined as on-site reduction of waste by changes to input of raw materials, technology changes, good operating practices and product changes. Off-site recycling by direct reuse after reclamation are also considered to be waste minimisation techniques, but have a distinctly lower priority compared to on-site prevention or minimisation of waste.

Abbreviations

BM only	Benchmarking Only portion of the drycleaning industry program
C	Continued participation in the drycleaning industry program
CECP	Centre of Excellence in Cleaner Production
CP	Cleaner Production
CPC	Cleaner Production Club
CSF	Critical Success Factors
DIA	Drycleaning Institute of Australia
DIA (WA)	Drycleaning Institute of Australia (Western Australian Branch)
EE	Eco-Efficiency
EMI	Environmental Management Indicator
EMS	Environmental Management System
EPE	Environmental Performance Evaluation
EPI	Environmental Performance Indicator
KPI	Key Performance Indicators
LT	Longer term
MT	Medium term
S	Sold business during the drycleaning industry program
SME	Small to Medium Sized Enterprises
ST	Short term
TUR	Toxics Use Reduction
UNEP	United Nations Environment Program
WBCSD	World Business Council for Sustainable Development
WD	Withdraw from the drycleaning industry program

1. Introduction

Sustainability is becoming an accepted goal of society, and small businesses will need to make an important contribution for sustainable development to be achieved. However, small businesses are inherently time poor and therefore need to prioritise their management and production activities. Furthermore, it is particularly difficult for new issues to be adopted let alone climb this priority ranking of management activities. Sustainability and Cleaner Production are two of these new activities now competing for the manager's attention. If Cleaner Production can be trigged through the ready identification of its economic benefits and integrated with current management priorities such as improving the bottom line, safety performance and product and service quality, the likelihood of continuous improvement in Eco-Efficiency increases and so will the demand for Cleaner Production.

Cleaner Production aims to change the behaviour of organisations towards the environment. Changing existing behaviour can be very difficult. For example: why is it so difficult for organisations to change their behaviour despite demonstrated economic and environmental benefits? What are the principal enablers for change, and why do apparently similar organisations differ so vastly in their Eco-Efficiency? Put at its most basic, for Cleaner Production programs to be successful it is necessary to attract the attention of business managers[1]. This attention needs to be retained while the Cleaner Production technical skills, business cultures are being developed, and the full benefits can be realised. These skills then will enable business managers to achieve a continuous improvement in environmental and economic performance for their business. Furthermore, such changes in culture need to be achieved initially without disrupting the day-to-day core operations of the business and at a manageable cost.

[1] Business managers in the context of small businesses refer to the owners, managers and operators; referring specifically to the person running the business with the risk/rewards of business success and failure.

This thesis investigates the applicability of benchmarking which is a proven business improvement tool backed by capacity building, in a program to achieve greater uptake of Cleaner Production in small and micro businesses[2].

1.1 Background

Businesses of all sizes are reported to have similar levels of environmental awareness (Merritt 1998; Tilley 1999a), with up to 90% of small businesses believing the environment is an important issue (Schaper 2000). The Eco-Efficiency of small businesses is however reported to be on average inferior to larger organisations (Ahmed, Montagno et al. 1998; Baylis, Connell et al. 1998a; Stanwick and Stanwick 1998). The Eco-Efficiency of large businesses also varies considerably (Lothe, Myrtveit et al. 1999). For some reason the comparable levels of environmental awareness appear not to be routinely converted into action creating a greater gap between awareness and performance for smaller businesses (Merritt 1998; Tilley 1999a; Schaper 2000; Advisory Committee on Business and the Environment 2001). The question arises why and what types of programs can best increase the uptake of Cleaner Production?

However, small businesses are not miniature versions of big businesses (Welsh and White 1981). The general nature of small business is characterised by long working-hours, (with 25% working more than 50 hours per week (Australian Bureau of Statistics 2001)), being more innovative than larger organisation, and often occupying niche markets by providing highly specialised services or products. According to Storey (1994), small businesses have a high failure rate due to poor business planning, lack of market penetration and cash-flow or liquidity constraints as they experience a

[2] Micro businesses are classified as employing between 1-4 staff and small businesses employ between 5 and 19 staff, (Australian Bureau of Statistics 2001). Non-employing businesses are also classified as small business. Just over 951,000 or 96% of Australian total non-agricultural private sector businesses were classified as small in 1998-99. These small businesses employed just over 3.1 million people or 47% of the total non-agricultural private sector workforce (Australian Bureau of Statistics 1999b).

greater difficulty in obtaining financial resources than larger businesses. In addition, they do not perceive themselves as having clear competitors within a limited geographically area. These characteristics of small businesses need to be considered in developing and implementing programs to improve their Eco-Efficiency.

Cleaner Production is a preventive environmental management strategy that emerged in the USA, and is currently promoted on a global scale through the efforts of bodies such as the United Nations Environment Program, the European Union and many national governments, including Australia. The aim of Cleaner Production is continuous improvement in Eco-Efficiency through the prevention of the generation of wastes and emissions. The term is often used interchangeably with Eco-Efficiency (Pagan, Pullar et al. 1999), and although both concepts are complementary (van Berkel 2000) and mutually reinforcing (UNEP & WBCSD 1996) there are subtle differences. According to Van Berkel (2000, p134), "*Eco-Efficiency is focusing on the strategic side of business ('value creation') and Cleaner Production on the operational side of business ('production')"*.

For small businesses to be able to improve their Eco-Efficiency and benefit from management and information tools proven in larger organisations, these tools need to be customised, to address specific barriers for small businesses and create incentives to sustain change. Furthermore, these tools need to be:

- suitable for integration into day-to-day management activities (Gerstenfeld and Roberts 2000).
- appropriate for the individual business' level of environmental impacts and risks (Ecotec 2000; Fay 2000; Gerstenfeld and Roberts 2000).
- systematic (Fenghueih 1998; Vickers and Cordey 1999).
- built on the management notion that 'what gets measured gets managed' (Bassi, Cheney et al. 1998; National Academy of Engineering 1999; WBCSD 1999; Pojasek 2000; Schaper 2000).

- reflecting on the widely held opinion that economic benefits are the primary driver for small businesses to improve their Eco-Efficiency.

Benchmarking has the potential to be such a tool. It is a process of continually searching for best practice performance and strategies and using this knowledge to systematically improve (your own) performance. It is a widely accepted systematic improvement tool (Cook 1995; Drew 1997; Elmuti 1998; Wheelen and Hunger 1998; Bergin 2000) and an effective method of deeply engraining best practice into companies (Benchmark Index 2001a). Benchmarking supports continuous improvement by requiring monitoring and tracking of key performance indicators (KPIs) for products, services and practices over time (Wheelen and Hunger 1998). Furthermore benchmarking has an external focus that promotes 'learning from your peers'. This focus increases managers' confidence in the knowledge and data being transferred between benchmarking partners as they see this information as transferable (relevant, applicable and trustworthy) to their situation. According to Piasecki (2001) benchmarks are perceived by management as being 'tactful' with the attributes of zeal, force, focus and technical competence. This confidence is the most important reason business managers have faith in industry benchmarks[3]. This confidence in benchmarks helps to overcome the disbelief of many business managers when they are told they are wasting X number of dollars (ibid) as suppliers almost universally overrate their performance (Wiarda and Luria 1998) and underestimate the environmental costs of their products and services (White, Savage et al. 1995).

Benchmarking has proven to be effective for achieving continuous improvement in many diverse areas of management performance[4]. It is therefore most likely also suitable for achieving continuous improvement in Eco-Efficiency (Bolli and Emtairah 2001). Research data suggests that managers of smaller organisations have absolutely no hesitation in

[3] As opposed to performance benchmarks developed from manufactures specification or theoretical assumptions and models.

[4] The ten most benchmarked business processes for 2001 in order were; consumer service, information systems, employee development, process improvement, call centres, performance management, employee recruitment, manufacturing, human resources and project management (The Benchmarking Exchange 2001).

recognising the potential of benchmarking as a tool for articulating and sharing their vision and create a clear sense of what is possible (Monkhouse 1995) Furthermore because benchmarking, when part of a program, should be carried out at regular intervals, environmental awareness is being increased and this is an important first step towards change. This process enables the progressive integration of environmental management into day-to-day management and operation of the business without an undue impact on core production processes. In addition, each new benchmarking round can identify additional environmental improvement options, improve environmental management skills, and further spur the learning process of the participants.

An additional potential advantage of benchmarking is that it can assist in the early identification of those environmental aspects that most likely offer the greatest potential for economic benefits (Aquatech 1997; NSWEPA 2000; Talluri 2000; European Commission 2002). This potential advantage is reinforced by support for the 80:20 rule or Pareto Principle. This principle states that 80% of the environmental costs (and impacts) are caused by 20% of the business's activities (de Smet, Gelders et al. 1997; Olvida, Alvarez-Rivero et al. 2000; Opierzynski and Rauschenbach 2000; Waldrip, Pojasek et al. 2000; Reyes 2001). Benchmarking can assist managers by initially targeting 'good housekeeping' options in aspects which have the greatest environmental costs and the most potential for profitable environmental improvements with limited costs. This encourages the notion of 'start small and seek early success', which is important to business managers with little or no experience in environmental management (Codling 1992; Pounder 1994; NEPA, China NCPC et al. 1996; Hennicke and Ramesohl 1998; USEPA 2001b). Furthermore improving the likelihood for early success in Cleaner Production programs, may increase the business managers' confidence to engage in more complex and innovative Cleaner Production methods (van Berkel 1994). Business managers will thereby be encouraged to implement innovations that in the longer term are likely to provide environmentally preferred and economically sound solutions.

Some Cleaner Production tools such as an Environmental Management System (EMS) require targets within the system (Australian Standards Organisation 1996). These targets can be derived internally as an element of program implementation based on the environmental review. However knowledge of industry benchmarks will ensure that any targets will be both realistic as well as challenging enough at least to approach best practice. They focuses externally on what other organisations are achieving and the practices they implement to achieve this performance. This process adds greater rigor, credibility and transparency to businesses' environmental programs.

Benchmarking can complement the Cleaner Production assessment methodology, which is essentially an open-ended process where potential benefits are not necessarily quantified early in the assessment process. The promotion of Cleaner Production has attempted to be overcome this aspect, through case studies and demonstration projects and documentation of achieved financial and environmental benefits via the adoption of Cleaner Production in similar companies. However these Cleaner Production solutions are generally not readily transferable to other businesses' situations (UNEP, 2002). The effectiveness of case studies and demonstration projects are therefore limited but necessary for the diffusion of Cleaner Production (Stone 2000; Duffy 2001). As supported by van Berkel 1996 (1996) who states that case studies and demonstration projects provide justification for the Cleaner Production methodology that has brought company specific solutions, but these solutions may not be directly transferable to any other business. Even businesses that have initially benefited from successful Cleaner Production programs, have in many cases not sustained the program (van Berkel, 1999; Green Business Network 2001) as the programs have been implemented as one-off projects, and not as a process integrated into the business (Emilsson and Hjelm 2002). A persistent external focus promoted by benchmarking can in principle encourage continuous improvement in Eco-Efficiency.

Benchmarking can serve many and widely varying aims. This research project, however, investigates benchmarking as a trigger for the consideration of Cleaner Production in small businesses, with the result that businesses will increase the demand for Cleaner Production assistance and receive environmental and economic benefits. This research considers benchmarking as a decision support tool for continuous improvement, and not as a measure to estimate the success (or failure) of environment policies, or to gain direct strategic or competitive advantage. The distinction between benchmarking as a process, and benchmarks as a threshold performance standard or baseline is important for understanding the potential use of benchmarking as a tool for continuous improvement.

Environmental Performance Indicators (EPI) can be broadly divided into macro and micro indicators that cater for external and internal stakeholders respectively. However, these indicators need to be linked (Thoresen 1999),

> "External stakeholders need a set of EPI on an aggregated scale that allows them to put pressure on the companies, to make sure that improvements are planned and implemented on a continuous basis. Internal stakeholders need more detailed EPIs to describe and control environmental performance of their products and individual activities or processes inside the company.
>
> Micro level uses:
> -Internal goalsetting, control and surveillance of product performance and performance of primary processes and sub-processes in individual companies.
> -Continuous process and product improvements triggered by benchmarking vs competitors' performance or vs branch average process or product performance". (Thoresen 1999, p366)

Both can drive environmental improvements in industry, government and society as a whole albeit in different ways. This research project is strictly focused on micro Eco-Efficiency indicators (ie at the level of a single business) and their use by business managers to improve Eco-Efficiency. Examples of such micro-indicators include kWh of energy consumption. The major use of macro indicators is for reporting in State of the Environment (Australian State of the Environment Committee 2001) type reports. Macro indicators also help to identify environmental hotspots and to assist in estimating the success of higher-level policies. Two examples of such indicators in relation to energy could be the tonnes of GHG emitted per dollar of GDP and the concentration of CO_2 in the atmosphere.

Improving environmental and economic efficiency is an essential starting point for contributing to sustainable development (von Weizsäcker, Lovins et al. 1997; Schmidt-Bleek and Weaver 1998; WBCSD 1999; Moffatt, Hanley et al. 2001). This thesis investigates the role benchmarking can play in improving Eco-Efficiency through promoting industry best practices and diffusing preventive and proven environmental technology. Hillary (2000) states ‘If all industry operated close to industry best practices the levels of environmental impact would be considerably reduced.’ In many cases, it is not the lack of environmental innovation, but a lack of adoption of proven technologies and practices that is a hindrance to more sustainable production systems. Assisting in overcoming this barrier is the focus of this research project.

1.2 Critical Success Factors

This research project is based on the assumption that successful benchmarking for Eco-Efficiency is conditional on achieving three conditions: a) the identification of a performance gap in areas of the business critical to its future, b) the existence of drivers to close the identified performance gaps, and c) the availability of the skills and experience to use these tools to close the performance gap. These three conditions are henceforth referred to as critical success factors (CSF). With regard to Cleaner Production, these are understood as variation in Eco-Efficiency, the economic benefit presented as a result of these variations and knowledge of the Cleaner Production assessment process.

These CSFs have not been stated and reported as such. They are partially supported by literature and partially experimentally or practice derived. All benchmarking texts discuss success factors in conducting benchmarking exercises (for more information see (Watson 1992; Boxwell Jr 1994; Evans 1994; Zairi and Leonard 1994; Camp 1995; Cook 1995; Codling 1996; Finnigan 1996; Rimmer, Macneil et al. 1996; Zairi 1996; Love, Bunney et al. 1998; Jarrar and Zairi 2000; Zairi and Whymark 2000).

This thesis seeks to operationalise and simplify benchmarking for the implementation of Cleaner Production in small businesses through a facilitated program that:

- investigates ways in which Eco-Efficiency performance gaps between companies can be monitored.
- assesses which environmental management drivers will convince business managers to close such performance gaps, and then promote these drivers.
- pilot tests the use of Cleaner Production Assessment as a tool for business managers to assist them in closing the performance gaps.

1.2.1 Investigating Eco-Efficiency Gaps

To identify Eco-Efficiency gaps there must first be some knowledge of the industry's major environmental aspects, including both risks and opportunities. Then it involves the selection and monitoring of key performance indicators, matching with benchmarking partners, analysis of the data and the establishment of performance gaps. The performance gap is the difference between current practices and best practice and needs to be realistic; that is, both challenging and achievable. When benchmarking programs are conducted in small businesses some allowance for economies of scale may be required.

Publicly available Eco-Efficiency data show considerable Eco-Efficiency gaps between comparable businesses in the same industry sector (OECD 2001). This variation in performance can be as great as thirty fold in cases where poor performance apparently does not have a major direct effect on overall business performance and viability. Four to five-fold differences are very common. Some examples are given in Table 1-1. However many small businesses claim to have no or minimal environmental impacts (Boyle 1998; Hillary 2000; van Berkel 2002b). This is supported by the findings of a UK survey which found that 51% of SMEs claimed to have a positive environmental impact and a further 39% to have no environmental impact (Smith, Kemp et al. 2000).

Industry	Performance Indicator	Unit	Max	Min	Fold Difference
Drycleaning (a)	Energy	kWh garment	15.5	4.5	4
	Perc	kg garments cleaned / lit perc	200	20	10
Book & Magazine Printing (b)	Energy	kWh/employee	699	26	27
	Water	kl/employee	240	7.8	31
	Transport fuel	litre/employee	7.8	0.56	14
Milk Processing (c)	Energy	kWh/litre	0.3	0.075	4
Commercial Buildings (d)	Room Heating	kWh/m^2	250	100	2.5
	General Energy	kWh/m^2	0.7	2	3
Meat Processing (e) # Hot Standard Carcass Weight	Energy	MJ/t of HSCW#	4800	1200	4
	Water	kl/t of HSCW#	15	6	2.5
	Waste to landfill	kg/ton of HSCW#	3	17	5.6
	BOD	kg/t of HSCW#	66	8	8.2

Table 1-1: Reported performance gaps

(a) (Environmental Technology Best Practice Program 1996b; Energy Efficiency Best Practice Program 2000)(b)(SPRU 2001) (c) (Amundsen 2000)(d)(Sage 2000) (e) (Trahair and Morris 1999)

Benchmarking should be considered as complementary or 'value adding' to Environmental Performance Evaluation (EPE) (Lee-Kuhre 1998). Unless a business has in place sound management practices and suitable EPE systems any effort to instigate environmental benchmarking without the appropriate systems will meet with questionable and sometimes negative results (Evans 1994; Sustainability 1996; Wheelen and Hunger 1998; Global Environmental Management Initiative n.d.). It therefore follows that businesses must have practices and monitoring equipment in place with which to obtain reliable environmental data and identify trends in resource consumption, waste generation and total environmental costs, and be prepared to share this information either directly or indirectly.

1.2.2 Activating Drivers to Close the Performance Gap

As this is a topic of much recent research, this research project does not investigate in detail the drivers for Cleaner Production. Instead, this research draws on such work. The foreword or introduction to any Cleaner Production manual or training program's material, lists many reasons for improving Eco-Efficiency and economic benefits always rank high on these lists. Other major drivers are regulatory drivers and drivers to increase market share through product differentiation and green marketing schemes.

Variations in Eco-Efficiency, such as those listed in Table 1-1, would be expected to lead to variations in net profits, and financial performance is indeed the prime driver to improve any aspect of a business' performance. Economic benefits contribute straight to the bottom-line (EEBP 2001), however, the direct financial saving may be eroded in the short-term by capital and staff retraining cost associated with the change in technology or practices. While the financial drivers to close the performance gap cannot be directly created, they can be cultivated and promoted through improved environmental management accounting. Furthermore, a direct driver can be created through policies to strengthen the market, which in turn increase the market-based or financial incentive for change. Programs then need to cultivate and reinforce the business case for Cleaner Production and Eco-Efficiency to owners and managers. To help cultivate the financial drivers to close the performance gap, economic benefits should be represented as an increase in net profit rather than savings on operational costs to add impact to the figures. Within Australian small businesses the average net profit is in the region of fifteen percent (Australian Bureau of Statistics 1999b; Entrepreneur Business Centre 2001). Therefore, a two percent reduction in total costs lifts the profit margin from 15 to 17% of turnover, which is a 13% increase in net profit.

1.2.3 Promoting Tools to Close the Performance Gap

Finally, businesses can only close performance gaps if they have access to improvement tools and posses the skills and experience to apply those (such as Cleaner Production). "*Performance improvement in any field is driven primarily by people who are given the right tool*" (Augenstein 1995, p12). However, while the Cleaner Production tools are available small businesses often lack the opportunity to develop the skill and experience to successfully use these tools. This barrier exists because many business managers have not had any formal training in Cleaner Production or similar systematic business improvement programs and they lack the resources, ability or the time to acquire these skills. Many business managers also consider in most instances the cost of employing consultants with expertise in Cleaner Production tools an unjustifiable expense (Palmer and van der Vorst 1996).

This thesis does not investigate which tool is the most appropriate for each business size in individual situations. Instead it draws on current thinking that a Cleaner Production assessment appears well suited as a broad-based and widely applicable tool for small businesses.

1.3 Barriers to Benchmarking for Cleaner Production

While the literature widely promotes benchmarking its success appears to be mixed. In Australia 51% of businesses employing more that 100 employees actively participate in benchmarking while only 15% of businesses employing less than 20 people have benchmarked (Department of Employment Workplace Relations and Small Business 1998). This suggests that barriers to benchmarking might exist for smaller businesses.

Success in Cleaner Production and benchmarking requires a number of conditions. These can be divided into cultural and technical aspects (Karch 1993; Mancneil, Testi et al. 1994; Fresner 1998; Stone 2000; Allemby 2001; Baumast 2001) and both are required for successful, and sustained implementation of these programs. The business culture calls on business managers to see the environment no longer as a threat but as an opportunity, that they accept that practices can always be improved upon, that they empower their employees and, that they are prepared to be open and share information with their peers.

Besides a lack of benchmarking experience, the technical barriers to its use relate largely to poor environmental management accounting[5]. Environmental costs are often allocated to overheads and not to those production processes or products that create these costs. This reduces the incentive to implement Cleaner Production programs. Alternatively businesses that purchase their natural resources (energy, water and materials) at subsidized prices or pay minimal waste disposal charges are not forced to internalize total environmental costs. In each of these cases the business will not be able to identify or achieve significant economic benefits. Consequently economic benefits fail as a driver for improving Eco-Efficiency. These barriers, and inappropriate business cultures must be overcome to increase the effectiveness of benchmarking for improving the Eco-Efficiency of small

[5] For example, research on the cost of waste generation in the UK identified that the average total cost of waste generation was 25 times that estimated by management (Phillips, Read et al. 1999).

businesses. Table 1-2 summarises the barriers to benchmarking discussed above.

Barriers	Critical Success Factors		
	Identification of Performance Gaps	Drivers to Close the Performance Gap	Tools to Close the Performance Gap
Cultural	• No external focus • Unwilling to share information	• No desire to protect the environment • No desire to improve Eco-Efficiency	• Involvement of entire workforce • Willingness to accept assistance
Organisational	• Identification of benchmarking partners	• Subsidies reduce the economic benefits of improving performance • Knowledge of environmental regulations	• Implementation of action plan
Technical	• Identification of KPIs • Measurement equipment • Environmental accounting • Calculation of performance gaps	• Identify economic benefits • Identify environmental risks • Low market exposure	• Conducting the Cleaner Production assessment • Identification of Cleaner Production options

Table 1-2: Barriers to benchmarking

1.4 Research Project

1.4.1 Research Aim

The aim of this research project is to investigate the applicability of benchmarking for overcoming the initial barriers towards Cleaner Production in small businesses. The research is based on the evaluation of a Cleaner Production program that uses benchmarking to generate and hold business managers' interest in and commitment to Cleaner Production and which uses capacity building to equip these business managers with the enabling tools and necessary skills to implement Cleaner Production. The benchmarks will be used to calculate performance gaps. These performance gaps will be combined with relevant resources and waste costs to calculate potential cost savings. This program will be evaluated quantitatively in regard to changes in Eco-Efficiency, and qualitatively in regard to the uptake of Cleaner Production concepts and practices, using measures of the business manager's awareness, management and implementation of Cleaner Production.

1.4.2 Research Outputs

The output of this research will be the development, implementation and assessment of a facilitated benchmarking and capacity building program for small businesses. Furthermore the Eco-Efficiency of participants will be monitored over the period of the program and feedback will be gathered on the capacity building program. A comparison will also be undertaken between businesses in the two programs. Furthermore the level of Cleaner Production uptake within four sectors of Western Australian industry will be estimated from the application of a Cleaner Production monitor, which measures awareness, management and implementation of Cleaner Production, for the drycleaning industry, metals fabrication, food processing and printing and bookbinding sectors. The assessment will indicate the success of benchmarking and capacity building programs to trigger and sustain Cleaner Production in small businesses. The output of this research may be used to make recommendations to government agencies and industry organisations on how they can better use performance indicators and benchmarking as a policy, as well as an educational and motivational tool for the diffusion of Cleaner Production technologies and practices among SMEs.

1.4.3 Drycleaners as a Case Study

This research project and its results are based on a case study conducted in collaboration with the drycleaning industry in Western Australia. The research project involved the selection of suitable performance indicators for monitoring the Eco-Efficiency of the drycleaning industry in consultation with the industry itself. Then recruiting business managers to participate in a Cleaner Production Club (with capacity building) and Benchmarking Only program. These indicators have been benchmarked over three rounds and the results analysed to determine if benchmarking against peers promotes continuous improvement in Eco-Efficiency. The operation of benchmarking programs involves much more than the identification of the performance gaps (current performance compared to the benchmark). The drivers have to be promoted and the appropriate tools provided. This was achieved in a capacity building program, which was explicitly targeted at closing the performance gaps. It included site visits, training workshops, Cleaner Production options checklists and assistance in the development of individual Cleaner Production Action Plans and presentation of Cleaner Production certificates.

1.5 Thesis Structure

Chapter two of this thesis covers the results of the literature review in relation to the current understanding of benchmarking for Cleaner Production in small businesses. It starts by discussing Cleaner Production and Environmental Performance Evaluation (EPE) and assesses their applicability to small businesses. Next, the process of conducting benchmarking is covered before linking Cleaner Production, benchmarking and continuous improvement. The latter is the overall aim of both benchmarking and Cleaner Production. This discussion leads into an investigation of the concept of the Learning Organisation, and small businesses innovation models.

Chapter three covers the program and study design for this research. It first introduces the intervention methods and then discusses the hypothesis and test variables. This design integrates elements of a learning organisation into the program.

Chapter four explains the benchmarking intervention implemented in the case study. It starts with the indicator selection and further deals with the calculation of results. The format of the benchmark reports for participants is then discussed. This includes the process of identifying economies of scale and, if these are present, adapting them to allow the generation of more realistic performance targets for individual participants.

Chapter five outlines the capacity building intervention, which includes the operation of a Cleaner Production Club. This chapter also investigates how benchmarking can be used to promote education and training in Cleaner Production for small businesses, by addressing the development and delivery of training materials, while considering the involvement of industry organisations in promoting Cleaner Production to their members.

Chapter six is divided into seven sections. The first section includes a description of the participating businesses. The second section presents the overall quantitative Eco-Efficiency results from the drycleaning industry program and compares the 'Cleaner Production Club' with the 'Benchmarking Only' group. Section three presents the qualitative results obtained from the Cleaner Production Monitor conducted by the Centre of Excellence in Cleaner Production. Section four outlines lessons learnt in conducting the benchmarking program, and section five covers the lessons learnt from the operation of the capacity building program. Section six lists several initiatives that have spun-off from this research. Finally, section seven integrates the principal findings for the various sections.

Chapter seven contains the conclusions and discussion of this project. It discusses barriers, opportunities and limitations to benchmarking as a trigger for Cleaner Production. This chapter also uses the results to recommend a two-tier approach to Cleaner Production capacity building programs.

Appendix one is the Cleaner Production Option Checklist developed for the drycleaning industry. Appendix two contains the Cleaner Production monitor used to qualitatively assess the level of uptake of Cleaner Production, and includes the questionnaire and a paper written to explain the Cleaner Production Monitor.

2 Literature Review

2.1 Introduction

This chapter covers the literature review for this thesis following four lines of inquiry.

- It begins by defining and discussing Cleaner Production and sustainable development, then exploring the business case for sustainable development.
- Following this, two Cleaner Production tools (the Cleaner Production assessment and Eco-Efficiency) are introduced before a discussion of Environmental Performance Evaluation (EPE), which is being established as a Cleaner Production tool in its own right.
- Next, benchmarking is introduced and discussed followed by an outline of the stages of conducting a benchmarking exercise.
- Finally, continuous improvement and the learning organisation (the ultimate aim of Cleaner Production, benchmarking and most other business improvement programs), is the fourth line of inquiry for this literature review. This includes a discussion of capacity building for Cleaner Production before an innovative SME model with its system of networks is discussed. This network comprises business, knowledge and regulatory sub-networks.

Upon completion of the reviews for each line of inquiry, the key findings are combined to explore their potential and applicability for improving small business' Eco-Efficiency.

2.2 Cleaner Production and Sustainable Development

Cleaner Production is an operational strategy that enjoys considerable industry and government support. Cleaner Production focuses on industry performing its traditional functions of producing goods and services demanded by the market, providing employment and producing a return to shareholders, with a considerably lower environmental impact than current practices allow.

The United Nations Environment Programme (UNEP), The World Bank, The Organisation for Economic Cooperation and Development (OECD), Asia Pacific Economic Cooperation (APEC) and the Australian New Zealand Environment and Conservation Council (ANZECC) support this strategy and the wide application of its principles. This support includes facilitation of a global network of Cleaner Production Roundtables, specific promotion of Cleaner Production by APEC, and the ANZECC release of an Australian Strategy for Cleaner Production (Australian and New Zealand Environment and Conservation Council 1999). The establishment of the Centre of Excellence in Cleaner Production by the Western Australian Government at Curtin University of Technology in 1999 was a local and practical example of the growing recognition for the potential of Cleaner Production to improve industry's environmental and economic performance.

Cleaner Production has been defined as:

> "The continuous application of an integrated preventative environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment.
>
> For production processes: cleaner production includes conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes before they leave a process.
>
> For products: the strategy focuses on reducing impacts along the entire life cycle of the product, from raw materials extraction, to ultimate disposal of the product.

For services: cleaner production reduces the environmental impact of a service provided over the entire life cycle, from system design and use, to the consumption of resources required to provide the service.

Cleaner production requires applying know-how, improving technology, and changing attitudes".
(Australian and New Zealand Environment and Conservation Council 1999, p11)

This definition of Cleaner Production requires a closer review of its distinctive features. It contains a number of components (terms and concepts) which are important to fully understand Cleaner Production and its contribution to both business and environmental performance. For clarify these terms will now be defined.

Continuous application. Efforts to improve a business' Eco-Efficiency need to be ongoing to encourage the identification of Cleaner Production options leading to progressive improvement in environmental and economic performance.

Integrated. Integration ensures that addressing one pollution problem or risk does not transfer the potential environmental impacts to other areas of the operation, nor create another risk. This is in contrast to other approaches that typically deal with only one environmental impact at a time and often environmental management remains the principal responsibility of the environmental division.

Preventative environmental strategy. Cleaner Production is based on a better understanding of the causes of waste and emissions generation and the investigation of ways to remove these causes rather than dealing with waste and emissions once these have been generated. By adopting a preventive strategy Cleaner Production is promoting a proactive approach that encourages up-stream and potentially more innovative solutions as opposed to more traditional end-of-pipe solutions.

Processes, products and services. While the manufacture of goods is considered the traditional domain of Cleaner Production, Cleaner Production is equally applicable to processes, products and services.

Increase efficiency. This component of the definition asserts that increasing efficiency is one of the means of achieving Cleaner Production and a contributor to sustainable development.

Reduce risk to humans and the environment. Cleaner Production focuses on reducing risk to both humans and ecological systems. It also gives some recognition to the pre-cautionary principle.

Applying know-how, improving technology, and changing attitudes. This component of the definition reflects on the need to integrate and continuously improve environmental management and performance with regards to both soft technologies (business strategies and practices, skills, management and information systems etc) as well as hard technologies (physical machinery and infrastructure). It acknowledges the role of attitudes and culture and the barriers to technology diffusion and acknowledges that a technology fix at times may not be the best option.

2.2.1 Cleaner Production's Link with Other Environmental Improvement Concepts

The term Cleaner Production is not universally accepted and is at times interchanged with Pollution Prevention (P2), Waste Minimisation, Green Productivity and Eco-Efficiency (UNEP 2001). Furthermore, as many of the concepts or tools have evolved independently over time they are now increasingly complementary to each other which tends to create confusion for advocates students and industry alike. Furthermore additional tools such as Clean Technology, Design for the Environment, Factor Ten, Environmental Management Systems, Extended Producer Responsibility, Industry Ecology, and Life Cycle Assessment create additional confusion. Text Box 2-1 lists a number of these tools developed for the implementation of environmental management.

Cleaner Production Guides	Life Cycle Costing
Corporate Environmental Reporting	Life Cycle Design
Design-for-Environment	Life Cycle Engineering
Design for Disassembly	Life Cycle Management
Eco-auditing	Life Cycle Value Assessment
Eco-compass	Pollution Prevention
Eco-Efficiency	Product Stewardship
Eco-industry Parks	Responsible Care
Eco-profiling	Social Justice Indicators
Environmental Auditing	ISO 14000 Standards and Various
Environmental Management Systems	National Environmental Standards
Environmental Performance Evaluation	Supply Chain Management
Environmental Performance Indicators	The Natural Step System Conditions
Life Cycle Assessment	

Text Box 2-1:Examples from the environmental management toolbox (Young, Brady et al. 2001, p2)

Figure 2-1 illustrates the level of overlap and therefore potential confusion between the tools. This figure is followed by a definition which help illustrates the potential for synergistic relationships.

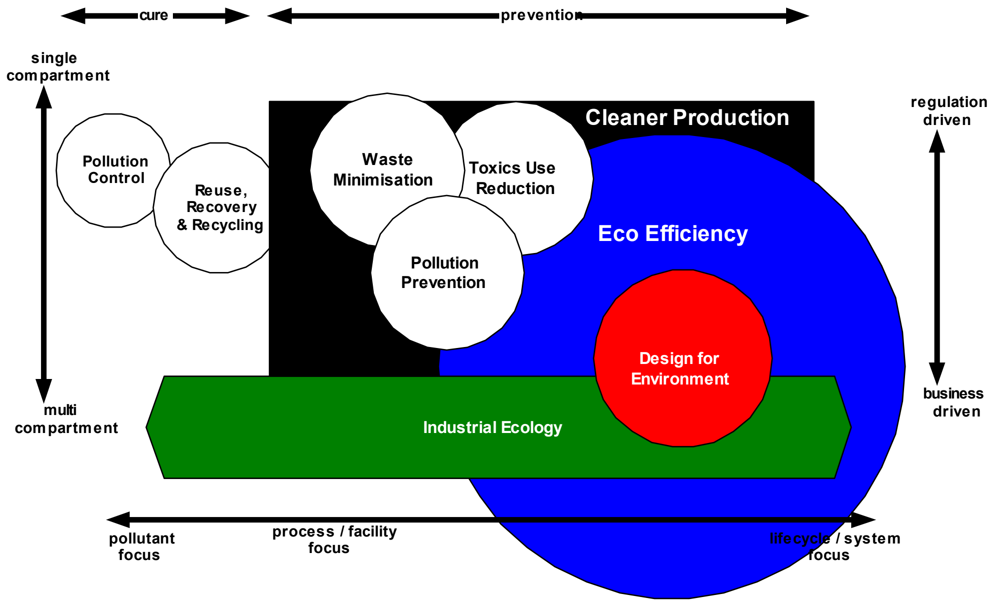


Figure 2-1: Complementary environmental improvement concepts

(Updated from: (van Berkel 2000), by Van Berkel unpublished: CRC for Coal and Sustainable Development Project 1.5: Task 1.2 Report Application of Cleaner Production Principles and Tools for Eco-Efficient Coal Processing – June 2003 - Final Draft).

Definition of these concepts:

Pollution Control

Pollution control is an after-the-event, 'react and treat' approach, traditional referred to as ‘end-of-pipe’.

Waste Minimisation

On-site source reduction of waste by changes of input raw materials, technology changes, good operating practices and product changes. Off-site recycling by direct reuse after reclamation is also considered to be waste minimisation techniques, but have a distinctly lower priority compared to on-site prevention or minimisation of waste, (UNEP 2001).

Toxics Use Reduction

Toxics Use Reduction (TUR) is a method to reduce the use of toxic chemicals so that there is no need to deal with hazardous waste, costly cleanups, or increased risks to exposed populations. TUR has been employed by Massachusetts industries for the last decade resulting in a 43% reduction in hazardous waste generation.

TUR is a planning process that involves examining your practices, inventorying (sic) the toxics you are using, and investigating alternative products and processes. While used successfully at the industrial level, the same concepts can be applied in small businesses, municipal operations and households. (Toxics Use Reduction Institute n.d.)

Pollution Prevention

Means source reduction and other practices that reduce or eliminate the creation of pollutants through: increased efficiency in the use of raw materials, energy, water or other resources, or protection of natural resources by conservation. (National Pollution Prevention Roundtable 2003)

Eco-Efficiency

The delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the earth's estimated carrying capacity, (UNEP & WBCSD 1996)

Design for the Environment

The continuous application of environmental improvement strategies to the design of products and their production, distribution, consumption and disposal systems, with a view to minimise the net environmental burden caused in all stages of the product life cycle (UNEP 2001)

Industry Ecology

Studies of industrial systems and economic activities, and their links to fundamental natural systems. With the aim to imitate the material recycling aspect of an ecosystem – a material flow management is the crucial aspect of these approaches, (Lifset and Graedel 2002).

This thesis investigates two of these tools in greater depth 'Cleaner Production Assessment' (not to be confused with Cleaner Production as an overarching strategy or concept) and 'Eco-Efficiency', as both of these tools are applicable to processing businesses of all sizes, have a level of acceptance within the business community, and collectively cover the majority of the other tools. However the level of implementation is relatively low and a strong individual business case for their implementation is required. While programs based on these tools can be made applicable for business managers with limited or no experience in environmental improvement programs some assistance is likely to be required. Therefore, these tools are most appropriate for this research project, considering the industry sector, its operations, the size of the businesses (micro and small businesses) and their skills and experience in environmental management. This research project however does not seek to identify which tool is more appropriate for any other situation.

2.2.2 Cleaner Production Practices

Cleaner Production is a generic strategy which upon application in business leads to specific solutions applicable to that individual business. The options found generally fit in one or more of five preventive practices i.e. good housekeeping; input substitution; technology modification; product modification; and onsite recycling. The option generation activity can be conducted in conjunction with the waste management hierarchy (avoid, reduce, reuse, recycle and dispose) The waste management hierarchy is applicable to more than waste management and is equally valid for managing all environmental impacts including resource and energy consumption. This guidance is important for people with limited or no experience in Cleaner Production and assists in the development of a systemic method for conducting Cleaner Production assessments. These five Cleaner Production practices are further explained below:

1. Good Housekeeping, involves improving the operation and maintenance procedures as well as the management and information systems to optimise the use of energy, materials and other resource inputs, and minimise the generation of waste and emissions. These options often require minimal or no capital cost, but nevertheless at times require a substantial in-kind investment through training and management attention towards alternative procedures and practices. Common examples for drycleaners include operating machines with full loads and turning off boilers and other equipment when not required and installing isolation switches.

2. Input Substitution, covers substituting inputs in the production process with environmentally preferred inputs, such as renewable materials and energy, or less toxic and more appropriate process auxiliaries. Common examples of input substitution for the drycleaning industry are the use of water-based spot removers, 'non-hydrocarbon' solvents and phosphate free detergents.

3. Technology Modification, involves changes in the production equipment to reduce its environmental impact. Technology modification can range from comparatively simple options, such as installation of more effective monitoring or control devices, lagging steam pipes or the use of low-pressure/high volume spray equipment, to innovative and complex options such as the introduction of renewable energy sources for energy generation and CO_2, ultra sound or wet cleaning machines to replace perc-based drycleaning equipment.

4. Product Modification, involves changing the product design to reduce the environmental impact of the product's manufacturing, packaging, use or disposal. The modified product might for instance require less energy to operate or be easier to dismantle for repair, reuse or recycling. Small service businesses such as drycleaners have limited or no ability to modify products, while fabric manufactures could modify their produce to make them more suitable for household washing machines by introducing shrink-proof properties into their products. However as packaging is classified as a component of the product (Brezet and van Hemel 1997; Environment

Australia 2001b), changes to the method of packing the garments ie paper or reusable suit-type bags rather than plastic wrap would be classified as product modification.

5. On-site Recycling, involves simple reuse of wasted energy or materials as is, or involves some reprocessing before reuse. Heat recovery is a proven example relevant to energy efficiency. All modern perc drycleaning machines recycle solvent in a 'built-in' still on their equipment, and increase efficiency of this still will increased on-site recycling. However only on-site recycling is classified as Cleaner Production and at times this restriction is counter to the aims of Industrial Ecology (van Berkel 1995).

2.2.3 Eco-Efficiency

The term Eco-Efficiency is developed and is promoted by the World Business Council for Sustainable Development (WBCSD). Their definition of the term is:

> Eco-efficiency is reached by the delivery of competitively prices goods and services that satisfy human needs and brings quality of life, while progressively reducing ecological impacts and resources intensity throughout the life cycle, to a level at least in line with the earth's estimated carrying capacity *(UNEP & WBCSD 1996)*

Eco-Efficiency is about delivering better products that

- have lower ecological impact
- better meet customer needs
- continuously improve the process.

The implementation of Eco-Efficiency is guided by seven objectives:

1. Reducing the material intensity of goods and services. Reducing the material required to provide the good or service through dematerialization, or improved design, or improved operational practices.

2. Reducing the energy intensity of goods and services. Reducing the energy required to provide the good or service through improvement in energy efficiency in production, together with reduced energy requirements for the operational phase.

3. Reducing toxic dispersion. Reducing the level of toxic material emitted in the provision of the good or service through improved efficiency, substitution of material, or through the avoidance of, or the increased recycling of chemicals. This applies to all life-cycle stages of material extraction, production, use and disposal.

4. Enhancing the materials' recyclability. Improving the recyclability of material in goods and services through improvements in product design, and improved disassemble features of the product. These improvements reduce material contamination and increase potential recycling rates and hence reduce cost.

5. Maximising sustainable use of renewable resources. Using renewable resources to the maximum level and ensuring that they are from sustainably managed sources.

6. Extending product durability. Endeavouring to produce goods and services which last longer and are repairable through improved, stronger design, modular construction and allowance for product or service upgrades while preventing planned obsolescence.

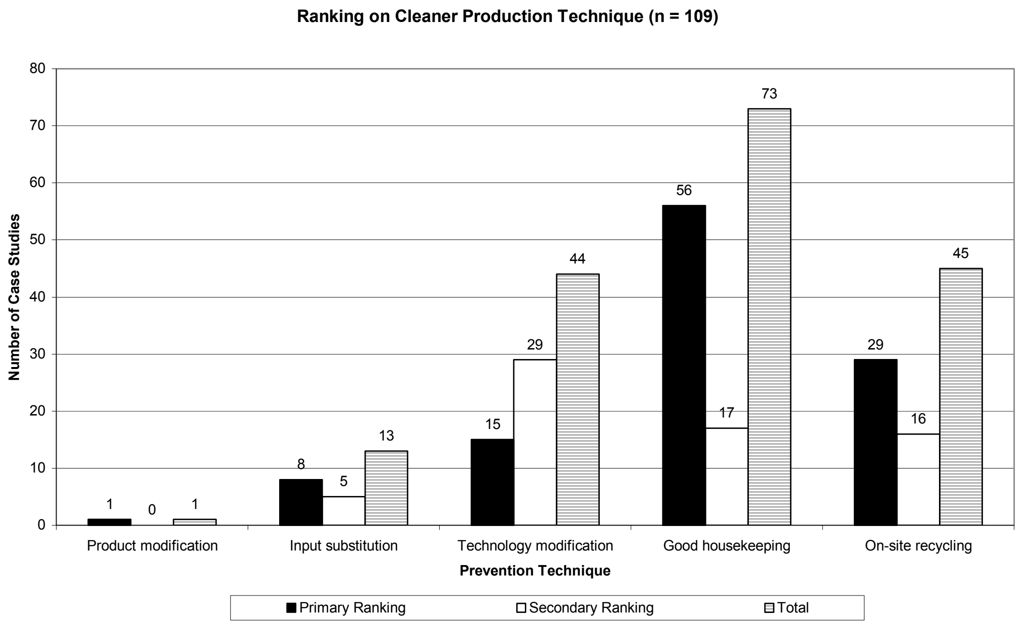
7. Increasing the service intensity of goods and services. By ensuring that goods and services are adaptable for a number of end-uses.

Adapted from (WBCSD 1999)

An examination of the above list shows the strong link between Eco-Efficiency and Cleaner Production. Eco-Efficiency is a business concept that results in an efficiency ratio with an increasing ratio reflecting a positive performance improvement (Global Reporting Initiative 2002). In summary, Eco-Efficiency is about producing more with less. The WBCSD promotes performance indicators to assist management with the development of Eco-Efficiency matrices.

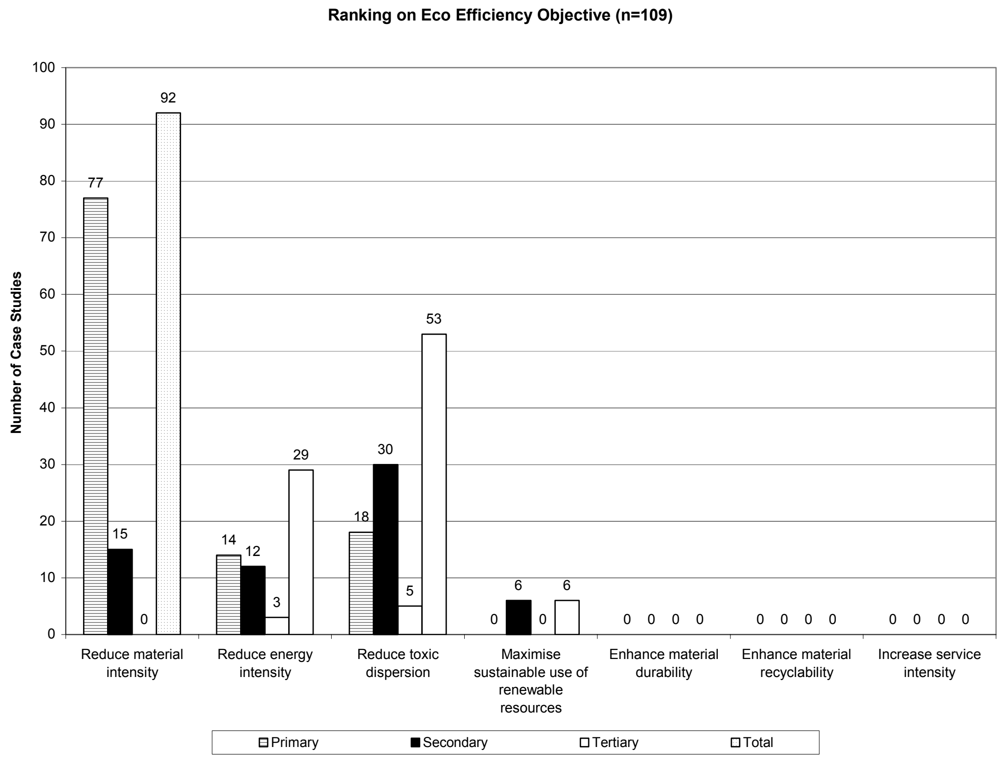
2.2.4 Cleaner Production and Eco-Efficiency Implementation

In the case of Cleaner Production, due to their lower cost or minimal disruption to operational activities good housekeeping options repeatedly turn out to be the most commonly implemented practice. Product modification is in general the most innovative solution but often perceived to carry the greatest business risk because of consumer resistance to changes in the final product (even though it may perform the same function or have the same features as the superseded good or service). Product modification is therefore implemented on far fewer occasions. This view is supported by a study of the Cleaner Production practices which was implemented by businesses registered on Environment Australia's Cleaner Production and Eco-Efficiency case study database, conducted by the Centre of Excellence in Cleaner Production in 2001 (van Berkel 2002b). The results of this study, classified using the five Cleaner Production practices, are presented in Graph 2-1; and classified using the seven Eco-Efficiency objectives, is presented in Graph 2-2. The primary and secondary classification in the case of Cleaner Production, and the primary, secondary and tertiary classification in the case of Eco-Efficiency is included as the aforementioned study concluded that a number of projects demonstrated more than one Cleaner Production practice or Eco-Efficiency objective.



Graph 2-1: Classification of project by Cleaner Production practices

This analysis of 109 case studies on Environment Australia's database as at April 2001, could suggest that good-housekeeping practices provide a superior economic and environmental outcome however this may be misleading. The more innovative solutions can provide the better economic and environmental solution and lead to an increased possibility of continuous improvement, but are more complex and require different skills to identify and implement.



Graph 2-2: Classification of options by Eco-Efficiency objectives

This analysis of 109 case studies on Environment Australia's database as at April 2001, suggests that the reduction of material intensity is by far the most frequently addressed Eco-Efficiency objective, followed consecutively by the reduction of toxic dispersion, the reduction of energy intensity, and the maximisation of the sustainable use of renewable resources. The final three objectives were not identified in the 109 case studies investigated.

2.3 The Business Case for Cleaner Production and Eco-Efficiency

The business case for Cleaner Production and Eco-Efficiency is developed on the premise that improvements in both ecological and economic efficiencies can be simultaneously achieved, and furthermore that businesses can be more competitive by being more sustainable. The WBCSD identified 10 conditions to allow a more comprehensive and global implementation of the business case for sustainable development, of which No.3 Eco-Efficiency is one albeit a very important one (see Text Box 2-2.).

1.The market: because markets encourage efficiency and innovation, which are both necessary for sustainable human progress

2. The right framework: because badly framed markets cannot encourage sustainable progress. Full costing of resources, less command and control regulations, protection of intellectual property, democracy and accepted rule of law all support sustainable development

3. Eco-efficiency: because the basic business contribution to sustainable development is eco-efficiency, which helps developed countries grow qualitatively and developing countries grow quantitatively while savings resources

4. Corporate social responsibility: because a coherent corporate social responsibility strategy, based on integrity, sound values and a long term approach, offers clear business benefits to companies as well as a positive contribution to the well being of society

5. Learning to change: because a movement toward corporate concern for the triple bottom line requires radical change throughout the corporation

6. From dialogue to partnership: because we can manage cooperatively what we cannot manage individually

7. Informing and providing consumer choice: because informed, responsible and knowledgeable consumers helps achieve sustainability through the market via a triple win, by improving the quality of life for consumers, by reducing environmental and social impacts, and by increasing the market share of sustainability-minded companies

8. Innovation: because innovation can enable companies to create wealth in ways that reflect the changing environmental and social concerns and values of the world

9. Reflecting the worth of the earth: because market solutions should be used as part of the package of tools against environmental degradation. Not only are they among the most powerful tools available, but properly structured, they can be the less painful.

10. Making markets work for all: because poverty is one of the greatest single barriers to sustainability, and business cannot succeed in a failing society.

Adapted from (Holliday, Schmidheiny et al. 2002; van Berkel 2002a; WBCSD 2002)

Text Box 2-2: The 10 building blocks of the business case for sustainable development

Current President of the WBCSD, Bjorn Stigson states that the basic business contribution to sustainable development, one we have been working on for a decade, is Eco-Efficiency, a term we (the WBCSD) invented in 1992 for the Rio Earth Summit (Holliday, Schmidheiny et al. 2002).

2.3.1 Drivers for Cleaner Production

Economic benefits are the most commonly quoted driver for Cleaner Production. The vast majority of Cleaner Production manuals and training materials promote economic benefits,(including the ability to forego additional costs), high on the list of reasons why business managers should consider Cleaner Production. A large number of research papers support the view that 'economic benefits are the major driver for business participation in environmental programs' (Lober 1996; Palmer and van der Vorst 1996; Rosenfeld 1996; Anon. 1998; Baylis, Connell et al. 1998b; Environmental Technology Best Practice Program 1998; Davies 1999; Day and Arnold 1999; Ransom and Lober 1999; Reinhardt 1999; Schwartz 1999; Vickers and Cordey 1999; Anon. 2000b; Ecotec 2000; Jasch 2000; NSWEPA 2000; Olvida, Alvarez-Rivero et al. 2000; Ilomaki and Melanen 2001). Most authors recognise that other drivers, such as risk management, moral and ethical reasons ie 'personal values' and a desire to improve Eco-Efficiency and act sustainable are needed to complement the economic benefit to drive successful implementation of Cleaner Production projects, but that economic benefits have a more universal appeal.

As this is a topic of much recent research, this research does not investigate the drivers for Cleaner Production in detail, instead draws on such research. For a more detailed description of drivers for Cleaner Production see (Gunningham and Sinclair 1997; Baylis, Connell et al. 1998b; Bianchi and Noci 1998; Plaut 1998; Australian and New Zealand Environment and Conservation Council 1999; Day and Arnold 1999; Deni Greene Consulting Services 1999; USEPA 2001a; Holliday and Pepper 2002). Text Box 2-3 contains a list of most acknowledged drivers which all have the ability to improve competitiveness.

- Cost savings
- Compliance with environmental laws and regulations
- Reduction of environmental impacts
- Improved risk management
- Proactive business strategies
    - Better products
    - Optimising new markets
    - Anticipate future business conditions and marketing opportunities
    - Influence regulation
- Marketing advantage
- HR benefits
    - Recruitment of better-qualified staff
    - Lower staff turnover
    - Lower absenteeism
    - Increased employee productivity

Text Box 2-3: Drivers for Cleaner Production

Improvements in Eco-Efficiency often have spin-offs in other areas of the business such as: better safety record; improved product quality and lower rejects and rework rates; and added capital value of the business.

With respect to small businesses, these drivers appear not to be as strong as they are for larger organisations (Baylis, Connell et al. 1998a). However, with regard to liability, the size of the risk in proportion to the business and the owner's wealth may be comparable[6]. The economic benefits for larger organisations are greater in absolute terms for larger organisations, but proportionately they maybe similar, while harnessing these savings might

[6] Often small business owners have all their wealth tied up in their business. In these cases the business represents their retirement nest egg or their private superannuation, all of which may be lost should there be an environmental incident of which they are found liable.

however also be more expensive for larger organisations. In summary, small businesses can often receive positive financial gains from pro-active environmental management projects, as can be seen through a great number of SME Cleaner Production case studies forming individual business cases for Cleaner Production.

2.3.2 Barriers to Cleaner Production

Although economic benefits are constantly promoted as the principal driver for Cleaner Production and improved Eco-Efficiency, supported by a large body of research indicating that significant savings accrue to businesses that undertake Cleaner Production programs. The vast majority of businesses still fail to take advantage of the potential savings, indicating that there are barriers and weakness to the Cleaner Production technique. These weaknesses were the subject of an experts' working group convened by the UNEP, titled 'New Horizons in Cleaner Production Invitational Seminar' whose final report was released in 1999. Text Box 2-4 contains some of the conclusions included from this report.

Low perceived relative attractiveness. While Cleaner Production projects improve cost effectiveness, the rate of return is often inferior to alternative investment, ie the opportunity cost is still negative. The barrier can be enhanced when net present value is used in decision making, as this method allocates a greater discount the further into the future the positive returns are generated.

An institutional bias against financing Cleaner Production. Due to a current lack of understanding of the business case by financial institutions, occasioned by their inability to fully evaluate the benefits of Cleaner Production projects, there may be a bias for least-cost capital investments.

A general lack of information. The current programs only reach a small proportion of the business population.

Inadequate tools. While a large number of tools have been developed, many of these tools are too complex, or unwieldy for the task required.
The demand is for appropriate tools and this is particularly vital to smaller businesses.

The clash of paradigms. Cleaner Production is challenging the dominant 'end-of-pipe' paradigm and this change of culture will require more than information and tools; it will require an acknowledgement of the importance of longer-term strategies, the importance of worker participation and that a technology-fix will not always provide the preferred solution.

Incoherence among challengers. This point confirms the earlier point that the competition between the numerous environmental improvement and sustainable development tools creates confusion among new participants
in environmental management and may dilute the resources available to promote the methods.

Insularity. The narrow group of Cleaner Production advocates are too removed from the real-world activities of industry to provide practical assistance. A greater interaction with industry is required.

The name. The term, Cleaner Production, is also consider by some to be a real barrier to its adoption as it is considered to be too generic, misleading or uninspiring.
Adapted from (Meima 1999)

Text Box 2-4: Barriers to Cleaner Production

Text Box 2-5 lists a number of initiatives and views expressed by this working group on how to overcome these barriers:

A new phase in the evolution of Cleaner Production. which involves a greater level of integration of Cleaner Production within the organisation, including links with health and safety and deeper understanding of the concept by decision-makers within management.

Opportunities for conceptual synergy. This involves presenting a more united front with other environmental management tools.

Link with consumption. The tools need to extend to the question of consumption and address the issues of sustainability from the two perspective (consumption and production) and consider the rebound affect.

Question of language. Cleaner Production advocates need to adopt the language of business. Although the intents are similar, the message can be misinterpreted if there is a divergence in the language.

Role of Cleaner Production centres and networks. Needs to be evaluated to ensure that the best use is made of the limited resources available.

Adapted from (Meima 1999)

Text Box 2-5: Recommendations on how to increase the uptake of Cleaner Production

2.3.3 Cleaner Production Assessment

Cleaner Production Assessment is generally understood as a systematic process, aimed at the identification, evaluation and implementation of Cleaner Production opportunities, (UNEP 2002; UNEP and WBCSD 1996; USEPA 1999). It has been argued that the Cleaner Production assessment should also contribute to the establishment of ongoing environmental improvement processes eg through changes in management and information systems, organisational change etc. (van Berkel 1995; van Berkel and Lafleur 1997; van Berkel, Williams et al. 1997). While there are different variations of how to conduct a Cleaner Production Assessment, van Berkel (1996) provides a broad-based synopsis of key elements. Text Box 2-6 outlines this procedure with the assessment process conducted in 20 tasks, divided in five stages.

Planning and Organisation: this stage ensures the support of management, sets goals and communicates the project to all staff.

Task 1: Obtaining management commitment
Task 2: Identifying barriers and solutions
Task 3: Set plant-wide goals
Task 4: Organise project teams

Pre-Assessment: this stage involves the development of accurate flow diagrams of energy and raw material use, and for the generation of all waste and emissions and assessing their costs. The pre-assessment may also lead to the early identification o obviously feasible options.

Task 5: Develop process flow charts
Task 6: Evaluate process inputs and outputs
Task 7: Select assessment focus

Assessment: This stage diagnoses the causes of waste streams and environmental impacts and involves the calculation of material balances to quantify sources of wastes and their allocation to areas with the major environmental impacts. It generates Cleaner Production options through research, external assistance or internal brainstorming.

Task 8: Derive material balances
Task 9: Assess waste generation causes
Task 10: Generate prevention options
Task 11: Screen prevention options

Feasibility Studies: In this stage the options identified in stage three are evaluated for economic, technical and environmental feasibility to identify which options can be introduced immediately, ie those to be introduced in the longer term, and those options which are not feasible under the current conditions.

Task 12: Preliminary evaluation
Task 13: Technical evaluation
Task 14: Economic evaluation
Task 15: Environmental evaluation
Task 16: Selection of feasible measures

Implementation and Continuation: In the final stage the feasible options are integrated into an action plan, funds are raised, responsibilities are allocated, and the plans are implemented, monitored and reviewed at regular intervals.

Task 17: Prepare Cleaner Production plan
Task 18: Implement feasible measures
Task 19: Monitor Cleaner Production process
Task 20: Sustain Cleaner Production

Adapted from (van Berkel 1996)

Text Box 2-6:The stages of a Cleaner Production assessment project.

2.3.4 Cleaner Production Assessment as a Tool for Small Businesses

Cleaner Production has in essence been developed for and pilot tested by, larger organisations and appears not to be readily suitable to the needs of small industry. Small businesses require hands-on, operational process tools and assistance programs (Kuhndt and von Geibler 2002). Therefore Cleaner Production tools available for small businesses tend to be less formal and require fewer resources (Palmer 2000). In particular, the Cleaner Production assessment has demonstrated its applicability and effectiveness for small businesses involved in process operations (van Berkel 1994; van Berkel and Lafleur 1997; van Berkel, Williams et al. 1997). This is due to the Cleaner Production assessment having a greater focus on improving practices and performance and the identification and evaluation of Cleaner Production options. Relatively little effort is directed at the establishment of a documented management system. The real benefit of a documented system is that it may maintain momentum over a prolonged period (Palmer and van der Vorst 1996), and entrenches improved practices thereby preventing a return to old, less effective practices. There is the opportunity to include some basic management system components in the Cleaner Production assessment which limits the possibility of practices reverting to more environmentally risky practises, without the full resource commitment of an Environmental Management System (EMS). This process helps ensure that good housekeeping measures are maintained (Fresner 1998). Both Cleaner Production and EMS list upper-management support as critical success factors. An EMS formalises this support with the development and promotion of an environmental policy. The EMS does not specify the instruments used, Cleaner Production can provide these (Fresner 1998; Montabon, Melnyk et al. 2000). "*Cleaner Production is what a good EMS is supposed to implement,"* p5 (Burton Hamner 1996). Environmental management systems makes businesses aware of their legal and statutory requirements and also of the environmental impacts of their businesses (Ilomaki and Melanen 2001). Businesses in Western Australia with a certified ISO 14001 EMS have a higher rate of adoption of environmental technology than comparable businesses (Marinova and Altham 2002).

However EMS proved to be cumbersome for the majority of small businesses (Gerstenfeld and Roberts 2000; Palmer 2000; Whalley 2000; Kuhndt and von Geibler 2002). Within small business there was the a perception that EMS focus on systems and procedures and not on direct actions, and therefore possibly added another layer of work to the environmental program; ie the management system to support the development, implementation and reviewing of the environment action plan. Therefore small businesses tend to resist the development of policies and procedures required for formal EMS (Palmer and van der Vorst 1996; Schaper and Raar 2001). Furthermore an EMS does not provide the same cost/benefit ratio to SMEs as opposed to larger organisations because of their lack of exposure in the market place and less ability to spread the cost of an EMS, including its certification costs.

Figure 2-2 integrates Cleaner Production with EMS, and shows the two should be seen as complementary tools which form a synergetic relationship. Cleaner Production addresses project management, while the EMS organises and secures the business' ongoing environmental management efforts and manages their environmental risk.

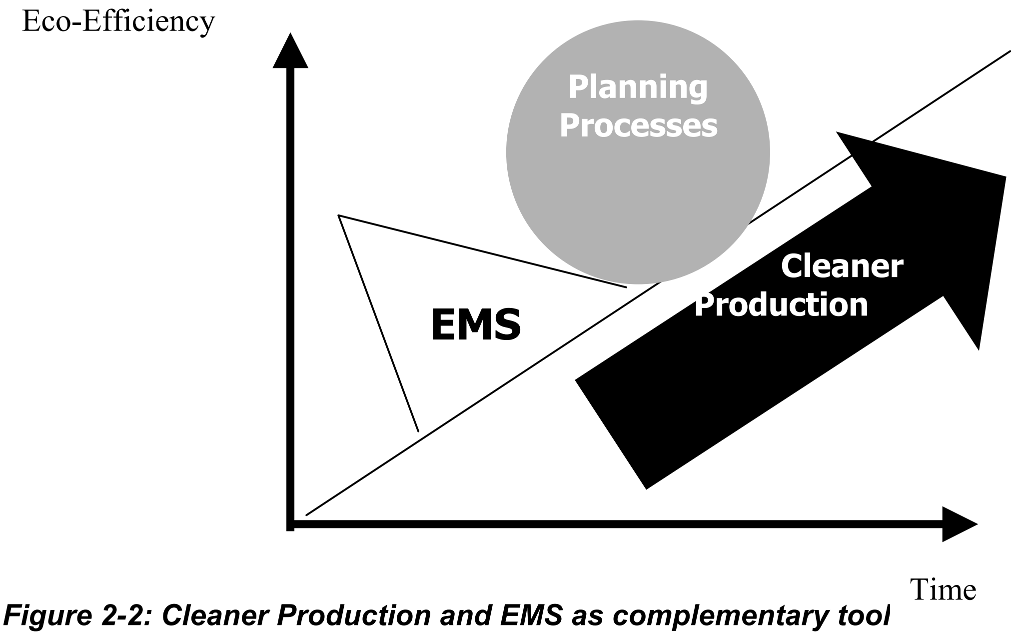


Figure 2-2: Cleaner Production and EMS as complementary tool

2.4 Environmental Performance Evaluation

2.4.1 Introduction

Environmental Performance Evaluation (EPE) is the ongoing, focused, measurement, monitoring and evaluation of the Eco-Efficiency of an organisation as an aid in decision-making (O'Reilly, Wathey et al. 2000). While there are many benefits of EPE, of greatest importance is its potential to target and track environmental improvement (Lee-Kuhre 1998). EPE was originally developed to complement existing Cleaner Production tools, particularly EMS and LCA to achieve their aims (O'Reilly, Wathey et al. 2000) and standardise EPE methods. However over time EPE has evolved into a tool in its own right, demonstrated by the development and release of an EPE Standard in 1998, ISO 14031 and the WBCSD's eco-efficiency program in 1999.

2.4.1.1 Why Monitor?

The first question managers should ask themselves is, what are the benefits of monitoring programs? The answer is that the results of monitoring will inform decision-making and ultimately improve business performance (Epstein 1996; WBCSD 1997; Australian Standards Organisation 1998; World Bank 1998; USEPA 2001a; USEPA n.d.). Benefits of monitoring include, but are not limited to the following.

- identifying significant environmental impacts
- identifying opportunities for better management
- identifying trends in Eco-Efficiency
- assessing the success of existing environmental programs
- increasing the organisational efficiency and effectiveness in achieving its environmental policy, objectives, benchmarks and targets
- identifying strategic opportunities
- motivating employees
- assisting in determining performance bonuses

2.4.1.2 Data Evaluation

To increase the usefulness of EPE and promote its use for benchmarking, data needs to be standardised and normalised, and on occasions aggregated. All three are at times equally important and critical for EPE programs.

2.4.1.2.1 Standardisation

Standardisation is the practice of reporting performance indicators in a common unit, using consistent measurement protocols with approved equipment by standard protocol to allow comparison between and within an organisation, for example kilolitre of water or kWh of energy.

2.4.1.2.2 Normalisation

Normalisation provides a basis for comparison of standardised measurements between different businesses or organisations, over time. It is most often achieved by dividing resource consumption by a reference value or normalisation factor (SETAC 1998). The output in units of production or dollars is the most common normalisation factor. This is to assist in the comparison of different sized businesses, or the same business over time allowing for variations in their output. The use of financial output to normalise indicators is well accepted this being due to other normalising factors not being available as opposed to its accuracy (Olsthoorna, Tyteca et al. 2001).

Table 2-1 illustrates the variation in normalisation factors used by the European Commission in its research on Measuring the Environmental Performance of Industry (SPRU 2001).

Sector	Normalisation Factor
Book and magazine printing	employee
Electricity generation	Giga Joule electricity generated
Fertiliser production	Euro total sales
Pulp and paper production	kilo tonne of paper
Textile finishing	kilo tonne of textile processed

Table 2-1: Normalisation factors used by SPRU

These normalisation factors were chosen on the basis of appropriateness as well as data availability. This process resulted in normalisation factors of; employee number, financial turnover and physical output, and demonstrate the problem of obtaining consistent normalisation factors, which in turn can affect the effectiveness of EPE programs.

2.4.1.2.3 Aggregation

Aggregation is the process of combining individual measurements into a more general category. This is done when there is a common link between the indicators. In the context of the EPE program, it is the process whereby measurements for different inputs and outputs having similar environmental impacts, are aggregated into one value, on the basis of the relative contribution of each substance to the respective environmental impact. The best-known example is the aggregation of greenhouse gas emissions, whereby emissions of CO_2, CH_4, CFC etc, are aggregated into CO_2 equivalent emissions using their global warming potential.

2.4.1.2.3.1 Single-Point Indicators

Aggregated indicators can be further weighted to develop a single-point indicator representing weighted aggregated indicators. This is achieved by multiplying the aggregated indicators for each environmental impact category with an impact category specific weighting factor reflecting its environmental significance, and then adding these sub-totals to arrive at a single indicator score. This process is voluntary under the ISO Life Cycle Assessment method (International Standards Organisation 1999). The selection of weighting factors can be quite subjective and open to the bias of those conducting the work. Weighting can result in an index. These are often used in accreditation schemes and awards programs, and to estimate the success of programs which measure a number of impact categories.

2.4.2 Indicators

The selection of indicators is critical for programs to improve performance. Much is written about the different types of indicators and their classification with the views expressed varying considerable. However, all agree that indicators selected should reflect their purpose. Figure 2-3 below gives an indication of the diverse range and application of environmental indicators. Indicators towards the left of the figure can track improvements in performance, such as Eco-Efficiency ratios, while those on the right of the figure track compliance, such as meeting environmental laws and regulations. Indicators towards the top of the figure are regularly recorded and allow the tracking of performance, while those in the lower half are more audit orientated and measured at points in time.

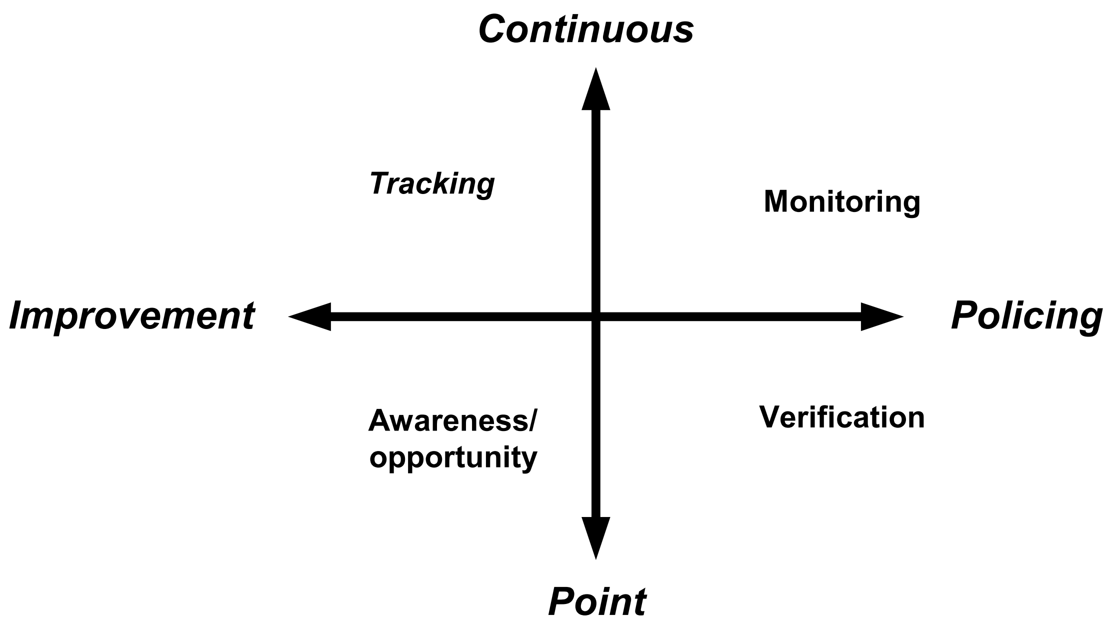


Figure 2-3: Categorisation of Eco-Efficiency indicators by purpose

(Bennett and James 1999) p44

In light of the diversity of indicators, it is also important to recognise the differences. The first point of differentiation is between 'leading' and 'lagging' indicators (USEPA 2000). As the name implies, a leading indicator reveals whether or not programs are in place to enable future progress towards the desired goals. Lagging indicators on the other hand, record performance after the time period hence there is a time delay in obtaining the results. Leading indicators are employed to measure management performance. A well-designed EPE program is generally based on a mix of leading and lagging indicators (Fiksel 2001). The Factor Ten Club differentiate indicators into activity-oriented or results-oriented indicators (Factor 10 Club 1999). Activity-oriented indicators can only be described and determined in qualitative terms and they are in general non-normalised and equate to leading indicators. While lagging indicators equate to results-oriented indicators which identify performance in quantitative terms. According to the Factor 10 Club, the ultimate proof of the success of an organisation's environmental program is the improvement in the company's Eco-Efficiency, something than can only be proven through quantitative results indicators. The World Bank (1998) and Jones and Alabaster (1999) broadly agree with this view.

However, there is a role for activity or qualitative indicators to assist businesses to track the adoption of new environmental management tools, increase environmental awareness, to estimate the influence of new initiatives and determine the stage of a program's introduction. Also, emerging environmental tools such as environmental reporting and supply-chain management activity indicators, even with their limitation, have an important role to play in monitoring the introduction and uptake of these tools. Finally, some indicators are very difficult to measure quantitatively such as culture, and in these cases activity indicators are important.

EPE programs often start with qualitative (activity) indicators that evaluate the programs and policies that the business is putting in place to improve and track its Eco-Efficiency, before considering more quantitative indicators (USEPA 2000). The shift from qualitative to quantitative indicators should represent an evolution and entrenchment of the environmental programs within the organisation. When starting with quantitative indicators, it is better to begin with simple, readily understood measures and to develop them over time (Bennett and James 1999). Even in mature EPE programs there remains a place for activity and/or qualitative indicators where performance cannot be reliably measured or quantified, or new mechanism are being introduced, and for these reasons a flexible approach is required.

The discussion on the comparison of different classes of indicators can be summed up by stating that different levels of management require different types of indicators to successfully carry out their roles within the business. Senior managers involved in strategic planning will seek activity indicators reflecting future strategies to improve competitiveness by their peers as well as other industry sectors. Human resource managers require indicators such as hours of training as well as level of employee confidence and level of empowerment etc to aid in their work. Production managers may require detailed results indicators in order to better understand their operation and to seek practices to improve their current performance standards, such as resource use, and waste and emission generated by the site.

2.4.2.1 International Standards Organisation

The Environmental Performance Evaluation Standard ISO 14031 (1998) distinguishes three major categories of indicators:

- Management Performance Indicators (MPI), measure the management effort of the organisation and evaluate the effectiveness of environmental policies and programs throughout the organisation.
- Operational Performance Indicators (OPI), measure material, water and energy flow through the plant, non-product output, noise, dust, emissions and any breaches of licensing conditions.
- Environmental Condition Indicators (ECI), provide information about the local, regional, national or global condition of the environment and changes therein.

Discussion of the third class of indicators is outside the scope of this thesis, given its focus on Cleaner Production as a plant level environmental improvement tool. Table 2-2 explains further the first two types of indicators.

Category	Subcategories
Management Performance Indicators Provide information about the management's efforts to influence an organisation's environmental outcomes	• Implementation of policies and programs • Conformation with policies and processes, including compliance with applicable laws and regulations • Financial performance • Community relations
Operational Performance Indicators Provide information about the Eco-Efficiency of an organisation's operations	• Inputs of materials, energy and services • Supply of inputs • Design, installation, operation and maintenance of physical facilities and equipment • Output of products, services, wastes and emissions • Delivery of outputs

Table 2-2: Outline of MPI and OPI

(Bennett and James 1999)

Operational performance indicators within the ISO 14031 framework are generally expressed as:

$$\text{Operational Performance Indicator} = \frac{\text{Unit of Environmental Effect}}{\text{Unit of Production}}$$

Equation 2-1: ISO's operational performance indicators

2.4.2.2 World Business Council for Sustainable Development

The World Business Council for Sustainable Development (WBCSD) developed its own system based on performance values. They calculate Eco-Efficiency ratios by the following method.

$$\text{Eco-Efficiency} = \frac{\text{Value (as output or \$)}}{\text{Environmental Impact}}$$

Equation 2-2: WBCSD Eco-Efficiency ratios

The ISO 14031 and WBCSD methods of indicator calculation vary in that the numerator and denominator are basically reversed and production is substituted for value; hence the Eco-Efficiency indicators apply a business perspective to the calculation of the respective indicators. The ISO method results in resource or production intensity ratios; a declining ratio reflects a positive improvement in Eco-Efficiency. The WBCSD method tracks resource or production Efficiency ratios; an increasing ratio reflects a positive performance improvement (Global Reporting Initiative 2002).

The WBCSD method is recommended for benchmarking, because a higher number represents better performance, and this is more intuitive to business users as better performance is generally associated with a higher value. The adoption of this method reduces confusion and increases the ease of understanding of the results for third parties.

2.4.2.3 Confusion of Tools and Indicators

There appears at times to be confusion between tools (a mechanism to identify and implement improvements in performance), and indicators (a metric to measure and report changes in performance) as they are increasingly being used interchangeably. However, while an indicator is always a tool, a tool is not always a dependable indicator. The effectiveness of the implementation of the tool is also important to determine overall changes in Eco-Efficiency. This has occurred as external stakeholders attempt to judge the relative performance of organisations by using the implementation of a Cleaner Production tool as an indicator without the ability to judge how effectively the tool has been implemented (Hardi and Barg 1997). This in turn has led to the misuse and misinterpretation of environmental activity indicators and relative Eco-Efficiency. The most commonly researched activity indicator is the existence of an EMS (either certified or uncertified), whilst the implementation of an EMS has in general not reflected relatively better Eco-Efficiency (World Bank 1998; Montabon, Melnyk et al. 2000; Ilomaki and Melanen 2001; SPRU 2001). According to research conducted by Petts et al. (1998) managers are over-optimistic about their performance and the effectiveness of management systems. Environmental reporting is now experiencing the same criticism, in that the measures used are a poor or confusing measure of actual Eco-Efficiency (Hussey, Kirsop et al. 2001).

2.4.3 Environmental Performance Evaluation for Small Businesses

EPE is promoted as having advantages over some of the more established Cleaner Production tools for small businesses. These advantages occur because of EPE's limited administrative requirements compared to an EMS (O'Reilly, Wathey et al. 2000). EPE can focus on input/output analysis to identify critical areas of Eco-Efficiency (International Standards Organisation 1999; O'Reilly, Wathey et al. 2000) which assists in the Cleaner Production assessment. It is promoted as suitable for small businesses because of its practical approach and its appropriateness for process operations (Azzone, Noci et al. 1996; van Berkel and Lafleur 1997). The EPE standard (ISO 14031) has been referred to as a useful practical guide (Bennett and James 1998), and many larger organisations will also see these benefits accruing to their organisations.

To support this view, an ISO's publication of EPE Case Studies goes to considerable length to reinforce the opinion that EPE is suitable for small businesses and a major aim of the Handbook was to illustrate the use of EPE, particularly for SME (International Standards Organisation 1999). EPE can act as a stand-alone Cleaner Production tool and has advantages over potentially more complex tools such as EMS for small businesses that require a focussed, cost-effective and value-adding way of managing improvement in their environmental performance (Jasch 2000; O'Reilly, Wathey et al. 2000). As discussed in section 2.3.4, a simplified EMS in conjunction with a Cleaner Production Assessment may entrench environmentally preferred work practices and reduce the risk of reverting to older less environmentally preferred work practices.

2.5 Benchmarking

It is very important to clarify the difference between benchmarks and benchmarking (Camp 1995), as the two are often confused (Bolli and Emtairah 2001). A benchmark is a performance level, while benchmarking is a process (Camp 1995). Benchmarking is the improvement process and the relationship is that a benchmark is a performance level which can be used to establish baselines or set future performance levels. The performance level does not necessarily need to be best practice, although benchmarking companies should in the long-term aim to achieve or better best practice. The aim of benchmarking is to identify and implement the practices that lead to superior performance.

According to Boxwell (1994, p15), and shown in Figure 2-4, successful benchmarking will have a profound impact on an organisation, transforming it from the left to the right of the figure:

An internally focused business		An external, competitive focus
From a not invented here mentality		Breakthrough ideas and learning
Gut feel decision making	TO	Fact-based decision making
Evolutionary change		Promoting revolutionary change
Industry laggard status		Becoming an industry leader

Figure 2-4: Organisational transformation after benchmarking

2.5.1 What is Benchmarking?

There are numerous quotes regarding what benchmarking is, and it has a different meaning to different people. Essentially, benchmarking is the process of continually searching for the best methods, practices and processes for conducting a task (Texas Instruments 1998). It also involves adopting or adapting good features to suit the aims of the organisation; (Garvin 1993) 'steal shamelessly[7]' is often advocated, remembering the heart of benchmarking is learning not copying (Laakso, Kleinhans et al. 1998). The greatest advantage of benchmarking is the opportunity for mutual learning (Wehrmeyer 1995). Benchmarking should be part of Best Available Technology selection (Kotronarou and Iacovidou 2001). Benchmarking brings about the highest potential improvement leaps (Cook 1995). Furthermore, benchmarking is essential for continuous improvement (Codling 1992).

Benchmarking can add value to EPE but unless there is an effective monitoring program in place the probability for success through benchmarking is reduced. Benchmarking produces the best results in companies that are already well managed (Evans 1994; Wheelen and Hunger 1998), because these businesses have the skills and abilities to close identified performance gaps. Furthermore, benchmarking can only succeed if it exposes weaknesses and inefficiencies within the organisation (European Commission 1997). This requires some knowledge of current operations.

A major strength of benchmarking is that it is a structured process with an external focus (Ahmad and Benson 1999). Benchmarking is a generic systematic improvement process (Finnigan 1996) with an external focus that creates the opportunity to identify innovations and adapt these to improve performance. The tool can be applied to improving performance on any issue considered important by management. Opportunities identified in-house also create improvements in performance. The external focus however, creates a balance between the internal and external sources of knowledge and experiences and provides for a fresh approach to barriers or mental blocks within the organisation. It promotes 'thinking outside the box'.

[7] This statement possibly creates as much fear and resistance to benchmarking as support because organisations perceive that if they become involved in benchmarking all their competitive advantage will be stolen.

Benchmarking is often broadly grouped as strategically benchmarking, performance benchmarking or process benchmarking (Watson 1992). Table 2-3 further explains these types, bearing in mind that different authors use different terms and groupings. This table also gives an indication of the level of resources required to implement particular benchmarking types.

Type of benchmarking	Definition	Support resources required for benchmarking program
Strategic	The analysis of world-class companies in non-competitive industries to determine opportunities for strategic change initiatives in core business processes. Professionally trained benchmark analysts perform these studies.	Low Medium
Performance	The analysis of relative business performance among direct or indirect competitors. These studies focus on open-literature analysis or are conducted as 'blind' studies using a third-party.	Low
Process	The analysis of performance in key business processes among identified best-practices companies selected without regard to industry affiliation. Studies are conducted by teams from process area.	High

Table 2-3: Benchmarking program elements

(Watson 1992, p10)

Industry best practice benchmarking searches for those practices that have been shown to produce superior results, selected by a systematic process and judged as exemplary, good, or successfully demonstrated (Yasar, Zaira et al. 2000). According to Tomas (2002) the aim of benchmarking should be to narrow the gap and eventually exceed current benchmarks. To add to, and at times confuse, the discussion on benchmarking, a number of terms have come into circulation including, good practice benchmarking (The Centre for Corporate Citizenship 2001). These adaptations have two effects. Firstly, by recognising the difficulty in defining best practice, and secondly it also acknowledges that many businesses are content to be early adopters and not expose themselves to the risks involved in continually being industry leaders.

Benchmarking is a generic performance improvement process and as such can be applied to any aspect of management performance ie sales, training, human resources, production, logistics, inventory, supply chain as well as Eco-Efficiency (Young and Welford 1998). Therefore, the methodology of environmental benchmarking does not differ from any other benchmarking process (Bolli and Emtairah 2001). Bolli argues that the title of such a program should be termed ‘benchmarking for continuous environmental improvement’ and not, ‘environmental benchmarking’ to imply that benchmarking is an accepted management performance improvement framework. However, this term will not be adopted in this work as continuous environmental improvement is also the stated aim of Cleaner Production and Eco-Efficiency, the adoption of which is the topic of this thesis.

2.5.1.1 Confidentiality

Business managers express concerns about confidentiality of information shared in benchmarking programs. This concern might be understandable. Recent research however concludes that successful companies operate in an ‘open’ information environment as part of their management style (Ali, Breen et al. 2001). These businesses accept that it is worth the risk, or they have the confidence, to disclose business performance data (leading to their competitors being better placed to compete with them in the market place) in return for access to recent developments in their field of business (Carroll and Tomas 1995; Finnigan 1996). These business managers realise that knowledge and practices are not readily transferable between businesses, and that tacit knowledge holds the key to future business competitiveness.

2.5.1.2 Non-Traditional Benchmarking Methods

As the popularity of benchmarking has increased, new benchmarking modus operandi have evolved. Welch (2001) identified nearly 200 websites on benchmarking or directly related improvement approaches. These initiatives included facilitated and co-operative benchmarking, which cover benchmarking programs organised by a third party, and with or without direct contact between benchmarking partners. Often these have an electronic scorecard that automatically generates a benchmarking report that is delivered electronically within minutes of supplying your business' data. These initiatives often operate online and require a subscription fee. Members can sponsor particular issues to be benchmarked if currently unavailable. These initiatives act to demonstrate that benchmarking is being used to cheaply and quickly identify performance gaps, potential areas of improvement, and costs savings. Examples of international programs include The Benchmark Exchange facilitated by The American Productivity and Quality Centre, The International Benchmark Clearinghouse facilitated by the United States Department of Energy (USDOE), the Environmental Technology Best Practice Program and the Energy Efficiency Best Practices Program, facilitated by Envirowise and sponsored by the UK government; the New Zealand Benchmarking Club facilitated by the Massey University in New Zealand. To further illustrate this point, The Benchmark Exchange (TBE) launched approximately 110 benchmarking surveys between February 1 2002 and May 2 2002, which is nine per week (author's subscription to website), provides the results instantaneously[8], and automatically included these results on their website displaying the overall results of that particular benchmarking project.

Another relatively new concept is Benchcasing (Lynn, Valentine et al. 1996; Gerigk, Johnson et al. 1997; Lynn, Abel.Kate. et al. 1999; Freytag and Hollensen 2001). Benchcasing is a practice developed to make greater use of case studies (including Cleaner Production cases, many of which are available online) and to make the information contained within case study

[8] Within 2-5 minutes to the email address supplied

databases more transferable between businesses. Like strategic benchmarking, benchcasing focuses on the underlying business features and conditions that lead to superior performance and seeks to instil similar features in other organisations. The process involves considering a number of case studies simultaneously to extract more generally applicable practices, by mixing and matching information from different case studies to suit and improve current practices. This process may also increase the business manager's confidence if a larger number of businesses have adopted a similar practice or technology, which are in turn recommended in a number of the case studies. Benchgrafting is a similar concept which uses the published results of benchmarking exercises to investigate methods to improve current practices without direct contact between business (Codling 1998).

A major weakness with these non-traditional benchmarking methods and initiatives is that they assume that business managers have the skills and experience to identify and implement the preferred practice within their operations without outside assistance or direct contact. Under traditional direct contact benchmarking, the interaction between the partners facilitates the exchange of skills and experience on how to improve practices. The assumption that performance can be improved without external assistance is hard to justify in particular in the environmental field for many small businesses (Elmuti and Kathawala 1997; Gunningham and Sinclair 1997; Ahmed, Montagno et al. 1998; Badrinath 1998; Wiarda and Luria 1998; Davies and Kochhar 1999; BALance Technology Consulting 2000; Bergin 2000; Lee, Bennett et al. 2000; Green Business Network 2001; Andrews, Stearneb et al. 2002). The majority of surveys report a lack of environmental management skills and experience and conclude that outside assistance is required for the successful implementation of Cleaner Production in small businesses. However these approaches can remove some of the concerns over confidentiality of material that many business owners and managers have with direct sharing of performance data (deVito and Morrison 2000) while still promoting Cleaner Production.

2.5.2 Conducting Benchmarking Programs

The conducting of a benchmarking program is generally broken down into a number of phases, steps and tasks with the number varying greatly between practitioners and advocates (Standards Australia/ Standards New Zealand 1996; Pemberton, Stonehouse et al. 2001). Zairi and Leonard (1994) studied fourteen benchmarking methodologies. Their score of methodology reflects the methods containing the seven key criteria thought to be essential for successful benchmarking programs. They judged if these were incorporated into each of the benchmarking methods studied. Text Box 2-7 lists the criteria;

Strategic Focus
The process leads to the setting up of objectives and stretch goals based on a thorough understanding of process capabilities

Operational Focus
Whilst benchmarking processes are about determining gaps in performance and setting clear objectives, it is absolutely essential that they translate into practices, through a focus on the process and its performance, at an operational level

Customer Focus
For a benchmarking process to be successful, it has to set clear customer-based targets and help drive the performance of processes for an optimized level of output which will present value for the end customer

Process Focus
Benchmarking is only meaningful as a process if it focuses on the process or the activity task. Knowledge of the organisation is critical for setting stretch targets. Many benchmarking exercises focus too much on the indicators, without a clear understanding of the why and how.

Links to TQM
Benchmarking is an integral element of the total quality management philosophy. It has a similar approach to internal methods of problem solving and quality improvements.

Continuous improvement
Process-based benchmarking exercises have to be repeated on a regular basis to strengthen the process further.

Continuous learning
Benchmarking is about newness and innovation. Benchmarking is a future focus approach: it is concerned with the next set of objectives.
(Zairi and Leonard 1994, p51-52)

Text Box 2-7: Criteria for successful benchmarking

The results of Zairi and Leonard's analysis are presented in Table 2-4. The maximum possible score is 21 (7x3) while the average score for the methods studied was 10.7.

	Ranking on Benchmarking Performance Criteria (1-3)							
Methodology	Strategic Focus	Operational Focus	Customer Focus	Process Focus	Link to TQM	Continuous Improvement	Continuous Learning	Aggregate
Xerox	2	2	3	2	2	3	3	17
PO Counters Ltd	1	3	1	3	0	2	0	10
Royal Mail	0	0	1	3	2	2	0	8
IBC	2	2	3	3	3	3	2	18
Vaziri	3	0	3	3	3	2	0	14
Price Waterhouse	2	2	2	0	1	3	0	10
McKinsey & Co	3	0	1	3	1	0	0	8
Codling	3	2	2	3	2	3	2	17
McNair & Leibfried	3	2	2	2	2	3	0	14
AT & T	3	0	1	3	3	3	0	13
Alcoa	3	0	3	1	3	0	0	10
NCR	0	0	0	0	0	0	0	0
TNT	0	0	0	3	0	2	0	5
Schmidt	3	0	3	0	0	0	0	6
Average	2.0	0.9	1.8	2.1	1.6	1.9	0.5	10.7

Table 2-4: Comparision of benchmarking methodology

(Zairi and Leonard 1994, p64)

These criteria have direct and important links to the aims of this research project. The operational and process (business' activities) focus fits well with the small business requirement of a suitable Cleaner Production tool. The links to Total Quality Management are beneficial because of the close links to Total Quality Environmental Management. Continuous improvement and continuous learning criteria are important because they are critical to achieving the aim of Cleaner Production; ie continuous improvement in Eco-Efficiency. Of the final two criteria, strategic relates to Cleaner Production as a strategy, while, in regard to customer focus, Eco-Efficiency describes goods and services that are required by consumers. Therefore these criteria are directly linked to this research project and important to long-term competitiveness.

This research identified three benchmarking methods as superior. The phases and steps of these methods are listed in Table 2-5 to give a better understanding of the tasks required to undertake a successful benchmarking exercise.

Xerox Methodology	IBC Methodology	Codling Methodology
Planning 1. Identify what is to be benchmarked 2. Identify comparative companies 3. Determine data collection method	**Planning** 1. Select process 2. Gain process owner's participation 3. Select leader and team 4. Identify customers expectations 5. Analyse process flow and measures 6. Define process inputs and outputs 7. Document process 8. Select CSFs to benchmark 9. Determine data collection 10. Develop a preliminary questionnaire **Collect Data** 11. Collect internal data 12. Perform secondary search 13. Identify benchmarking partners 14. Develop a survey guide 15. Solicit participation of partners 16. Collect preliminary data 17. Conduct visit	**Planning** 1. Select subject area 2. Define the process 3. Identify potential partners 4. Identify data sources
Analysis 4. Determine current performance gap 5. Project future performance levels **Integration** 6. Communicate benchmarking findings and gain acceptance 7. Establish functional goals	**Analyse Data** 18. Aggregate data 19. Normalise performance 20. Compare current performance to data 21. Identify gaps and root causes 22. Project performance to planning horizon 23. Develop case studies of best practice 24. Isolate process enablers 25. Assess adaptability of process enablers	**Analysis** 5. Collect data: select partners 6. Determine the gap 7. Establish process differences 8. Target future performance
Action 8. Develop action plans 9. Implement specific actions and monitor progress 10. Recalibrate benchmarks	**Adapting and Improving** 26. Set goals to close, meet and exceed gap 27. Modify enablers for implementation 28. Gain support for change 29. Develop action plan 30. Communicate plan 31. Commit resources 32. Implement plan 33. Monitor and report progress 34. Identify opportunities for benchmarking 35. Recalibrate benchmarks	**Action** 9. Communicate 10. Adjust goal 11. Implement 12. Review: calibrate

Table 2-5: Stages and tasks of benchmarking methods

Adapted from (Zairi and Leonard 1994, p52 to 59)

While repeating that benchmarking is an improvement process applicable for any area of interest to management, this research only came across one benchmarking method specifically developed for environmental management. The Global Environmental Management Initiative (GEMI) (1994) publication Benchmarking: the Primer, benchmarking for continuous environmental improvement[9]. This publication was a joint effort of AT&T, Law Companies Environmental Policy Centre and the GEMI's Environmental Management Tools & Methods Work Group. This method is presented in Table 2-6. Initial concerns over this benchmarking method were raised because the AT&T model performed moderately on the Zairi and Leonard analysis with a score of 13 (see Table 2-5). However an investigation into these deficiencies indicates that the model developed for GEMI and published in their primer apparently overcomes these deficiencies, or at least identifies them, for rectification in the implementation of benchmarking within the organisation. The deficiencies were lack of operation focus and continuous learning. The first is explained with the realisation that the AT&T benchmarking methodology was developed following the strategic dilemma of market deregulation and therefore the methodology is intended to be strategic and not operational in its focus. The second area where the AT&T method under performs was the result of the AT&T program relying on a specialist benchmarking team and not using the existing process owners (possibly because of time constraints to conduct the program before government policy was changed or implemented)[10].

[9] The age of this publication (published in 1994) and the fact that no more recent publications were identified on environmental benchmarking may support the view that environmental benchmarking is a process similar to benchmarking other business activities and therefore specific methods for environmental benchmarking have not been developed and published.

[10] If the AT&T method received the medium score on these two criteria, they would have achieved an equal highest score overall. Alternatively when the other 5 criteria only are totalled, the AT&T method achieved the equal highest score.

Project Conception • Establish an environment conducive to benchmarking • Establish the benchmarking project scope • Estimate and commit the necessary project resources • Establish a realistic and achievable project schedule • Form an effective benchmarking team • Develop project specifics with benchmarking team
Planning • Develop the benchmarking project plan • Share it with project management
Preliminary Data Collection • Develop criteria for selection of best-in-class companies • Develop entry form for data research • Establish data collection techniques and sources • Collect preliminary data • Baseline current programs/processes
Best-in-Class Selection • Select benchmarking partners that have best-in-class processes based upon research to date • Review and refine the question set for upcoming visits
Best-in-Class Data Collection • Revisit the team's data collection approach • Schedule and prepare for the data collection sessions • Assign visiting team roles and responsibilities • Prepare visiting briefing packages • Develop visit reports • Follow up team visits
Assessment • Analyse the data collected • Define elements of a best-in-class model • Identify gaps between best-in-class model and current programs and processes • Identify sources for improvement and associated recommendations
Implementation Planning • Assess organisational change readiness • Develop operational plans for program or process improvements • Develop change strategies • Develop implementation plans
Implementation • Monitor change process • Manage the change process
Recalibration • Determine a set of drivers for recalibration • Develop and begin the recalibration process

Table 2-6: Phases and steps in the GEMI benchmarking method

Source (Global Environmental Management Initiative 1994)

2.5.3 Measuring Success of Benchmarking Programs

Before discussing the critical success factors of benchmarking in greater detail it is important to define what makes a benchmarking program successful. In general, a continuous improvement in the area of the business being benchmarked (the KPIs) signifies success of the benchmarking program. Coincidentally and equally important, continuous improvement is the defined measure of success for Cleaner Production. However continuous improvement being a process and not a performance level makes determining success difficult.

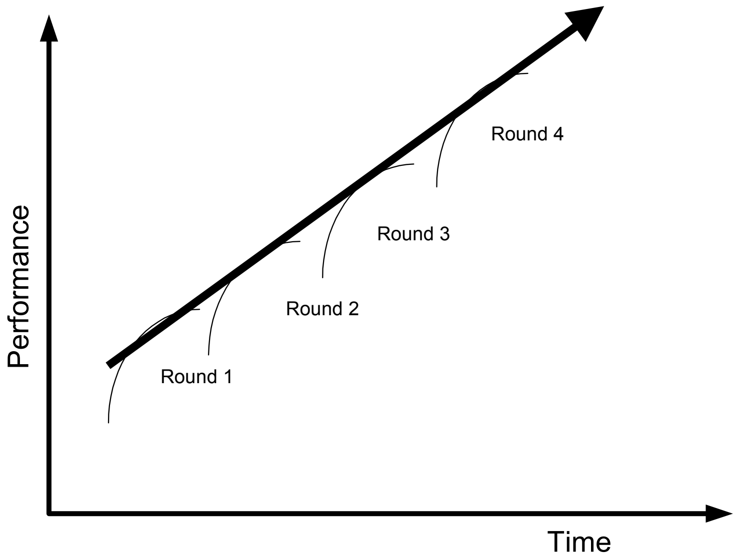


Figure 2-5: Improving performance over time

Figure 2-5 illustrates how benchmarks can improve over time by creating a leapfrog effect in performance standards with each round of benchmarking assisting individual businesses to identify and implement performance improvements. The improved performance in each round is shown in the figure. This effect is important to achieve radical improvements in Eco-Efficiency.

The process of continuous improvement through benchmarking requires an ever-improving level of performance to set new performance levels.

Consequently, to achieve the level that drives continuous improvement requires some leapfrog effect, a steady incremental improvement, or some businesses (generally the industry leaders) to ‘think outside the box’. This is in fact the case when benchmarking is not advocated as a suitable improvement tool for industry leaders, and these business managers should implement more challenging and innovative programs (Romm 1999; Longbottom 2000). Industry leaders are needed to establish new benchmarks to improve the performance level of the remainder of industry. However program facilitators need to ensure the continual involvement of industry leaders in benchmarking to help identify new benchmarks to ensure they (the industry leaders) are still industry leaders and importantly to recruit potential mentors (Gardstrom and Norrthon 1994).

2.5.4 Practical Experience

While benchmarking is widely accepted and implemented by industry in general, success in benchmarking programs is by no means universal. Eighty two percent of replies to a major annual survey claim that benchmarking does not deliver as much as it promises (Rigby 2001). Work from the CCI (1993) and Lewis (2000) and reported by Pemberton et.al. (2001) concludes that as few as 5% of benchmarking projects actually result in the transfer of best practices. Regardless of this, they still claim that benchmarking can and does produce impressive results (ibid). Benchmarking has been shown to increase the number of improvement options identified because it encourages managers to actively seek information and cultivate an external focus. However this does not always translate into greater numbers of options being implemented (Lee 1999). This may be because many benchmarking programs do not provide the tools to fully or correctly implement the options identified. There is often a lack of employee participation (Brah and Lin Ong 1999). Benchmarking needs follow-up with practical action plans (Australian Dept of Industrial Relations 1996; Bergin 2000; Bogan and Callahan 2001) and the development of such action plans and transfer of the skills required to develop and implement such action plans is often overlooked (Atkin 2000) or there is often a lack of employee participation (Brah and Lin Ong 1999).

2.5.4.1 Barriers to Benchmarking

The literature reports a number of barriers to benchmarking (Elmuti and Kathawala 1997; Elmuti 1998; Davies and Kochhar 1999; BALance Technology Consulting 2000; Kumar and Chandra 2001). The common barriers to benchmarking include:

- lack of acceptable performance indicators
- lack of ability by many businesses to reliably measure resource use, wastes and emissions
- concerns regarding confidentiality of data collected
- concerns about the applicability of benchmarks being compared across businesses and their usefulness to drive improvement programs.

The literature review also shows that that while small businesses have the opportunity to receive similar benefits from benchmarking as larger businesses, according to Department of Employment Workplace Relations and Small Business (1998) (see Table 2-7), far fewer small businesses in Australia actually participate in benchmarking. Despite their lack of participation, small businesses still considering benchmarking an appropriate performance improvement tool, (Rothman 1992; Monkhouse 1995; Vesterdorf 1997; Bergin 2000; Dodd and Turner 2000; Benchmark Index 2001b).

Business Size (No. of employees)	% Benchmarked
Less than 5	11
Less than 20	15
20 to 200	41
Greater than 200	51

Table 2-7: Size of business and percentage that benchmark.

This may indicate that smaller businesses face greater barriers in conducting benchmarking than larger organisations. These differences may be caused by a number of factors including lack of available resources, lack of skills within the workforce, no direct access to specialists, limited networking opportunities, inability to locate benchmarking partners and the lack of a critical mass of employees to aid innovation. Smaller businesses are also, less systematic in their approach to problem solving and improvement programs to start with.

These barriers are reflected in the small business' inability to identify key performance indicators (KPI), select benchmarking partners, collect and analyse data, identify performance gaps, establish challenging but achievable improvement targets and finally in the development and implementation of their action plans. Because improvement programs including benchmarking promote change they also provoke resistance from those within the organisation who have a vested interest in not changing (European Commission 1997).

2.5.5 Limitation of Benchmarking to Trigger Cleaner Production

There are a number of factors that restrict the potential of benchmarking to trigger firm level improvements in Eco-Efficiency. These are discussed below in relation to the critical success factors for benchmarking.

2.5.5.1 Poor Gap Identification

The identification of performance gaps has two main barriers for small businesses. First, the identification of environmental aspects and impacts for individual industries. Small businesses often consider they have no environmental aspects and therefore require assistance with the selection of KPIs. The second relates to poor or non-existent environmental monitoring and accounting practices (Todd 1999). Furthermore when environmental costs are identified, they are often allocated to overheads, which masks the source of the expense (White, Savage et al. 1995; Epstein 1996; Environment Australia 1999) and reduces drivers for improvement. Improved environmental cost accounting leads to the identification of additional Cleaner Production options (van Berkel 1994; Olvida, Alvarez-Rivero et al. 2000). Where environmental accounting practices are implemented they often contain a very narrow definition of environmental costs. For example, Kmart concluded that the direct cost of their packaging disposal represented only 1% of the total cost of its disposal ($30 per ton). The major cost was labour ($3,000 per ton) required to collect, transfer and compact the material to the waste collection point ready for collection (Fox, Gertman et al. 1997). The direct costs are often only the 'tip of the iceberg' for the total environmental costs (Environmental Technology Best Practice Program 1998). Another example of the poor recognition of waste costs comes from the UK. When a group of businesses were asked to estimate their waste costs before a complete waste audit was conducted; the actual cost of waste was on average 25 times that estimated (Phillips, Read et al. 1999). Similarly in the US an oil refinery estimated their environmental costs at 3% of non-crude operation cost while it was in fact 22% (Li 2001). Poor environmental accounting practices result in limited or no recognition of potential cost saving, which in turn diminishes economic benefits as a driver for improving Eco-Efficiency.

2.5.5.2 Weak Drivers

A mix of drivers increases the incentive to improve Eco-Efficiency. These drivers can be split into internal drivers and external drivers. They impact on efficiency and competitiveness respectively (given a level of overlap). Internal drivers seek improvements in efficiency, while external drivers seek recognition from awards and accreditation for the business's superior Eco-Efficiency leading to competitive and marketing advantages. However, such external drivers are of limited influence on small businesses because of the unsuitability of current accreditation programs (ISO 14001 etc) and the limited visibility of small businesses in the market.

Economic benefits can be a poor driver to reduce environmental impacts if the link between 'environmental impacts' and 'environmental costs' is weak. This situation is created by limited implementation of the 'polluter pays' principle, hidden subsidies and the lack of internalisation of externalities (Roodman 1996; Commission on Sustainable Development 1997; Ilomaki and Melanen 2001). The presence of externalities encourages the overexploitation of natural resources because the price paid is less than the real cost of these resources. This situation leads to an increase in demand for the resources and diminished incentive to increase efficiency or identify substitutes. These subsidies reduce the potential economic benefits that can be generated by improved eco-efficiency, hence also diminishes its value as a driver for change. Under current policy the market often does not provide the correct price signals to support more environmental sustainable practices. This has led to calls to 'strengthen the market' (Commission on Sustainable Development 1997; Australian and New Zealand Environment and Conservation Council 1999; Holliday, Schmidheiny et al. 2002).

Australia's agriculture sector receives an indirect subsidy of $3.322 billion dollar a year due to low water charges (Environment Australia 1996b). In Australia the total value of environmental subsidies was estimated to be approximately $14 billion or 3.3% of GDP (Environment Australia 1996b).

Text Box 2-8: Examples and costs of environemnatal subsidies

Risk management is also a weak driver in situations where business managers have a poor understanding of the potential environmental and health impacts of the materials they use, the waste they create and the emissions they release. Further, if the enforcement of regulation is questionable, fear of prosecution or licence withdrawal as drivers to improve Eco-Efficiency will also be diminished.

2.5.5.3 Limited Understanding of the Cleaner Production Assessment Procedure

By using benchmarking to target those areas of Eco-Efficiency that have the greatest opportunity for economic benefit, business managers may not investigate the full range of their environmental impacts, but only those with major direct environmental costs attached. Furthermore, business managers are tempted to consult checklists, case studies, demonstration sites, and published material rather than conduct a full cause assessment, or fully explore the full range of Cleaner Production practices. Therefore, they often end up with solutions that are not appropriate to their situation, and which do not providing long-term innovative solutions (Wanzenried, Dvorak et al. 1999). The Cleaner Production Action Plan as developed in this program may be considered an abridged method of conducting a Cleaner Production assessment. To help counter this limitation of benchmarking, the program continually reinforces the message that sound environmental management requires the analysis of root causes, and for those seeking a more sustainable and innovative solution they need to use more comprehensive Cleaner Production tools. This concern is echoed in the report of the Quick-scan program in the Netherlands (de Bruijin and Hofman 2000).

The Table 2-8 summarises the limitation under the current business paradigm for benchmarking to trigger Cleaner Production and indicates the level of failures (* low - ***** high; values are very subjective on the basis of the literature review). This table indicates that information failure created the greatest barrier to gap identification and tools to close the performance gap in benchmarking for smaller businesses, while direct or indirect subsidies and the lack of the polluter pays principles dampen the drivers for Cleaner Production in small businesses.

Critical success factors for Cleaner Production benchmarking		Failures[11] for Small Business (potential solutions)		
		Policy	Market	Information
Gap Identification	Selection of KPIs	**	**	*****
	Environmental Accounting	****	***	*****
	Data processing	*****	*	*****
Drivers	Cost saving - subsidies externalities	***** *****	**** ****	** **
	Risk Management	*****	***	****
Tools	Action Plan	**	**	*****

Table 2-8: Cleaner Production benchmarking failures

2.5.6 Benchmarking for Small Businesses

The majority of the published literature on benchmarking, reports on the experiences of larger organisations. Much less is known of the experiences of small businesses. Despite this lack of experience many advocates maintain that benchmarking is as relevant to small businesses as it is to the larger companies, (Rothman 1992; Monkhouse 1995; Vesterdorf 1997; Bergin 2000; Dodd and Turner 2000; Benchmark Index 2001b). Furthermore, it has been reported that the majority of small business benchmarking programs were established for the advancement of the facilitating organisation and not for the participating business managers (Bergin 2000). This is possibly caused by the fact that many of these projects are established with short-term funding for short-term projects and are used to establish benchmarks or baselines and not to implement complete benchmarking programs as an improvement tool. Therefore they do not implement the capacity building programs required to assist small businesses close their performance gaps.

[11] There is always some overlap between the types of failures.

2.6 Continuous Improvement and Learning Organisation

Continuous improvement is a regular theme in initiatives to improve industry's performance in general, and Cleaner Production, Environmental Management System and Total Quality Environmental Management in particular. However, in practice continuous improvement is very difficult to achieve. Many businesses have introduced very successful environmental improvement programs, but the success of these programs has often had limited impact on other environmental issues within the company or other companies within or outside that industry sector, (Aquatech 1997; van Berkel 1999). Swedish research concluded that this could be because the work is viewed as a project and not as a continuous process that is integrated into the organisational operation or management procedures. (Emilsson and Hjelm 2002)

The literature on continuous improvement always goes back to the concept of the learning organisation: leading to a conclusion that continuous improvement is the ultimate success indicator for a learning organisation (Garvin 1993; Jones 1995; Rheem 1995; Bessant 1996; Little and Cayer 1996; Black and Synan 1997; di Bella 1997; Gibb 1997; Tompkins 1997; Dervitsiotis 1998; Martensen and Dahlgaard 1999; Bessant, Caffyn et al. 2001). Furthermore, the process is similar for organisations of all sizes, although with different constraints (Chapman and Sloan 1999; Wyer, Mason et al. 2000; McAdam and Reid 2001). A learning organisation has been defined '*as an organisation skilled at creating, acquiring, and transferring knowledge, and at modifying its behaviour to reflect new knowledge and insights' (Garvin 1993, p80).* The ability to learn from past mistakes is increasingly recognised as critical to the creation of a learning organisation (Garvin 1993). The learning process should be a well-managed process and not be expected to be a random occurrence or a matter of luck (Garvin 2000). The learning process needs to incorporate a number of feedback loops because learning is not a linear process (Lee, Bennett et al. 2000; Stewart 2001).

Reported barriers to a learning organisation include organisational inflexibility and lack of innovation due to conservative values and lack of vision (Kane 2000). These barriers can be linked to the business' current culture.

2.6.1 Capacity Building

Three broad approaches can be taken to foster the uptake of Cleaner Production. These are, correction for lack of information (reduce information failures), changing incentives (correct market failures) and mandating specific behaviour (overcoming policy failures) (Lindhqvist 2001). In simple terms these initiatives can range from handholding or spoon-feeding at one extreme and command and control at the other (enforcement with a big stick). The intermediate approach involves actively improving industry's knowledge to allow participants to act on enlightened self-interest, through assistance in developing the business case, teaching the 'tools of the trade' and encouraging self-assessment and diagnosis. This method is well supported (Vickers and Cordey 1999; Ecotec 2000). This research project promotes this intermediate approach while acknowledging that the other approaches do have a role to play.

Cleaner Production programs impose different requirements and responsibilities on the various stakeholders participating in any capacity building program. Business managers require certain attributes, and these are referred to as the demand criteria, or pre-requisites for successful integration of the skills required and information available. The capacity building providers need to ensure that the program is designed and delivered in a way to maximise its chances of transferring the information and skills leading to the program's success. These are referred to as supply criteria.

2.6.2 Desired Industry Competencies

According to van Berkel (van Berkel 1996) the adoption of Cleaner Production is influenced by four inter-related constraints and incentives.

Conceptual: relates to the attitudes and perceptions of business managers, company management and other key persons in the company.
Organisational: relates to the division of tasks and responsibilities between different persons and departments within the company and management and information systems in use.
Economic: relates to the cost of materials, energy, technology, labour and utilities and the financial and fiscal incentives for Cleaner Production
Technical: relates to the physical state of the installed plant equipment and opportunities to integrate or add Cleaner Production practices and technologies to this installed plant equipment (van Berkel 1996, p259).

The presence of these traits increases the demand for Cleaner Production. These competencies could be demonstrated through:

- strategic orientation and commitment of top management
- environmental activities being integrated with mainstream management
- availability of internal know-how in relation to Cleaner Production
- presence of an internal key actor to drive program
- identification of the benefits of Cleaner Production to the business
- active involvement of staff in Cleaner Production programs
- lasting integration of external support
- presence of an external stimuli

Adapted from (Hennicke and Ramesohl 1998).

This study showed that strength in only one area could be sufficient for success. However, if only one key variable is present the program may stumble on any change in the business conditions, or if the champion leaves or top management personal changes. Once this strength has been tapped, the successful implementation of programs requires a positive attitude ie:

> 'They think it can be done'. This requires that internal company actors perceive they have sufficient resources and know-how to cope with the challenges brought about by the projects, and they will be able either to avoid or to overcome possible difficulties and inconveniences in the course of implementation. Factors strongly influencing the feeling of self-efficacy are: financial and especially time resources inside the company, support by top management for key actors on lower levels, energy related know-how, experience with energy efficiency and the availability of data (key figures) on energy consumption inside the company'
> (Hennicke and Ramesohl 1998, p44)

For benchmarking an open approach extends to the willingness to share experience with peers and not seeing such sharing as a threat to one's own competitiveness, but instead as an opportunity to learn. Furthermore for management to successfully implement benchmarking they need to adopt an external focus and develop a business philosophy of continuous improvement which acknowledges that you can 'always improve' and possess an openness to change (Dames and Moore 1995).

Within the literature on each of the three core themes of this thesis (Cleaner Production, benchmarking and continuous improvement) culture is singled out as an important but less tangible condition for success (Karch 1993; Monkhouse 1995; Irani and Sharp 1997; Ahmed, Loh et al. 1999; Tilley 1999b; O'Reilly, Wathey et al. 2000; Stone 2000; Yasar, Zaira et al. 2000; Zairi and Whymark 2000; Baumast 2001; von Ahsen and Funck 2001). Culture in this context refers to the business or corporate culture, and to encourage true integration these values need to be in line with the employee's private culture, values and ethics. The view has also been expressed that the challenge of Cleaner Production is profoundly cultural (Allemby 2001) and there are many cultural (and economic) obstacles to the rapid adoption of Cleaner Production (Evans and Stevenson 2001). The success of any program requires both technical and cultural aspects to be considered and integrated into the program's design.

2.6.3 Current Industry Competencies

Currently the ability of small businesses to improve its Eco-Efficiency is hindered by a number of factors. SMEs have a poor knowledge of environmental impacts (Gunningham and Sinclair 1997; Smith, Kemp et al. 2000) and the majority do not consider that they have any serious environmental impact (Boyle 1998; Hillary 2000; van Berkel 2002b). Business managers have limited awareness of relevant environmental legislation and hold the view that compliance is costly (Smith, Kemp et al. 2000). There is also a lack of environmental accounting practices (Gunningham and Sinclair 1997). Furthermore, small businesses have limited opportunities to network causing a lack of external focus and stimuli for the business managers. An inward focus leads to limited or no knowledge of environmental and other benchmarks, while the trigger for performance improvement often comes from outside the organisation (Codling 1992; Hennicke and Ramesohl 1998; Chaston, Badger et al. 2001). Overcoming these may allow small businesses to compare their performance with peers, which in turn might trigger improvement (Holmes and Girardi 1999).

2.6.4 Competency Gap Analysis

Any generalisation into generic competency gaps needs to be treated with caution because small businesses are not a homogeneous group. In the current situation many small businesses consistently face a combination of the following gaps:

- an inability to recognise environmental impacts of their own operation and products
- lack of skills, tools, information and experience to improve Eco-Efficiency
- limited opportunities to network
- resistance to cultural change on the part of management
- competing business priorities, especially cash-flow
- perceived high cost of new, cleaner technology

One of the questions raised at the beginning of this thesis was why do apparently similar businesses have vast variations in their Eco-Efficiency? The answer is related to their culture and reflected in the priority the business managers give to environmental management. Businesses have been classified as ‘minimalists’, ‘converts’ and ‘committed’ organisational types based on the level of environmental development within the business (Gerrans and Hutchinson 2000). It is the committed businesses with a pro-active environmental culture that gives priority to Cleaner Production. The other stages are important to the evolution of a business’ environmental program, but only as stepping-stones to the final outcome. The key to overcoming the lack of pressure for Cleaner Production is a question of management priority for Eco-Efficiency. Culture, values, ethics, attitudes as well as economics drive priority setting, and in many cases this leads to a low priority for environmental management. A cause of the gap can just be the view that because of current knowledge it is not worth investing in Cleaner Production and the lack of a positive role model or mentor reinforces this stance. A key and often-single priority for business managers is to survive in business. Greater implementation of Cleaner Production will require the realisation by business managers that improved Eco-Efficiency makes good business sense and therefore needs to be a priority. How to create environmentally committed business managers is still a largely unanswered question, see (Petts, Herd et al. 1998).

2.6.5 Supply Criteria

Turning to the supply side of Cleaner Production capacity building, it is important that capacity building programs while maintaining a long-term focus promote shorter-term benefits. To increase the uptake of Cleaner Production among small businesses requires correctly designed activities delivered through a mix of initiatives, in an agreed timeframe. Although a number of surveys report high levels of environmental awareness, the literature goes on to say that this awareness is often not converted into improved performance (Schaper and Raar 2001). This indicates that while levels of awareness are adequate, the capacity building programs to capitalise on this awareness have not been in place to improve Eco-Efficiency. It is important to make the distinction between awareness, action and implementation, in particular for SMEs (Advisory Committee on Business and the Environment 2001).

Successful capacity building programs for SMEs need to be inexpensive, co-operative, locally based, flexible, unique and accessible (Tilley 1999a; Gerstenfeld and Roberts 2000; Schaper and Raar 2001), while ensuring that the delivery of activities and their associated training is as clear and simple as possible (Beardsley 1996; Palmer and van der Vorst 1996). An effective capacity building program must provide training with clear, concise, dependable sector-specific information and support (Bartolomeo and Ranghieri 1999; Gerstenfeld and Roberts 2000). Furthermore, it is important to communicate the right message with clear next steps, personally, to top management and to provide ongoing support while they are taking action (Clark 2000). The information conveyed must be relevant and timely (Hunt 2000). The language and concepts must be familiar to participating business managers with the aim being not to show how smart the training provider is, but to offer practical assistance. Cleaner Production capacity building activities have been criticised as creating confusion for small business managers through providing conflicting information (Bichard 2000). A good example of the breakdown caused by language and the poor linking between the micro and macro environmental issues is demonstrated by a survey undertaken by the Town of Kwinana (Western Australia) into issues of concern to their ratepayers. The question of sustainable development (a macro indicator) ranked 35 out of 53 issues covered by the survey, while 9 of the 13 highest ranking responses were micro environmental issues generally relating to waste generation and management, and pollution issues[12](Kwinana Town Council 2002). Respondents in the survey formed no link between waste management and pollution and sustainable development.

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[12] These views were supported at the workshop titled 'How can ideas of effective environmental management systems, learning and improving institutions reach micro, small and medium sized enterprises' held at the Seventh European Roundtable on Cleaner Production (Engelhardt and Fresner 2001)

The distinction between education and training is often fluid. However, in general and for the purpose of this thesis, the aim of education is to increase knowledge and know how to foster personal development which in turn will enable longer-term improvements in performance. Training on the other hand is directed at practical application and knowing what facilitates the introduction and improvement of current practices. Knowledge can be considered the ability to use information to the best of its potential. To change behaviour requires both the transfer of knowledge and information in an interactive, non-threatening environment. However, the transfer of knowledge is much more complex than the transfer of information. The transfer of knowledge is assisted by a two-way interaction, which provides for in-depth analysis of the concepts and the opportunity to reflect on the information and knowledge provided. Elements of 'hands-on' or 'learning-by-doing' offer an ability to learn from the instructor's experience when the transfer of knowledge is not straightforward. This can be enhanced by 'face-to-face' contact. Knowledge incorporates explicit and implicit information, tacit knowledge and experience.

In summary, successful capacity building requires on-going, process-focused activities, leading the participants to discover their business case for developing and implementing an action plan customised to their operations. The action plan should deliver to this business case. Cleaner Production is to be implemented without upsetting the core business processes on which the business is based. The Cleaner Production assessment methodology is in principle suitable to provide a process focus suited to this task.

2.6.6 Delivering Capacity Building

After the business manager's attention is triggered, the capacity building activities need to be in place to capitalise on this attention and willingness to participate ie utilising 'the window of opportunity'. There are benefits from a large number of active stakeholders participating in the development and delivery of capacity building activities in a co-ordinated and strategic manner (Tilley 1999a). This adds credibility, quality and rigour to capacity building activities and assists in recruiting participants if they consider the program has widespread support.

2.6.6.1 Networking

The literature covering Cleaner Production, benchmarking and continuous improvement concludes that the time, finance and the access to information are main barriers to the introduction of these initiatives in small businesses. A mechanism promoted to help overcome these barriers is networking. Networks are characterised by two or more autonomous but interdependent participants (Duffy 2001) who cooperate for their individual and collective benefit. Furthermore networks provide access to additional resources (Hennicke and Ramesohl 1998). As a critical mass of experience and knowledge is required to foster and diffuse innovation networking can be a cost-effective method of delivering programs, provide a wide-range of activities, while allowing participants to share their experience. This critical mass can be achieved within a single large organisation with its wider range of in-house skills, knowledge, experience and contacts. However, as small businesses often do not have this opportunity, the formation of a network can help overcome this barrier.

A common barrier to the establishment of networks is that they often require third party facilitation and some injection of resources, at least to become established. When networks are established they can increase the opportunity for business managers to share their experiences and build on their ideas and bounce ideas off each other in brainstorming sessions (either structured or unstructured ie or over a drink). These benefits need to be weighed against the view that innovation comes from different industry sectors and situations, and that business managers will be unwilling to share information and experiences with their direct competitors (as discussed in Section 2.5.1.1). Networks require that all relevant stakeholders are involved in a co-ordinated and strategic manner in a web of interdependence and interconnectedness (Tilley 1999a). However, facilitation is generally required between the various stakeholders to co-ordinate, resource and create these types of network and to provide the required Cleaner Production capacity building programs.

2.6.6.1.1 Diffusing Innovation Through Networks

Meredith (2000) introduces an innovative SME model. To be successful in creating innovative SME this model stipulates the integration of three sub-networks; a business network, a regulatory network and a knowledge network. Stakeholders can be part of more than one network playing a different role in each.

The business sub-network allows for the creation of a critical mass that fosters innovation and increases the confidence business managers have in any potential solution. It also provides the opportunity to follow-up new practices introduced within their operations with peers to discuss their success and failures. These business networks can comprise a mix of stakeholder groups including, but not restricted to peers, industry and professional organisations, the supply chain, and service providers (ie accountants and consultants).

Industry organisations are well placed to coordinate the business network and promote innovation and change the culture by promoting industry best practice to their members; and preferably non-members alike. Businesses often have trust in their industry organisation (Engelhardt and Fresner 2001; Green Business Network 2001; Andrews, Stearneb et al. 2002). These organisations are not seen as threatening to the individual business managers and have established lines of communication. The Australian Cleaner Production Strategy reinforces the role of industry and professional associations by recommending that the "*Government must work in partnership with industry and professional associations to provide targeted Cleaner Production information and awareness packages'*" (Australian and New Zealand Environment and Conservation Council 1999, p26). This is currently being implemented through a program of 'Eco-Efficiency Agreements' with peak industry organisations (Environment Australia 2001a).

The strategy goes on to say ‘SMEs in particular suffer from a lack of resources and expertise to devote to investigating best environmental practice in their industry’ (Australian and New Zealand Environment and Conservation Council 1999). This strategy advocates benchmarking programs to assist in the aim of overcoming the lack of resources and expertise.

Within the business sub-network there is a limited role for consultants because of costs involved in employing them, but the potential remains to utilise consultants with their specialist knowledge within the business or knowledge sub-network to promote environmentally preferred technologies and practices in a more cost effective manner such as speaking at seminars and workshops.

To foster continuous improvement particular emphasis needs to be given to linkages with external sources of knowledge, including regulators (Vickers and Cordey 1999). A number of stakeholders should be involved in the knowledge sub-network to add variety, balance and rigour to capacity building activities. High profile Cleaner Production knowledge networks include the UNEP’s Cleaner Production Network and the establishment of Regional Cleaner Production Roundtables and the Regional Network of the WBCSD. Many of these Centres are co-locating with educational institutions to help create the appropriate corporate culture, show leadership and conduct high quality training programs, research and development. The knowledge network should also include private and public research centres, think tanks, NGOs and Natural Resource Management agencies.

The regulatory sub-network includes self-regulation and economic instruments and extends to liability considerations, because they can act as drivers for the development and diffusion of sustainable solutions. These mechanisms greatly expand the range of stakeholders involved in the innovative SME’s model. Local Government Agencies (LGA) are well placed to engage small-unregulated industry because of their close working relationship. Such channels of communication should be exploited. This working relationship includes minor planning approval and town planning. The LGA are also often the first point of complaint from residents regarding environmental incidents.

Figure 2-6 represents the innovative business model. This innovation model forms a network, which includes many stakeholders such as regulators, natural resource management agencies, community and the market in a board network of stakeholders (Altham and Gergin 1999).

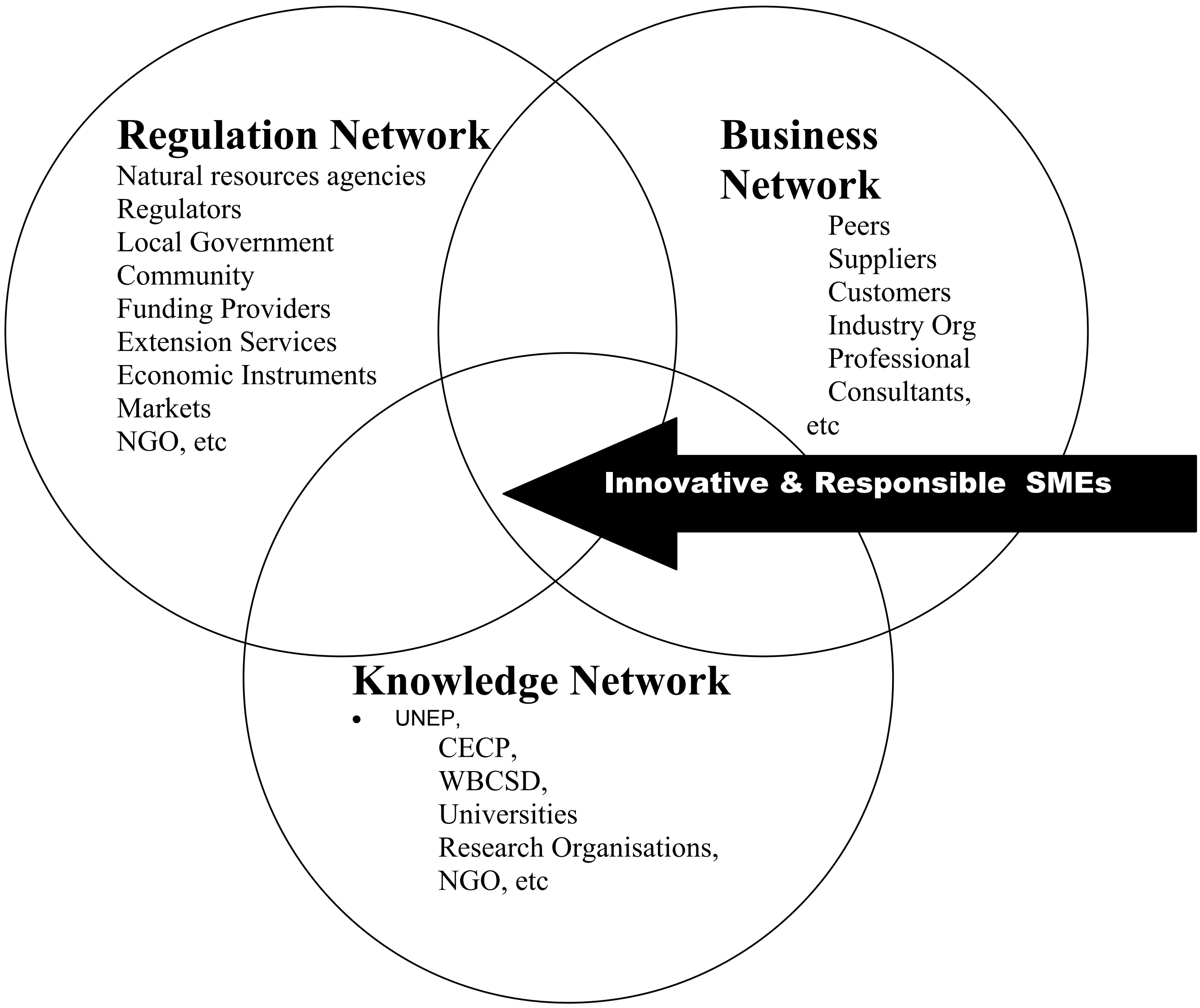


Figure 2-6: The innovative SME model

2.6.6.2 Sector Specificity

The literature covering networks is in support of sector specific programs (Ecotec 2000; Gerstenfeld and Roberts 2000; Hunt 2000; Green Business Network 2001). Sectoral benchmarking concentrates on specific resource use and waste generation for the sector concerned (European Commission 1997), which on the surface should offer greater benefits to participants and more direct assistance.

The downside of industry specific networks might be lower levels of participation, confidentiality concerns and the lack of contact and ability to learn from other sectors. They may incur greater establishment and operating costs because of the need to develop industry specific material as opposed to using generic material. However, this needs to be weighed against the cost and resources required in operating a multi-sector program, and the difficulties in identifying suitable personnel to facilitate such a program. Sector specific programs are well suited to promotion by industry organisations. Industry specific networks are also generally horizontally focused which at times prevents contact up and down the supply chain, thereby restricting 'thinking-outside-the-box' and locks into incremental change ('evolution not revolution'); but this can be overcome by involving a wide cross section of stakeholders. However, if the participants are prepared to share their experiences and have limited concern over losing competitiveness, sector specific programs appear to have the greatest potential for performance improvements.

There is also the issue of the programs only being made available to the industry organisation's members, which is highly likely to restrict the number of participants and prevent the participation of the poorest performing members of the industry, who are more than likely not industry organisation members. Furthermore the best performers are not always members of industry organisations.

2.6.6.3 Financing Capacity Building

There are mixed views on the role financial assistance plays in capacity building and environmental technology diffusion. The traditional view is that the provision of financial assistance increases the uptake of innovation, because it reduces the cost and pay-back period, and therefore financial risk, of introducing environmentally preferred technologies and practices. The conflicting view is that financial assistance has very little or no impact on implementation rates. The business' priority determines if Eco-Efficiency improves within a business. In this case the barriers are knowledge, experience and confidence, not money (Hennicke and Ramesohl 1998). It has been noted by a number of authors that it is difficult to encourage SME to take up free and highly subsidised opportunities of assistance to improve their Eco-Efficiency ,(Rowe and Hollingsworth 1996; Merritt 1998) and (Smith, Kemp et al. 2000), conclude many programs are underutilised. Furthermore, SME often consider the subsidy application procedure too bureaucratic, complex and uncertain to allocate their limited resources to the application process. However, subsidies can have a strong psychological effect by signalling the usefulness of the technology or method proposal (Hennicke and Ramesohl 1998). The report goes on to claim that the most effective method to assist small businesses improve their Eco-Efficiency is through well-resourced extension programs and funding of business networks and not through direct subsidies to assist in funding the implementation of environmental technology.

The conclusion that can be drawn from the literature is that the most effective method of providing financial incentive for Cleaner Production is through providing the correct market signals (allowing the market to work by creating stronger business cases). The preferred system is to drive the implementation of Cleaner Production technologies and practices through correct market signals, and allocate public funds to extension, training and demonstration activities to overcome information failures and to allow self-interest to drive implementation.

Under many of the current Cleaner Production models, members of the regulation sub-network are the major funding providers and provide an overarching framework for promoting industry best practice to foster the uptake of Cleaner Production. This at times creates a conflict of interest between environmental regulators, extension agencies and businesses, leading to reluctance on the part of many small businesses to become involved with these programs (Vickers 2000). This issue is increasingly being addressed with the shift to partnerships covering a number of and preferably all of the stakeholders required to promote innovation.

2.6.6.4 Program Length

Following the establishment of environmental programs for businesses, policy makers should expect a delay of at least three years (Rosenfeld 1996), 3-4 years (Enright and Ffowcs-Williams 2000), and up to 5 years (Hennicke and Ramesohl 1998) for any significant change in the business' Eco-Efficiency. With time the cost of delivering programs per participant fall as the programs start-up costs are spread and economic and environmental benefits snowball.

2.7 Benchmarking for Cleaner Production in Small Business

While small businesses face barriers to benchmarking and overall improvement in their Eco-Efficiency, many advocate benchmarking as a suitable tool if correctly implemented and supported by appropriate capacity building activities. These barriers are caused by the lack of external stimuli and lack of focus on Eco-Efficiency for SMEs (van Hemel 2001). This view is supported by reports from the Australian Industry Group and Green Business Network. Both recommend that industry sector specific benchmarks be published to encourage greater participation in Cleaner Production. Under today's price competitive environment, efficiency improvements are the quickest way to increase profitability (Schwartz 1999), and the role benchmarking can play in identifying economic benefits is constructive.

Organisations and authors that promote the role of benchmarking to trigger the improvement in the Eco-Efficiency of industry include the WBCSD, the UNEP and the World Resources Institute. For more discussion see (Environment Australia 1996a; UNEP & WBCSD 1996; Commission on Sustainable Development 1997; Ditz and Ranganathan 1997; van Berkel, Williams et al. 1997; WBCSD 1997; Piasecki, Fletcher et al. 1999; Thoresen 1999; Jasch 2000; NSWEPA 2000; Verfaillie and Bidwell 2000; Gerde and Logsdon 2001; Green Business Network 2001; Kotronarou and Iacovidou 2001).

Research into the barriers to and benefits of benchmarking for small businesses in Australia concluded that while there are many benefits to small businesses undertaking benchmarking, they may require initial support in order to effectively implement benchmarking as a continuous improvement program (Bergin 2000).

These observations complement the conclusion of Workshop 16 held at the 7th European Roundtable on Cleaner Production in May 2001, which identified benchmarking and regulation as the two triggers to most likely motivate SMEs to adopt Cleaner Production (Engelhardt and Fresner 2001). Furthermore, networking and industry organisation were considered the most likely entry-points, or promoters of Cleaner Production (ibid). Therefore the establishment of a program, which implements both initiatives, is deserving of further investigation.

2.8 Benchmarking and Sustainable Development

Sustainable Development is defined as:

'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' (World Commission on Environment and Development The 1987)

Cleaner Production and Eco-Efficiency are strategies to assist businesses to contribute to sustainable development. To achieve this aim improved Eco-Efficiency is essential (Moffatt, Hanley et al. 2001). This research does not claim that benchmarking will create sustainability, but that benchmarking has the potential to trigger Cleaner Production and Eco-Efficiency and thereby enable businesses to increase their contribution to sustainable development. However, this limitation of benchmarking needs to be acknowledged by researchers in the field to prevent overselling the concept. This research program is designed to improve the performance of any business regardless of their current level of performance, and is not targeted at the industry leaders. In acknowledgement of this, benchmarking is not promoted as the most effective improvement tool for industry leaders (Romm 1999; Longbottom 2000). This research program is designed to encourage the early adopters through to laggards,(the 90-99% of industry whose performance standard lags behind Best Practice), to improve their performance, initially through the implementation of good housekeeping practices. Industry leaders, when identified, should be encouraged to set challenging targets for themselves which become the new benchmarks, and to act as mentors to the industry and drag the rest of industry along and potentially create a leap-frog effect of performance improvements.

Figure 2-7 illustrates that the Eco-Efficiency goals should be achievable within the individual business, acknowledging their current skills and experience. Laggards should be encouraged to aim for industry average in a stepped process, starting with good housekeeping practices (Palmer and van der Vorst 1996; Wheelen and Hunger 1998) and minor technology modification. Once they achieve this level of performance, they should be encouraged to strive for best practices and more innovative solutions. Best practice performance should not be sought from the outset, as the targets may appear too difficult (Palmer and van der Vorst 1996; Wheelen and Hunger 1998).

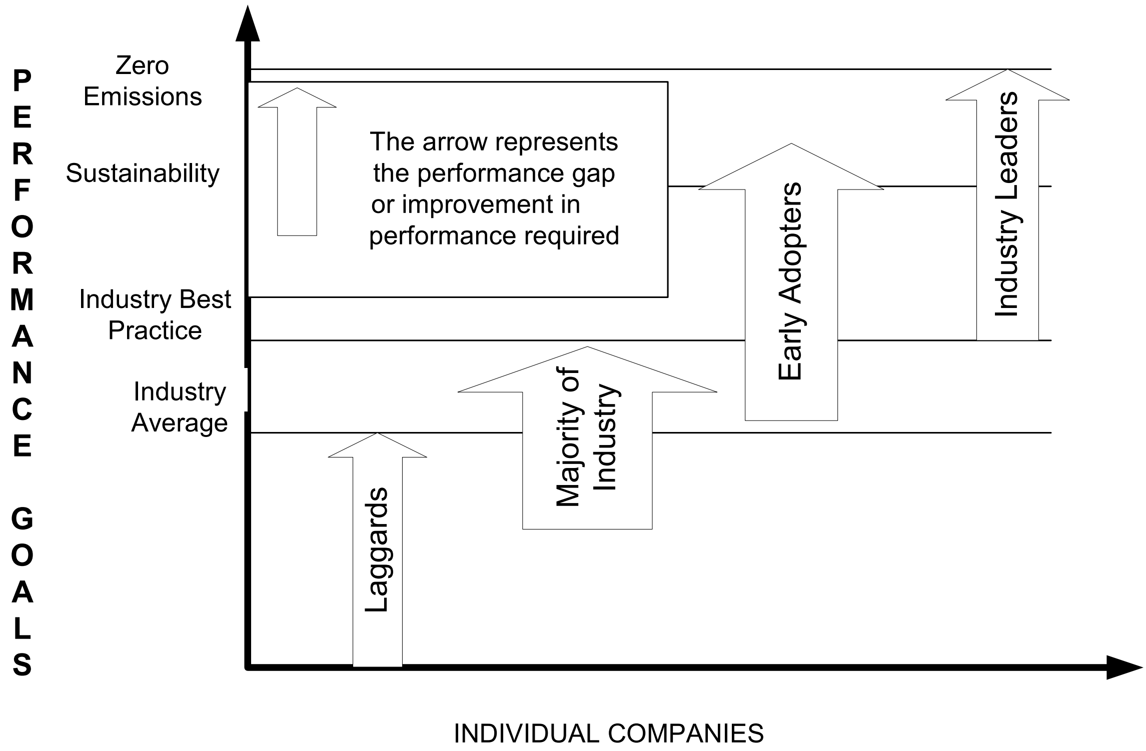


Figure 2-7: Linking benchmarking to sustainability with challenging but achievable targets

Benchmarking should be seen as a process which 'adds value' to existing EPE programs. Benchmarking can be a cost effective way to gain attention for Eco-Efficiency, create an external management focus, and gather innovative ideas, thereby increasing the number of Cleaner Production options identified as compared to a traditional approach to Cleaner Production. However unless Cleaner Production options are integrated into management and supported through well-resourced and dedicated action-plans its impact on actual performance will be less than desirable.

2.8.1 Efficiency and Effectiveness

Cleaner Production and Eco-Efficiency focus principally on efficiency, but the question of effectiveness needs to be addressed in the quest for sustainability. Eco-efficiency has been described as a strategy that aims for more with less, it has also be described as "*a strategy trying to be better by being less bad*" (McDonough and Braungart 2001, p145). Effectiveness, however, gives an indication on whether policies or practices will achieve the ultimate objective of sustainable development in the longer term. An admission of this point in the WBCSD definition of Eco-Efficiency acceptance is made that we need to operate within the earth's carrying capacity. Furthermore, the differences between efficiency and effectiveness are now being discussed in increasing depth. For example, a paper presented to the International Council on Metals and the Environment examined a number of Eco-Efficiency models and found that they had limitations as management strategies for renewable resources which were in danger of overexploitation, ie timber in this study[13] (Five Winds International 2001). The paper went on to claim that renewable resources are currently under the greatest strain (ibid). This discussion is further developed by (Hukkinen 2001; McDonough and Braungart 2001). Hawken et.al (1999). discuss 'what if efficiency isn't enough' in their book Natural Capitalism. This is in part caused by the links and confusion between 'renewable' and 'sustainable'. 'Sustainable' represents a management strategy whereas 'renewable' represents a class of natural resources.

2.8.1.1 Regulating for Eco-Efficiency

Traditionally, regulation has focused on practices and/or technologies. Regulation for efficiency has not been considered an effective method of influencing industry behaviour. Meanwhile benchmarking was slotted into the realm of self-assessment, self-regulation and business improvement programs. However, this is changing with the Dutch investigating the establishment of benchmarks as a component of their regulatory mechanisms (van den Akker 2000). Benchmarks can only become a

[13] Further examples that demonstrate the difference between effectiveness and efficiency include the issue of trading carbon permits and the non-inclusion of annex B countries in the Kyoto Protocol. The right to trade carbon permits may be the most efficient policy, i.e. incurring the least monetary cost to industry and the economy, to reduce GHG, however if 100 million tonnes CO_2 equivalent in permits is allocated, and the ecosystem only has the ability to assimilate 90 million tonnes CO_2 equivalent the policy will be ineffective in controlling global warming; although being the most efficient, ineffective method. A further example of this relationship relates to fishery management using tradeable quotas. While this may be the most efficient method of management if the catch allocated is above the sustainable harvest of the fishery, or if the policy is not policed, the natural resource management policy will be ineffective in maintaining fish stocks. Efficiency at times needs to be a secondary consideration after effectiveness.

credible component of environmental regulation with sound knowledge of the industry's Eco-Efficiency, and identification of industry best practice standards, as well as the ability for regulators to accurately check an individual's performance

2.9 Conclusion

The Literature Review supports the view that Cleaner Production is a mechanism well suited to small businesses, because of its practical approach and focus on economic and environmental benefits. Environmental Performance Evaluation, developed in its own right as a Cleaner Production tool, also has these attributes and should be considered as a pre-requisite for benchmarking, ie benchmarking should be seen as 'value adding' to EPE. Benchmarking itself is a continuous improvement tool or process while benchmarks are performance standards. Benchmarking data can be used to compare performance, set targets, track performance trends, and to assist in identifying areas for potential improvement programs. However, the success of benchmarking programs is not universal.

Key performance indicators if integrated with the business' decision-making and remuneration systems are not passive. They will change practices and technologies, and as such their selection needs to be done correctly. The indicators selected should reflect the stage of the business' environmental program and the level of environmental impacts, creating a balanced scorecard of indicators important to the business. As the company's environmental management program matures, there may be the opportunity to switch from activity-based indicators to performance-based indicators.

Important criteria for small business capacity building programs are that the programs need to be process focused, provide practical assistance, acknowledge the business manager's current levels of skills and knowledge, and the business' environmental impacts, while recognising the role short-term financial consideration plays in management decisions. With these points considered, the program needs to work continuously towards, and finally produce and implement, an action plan. An adapted EPE process implemented via a sector specific network appears to have good prospects of achieving success. Program designers must also realise that all initiatives have technical and cultural aspects and integrate these aspects into the program's design. Generically the three key requirements of a successful long-term project are: a systematic process, appropriate use of measurement and employee involvement – regardless of whether the project concerns the implementation of Cleaner Production, creating learning organisation or establishing benchmarking programs.

In order to change industry's environmental behaviour, capacity building programs need to gain and hold the business manager's attention, transfer the required skills and knowledge and initially not interfere in the day-to-day core operation, while integrating environmental management into the priority and culture of the organisation. Cleaner Production benchmarking and capacity building has the potential to achieve this. Benchmarking has the ability to gain attention, but not interfere with the day-to-day business operation, at a manageable cost to the business. If benchmarking is repeated regularly, this attention can be retained to allow appropriate capacity building activities to transfer the driver and tools to improve Eco-Efficiency. However, an appropriate capacity building program needs to be in place before management is triggered to adopt Cleaner Production. If this Cleaner Production capacity building program has not been put in place, authorities run the risk that business managers will turn their attention to another topic, and if support is not available they will be lost from Cleaner Production for a period of time.

There are three critical success factors for benchmarking:

- Identify performance gaps in issues important to long-term competitiveness
- Promote and cultivate the driver to improve performance, and

- Ensure business managers have the skills and tools to close the performance gap.

These CSFs and desired capacity building activities can be delivered within a network to create the critical mass conducive to innovation and improving performance. The network can foster innovation with the active participation of business, regulatory and knowledge stakeholders. The business stakeholders are well suited to identify the performance gaps, the regulatory stakeholders to provide the drivers to close the performance gap and the knowledge stakeholders to provide the tools to close the performance gap.

3 Program and Study Design

3.1 Introduction

The literature review hypothesised important design criteria for a Cleaner Production program based on capacity building and facilitated benchmarking for small businesses. Furthermore, demand driven programs were identified as critical for the wider adoption of the Cleaner Production strategy, and it was noted that the trigger for change often comes from outside the individual business. Finally, the required changes need to be integrated with current practices. This chapter translates these findings into the design of an applied Cleaner Production capacity building program that integrates the critical success factors for benchmarking. It also addresses small business's demands and barriers in Environmental Performance Evaluation, promotes basic environmental management accounting and seeks to incorporate mechanisms that encourage continuous improvement by instilling an innovative and learning focused business culture.

This chapter starts by discussing the intervention program that has been designed on the basis of this research's literature review and serves as the case study for the remainder of this research. Next the research framework is outlined, including the hypothesis, objectives and research questions. The detailed explanation of the study and program design follows. Finally this chapter focuses on the selection of a suitable industry sector and method of selecting and obtaining industry collaboration.

3.2 Study Design

3.2.1 Research Aim

The aim of this research is to assess whether benchmarking, in isolation and in combination with industry specific capacity building, leads to the greater uptake of Cleaner Production in small businesses and consequently improved results in Eco-Efficiency. Cleaner Production uptake is expected to enable participating businesses to continuously improve their plant level environmental and economic performance.

3.2.2 Research Questions

The research aim led to three research questions:

1. How can benchmarking be made operational for promoting Cleaner Production in small businesses generally and for the pilot industry sector specifically (developed and discussed in Chapter 4).

2. How can capacity building be made operational for promoting Cleaner Production in sectors of small business generally, for the pilot industry sector specifically (developed and discussed in Chapter 5).

3. What is the effectiveness of benchmarking and capacity building, in isolation and in combination, with regard to the uptake of Cleaner Production, on the basis of results in the pilot industry sector (presented and discussed in Chapter 6).

3.2.3 Hypothesis

The hypothesis was developed from the research aims and objectives and is used to set the direction for the objectives and research questions for this thesis. The hypothesis is:

> That the Cleaner Production uptake in the ‘Cleaner Production Club’ will be higher than the Cleaner Production uptake in the ‘Benchmarking Only’ group, which will in turn be higher than the Cleaner Production uptake in the ‘control’ group which operated in the absence of any of the program interventions (benchmarking and capacity building).

The hypothesis is tested quantitatively between the Cleaner Production Club and Benchmarking-only group, by means of an 18 months longitudinal study of Eco-Efficiency performance. For the control group, quantitative data are not available in comparable detail (due to not having monitored Eco-Efficiency performance over 18 months). Therefore a qualitative method, referred to as 'Cleaner Production Monitor', has been used to assess differences in uptake of Cleaner Production between all three groups.

3.2.4 Research Objectives

To address the research questions, three research objectives were set, these are.

1. To operationalise the benchmarking and capacity building (incorporating networking) into intervention programs suitable for the promotion of Cleaner Production to small businesses.

2. To conduct (in collaboration with the industry sector association and managed by the Centre of Excellence in Cleaner Production) the intervention program for a pilot industry sector, dominated by small businesses having significant environmental aspects and with comparatively little previous exposure to Cleaner Production.

3. To assess the effectiveness of the intervention program, (for benchmarking and capacity building, both in isolation and in combination), for the uptake of Cleaner Production as reflected in improvements in eco-efficiency of the participating businesses

3.2.4.1 Quantitative Test Variables

The quantitative test is based on a balanced scorecard, for reference purposes referred to as the (industry sector specific) Eco-Efficiency Scorecard. Strictly speaking the indicators are a combination of two types of performance indicators; managerial and operational indicators.

3.2.4.1.1 Environmental Management Performance Indicators

Management performance indicators measure the management effort of the organisation and evaluate the implementation of environmental policies and programs throughout the organisation. Environmental management performance indicators are often not normalised, ie not influenced by output, (for example the presence of an EMS), while other management performance indicators can be normalised, such as the level of training normalised per employee.

$$\text{Environmental Management Performance Indicator} = \frac{\text{Unit of Environmental Management Effort}}{\text{Unit of Production or Non-normalised}}$$

Equation 3-1: Management performance indicators

3.2.4.1.2 Environmental Operational Performance Indicators

Environmental operational performance indicators measure material and energy flow through the plant as well as emissions and waste generation, breaches of licences and spills etc. There are two board approaches to reporting environmental operational performance ie that promoted through ISO 14031, and that promoted through the WBCSD Eco-Efficiency program. The differences are as follow;

3.2.4.1.3 ISO Method

The ISO method was discussed at length in section 2.4.2.1, and uses the following method to calculate environmental operational performance indicators.

$$\text{Environmental Operational Performance Indicator} = \frac{\text{Unit of Environmental Impact}}{\text{Unit of Production}}$$

Equation 3-2: Operational performance indicators

3.2.4.1.4 WBCSD Method

The WBCSD method was discussed at length in section 2.4.2.2, and uses the following method to calculate Eco-Efficiency ratios or environmental operational performance indicators

$$\text{Eco-Efficiency} = \frac{\text{Value (as output or \$)}}{\text{Unit of Environmental Impact}}$$

Equation 3-3: Eco-Efficiency indicators

3.2.4.2 Qualitative Test Variables

The qualitative assessment of the influence of this research project was recorded on the 'Cleaner Production Monitor'. This monitor was applied to the drycleaning sector for two reasons, first as a reference group for a cross-sector comparative assessment (forming the non-drycleaners control), and secondly as a control group for this research (forming the drycleaners control). The qualitative test variable was an uptake score, which is the combination of three aggregated indicators (Cleaner Production: awareness, management and implementation) to estimate the level of uptake of Cleaner Production within monitor participants (see Text Box 3-1). Appendix two contains the complete survey form and the scoring method.

The survey instrument implemented in the Cleaner Production Monitor was designed to elicit one score for each of: awareness; management incentives; and implementation of cleaner production and eco-efficiency. To avoid response bias, the survey instrument was designed to minimise/maximise concurrent implementation by management in industry with awareness. A brief summary of the indicators/survey questions asked to calculate these scores is included here, the full survey is included in Appendix2.

Awareness: This score reflects the level of awareness and understanding of Cleaner Production and Eco-Efficiency by the organisation's owners/operators. It is based on recognition that Cleaner Production should be integrated into management programs, and that it is a preventive strategy that creates business opportunities in both short and longer term.

Management Incentives: This score indicates if management and information systems or their elements are in place to support cleaner production/eco-efficiency initiatives. Information was obtained on whether the business has an environmental management policy or plan, and if so requested a brief description of the policy or plan; who endorses it, if available to the public, and the level of management involved in devising, implementing and actioning the plan. The survey also investigated knowledge of the business's environmental costs, ie energy and water bills and waste disposal costs.

Implementation: This score indicates if the business has implemented management, organisational or technical innovation that has resulted in cleaner production/eco-efficiency outcomes. The interviewer requested information on the number of innovations implemented to improve operational efficiency and cut costs over the last three years that have led to reduced energy or water usage or a reduction in liquid effluent, solid waste or air emissions.

Uptake is the sum of the above three scores. Each component has a maximum score of 100, giving a total possible score of 300. (Howgrave-Graham and van Berkel 2001)

Text Box 3-1: Qualitative test variables

3.3 Intervention Program

On the basis of the findings of the literature review it is plausible to expect that Cleaner Production benchmarking and capacity building will improve the Eco-Efficiency of small businesses. However, because the vast majority of benchmarking research has been conducted in collaboration with large businesses, this research program needs to operationalise and simplify benchmarking and make it suitable for small businesses. An intervention program was therefore designed based on these two interventions, which were to be implemented individually and in conjunction. These are:

- Benchmarking: ie assisting businesses to monitor KPIs and providing them with an assessment of likely benefits (economic and environmental) from adopting Cleaner Production
- Capacity Building: ie strengthening the business manager's ability to implement systematic improvements, in particular Cleaner Production, through training and moderated networking as well as information exchange between business managers operating in the same sector.

The Centre of Excellence in Cleaner Production implemented the intervention programs in collaboration with an industry sector dominated by small businesses, and with prominent environmental impacts (drycleaning industry in Western Australia, see section 3.4). Having a research program with two interventions that can be implemented individually or collectively, leads to four possible combinations of interventions (as shown in Table 3-1).

	No Benchmarking	Benchmarking
Information dissemination	**Group I** (Drycleaners control)	**Group II** (Benchmarking Only)
Capacity building	**Group IV** (Capacity building only)	**Group III** (Cleaner Production Club)

Table 3-1: Overview of Cleaner Production intervention program

3.3.1 Group I: Drycleaners Control

Businesses in this group are not exposed to any of the two interventions. A sample of these was surveyed as part of the Cleaner Production Monitor to estimate the level of uptake of Cleaner Production within SME in Western Australia. This group of small businesses formed 'experimental group one' and will be further referred to as the 'drycleaners control' group. A second control group (non-drycleaners control) was formed from respondents in the Cleaner Production monitor from the non-drycleaning sectors.

3.3.2 Group II: Benchmarking-Only

This group was involved in the facilitated benchmarking program, and received printed material, but did not engage themselves in the group-based capacity building activities provided by the Centre of Excellence in Cleaner Production. This group of small businesses formed ‘experimental group two’ and will be referred to as the ‘Benchmarking Only’ group. This group was established through a self-selection process as these business managers were willing to participate in the benchmarking program but unwilling or unable to allocate time and resources to participate in the capacity building activities.

3.3.3 Group III: Cleaner Production Club

This group was involved in the facilitated benchmarking program, and in the capacity building activities provided by the Centre of Excellence in Cleaner Production. These capacity building activities were delivered through an industry specific network and included among other activities, a series of five training workshops and assistance in developing a business specific action plan. This group of small businesses formed ‘experimental group three’ and will be further referred to as the ‘CP Club’. This group was also established through self-selection as these business managers gave a priority to environmental management as demonstrated by their willingness to participate in the benchmarking program and their commitment to allocate time and resources to participate in the capacity building activities.

3.3.4 Group IV: Capacity Building Only

This group was not established, as it was impractical to implement in an industry sector with comparatively low numbers of businesses. It would imply moderated discussion and capacity building without disclosing industry specific benchmarking knowledge. The Centre of Excellence in Cleaner Production is conducting these types of capacity building programs with other sectors, and this type of capacity building intervention is similar to the majority of Cleaner Production programs implemented globally.

3.4 Program Design

The hypothesis is tested through monitoring of Eco-Efficiency following the development and implementation of an intervention program providing facilitated benchmarking and Cleaner Production capacity building, both individually and in combination. This is complimented by a survey to gauge the level of uptake of Cleaner Production as recorded on the Cleaner Production monitor. The design of these activities needed to address small business's barriers to Cleaner Production and benchmarking, while incorporating elements of a learning organisation to promote continuous improvement in Eco-Efficiency. Table 3-2 shows the program's inputs to each experimental group, based on the benchmarking framework. This framework is similar to, and loosely based on the Deming cycle of 'plan-do-check-act' and also implemented in Total Quality Environmental Management programs (Global Environmental Management Initiative 1994). The program's design needs to maximise the potential of satisfying the three CSF's for benchmarking and promote innovation and stretch targets. An estimation of its ability to achieve this is included in the last three columns, split between each of benchmarking's critical success factors. 'Gap' stands for the identification of any performance gaps. 'Drivers', indicates if the particular activity of the program creates or promotes the drivers to close the performance gap. 'Tools', indicates if the tools are provided to assist business managers close any performance gaps.

<table>
<tr><td rowspan="2">Stage of Benchmarking Exercise</td><td colspan="2" rowspan="2">Inputs provided to each group

<u>All participants</u></td><td colspan="6">Contributions to achieving Benchmarking's Critical Success Factors
(***Major, ** Moderate,
* Minor, - Nil)</td></tr>
<tr><td colspan="2">Gap</td><td colspan="2">Drivers</td><td colspan="2">Tools</td></tr>
<tr><td>Planning</td><td colspan="2">• Analysis of drycleaning sector, identification of environmental aspects and impacts, the selection of key Eco-Efficiency indicators and development of an industry specific Eco-Efficiency scorecard</td><td colspan="2">***</td><td colspan="2">-</td><td colspan="2">-</td></tr>
<tr><td>Collecting Data</td><td colspan="2">• Develop scorecards, gain industry participation and guide businesses in completing scorecards</td><td colspan="2">**</td><td colspan="2">*</td><td colspan="2">-</td></tr>
<tr><td>Analysis of Data</td><td colspan="2">• Develop size differentiated performance targets, deliver benchmarking and cost savings reports</td><td colspan="2">***</td><td colspan="2">***</td><td colspan="2">-</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td rowspan="2">Adapting and Improving</td><td rowspan="2"><u>Benchmarking Only</u>
Overview of general applicable Cleaner Production options for drycleaners.</td><td rowspan="2"><u>Cleaner Production Club</u>
Moderated network, including training in Cleaner Production principles and tools, and assistance to develop and implement business specific action plans.</td><td>BM</td><td>CPC</td><td>BM</td><td>CPC</td><td>BM</td><td>CPC</td></tr>
<tr><td>-</td><td>-</td><td>–</td><td>***</td><td>*</td><td>***</td></tr>
</table>

Table 3-2: Overview of program design

Note: no inputs are provided for the control group

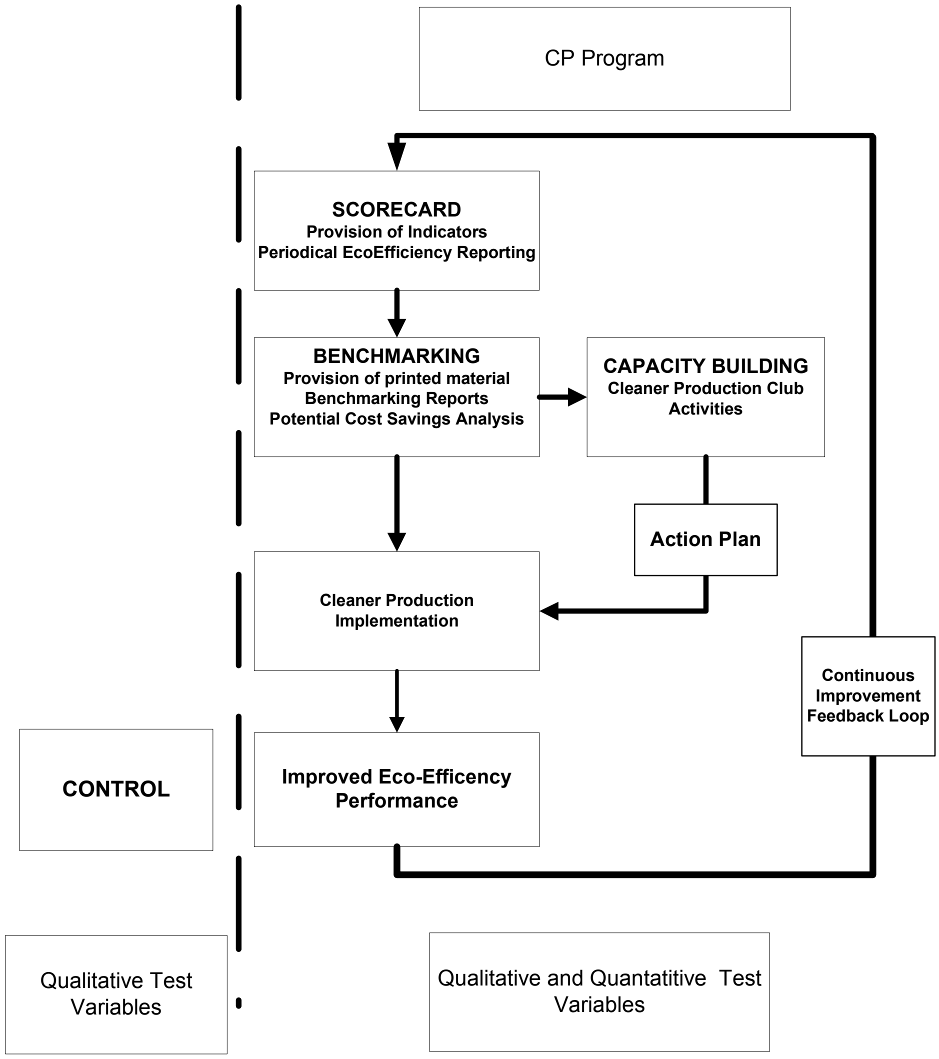


Figure 3-1: Program design flow diagram

3.5 Case Study

As industry sector selection for the case study has ramifications for the applicability of the findings to other industry sectors, the selection of the industry sector for the case study was critical for this research. To ensure a suitable industry sector was selected a number of criteria were developed and implemented. These are:

- Sector dominated by small businesses: to address small business issues with regard to environmental management and capacity building.

- Sector with highly comparable operations, technologies and practices: to ensure transferability of benchmarks and suitability of targets within the sector. This also increases confidence of participants in the relevance of the program to their needs.
- Sector with significant environmental aspects and impacts: To increase the participation rate and assist in meeting industry needs.
- Sector with limited Cleaner Production history: To ensure changes in performance were due to this intervention program and not lags from previous Cleaner Production capacity building activities. To aid in the generation of un-contaminated results.
- Industry sector association willing to participate: This is required to increase participation rate, allow the use of existing communication channels and ensure that intervention activities would be beneficial to industry.

Preliminary screening led to consideration of the motor traders, cabinetmakers, printers and the drycleaners as sectors that would broadly comply with the above criteria. After consultations with these industry sectors and their organisations it was discovered that the Motor Trades Association of WA was developing its own Cleaner Production program (http://www.mtawa.com.au/greenstamp.htm) so were therefore considered inappropriate for this intervention program. The cabinetmakers sector had a fragmented industry association whose members carry out a variety of work (including furniture-making, kitchens and bathrooms construction, both new and renovations). The elimination of these two sectors left the drycleaners and the printers as both suitable. The drycleaning sector was the first sector able to proceed.

3.5.1 The Drycleaning Operations

The drycleaning industry is a service industry for the convenient cleaning of clothes, manchester, leather goods, and other items made of fibres including household furnishings and drapes. Drycleaners typically use either synthetic halogenated or petroleum distillate organic solvents for cleaning purposes. The drycleaning industry is the sources of 94% of tetrachloroethylene emission in Australia, while over 95%[14] of drycleaning use this chemical. Tetrachloroethylene (commonly called perchlorethylene and referred to as perc in this thesis) ranked 16 on the National Pollutant Inventory (NPI) total hazard score, out of 208 categories covering the 400 substances considered for inclusion on the NPI reporting list (one equates to the highest hazard score) (National Pollutant Inventory 2003)

It is estimated that there are 2,200 drycleaning businesses currently operating in Australia with an estimated turnover of approximately $400 million per year (average gross turnover of $182,000 per operation [15]). Eighty percent of drycleaning businesses in Australia are independently owned, with the balanced franchised (Entrepreneur Business Centre 2003).

Small business market analysts consider the drycleaning industry as an industry with the potential for healthy profits, with growth over the last 15 years of fifty percent, and employment growth of five percent per year over that period. This trend is expected to continue for a number of reasons including, customer concern that supposedly washable garments cannot stand repeated washing at home, the increasing cost of fashionable clothes, and increasing number of time poor two income households. The important factors for profitability in the drycleaning industry are location and service. Quality of service refers to both satisfaction with the finished garment, and the ease of delivery and pick-up of garments. This is achieved through either long opening hours or an effective pick-up and drop-off service. Over 70% of garments are dropped off in the early morning and picked-up late afternoon either on the way to, or from work. This feature of the industry makes

[14] The remainder is white spirits.

[15] Within this research project, 53 % of the participating businesses had turnovers greater that $200,000, while 35% had turnover equal or less than the national average, with the average turnover for all participating business of $275,000. This result indicates that larger operators were involved in this project, but may reflect that operators in Western Australia are bigger than the national average. Western Australia has approximately 5% of the drycleaning businesses, for 10% of the national population.

location, parking and well trained staff critical to business success (Entrepreneur Business Centre 2003).

Dry cleaners process garments in a way that avoids saturating fabrics with water. Because dry cleaning solvents do not saturate the fibres of the fabric, the swelling and shrinking from water is avoided, allowing nearly all types of fabrics and garments to be dry-cleaned. (There is less wrinkling and shrinkage of fabrics because fibres are less distorted than by other cleaning methods.) Dry cleaning processes also enable the use of water to be all but eliminated.

Fabric or garment cleaning consists of three basic functions: cleaning, drying, and finishing. Garments are pre-treated for stains, and then machine cleaned in a solution of solvent and detergents. The solvent is extracted by first draining, and then spinning the clothes. Finally, the garments are dried through a combination of aeration, heat and tumbling before being examined for spots. When satisfied that the garments are clean, they are pressed. This final step of steam pressing has the side-effect of reducing to a minimum the solvent remaining in a garment at the end of the other processes. (Source (National Pollution Inventory 1999))

Text Box 3-2: The drycleaning operation

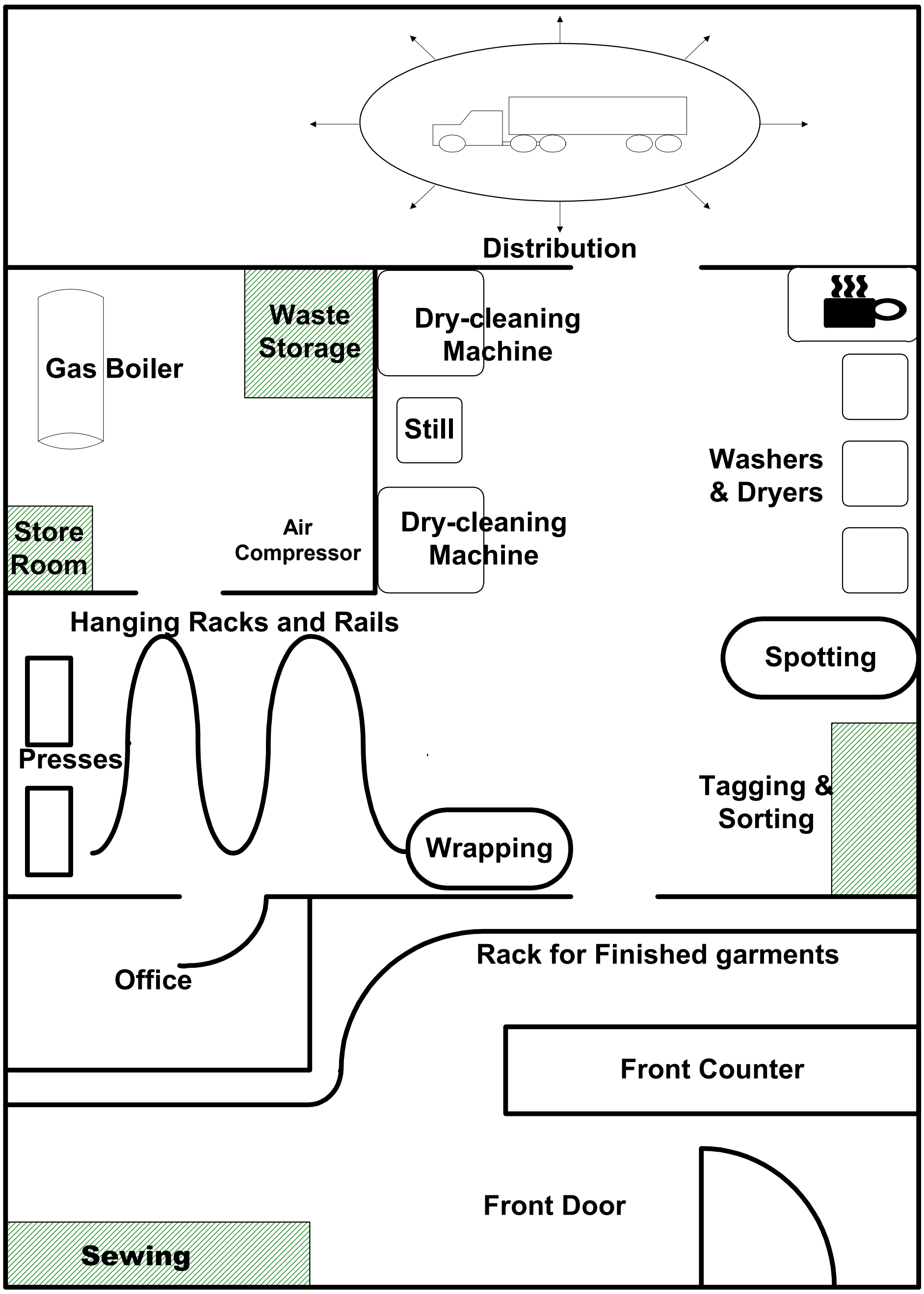


Figure 3-2: General site map of a drycleaning operation

The main areas of operation are the spotting table, drycleaning machine, presses, wrapping and front counter.

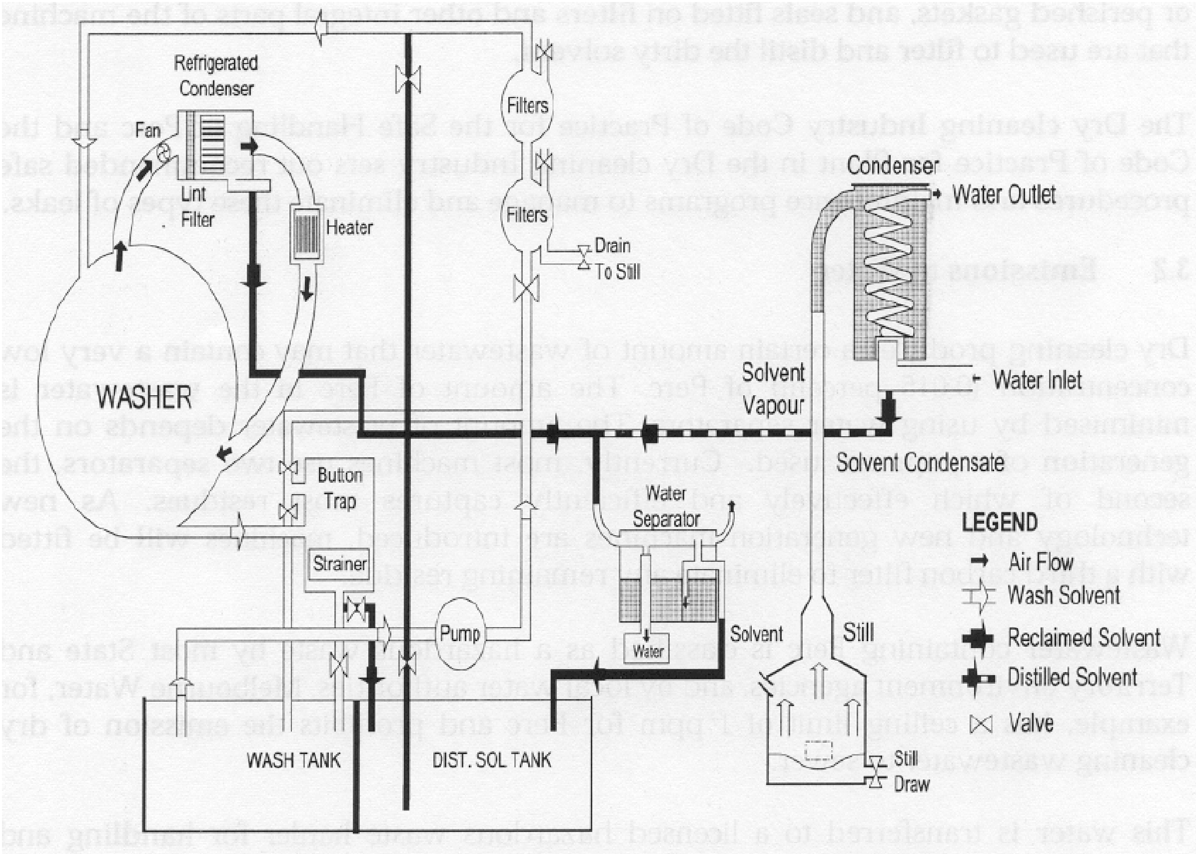


Figure 3-3: Flow Diagram of drycleaning machine

(National Pollution Inventory 1999)

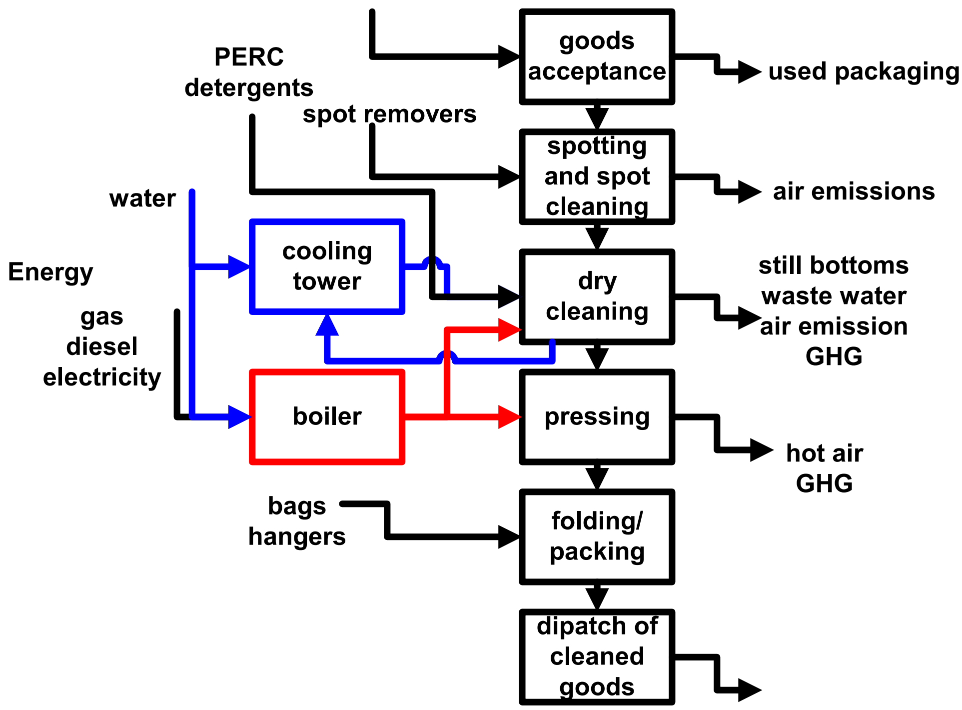


Figure 3-4: Flow chart of drycleaning operation

3.5.1.1 Alternative Drycleaning Technology

The drycleaning industry is actively investigating alternatives to the perc technology to clean garments. The most likely of these include wet cleaning, so-called ‘green solvents’, liquid CO_2 and ultra sound technology. These technologies have been investigated to different degrees and their feasibility estimated. While these methods have environmental merit, the capital cost of the equipment at present is prohibitive with the exception of wet-cleaning.

A number of businesses in WA have installed wet cleaning machines. A wet-cleaning machine operates in a similar manner to a traditional washing machine, except the cage rotates very slowly (30 rotations per minute) and dries the garments under controlled conditions to prevent shrinkage. While the process does not require the use of perc, the process uses additional energy and water, requires additional labour and the method is questionable with regards to the quality of cleaning and protection of the garment in some cases. The table below lists the benefits and challenges of wet-cleaning. The capital cost of a wet cleaning machine is between one third and half the cost of a similar capacity perc machine.

	Benefits of Wet Cleaning	Challenges of Wet Cleaning
Effects on Clothes	• No chemical smell • Whiter whites • Easier to remove water stains • Better cleaning performance for some items	• Some garments can shrink
Environmental Effects	• No hazardous chemical use • No hazardous waste generation • No air pollution • Reduced potential for water and soil contamination	• Increased water use • Increase energy use
Cost	• A larger portion of the cost of cleaning clothes is associated with workers' salaries rather than chemical production and hazardous waste disposal	• Cleaners may charge more for some items to cover the increased labour costs associated with pressing and finishing
Types of Clothes	• Cotton • Wool • Silk • Leather/suede • Wedding gowns • Highly decorated beads and sequins	• Some acetate linings • Antique satin • Gabardine • Some highly structured garments

Table 3-3: Wet cleaning technology

The Liquid Carbon Dioxide system uses high pressurised liquid carbon dioxide as a substitute for perc in a similar process, under sufficient pressure to liquefy the CO_2. However, the capital cost of the machine to maintain the pressure to liquefy the CO_2 based on American data is in the order of four to five times the cost of traditional perc machines, with operating cost similar to perc operations. There are also some safety issues with liquefied CO_2 machines due to the pressures required for operation.

Ultra-sound technology uses ultrasound waves to vibrate the dirt free from the fabric to allow it to be flushed away. This technology is still it its early development stage and limited information is available at this time.

3.5.2 Achieving Industry Collaboration

The WA Branch of the Drycleaning Institute of Australia (DIA WA) was very interested in collaborating for a number of reasons, principally 'duty of care' and 'a licence to operate'. Industry leaders were of the opinion that unless the drycleaning industry becomes more environmentally pro-active it would be under increasing environmental regulatory and community pressure. As a demonstration of this concern, the national body of the DIA obtained a grant from Environment Australia to develop a self-regulatory code of practice 'The Australian Drycleaning Industry Regulation Standard' (Drycleaning Institute of Australia 1999) which was released in late 1999.

Furthermore, tetrachloroethylene (commonly called perchlorethylene in Australia and referred to as perc in this thesis), was listed on the National Pollutant Inventory in 1999 (National Pollution Inventory 1999). General concerns are increasing over the chemical's (perc) effect on human health, soil and air emissions. Furthermore, commercial landlords are making it increasingly difficult for drycleaning operators to obtain leases in major shopping centres. The willingness of the industry to be involved in this project was maintained by a major toxic waste fire at the drycleaning industry's major waste contractor on 15/02/01 (Four Corners 2001). Advocates for improving the industry's Eco-Efficiency pushed the view 'that the capital value of your business is your superannuation' and therefore prudent risk management is required to protect your retirement life-style. In summary, as well as a general interest to reduce operating cost, the drycleaning industry had a number of major issues concerning occupational health and safety, noise, general legislation and disease control created by cooling towers (legionnaires disease).

3.5.3 Achieving the Business manager's Participation

As previously mentioned details of the intervention program were developed in collaboration with the Western Australian branch of the DIA. However, participation was not restricted to DIA members. Through a search of on-line business databases and telephone directories, approximately 80 business managers (operating approximately 125 businesses) in Western Australia were identified. A personally addressed introductory letter was sent to all. This outlined the program, the potential benefits of Cleaner Production for these businesses and the role of the Centre of Excellence in Cleaner Production. This letter was followed up three weeks later with a telephone call. At this time the business manager was asked if he/she had any questions on the proposed program, and invited to participate in the program. Many requested further material, which was sent. A second telephone contact was made a further four weeks later to again solicit participation in the program from those who expressed interest but had not followed through on their initial expression of interest.

The approach taken during these contacts was that this was an invitation to participate in an industry specific program that would use benchmarks to help identify areas of their operations with the greatest potential for economic benefits. The business managers, who wished to participate, expressed their willingness very early in the discussion. It appears that these business managers were almost looking for an opportunity to participate in an industry program. Most business managers, who desired more time and information to consider the invitation, did not commit to participation in the program.

Sixteen business managers with seventeen businesses agreed to participate in the initial phase of the program. This number was split between two experimental groups with seven in the CP Club and nine (covering ten businesses) in the ‘Benchmarking Only’ program. This equates in total to approximately 22 percent of the drycleaning operators in Western Australia.

3.6 Conclusion

This research was based on the hypothesis that businesses that participate in a facilitated benchmarking and Cleaner Production capacity building will outperform businesses that do not participate in any of those activities. A pilot program covering benchmarking and capacity building in conjunction and in isolation was implemented by the Centre of Excellence in Cleaner Production, and evaluated in detail for this research. The program's success was measured quantitatively on Eco-Efficiency performance and qualitatively with a Cleaner Production Monitor.

The drycleaning industry was specifically selected as the pilot industry sector, given the dominance of small businesses in this sector, its significant environmental aspects, and limited past exposure to Cleaner Production. The industry association played a critical role in promoting the Cleaner Production initiative to the sector, and obtaining business manager participation.

The next chapter outlines and explains the operations of the facilitated benchmarking program, while the Cleaner Production capacity building procedure is outlined in detail in Chapter five.

4 Benchmarking Methodology

4.1 Introduction

This chapter expands on how the facilitated benchmarking program was designed and conducted to assist the participating small businesses in identifying and implementing Cleaner Production. The chapter starts with the development of the Drycleaners' Eco-Efficiency Scorecard. This includes a discussion on KPIs for the sector, and how to measure and collect those indicators. Next is the explanation of the analytical protocol and procedures for data collection and processing. This includes the procedure for amending performance targets for economies of scale. This process is to ensure that performance targets are realistic for individual businesses. The feedback mechanism is then outlined.

4.2 Drycleaners' Eco-Efficiency Scorecard

To increase the likelihood of success in benchmarking, it is important that the indicators selected satisfy three criteria (Richards 1999) These are:

- Relevance: Ensuring that the business managers consider the indicators selected important to their future ie they would act on results reflecting poor performance compared to their peers.
- Practicability: Ensuring that the measurement and monitoring of the indicators is practical, reliable and within the resources available to the business.
- Appropriateness: Ensuring that the indicators reflect actual environmental impacts.

These factors are the initial considerations for benchmarking participants. Other issues for consideration by program facilitators and designers are the ability to standardise, normalise and aggregate data and finally the sensitivity of data to the business managers. Sensitivity of data, in part, relates to confidentiality concerns expressed by business managers not wanting to loose any competitive advantage they may possess, whether actual or perceived. Business managers also often have concerns about their data being accessed by external parties, particularly tax authorities and regulators. To further illustrate this point, a number of businesses gave (as their excuse for not participating in this program) concerns that environmental incidents could be reported to environmental regulators and that their financial or turnover data could be accessed by tax authorities. These concerns were addressed with mixed success.

4.2.1 Drycleaning Eco-Efficiency Scorecard

Benchmarking is more likely to lead to a general improvement in Eco-Efficiency if it involves a combination of KPIs covering leading and lagging indicators as well as management activities and operational performance.

Leading indicators measure a proxy for successful environmental management. Training for example is a leading indicator, as it is expected that additional training will enable improvements in performance. Likewise, energy audits are undertaken in the expectation of improved energy efficiency. Leading indicators are generally related to management activities. Operational indicators on the other hand are lagging because they report resource consumption, waste generation, emissions, and environmental risk management after they have occurred.

A balanced scorecard is important for two reasons. Firstly, to make the program comprehensive by covering a range of management activities and environmental aspects. Secondly, it can assist in identifying areas in which there are the greatest opportunities to improve Eco-Efficiency. The views that ‘what gets measured gets managed’ linked with ‘you are what you measure’ and ‘you imitate whom you benchmark against’ (Wehrmeyer 1995) all indicate that KPIs are not passive, but actively impact on decision-making by businesses in their choice of practices and technologies. For illustration of this point, if the majority of the indicators reported related to energy efficiency with no water consumption indicators selected, management efforts would gravitate to the improvement of energy efficiency at the expense of water efficiency and other, possibly more severe environmental impacts.

As outlined in the Literature Review (chapter two) and in the development of the Study and Program Design (chapter three) the indicators selected in this research are micro indicators. Business managers use these indicators to aid decision-making, to monitor performance and identify trends in performance to determine the success of the implementation of Cleaner Production.

The range of quantitative indicators selected was initially modelled on the four impact categories promoted in many Cleaner Production/Pollution Prevention training manuals and programs (Richards 1999; Centre of Excellence in Cleaner Production 2001; Environment Australia 2001a; GreenBiz 2001; Wuppertal Institute 2001). These are Materials, Energy, Water and Wastes. However, water was then left out as a KPI in the original scorecard because of an initial underestimation of the level of water consumed in the drycleaning industry and difficulties in measurement due to lack of individual business meters.

Inclusion of only these three impact categories would bias the scorecard to operational performance and lagging indicators without recognition for management activities or leading indicators. To correct this situation the level of education and training, the number of industry publications received, the reporting of environmental incidents and waste management practices were added to include leading indicators for the potential of the business to improve performance and catalyse learning for continuous improvement. The addition of these indicators produced a more comprehensive scorecard, because these are leading indicators relevant to small businesses that could be reliably and easily monitored. Moreover, it includes some indication of risk-assessment, because industry publication cover current issues of concern to the industry (both financial and environmental risk) and hence creates the potential to be proactive in relation to the future direction of the industry and changes to its operating environment, as well as to initiatives related to learning and maintaining an external focus.

4.2.2 Confidentiality Consideration

To help overcome resistance to information sharing, the researcher promoted the view that the pressure for the drycleaning industry to improve its Eco-Efficiency will not be internal to the industry (from direct competition within the industry through the sharing of performance data), but external to the industry (from regulators and the community). In addition, it is in the interest of the industry as a whole to proactively manage and reduce its environmental impacts, otherwise overall regulatory pressures on the industry will increase. As the 'licence to operate' for the better performers in the sector is influenced by the poor performance of the laggards in the sector it is in the interest of these industry leaders to improve the performance of laggards. This opinion was however not always accepted by the industry.

4.2.3 Micro indicators

In identifying suitable performance indicators, it is important to differentiate between measurements. These are the collection of raw data (such as meter readings, purchased quantities, etc), and indicators, which are at times calculated from a number of measures. All indicators aid decision-making. The next section lists the indicators, which emerged from the discussions between the researcher and the industry. First a background is given to the issue for the drycleaning industry. Next is a listing of the range of data collected and finally it is explained how this data was used to calculate the required indicators.

4.2.3.1 Output

Although apparently a straightforward indicator, production output can in reality be very difficult to measure accurately, for a number of reasons, not the least of which is the simple reluctance of business managers to provide this data. Moreover, often there is poor or no direct measurement of physical output recorded. In these cases financial output (sales) can act as a proxy, but, whilst being readily accepted, it is not a totally satisfactory measure. This research obtained average garment drycleaning prices ranging from $4.50 to $8.10, which in turn implies that sales can hide factor 2 differences in physical output. The production data collected in this program included: financial turnover, physical output (garments cleaned) and the number of employees (full time equivalent).

4.2.3.2 Education and training

All education and training activities were included as it was considered that there would be limited opportunity for the business managers or employees to be engaged in dedicated environmental training. Furthermore, any training activity would indicate a business willing to learn new practices and procedures, and seek this outside the business. This indicator is a leading management indicator reflecting the business' potential to improve its performance through better staff capacity and a willingness to adopt new practices. Education and training is reported in hours per employee per month and is considered a direct indicator of a learning organisation.

4.2.3.3 Industry Publications

Industry publications are a common method for business managers to keep up-to-date with the latest developments in their industry. While this indicator has some direct links with education and training it also assists in the acquisition of new knowledge and information. Although this knowledge may not be directly relevant to the business manager's current practices, it is important to maintain knowledge of the industry. This indicator is a leading management indicator as it reflects the business' potential to improve its performance through greater awareness of the latest practices and technologies within the industry. It is reported through the number of publications received by the business per month.

4.2.3.4 Incidents and spills

Two indicators were selected for management processes. The first one relates to environmental issues, with a report of the number of environmental incidents or spills that have occurred. The other relates to staff involvement in improving current practices through the lodgement of corrective action requests. Both are lagging management indicators reflecting the business' risk management skills and procedures of the organisation, which record an event after it has occurred. Both were reported in number per month.

4.2.3.5 Materials Consumption

A range of materials was considered as potential indicators for material consumption including perc (drycleaning solvent), spotting agents, plastic wrapping and coat hangers. After considering the importance of each to management, the reliability of data and discussion with the industry representatives only perc consumption and spotting agents were further considered as lagging indicators for operational Eco-Efficiency. The number of coat hangers used, or if coat hangers were recycled[16] together with the amount of plastic-wrap used was considered outside the ability of businesses to influence, until an acceptable substitute becomes available. Collecting this data would not add value to the program, while significantly increasing measuring and reporting requirements. Solvent (perc) consumption was measured in litres and converted to perc mileage, which represents the weight of clothes cleaned in kilograms per litre of solvent consumed.

[16] The DIA have introduced hanger caddies and encouraged the recycling of coat hangers by their members and their customers.

However, none of the participating drycleaners weigh garments before cleaning, but after discussion with participating business a decision was reached that the garments on average weighed approximately 0.5 Kg, and this value was used to convert number of garments to weight. The spotting agent indicator is calculated by dividing the physical output by the amount of spotting agent consumption. These two indicators are lagging operational indicators that reflect past Eco-Efficiency.

4.2.3.6 Energy

Energy is required in a number of forms for the drycleaning machines (including pumps and refrigeration units), lighting, operations of air compressors and water tower. Energy is required to operate the industrial boiler (fired by gas, diesel or electricity) to generate steam that is used in forming and finishing garments, and to provide heat for the drying and distillation processes within the drycleaning machine. When the program was developed it was anticipated that all businesses had gas-fired boilers. A number however, proved to have electric or diesel fired boilers. This is reflected in the final scorecard that requested data on electricity, gas and diesel consumption.

The data collected on the scorecards was used to calculate four energy indicators: energy costs in cents per garment cleaned; energy costs as a percentage of turnover, kWh of energy per garment cleaned[17], and kg of CO_2 equivalent GHG emitted per garment cleaned[18]. The last two indicators were not included in the benchmarking reports for two reasons. Firstly, the inclusion of four energy indicators would bias the scorecard towards energy efficiency. Secondly, reporting on kWh of energy would be duplicating the other two energy indicators and the greenhouse gas emissions are too abstract for business managers for meaningful integration into their decision-making. Also, variations in performance of these two indicators are to a large extent a reflection of the energy source (electricity, gas or diesel) and not the

[17] This was achieved by using generic industry data to convert units of energy consumed and converting to kWh and divide by number of garments cleaned.
[18] This was achieved by using generic industry data and converting energy consumption to kg of CO_2 emitted and dividing by the number of garments cleaned.

efficiency of its use. Furthermore, the major driver to change in energy use was most likely cost, which is reflected in one of the other energy indicators. However, the last two indicators (those not reported on the benchmarking reports) were useful in assessing the success of this program with respect to its influence on reducing the industry's environmental impacts. These four indicators (including the unreported indicators) are lagging operational indicators that report past Eco-Efficiency.

4.2.3.7 Water

Water is used to cool the solvent as it passes through the drycleaning machine in the cooling cycle to increase the solvent recovery from the air circulating within the drycleaning machine's cage and pipe-work (see figure 3.2). This water passes through a cooling tower to release heat before the water is returned to the drycleaning machine in a semi-closed loop to aid cooling for the recovery of perc. Some water is lost through evaporation in the cooling tower, and there is a need to replenish, bleed and flush the cooling system for effective operation and maintenance of the cooling tower. This indicator is a lagging operational indicator, reflecting past Eco-Efficiency.

4.2.3.8 Waste

Three measurements of waste generation are collected: the total costs of waste management services (including recycling); the cost of the waste recycling service; and the cost and quantity of hazardous waste services (perc and contact water containing perc[19]). These were used to calculate four indicators: the amount of waste perc generated per garment; the amount of waste perc generated in proportion to perc consumption (to reflect perc recovery rates); total waste costs per garment, and cost of waste going to recycling services as a percentage of the total cost of all waste management services. The first three are lagging operational indicators reflecting past

[19] Waste containing perc is regulated waste and has to be disposed off through a regulated waste management contractor. Waste containing perc includes the still bottoms (concentrated perc/oil/dirt mixture) and perc contact water (diluted perc in contact wastewater).

Eco-Efficiency. The waste management indicator reports management activities and could be classed as either a lagging indicator of current practices or a leading indicator of potential improvements in waste management practices.

4.2.4 Performance Indicators and Drycleaning Scorecard

The reliability of the measurements collected is analysed in Tables 4-1, 4-2 and 4-3. They include a further explanation of how indicators were calculated. The tables illustrate the problem of compounding errors in the calculation of performance indicators. Table 4-1 lists the measurements required for full participation in the program, with an estimate of the reliability of the data with a short explanation of the reasons for potential errors. Table 4-2 provides an overview of the indicators, including their formula, units and type. Table 4-3 estimates the total reliability of indicators. This total reliability score is used to aid the final selection of indicators. The reliability estimates are subjective estimates, which were arrived at following discussion with participants, experience and some guesswork.

Measurement Item	Reliability of data % (error margin: 100% – reliability %)	Comments on reasons for error
Survey time periods, except for Ed & Training Perc consumption Spotting agent consumption Waste Perc collection	100 85 (+/- 15%) 85 (+/- 15%) 75 (+/- 25%) 75 (+/- 25%)	In determining the time period to calculate consumption rates. If the measurement of the resource has a set accounting period, regular invoicing or parts of taxation procedure such as energy the survey period is accurate. However, for resources which are purchased as required such as perc, or waste is collected as requested, often with an overlap between survey periods, the reliability of the time period varies considerably
Number of full-time equivalent employees	90 (+/- 10%)	Flexible hours and changes to reflect workloads can make recording this measurement difficult
Number of garments cleaned	90 (+/- 10%)	No direct count and linked to accounting method such as invoices issued create a potential error
Percent of garments wet cleaned	80 (+/- 20%)	No direct counting but estimates, which can be accurate with experienced client
Turnover in $	100	Sound and accurate accounting practices
Hours of education and training	80 (+/- 20%)	Poor recording of activities and the length of training varies depending on the number of participants and their interaction
Number of industry publications	100	Easy to measure and small numbers
Corrective action requests completed	100	Easy to measure and small numbers
Number of environmental incidents	100	Easy to measure and small numbers
Perc consumption	90 (+/- 10%)	Poor recording of when chemical added to perc tanks and non-measurement of quantity (often pored or pumped from larger container). At times the perc consumption is only estimated from site glass.
Spot remover consumption	60 (+/- 40%)	Operators will have up to 15 different spot removers in use at any time, and the calculation of the amount consumed in a set period is very difficult
Electricity consumption	100	Calibrated meters, and regular invoicing
Gas consumption	100	Calibrated meters, and regular invoicing
Diesel consumption	100	Sound and accurate accounting practices, however often some stocks carried between periods
Water consumption	50 (+/- 50%)	Many businesses located in strata titled premises without individual meters. The majority of drycleaning operations also have a laundry operation attached without individual meters.
Total cost of waste management services	80 (+/- 20%)	In many cases waste costs comprise a component of council rates or body corporate fees and are not directly accountable (especially for the management and disposal of general rubbish and co-mingled recyclables)
Cost of recycling services	80 (+/- 20%)	As above
Perc waste generated	100	Sound and accurate accounting practices

Table 4-1: Data collected and estimated realiability

	Formula	Units	Type of Indicator				
			Economic Performance	Eco-Efficiency (ISO method)	Eco Efficiency (WBCSD method)	Leading/ lagging	Management/ operational
1. Financial Turnover	$ Turnover/Time	$ / month	#			Lag	Op
2. Physical Output	Number of garments cleaned/Time	Garments / month	#			Lag	Op
3. Education and Training	Hours of education and training/time/employees	Hour / employee / Month		#		Lead	Man
4. Publications	Number received/time	Number / Month		#		Lead	Man
5. Incidents and Spills	No. Incidents and Spills /Time period	Number / Month		#		Lag	Man
6. Corrective Action Requests	No. Corrective Action Requests / Time Period	Number/ Month		#		Lag	Man
7. Perc Mileage	Kg garments/litres perc consumed	Kg of garments cleaned per litre of perc consumed			#	Lag	Op
8. Spotting agent	No. Garment/litres agent consumed	Number of garments cleaned per litre of agent consumed			#	Lag	Op
9. Energy per Garment	Total energy costs/No. garments	Cents / garment		#		Lag	Op
10. Energy as % turnover	Total energy costs / Turnover	Ratio Percentage		#		Lag	Op
11. kWh energy per garment	Total kWh energy / No. garments	KWh / garment		#		Lag	Op
12. GHG per garment	Total Kg GHG / No. garments	Kg GHG / garment		#		Lag	Op
13. Water efficiency	No. garments /Kilolitres of water	No. garment/kilo litre			#	Lag	Op
14. $ waste per garment	Total cost of waste management services / No. garments	Cents / garment	#			Lag	Op
15. Garments cleaned per litre of waste perc	No. garment / litres waste perc	Garments/litre			#	Lag	Op
16. Perc waste to consumption ratio	Perc waste / perc consumption	Ratio in percentage		#		Lag	Op
17. Waste management practices	$ cost of recycling services / total waste management services	Ratio in percentage		#		Lead	Man

Table 4-2: Indicators description

Indicator	Reliability of Data Calculations (value from table 4.1)			Total reliability	Comments
	Measurement(s)		Time Period	%	
Education and training	90	80	85	61.2	Includes all education and training
Publications	100	-	100	100	
Environmental incidents	100	-	100	100	
Corrective action requests	100	-	100	100	Not included because no reported data over the length of program
Perc mileage	90	90	75	61	
Spotting agent	90	60	56	30	Not included because of low reliability of data and minor cost
Energy cost per garment	100	90	100	90	
Energy as % turnover	100	100	100	100	
KWh per garment	100	90	100	90	Neither of these indicators were reported because of concern of un-balancing the scorecard with a high energy weighting, with these being the most abstract energy indicators calculated
Kg GHG per garment	100	90	100	90	
Water per garment	50	90	100	45	Not included because of low reliability of data and minor cost
Waste perc per garment	90	100	75	68	
Waste perc to consumption	100	100	50	50	Not included because of lowest reliability of the four waste indicators
Waste costs per garment	90	80	75	54	
Waste management practices	80	80	90	58	

Table 4-3: Final indicators selection

Centre of Excellence in Cleaner Production

Drycleaner's Quarterly Best Practice Self Assessment Scorecard

Business Details: **(if time period not quarter please give details)**

Company ________________ Code ________ Survey Period ________to________

Production Data: Employee numbers__________ Full Time Equivalent

Number of garments processed;

Dry-cleaned ________ __day(s)___week(s)____month(s)

Percentage of garments wet-cleaned or washed: __________________%

Turnover $ ________ __day(s)___week(s)____month(s)

1. Education and Training

Has there been any educational or training activities carried out in the last quarter at this business? (Note; include all training and not only environmentally related)

No ❑ go to question 2 **Yes ❑**

⇩

Total hours of the following activities were participated in by owner(s) or employees of this business.

TAFE courses ________________ hours

Industry association workshop/seminar(s) ________________ hours

Other courses (i.e. government agencies etc) ________________ hours

Attended trade show(s) ________________ hours

Reading industry publication(s) ________________ hours

Number of industry publications received ________

Reading other publication(s) ________________ hours

Number of other publications received _________

2. Environmental Incidents

2a) Have any environmental incident(s) or spills occurred at this business in the last quarter?

No ❑ go to question 2b **Yes ❑** Number _________ and brief description:

____

____

2b) Has there been any Corrective Action Request form(s) submitted at this business in the last quarter? **No ❑ go to question 3** **Yes ❑ Number ___________**

3. Resource Use Data (please specify time period)

Perc consumption ________litre $________ per _____ week(s)____month(s)

Water consumption ________k/litre $________ per _____ week(s)____month(s)

Spot remover ________litre $________ per _____ week(s)____month(s)

Electricity ________kW $________ per _____ week(s)____month(s)

Gas/diesel (boiler) ________m^3 $________ per _____ week(s)____month(s)

4. Waste Generation, Recycling and Disposal Costs

What is the total cost of your waste (including recycling) management service?

$__________________ per _______week(s) _______month(s)

What is the total cost of your waste recycling service?

$__________________ per _______week(s) _______month(s)

Perc waste ___________litre $_________ per ______week(s)____month(s)

All data received will be treated with the strictest confidence.

Please return this Industry Best Practice Scorecard by post or fax it to; Jim Altham, Centre of Excellence in Cleaner Production, Curtin University, PO Box U1987, Perth, 6845, Western Australia. Fax Number 9266 4811

4.2.5 Indicator Selection

Table 4-4 includes the indicators included in the Benchmarking Report provided to participating businesses. The selection was made on the basis of developing a balanced scorecard, delivering acceptable levels of reliability of data as determined by tables 4-1, 4-2 and 4-3. Water efficiency is notable by its absence, despite additional effort being made to include it. However, its low reliably as shown in table 4-3 and the low level of inclusion on the returned scorecard made benchmarking and reporting unachievable. This table also informs again whether the individual indicators are environmental management indicators (EMI), environmental performance indicators (EPI) or eco-efficiency (EE) indicators.

	Leading	Lagging
Management	• Education and training (EMI) • Industry Publication (EMI)	• Environmental Incidents (EPI) •
Operational	• Waste management practices (EMI)	• Perc Mileage (EE) • Energy in cents per garment (EPI) • Energy as % of turnover (EPI) • Waste perc per garment (EPI) • Perc waste to consumption (EE) • Waste costs per garment (EE)

Table 4-4: Overview of the drycleaning Eco-Efficiency indicators

4.2.5.1 Scorecard

The required measurements were incorporated onto a scorecard, Figure 4-1 and this scorecard was pilot tested on a small number of drycleaners and adapted accordingly. A decision was made jointly by industry and the researcher to leave the full range of production, management activities and resource consumption measurements on the scorecard because they could generate useful information for the participants. In reality this was not the case and by the end of this research it was clear that little attention was being paid to several of the indicators calculated from the data (see section 6.5). The aim of the researcher was to restrict the scorecard to one-side of an A4 sheet and to include contact details on the page while maintaining a balance between the different types of KPI. Coloured paper was selected for the scoresheet to prevent it from getting lost on a cluttered desk.

4.3 Benchmarking

The benchmarking program was a facilitated, benchmarking program. The Centre of Excellence in Cleaner Production (CECP) (the third party) selected indicators, collected data, analysed the data, identified the performance gaps and developed and distributed benchmarking reports. Moreover, CECP selected benchmarking partners. Scorecards would be forwarded every six months, and data would be collected for the previous quarter or month, depending on the business manager’s business records, and converted to monthly results. The benchmarks were frozen after the first round of data to calculate if the performance of program participants had improved against the benchmarks, ie to determine if they had closed their performance gap to assist in judging the success of this program.

4.3.1 Data Collection Protocol

All scorecards were returned by fax or mail. An initial analysis was made of the raw data to get a feel for the information. The business managers with the best and poorest performance levels were contacted, to check the data for accuracy; and in the case of the better performers to identify industry best practices for including in the capacity building workshops (see chapter five); and to develop a Cleaner Production option checklist. The figures of the best performers had to be confirmed because their data was used to establish the performance standards for the other participants. Hence confidence was needed that these levels of performance were actually being achieved within the program. In subsequent rounds business managers whose performance varied markedly from previous rounds were contacted to verify data and possibly determine a reason for the variation (either positive or negative) if the data proved correct[20].

4.3.2 Analytical Protocol

The first stage of the analysis involved converting the reported data into monthly results and recording it onto a Drycleaning Eco-Efficiency Spreadsheet. This conversion was carried out using Microsoft Excel's spreadsheet program. The SPSS statistical package was used to estimate if there were any significant correlations between physical output and Eco-Efficiency to determine if economies of scale had a significant influence on performance.

4.3.2.1 Standardisation

The issue of standardisation was of major concern to this research. Even though the research was a facilitated benchmarking project, which allows full control over the indicators selected, the basic data collection was the full responsibility of the participants and as previously stated was accepted in good faith. An assumption was made that measurement methods were similar and the equipment required to measure data was available and accurate. All businesses were visited at least twice, the best and worst results double-checked, and individual business' performance trends examined over the period of their participation, and this assumption appears to hold true because of the similarities in their operations.

4.3.2.2 Normalisation

Normalisation of data also created some problems, due to the design of the scorecard requesting a number of output measures and businesses only

[20] Of the approximately 656 indicators calculated from the scorecard only eight were questionable.

supplying some of these measurements and accepting variations in time periods. Four measurements were used for the normalisation of indicators for production; financial turnover; number of garments cleaned; number of employees; and time period. The accuracy of normalisation using time period as a factor varies considerably between indicators. For example, with energy indicators, time periods could be very accurate because of the consistent timing of energy accounts. However, if this data is combined with uncertainty in the time period for the number of garments cleaned, or the time periods do not correspond, errors arise. For wastes it is more problematic, as pick-ups were arranged as required with the intervals being often irregular and greater than the survey period. Number of employees varies across the survey period and the conversion of part time to full time equivalents can be a source of error. Garment count was often complicated with a proportion of the garments being washed, hence the inclusion of a measure of the percentage of garments wet-cleaned in later rounds.

4.3.2.3 Aggregation

Different energy sources (gas/electricity/diesel) need consideration and these values were aggregated on kWh and kg of GHG using the conversion factors in Table 4-5.

Energy source	Unit	kWh	kg CO_2 equ/Unit
Electricity from Black Coal	1 kWh	1	1.114
Diesel	1 Litre	10.72	2.702
Natural Gas	1 kWh	1	0.196

Table 4-5: Energy conversion factors

(Australian Greenhouse Office 2003)

Further weighting and combining (summing) of indicators was achieved through the calculation of the area of the radar chart graph covered by the indicators using the percentage of the difference between the best and poorest performers as the interposed score. This reports the performance gaps as a single score. This calculation method is a more stringent calculation method than using straight percentages of industry best practice performance, but strongly indicates potential to improve. For example, assume an indicator ranges between 60 and 100, and this particular business scored 80. If the score included on the radar chart graph was calculated on straight scores as a percentage of the performance target, the business would receive a score of 80%. However, if the score is calculated as a percentage of the difference between the best and poorest performers, the score for this business would be 50% (the difference between the highest and lowest score is 40 and the particular business having a performance level of 20 above the lowest).

Selecting or changing the number of related indicators and its allocation to axes on the radar chart diagram in effect weights performance. The results of this research give an equal weighting, with two axes allocated to each of; energy consumption, chemical (perc) consumption, waste generation and learning categories and half these weightings (one axis) to risk management[21]. The single score results were not pushed to participants within the program because it was considered as potentially too abstract a concept and greatly influenced by the data accuracy and level of participation. Also keeping true to the theme of this research project, this indicator being an macro indicator, which would be of limited assistance in decision-making.

[21] If the number of axes representing energy consumption was increased to three and the number to waste reduced to one; energy consumption would be weighted at three time waste generation. In this way the weighting can be adjusted between the impact categories or indicators.

4.3.2.4 Identification of Performance Gaps

The identification of performance gaps was calculated on Excel spread sheet and reported on the table as part of the benchmarking report.

4.3.2.4.1 Economies of Scale

While normalisation is important to allow benchmarking between businesses, when comparing businesses with many-fold differences in physical output it may prove important to amend performance targets to allow for economies of scale. In the end business managers must be convinced that performance targets set are achievable. The first stage is to determine what is the primary cause of variations in Eco-Efficiency: ie is it physical output or other factors? A decision cannot be made on whether economies of scale are having a significant influence on Eco-Efficiency until after the cause of variations in performance has been investigated.

Economies of scale are caused by two factors. First the fixed cost – variable cost mix, and secondly through efficiency gains from using larger equipment. In relation to the first, a drycleaning operation will use a relatively fixed amount of resources just to open the shop before it cleans its first garment for the day. These resources will include electricity for lights and cash register operations, gas to fire the boiler and fuel for pick-up and delivery services, and as more garments are cleaned for the day, this cost per garment can be expected to fall. In relation to the second cause of economies of scale, for example a 18.5kg machine while 85% bigger than a 10 kg machine, uses only an additional 47% energy to operate a comparable cycle (Union Pty Ltd 2000). This means that even though individual businesses may have exactly the same equipment, economies of scale will result if the level of output varies.

4.3.2.4.1.1 Establishing if Economies of scale are present

To establish whether economies of scale did influence performance of individual businesses the data was analysed with the SPSS program. If the results show a significant correlation between a business's physical output (the independent variable) and the same business's Eco-Efficiency (the dependent variable), economies of scale are present in that indicator. It is important to note that this work assumes that the sample population accurately reflects the industry performance profile, and this assumption could not be statistically tested in this research project[22]. If the test indicates that economies of scale are present, the performance targets need to be amended to allow for differences in Eco-Efficiency caused by the size of output and those created by other factors. This process allows the calculation of realistic performance targets for the business concerned taking into consideration the size of its operations.

4.3.2.4.1.2 Amending Performance targets to Reflect Economies of Scale

The calculation of amended performance targets involves the following steps. After determining if economies of scale are present on SPSS or Excel:

1. Graph physical output against performance on a scatter plot.
2. Construct a number of trendlines together with their respective R^2 values and equations, in this research logarithmic, power, exponential and linear functions were used. The R^2 value[23] indicates the proportion of the variation in performance (the dependent variable), which is caused by variations in the level of physical output (the independent variable) and the variation caused by other management factors. This was achieved on SPSS.
3. Select the curve with the highest R^2 value and its corresponding equation. Visually determine that the curve is appropriate, with a reasonable degree of

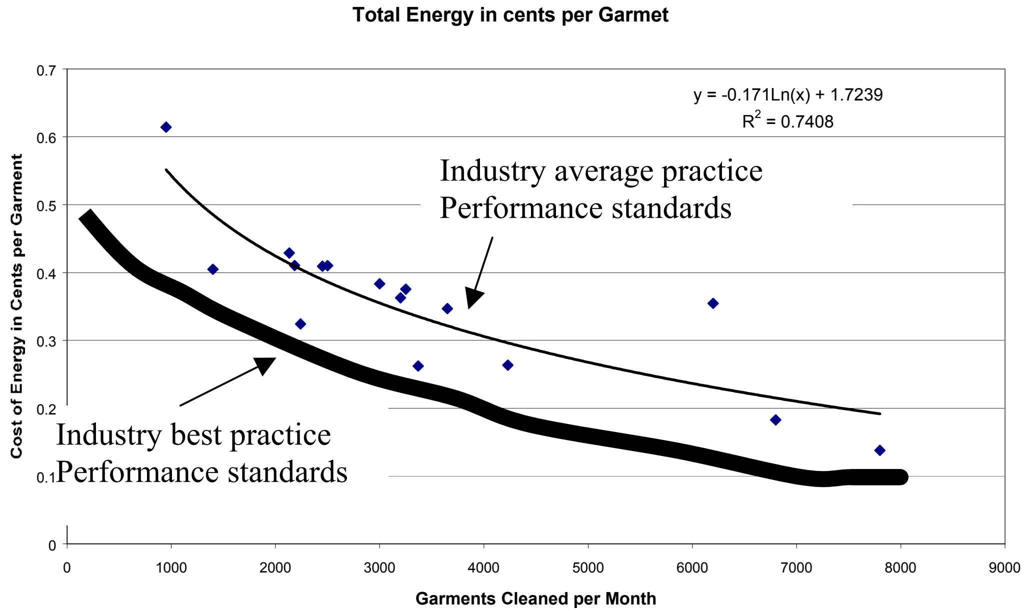
[22] Because of the self-selection process and the limited number of participants this assumption may not hold.
[23] Scores are between zero and one; with 0 being 0% and 1 being 100% of the variation

curve so it does not to cross the X or Y-axis in the region of the businesses performance[24].

4. From the selected equation, the level of performance, which fits this line for each business, is calculated. This is in reality calculating an industry average performance curve for each level of reported physical outputs.
5. This industry average performance is then subtracted from the actual level of performance for individual businesses, and the business with the greatest positive difference is selected as the industry best practice performer and this performance level is used to set industry best practice.
6. This gap is subtracted from each average performance to give specific size adjusted best practice performance target

A visual way to describe this process (see Graph 4-1) is to first compile a line which best represents average performance; each dot on the graph represents an individual business. Next, shift this line until it passes through the last point (best performance, ensuring whether a high or low score represents better performance), and in this case shift the line down. This process establishes the industry best practice performance curve and the target for individual businesses. To set performance targets draw a line up from the X axis at the size of business in question until striking the (new) industry best practice curve, then across to the Y axis to determine the level of performance which equates to industry best practice for that particular level of physical output. New targets are calculated mathematically by the method outlined above, the second method and the graph are to aid description only.

[24] If this was to occur the businesses would need to be split into to groups representing quartiles of physical output. However, this is only possible if the sample group is large enough.



Graph 4-1: Illustration of IBP performance for variations in physical output

4.3.3 Feedback Protocol

The benchmarking results were presented to the participants as a benchmarking report, which consisted of a table and radar chart graph, and a potential cost savings report covering energy and perc.

4.3.3.1 Benchmarking Report

The procedure to develop the benchmarking report was to calculate a master results table, and then to copy the individual results to a business specific benchmarking report. This report is provided in two parts; the first comprises a table and the second contains a radar chart diagram depicting the individual indicators.

4.3.3.2 Benchmarking Table

Table 4-6 is an example. This table lists the best, poorest and the average performance levels (unadjusted), and positions the particular business's performance level among those. It also calculates the percentage of the benchmark performance standard achieved. The next line lists a calculation used to calculate the area of the radar chart covered. The bottom section of the table is used to track the performance history of the individual business to allow managers to identify trends in their performance compared to their peers and to assist in identifying the success of this program to improve their Eco-Efficiency.

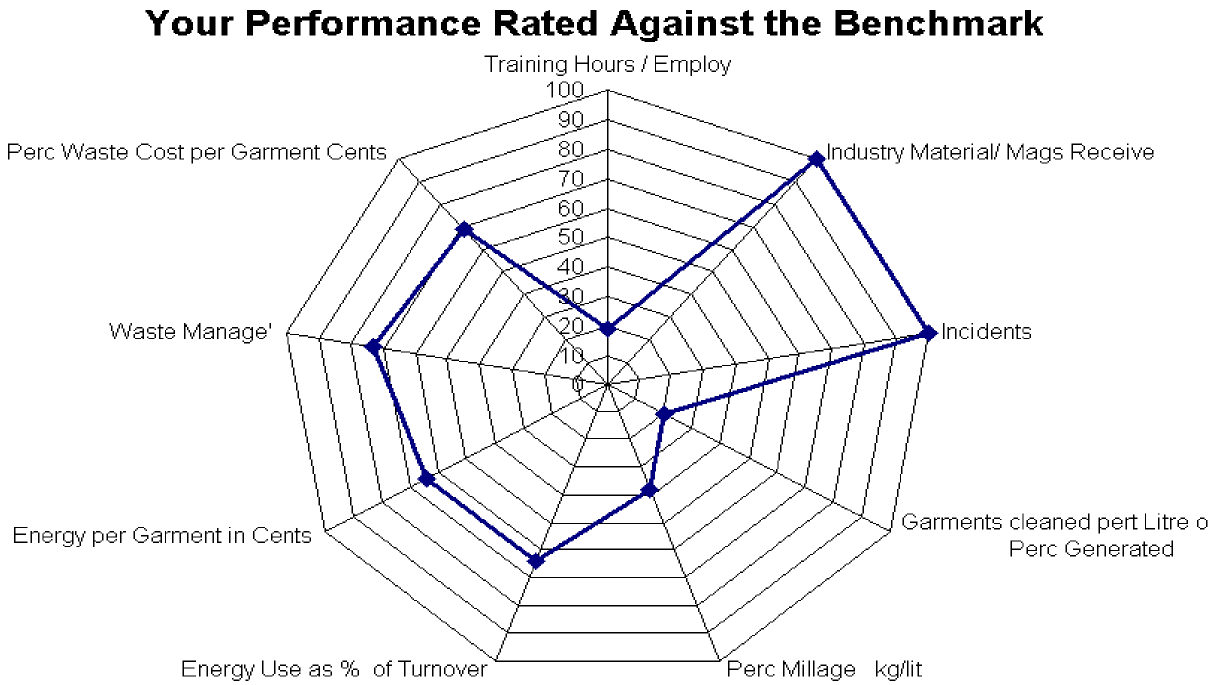
Summary Table (n=17)

	Garments Number Month	Training Hours / Employ	Industry Material/ Mags Receive	Incidents	Garments cleaned pert Litre of waste Perc Generated	Perc Millage kg/lit	Energy Use as % of Turnover	Energy per Garment in Cents	Waste Manage'	Perc Waste Cost per Garment Cents	Area of Web Covered (see below)
Best (Benchmark)	12000	12.7	5	0	583	79	3.5	23.91	100	0.34	
Poorest	579	0	0	1	23	22	12.3	91.54	22	11.40	
Average	3357	2.4	5	0.1	137	43.5	6.7	48	79	3.81	
ABC Drycleaners	**3357**	**2.4**	**5**	**0**	**137**	**44**	**6.7**	**48**	**79**	**3.8**	
% of Benchmark		**19**	**100**	**100**	**20**	**38**	**64**	**64**	**73**	**69**	**2.893**
% / 100		**0.189**	**1.000**	**1.000**	**0.203**	**0.379**	**0.636**	**0.644**	**0.731**	**0.687**	**1.036**
Rank (1 High)											
History (actual) To track how your performance changes over time											
Q2	**3357**	**2.4**	**5**	**0**	**137**	**43.5**	**6.7**	**48**	**79**	**3.8**	**36%**
Q1	3800	5	3	1	No Result	40	7	45	79	4.5	31%

Table 4-6: Summary table for benchmarking report

4.3.3.3 Radar Charts

The radar charts (see Graph 4-2 for an example) were created to integrate and weight the performance indicators calculated. This gives a graphical presentation of performance to assist business managers interpret their results. This graph illustrates how the business compares with its peers, and easily identifies the issues with the greatest potential for improvement. Nine indicators of the total of fourteen calculated, were included on the Benchmarking Report distributed to participants.



Graph 4-2: Spiral graph as included on benchmarking reports

The indicators were integrated and weighted to form an index by calculating the area of the radar chart graph covered. The area covered by the web is calculated automatically by request with the inclusion of the formula on the spreadsheet report. The base formula used to calculate the surface measure of overall performance (SMOP) is as follows

SMOP=[(P1*P2)+(P2*P3)+(P3*P4)+(P4*P5)+(P5*P6)+….+(Pn*P1)] *sin(360/n)/2, with P representing the individual scores. (Mosley and Mayer 1998)

Equation 4-1: Calculation of area covered by radar chart

4.3.3.4 Potential Economic benefits

The potential economic benefits report is calculated using the industry best practice performance standard, amended for economies of scale if these are at play. The potential economic benefits are also used to estimate the potential increase in net profit and saving over an annual and five year period. This conversion to savings as an increase in net profit, serves two purposes. Firstly it illustrates that economic benefits go straight to the bottom line. Secondly, there is a multiplier effect of cost saving (Hennicke and Ramesohl 1998), for example if net-profit is 15 percent of turnover, a two percent reduction in cost equates to a thirteen percent increase in net-profits. The calculation of the potential increase in net profit uses data collected on Australian businesses and reported through the Business Benchmarking Series collated by the Entrepreneur Business Centre in collaboration with the University of New England (Armidale), NSW (Entrepreneur Business Centre 2001). The data used to calculate results is collected from a large number of accountants who subscribe to, and receive information on a large number of business sectors. This organisation has collected data from the drycleaning industry for a number of years. These results concluded that the net profit for a drycleaning business with a turnover of less than $150,000 is 33.5% of turnover, while for businesses over $150,000 in turnover the net profit is 14.7% of turnover. For this research, it was considered that the use of only two categories may distort the results so an intermediate category was inserted, those businesses with a turnover of between $150,000 and $250,000 received a net profit of 24% of turnover (the average between 14.6 and 33.5). The major cause of the higher profits in the small businesses is lower wage cost, as the owner does the majority of the work.

Turnover	Estimated Profit %	Number of Participants in group
< $150,000	33.5	2
$150,000 - $250,000	24	7
> $250,000	14.6	8

Table 4-7: Net profit falls as turnover increases

It is extremely important to once again stress the speculative nature of the calculated potential profit increase. The enthusiasm of business managers involved and the notion that benchmarking is a process, at least on the surface, indicate that the estimated economic benefits were accepted as a realistic figure for the possible improvements in Eco-Efficiency.

4.4 Conclusion

This chapter presented and justified the benchmarking program, including the importance of a balanced scorecard, and to limit reporting to those indicators that are likely to influence management decisions. As part of a balanced scorecard both leading and lagging indicators were monitored through management and performance indicators covering the four major environmental impact categories, ie energy, water, materials and waste generation including emissions. A novel approach was developed and successfully applied for calculating size adjusted performance targets. This process, while of limited concern for the larger organisation that are generally reported for their involvement in benchmarking is critical to small businesses. Moreover, the issue of combining and weighting indicators to obtain a single score of performance was addressed by using radar chart diagrams, and calculating the area covered. The selection of performance data and the calculation of indicators highlighted the problem of compounding errors in reporting performance standards. To a large extent these errors need to be accepted to make the program work. However, every effort must be made to minimise these errors, in the expectation that these errors can be reduced over time. The next chapter outlines the Cleaner Production capacity building activities implemented in this intervention program.

5 Capacity Building

5.1 Introduction

This chapter explains the capacity building activities developed and provided as part of the intervention program to enable greater uptake of Cleaner Production. In line with the focus of this thesis on three critical success factors for benchmarking, the capacity building activities built on two of these: cultivating the drivers and providing the tools for closing the performance gap. The facilitated benchmarking program (covered in chapter four) assisted in identifying and quantifying the performance gaps. The capacity building activities are detailed and explained here, covering how they fill the gap in the business competencies identified.

Cleaner Production is either driven by suppliers of Cleaner Production services, or by the demand for such services from companies, with the possibility for an overlap. Currently, Cleaner Production is generally promoted from the supply-side (UNEP 2002; Clean Production Action n.d.), and this strategy is having a less-than desirable impact on environmental behaviour and performance of small business (Evans and Stevenson 2001). Recent efforts have shifted to initiate the introduction of Cleaner Production from the demand-side (UNEP 2002). Demand side drivers for Cleaner Production include greater awareness, better environmental management accounting, in particular, the internalisation of externalities and the removal of disclosed or hidden subsidies, and green procurement practices (by government and industry).

In creating the desire and active demand for change, access to information is only one condition for changing behaviour (Veleva, Bailey et al. 2001). While benchmarking promotes the transfer of information, such access to information does not necessarily change behaviour (Gerstenfeld and Roberts 2000). Information provision can lead to greater awareness if the information is perceived to be relevant, reliable and from a credible source. Greater awareness can result in the intent to change behaviour, with the actual behavioural change only occurring if it becomes the person(s) having the incentive (driver) and the ability (tools) to change behaviour perceives a gain in net benefit from doing so. Information provision is thus an important first step, although it is also necessary to build the capacity of managers and other staff to act on their awareness (current or created) and therefore enable environmental and business performance improvements. The triggers for the introduction of Cleaner Production (and many other improvement programs) are often generated outside the business, within its networks (both formal and informal) of stakeholders (Hennicke and Ramesohl 1998). Capacity building activities are therefore ideally aligned with creating a culture of the drivers and shapers for changing behaviour,\ within a comprehensive framework (Diebacker 2000). This can create a 'window of opportunity' for successful capacity building. Benchmarks (as discussed in chapter 4) aim to create such a window of opportunity and capacity building aims to enact the tools and drivers.

5.2 Capacity Building Interventions

The capacity building intervention was provided in the form of an industry specific network. The literature review investigated the requirement of a practical capacity building program for small businesses and identified the gaps between current business competencies and those required for successful Cleaner Production uptake in small businesses. These were the:

- inability to recognise environmental aspects of their own operation and products
- lack of skills, tools, information and experience, particularly among small firms
- limited opportunities to network
- resistance to cultural change on the part of management
- competing business priorities, especially the pressure for short term income

- perceived high cost of new, cleaner technology.

5.2.1 Twin capacity building interventions

Two interventions were developed and implemented in this research project. Individual business managers were allocated into these groups depending on the level of resources individual managers were willing and able to commit to improving their Eco-Efficiency. In this way experimental groups and their intervention(s) were self-selecting. Once an business manager participates in the capacity building program it is not expected they will need to repeat the process in the shorter term, but in the longer term refresher activities could be required.

The following section is a summary of the capacity building interventions implemented in the case study for this thesis. Table 5.1 summarises the intervention programs while the activities are further explained in the following section.

Capacity Building Elements	Group provided to		Potential Contribution to achieving CSF * low, to ***** high	
	BM only	CP Club	Drivers	Tools
Provision of printed material	*	*	**	*
Provision of checklist	*	*	**	*
Site visits by experts		*	***	**
How to workshops		*	*	*****
Self-assessment worksheets		*	*	**
Assistance in developing Cleaner Production action plan		*	***	*****
Selection of improvement targets	*	*	****	**
Certificate to recognise achievement		*	****	**

Table 5-1: Capacity building activities

The printed material and the Cleaner Production options checklist and Benchmarking reports were distributed to all participating businesses. The remainder of the capacity building inputs and resources were restricted to the CP Club. The Benchmarking Only group thus only received information and was not assisted in customising the information to aid the business implement it.

5.2.2 Cleaner Production Network/Club

The core capacity building activities of the program were delivered in the form of an industry specific network providing the opportunity and encouraging business managers to learn from their peers. In this process the role of the DIA (WA) and its management committee was important.

5.2.3 Printed material

As an aid to the establishment of this program a number of articles were identified as having potential benefit to participants. The Centre and the researcher did not have the knowledge or resources to produce their own printed material with the exception of the Cleaner Production option checklist. The researcher (and supervisor) published an article in the industry magazine during the program. Case studies were added as developed and added to the CECP's website. This material was also linked from the Centre's website (http://cleanerproduction.curtin.edu.au/industry/drycleaners.html).

- Cost Effective Solvent Management (Environmental Technology Best Practice Program 1996a)
- Solvent Consumption in Dry-Cleaning (Environmental Technology Best Practice Program 1997)
- Case Study: Wetcleaning Systems for Garment Care (USEPA 1999)

- Drycleaning Regulations in Western Australia (Anon. 2000a)
- Energy benchmarking (Energy Efficiency Best Practice Program 2000)
- Profile of the Dry Cleaning Industry-USEPA Sector Notebooks (USEPA 1995)
- Solvent and ultrasonic alternatives to perchloroethylene drycleaning of textiles (McCall, Patel et al. 1998)

5.2.4 Checklist

As previously mentioned, business managers with the best performance standards were contacted to learn about their operating practices as compared to their peers. This process, the search of industry best practice case studies and site visits allowed further development for a Cleaner Production Option Checklist. This checklist (Appendix one) was distributed to all participants, with a request for feedback. The feedback was incorporated into the final version of the checklist and was utilised as appropriate in the remainder of the program.

While a number of the options included are not strictly Cleaner Production, these were included as measures required by the industry to improve performance, manage risk and for compliance with regulation. These options are a component of the Drycleaning Industry Regulatory Standard, a voluntary industry standard developed and implemented by the Drycleaning Industry Association of Australia, with funding support by Environment Australia. The aim of the standard is to improve the environmental performance of the industry and is included to integrate industry practices with this program to increase industry participation.

5.2.5 Site visits

A number of site visits were made to the Cleaner Production Club participants with the aim of:

- familiarising the researchers with the operation of the drycleaning industry
- demonstrating the Centre's commitment to the industry and this program
- maintaining participation of participants
- verifying Cleaner Production options checklist
- assisting in the development of a business specific action plan.

5.2.6 Workshop Program

The training program comprised five workshops held at the University's campus. These were scheduled to occur late afternoon mid week. Arranging a suitable time to conduct workshops for business managers appeared to be difficult because of uncertain business commitments. The level of attendance varied considerably across the workshops, and the timing of a workshop was a predicament for all organisations involved in small businesses training.

The training material provided included a workbook (Centre of Excellence in Cleaner Production 2001) containing the material covered in each of the workshops. The workbook provided a generic, non-sector specific framework for the development and implementation of Cleaner Production in small businesses. In the delivery of the drycleaners program, sector specific content was added. The workshop program starts with an introduction to Cleaner Production, before instruction in the process of developing material balances and cause identification in the second workshop. The third and fourth workshops investigate materials and waste, and water and energy respectively, as specific areas for generating Cleaner Production options. The final workshop dealt with Cleaner Production implementation and evaluation of Cleaner Production options. Discussions were also held during the workshops to encourage business managers to raise their own issues and concerns and to discuss their personal practices and experiences. At times this discussion became very informative and many ideas were generated and 'bounced' off each other while on other occasions there was little interaction.. Figure 5-1 outlines the workshops, modules, and assistance provided to individual businesses and the outcomes expected from the program. Table 5-2 indicates the topics covered in each workshop in greater detail.

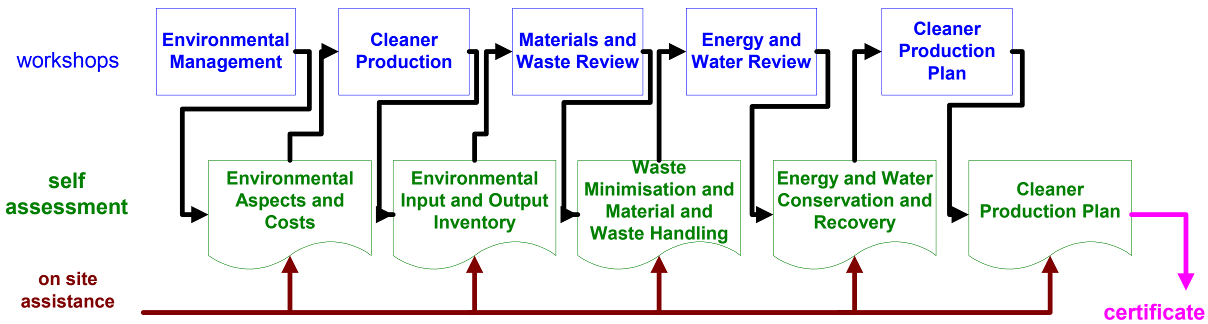


Figure 5-1: Structure of workshops

Module	**Content**
Module 1	• Overview of Cleaner Production planning process • Summary of key environmental regulatory requirements • Principles and tools for environmental cost accounting (total cost accounting for waste streams) • Examples of environmental aspects, risks and costs

Module 2	• Operational definition for Cleaner Production and generic prevention practices
	• Cleaner Production option generation model, consisting of:
	  ○ Source inventory
	  ○ Cause diagnosis
	  ○ Option generation
	• Material and energy input/output inventory

Module 3	• Application of material balances for assessment of production processes, products and services • General Cleaner Production options for reducing consumption of materials and minimising waste • Waste management logistics; safe handling of solid, liquid and hazardous waste
Module 4	• Application of energy and water analysis for assessment of production processes and utility systems • General Cleaner Production Options for reducing the consumption of water and energy, and for recovery and reuse of energy and water
Module 5	• Feasibility analysis of Cleaner Production options • Planning for implementation of Cleaner Production options • Incorporating Cleaner Production into day-to-day operations/environmental management systems

Table 5-2: Content of Cleaner Production training program

5.2.6.1 Self-assessment Worksheets

As part of the workshops, business managers were requested to complete a set of worksheets that were intended to be returned to the researcher, and to assist in the development of the action plans. The level of completion of worksheets was poor and indicated that while the material presented at the workshops was applicable, the required data to complete the worksheets was not routinely collected by small businesses, which meant that worksheets could not be completed accurately, or that the level of work required to complete worksheets was too time consuming for most participants. To improve this situation the business managers required improved instruction and greater motivation to complete this work, to ensure the required data was readily available. In total there were 31 worksheets covering 51 pages. This experience has resulted in changes to the training material to better reflect the knowledge and information demands of the participants and also to a reduction in the number of worksheets included in recent Cleaner Production training programs.

Module	Worksheets
Module 1	Worksheet 1: Environmental aspects and impacts • Company Description • Company Site Map • Identification of Environmental aspects and impacts Worksheet 2: Regulatory Requirements Worksheet 3: Waste Costs • Direct External Costs • Direct Internal Costs • Indirect External Costs • Indirect Internal Costs
Module 2	Worksheet 4: Process Flow Chart Worksheet 5: Environmental Input Inventory Worksheet 6; Environmental Output Inventory
Module 3	Worksheet 7: Material Balance • Inputs • Outputs • Losses Worksheet 8: Generating and Screening Cleaner Production options • Generating Cleaner Production options • Screening Cleaner Production options Worksheet 9: Optimising Waste Management • Storage of Wastes; description • Storage of Wastes; method • Storage of Wastes; alternatives
Module 4	Worksheet 10: Energy and Water Analysis • Water flow diagram • Water analysis • Energy flow diagram • Energy analysis Worksheet 11: Generating Cleaner Production options • Generating Cleaner Production options • Screening Cleaner Production options Worksheet 12: Optimising Energy and water Management
Module 5	Worksheet 13: Evaluating Cleaner Production Options • Technical Evaluation • Financial Viability • Environmental Evaluation Worksheet 14: Preparing and Implementing an Action Plan Worksheet 15: Integrating Cleaner Production into Management Systems

Table 5-3: List of worksheets

5.2.7 Cleaner Production Action Plan Development

Club members used the workshops, worksheets and benchmarking reports to assist in the development of their Cleaner Production Action Plans (with assistance from the researcher). These focused on areas identified by the benchmarks as having the greatest potential for improvements and economic benefits. These action plans included general information on the business, baseline Eco-Efficiency performance, its Cleaner Production project(s), staff member(s) responsible for the project, estimated time to implement projects and the expected financial and environmental benefits of the projects. Projects are divided into, on-going, short, medium or longer-term projects to aid business planning. Figure 5-2 and 5-3 are examples of the Cleaner Production action plans required and submitted before Cleaner Production Certificates were presented.

The targets incorporated into the action plans, were established as the business size adjusted benchmarks (if economies of scale were present) with 50% of the improvement allocated to the first six months following the completion of the Action Plan and the second 50% in the following 12 months. This was done as it was anticipated that the first 50% of Eco-Efficiency improvements would be the easiest to achieve. All drycleaners were revisited to finalise and sign-off on their Cleaner Production Action Plans. Following this, Cleaner Production Certificates were presented for display in their workshops, to assist businesses' demonstrate their commitment to environmental excellence to their customers and staff. The presentation was held at an industry function where their peers and staff members were in attendance

Cleaner Production Action Plan: ABC Drycleaners

Our Company

ABC Drycleaners operates a drycleaning and laundry operation in Perth Central Business District. We employ eight staff and dryclean approximately 6,000 garments each week. The main areas of operation are the spotting table, drycleaning machine, presses, wrapping and front counter. We operate two perc drycleaning machines and six presses. We operate an extensive delivery service and service a number of major commercial clients in the Perth Central Business District.

Our Plan:

Our plan has been developed as a result of our participation in the 'Drycleaners Cleaner Production Club' as a component in the Cleaner Production Program for Small to Medium Sized Enterprises delivered by the Centre of Excellence in Cleaner Production at Curtin University of Technology. The program was delivered in collaboration with the Drycleaning Institute of Australia (WA Branch)

Our Environmental Impacts:

The main environmental impacts (or potential impacts) of our operations are:

- Contamination of ground and/or storm water by waste water and perc spills
- Air emissions from solvents (perc and spotting agents)
- Controlled waste (still wastes and drycleaning water)
- Noise and traffic congestion by delivery service

We have assessed our baseline Eco-Efficiency for the 4th quarter of 2000 as follows:

- Perc Mileage — 38 kg of garment cleaned per litre of perc consumed
- Perc Waste — 52 garments cleaned per litre of perc waste generated
- Energy — 2.7 kWh of energy consumed per garment cleaned

We realise that we are indirectly responsible for additional impacts from our suppliers. For example, we recognise the impacts such as the production of air emissions associated with the supply of energy used in our operations

Our Objectives:

Our objectives are to continuously identify and implement cost-effective ways to use our resources more efficiently thereby:

- Reducing the amount of waste and pollution generated by our operations,
- Reducing our operating costs
- Continuously reduce our dependence on natural resources and hazardous materials

Our Cleaner Production Priorities:
The key areas in which we will focus our efforts to improve resource efficiency are:

Area	Use Area	Target	Key Performance Indicators
Solvents	Drycleaning machine	Increase efficiency by 25% by December 2001 and 50 % by December 2002	Kg of garments cleaned per litre of perc consumed (perc mileage)
Controlled Waste	Drycleaning machine	Reduce waste generation by 50 % by December 2002	Garments cleaned per litre waste perc generated
Energy	All areas	Reduce energy consumption by 10% by June 2001 and 20% by June 2002	KWh of energy consumed per garment cleaned

Our Way Forward:
ABC Drycleaners is committed to continuously improving the environmental and economic performance of our business. As part of this commitment we will constantly look for ways to manage our resources more efficiently and responsibly, thereby reducing our environmental impacts and our operating costs.

In order to manage this process, a specific action list has been developed (attached). This list will be reviewed and updated on a quarterly basis. All employees and suppliers will be informed of the importance of our Cleaner Production Action Plan, and encouraged to contribute suggestions on how its objectives can be achieved. Training on the Action Plan will be incorporated into the site induction process.

Finally, an annual review, by management, of this document and associated activities will be conducted to ensure the objectives are being met, and if not, to determine the appropriate measures required for the following year.

Signed: ______________________ Date: __________________
MANAGER/DIRECTOR

Figure 5-2: Participant Cleaner Production action plan

Action List – ABC Drycleaners (DIRS = requirement of Drycleaning Industry Regulation Standard)
NOTE: This document is to be reviewed and updated on a quarterly basis.

	Project Name (including tasks and dates if available)	Person Responsible	Environmental Benefits	Expected Financial Benefits	Key Performance Indicators	Status	Completion Date
Completed with ongoing monitoring, maintenance and inspections required							
1.	Minimise door opening time • Alter procedure	D/C machine operator	Reduce hazardous chemical use	Difficult to quantify	Perc mileage	Continue **DIRS**	Done
2.	Storage and handling of perc and perc waste • Install bund areas	Manager	Reduce risk of spills	Difficult to quantify	Number of incidents	Continue **DIRS**	Done
3.	Preventive maintenance • Establish schedule • Allocate tasks • Purchase leak detector	Manager and plant operators	Less accidental leaks	Difficult to quantify	Number of incidents	Continue **DIRS**	Done
4.	Regular rake and scrape still sides • Develop procedure	Manager	Reduce hazardous chemical use and waste generation	Difficult to quantify	Perc mileage	Continue	Done
5.	Lag pipes • Purchase and install lagging	Manager	Reduced energy demand	Difficult to quantify	Energy use per garment	In Place	Done
Short Term (Before 1st June 2001)							
6.	Correct loading of machine by weighing individual loads • Purchase scales • Alter procedure	D/C machine operator	Reduce hazardous chemical use and waste generation Reduced energy use	To Be Confirmed	Perc mileage & energy use per garment	Investigate and trial	1st June 2001
7.	Establish standards and procedures for energy efficient equipment operation	Manager	Reduced energy demand	To Be Confirmed	Energy use per garment	Investigate	1st May 2001
Medium Term (Before 1st January 2002)							
8.	Better boiler utilisation • Estimate peak demand • Match demand and supply	Manager & operators	Reduced energy demand	To Be Confirmed	Energy use per garment	Investigate	1st December 2001
Long Term (Before 1st January 2003)							
9.	Two bath system • Investigate installation	Manager	Reduce hazardous chemical use and waste generation	To Be Confirmed	Perc mileage	Continue	Investigate
10.	Use environmental preferred fuels • Obtain quotes for conversion of vehicles	Manager	Reduced pollution	To Be Confirmed	GHG per delivery	Deferred	Not defined

Figure 5-3: Cleaner Production program

5.3 Conclusion

Awareness raising and altering values are the first critical steps in changing behaviour and making environmental management a priority. The raising of awareness requires the constant and regular focus on the issue. All stakeholders have a role in this task, with the lead being taken by industry and professional organisations supported by Cleaner Production centres for training programs and technical advise.

During the course of delivering this program businesses were contacted approximately 15-20 times for the Benchmarking Only group and 25-30 times for participants in the Cleaner Production Club. Most of this contact was by mail and telephone, with attendance at workshops and site visits comprising the remainder. While the aim of this contact was short and concise it was the regular and constant focus on the issue that consolidated the process as much as the subject of the communication. While this level of contact on the surface may appear excessive, it can be justified for two reasons: firstly because most members of the drycleaning industry have little or no experience in Cleaner Production, and secondly to build trust with the participants. The key to the success of any industry programs for small businesses is reported to be their trust (Sohal, Perry et al. 1998). Trust that the program and its providers are genuinely trying to assist them in their business, understand their problems and aspirations and that the researcher is knowledgeable of their industry and the institution is in the project for the long-term. Once this trust was achieved there was a need to integrate Cleaner Production without interfering with the day-to-day operations.

The provision of tool(s) to close the performance gap was achieved through a training program to help overcome the lack of knowledge of the Cleaner Production assessment process leading to the development of a Cleaner Production Action Plan.

6 Results and Discussion

6.1 Introduction

This chapter presents and discusses the key results of the case study. It is divided into seven sections. The first section includes a description of the participating businesses. The second section presents the overall quantitative results from the drycleaning industry program and compares the Cleaner Production Club with the Benchmarking Only group. Section three analyses qualitatively the impact of the program on the drycleaning sector as a whole. This is done on the basis of results for the Cleaner Production Monitor conducted by the Centre of Excellence in Cleaner Production. Section four contains lessons learnt in conducting the benchmarking program, and section five covers the lessons learnt from the operation of the capacity building program. Section six lists several initiatives that have spun-off from this research. Section seven integrates the principal findings from the various sections.

Four groups are covered in this results chapter. Table 6-1 lists those groups.

	Group Name	Group Description
CASE STUDY	Cleaner Production Club (n=7; including two business managers who sold businesses during program)	Participated in the benchmarking program and the capacity building activities
	Benchmarking Only (n=10; including four business managers who sold businesses during program and two who withdraw)	Participated in the benchmarking program only
MONITOR	Drycleaning Control (n=13)	Drycleaners who did not participate in the program but surveyed for the Cleaner Production monitor program form the first control group
	Non-drycleaning Control (n=121)	Participants from the metal products, food processing and paper based printing sectors, surveyed in the Cleaner Production monitor program form the second control group

Table 6-1: Sample groups

The case study initially included 17 businesses: seven in the Cleaner Production Club and ten in the Benchmarking Only program. Three rounds of data were collected and analysed. The first round covered the period July/September 2000, the second round covered January/March 2001 and the third round covered the period of September/November 2001. The survey for the Cleaner Production Monitor was undertaken in November and December 2001.

In total, the case study lasted 18 months. Nine businesses participated in the case study until the completion of the research project. Eight of these provided useable data; four in each of the groups and one business manager provided an incomplete scorecard for the third and final round of data. Of the eight businesses that dropped out of the program, six sold their business, while two considered the program not worth their continued involvement and therefore withdrew from the program. At the start of the case study a comprehensive list of drycleaners in Western Australia was compiled from various sources. This included 80 actual drycleaning business managers (not including depots or agencies) and is potentially the best possible estimate of the total size of the drycleaning sector on Western Australia. Figure 6-1 shows the overall level of industry participation. Approximately 22% of drycleaning business managers from Western Australia initially participated in the program. Figure 6-2 indicates the action of the business managers who agreed to participate. Table 6-2 summarises the key features of each business.

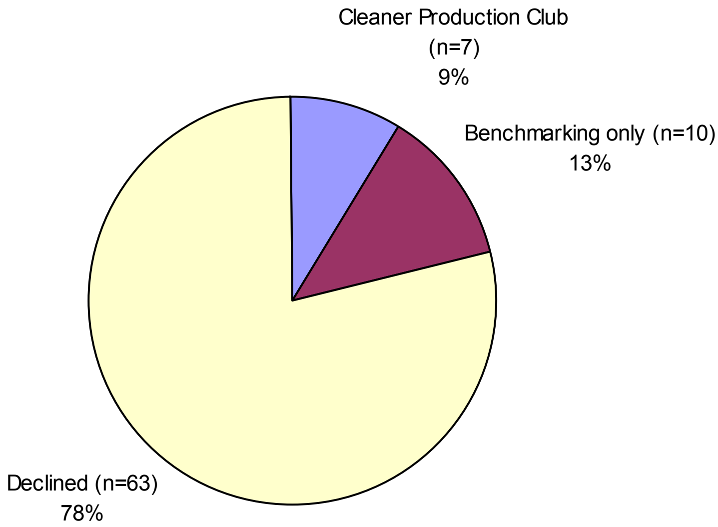


Figure 6-1: Level of industry participation (n=80 – all drycleaning in WA)

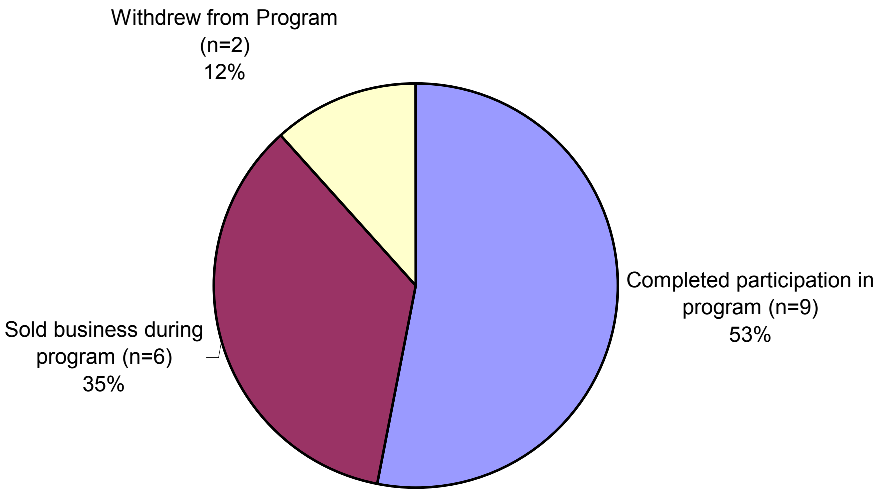


Figure 6-2: Break down of participants (n=17)

To calculate performance ranges between the different businesses on individual indicators and the cause of variations in performance, the results for each business was averaged over the data received (total number of businesses reported in this analysis is 17). The performance of individual businesses in the first round was used to calculate benchmarks and targets[25]. Individual business data from round one and round three were used to calculate improvements in performance. This analysis was only conducted on businesses that completed the program (total number of businesses reported in this analysis is eight). For reasons of business confidentiality only company codes are included in this thesis, these codes were allocated in order as the first round of scorecards were received.

6.2 Participant Background and Individual Results

This section gives a brief description of each business to help the interpretation and analysis of the results, and to potentially give a greater depth of understanding of the limitation of this program and therefore ways in which to improve the design and implementation of future programs. The program was promoted as an industry best practice program and 'using benchmarking to identify where the greatest opportunity for improved Eco-Efficiency are likely to be found' and these improvements may also have health and safety, and quality spin-offs. The owners, if they worked the majority of their time at the operations are classified as an employee for the purpose of calculating production; this was always the case. Table 6-2 provides a summary of the participants.

[25] No effort was made (though considered) to group the businesses into size categories because of the number of participants. In programs with large numbers of participants allowing groups to contain for example 20 businesses, or moving averages, this approach may add value to the program by generating more suitable performance targets, provided there are enough participants.

Code	Output	Employ	Output/Employees (1)			Delivery Service (2)	Level of participation (3)			Description of Business (4)
	Garme nt /Mth	No.	No.	Rating	Rank		C	S	WD	
CPC1	17306	15	1154	H	4	Extensive	*			Large CBD, commercial and domestic operation
CPC2	2410	3	803	M	11	Limited		*		Small suburban domestic operator.
CPC3	7082	6	1180	H	3	Extensive	*			Medium-sized suburban domestic operator
CPC4	3000	3	1000	M	7	None		*		Small suburban domestic operator.
CPC5	7800	13	600	L	17	Extensive	*			Medium-sized suburban domestic
CPC6	1349	2.5	540	L	16	Limited	*			Small suburban domestic operator
CPC7	4015	6	669	L	15	Extensive	*			Small-medium-sized CBD, commercial and domestic operation
BM1	6200	8	775	L	12	Extensive			*	Medium-sized suburban, commercial and domestic operation.
BM2	2184	2	1092	H	5	None		*		Small suburban domestic operator.
BM3	2132	2	1066	H	6	None		*		Small suburban domestic operator.
BM4	3118	2.2	1417	H	2	Limited	*			Small suburban domestic operator
BM5	2535	3	845	M	10	None		*		Small suburban domestic operator.
BM6	3250	3.5	929	M	8	None	*			Small country domestic operator
BM7	910	1	910	M	9	None	*			Very-small suburban domestic operator
BM8	2257	3	752	L	13	None			*	Small country domestic operator
BM9	2250	3	750	L	14	Limited		*		Small country domestic operator.
BM10	4069	2	2034	H	1	Limited	*			Small-medium sized suburban domestic operator
						TOTALS	9	6	2	

(1) Rating is based on the number of garments cleaned per employee; less than 800 is classed as low, 800 to 999 as medium and 1000 or greater as high

(2) Delivery services; limited means a maximum of three outlets, while extensive delivery service means a network of pickup and delivery points.

(3) Participation; 'C' completed program, 'S' sold business during program, 'WD' withdrew from program.

(4) Domestic: personal garments, Commercial; Drycleaning industrial garments under contract; clients including hotels, government agencies and sporting clubs

Table 6-2: Summary profile of participants

6.2.1 Cleaner Production Club Participants

CPC1: This participant operates a larger central business district operation with an extensive pick-up and drop-off network. The business is independently located within a light industrial area, on a freehold site, which possibly influenced any decision to refit the site. The business relies on the front counter for only a small proportion of their work, with the balance from depots and regular larger clients. The business caters for commercial as well as domestic clients. This drycleaning operation employs 15 full time staff, operates four drycleaning machines linked to a gas-fired boiler, together with one wet-cleaning machine and a carbon-activated filter. The business also claims that wedding dresses are a speciality and is involved in the local 'Bridal Fair' and actively promotes the business at every opportunity. This business sponsors a number of high profile sporting teams including the state's football, soccer and basketball teams and as part of this sponsorship cleans the clubs and supporting staffs uniforms. The business is a long established family business with a relatively loyal staff. The present owner bought the business after a career in the banking sector (ie has business skills).

The owner acts as a champion for the industry in regards to the industry's environmental management and represents the industry in dialogue with the local environmental regulator on mechanism to reduce the industry's environmental impacts, improve compliance and improve the industry's image.

The owner expressed the view that they could reduce their energy bill by a further $10,000 annually with improved staff cooperation to change current work practices in relation to boiler operations.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	20,000	12,000	19,918
Energy (cents/garment)	17	28	16
Energy (kWh/garment)	2.4	4.1	2.6
Perc Mileage (kg garments cleaned / lit of perc consumed)	45	27	62
Perc Waste (No. garments cleaned / lit perc waste generated)	154	92	332

Table 6-3: CPC1 performance

The business manager operates the largest commercial drycleaning operation in this program. For this business the number of garments cleaned per employee per month was 1154 and ranked as high on the productivity scale. This result meant the business was ranked as 4rth out of the 17 participants. Finally this participant was a member of the executive committee of the Western Australia branch of the DIA when the program was established.

CPC2: This business is a small suburban domestic operator, in an outer eastern suburb of Perth located on a freehold site. They offer a limited delivery service and receive the majority of work over the front counter. They employ three full time staff and operate two drycleaning machines linked to a gas-fired boiler. This business manager was a recent entry into the industry (12 months before this program commenced) with no previous drycleaning industry experience. Although the business manager had a long history of self-employment, this meant that although he had business experience, he lacked experience in the drycleaning industry. This inexperience led him to purchase a business in which the general condition of the capital equipment was in some areas below expectation and considerable money was spent trying to improve the boiler efficiency without results. Furthermore, under the previous owner, the business had been allowed to operate relatively independently with on-site staff making the operational decisions. The new owner had difficultly in changing entrenched work practices. The major reason given by the participant for the purchase of this particular business was its freehold status. The owner sold the business in 2001 and therefore did not complete the program. However, he was keen to improve and promote his environmental responsibility, hence the business manager's initial reason for joining the program.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	3,200	1,619	Sold
Energy (cents/garment)	36	80	Sold
Energy (kWh/garment)	6.2	10.9	Sold
Perc Mileage (kg garments cleaned / lit of perc consumed)	48	22	Sold
Perc Waste (No. garments cleaned / lit perc waste generated)	53	39	Sold

Table 6-4: CPC2 performance

For this business the number of garments cleaned per employee per month was 803 and ranked as medium on the productivity scale. This result meant the business was ranked as 11th out of the 17 participants.

CPC3: This business is a medium-sized suburban domestic operator, which employs six full time staff and operates two drycleaning machines linked to a gas-fired boiler. They operate an extensive network of depots with a fleet of three vans for pick-up and drop-offs. The operation is located on a freehold location. This business manager was a recent entry to the industry (less than three years) and operates a single shop in one of the more affluent western suburbs. As a general practice the owner allocated one day each week to office/management activities of the business, including accounting tasks.

Incidentally he was the only owner to attend all the workshops and completed more worksheets than any other club member. This time-out from the drycleaning facility indicates his confidence in his staff, as well as processing the required resources to hire additional staff to fill-in in his absence from the operation.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	6,800	6,867	7,578
Energy (cents/garment)	18	19	17
Energy (kWh/garment)	2.1	2.2	2.2
Perc Mileage (kg garments cleaned / lit of perc consumed)	38	77	63
Perc Waste (No. garments cleaned / lit perc waste generated)	85	172	175

Table 6-5: CPC3 performance

For this business the number of garments cleaned per employee per month was 1180 and ranked as high on the productivity scale. This result meant the business was ranked as third out of the 17 participants. Finally this participant was a member of the executive committee of the Western Australia branch of the DIA when the program was established.

CPC4: This business is a small suburban domestic operator, which employs three full time staff. The business is located within a small shopping complex. It does not operate any delivery services, but instead relies solely on its front counter for its business. The owner of this business has had 30 years experience in the drycleaning industry, but sold one business after the first round of data was collected to ‘seek a change of life’ selling boats. However, the call of the industry was too great and he purchased a different drycleaning business 12 months later. He contacted the researcher a further six months later requesting he resume participation in the project. As he had sold the business, the Cleaner Production training program had been completed and he was operating at a different site, it was not a simple matter of resuming where he had left off. However, because he had spent a considerable amount of capital up-grading the new site on Eco-Efficiency principles, the proposition was put to him that, if he was prepared to provide performance data from before and after the up-grade at the new site, we would assist in the development of a case study for promotion by the Centre and develop an action plan for further implementation of Cleaner Production at his current site. In return, he would be provided with the balance of the training material and be awarded a Cleaner Production Certificate[26]. A summary of the case study developed for the new shop is included in section 6.2.1.

Indicator	Old Shop	New shop	
	Round 1	Round 2	Round 3
Turnover (garments per month)	3000	2600	2600
Energy (cents/garment)	38	31	26.5
Energy (kWh/garment)	4.9	3.9	3.4
Perc Mileage (kg garments cleaned / lit of perc consumed)	45	13	65
Perc Waste (No. garments cleaned / lit perc waste generated)	50	65	130

Table 6-6: CPC4 performance

For this business in the old shop the number of garments cleaned per employee per month was 1000 and ranked as medium on the productivity scale. This result meant the business was ranked as 7th out of the 17 participants. With the new shop, the level of productivity has risen slightly with the number of garments cleaned falling to 2,600 per month (previously 3,000) and with the number of staff cut to two and one half full time

[26] The new premises also featured in the Cleaner Production Training Video 'Protecting Your Profits: more profit with less waste' covering technology modification of the five Cleaner Production practices developed by the Centre of Excellence in Cleaner Production.

equivalents. The operation is operating at 60% capacity and the business manager anticipates this to increase, and when this occurs, productivity as measured by number of garment cleaned per staff member is expected to increase. As a final note, this business manager purchased the two businesses BM2 and BM3 in November 2002 after the program finished. These businesses had an intermediate owner after being sold by the original participant (who operated both shops) in this program.

CPC5: This business is a medium-sized suburban domestic operator, which employs 13 full time staff and is located in a small shopping centre. The business operates two drycleaning machines linked to a gas-fired boiler. They operate an extensive network of depots with all garments being returned to a central site for cleaning. This business manager was possibly the most expansive minded in the program. However, his focus was on expanding his business. The business is located in a rapidly growing area of Perth's southern suburbs without major nearby competition, and his strategy was to keep it that way. Therefore, the need to leave much of the day-to-day operations of his business to hired staff meant the level of performance improvement was below that of many other participants.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	7,800	4,800	4,800
Energy (cents/garment)	14	29	18
Energy (kWh/garment)	1.7	2.9	2.5
Perc Mileage (kg garments cleaned / lit of perc consumed)	69	54	69
Perc Waste (No. garments cleaned / lit perc waste generated)	160	160	160

Table 6-7: CPC5 performance

For this business the number of garments cleaned per employee per month was 600 and ranked as low on the productivity scale. This result meant the business was ranked as 16th out of the 17 participants. While this business was following an expansionary policy, the success of the business plan at this stage was open to question when measuring the number of garments cleaned per month. Finally this participant was a member of the executive committee of the Western Australia branch of the DIA when the program was established.

CPC6: This business is a small suburban domestic operator, which employs two and one half full time staff within a small shopping complex, operating a single drycleaning machine linked to a small electric boiler. They operate a limited network of depots with a single van for pick-up and drop-offs. This business manager was a very recent entrant to the industry, purchasing the business approximately one year before joining the program. Prior to purchasing the business the owner held a senior management role within a national food-chain organisation, and had therefore established management and business skills. Although the business manager was enthusiastic about the potential of the program, his lack of drycleaning experience made him reluctant to try new practices, and he was clearly still under the influence of the previous owner. Furthermore, because of no previous experience in the industry, there were two equipment/capital issues not identified at the time of purchase that were having an effect on his Eco-Efficiency; an electric boiler and the lack of a cooling tower, both factors he wanted to correct before allocating capital to other parts of the business. This business is situated in a more industrial region of Perth with a large proportion of single residents. This possibly resulted in a greater energy use on the laundry side of the operation, without the ability to allocate energy use between the two operations.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	1,400	1,400	1,248
Energy (cents/garment)	41	54	41
Energy (kWh/garment)	6.9	6.1	5.1
Perc Mileage (kg garments cleaned / lit of perc consumed)	48	63	48
Perc Waste (No. garments cleaned / lit perc waste generated)	42	42	42

Table 6-8: CPC6 performance

For this business the number of garments cleaned per employee per month was 540 and ranked as low on the productivity scale. This result meant the business was ranked as 17th out of the 17 participants. Finally this participant was a member of the executive committee of the Western Australia branch of the DIA when the program was established.

CPC7: This business is a medium sized central business district commercial and domestic operator, which employs six full time staff, operates two drycleaning machines linked to a gas-fired boiler. It operates an extensive delivery service, while relying heavily on its front counter for its business. This business manager is attempting to break into the fast growing and very competitive commercial market (hotel chains, restaurants and corporate clients). Due to this situation, while the business manager saw merit in the business case for Cleaner Production and Eco-Efficiency, his focus was on the short-term cash flow and the purchase of essential labour saving equipment. The indication given is that Eco-Efficiency is the future but current demands on his time prevent Cleaner Production from being a top priority at present.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	4,230	3,800	4,230
Energy (cents/garment)	26	44	NA
Energy (kWh/garment)	2.7	5.3	6.2
Perc Mileage (kg garments cleaned / lit of perc consumed)	38	37	NA
Perc Waste (No. garments cleaned / lit perc waste generated)	52	42	NA

Table 6-9: CPC7 performance

For this business the number of garments cleaned per employee per month was 699 and ranked as low on the productivity scale. This result meant the business was ranked as 15th out of the 17 participants. Finally this participant was a member of the executive committee of the Western Australia branch of the DIA when the program was established.

6.2.2 Benchmarking Only Participants

BM1: This business is a medium-sized suburban domestic operator, which employs 8 full time staff, operates two drycleaning machines linked to two diesel-fired boilers. The business is on a freehold title located in one of Perth's medium to heavy industrial areas. It therefore needs to operate a delivery service and relies on a series of depots for its work with little reliance on its front counter for business. This business operated from an old factory style operation in an industrial area. This was the only site with a clear smell of perc in the work area. The work area was cluttered but extensive and many pipes unlagged and going nowhere (equipment had been removed and pipes closed-off). The operation runs two diesel fired boilers, one large and one small with both being fired-up at the start of the day, and the smaller one used until the larger boiler reaches operation temperature at which time the smaller one is shut down. This business only completed one round of data and despite further approaches was unwilling to participate. A possible reason for this is the owners had limited understanding of English and were not confident to communicate without the presence of an old employee who spoke English.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	6,200	Withdrew	Withdrew
Energy (cents/garment)	35	Withdrew	Withdrew
Energy (kWh/garment)	3.9	Withdrew	Withdrew
Perc Mileage (kg garments cleaned / lit of perc consumed)	39	Withdrew	Withdrew
Perc Waste (No. garments cleaned / lit perc waste generated)	155	Withdrew	Withdrew

Table 6-10: BM1 performance

For this business the number of garments cleaned per employee per month was 775 and ranked as low on the productivity scale. This result meant the business was ranked 12^{th} out of the 17 participants.

BM2 and BM3: Both of these businesses were owned by the same business manager, and are small suburban domestic operators in adjoining suburbs, each employing two full time staff members, with a single drycleaning machine linked to gas-fired boilers. Both businesses are located within small shopping complexes. Neither operates a delivery services but instead rely solely on the front counter for their business. Although the business manager was one of the easiest to persuade to participate, he demonstrated a lack of environmental management experience. Furthermore, because of the small size of his operation he considered that he could not take the time-off to participate in the capacity building activities provided as part of the Cleaner Production club. Unfortunately, he sold both businesses after six month of the program commencing and therefore was dropped from the program.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	2,184	Sold	Sold
Energy (cents/garment)	41	Sold	Sold
Energy (kWh/garment)	2.6	Sold	Sold
Perc Mileage (kg garments cleaned / lit of perc consumed)	20	Sold	Sold
Perc Waste (No. garments cleaned / lit perc waste generated)	37	Sold	Sold

Table 6-11: BM2 performance

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	2,132	Sold	Sold
Energy (cents/garment)	43	Sold	Sold
Energy (kWh/garment)	5.6	Sold	Sold
Perc Mileage (kg garments cleaned / lit of perc consumed)	24	Sold	Sold
Perc Waste (No. garments cleaned / lit perc waste generated)	32	Sold	Sold

Table 6-12: BM3 performance

For the first business owned by this business manager the number of garments cleaned per employee per month was 1092 and ranked as high on the productivity scale. This result meant the business was ranked 5th out of the 17 participants. For the second business owned by the business manager the number of garments cleaned per employee per month was 1066 and ranked as high on the productivity scale. This result meant the business was ranked as 6th out of the 17 participants. The relatively high productivity of these two businesses could be partly contributed to them being operated by family members: the owner’s daughter operated the second business, while he operated the other himself. These two businesses were eventually purchased by business CPC4.

BM4: This business is a small suburban domestic operator which employs two and one fifth full time staff with a single drycleaning machine linked to a gas-fired boiler. The business is located within a small shopping complex. It operates a limited delivery service, and relies on its front counter for the majority of its business. This business manager proved to be the most efficient business for perc mileage and a very close second (0.75 of a cent per garment) for energy cost adjusted for economies of scale. The owner had a long history in the industry and kept good records of his environmental costs and had done so over a long period of time. The owner was reluctant to join the Cleaner Production Club because of the time commitments involved, as he only employed one other full-time staff member. However, he decided to undertake a non-industry specific Cleaner Production training program 12 months later, for which he developed a Cleaner Production Action Plan for his business and received a Cleaner Production Certificate. This process indicated that once he had gained a greater understanding of Cleaner Production (through the Benchmarking reports and printed material) and he desired to further improve his performance, he realised that he required specialised Cleaner Production training to be further able to improve his Eco-Efficiency.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	3,370	3,497	2,487
Energy (cents/garment)	26	24	25
Energy (kWh/garment)	3.4	3.1	3.4
Perc Mileage (kg garments cleaned / lit of perc consumed)	76	79	83
Perc Waste (garments cleaned / lit perc waste generated)	84	100	131

Table 6-13: BM4 performance

The modest level of improvement in part reflects current high levels of performance restricting potential to further improve. For this business the number of garments cleaned per employee per month was 1417 and ranked as high on the productivity scale. This result meant the business was ranked as 2nd out of the 17 participants.

BM5: This business is a small suburban domestic operator, which employs three full time staff and operates two drycleaning machines linked to a gas-fired boiler. The business is located within a small shopping complex. It does not operate any delivery services, but instead relies solely on its front counter for its business. This business manager established the energy costs benchmark for this research program in cents per garment cleaned, adjusted for size of operation and in general operated an efficient operation. He was, however, looking to leave the industry and did so after the second round of data was collected. This business manager had a recent history in the banking sector and entered the drycleaning industry after taking voluntary redundancy following the re-structure of the banking industry during the 1990's.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	2,240	2,829	Sold
Energy (cents/garment)	32	33	Sold
Energy (kWh/garment)	4.9	4.4	Sold
Perc Mileage (kg garments cleaned / lit of perc consumed)	50	48	Sold
Perc Waste (No. garments cleaned / lit perc waste generated)	224	141	Sold

Table 6-14: BM5 performance

For this business the number of garments cleaned per employee per month was 845 and ranked as medium on the productivity scale. This result meant the business was ranked 10th out of the 17 participants.

BM6: This business is a small country domestic operator, which employs three and one half full time staff, operating a single drycleaning machine linked to a gas-fired boiler. The business is located on a freehold leased site. It does not operate any delivery services, but instead relies solely on its front counter for its business. The business is run in partnership, and while one owner was very keen to participate, they wanted the other to do the work involved in participating in this program. Hence their participation only lasted for the first round, and was one of only two businesses to directly withdraw from the program. It was interesting to note that this was the only business to weigh each load before drycleaning; a practice they continued from the previous owner, and a practice five of the seven Cleaner Production Club members included in their action plans. Unfortunately they were not in the position to take advantage of this practice because they did not clean sufficient garments to make full loads on most occasions.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	3,250	Withdrew	Withdrew
Energy (cents/garment)	38	Withdrew	Withdrew
Energy (kWh/garment)	4.8	Withdrew	Withdrew
Perc Mileage (kg garments cleaned / lit of perc consumed)	22	Withdrew	Withdrew
Perc Waste (No. garments cleaned / lit perc waste generated)	81	Withdrew	Withdrew

Table 6-15: BM6 performance

For this business the number of garments cleaned per employee per month was 929 and ranked as medium on the productivity scale. This result meant the business was ranked as 8th out of the 17 participants.

BM7: This business is a very-small suburban domestic operator, which employs one full time staff (the owner), operating the latest generation machine linked to a diesel-fired boiler. The business is located within a small shopping complex. It does not operate any delivery services, but instead relies solely on its front counter for its business. This business manager has a long history in the drycleaning industry and is well experienced in the major environmental issues facing the industry. This operation was the smallest drycleaner in the program. Although safety and efficiency were of concern, the size of the operation made it, in the opinion of the owner, difficult to alter current practices. The business managers investigated switching fuel source, but the cost of connecting gas made the gas conversion too expensive. The drycleaning machine was less than two years old and operated at high efficiency. While the business manager was enthusiastic about the concept of the program and completed the three scorecards, he was nearing retirement, and the small size of the operation made him reluctant to radically alter his operations.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	950	579	1,200
Energy (cents/garment)	59	92	48
Energy (kWh/garment)	6.0	9.6	4.7
Perc Mileage (kg garments cleaned / lit of perc consumed)	25	29	30
Perc Waste (No. garments cleaned / lit perc waste generated)	56	23	109

Table 6-16: BM7 performance

For this business the number of garments cleaned per employee per month was 910 and ranked as medium on the productivity scale. This result meant the business was ranked 9th out of the 17 participants. The size of the operation restricted the ability to reduce cost, however there was a constant improvement in perc mileage and reduction in perc waste generated. Equipment had also been installed to treat perc contact water to make it suitable to dispose down the drain.

BM8: This business is a small country domestic operator, which employs three full time staff, operates a single drycleaning machine linked to a gas-fired boiler. The business is located within a small shopping complex. It does not operate any delivery services, but instead relies solely on its front counter for business. This is a well-run country operation, and the distance to Perth was the major reason why the owner did not participate in the Cleaner Production Club. He completed the three scorecards and expressed an interest in completing the training if it was available in his area.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	2450	2200	2122
Energy (cents/garment)	41	42	40
Energy (kWh/garment)	6.6	5.9	5.8
Perc Mileage (kg garments cleaned / lit of perc consumed)	22	25	31
Perc Waste (No. garments cleaned / lit perc waste generated)	109	110	110

Table 6-17: BM8 performance

For this business the number of garments cleaned per employee per month was 752 and ranked as low on the productivity scale. This result meant the business was ranked 13th out of the 17 participants.

BM9: This business is a small country domestic operator, which employs three full time staff, operates a single drycleaning machine linked to a diesel-fired boiler. The business is located within a small shopping complex, and operates a limited delivery service and relies on the front counter for the majority of its business. This is an old style country operation located in overlarge premises with the boiler located a great distance from where the steam is demanded, possibly a reflection of older style design where the boiler was located away from the work areas for safety consideration. Pipe lagging was incomplete, while the work area was cold and dark when visited.

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	2,500	2,000	Sold
Energy (cents/garment)	41	45	Sold
Energy (kWh/garment)	3.7	4.5	Sold
Perc Mileage (kg garments cleaned / lit of perc consumed)	45	45	Sold
Perc Waste (No. garments cleaned / lit perc waste generated)	250	200	Sold

Table 6-18: BM9 performance

For this business the number of garments cleaned per employee per month was 750 and ranked as low on the productivity scale. This result meant the business was ranked as 14th out of the 17 participants.

BM10: The owners of this business had 26 years experience in the industry. The business is a small suburban domestic operator which employs two full time staff and operates two drycleaning machines linked to a gas-fired boiler. The business is located within a small shopping complex and operates a limited delivery service and relies on the front counter for the majority of its business. This operation was in the process of restructuring following the recent purchase of the business. The new owners initially agreed to participate in the Cleaner Production Club and attended the first workshop. However, they found that due to staff constraints, they could not make time available, and continued participation in the Benchmarking Only program. After the program had been operating for eight months, the business relocated to a nearby vacant site. The owners' participation in the Cleaner Production program was included as a component of their successful planning application for the new site to the local council. The owners shifted some equipment from the old site and purchased some additional equipment. The new site was arranged and equipped along Eco-Efficiency principles to improve energy efficiency and productivity. This work is the subject of one of the case studies whose summary is included in Section 6.2.1

Indicator	Round 1	Round 2	Round 3
Output (garments per month)	3,650	NA	4,488
Energy (cents/garment)	35	NA	32
Energy (kWh/garment)	4.2	NA	4.1
Perc Mileage (kg garments cleaned / lit of perc consumed)	61	NA	112
Perc Waste (No. garments cleaned / lit perc waste generated)	101	NA	112

Table 6-19: BM10 performance

For this business the number of garments cleaned per employee per month was 2034 and ranked as high on the productivity scale. This result meant the business was ranked 1st out of the 17 participants. The staff members were both owners. Finally this participant was a member of the executive committee of the Western Australia branch of the DIA when the program was established.

6.2.3 Drycleaning Case Studies

Atlas Dry Cleaners, a leading firm in Perth, is committed to environmental best practice. It has been achieving business benefits for itself by pursuing cleaner production initiatives and it has been encouraging improvements by the industry. Through pipe lagging alone it has reduced its daily gas use by 30% and electricity use by 11%. It has been investigating a PERC re-use process, which would reduce its cleaning residue waste volume by 70% and save it $3500 a year.

Atlas is committed to high standards of Eco-Efficiency and has an environmental policy covering all of its main environmental impacts. It has developed and implemented procedures for compliance with dry cleaning industry codes for plant and the safe handling of perchloroethylene (PERC), and with EPA requirements. It actively encourages improvement by other firms. Atlas participated as one of the core members of the inaugural Cleaner Production Club for Dry Cleaners, facilitated by the Centre of Excellence in Cleaner Production, Curtin University of Technology, and the Dry Cleaning Institute of Australia (WA Branch). Atlas have installed a wet cleaning process; the steps are basically the same as for dry cleaning except that water is used (using biodegradable soaps) instead of solvent. The drying and finishing process uses a 3-dimensional machine, which does not rely on the use of hot irons. Liquid waste from the still separates into contact water (from humidity, perspiration, spotting and absorbed in the garments) and a heavier layer containing greases, fats, various solid materials, and solvent. The water is drained to the sewer after processing through an activated carbon filter and the heavier layer of liquid waste has traditionally been drummed and taken away for landfill by a waste contractor. Other wastes are scrapings from the still sides, contaminated powder from the powder filters and solids from the non-powder filters. These wastes are also drummed as solid wastes and removed by a licensed special waste contractor. General waste includes packaging and office material.

Cleaner production Initiatives
Cleaner production initiatives have been pursued in reducing PERC and energy consumption through technology modification, good housekeeping and on-site recycling.

PERC emissions are minimised by:

- The use of advanced machines and the still system designed for recirculation.
- Leak prevention through correct operation and procedural controls (use of full loads and minimising door opening times).
- Preventive maintenance, including establishing a schedule, allocating task and the purchase of a leak detector.
- Good housekeeping in storage and handling of solvents and solvent waste.
- Installing a carbon filter to remove PERC traces in contact water before discharge to the sewer

Energy efficiency Besides its investment in cleaning equipment Atlas has, over the past 5 years, invested in various energy efficiency improvements including:

- Reducing steam pipe losses and demand on the boilers: Using engineering consultants, the plant was revamped to replace un-lagged, undersized pipes with lagged pipes of sufficient size to meet production needs and allow capacity expansion. This reduced overall demand on the two boilers, previously constantly running, and allowed one of the boilers to cope amply.
- Improving boiler utilisation: By estimating peak demand and matching demand to supply, steam demand was also reduced and the boiler does not need to be constantly running.
- Reduced need for fans and air conditioning: The above measures improved working conditions. Evaporative coolers are in place that only need to be set at half of maximum setting for a comfortable working environment.
- Improved lighting by replacing neon with more efficient low bay lights where they are needed.

Barriers
For the major process improvements the main barrier was the $0.5m cost
Cleaner production incentives
The initiatives have been driven by Atlas' commitment to business efficiency, quality and environmental improvement.

The case study is a typical Cleaner Production project that has produced economic, environmental and workplace benefits. The project involved a premises refit including purchasing of the latest drycleaning machine and the installation of a carbon filter to eliminate solvent contact wastewater. This work has enabled the business to reduce its use of chemicals by 83%, reduce its generation of hazardous wastes by 50%, eliminate the generation of contact wastewater and reduce its energy consumption by 14%. In relation to work-place benefits, the new plant requires less space allowing the workplace to be less cluttered. Productivity has improved while the level of fugitive emission has dropped considerably leading to a safer workplace for both staff and management.

The Herdsman Drycleaners is committed to improving its Eco-Efficiency and is participating in an Industry Best Practice Program for the Western Australian Dry Cleaning Industry, a joint initiative of the Drycleaning Institute of Australia (DIA) and the Centre of Excellence in Cleaner Production of Curtin University of Technology. This program benchmarks the environmental and financial performance of the local industry and provides information on how performance can be improved. This participation lead to the development of an approved Cleaner Production Action Plan and the presentation of a Cleaner Production Certificate by the Centre of Excellence in Cleaner Production. This action plan was the initiative that lead to many of the improvements outlined in this case study.

Cleaner Production Initiative

Initiatives have included the purchase of an advanced drycleaning machine, to replace the two existing machines; an additional feature of this machine is that it creates negative pressure within the cage when the door is opened to prevent perc fumes from entering the work area. The installation of a carbon filter and a variety of good housekeeping measures introduced during and since the premises were refit. Many improvements, particularly in perc efficiency together with a reduction in the generation of hazardous wastes, improved energy efficiency as well as an improvement in the work environment and increases in productivity have been achieved.

On-site Recycling

The new drycleaning machine contains a double water/perc separation system that allows an increased recovery of perc and an improved quality of contact water. To further recycle this contact water, Herdsman Drycleaners installed an Activated Carbon Filter. This filter allows the contact water to be filtered to a level acceptable to the WAWA standards, after this the water can be disposed of with the normal wastewater.

Safety and Productivity

Of great concern to the new owners was the liability risk of the existing machines as they emitted detectable levels of perc into the work area. Worker productivity improved with the purchase of a new drycleaning machine for two reasons. Firstly the new machine was physically smaller than either of the existing machines and this extra workspace has allowed an improved flow of garments that had improved productivity. Secondly, the new machine has a greater capacity and its cycle times are shorter with a greater degree of flexibility to select cycles to suit the type of garments and throughput. These productivity improvements have allowed the owner to reduce their workforce; not a decision he took lightly.

Barriers

For Herdsman Drycleaners the main barrier to the implementation of the Cleaner Production options has been staff participation. The majority of the staff carried their employment over from the previous ownership and were reluctant to alter established work-practices. As in most small businesses, time is a precious commodity and it is primarily dedicated to running the business and satisfying customer requirements.

Cleaner Production Incentive

Herdsman Drycleaners is committed to improving all aspects of their business and introduced Cleaner Production practices into its operations in order to improve both the environmental and financial performance of the company. To achieve this aim the owner is considering the introduction of a closed water system. This process would eliminate the need to maintain the cooling tower that must be maintained by licensed contractors to reduce the possibility of disease developing within the water tower. The owner is also investigating the reworking of his steam lines to increase the boiler efficiency.

Top Hat Drycleaners is a South Perth based business whose proprietors have 20 years experience in the drycleaning industry. Top Hat relocated to its current location in January 2001. Top Hat recognised an opportunity to introduce Cleaner Production improvements to their operation when they made the decision to relocate their business. Reduction of energy consumption is one of the key issues for the company and improvements are being continuously investigated. The company is committed to improving its Eco-Efficiency and is participating in an Industry Best Practice Program for the Western Australian Dry Cleaning Industry. This joint initiative of the Drycleaning Institute of Australia (DIA) and the Centre of Excellence in Cleaner Production of Curtin University of Technology is benchmarking the environmental and financial performance of the local industry and providing information on how performance can be improved.

Cleaner Production Initiative
Through a variety of good housekeeping measures taken during and since the relocation of Top Hat Dry Cleaners to its new premises, several improvements, particularly in energy efficiency, have been achieved. The company has moved into significantly smaller premises so planning the layout of the new store was a critical activity and offered opportunities for introducing efficiency improvements.

Equipment was organised so as to make operations as efficient as possible. This also allowed steam and condensate pipe lengths to be minimised to reduce heat loss. To further reduce heat losses from the pipes, and to reduce the risk of burns from contact with the pipes, the pipe work is also being insulated.

A new boiler was purchased for the new location, and an assessment of needs enabled the company to reduce the size of the boiler by 50%. The company used a 40hp boiler in the old premises but was able to comfortably downsize to a 20hp boiler, despite an increase in the number of garments cleaned each week. In addition, Top Hat is currently experimenting with different operational modes of the boiler to determine which is the most efficient. Daily readings of the gas meter are helping in their assessment.

The load on the boiler and the time it is in operation is also reduced by only turning on the company's shirt machine (used for forming and conditioning the fabric) when required. The shirt machine consumes 25% of the steam generated by the boiler.

Since the company has moved into its new premises the number of garments cleaned each week has increased by over 40%. Despite this increase, energy consumption has increased by only 25%. This has meant the company's energy cost per garment cleaned has already fallen by 9% and further improvements are expected when such projects as the lagging of all steam pipes are completed.

Without the energy efficiency improvements that have been achieved, the company would be paying an extra $2,200 on its energy bills and consuming an extra 14,000kWh in order to clean the increased number of garments each year.

Barriers
For Top Hat Drycleaners the main barrier to the implementation of the Cleaner Production options has been a lack of resources. As in most small businesses, time is a precious commodity and it is primarily dedicated to running the business and satisfying customer requirements. Projects such as the lagging of pipes and assessing the performance of equipment has to be squeezed in around these priorities so are difficult to complete within the timeframes the company would like.

6.3 *Program Achievements*

One business participating in the program was much larger (2.2 times the size of the second largest participant) than the other businesses in the program and was therefore removed from the calculation of economies of scale. This was done because it was expected that this business would bias the 'line of best fit' through the data and also distort the calculation of the size amended performance targets.

Table 6-20 contains an overview of the results of the program. It provides an overview of performance changes for all businesses, including those that sold their business and the two businesses that withdrew from the program. This is followed by a series of raw data graphs, combined and split between the two groups. The results are then linked to the critical success factors for benchmarking. This starts with the identification of performance gaps, followed by an investigation to determine the existence (or not) of economies of scale. Next is a discussion of the drivers to close the performance gap, bearing-in-mind that these were not explicitly identified from participants[27], but estimated from the review of the results and the business manager's behaviour, a review of action plans and views expressed in the capacity building activities. Finally, the effectiveness of Cleaner Production assessments as a tool to improve the Eco-Efficiency of small businesses is discussed.

[27] This was to ensure we did not get the expected, desired or stock answers

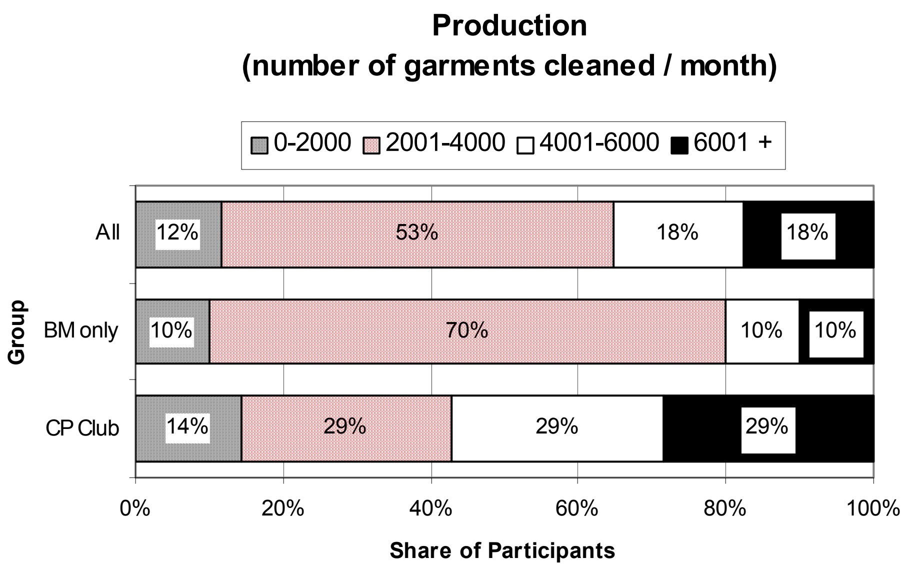
Company Code / Indicator		Poorest or Lowest	Best or Highest	Group Averages CPC	BM Only	All	Cleaner Production Club CPC1	CPC2	CPC3	CPC4	CPC5	CPC6	CPC7	Benchmarking Only BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	BM9	BM10
Output	R1	950	20000	6633	2893	4433	20000	3200	6800	3000	7800	1400	4230	6200	2184	2132	3370	2240	3250	950	2450	2500	3650
(Garments per month)	R2	579	12000	5081	2221	3781	12000	1619	6867	S	4800	1400	3800	WD	S	S	3497	2829	WD	579	2200	2000	NA
	R3	1200	19918	7555	2574	5341	19918	S	7578	S	4800	1248	4230	WD	S	S	2487	S	WD	1200	2122	S	4488
		910	17306	Average		4113.9	17306	2409	7081	3000	5800	1349	4087	6200	2184	2132	3118	2535	3250	910	2257	2250	4069
Ed & Training	R1	13	0	1.8	1.9	1.9	0.00	3.33	0.00	0.00	8.15	0.00	1.33	0.00	0.00	0.00	0.00	3.00	0.00	0.00	2.67	13.33	0.00
(Hours per employee per qu	R2	13	0	2.4	3.3	2.8	0.27	3.33	7.60	S	1.92	0.00	1.33	WD	S	S	12.68	3.67	WD	0.00	0.00	0.00	NA
	R3	4	0	0.3	0.9	0.7	0.50	S	NA	S	NA	0.00	NA	WD	S	S	3.70	S	WD	0.00	0.00	S	0.00
		7	0	Average		1.8	0.26	3.33	3.80	0.00	5.04	0.00	1.33	0.00	0.00	0.00	5.46	3.33	0.00	0.00	0.89	6.67	0.00
Publication	R1	6	0	2.1	0.8	1.4	0	4	0	3	6	0	2	0	0	0	0	2	0	1	2	3	0
(Number received per mont	R2	6	0	3.0	2.6	2.8	3	4	6	S	3	0	2	WD	S	S	5	2	WD	1	2	3	NA
	R3	6	0	2.8	2.3	2.5	2	S	6	S	3	0	NA	WD	S	S	5	S	WD	1	2	S	1
		4	0	Average		1.8	1.7	4.0	4.0	3.0	4.0	0.0	2.0	0.0	0.0	0.0	3.3	2.0	0.0	1.0	2.0	3.0	0.5
Incidents	R1	1	0	0.0	0.3	0.2	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0
(Number per month)	R2	1	0	0.2	0.0	0.1	1	0	0	S	0	0	0	WD	S	S	0	0	WD	0	0	0	NA
	R3	0	0	0.00	0.00	0.00	0	S	0	S	0	0	NA	WD	S	S	0	S	WD	0	0	S	0
		1.0	0.0	Average		0.20	0.33	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mileage	R1	20	76	47	38	42	45	48	38	45	69	48	38	39	20	24	76	50	22	25	22	45	61
(Kg of garments cleaned	R2	22	79	47	45	46	27	22	77	S	54	63	37	WD	S	S	79	48	WD	29	25	45	NA
per litre of perc consumed)	R3	30	112	61	64	62	62	S	63	S	69	48	NA	WD	S	S	83	S	WD	30	31	S	112
		20	87	Average		44.5	45	35	60	45	64	53	37	39	20	24	79	49	22	28	26	45	87
Energy/garment	R1	0.59	0.14	0.27	0.39	0.34	0.17	0.36	0.18	0.38	0.14	0.41	0.26	0.35	0.41	0.43	0.26	0.32	0.38	0.59	0.41	0.41	0.35
(Total energy costs in cents	R2	0.92	0.19	0.42	0.47	0.44	0.28	0.80	0.19	S	0.29	0.54	0.44	WD	S	S	0.24	0.33	WD	0.92	0.42	0.45	NA
per garment cleaned)	R3	0.48	0.16	0.23	0.36	0.30	0.16	S	0.17	S	0.18	0.41	NA	WD	S	S	0.25	S	WD	0.48	0.40	S	0.32
		0.66	0.18	Average		0.37	0.20	0.58	0.18	0.38	0.20	0.45	0.35	0.35	0.41	0.43	0.25	0.33	0.38	0.66	0.41	0.43	0.33
Energy/Turnover	R1	8.10	2.07	4.94	6.05	5.59	6.59	8.10	2.26	4.42	2.07	7.08	4.05	7.33	5.53	5.91	5.89	4.15	5.65	7.41	6.66	6.83	5.13
(Total energy costs as a	R2	12.32	2.90	5.81	6.68	6.21	5.67	7.90	2.90	S	3.86	9.38	5.18	WD	S	S	3.49	3.98	WD	12.32	7.18	6.43	NA
percentage of financial	R3	8.50	2.54	5.07	5.65	5.36	6.22	S	2.54	S	3.00	8.50	NA	WD	S	S	4.01	S	WD	6.88	6.60	S	5.13
		8.87	2.57	Average		5.7	6.16	8.00	2.57	4.42	2.98	8.32	4.62	7.33	5.53	5.91	4.46	4.07	5.65	8.87	6.82	6.63	5.13
kWh Energy/garment	R1	6.88	1.70	3.83	4.56	4.26	2.4	6.2	2.1	4.9	1.7	6.9	2.7	3.9	2.6	5.6	3.4	4.9	4.8	6.0	6.6	3.7	4.2
(Total kWh of energy	R2	10.90	2.17	5.26	5.51	5.38	4.1	10.9	2.2	S	2.9	6.1	5.3	WD	S	S	3.1	4.4	WD	9.6	5.9	4.5	NA
consumed per garment	R3	6.18	2.16	3.70	4.49	4.05	2.6	S	2.2	S	2.5	5.1	6.2	WD	S	S	3.4	S	WD	4.7	5.8	S	4.1
		8.53	2.14	Average		4.6	3.0	8.5	2.1	4.9	2.4	6.0	4.7	3.9	2.6	5.6	3.3	4.7	4.8	6.8	6.1	4.1	4.2
Kg GHG/garment	R1	5.02	0.77	2.09	1.62	1.81	0.78	2.82	0.92	2.09	0.77	5.02	2.25	1.33	1.25	1.71	1.29	1.56	1.44	2.38	1.94	1.64	1.65
(Kg of GHG emitted per	R2	3.59	0.92	2.07	1.97	2.02	1.36	3.52	0.92	S	1.49	2.99	2.14	WD	S	S	1.14	1.39	WD	3.59	1.83	1.88	NA
garment cleaned)	R3	3.80	0.89	1.86	1.67	1.78	1.04	S	0.89	S	1.20	2.38	3.80	WD	S	S	1.42	S	WD	1.89	1.73	S	1.65
		3.46	0.91	Average		1.8	1.06	3.17	0.91	2.09	1.15	3.46	2.73	1.33	1.25	1.71	1.28	1.48	1.44	2.62	1.83	1.76	1.65
Perc waste	R1	32.44	250	85	113	102	154	53	85	50	160	42	52	155	37	32	84	224	81	56	109	250	101
(Number of garment	R2	23.16	200	91	115	102	92	39	172	S	160	42	42	WD	S	S	100	141	WD	23	110	200	NA
cleaned per litre of waste	R3	41.60	332	177	116	146	332	S	175	S	160	42	NA	WD	S	S	131	S	WD	109	110	S	112
		32.44	225	Average		104.7	193	46	144	50	160	42	47	155	37	32	105	183	81	63	110	225	107
Waste costs	R1	12	1	3.9	5.3	4.7	2.95	2.44	3.68	4.70	4.81	7.07	1.94	1.37	6.64	5.21	2.97	0.89	4.12	10.21	4.29		12.33
(total waste cost in cents	R2	17	1	5.2	6.0	5.6	4.92	7.10	1.03	S	2.71	10.50	4.92	WD	S	S	1.86	4.98	WD	16.75	4.77	1.50	NA
per garment cleaned)	R3	5	2	3.5	3.1	3.2	5.00	S	1.90	S	NA	NA	NA	WD	S	S	2.60	S	WD	4.30	2.60	S	2.80
		10.4	1.4	Average		4.6	4.29	4.77	2.20	4.70	3.76	8.79	3.43	1.37	6.64	5.21	2.48	2.94	4.12	10.42	3.89	1.50	7.56
Waste Management Practic	R1	0	100	56	87	74	22	15	54	100	0	100	100	71	100	100	100	100	100	100	100	0	100
(Total recycling waste	R2	22	100	83	79	81	22	74	100	S	100	100	100	WD	S	S	100	88	WD	68	38	100	NA
management cost as a	R3	44	100	NA	72	72	NA	S	NA	S	NA	NA	NA	WD	S	S	44	S	WD	NA	NA	S	100
		22	100	Average		79.0	22	44	77	100	50	100	100	71	100	100	81	94	100	84	69	50	100

* energy cost have been adjusted for a average 8% increase in energy charges following the introduction of the GST, no other price changes have been allowed for

Table 6-20 Overview of performance

6.3.1 Raw Individual Indicator Graphs

6.3.1.1 Turnover



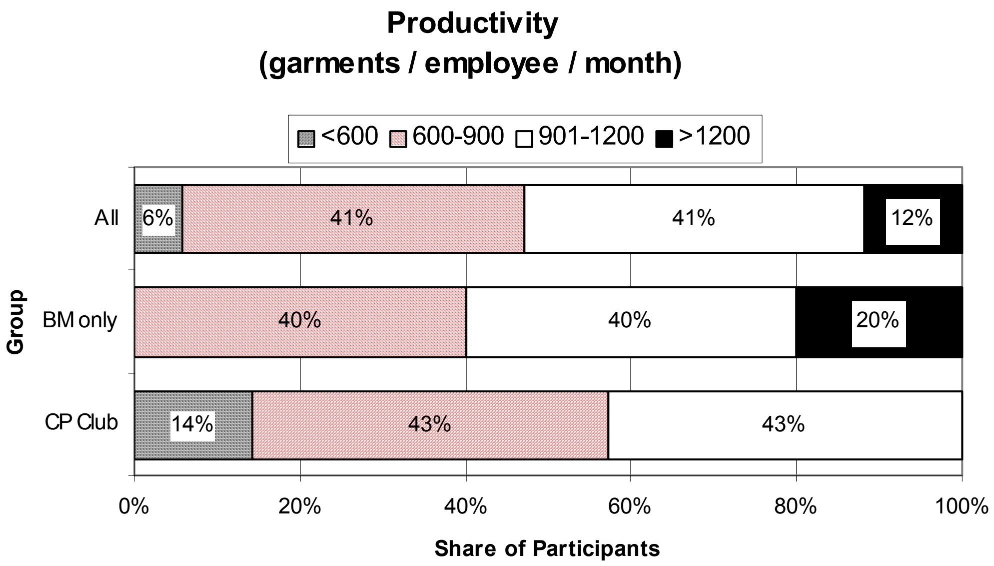
Graph 6-1: Production

Graph 6-1 shows that a relatively greater proportion of the larger businesses participated in the Cleaner Production club, and that the Club also had a greater spread of business size. Only 43% of the Cleaner Production Club participants cleaned less than 4001 garments per month, while 80% of the Benchmarking Only participants fell within this category.

Group	Average Performance on Indicator
Cleaner Production Club	6,423 garments / month
Benchmarking Only	2,563 garments / month

Table 6-21: Group comparision on production

6.3.1.2 Productivity



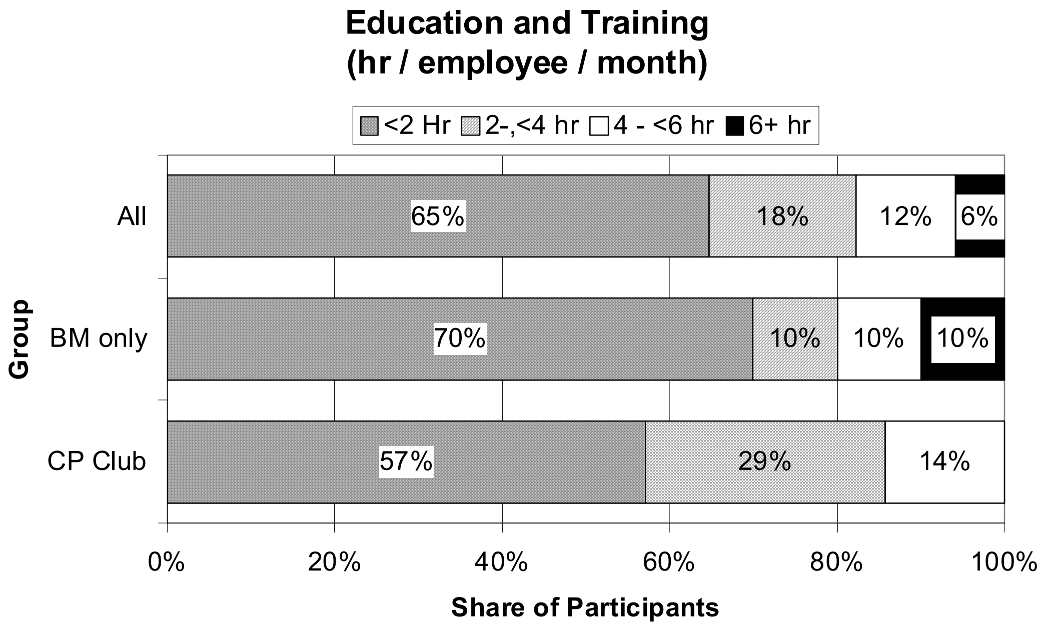
Graph 6-2: Employee productivity

The owners, if they worked the majority of their time at the operations, are classified as an employee for the purposes of calculating productivity. The higher score represents better performance. The above graph indicates that businesses that participated in the Benchmarking Only program had better productivity when measured on the number of garments cleaned per staff member than the Cleaner Production Club. The two highest-ranking businesses participated in the Benchmarking Only group, while the three lowest ranking businesses participated in the Cleaner Production Club. A logical explanation for this is that the smaller businesses and the benchmarking group had a larger share of employees being owners, with a likely above average contribution (eg, working longer hours, greater experience and incentive to work more efficiently)

Group	Average Performance on Indicator
Cleaner Production Club	849 garments / employee / month
Benchmarking Only	1,057 garments / employee / month

Table 6-22: Group comparison on employee productivity

6.3.1.3 Education and Training



Graph 6-3: Education and training

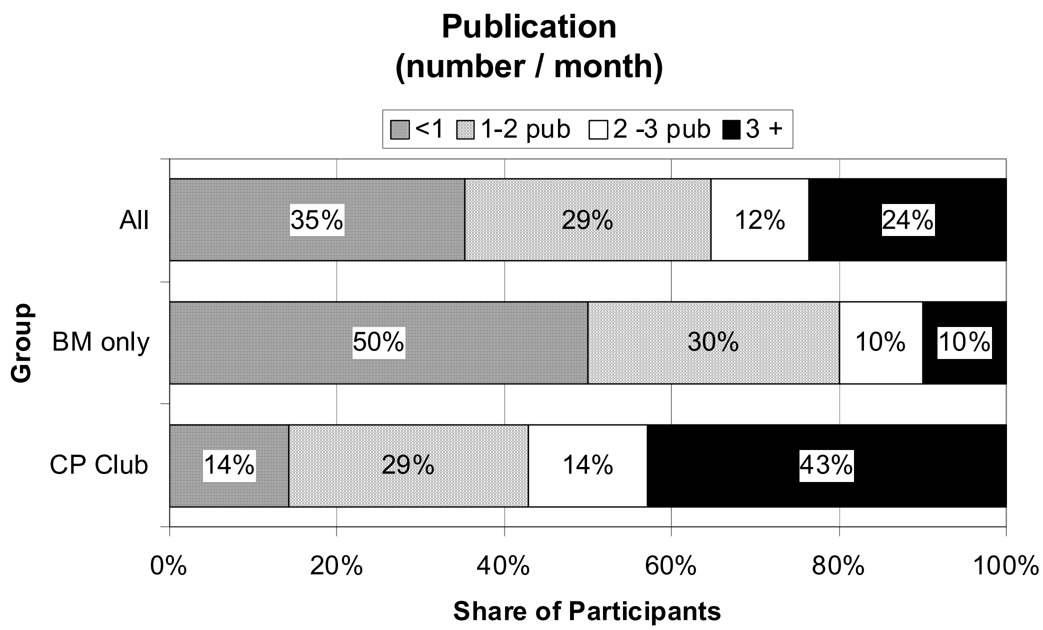
Graph 6-3 reports the level of education and training in hours per employee per month. The performance was relatively even between the two groups; note that a higher score represents a better performance.

The level of education and training, for business managers and employees reported by participants in the program ranged from zero to 6.7 hours per month per employee, with an average of 1.77. This equates to a range of 0 to 9.7 days and an average of 2.6 days per employee per year. This is similar to UK data which report that half the employees received less than 2.1 training days per year, with values ranging from zero to more than 20 days per year (Process Industry Centre for Manufacturing Excellence 2001).

Group	Average Performance on Indicator
Cleaner Production Club	1.5 hours / employee / month
Benchmarking Only	2 hours / employee / month

Table 6-23: Group comparision on level of education and training

6.3.1.4 Publications



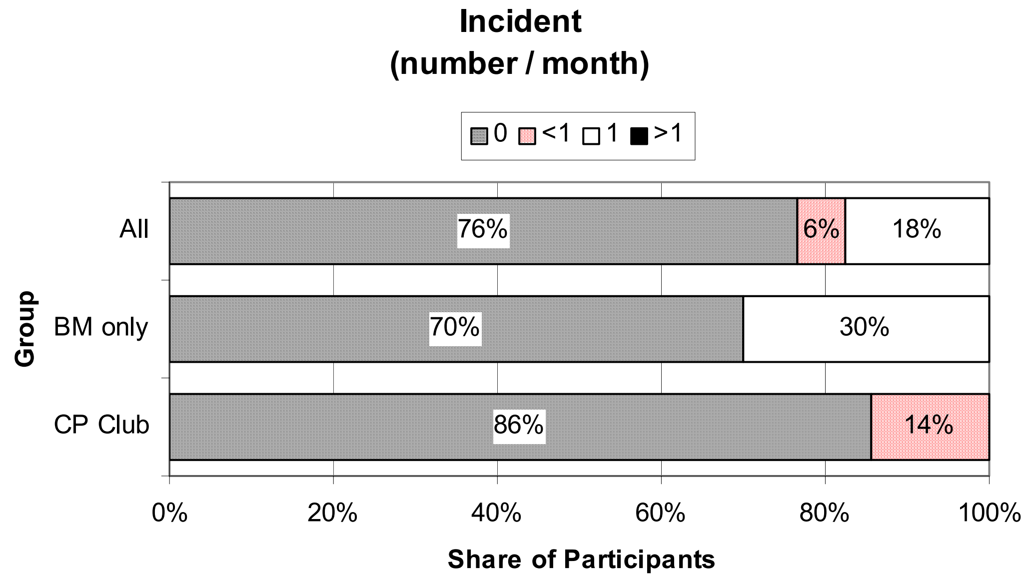
Graph 6-4: Publications

Graph 6-4 reports the number of publications received by participants per month. Note that a higher score represents better performance. The result indicates that members of the Cleaner Production Club receive more publications than the Benchmarking Only group. This result could be influenced by business manager's definition of publication (whether industry specific or general industry/management style magazines) and poor record keeping or reporting.

Group	Average Performance on Indicator
Cleaner Production Club	2.6 publications /month
Benchmarking Only	1.9 publications /month

Table 6-24: Group comparision on publication

6.3.1.5 Environmental Incidents or Accidents



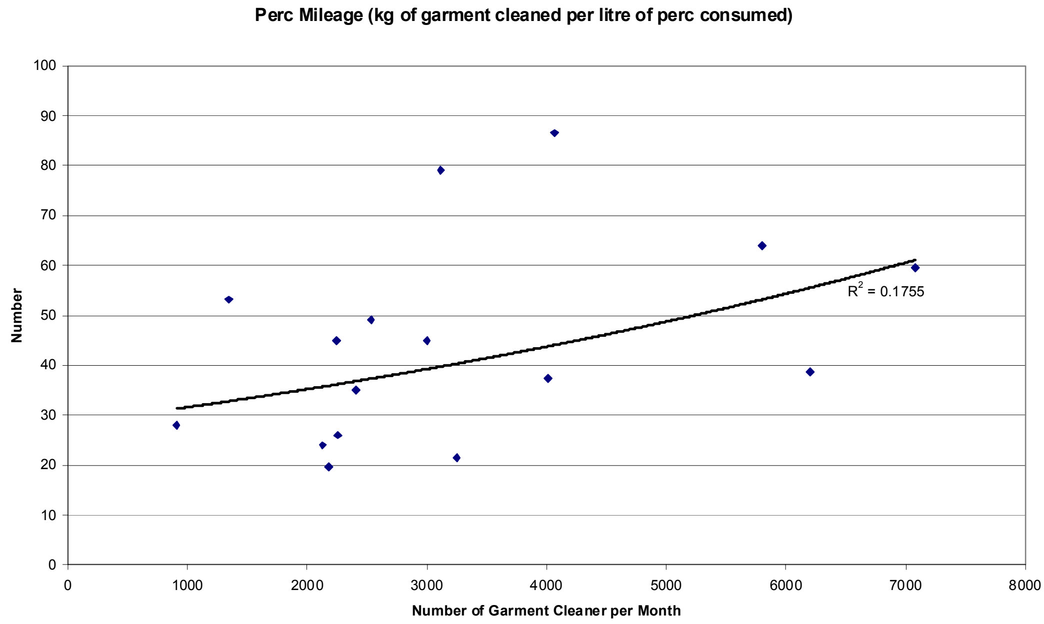
Graph 6-5: Incidents

Three quarters of all participants reported no incidents at their operation. Note that a lower score represents better performance. This low result could be partly caused by variations in the definition of an incident by individual business managers and poor record keeping. Alternatively, business managers are in general very hesitant to acknowledge that environmental incidents have occurred on the premises for fear of third parties obtaining this information. This leads to a self-reporting bias. However, four business managers reported that incidents had occurred at their premises and the results as reported were accepted in good faith.

Group	Average Performance on Indicator
Cleaner Production Club	0.1 incidents / month
Benchmarking Only	0.1 incidents / month

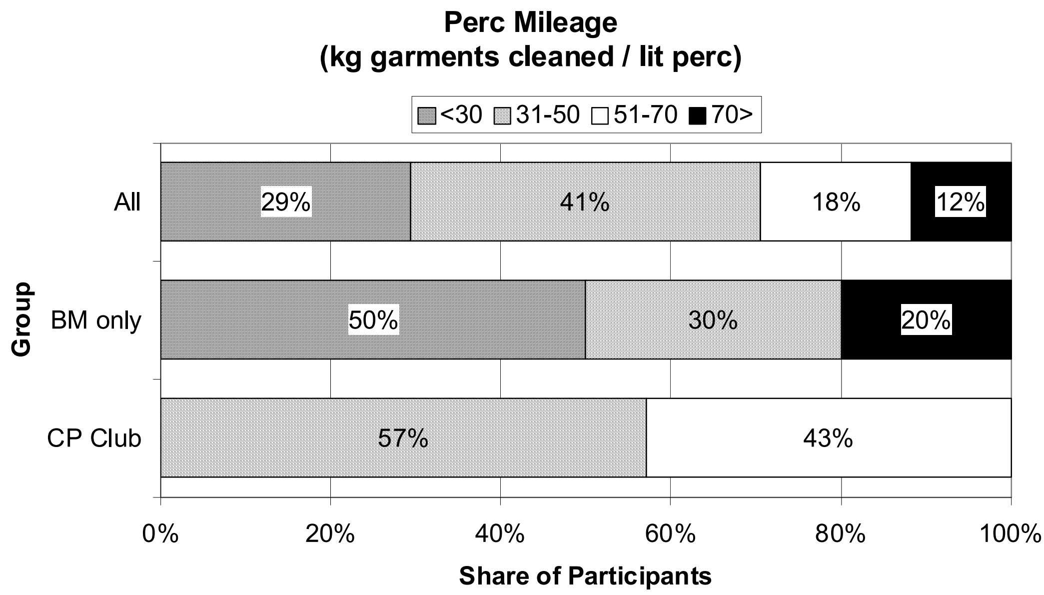
Table 6-25: Group comparision on incidents

6.3.1.6 Perc Mileage



Graph 6-6: Perc mileage

The relationship between the perc mileage and physical output as shown in Graph 6-6 is relatively weak. Note that a higher score represents better Eco-Efficiency. This result indicates a weak positive relationship between perc mileage and physical output. However, an inspection of the business with a physical turnover of between 2-2,500 garments identified a performance ranging from 20 to 50. Perc costs equate to 0.72% of the turnover on average and range from 0.34% to 1.35%. Because perc costs are a minor component of total cost and below the supposed threshold of 2% of turnover, it can be expected that management had paid limited attention to improving perc performance and therefore that a number of good housekeeping practices have not been identified or implemented.



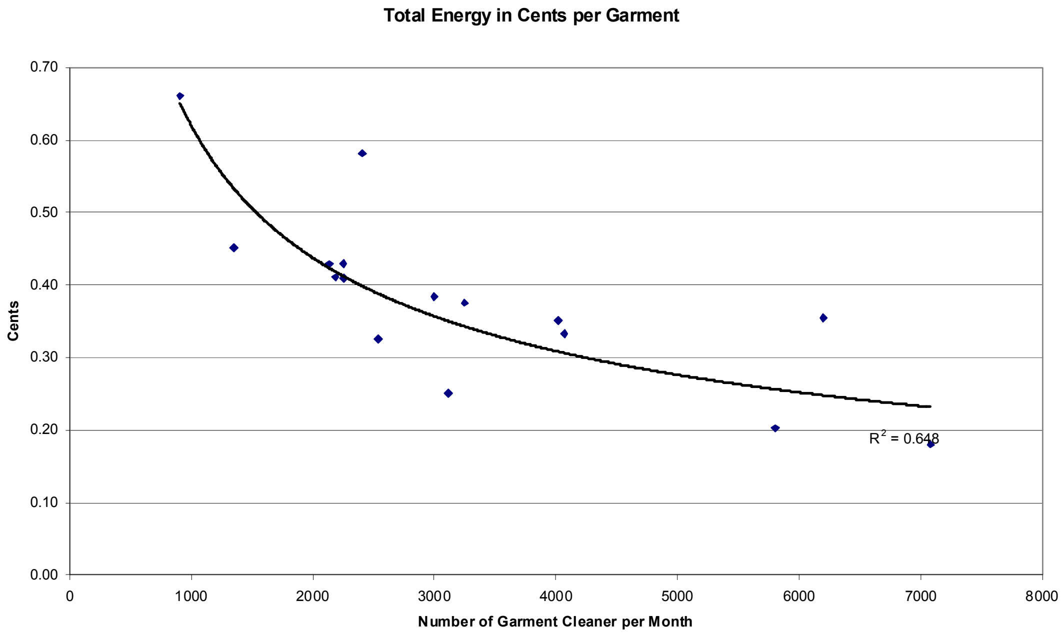
Graph 6-7: Perc mileage by group

Graph 6-7 indicates that while businesses in the Benchmarking Only group reported a greater spread of performances than the Cleaner Production Club.

Group	Average Performance on Indicator
Cleaner Production Club	52 kg garments cleaned / litre of perc
Benchmarking Only	49 kg garments cleaned / litre of perc

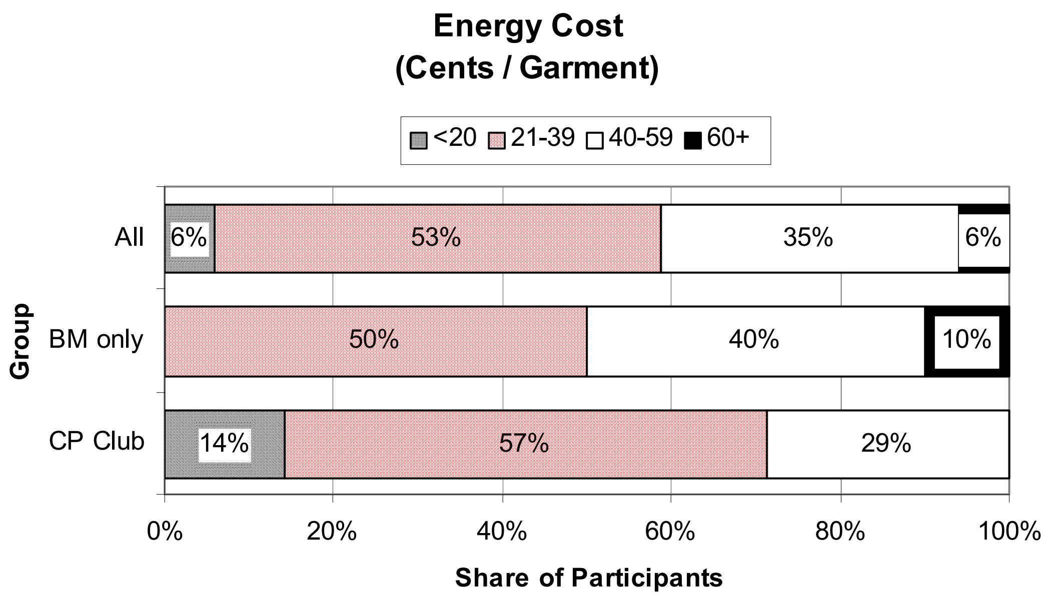
Table 6-26: Group comparison on perc mileage

6.3.1.7 Total Energy Costs in Cents per Garment



Graph 6-8: Energy costs

The relationship between total energy costs and physical output is shown in Graph 6-8. Note that a lower score represents better Eco-Efficiency. The relationship is relatively strong and proves to be significant. This result indicates a strong negative relationship between the energy costs in cents per garment and number of garments cleaned. Energy costs equate to 5.6% of turnover on average and range from 2.6% to 8.9%. The energy costs are a major component of total cost and well in excess of the 2% threshold (McGrath and Gilbert-Miller 1999) considered to trigger management attention and therefore a potential driver for Cleaner Production and Eco-Efficiency. It can therefore be expected that only a few good housekeeping practices are yet to be identified. The majority of business managers will need to investigate the more innovative Cleaner Production practices to further improve their energy efficiency. However, this data does indicate that the individual business managers can improve their energy efficiency considerably by implementing good housekeeping practices. The three businesses at approximately 3,000 garments per month ranges from 25 to 39 cents per garment, the two businesses at approximately 6,000 garment range from 21 to 35 cents per garment.



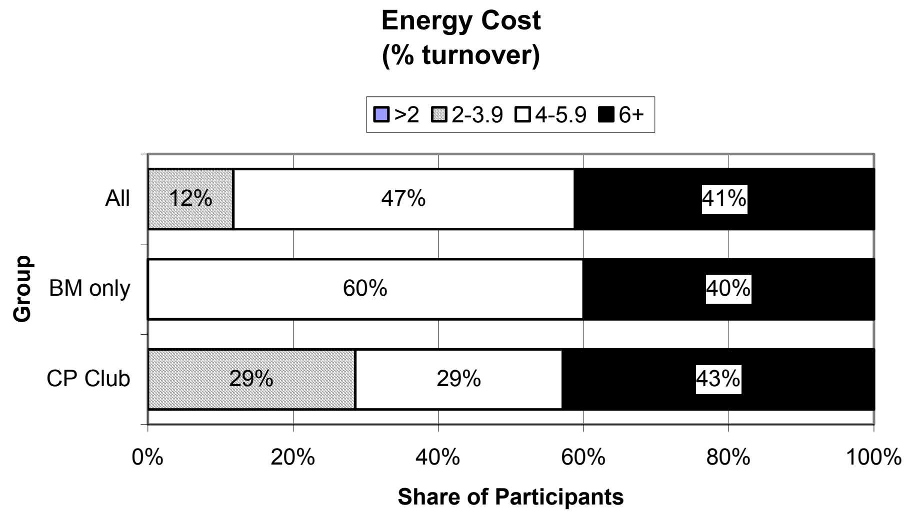
Graph 6-9: Energy costs by group

Graph 6-9 indicates that businesses in the Cleaner Production Club performed better than the Benchmarking Only group. However, due to the presence of economies of scale and the largest operators are in the Cleaner Production Club this would be expected. While the two businesses with the best (adjusted) energy efficiency were both in the Benchmarking Only group.

Group	Average Performance on Indicator
Cleaner Production Club	31 cents / garment
Benchmarking Only	41 cents / garment

Table 6-27: Group comparision on energy costs

6.3.1.8 Energy Cost as Percentage of $ Turnover



Graph 6-10: Energy costs as a percentage of $ turnover

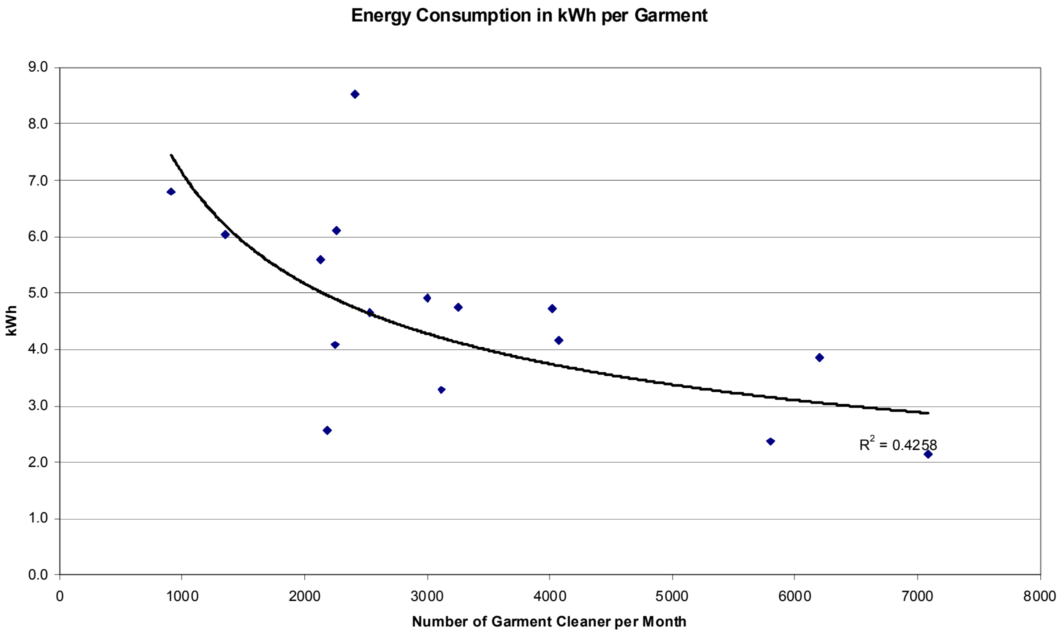
Graph 6-10 indicates that there was not a major difference between the two groups. Note that a lower score represents a better Eco-Efficiency. The price of drycleaning per garment charged by the participants[28] ranged from $4.45 to $8.67 per garment and would be expected to interfere with this result as an indicator of Eco-Efficiency. The variation was caused by a number of factors including the level of competition between individual drycleaning shops and the socio/economic status of clientele and business overheads including rental charges.

Group	Average Performance on Indicator
Cleaner Production Club	5.27% of turnover
Benchmarking Only	6.13% of turnover

Table 6-28: Group comparision on energy cost as % of turnover

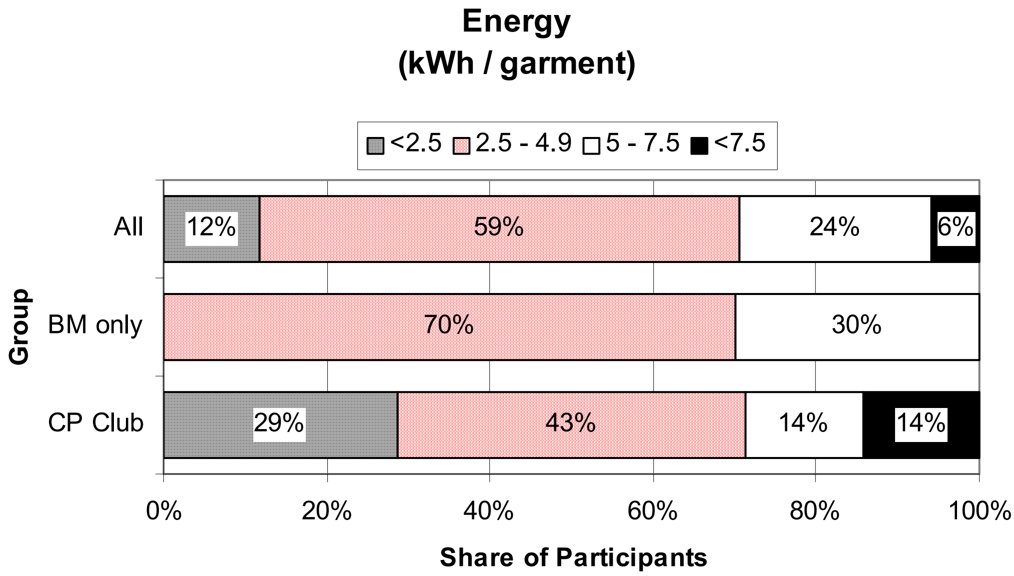
[28] This does not include the largest business whose average garment price was $2.61 on a much larger physical output.

6.3.1.9 Energy Consumption in kWh per Garment



Graph 6-11: Energy in kWh

The relationship between total energy usage in kWh and number of garments cleaned is shown in Graph 6-11. Note that a lower score represents a better Eco-Efficiency. The relationship is moderately strong and proves to be significant. This result indicates a negative relationship between the energy consumption and physical output, and was expected following the previous discussion of energy costs and physical output.



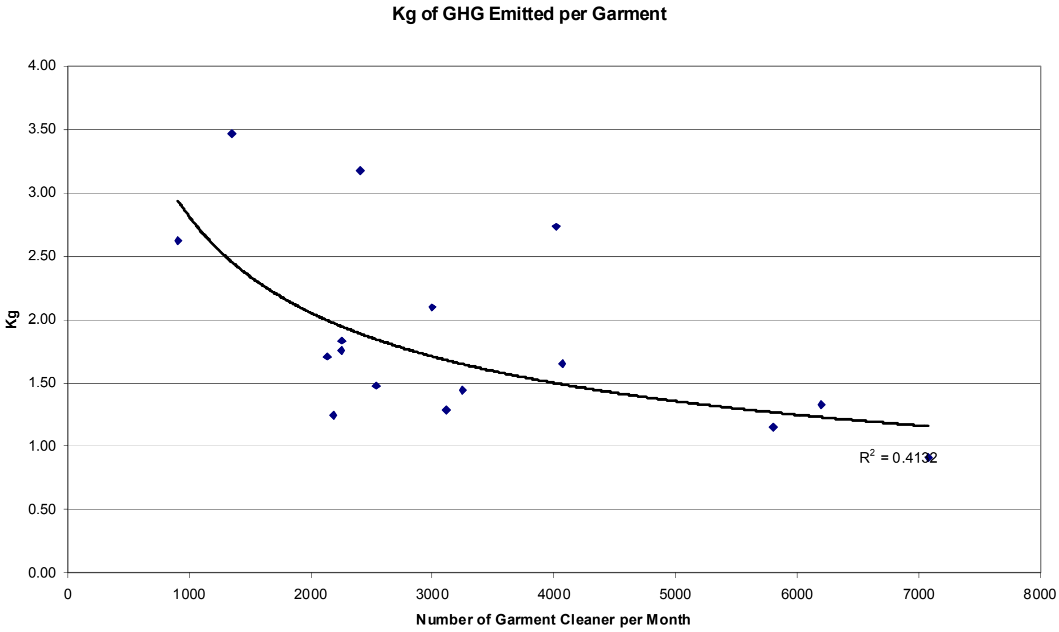
Graph 6-12: Energy kWh by group

Graph 6-12 indicates that the Cleaner Production Club members had a greater spread of performers containing both the lower and highest energy consumers per garment cleaned.

Group	Average Performance on Indicator
Cleaner Production Club	4.26 kWh consumed / garment
Benchmarking Only	4.85 kWh consumed / garment

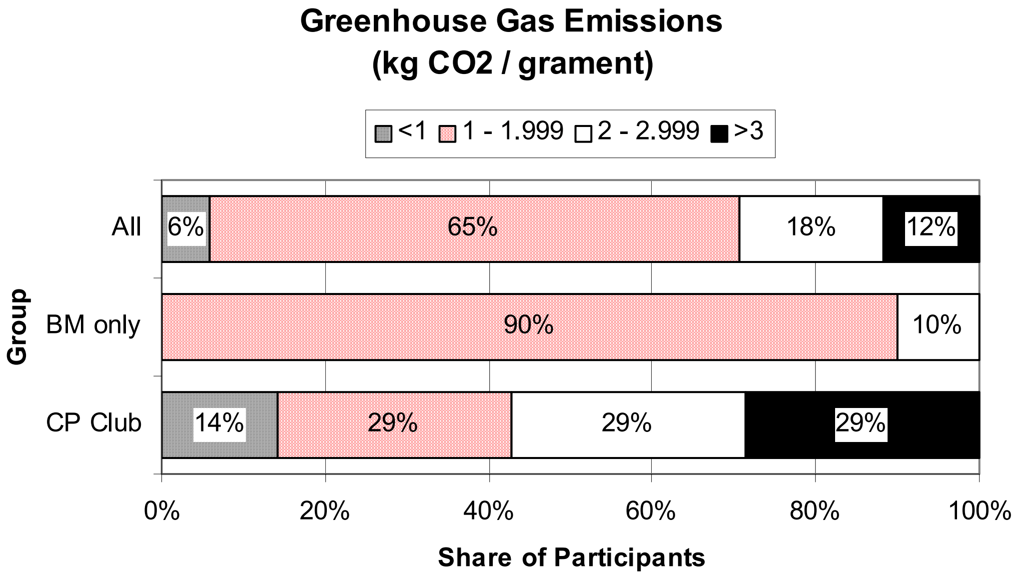
Table 6-29: Group comparision on kWh energy

6.3.1.10 Kg of Greenhouse Gases Emitted per Garment



Graph 6-13: GHG emissions

The relationship between greenhouse gases (GHG in kg of CO_2 equivalent) emitted and physical output is shown in Graph 6-13. Note that a lower score represents a better Eco-Efficiency. The relationship is moderately strong but does not prove to be significant. This result indicates a negative relationship between the GHG emissions and physical output, and was expected following the previous discussion of energy and physical output.



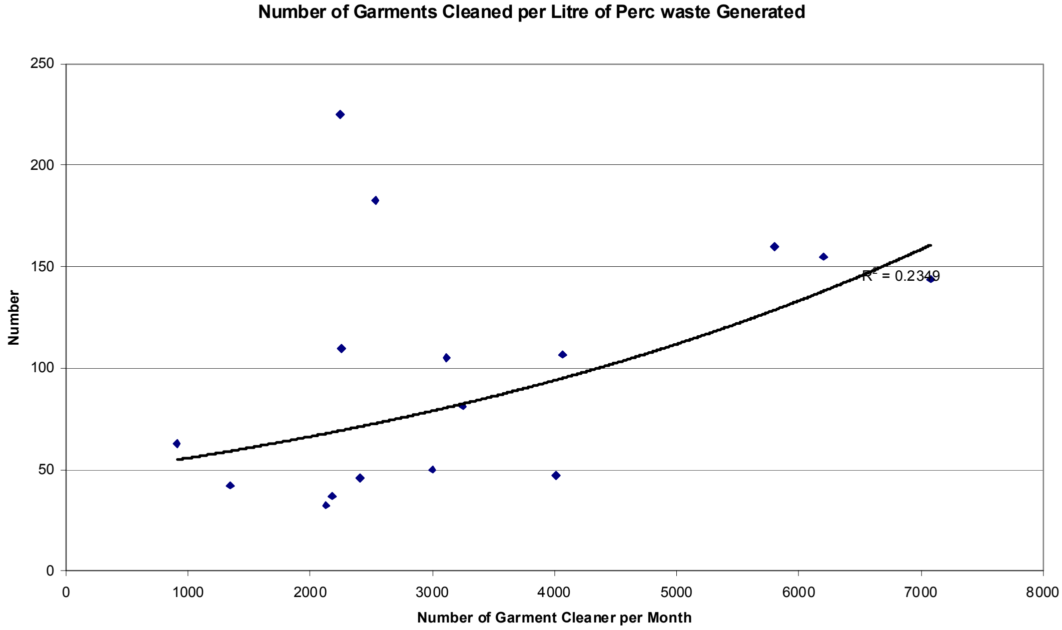
Graph 6-14: kg GHG per garment by group

Graph 6-14 is a similar result to the previous indicator, indicating that the Cleaner Production Club members had a greatest spread of performers containing both the lower and highest GHG emissions per garment cleaned.

Group	Average Performance on Indicator
Cleaner Production Club	2.01 kg CO_2 emitted / garment
Benchmarking Only	1.75kg CO_2 emitted / garment

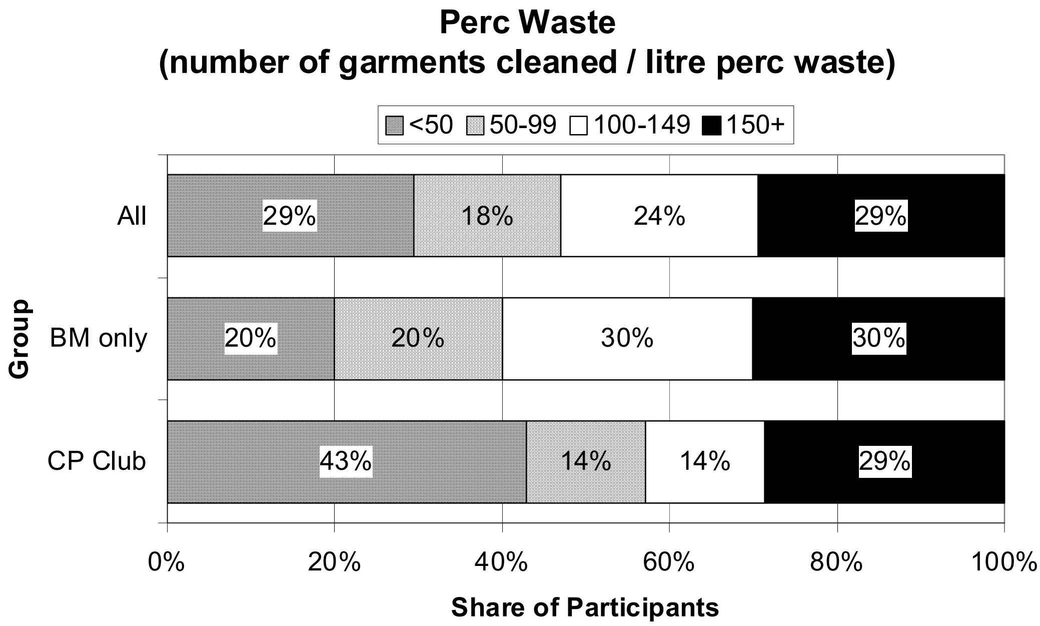
Table 6-30: Group comparision on greenhouse gasses

6.3.1.11 Garments Cleaned per Litre of Waste Perc



Graph 6-15: Perc waste generation

The relationship between perc waste generated and physical output as shown in Graph 6-15 is relatively weak. Note that a higher score represent better Eco-Efficiency. This result indicates a weak positive relationship between the numbers of garment cleaned per litre of waste perc generated. However, an inspection of the businesses with a physical turnover of 2,000 to 2,500 garments reveals a performance ranging from 32 to 225 garments cleaned per litre of waste. Perc waste costs equate to 0.38% of turnover on average and range from 0.1% to 0.72%. Perc waste costs are a minor component of total cost and less than the expected 2% threshold of turnover to drive the reduction in the amount of toxic waste generated. Because of this management has not seriously addressed the issue and therefore it can be expected that a number of good housekeeping practices have not been considered.



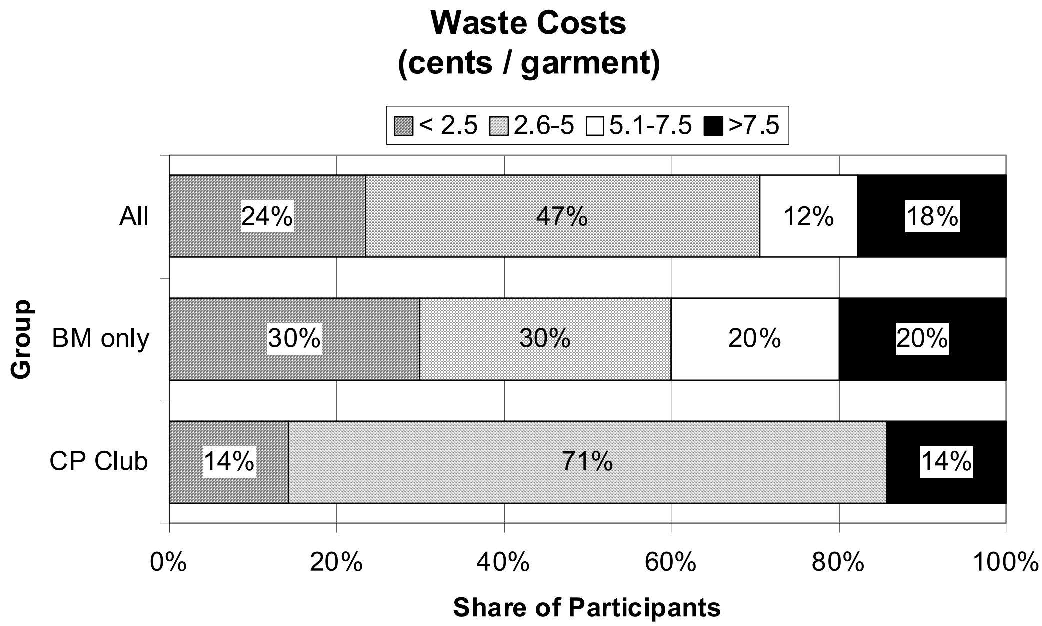
Graph 6-16: Perc waste generation by group

Graph 6-16 shows that there was little difference between the two groups in the performance standards of the level of generation of waste perc per garment cleaned.

Group	Average Performance on Indicator
Cleaner Production Club	118 garments cleaned / litre waste perc
Benchmarking Only	114 garments cleaned / litre waste perc

Table 6-31: Group comparision on perc waste generation

6.3.1.12 Total Waste Costs in Cents per Garment



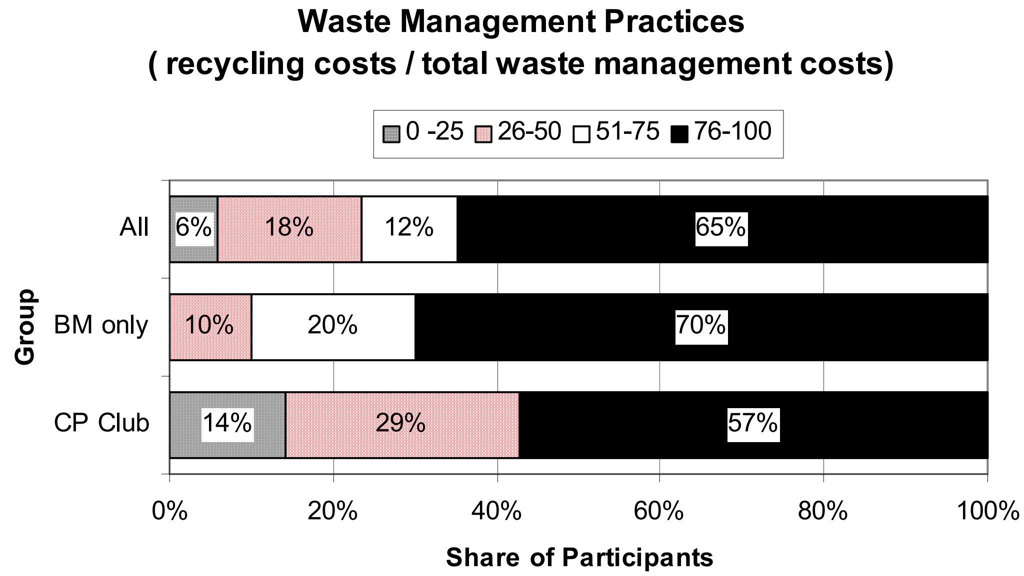
Graph 6-17: Waste costs by group

Graph 6-17 indicates some difference between the two groups, with the benchmarking group displaying both poor and superior performers. Note that a lower score represents better Eco-Efficiency. Total waste costs (including perc costs) equate to 0.75% of turnover on average and range from 0.1% to 1.8%. This range in results could be partly caused by poor record keeping or reporting. In some instances waste collection charges are incorporated in council or city rates, or as a component of body-corporate fees for rental or shopping centre fees and therefore overlooked as an environmental costs.

Group	Average Performance on Indicator
Cleaner Production Club	4.2 cents / garment
Benchmarking Only	4.8 cents / garment

Table 6-32: Group comparsion on waste costs

6.3.1.13 Waste Management Practices



Graph 6-18: Waste management practices between the two groups

The aim of this indicator was to promote the environmentally preferred methods of waste disposal. Note that a higher score represents more environmentally preferred waste management practice. This range in results could be partly caused by poor record keeping or reporting. In some instances waste collection charges are incorporated in council or city rates, or as a component of body-corporate fees for rental or shopping centre fees. Seven business managers claimed that all their waste is collected by waste recycling contractors (score equals 100), which supports this view.

Group	Average Performance on Indicator
Cleaner Production Club	69% of direct waste management costs, is the cost of recycling services
Benchmarking Only	79% of direct waste management costs, is the cost of recycling services

Table 6-33:Group comparision on waste management practices

6.3.2 Were the Critical Success Factors for Benchmarking Present?

6.3.2.1 Identification of performance gaps

Table 6-34 summarises the variations in the performance levels over the period of the data collection. This data shows a large variation in the performance levels of participating businesses.

Indicator	Performance (d)			
	Poorest	Best	Average	Fold difference
Education and Training (Hours/Employee)	0	6.7	1.8	N/A
Publications (Number/month)	0	4	1.8	N/A
Incidents (Number/month)	1	0	0.2	N/A
Perc Mileage (a)	20	87	44	4.4
Perc Waste Generation (b)	32	225	105	7
Energy (Cents / Garment)	66	18	37	3.7
Energy (% of Turnover)	8.87	2.57	5.7	3.5
kWh / Garment	8.5	2.1	4.6	4
Kg GHG / Garment	3.46	0.91	1.8	3.8
Waste Costs (cents/garment)	10.4	1.4	4.6	7.4
Waste management practices (c)	22	100	79	4.5

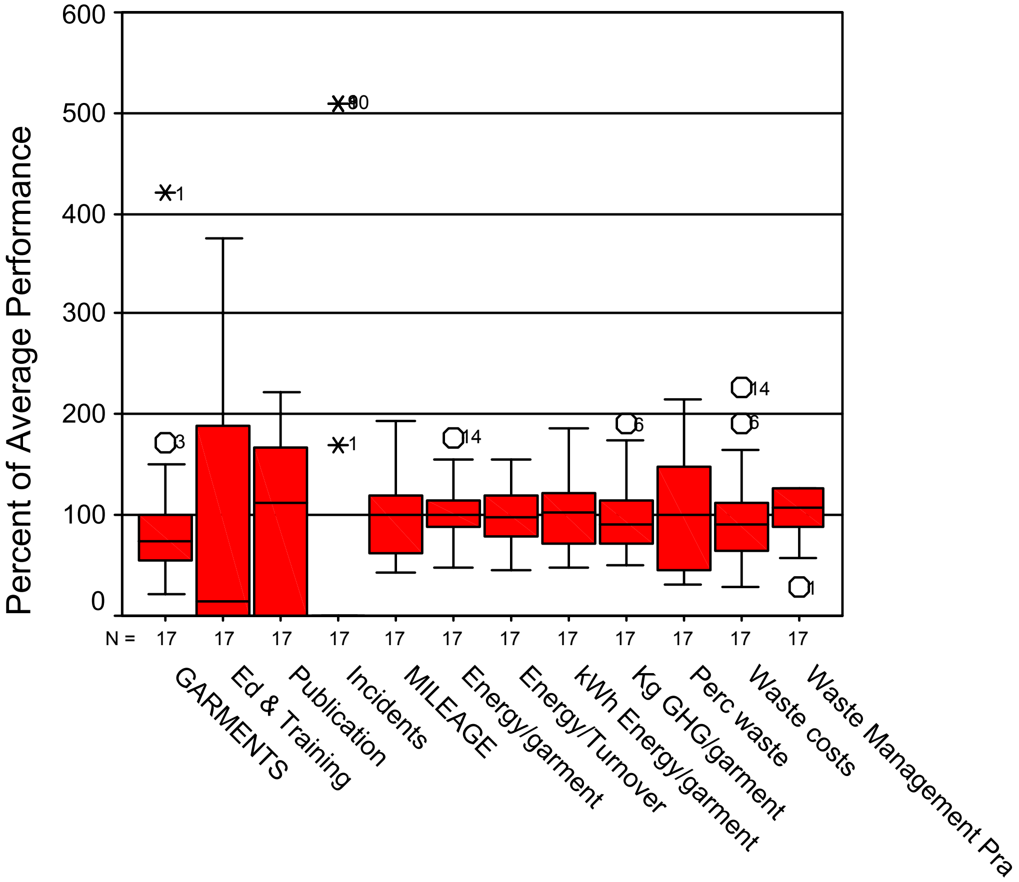
(a) Kg of garments cleaned per litre of perchlorethylene (perc) consumed

(b) Garments cleaned per litre of waste perc generated

(c) Recycling cost/total waste costs as %

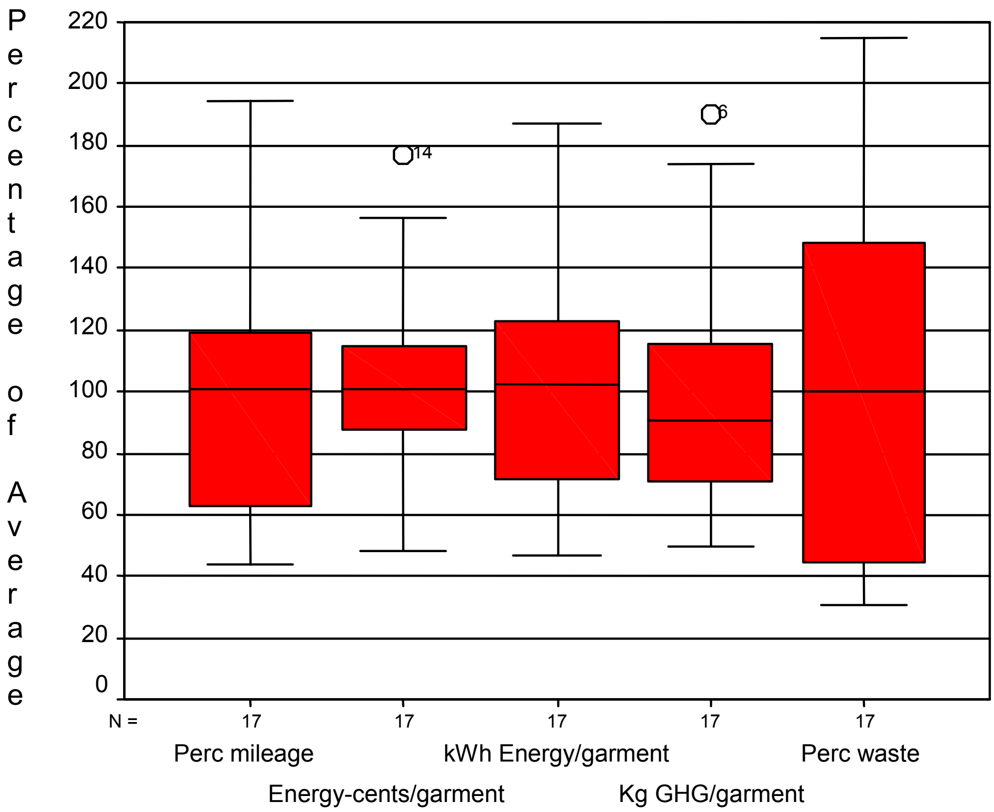
(d) Average performance for individual businesses, based on all available records for each business.

Table 6-34: Performance variations



Graph 6-19: Performance variation – all indicators

Graph 6-19 illustrates the large variation in performance between participants. It also shows that energy indicators have the lowest variation. Graph 6-20 includes the most important indicators in greater detail.



Graph 6-20: Main indicator performance variations

6.3.2.1.1 Cause of Performance Gaps

These performance gaps were further investigated to determine if the variations in performance are caused by physical output (reflecting economies of scale) or by other factors. These other factors include not only management and work practices, as well as business culture, but also the type of services offered (e.g. delivery, same-day service etc.), layout of equipment, age and make of the drycleaning machine, boiler fuel source, percentage of steam pipes lagged, and the amount of 'other activities' such as alteration and laundry services provided by the business. These results (with the large operator removed i.e. n=16) are presented in Table 6-35.

Indicator	R^2 (R^2 if n=17)	Direction of relationship with physical output	Cause of Variation (%)	
			Physical Output	Other Factors
Education and Training	0.067 (0.008)	positive	7	93
Publications	0.108 (0.058)	positive	11	89
Incidents	0.004 (0.012)	positive	0	100
Perc Mileage (a)	0.176 (0.123)	positive	17	83
Energy in Cents / Garment	0.645 (0.650)	negative	65	35
Energy as % turnover	0.493 (0.251)	negative	49	51
kWh / garments	0.424 (0.404)	negative	42	58
Kg GHGs / Garment	0.409 (0.444)	negative	41	59
Garment/ Perc waste	0.232 (0.290)	positive	23	77
Waste costs	0.465 (0.297)	negative	47	53
Waste management	0.050 (0.531)	negative	5	95

Table 6-35: Cause of performance variations

These results are achieved through the calculation of the R^2 value, which indicates the amount of variation in the independent variable (physical output) caused by variations in the dependent variable (management activity, resource use or waste generation). These results are important, because if physical output creates the majority of the variation in performance, business managers would be expected to have less ability to improve performance through good housekeeping and minor technology modification practices, particular in the short term, and in these cases more innovative Cleaner Production solutions would be required. Alternatively, in situations where other management factors account for the majority of the variation in performance, priority should be directed at investigating ‘good housekeeping practices’ to improve performance. However, in the longer term the business managers must also be encouraged to seek more innovative solutions to maximise the likelihood of continuous improvement in Eco-Efficiency and the integration of Cleaner Production into the general management tasks of the business.

Table 6-35 shows that in regard to perc mileage and perc waste generation the major cause of variation is due to factors other than the physical turnover of the business. This indicates the size of operation is ‘no excuse’ for poor performance in the majority of businesses. Energy indicator reported in cents per garment cleaned was the only indicator where greater than 50 percent of the variation in Eco-Efficiency can be attributed to the size of the business

6.3.2.1.2 Ranking Across Indicators

The data was further interrogated to identify if individual business managers were better in some areas of Eco-Efficiency than others, as this variation is promoted as an incentive for business managers to participate in benchmarking programs and capacity building activities in general. If this is the case there are likely to be indicators where business managers can learn from their peers and other areas where they can teach their peers (Ogden 1998; Wiarda and Luria 1999). This situation may reflect that business managers had paid greater attention to some elements of their operations than to others, and reflects past experience and practices of the business or reflect plant improvement. The data for the five indicators considered as being the most reliable and consistent are shown in Table 6-36 below.

Company Code	Business's Ranking on Indicator					Rankings*	
	Training	Pub	Mileage	Waste	Energy	Highest	Lowest
CPC1	7	9	7	5	2	2	17#
CPC2	3	2	5	12	9	2	12
CPC3	7	9	11	8	3	3	17#
CPC4	7	3	7	14	11	3	17#
CPC5	2	1	2	1	1	1	2
CPC6	7	9	5	15	12	5	17#
CPC7	6	5	11	13	5	5	13
BM1	7	9	10	4	8	4	17#
BM 2	7	9	17	16	14	14	17
BM 3	7	9	14	17	16	14	17
BM 4	7	9	1	9	4	1	17#
BM5	4	5	4	3	6	3	6
BM 6	7	9	15	10	10	10	17#
BM7	7	8	13	11	17	11	17
BM8	5	5	15	6	13	5	15
BM9	1	3	7	2	14	1	14
BM10	7	9	3	7	7	3	17#

Table 6-36: Ranking Across Indicators

*If a business scored equal poorest on an indicator it received a ranking of 17 to signify that no business had a poorer result on that indicator. Where this has occurred, the ranking is marked with a # sign. This only occurred on education and training and publication indicators.

These results indicate that some business managers did manage some environmental and management issues in their businesses more effectively than others. Some were however poor performers across the board, while others were good across the board, as shown by a strong correlation between energy efficiency, resource efficiency and lower waste generation. The lowest, best ranking any particular business achieved was fourteen, out of seventeen participants. Nine of the seventeen businesses scored a ranking of three or better in at least one of the indicators and thirteen scored better than five.

6.3.2.1.3 *Economies of Scale*

This section describes the identification and allowance for economies of scale (if they are present). The first stage of this process involves determining if there is a significant correlation (at a level of 0.05 between physical output and the list of indicators calculated). These results, reported in Table 6-37 were calculated using SPSS on first round of data, and the overall results only and removed the large organisation[29].

Indicator	Round One		Overall	
	Corr.	Sig.	Corr.	Sig.
Ed & Training (hours/employee/month)	0.151	No	0.224	No
Publications (number/month)	0.290	No	0.313	No
Incidents (number/month)	0.012	No	0.061	No
Mileage (kg garments cleaned/ lit perc)	0.370	No	0.395	No
Energy cost/garment (cents/garment)	-0.830	Yes	-0.754	Yes
Energy cost/turnover ($ of $ turnover)	-0.616	Yes	-0.622	Yes
kWh Energy/garment (kWh/garment)	-0.713	Yes	-0.639	Yes
Kg GHG/garment (kg $CO^{2\ equi}$/garment)	-0.543	Yes	-0.565	Yes
#Perc waste (garments cleaned/litre waste perc)	NA	NA	0.415	No
Waste costs (total waste costs in cents/garment)	-0.328	No	-0.569	Yes
Waste Management Practices (recycling costs/total waste costs as percentage)	-0.494	No	-0.223	No

Table 6-37: Correlations with physical output

The perc waste indicator reported as the number of garments cleaned for each litre of waste perc generated was added for the second and third rounds of data only.

The four energy indicators are the only indicators for which physical output had a significant correlation with the performance levels from the first round

[29] If the largest business, which is 2.2 times the size of the next largest business is included, the correlation changes and the function representing the industry average performance curves changes, and the performance of the large business is calculated to fall from 17 to 1.3 cents per garment a value which appears unrealistic.

of data. Furthermore, there was a significant correlation between all four: a result somewhat expected. Therefore, economies of scale are present and were allowed for only in respect to energy consumption expressed in cents per garment, as this was assessed to be the most attention gathering indicator and useful to operators/managers. This significant result means that energy cost targets need to be amended for economies of scale as detailed in Section 4.3.2.5.1. This adjustment calculated a performance target that varied depending on physical output, to generate more realistic and credible targets for individual small businesses[30]. This approach has the potential to boost the acceptance of benchmarking, because it directly considers the size of the business in calculating suitable benchmarks, while helping convince the majority of business managers that the size of their business is no reason or excuse for their current lower level of performance compared to their peers.

6.3.2.1.4 Adjustment of energy cost performance targets

1) The first stage of this process involved calculation of trendlines, their equations and R^2 values and then selecting the trendline with the highest R^2 value. These results and their equations are presented in Table 6-38.

Trendline Function Type	R^2 value	Equation
Log (semi log)	0.7425	$Y = -0.1646Ln(x) + 1.6709$
Power	0.6836	$Y = 22.746x^{-0.5265}$
Exponential	0.7397	$Y = 0.5767e^{-0.0002x}$
Linear	0.6893	$Y = -5E-05x + 0.5099$

Table 6-38: Strength of relationships and equations

In this case the log trendline produces the highest R^2 value (the differences in the R^2 value is only marginal for the semi log and exponential functions)

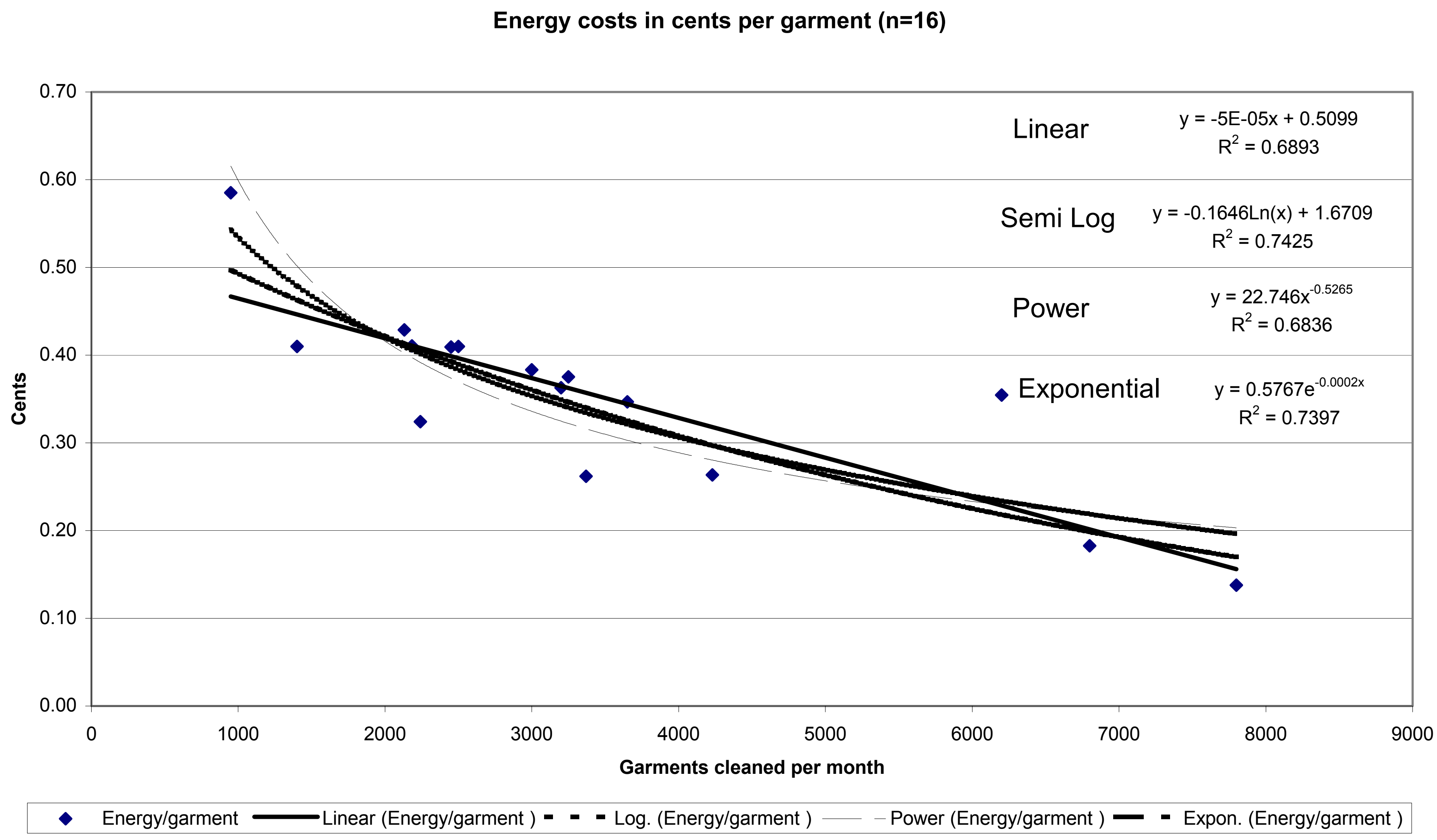
[30] The unadjusted average energy saving is 55% of current energy costs, while the adjusted value is 23% a value which appears a much more realistic figure and equates to an average of $3,384 per participant. An energy saving of 23 % equates to a 1.2 % reduction in total costs and an average 8% rise in net profit.

and following a visual inspection of the scatter plot and trendline it is selected as the best representation of industry best practice performance curve for different levels of physical outputs[31], [Y = -0.1646Ln(x) + 1.6709].

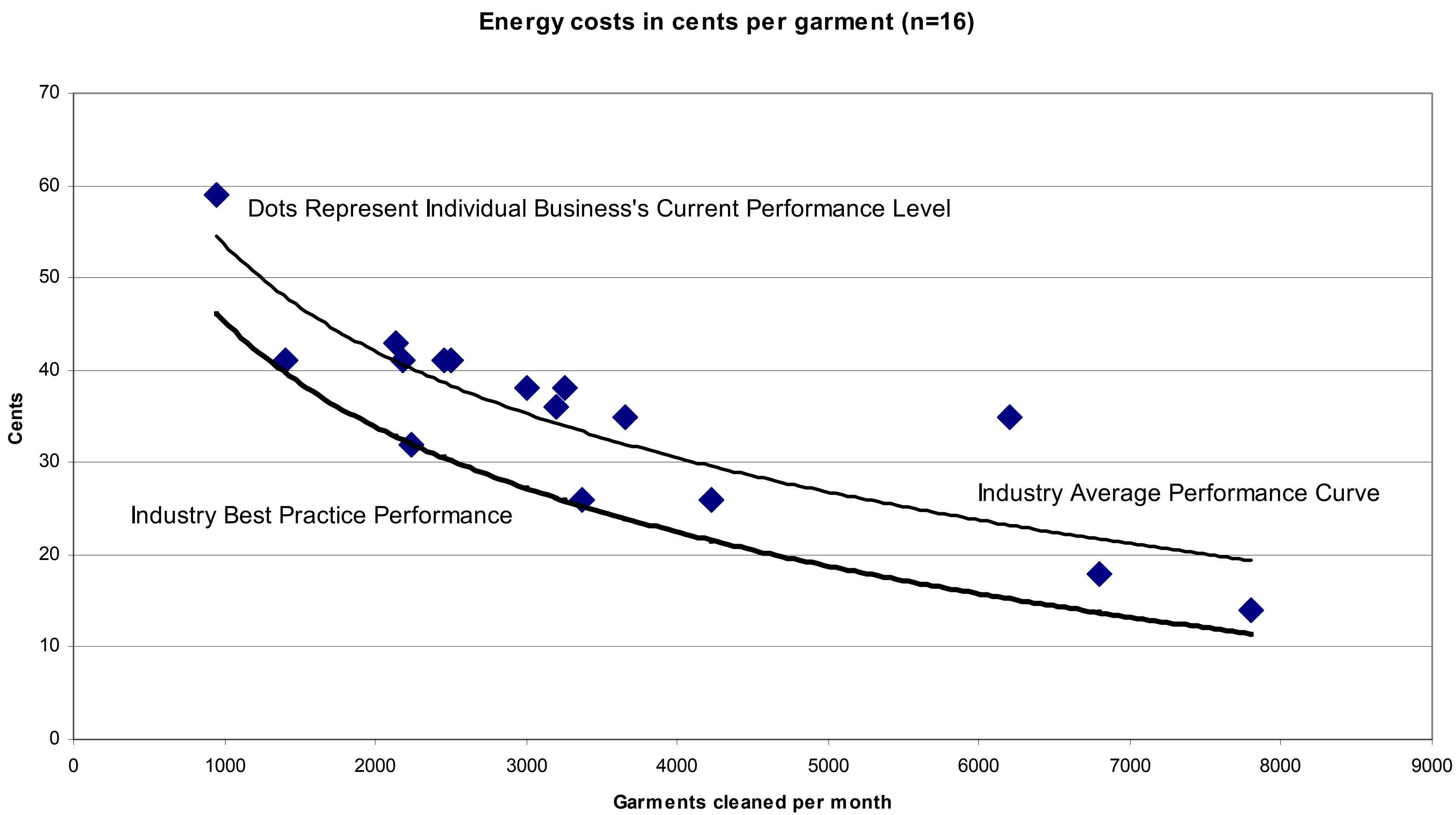
2) The equation for the (semi) log trendline is used to calculate average performance. The business with the best performance (greatest positive gap in relation to the trendline), is then selected to calculate the level of improvement required to bring all businesses up to industry best practice standard (see graph 6-21 and 6-22).

3) The results of this process are shown in Table 6-39. The following table only includes the log function for ease of explanation. The equation is then transferred to a spreadsheet that contains the current energy performance and output data. The equation is inserted and the average performance is calculated. The current performance is subtracted to give the best performing business. In this case business BM5 performance is 8.11 cents better than industry average. This value is then subtracted from the average performance for each level of physical output to generate industry best practice performance for each level of physical output.

[31] There is an argument to taper the improvement for the larger businesses as it would be anticipated that to reduce energy costs by 8.2cents per garment for a business whose costs is 50 cents would be more achievable than to save 8.2 cents when total energy cost is 20 cents. Furthermore, the larger businesses have currently lower energy costs, which are reflected in the calculation of industry best practice line and function. It is important that the line of best fit does not appear to cross the X or Y-axis in the performance ranges identified by the data. If it does the sample should be split otherwise the targets for the businesses at either end of the sample will be unrealistic.



Graph 6-21: Energy performance



Graph 6-22: Average and best practice performance

Company Code	Current energy performance (cents per garment)	Output (Garments cleaned / Mth)	Industry Average Performance	Industry Average less individual business's current performance	Industry best practice performance level altered to output	Performance gap to industry best practice performance level	$ saving per year if operate at industry best practice performance level	% energy savings using unadjusted benchmarks	% energy savings adjusted benchmarks	Percentage increase in net profit from operating at industry best practice
BM7	59	950	54.23	-4.77	46.12	-12.88	1468	76.27	21.83	4.87
CPC6	41	1400	47.85	6.85	39.74	-1.26	212	65.85	3.08	0.66
BM3	43	2132	40.93	-2.07	32.81	-10.19	2606	67.44	23.69	5.85
BM2	41	2184	40.53	-0.47	32.42	-8.58	2250	65.85	20.93	4.81
BM5#	**32**	**2240**	**40.11**	**8.11**	**32.00**	**0.00**	**0**	**56.25**	**0.00**	**0.00**
BM8	41	2450	38.64	-2.36	30.52	-10.48	3080	65.85	25.55	7.09
BM9	41	2500	38.31	-2.69	30.19	-10.81	3242	65.85	26.36	7.49
CPC4	38	3000	35.31	-2.69	27.19	-10.81	3891	63.16	28.44	8.56
CPC2	36	3200	34.24	-1.76	26.13	-9.87	3790	61.11	27.42	9.17
BM6	38	3250	33.99	-4.01	25.87	-12.13	4729	63.16	31.91	12.53
BM4	26	3370	33.39	7.39	25.28	-0.72	292	46.15	2.78	0.68
BM10	35	3650	32.08	-2.92	23.96	-11.04	4834	60.00	31.53	11.21
CPC7	26	4230	29.65	3.65	21.54	-4.46	2266	46.15	17.17	4.71
BM1	35	6200	23.36	-11.64	15.24	-19.76	14700	60.00	56.45	28.02
CPC3	18	6800	21.84	3.84	13.72	-4.28	3491	22.22	23.77	3.63
CPC5	14	7800	19.58	5.58	11.46	-2.54	2374	0.00	18.12	2.61
Average	**35.25**		**35.25**		**27.14**	**-8.11**	**3327**	**55.33**	**22.44**	**6.99**

#Business BM5 is the most energy efficient business adjusted for economies of scale, participants are listed by size

Table 6-39: Size adjustment for total energy costs

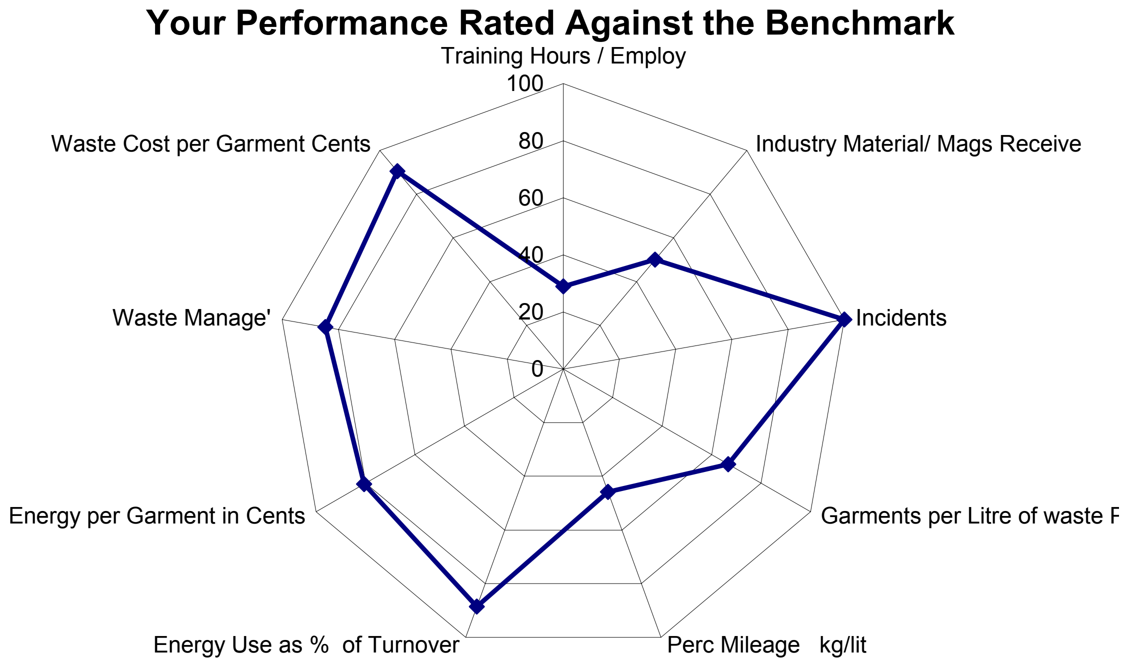
Centre of Excellence in
Cleaner Production

Drycleaners

Industry Benchmarking Program; Quarter Two Report

Summary Table (n=12)

	Garments Number Month	Training Hours / Employ	Industry Material/ Mags Receive	Incidents	Garments per Litre of waste Perc	Perc Mileage kg/lit	Energy Use as % of Turnover	Energy per Garment in Cents	Waste Manage'	Waste Cost per Garment Cents	Area of Web Covered
Best (Benchmark)	12000	12.7	6	0	200	79	2.9	18.88	100	0.34	
Poorest	579	0	0	1	23	22	12.3	91.54	22	11.40	
Average	3770	2.8	2.58	0.08	142	47.2	6.1	44	83	3.49	
Nearly Clean	**2829**	**3.67**	**3**	**0**	**141**	**48**	**3.98**	**33**	**88**	**1.4**	
% of Benchmark		**29**	**50**	**100**	**67**	**46**	**89**	**81**	**85**	**90**	**2.893**
% / 100		**0.290**	**0.500**	**1.000**	**0.666**	**0.458**	**0.886**	**0.806**	**0.846**	**0.904**	**1.428**
Rank (1 High)											
History (actual) To track how your performance changes over time											
Q2	**2829**	**3.67**	**3**	**0**	**141**	**48**	**3.98**	**33**	**88**	**1.4**	**49%**
Q1	**2240**	**3**	**2**	**0**	No Result	**50**	**4.2**	**32**	**100**	**1**	31%
Q3											
Q4											



The Centre of Excellence in Cleaner Production is Proudly Supported by the Waste Management & Recycling Trust Fund

Figure 6-3: Example of a benchmarking report

Centre of Excellence in Cleaner Production

DIA
DRYCLEANING INSTITUTE OF AUSTRALIA

curtin
University of Technology Western Australia

Company Name	Nearly Clean		Q2
Perc Calculator;			
The cost of perc to your business, and the potential cost savings from increasing your perc efficiency			
		WA (IBP)[1]	**Size Amended**
Required Information from Scorecard			
Perc Mileage [3] Benchmark		**76**	**71**
Number of Garments Cleaned / Mth		**2132**	
Litres of Perc Used / Mth		**40**	
Calculated Information			
Current Perc Mileage		**23.985**	
Current Perc Cost per Garment in cents [4]		**9.5**	
Expected Perc Cost per Garment in cents at Group Benchmark		**3.0**	**3.2**
Results			
Current Perc Costs per Month		**202**	
Expected Perc Cost per Month		**64**	**68**
Expected Perc Saving per Month		**138**	**134**
Perc Savings per Year in Adopting IBP	**$**	**$1,659**	**$1,605**

Energy Calculator;			
The cost of energy to your business; and the potential cost savings from increasing your energy efficiency.			
Required Information from Scorecard			
Industry Best Practice Energy Benchmark (cents/garment)		**14**	**33**
Number of Garments Cleaned / Mth		**2132**	
Energy Gas	**610**		
Electricity	**304**		
Diesel	**0**		
Petrol	**0**		
Total		**914**	
Calculated Information			
Current Energy Costs per garment in cents		**42.9**	
Results			
Current Energy Costs per Month		**914**	
Expected Energy Cost per Month		**298**	**704**
Expected Energy Saving per Month		**616**	**210**
Energy Savings per Year in Adopting IBP	**$**	**$7,386**	**$2,525**
Business Turnover		$185,436	$185,436
Current Net Profit [5]	24.04%	$44,579	$44,579
Annual Total Potential Savings		**$9,045**	**$4,131**
Saving over 5 Years		**$45,227**	**$20,653**
Net Profit After Implementation of IBP		$53,624	$48,709
Saving as a % of Net Profit		**20.29%**	**9.27%**

1) WA Industry Best Practice and Cleaner Production Club
2) UK ETBPP Environmental Technology Best Practice Program
3) Perc Mileage is the weight of clothes cleaned divided by litres of perc used- the answer will most likely be in the range between 10 and 80
4) Cost of perc estimated at $5 per litre; $3.20 purchase & $1.80 disposal
5) Net profit % is obtained from FMRC Business Benchmarks; the current data is for 1997 and 1998
Net profit for businesses with turnover of less than $150,000 is 33.5%
Net profit for businesses with turnover greater than $150,000 is 14.57%
Net profit for all businesses 24.04%

Disclaimer: The information provided here is based on data supplied by your business and available international benchmarking data. Curtin University of Technology shall not be liable to your drycleaning business, either directly or indirectly for any loss or damage or for any indirect, incidental or consequential loss arising from the information

Figure 6-4: Example of a potential economic benefits report

Included on the potential cost saving table (Figure 6-4) are two columns. The first contains unamended targets, which are derived directly from the scorecards and represent the actual best performance. The second contains the amended targets. Both are included to give the business manager a direct comparison with their peers and an indication of targets for the size of the business, and the outright benchmark. In this case the target would have been 14 cents and not 33 cents, the current performance is 42.9 cents, a target of 14 cents equates to a 65% reduction, a value most business would not consider realistic. This could also be an incentive for those approaching near best practice for their respective output to aim for more challenging targets. The targets included on these sheets and the potential cost savings are automatically calculated via formulas embedded in the spreadsheets. The overall result indicates the potential to increase net profit by 9.27 %, the unadjusted forecast increase in net profit is 20.29%.

6.3.2.2 Drivers to Reduce Performance Gap

Drivers to close the performance gap were not directly identified in this research, but inferred from this research and the current understanding of the drivers and barriers for Cleaner Production for small businesses, as well as through feedback from participants during the program. Overall from this research two drivers emerged as having a major influence on the implementation of Cleaner Production for participants. This is broadly in line with current thinking that economic benefits and regulatory concerns are the main drivers for improvements in environmental management including Eco-Efficiency for small business. Further, a wish to be seen as good corporate citizens is increasingly becoming a driver for change in small businesses. This is in the light of greater community concern over environmental quality as demonstrated by greater public participation in planning policy and decisions, and an indication from the environmental regulators that solvent regulations and licensing for drycleaners was being seriously considered by the Western Australian environmental regulator. Community concerns are increasingly being demonstrated through increases in insurance premiums, contaminated sites legislation, landlords making it increasingly difficult to obtain sites to operate and restriction on planning by-laws.

The next section discusses chemical use and energy specifically. The research indicated that economic benefits were the principal or key driver to close the energy performance gap. Risk management and influence of future environmental regulations were identified as the major drivers to improve perc mileage and reduce waste generation. The results also indicate that management had paid greater attention to energy costs in the past, because of the better fit to the industry average performance curve as measured with R^2 values. Furthermore, economic benefits will continue as a driver for energy efficiency with participants considering that there are further opportunities to reduce energy consumption (energy costs are on average 5.7 % of turnover). It is the opposite with perc consumption and perc waste generation in which the major cause of variation in performance was attributed to other factors including management practices (82% and 77% of variation in performance levels respectively). This is understandable as perc costs and perc waste disposal charges are on average 0.72% and 0.38% of turnover respectively, and these costs have therefore not trigged the business manager's attention to potential Eco-Efficiency improvements. This indicated that in the past there was no real driver for improvements in perc management, which is likely to have left many good housekeeping practices untouched. Furthermore, the attention paid to increasing perc efficiency and reducing perc waste generation in the workshops and expressed during the site visits, indicated that concern regarding the risk associated with using hazardous materials was increasing considerably within the Western Australian drycleaning industry for both environmental as well as safety reasons. In conclusion there is no firm evidence that drivers other than economic benefits were important to participants, although regulation (or fear thereof) was an underlying theme in the workshops with respect to perc and perc waste.

6.3.2.2.1 Promotion of Potential Cost Savings

Potential cost savings were reported as a potential increase in projected net profit. The areas in which these savings could be made were: 62% from improvements in energy efficiency; 28% from improvements in perc efficiency; and 10% from reduction in the generation of perc waste, again reflecting current cost structures. The potential economic benefits are reported in Table 6-40.

	$ Month	$ Year	% savings of resource use	% of $ savings
Energy	287	3444	22	69
Perc	94	1128	78	23
Waste	33	396	78	8
Totals	414	4968		100

Table 6-40: Potential economic benefits reported

Graph 6-23 splits the increase in net profit between the three main Eco-Efficiency areas and this graph shows that the potential to increase profits varies considerably between participating businesses. The potential increases in net profit for participants range from 1.1% to 33.6 %, with the average at 10.9 %.

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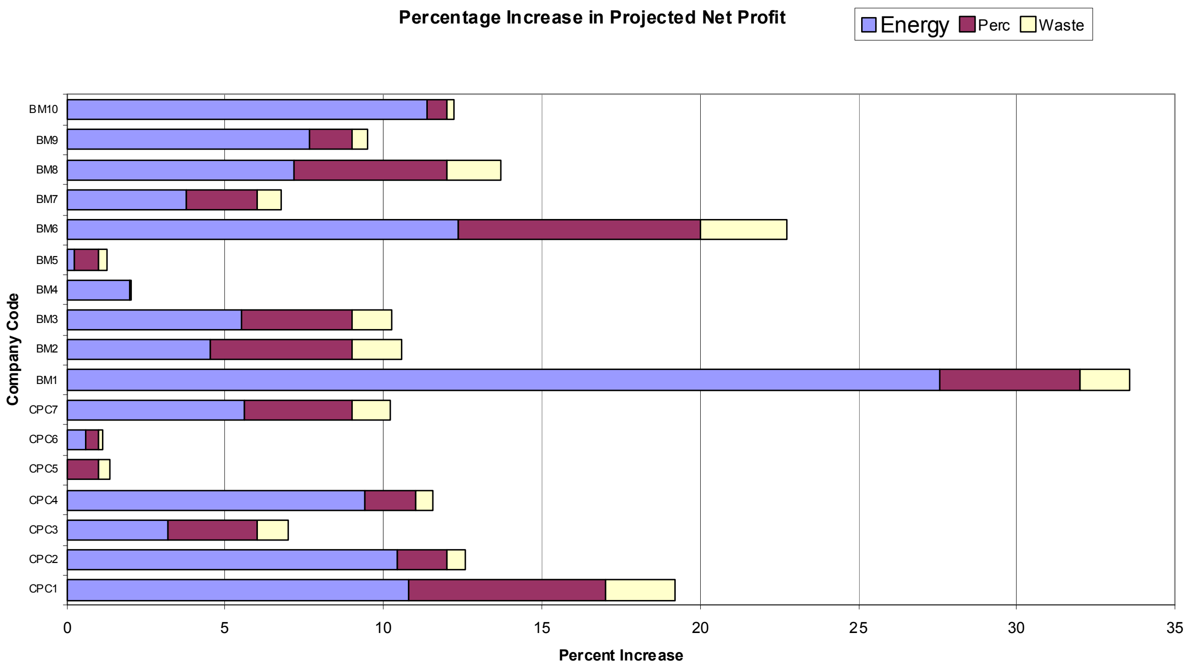


Graph 6-23: Percentage increase in net profit

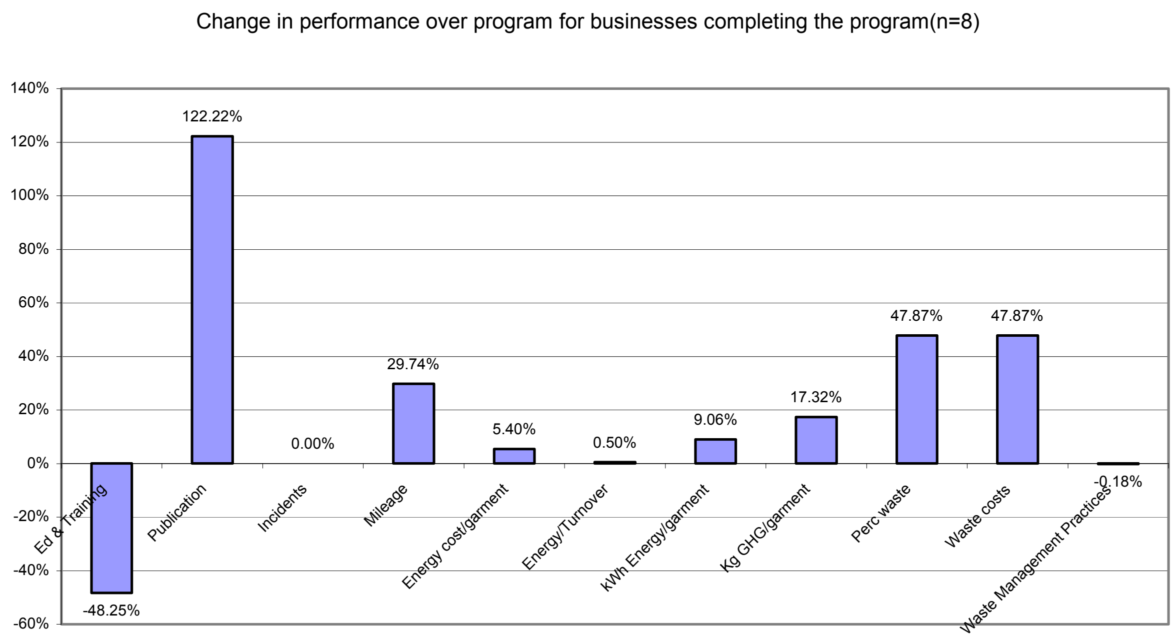
All participants further stated they were paying greater attention to operational procedures and environmental management accounting and were investigating additional practices, procedures and equipment to reduce these costs. This is in line with the general expectation, but quantitative data is not available to support this claim.

6.3.2.3 Tools to close the performance gap

Only one tool, Cleaner Production Action Plans following a Cleaner Production Assessment was implemented in this research, hence no quantitative results relative to other Cleaner Production tools are available to gauge its effectiveness. However, estimating the tool's effectiveness by an analysis of the results of the program gives some insight into its success. The rate of improvement is uneven between the businesses that completed the program indicating that the three critical success factors for benchmarking were not present for all businesses and the issue of business culture needs further investigation.

6.3.2.3.1 *Effectiveness of Benchmarking and Capacity Building*

Eleven key performance indicators were included on the original scorecard. All were considered beneficial from the original consultation with the DIA and the pilot testing. However, only four indicators turned out to impact on decision-making or created an interest in the capacity building activities. The remainder were either unreliable to collect or not of real concern to the drycleaning business managers participating in this research project.



Graph 6-24:Change in performance by indicator (round 1 to round 3)

Company Code Indicator		Group Averages CPC	 BM Only	 All
Output (Garments per month)	R1	9000	2605	5803
	R2	6267	2092	4478
	R3	8386	2574	5480
Ed & Training (Hours per employee per quarter)	R1	2.0	0.7	1.4
	R2	2.4	4.2	3.2
	R3	0.3	0.9	0.7
Percentage change in performance R1 to R3		-87.74%	38.75%	-48.25%
Publication (Number received per month)	R1	1.5	0.8	1.1
	R2	3.0	2.7	2.9
	R3	2.8	2.3	2.5
Percentage change in performance R1 to R3		83.33%	200.00%	122.22%
Incidents (Number per month)	R1	0.0	0.0	0.0
	R2	0.3	0.0	0.1
	R3	0.00	0.00	0.00
Percentage change in performance R1 to R3		NA	NA	NA
Mileage (Kg of garments cleaned per litre of perc consumed)	R1	50	46	48
	R2	55	44	51
	R3	61	64	62
Percentage change in performance R1 to R3		20.87%	39.40%	29.74%
Energy/garment (Total energy costs in cents per garment cleaned)	R1	0.23	0.40	0.31
	R2	0.32	0.52	0.41
	R3	0.23	0.36	0.30
Percentage change in performance R1 to R3		-2.02%	9.57%	5.40%
Energy/Turnover (Total energy costs as a percentage of financial turnover)	R1	4.50	6.27	5.39
	R2	5.45	7.66	6.40
	R3	5.07	5.65	5.36
Percentage change in performance R1 to R3		-12.58%	9.87%	0.50%
kWh Energy/garment (Total kWh of energy consumed per garment cleaned)	R1	3.26	5.06	4.16
	R2	3.84	6.22	4.86
	R3	3.08	4.49	3.79
Percentage change in performance R1 to R3		5.54%	11.33%	9.06%
Kg GHG/garment	R1	1.87	1.81	1.84
	R2	1.69	2.19	1.90
(Kg of GHG emitted per garment cleaned)	R3	1.37	1.67	1.52
Percentage change in performance R1 to R3		26.56%	7.78%	17.32%
Perc waste (Number of garment cleaned per litre of waste perc generated)	R1	110	88	99
	R2	117	78	100
	R3	177	116	146
Percentage change in performance R1 to R3		60.54%	31.90%	47.87%
Waste costs (total waste cost in cents per garment cleaned)	R1	4.6	7.4	6.0
	R2	4.8	7.8	6.1
	R3	3.5	3.1	3.2
Percentage change in performance R1 to R3		25.43%	58.71%	47.00%
Waste Management Practices (Total recycling waste management cost as a percentage of total waste costs)	R1	44	100	72
	R2	81	69	75
	R3	NA	72	72
Percentage change in performance R1 to R3		NA	-28.08%	-0.18%

Table 6-41: Performance by group and round

Some of the results presented in Graph 6-23 need to be treated with caution, particular the increase in publications and the reduction in education and training. Although it cannot be quantified, it can be anticipated that there will be some improvement in reporting accuracy over time as business managers integrate the benchmarking program into their management practices[32].

Those indicators that proved important from the interaction of the researchers with the industry were:

- Energy cost in cents per garment
  - Over the period of the program the cost of energy to the customer increased by an average of eight percent (the research period included the introduction of the GST), for ease of interpretation the energy costs were amended to reflect this. In reality, the total energy costs in cents per garment increased by 2.2%. However, when adjusted for the increase in price, the value of a reduction of 5.8% results. This value is consistent with the value of energy as a percentage of turnovers, which remain relatively constant, and the kWh and kg of GHG indicators improved by 9.06% and 17.32% respectively.
- Energy consumption in kWh per garment
- Perc mileage (kg of garment cleaner per litre of perc consumed)
- Garments cleaned per litre of waste perc generated

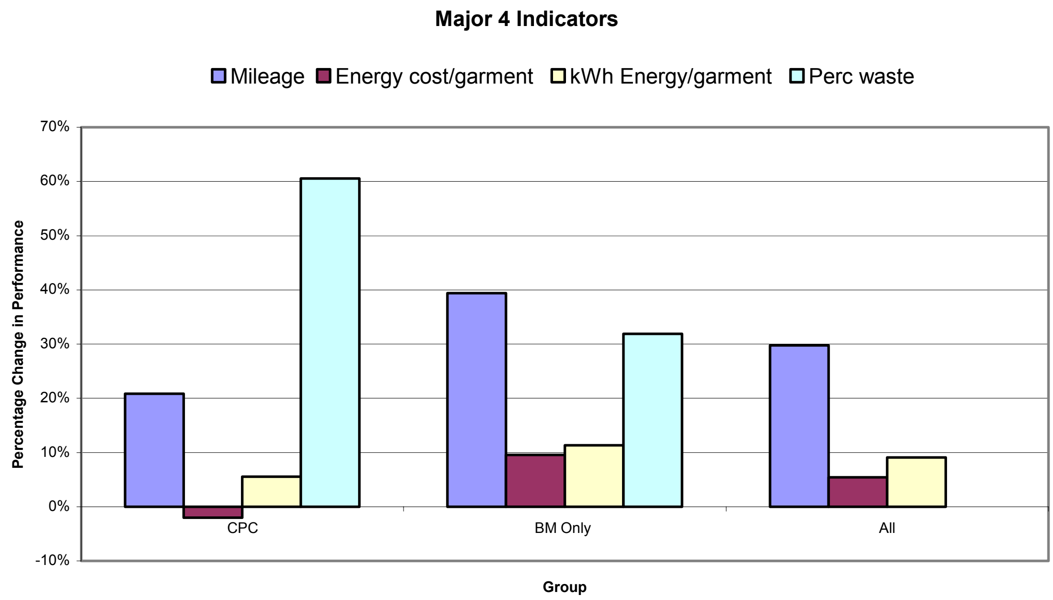
The reason for this is difficult to determine precisely. However, these indicators undoubtedly represent the major cost and future regulatory threat to the industry.

6.3.2.3.2 Cleaner Production Club versus Benchmarking Only

These indicators where isolated and used to calculate individual participant performance compared to benchmarking. The results are included in the

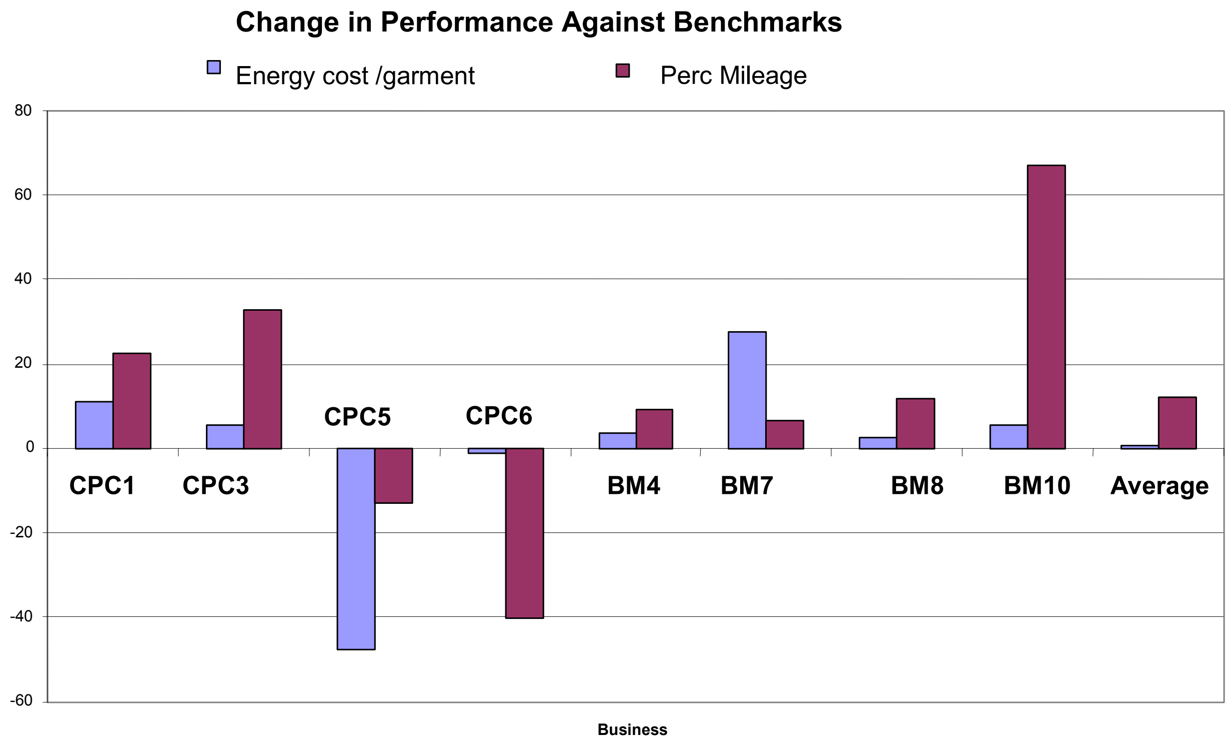
[32] If a similar program were to run for a number of years, the data from the first round could be removed to determine the success of any such program.

following two graphs. These results indicate that the Benchmarking Only group improved performance more than CP Club members. The results of the program were divided into the two groups, (the Cleaner Production Club and the Benchmarking Only group) to determine if, and if possible why, there is a difference between the two groups. This analysis only includes results from businesses that completed the program and provided useable data for all three rounds for the indicators which provided the most reliable data, or was of the most practical assistance to the business. This group comprised eight businesses; four from each group (CP club and Benchmarking Only group).



Graph 6-25: Changes of performance, comparing the two programs

Graph 6-25 shows the improvement in performance and splits it between the two groups. Graph 6-26 reports on the amount of the performance gap closed over the period of the research project.



Graph 6-26: Performance improvement against benchmarks

It is interesting to note that the two businesses that performed the poorest on the above measure CPC5 & CPC6 both had a very low level of productivity as measured by number of garments cleaned per employee, in fact ranking 16 and 17, the lowest two participants. It is also interesting to note that the two operations with the highest level of productivity were both in the Benchmarking Only program while the poorest three were in the Cleaner Production Club. Furthermore, the two benchmarks most actively promoted in this research project, (energy cost in cents per garment and perc mileage) were both established by business in the Benchmarking Only program. Finally, business managers with a longer history in the industry appeared to have the most consistent improvement in performance. CPC6 had the shortest history in the industry while business managers who had been in the industry over 20 years consistently improved their performance, See section 6.3.2.6 for further discussion of this point.

The first four businesses were members of the Cleaner Production Club while the second four businesses participated in the Benchmarking Only group. Graph 6-26 shows the progress made to close the performance gap identified through the benchmarking. From the graph it is clear that businesses CPC5 and CPC6 did not respond well to this program, with their performance falling and dragging the group averages down. The exact reason for this is very difficult to determine. However, an investigation in to possible reasons would help advance the field of Cleaner Production. A partial explanation could be that business CPC5 was undergoing very rapid expansion, while the business manager from business CPC6 was a very recent entrant into the industry, and may have felt pressure from his recent membership to the DIA management committee to join the program. Furthermore, his lack of experience within the industry might have made him reluctant to change his practices from those shown by the previous owner. Business managers from CPC5 and CPC6 appear to have different management styles to CPC1 and CPC3, the latter two, while always keen for new business, were not as aggressively attempting to expand and had well established operating practices and a stable workforce into which improved work practices could be implemented and reliably carried out by all staff.

The results indicate that the Benchmarking Only group achieved greater performance improvements than the Cleaner Production Club in eight of the eleven indicators, with one being equal. This deserves further analysis, and better pre-program performance needs to be acknowledged. Table 6-42 helps to illustrate this point. The table illustrates which group had the best actual performance before and after the program, as well as which group's performance reported the highest percent improvements. This table reports that the Benchmarking Only group's performance was still inferior to the Cleaner Production Club despite the better rate of improvement.

Indicator	Group		
	Best performance before program	Best performance after program	Greatest change during program
Education and Training (Hours/Employee)	CPC	BM	BM
Publications (Number/month)	CPC	CPC	BM
Incidents (Number/month)	Because of low level of response rated as equal		
Perc Mileage (a)	CPC	BM	BM
Perc Waste Generation (b)	CPC	CPC	CPC
Energy (Cents / Garment)	CPC	CPC	BM
Energy (% of Turnover)	CPC	CPC	BM
kWh / Garment	CPC	CPC	BM
Kg GHG / Garment	BM	CPC	CPC
Waste Costs (cents/garment)	CPC	BM	BM
Waste management practices (c)	BM	BM	BM

	Cleaner Production Club	Benchmarking Only	Same performance
Better performance before program.	8	2	1
Better performance after program.	6	3	2
Highest % improvement during program.	2	8	1

Table 6-42: Rate of improvement achieved between groups

The businesses involved in the Cleaner Production Club were on average larger companies than the participants in the Benchmarking Only group. This may impact on the results as larger operations have a greater potential for communication failures and resistance/barriers to change practices from employees. Part of the explanation may also be that a number of the larger businesses were expanding, which may interfere with maintaining focus or control over the operational practices.

Overall the comparison of Eco-Efficiency between the Benchmark Only and Cleaner Production Club results gives mixed results. These turned out to be not statistically significant because of the inconsistence of the rate of improvement in Eco-Efficiency and the small sample size, but noteworthy improvements were made just the same. The Cleaner Production Club had a lower level of Eco-Efficiency improvement than the Benchmark Only group in two of the three major eco-efficiency indicators.

It might also be concluded that there was no major difference in the ability of the business managers in both groups, and participation was determined by operational constraints and not environmental awareness. Finally, business managers with initial low performance can achieve improvements in their Eco-Efficiency by means of participation in a benchmarking program, and only when their level of performance approaches industry best practice, a more comprehensive capacity building program such as that provided through the Cleaner Production Club appears to be required.

6.3.2.4 Action Plans

The following table lists the Cleaner Production options agreed to in the Cleaner Production action plans developed by the members of the Cleaner Production Club. The following key is used:

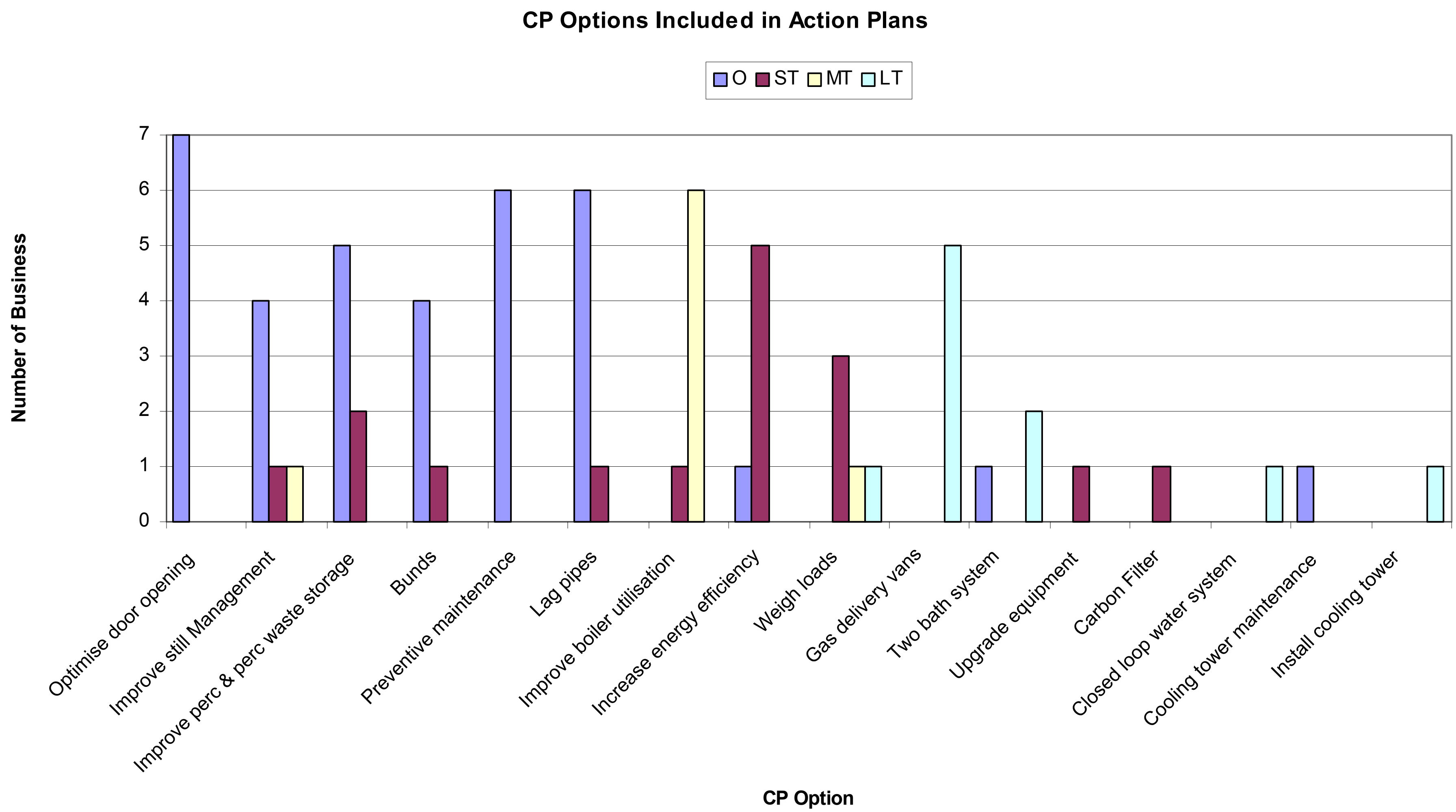
- – Ongoing, however monitoring, maintenance and inspection is required
- ST – Planned in the shorter term, i.e. within six months of completion of action plan
- MT – Planned in the medium term, i.e. within twelve months of completion of action plan

- LT – Planned in the longer tern, ie within 24 months of completion of action plan
- No - Not listed on any action plan

This list produces some interesting results. While the majority of the businesses focus on many similar areas of operation, and all considered improving boiler utilisation, which involves matching demand and supply of steam, most were only going to do this in the medium term. Five of the seven businesses are considering weighing loads, but none do so at present. Five of the business had considered converting delivery vehicles to gas, but because of the capital cost involved this was considered a longer-term Cleaner Production option.

Cleaner Production Option	Cleaner Production Practice	CPC 1				CPC2				CPC3				CPC4				CPC5				CPC6				CPC7				Total				
		O	ST	MT	LT	O	ST	MT	LT	O	ST	MT	LT	O	ST	MT	LT	O	ST	MT	LT	O	ST	MT	LT	O	ST	MT	LT	O	ST	MT	LT	NO
Optimise door opening	Good Housekeeping	X				X				X				X				X				X				X				7	-	-	-	0
Improve still Management	Good Housekeeping	X					X					X		X				X				X								4	1	1	-	1
Improve perc & perc waste storage	Good Housekeeping	X					X			X				X				X					X			X				5	2	-	-	0
Bunds	Technology Modification	X					X							X				X								X				4	1	-	-	2
Preventive maintenance	Good Housekeeping	X				X				X								X				X				X				6	-	-	-	1
Lag pipes	Technology Modification	X				X					X			X				X				X				X				6	1	-	-	0
Improve boiler utilisation	Good Housekeeping		X					X				X				X				X				M				X		-	1	6	-	0
Increase energy efficiency	Technology Modification		X				X			X									X				X				X			1	5	-	-	1
Weigh loads	Good Housekeeping			X			X						X						X								X			-	3	1	1	2
Gas delivery vans	Technology Modification				X				X				X								X								X	-	-	-	5	2
Two bath system	Technology Modification								X													X							X	1	-	-	2	4
Upgrade equipment	Technology Modification														X															-	1	-	-	6
Carbon Filter	On-site Recycling														X															-	1	-	-	6
Closed loop water system	On-site Recycling																X													-	-	-	1	6
Cooling tower maintenance	Good Housekeeping																	X												1	-	-	-	6
Install cooling tower	Technology Modification																								X					-	-	-	1	6

Table 6-43: Cleaner Production options from action plans



Graph 6-27: Cleaner Production options from action plans

Cleaner Production Approach	%	% (in action plans)			
		Ongoing	Short term	Medium term	Longer term
Good Housekeeping	57	33	10	12	1.4
Product Modification	0	0	0	0	0
Technology Modification	41	17	12	0	12
Input Substitution	0	0	0	0	0
On-site Recycling	3	0	1.4	0	0
		50	23.4	12	13.4

Table 6-44: Summary of action plans

6.3.2.5 Seasonal Performance Trends

It was interesting to note from comparing the rounds of data, that even though the first and third rounds of data were similar, the second round showed a decline in Eco-Efficiency. The second round of benchmarking data covered a traditionally low season for the drycleaning industry, with output declining by 25 percent, and this is clearly reflected in the results. The results showed that on average, energy costs per garment cleaned had increased by 37% and perc efficiency fell by 9% for this second round [July – Sept 2000] compared to the first round [Jan – March 2001]. However, four businesses maintained their energy cost within 5 % of their high season figures, while others increased by over 50%. This shows that operational practices do not always alter to take account of changes in physical output. This decline of Eco-Efficiency could be the subject of further research, and suggests that many businesses were managed by habit and entrenched practices.

6.3.2.6 Participation of Experienced Drycleaners

An encouraging outcome of this research project is that four business managers, with collectively over 100 years experience in the drycleaning industry, all operating high productivity operations (cleaned more than 1000 garments per month per employee) participated in the program. The four are singled out for this section, as the business managers with the greatest experience in the industry and those who could be expected to have the least to gain from this program. Three of these four were also the subjects of drycleaning Cleaner Production case studies presented. Table 6-38 summarises the performance of these particular businesses; to add balance two were from each group.

Business Code	Years in Industry	Productivity (garment/ employee/ month)	Indicator	Start	End	% Change
CPC1	32	1154	Energy (cents/garment	17	16	6%
			Perc Mileage	45	62	38%
			Perc Waste	154	332	116%
CPC3 (new store only)	32	1040	Energy (cents/garment	31	26.5	15%
			Perc Mileage	45	65	44%
			Perc Waste	65	130	100%
BM4	14	1417	Energy (cents/garment	26	25	4%
			Perc Mileage	76	83	9%
			Perc Waste	84	131	56%
BM10	28	2034	Energy (cents/garment	35	32	9%
			Perc Mileage	61	112	84%
			Perc Waste	101	112	11%
Averages (non-weighted)	26.5	1411	Energy (cents/garment	27	25	8.2%
			Perc Mileage	57	81	44%
			Perc Waste	101	176	71%

Table 6-45: Results of the experienced drycleaners

What is interesting to note from these results is that while the gains in energy costs were modest and comparable to the overall results of the program (8.2% compared to 5.4%). The improvement in perc mileage (44% compared to 29.7%) and the increase in the number of garments cleaned per litre of perc waste (71% compared to 47.9%) were considerable. This could demonstrate that benchmarking did trigger managements' attention on additional elements of the business's operations regardless of current levels of performance and experience in the particular industry.

These business managers also saw some value in acting as mentors for the industry and an opportunity to improve the profile of the industry to the community and to be pro-active in the future direction of the industry.

This analysis shows that even though these particular businesses had a long history in the industry and operated efficient operations the opportunity to focus on some elements of their economic and environmental performance armed with benchmarks from their peers and competitors did led to further performance improvement. Furthermore, the rate of improvement was 52% higher for energy costs and 47% higher for perc mileage and perc waste, than the results for the program as a whole.

6.3.2.7 Comparison to International Benchmarks

6.3.2.7.1 Energy

Table 6-46 compares the energy efficiency of participants in the industry best practice program with UK data (Energy Efficiency Best Practice Program 2000). This comparison shows that Western Australian (WA) drycleaning used less energy than UK drycleaners. The reason why the WA best is better than in the UK could be caused by different regulations which require much longer drying periods in the UK to reduce the level of perc remaining in garments, and the type of fabrics cleaned, as it would also be expected that UK garments would be of heavier material and subject to ambient air temperatures. Furthermore, the measurement protocols in the UK may have been different than those adopted in this research.

In kWh/kg garments	WA Drycleaners (2000)	UK Drycleaners (1999)
Range	2.1 – 10.9	4.1-15.6
Median	4.7	7.5
Average	4.6	5.8

(Energy Efficiency Best Practice Program 2000)

Table 6-46: International energy benchmarks

6.3.2.7.2 Perc

In contrast, the international comparison on perc mileage highlighted the poor performance of the Western Australian drycleaners. The best-performed drycleaners in Western Australia are below the average in the UK. Again this may be caused by the regulations in the UK forcing operators to run longer cycles thereby increasing the perc reclaim rates from garments, leading to better perc mileage, while local businesses focus on increase throughput per machine.

Perc Mileage	WA Drycleaners (2000)	UK Drycleaners (1999)
Range	20-76	20-210
Average	42	79

(Environmental Technology Best Practice Program 1997)

Table 6-47: International perc benchmarks

6.4 Control Assessment

6.4.1 Introduction

The Cleaner Production Monitor surveyed the level of Cleaner Production uptake (awareness, management and implementation) by SMEs in four industry sectors. The sectors surveyed were food processing, metal products, paper-based printing and drycleaning sectors. Eighty percent of businesses and all of the drycleaners surveyed were from Western Australia. The monitor[33] used the drycleaning industry as a reference group to estimate the success of the Drycleaners program. The drycleaners surveyed in the Cleaner Production Monitor research were divided into Cleaner Production program participants and the drycleaners control groups, with the first group

[33] This research method was developed and implemented in November and December 2001 independently of the research student who was responsible for establishing and conducting the drycleaning program. The results were analysed in December 2001 and available from the Centre of Excellence in Cleaner Production, the researcher/author and the research supervisor. See Annex 1 for greater details on the survey tool.

further divided into the CP Club and the Benchmarking Only groups[34]. The results of this survey were used to determine in an objective semi-quantitative manner the success of the two intervention programs (benchmarking and capacity building), and to determine if members of the drycleaning industry not participating in the research program (drycleaning control) had similar levels of Cleaner Production uptake as the other industry sectors (non-drycleaning control). Also to determine whether they were inferior to those participating in the intervention program, or similar to those participating in the program and superior to the other three industry sectors (non-drycleaning control).

With qualitative surveys, the problem of selection and response bias is an important issue. The interviewee may supply answers, that in their opinion will either satisfy the interviewer by providing the desired answer, or reflect intentions rather than current actions. Therefore survey responses may not reflect actual behaviour. To help overcome this, the interviewer made no reference to Cleaner Production or environmental management and only identified himself as working for Curtin University, and did not disclose any links with Cleaner Production until the end of the interview. The interview process had a relatively high success rate, as measured by contacts to successful survey completion. The overall successful response rate was 32.7% while the drycleaner response rate was 37% (i.e. of 51 businesses contacted 19 agreed to complete the Cleaner Production Monitor). This was in an endeavour to minimise the problem of selection bias, although this can never be completely overcome or discounted.

6.4.2 Overview of Data

Raw scores of drycleaners survey, and the averages for the non-drycleaning sectors in the Cleaner Production Monitor Program are included in Table 6.29. For greater details on the survey please refer to section 3.3.4.2 or Appendix two. As a short recap, awareness gauges the level of awareness

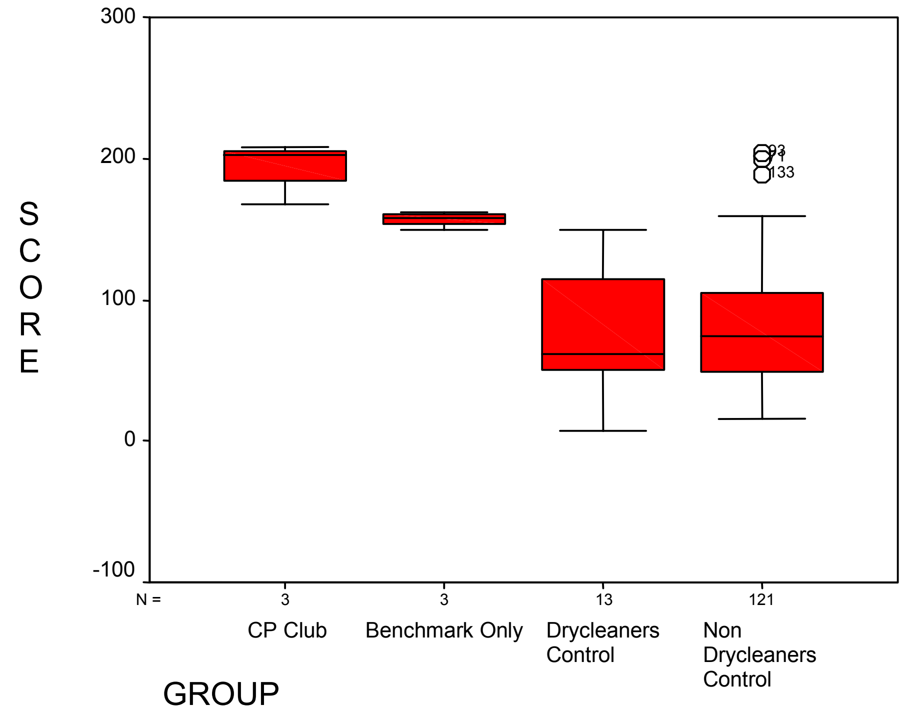
[34] The survey participants were chosen at random, 3 of the 7 business managers in the Cleaner Production Club and 3 of the 9 business managers participating the Benchmarking Only program were interviewed.

and understanding of Cleaner Production and Eco-Efficiency. Management gauges if management and information systems are in place to support Cleaner Production and Eco-Efficiency, while implementation gauges the level of implementation of Cleaner Production or Eco-Efficiency within the business. Each is scored out of 100 and the sum is the cumulative score. Note that the industry drycleaning program is the combination of the Cleaner Production Club and the Benchmarking Only participants.

	Awareness	Management	Implementation	Sum
CP Club (n=3)	70	66	57	193
Benchmark only (n=3)	50	67	40	157
Industry Drycleaning Program (n=6)	60	66	48	175
Drycleaning Control (n=13)	19	46	17	82
Non Drycleaning Control (n=121)	21	41	19	81

Table 6-48: Results of the Cleaner Production Monitor

Figure 6-48 provides an overview of the Cleaner Production Monitor survey with a Box Plot of results. In the non-drycleaning control there were three outlying businesses. These businesses were two large national food-processing businesses and a metal processor (with scores of 200, 204 and 189 respectively) and non-compatible with the industry best practice participants, and therefore did not influence the conclusion of these results. An outlier is a score or case with values between one and one half and three box lengths from the upper or lower edge of the box. The box length is the interquartile range. The box-plots visually illustrate the range in performances between the sample groups. The maximum score possible is 300.

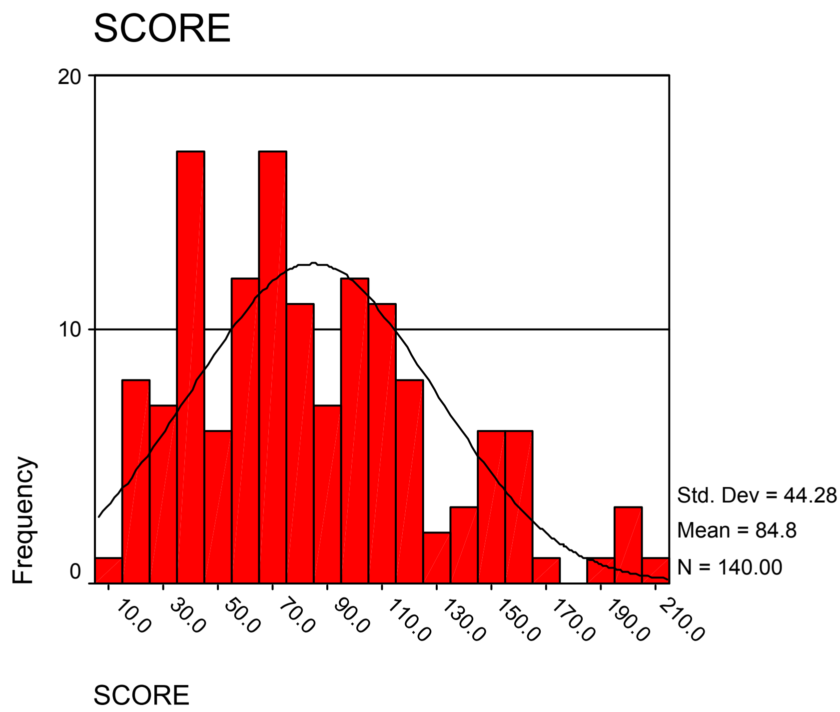


Graph 6-28: Box plot of Cleaner Production monitor results

Graph 6-28 shows the difference between the CP Club, the Benchmarking Only group and the control groups. The similarity of the two control groups indicates that in the absence of the program, uptake of Cleaner Production would not have been higher in the drycleaning sector.

6.4.3 Overall Analysis of Data

Because of the small sample size in two of the sample groups (n=three) and the apparent large variation in performance between the groups, the sample must be tested to determine if the population follows a normal distribution. This 'test of normality' is carried out with the Kolmogorov-Simirnov and the Shapiro-Wilk test. The graph below provides a plot of the scores while the statistical results are provided in following table.



Graph 6-29: Frequency distribution of Cleaner Production monitor scores

Descriptives

			Statistic	Std. Error
SCORE	Mean		84.76	3.743
	95% Confidence Interval for Mean	Lower Bound	77.36	
		Upper Bound	92.16	
	5% Trimmed Mean		82.45	
	Median		80.00	
	Variance		1961.034	
	Std. Deviation		44.284	
	Minimum		8	
	Maximum		208	
	Range		200	
	Interquartile Range		61.75	
	Skewness		.698	.205
	Kurtosis		.029	.407

Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SCORE	.092	140	.006	.954	140	.000

a Lilliefors Significance Correction

Because the Sig. value is below 0.05 on both tests the scores are deemed not normally distributed. In this case neither the ANOVA or T test are suitable, and instead the Kruskal-Wallis test is used for samples comparing three or more groups and the Mann-Whitney U test for samples comparing two groups only.

Kruskal-Wallis Test

Ranks

	GROUP	N	Mean Rank
SCORE	CP Club	3	137.67
	Benchmark Only	3	130.33
	Drycleaners Control	13	67.50
	Non Drycleaners Control	121	67.67
	Total	140	

Test Statistics[a,b]

	SCORE
Chi-Square	15.420
df	3
Asymp. Sig.	.001

a. Kruskal Wallis Test

b. Grouping Variable: GROUP

The Kruskal-Wallis test proves that there is a significant difference in the level of uptake of Cleaner Production between at least two of the four groups, recording a Sig. Value of 0.001, which is less than 0.05 (CP club, Benchmarking Only, drycleaning control and the non-drycleaning control). This test does not determine which particular groups vary.

The next stage is to compare the individual groups within this sample population to identify between which groups there is a significant difference and between which there is no significant difference in scores.

Mann-Whitney Test

Ranks

	PROGRAM	N	Mean Rank	Sum of Ranks
SCORE	Drycleaners Control	13	7.08	92.00
	Research Program Drycleaners	6	16.33	98.00
	Total	19		

Test Statistics[b]

	SCORE
Mann-Whitney U	1.000
Wilcoxon W	92.000
Z	-3.339
Asymp. Sig. (2-tailed)	.001
Exact Sig. [2*(1-tailed Sig.)]	.000[a]

a. Not corrected for ties.

b. Grouping Variable: PROGRAM

This test reports a significant difference in Cleaner Production uptake between businesses who participated in the program (combined CP Club and Benchmarking Only groups) and the drycleaning control because the Asymp. Sig. Value of 0.001 is less than 0.05.

NPar Tests
Mann-Whitney Test

Ranks

	PROGRAM	N	Mean Rank	Sum of Ranks
SCORE	Drycleaners Control	13	67.42	876.50
	Non Drycleaners Control	121	67.51	8168.50
	Total	134		

Test Statistics[a]

	SCORE
Mann-Whitney U	785.500
Wilcoxon W	876.500
Z	-.008
Asymp. Sig. (2-tailed)	.994

a. Grouping Variable: PROGRAM

This test reports that there is no statistically significant difference between the uptake of Cleaner Production between the non-drycleaning control (printing, food and metals) and drycleaning control, because the Asymp. Sig. Value of 0.994 is not less than 0.05. This would indicate that drycleaners not participating in the research program who were not exposed to other programs promoting Cleaner Production, had no greater level of up-take of Cleaner Production than businesses in the other industry sectors

NPar Tests
Mann-Whitney Test

Ranks

	GROUP	N	Mean Rank	Sum of Ranks
SCORE	CP Club	3	15.00	45.00
	Drycleaners Control	13	7.00	91.00
	Total	16		

Test Statistics[b]

	SCORE
Mann-Whitney U	.000
Wilcoxon W	91.000
Z	-2.625
Asymp. Sig. (2-tailed)	.009
Exact Sig. [2*(1-tailed Sig.)]	.004[a]

a. Not corrected for ties.

b. Grouping Variable: GROUP

This test reports a significant difference in Cleaner Production uptake between the Cleaner Production Club and the drycleaning control because the Asymp. Sig. Value of 0.004 is less than 0.05

NPar Tests
Mann-Whitney Test

Ranks

	GROUP	N	Mean Rank	Sum of Ranks
SCORE	Benchmark Only	3	14.67	44.00
	Drycleaners Control	13	7.08	92.00
	Total	16		

Test Statistics[b]

	SCORE
Mann-Whitney U	1.000
Wilcoxon W	92.000
Z	-2.496
Asymp. Sig. (2-tailed)	.013
Exact Sig. [2*(1-tailed Sig.)]	.007[a]

a. Not corrected for ties.

b. Grouping Variable: GROUP

This test reports a significant difference in Cleaner Production uptake between the Benchmarking Only and the drycleaning control because the Asymp. Sig. Value of 0.007 is less than 0.05.

NPar Tests
Mann-Whitney Test

Ranks

	GROUP	N	Mean Rank	Sum of Ranks
SCORE	CP Club	3	5.00	15.00
	Benchmark Only	3	2.00	6.00
	Total	6		

Test Statistics[b]

	SCORE
Mann-Whitney U	.000
Wilcoxon W	6.000
Z	-1.964
Asymp. Sig. (2-tailed)	.050
Exact Sig. [2*(1-tailed Sig.)]	.100[a]

a. Not corrected for ties.

b. Grouping Variable: GROUP

This test reports a significant difference in the Cleaner Production uptake between the Cleaner Production Club and Benchmarking Only group on a two tail test, but not on the one tailed test because the Asymp. Sig. value is less than 0.05. This result is inconclusive, but indicates that the program implemented in this research project warrants further investigation by researchers and business development agencies.

An alternative method of investigating the level of difference in the level of Cleaner Production uptake between the drycleaning control and businesses involved in the program, was to determine how much the score for the drycleaning control needs to be increase before the difference is not significant. The result is greater than 50% but less than 60% increase (or total score of 132 [82 + 50]) before no significant between the two groups is detected.

6.4.3.1 Summary of Statistical Test Results

The results of this analysis reports that businesses that participated in the research project, as a group, had a significantly higher uptake of Cleaner Production than those that did not. The drycleaning control and the non-drycleaning control groups had similar levels of uptake of Cleaner Production, indicating that the improvement can be attributed to this research project. However, identifying if there is a significant difference in the uptake in Cleaner Production between the Cleaner Production Club and the Benchmarking Only groups of the research program is uncertain because of the low number of businesses in the two samples at the completion of the program. From these results the conclusion can be drawn that the research project did increase the level of uptake of Cleaner Production, however which intervention component (benchmarking or capacity building) had the greatest influence cannot be determined.

6.5 Lessons From The Benchmarking Program

A number of problems were encountered and these were addressed as they occurred. This section summarises the limitations in the design of the program. These in general regard data collection and feedback of the results to participants. There needs to be a very clear indication of the exact data required, including the time period. Many businesses also lack individual metering facilities and therefore could not directly measure the amount of resources used in total, let alone for the individual sections of their operation, or tasks within the business such as laundry or drycleaning. This barrier also applies to waste management costs, which are often included in local council charges or body corporate fees. However, the investment required in equipment to monitor resource use or waste generation is often profitable (Pullar and Pagan 1998). However, this is often not carried out because of initial costs and a lack of understanding of the potential economic benefits of improved Eco-Efficiency by small businesses.

6.5.1 Data reliability

While benchmarking is understood to be a process and not just the establishment of a performance target, it is recognised that data reliability is critical for ongoing support and involvement in the program. Every effort was made to check data, but in the end information had to be accepted in good faith. While the results were crosschecked with international performance levels to assist in determining the accuracy of the reported data, the application of the international performance levels was limited to discussion in the workshops.

A study of tables 4-1, 4-2 and 4-3 illustrates the problem of compounding errors when questionable raw data is combined with raw data of the same quality to develop final indicators. It is important to be aware of this issue and continually attempt to improve the quality of data. This limitation is, however, not critical to the program because of the close working relationship between the researcher and participants, and the fact that the data from the various businesses are of comparable quality. This work mirrored many other environmental monitoring programs that highlight the lack of experience of small businesses in Environmental Performance Evaluation.

6.5.2 Time Periods

Program designers should make the selection of periods strategically to correspond with other business and accounting record keeping activities. Furthermore the time period should be selected to smoothen the performance for indicators which are spasmodic such as education and training or incidents while coinciding with accounting periods for indicators with more rigid accounting practices such as energy consumption. Efforts were made to ensure completion of scorecards coincided with general accounting periods such as tax returns. However, this is still problematical to achieve in practice.

6.5.3 Radar charts

In this research there were too many indicators included on the radar charts resulting in too many axes. There should be a leaning towards fewer rather than more indicators; Mosley and Mayer (1998) maintain that if more than six to eight axes are included the graph becomes hard to understand and interpret. The relative position of the axis will also influence the area of the diagram covered and is therefore a unreliable measure of overall success of any program which uses it as a method to determine the level of success. While its usefulness remains for visual representation of the results, it is unsuitable for determining the success of any program. In this research the area covered by the polar chart was not used to judge the effectiveness of the research.

6.5.4 Amendments to indicators

Over the period of the project two indicators were dropped and one was altered based on the experience gained in conducting the program. Both perc waste as a proportion of virgin perc and waste management practices were dropped over concerns with the reliability of data collected as it was considered a reflection of equipment not management. This waste indicator was replaced by the number of garment cleaned per litre of waste perc generated. The waste management practice was dropped, because of poor data measurement, including the fact general waste costs are often included in council rates or body corporate fees.

The percentage of garments wet-cleaned was added for the second and third rounds of data to improve the quality of the physical output measure, and therefore any indicator that this measure was used to calculate. This effort proved futile because of the confusion between wet cleaning and washing in a traditional washing machine, and lack of data provided. To improve the quality of data and improve consistency between participants, any business manager who only provided financial turnover was contacted and details of physical output were obtained. Table 6-49 below explains briefly the effectiveness of the indicators, those marked with # were included in the benchmarking reports.

Indicator (# Included in drycleaning program)	Comments
# Education and training	Useful leading indicator but needs to be treated with caution
# Publications	Reliable indicators but need to check relevance of publications received.
# Environmental incidents	Limited reports received, concern expressed over what defines an incident and some reluctance to report
Corrective action requests	No reports received
# Perc mileage	No garment weighing so estimated from average garment weight
Spotting agent	Poor reporting, poor reliability made the spotting agent a poor indicator and is not recommended for future use. Also major variations in pre and post spotting procedures.
# Energy cost per garment	Industry major direct environmental cost at present influenced by gas, diesel and electricity prices
# Energy as % turnover	Is influenced by variations in price charged by individual businesses, which is in-turn influenced by location and client base.
KWh per garment	Reflect energy sources as well as efficiency of its use
Kg GHG per garment	Relays on generic data of CO_2 equivalent
Water per garment	Lack of data reported
# Waste perc per garment	Good indicator, although concern over its accuracy, impact of powder or non-powder filters, still types and level of detergent used. This results in variation of the concentration of perc in the perc waste.
Waste perc to consumption	As above
# Waste costs per garment	Poor measurement of waste costs as hidden in overheads, and poor accounting practices
# Waste management practices	Questionable measurements
#Area of web covered	Questionable value, but useful to determine success of long-term programs

Table 6-49: Indicator Effectiveness

6.5.4.1 Water

A water efficiency indicator should have been included to reflect the increasing importance of water management to industry as the demand for water increases and questions are asked about the future reliability of water supply. However, data on water consumption was difficult to obtain because many sites were in strata-titled premises, which did not have individual metering, or operated a laundry in conjunction with the drycleaning operations without separate meters. Therefore the provision of this data was limited and the indicators not included in the benchmarking reports. The request for data was continued in an effort to increase the awareness (the first step to change) of the importance of water efficiency. To highlight the concern of water consumption, a number of participants are investigating the installation of closed loop water systems that use the refrigeration unit (already incorporated in the drycleaning machines[35] see Figure 3-3) to cool the water instead of the cooling tower. But in relation to this project water efficiency results were disappointing.

6.5.5 Withdrawal from Program

On the surface there appears to be a high dropout rate (8 of 17 participants), however, 75% of the dropout was caused by sale of businesses, ie change of ownership. Efforts could have been made to recruit the new owners when businesses change hands. This was not done in this program, for a fear of becoming involved in sales discussions and alienating the industry, and the question of how applicable the previous owner's performance was to measure changes in performance by the new owners. However, this work may have provided some useful insights to how performance changed with new owners, such as will Eco-Efficiency improve, fall or remain constant? Only two of the 17 (12%) businesses withdrew from the program because of an unwillingness to provide data, or because they did not see any benefit to their businesses from further participation.

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[35] The question of the capacity of these refrigeration units needs to be considered.

6.5.6 Future improvement to Benchmarking Programs

6.5.6.1 Scoresheets

Another recommended major change t would be in the selection of indicators and the reporting period. With collaboration of the participating industry, the program should start with the collection of a much smaller number of indicators (preferable 1-3 separate indicators) at much shorter intervals, possibly as frequently as weekly. This would reduce the number of indicators collected, but the increased frequency should improve accounting methods and increase the awareness. This method may not generate a balanced scorecard in the initial stages of the program. However, once the program is established, the opportunity exists to add more indicators if requested and possibly increase the reporting intervals. From the research of the Cleaner Production monitor implemented by the Centre of Excellence in Cleaner Production, businesses appear to have reliable environmental costs on hand and most accounts are received monthly for business accounts. The small number of measures could be reported on a scoresheet such as shown in Figure 6-4. In this way the business managers could also keep a record of their performance on a communal notice board if desired.

The final selection of indicators will be a balance between carefully weighted scorecard and what it is practical to include, as well as the desire is to trigger an interest in Cleaner Production. After the interest is created the program can be altered to suit the participants.

Business Name & Address……………………….. Manager ………………….

Resource	Measurement Units	Month & Year ……………………………					
Output	Garments						
Ed/Training	Hours						
% of Garments Washed							
Energy	Gas m^3						
	Elect kWh						
	Diesel						
	$ total energy						
Perc	Litres						
Perc Waste	Litres						
Water	k/litres						

Figure 6-4: Cleaner Production benchmarking scoresheet

6.5.6.2 Align With Accounting Tasks

A method to assist in data collection, reduce business managers' workload and hopefully reduce the dropout rate is to align data more closely to current accounting activities. For this purpose an investigation should be undertaken as to the reporting requirements of the GST (Goods and Services Tax) and BAS (Business Activity Statements). Also removing the room for choice of data and obtain data on output only (not financial data) as unit of production will aid data processing and improve the quality of comparisons between participants. If more than one value was requested for a similar indicator, ie. turnover in $ and number of garments, only one was usually provided. In the long term, business managers need to be educated on the need to introduce material accounting practices to complement financial accounting, together with an awareness of the important role management information systems and appropriate environmental management systems can play in pro-active environmental management.

Exploratory discussions have also been held with two organisations, to investigate the possibility of developing a generic environmental scorecard to be included in commercial computerised accounting packages. One group is involved with the Entrepreneur Business Centres and CCH Benchmarking, and the second develops and distributes the software used by many drycleaning businesses in Australia. This particular software is used for accounts and to tag garments as they proceed through the operations. Discussion has also been held between MYOB's producers and a number of agencies including the US EPA to develop and include a module within their accounting package to be able to generate a report which includes all of an individual business' environmental costs. All these initiatives should be further explored in an effort to make improved environmental accounting a reality, and therefore benchmarking more accessible to small businesses.

6.5.6.3 Selection of Eco-Efficiency Ratios

The indicators reported in this research were split between the ISO and the WBCSD methods. Under the ISO method a lower score represents superior performance, while under the WBCSD method a higher score represents superior performance. In the case of six indicators, a low score represents better, while in five indicators a high score represents better performance. This situation should be corrected in future projects to minimise confusion for all (including the researcher).

6.5.6.4 Presentation of Potential Economic benefits

An alternative and simpler method of calculation of potential cost saving could be the use of a table or ready-reckoner which includes performance improvements, size of operation and $ saved per year as illustrated in Table 6-50.

Potential Energy Saving ($ per year)						
Garment Cleaner per week	Energy saving in cents per garment					
	2	4	6	8	10	15
250	260	520	780	1040	1300	1950
500	520	1040	1560	2080	2600	3900
750	780	1560	2340	3120	3900	5850
1000	1040	2080	3120	4160	5200	7800
1250	1300	2600	3900	5200	6500	9750
1500	1560	3120	4680	6240	7800	11700
1750	1820	3640	5460	7280	9100	13650
2000	2080	4160	6240	8320	10400	15600
2250	2340	4680	7020	9360	11700	17550
2500	2600	5200	7800	10400	13000	19500

Table 6-50: Energy savings table

A formula could also be developed which allows a business manager to enter their particular data on production and potential saving to calculate annual savings. This method, however, still requires the business managers to work this out, generating the potential for error, while the table approach gives an instant result.

6.6 Lessons from the Capacity Building Program

The feedback from business participants, industry association and trainers/facilitators is now discussed including the most important business imperatives. These imperatives are important criteria for capacity building design and to aid in Cleaner Production becoming a priority for participants.

6.6.1 Relevance

The first key message is that the program must focus on the business managers' aspirations, and ensure that short-term relevance is combined with the longer term focus. The low number of completed worksheets, and the limited data on some of the performance indicators implies that some of the capacity building activities were of limited relevance; possibly due to limited experience or lack of essential data for improving Eco-Efficiency. This reflects the lack of skills to complete and utilise the materials included in the worksheets, such as an accurate mass-balance and input output analysis; a gap that must be filled for success of future programs. Relevance was promoted through cost saving and risk management as drivers, and by adopting the activities to reflect the business manager's level of Cleaner Production experience and the environmental impacts of their activities as well as the complexity of their operation. This resulted with a process focus outcome without the need to develop a complex management system.

6.6.2 Flexibility

The five approaches to Cleaner Production were promoted in the workshops and the development of the action plan. The program must maintain flexibility and guide participants towards practicable solutions focusing on the five Cleaner Production practices: good housekeeping (GHK), product modification (PM), technology modification (TM), input substitution (IS) or on-site recycling (OSR). Together with the waste hierarchy: avoid, reduce, reuse and recycle. This approach had mixed success, (see Table 6-51). The majority of practices concentrate on good housekeeping and practical, low cost technology modification. Three percent of the Cleaner Production practices included in the action plans relate to on-site recycling. While no proposed Cleaner Production option fall under the product modification or input substitution category. This reflects the reality of small businesses. However, practices such as changing packaging system could be considered product modification, while switching to more environmental preferred detergent and spotters are input substitution practices.

Cleaner Production Approach	%. from action Plans	Applicability to drycleaning industry
GHK	57	Potential to increase eco-efficiency
PM	0	Because of the nature of the industry, drycleaners have limited ability for product modification, however packaging can be classified as product modification
TM	41	Limited opportunity to change core technology but ability to get latest machines, which provide better Eco-Efficiency; also some interest in wetcleaning. Potential for opposition from customers. Technology modification in regards to energy and carbon activated filters.
IS	0	Requires large capital cost with potential back-lash from customers to switch to alternative solvents. However, some businesses are introducing more environmental preferred detergents and spotting agents
OSR	3	Practical on perc, can improve practices to increase recovery; also installation of water recycling technology

Table 6-51: The application of the five cleaner production approaches to drycleaning

6.6.3 Systems Approach

Cause identification and option generation was carried out through a systematic approach resulting in an agreed action plan towards individual targets etc. However, in practice, it is questionable the degree to which the systems approach was adopted , as opposed to a focus on the checklist and what practices peers had adopted. Within the group, two or three business managers were acknowledged as industry leaders, and others in the group were prepared to follow them. This approach could potentially hinder longer-term Eco-Efficiency improvement, if the group dynamics does not let the best performers lead the discussions.

6.6.4 Future Improvements

Parts of the capacity building program created a mis-match between the materials covered in the workshops, the development of action plans and requirements of the worksheets with the challenge of managing a drycleaning operation on a day-to-day basis. Furthermore, the knowledge and skills of participants varied considerably, and some had considerable difficulty with the material included in the program.

Any capacity building program has some pre-requisites, (some level of knowledge and understanding of Cleaner Production), and awareness of the environmental risk they generate (Altham and van Berkel 2001; Western Australian Sustainable Industry Group 2002; Centre of Excellence in Cleaner Production n.d.). The aim should be to ensure that the skill and experience required to achieve success is incorporated into the program's design as much as possible, and not assumed to be present or considered outside the scope of the program. The final success of any program will depend on these skills and experiences, and the ability to pitch the message at the right level. However, some level of knowledge and drive will always be required to increase the opportunity of success and optimise the use of resources. Some method for screening businesses would allow targeting resources to the knowledge and experience of participants, to increase the effectiveness of capacity building delivery.

The generic competencies required to promote environmental management within a business were supported by the results of this research. They are:
An individual who leads and champions the cause
A positive attitude to the business opportunities arising from improvements in Eco-Efficiency and not viewing environmental management as a business threat.

- An open approach to, and empowerment of, employees, particularly through training and provision of opportunities for influence and comment.

One of the successes of the capacity building program was having the participants realise that waste cost include the cost of replacing the contaminated perc with fresh perc, while the cost of disposal was in the order of $1.50 a litre while the cost to replace the perc included in the waste was in the order of $4.00 a litre. Therefore the total cost of disposal was in the order of $5.50 a litre and not $1.50 a litre, an important first step in Cleaner Production thinking.

6.7 Spin-off Industry Cleaner Production Program

A number of initiatives have been established, which can be linked to this project. How much credit can be claimed by this research for this is open to debate, and due to the Centre of Excellence in Cleaner Production funding guidelines and resource constraints within the industry organisation and the change of its president, the longer-term future of these activities is open to question. The major initiatives included:

- DIA (WA) became an inaugural signatory to Western Australian Cleaner Production Statement in May 2001. As part of this process the industry organisation developed and implemented an action plan for the 2001-2003 period to promote Cleaner Production throughout the industry (Drycleaning Institute of Australia (WA Branch) 2001). The DIA (WA) reaffirmed their signatory to the Cleaner Production Statement in 2003 and submitted an action plan for the 2003-2005 period.

- DIA (WA) received a grant of $20,000 over two years (2001-2003) from the Waste Management and Recycling Fund to support the initiatives listed in their action plan. The researcher and his supervisor presented an update on the program at their annual AGM.

- The drycleaning benchmarking program was launched Australia wide in 2002. This program is noted in the action plan submitted by the DIA (WA) as a requirement of being a signatory to the Cleaner Production Statement. However due to the Centre of Excellence in Cleaner Production funding guidelines. the promotional work to establish and continue the program was to be carried out by the Australian organisation of the DIA. The researcher and the Centre of Excellence in Cleaner Production carried out the analysis of the data and provided feedback to participants and included the use of the centre's and the DIA's website when applicable. While the initial phase of the promotion of the program was carried out, the resignation of the director and a funding crisis (the organisation is now insolvent) has caused the program to falter. Data was received from two businesses from the initial promotion, one from Victoria and one from Queensland which indicates the appeal of demand driven programs and the acceptance of benchmarking by industry.

A point worthy of note was the attitude of members of the Benchmarking Only group to capacity building, in that 33% (three in nine) wanted to join a future Cleaner Production Club, while a further 33% (three in nine) either sold their business or withdrew from the program altogether. This may indicate that 66% (six in nine) felt that without the capacity building activities they did not believe they could not improve their Eco-Efficiency to Industry Best Practice standards. Of these six businesses, half were prepared to increase the resources they would allocate to improving their Eco-Efficiency, while the other half choose to withdraw from the program. One of these businesses joined a multi-sector capacity building program conducted by the Centre in 2001.

6.8 Conclusions

6.8.1 Hypothesis

This research was designed to test the following hypothesis:

> That the Cleaner Production uptake in the Cleaner Production Club will be higher than the Cleaner Production uptake in the Benchmarking Only group, which will in turn be higher than the Cleaner Production uptake in the 'control' group which operated in the absence of any of the program interventions (benchmarking and capacity building).

The ability of the research to prove this hypothesis was significantly hampered by operational factors, inherent in the fluid nature of small businesses, resulting in too few businesses completing the program and generating data of only moderate accuracy.

The available results showed large factor performance gaps, ranging up to 10 fold. This variation in performance turned out not to be created by the size of the business in all indicators reported, except energy related indicators. This suggests that many good housekeeping opportunities are therefore still available to these small businesses and these could be picked up by the introduction of a basic Cleaner Production action plan. Furthermore, it indicates that little attention had been paid to environmental impacts in the past, with energy cost being the only exception, which triggered steps to improve energy efficiency. The research suggests that the cost triggers for improved efficiency in any particular resources or waste disposal cost is somewhere between one and six percent of total costs, and the published value of two percent of total cost could be correct. With respect to energy costs, economies of scale were present and targets were amended to generate more realistic performance targets. Business managers were better at managing some areas of their environmental management than others, although four businesses were uniformly poor. Drivers for improved performance were not directly assessed. However, economic benefits were a major driver for improving energy efficiency. Risk management or fear of regulation was the major driver to improve perc mileage and waste generation, most likely as a result of the realisation that these environmental costs were likely to increase substantially in the near future (prices have increased from a average value of $1.70 to $4.50 per litre during this program). When comparing results from the different rounds of data, business managers at times manage by habit, creating inefficiencies as shown by falling Eco-Efficiency in periods of lower physical output; ie. the same amount of resources were being used for a lower level of output.

The research aim was to investigate and operationalise benchmarking, then to use this knowledge to establish a program to trigger and sustain Cleaner Production to allow participants to improve their Eco-Efficiency via:

- assisting business managers to monitor key Eco-Efficiency indicators, benchmarking their performance against their peers and identify potential savings
- strengthening the business managers' ability to implement systematic improvements, in particular Cleaner Production through training, moderated networking and information exchanges between business managers operating in the same sector.

However, in this research the criteria for the intervention program were too rigid and the large business turnover of businesses resulted in the sample size being very small which cast some doubt on the results. Therefore answering the research question directly proved difficult for reasons previously mentioned. However considering the following questions gives some indication of the affect of the research program.

6.8.2 Did the intervention program trigger Cleaner Production?

The level of up-take of the program at 22 % is encouraging. To claim that this value represents success or an acceptable level of participation is problematical, but it is higher than a number of alternative environmental improvement programs. For example the green stamp, a program developed and promoted by the Motor Trades Association in Western Australia and commenced at a similar time has had an uptake of less than1%, for motor repairers (2 of 448 members) and smash repairers (2 of 225 members) – as at September 2003. While a program promoted by the Swan River Trust had a similarly very poor participation rate.

6.8.3 Did the intervention program maintain business managers' attention on Cleaner Production?

While the level of turnover in business ownership was not expected, of the owners who agreed to participate and still operate in the industry, over 80% remained in the program after 18 months (nine of eleven).

6.8.4 Did the intervention program increase the up-take of Cleaner Production?

The qualitative results indicate that program participants did have a significantly higher level of uptake of Cleaner Production as measured on the Cleaner Production Monitor, when compared to the control groups: drycleaners who did not participate in the program and three other industry sectors. There was not a significant difference between the two control groups. This result indicates that drycleaners not participating in the program had a similar level of Cleaner Production uptake to general industry, while those participating in the program had a significantly higher level of uptake. The statistical comparisons between the three groups on the statistical test are summarised in Table 6-52. However, the level of the uptake of Cleaner Production between the two groups before the program was unknown.

	Research Program (n=6)	DC Control (n=13)
DC Control (n=13)	Significant	
Non DC Control (n=121)	Significant	Not Significant

Table 6-52: Statistically significant differences between the intevention programs as repoted by the Cleaner Production monitor

6.8.5 Did the intervention program improve performance?

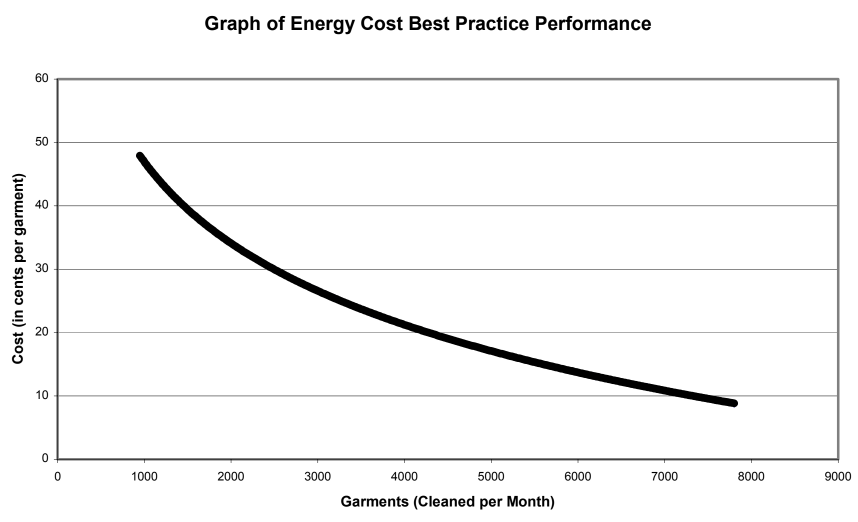
Program participants who completed the program (n=8) on average improved their energy efficiency[36] (kWh/garment) by 9%, chemical efficiency (perc mileage) by 30%, and reduced hazardous waste generation (garments cleaned / litre waste perc) by 48%. Perc and perc waste cost are still a minor costs to the business, but are becoming of increased importance due to concerns over their 'licence to operate', potential of regulatory changes, the increasing cost of waste disposal and liability considerations. The results of this research project found that there is not a significant difference in the rate of improvement in Eco-Efficiency between the two program groups (Cleaner Production Club and Benchmarking Only group). Furthermore, the reported levels of Eco-Efficiency improvement were not uniform. The businesses with the higher productivity (measured as garments cleaned per employee) and/or the longer experience in the industry improved their performance more than the average, regardless of which program they participated in, giving further support to the view that well managed businesses have the greatest potential to gain from a systematic program such as this.

With respect to energy efficiency indicators, economies of scale were present. Therefore, an improvement in energy efficiency may require an improved cause analysis or more innovative or technical solutions. This is because owners directed constant attention to improving energy efficiency as energy costs were sufficiently high (as a percentage of turnover) to flag as an area of concern for long-term profitability. In regards to perc mileage and the generation of perc waste, the majority of the variation in performance was caused by other management factors. This is because little or no attention had been directed at improving perc mileage or reduction of waste perc generation, because perc costs were low (as a percentage of turnover) and therefore perc management was not flagged as an area of concern for long-term profitability. These final two results suggest the many 'good housekeeping practices' are still available to improve perc mileage and perc waste performance. Business managers should therefore initially be directed

[36] As opposed to energy cost in cents per garment which fell by 5.4%.

towards improving current practices and procedures through good housekeeping and low-cost technology modification options rather than through more advanced technical solutions.

The large variations in the physical output of the businesses required statistical testing for the presence of economies of scale, and if found, to correct for these. If economies of scale are present, the unadjusted targets are unrealistic and therefore limit the effectiveness and credibility of such programs and hence threaten continued participation in the program. In the case of this research, targets calculated without allowance for economies of scale identified average energy savings of 55%, compared to an average 22% improvement in energy efficiency with adjusted targets. The latter figure is more in the range generally endorsed for savings with many energy efficiency programs. If economies of scale are not present, the results show that the small size of any operation is no excuse for poor Eco-Efficiency. Graph 6-30 gives an example of an industry best practice curve that should be used to establish energy targets amended to levels of physical output when economies of scale are present.



Graph 6-30: Energy best practice performance against size of business

6.8.6 Did the intervention program improve performance more than in the absence of the program?

This statement cannot be supported on the results obtained due to the lack of a control group, but appears realistic. Eight Cleaner Production Certificates have been presented, (including one drycleaner who initially joined the benchmark only group and who latter undertook the capacity building program). The DIA (WA) has signed the Western Australian Cleaner Production Statement and has started implementing a Cleaner Production Action Plan. Three drycleaners case studies have been developed and are available to the industry and the public on the Centre of Excellence in Cleaner Production website. Finally, the winner of the Small Business Environment Award 2002 in his written response acknowledged his involvement in the Drycleaning Cleaner Production Club as one of the enablers for his environmental efforts (Department of Environment Water and Catchment Protection 2002).

The study of the quantitative results therefore showed mixed and inconclusive results. When linked to the results of the Cleaner Production Monitor, they indicate an improvement in performance of program participants due to their participation in this program and not other factors. The aim of this research project was to assess whether benchmarking, in isolation and/or in combination with industry specific capacity building, leads to the greater uptake of Cleaner Production in small businesses. Furthermore, this uptake of Cleaner Production is expected to enable participating businesses to continuously improve their plant level environmental and economic performance. It can be argued that this has been achieved and results in a process that has the potential to lead to continuous improvement, which demands measurement, an external focus and reviewing of current practices. However, the program did run over a sufficient period to prove this claim.

6.8.7 Discussion

The potential of a benchmarking only program is encouraging. The distribution of printed material together with short site visits can start business managers on the road to Cleaner Production, particular in industry sectors with limited history of Cleaner Production involvement, and major variation in Eco-Efficiency (criteria most Western Australia small business sectors would be expected to meet). As more of the good housekeeping practices are discovered and practices changed to pick-up on these opportunities, the demand for more comprehensive Cleaner Production capacity building programs will increase. There is a significant potential for improvement through good housekeeping practices for business managers with a limited history of Cleaner Production. A comparatively simple benchmarking exercise can trigger and sustain Eco-Efficiency gains. From this research it appears that 'what did get measured does get managed', particularly when there is a local reference point ie.- peer's benchmarks.

An encouraging outcome of this research project is that four business managers, with collectively over 100 years experience in the drycleaning industry, all operating highly productivity operations (cleaning more than 1000 garments per month per employee) participated in the program. An analysis of these particular businesses showed that attention on Eco-Efficiency armed with benchmarks from their peers and competitors did lead to further performance improvement. This shows that the more experienced or more productive business managers achieved the largest improvement in performance, supporting the theory, that generally only the well managed businesses have the skills to take full advantage of the opportunities offered by benchmarking and capacity building programs. Furthermore, one business included his involvement in the program in a relocation application, and another in a major tender. Both were successful.

The research results confirm that there has been a significant increase in the uptake (awareness, management and implementation) of Cleaner Production in the participating drycleaning businesses. There has, however, only been a mixed improvement in Eco-Efficiency measured by quantitative test indicators. Although the higher level of Cleaner Production uptake has not yet resulted in more profound Eco-Efficiency improvements over the period of this research, in the longer term a greater understanding of Cleaner Production should increase the possibility of continuous improvement in Eco-Efficiency. However, this program did not run for a sufficient length of time for this to be shown. These mixed results may also be partly attributed to the material costs of the drycleaning industry being relatively minor[37], (on average only 11% of total costs, this compares to approximately 30% for wages in the drycleaning industry (Entrepreneur Business Centre 2001)).

The use of a large number of indicators, less than desirable data collection practices, and the high business turnover leading to a small sample size makes it important to treat the Eco-Efficiency results reported in section 6.2 with caution. However, this concern was somewhat offset by the results obtained by the Cleaner Production Monitor and reported in section 6.3 which revealed a significant difference in the uptake of Cleaner Production and in time, this knowledge should be transferred to improvements in Eco-Efficiency. The emphasis in this program on capacity building to close the performance gaps established through benchmarking has the potential to trigger and sustain Cleaner Production programs in small businesses.

[37] This compares to other industry sectors were material costs are a much higher % of their total costs such as cabinet makers 48%, printers 35%, concreting contractors 33%, electrical contractors 44%, and nurseries and landscape suppliers 60% of total costs (Entrepreneur Business Centre 2001).

7 Conclusions and Discussion

7.1 The Research Program

This research project's objectives were to operationalise and simplify benchmarking to make it suitable for small businesses, with the aim of continuous improvement in their Eco-Efficiency. Then to establish a facilitated benchmarking program for small businesses to analyse the impact of the program on the participants' uptake of Cleaner Production. Furthermore, this research project investigated whether benchmarking in isolation or in combination with industry specific capacity building leads to a greater uptake of Cleaner Production in small businesses and transfer to improved Eco-Efficiency. The basic supposition was that the identification, notification and promotion of variations in Eco-Efficiency through a benchmarking program should trigger and sustain the adoption of Cleaner Production in participating businesses. Two intervention groups were established, the Benchmarking Only and the Cleaner Production Club groups. The Benchmarking Only group completed a Drycleaning Industry Scorecard and had their Eco-Efficiency benchmarked against their peers. The Cleaner Production Club participated in the benchmarking program as well as a number of capacity building activities, including attending a series of five Cleaner Production workshops and assistance in developing and implementing a Cleaner Production Action Plan. The intervention program was examined on the basis of: a) Quantitative test variable by monitoring Eco-Efficiency for an eighteen-month period b) Cleaner Production monitor as a semi-qualitative test variable, ie awareness; management and implementation of Cleaner Production (CP Club, Benchmarking Only, Drycleaning Control and Non-drycleaning Control).

The intervention program resulted in four sample groups: the Cleaner Production Club, whose members comprised business managers who participated in the benchmarking program as well as attended a series of workshops and developed and committed to implement an action plan; the Benchmarking Only group which participated in the benchmarking program and received published material, but did not participate in the workshops, nor develop an action plan; and the Drycleaning Control group which consisted of drycleaners who were invited but did not participate in the program, but agreed to be surveyed by the Cleaner Production Monitor. The Non-drycleaning Control group, comprised non-drycleaning businesses that participated in the Cleaner Production Monitor. The Cleaner Production Club and the Benchmarking Only groups are collectively referred to as the Drycleaning Industry Program.

7.1.1 Theoretical model

A well-designed Eco-Efficiency benchmarking program can trigger and sustain Cleaner Production. The critical success factors for Eco-Efficiency benchmarking programs include:

- The use of Eco-Efficiency indicators to identify performance gaps in areas important to the long-term viability of the business.
- Identifying and cultivating the main Eco-Efficiency drivers to close the performance gaps.
- Provision and instruction in suitable Cleaner Production tools to assist small businesses to close their performance gaps.

The strength of a benchmarking program is that it builds on a widely accepted industrial management concept while promoting an external focus for business managers. There is high confidence in the benchmarks and these give an indication of the greatest potential for Eco-Efficiency improvements. This in turn increases the likelihood of early success in improving Eco-Efficiency, in many cases starting with good housekeeping options. This success may entice businesses to become involved in more comprehensive and innovative Cleaner Production efforts.

7.2 Research Results

The following research hypothesis was studied in this research project:

> That the Cleaner Production uptake in the business participating in the benchmarking and capacity building programs will be higher than the Cleaner Production uptake in the businesses participating in the benchmarking only program, which will in turn be higher than the Cleaner Production uptake in the absence of benchmarking and capacity building.

However, in this research the criteria for the intervention program were too rigid and the large business turnover of businesses resulted in the sample size being very small which cast some doubt on the results. Therefore validating the research hypothesis directly proved difficult for reasons previously mentioned. However, the result of this research project does give some encouraging indication.

The results for the qualitative method showed that the Cleaner Production uptake by the program participant (n=6, average score 175) was significantly higher than the Cleaner Production uptake in the drycleaning control (n=13, average score 82), which in turn was similar to the non-drycleaning control group (n=121, average score 81). The hypothesis is accepted as being partly proven: ie it shows that the program as a whole was successful, but could not determine if the benchmarking exercise or the capacity building activities was the major influence. With respect to Eco-Efficiency, participants on average improved energy efficiency by 9%, perc mileage by 30% and reduced perc waste generation by 48%. However the rate of improvement was not constant, with the most experience and productive drycleaning showing the greatest improvements. On average participants identified a potential saving of ~ $5,000 each per annum.

7.2.1 Practical model

The case study found that the critical success factors of this drycleaning Cleaner Production program incorporating environmental benchmarking were:

- The monitoring of specific energy consumption, perc consumption and perc waste generation, and the survey identified large performance gaps.
- The main drivers were economic benefits, general business risk management and/or fear of regulation.
- The Cleaner Production Action Plan was considered an appropriate tool to close the identified performance gaps.

These results support other studies that conclude that economic considerations are the main driver for improvement in Eco-Efficiency. The task is how to better exploit this driver to improve the long-term Eco-Efficiency of small businesses. This research also showed the benefit of an external stimulus for change.

Qualitative results from this research showed that:

- Participants accepted benchmarking as a valuable management concept for small businesses.
- Participants improved their monitoring of resource consumption and waste generation and reporting of environmental costs.
- Participants demonstrated a willingness to exchange practices.
- Participants demonstrated a need for capacity building and assistance in closing the performance gap.
- The Cleaner Production Club provided a framework for exchange and learning.

7.3 Limitation of Benchmarking to Trigger Cleaner Production in Small Businesses

There are a number of factors that restrict the potential of benchmarking to trigger improvements in Eco-Efficiency. These are important because economic benefits are one, if not the major, driver for improved Eco-Efficiency. The limitation include:

- The identification of performance gaps for small business. Firstly, small businesses do not recognise their environmental aspects and therefore require assistance with the selection of KPIs. Secondly, environmental management accounting practices do not track environmental costs, opportunity cost and liabilities in sufficient detail.
- Subsidies (hidden or otherwise) weaken the financial drivers to improved Eco-Efficiency, and hence diminish it as a driver for change. Furthermore, risk management is a weak driver in situations where business managers have a poor understanding of the potential environmental and health impacts of the material they use, the waste they create and the emissions they release. If enforcement of regulation is weak, the drivers to improve performance will also be diminished (Vickers and Cordey 1999).
- By focusing on areas of Eco-Efficiency identified through benchmarking aided by checklists, case studies, demonstration sites, and published materials, as having the greatest opportunity for cost saving, business managers may not investigate the full range of their environmental impacts, not conduct a full cause diagnosis, nor fully explore the full range of Cleaner Production practices.

7.4 Final Remarks

Small businesses face a number of barriers to Cleaner Production and benchmarking. The barriers to Cleaner Production include identifying environmental aspects and cost, knowledge of method to improve Eco-

Efficiency and the resources and time to identify and implement Cleaner Production options. The barriers to benchmarking include identifying key performance indicators, collecting and analysis of data, selecting benchmarking partners, networking with all stakeholders, and the development and implementation of actionable improvements. Because of these barriers, benchmarking and Cleaner Production programs for SMEs need to be facilitated by a third party and implemented as a sector specific network in collaboration with other active stakeholders. These mechanisms also promote continuous improvement, which requires continuous identification of new knowledge or information, regular reviewing of current knowledge and practices coupled with the enablers to act on this new knowledge.

Initially there was poor recognition of the industry's environmental aspects. This research project revealed that Eco-Efficiency gaps existed and some of these gaps were considered important for individual business managers. Economic benefits, risk management and fear of regulation were the primary drivers to improve Eco-Efficiency in the drycleaning industry. The introduction of Cleaner Production in the drycleaning sector was triggered by benchmarking and, in the case of this program, was supported by suitable capacity building activities. This twin intervention overcame many of the barriers to Cleaner Production for small businesses and also attempted to promote capacity building at a level in accordance with the business manager's experience and knowledge of environmental issues.

This research project identified the potential of two-tier programs (Benchmarking Only programs, or the establishment of Cleaner Production Clubs) to maximise capacity building while obtaining the best use of limited resources. The initial establishment of Benchmarking Only programs which selected KPIs, established benchmarks, distributed printed material together with short site visits can start business managers on the road to Cleaner Production. This is particularly the case in industry sectors with a limited history of Cleaner Production, major variations in Eco-Efficiency, and poor environmental management accounting practices (criteria most small businesses would meet). These programs are well suited to be delivered by industry organisations with assistance from Cleaner Production centres. As more of the good housekeeping practices and minor technology modification practices are implemented and practices changed, the demand for more comprehensive Cleaner Production Club capacity building programs will increase, and this training should be provided by Cleaner Production centres. The conclusion is that there are large numbers of good housekeeping and minor technology modification practices not utilised for industries with a limited history of Cleaner Production, and that simple benchmarking and basic environmental management accounting practices do trigger Eco-Efficiency initiatives. This approach allows low resource programs (for both facilitators and businesses) to be established before introducing more comprehensive Cleaner Production capacity building programs when demanded by industry. This demand-side drive for Cleaner Production programs increases the likelihood of success. These programs should be established in collaboration with all stakeholders and with the industry organisation facilitating the program to utilise established lines of communication and the trust between business managers and industry organisations. From this research it appears that 'what did get measured does get managed' particularly when there is a local reference point ie peer benchmarks.

Furthermore, benchmarking with appropriate capacity building activities in a balanced, multi-stakeholder network, can develop the critical mass required to drive the diffusion of innovation. Thereby creating learning, responsible and innovative small businesses, this process can result in continuous improvement. The networking and workshops facilitated by the program create an atmosphere supportive of 'learning from peers' in a non-threatening and non-competitive environment. This capacity building requires a multi-stakeholder network to overcome the lack of resources, skills and experience in small businesses and achieves increased confidence in the process by all stakeholders. It requires ensuring capacity building materials are relevant, of a suitable quality and rigour and delivered in a method suitable to the participants. This process can create the critical mass required to promote innovative environmental solutions.

The innovative SME model promoted in this research project with its three sub-networks complements the three CSFs for benchmarking as illustrated in Figure 7-1).

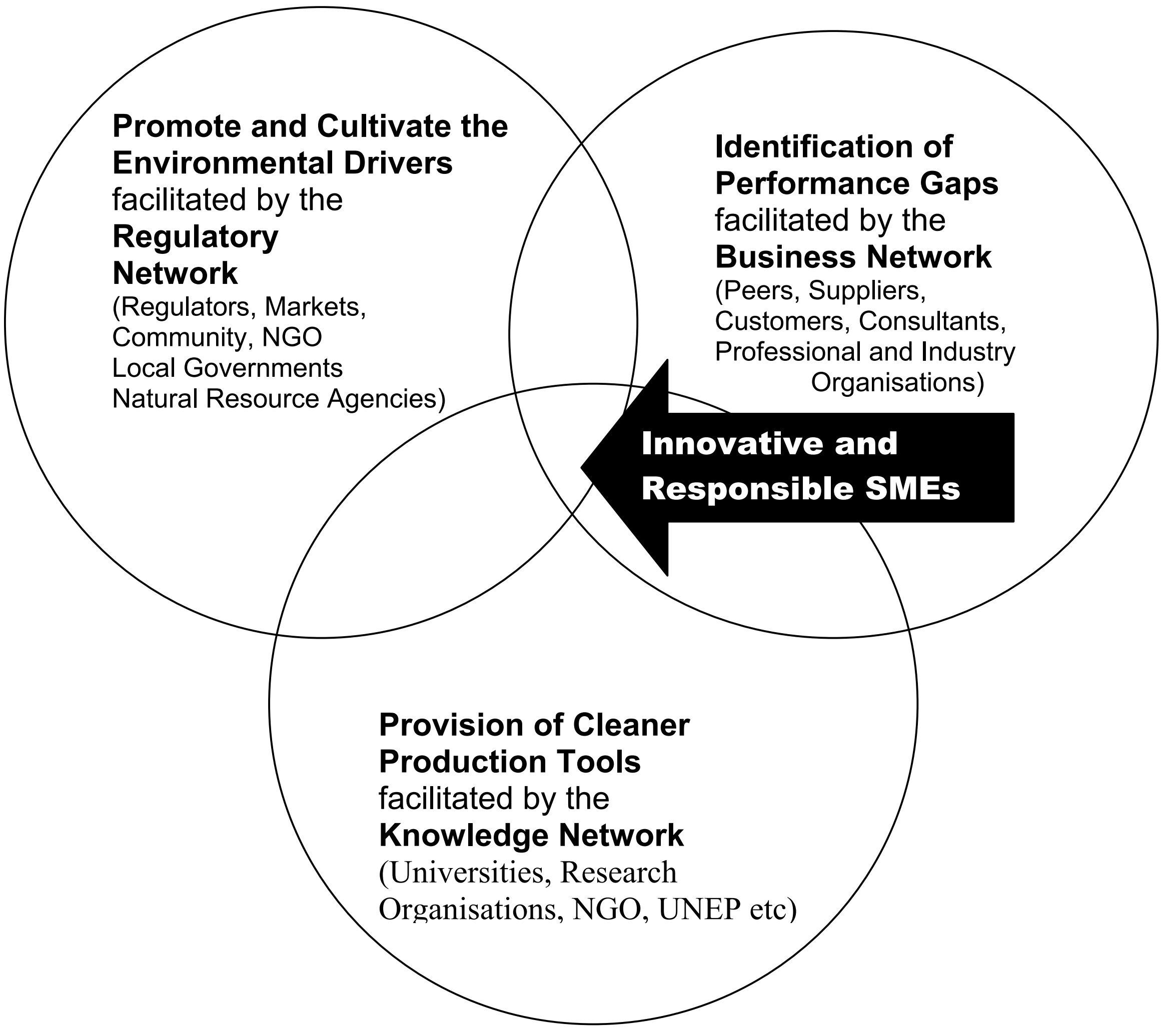


Figure 7-1: The links between the innovative SME model and benchmarking's 3 critical success factors

As stated at the outset of this research, Cleaner Production programs need to attract the business manager's attention, and then retain this attention while transferring the Cleaner Production technical skills and establishing a supportive business culture. This requires not interfering in the day-to-day operation, ensuring initial minimal or no direct cost, and understanding the reality of small businesses in that the highest priority will be given to short-term financial considerations. This is achieved by promoting savings in both dollars and percentage increase in net profit. Benchmarking generates and maintains attention on the benefits of Cleaner Production, while the capacity building activities transfer the Cleaner Production tools and assist in developing an environmentally proactive business culture. This research program provided encouraging results by attracting the participants' attention, while on-going interactions and additional benchmarking rounds consolidated this attention. Capacity building activities aided the development of an environmentally proactive business culture. The mechanisms implemented in this research project demonstrate the potential to increase the demand-driven uptake of Cleaner Production in small businesses.

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Appendix One Drycleaners Cleaner Production Options Checklist

(**DIRS = Requirement of Drycleaning Industry Regulatory Standard)**

Completed by……………………….. on ……………………………….200…

	Project Name DIRS; requirement of DIRS	Implemented Yes/No/Part	Current performance Low/Med/High	Not Applicable (in managers view)	Priority/Status (Implemented or ongoing; short/med/long term objective)
Solvent Management					
Perc Storage and Handling					
1	Bunding for new solvent, solvent waste and perc waste water storage areas **DIRS**				
2	Current MSDS Available **DIRS**				
3	Purchase solvents in 'easy to handle' containers				
4	Transfer solvent by pump				
Perc Consumption					
5	Preventive maintenance program **DIRS**				
6	Optimum drying times				
7	Minimise door opening time				
8	Regular rake still & scrape sides				
9	Correct loading of machine • Weigh loads				
1	Two bath system				
Energy Management					
Boiler Operation					
1	Lag pipes				
1	Better boiler utilisation				
1	Regularly check for steam leaks				
1	Maintain water quality in boiler				
1	Match boiler size to steam demand				
1	Preventive maintenance of equipment **DIRS**				
1	Correct pipe layout and size				
1	Isolation valves installed				
1	Establish standards and procedures for energy				

	efficient equipment operation				
Electricity					
2	Clean condenser fins				
2	Install energy efficient appliance				
2	Install timers				
2	Energy efficient lighting				
2	Install sky-lights				
2	Utilise natural ventilation				
2	Optimum Compressor utilisation • Size of compressor • Tank size • Operating pressure (cut in)				
2	Check air lines for leaks				
2	Purchase green power				
2	Establish standards and procedures for energy efficient equipment operation				
Spotter Management					
Consumption					
3	Post clean spotting				
3	Optimise spotter consumption				
3	Environmentally preferred spotters				
Detergent Management					
Consumption					
3	Optimise detergent consumption				
3	Environmentally preferred detergents				
Packaging Management					
3	Use environmental preferred products				
3	Recycle hangers				
Water Management					
3	Install water efficient appliances				
3	Cooling tower operations				
3	Closed water system machines				
4	Install anti back-flow valve **Water Regulations**				
Waste Management					
4	Solvent recycling program **DIRS**				
Delivery Service Management					
4	Use environmental preferred fuels				
4	Minimise distance travelled				
General Environmental Management					

4	Develop policy **DIRS**				
4	Supplier Accreditation **DIRS**				
4	Training Program **DIRS**				
4	Corrective action procedure **DIRS**				
4	Assessment of Risk **DIRS**				
4	Spills and Leakage Procedure **DIRS**				
5	Monitor and Maintain Air Quality **DIRS**				
5	Complete Document register **DIRS**				
5	Management Review Meeting **DIRS**				
5	Develop EMS				
5	Monitor resource consumption				
Alternative Cleaning Technologies					
5	Multi-stage wet-cleaning				
5	Green solvents				

Figure 0-1 Drycleaners Cleaner Production checklist

Appendix Two Cleaner Production Monitor:

[Please note that this survey was developed and conducted by Dr Alan Howgrave-Graham and Professor Rene van Berkel from the Centre of Excellence in Cleaner Production, Curtin University of Technology and while the survey method and scoring system is as yet unpublished, the final report is available from the Professor Rene van Berkel through the Centre of Excellence in Cleaner Production. All material included in this Appendix is sourced from this report. The research student greatly appreciated the opportunity to use this information as a mechanism to evaluate the drycleaning program implemented for this thesis over the proceeding 2 years]

This Appendix contains the Survey questionnaire and the scoring system use to identify the level of uptake of Cleaner Production. The survey instrument used in this study was designed to elicit one score for each of: awareness; management, and implementation of Cleaner Production. Management incentives represent systems in place supporting Cleaner Production implementation rather than actual incentives to or by management. Eco-Efficiency was also considered in the 'awareness' category. In the questionnaire, CEO's from metal, food processing industries, drycleaners, printers and bookbinders were required to answer a series of questions pertinent to the above three categories. All respondents were from Perth and surrounds in Western Australia except for the printers and bookbinders with 20 from this region and another 20 from either Queensland or South Australia. The decision to make the instrument a telephone-based one was made to minimise response bias, which occurs when respondents answer in a certain direction, ie. they 'consciously or unconsciously misrepresent the truth' (Zikmund 2000). It is anticipated that this response bias would be far more marked in a written survey in which respondents can identify the purpose of the survey and respond to the awareness questions according to what they believe the researcher wants to hear. The telephone survey was specifically designed to prevent the respondent from knowing the purpose of the questionnaire until management incentive and implementation initiatives relevant to Cleaner Production were allowed to emerge, so as to determine environmental commitment of the company CEO.

Organisation:	Name:	Surname:	Job Title:

Address:	Suburb:	Post Code:

Phone:	Fax:	Mobile:	Email:

PREAMBLE

I am (name) of Curtin University and we are cooperating with the Chamber of Commerce and Industry and the State Government to investigate innovations by some industries to improve operational efficiency. Would you mind sparing 10 minutes of you time to answer some questions?

Question 1: What activities take place on your premises, and what activities do you carry out on your customers' premises?

If these are servicing of machinery, fabrication or processing based, continue. Otherwise terminate the interview.

- ☐ Servicing — Servicing type: ______
- ☐ Fabrication — Fabrication type: ______
- ☐ Processing Food — Processing Food type: ______
- ☐ Processing Metal — Processing Metal type: ______
- ☐ Ship/Boat Building — Ship/Boat building material: ______
- ☐ Drycleaner
- ☐ None of the above — NOTB type: ______

Question 2: How many employees work on your premises?

Number of staff: ______ *If the answer falls between 3 and 250 continue, otherwise terminate the interview*

IMPLEMENTATION QUESTIONS

Question 3: What innovations are you aware of that your company has implemented to improve operation efficiency and cut costs over the last three years?

- Project 1: ______ ☐ Env Aware 1
- Project 2: ______ ☐ Env Aware 2
- Project 3: ______ ☐ Env Aware 3
- Project 4: ______ ☐ Env Aware 4
- Project 5: ______ ☐ Env Aware 5

Question 4: Did these innovations contriubute to reducing energy or water usage by your premises; or a reduction in liquid effluent, solid waste or air emissions?

☐ Energy Reduction ☐ Water Reduction ☐ Liquid Effluent Reduction ☐ Solid Waste Reduction ☐ Air Emission Reductio

☐ Real E R ☐ Real W R ☐ Real L E R ☐ Real S W R ☐ Real A E R

Question 5: Please explain how this was achieved:

- Achieve P1: ______
- Achieve P2: ______
- Achieve P3: ______
- Achieve P4: ______
- Achive P5: ______

MANAGEMENT INCENTIVE QUESTIONS

Question 6: Does your company have an environmental management policy or plan? ☐ Plan ☐ Policy

Question 7: Briefly describe this plan.

Does it fit the description of such a plan and does it prioritise the reduction of waste?

Description ______

☐ Witten ☐ Endorsed by senior management ☐ Available to public ☐ Reviewed annually ☐ Implemented

Question 8: Who in your company is/was involved in devising, implementing and actioning the plan?

☐ Senior Management ☐ General Staff ☐ Engineering Department ☐ Environmental Managers

☐ Outside Contractors ☐ OHSE ☐ Other

Question 9: Who is responsible for the environmental affairs of your company?

☐ Senior Management responsible ☐ Engineering Manager ☐ Environmental Manager

☐ OHSE responsible ☐ Other responsible

Question 10: Do you consider environment and energy in your performance evaluation of your staff?

☐ Environment in PE ☐ Energy in PE

Question 11: Do you keep separate records for your gas and fuel bill, power bill, water bill and waste management bill?

☐ Keep Records

If the answer to question 11 is yes, ask question 12, if no go to question 13

Question 12: Please tell me roughly what your latest accounts, and account periods, for the following are:

Gas Cost: ____ Liquid fuel cost: ____

Electricity cost: ____ Water consumption cost: ____

Waste management cost: ____ Effluent discharge cost: ____

AWARENESS QUESTIONS

Question 13: Are you aware of Cleaner Production and Eco-Efficiency and their implications? If so, please give up to three features of each.

☐ Aware of CP CP F1: ____

☐ Understand CP CP F2: ____

CP F3: ____

☐ Aware of EE EE F1 ____

☐ Understand EE EE F2 ____

EE F3 ____

Question 14: How do you believe your company can benefit from Cleaner Production and Eco-Efficiency?

☐ Image ☐ Cost savings ☐ Work environment ☐ World environment

Other benefits: ____

Question 15: What are the greatest barriers to you implementing these initiatives?

Barrier 1: ____

Barrier 2: ____

Barrier 3: ____

☐ Cost barrier ☐ Time barrier ☐ Labour barrier ☐ Staff commitment barrier ☐ Staff knowledge barrier

Question 16: Do you agree with the following statements?

(S1) To employ Cleaner Production it will cost your company money in both the short-term and the long-term. Please expand on your answer.	☐ Agree S1 ☐ Don't Know 1
(S2) Cleaner Production targets the cleaning up of wastes rather than its prevention.	☐ Agree S2 ☐ Don't Know 2
(S3) Cleaner Production should be integrated into management programs rather than be a separate issue.	☐ Agree S3 ☐ Don't know 3
(S4) Cleaner Production is always a good thing. Please clarify (look for a reference to industrial ecology	☐ Agree S4 ☐ Don't know 4

Other Comments: ____

CONCLUSION

Thank you for your participation in this survey and would you like to contirbute to a more detailed but brief survey for Envrionment Australia and the Chamber of Commerce and Industry. If so, may I please have your fax number.

Figure A0-1 Cleaner Production Monitor Survey Form

Cleaner Production Monitor Scoring System

Implementation Score

Here three questions were asked of respondents. These questions were asked at the beginning of the interview so as not to reveal the survey's true purpose and allowing recent implementation of CP to emerge ie. those innovations in which the environment as well as improved performance were considered. The questions were as follows:

1 'What innovations are you aware of that your company has implemented to improve operational efficiency and cut costs over the last three years?' (This is an open-ended question with space for five individual projects. Next to each text box is a click box for entering whether the innovation was environmentally aware or not. The authors used expert knowledge to assess each project for environmental awareness. Ten points were awarded for each environmentally aware project. Maximum = 50 points).

2 'Did any of these innovations contribute to reducing energy or water usage by your premises; or a reduction in liquid effluent, solid waste or air emissions?' Click boxes for each of these categories were used to record the CEO's response and in the next question:

2.1 'Please explain how this was achieved', details were recorded by the interviewer. The CEO's response was then evaluated in light of these and recorded as a 'real reduction in: energy, water, liquid effluent, solid waste or air emissions'. (For example, use of more energy efficient machinery or adding insulation to water baths were considered to have resulted in a real reduction while using 'off-peak power' instead of 'peak power' was not). Ten points were allocated for each innovation leading to a true reduction in resource used or waste disposal (Maximum = 50 points).

Maximum for this implementation section = 100 points.

Management Score

As discussed in the background section, it would be more suitable to describe this score as being a reflection of management systems in place to support CP. Seven questions were asked of respondents:

1 ‘Does your company have and environmental management policy or plan?’ (click box for plan and another for policy. No points were awarded for responses to this question)

2 ‘Briefly describe this plan.’ (this is an open-ended question with a place for comments but had click boxes for: written; endorsed by senior management; available to the public; reviewed annually; implemented. Four points were given for each of these that received a positive response. Maximum = 20 points). Comment: some of the respondents indicated that their written plan was not available to public as it was part of the franchise agreement and, on the point’s system, would be penalised for this. In addition, some of the plans (especially of small companies) would be an unwritten and loose undertaking to eg. recycle – for this, 12 points could be attained.

3 ‘Who in your company is/was involved in devising, implementing and actioning the plan?’ (this question was only asked if there is a policy or plan. Tick boxes were given for ‘senior management’, ‘occupational health, safety and environment officer’; and ‘environmental manager’, each of which were awarded 4 points. One point each was awarded for the other categories ticked, namely: general staff; engineering department; outside contractors; and ‘other’. Maximum = 10 points)

4 ‘Who is responsible for the environmental affairs of your company?’ (Tick boxes were given for: senior management; engineering manager; environmental manager; occupational health, safety and environmental manager; and ‘other’. Senior management was given 8 points and each of the others 3 points. Maximum 20 points) Comment: questions 3 and 4 overlap to a certain extent while question 3 leaves the word ‘responsible’ open to interpretation. More clarity should be given here and, when pressed on the issue by respondents, the interviewer indicated that this meant ‘accountable’. Maybe question 4 should be replaced by two questions: ‘who in your organisation is accountable…’; and ‘who in your company is involved in the implementation of environmental practises’

(which alludes to who does recycling, minimises waste etc. - this may be clarified to the respondent).

5 ‘Do you consider environment and energy in your performance evaluation of your staff?’ (Tick boxes were given for each of these with 5 points given for considering the environment and 5 for considering energy. Maximum = 10)

6 ‘Do you keep separate records for your gas and fuel bill, power bill, water bill and waste management bill?’ (16 points were given for a positive response and 0 for a negative response) Comments: all but one respondent indicated that they kept separate accounts as this is how they arrived (separately) and they had to be retained for tax purposes. This question is thus fairly pointless except that it leads to the next one. The points allocation is justified by the fact that it is so low in relation to the potential points that may be accrued.

7 ‘Please tell me roughly what your latest accounts, and account periods for the following are: gas cost; electricity cost; waste management cost; liquid fuel cost; water consumption cost; effluent discharge cost.’). (4 points were given for each value given. If the respondent could give at least one of the costs but omitted some of the others because they were ‘not relevant’, ‘minimal’, ‘none’ ‘confidential’ or ‘shared with other tenants on the premises’, two points were given for the other values not revealed. If, however, not one cost was given (due to the respondent not being aware of their costs or stating that they were confidential) 0 points were allocated throughout. Maximum points = 24) Comments: Initially, 5 points were awarded for each cost given (maximum = 30 points). This resulted in the penalising of respondents who claimed to know all their accounts, gave eg. 3, indicating that the rest were irrelevant, nil or minimal (and thus did not get a score for these) – the new system gives them credit for generally being aware of their costs. Scores allocated to some respondents (including financial controllers) indicated that these figures were confidential and may harm their competitive advantage. They were penalised for this stance. In other cases, some values (such as liquid fuel costs) were considered by respondents to be irrelevant, as there was no such cost to the industry concerned. In small businesses sharing facilities

within a shopping centre, the water costs are shared equally between all patrons, making individual usage indeterminable. The instrument should thus be modified by adding tick boxes to indicate which of the above scenarios were true while the waste management cost should be specified as ‘solid waste management cost’ since some respondents included their effluent costs in this category. An additional category could be included to request information on revenue generated through selling of waste while information such as ‘cost per drum’ should be expanded upon by the respondent to include how many drums per month/year. If this questionnaire remains as is, the interviewer should fill ‘0’ in the relevant box if the respondent indicates ‘none’, rather than leaving it blank as was done for all interviews.

Maximum points for this management incentive section = 100.

CEO Awareness Score

Two awareness (of CP and Eco-Efficiency (EE)) questions were asked of the CEO's after the implementation and management incentive questions but just before terminating the interview. These questions were:

1 'Are you aware of Cleaner Production and Eco-Efficiency and their implications? If so, please give up to three features of each.' (click boxes in the margin allowed the researchers to qualitatively identify whether the respondents were aware of and/or understood CP or EE, based upon their responses. Ten points were awarded for what was deemed awareness of CP, another ten for awareness of EE, while twenty points was awarded for understanding each of these concepts (maximum = 60 points)).

2 'Do you agree with the following statements?'

2.1 'To employ Cleaner Production will cost your company money in both the short-term and the long term.' (disagree = 10 points; agree = 0 points)

2.2 'Cleaner Production targets the cleaning up of wastes rather than its prevention.' (disagree = 10 points; agree = 0 points)

2.3 'Cleaner Production should be integrated into management programs rather than be a separate issue.' (agree = 10 points; disagree = 0 points)

2.4 Cleaner Production is always a good thing' (agree = 10 points; disagree = 0 points)

The maximum score on awareness for each respondent company is thus 100. Two additional questions were posed to the CEO's of companies who had heard of CP and/or EE and attempted a definition of EE. Where the respondent had not heard of CP or EE but showed an interest, the interviewer gave a brief description and then asked these questions in any case (no scores were awarded for a response). Those respondents who had no idea of CP were not asked question 2 or the following questions unless it had been described to them. The two additional questions were:

'How do you believe your company could benefit from Cleaner Production and Eco-Efficiency?' (in addition to the question being open ended, click boxes were added to include image, cost saving, work environment and world environment)

'What are the greatest barriers to you implementing these initiatives?' (This was also an open-ended question with additional click boxes for cost, time, labour, staff commitment and staff knowledge barriers).

Additional Questions

In addition to the contact details requested at the beginning of the questionnaire, some questions were included in the survey to gauge the opinions of CEO's regarding CP and Eco-Efficiency. No points were allocated for these responses but the information recorded would be useful for policymakers to determine receptiveness and obstacles to implementing these initiatives. Respondents were only asked these questions if they had attempted to define CP and/or Eco-Efficiency or, due to their interest, had had these concepts explained to them after having been asked their meanings. These questions were:

'How do you believe your company can benefit from Cleaner Production and Eco-Efficiency?'

'What are the greatest barriers to you implementing these initiatives?'

Click boxes were allocated for the responses to be entered as separate factors, namely: image, cost saving, work environment, world environment for question 1; and cost barrier, time barrier, labour barrier, staff commitment barrier or staff knowledge barrier for question 2. Comment: 'labour barrier' is not specific and may represent repetition of 'staff commitment' or 'staff knowledge' barriers and could thus be omitted.

A section at the bottom of the questionnaire allowed the respondent to make comments if so desired, before being thanked for participating in the survey and being asked if they would like to participate in the second written survey.

Cleaner Production Monitor Scores

Raw scores of drycleaners survey in the Cleaner Production Monitor Program in included in the following table.

	Awareness	Management	Implementation	Uptake
CP Club				
Business 1	80	58	70	208
Business 2	50	68	50	168
Business 3	80	72	50	202
Averages	**70**	**66**	**56.67**	**192.67**
Benchmark only				
Business 4	60	72	30	162
Business 5	40	50	60	150
Business 6	50	78	30	158
Averages	**50**	**66.67**	**40**	**156.67**
Industry Drycleaning Program				
Average	**60**	**66**	**48**	**175**
Drycleaning Control				
Business 7	0	36	0	36
Business 8	20	64	30	114
Business 9	60	40	50	150
Business 10	0	60	0	60
Business 11	0	8	0	8
Business 12	0	50	0	50
Business 13	0	62	0	62
Business 14	0	40	0	40
Business 15	70	40	40	150
Business 16	0	49	10	59
Business 17	30	34	20	84
Business 18	40	62	40	142
Business 19	30	47	30	107
Averages	**19.23**	**45.54**	**16.92**	**81.69**
Non Drycleaning Control (Metals, Food & Printing)				
Average	**21**	**41**	**19**	**81**

Table A 0-1: Drycleaners results of the Cleaner Production Monitor