Waste Minimisation Clubs in South Africa: Towards a Sustainable Model

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ABSTRACT

Every time a good is produced, waste occurs as an unwanted by-product. Waste has become a real environmental issue across the world, contributing to the degradation of the environment and human health. As part of a local and international effort to lessen industrial pollution, a concept to reduce waste production at source was introduced to companies in the early 1990s. Pioneered in the Netherlands and the United Kingdom (UK), this concept has been termed 'waste minimisation'. Waste minimisation is achieved by implementing changes to business practices and processes, such as improved housekeeping (e.g. prevention of spills), and changes to equipment that is less wasteful. It is often undertaken by a group of organisations, including for example service providers, manufacturing companies and regulators that join a waste minimisation club (WMC). This provides an opportunity in which training can be received by, waste minimisation assessments made on, and information and ideas about waste reduction at source exchanged by member companies. WMCs have been used successfully in Europe to achieve waste minimisation in industry and residential communities.

This study aims to contribute to the development of a sustainable WMC model in South Africa. It analyses the WMC support structures in South Africa and compares them to support structures offered in the UK. This offers a point of reference from which the impact of South African support structures on WMCs in general, and the Pietermaritzburg Waste Minimisation Club (PWMC) in particular, can be established. The PWMC consists of small and medium companies across sectors, each with less than 200 employees and with an annual turnover less than 40 million rand. The club was initiated by the Pollution Research Group of the University of KwaZulu-Natal (UKZN). It was the first of its kind in South Africa, having been facilitated on a small budget by staff and students from the UKZN.

The study found that the self-help approach adopted by the PWMC was only partially successful. The PWMC was successful in terms of raising awareness of its members to waste minimisation issues. The study also found that member companies, both from the PWMC and WMCs generally, need to be shown in practical terms that

waste minimisation can result in financial savings before management buy-in can be attained. If more University manpower had been allocated, in the form of students for instance, to identify and orchestrate implementation of sustainable waste minimisation solutions, the PWMC member adoption rate of waste minimisation may have been raised. The small PWMC budget may have made this impossible, however. Lack of funding may also have prevented facilitators putting together a large support team, as has been done for a similar and more successful project in England. This demonstrates that self-help WMCs need an initial funding boost to be successful. This funding should be invested in gaining buy-in from company personnel rather than to drive the waste minimisation process on behalf of member companies. Driving waste minimisation on behalf of companies or 'hand-holding' leads to a passive acceptance of waste minimisation as is currently the case in South Africa, as well as 'shirking' as has been observed in the UK. Such a facilitated self-help approach can then lay the basis for WMCs, which use the support infrastructure established by their predecessors.

Studies of WMCs in England and Wales based on a self-help approach showed that they achieved financial savings that are comparable to those in demonstration clubs. The promotion of such sustainable WMCs in South Africa needs to be performed by a central support agency such as the British Envirowise. Envirowise was seen to successfully promote waste minimisation among those it reached. However, it reached only a small percentage of overall industry. A successful South African agency therefore needs to promote itself effectively and nation-wide. A successful South African Envirowise organisation should also facilitate the creation of WMCs by leading a forum of industry, service providers, higher education and waste minimisation champions of proven worth, to create an action plan for WMC development for each province. Each province would then allocate funds for a waste minimisation champion who, in conjunction with the local development agency, would create a provincial action plan for the development of facilitated self-help WMCs. The local support and expertise recruited to form and manage WMCs would decrease costs and leverage income.

This kind of support agency needs to be upheld by waste management legislation based on the concept of sustainable development, recognising the need for environmental protection alongside that of economic growth. To date no such legislation is in place in South Africa. It is hoped that the White Paper on Integrated Pollution and Waste Management, which endorses the principle of sustainable development alongside with the necessity to reduce waste at source, will form the basis for a successful South African WMC culture.

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1 MOTIVATION FOR THE STUDY

Every time a good is produced, waste occurs as an unwanted by-product. Waste has become a real environmental issue across the world, contributing to the degradation of the environment and human health. Traditionally industry has dealt with waste once it had been created rather than avoid or minimise it at source. End-of-pipe solutions to deal with waste included recycling at best and un-treated dumping worst. As part of a local and international effort to lessen industrial pollution, a concept to reduce waste production at source was introduced to companies in the early 1990s. Pioneered in the Netherlands and the United Kingdom (UK), this concept has been termed 'waste minimisation'. Waste minimisation, also known as waste reduction at source, pollution prevention and cleaner production, ranks as a preferred option on the Environmental Management Options Hierarchy (Figure 1). It is often undertaken by a group of organisations, including for example service providers, manufacturing companies and regulators, that join a waste minimisation club (WMC). This provides an opportunity in which training can be received by, waste minimisation assessments made on and information and ideas about waste reduction at source exchanged by member companies. They have been used extensively in Europe to achieve waste minimisation in industry and residential communities.

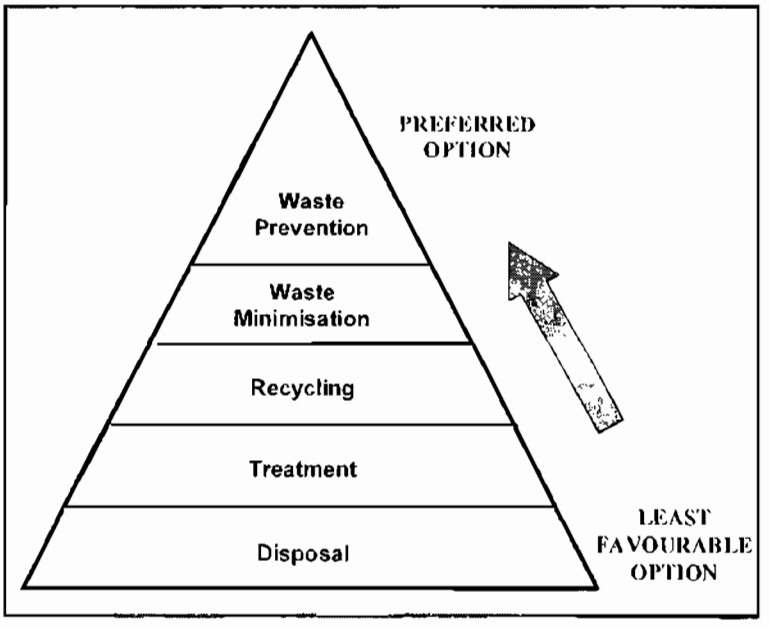

Figure 1: Environmental Management Options Hierarchy, after U.S. Environmental Protection Agency [EPA 1992]

Today the waste minimisation concept has been adopted by organisations in many countries, amongst them South Africa. To date about 266 companies have been members of WMCs in South Africa [Oldham 2004]. Yet establishing and running a WMC in South Africa has its own peculiarities, quite distinct from those experienced in the first world. Unlike their United Kingdom (UK) and Dutch counterparts, fragmented legislation on the conceptualising, resourcing and enforcing of sustainable waste management has meant that government provides little help to South African clubs. While South Africa is aiming to make waste management mandatory once a National Integrated Waste Management Bill is promulgated, no coherent structure to support waste minimisation clubs exists to date.

In light of the absence of a coherent support structure for WMCs, the University of KwaZulu-Natal's Dr Nicola Brown and Dr Sally Spankie identified the need to develop a low-cost sustainable model for running waste minimisation clubs in South Africa. Between 2001 and 2003 they ran a club themselves. The Pietermaritzburg Waste Minimisation Club (PWMC) was initiated by the Pollution Research Group (PRG) of the University of KwaZulu-Natal (UKZN) and steered by Drs Brown and Spankie. Its aim was to assist small and medium enterprises (SME) in the Pietermaritzburg region. SMEs are companies with less than 200 employees and an annual turnover less than 40 million rand [National Small Business Act 1996]. The PWMC was one of the first of its kind in South Africa, having been solely facilitated by a University. Its main aims were to provide training in waste minimisation principles and practice, using materials prepared by the March Consulting Group (now Enviros March), and to provide a forum for industry, service providers and regulators to meet and exchange experiences and information. A secondary aim was to offer company audits or preliminary assessments, which would be undertaken by students as part of their honours or masters of science degree. These audits, among other things, would suggest changes to minimise waste generation based on the collection and analyses of data and measurements. Limited funding was provided by the Water Research Commission (WRC) and participants were asked to pay an annual membership fee of 400 rand in 2001, and 500 rand in 2002.

So far most studies about South African WMCs have been restricted to case studies about the dynamics of individual clubs. This has centred on an analysis of the clubs' successes and failures based on the performance of the member companies in achieving financial and environmental savings. To date no study has in detail considered what impact external support structures have had on the WMCs' successes and failures. This study will undertake an analysis of South African support structures for WMCs and consider how these have impacted on the successes and failures of the PWMC. By highlighting the links between high-level support for WMCs and the PWMC failures and successes, it is hoped that this study will contribute to the development of a low-cost, sustainable model for running Waste Minimisation Clubs in South Africa.

1.1 Problem Statement

South Africa's fragmented waste management legislation suggests a lack of centralised support for WMCs in the country. As yet no study has analysed to what extent this fragmentation has affected WMC performance in South Africa. Similarly no identification and documentation of the support structures available to WMCs in South Africa has been carried out. An analysis of legislative and existing support structures and their effects on the operation of WMCs therefore needs to be undertaken. The analysis of the PWMC undertaken in this study seeks to determine the relationship, or lack thereof, between the club's achievements and failings and the current WMC support structures in South Africa. In turn these findings will be used to suggest how WMCs can adopt a low-cost, self-help approach to waste minimisation. The study aims to answer following questions:

- What are the support structures for WMCs in England and Wales?
- What are the support structures for WMCs in South Africa?
- What were the initial aims and objectives of the PWMC?
- To what extent were these aims and objectives met?
- What links exist between the performance of the PWMC and support for WMCs in South Africa?

1.2 Research Aim

This research project seeks to contribute to the development of a low-cost, sustainable model for running Waste Minimisation Clubs in South Africa by:

- analysing current support structures for South African WMCs and establishing how these compare with those offered in England and Wales, and
- establishing how these support structures have impacted on the performance of the PWMC.

1.3 Research Objectives

- To give an overview of the Waste Minimisation process and how it is applies in the context of a club.
- To determine what support structures currently exist for WMCs in South Africa and to compare these with support structures abroad.
- To understand the structure, aims and objectives of the PWMC.
- To determine the strengths and shortcomings of the PWMC through a historical review of the club members attitudes and achievements in waste minimisation when the club was running, and through a live survey of the club members attitudes and achievements in waste minimisation now that the club has terminated.
- To establish the extent to which the four established waste minimisation analysis techniques, taught on the PMWC training course, were used by the member companies.
- To compare the support available to WMCs in South Africa and the achievements and failings of the PWMC.

2 PUTTING WASTE INTO CONTEXT

This section provides a definition of the type of waste relevant to this study. It then considers the extent of this waste and the effects it has on humans and the environment.

2.1 Waste Defined

According to Collins's English Dictionary [Collins 2002], waste is something that is "*rejected as worthless*" or simply just "*rubbish*". This definition does not describe the nature of waste, that is what such waste is made of or what effects it might have on environment and human health. Waste of course may not always be harmful or worthless. In this study the term waste is used to describe polluting substances which arise as a result of industrial production. The definition for pollution found in the White Paper on Integrated Pollution and Waste Management does classify pollution as something present in the environment, which at some level will cause harm to the environment or humans. It describes pollution as:

"the introduction into the environment of any substance property (including radiation, heat, noise and light) that has or results in direct harmful effect to humanity or the environment or that makes the environment less fit for its intended use." [DEAT 2000].

The PRG of the UKZN's definition puts waste into a more industrial rather than an environmental context. According to the PRG [2002] waste is:

"*anything that goes into a process and does not come out as product*".

In light of the above definitions it is useful to look at what goes into and comes out of an industrial process. Material inputs that go into a manufacturing process come in the form of direct inputs such as water, energy, raw materials and packaging, all of which end up in the finished product. Indirect inputs like solvents, water, machine lubricating oil and safety gear (such as personal protective equipment) are essential for running the process but are not turned into the product. The process outputs other than the finished product may take the shape of polluted water and carbon dioxide emissions, which can cause harm to the environment and humans [PRG 2002].

Many organisations regard waste as what ends up in the company's waste bins, such as rejects or packaging. Yet, waste often appears in less visible forms such as

leakages and fugitive emissions that causes air, surface or water pollution and inefficient heating causing air pollution [Envirowise 2003]. However there are often substantial costs associated with less visible wastes. These costs are generally referred to as hidden costs. Envirowise [2003] estimates that hidden costs incurred by less visible waste, is ten times greater than the cost associated with the disposal of visible waste. As an example, a WMC in Leicester, United Kingdom, comprising of ten companies estimated its costs associated with waste to be 500,000 pound sterling per annum. The true figure, which included hidden costs, was later estimated to be closer to 13 million pound sterling [Envirowise 2003].

2.2 The Waste Issue

The industrial revolution started off a trend of unsustainable production practices that have brought about the degradation of the world's biosphere. The continuation of rapid industrial development throughout the 21st century and the pollution it caused has triggered phenomena such as global warming [Wilson 1988]. Global warming refers to the warming of the world's atmosphere through excessive carbon dioxide emissions. The deadly hurricane 'Mitch' in 1998, for example, and the melting of the ice caps are attributed to global warming. Carbon dioxide is emitted by burning fossil fuels for energy production and other industrial processes [OECD 2005]. While most of carbon dioxide emission is attributed to the developed world, the consumption of developing countries has steadily increased since 1971. The burning of coal in China, for instance, has increased levels of carbon dioxide by 1.9 billion tonnes between 1971 and 2002 [OECD 2005].

Industrial activity also poses a major threat to the world's fresh water reserves. Industry in high-income countries is believed to use as much as 59 percent of fresh water reserves. This stands in stark contrast with the 8 percent used by their low-income counterparts. The world's average industrial consumption is 22 percent of total available fresh water and is predicted to rise to 24 percent by 2025. Studies have shown that industrial waste such as heavy metals and toxic sludge contaminates up to 500 million tons of water every year [UN 2003]. These are worrying statistics in light of the world's overall fresh water shortage from which two billion people in forty countries are suffering [UN 2003].

Global warming and fresh water contamination are only two examples of how industrial waste impact on the environment and health. Other examples include waste produced as a result of industrial activity ending up on landfill. Such disposal to landfill can create noxious gases as well as leachate, which can contaminate ground water. Accidental environmental pollution arising during the transport and disposal of toxic waste or through the mismanagement of industrial toxic wastes also represent a constant risk to humans and the environment [UNEP 2000].

The stresses to the environment and health related to industrial activity are no different in South Africa. Indeed, it can be argued that they are similar or worse compared to those of industrialised first world countries as economic activity has picked up rapidly since the abolishment of the apartheid regime in 1994 as a result of sanctions lifted on South African goods [see Mongabay 2005, BBC 2005]. Ranked third in the world in terms of biological diversity, South Africa recognises that already all its ecosystems have been affected by human activity such as industrialisation [DEAT 1999(a)]. About 22 million tonnes of waste of which 2 million tonnes are hazardous, are produced yearly by South African industry [GAIA 2003]. Notably, only five percent of the hazardous waste is treated or stored safely [Enviropaedia 2002]. As a result South Africa suffers similar waste related problems to industrialised nations such as increased pressure on fresh water supply, degradation of the environment and risks to human health [EIA 2004, Enviropaedia 2002].

The amount of waste produced world-wide is an indication of a prevailing economic inequality amongst the population on earth. The increase of waste has grown on the back of the rising consumption needs of the world's industrialised minority. The industrialised nations consume 70 percent of the globe's natural resources [HBF 2002] and produce 75 percent of the world's municipal and industrial waste [ABS 2001]. This reflects an inherent inequality represented by the industrialised few destroying the world's biosphere necessary for the survival of all. Ironically Western-style-development is at the forefront of many developing countries' government economic growth policy-making to alleviate their nations' poverty. In a Memorandum for the World Summit on Sustainable Development, the Heinrich Böll Foundation

describes this as 'Copycat Development' of developing countries who aspire to live like their developed counterparts [HBF 2002]. Yet, if the minority of the world's population is responsible for the majority of the world's pollution, then a copycat-type development is unsustainable and inappropriate.

The world's governments today are faced with the challenge to reverse the current trend in environmental degradation, while providing a minimum standard of living for the world's increasing number of inhabitants. This realisation has gained momentum, especially in the last decade. This is seen in the many reports, conferences, conventions and treaties, which have focused on addressing pollution and waste issues [DEAT 2000]. A particularly momentous conference was the Earth Summit in Rio de Janeiro in 1992, in which sustainable development has been officially recognised as the key to solving the world's environmental degradation and concomitant inequality issues [Phillips, Adams, Read and Green 2000]. As a result of the summit a global action called Agenda 21 was adopted by more than 178 countries as a plan to implement sustainable development [UN 2004]. Sustainable development has been defined as:

'...development that meets the needs of the present without comprising the ability of future generations to meet their own needs'. [Brundtland 1987]

The Agenda identifies unsustainable consumption and production, particularly by the industrialised few, as the main cause of environmental degradation [UNEP 2003].

Many countries have adopted a pollution and waste strategy in an effort to realise the objectives of Agenda 21. At the heart of the Agenda's waste strategy lies the necessity to reduce waste at source [see chapters 20&21 in Agenda 21]. Also known as waste minimisation, reducing waste at source is recognised by many governments to be pivotal in the sustainable resolution of waste-related issues.

3 WASTE MINIMISATION

The aim of this Section is to create a sound understanding of what waste minimisation is, how it is implemented in industry and what drivers as well as barriers exist to adopting it.

Section 3.1 defines the term 'waste minimisation' and describes the approaches that can be used to reduce waste at source. Section 3.2 considers the actual process of putting waste minimisation in place. One of the stages of this process involves undertaking a waste minimisation audit. The different types of analyses used in these audits are described in more detail in Section 3.3. Finally, Section 3.4 reflects on the drivers and barriers to an organisation in adopting waste minimisation.

3.1 Waste Minimisation Defined

According to Oldham [2004] industrialised nations have responded in four ways to deal with waste:

- ignoring it,
- diluting its effects,
- applying end-of-pipe solutions, and
- reducing it in the production process.

The latter is generally referred to as 'waste minimisation'. Waste minimisation is a "*systematic approach to reducing waste at source*", rather than creating and then having to manage it [PRG 2004(a)]. More stringent environmental legislation and a realisation by industry that end-of-pipe solutions are costly to operate have elevated waste minimisation within the environmental management options hierarchy depicted in Figure 1 in Section 1.

The PRG and UK based consultant Enviros March identify five approaches to reduce waste at source [Barclay, Thambiran, Maharaj, Buckley and Mercer 2000]. They are improved housekeeping, raw material changes, product changes, technological and equipment changes and on-site recycling (Figure 2). These approaches or options are discussed below.

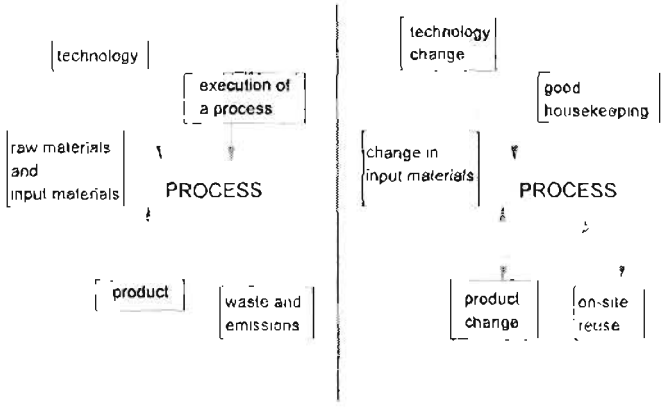

Figure 2: The five possible changes that can be made to a process or business operation to reduce waste at source [PRG 2002]

- **Improved housekeeping:** This is generally seen as the easiest and cheapest approach to minimise waste at source. Improved housekeeping is frequently referred to as a low cost-no cost waste minimisation option or measure. Such an option can be implemented after being identified and quantified through the preliminary assessment or audit phase of a waste minimisation programme and does not need to be rigorously assessed using technical or feasibility analyses. Measures mainly involve improving process performance by staff training and altering administrative procedures and factory practices. Common examples quoted in the literature are prevention of spills through better materials handling and introduction of waste segregation [PRG 2002].
- **Raw material changes:** This may involve changing from toxic to non-toxic raw materials. Alternatively it may mean the reduction of the amount of existing raw materials used or using a purer form of these raw materials which do not introduce waste impurities into the process.
- **Product changes:** This may involve redesigning the product so as to use fewer raw materials or to increase its working life. This option is not widely reported in the literature as being adopted by manufacturers.
- **Technological and equipment changes:** This can be achieved through improving or introducing automated processes and/or re-designing equipment. Replacing old equipment with new is one way to achieve reduction of waste. A study has shown that replacing traditional barrels used by the metal finishing

industry for electroplating with better draining models, lowers the drag-out rate. This reduces wastage of raw materials as effluent [Altmayer, Zak, Wasag and Cavanaugh 2002].

- **On-site recycling:** Returning waste material to the original process as an input material and/or the use of waste in another process as an input material are examples of on-site recycling. This can take the shape of using dirty water from a cleaning process to clean floors or purifying dirty rinse water so it can be re-used in the same rinse system.

3.2 Implementing Waste Minimisation

There are several stages necessary to successfully implement a waste minimisation programme in an organisation (Figure 3).

The first stage involves getting management commitment to reduce waste at source. This commitment needs to be materialised in a provision of a company policy endorsing the waste minimisation process, of adequate resources and staff training [Sustainabulletin February 2001].

Once commitment has been obtained from management, a project champion needs to be appointed. His/her role is to co-ordinate and facilitate the waste minimisation effort. He/she appoints a project team to assist him/her in carrying out the waste minimisation programme [Sustainabulletin February 2001].

An assessment stage follows usually in which a waste minimisation audit is undertaken. During the audit waste streams are identified, quantified in terms of material flows and ranked in terms of their waste minimisation potential. This involves collecting new and existing data for analyses with established waste minimisation tools. Assessment tools such as the scoping audit, mass balance and true cost of waste analyses and monitoring and targeting have been developed and used in a range of industries. These will be discussed in more detail in Section 3.3. At the end of the assessment phase, waste minimisation opportunities are identified and given priority in terms of potential environmental and financial savings that can be made [Crittenden and Kolaczkowski 1995].

Once the high priority waste minimisation opportunities have been identified, a feasibility study is undertaken. This involves performing a technical evaluation that considers how waste minimisation will influence factors such as production time and product quality. Economic evaluations such as a waste minimisation option's payback period - the period it takes to pay back costs incurred by implementing a waste minimisation option - are also undergone during the feasibility study [Crittenden and Kolaczkowski 1995, EPA 1992]. Waste minimisation options that are inexpensive and easy to implement, such as fixing a leak, do not have to undergo a feasibility study and can be implemented straight away [PRG 2002]. These are commonly termed waste minimisation measures.

Once the feasibility study has been completed, the chosen approaches to reduce waste can be implemented.

Waste minimisation is not a one-off activity and continuous monitoring and targeting analysis is essential for monitoring the programme's performance [PRG 2002]. Periodic reviews need to be undertaken to measure progress against targets [Crittenden and Kolaczkowski 1995]. It is therefore pivotal to be able to measure performance. It has been shown that this starts with collecting good data. Therefore measuring devices should be installed where possible to measure waste streams and raw material and utility usage directly. An ongoing cycle of monitoring, re-assessment and re-implementation is necessary to ensure long-term success of waste minimisation projects (Figure 3) [PRG 2002].

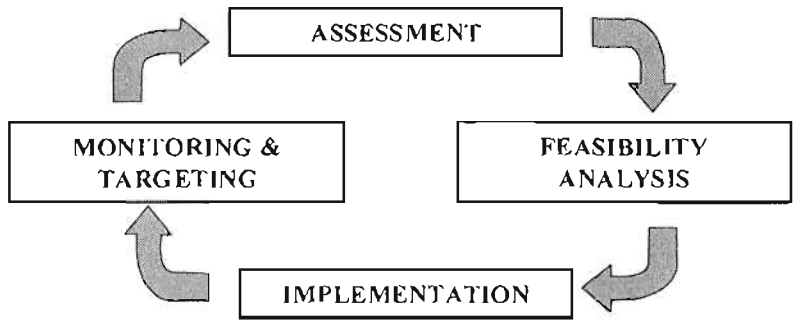

Figure 3: The waste minimisation cycle

3.3 Waste Minimisation Audit

Gathered data during a waste audit can be analysed by using one or more of the following well-established methods:

- Scoping Audit
- Mass Balance Analysis
- True Cost of Waste Analysis
- Monitoring and Targeting

While in theory it is best to use a combination of these four methods, the literature shows that it is not always done in practice. Time, money or other constraints may lead an organisation to choose only one form of audit or relying on qualitative findings from observation of the process. The scoping audit would be the obvious single analysis technique to use as it is the easiest and cheapest to perform [Spankie 2004 *pers. comm.*].

3.3.1 Identifying the Process and Material Flows

Before data can be gathered for an audit it is necessary to gain a thorough understanding of the process audited and its material flows [ETBPP 1996]. 'Process mapping', a technique in which a process flow diagram is drawn, helps to determine the input, use and output of materials going into a process [Environment Agency 2001]. Inputs to produce a product come in the form of raw materials, water, energy, consumables and packaging. Outputs are not only restricted to the end product, but also consist of input losses to the environment such as air pollution through particulate or gaseous emissions. Figure 4 depicts a generalised process map.

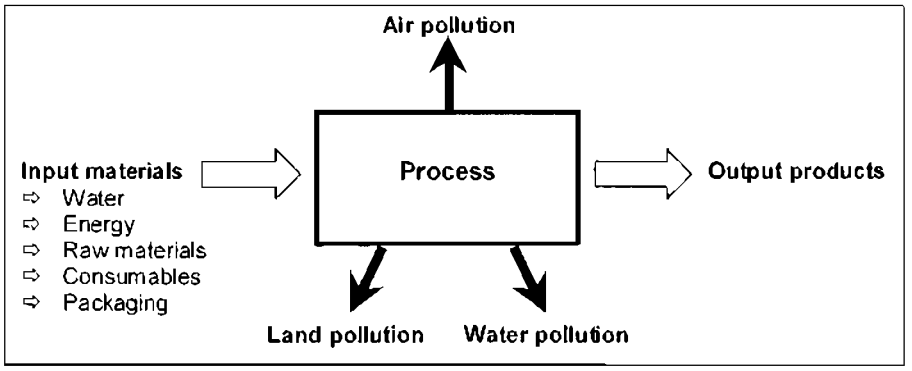

Figure 4: A generalised process map [PRG 2002]

3.3.2 Scoping Audit

There is a generally accepted 'scope to save' for most process in- and outputs which has been determined empirically from a study carried out in the UK (Table 1). A scoping audit uses annual financial and consumption data for process inputs including for example water, energy and raw materials, and for outputs such as finished goods, solid waste and effluent. This method can be used to determine the potential areas in which an organisation can save and to quantitfy the levels of saving which can be made. The scoping audit tool is normally presented in tabular form showing the minimum and maximum scope to save as a percentage of the cost. The inputs and outputs can then be ranked in order of the maximum scope to save and so highlight those areas where the greatest savings can likely be made. These then represent target areas for waste minimisation for which waste minimisation options can be determined [Enviros March Consulting 1999].

In/Output	Scope for Saving in %
Raw materials	1 to 5
Packaging	10 to 90
Ancilliary materials	5 to 20
Consumables	10 to 30
Electricity	5 to 20
Heat for process and space heating	10 to 30
Water	20 to 80
Effluent	20 to 80
Solid Waste	10 to 50

Table 1: Scope for saving [Enviros March Consulting 1999]

3.3.3 Mass Balance Analysis

Mass balance is based on the principle that matter can neither be created nor destroyed [Biffa 2005]. Thus the mass of the material inputs into an industrial process has to equal the mass of the outputs (Equation 1) [Zbontar and Glavic 2000].

$$\text{Mass inputs} = \text{Mass outputs} \qquad \text{Equation 1}$$

The literature shows that mass balancing has been largely used in two ways for waste minimisation analyses. Firstly it has been used as a means of calculating

missing data for a system where some data has not been or cannot be easily measured [Ritter and Coutin/Robert 1995]. Secondly it has been used to determine the losses a system has experienced when the quantities of all the inputs and other outputs are known. In the first case, for example, it can be used where the exact composition of an output stream is unknown and cannot be otherwise quantified [Ritter and Coutin/Robert 1995]. In the second case, if the equation does not balance it means a loss has occurred in the process [Environment Agency 2001].

The literature also shows that mass balancing has been carried out at a number of different levels. Mass balancing studies range in size from factory-wide [Wood 1991, Thevendiraraj, Klemenš, Paz, Aso and Cardenas 2003] through to a single process down to a step in a process [Smith and Schurig 1994]. The data collected for processes or waste streams can be described as 'bulk' or macro- scale data and more detailed micro-scale data. Flow rate and volume of water as well as supplier values for composition, for instance, may be considered as bulk data. Chemical concentration data obtained from chemical analysis on streams, for example, can be considered as more detailed data.

The mass balance equation given in Equation 2 describes the simplest situation where the annual inputs to a process are equated to the annual outputs from the process. Inputs include the mass of raw materials, recycled materials and utilities. Examples of mass outputs are finished products, product items going onto another step of the process (work in progress), rejected products, products not recovered from the process, municipal solid waste and effluent as well as stock changes and losses. Stock changes, if included in the equation, refer to raw materials that have been requisitioned by the process but not yet used in it or can be products still being processed. Losses in Equation 2 generally describe wastage that is not captured and thus unmeasured. This often includes unused raw materials.

$$\text{Inputs} = \text{Outputs} + \text{Loss from process} (+\text{Stock changes}) \qquad \text{Equation 2}$$

The literature shows water to be the most commonly selected single material for mass balance analysis over an entire factory. Examples have been found in

chemical [Zbontar and Galvic 2000] and textile [Petek and Galvic 1996] manufacturing and the metal finishing [Ritter and Coutin/Robert 1995, Wood 1991] industries, amongst others. The incoming metered volume of water recorded by the service provider should equal the sum of all the water volumes used as a primary and secondary raw material, in waste treatment, in heat exchangers and so forth. Water lost from the factory through evaporation, spillage, leaks, effluent discharge and in finished product should be added to the mass balance analysis. Water may be sourced from mains, borehole or on-site purified or re-cycled water.

The results from this large-scale mass balancing can be used to indicate waste minimisation opportunities and where financial savings may be made. However more process-specific mass balancing is needed in order to determine where and how waste is generated and suitable waste minimisation options. More detailed mass balances on individual processes have been used to prioritise waste streams within a process for waste minimisation, to provide baseline data for feasibility analyses of waste minimisation options and to set up targets against which to monitor the performance of these waste minimisation options once implemented. Despite these benefits, very few mass balances have been performed on the chemical raw materials used in industrial processes. A lack of suitable data has been identified as the main reason for this. Companies seldom gather such information as new data, or have it available as existing data.

A single process, or step(s) in a process, may be selected for analysis because a deeper understanding of the source of, migration of and sink for waste within the process is desired [Ritter and Coutin/Robert 1995, Wood 1991]. This necessitates firstly identifying and quantifying material input and waste streams for the process and compiling a process flow diagram. An appropriate mass balance equation applicable in this case would be Equation 3. The mass balance would be carried out over the operating period or cycle of the process. Equation 3 can be used for balancing the mass of all materials together or for a selected material.

$$\text{Input} + \text{Generation} = \text{Output} + \text{Consumption} + \text{Accumulation} \qquad \text{Equation 3}$$

Whereby:

Input = Mass of materials entering the process
Generation = Mass of materials produced by the process
Output = Mass of materials exiting the process
Consumption = Mass of materials used up by the process
Accumulation = Mass of materials collecting in the process

3.3.4 True Cost of Waste

Equation 4 shows that costs related to waste do not merely consist of its disposal cost. There are a number of other costs that have to be taken into account if the true cost of waste (TCW) is to be established [Environment Agency 2001].

$$TCW = RM + WT + SL + RW + P + D \qquad \text{Equation 4}$$

Factors contributing to the production and 'destruction' of waste (Equation 4) are described below.

- **RM = Raw material cost**
  In its most simplistic form this is the cost of raw material wasted (unused) after processing. It can be equated to the cost of raw material purchased (or added to a process if this has been measured) minus the amount of raw material ending up in the product.
- **WT = Waste treatment cost**
  This includes the cost of on-site processing of waste such as chemical treatment of effluent and safe storage of hazardous waste prior to removal off-site. There may also be monitoring costs associated with these to check that the waste has been fully treated and to ensure the integrity of any storage facility.
- **SL = Cost of stock losses**
  This is the cost of purchased materials which never reach the process because they are for example past the expiry date, spilt or used elsewhere.
- **RW = Re-work cost**

Off-specification products may be re-processed or re-worked in order to bring them up to specification and suitable for sale. There are many costs incurred here for example chemical treatment in order to prepare item for going through the process again, the repeat manufacturing costs ie. raw material costs, waste treatment costs, manpower costs and the cost of residence time in the process (lost profit on the new item which could have been made in this time).

- **P = Productivity losses**

  Waste may affect productivity. Staff may spend a lot of their time with waste related issues, for instance, such as mopping up leakage and administration of waste removal.

- **D = Disposal cost**

  This covers disposing of waste off-site. It involves up-lift, transportation and other handling charges made by the municipality and private contractors to dispose of the waste to landfill or sea or by incineration.

The true cost of waste can be as much as 4% of company turnover [PRG 2002].

3.3.5 Monitoring and Targeting

Not much has been reported in the waste minimisation literature on studies using monitoring and targeting (M&T). M&T is the logical last step of the waste minimisation audit for characterising waste minimisation opportunities. The scoping audit and mass balance and true cost of waste analyses should have identified and quantified the waste streams and then established their underlying cause i.e. which process stream(s) the waste streams originate from. M&T looks more closely at the process stream/waste stream relationship. M&T seeks to establish relationships between a consumption variable and a production variable [Blomquist and Brown 2004]. Monitoring starts by measuring the amount of an output from the process together with that of an input to the process whose consumption is dependent on production. This data is obtained over a number of time periods of equal lengths. A time interval of a week has been successfully used for this in the beverage and fine-chemicals industries [Mercer 2004]. In the former case the variables measured were energy and water consumption and the production of clean bottles. The output level of a production variable must be monitored over the same time periods and these

pairs of variables plotted with production on the horizontal axis and consumption on the vertical axis. A line can be drawn through these plotted points which bests fits the scatter of the points and this is called a regression line. In the case of linear regression the equation can be taken as that for a straight line. Targeting involves the identification of the level of consumption, which is desirable. So basically targeting determines a performance level for each of these relationships, for example specifying reduced raw material usage in terms of the mass of finished product.

The regression line has been used to highlight several features of the process. Firstly, the y-intercept gives the baseload of the process, which is the amount of input material consumed at zero production. The slope or gradient indicates the process efficiency of the plant. The smaller the slope, the less input is consumed for a given output level and the more efficient the process is at converting inputs to outputs. Therefore a small slope would be desirable if the consumption variable was water or raw materials and the output was finished product. Finally, the spread of the points on either side of the line gives a measure of the level of control, which has been achieved for the process. A significant level of correlation between a set of consumption and production data needs to be present in order to target a relationship and establish an "acceptable" range around the target line.

Consumption data can then be more usefully measured against variables of production rather than time. This allows process performance levels to be used in assessing areas where waste minimisation opportunities exist. Production versus consumption scatter plots can be used to show fluctuations from expected material and utility consumption after setting consumption targets [University College Northampton 2005]. As an example, Envirowise has established a baseline level for water consumption over a range of surface areas and masses of product treated in the metal finishing industry [Envirowise 1996(a)]. Individual companies can compare their performance to the industry average as indicated by the average line shown in Figure 5. The area above the average line indicates a worse than industry performance, and the area below the average line a better than industry average. By continuously measuring their own performance and comparing it to the industry average, individual companies can gauge how well they are doing compared to their

competitors. It also allows them to target a better performance each year. A better than industry performance indicates a competitive advantage for a company, as it implies a reduction of the amount of water used, and thus costs related to water necessary to produce a product [Envirowise 1996(a)]. A poorer than average performance represents a waste minimisation opportunity. Similar graphs have been drawn using empirical data collected on powder and acid consumption in the powder coating and electroplating industries [Envirowise 1996(b), Envirowise 1997].

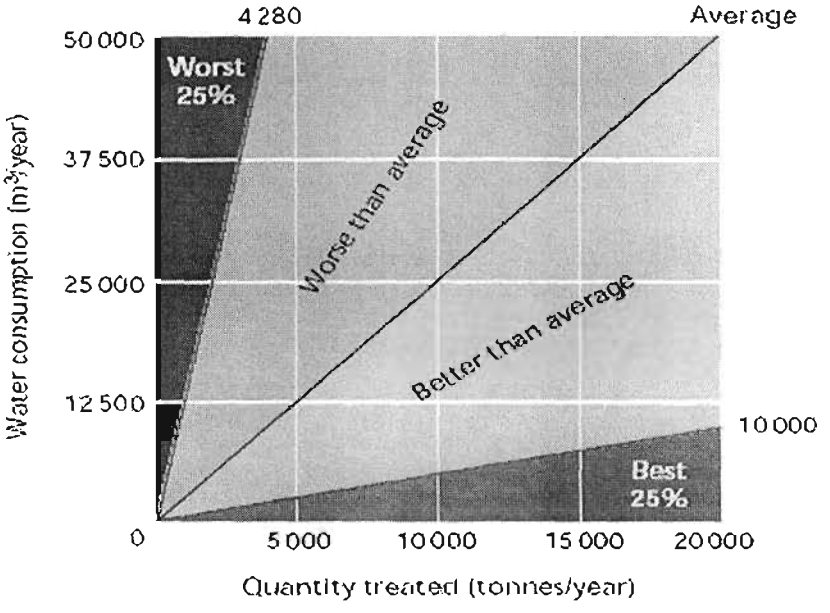

Figure 5: Water economy diagram [Envirowise 1996(a)]

However to carry out M&T requires a good deal of reliable data and usually plenty of it. This means process consumption of raw materials and utilities needs to be gathered either because the data is not usually routinely collected at all or not frequently enough. The ability to measure is therefore crucial for initiating effective M&T. Meters therefore need to be installed or new data records kept on production processes so that their raw material and utility consumption and finished goods and solid and effluent waste levels can be measured [University College Northampton 2005]. Manpower is also needed for this undertaking and these 'barriers' would seem to have led to very little independent research using this methodology.

However it is an important tool not just for the assessment but also the implementation stages of a waste minimisation programme. M&T provides a means

of determining the effectiveness of the waste minimisation options once they have been implemented in stage. This would involve frequent comparison of consumption to targets, identifying variances and taking action to correct variances. However, M&T has not been widely used in this respect.

3.4 Drivers and Barriers to Waste Minimisation

This section aims to create an understanding of the factors that drive as well as hinder the adoption of waste minimisation by organisations.

3.4.1 Drivers to Waste Minimisation

There are a multitude of ethical reasons why organisations should practice waste minimisation, such as to reduce their contribution to global warming (Section 2.2). However, in a profit driven society ethics is not always the main driver that motivates waste minimisation, although it has its place as findings emanating from a study done about two South African Waste Minimisation pilot clubs show [see Barclay 2001]. Factors reported to play a major role in motivating organisations to be environmentally friendly have to make commercial sense or are a result of legal pressure [SAFM 2004]. Literature suggests five factors that drive waste minimisation:

- **Compliance**

  National and international regulatory requirements may necessitate organisations to reduce waste. International legally binding treaties such as the Kyoto Protocol, for instance, have led to signatory countries tightening their environmental laws in order to achieve emissions reduction quotas [IndEco 2005]. This in turn has led to stricter national regulatory requirements in terms of waste emissions for industry. Non-compliance is often penalised through financial penalties (also known as 'polluter pays'), for instance. Waste minimisation can be a tool in complying to stricter legal requirements.

- **Risk reduction**

  Handling and storing waste may represent a health and safety (H&S) risk to employees. Reducing the amount of waste on site will improve the H&S risks of staff [Environment Agency 2001]. Keeping waste at a minimum also minimises the risk to the environment by reducing emissions to land, water and air [Envirowise 2003].

- **Market positioning**

  Increasing demand in environmentally friendly products can make waste minimisation a marketing tool. Industry norms such as the German 'Der Blaue Engel' for instance, whereby firms receive a blue angel logo on their packaging if it is recyclable, meet the demand for environmentally friendly products in Germany [Trittin 2004].

- **Cost savings**

  Waste minimisation can help to increase profitability, without increasing sales, through utilising some or all of the four approaches discussed in the above namely improved housekeeping, raw material changes, product changes and technological/equipment changes. Cost savings can come in the shape of reduced materials usage, reduced onsite waste monitoring costs, reduced waste disposal costs, reduced administrative costs associated with waste disposal and reduced waste storage costs [Crittenden and Kolaczkowski 1995].

- ***Environmental savings***

  'Environmental savings' is the reduction in the amount of waste generated and is usually measured in terms of mass or volume. It therefore reduces the spatial and polluting effects of waste storage and pollution on the environment. It includes reduction in carbon dioxide emissions into the air and a reduction in water usage, hence effluent production. Although environmental savings may not rank amongst the top incentives for waste minimisation for companies, it is inherently linked to cost savings. To give an example, saving electricity by using energy efficient light-bulbs will not only reduce a company's electricity bill, but will also reduce their environmental impact as less carbon dioxide, which occurs in the production of energy through burning fossil fuels, will be expelled into the atmosphere. The link between environmental and costs savings is not necessarily proportional, e.g. saving a lot of water may not save a lot of money as water is cheap. However when the resource is scarce, like fresh water in a drought situation, environmental savings are significant. Environmental savings are of course also linked to above mentioned compliance, which in turn is legislation introduced as a result of a national as well as global consensus about the necessity for sustainable industry practices (see 'Agenda 21' in Section 2.2).

3.4.2 Barriers to Waste Minimisation

While there is a plenitude of good reasons for companies to practice waste minimisation, many barriers have been reported to exist to adopting waste minimisation practices. Economic, technical, regulatory, and cultural barriers have been reported in the literature [Barclay 2001].

- **Economic barriers**

  Economic barriers have been reported in situations where management decides that too few funds exist to adopt and implement the waste minimisation options generated from a waste minimisation programme [Barclay 2001].

- **Technical barriers**

  Technical barriers have been observed in cases where the implementation of a waste minimisation option may (be perceived to) lead to a change in product quality and threaten customer acceptance [Barclay 2001]. This of course may result in a customer going elsewhere to buy the product.

- **Regulatory barriers**

  Companies meeting the required discharge limits for effluent for example have been found to be reluctant to lower the pollutant levels in that effluent any further. This is despite the fact that improving on their existing environmental performance can put them in a good position to comply when the limits are lowered and give them an environmentally conscious image, as well as being good practice.

- **Cultural barriers**

  Companies with a strong tradition in preserving how things have been done and run have been recognised as being inflexible to changes, which achieve waste minimisation. This has been termed cultural barriers to waste minimisation [Barclay 2001].

4 WASTE MINIMISATION CLUBS

Waste minimisation is sometimes adopted by a group of like-minded organisations, which form a waste minimisation club (WMC). Section 4 explains waste minimisation in the context of a WMC (Section 4.1.). It is also concerned with outlining how a

WMC is formed (Section 4.2) and considers its roots by giving an account of its historical background (Section 4.3).

4.1 The Concept

A WMC consists of a like-minded, usually geographically close, group of enterprises that aim to reduce waste generation at source of production. Club members exchange information and experiences about waste minimisation processes and encourage each other to achieve their waste minimisation goals [Barclay and Buckley 2002]. The clubs, which usually consist of ten or more members, can either be cross-sectoral, i.e. from a range of industries, or from the same industry. Although some clubs are operated by the organisations involved, most clubs are run by a partnership of stakeholders from various backgrounds. Partners may be from business support organisations, environmental consultancies, local authorities, environmental organisations and waste management companies [Environment Agency 2001]. The motivation for a company to join a club lies in its cost-effectiveness. Training and advice received in the context of a club is far cheaper than if funded by an individual company [PRG 2002].

4.2 Forming and Managing a WMC

Figure 6 shows the different stages necessary to form and manage a WMC. The beginnings of a club occur when a club facilitator, in the shape of either an individual or organisation, is approached or has him/herself identified the need for waste minimisation among a group of companies. It is the facilitator's role to raise awareness of potential club members about reducing waste at source once the need for a club has been identified. This can be done by visiting companies individually or inviting them to a meeting. The next stage in the birth of a club is the recruitment of companies. Interested parties are recruited, informed of costs as well as aims and activities are discussed. In the stage that follows, the club is organised for action. This involves establishing club structures and the definition of the facilitator's role. This is followed by an assessment stage (Section 3.4), necessary to identify and quantify waste minimisation opportunities. The assessment can be done in-house or conducted by outside parties, such as external consultants. A feasibility study is undertaken as part of the assessment stage to determine which waste minimisation opportunity can be implemented. Once the feasibility of waste reduction options has

been established, club members apply them in the implementation stage. At a later stage an analysis of results is undertaken. This is important to measure the effectiveness of implemented waste minimisation activities [PRG 2002].

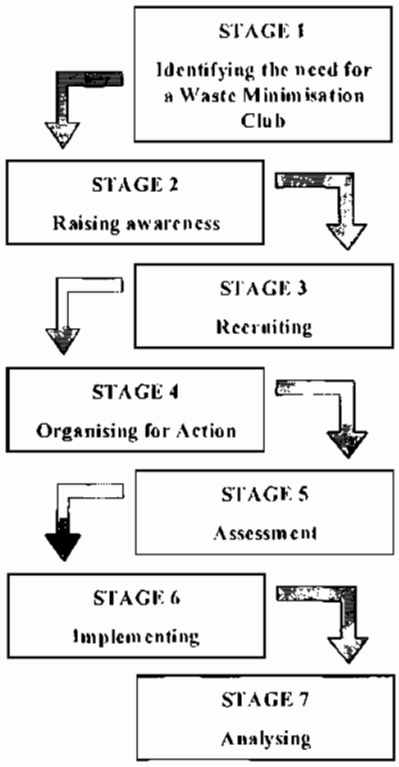

Figure 6: Forming and managing a waste minimisation club [PRG 2002]

When the last stage is completed and the success of the WMC is analysed, it is essential to disseminate findings to other organisations [PRG 2002]. This prevents other companies making the same mistakes and lets them know what solutions work.

The success of the stages involved in forming and managing a WMC depend on adequate management. Each club member needs to appoint a project champion who in turn appoints a project team (Section 3.2). Moreover, a steering group needs to be put in place, which meets regularly to swap information and ideas on waste minimisation. The steering group usually consists of the members' project champions, a facilitator and outside consultants. Other interested parties such as company suppliers, directors or local authorities can also be involved in the steering group. The steering group plays a pivotal role as the driving force behind the waste

minimisation club, providing a forum for information exchange and dissemination, training, social interaction and much more. The facilitator's duty is to define the steering group's role, arranging and calling meetings as well as organising training. The facilitator also gets involved in tasks such as investigating outside funding [PRG 2002]. A typical organisational structure is depicted in Figure 7.

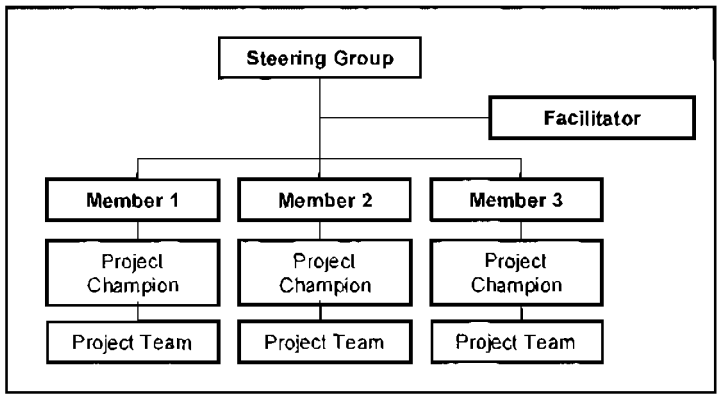

Figure 7: Typical structure of a waste minimisation club [PRG 2002]

4.3 The Historical Background to WMC

The WMC concept is relatively new. It was first tried in the Netherlands in the early 1990s. The Dutch project 'Prisma' reported a 30% waste reduction across ten cross-sectoral companies in 1989 [Oldham 2004].

UK based waste minimisation initiatives such as the Aire and Calder project followed soon after. The three-year Aire and Calder project (1992-1995) demonstrated that waste minimisation cannot only be beneficial in terms of accomplishing environmental savings, but can also achieve substantial financial savings for its participants. The eleven project members reported annual financial savings of 3.3 million pounds sterling after eighteen months through the implementation of simple measures with short payback times [Envirowise 2004(a)]. An overview of the results is given in Table 2.

Number of waste minimisation opportunities identified	399
Savings achieved	annual £2.38 million
Potential savings identified	annual £9.24 million
Environmental savings identified	annual 12000tons to landfill
	1.9 million kl per annum water
	1.8 million tons per annum liquid effluent

Table 2: Aire and Calder: summary of results [Maharaj, Barclay, Mercer and Buckley 1999]

Following the success of the Aire and Calder project, the Don Rother Dearne waste minimisation club was established. This 24 member strong cross-sectoral club ran from 1996 to 1998. Don Rother Dearne similarly demonstrated that substantial savings can be achieved with little or no capital cost. One million pounds worth of savings through minimising waste were identified, of which more than 50 percent involved zero capital expenditure. A breakdown of payback periods is depicted in the pie chart below (Figure 8) [Oldham 2004].

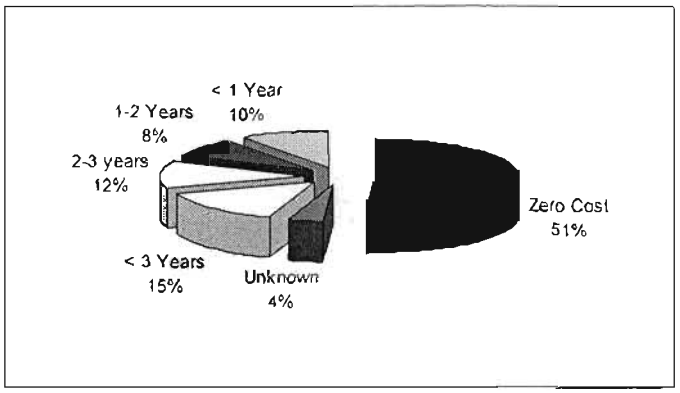

Figure 8: Payback period Don Rother Dearne [Oldham 2004]

Other pioneer clubs include the two New Zealand based clubs that ran under the banner of 'Target Zero' from 1997 to 1999. Its members came from varied industrial backgrounds. The waste minimisation concept has not escaped developing nations either. India, for instance instigated a concept similar to waste minimisation clubs, with the difference that membership was restricted to five SME from the same sector [Barclay, Buckley, Maharaj, Thambiran and Mercer 2000].

5 WASTE MINIMISATION CLUBS - THE SOUTH AFRICAN CONTEXT

Section 5 aims to put WMCs into the South African context. It gives a brief historical account of South African WMCs (Section 5.1) and outlines the legislation that governs waste minimisation in South Africa (Section 5.2).

5.1 Historical Background to South African WMC

The first two South African WMCs were established in 1998 with the aim to promote sustainable business practice and to create a model that can be replicated in the future. The clubs were initiated by the Pollution Research Group (PRG) of the UKZN and funded by the South African Water Research Commission (WRC) as well as the European Union Directorate General XVIII (EU Directorate). Two European consultants, Enviros March from the UK and Cowi from Denmark, were involved upon request of the EU Directorate [Barclay, Buckley, Maharaj, Thambiran and Mercer 2000].

Club number one, the Metal Finishing Waste Minimisation Club, was formed in June 1998. Its 29 members, of whom 50% had less than 50 employees and 60% were jobbing shops, achieved combined savings of more than 2 million rand per year between 1998 and 2000; these savings were expected to occur on a yearly basis after 2000. The bulk of these savings were achieved through implementing low- and no-cost procedures such as fixing leaks, reusing rinse water and training staff [Barclay, Buckley, Maharaj, Thambiran and Mercer 2000]. Most of the financial savings are also reflected in environmental savings as shown in Table 3.

Item	*Environmental savings / year*	*Cost Savings / year*
Water & effluent	169 500 kl	332 516
Chemicals and Metals	112 tons (for 5 companies)	1 325 000
Energy	16 000 MWH	320 430
Carbon dioxide	1 400 tons	
Sulphur dioxide	13 tons	
Nitrous oxide	6 tons	
TOTAL		**1 977 964**

Table 3: Summary of reported environmental savings for the Metal Finishing Club [Barclay 2001]

The second club (Hammarsdale Waste Minimisation Club) was formed in November of 1998. Its club members were discharging their wastewater into a wastewater treatment works, which at the time was not complying to the limits of final discharge set by the Department of Water Affairs and Forestry (DWAF). The eight Hammersdale club members, six companies from the textile industry, a chicken

abattoir and a chemical manufacturing plant, employed between 250 and 800 staff [Barclay, Buckley and Mercer 2000]. The club achieved annual combined savings of over 10 million rand with the potential to save another 10 million rand (Table 4). In the majority of cases savings have been achieved with a payback period of less than a year [Barclay 2001].

Company	Water R/y	Energy R/y	Consumables R/y	Raw Material R/y	Effluent R/y	Other R/y	Totals R/y	Potential R/y
COMP1	5 460	1 151 700		109 620	171 300	39 600	1 477 680	
COMP4	212 400	89 700	272 000	113 500	212 400		900 000	5 925 000
COMP6	458 100			1 000 000	431 400	1 200 000	3 089 500	
COMP3	1 655 800	1 646 000			1 879 000		5 182 800	3 000 000
COMP2		143 000					143 000	
COMP5							0	708 000
COMP7							0	425 000
COMP8							0	750 000
Totals	2 341 760	3 032 400	272 000	1 223 120	2 694 100	1 239 600	10 802 980	10 808 000
% of Total	22	28	3	11	25	11		

Note: Other refers to savings that could not be separated and include savings in water, energy, dyes and chemicals

Table 4: Reported total annual savings Hammersdale club [Barclay 2001]

The environmental savings were equally impressive and accounted for more than 8 million rand of the annual savings [Barclay 2001].

To date 266 companies have participated in a WMC in South Africa [Oldham 2004]. This amounts to 29 clubs, most of which have been run by the BECO Institute for Sustainable Business. A list of South African WMCs and their status can be viewed in Appendix A. Some local governments, like the city of Cape Town are today promoting and funding WMCs as part of their local Waste Management Strategy. It is, however, recognised that budget constraints are not achieving optimal results [City of Cape Town 2004]. This may be an indication that while the WMC concept has been recognised as beneficial for South African Waste Management, partial adoption and lack of funding have hampered its widespread use. An analysis of the status of WMCs in South Africa will be undertaken as part of this study's primary research.

5.2 Waste Minimisation in South African Legislation

No one piece of legislation exists at present that covers the management of waste. This can be attributed to waste management having traditionally been left to local authorities. As a result a wide range of local regulations and by-laws exist in South Africa [City of Cape Town 2004]. There are several provisions made in South African law that are relevant to waste management and waste minimisation in particular. First, and foremost, there is The Constitution of South Africa (Act No.108 of 1996), which states the following in Chapter two of The Bill of Rights:

"*Everyone has the right -*

a. to an environment that is not harmful to their health or well-being; and

b. to have the environment protected. For the benefit of present and future generations, through reasonable legislative and other measures that -

i. prevent pollution and ecological degradation;

ii. promote conservation; and

iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development" [Constitution of the RSA 1996].

To uphold the constitutional right of a clean environment for South African citizens, the government has introduced legislation that protects it. As mentioned in the above, numerous laws in regards to the management of waste exist. The following list is therefore by no means exhaustive. Its aim is to cover the main legislation governing waste management that is particularly relevant to waste reduction at source:

- **The National Environmental Management Act** (NEMA) (Act 107 of 1998) NEMA is the umbrella legislation that governs environmental legislation. According to NEMA (Section 2(4)(a)(iv)) sustainable development requires:

  "*that waste is avoided, or where it cannot altogether be avoided, minimised and reused or recycled where possible and otherwise disposed of in a responsible manner".* [DEAT 1998]

- **The Environment Conservation Act** (Act 73 of 1989)
  Section 24 (I) of this Act is of particular interest as it gives the Minister of Environmental Affairs and Tourism the power to promulgate legislation for:

  "the imposition of compulsory charging, deposits or related financial measures on waste types or specified items in waste types with the concurrence of the Minister of Finance". [DEAT 1989]

  Charging for waste can be seen as a strong incentive to practice waste minimisation.

- **The National Water Act** (Act 36 of 1998)
  Section 19 (1) of the Water Act prescribes that land owner, person in control, user or occupier have to take reasonable measures to prevent water pollution from occurring, continuing or recurring. It further prohibits the:

  "disposing of waste in a manner which may detrimentally impact on a water resource". (Section 21(g)) [DWAF 1998]

- **The Atmospheric Pollution Prevention Act** (Act 45 of 1965)
  This Act prescribes measures to control emissions of noxious and offensive gases, smoke, dust and fumes emitted by vehicles [DEAT 1965]. It is, however considered outdated, and DEAT intends to replace it with The National Environmental Management: Air Quality Act (NAQA). NAQA (No. 39 of 2004) was gazetted earlier this year but has not been effected. Atmospheric Emissions Licences will be introduced to regulate industry emissions. Once NAQA is passed into law, polluters will face fines and jail sentences if they contravene such a licence, according to the 'polluter pays' principle [EIA 2004].

- **The Water Services Act (Act 108 of 1997)**
  Regulating the rights to access to and services of water this Act requires that:

"...no person may dispose of industrial effluent in a manner other than that approved by the water service provider nominated by the water service authority.." (Section 7(2)) [DWAF 1997].

As a result of the fragmented nature of waste legislation, a National Waste Management Strategy (NWMS) is currently being implemented. DEAT recognises that fragmentation emanated from a low-priority approach to waste, which has detrimentally impacted on humans and environment in South Africa [DEAT 1999]. The country's low priority with regards to waste can also be observed in the often inadequate policing of environmental law [Moosa 2001]. Currently the government is in the process of formulating a key legislation that will serve as a vehicle to implement the NWMS:

- **The White Paper on Integrated Pollution and Waste Management** (IP&WM) The White Paper on IP&WM aims to change the more traditional 'end-of-pipe' way of dealing with waste to an approach that favours prevention and minimisation [DEAT 2000]. The promotion of WMCs is seen as one way to achieve reduction of waste at source. The white Paper on IP&WM also endorses the 'polluter pays' and 'cradle to grave' principles as well as acknowledges the importance of information dissemination and economic incentives to waste management. It proposes a waste management hierarchy similar to the one discussed in Section 1 (Figure 1).

6 THE PIETERMARITZBURG WASTE MINIMISATION CLUB - AN OVERVIEW OF EXISTING RESEARCH

This Section will briefly discuss the key findings of the Pietermaritzburg Waste Minimisation Club (PWMC) to date. A key source in this matter is Heather Dempster's Masters Dissertation entitled 'An Assessment of the Pietermaritzburg Club and the Waste Minimisation Opportunities on a Coil Coating Plant'. Interviews with the club's facilitators Drs Sally Spankie and Nicola Brown from the Chemical Technology Group (CTG) of the University of KwaZulu-Natal (UKZN) were also undertaken to get a full understanding of the PWMC.

6.1 Introducing the PWMC

After the Hammersdale and Metal Finishing WMC success, the PWMC was launched in February 2001 as part of the PRG's drive to form WMCs. Funded by the Water Research Commission (WRC), the PWMC consisted of eleven active members (Table 5) mostly from the small and medium enterprise (SME) sector. SMEs are companies with less than 200 employees and an annual turnover less than 40 million rand [National Small Business Act 1996]. Club member number 10 was an unofficial observing member of the club. The club was run by the CTG of the UKZN, which was responsible for organising its meetings, the training of its members as well as its administration.

Company Name	Products	Number of Employees	Classification
Company 1	Air conditioning	73	SME
Company 2	Leather & textile	60	SME
Company 3	Steel brackets	6	SME
Company 4	Printing Plates	200	SME
Company 5	Semi-fabricated Aluminum products	1500	Large
Company 6	Personal (retired)		Private
Company 7	Waste Management		Regulator
Company 8	Automotive components, metal pressing & plastics	200	SME
Company 9	Edible refined oil, soaps & candles	250	SME
Company 10	Sewage water		Regulator
Company 11	Waste Management	10	Service
Company 12	Springs, wire and sheet metal products	75	SME

Table 5: Members of the Pietermaritzburg waste minimisation club [Dempster 2002]

6.2 Initial Successes and Failures of the PWMC

The PWMC's aim was three-fold:

1. to create awareness of waste minimisation,
2. to train members in waste minimisation analysis techniques and how to set up and run a waste minimisation programme
3. to achieve financial savings and environmental savings for its members through waste minimisation.

This section will briefly describe the PWMC's initial performance with respect to achieving these aims.

6.2.1 Creating Awareness

In order to create awareness of waste minimisation seven training modules were developed by Enviros March Consulting. A survey by Heather Dempster [Dempster 2002] of the usefulness of the training material found that it introduced the concept of waste minimisation well, but was lacking in showing members how best to implement waste minimisation in practice. Indeed it was found that most members failed to use the taught techniques to identify waste minimisation opportunities in their factories. Most companies were unwilling or unable to allocate manpower to undertake the initial audit. Indeed most companies remarked that they would rather receive outside help to undertake an initial audit rather than carry it out themselves. Guest speakers at meetings who presented ideas for the practical implementation of waste minimisation also had only limited impact. It was further found that five out of eleven members found it unrealistic to appoint a project champion to drive the waste minimisation effort within the company. The reason for this can be attributed to the small size of the workforce for member companies. Only two companies, both of which employed more than 70 staff, thought it easy to involve people, in addition to the project champion, in the waste minimisation process. It can therefore be concluded that while member awareness of waste minimisation was created, only little of it was translated into a pro-active implementation of the programme.

The barriers identified may give some indication as to why members were not proactive in steering the waste minimisation effort in the companies. The largest barrier identified was 'production pressure'. This refers to companies' having to meet tighter production deadlines and fulfil more orders in order to operate at greater profit. This translated into their inability to allocate time and manpower to drive waste minimisation. 'Operational constraints', the difficulties of accomplishing efficient changeovers in a process to achieve waste minimisation, was found to be the second largest barrier. The third and fourth largest barriers were 'lack of human resources' and lack of 'management time'. They can be attributed to the member companies' being too small to dedicate a person to internally drive waste

minimisation. Another reason for companies not achieving waste minimisation is the fact that South Africa is still relatively new in taking on environmental responsibility [Dempster 2002].

It was noted that half of the members were initially very concerned about achieving success in waste minimisation in their companies. These concerns faded as low-cost waste minimisation opportunities were identified through casual observation. It seems that initial scepticism can only be overcome by proof that implementing waste minimisation options can realise savings in individual companies. A more individual, company specific training may thus achieve better and earlier company buy-in.

In light of companies' gradual appreciation of the benefits of waste minimisation it is not surprising that 'financial savings' was ranked low as a driver of waste minimisation at the beginning of the club. This jumped to one of the highest ranking drivers once members had realised the cost savings they could achieve through waste minimisation. On par with 'financial savings' was 'improved plant utilisation', followed by 'improved environmental performance'. Interestingly 'more stringent legislation', ISO14000 and improved image ranked lowest among waste minimisation drivers. This suggests that a lack of legislative pressure in South Africa, as well as the absence of demand for environmentally friendly products and processes, are barriers to companies practising waste minimisation.

In conclusion, member awareness was raised, in terms of theoretical knowledge of waste minimisation. Little proactive practical participation by the members in assessing the need for and implementing the solutions to waste minimisation was observed. Operational pressures to meet deadlines and make profits, the difficulty to change-over and introduce new processes and lack of human resources were identified as the main barriers to the members implementing waste minimisation. This may be linked to the belief that human and monetary efforts invested in waste minimisation will adversely affect profit. This belief seems particularly strong in SMEs, which due to their size have less staff and money available for capital investment. Paradoxically, waste minimisation has a proven track record in achieving cost savings. It was observed that initially pessimistic companies warmed to the

concept once they could apply it to their own processes. This may be an indication that training may have been too general and that sector specific training may be necessary to secure active participation. The absence of legislative pressure and a market for environmentally friendly products may be another explanation for company apathy.

6.2.2 Anticipated Financial and Environmental Savings

Staff and students from UKZN calculated potential financial and environmental savings for one process only in some of the member companies. Only processes that use either water or chemicals or both were considered. No potential savings data exists for any companies' whole operation. Information about anticipated savings is restricted to the following [Spankie 2005 *pers. comm.*]:

- Company 1: R5030 financial savings per year
- Company 5: R19500 financial savings per year, 1594 kilolitre environmental savings per year.
- Company 12: R32626 financial savings per year.

7 METHODOLOGY

This section presents the methodology that has been used to characterise the PWMC and determine its usefulness as a sustainable model for the operation of WMCs. A qualitative approach to research has been taken using interviews and structures questionnaires in order to accomplish this study's aim and objectives. The study is divided into four distinct research components:

- **Charaterisation of South African support structures for WMCs for comparison with those offered in England and Wales.**
  A detailed review of literature on WMC support structures available in England & Wales was undertaken. This involved looking at legislation as well as papers written on support structures in England and Wales.

  Little information on South African support structures was available in the

literature. Additional information was obtained through interviewing a range of individuals that are knowledgeable on this subject.

- **Determination of the impact of South African support structures on the performance of the South African WMCs.**
  This research component was based on interviews with specialists on WMCs.

- **Determination of the various assessment techniques used by PWMC members to analyse the success of the club.**
  To determine the various waste minimisation audit techniques used by the PWMC members, a structured self-administered and closed-ended questionnaire was developed. This allows the person answering the questions to choose from several options. The questionnaire was handed to relevant persons in each member company and then follow-up in-person interviews were conducted. The questionnaire was used as a basis to probe the answers filled in by the respondent. The idea of the closed-ended questionnaire was to stimulate interviewees to think about the subject prior to the interviews taking place, thus preparing them for the more in-depth questions that would be asked during the interview stage. This helped to maximise the quality and relevance of the information obtained using the questionnaire. Moreover, closed questions alone force people into an avenue of answering that may not give them the flexibility to fully express their views [Lewis-Beck 1994]. Another reason therefore to following up the initial closed-ended questionnaire was to allow interviewees to fully express their views. In addition it gives the interviewer more flexibility to explore areas that need more attention.

- **Determination of the impact of South African support structures on the performance of the PWMC.**
  This research component consists of drawing conclusions from the results obtained from the three research components described above.

8 WASTE MINIMISATION SUPPORT STRUCTURES

WMCs have become synonymous with instituting successful waste minimisation programmes. However researching the literature shows that this success has not been fully assessed against well-defined criteria. This section considers the structure of and strategy behind the fundamental types of WMCs, which have evolved in England and Wales over the last 15 years. This is discussed in terms of both club management and member profiles together with the support and services offered to club members and received by the club itself. It also examines how the effectiveness of WMCs has or has not been assessed in this time. This involves looking at both potential and measured indicators of success and understanding their scope and limitations.

8.1 Support structures in England and Wales

WMCs in England and Wales have undergone considerable change since they came into being in the early 1990s. These changes can be considered under the following broad headings:

- structure of the club
- scope of the club
- provisions offered by the club to members
- resources available to run the club

It can be observed that these changes have paralleled the movements in England and Wales's waste management policy and also coincide with the drop in available funding for WMCs to promote waste minimisation.

Pressure from EU legislation was instrumental in broadening the UK's Waste Strategy. In 1995 the UK's environmental legislation was marked by a move towards the integration of waste management with sustainable production [DEFRA 1998]. Sustainable waste management came of age with the Waste Management Act of 1998. The Act clearly states that it is unacceptable to have increased wastage as a consequence of increased manufacturing output [Clarkson, Adams and Phillips 2002]. WMCs were put forward as a way to lower the levels of industrial waste and

improve production efficiency. Government papers entitled 'Sustainable Waste Management' and 'Opportunities for Change' in 1998, 'A Way with Waste' and the 'Sustainable Development Strategy' in 1999 and a year later 'Waste Strategy 2000' sought to broaden the definition of environmental protection found in the legislation. This included moving beyond the natural environment into something with more of an ecosystem approach and which looks at domestic waste as well as industrial. England and Wales' current Waste Management Strategy is based on the principle of sustainable development, which recognises the need for economic growth for everyone alongside the protection of the environment and conservation of resources [DETR 2000]. This broadened the existing waste strategy, which previously was ruled solely by the principle of the waste hierarchy [Cheeseman and Phillips 2001]. The new model introduced the concept of Best Practicable Environmental Option (BPEO) and the Proximity Principle. BPEO requires waste managers to limit environmental pollution but not at prohibitive expense to the company as expressed below:

"...to take decisions which minimise damage to the environment as a whole, at acceptable cost, in both the long and short term." [DETR 2000]

BPEO embraces the waste hierarchy concept, which puts prevention/reduction before disposal. If waste needs to be disposed of, however, BPEO acknowledges that this must be done cost effectively for the company. This means that companies are not put at risk of being put out of business because they do not have the finances to install the best waste management technology. The proximity principle is designed to reduce the risk to the environment of transporting waste long distance form source to disposal site.

"*BPEO requires waste to be disposed of as close to the place of production as possible. This avoids passing the environmental costs of waste management to communities which are not responsible for its generation, and reduces the environmental costs of transporting waste.*" [DETR 2000]

To achieve its aims of reducing waste generation both in the workplace and at home, Waste Strategy 2000 suggests the creation of partnerships with businesses, local authorities, regulators, facilitators (higher education institutions and parastatals), community groups and the public. It considers this kind of partnership crucial to changing people's attitude to waste and serves as a basis for developing low cost WMCs (Table 6). The Strategy also recognises that businesses can increase their competitiveness by reducing their waste. Waste Strategy 2000 recognises WMCs as a good vehicle to carry out effective waste management [DETR 2000]. As part of its waste management strategy, government sets statutory performance targets to Local Authorities to reduce municipal solid waste as well as waste arising from industrial activity. However WMCs can be seen as a less coercive and more supportive means to bring about sustainable waste management practice and attitudes.

This has led to two club approaches being used to promote waste minimisation principles and practices in industry, namely 'Demonstration' and 'Project'. The latter has been divided into facilitated self-help and self-help clubs. These have become known as *first generation*, *second generation* and *third generation* WMCs respectively [Cheeseman and Phillips 2001, Clarkson, Adams and Phillips 2002, Phillips, Pike, Bates and Read 2000]. Each of these can be classified as sectoral or sector-specific (members are recruited from one industry only) or multi- or cross-sectoral where companies are recruited from one geographical area. In the UK the latter has been more widely adopted by industry than the former [Phillips, Pike, Bates and Read 2000].

The differences between Demonstration and Project clubs appear to arise from their different structures. Demonstration Clubs use a consultant-based approach to deliver the waste minimisation initiatives while Project Clubs use a partnership structure. This is consistent with the shifting of waste minimisation expertise provision to the club members from private consultants, as in Demonstration Clubs, to trainers and researchers in, for example, tertiary education institutions, trade associations, utility companies, environmental/industrial support organisations or in member companies themselves in the Project Clubs. Sponsorship of WMCs by external agencies has

been observed to drop since the mid-1990s [Phillips, Dempsey, Freestone and Read 2004]. The characteristics of UK WMCs are summarised in Table 6 and are discussed below.

Club Structure	Membership	Sope and priorities	Funding and its sources	UK examples
Demonstration	• Companies • Consultants	• Little participation by company • Audits done by consultants	• High cost and high sponsorship from fees, charities, research grants and government	• Catalyst, • Aire & Calder, • Leicester Waste Minimisation initiative, • Humber
Project Facilitated self-help	• Companies • Few consultants • Many partners	• Participation by company as project team and champion • Training of company personnel in waste minimisation by consultants	• Considerable cost • Some sponsorship form LCTS	• Northampton Resource Efficiency Project • Kettering • Northampton • Wellingborough
Project self-help	• Companies • Few partners	• Considerable participation by company as project team and champion • Training of company personnel in waste minimisation by partners • Exit strategy, information dissemination, education and skills training for formal accreditation reduces duplication of effort	• Low cost and little sponsorship from partners, club fees	• Hereford • Worchester

Table 6: Characteristics of UK waste minimisation clubs

Demonstration clubs, created to 'demonstrate best practice' were the first to be introduced into the UK using an approach imported from continental Europe [Coskeran and Phillips 2004]. These were found to be very expensive to run requiring significant funding (200,000 - 1,000,000 pounds sterling). This high cost was largely because the waste minimisation expertise was bought-in and consultants performed the waste audits and ran out the waste minimisation programme. Consequently when the project closed there was no company personnel with any expertise to continue the waste minimisation effort or to communicate the results to

other companies and institutions outside the club [Coskeran and Phillips 2004, Phillips, Clarkson, Adams and Read 2003].

Project Clubs were designed for industry to share experiences and ideas on best practice through forming self-sustaining partnerships with local authorities, utility companies, trade associations etc. where members would work together to help themselves. One of the weaknesses observed for clubs receiving training from their own members on how to conduct waste audits is the problem of poor attendance at meetings [Phillips, Pratt and Pike 2001(a)]. If the team or the trainers do not turn up at meetings then the training in waste minimisation techniques cannot take place and the programme is likely to fail. However where training has been supplemented to a lesser (self-help) or greater degree (facilitated self–help) by involving subsidised private, educational or governmental organisations as facilitators, such problems are reduced [Phillips, Dempsey, Freestone and Read 2004]. A project champion and a project team would be trained in conducting waste audits and implementing waste minimisation programmes. The training together with the experience of carrying out the programme have allowed such WMCs to prepare an Exit Plan. This is a strategy to enable information to be available after the club has terminated and to initiate the formation of new clubs through activities of previous ones.

The main driver of waste management in the UK is the Environment Agency. It plays a crucial role in supporting and sponsoring WMCs and drawing together all organisations necessary for successful waste minimisation projects [Phillips, Pratt and Pike 2001(a)]. Moreover, the Environment Agency offers a service delivered by Envirowise, previously known as the Environmental Technology Best Practice Programme, which provides free advice to businesses via a phone help-line, as well as free publications about best practice. SMEs benefit from a 'Fast Track' service offered by Envirowise, which offers preliminary company audits by specialists free of charge [Envirowise 2004(b)]. The companies are therefore supported with quality technical help, from auditors and literature, rather than with direct funding. These Project Clubs have offered a low cost means of operating WMCs. The costs incurred range from around 20,000 pounds sterling for self-help to 100,000 pounds sterling for facilitated-self help. This has come from public funds like taxation and grants.

However many of the direct funding sources are no longer available. An example of this is the Landfill Tax Credit Scheme which put a tariff per kilogram of solid waste dumped at landfills and used the earnings to fund a number of environmental programmes including until recently WMCs [Phillips, Dempsey, Freestone and Read 2004].

8.2 Assessing WMC Performance in England and Wales

Little analysis has been done to compare the success of the different club approaches in order to establish which is the most effective structure for adoption by future clubs. Performance criteria or measures, which have been used or have the potential for being used to assess the success of WMCs have been identified from the literature [Phillips, Pratt and Pike 2001(b)]. These are presented in Table 7 under three broad headings. The quality of the available data on the criteria used in judging performance of WMCs is discussed below.

Performance Criteria	Example of some performance criteria or associated issues
Economic measures	1. Actual financial savings 2. Potential financial savings 3. Savings as % of turnover 4 Payback period 5. Internal rate of return 6. Net present value 7. Total cost analysis 8 Cost/savings ratio 9. Cost benefit analysis
Environmental measures	10. Environmental (as actual or potential) savings on solid waste (MSW and toxic) 11. Environmental (as actual or potential) savings on effluent 12. Environmental (as actual or potential) savings on water usage 13. Environmental (as actual or potential) savings on gaseous emissions
Club measures	14. Number and type of clubs forming - Cross sectorial or sectorial 15. Duration -Completion or failure 16 Recruitment -Membership numbers 17. Reporting results- Production of final report, Quality of final 18. Publicising results - Information dissemination and access both within club and abroad, during clubs lifetime and after termination 19. Cascading effect – Preparation and execution of exit strategy to facilitate new club formation

Table 7: Performance criteria [Phillips, Pratt and Pike 2001(a)]

Entries 1 to 7 in Table 7 represent increasingly more sophisticated ways of calculating the financial benefits made by individual companies through practising

waste minimisation. The complexity in calculating the performance measure can be linked to the cost to the company (often of a capital investment) of putting a waste minimisation option in place. Such expressions of financial gains made by individual companies through being part of the WMC have been widely used to indicate the success of WMCs. However they are based solely on the waste minimisation opportunities achieved by the club members in their own companies. Entries 8 and 9 look at costing the financial benefits to the companies in terms of the expense to the club and Entry 9 also considers the cost to the wider environment and society of companies not practising waste minimisation through WMCs. Entries 10 to 13 represent reductions in environmental impact made by companies practising waste minimisation. These measures, like that in Entry 9, represent a broader view of the benefits of WMCs and do not merely focus on those achieved by and for individual companies. It has been observed that the environmental savings made from solid waste and effluent minimisation are more widely reported than those from fugitive carbon dioxide emissions. Reduction in the volumes of such waste obviously reduces stresses on the environment. Solid waste reductions mean less ground is used up for the disposal of waste in landfills, and reductions in effluent discharge mean less effluent discharge is being sent through municipal sewage works for cleaning up and returning to the water course. Unlike financial indicators these reductions are not usually expressed as a percentage of the value for original waste stream or as a percentage of the total waste reduction. The most recent developments in sustainable waste management policy have taken a more holistic approach. This has included promoting domestic waste minimisation and extending the functions of WMCs. The latter has involved using WMCs to raise awareness about waste minimisation and widen participation beyond the traditional target groups into the broader industrial, commercial and service areas and into residential communities [Phillips, Pratt and Pike 2001(a)].

Waste management legislation based on the principles of sustainable development, effective legislative policing, and a service (Envirowise) dedicated to promoting the reduction of waste at source have produced an estimated 145 clubs (Table 8) since the WMC concept was adopted in the UK [Coskeran and Phillips 2004]. The success of WMCs can be measured by the actual number of clubs which have formed

compared to the number of clubs proposed as needed to achieve waste minimisation and sustainable waste management throughout the country. However clubs which form must also go to completion in order to be considered successful. One measure of successful completion that has been used for assessing clubs performance is the production of a Final Report. However, the lack of consistency and detail in the reported data has led to many of the criteria in Table 8 being regarded as doubtful indicators of WMC success.

Regions	*Number of clubs*	*Reported number of businesses as members**
Northwest	20	729
Northeast	9	68
Yorkshire and the Humber	8	1165
East midlands	11	153
West midlands	13	370
Southeast	15	215
Southwest	14	443
London	11	420
East	13	863
Total England	114	4266
Scotland	20	844
Wales	5	112
Northern Ireland	6	40
Total UK	145	5222

*The minimum number of members reported by clubs themselves.

Table 8: Waste minimisation clubs in the UK - 1992-2004 [Coskeran and Phillips 2004]

Waste Strategy 2000 suggests a necessary 100 self-sustaining clubs in existence at any one time for adequate UK coverage [DETR 2000]. Estimates have shown that the maximum figure lies at 50 clubs [Coskeran and Phillips 2004]. It is generally accepted that Envirowise has failed in promoting WMCs throughout the country. While 90% of companies in Envirowise targeted areas are aware of the service, only 5% of companies are aware countrywide [Coskeran and Phillips 2004]. The distribution of clubs has meant that some areas like London have been neglected.

In line with Waste Strategy 2000's alignment of waste management and sustainable development, Envirowise promotes a self-help low-cost approach to setting up WMCs [Envirowise 2004]. Yet, WMCs are still reliant on external funding [Coskeran and Phillips 2004]. Moreover, the number of waste minimisation projects looking for funding, has dramatically increased since the concept was introduced to the UK

more than a decade ago. This makes it impossible for funders to accommodate every application [Clarkson, Adams and Phillips 2002]. Receiving funding has recently become even more difficult since the UK government has withdrawn access to the Landfill Tax Credit Scheme (LTCS), which provided a significant amount of funds [Phillips, Dempsey, Freestone and Read 2004]. The reasoning behind the governments decision was that there is no evidence that sustainable waste management, the category under which WMC projects were funded, had brought enough change [HM Treasury 2002]. As has been discussed, little evidence exists as to whether and how successful WMCs are in the UK and how this can be determined. While government acknowledges that WMCs are instrumental in reducing waste, no standard economic appraisal or evaluation of clubs has been applied to establish if funds invested in them are justified [Coskeran and Phillips 2004]. Moreover, the lack of uniformity of reporting makes it difficult to analyse comparative success between clubs [Phillips, Pratt and Pike 2001(a)].

A further negative effect linked to a reduced availability of funds, as well as proof of WMC's inability to be self-sufficient, is suggested in a study by Coskeran, Phillips and Smith [2005]. The study suggests that the initial benefits from waste minimisation experienced by companies were related to widely available funding. This funding made joining WMCs easier and meant that companies invested less time and money on waste minimisation effort. With less funding available a shirking culture was seen to emerge, where club members put less effort into reducing waste. This led to a shortening of clubs' lifetime and indeed to the curbing of new club formation since 1999.

The existence of a dependence of WMCs on outside support is demonstrated by a study revealing that clubs' financial savings from waste minimisation practice drop as external support ceases. This is attributed to the absence of a waste minimisation methodology being incorporated into the business activity by supporters and club members alike [Clarkson, Adams and Phillips 2002].

However there has been little or no use of internal rate of return and cost/benefit analyses to assess the performance of WMCs. The most popular economic indicator

used has been cost/savings ratio. When considering cost/saving ratio, the facilitated Project Clubs have been observed to do as well as the Demonstration Clubs but without requiring a huge outlay in money [Phillips, Dempsey, Freestone and Read 2004]. This has not been without problems when evaluating the performance of different clubs. For example financial data used in cost/savings ratio have not been clearly defined as net or gross nor as discounted or current and have not been collected over the same time period [Phillips, Pratt and Pike 2001(a)]. Performance comparisons can therefore be ambiguous. This has lead to a call for standardisation of auditing procedure and in the calculating and reporting findings on the performance of WMCs [Phillips, Pratt and Pike 2001(a)].

In recognition of clubs' failure to adopt a more self-help, low-cost approach projects such as the Northamptonshire Resource Efficiency Project (NREP) have been launched. Although NREP was funded to a certain extent, a substantial proportion of support was given 'in kind' (e.g. expertise, time, manpower) from a variety of organisations such as Envirowise, the University College of Northampton (UCN), Northamptonshire County Council and Business Link. Funding of 145 000 pounds sterling and in-kind support to an estimated value of 143 000 pounds sterling led to actual savings of 1.89 million pounds sterling with a further 1.24 million pounds sterling of identified savings [Envirowise 2001]. Importantly NREP demonstrated that its low-cost, self-help approach achieved percentage savings in line with heavily funded demonstration clubs. Another important aspect of NREP is that the partnerships it forged with various local organisations have led to the creation of a support infrastructure that can be used by succeeding clubs in the same region. This was not the case with demonstration clubs whose support structures came in the shape of paid outside consultants, who did not stay after their completion [Clarkson, Adams and Phillips 2002].

NREP's success can be attributed to its ability to incorporate local structures into the waste minimisation effort when implementing it in industry. Indeed, traditionally government focus was on consultants working with industry in terms of implementing waste minimisation [Phillips, Holley, Bates and Freestone 2002]. This is changing with the introduction of a new breed of British waste minimisation projects, which

take a more holistic approach to waste reduction, in line with Waste Strategy 2000. The 'Corby Waste Not' (CWN) project, a Northamptonshire club that built on NREP's existing support infrastructure, stands out in its holistic approach to waste minimisation. It pioneered this approach through getting everyone in Corby town and vicinity, across businesses, community, local authority, schools and university, to work together on reducing waste [EMRA 2005].

Holistic waste minimisation can be thought of as integrating sustainable waste management with the community. In keeping with this idea NREP and CWN have developed a set of performance criteria or indicators against which WMC success can be evaluated. The NREP used 12 indicators. Clubs appear to be evaluated on a four-point scale. Achievement of the individual indicators is described as 'very good progress'. This scale decreases in the order of 'good progress', 'fair progress' through to 'no progress'. The CWN team designed the following seven indicators under which a number sub-divisions or points are identified and scored to measure the level of success in holistic waste minimisation:

1. **Waste Management Tools**

   This indicator has three sub-divisions. It is based on BPEO, the waste hierarchy and the proximity principle.
2. **Waste Categories**

   This indicator has four sub-divisions. It includes controlled wastes (industrial and domestic), non-controlled wastes (e.g. agriculture), water and energy.
3. **Geography**

   This indicator has two sub-divisions. It includes rural and urban.
4. **Social Group**
5. **Partnership**

   This indicator has eight sub-divisions. It includes regulators, facilitators, industry bodies, local authorities, waste industry, voluntary sector, education and local media.
6. **Education and Training**

   This indicator has three sub-divisions. It includes junior schools, senior schools, colleges and vocational training.

7. *Time Scale*

This indicator, with three sub-divisions, includes short, medium and long-term planning [Phillips, Holley, Bates and Freestone 2002].

A performance level was obtained by adding together the number of sub-divisions attained in a project and dividing it by the total number of sub-divisions (28). CWN attained a holistic ranking of 24 out of 28, which translates into a holistic percentage of 86%. By applying this indicator to other clubs (Table 9) comparisons could be made in terms of their holistic approach. The earlier discussed Don Rother Dearne (Section 5.1), for instance, only achieved a holistic ranking of 50%.

Club	*% Holistic score*
Corby Waste Not	86
Wellingborough	68
Kettering	68
NREP	58
Northampton	54
LWMA	54
Dee Catchment	50
Don Rother Dearne	50
Catalyst	50
East Anglia Food and Drink	50

Table 9: Holistic ranking for some Northamptonshire and key national waste minimisation clubs [Phillips, Holley, Bates and Freestone 2002]

CWN's approach made a positive impact throughout Corby Borough. The recycling rate rose from 1.2% in 1999 to 2.3% in 2002; the kerbside collection of paper was introduced; 80% of University graduates assigned to the project went on to a full-time job in the environment sector or to study for a higher degree; 4000 school children received waste education and eight community groups set up a variety of related successful schemes. The companies involved in the project achieved combined savings of 240,000 pounds sterling per year, and many more potential savings through waste reduction were identified. It is worth mentioning that a publication entitled 'Waste Not Pack' has been produced as a result of CWN, which gives guidance in setting up similar projects [EMRA 2005]. While CWN is a success story both in terms of low-cost/self help and in its holistic nature, it would not have been possible without specialist management provided by the UCN and other 'in-kinders'.

One can thus assume that it would not work as well in areas were such help is not readily available [Phillips, Holley, Bates and Freestone 2002].

Despite more sustainable projects like NREP and CWN, the number of new UK clubs has dramatically declined since 1999 [Coskeran, Phillips and Smith 2005]. This can be attributed to the failure to promote WMCs effectively, the failure to instil a self-help WMC culture and the recent loss of the major funding source that is LTCS. A recent paper by Phillips, Dempsey, Freestone and Read [2004] suggests several steps necessary to revive and improve WMCs in the UK. First, the LTCS funding scheme for WMCs needs to be re-instated. Even in the case of self-help clubs such as CWN, initial investment from LTCS was instrumental in gaining additional funds. Second, an Envirowise led forum that consists of industry, service providers, higher education and waste minimisation champions of proven worth needs to be formed. This forum will produce an Action plan for WMC development for each Region in England. The Regions will each allocate funds to sponsor the waste minimisation champions:

"...who would liaise with the Regional Development Agency and other regional bodies to produce an Action Plan for WMC development, based on a facilitated self-help model. This way, a wide range of local expertise and support will be recruited to the formation and management of WMC, decreasing costs and income leverage" [Phillips, Dempsey, Freestone and Read 2004].

8.3 Conclusion

England and Wales's waste management strategy (Waste Strategy 2000) is based on sustainable development, embracing the principle of BPEO. Waste Strategy 2000 acknowledges the need to form partnerships as a means to reduce waste generation. It also recognises WMCs as a tool to bring about waste minimisation. This recognition has led to the formation of three club approaches: demonstration, facilitated self-help project and self-help project, also known as first, second and third generation clubs respectively. In the case of demonstration projects implementation of waste minimisation practices has been carried out by independent consultants. This consultant based approach has been found to have two significant

disadvantages. In the short term these clubs are expensive to run and in the longer term they hinder existing club skills development and new club formation. For example company personnel have been left without the necessary expertise to continue the waste minimisation process and the knowledge base from which to advise other clubs on successful waste minimisation options. Second and third generation clubs are less expensive and an exit strategy ensures that a support infrastructure is left for new clubs. The downside of second and third generation clubs is that their success depends on trainers and companies being motivated to drive the waste minimisation process. Help is available for WMCs from Envirowise, a governmental agency that provides free information on waste minimisation best practice, as well as offering free audits to SMEs.

Despite what appears to be a solid support structure backed by adequate legislation, the adoption rate of the WMC concept by UK companies is seen largely as a failure. Waste Strategy 2000 has made waste management a key element of sustainable development within the UK. While government recognises that WMCs are able to reduce waste, it is unclear whether they can justify the investment needed to initate and run them. Uncertainty surrounding WMC success in promoting sustainable waste management can be attributed to the failure of having adequately assessed WMC performance. However clubs like CWN have proven that WMCs can be relatively self-sufficient by relying on in-kind support and laying a foundation for future clubs. However one study suggests that an Envirowise led forum could provide a better platform for successful self-sustainable WMCs in the future. An action plan would be drawn up for each individual region, which would be implemented by competent WMC champions. Such a forum could lead to more standardised models specific to each region. This would make appraisal and evaluation of individual clubs easier, and so be more likely to secure the success of WMCs in reducing waste.

9 RESULTS AND DISCUSSION

This chapter presents the results from the study of waste minimisation clubs in South Africa and from the survey conducted on the Pietermaritzburg Waste Minimisation

Club. In the first case the data was collected through face to face and telephone interviews with people experienced in working in and running waste minimisation clubs in South Africa. This research work looks at establishing what support is given to WMCs in South Africa. It aims to identify the barriers and drivers, which have been found to contribute to the successfully running and completion of WMCs in South Africa. The third study (Section 9.3) uses a structured questionnaire (Appendix C) to interview former members of the PWMC to establish their independent progress in continuing waste minimisation programmes and how the PWMC helped them in achieving waste minimisation.

9.1 Assessing Support Structures in South Africa with Reference to England and Wales

To date the lack of an integrated legislative approach to waste (Section 5.2) has affected the practice of waste minimisation in South Africa. The first hurdle arises when companies look for information on waste minimisation and how to start a WMC. While ample literature on waste minimisation is available on the Internet, very little of it is written for South African companies [pers. obs.]. Most sites are addressed to the European and United States of America (US) markets. These countries' governments have set up agencies that encourage and support the Waste Minimisation effort. One South African waste minimisation site exists on the Internet (www.nu.ac.za/wasteminclubs). Run by the PRG, it gives some useful hints as to who to contact and refers to useful literature as well as giving a list of Clubs in South Africa. It appears, however, that this Internet site has not been updated for several years [pers. obs.].

A company interested in applying waste minimisation may be inclined to enquire at the Department of Environmental Affairs and Tourism (DEAT). However no link to information about waste minimisation or waste management exists on the department's Internet site (http://www.environment.gov.za), (pers. obs). During the study several DEAT employees, including the DEAT Director of Communications and the Environmental Quality & Protection Branch Communicator in Pretoria, were asked in writing about the supply of information concerning waste minimisation. No meaningful replies were received to the e-mails written (Appendix B). Another obvious source of such information is the Department of Trade and Industry (DTI).

Difficulties were encountered in finding the right person to talk to. After having been transferred to the wrong person several times, the Department's Standards and Environment Deputy Director in Pretoria finally referred the author to the National Cleaner Production Centre (NCPC). This is a DTI co-funded organisation, which will be discussed later in this Section. While no effort has been made to contact regional governmental authorities, the difficulties encountered to receive information about cleaner production on a national governmental level may be regarded as an indication of an intra-governmental lack and/or fragmentation of information about this subject.

The authorities on waste minimisation in South Africa appear to be a handful of independent organisations. The most visible of them is the BECO-Institute for Sustainable Business (BECO-ISB), a consultancy currently commissioned by the City of Cape Town to run several WMCs in the Western Cape. BECO-ISB has been involved in the running of the majority of WMCs in South Africa (Appendix A). The Cape Town based consultancy keeps a small library on waste minimisation [Kothuis 2005 *pers. comm.*]. Then there is the PRG of the University of KwaZulu-Natal. This agency was co-initiator of the first two pilot clubs in South Africa and authored a comprehensive facilitator's manual on how to run a WMC in a South African context. The manual highlights potential governmental funders, which include the Water Research Commission (WRC), The Department of Water Affairs and Forestry (DWAF) and the Department of Trade and Industry (DTI). Internet information sources and useful contacts are also listed in the manual. In the author's knowledge this manual represents the only comprehensive South African guide on waste minimisation and WMC best practice. Its long list of national and international contacts, funders and other resources concerning waste minimisation demonstrates quite clearly the lack of a coherent approach to waste minimisation in South Africa. The manual's author, Susan Barclay who now runs a consultancy providing advice on cleaner production, acknowledges the lack of, and need for, a visible first point of contact for companies interested in pursuing waste minimisation [Barclay 2005 *pers. comm.*].

The Ministry of Foreign Affairs of Denmark (DANIDA) has helped in advancing waste minimisation in South Africa. DANIDA has funded various cleaner production projects as part of its international development programme, notably:

- the 'Cleaner Metal Finishing Industry Production Project' (2000-2003) in which DANIDA provided 15000 rand for each of the three participating WMCs,
- three study trips to Denmark with the purpose of raising awareness about cleaner production principles of industry, government as well as Research and Development institutions,
- and a 'Cleaner Textile Production Project'. This project is said to have been particularly successful in terms of its self-help, low-cost approach [Foure 2005 *pers. comm.*].

DANIDA was approached by DEAT and DTI to facilitate the transfer of cleaner production knowledge from Denmark to South Africa [du Preez 2005 *pers. comm.*]. DANIDA provided a diverse range of assistance to companies involved in waste minimisation but did not focus primarily on providing information about setting up WMCs in South Africa.

Last, but not least, a company may have identified the earlier mentioned NCPC as source on how to establish and run a WMC. The NCPC is believed by some to be a potential first point of contact for companies wanting to know more about how to set up a WMC [Foure and Barclay 2005, pers. comm]. The NCPC is jointly funded by United Nations Industrial Development Organisation (UNIDO), the Austrian and Swiss governments and the DTI. The NCPC's mandate is to promote cleaner production practices in South Africa through awareness raising and capacity building [CSIR 2003]. It runs both theoretical and practical training programmes for industry and government on how to identify and implement cleaner production practices with emphasis on waste reduction at source [Celliers 2005 *pers. comm.*]. Since its inception in 2003 it has served approximately 20 companies in this way. Case studies on two of these are available on their internet site. While it has the potential to be the South African first contact for information on cleaner production issues, it seems to have failed to promote itself strongly enough [Foure and Barclay 2005,

pers. comm]. Moreover, discussions with staff revealed that while NCPC's focus is on cleaner production, it does not actively promote the formation of WMCs [Anonymous 2005, pers. comm]. It is currently applying for an extension of funding which is ceasing at the end of 2005 [Celliers 2005, pers. comm].

In light of the above it is not surprising that South African WMC members represent only 0.024% of all businesses in South Africa[1] compared with the still relatively low 0.14% in the UK[2] [Coskeran and Phillips 2004]. The effects of fragmented waste management legislation and lack of WMC support will be discussed in Section 9.

9.2 South African WMCs

Section 9.1 outlined the lack of support for WMCs in South Africa. This manifests itself through limited and low-key government involvement in promoting waste minimisation in the form of enacting and enforcing environmental legislation and offering assistance through advisory bodies. As a result a handful of independent national and international organisations are left to support South African WMCs, notably DANIDA, NCPC, BECO-ISB, WRC and other private consultants. While many of these organisations are collaborating with the South African government, there is no large-scale governmental move to bring WMCs and support agencies together. Moreover, no governmental initiative like Envirowise exists where information about setting up a club, sourcing expertise and securing funding is available. Most WMCs that have made it to date are demonstration and some project facilitated self-help type clubs similar to those described in Section 6.1. These clubs are, the first to a greater and the latter to a lesser degree, heavily reliant on outside funding and support. Little has been done to promote self-help or third generation approaches to running WMCs. This Section explores the effects such a poor support structure has on the development of South African WMCs.

Table 10 summarises the results obtained through discussions with environmental professionals working in the WMC field. The results are discussed below.

[1] There is a total of 1290569 businesses in South Africa [Statistics South Africa 2005], and an estimated 300 companies that are or have been members of a WMC [BECO 2004].
[2] based on amount of businesses in 1999 and WMC club members in 2004

Person interviewed/ Organisation	Waste minimisation driver or barrier	Reason
Kothuis B. (BECO-ISB)	• Member apathy	• No compelling legislation
	• Lack of detailed waste minimisation analyses • Lack of detailed final report	• Lack of funding for these activities
Zwavel S. (BECO-ISB)	• Lack of training of club members	• Lack of funding for this activity
Barclay S. (Private consultant)	• Member apathy	• No compelling legislation
Danks J. (Saayman Danks Electro Plating)	• Management commitment	• Realisation that financial savings can be achieved • Legislative pressure
Foure P. (Project Leader, Cleaner Textile project)	• Target waste minimisation opportunities in waste and process streams with established options e.g. water and effluent in wet industries	• Motivation to continue from achieving successful results
	• Award scheme	• Motivation to continue from winning
	• Successful training format and delivery	• Club members trained in practical aspects of waste minimisation techniques that they can apply. • Training completed in a short time period (2 months or less).

Table 10: Waste minimisation club drivers and barriers in South Africa

During interviews held with a range of authorities on waste minimisation in South Africa, member apathy emerges as the main problem faced by WMCs. Bas Kothuis from BECO-ISB states that most companies are not pro-active in their approach to practice waste minimisation [2005 *pers. comm.*] This has also been observed in companies participating in cleaner production projects run by the National Cleaner Production Centre (NCPC) [Celliers 2005 *pers. comm.*]. Many believe that one reason for this apathy or absence of motivation to practice waste minimisation may well be the lack of legislative pressure exercised by government [Danks, Barclay, Foure, Oldham, Kothuis 2005, pers.comm.]. This could also be due to companies not realising the true cost of their waste especially if their profits appear reasonably healthy.

It appears that lack of funding is also partly responsible for WMC apathy. This arises where the club members do not know what to do in order to institute waste minimisation programmes themselves (no funds for training) and there is no paid consultant to perform the assessments (no funds for expertise). The situation in South Africa is such that government gives out tenders to manage WMC projects to independent consultants who compete to get the contract. This kind of competition leads to a situation whereby proposed costs for setting up and managing WMCs are underestimated in order to win the contract [Barclay 2005 pers.comm.]. Lack of funding means that crucial elements necessary to running a WMC and ensuring the success of future WMCs are not being instituted adequately. BECO, for instance, which currently runs several WMCs in the Western Cape, has not enough funds to research and produce in-depth reports about the success of its clubs [Kothuis 2005 *pers. comm.*]. This has been recognised in the UK as a crucial step in the waste minimisation process and part of the exit strategy that benefits other WMCs. This is particularly important in South Africa where there is a need to establish base line data on which to monitor the impact of waste minimisation in the country. Lack of funding has also meant that little time is spent on training club members [Zwavel 2005 pers. comm]. Without training, however, club members cannot drive the waste minimisation process themselves or independently run a WMC. The scope for WMC members to be pro-active and to self-help is therefore very minimal. Inadequate funding can also lead to a shirking culture as has been observed in the UK in the case of the discontinuance of Landfill Tax previously available to WMCs. A study showed that effort of club members reduced as funding decreased (Section 6.2).

Limited agency support as a result of under-funding is particularly detrimental to WMCs for SMEs as well as companies that struggle financially. Both of these examples are often unwilling to allocate internal funds and manpower themselves to assist or drive the waste minimisation process [Oldham 2005 *pers. comm.*]. This represents a paradox, as waste minimisation can more often than not achieve financial savings.

Kevin Celliers from the NCPC believes that only companies who believe in and understand the benefits of waste minimisation will proactively participate in the waste

minimisation process [2005 *pers. comm.*]. It seems that cases where such a company buy-in has been observed are few and far between in South Africa.

One success story is the Saayman Danks Electroplating company in Durban. For a long time its co-owner John Danks did not believe that reduction of waste at source could save him money. He attributes his initial pessimism to the fact that proposed waste minimisation solutions seemed to bring minimal return and did not seem worth the effort. Legislative pressure from eThekwini Metropolitan to reduce chemical and metal output in wastewater, as well as rising water prices eventually convinced Danks to implement waste minimisation options. Cumulative savings from proposed solutions finally convinced Danks of the benefits of waste minimisation. He names legislative pressure and cost savings as the main drivers for waste minimisation in his company. Both cost savings and the law were crucial factors in achieving management buy-in, which is quintessential to making waste minimisation work in an organisation according to Danks [Danks 2005, pers. comm]. This confirms emphasis in literature put on achieving management buy-in before implementing any other waste minimisation steps (Section 3.2).

The DANIDA funded Cleaner Textile Project (2000-2004) is another example of the successful adoption of waste minimisation practices by companies. Little funding was available for this project most of which has been spent on training member companies. The onus was on instilling a self-help culture with the skills to implement waste minimisation provided during the training sessions. The majority of participating textile companies went on to successfully implement waste minimisation solutions without any other outside assistance. One of the Project Leaders, Pat Foure, describes several factors that may have contributed to its success. First, Foure believes that there is a great scope to save in the textile industry, which traditionally has always used a lot of water and energy. This acts as a prime motivator to practice waste minimisation. Second, the style of training appeared to be very successful. During the six to eight week courses, participants were tasked to undertake process flow analyses, scoping audits and come up with ideas for waste minimisation options for their companies. This training style differs from the approach used in most other South African clubs, where support agencies take the lead in

these types of analyses, rather than to provide the skills to companies to do it themselves. Finally, the introduction of Cleaner Production Awards promoted healthy competition to do well [Foure 2005, pers. comm].

Lack of a structured approach to support is clearly counteractive to instilling a successful WMC culture in South Africa. The absence of a central agency disseminating learnings and information stunts the success rate of existing and creation of new WMCs. No standardised reporting structure means that WMC success is difficult to measure. Moreover, lack of legislative pressure, too little funding and the absence of creating a self-help culture have led to WMC member apathy or 'passive acceptance'. This kind of passive acceptance of waste minimisation by WMC members translates into less efficient waste minimisation in the long term. Successful waste minimisation projects have highlighted the need to instil a self-help attitude to waste minimisation. Training helping companies to help themselves seems to have been a successful approach to achieve this. Moreover, an award scheme attached to training creates healthy competition, motivating members to implement good waste minimisation solutions. Crucially, however, management needs to buy into the benefits of waste minimisation before it can happen. Cost savings and legislative pressure are both important factors in achieving such a buy-in.

9.3 The PWMC

The findings of the PWMC are discussed in three Sections. Section 9.3.1 identifies the 'drivers' for or reasons why club members used waste minimisation as part of their waste management strategy while Section 9.3.3 looks at the 'barriers'. Section 9.3.2 looks at the effectiveness of the PWMC as a 'driver' or means to achieve waste minimisation.

9.3.1 Waste Minimisation Drivers for Club Members

At its inception the PWMC consisted of twelve members (refer to Table 5 for a list of PWMC members). Two of these members were regulators (Umgeni Water and Msunduzi TLC Waste Management), and one a service provider (Waste Tech). These were part of the club to add expertise and information to the process, rather than to learn about waste minimisation. They were excluded from this study. From

the remaining nine organisations, no one at the air conditioning company was available for an interview, and new management at the semi-fabricated aluminium products company did not know anything about the PWMC. One private individual could not be located. One member, a household timber products manufacturer, was not included in the initial study by Heather Dempster but had requested to be audited by the CTG. This company had received no training in waste minimisation techniques. The first was excluded from the study, while the latter was included. This leaves seven companies, all of them SME, which are outlined in the table below (Table 11).

Company Name	Products	Number of Employees
Company 1	Automotive components, metal pressing & plastics	320
Company 2	Springs, wire and sheet metal products	95
Company 3	Leather and textile auxiliaries	95
Company 4	Printing plates	160
Company 5	Galvanised eteel brackets	6
Company 6	Edible refined oil, soaps & candles	200
Company 7	Household timber products	150

Table 11: Pietermaritzburg waste minimisation club members 2005

Four out of seven companies undertook their own in-house assessment and implemented waste minimisation solutions as a direct result of the PWMC. In order to understand why these companies embarked on this work and introduced waste minimisation practices, they were given a choice of seven responses and asked to name the three most relevant ones to them. These responses are listed below and were introduced with the following statement:

Our company introduced some waste management practices through their involvement with the PWMC because...

- it produces financial savings
- it improves environmental performance
- of stringent legislation
- of pressure from customers
- we want to attain ISO 14000 or another environmental management standard

- it improves plant utilisation
- it improves company image

The company responses to these points are displayed graphically in Figure 9.

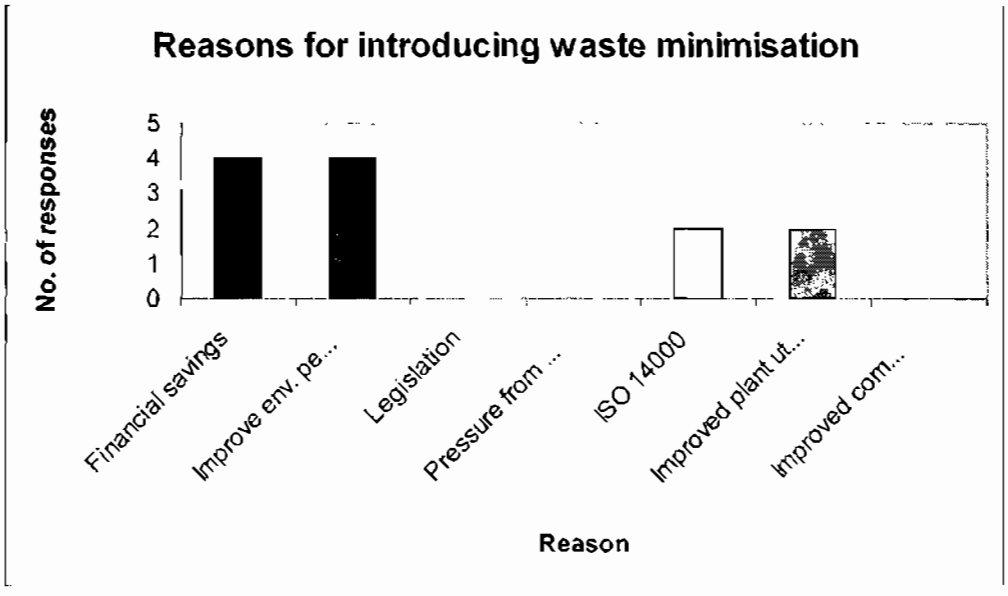

Figure 9: Reasons for introducing waste minimisation

Overall, 'financial savings' that can be achieved and 'improved environmental performance' were voted as the most important reasons to adopt waste minimisation. 'Financial savings' was chosen by all four members. This agrees with Danks's and Foure's statements that cost savings are a prime motivator to practice waste management. This is also named as a crucial late onset motivator by Dempster (Section 7). Dempster noted that companies appeared only to fully realise that financial savings can be achieved after they had introduced waste minimisation solutions themselves through casual observation. This kind of change of heart, also noted by Danks, may be an indication that initial waste minimisation efforts need to be orchestrated by an outside agency to gain buy-in.

The wish to 'improve environmental performance' by companies came as a surprise. In a previous study by Dempster it featured amongst the lowest motivators for waste minimisation. The new study revealed the reasons for companies wanting to improve environmental performance. One company caused a major pollution incident and

wishes to avoid a similar incident and redeem its image. Two companies aspire to be ISO 14000 accredited and need to perform better and document their environmental performance. The fourth company, a division of a major Canadian company, has to run according to the same environmental standards as its parent company. These are higher than those required in South Africa. This result may be skewed somewhat, as these companies' reasons to improve environmental performance may not be typical of every South African SME. It is interesting to note that three out of the four companies want to improve environmental performance as a result of pressure from their customers or parent company. In all three cases the companies are subsidiaries or branches of large international enterprises. Many small companies supply to bigger companies, which may export to international markets with higher environmental standards. These bigger companies may therefore require their suppliers to adhere to environmental standards higher than those demanded in South Africa. This kind of snowball effect may inadvertently create a need in some SMEs to improve their environmental performance.

'ISO 14000' and 'improved plant utilisation', came equal second in their importance for implementing waste minimisation. 'ISO 14000' was voted by two companies supplying large automotive enterprises, which demands from its suppliers to be ISO 14000 accredited. 'Improved plant utilisation' refers to optimising (monitoring and managing) processes and includes avoiding spills or wastage through implementation of waste minimisation solutions. It may have arisen through a desire to save costs by minimising wastage. All companies introduced and were keen to identify further opportunities to reduce cost-incurring wastage.

'Legislative pressure', 'pressure from customers' and the 'need to improve company image' received no vote. These can be considered as factors external to the company, i.e. legal penalties and client and public opinion. The first is in line with South Africa's fragmented waste management legislation. The latter two demonstrate an absence demand for environmentally friendly products in South Africa by companies' customers and by the general public. The desire to be ISO 14000 accredited has been identified to be driven by customers outside of South Africa. Interestingly, both legislative pressure and market demand for

environmentally friendly products have been instrumental in driving waste minimisation in pioneer countries (Section 6). It appears that the drivers for our four companies have been monetary on the one hand (financial savings and plant utilisation), and pressure from regulators and non-South African customers on the other hand. It could be argued that such differences are indicative of the differences in first and third world economic policies and values.

9.3.2 The PWMC as Driver for Waste Minimisation

One of the study's aims was to test the effectiveness of the training delivered by the club (Questionnaire A in Appendix A). This involves determining whether or not the analyses methods taught during training courses were employed in practice. Another aim was to establish what benefits, other than identifying waste minimisation opportunities and practical solution option through waste minimisation analyses, members had gained from the PWMC.

Three questions were posed to the four PWMC members that had undertaken waste minimisation assessments and implemented solutions as a result. The three questions asked in order to test training effectiveness were:

1. Were any data or information collected directly from the factory floor?
2. Were any data or information for the assessment collected from any department other than the factory floor?
3. Have you been able to use the data or information from the above to carry out:
   - Process and material flow diagrams?
   - Scoping audit?
   - Mass balance analysis?
   - True cost of waste analysis?
   - Monitoring and targeting?
   - any other monitoring practices?

The first two questions were on information gathering. These were used to find out what sort (qualitative or quantitative) of data were collected. This influences the type of waste minimisation analysis techniques which can be used and provided a check

on the answer to the third question. The third question asked about the actual waste minimisation techniques used by the company. The responses to the questions are discussed below under the headings 'Question 1', 'Question 2' and 'Question 3'.

Question 1

All four members collected information from the factory floor. Most information was gathered from the factory floor by observation only. This included gathering information on excessive waste packaging, leaks and other wastage. All four members have an in-house chemical treatment plant from which pH is monitored and chemical treatment is undertaken. It emerged that one of the main reasons for companies to treat chemical effluent is that Umgeni Water 'charges for discharges' with a high pH. More exactly, the effluent officers issue an on-the-spot warning if pH is greater than 9.5 and below 6.5, and then re-test at a fee of around R500 within the next two weeks.

Two companies have meters from which electricity and water consumption is monitored. One company installed a water meter as a result of the PWMC. All companies keep daily records of what they are monitoring, be it water, electricity, effluent, packaging, rejects or a combination thereof. No company monitored all of the above, but all companies monitor water consumption.

Question 2

The utility bill issued by Msunduzi Municipality charges companies for the water they have used in (one month) arrears and calculates the trade effluent charge for wastewater on the consumption volume. All four members collect information about water and electricity consumption from bills. The bills are held by the administration in all companies. All company administration departments also keep information about bought compared to raw materials used. It was found that information gathered by the administration department is frequently shared with factory floor in all four companies to monitor use of water, electricity and raw materials.

Question 3

Two members have started monitoring practices such as looking out for leaks and monitoring water, while the other two use a combination of auditing methods. The latter two do this through automated monitoring of processes that are undertaken on a daily basis. When asked to identify the easiest auditing method, none of the members named scoping audit, the most basic of all.

Further discussions with the four members revealed that only one company has assigned an individual whose responsibility is to oversee the waste minimisation process. Some mentioned that low cost and ease of implementation were criteria for implementing waste minimisation practices, and all companies admitted that there is still scope for improving their waste minimisation practices.

It can be observed that members who assessed and implemented waste minimisation do use methods described during the PWMC training. Most solutions were implemented as a result of observation, and all members undertake measuring of water, electricity or effluent, described as a key audit tool during training to identify waste minimisation solutions. It was noted that all companies appear to monitor pH and water as a result of pressure from Umgeni Water. It can therefore be concluded that while the PWMC has provided the theoretical knowledge on how to implement waste minimisation, the practical application of it was motivated by pressure from customers and legislation. This stands in contrast to Dempster's findings, which may indicate a rise in demand for environmentally friendly products as well as a more stringent environmental policing by Umgeni Water than four years ago.

It emerged that a list of Internet sites given to members, which provides links to useful organisations and information about waste minimisation practices was only used by two out of the seven members. Also, only two out of the seven members were able to produce the training manuals received during training when asked, and only two members referred to it after completion of the club. This may be an indication that training material was considered by most to be not useful or its use inadequately explained during training.

The vast majority (six) of the PWMC members found the actual training undertaken by the University of KZN was useful, however, even if in some cases it did not lead to actual implementation of waste minimisation practices. The main perceived benefit of training, other than learning how to implement it, was that it raised awareness of waste minimisation. All but one participant felt that they have knowledge about the principles of waste minimisation as a result or partly as a result of the PWMC, and could put a waste minimisation programme in place.

Several questions were asked to all seven members to determine other, perhaps more unexpected, benefits that had come from being involved with the club.

All but one interviewed member felt that the PWMC helped forge relationships with other companies and/or regulators that attended the club meetings. The same six stated that they were comfortable approaching regulators. This may be attributable to the PWMC, although all six stated that they had been comfortable approaching regulators before. Four companies felt that the PWMC was, to varying degrees, instrumental in crafting links between them and support structures. Support structures named were the Pietermaritzburg Chamber of Commerce, Umgeni Water and the Durban Metal Finishing Association. These, together with the Msunduzi Municipality and suppliers, were also named as organisations that had at some point offered members help in waste management related matters. Umgeni Water offered advice on how to reduce pH in effluent, Msunduzi Municipality made a study about waste in the timber industry, the Chamber of Commerce runs an environmental forum to raise environmental awareness of industry, and the Durban Metal Finishing Association gives advice about techniques to reduce raw material wastage and effluent treatment to its members.

Thus, the PWMC was successful in creating awareness of waste minimisation in its membership. It also contributed to forging links with other organisations and may have improved dialogue between members' and regulators. The majority of members did not consider training material useful.

9.3.3 Barriers to adopting waste minimisation practices

To establish what hindered the waste minimisation process in PWMC members, all seven companies were asked to choose the three responses most relevant to them from the list of seven options given below:

- Waste minimisation is not profitable, e.g. in terms of costs savings that can be achieved
- Lack of human resources makes it difficult to practice waste minimisation
- Lack of available company finance makes it difficult to practice waste minimisation
- Production pressure, e.g. meeting order deadlines, makes it difficult to practice waste minimisation
- Legislation not being enforced or the lack of other outside pressure makes it difficult to practice waste minimisation
- Operational and process constraints makes waste minimisation options difficult to implement, e.g. necessary changeovers resulting in non-optimal production performance
- Lack of technical or other knowledge makes it difficult to implement waste minimisation

From this it emerged that 'lack of human resources' is the greatest hurdle to implementing waste minimisation. This is followed by 'production pressure', 'operational & process constraints' and 'lack of technical knowledge', all on a par. 'Lack of finance' features as the least restricting of reasons to implementing waste minimisation.

An unwillingness or inability to allocate human resources to implement waste minimisation practices has also been identified by Dempster as a major barrier. The reason for this barrier may indeed lie in the small size and restricted monetary ability of the companies. For example it may be difficult for a company to release an employee from their job to undertake waste minimisation duties. The same rationale can be applied to companies having named 'production pressure' and 'operational &

process constraints' as a barrier. The pressure to maximise profit may make it difficult to make alteration to machinery and processes.

'Lack of technical knowledge' may be an indication that PWMC training was not company-specific enough. During interviews members confirmed that training was too general and not tailored to individual company needs. Moreover, Dempster observed in her study that members found training not practical enough. This may also be a reason for the prevailing 'lack of technical knowledge' among members.

None of the club members found that waste minimisation is not profitable or felt in any way that lack of legislation had something to do with not practising waste management (Figure 10).

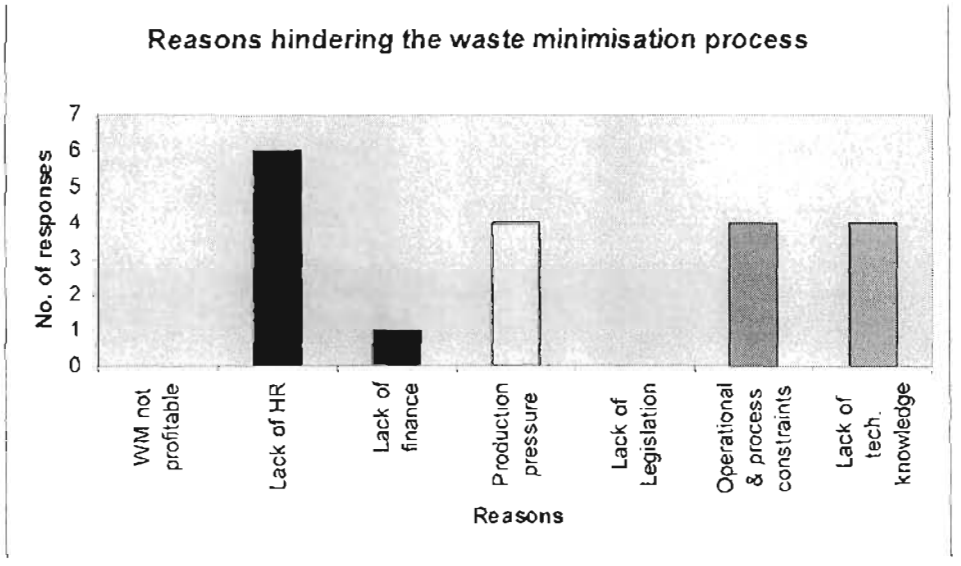

Figure 10: Reasons hindering the waste minimisation process

The pattern of responses changed, as the members were asked which statements they thought would be relevant for their companies in the future (Figure 11). Interestingly most thought that legislation, or the lack thereof, would hinder the waste minimisation process in their organisation. This implies that legislation is seen as a driver of waste minimisation. In other words there is a cut-off point at which waste minimisation is going no further without legislative pressure.

Companies also felt that lack of technical knowledge will restrict the waste minimisation effort in the future. Once all low or no cost options have been implemented, then options with more technical knowledge, capital investment and longer payback issues have to be considered. This also requires feasibility studies and so is more expensive to institute. This might explain the legislative pressure deemed necessary by the PWMC members to motivate further implementation of waste minimisation solutions.

This part of the study also revealed that waste minimisation is perceived by some to be unprofitable in the future. This could be linked to companies not being able to invest in solutions that are expensive and have long payback period. Indeed the literature review, a previous study about the PWMC as well as findings have revealed that SMEs are often not willing or able to invest in waste minimisation solutions that require initial capital.

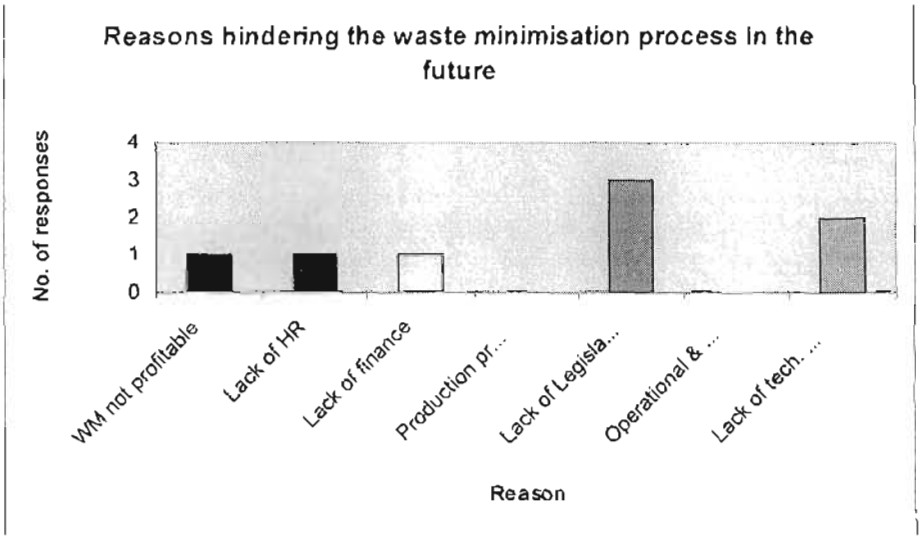

Figure 11: Reasons hindering the waste minimisation process in the future

9.4 Conclusion

Four out of the seven interviewed companies introduced waste minimisation practices into their organisations as a direct result of the PWMC. The extent to which waste minimisation has been introduced, as measured by the assessment techniques used in the companies, differs from member to member. Their use of some of the methods taught during training may be regarded as a partial success,

even if training material itself was not considered relevant. Although no in-depth analysis about financial and environmental savings as a result of waste minimisation practices has been done, members did report cost and raw-material savings, particularly in regards to water. Thus, the PWMC's aim to achieve financial and environmental savings was also partially successful. Moreover, a majority of members agreed that the PWMC was instrumental in raising awareness and forging links with other organisations. It can therefore be concluded that awareness raising has been successfully achieved by the PWMC.

The greatest barrier to waste minimisation within the PWMC is perceived to be a lack of human resources. This can be attributed to the small size of the companies involved, which were either unwilling or unable to allocate labour to drive waste minimisation. Restricted financial as well as resources may also be the cause of other barriers to the PWMC success, such as production pressure. An interesting finding is the legislative pressure perceived necessary by members to drive waste minimisation in the future. Also considered a future barrier is technical knowledge, which will be increasingly necessary once all the 'low-hanging fruits' have been reaped and the remaining waste minimisation options become more technical. The importance given to lack of legislation and technical knowledge in the future, suggests that current legislative pressure is inadequate to drive future, more expensive waste minimisation practices once all simple and low cost-no cost waste minimisation options have been implemented. This highlights the necessity to consolidate and fortify current law in regards to waste management so that the long term buy-in of companies to practice waste minimisation is ensured.

The two main drivers for waste minimisation identified by companies were the opportunity to save money and to improve environmental performance. The first is driven by the desire to maximise profit, the latter by pressure from the local regulator and large international customers demanding environmentally friendly goods. These pressures highlight the importance of good policing of, and stricter environmental standards for South African companies to achieve better waste management.

It can be concluded that the self-help approach adopted by the PWMC was only partially successful. The PWMC was successful in terms of raising awareness of its members to waste disposal issues. The study found that companies need to be shown, in practical terms, that waste minimisation can result in financial savings before management buy-in can be attained. However there seems to be no data on which annual financial savings can be calculated for any company. If more University manpower had been allocated, in the form of students for instance, to identify and orchestrate implementation of low or no-cost waste minimisation solutions, member adoption rate of waste minimisation may have been raised. However, the small PWMC budget may have made this impossible. Lack of funding may also have prevented facilitators putting together a large support team, as has been done for the English NREP project. This demonstrates that self-help WMCs need an initial funding boost to be successful. This funding should be invested in gaining buy-in from company personnel rather than to drive the waste minimisation process on behalf of member companies. This kind of 'hand-holding' leads to a passive acceptance of waste minimisation as is currently the case in South Africa, and 'shirking' as has been observed in the UK. Such a facilitated self-help approach can then lay the basis for third-generation WMCs, which use the support infrastructure established by their second-generation counterparts. Studies of WMCs in England and Wales based on a self-help approach showed that they achieved financial savings that are comparable to those in demonstration clubs (Section 6). The promotion of such sustainable WMCs in South Africa needs to be performed by a central support agency such as the British Envirowise. Envirowise was seen to successfully promote waste minimisation among those it reached. However, it reached only a small percentage of overall industry. A successful South African agency therefore needs to promote itself effectively and nation-wide. A successful South African Envirowise organisation should also facilitate the creation of WMCs by leading a forum of industry, service providers, higher education and waste minimisation champions of proven worth, to create an action plan for WMC development for each province, as suggested by Phillips, Dempsey, Freestone and Read [2004]. Each province would then allocate funds for a waste minimisation champion who, in conjunction with the local development agency, would create a provincial action plan for the development of facilitated self-help WMCs. The local

support and expertise recruited to form and manage WMCs would decrease costs and leverage income. This kind of support agency needs to be upheld by waste management legislation based on the concept of sustainable development, recognising the need for environmental protection alongside that of economic growth. To date no such legislation is in place in South Africa. It is hoped that the White Paper on IP&WM, which endorses the principle of sustainable development alongside with the necessity to reduce waste at source, will form the basis for a successful South African WMC culture.

10 REFERENCES

Agenda 21 1992

Altmayer, F., J. Zak, K. Wasag and B. Cavanaugh. February 2002. *The Effect of Barrel Design on Drag-out.* Plating and Surface Finishing. pp.32-37.

Australia's Bureau of Statistics (ABS). 2001. *Australia's Environment: Issues and Trends 2001.*

Barclay, S. 2001. *Final Report: Applicability of Waste Minimisation Clubs in South Africa: Results from Pilot Studies; Synthesis Document.* Durban: Pollution Research Group. School of Chemical Engineering. University of Natal.

Barclay, S. 2001. *Waste Minimisation and Effluent Treatment clubs: Phase 1 - Initial Assessment and Pilot Study, Final Report.* Water Research Commission. WRC Doc No TT 161/02.

Barclay, S. and C. Buckley. 2002. *Promoting sustainable industry through waste minimisation clubs.* Water. Science and Technology. Vol. 46(9). pp.79-86.

Barclay, S., C. Buckley, D. Maharaj, N. Thambiran and D. Mercer. August 2000. *Waste Minimisation Clubs: A Route to Sustainable Industrial Development?.* Nairobi: UNEP First African Cleaner Production Roundtable.

Barclay, S., C. Buckley and D. Mercer. September 2000. *Waste Minimisation clubs - Managing them for success.* Cape Town: the proceedings from Wastecon 2000.

BBC News/Country Profiles 2005. *Timeline South Africa* [online]. Available at newswww.bbc.net.uk/1/low/world/africa/country_profiles/1069402.stm. [30/05/05].

BECO-Institute for Sustainable Business (BECO-ISB). May 2004. *Status of Waste Minimisation Clubs in SA*. available from BECO-ISB. Mill Street 8010. Cape Town. South Africa.

Biffa. 2005. *What is Mass Balance?*. available at www.biffa.co.uk/content.php?name=massbalance/index.html [online]. [24/02/05].

Blomquist, P.A. and N.J. Brown. April 2004. *A review of the pre-assessment and assessment techniques used in waste minimisation audits*. Water SA. Vol. 30(2). pp. 131-141.

Brundtland, G. H. 1987. *Our Common Future*. Report presented to the United Nations General Assembly 04/08/1987.

Cheeseman, K. and P.S. Phillips. 2001. *The Northamptonshire Resource Efficiency Project: the exit strategy*. Resources, Conservation and Recycling. Vol. 32(3). pp. 31-54.

City of Cape Town. 2004. *Integrated Waste Management - Final Status Quo Report*. Cape Town: City of Cape Town.

Clarkson, P.A., J.C. Adams and P.S. Phillips. 2002. *Third generation waste minimisation clubs: a case study from the East Midlands of England*. Resources, Conservation and Recycling. Vol. 36(1). pp. 107-135.

Collins Gem English Dictionary. 2002. Glasgow: Harper Collins Publishers.

Constitution of the Republic of South Africa. 1996. Act No. 108 of 1996. 08/05/1996.

Coskeran, T. and P.S. Phillips. 2004. *The economic evaluation of waste minimisation clubs: proposal to inform the design of sustainable clubs.* 19th International Conference on Solid Waste Technology & Management. March 2004. Philadelphia. USA. ISSN: 1091-8043.

Coskeran, T., P. Phillips and S. Smith. 2005. *An Analysis of the Contribution of Waste Minimisation Clubs to Sustainable Waste Management in the UK using Economic Theory of the Firm.* 20th International Conference on Solid Waste Technology & Management April 2005. Philadelphia. USA.

Council for Scientific and Industrial Research (CSIR). 2003. *Official inauguration of CSIR-based SA National Cleaner Production Centre.* available at www.csir.co.za/plsql/ptl0002/PTL0002_PGE013_MEDIA_REL?MEDIA_RELEASE_NO=7075969 [online]. [05/03/05].

Crittenden, B. and S. Kolaczkowski. 1995. *Waste Minimisation: a practical guide.* Rugby: Institution of Chemical Engineers.

Dempster, H.J. July 2002. *An Assessment of the Pietermaritzburg Waste Minimisation Club and the Waste Minimisation Opportunities on a Coil Coating Plant.* Submitted in the fulfilment of the academic requirements for the degree of Masters of Science. Pietermaritzburg: University of Natal.

Department of Environmental Affairs and Tourism (DEAT). 1965. *The Atmospheric Pollution and Prevention Act.* Act 45 of 1965.

Department of Environmental Affairs and Tourism (DEAT). 1989. *Environment Conservation Act.* Act 73 of 1989.

Department of Environmental Affairs and Tourism (DEAT). 1998. *National Environmental Management Act.* Act No. 107 of 1998.

Department of Environmental Affairs and Tourism (DEAT). 1999(a). *State of the Environment South Africa.*

Department of Environmental Affairs and Tourism (DEAT). 15 September 1999(b). *Action Plan for Waste Minimisation and Recycling.* Version C. Document Ref.: PMB136/PSC 75.

Department of Environmental Affairs and Tourism (DEAT). 17 March 2000. *White Paper on Integrated Pollution and Waste Management for South Africa.* Government Notice No 227. Pretoria.

Department of Environment, Transport and the Regions (DETR). May 2000. *Waste Strategy 2000 for England and Wales.* London.

Department for Environment, Food and Rural Affairs. 1998. *Less Waste. More Value. Consultation Paper on the Waste Strategy for England and Wales.* available at www.defra.gov.uk/environment/consult/waste/chapter2.htm [online]. [04/06/05].

Department of Water Affairs and Forestry (DWAF). 1997. *The Water Services Act.* Act No. 108 of 1997.

Department of Water Affairs and Forestry (DWAF). 1998. *National Water Act.* Act No. 36 of 1998.

East Midlands Regional Assembly (EMRA). 2005. *Success Stories.* available at www.emra.gov.uk/s_d_success/corby_wate.asp [online], [4/03/05].

Energy Information Administration (EIA). November 2004. *South Africa: Energy and Environmental Issues.* available at www.eia.doe.gov/emeu/cabs/safrenv.html [online]. [29/03/2005].

Environment Agency. 2001. *Waste Minimisation: An Environmental Good Practice Guide.* Bristol: The Environment Agency.

Environmental Protection Agency. 1992. *Facility Pollution Prevention Guide.* Washington D.C.: Office of Solid Waste. Document ref. EPA/600/R-92/088.

Environmental Technology Best Practice Programme (ETBPP). 1996. *Saving Money through Waste Minimisation: Raw Material use*. GG25. UK: Crown Copyright.

Enviropaedia. 2002. *Waste.* World Summit Edition. Simonstown: Eco-Logic Publishing.

Enviros March Consulting Group. 1999. *Training Manual for the PWMC: Module 3: Identification of Opportunities.*

Envirowise. 1996(a). *Water in the metal finishing industry*. Environmental Performance Guide EG45.

Envirowise. 1996(b). *Acid use in the metal finishing industry*. Environmental Performance Guide EG44.

Envirowise. 1997. *Paint and powder coating use in the metal finishing industry.* Environmental Performance Guide EG72.

Envirowise. October 2001. *Northant partners keep up county momentum*. Club News. Issue 10. Didcot: Envirowise.

Envirowise. 2003. *Waste Minimisation Clubs: setting them up for success.* Didcot: Harwell International Business Centre.

Envirowise. 2004(a). *Aire & Calder Club*. available at www.envirowise.gov.uk/envirowisev3.nsf/key/WMClubs/027 [online]. [03/08/2004].

Envirowise. 2004(b). *Waste Minimisation: What next?*. available at www.envirowise.gov.uk/envirowisev3,nsf/key/MROZ5YAF6R [online]. [17/08/2004].

Global Alliance for Incinerator Alternatives (GAIA). 2003. *South Africa.* available at www.no-burn.org/ggm/gmcrep-za.html [online]. [08/05/2005].

Heinrich Böll Foundation (HBF). 2002. *The Jo'burg Memo*. Berlin: Heinrich Böll Foundation.

HM Treasury. 2002. *Information note on the changes to the Landfill Tax Credit Scheme*. London cited in Phillips, P.S., M. Dempsey, N.P. Freestone and A.D. Read. 2004. *A radical new proposal to develop and fund new waste minimisation clubs in England, due to the demise of Landfill Tax Credit Scheme funding.* Resources, Conservation and Recycling. Vol. 43. pp. 35-50.

IndEco. 2005. *News on the Kyoto Protocol & Climate Change.* available at www.indeco.com/kyoto [online]. [30/05/05].

Lewis-Beck, M.S. 1994. *Research Practice*. Vol. 6. London: Sage Publications Ltd.

Maharaj, D., S.J. Barclay, D. Mercer and C.A. Buckley. 1999. *Practical cost savings through the implementation of a waste minimisation programme at a textile plant.* available at www.nu.ac.za/wasteminclubs/pdf/paper9.pdf [online]. [25/05/05].

Mercer, D. June 2004. *Utility Management through Monitoring & Targeting*. Enviros Consulting Limited. Waste Minimisation Interest Group Workshop.

Mongabay Country Studies. 2005. *South Africa - the Economy*. available at www.mongabay.com/reference/country_studies/south-africa/ECONOMY.html [online]. [30/05/2005]

Moosa, V. 2001. *Speech by Minister M.V. Moosa, Environmental Affairs and Policy Speech. NCOP. 26th June 2001.* available at www.info.gov.za/speeches/2001/010626410p1001.htm [online]. [11/05/05].

National Small Business Act. 1996. Act No. 102 of 1996. 27/11/96

Oldham, S. 2004. *Waste Minimisation Clubs in South Africa.* Sustainable Business. Yearbook 2004. pp. 15-17.

Organisation for Economic Co-operation and Development (OECD). 2005. *OECD Factbook 2005: Economic, Environmental, and Social Statistics.* available at uno.sourceoecd.org/vl=4725162/cl=66/nw=1/rpsv/factbook [online]. [08/05/05].

Petek, L. and P. Galvic. 1996. *An Integral approach to waste minimisation in process industries.* Resources, Conservation and Recycling. Vol. 17. pp. 169-188.

Phillips, P.S., K.T. Adams, A.D. Read and A. Green. 2000. *The UK draft waste policy and waste minimisation: Regional trends in waste minimisation strategies.* Regional Studies. Vol. 34(3). pp. 216-222.

Phillips, P.S., P. Clarkson, J. Adams, A.D. Read and P.C. Coggins. 2003. *County Waste Minimisation Programmes: A case study from Northamptonshire, UK.* Sustainable Development. Vol. 11. pp. 103-118.

Phillips, P.S., M. Dempsey, N.P. Freestone and A.D. Read. 2004. *A radical new proposal to develop and fund new waste minimisation clubs in England, due to the demise of Landfill Tax Credit Scheme funding.* Resources, Conservation and Recycling. Vol. 43. pp. 35-50.

Phillips, S.P., K. Holley, P.B. Bates and N.P. Freestone. 2002. *Corby Waste Not: an appraisal of the UK's largest holistic waste minimisation project.* Resources, Conservation and Recycling. Vol. 36(1). pp. 1-33.

Phillips, P.S., K. Pike, M.P. Bates and A.D. Read. 2000. *Developing effective waste minimisation clubs: a case study from the East Midlands of England.* Journal of Solid Waste Technology and Management. Vol.26(3,4). pp. 97-113.

Phillips, P.S., E.M. Pratt and K. Pike. 2001(a). *An Analysis of UK waste minimization clubs: key requirements for future cost effective developments.* Waste Management. Vol. 21. pp. 389-404.

Phillips, P.S., E.M. Pratt and K. Pike. 2001(b). *Waste Minimisation Clubs in the UK: Key Factors for Cost Effective Future Developments.* Waste Management. Vol. 21. pp. 389-404.

Pollution Research Group (PRG). 2002. *Waste Minimisation Clubs Facilitator's Manual: a Guide to Establishing and Managing Waste Minimisation Clubs in South Africa.* Durban: University of KwaZulu-Natal.

Pollution Research Group (PRG). 2004(a). *Waste Minimisation*, available at www.ukzn.ac.za/departement/extra.asp?id=17&dept=prgund [online], [26 July 2004].

Pollution Research Group (PRG). 2004(b). *Waste Minimisation Clubs Facilitator's Manual: a Guide to Establishing and Managing Waste Minimisation Clubs in South Africa (Draft).* Durban: University of KwaZulu-Natal.

Pratt, R. M. and P.S. Phillips. 2000. *The role of UK waste minimisation clubs in the correction of market and information failures.* Resources, Conservation and Recycling. Vol. 30(3). pp. 201-219.

Ritter, C.A. and C. Coutin/Robert. August 1995. *Using Material Balance to improve design of electrolytic degreasing plants.* Plating and Surface Finishing. Vol. 82(8). pp. 33-35.

SAFM. 2004. *AM Live with John Perlman.* 08/09/04.

Smith, E.H. and A.C. Schurig. August 1994. *Application of material balance concept in waste minimisation assessment of a metal finishing process.* Environmental Progress. Vol. 13(3). pp. 202-207.

Sustainabulletin: Newsletter of the Waste Minimisation Club for large Companies in the Western Cape. February 2001. *The Waste Minimisation Approach*. Issue 1. Western Cape: Sustainabulletin.

Statistics South Africa (Statistics SA). 2005. *Total number of businesses in South Africa*. compiled by Feroza, M. Information professional at Statistics SA.

Thevendiraraj, S., J. Klemenš, D. Paz, G. Aso and G.J. Cardenas. 2003. *Water and wastewater minimisation study of a citrus plant*. Resources, Conservation & Recycling. Vol. 37(3). pp 227-250.

Trittin, J. 2004. *The Blue Angel*. available at www.blauer-engel.de/englisch/navigation/body_blauer_engel.htm [online], [22/06/04]

United Nations (UN). 2003. *The UN World Water Development Report: Water and Industry*. available at www.unesco.org/water/wwap/facts_figures/water_industry.shtml [online]. [08/05/2005].

United Nations (UN). 2004. *Agenda 21*. available at www.un.org/esa/sustdev/documents/agenda21/index.htm [online], [08/05/05].

United Nations Environment Programme (UNEP). 2000. *Global Environmental Outlook 2000:Toxic chemicals and hazardous waste*. available at www.unep.org/geo2000/english/0037.htm [online]. [12/02/05].

United Nations Environment Programme (UNEP). May 2002. *The state of the planet is getting worse but for many it's still "business as usual"*. available at www.unep.org/documents.multilingual/default.asp?documentID=2488&articleID=30498&l=en [online], [22/02/05].

United Nations Environment Programme (UNEP). 2003. *Global Environmental Outlook 3.* available at www.unep.org/geo/geo3/english/433.htm [online]. [22/12/2004].

University College Northampton. 2005. *Monitoring, targeting and maintaining momentum.* available at www.northampton.ac.uk/aps/env/waste_min/ontrack/ontrack.html [online]. [11/04/04].

Wilson, E.O. 1988. *Biodiversity.* Washington: National Academy Press.

Wood, D.A. April 1991. *The use of simple material balances to solve problems in a circuit board manufacturer's wastewater treatment system.* Plating and Surface Finishing.

Zbontar, L. and P. Galvic. 2000. *Total site: Wastewater minimization Wastewater reuse and regeneration reuse.* Resources, Conservation and Recycling. Vol. 30. pp. 260-275.

Zbontar, L. and Glavic P. 2000. *Total site: Wastewater minimization, wastewater reuse and regeneration reuse.* cited in Blomquist, P.A. and N.J. Brown. April 2004. *A review of the pre-assessment and assessment techniques used in waste minimisation audits.* Water SA. Vol. 30(2). pp. 131-141.

Personal Communication

Anonymous. 2005. Cleaner Production Centre. Pretoria.

Barclay, S. 2005. Self-employed Consultant and author of key waste minimisation papers. Durban.

Brown, N. 2004. Co- Facilitator of the PWMC. Pietermaritzburg.

Foure, P. 2005. Clothing and Textile Environmental Linkage Centre. Cape Town.

Celliers, K. 2005. Cleaner Production Technical Expert at the National Cleaner Production Centre. Pretoria.

Danks, S. 2005. Simon Danks Electroplating. Durban.

Kothuis, B. 2005. BECO-Institute for Sustainable Business in South Africa. Cape Town.

Oldham, S. 2005. BECO-Institute for Sustainable Business in South Africa. Cape Town.

du Preez, S. 2005. South African Metal Finishing Association. Durban.

Spankie, S. 2005. Co- Facilitator of the PWMC. Pietermaritzburg.

Zwavel, Z. 2005. BECO-Institute for Sustainable Business in South Africa. Cape Town.

11 ABBREVIATIONS

B

BECO-ISB:	BECO - Institute for Sustainable Business
BPEO:	Best Practicable Environmental Option

C

CTG:	Chemical Technology Group
CWN:	Corby Waste Not

D

D:	Disposal cost
DANIDA:	Ministry of Foreign Affairs of Denmark
DTI:	Department of Trade and Industry
DWAF:	Department of Water Affairs and Forestry

E

EIA:	Energy Information Administration
EU Directorate:	European Union Directorate General XVII

I

IP&WM:	White Paper on Integrated Pollution and Waste Management

M

M&T:	Monitoring and Targeting

N

NAQA:	The National Environmental Management: Air Quality Act
NCPC:	National Cleaner Production Centre
NEMA:	National Environmental Management Act
NREP:	Northamptonshire Resource Efficiency Project
NWMS:	National Waste Management Strategy

P

PWMC:	Pietermaritzburg Waste Minimisation Club
P:	Production Losses
PRG:	Pollution Research Group of the University of KwaZulu-Natal

R

RM:	Raw Material Cost
RW:	Re-work Cost

S

SME:	Small or Medium and Enterprise
SL:	Cost of Stock Losses

U

UCN:	University College of Northampton
UK:	United Kingdom
UKZN:	University of KwaZulu-Natal
UNIDO:	United Nations Industrial Development Organisation
US:	United States of America

T

TCW:	True Cost of Waste

W

WMC:	Waste Minimisation Club
WT:	Waste Treatment Cost
WRC:	Water Research Commission

REFERS TO QUESTIONNAIRE SECTION B(i)

(a) Have these prevented you from practising WM as you would like?
(b) Do you think that you may tick some of the statements in the future that you have not ticked today? If yes, why?
(c) Are your answer based on your current situation, or would you have ticked the same when the club was running?

ADDITIONAL QUESTIONS

(a) Have you received any other information/help about waste management/minimisation from other bodies such as Regulators and Suppliers?
(b) Have you got any idea on what sort of information/help you would like? (Anything specific or more general?)
(c) Would you be willing to pay for that sort of information/help? If yes, how much (more than R1000, more than R5000)?
(d) Do you feel the PWMC has created links to support structures such?
(e) Have you used any of the web site addresses given to you?
(f) Have you used ENVIROWISE?
(g) Roughly how much (in %) do you export and how much do you sell to domestic market?
(h) Is a lot of time spent on exchange rate related activities, such as re-evaluating charging scheme and re-quoting?

12 APPENDIX A

This Appendix contains a list of current and past WMC in South Africa. The consultants BECO-ISB in Cape Town have provided this list.

BECO

Institute for Sustainable Business

BECO STATUS OF WASTE MINIMISATION CLUBS IN SA

Name	Place	Industry	Members	Financial support	Facilitators	Status
KZN Metal Finishing Waste Minimisation Club (now Association)	Durban	Metal Finishing only	About 29 members when initiated (metal finishers and one chemical supplier). Now 70-80 members under the association.	Water Research Commission (R1.2m.). THERMIE Programme funds two consultants	Pollution Research Group from University of Natal Durban	Started June 1998. Project closed, but continues as an industry association.
Hammersdale Waste Minimisation Club	Durban	Cross-sectoral	10 members: 6 from textile, chemical manufacturer, chicken abattoir, and local sewage works	Water Research Commission and THERMIE Programme funds two consultants	Pollution Research Group from University of Natal, Durban	Start Nov 1998, ended end of 2000.
2nd KZN Metal Finishing Waste Minimisation Club	Durban	Metal Finishing	15 members , mainly electroplaters	Danced, DWAF, WRC	KZN Metal Finishing Association	Started Jan 2002 Finished begin 2003
Gauteng Metal Finishing Waste Minimisation Club	Gauteng	Metal Finishing	10 members: metal finishers and chemical suppliers, and water company.	Danced, DWAF, WRC	Gauteng Metal Finishing Association	First meeting Oct 2001 Merged with metal finishing association
Cape Metal Finishing Waste Minimisation Club	Cape Town	Metal Finishing and Chemical Suppliers	24 members: 17 finishers and 7 chemical suppliers	Danced, DWAF, DTI Sector Partnership Fund, WRC	Cape Metal Finishing Association (CMFA) + BECO – ISB	First meeting August 2000. 20 meetings so far. Merged with metal finishing association
Waste Minimisation Club for Large Companies in Western Cape	Cape Town	Cross sectoral	7 members, all large companies	DTI Sector Partnership Fund and NOVEM (Dutch government organisation)	BECO – ISB	First meeting November 2000. 18 meetings so far
The Pietermaritzburg Waste Minimisation Club	Pietermaritz -burg	Cross sectoral	11 members from a variety of industries, service providers and regulators	Water Research Commission through Pollution Research Group	University of Natal, PMB, Chemical Technology Group	Launched October 2000. Nine meetings, closed end 2002.
Nelson Mandela Metropole Metal Finishers Waste Minimisation Club	Port Elizabeth	Metal Finishing - Might become cross sectoral	12 metal finishers. Want to include other industries w effluent problems	BHT Water Treatment funds newsletter	University of Port Elizabeth, Inst. of environmental and Coastal management.	1st meeting March 2001. Stopped end 2002 due to moving of members.

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BECO STATUS OF WASTE MINIMISATION CLUBS IN SA

Name	Place	Industry	Members	Financial support	Facilitators	Status
City of Cape Town Waste Minimisation Club for the Plastics Industry	Cape Town	Plastics industry	10 plastics companies	City of Cape Town and DTI Sector Partnership Fund (*)	BECO – ISB	First meeting March 2002. 8 meetings so far
City of Cape Town Waste Minimisation Club for the Convention Centre Construction	Cape Town	Construction industry	All contractors to the site of this new convention centre	City of Cape Town	BECO – ISB	Initial start up failed due to lack of interest.
City of Cape Town Waste Minimisation Club for Blue Route Shopping Centre	Cape Town	Retail and restaurants	7 tenants of the shopping centre	City of Cape Town	BECO – ISB / City of Cape Town	First meeting March 2002. 3 meetings, closed mid 2003.
City of Cape Town Waste Minimisation Club for the Meat processing industry	Cape Town	Meat processing industry	6 slaughter houses and meat processing industries	City of Cape Town	BECO – ISB	First meeting April 2002. 4 meetings. Merged with Food Ind. WMC Jan '03.
City of Cape Town Waste Minimisation Club for the Car Repair industry	Cape Town	Garages	6 garages, including 2 fleet maintenance facilities of the City of Cape Town	City of Cape Town	BECO – ISB / City of Cape Town	First meeting March 2002. 6 meetings so far, closed end of 2003
City of Cape Town Waste Minimisation Club for the Cape Town Civic Centre	Cape Town	Office departments	8 departments in the Cape Town Civic Centre	City of Cape Town	BECO – ISB / City of Cape Town	First meeting February 2002. 8 meetings so far.
City of Cape Town Waste Minimisation Club for the Atlantis industrial area	Cape Town	Cross sectoral	8 companies in the Atlantis industrial area	City of Cape Town and DTI Sector Partnership Fund (*)	BECO – ISB / City of Cape Town	First meeting February 2002. 10 meetings so far.
Waste Minimisation Club for the Paarl region.	Paarl	Cross sectoral	7 industries in Paarl	n.a.	BECO – ISB	Start up failed due to lack of interest and lack support by municipality.

(*) Application submitted

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BECO STATUS OF WASTE MINIMISATION CLUBS IN SA

Name	Place	Industry	Members	Financial support	Facilitators	Status
Waste Minimisation Club for Wine farms in the Breede river valley	Robertson	Winemakers	10 wine makers in the same valley	Western Cape Provincial Government + DTI Sector Partnership Fund	BECO – ISB	First meeting January 2002. 10 meetings so far.
Waste Minimisation Club for the food and beverage industry. Monthly regional meetings alternately in Cape Town or Boland area.	Cape Town	Food and beverage industry	8 Food and beverage industries	DTI Sector Partnership Fund	BECO – ISB	First meeting August 2002, 10 meetings so far.
	Boland	Food and beverage industry	9 Food and beverage industries			First meeting October 2002, 11 meetings so far
Waste Minimisation Club for Mogale city	Mogale city	Cross sectoral	5 industries in Mogale, a.o. leather tanning, abattoirs and meat processing	Frysian water Alliance (**),	BECO – ISB	First meeting in April 2003, 5 meetings so far
Waste Minimisation club for large companies in the West rand area	West Rand, Greater Joh'burg	Cross sectoral	6-8 large companies in the West Rand area	Rand water (*), Mogale city (*),	BECO – ISB	Start up phase, first meeting expected in end of 2004
Waste Minimisation Club for Rosslyn industrial area	Rosslyn, Tshwane	Cross sectoral	8 industries in the Rosslyn Industrial area (Tshwane)	DTI Sector Partnership Fund (*)	BECO – ISB	First meeting in July 2002, 9 meetings so far.
Waste Minimisation Club for Parow Industria industrial area	Cape Town	Cross sectoral	6-8 industries in Parow Industria	Parow Industria City Improvement District	BECO – ISB	First meeting May 2003, 5 meetings so far
Waste Minimisation Club at Eben Donges hospital	Worcester	Hospital (in house)	different departments	Western Cape Provincial Government	BECO – ISB	First meeting August 2003, 6 meetings so far
Sasol in-house	National	Petrochemical (in house)	27 business units within Sasol, a large petrochemical company.	Sasol	Sasol	Meeting in February 2001. WMC integrated with existing structures.

(*) Application submitted
(**) Application in preparation

May 7, 2004

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BECO STATUS OF WASTE MINIMISATION CLUBS IN SA

Name	Place	Industry	Members	Funding	Facilitators	Status
Waste Minimisation Club for the Belville South industrial area	Cape Town	Cross sectoral	7 companies in the Belville South industrial area	Western Cape Provincial Government	BECO – ISB / Western Cape Provincial Government DEA&DP	First meeting January 2003, 8 meetings so far
Wast Minimisation Club For Mining Industry	Gauteng	Mining industry	+/-7 mines	Water Research Commission	BECO – ISB, PRG, Digby Wells & Associates	Start up phase, first meeting expected mid 2004.
3 Waste Minimisation Clubs for Ekurhuleni	Ekurhuleni	Cross sectoral	3 x +/- 7 companies	DBSA – Ekurhuleni Municipality (*)	BECO-ISB	Planned for end 2004
Waste Minimisation Club for offices of the KZN provincial government	Pietermaritsburg	offices	departments	KZN provincial government, DAEA (**)	BECO-ISB, Susan Barclay	Planned for end 2004
WMC for Richards Bay	Richards Bay	Cross sectoral	+/- 7 companies	KZN provincial government, DAEA (**)	BECO-ISB	Planned for end 2004

(*) Application submitted
(**) Application in preparation

February 21, 2004

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13 APPENDIX B

This Appendix contains e-mail requests from the author to DEAT staff, among them the Director of Communications and the Environmental Quality & Protection Branch Communicator in Pretoria.

This message is not flagged. [Flag Message - Mark as Unread]

Date: Mon, 23 Aug 2004 11:51:42 +0100 (BST)

From: "Alex Hurth" <a_hurth@yahoo.co.uk> Add to Address Book

Subject: Waste Minimisation in South Africa

To: pmakwakwa@iafrica.com

Dear Ms Makwakwa,

I am an Environmental Management Masters Student at the university of KZN. As part of my research I am looking at the issue of Waste Minimisation in South Africa. While perusing your department's internet site, I noticed that there is a new SoE report (2005) available. Yet, I was unable to download it. Do you know of any other way I can get hold of it?

On another note, I would be interested to know to what extent the 'Action Plan for Waste Minimisation and Recycling' has been implemented. Is there a document available that provides an update? I am particularly interested in what the DoE is doing in terms of facilitating and/or promoting waste minimisation clubs in South Africa.

Many thanks for looking into my enquiries. I look forward to hearing from you.

Yours sincerely,

Alex Hurth
0721 444 643

Date: Thu, 20 Jan 2005 07:39:23 +0000 (GMT)

From: "Alex Hurth" <a_hurth@yahoo.co.uk> Add to Address Book

Subject: Re: Fwd: Waste Minimisation in South Africa

To: "Irvin Molamu" <imolamu@deat.gov.za>

CC: "Edwin Moimane" <Emoimane@deat.gov.za>

Dear Mr Molamu,

I have tried several times to get information about support structures/motivating factors provided by government for companies wanting to practice Waste Minimisation and/or Waste Minimisation clubs. I understand that it must be very busy in your department, but would you maybe sacrifice 5 minutes to respond to my e-mail or even give me a quick ring (0721 444643/033 7011520). I promise not to keep you long - it would help me a great deal in my research.

Many thanks in advance.

Alex Hurth

Edwin Moimane <Emoimane@deat.gov.za> wrote:

> Irvin
>
> Please assist Mr Hurth who has been requesting the information for some time now.
>
> Regards
>
> >>> Alex Hurth 04/12/02 10:46:40 >>>
> Dear Mr Moimane,
>
> I am a studewnt at the University of KZN, writing a Maters dissertation about Waste Minimisation clubs. I wrote to you a couple of months ago asking what

sort of government support structures exist for companies wanting to perform waste minimisation or wanting to join waste minisation clubs. Are funding or advice offered by any government structures? If so where can one get help?

You forwarded my message to a collegue called Irvin, who was not able to answer me yet. I do not have his e-mail address, and was wondering if you could forward my message.

Many thanks & kind regards

Alex Hurth
0721 444 643

Edwin Moimane wrote:
Dear Alex

I merely referred your quiry to one of our officers in our department for assistance.

I hope he responds as soon as possible and i will also do a follow up on your request.

Regards

>>> Alex Hurth 04/08/27 03:07:23 >>>

Dear Mr Moimane.

Thank you very much for your prompt reply. Unfortunately I was unable to open the word attachment you have sent to me. Would you mind sending it again * maybe saving it as a Windows 98 or 2000 version.

Many thanks in advance and have a good week-end.

Kind regards

Alex Hurth

Edwin Moimane wrote:Irvin

Please assist

Regards

This message and any attachments transmitted with it are intended solely for

the addressee(s) and may be legally privileged and/or confidential.

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The views and opinions expressed in this e-mail message may not necessarily be those of DEAT or DEAT-Management.

<<<>>>

> ATTACHMENT part 2 application/msword
name=FWWasteMinimisationinSouthAfrica.doc

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14 APPENDIX C

Appendix C contains a copy of the questionnaires used to assess the PWMC performance. Club members were asked to complete Sections A and B of the questionnaire before the interview. They lay the basis for more in-depth questions, examples of which are illustrated in Section C.

QUESTIONNAIRE PIETERMARITZBURG WASTE MINIMISATION CLUB (PWMC)

SECTION A - Please tick the most appropriate answer to the questions concerning waste minimisation in your company.

1)	Have you undertaken your own in-house waste minimisation assessment since the inception of the PWMC? If your answer is 'No', please go directly to question 5).	Yes, started ☐	Yes, fully completed ☐
		Yes, partially completed ☐	No ☐
2)	Was any data or information for the assessment collected directly from the factory floor?	Yes, by observation ☐	Yes, by installing meters to read pH, conductivity, water, etc. in the process ☐
		Yes, by chemical supplier ☐	Yes, by using hand-held instruments to read pH, conductivity or other. ☐
		Yes, by in-house chemical testing or analysis ☐	Yes, but using none of the above ☐
		No ☐	
3)	Was any data or information for the assessment collected from any department other than the factory floor? This includes data on costs, raw materials, water, packaging, waste, chemicals etc. retrieved from documents such as electricity bills, water bills, Umgeni water reports, invoices or receipts.	Yes ☐	No ☐
4)	Have you been able to use the data or information from 2) & 3) to carry out:	Process and material flow diagrams? ☐	Scoping audit? ☐
		Mass balance analysis? ☐	True cost of waste analysis? ☐
		Starting any monitoring practices and keeping record of it, e.g. water meter readings ☐	Monitoring and Targeting ☐
		No ☐	
5)	Has the training undertaken by the University of KZN students/staff been useful in any way concerning waste minimisation e.g. from understanding and raising awareness to practice.	Yes ☐	No ☐
6)	Did your organisation benefit in any other way from the PWMC? For example, forging links with other companies, getting help from regulators and service providers like Umgeni Water and Wastech?	Yes ☐	No ☐

QUESTIONNAIRE PIETERMARITZBURG WASTE MINIMISATION CLUB (PWMC)

SECTION B - Please tick the most relevant statements concerning your understanding about waste minimisation and its application.

(i) Please tick the 3 most relevant to your company	Tick
Waste minimisation is not profitable, e.g. in terms of cost savings, that can be achieved	☐
Lack of human resources makes it difficult to practice waste minimisation	☐
Lack of available company finance makes it difficult to practice waste minimisation	☐
Production pressure, e.g. meeting order deadlines, makes it difficult to practice waste minimisation	☐
Legislation not being enforced or the lack of other outside pressure makes it difficult to practice waste minimisation	☐
Operational and process constraints makes waste minimisation options difficult to implement, e.g.necessary change-overs resulting in non-optimal production performance	☐
Lack of technical or other knowledge makes it difficult to implement waste minimisation	☐

(ii) Please tick the 3 most relevant to your company Our company introduced some waste management practices through their involvement with the PWMC because:	Tick
it produces financial savings	☐
it improves environmental performance	☐
of stringent legislation	☐
of pressure from customers	☐
we want to attain ISO 14000 or another environmental management standard	☐
it improves plant utilisation	☐
it improves company image	☐
Our company was unable to introduce waste management practices	☐

SECTION C

COMPANY INFO

Name of company:
Date visited:
Contact person:
Position:
Core Business:
Market:
No. Employees:
Wastes:

COMMENTS:

REFERS TO QUESTIONNAIRE SECTION A

QUESTION 1

Have you undertaken your own in-house waste minimisation assessment since the inception of the PWMC? If your answer is 'No', please go directly to question 6).

(a) Did you focus on a few select processes or whole factory?
(b) If you chose only few select processes, how and why did you identify these processes (e.g. because easy or because particularly polluting)?
(c) Do you keep a written record of what you are doing/have done? If yes, can I have a copy of it?
(d) Did you assign a specific person to do it? If yes, who got involved?
(e) Can you think of any other processes now that have a waste problem associated with them?

QUESTION 2

Was any data or information for the assessment collected directly from the factory floor?

(a) Is there a record of this?
(b) How often do you do it?
(c) Do you keep information like water bills etc?
(d) Do you monitor how much water and/or electricity you are using and/or effluent you are discharging?
(e) What do you take measurements of?
(f) Do you take measurement of inputs or waste or both?
(g) Do you ask suppliers for any specifications e.g. about chemicals going into a process? (NB Bohme Africa put chemicals into their reactor).
(h) Does the supplier come on-site and take samples of anything?
(i) Do you collect any data on solid waste (toxic or sludge?)
(j) Do you have your own effluent plant. If yes, what treatments do you use before you send off the effluent?

QUESTION 3

Was any data or information for the assessment collected from any department other than the factory floor? This includes data on costs, raw materials, water, packaging, waste, chemicals, etc. retrieved from documents such as electricity bills, water bills, Umgeni water reports, invoices or receipts.

(a) What data are you collecting and which department does it come from?
(b) Where does the data come from? Bills?
(c) Do you keep record of what you buy compared to what you use?
(d) Do you collect information about rejects?

QUESTION 4

Have you been able to use the data or information from Qs 1&2 to carry out Process and Material Flow Diagrams, Scoping Audit, Mass Balance Analysis, True Cost of Waste Analysis, Starting any monitoring practices and keeping record of it, e.g. water meter readings?

(a) Did you do it yourself or someone else?
(b) Which do you think would be the easiest to do?
(c) Does a flow diagram of the plant exist? If yes, where does it come from?

QUESTION 5

Has the training undertaken by UKZN students/staff been useful in <u>any way</u>, concerning waste minimisation, e.g. from understanding and raising awareness to practice?

(a) Do you feel you have knowledge about principles of waste minimisation?
(b) Do you feel you have ability to put waste minimisation practices in place?
(c) If it has not been done already, is there someone suitable available that could do it, and would that someone need training?

QUESTION 6

Did your organisation benefit in any other way from the PWMC? For example, forging links with other companies, getting help from regulators and service providers like Umgeni Water and Wastech?

(a) How have you benefited?
(b) Do you keep in touch with other members of the PWMC?
(c) Do you feel comfortable to approach regulators if you have a problem?
(d) Are you able to get any help from suppliers, i.e. to offer you raw materials that produce less waste?