A Review of International Approaches to Waste Prevention, and Minimisation

Report to Defra, Business Resource Efficiency and Waste (BREW) Programme
January 2007
Executive summary

The BREW programme has initiated a project assessing the feasibility of introducing waste minimisation and prevention into the planning phase of a construction or demolition project. As part of this project AEA Energy & Environment has carried out a review of how other countries implement waste minimisation and prevention. This review provides indication of the best practice internationally and identifies potential methods to be introduced in England.

The report reviewed waste minimisation and prevention drivers, methods and implementation in:

- Australia
- Finland
- Netherlands
- New Zealand
- Singapore
- United States of America

The main drivers for reducing the volume of waste going to landfill include:

- **Lack of Landfill space:** A number of the countries reviewed have high population densities and/or minimal landfill void and as such are attempting to divert waste from landfill. This extends the working life of the landfill that is present as less waste is deposited and provides greater capacity for more difficult waste that cannot be easily recycled or reused.

- **Legal requirement:** A number of countries had introduced national legislation to promote the prevention or minimisation of waste entering landfill. Members of the European Union are required by the 1999 Landfill directive (1999/31/EC) to divert waste from landfill.

- **Lack of Raw materials:** A number of countries promote waste minimisation and prevention to provide greater resource efficiency. This occurred for two main reasons. Firstly it reduced dependence on foreign countries. Secondly it is cost effective as importation is more expensive.

There were three methods used to promote waste minimisation and prevention, these were:

- **Market Mechanisms:** Using market forces to promote the use of recycled material and to reduce the appeal of disposing of waste.

- **Non-legal agreement:** A number of governments had informal agreements with the Construction and Demolition (C&D) sector based upon the promotion of waste minimisation and recycling.

- **Legal requirement:** The main method employed was the imposition of landfill taxes on the disposal of C&D waste

There were eight overarching systems of implementing these methods of promoting waste prevention and minimisation identified within the sample countries. The methods include:

- **Financial cost:** This entailed penalising companies that dispose of C&D waste to landfill through financial mechanisms, the most common of which was the use of a landfill tax.

- **Financial benefit:** This ranged from the use of bonuses for companies that utilised recycled material to the provision of contracts to companies that achieved a high level of minimisation or prevention for government building projects.

- **Legal Ban:** The use of legislative bans was applied to categories of C&D waste. For example the Netherlands has made it illegal to landfill re-usable C&D waste removing this as an End of Life (EoL) option.

- **Training of the workforce:** This occurs either through the government or by encouragement to companies to train their personnel. Whilst training is often not done specifically with waste minimisation or prevention in mind creates skilled personnel who are more aware of the
benefits of good waste management and produce a higher quality of work reducing waste caused as a result of error.

- **Information dissemination**: The provision of information and guidance to C&D companies on the best practice in waste management highlighting the benefits both financially and environmentally.

- **Contractual promotion of practice**: This is where governments tender C&D contracts for building works that required waste minimisation and prevention.

- **Waste champion**: This is a requirement for a person on the site of large projects to champion environmental issues. The environmental champion promotes best practice and ensures it is occurring.

- **Longevity**: The promotion the longevity of buildings occurs either through research into problems that cause building decay or through ensuring buildings retain functionality over time.

England already utilises some of the methods utilised in other countries reviewed, most notably the landfill tax and the dissemination of information through the BREW and Envirowise programmes. The report identifies a number of other methods that could be utilised in the England however there is a need to carry out further research to identify the best methods. The countries reviewed indicate that an integrated approach to waste management and prevention is seen as the most successful, that is the use of incentives and punishments to achieve the countries goal.
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1 Introduction
1 Introduction

1.1 OBJECTIVES OF THIS REPORT

The BREW programme has initiated a project to assess the feasibility of introducing waste minimisation and prevention into the planning phase of a construction or demolition project. As part of this project AEA Energy & Environment has carried out a review of international policy and methods of implementing waste minimisation and prevention practice. This review will provide indication of best practice internationally and then identify the potential for these to be introduced in England.

1.2 BACKGROUND

In 2002/03 the UK produced 335 million tonnes of waste of which the C&D sector was responsible for 107 million tonnes (32%). Over the same period 52.5 million tonnes of C&D waste (50%) was recycled. The industry has seen an increased rate of recycling recently, spurred mainly by the rising cost of landfill. The industry further impacts UK waste arisings as it is the main user of extractive industry outputs. The extraction of raw materials in 2002/03 created 52 million tonnes of quarry and slate waste. Therefore, making the crude assumption that all quarry and slate waste is due to the C&D sector one can state that 47% of the UK waste arisings are as a direct or indirect result of the C&D industry. Importantly the UK has a recycling infrastructure already in place for much of the waste streams occurring as a result of the C&D sector for example steel, hardcore, wood and plastic.

The UK government already uses a range of different tools to encourage waste minimisation and prevention, including:

- Landfill tax, with an escalator system increasing the cost of landfill faster than inflation.
- Implementation of the packaging and packaging waste directive, through the Producer Responsibility Obligations (Packaging Waste) Regulations 2005
- Dissemination of advice and support from business on resource efficiency, minimising waste production resulting in improved bottom line performance through the Business Resource Efficiency Waste Programme (BREW) and the Envirowise programme.
- Providing financial support and assistance to developing recycling infrastructure through WRAP (Waste and Resources Action Programme).
- Developing standards for recycled (secondary) aggregates through WRAP.
- Working with industry and professional bodies to develop better methods of demolition and construction and to demonstrate examples of best practice through the Department for Trade and Industry.
- Some government departments and local government have taken into account waste reduction strategies when commissioning new buildings
- Introduction of an aggregate levy on the quarrying of sand gravel and rock at £1.60 per tonne to reduce demand for aggregate and to encourage the use of alternative materials where available.

Recently the Site Waste Management Plan (SWMP) has been developed and promoted by industry bodies (Constructing Excellence), government departments and agencies (e.g. DTI, Defra, Department of Communities and Local Government & Environment Agency). SWMPs promote waste prevention and minimisation by:

1. Predicting materials use and waste generation.
2. Identifying the potential for prevention of waste arisings.
3. Identifying re-use and recycling routes.
4. Recording actual waste generation and subsequent re-use recycling.
5. Updating of SWMP through the construction programme.

A few local authorities have made SWMPs a compulsory part of the planning process, and the government is considering making this the case for the whole of the UK from October 2007.
Research
2 Research

An initial search was undertaken to determine methods for, and level of, waste minimisation that is present internationally. A review was undertaken of countries with specific issues that are potentially comparable to the UK or where innovative waste reduction procedures occur. As a result the following countries C&D waste management systems were investigated further:

- Australia
- Finland
- Netherlands
- New Zealand
- Singapore
- United States of America

For each country examples of waste minimisation and recycling were identified for the C&D sector. The following sections explore the C&D industry for each country and look at the background and drivers for waste minimisation and, where available, details of the effects government intervention / programmes have had on achieving this goal.
2.1 UNITED STATES OF AMERICA (USA)

2.1.1 Background

In the USA information detailing C&D waste is present at both federal and state level. The most recent nationwide study on C&D waste that has been done on a national level occurred in 1998 when it was found that C & D waste accounted for 37% of total municipal waste generated. It should be recognised that due to the vast differences found across the USA in accounting for waste at national, state and county level direct comparisons across the country are difficult.

2.1.2 Drivers for waste minimisation

The USA is rich in natural resources, has a large volume of landfill void and low haulage costs compared to the UK. However, in recent years this approach to waste management has started to change due to a number of factors, including:

- The introduction of waste management plans as part of government construction programmes.
- Cost increases to landfill waste due to compliance with new regulations and competition for landfill space, on a local basis.
- Increased transport costs due to increased world oil price.

2.1.3 Government Programmes

Nationally the government has undertaken a policy of awareness raising, promotion of good practice through voluntary agreements with industry and contractual requirement in government funded projects. The Environmental Protection Agency (EPA) has introduced initiatives that highlight good practice and enters into voluntary agreements with industry, state governments and government agencies to reduce C&D waste. One of the voluntary programmes adopted is the Leadership in Energy and Environmental Design (LEED). LEED is a voluntary standard for rating high-performance sustainable buildings developed by the US Green Building Council (USGBC). In order to attain LEED Certification, a new building project must demonstrate performance in five areas:

- Sustainable sites
- Water efficiency
- Energy and atmosphere
- Materials and resources
- Environmental quality

The LEED system is at an early stage having been operating since 2000 with only 550² buildings certified to this standard by 2006. Over the seven years best practice has been highlighted to the C&D industry and the public through articles in trade magazines, the web and the USGBC’s ‘Green building bible’.

Green development is being promoted throughout the USA by a number of other government departments including the Department of Defence, the US Air Force, US Corp of Army Engineers and the US Navy that all have green procurement programmes emphasising the need to minimise waste during C&D projects.

2.1.4 State Government

State government action consists of using market forces to influence how C&D waste is managed. The main methods identified were:

- Encouraging competition within the waste market so that landfill prices are higher than recycling costs including the use of landfill taxes and reduced permit costs for recycling businesses.
- Encouraging contractors to take up green building measures by providing demonstrations of best practice and assisting with training programmes.
- Encouraging green purchasing practices by state and county government.
- Increasing the cost of landfill by introducing requirements for the engineering of C&D landfills

2.1.5 Effectiveness of Actions

Due to the wide variation in reporting requirements and styles employed by Counties, Cities and States within the USA a comparison of the country is not feasible. It also appears there is currently not a nationwide format for recording the effectiveness of the measures implemented. This makes analysis of the effectiveness of the methods employed impossible.
2.2 SINGAPORE

2.2.1 Background

Singapore’s island status means that competition for a number of different resources is high resulting in a set of conditions that aid waste minimisation. Space for landfill is severely limited and there are few natural resources resulting in the importation of all building materials. Due to pressure on space virtually all construction requires the demolition of old buildings. All of these factors provide a strong incentive for high recycling in Singapore, which is currently 90+% of C&D waste arisings.

2.2.2 Structure of The Construction Industry

Singapore's construction industry is made up of local and foreign companies that use some of the most advanced construction technologies available. The procedures and practices adopted by the construction industry are based on those prevailing in the United Kingdom, for reasons of history. However, progressive concepts and technologies from all over the world, especially Japan, the United States and the more advanced European countries are also incorporated.

The Singaporean construction industry has in the past twenty years faced some major challenges to the way it carries out construction projects. These include but are not limited to:

- A reduction in skilled Singapore residents willing to enter the construction industry.
- A reputation for poor quality due to an over reliance on unskilled labour.
- Environmental pressures on construction projects including the need for proper waste management.

2.2.3 Drivers Towards Waste Minimisation

The following drivers have been identified as influencing waste minimisation in Singapore:

- High landfill costs and a ban on landfilling of combustible waste.
- Skilled labour shortage that has resulted in a design and planning system that encourages prefabrication.
- Training for construction workers.
- Environmental control officers required on sites.
- High cost of raw materials providing a market for recycled materials and a reason not to waste resources.

High Landfill Costs and Landfill Bans

The government controls all refuse disposal in Singapore. The National Environment Agency is responsible for the operation and management of sites including four incineration plants, a waste transfer station and the landfill located offshore at Pulau Semakau, an artificial island created by the Singapore Government.

This landfill monopoly provides the government with the ability to control disposal costs of to C&D companies. This aligned with the lack of landfill space has seen the government set high landfill disposal costs (proportionally 2% of the average wage in Singapore compared to 0.2% of the UK annual average wage for landfill in the UK), creating a strong disincentive for the landfilling of C&D waste.

In addition the Singapore government has adopted regulations (Code of Practice for Licensed General Waste Collectors) similar to the EU Landfill Directive banning combustible waste from landfill. All waste collected by general waste collectors must be screened and separated into combustible and non-combustible waste; all combustible waste must be sent for incineration. Non-combustible waste does however include construction wastes, PVC and large pieces of timber.
**Building Regulations**

A drive to improve quality and skill levels in the Singapore construction trade whilst reducing reliance on foreign unskilled construction workers was commenced in 1995. This has resulted in a number of different initiatives, including:

- Training for construction workers at all levels of the industry.
- Quality standards for work including painting, plumbing and plastering.
- A system of building regulations (Code of practice on Buildable Design) that encourage the use of labour efficient designs and prefabricated structures e.g. concrete slabs in order to reduce the use of labour and increase quality within the building industry.
- Appointment of an Environmental Control Officer at each building site.

These drivers provide a format for waste management encouraging prefabricated construction, improving quality and appointing environmental control officers on site reduced waste production is also achieved.

**Training and Quality Systems.**

Since the 1960’s, Singapore has had a long-term aim to improve skills in all technical trades. In 1983 it set up the Construction Industry Training Institute (CITI). CITI aims to train existing workers and new entrants to the industry. The aim is to ensure workers can operate safely, produce a high quality product and includes best practice training for waste management.

In the years between 2000 and 2004 over 130,000 workers were skills tested within the construction industry. (Source: CITI). This has assisted in gains in quality measured by the Singapore Government’s Building and Construction Agency CONQUAS system whereby building projects are assessed on the quality of building work achieved by independent inspectors. In 2000 only 19% of building projects achieved a score of 82% or above using the CONQUAS scoring system compared to 2004 when 39% of building projects achieved a score of 82% or above.

**Environmental Control Officers**

The requirement to have Environmental Control Officers (ECO’s) on construction sites is a relatively new requirement in Singapore and has only been implemented since November 1999. Under the Environmental Public Health (Registration of Environmental Control Officers) Regulations construction sites are required to engage an ECO part-time (15 hours per week) if the contract exceeds S$10 million (approximately £3.3 million) if the contract exceeds S$50 million (Approximately £16.5million) the ECO will need to be full time (at least 40 hours per week). Safety officers providing they have passed the relevant course can combine the duties of an ECO with their duties as a safety officer.

The purpose of an ECO is to look out for conditions and situations in construction sites that cause or are likely to cause environmental health problems. These include the management and proper disposal of construction wastes as well as food hygiene, keeping drains clear and controlling pests, dusts, noise and air pollution. An ECO must undertake a part time 8 week course and exam before qualifying as an ECO.

Before construction starts the contractor must submit, on consulting with the ECO, a Site Environmental Control Programme to the National Environmental Agency. The report includes a site plan with proper layouts of all facilities on the construction site, plans for proper storage and disposal of wastes, noise reduction and earth littering preventive measures.

In addition, an ECO is required to submit a Site Environmental Control Report to the occupier of the construction site fortnightly. The report should include shortcomings detected in the construction site, actions taken by the management of the construction site to rectify the shortcomings, measures taken to establish and promote a clean and healthy working condition, occurrence of any environmental hazards. An ECO can be fined considerable amounts if they fail to comply with the provisions of the Environmental Public Health (Registration of Environmental Control Officers) Regulations. The contractor can also be fined if they fail to engage an ECO.
2.2.4 Effectiveness of Actions

Singapore achieves a high rate of C&D recycling at 94%\textsuperscript{viii}. This is 33% more than was achieved in 2000\textsuperscript{ix}, which is a significant achievement.
2.3 AUSTRALIA

2.3.1 Background

In Australia, construction waste currently accounts for approximately 44% of total annual waste production. The country has huge natural resources and no shortage of space for landfills. The Australian government is seeking to reduce reliance on landfill sites and increase the use of alternative technologies such as recycling where this policy is appropriate.

2.3.2 Government Policies and Programmes

The Australian Government has taken the approach of co-operation with industry, national, state and local governments on construction waste. The approach towards construction waste forms part of a programme that aims to reduce the overall environmental impact of buildings.

The Department of the Environment and Heritage provides information, training and guidance to improve sustainability in the C&D sector. Australia has developed a number of principal guidance tools, including:

The Australian Building Code
The Australian Building Codes Board has signed a memorandum of understanding (MoU) with the Australian Government that emphasises the need to improve the sustainability of construction. At present the Board appears to be concentrating on improving the energy efficiency of buildings and has not started to examine what it can do to improve resource use and waste minimisation during the construction and demolition of buildings.

Waste Awareness Programme
The WasteWise Construction Program ran between 1995 and 2001. WasteWise was a partnership between the government and major companies / associations from the C&D industry who had volunteered their involvement. The program was designed to reduce the amount of construction waste going to landfill. Under the WasteWise program government and industry partners attempted to identify and address the technical and behavioural barriers to efficiently reduce waste.

Five leading construction companies funded their own participation in order to adopt a best practice approach to environmental management. The aim was to protect the environment, save resources, avoid waste, increase the reuse and recycling of materials, and reduce the amount of waste going to landfill. They successfully worked within the bounds of normal commercial imperatives, Federal, State and Territory legislation, and a memorandum of understanding (MoU) with Australian and New Zealand Environmental Conservation Council (ANZECC).

As a result of the programme a large number of projects were carried out that took account of the increased complexity of carrying out waste programmes alongside traditional construction. These demonstrations saved significant volumes of building material waste. Materials including concrete and steel, were reused and recycled with, in many cases, a decrease in capital expenditure. A number of these projects were benchmarked allowing direct comparison with similar projects.

The project found that waste minimisation could be improved across the C&D industry by:

- Conducting waste reduction trials in their own operations recognising the ‘bottom line’ benefits of waste minimisation
- Developing and adopting best practice waste reduction techniques
- Sharing techniques with other operators in the industry
- Addressing coordination issues and identifying the legal barriers to carrying out best practice waste reduction, so that industry could work to overcome them
- Recognising the benefit of a national voluntary approach
- Becoming involved, through industry representative groups or as key stakeholders, in the development of future nation-wide waste reduction arrangements.
One of the most useful outcomes of the Wastewise programme was that as several of these companies operate internationally (Bovis Lend Lease, Multiplex, and Mowlems), they have spread this practice internationally throughout their organisations including to the UK.

**Recycling Guide for Aggregates**

In 2002, the Department of the Environment and Heritage in partnership with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Inner Sydney Waste Board, the South Australian EPA, and EcoRecycle Victoria developed a national guide for the use of recycled concrete and masonry materials in non-structural applications. The Guide aims to divert concrete and masonry waste from landfill into useful new applications. Since this document has been published individual state governments and local governments have developed guides for recycling facilities for aggregates in their region.

**The GreenSmart Programme**

Since 1998 the Department of Environment and Heritage has worked with the Housing Industry Association (HIA) on a partnership agreement called Partnership Advancing the Housing Environment (PATHE). This agreement has resulted in the GreenSmart Initiative. The GreenSmart Initiative helps the housing construction business by showing practical ways of incorporating environmental design, building practices and products into homes, to meet the growing market trends for environmentally sustainable homes. The programme has provided training to building professionals, instituted a series of awards for environmentally sensitive construction and show cased environmentally sensitive housing to the wider public through a series of demonstration villages.

**Lifecycle Analysis**

The Life Cycle Assessment (LCA) Tools in Building and Construction project was completed in 2001. The project was commissioned by Environment Australia, and the project consortium was lead by the Centre for Design at the Royal Melbourne Institute of Technology (RMIT). The project aimed to improve the environmental performance of the building and construction sector, by promoting LCA as a tool to assess the environmental impacts of building materials and building systems in Australia.

**2.3.3 State and Local Government**

States have taken individual action on C&D waste appropriate to their region. New South Wales (NSW) in particular has implemented a number of different initiatives to encourage C&D waste minimisation. These initiatives have been assisted by legislation the Waste Minimisation and Waste Management Act 1995 passed by the State government. The Act includes a requirement that it be reviewed every five years, ensuring can be updated in line with current understanding and requirements. Since then the 2001 Waste Avoidance and Resource Recovery Act 2001 has set up Resource NSW. Under the Act, Resource NSW was charged with developing a statewide strategy for waste avoidance and resource recovery. In February 2003, the NSW Government released the first Waste Avoidance and Resource Recovery Strategy. The strategy provided a framework and set targets for all sectors of the community to reduce waste and increase the recovery of resources from waste. It identified priorities for action to avoid waste, recover and reuse more secondary resources, and reduce toxicity in products and materials as well as littering and illegal dumping.

The implications of the act for the construction industry have included the following:

- Most local councils in New South Wales require waste management plans to be submitted during planning applications.
- Landfill taxes of AUS$22.70 per tonne in urban areas on all wastes going to landfill (In rural areas these costs fall to AUS$15 per tonne)
- Building companies are required to submit waste management plans when tendering to carry out major projects on behalf of national, state and local governments.
- State projects often require the use of recycled materials for pavements, earthworks and drainage.
- State and local governments now provide recycling directories for the construction and demolition industry.
- Training programmes on reducing waste from construction sites have been introduced for businesses and regulators.
2.4 NEW ZEALAND

2.4.1 Background

In the 1990’s the government set a national target to reduce waste by 80% to 1988 levels. However, the information gathered in the 1990’s on the amount of waste going to landfill tended to ignore waste going to cleanfills. The distinction is important as in New Zealand construction waste debris such as soil and rubble are viewed as inert and are often sent to cleanfills.

New Zealand has currently set itself an aspiration of becoming a zero waste country. The National government has set a specific target in relation to C & D Waste. The government aims to reduce C&D waste to 50% of levels reaching landfill in December 2005 by December 2008.

2.4.2 Local Programmes

In 2004 a partnership comprising the Government, local authorities and commercial interest groups commissioned a series of studies on ways of achieving reduction in C&D wastes. Part of the task involved looking at using existing New Zealand legislation and how it could be used to reduce construction waste. The report concluded:

• A central register of waste carriers needed to be set up.
• A verifiable duty of care system for tracking what happened to waste needed to be put in place.
• A licensing system for landfills and cleanfills utilising local government bylaws
• The introduction of levies on the disposal of certain wastes to landfill/cleanfill according to local government plans and the use of these levies for use in waste minimisation strategies.

In order to hasten the introduction of environmental legislation the government has decided to utilise existing local government legislation where necessary and only introduce legislation requiring local government to draw up waste strategies where necessary. This current system is likely to change in the long term in order to support the national waste strategy.
2.5 THE NETHERLANDS

2.5.1 Background

After World War II, there was pressure to re-use the large amounts of building rubble created by demolishing war-damaged buildings. This generated ideas and techniques and, at the same time, the Government made sure to boost the market for recycling and re-used materials. Continuing this practice, the Dutch Government also took a leading role in environmentally conscious building practices. In 1985 C&D recycling and reuse was 50%. Estimated recovery and recycling by 1999 had risen to 91% and in recent years has been almost 95%. Almost all the stony construction and demolition waste is transformed in crushing plants into granulate for recovery (mainly in road construction). Large quantities of wood are also recovered. The substantial rise in the landfill charges has been a powerful moving force in this respect. In 1995, the quantity of construction and demolition waste sent to landfill stabilised at approximately 1 million tonnes.

The Netherlands Agency for Energy and Environment (NOVEM) has a long-term aim to achieve a reduction of 20% in the use of materials in the construction of buildings (associated with environmental performance standards for new build houses) by 2010. They also want to achieve 99% re-use of construction and demolition waste from their current rate of 95%.

2.5.2 National Programmes

The Dutch government has utilised a number of different policies to encourage waste minimisation, including:

- Ban on landfilling re-useable and combustible C&D waste, introduced in 2000.
- Promotion of secondary (recycled) aggregates
- Voluntary agreement with industry
- Research and development programmes
- Quality standards for recycled aggregates
- Landfill tax

Since 1997 there has been a national ban on the disposal of re-useable C&D waste. As a result only certified C&D crushers and sorters are allowed to dispose of non re-useable C&D waste. Under Dutch law only rubble contaminated with coal tar, asbestos and other forms of chemical contamination are considered non-re-useable. There are stringent laws on soil protection that promote the use of secondary materials.

The Government also provides bonuses to contractors who use secondary aggregates instead of natural gravel when working on projects that come under the supervision of the ministry of transport, public works and water management.

The Government has also entered into over 20 voluntary agreements with industry organisations, including BABEX (the demolition waste contractors organisation), to measure, prevent and re-use C&D waste. This has been incorporated into policy declarations. These voluntary agreements include the use of site waste management plans.

The Government and other public organisations run their own research and development programmes in the field of prevention, re-use and recycling of C&D waste. In addition standards have been agreed for the use of recycled and mixed aggregates. The Dutch Government has also supported the development of tools such as Eco-Quantum and GreenCalc in order to determine the sustainability of buildings during design. There are plans to make the use of these tools compulsory during the planning process.
2.5.3 Local Programmes

Local and regional governments are able to use a range of different planning controls and byelaws to manage C&D waste. In addition they utilise a number of other schemes to promote waste minimisation. These include the following:

- By-laws to encourage the segregation and recycling of waste materials.
- Landfill and incineration taxes.
- Design of long-term plans on policy, planning and waste.
- Creation of temporary incentives.
- Utilising building specifications that promote waste minimisation, secondary aggregates and recycled materials when commissioning buildings for public use.
- Planning permissions that specify recycling and site waste management plans.

2.5.4 Effectiveness of Actions

The Netherlands have achieved significant success in diverting over 95% of C&D waste to re-use and recycling and away from landfill and final disposal. This observation is not without caveats; this process has been going for at least 10 years and most aggregates that are re-used end up in low quality applications due to poor segregation of materials during C&D despite laws to prevent the mixing of wastes\textsuperscript{xxxvii}. In addition little progress has been made on the more minor C&D waste streams such as wood, plastic and glass.
2.6 FINLAND

2.6.1 Background

Finland is one of the most sparsely populated countries in the European Union. It has committed itself to implementing a number of policies on sustainable development including those resulting from the 1992 Rio declaration and the 2002 Johannesburg Summit as well as the policies of the European Union.

2.6.2 Drivers for waste minimisation

The Finnish Government as part of its 2002 National Waste Plan has also introduced a ban on waste containing more than 5% biodegradable matter being deposited in landfills without pre-treatment. A landfill requirement has been introduced and on all but the smallest sites for C&D waste to be separated into at least the following fractions:

- Timber
- Soils
- Mineral wastes
- Metals

In addition the construction industry were set targets that by 2005 they must reduce the amount of waste generated by 15% during C&D activities and they must also ensure that at least 70% of waste is recovered.

Another driver for the construction industry is the depletion of gravel reserves close to urban areas. This has meant that the construction industry has had to increasingly rely upon either the use of natural rock or use secondary aggregates generated during demolition. The construction industry is also looking to use other suitable industrial by-products as a source of aggregates e.g. bottom ash from waste incinerators.

2.6.3 Government Programmes

The Finnish Government has also set a number of other objectives to improve the sustainability and longevity of buildings. These include:

- Making buildings durable and easy to repair with regular maintenance schedules.
- Increases in the use of wood in the construction (Finland has large forests and therefore timber is an easily available material).
- Use of less energy and materials during the construction and entire life cycle of buildings.
- Increasing the versatility and adaptability of buildings so they can be adjusted to the needs of an increasingly ageing population.
- Allowing residents to have more opportunities in the use and design of buildings.
- Improve the quality of buildings
- Reduce problems related to humidity, poor air quality and noise that are caused by poor design or construction.

It aims to solve these problems by implementing a variety of measures including:

- Legislative procedure
- Training
- Incentives
- Best practice guidance

The Ministry of the Environment and the State owned Technology Development Centre (TEKES) have partially or fully funded numerous projects on environmentally sound buildings, including aspects related to C&D.
2.6.4 Regional and Local Government Programmes

In local waste regulations some municipalities provide more specific guidance (and requirements) on the sorting, collection and processing of C&D waste. Incorrectly sorted or handled waste can be returned to its last holder. Regional waste authorities may also provide advice to C&D contractors on waste minimisation and recycling.

2.6.5 Effectiveness of Actions

Between 1995 and 1997 C&D waste recycling doubled but it has been difficult to obtain more recent figures. Facilities to recycle C&D wastes have increased in the last ten years that would indicate that more C&D waste is being recycled but it has been difficult to determine if the amount of C&D waste produced has reduced over the last ten years.
3 Discussion
3 Discussion

International construction waste prevention and minimisation is a new and emerging area in the countries reviewed. No country has a history of active waste minimisation or prevention dating before 1945, with most not starting until the 1980’s or later. Initial efforts were generally weak and/or were not given a monitoring mechanism to ensure compliance.

The main drivers for reducing the volume of waste going to landfill were:

- **Lack of Landfill space:** A number of the countries reviewed have high population densities and/or minimal landfill void and as such are attempting to divert waste from landfill. This extends the working life of the void that is present as less waste is deposited and provides greater capacity for more difficult waste that cannot be easily recycled or reused.

- **Legal requirement:** A number of countries had introduced national legislation to promote the prevention or minimisation of waste entering landfill. Members of the European Union are required by the 1999 Landfill directive (1999/31/EC) to divert waste from landfill.

- **Lack of Raw materials:** Countries promote waste minimisation and prevention to provide greater resource efficiency. This occurred for two main reasons. Firstly it reduced dependence on foreign countries by gaining greater efficiency of national resources or materials imported. Secondly it is cost effective as importation incurs an additional cost to the company.

This study found that the approaches to C&D waste minimisation and prevention vary widely across the countries investigated. Methods range from relying on voluntary agreements and market mechanisms in the USA to a legislative approach with taxation and requirements in Singapore.

All the countries surveyed in this report recognised that C&D waste was a problem and had taken measures to encourage the minimisation of C&D waste but they were just beginning to tackle the greater challenge of encouraging waste prevention. The reason for this is assumed to be that it requires a cultural change in both persons and companies with regards to construction, buildings and lifestyle options. Tackling this is far harder than promoting recycling, hence the greater focus on End of Life (EoL) management by the countries reviewed. All the countries encourage the use of a SWMP, with Singapore, Australia and the Netherlands making it a mandatory part of the planning process. However, none of the countries monitor compliance with the SWMP by the companies either during or after construction has taken place, significantly weakening the usefulness of the SWMP as a tool for waste minimisation and prevention.

In many cases it is difficult to analyse how successful waste strategies have been at achieving waste minimisation without statistics over a number of years that show the amount of C&D waste produced and its End of Life (EoL) management. In addition some of the countries reviewed utilised a decentralised approach to tackling waste issues, where schemes were run at the state and city level, producing a lack of consistency of data within a country as well as between country’s. This was particularly true of America, New Zealand and Australia.

The research shows two main approaches to the promotion of waste prevention and minimisation legislative and non-legislative. The non-legislative approach entails the use of market mechanisms or non-legal agreements to encourage C&D companies to use prevention and minimisation.

The two approaches can be further divided into specific methods that are employed in the countries, these include:

- **Financial cost:** The main financial tool used was the use of landfill taxes to make this option less appealing to the C&D industry.

- **Financial benefit:** This ranged from the use of bonuses for companies that utilised recycled material to the provision of contracts to companies that achieved a high level of minimisation or prevention for government building projects.

- **Legal Ban:** The Netherlands has made it illegal to landfill re-usable C&D waste removing this as an EoL option.
- **Training**: This can occur either through a government sponsored body or by encouragement to companies to train their personnel. Training is provided as skilled and qualified personnel are more aware of the benefits of good waste management and produce a higher quality of work reducing waste caused as a result of error.

- **Information dissemination**: Governments provide guidance to C&D companies on the best practice in the industry. Facilitating best practice throughout the construction sector.

- **Promotion of practice**: Governments tender C&D contracts for government buildings that required the consideration of waste minimisation and recycling.

- **Waste champion**: Singapore requires an ECO (fill in) to be present on sites, to ensure that environmental considerations occur throughout the project. One of the duties for the ECO is waste minimisation and recycling.

- **Longevity**: Some Scandinavian countries reviewed were researching and promoting methods to increase the lifetime of a building therefore reducing the waste arisings over time.

Overall there were a variety of methods employed by the countries investigated. Whilst each method had its pros and cons it was hard to isolate the exact reason for success due to a lack of quality data. The two most lacking factors found in the review were enforcement and data collection. The lack of these meant that countries were often unable to know or realise the true impact of the method they employed. Enforcement is vital for the success of any scheme used, without it a scheme is easily negated making it a lame duck in effect. Data collection is of more importance to capture the impact of the system and identify where it can be improved or is not working.

During the course of this research numerous C&D waste minimisation and prevention studies were examined. Across the world it has been proved time and again that when waste minimisation programmes are followed they save money and reduce waste. However there still appears to be reluctance on behalf of everyone involved to use them.
4 Conclusions
4 Conclusions

Any method that is chosen will require a robust system of enforcement. This will provide it with the strength necessary to ensure compliance by the C&D industry. There is also a need for quantified data to be collected to allow analysis of the impact of any legislation and identification of strengths and weaknesses in achieving the goal of waste minimisation and prevention.

Research indicates that countries use an integrated approach to waste minimisation and prevention, using both incentivisation and punishment to achieve their goals. However there is no clear set method used to achieve waste minimisation and prevention internationally. Identification of the best methods to promote waste minimisation and prevention in England will require further research and is beyond the remit of this report. However the report does provide a list of methods that could be utilised in the UK, indeed some already are, these would be a good starting point for any such research.
Appendices
Appendices

Appendix 1: Websites highlighting best practice
Appendix 2: References
Appendix 1

Websites highlighting best practice in waste minimisation.

CONTENTS

- Websites showing site waste management plans
- Websites highlighting best practice in waste minimisation

These websites were visited during the project and were found to contain useful links with in many cases links to other sites

Websites Showing Site Waste Management Plans

USA

Massachusetts. Sample C&D Waste Plan
http://www.mass.gov/dep/recycle/reduce/managing.htm#project

US Forces Handbook on minimising construction waste this site includes copies of waste plans

Singapore

Site Environmental Control Plan

Australia.
Inner Sydney Waste Board Construction Guidelines

Websites showing Case Studies on Construction waste minimisation

USA

Massachusetts Case Studies http://www.mass.gov/dep/recycle/priorities/dswmpu01.htm#c&d

Greener Buildings

US Forces handbook on minimising construction waste

Australia

Useful website with links to many other websites.
http://onsite.rmit.edu.au/
• Building Construction Case Study
http://www.cfe.cornell.edu/wei/cwei/build.html
This site contains Fletcher Construction Australia's 1993 case study of their Melbourne based construction and demolition waste minimisation project. The site offers practical and informative information on the benefits of C&D waste management, as well as a clear description of how the project was structured.

• EcoRecycle's Solid Waste Minimisation Strategy for Metropolitan Melbourne - Construction and Demolition
The C&D section of this report details strategies for waste reduction in the construction and demolition sector. The strategies are presented in order of the waste minimisation hierarchy of prevention (reduce, re-use and recycle). This is a detailed report that addresses how Melbourne can reduce its C&D waste. It has a lot of ideas and covers a lot of ground, including sustainable architecture and eco-labelling.

• C&D Waste Web
A Canadian site jointly funded by industry and government. Aims to inform and assist building managers and home owners, architects and contractors in reducing and recycling waste from renovation, construction and demolition sites. Includes residential and commercial case studies, reference documents and training material.

• California Integrated Waste Management Board
http://www.ciwmb.ca.gov/mrt/cnstdemo/default.htm
The California Integrated Waste Management Board is responsible for managing California's solid waste stream. The site includes fact sheets, case studies, links, two Californian databases (recycled content construction product manufacturers, and construction and demolition recyclers) and a market development plan. The fact sheets - covering everything from drywall recycling to recycled latex paint - are outstanding in their detail.

• Smart Growth Network's Approach to C&D Waste Minimisation and Smart Buildings
http://www.smartgrowth.org/library/resident_const_waste.html
Coordinated by the US EPA's Urban and Economic Development Division (UEDD). The section on Smart Buildings contains articles on building design, deconstruction versus demolition, building materials management, issues associated with the redevelopment of homes, buildings and communities. This site has a broad range of articles that cover most aspects of C&D waste minimisation, including residential.

• Triangle J Council of Governments: Solid Waste Program
http://www.tjcog.dst.nc.us/TJCOG/solidwst.htm#demol
The Triangle J Council of Governments is one of 18 regional planning councils in North Carolina, USA. Its solid waste program aims to help local governments achieve their goal of 40% waste reduction by the year 2001. One output from this program is the Wastespec Manual, which provides architects and engineers with model specifications and background information that addresses C&D waste reduction, reuse, and recycling. Sections of the manual are available on the site, including ten case studies.

• Constructing Excellence Website Joint Swedish / UK initiative on Construction Waste
http://www.constructingexcellence.org.uk/uksweden/activeprojects.jsp
Appendix 2

References
The Business Resource Efficiency & Waste programme (BREW) provides advice and support on improving resource efficiency measures, minimising waste production and improving its bottom line through a number of projects that it funds.

Envirowise offers UK businesses free, independent, confidential advice and support on practical ways to increase profits, minimise waste and reduce environmental impact.

DEFRA Waste Statistics provides detailed statistics on waste in the UK, including landfill tax rates and other environmental policies.

The current rate of landfill tax in the UK is £21 per tonne for active waste and £2 per tonne for inactive wastes e.g. soil and rubble.

The UK government has included an escalator system on landfill tax ensuring that it increases rapidly above inflation. This further influences the landfill market, as companies know costs will increase rapidly. It also provides a steady tax increase to the level the government desires to achieve its goal, dampening the impact of the tax.


LEED website provides information on green building practices and certification in the United States.

Singapore National Environment Agency provides waste statistics for Singapore, including information on landfill costs and other waste management practices.


Netherlands Ministry of Housing, Spatial Planning and the Environment June 2001 Factsheet General Policy on waste in the Netherlands page 5
http://international.vrom.nl/docs/internationaal/01GenPoliwaste.pdf

NOVEM Website http://www.senternovem.nl/senternovem/subsites/index.asp


Website describing operation of Eco-Quantum
http://www.ivam.uva.nl/uk/producten/product7.htm

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http://www.greencalc.com/

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