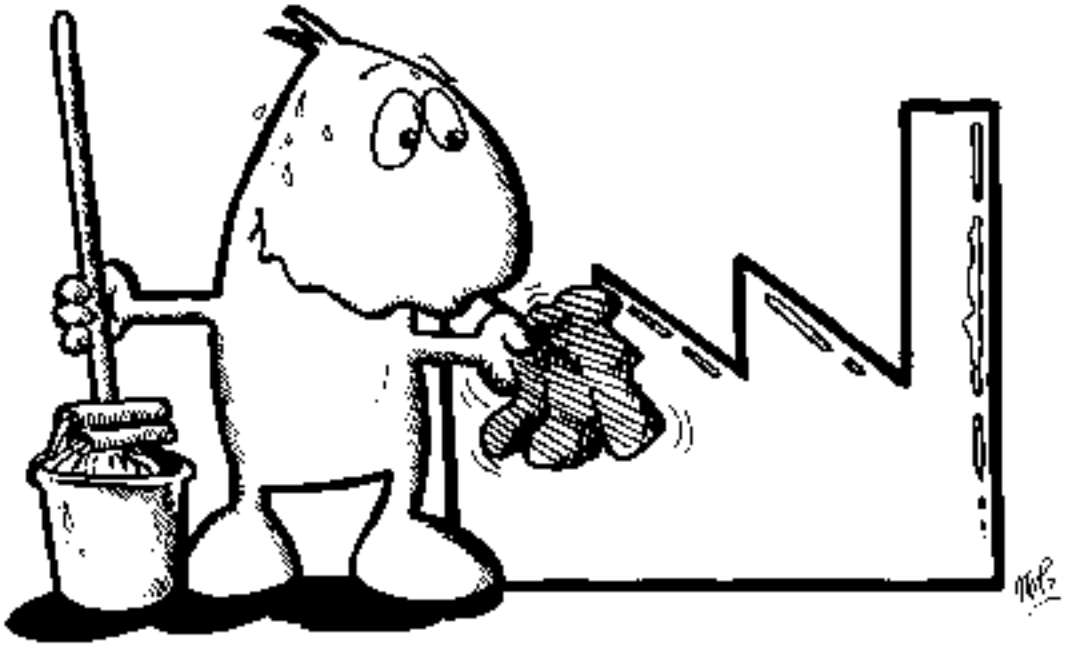
BOOK 7

OF TREADING LIGHTLY ON THE EARTH

CLEANER PRODUCTION



TECHNOLOGY'S CONTRIBUTION TO BUSINESS SUCCESS AND A HEALTHY ENVIRONMENT

TREADING LIGHTLY ON THE EARTH

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Treading lightly on the earth

A technology and science curriculum resource for secondary schools on solid waste

AUCKLAND REGIONAL COUNCIL *1999*

IN THIS EDUCATION RESOURCE KIT

Products and materials samples

Eight booklets covering the following topics: **Level of difficulty:**

1. **Introduction:** How to use this resource
   Assessing awareness: BEFORE and AFTER this unit of study
   Ideas for revision exercises
   Relief Teacher Lesson
   Topic 1: An overview of solid waste: 'What a waste!' ♻ to ♻♻♻
2. **Topic 2:** Composting: 'Green waste to black magic' ♻ to ♻♻♻
3. **Topic 3:** Recycling: 'The endless loop' ♻ to ♻♻♻
4. **Topic 4:** Re-using construction waste: 'Demolition derby' ♻♻ to ♻♻♻
5. **Topic 5:** Hazardous waste: 'Handle with care!' ♻ to ♻♻♻
6. **Topic 6:** Environmental audit: 'Your school's ecological footprint' ♻ to ♻♻♻
7. **Topic 7:** Cleaner production:
   'Less waste = more profit for environmentally friendly business' ♻♻ to ♻♻♻
8. **Topic 8:** Waste disposal: 'The last resort' ♻ to ♻♻♻

A general guide to the Level of each activity

Difficulty	Suitable for	Level
♻	Years 7-8	4 and 5
♻♻	Years 9-10	6 and 7
♻♻♻	Years 11-13 or very able students	8

Most topics contain a range of activities at a mix of levels ♻ to ♻♻♻, so that you will generally be able to find something in each topic for a class working at any level.

If you only want to do one or two self-contained activities from each topic, you will find the ♻ activities best suited for this.

This means your class can re-visit the same topics in successive years, avoiding repetition by doing more advanced activities.

To find out more, call the Auckland Regional Council on 09-366 2070.

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TOPIC 7

CLEANER PRODUCTION: TECHNOLOGY'S CONTRIBUTION TO BUSINESS SUCCESS AND A HEALTHY ENVIRONMENT

CONTEXT

Cleaner production means using better housekeeping, management and technology to minimise the harmful environmental effects of manufacturing products and providing services. It includes the efficient use of energy and resources to eliminate, reduce or produce less harmful wastes, in order to produce environmentally sound products and services. Most companies also find this reduces costs and increases profits. Technology has a major role to play in reducing pollution and wasteful use of energy and resources while making businesses more profitable.

Activities in this topic are generally aimed at a higher level of achievement, but may be able to be adapted to lower levels. Activities can be selected according to level and the availability of speakers, sites to visit and time, but this topic may prove difficult for some classes.

The cleaner production investigation of a real-life firm is best done after students have done an environmental audit of their own school in book 6, though this is not essential. However, the other activities will build a good picture of cleaner production even without a site visit.

Contents

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Technological information for teachers

A general guide to the level of each activity

Difficulty	Suitable for	Level
♻	Years 7-8	4 and 5
♻♻	Years 9-10	6 and 7
♻♻♻	Years 11-13 or very able students	8

Specific learning objectives

Specific learning objectives are to:

- familiarise students with concepts of waste reduction, re-use and recycling, and with the principles and technologies of cleaner production
- show students good business and good environmental management go together

Preparation

- see the notes for each activity as well as the information at the back of the booklet

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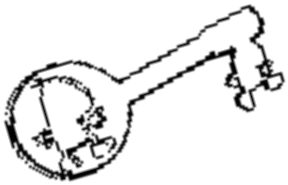
SETTING THE SCENE

Select one or both of motivational activities 1 and 2

ACTIVITY 1 What is cleaner production?

Teachers: Key Messages



For too long we have accepted that industry pollutes — initially because wastes were not treated and, more recently, despite expensive treatment processes. Now we are turning to reducing or even eliminating waste as a better alternative. This is cheaper and more environmentally effective than waste treatment and thus has much to offer industries and communities.

PREPARATION

- make an overhead transparency or photocopy the pages for this activity

1

Show the class an overhead or circulate copies of the case study on page 5 about PCA International. Encourage a general discussion.

2

Divide the class into groups and give each one a set of New Zealand case studies on pages 7 to 14 to look at. Ask each group to report back to the class as a whole on the questions at the foot of each page. Encourage a general discussion.

Quotable Quotes

If humanity is to survive, we shall require a substantially new manner of thinking.

(Albert Einstein)

New integrative and preventative approaches are achieving more sustainable development by reducing environmental risks and improving economic profitability around the world for small, medium and large businesses.

(Dr Donald Huisingh, Lund University)

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3

Using the technological information for teachers, lead the class in a brainstorm/class discussion on the following:

- what is cleaner production?
- what were some of the inputs for firms in the case studies?
- what were some of the polluting outputs?
- how many of the wastes were actually valuable product going 'down the drain'?
- what benefits can cleaner production offer firms?
- what are the environmental benefits of cleaner production?
- is cleaner production a good idea?

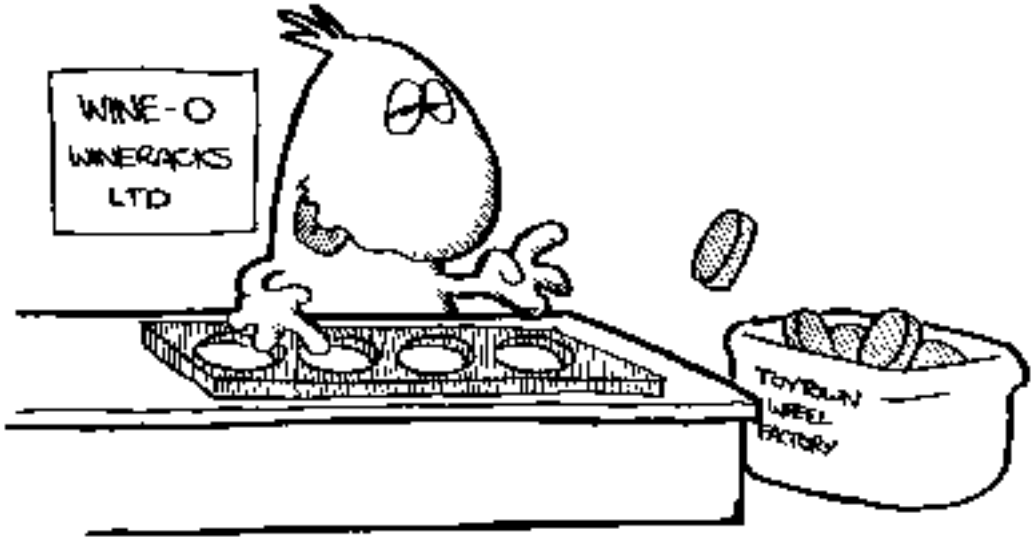
4

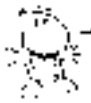
On the basis of the discussion, encourage the class to create an input-output diagram similar to the one in the model answers on page 39.

5

Use the overhead transparency on page 15 to encourage a discussion of the pie chart based on the case studies:

- what do the different terms mean? (See glossary).
- is technology the only way of reducing waste?
- give common examples of each way of reducing waste?





INFORMATION FOR ACTIVITY 1, QU. 1

GOING GREEN - WHAT'S IN IT FOR BUSINESS?

Source: *Dr Donald Huisingh*

PCA International, a photographic film processor in North Carolina, USA

The situation

The company was tipping all photographic processing wastes down the drain after use and regularly caused major fish kills in a popular trout-fishing stream. Government officials gave the company notice to comply with environmental protection laws and told it to treat the waste so it was less harmful to the river.

An 'end-of-pipe' waste treatment system was estimated to cost $US20 million to install and another $US900,000 a year to operate. The company could not afford this and instead looked at reducing the amount of waste it created by looking at cleaner production.

Technology changes

The company manager and staff plus two university researchers found by reducing waste, they could eliminate the discharge of effluent into the river and at the same time improve the firm's operating efficiency and product quality.

At a cost of $US20,000 they installed:

- an ion-exchanger to regenerate film-developing fluids
- a reverse osmosis system to treat rinse water
- an electrostatic unit to recover silver from the fixer solution

Waste containing fixer developer and bleach went to zero from 300,000 cubic metres per year (enough to fill 159 Olympic swimming pools every year).

Savings

Savings in materials PCA no longer had to buy amounted to $US360,000 in developing solution, $US425,000 in fixer solution and $US780,000 in bleach. With additional earnings of $US1.4 million for the silver it recovered, its annual saving totalled $US2.575 million — a payback period of less than a month.

The environmental benefit: three years after installing its cleaner production measures, a fishing contest was held downstream of the company's site — with plenty of healthy fish being caught.

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In New Zealand

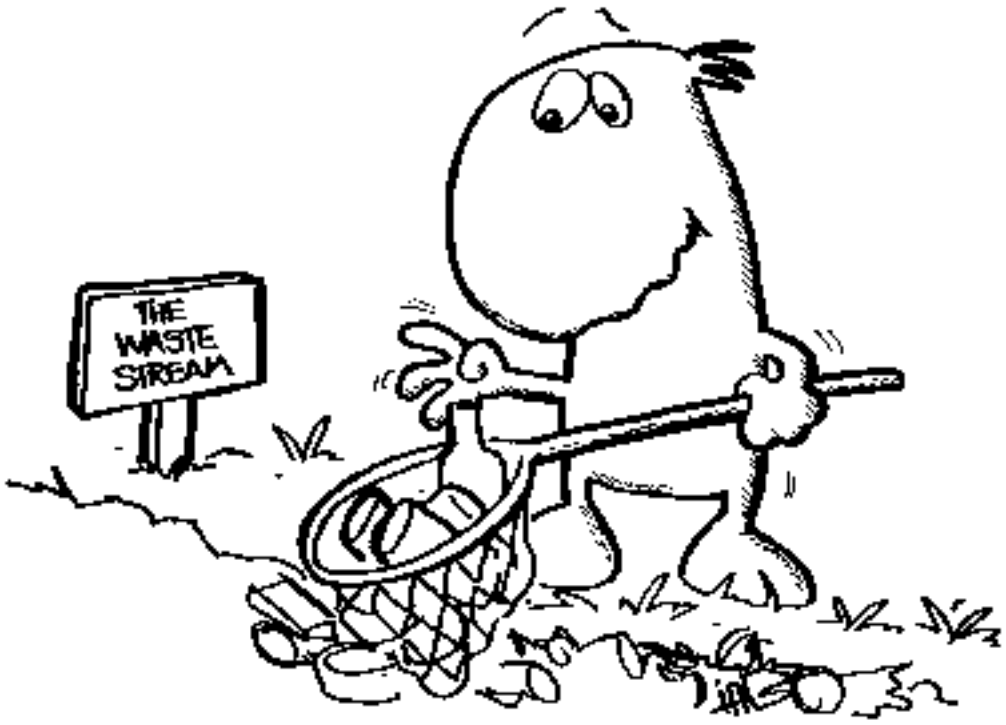
- ✓ A six person Wellington panelbeating firm saves $550 a month in spray paint and thinners as a result of an environmental programme.
- ✓ A large North Island dairy factory earns $5 million a year and saves another $230,000 a year as a result of environmental improvements.

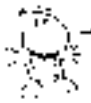
Payback times

Payback time means how long it takes for the cost of cleaner production technologies to be paid off by the savings made. Payback times for nearly 40% of the cleaner production changes made by 14 British companies were ZERO - they cost the company nothing or they paid the company back instantly.

Another third of the changes made had a payback period of 12 months, while less than 20% of the identified improvements had a payback period of more than two years.

Good environmental management benefits ALL firms - large and small.





INFORMATION FOR ACTIVITY 1, QU. 2

CLEANER PRODUCTION CASE STUDIES 1

Source: *Ministry for the Environment, 1994. Cleaner production guidelines*

Methven Tapmakers in Dunedin

Technology changes

The company's electroplating rinse tanks had separate water inlets and outlets, wasting a lot of water. Methven reduced the number of inlets, put a water meter on each inlet and interlinked the tanks so water could be re-used in subsequent tanks if it was not contaminated. Staff also now turn valves off when water is not needed.

Savings

The company reduced its water use by over 40%, saving $12,000 a year - a payback period of 17 days. There are also significant annual savings on trade waste charges.

Wiremakers, a branch of Pacific Steel in Auckland

Technology changes

The company started recovering iron and sulphuric acid from its pickling baths by an acid recovery process. The liquid is cooled to a stage where iron salt crystallises and drops out of solution to the bottom of the cooling tank. The liquid at the top is siphoned back to the pickling tanks as recovered acid and the crystals are dropped via draining bins back into hoppers to be sold as ferrous sulphate heptahydrate for fertiliser blending. Caustic soda use was reduced by 33%.

Savings

About $60-100,000 a year even without considering reduced trade waste charges. Capital costs of the project were recovered in five months.

Griffins Foods in Manukau City

Technology changes

The company spent $10,000 to reduce water use, which also reduced trade waste volumes.

Savings

Over $80,000 a year in trade waste charges - a payback period of six weeks - as well as more than $24,000 a year in water charges.

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A firm of textile manufacturers

Technology changes

By recovering CO_2 from the boiler flue and using it to neutralise its alkaline wastewaters before discharge to trade waste, it could eliminate the use of sulphuric acid. The heat recovery also reduces its power bill as well as greenhouse gas emissions.

Savings

$40,000 a year in chemical costs and $16,000 a year in waste disposal charges.

1

Read the case studies and discuss the costs and benefits described.

2

How has technology helped these firms save money and reduce pollution?

3

Is technology the only change all these firms made?

INFORMATION FOR ACTIVITY 1, QU. 2

CLEANER PRODUCTION CASE STUDIES II

Source: *Ministry for the Environment, 1994. Cleaner production guidelines*

Reese Plastics in Christchurch

Technology changes

The company developed a machine to mould labels onto lids instead of gluing them, eliminating the use of toxic substances and decreasing reject rates by more than 20%. The weight of the lids dropped by 12 grams, reducing material and transport costs. Installing the new machine was part of a three-month project costing $26,000 in capital costs and labour.

Savings

$80,000 was saved in the first year by increased production and decreased reject rates. There were other significant savings on disposal of rejects and the adhesives and labels previously used. The company spent $30,000 to achieve savings of $75,000 a year - a payback period of less than six months.

Artrix Glass Studio, a two-person firm in Upper Hutt

Technology changes

The company started re-using sandblasting grit until it is all gone instead of discarding it using it once. It sends plastics, aluminium and paper waste for recycling instead of landfill.

Savings

30% reduction in waste disposal costs.

New Zealand Dairy Group - Anchor Products, Hautapu plant

Technology changes

Casein needs to be washed during manufacture. The washwater contains dilute whey solids which were irrigated onto farm land for disposal. The company decided to recover this lost whey as stock food. It installed a reverse osmosis plant to concentrate the solids out of the water and produce a clean water stream. The process uses high-pressure pumps to force water through a tight molecular structure, concentrating the solids to five times their original concentration.

Savings

Water from the reverse osmosis plant is used within the factory instead of treated river water and the whey product is sold as stock food. The company now makes money out of what was previously waste and no longer has to dispose of the waste onto the farm. Savings are $30,000 per year.

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Collyer Watson Fellmongery, processors of sheep and lamb pelts into leather

Technology changes

Hides went to the plant in one-way polythene liners secured with tape. These leaked blood and water into railway carriages and could only be used once, creating 4 kg of waste plastic per railway wagon. The company replaced the liners with a stronger PVC fabric which doesn't leak and can be easily cleaned for re-use.

Savings

The old liners and tape cost $44 each at 900 a year - a total annual cost of $39,000, plus $1000 a year in disposal costs. The new liners cost $410 each, totalling $3690 for nine containers. The payback period was 10 weeks, a total of about 10 trips. The lifespan of the new liners is not yet known as they are still being used. Tears and rips are successfully patched and total savings were $60,900 in 18 months.

1

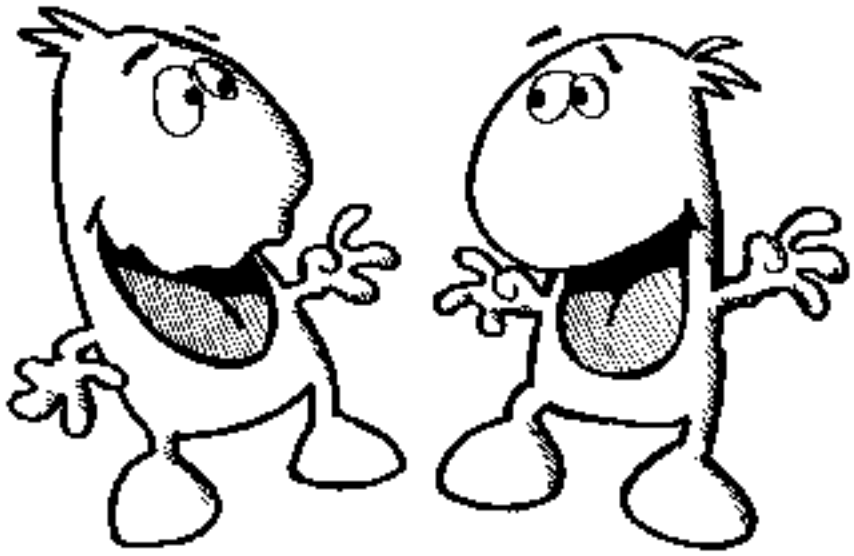
Read the case studies and discuss the costs and benefits described.

2

How has technology helped these firms save money and reduce pollution?

3

Is technology the only change all these firms made?



INFORMATION FOR ACTIVITY 1, QU. 2

CLEANER PRODUCTION CASE STUDIES III

Source: *Ministry for the Environment, 1994. Cleaner production guidelines*

Globe Export Fisheries, a Dunedin firm

Technology changes

This company of 25 staff used to bury its waste - up to 700 kg per tonne of finished product. It now uses its fish waste to produce biogas and solid and liquid fertilisers. This has yielded large savings in energy and waste disposal costs and a new source of income from selling the new products.

Savings

The company now saves $20,000 a year in disposal costs and $6500 a year in energy costs, while fertiliser sales from the previously wasted fish bring in $15,000 a month.

Barry Mansfield Smash Repairs, a Wellington panelbeater

Technology changes

The firm replaced its inefficient spray guns with new HVLP guns to target paint delivery better and reduce paint use. Four new guns cost $600 each.

Savings

Paint used to cost $4-5000 a month. Now it costs $3-4000. At an average saving of $500 per month, the payback period for the guns was less than five months. The business saves another $40 per month by recycling used thinners through Refined Solvents instead of buying new thinners and having to dispose of used thinners.

Bluebird Foods in Auckland

Technology changes

By turning water and other materials once treated as waste into re-useable resources, the company has made major savings in the cost of energy, water and edible oil.

Savings

Charges for waste collection and disposal have dropped by more than half from $85,000 a year to $35,000 a year, while selling re-useable products generates nearly $40,000 a year.

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New Zealand Dairy Group - Anchor Products, Hautapu plant

Technology changes

The company built a whey protein concentrate plant to process sweet whey and recover permeate from it for lactose. Processing of sweet whey increased by 57% and recovery of permeate by 254%, resulting in a recovery of 50-70 tonnes per day of lactose which was previously lost as waste.

Savings

Reduced waste discharges to the river and onto farmland, plus a recovery of saleable product worth $5 million per year.

1

Read the case studies and discuss the costs and benefits described.

2

How has technology helped these firms save money and reduce pollution?

3

Is technology the only change all these firms made?

INFORMATION FOR ACTIVITY 1, QU. 2

CLEANER PRODUCTION CASE STUDIES IV

Source: *Ministry for the Environment, 1994. Cleaner production guidelines*

A South Auckland chemical-based industry

Technology changes

The company used to discharge wastewater into groundwater which eventually discharged into the Manukau Harbour. It now uses the former 'waste' water as top-up water in a reverse cycle through its waste treatment plant.

Savings

The payback period for installing this system was 18 months. The company now makes significant savings in product recovery from its treatment system - dollars which formerly went into the harbour and had to be spent buying new chemicals.

New Zealand Dairy Group - Anchor Products, Hautapu plant

Technology changes

Milk typically contains more than 85% water but many milk products are dry. Recovering this lost water allows it to be re-used - up to 2500 cubic metres per day - 830 milk tankers worth. The water is captured by evaporation and purified through a reverse osmosis plant.

Savings

The system produces 550-750 cubic metres of clean water per day, saving the plant $150,000 per year. The plant takes less water from the nearby river and discharges less waste into it - a double benefit. It also saves the cost of irrigating excess wastewater onto nearby farms.

Dominion Breweries in Auckland

Technology changes

2.5% of packaging was being wasted, 70% of this from aluminium cans and two specialist glass bottles, at a loss of $300,000 a year. The main loss was faulty containers provided by suppliers, damaged materials entering production lines and causing more damage, design problems with some conveyors and a lack of understanding of the extent of the losses. Changes involved rejecting faulty raw materials and discussing the problems with the manufacturer; re-routing some conveyors and improving staff access to them, and continually notifying staff of progress made in waste reduction.

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Savings

There was no technological innovation but staff had to be trained in new ways of operating and waste reduction. Improved productivity from less downtime due to blockage on production lines and reduced waste has saved more than $250,000 per year.

Reidpaints Ltd. an Otaki paint manufacturer

Technology changes

The company buys raw materials in 200 litre drums which can be sold for re-use if clean: about 25 drums a day are washed. Washing used to be done by staff putting a hose into a drum and returning when they had time to check it. They measured how much water gave an optimum wash and installed a $60 volume control meter so drums can safely be left unattended. They also built a stand to store drums by colour-code and stop them rolling around the site and getting dirty.

Savings

Greatly reduced volumes of wash water to the sewer have resulted in savings of over $400 per year on water - a payback period of eight weeks - and a safer workplace.

1

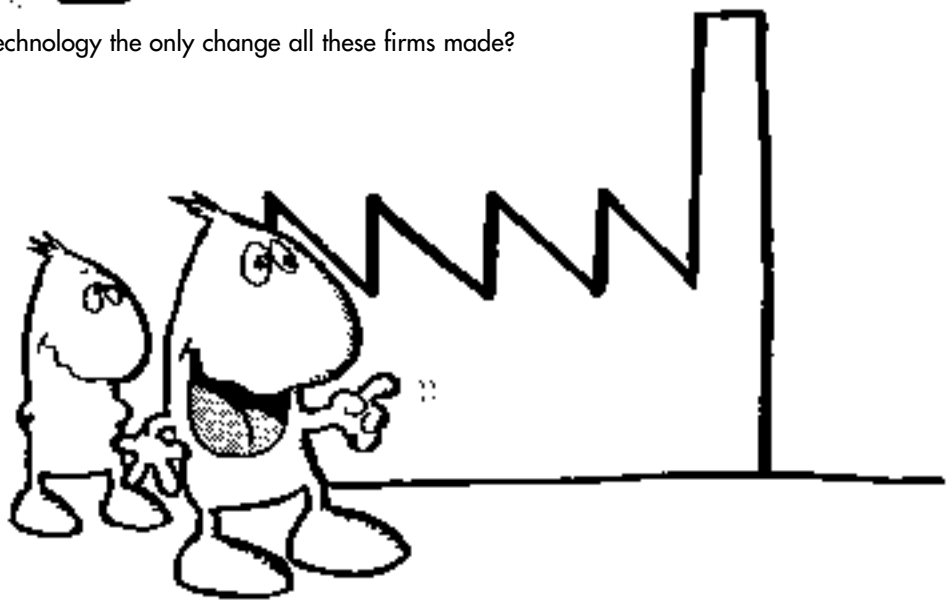
Read the case studies and discuss the costs and benefits described.

2

How has technology helped these firms save money and reduce pollution?

3

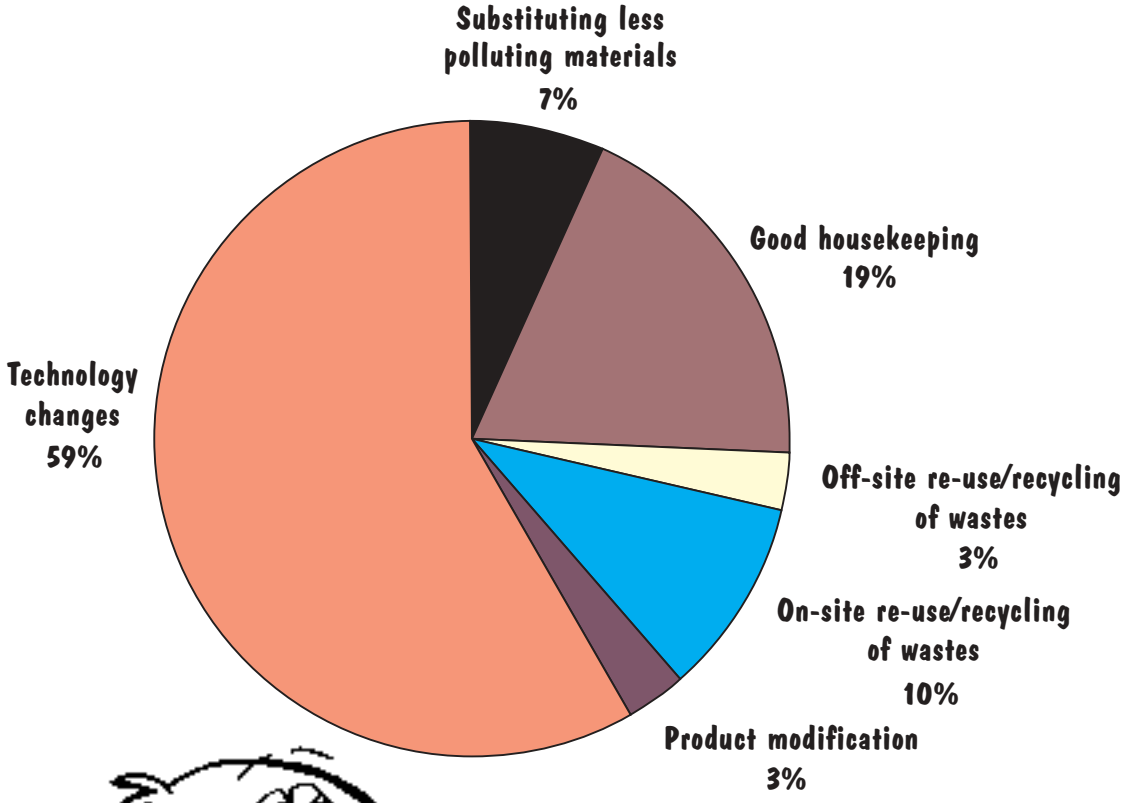
Is technology the only change all these firms made?

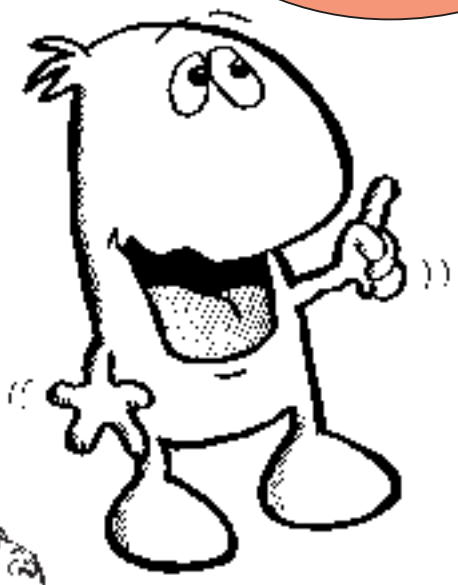


INFORMATION FOR ACTIVITY 1, QU. 5

WHERE MANY FIRMS FIND OPPORTUNITIES FOR WASTE MINIMISATION

Source: *Target Zero*





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ACTIVITY 2 Supermarket survey: The use of environmental technology as a marketing tool

PREPARATION

- arrange a visit to a supermarket in such a way that students can be closely supervised in small groups without disrupting normal business
- ask Telarc (09-525 6655) or Ministry for the Environment for detailed information about the Environmental Choice New Zealand environmental labelling scheme and the product requirement specifications

1

Divide the students into groups and ask them to list all the products that:

- have recycle logos
- have plastic recycling numbers
- are made of recycled content products
- have packaging made of recycled products
- make any kind of environmental claim to encourage people to buy them

2

Ask the students to collate and summarise their results under headings, for example, according to type of product or type of information given or claim made.

3

Encourage a class discussion about their findings.
Ask questions such as:

- would they choose a product on the basis of environmental information?
- how can environmental claims be trusted?
- do we need an independent agency to verify environmental claims?

4

Hand out the Environmental Choice information (operated by International Acceditation New Zealand) and ask students to identify three key points which they think are interesting or important. Encourage a class discussion. Copies of this material are included with this resource however further copies can be obtained from IANZ ph (09) 525 6655.

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IDENTIFYING NEEDS AND OPPORTUNITIES

Speculating, clarifying, finding solutions: Select any one or more of activities 3-8

ACTIVITY 3 Cleaner production: A worked example of how to start your own cleaner production programme

PREPARATION

- photocopy the briefing notes and worksheets as indicated below
- visit the joint Auckland Regional Council and Ministry for the Environment cleaner production website at www.arc.govt.nz/cp/
- find another case study to give out as briefing notes (there are plenty overseas examples on the internet as well as the New Zealand ones at the site above, so doing an internet search could be an optional research topic)
- see the model answers on page 39

Note: The cases are hypothetical so costs are not those actually experienced.

Quotable Quotes

Pollution prevention is an integrated part of developing products and technological processes.

(Dr Donald Huisingh, Lund University)

1

Divide the class into three or more groups as follows:

- Group 1 with case 1 briefing notes and a set of worksheets
- Group 2 with case 2 briefing notes, a set of worksheets and the model answers for case 3
- Group 3 with case 3 briefing notes only
- additional groups may use other case studies from the internet or other sources, or do the same exercise as another group

2

Each group uses the briefing notes to fill out the worksheets as best they can. The information is all mixed up - this is an attempt to reflect the real world, in which many firms have little knowledge of how much material they waste, what their wastes are and how much waste costs them.

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3

Encourage the students to evaluate payback periods, or how long it will take for cleaner production expenditure to be recovered from savings. The formula is:

payback period = cost of new technology ÷ savings per unit time

For example:	cost of new technology	=	$50,000
	savings	=	$10,000 per month
	∴ payback period	=	50,000 ÷ 10,000
		=	5 months

4

Encourage a class discussion on how the students found the exercise:

- how easy or difficult was it?
- did they find the worksheets a helpful way of putting together the information and working with it?
- do they think staff of real firms could make similar savings for their companies?

INFORMATION FOR ACTIVITY 3

Cleaner production briefing notes

Case 1: A fruit juice factory (adapted from the Target Zero manual)

This large apple juice factory in a small town in a North Island coastal region processes all the juicing apples from the region. It buys 250,000 tonnes per year of apples at average rates of $100/tonne and also buys 5000 litres of concentrate a year at $500/100 litres. It produces 120 million litres of fruit juice a year selling at $1 per litre.

When the apples come into the plant, they are thoroughly washed, sorted into green and red apples to make different types of juice with reject apples (about 1000 tonnes a year) going to landfill. They are pressed to extract the juice, and the crushed apple solids are landfilled. The juice is centrifuged to clarify it and the heavier components are filtered to extract more juice. This process produces 10,000 tonnes of sludge and 40,000 tonnes of waste filter medium a year, both of which are landfilled. New filter medium costs $50/tonne but improved backwashing would reduce filter medium use to 25%. The juice is pasteurised by being heated to steam and condensed, producing 18 tonnes per year of aromatic compounds which are sold to the scent industry for $100 per tonne. The juice is put into 1 litre packages, which cost 20 cents each, and they are put on pallets for sale.

The plant employed a new accountant and one of her first jobs was to re-negotiate the plant's contract with its solid waste removal operator. She was amazed to discover that collection and tipping fees together amounted to $50 a tonne, so asked the plant engineer to take her on a tour of the plant and explain the processes to her.

One of the first things she noticed was a hose on the ground left running by the apple wash. She was told the tap was at the other end of the production line, so staff never turned it off because it was to far to walk. She also saw a pipe dripping water into an open floor drain. She was told it was an overflow of juice from the filters because a faulty valve had put too much juice in them.

Looking at the reject apples, she thought many of them looked quite good and asked if anyone else could use them. The engineer said they used to give them to charity, but the staff member who used to arrange it left so now they are dumped. She also looked at the crushed apple residue and the engineer said he was looking at selling it to a new compost manufacturer in town.

The engineer pointed out the heating unit for the pasteuriser was inefficient because it was overdue for replacement. He had costed a new unit which would save them one-third of their present power bill, but because it would take a two-year payback, the previous accountant had said it wasn't worth replacing. Together they agreed they should recommend getting a new one.

She asked why there were so many reject juice cartons by the packing machine. The engineer said every time they changed juice, there was a delay in changing packages and a lot of juice and packages were wasted. On looking at the accounts, the accountant realised the firm was buying 26 million extra packages - a 20% wastage rate. The industry benchmark is about 2% wastage. At around 3.8 grams per carton, this added up to 100 tonnes a year, a landfill cost of $5000.

While she was working late one night, she heard noise coming from the plant even though the second shift had knocked off for the day. She looked in to discover all the conveyor belts had been left on and the washing system for the press was still running (the switch is a long way from the door so she couldn't find it). She also noticed all the lights, computers and air conditioning were still on in both the plant and the offices, even though no-one else was there. When she looked at the bills, she found the plant spent $2 million a year on electricity and $500,000 a year on 3 million cubic metres of water a year. The plant also spent $400,000 a year on wastewater charges to dispose of wastewater to the sewer. The engineer estimated electricity use could be reduced by 5-20% just by good housekeeping, while water use (and therefore wastewater discharges) could be halved with better equipment and housekeeping.

With the agreement of the plant's general manager and the help of the engineer and plant staff, she started a cleaner production programme to minimise wastes and save the company money.

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INFORMATION FOR ACTIVITY 3

Cleaner production briefing notes

Case 2: A spray-painting business (adapted from the Target Zero manual)

Group 2 fills out the cleaner production worksheets (except for worksheet 1) for this case study, using the completed calculations in the MODEL ANSWERS to save time.

This small company in the industrial area of a major city paints metal components for sale to an assembly plant. It buys 350,000 components a year and pays $25.50 per 10-litre pail for paint, paying in total $459,000 a year for 180,000 litres of paint.

An Occupational Safety and Health inspector visited its workshop and said its spray guns were emitting too many spray paint fumes which was not good for its employees' health. He advised the company to approach its paint supplier for help. The sales person at the paint supplier said the company had just got an environmental award for changing the product specifications so that the emitted far fewer volatile organic compounds (VOCs). She said this makes the paint more environmentally friendly and safer for people to use.

However, she also thought the spray-shop people should look at the efficiency of their equipment and ask their spray-gun supplier for more advice. She offered to talk directly to the spray-gun supplier to find out if the new paint would be compatible with the old guns or any new ones.

The spray-painting firm's main customer said it was having trouble with the components because sometimes the paint was too thick, causing assembly and quality problems.

The spray-gun supplier and the paint sales person visited the spray shop together and analysed how much paint was being bought, applied to the components and lost into the air - and the lungs of the staff. They found those components with the right amount of paint weighed 2 kg unpainted and 2.3 kg painted. However, 40% of them had too much paint and these weighed 2.5 kg.

The spray-gun supplier said he could provide new guns with nozzles which were 25% more efficient. These would reduce their paint costs to 75% of current costs, produce fewer fumes and provide an even coat of paint on all components. The four new guns would cost a total of $3200.

The sales person noticed numerous paint pails with waste paint in them (much of it all one colour), and asked why so much was wasted. She was told if they changed colour, they had to clean the lines and guns and tip out unused paint because it often went off before they could use it. She spoke with the spray-shop manager and together they made four suggestions for reducing waste from paint changeover which would reduce the amount of wasted paint disposed of by the hazardous waste disposal operator by 80%.

The hazardous waste disposal fees are $100 a tonne so an 80% saving would be significant. The company buys 900 kg of cleaning rags a year at 50 cents a kg but because they get full of solvent, they are deemed to be a hazardous waste. With the added paint on them, they weigh 1000 kg at disposal. However, the sales person and spray-shop manager estimate with less over-spraying and changeover cleaning, they will only need half the rags they used to. They will only be 10% heavier instead of 55%.

Further, the company discharges 8,000,000 litres of washwater to the sewer a year at a cost of $1 per cubic metre (1 cubic metre = 1000 litres) and the improved colour changeover practices could reduce this by at least half.

The spray-shop manager agreed to implement all the changes recommended by the paint sales person and spray-gun supplier. The Occupational Health and Safety inspector was pleased with the results on his next visit.

INFORMATION FOR ACTIVITY 3

Cleaner production briefing notes

Case 3: A spray-painting business (adapted from the Target Zero manual)

Group 3 does the calculations below for this case study, without doing the worksheets

This small company in the industrial area of a major city paints metal components for sale to an assembly plant. It buys 350,000 components a year and pays $25.50 per 10-litre pail for paint, paying in total $459,000 a year for 180,000 litres of paint.

An Occupational Safety and Health inspector visited its workshop and said its spray guns were emitting too many spray paint fumes which was not good for its employees' health. He advised the company to approach its paint supplier for help.

The spray-painting firm's main customer said it was having trouble with the components because sometimes the paint was too thick, causing assembly and quality problems.

The spray-gun supplier and the paint sales person visited the spray shop together and analysed how much paint was being bought, applied to the components and lost into the air - and the lungs of the staff. They found those components with the right amount of paint weighed 2 kg unpainted and 2.3 kg painted. However, 40% of them had too much paint and these weighed 2.5 kg.

The spray-gun supplier said he could provide new guns with nozzles which were 25% more efficient. These would reduce their paint costs to 75% of current costs, produce fewer fumes and provide an even coat of paint on all components. The four new guns would cost a total of $3200.

The sales person noticed numerous paint pails with waste paint in them (much of it all one colour), and asked why so much was wasted. She was told if they changed colour, they had to clean the lines and guns and tip out unused paint because it often went off before they could use it. She spoke with the spray-shop manager and together they made four suggestions for reducing waste from paint changeover which would reduce the amount of wasted paint disposed of by the hazardous waste disposal operator by 80%, saving up to $100 a month.

How did they work out the company's current efficiency and the improved performance which would result from the recommended changes?

1. How much paint goes onto the 60% of components with the right amount of paint on them?
2. How much paint goes onto the 40% of components with too much paint on them?
3. If 1 litre of paint weighs 1.3 kg, how many litres of paint are applied to the components?
4. What is the efficiency of paint application in percentage terms?
5. How much paint is wasted by changing colour, loss through fumes and cleaning rags?
6. How much does this loss cost?
7. If all components were properly sprayed with the old guns, how much paint would be used?
8. How much money would this save?
9. With the 25% reduction in applying this amount of paint with new guns, how much paint is saved?
10. How much money would this save?
11. With the 80% reduction in waste paint removed, how much more money is saved?
12. What is the payback period of the new guns?
13. How much money will the two amounts of savings in questions 10 and 11 save?
14. Which ways can you think of to reduce paint wastage from colour changeover?
15. Do you think these savings are worthwhile to the company?

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INFORMATION FOR ACTIVITY 3

Cleaner production worksheets 1-4

WORKSHEET 1: PROCESS FLOW DIAGRAM

Instructions: Draw a map of the plant layout which shows all the different processes involved and how flows of materials and wastes move through the plant.

NB: In a real waste assessment, inputs and outputs will be measured for each process unit, to identify exactly where materials are wasted and wastes are generated. If you have time and the company has the resources, you may wish to do this, using worksheet 4 for each process unit.

Source: *Adapted from Auckland Regional Council, 1997; Target Zero, 1997; Ministry for the Environment 1994.*

WORKSHEET 2: WALK-THROUGH

Instructions: Use this form to list any observations of wasteful practices during your walk-through, and any cleaner production options you can think of to eliminate, reduce, re-use or recycle this waste

What wasteful practice did you see?	Where did you see it?	Why was the waste occurring?	How could the waste be avoided or minimised?
Waste of water — hose running	By washbay	Tap left on over tea break	Ask staff to turn tap off Put a spring-loaded valve on hose

Source: *Adapted from Auckland Regional Council, 1997; Target Zero, 1997; Ministry for the Environment 1994.*

WORKSHEET 3: EVALUATION OF CLEANER PRODUCTION OPTIONS

Instructions: Summarise the technical, environmental and economic aspects of the cleaner production options you can think of on this form.

Scoring: **EITHER** give each criterion (technical, economic and environmental) a simple YES/NO score depending on how technically workable, economically and environmentally beneficial you think it could be; **OR** if you prefer, use a 1-3 system, where 1 = NO, 2 = MAYBE and 3 = DEFINITELY.

CLEANER PRODUCTION OPTION	SCORE: YES or NO or 1, 2, 3			TOTAL
BRIEF DESCRIPTION OF OPTION	TECHNICAL: Is it technologically workable?	ECONOMIC: Will it be affordable and will we save a lot of money?	ENVIRONMENTAL: Is there likely to be an environmental benefit?	Will this option reduce waste, save money and benefit the environment?
				Yes/No
				Yes/No
				Yes/No
				Yes/No
				Yes/No
				Yes/No
				Yes/No

Source: *Adapted from Auckland Regional Council, 1997; Target Zero, 1997; Ministry for the Environment 1994.*

WORKSHEET 4:
OVERALL INPUT-OUTPUT SUMMARY

Instructions: List the most significant inputs and outputs, giving actual quantities and costs for the most recent financial year. List the different processes which go on in the plant in the middle column. List all wastes and their costs in the right-hand column, as well as the saleable products (value is optional for this item, for a real firm). Complete the lower half after completing the other worksheets.

BEFORE DOING A CLEANER PRODUCTION AUDIT		
Inputs	**Processes**	**Outputs**

AFTER IMPLEMENTING CLEANER PRODUCTION STEPS		
Inputs	**Outputs**	**% saving: volume and $**

Source: *Adapted from Auckland Regional Council, 1997; Target Zero, 1997; Ministry for the Environment 1994.*

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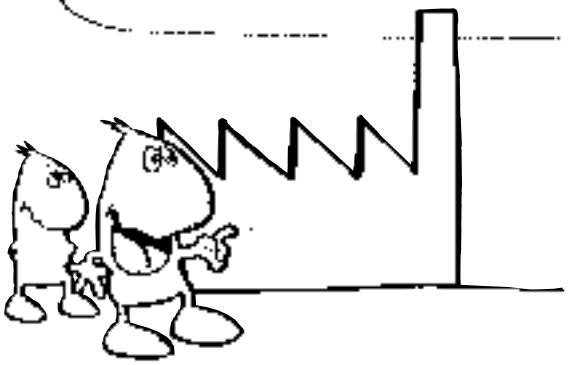
ACTIVITY 4

Cleaner production: A site visit to a real firm: What goes to waste?



PREPARATION

- it is best to have completed topic 6 (book 6), a waste audit of your own school, before doing this activity
- you may do either or both the cleaner production WORKSHEET analysis and the SOLID WASTE audit outlined overleaf
- use the project planning sheet at the end of this booklet to cover all likely needs for this activity: The class may be able to take part in this
- prepare an introduction to a request to a local firm which would persuade it to let you do either or both of a cleaner production assessment and a solid waste audit of its plant. Include some environmental policies, from: http://www.xerox.com/ehs/policy.html and http://www.dupont.com/corp/environment/commitment.html
- select several likely firms to contact (for example, a students parent may work in a suitable firm), then phone and ask to speak to the person responsible for managing waste disposal
- explain your class is doing a major unit of study on waste reduction and you have completed a survey of your own school's waste stream (topic 6). Offer to send the company a copy of your findings and some examples of the experience of other New Zealand firms, from Ministry for the Environment case studies on cleaner production
- explain that to follow on from that survey and your case studies, you would like to carry out a study of opportunities for local firms to save money by reducing waste, and that you would like to study their firm
- ask if the company would be willing to have a class walk through its plant and fill out some observation forms. Also ask if the company would allow prepared to have students to do a solid waste audit and analysis (bear in mind health and safety issues). Offer to send a copy of all the forms to be used (Cleaner production worksheets 1-4 from activity 2 of this topic and the solid waste procedures overleaf)
- ask if the company manager is willing to release some key figures on input and output costs for the top half of worksheet 4. Ask for the top five most expensive items in the inputs column, and the top five most expensive wastes and where they are disposed of for the output column
- ask the manager to provide a guide or supervisor who has the information to help students with the worksheets
- photocopy a set of the worksheets for each student or group of students

1

CLEANER PRODUCTION GROUP:

1) Ask a company staff member to go through the information on worksheets 1 and 4 so all students are familiar with the plant and its processes
2) Guide the students through the plant (being careful about safety) and ask them to look out for anything that might be waste and note it on worksheet 3. Ideas may include:
   - waste bins with mixed materials in them so they can't be recycled
   - taps, lights, machinery or equipment left on when they don't need to be
   - spills (wasted raw materials)
   - unlagged pipes wasting heat
   - points in the production process where materials seem to be wasted (e.g. bins placed there)
   - waste stock piles for removal
3) Students may fill out column 3 of worksheet 2 at the site if they have time, or work on ideas in groups back in the classroom.
4) If there is time, students may ask their tour guide to discuss ideas for cleaner production options and may seek help in completing their worksheets.

2

SOLID WASTE AUDIT GROUP:

NOTE: This activity could also be done on its own using the additional suggestions below.

On the basis of their investigations, students should:

- complete worksheet 4 on their own or with the help of someone from the firm
- write up the findings of their solid waste audit
- make recommendations about how the company could minimise its waste, perhaps considering matters such as:
  - the RENEW programme: Which wastes could the company buy or sell as resources, instead of disposing of them?
  - are there any firms locally where wastes could be exchanged (see activity 5)
  - environmentally responsible market development
- invite the company manager and other staff to the classroom to be presented with their ideas, and/or send a copy of their report to the plant manager

Quotable Quotes

Pollution controls and waste disposal fees are no longer seen as an unwanted cost of operation: Wastes eliminated are money in the bank, while residual wastes are considered potential resources.

(Dr Donald Huisingh, Lund University)

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SOLID WASTE ANALYSIS METHODOLOGY

Identify all areas in the firm where wastes are collected. Consider:

- litter
- office
- gardens
- restrooms
- production areas
- cafeteria or tuckshop
- outdoor waste collection areas and bins
- any other areas

Collect all solid waste into one area. Use gloves to protect yourselves from cuts and dirty items and a tarpaulin so the waste can be tidied away easily.

Weigh the total or measure its total volume (wastes such as metals are heavy but compact while others, like plastics, are light but bulky, affecting landfill space).

Sort your wastes into categories using the waste analysis protocol on page 30.

Within each category there may be sub-categories. Each sub-category may need to be dealt with differently in your waste reduction plan. For example:

- paper can be divided into newspaper, office paper, cardboard and waxed paper
- plastics may be sorted into types 1 and 2, which can be recycled in large amounts in New Zealand, and types 3 or higher, for which it may be more difficult to find recyclers
- glass can be sorted by colour - clear, green, brown
- metal can be divided into steel, aluminium or other
- organic can be divided into food or garden waste
- potentially hazardous wastes could include aerosols, paint or solvent soaked rags

Create a recording sheet and weigh or measure each category. Add the weights of the solid categories together. The totals should equal those in step 3.

7

Work out how much of your total waste is made up by each category:

$$\frac{\text{weight of category}}{\text{total weight}} \times 100 = \%$$

8

Find out how much it costs the company each year to pay to dispose of these wastes.

9

Write up a report as indicated for ALL GROUPS.

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