

Cleaner Production for Small to Medium Sized Enterprises

Module 5: The Cleaner Production Plan

5. Module 5: The Cleaner Production Plan

At the end of this module you will:

- *Have further assessed the feasibility of Cleaner Production options*
- *Have developed a Cleaner Production action plan*
- *Have taken steps for the integration of Cleaner Production into day-to-day management and operation of a business*

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5.1. Stage 5: Action Planning

In the previous modules we have seen how to determine the environmental impacts of our operations and how to generate options for minimising these impacts. The final step is to put in place an Action Plan to ensure that the viable options are implemented. The Action Plan should also address how the process will be integrated into the day-to-day operations of your business so that continuous improvements are achieved.

Before preparing the Action Plan itself, further evaluation of some options may be needed, now or as part of future actions. If further evaluation is not required, go to Task 5.2

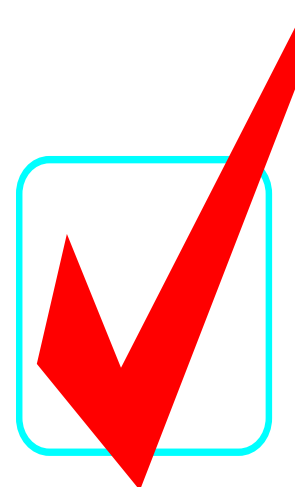
Stage 5: Action Planning

- Task 5.1: Further evaluation of Cleaner Production options
- Task 5.2: Prepare and implement action plan
- Task 5.3: Integration into (environmental) management system

5.1.1. Task 5.1: Further evaluation of Cleaner Production options

In Stages 3 and 4 (Modules 3 and 4) you have generated Cleaner Production options which may be proposed for implementation without further evaluation. Where further investigation and evaluation is needed the feasibility of the options will need to be further evaluated using Worksheets 5.5. There are three requirements that an option will need to satisfy before it can be implemented:

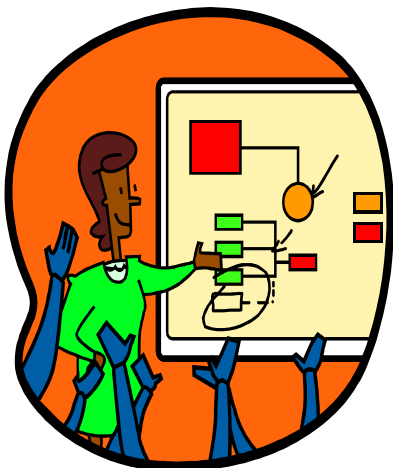
- Technical feasibility
- Financial viability
- Environmental benefits



Where more research and investigation is needed than can be carried out in a short project, and the effort could be worthwhile, an investigation project may be included in the action plan.

Technical Evaluation

The technical evaluation is an assessment of whether the proposal will work. Once you have decided what new and/or modified equipment or what operational changes are required you can assess the two main factors of the technical evaluation:



1. Assessment of functionality (reflected in detailed engineering), consisting of:
 - Availability and reliability of equipment
 - Requirements for utilities, process monitoring and control
 - Maintenance requirements
 - Required technical skills (operators, technicians)
2. Assessment of performance, consisting of:
 - Projected changes in operational performance to provide a basis for a before and after comparison

Example: An insulation manufacturer came up with an option to replace its main raw material for its primary product with another material. The following table shows a before and after comparison, forming part of the technical evaluation.

Consumption rates	Before implementation	After implementation
Main raw material in solid waste	120 tonnes/year	0 tonnes/year
Resin fumes	5m ³ /year (estimated)	0/year
Energy		>50% reduction (no extraction equipment used to remove fumes, no heating of raw material required)
Reject products (in solid waste)	7.5% of production	1% of production
Transport		Reduced for main raw material as it is lighter and less bulky
Storage		Reduced for main raw material as it is lighter and less bulky
Productivity		> 200% improvement, ie takes less than half the time to process new raw material
Product quality		Improved
Product cost to consumer		Reduced due to lower cost of main raw material

Financial Viability

The financial evaluation, or cost-benefit analysis, determines whether the option is cost-effective for the organisation. That is, whether the option will give an acceptable return on investment.

It should be noted that the “acceptable” return on investment will vary significantly between businesses. There may also be non-economic factors, such as compliance with regulations or occupational health and safety which influence the accepted return on investment.



The financial evaluation will consist of:

- Data collection on:
 - Investment costs derived from detailed engineering
 - Extra cash flow – savings in operational costs and extra earnings (derived from before and after comparison). It is important to include all the benefits of an option, including those that are perhaps less tangible
- Choice of economic evaluation criteria
 - Payback, net present value, internal rate of return
- Economic calculation and interpretation

Simple Payback

The easiest method of evaluating a project is to calculate the simple payback. Simple payback tells you how long it will take to recoup the money invested to implement a project. The payback period is calculated using the following equation:

$$\text{Payback period} = \frac{\text{Investment}}{\text{Annual cash flow}}$$

Simple payback is a useful tool for comparing projects that have the same expected outcome. Generally, the project with the shortest payback period will be the preferred option.

Acceptable payback periods vary substantially from business to business, but generally a payback of three years or less is deemed acceptable. Many businesses consider projects with less than a one year payback period essential investments.

One of the main shortcomings of the simple payback evaluation method is that it does not account for the time value of money. It also takes no account of savings that accrue after the project has paid for itself. Alternative evaluation methods that do account for this are Net Present Value and Internal Rate of Return.

Example: The insulation manufacturer will have to spend \$300,000 on having new equipment installed and operators trained in order to use the alternative raw material. Savings will be \$30,000 in waste disposal costs and \$25,000 in energy, transport and ancillary materials. Moreover, there will be increased earnings worth \$120,000 through increased productivity.

$$\begin{aligned}\text{Payback} &= \$300,000 \div (\$30,000 + \$25,000 + \$120,000) \\ &= \$300,000 \div \$175,000 \\ &= 1.71 \text{ years}\end{aligned}$$

The simple payback period for the project is one year and nine months. The project would therefore be deemed financially viable.

Other financial evaluation approaches include the Net Present Value and Internal rate of Return methods, summarised in the Annex to Module 5

Environmental Evaluation

The final part of the evaluation is the environmental evaluation. Your option may be technically and financially viable, but does it really deliver environmental benefits? Does it introduce new environmental impacts to your process which outweigh the potential improvements? The environmental evaluation will consist of determining whether the option has **net** environmental benefits, such as:

➤ Reduction in pollutants generated



- Reduction in energy consumption
- Reduction in water usage
- Reduction in material consumption
- Reduction in toxicity of wastes and emissions
- Reduction of pollutants in product

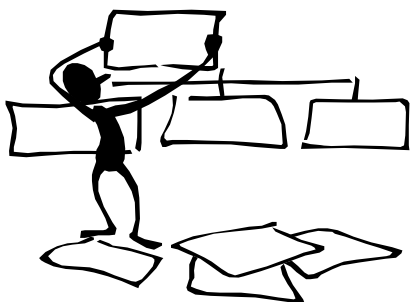
5.1.2. Task 5.2: Prepare and Implement Action Plan

The goal of the action planning phase is to decide which options to pursue, and plan how they will be implemented. This involves:

- Integrating the results of the feasibility studies for the different options
- Selecting the best possible combination/s of options
- Planning for implementation of selected options

Selecting options

A logical way of deciding which options to pursue is to:



1. Eliminate non-feasible options, those with:
 - Expected unsatisfactory technical performance
 - Unfavourable cost/benefit analysis
 - Doubtful net environmental benefit

NPV Ratio is the ratio of the NPV divided by the cost of investment. The higher the ratio, the more financial benefit is gained from the investment.

2. Select among mutually exclusive options, those with:
 - Highest NPV ratio or shortest payback
 - Lowest investment cost
 - Best environmental benefit
3. Combine remaining feasible options
 - Implement in most practical sequence or in order of decreasing NPV ratio or increasing payback period

Action Plan

Your action plan should contain every option selected for implementation and should include the following information for each option:

- A management summary (Worksheet 5.1)
- Cleaner Production priorities, targets (Worksheet 5.2)
- A list of projects with estimated costs and benefits (worksheet 5.3)
- Project implementation plans with tasks, completion dates and responsibilities for implementation (Worksheet 5.4)
- Specifications for monitoring performance (Key Performance Indicators) upon completion of implementation (in Worksheets 5.2 and 5.3)

Example: The Action Plan for the insulation manufacturer takes the following form.

Option	Responsible Staff	Completion Date	Cost	KPI's for monitoring
Replacement of xxx raw material	Production Manager	1/2/2001 (6 months)	\$300,000	xxx in solid waste (tons)
...				

Implementation

Implementing your options will involve:

- Technical equipment modifications
- Housekeeping changes
- Construction plans (if a new construction)
- Reviewing alternatives offered by different suppliers
- Training staff (where appropriate)

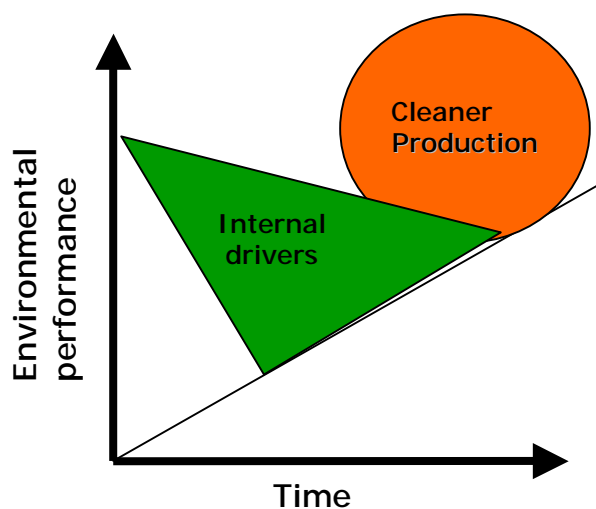
When feasible Cleaner Production options have been implemented, the results should be monitored and evaluated. Further improvements should be looked for, and the Action Plan should be updated to include them.

5.1.3. Task 5.3: Integrate into Management Systems

The next task is to ensure that Cleaner Production is integrated into your management systems. This enables on-going implementation of accepted Cleaner Production options, along with continuous identification of further Cleaner Production opportunities.

Key elements of successful, sustainable Cleaner Production programs are:

- Proper management accounting, including all environmental costs
- Employee participation
- Leadership from senior management other than the environmental department
- Integration of program into environmental management system



5.2. Environmental Management Systems (EMS)

5.2.1. Overview, Functions and Elements

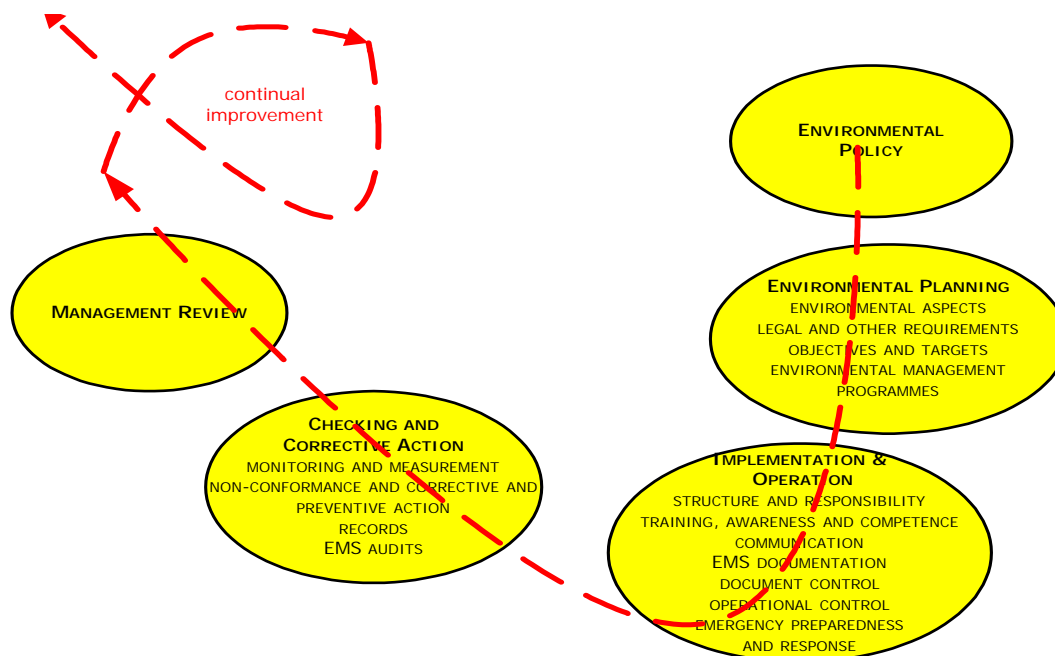
An Environmental Management System is *“that part of the overall management system which includes the organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy”* (ISO 14001)

Environmental Management Systems aim to:

- identify and control environmental aspects, impacts and risks
- establish and achieve environmental policy, objectives, and targets, including compliance with legislation
- identify opportunities for environmental improvement
- monitor and continually improve environmental management

Certification of EMS's is possible through independent bodies, and depends on compliance with ISO 14001 or other relevant standards (BS 7750, EMAS). ISO 14001 is the international standard for establishing and maintaining EMS's.

Figure 5.1 – Elements of an Environmental Management System



5.2.2. Link to Cleaner Production

EMS's can provide the organisational structure and information and management systems to continuously plan for and implement Cleaner Production options. The following table shows various components of ISO 14001 which must be satisfied to achieve certification. Many of these requirements are addressed by the Cleaner Production Procedure covered in this program.

Element	Key Requirements [ISO 14001]	CP Procedure
Environmental Policy [4.2]	<ul style="list-style-type: none"> ➤ Appropriate to environmental aspects of activities, services and products ➤ Continuous improvement commitment ➤ Commit to legal requirements ➤ Set targets and objectives – and review these ➤ Document and communicate to employees, and to public 	<p>[1.1]</p> <p>-</p> <p>[1.2]</p> <p>[1]</p> <p>-</p>
Planning [4.3]	<ul style="list-style-type: none"> ➤ Procedures to identify environmental aspects of activities, services and products ➤ Identify aspects which can have significant impact on environment ➤ Procedures to identify and assess legal requirements ➤ Establish targets and objectives consistent with policy ➤ Consider views of interested parties ➤ Establish an environmental management programme designating responsibilities and the means 	<p>[1.1]</p> <p>[1.1]</p> <p>[1.2]</p> <p>-</p> <p>-</p>

		[5.2]
Implementation and Operation [4.4]	<ul style="list-style-type: none"> ➤ Define and document structure and responsibility for effective environmental management ➤ Provide resources, skills and finances for EMS ➤ Appoint management representative to ensure implementation and report to management ➤ Training, awareness and competence of personnel with significant impact on environment on (a) importance of conformance; (b) possible adverse impacts of work and benefits of improvements in performance; (c) roles and responsibilities, including emergency preparedness; and (d) potential consequences of departure from procedures ➤ Establish procedures for communication with internal and external interested parties ➤ EMS documentation to be maintained and point to related documents ➤ Document control – available, reviewed and revised, remove or identify obsolete documents ➤ Documents to be dated with dated revisions ➤ Ensure operational control over activities with significant environmental aspects ➤ Activities, including maintenance, should be planned to ensure specified conditions are met ➤ Establish procedures where required to prevent deviations from EMS policy ➤ Define operating criteria and include aspects related to suppliers and contractors ➤ Establish emergency preparedness and response procedures ➤ Test, review and revise such procedures 	<p>-</p> <p>[5.2]</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>[5.2]</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p>
Checking and Corrective Action [4.5]	<ul style="list-style-type: none"> ➤ Monitor and measure EMS activities, record and track performance and compliance ➤ Monitoring equipment shall be calibrated and maintained ➤ Nominated staff investigate non-conformances and take action to mitigate any effects ➤ Corrective and preventive actions – appropriate to magnitude of impact ➤ EMS records to be maintained and readily retrievable, defined retention periods ➤ Conduct periodic EMS audits to determine that planned arrangements, and the requirements of the Standard are met ➤ Audit program to be comprehensive and based on environmental importance 	<p>[5.2/5.3]</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>[5.3]</p> <p>[1/5]</p>
Management Review [4.5]	<ul style="list-style-type: none"> ➤ Review effectiveness of EMS, consider changes, commitment to continual improvement 	[5.2/5.3]

Results

Effective Action Planning results in:

- Detailed feasibility analysis of all options
- Action plan for staged introduction of all accepted options

- Implications for day-to-day management

The Action Plan should be used to:

- monitor progress in reducing waste and emissions
- further develop the Environmental Management System

Conclusion

- Action planning involves selection and implementation of options after detailed feasibility studies.
- Extension into a full Environmental Management System can enable inclusion of Cleaner Production in daily operation and management of the business.

ANNEX (MODULE 5): NET PRESENT VALUE AND INTERNAL RATE OF RETURN

Net Present Value (NPV)

A more accurate evaluation of the financial viability of a project can be obtained by calculating its net present value (NPV). NPV takes into account the time value of money ie it presents the future cash flow of a project in terms of today's dollars. If the NPV is positive (that is, greater than the cost of the project) then the project will be profitable and should go ahead.

Net Present Values are calculated using the following formula. In the formula, CF_x = cash flow in period x , n = the number of periods (normally the expected lifetime of the project), and r = the discount rate. CF_0 = investment cost which will be negative as it is money paid out.

The 'time value of money' refers to the fact that a dollar you have today is worth more than a dollar you receive in the future. The dollar you receive in the future is discounted to a present value and there is an opportunity cost involved in spending it today eg interest.

$$\text{Net Present Value (NPV)} = CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \frac{CF_n}{(1+r)^n}$$

Choosing the correct discount rate is a very important part of any NPV calculation. As it is essentially an interest rate, there are two basic ways of selecting which rate to use.

1. If you are going to borrow capital to implement the project you can simply use the interest rate you will be charged on the loan.
2. If you will not be borrowing to fund the project, use the interest rate you would receive if you were to invest the money.

Most companies will add a small risk margin of 2-5 % to the discount rate, for example, in case interest rates go up. If you are borrowing, you may also want to take into account the effect on the discount rate of the tax deductions allowable on interest payments for business loans.

Example: The insulation manufacturer will need to borrow money in order to fund this project. The interest rate on the loan will be 8.5%. The loan will be for the full \$300,000 and will be for a four year term.

$$\begin{aligned}
 \text{NPV} &= -300,000 + [175,000 \div (1+0.085)^1] + [175,000 \div (1+0.085)^2] + [175,000 \div (1+0.085)^3] + [175,000 \div (1+0.085)^4] \\
 &= -300,000 + [175,000 \div 1.085] + [175,000 \div 1.177] + [175,000 \div 1.277] + [175,000 \div 1.386] \\
 &= -300,000 + [161,290.32] + [148,683.09] + [137,039.94] + [126,262.63] \\
 &= 273,275.98
 \end{aligned}$$

Therefore, as the NPV is positive (that is, greater than the cost of investment) the project is financially viable.

Internal Rate of Return (IRR)

The internal rate of return (IRR) method of evaluating projects works in the opposite way to the NPV method. It enables you to calculate the interest rate that is equivalent to the return, in dollars, that you expect from the project over its lifetime. When you know this rate you can compare it to the rates you would receive if you invested the money elsewhere (either in other projects or in a bank, shares, etc). Generally, if the IRR is higher than your cost of borrowing (ie the rate of interest you would pay on a loan) then the project is financially viable.



IRR is best calculated on a financial calculator or computer, as it is an iterative process that can be time consuming. Calculation of IRR is based on the same equation as NPV, but in this instance the equation is solved for r.

$$0 = CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \frac{CF_n}{(1+r)^n}$$

Another way to work out IRR is to use 'present value tables'. Present value tables are included in General Annex 5, along with instructions for their use.

Example: The insulation manufacturer has an internal rate of return of 15% over a five year period as its internal hurdle rate for projects. That is, projects must have an internal rate of return of at least 15% over a five year period to be considered financially viable.

$$0 = -300,000 + [175,000 \div (1+r)^1] + [175,000 \div (1+r)^2] + [175,000 \div (1+r)^3] + [175,000 \div (1+r)^4] + [175,000 \div (1+r)^5]$$

Try r=0.15 (15%)

$$X = -300,000 + [175,000 \div (1 + 0.15)^1] + [175,000 \div (1 + 0.15)^2] + [175,000 \div (1 + 0.15)^3] + [175,000 \div (1 + 0.15)^4] + [175,000 \div (1 + 0.15)^5]$$

$$X = -300,000 + 152,173.91 + 132,275.13 + 115,055.88 + 100,057.18 + 87,021.38$$

$$X = 286, 583.48$$

Try r=0.50 (50%)

$$X = -300,000 + [175,000 \div (1 + 0.50)^1] + [175,000 \div (1 + 0.50)^2] + [175,000 \div (1 + 0.50)^3] + [175,000 \div (1 + 0.50)^4] + [175,000 \div (1 + 0.50)^5]$$

$$X = -300,000 + 116,666.67 + 77,777.78 + 51,775.15 + 34,584.98 + 23,056.65$$

$$X = 3861.23$$

Therefore, the internal rate of return is just over 50%. This is well above the company's stated internal hurdle rate, so the project is definitely financially viable.