Japan International Cooperation Agency (JICA)

Malaysia
SIRIM Berhad

The Study on Promotion of Cleaner Production in Industrial Sector

Final Report

(Summary)

September 2002

Mitsubishi Chemical Engineering Corporation

Japan International Cooperation Agency (JICA)

Malaysia
SIRIM Berhad

No.

The Study on Promotion of Cleaner Production in Industrial Sector

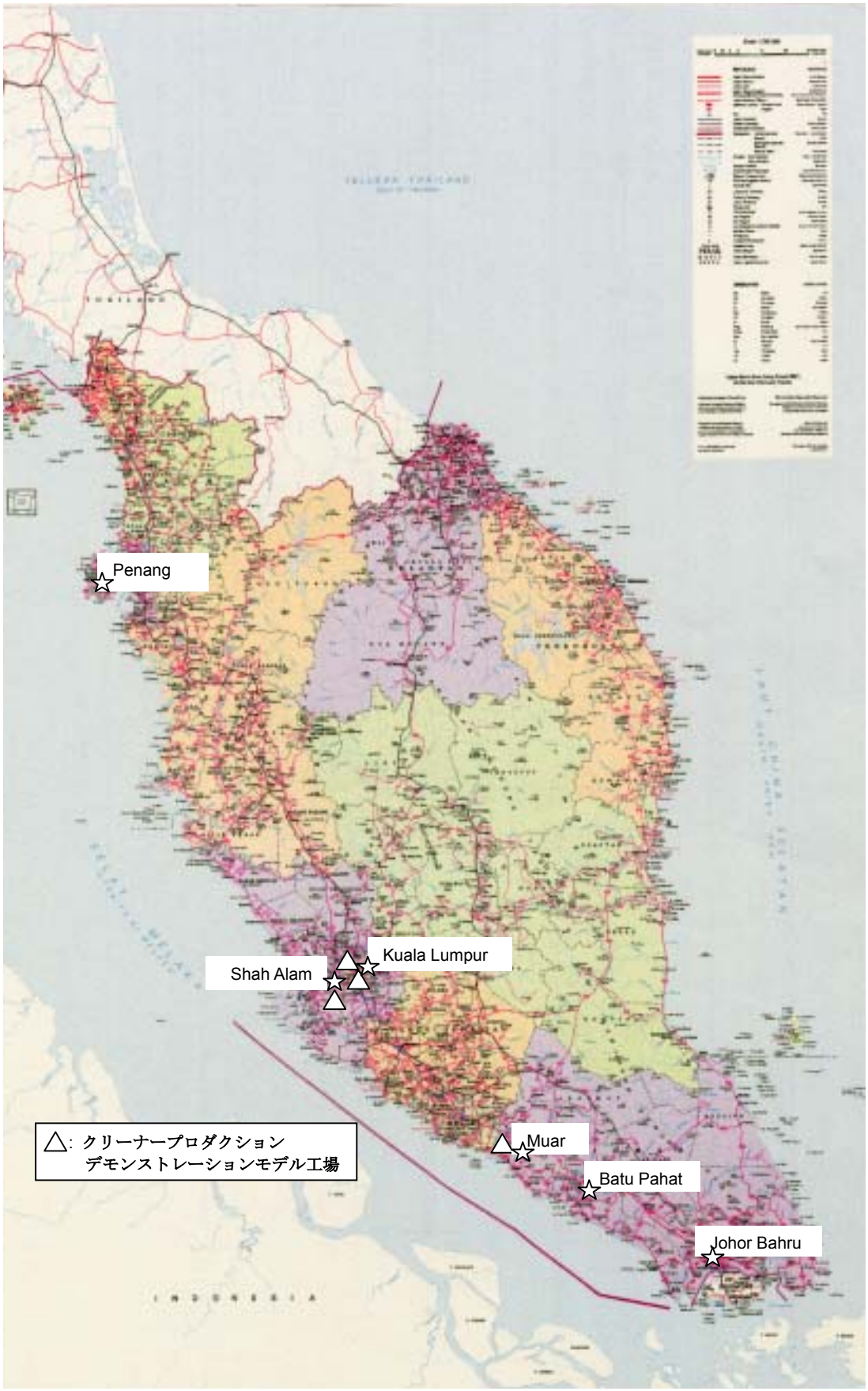
Final Report

(Summary)

September 2002

Mitsubishi Chemical Engineering Corporation

調査地域（半島マレイシア）地図



OUTLINE

1. Introduction

In response to the request from the Government of Malaysia (GOM), Japan International Cooperation Agency (JICA) concluded the Scope of Work (S/W) on 13 July 2000 regarding the implementation of the Development Study on Promotion of Cleaner Production (CP) in Industrial Sector. This Study has been executed in accordance with the S/W and the Minutes of Meeting (M/M) concerning the S/W in close cooperation with SIRIM Berhad.

The objective of this Study is to contribute towards the abatement of industrial pollution in Malaysia by:

1. Promoting CP through capacity building of SIRIM and other related institutions and human resources; and
2. Making recommendations and an action plan for CP promotion .

The Study covers the following:

(i) Review of present situation of industrial pollution control;
(ii) Analysis of industrial pollution in the targeted sub-sectors;
(iii) Survey for representative factories;
(iv) Pilot activities for the promotion of CP:
- Demonstration projects at model factories
- Dissemination of CP information;
(v) Comparative analysis on CP promotion measures; and
(vi) Recommendations on measures and action plan for the promotion of CP and industrial pollution control.

2. Summary of Achievement of the Pilot Project for Promotion of CP

CP Demonstration Projects were conducted by introducing CP equipment to the following four model factories in different fields:

Electroplating: Metal Polishing Industries Sdn. Bhd.
Aluminum anodizing: Perusahaan TGB Sdn. Bhd.
Food: Winner Food Industries Sdn. Bhd.
Textile: South Asia Textiles (M) Sdn. Bhd.

CP equipment introduced to the four model factories proved the function originally

intended. and the The targeted factories will enjoy benefits of improved productivity and product quality while complying with environmental regulations. Additionally, the nation will enjoy the benefit of reduced consumption of precious resources as well as environmental preservation.
On the basis of the achievement of the demonstration projects, it is desirable that appropriate measures be taken to promote the adoption of CP.

3. Summary of Proposed Measures

For promoting CP in the industrial sector, there exist various barriers such as lack of information and knowledge on CP and human resources in enterprises, insufficient access to existing incentives, and lack of implementing rules and provisions relating to CP or waste minimisation practices. Therefore, CP cannot be promoted through a single measure; instead, it is extremely necessary to work out and implement comprehensive measures.

Figure-1 shows how the issues, which factories are currently facing to, are to be incorporated into CP promotion strategy.

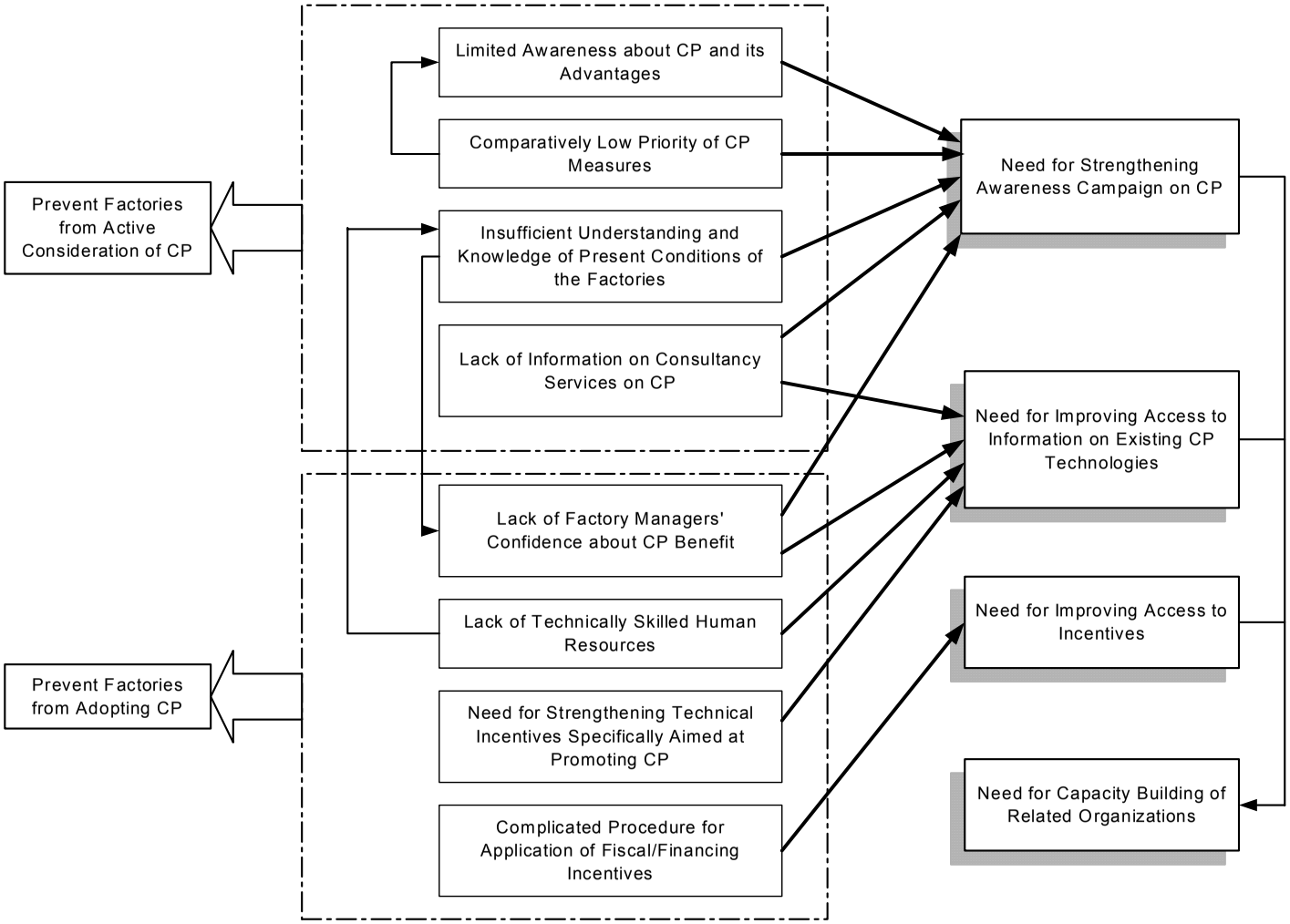


Figure -1 Relation between Issues of SMIs and CP Promotion Measures

In this Study, measures for promotion of CP mainly in SMIs have been studied and are proposed on the following basis:
It is expected that large industries can implement CP measures by themselves, and
It is expected that large industries can comply with the environmental regulations through command-and-control .
Followings are the set of measures proposed:

i) Development of National Strategy/Policy on CP
ii) Awareness Campaign, Networking and Dissemination of Information
- Demonstration programme
- Campaign on Benefit of CP and Incentives
- Industrial Association and NGO
- CP National Roundtable
iii) Access to CP Technology/Service
- Training Programme for Corporate Manager, Engineer and Operator
- CP Audit
- Training Programme for CP Auditor
- Certifying CP Auditor
- Registration of CP Auditor
- ESCO (Energy Service Company)
iv) Incentives
- Improve SMI Access to Incentives
- Promote CP Investments through MIDA Incentives
- Improve Access to and the operation of the Existing Financing Schemes
- Award System
v) Strengthening the Regulatory-policy Framework
- Wider Application of Contravention Licenses
- Self-environmental Auditing/Monitoring
- Self Disclosure
- Energy Efficiency Regulation
- Economic instruments
vi) Capacity Building

4. Summary of Proposed Action Plan for CP Promotion

Chapter 4 in the Report presents action plans for CP promotion, which are comprised of formulating the national policy/strategy, awareness raising in enterprises, improvement of access to technology/services, strengthening the regulatory policy framework, and

capacity building of related organisations. The following summarises actions to be taken by each institution.

(1) Economic Planning Unit（EPU）

(i) Take an initiative to formulate the national CP strategy/policy on a short-term basis; and

(ii) Work out and secure a new funding system for promoting CP demonstration programmes.

(2) Ministry of Science, Technology and Environment（MOSTE）

(i) Participate in the activities lead by EPU for formulating the national CP strategy/policy;

(ii) Institutionalise regulations related to the self environmental-monitoring and reporting system, and the system of accreditation and registration of CP auditors; and

(iii) Work out and secure a new funding system for promoting CP demonstration programmes; and

(3) SIRIM Berhad

(i) Participate in the activities lead by EPU for formulating the national CP strategy/policy;

(ii) Campaign for the scheme of CP audits and CP demonstration prgrammes, and for the system of accreditation and registration of CP auditors;

(iii) Conduct CP audits and CP demonstration projects as a main implementing agency;

(iv) Establish and strengthen the CP network with industrial associations by creating CP forum etc.;

(v) Conduct planning and coordination activities regarding preparation of a consistent system for CP training programme, prepare and implement training programmes for enterprises and CP auditors; and

(vi) Establish and activate the National CP Centre.

(4) Department of Environment（DOE）

(i) Participate in the activities lead by EPU for formulating the national CP strategy/policy;

(ii) Prepare guidelines for environmental auditing, monitoring and reporting system and conduct training for enterprises;

(iii) Collect, evaluate and analyse basic data from enterprises based on the

environmental monitoring and reporting system and set up benchmarks in collaboration with MITI;

(iv) Campaign for the scheme of CP audits and CP demonstration programmes;

(v) Create an Environmental Manager System and introduce a certification and examination system for Environmental Managers;

(vi) Conduct training for enterprises and environmental consultants on the Environmental Manager System;

(vii) Establish a Pollution Prevention Partnership (P3) committee;

(viii) Conduct campaigns for the accreditation and registration system for CP auditors and accreditation and registration of CP auditors based on a state exam; and

(ix) Create and implement a CP promotion award system.

(5) Ministry of Finance（MOF）

(i) Participate in the activities lead by EPU for formulating the national CP strategy/policy from the point of view of tax incentives.

(6) Ministry of International Trade and Industry（MITI）

(i) Participate in the activities lead by EPU for formulating the national CP strategy/policy; and

(ii) Set up benchmarks in collaboration with DOE,

(7) Ministry of Housing and Local Government（MHLG）

(i) Participate in the activities lead by EPU for formulating the national CP strategy/policy from the point of view of waste recycling;

(ii) Include a provision of efficient recycling of waste in the draft of Solid Waste Act; and

(iii) Set up a clear target for waste recycling.

(8) Malaysia Industrial Development Authority (MIDA)

(i) Participate in the activities lead by EPU for formulating the national CP strategy/policy from the point of view of industrial development promotion;

(ii) Clarify and add new descriptions indicating that the existing MIDA tax incentives are applicable to environmental and CP investment in the brochure;

(iii) Provide easy access for SMIs to MIDA and assist SMIs in completing procedures and forms to apply for tax incentives;

(iv) Conduct training for MIDA officers on CP implementation in order to

support SMIs; and

(v) Create incentives for energy conservation promotion.

(9) SMIDEC

(i) Participate in the activities lead by EPU for formulating the national CP strategy/policy from the point of view of SMI development programme;

(ii) Conduct CP training programmes for financing organisations;

(iii) Conduct campaign for incentives for CP audits;

(iv) Improve access to incentives by preparing a brochure on the existing ITAF and factory audit scheme applicable to CP implementation and shortening the application procedure for such incentives; and

(v) Conduct training for SMIDEC officers on CP implementation in order to support SMIs.

(10) MECM

(i) Gazette the regulations for energy efficient use.

(11) Energy Commission

(i) Participate in the activities lead by EPU for formulating the national CP strategy/policy from the point of view of promoting energy efficiency improvement;

(ii) Manage enforcement of regulations for energy efficient use and the energy manager system; and

(iii) Prepare standards and guidelines for energy conservation and promote the implementation of energy audits on a mid- and long-term basis.

(12) Financing Organisations

(i) Provide easy access to financing schemes for SMIs' CP investment by clarifying applicable schemes among various schemes and conduct campaigns for CP financing; and

(ii) Conduct training for bankers to strengthen awareness on environmental issues and CP.

(13) Other Organisations

(i) Industrial Associations and NGOs are to cooperate with SIRIM and DOE in establishing a CP information network;

(ii) Industrial Associations, NPC, FMM and/or NGOs are to cooperate with SIRIM in preparing and conducting CP training programmes;

(iii) Industrial Associations are to cooperate with SIRIM, DOE and other organisations in disseminating CP information ; and

(iv) Industrial Associations are to cooperate with DOE in conducting the CP promotion award system.

CONTENTS

Table List

Figure List

CHAPTER 1

BACKGROUND AND OBJECTIVES OF THE STUDY

CHAPTER 1 BACKGROUND AND OBJECTIVE OF THE STUDY

(1) Background to the Study

The average GDP growth rate in Malaysia has been 7-8 % during the 10 years until 1997 and the economy is on recovery from Asian economic crisis. Foreign investment in the industrial sector has increased, particularly after the deregulation in 1986 on foreign investments for export-oriented projects. In addition, Malaysia is aggressively promoting economic and industrial development, with the aim of becoming a fully-developed nation by the year 2020. However, economic development has been accompanied by a big social problem of industrial pollution such as air and water pollution, caused by exhaust gas, wastewater and other waste from factories.

Whereas End-of-Pipe (EOP) technology, which has been conventionally utilised in pollution prevention, treats pollutants by using treatment facilities at the final stage of production, CP technology provides an improvement in productivity as well as the reduction of pollutants discharged, through the improvement of the production process itself. Such a win-win approach can give factories the incentive to adopt CP as an industrial pollution prevention measure. The Government of Malaysia (GOM) is aiming to promote production technologies that bring about less environmental impact, and stated "the promotion of Cleaner Technology" in the environmental control section of the Seventh Malaysia Plan (1996-2000.)

Under these circumstances, this Study on Promotion of Cleaner Production in the Industrial Sector has been executed.

(2) Objective of the Study

The objective of the Study is to contribute towards the abatement of industrial pollution in Malaysia by:

i. Promoting CP through capacity building of SIRIM and other related institutions and human resources; and
ii. Making recommendations and an action plan for CP promotion.

(3) Scope of the Study

The Study covers the following:

i. Review of present situation of industrial pollution control;

ii. Analysis of industrial pollution in the targeted sub-sectors;
iii. Survey for representative factories;
iv. Pilot activities for the promotion of CP;
    (a) Demonstration projects at model factories;
    (b) Dissemination of CP information
v. Comparative analysis on CP promotion measures;
vi. Recommendations on measures and action plans for the promotion of CP and industrial pollution control.

CHAPTER 2

PRESENT STATUS AND ISSUES

CHAPTER 2 PRESENT STATUS AND ISSUES

2.1 Cleaner Production (CP) in Malaysia

(1) CP Promotion Activities

(i) Background

Cleaner Production (CP), as a win-win approach that brings profit to both enterprises and government, has many advantages over End-of-Pipe technologies in aiming at industrial pollution prevention, especially in developing countries. While CP brings cost reduction and profit increase for enterprises through productivity improvement, improvement of public image as enterprises responsible for environment, better access to special funds, decrease of business risk by resulting strengthened regulations, and improved competitiveness in the international market, it also helps to reduce monitoring costs for the government.

In Malaysia continuous efforts undertaken by governmental and non-governmental organisations raised public awareness of the environmental issues and the recent rise of prices of city water supply and fuel oil has prompted factories to reduce utility consumption; thus, cost effective measures for environmental protection have become the object of enterprises' attention.

(ii) CP in Development Plan

In Malaysia environmental programmes specifically related to Cleaner Production (CP) or waste minimisation were limited before the Sixth Malaysia Plan (1991-1995). Until then, environmental programmes were mainly based on the 'command and control' approach.

In the Eighth Malaysia Plan, environmental issues are addressed from various aspects including energy efficiency, resource conservation, cleaner technology and industrial waste.

The Second Industrial Master Plan (IMP2: 1996-2005) raises the main issue of enhancing competitiveness through industry cluster development by deepening and broadening industrial linkages and enhancing productivity. The IMP2 mentions that SMIs are the critical and strategic link to develop and strengthen cluster formation and increase domestic spin-offs and value added products and services. It also states that "Environmental concerns will continue to be emphasised in all future projects"/

Thus, in addition to conventional environmental pollution control, CP has emerged as an increasingly important and economically viable option that is acceptable to SMIs.

(iii) Activities of Relevant Organisations for CP Promotion

- SIRIM Berhad (SIRIM) established the Environmental and Energy Technology Centre (EETC) and is undertaking a Cleaner Technology Extension Service (CTES) and a Cleaner Technology Information Service (CTIS). In cooperation with relevant agencies and organisations, the EETC is conducting actively Cleaner Technology factory audits, holding workshops and seminars on CP, conducting SIRIM-DANCED Cleaner Technology Project and SIRIM-JICA Development Study on Promotion of CP in the Industrial Sector, establishing waste database, and publishing a newsletter "Cleaner Technology".
- As the leading agency in industrial pollution abatement and control, the Department of Environment (DOE) is undertaking programmes such as awareness campaign seminar/workshops, the study on CP implementation, training of DOE officers, the publication of CP handbooks, the Malaysian Agenda for Waste Reduction (MAWAR) and Environmental Auditor registration.
- The National Productivity Corporation (NPC) is conducting seminars, conferences and training related to productivity improvement in the industrial sector and is making an effort to bring Green Productivity consultancy and training activities into Malaysia.

  In addition to NPC, the National Institute of Administration (INTAN) also conducts courses and training related to productivity improvement normally designed for the government agencies and selected industrial companies.
- The Ministry of Housing and Local Government (MHLG) is undertaking programmes related to waste reduction, reuse and recycling for municipal wastes. The First and Second National Recycling Programmes started in 1996 and December 2001 respectively.
- The SMI Association of Malaysia held the first SMI One Stop Solution 2000 in July 2000 and has already carried out 3 road shows to promote CP to its members in 2001. Formed as a non-profit, membership organisation, the Environmental Management & Research Association of Malaysia (ENSEARCH) is conducting various activities to promote and increase environmental awareness and to provide training on available environmental management methodologies and technologies.
- The Federation of Malaysian Manufacturers (FMM) is conducting a Waste Exchange Registry Campaign to recycle waste materials by connecting waste generators with

waste “re-users”.

- In the energy area, the government aims to decrease power consumption by up to 10% and reduce the impact of using non-renewable energy sources on the environment by introducing the Energy Efficiency Regulation.

  The Malaysian Energy Center (MEC), established in 1998 under the Ministry of Energy, Communication and Multimedia (MECM), undertakes energy-related research and development, and energy audit services.
- The ISO14001 series of standards for Environmental Management System (EMS) has attracted significant attention from industries. The number of companies certified for ISO14001 in Malaysia increased steadily and reached 188 as of May 2001.

(2) Present Status of CP in Industries

(i) Findings from SIRIM-JICA Study

No specific CP measures were implemented at the other 16 of 20 factories audited, although a few exceptional cases were found among the 20 companies audited in the Study. The present situation of production management or productivity improvement activities at the 20 companies audited can be summarised as follows:

- In general, factory managers have strong intentions to reduce production costs; however, they are not certain about what to do because real problematic issues to be solved are hidden or not clear to them. This is mainly due to insufficient knowledge and understanding about the present and actual condition of production processes, including process data.
- Awareness about utility costs was raised by the increase in the prices of city water and fuel oil.

(ii) Findings from DANCED project

The status of CP in Malaysia during the phase 1 SIRIM-DANCED project, which started in 1996, is summarised as follows:

- Awareness about CT among industries was quite low;
- Resources such as water and electricity were not efficiently utilised; and
- SMIs were not interested in improvement by automation, because labour cost was low.

Afterwards, SIRIM conducted CT promotion activities and it was recognised in the workshops held in 2001 that awareness about CT was higher than the initial stage of the project. The phase 2 SIRIM-DANCED project, which started in 2000, expanded its

targeted area to the East Malaysia. The status in the East Malaysia is similar to the phase 1 SIRIM-DANCED and awareness about CT is very low.

(iii) CP Demonstration Projects

It was reported that six demonstration projects were conducted during the first phase SIRIM-DANCED project for the Promotion of Cleaner Technology in Malaysian Industry. In the SIRIM-JICA project, four demonstration projects are being conducted as listed in Table S-1.

It is worth noting that all the projects mentioned above have been successfully implemented and have realised their expected benefits. Accordingly, it is expected that by adopting CP, Malaysian Industry and SMIs in particular, have potential for improvement in productivity and reduction in environmental pollution load.

Table S-1 Summary of SIRIM-JICA CP Demonstration Projects

Sector	Company	CP Option	Investment	Expected Benefit
Electro-plating	Metal Polishing Industries Sdn. Bhd.	(1) Water conservation by controlling the city water inlet pressure (2) Rinsing water recovery and reuse (3) Filtering systems on Cr tanks	RM216,120	1) Cost savings ・ Water RM3,000 ・ Wastewater RM24,000 ・ Manpower RM53,000 ・ Increased operation cost: RM11,000 2) Product quality improvement 3) Reduction of wastewater volume by 70% 4) Improvement of productivity by 5%
Metal Finishing	Perusahaan TGB Sdn. Bhd.	(1) Electrical energy conservation by improving the electrical system (2) Wastewater reuse	RM400,281	1) Cost savings ・ Electricity RM105,000 ・ Water RM7,000 2) Product quality improvement 3) Reduction of wastewater volume by 20% 4) Improvement of productivity by 20%
Food	Winner Food Industries Sdn. Bhd.	(1) Water conservation by introducing a new rice washing machine (2) Effective cooling system for the noodle cooling unit (3) Sanitary treatment and softening of underground water for process and boiler use	RM270,000	1) Cost savings ・ Water RM11,000 2) Reduction of required WWTP size
Textile	South Asia Textiles (M) Sdn. Bhd.	(1) Wastewater quality improvement for recycling for process use	RM305,000	1) Cost Savings ・ Water RM110,000 2) Reduction of wastewater volume by 40%

(3) Issues

So far, promotion of CP in Malaysia has shown limited progress.
Many factors still limit the application of CP, especially in SMIs. Four steps of barriers should be cleared before CP is implemented in industries; i.e. intention to introduce CP, capability of working out CP measures, confidence in CP benefits, and financing.

(i) Obstacles for being less Active to Introduce CP

- **Limited Awareness about CP and its Advantages over Pollution Control**

In many cases SMI owners are confident of their technologies that were inherited from their predecessors and are still considerably profitable to operate. Thus, they are reluctant to recognise the potential benefits of new technologies including those called CP, especially in cases where their introduction requires large investment.

- **Comparatively Low Priority of CP Measures**

CP measures are often seen as a low priority in SMIs because the highest priority in SMIs is to survive. As a single decision-maker, as is usually the case with a SMI, the factory manager has to work out measures to solve issues the factory is confronted with, and thus tends to be sales-oriented and reluctant to change existing facilities.

- **Insufficient Understanding of Present Conditions of the Factories**

In many SMI factories, the present conditions are not sufficiently known nor understood by managers; i.e. basic data are not collected and analyzed. Therefore, an essential issue may be hidden under the daily problems the factory managers are facing, until a really serious problem occurs.

- **Insufficient Maintenance of Production Equipment**

Maintenance of equipment in SMI factories tends to be insufficient; accordingly, issues caused by insufficient maintenance may necessitate immediate attention and sidetrack consideration of CP measures.

- **Free or Cheap Pricing of Resources**

The charge of water supply is in the level of half of operational and maintenance cost. The recent rise in the price of city water and fuel oil had a certain impact on companies' consideration of adopting CP measures for reducing the consumption of city water and

fuel oil.
On the other hand, there is no encouragement for factories to introduce measures for reducing the consumption of underground water, which still remains substantially free.

- **Lack of Access to Information on Existing CP Technologies**

It is difficult to encourage factory owners to consider the introduction of CP unless they are provided with easier access to information on CP measures that can be practically adopted in their factory and that meet their unique industrial needs. Thus, the final solution is to provide information based on an actual audit conducted on their factory.

(ii) Obstacles to Working Out CP Measures

In general, most SMIs are not capable of working out CP measures by themselves.

- **Lack of Technically Skilled Human Resources**

It is difficult for staff in most SMIs to develop their capability to work out CP measures, because they have no opportunities to experience actual practices to reduce losses by reducing process input or to minimise waste by reutilising non-product output because factories are not aware of such CP measures.
They need information and advice on practical CP measures from outsiders.

- **Lack of Consultancy Services on CP**

Due to the lack of internal capabilities, SMIs unavoidably depend on outside consultants for working out CP measures; however, there are a limited number of consultants at present.

(iii) Obstacles to Confidence of CP Measures

A large barrier against the adoption of CP is the reluctance of managers to take risks with new technologies, because they are skeptical of the benefits or technological soundness of CP measures.

(iv) Obstacles to Financing

The final barrier is financing. If a company cannot afford to provide its own funds, it can apply for external funds such as loans; however, the current system has a number of problematic issues, which impede financing for SMIs.

(v) Others

In order to solve the issues impeding CP promotion as mentioned above, various measures can be taken, while at the same time fulfilling the continuous need to build the capacity of related organisations.

2.2 Present Status of environmental Regulations

(1) Environmental Regulations

(i) Environmental Quality Act, 1974 (EQA)

The environment as a contemporary issue began to receive attention in Malaysia in the 1970s when the country embarked on its industrialisation programme. This was followed by the enactment of EQA in 1974. The EQA is considered the most comprehensive legislation on environmental matters in Malaysia. The word 'environment' in the Act is defined as the physical factors of the surroundings of human beings including land, water, atmosphere, climate, sound, odor, taste, the biological factors of animals and plants and the social factor of aesthetics.

(ii) CP and EQA

In the EQA, the terms CP, waste minimisation, recovery, recycling, reuse or reutilisation are not defined nor interpreted. This is quite understandable as the EQA is an enabling Act to prevent, abate and control pollution by regulating emissions, discharges and wastes from source points. However, the part which relates to CP and recycling included in EQA is as follows.

- Environmental audit in Section 33A
- Environmentally hazardous substance in Section 30A
- Deposit and rebate scheme" in Section 30B
- Environmental Fund in Section 36E

The following are systems related to CP and recycling.

- Effluent-related license fee
- Contravention license
- Use of material substitution for banned substances

(iii) Energy Efficiency Regulations

Today, there are no laws or regulations to promote energy efficiency being enforced in Malaysia. When first disseminated for comments, the energy efficiency regulations were known as the proposed Energy Efficiency Regulations 1999 under the Electricity Supply Act 1990. This Act only provides for Electricity Efficiency and not Energy Efficiency. This draft is currently being revised and when it is finalised, it will be then be sent to the

Minister for endorsement.

There are two main parts of the regulation:

- The responsibilities and obligations of specified installations
- The labeling of electrical products.

The proposed regulation is expected to affect about 500 users, mainly the big installations initially.

(2) Present Status of Industrial Pollution

Industrial pollution can be categorised mainly as air pollution, water pollution and waste. The DOE monitors various pollutant levels on a regular basis. In the industrial sector, water pollution from factories appears to be more significant than air pollution. Present status of air and water pollution, and SMIs are described in the followings.

(i) Air Pollution

The total number of stationary air pollution sources identified in 2000 was 14,996. The air emission load for the year 2000 was about 2,271,596 metric tones (mt) of carbon monoxide, 134, 227 mt of hydrocarbons, 349,005 mt of oxides of nitrogen, 374,223 mt of sulphur dioxide and 109,386 mt of particulate matter. Emissions from mobile sources were the most significant contributor to air pollution (81.6%), followed by emissions from stationary sources, such as power stations (8.9%); industrial fuel consumption (6.3%); industrial process (2.0%); domestic fuel consumption (0.3%) and open burning at solid waste dumping sites (0.9%).

(ii) Water Pollution

For the year 2000, a total of 901 water quality stations along 120 rivers were monitored. DOE showed that 34 rivers were categorised as clean, 74 rivers slightly polluted and 12 rivers polluted in 2000. The number of polluted rivers had decreased from 13 in 1999 to 12 in 2000 and the number of slightly polluted rivers had increased from 72 to 74 in the same period. The number of clean rivers had decreased from 35 in 1999 to 34 in 2000. The main sources of river pollution are agro-based industries, manufacturing industries, sewage, earthworks and land clearing activities.

The estimated number of effluent-related sources for the year 2000 was 13,992 comprising mainly of agro-based industries, manufacturing industries, pig farms and sewage treatment plants. The pollution load contributed by these four sectors significantly affects the river water quality in Malaysia. Based on the source inventory compiled in 2000 by DOE, out of the 16 types of manufacturing industries, the main water polluting sources were the food and beverage industry with 1,538 sources

constituting 23.7% in the total number, followed by electric and electronic industry (1738,1.4%), chemical based industry (729,11.2%), paper (571,8.8%), textile (481,7.4%), metal finishing & electroplating (343,5.3%).

(iii)Solid Wastes from Factories

As industrial activities are not directly under the purview of the local authorities, data of solid waste directly discharged from factories is not available to the local authorities, unless the industry is concerned about applying for the disposal of industrial wastes at the local authority's dumping/landfill site

(a) Types of Solid Wastes from Factories

The solid wastes directly discharged from factories are paper, cartons, plastics, bottles, metal scraps (copper, aluminum, tin, zinc and solder etc.), which currently are disposed via licensed vendors at landfill sites or resold to other industrial premises for the purposes of recovery and recycling.

(b) Scrap Vendors

Currently, the local authorities license these scrap vendors under the Licensing By-Laws of the Local Government Act, 1976. Licensed vendors or contractors can dispose at approved landfill sites with permission from local authorities.

(c) Illegal Dumping and Trade

Based on the DOE's records and media coverage pertaining to illegal dumping of waste, such illegal dumping of scheduled wastes has been quite rampant over the years.

(iv)Recovery and Treatment Facilities of Scheduled Waste

(a) Treatment of Scheduled Waste in 2000

Table S-2 shows scheduled wastes treated in 2000

Table S-2 Treatment of Industrial Waste and Clinical Waste (tones)

2000

Treated Waste	Amount Treated	Percent
Kualiti Alam Sdn. Bhd	84,321	24.5
Clinical incinerators	3,781	1.1
Exported for recovery	4,878	1.4
Off-site recovery	120,571	35.0
Kept inside factory premises	130,998	38.0

In spite of the Government's efforts to facilitate treatment and control of disposed industrial wastes by constructing good treatment facilities, there still exists 38.0% in 2000 of untreated waste kept inside factory premises while 35.0% in 2000 of scheduled waste is recycled in off-site recovery plants.

(b) Recovery and Utilisation Facilities

Currently, there are thirty-five (35) off-site waste recovery facilities and five (5) approved facilities licensed by the Department of Environment for the utilisation of wastes. The growth of off-site recovery plants over the past seven years (7 in 1993 and 35 in 2001) indicates that the market demand has grown over the years.

(v) SMIs

The other main contributors to these environmental problems are SMIs that supply goods and services to larger corporations. Based on a 1993 survey of manufacturing industries, SMIs accounted for more than 84% of total manufacturers. SMIs are in the traditional sectors of food & beverages, fabricated metal products, wood and wood products, basic metals, leather, textile and worn apparel. The treatment and disposal methods were generally lacking or poor in SMIs. SMIs are thus seen to be a major source of industrial pollution due to their use of old technologies, and lack of proper waste management and pollution control practices. SMIs face various constraints such as low capital investment, low profit margins, lack of technical know-how and lack of access to modern technologies, low budget operations and inadequate management. All these therefore identify SMIs as the primary targets for adoption of CP.

(vi)Overview of Targeted 4 Sectors and Factories

Considering the severity of the pollution problem and the importance of the industry to the Malaysian economy, four industrial sectors were selected as targeted sub-sectors: metal finishing and electroplating, food, textile and pulp and paper industries, which recorded a low compliance status under the Environment Quality (Sewage and Industrial Effluents) Regulations, 1979. Although the palm oil and raw natural rubber industries mark low compliance rate, these industries were not selected because of insufficient experience in Japan.

In the early stage of the Study, factory audits were conducted at 20 representative factories to identify current issued in the production process and to work out potential measures for improvement through CP application.

Based on the factory audits four factories were selected as CP demonstration model

factories. The demonstration projects consisted of introduction, operation and evaluation of CP equipment at the model factories, and dissemination of information on performance and benefits of CP equipment through demonstration seminars and site visits. All the demonstration projects were successfully completed and their outlines are summarised in Table S-1.

(a) Metal finishing and electroplating industry

Much of the wastes generated from this industry are collected and transported to off-site recovery plants for recycling.

Recycling or recovery of nickel and copper are businesses that are doing very well because of the high prices for these metals. However metal recovery from chromate, zinc and zinc dross is difficult because of the comparatively lower prices of these metals.

(b) Textiles

(Preparation of fabric)

Recycling of fiber wastes is not practical in Malaysia. During production of yarn, fiber wastes are generated but the volume is not large enough to warrant the installation of a recycling unit that recycles the wastes into yarn again. Environmental issues include the discharge of coloring chemicals and spillages in the production processes. However, so far no one is doing any recycling of dye/chemicals in Malaysia.

(Finished products)

Wastes are high in the form of work piece remnants, over purchased stocks, and off-spec products. Some people buy these wastes to do other things like making cheap apparel, rags, blankets and other cloth-related products.

(c) Food and Beverage

A few of the recycling initiatives include the following:

- The use of coconut wastes to make animal feed
- The use of skin and bones from abattoirs to make glue
- The use of prawn shells to make Chitosan for removing fats

(d) Pulp and Paper

Used newspapers, computer printing paper, magazines, and cardboard and cartons are actively being collected for recycling at a number of paper factories.

(vii) Status of compliance with the Sewage and Industrial Effluents Regulations 1997 (SIER)

The Environmental Report 1998 stated that 86% out of 3,889 manufacturing industries inspected under the SIER, complied with the Regulations. Specifically, those industries with low compliance rate were Food and Beverage (72%), Paper (71%), Metal Finishing and Electroplating (65%), Textiles (60%) and Fisheries and Animal Food (50%). Table S-3 shows the compliance rate of the four targeted sectors.

Table S-3 Comparison of Selected Sub-sectors

	% of Compliance	Number of industries
Food & Beverage	72	603
Paper	71	127
Metal Finishing and Electroplating	65	190
Textile	60	176

Source:DOE, Environmental Quality Report (1998)

(3) Issues of Environmental Regulations

Issues of environmental regulations are summarised below.

(i) Issues of CP

Although the EQA has sections related to promotion of CP, they are not actually implemented.

(ii) Issues of Enforcement of Regulation

- Because factories need investment to meet regulation standards, factories need time to prepare design and raise funds. This requires a wider application of contravention licenses for such factories.
- It is observed that regulatory enforcement by DOE needs to be strengthened and the costs of conducting enforcement and the associated site visits are expensive. The allocation of budget is required to solve the issue.
- Although the Electricity Efficiency regulation was drafted, it is not yet enforced. Early enforcement of the regulation is recommended.

(iii) Issues of Pollution Prevention Approach

- The use of economic instruments is limited due to introduction of system for each instrument, while the effectiveness of economic instruments is proven in Malaysia. The government with leadership is expected to introduce instruments.

- Voluntary approach, such as self-environmental auditing/monitoring and self-disclosure by the factories, is not advocated. This approach is very effective for pollution prevention. This approach should be widely adopted to promote pollution prevention activities.

2.3 Incentives

(1) Present Status of Incentives

Incentives currently applicable in Malaysia are shown below.

(i) Tax Incentives For Investment

Tax incentives, both direct and indirect, for the manufacturing, agriculture and tourism sectors are provided in the Promotion of Investments Act 1986, Income Tax Act 1967, Customs Act 1967, Sales Tax Act 1 972 and Excise Act 1976. The direct tax incentives are designed to grant partial or total relief from the payment of income tax for a limited period of time. Indirect tax incentives are given in the form of exemptions from import duty, sales tax and excise duty. Tax incentives for CP investment are not specified in Malaysia. The applicable incentives for CP investment are described hereafter.

- Incentives for the Environmental Protection
  - Incentives for the Storage, Treatment and Disposal of Toxic and Hazardous Wastes
  - Incentives for Energy Conservation
  - Incentives for Waste Recycling Activities
  - Incentive for Utilising Biomass
  - Additional Incentives for Environmental Protection Projects
- Exemption from Import Duty and Sales Tax on Machinery and Equipment
- Incentive for the Use of Environmental Protection Equipment
- Incentives for the Manufacturing Sector
  - Main Incentives for Manufacturing Companies
    - Pioneer Status
    - Investment Tax Allowance (ITA)
  - Additional Incentives for the Manufacturing Sector
    - Reinvestment Allowance (RA)
    - Accelerated Capital Allowance (ACA)
    - Tax Exemption on the Value of Increased Exports

(ii) Grant

Grants specifically designed for CP investment are not provided in Malaysia. There are various kinds of grants for SMIs investments. Among the grant schemes, the Industrial Technical Assistance Fund (ITAF) Scheme and Factory Auditing Fund provided by SMIDEC will be applicable to SMIs' CP. Especially ITAF2 is applicable among ITAFs to improvement and upgrading of existing processes for CP.

(iii) Loans for SMIs

There are many loan schemes providing low interest loan for SMIs. Especially during and after the currency crisis, Government provided more preferential conditions for SMIs, such as the Financial Package for SMIs. The following loans are useful for promotion of CP investments among various finance sources for SMIs.

- Modernisation and Automation Scheme (MAS)
  Purchase of machinery & equipment for modernisation and automation
- Quality Enhancement Scheme (QES)
  Purchase of machinery & equipment for quality enhancement
- Financial Package for SMI (PAKSI)
  Purchase of factory, machinery & consultancy
- Small & Medium Scale Industry Promotion Programme (SMIPP)
  Purchase of fixed assets, machinery & equipment

(iv) Award

There is the prestigious Hibiscus award for environmental issues introduced in 1996. The winner of the award receives a plaque, certificate and the entitlement to use the Hibiscus Logo for publicity purposes.

(2) Issues of Incentives

Though the tax incentives for promotion of CP among tax incentives are available and some soft financing for CP investment is applicable, the bottlenecks are listed below.

- SMIs' lack of awareness of incentives for CP investment
- Difficult access to incentives
  - SMIs lack of knowledge of the procedures to approach such incentives
  - Complicated application forms for accessing incentives
  - Lack of friendly support for SMIs to access incentives
- Lack of clarity on eligibility of incentives
  - CP is not mentioned in the documents on eligibility
  - No indication of ITAF availability for CP promotion
- Difficult access to bank financing and poor operation of existing financing schemes

- Poor support for SMIs to access to bank finance, particularly on the issue of collateral
- Complicated financing scheme
- Lack of bankers' understanding on CP

- Lack of award system for CP promotion

2.4 Potential of Cleaner Production (CP)

(1) Market Assessment of CP

No reports are currently available on the market for CP in Malaysia. According to a limited number of information, the environmental market in Malaysia is estimated at RM1,200 million per annum excluding the market of RM1,100 million for water resources. It should be noted that treatment technology related businesses account for the majority of the estimated market.

According to percent investment in the manufacturing industry in Japan classified by objectives, it is considered that an approximately same level of investment has been made for CP since 1985.

It may be given as a conclusion that the market for CP in Malaysia is estimated at approximately RM1,000 million per annum.

(2) Role and Effectiveness of CP in Industrial Development

As CP has a position as a Win-Win approach, it is expected that CP can play a more important role in industrial development as well as contributing to the environmental protection. CP should bring about benefits to both an implementing enterprise and the whole society.

Benefits that an enterprise can enjoy are summarised as follows:

- Productivity improvement through cost reduction comprised of the following elements:
  - Reduction of treatment cost required for the prevention of air pollution and water pollution through waste minimisation,
  - Cost reduction through improving unit consumption of raw materials, supporting goods and utilities, and/or
  - Reduction of labour cost through improved efficiency.
- Compliance with the environmental regulations.

- Improvement of product quality through optimal operation,
- Improved corporate image, and
- Enhanced business opportunity as an integrated effect of the factors mentioned above.

Accordingly, it is expected that CP contribute to improving the corporate nature of SMIs as a cost effective measure.

On the other hand, CP promotion cannot be conducted autonomously but needs strong leading measures supported by the government. In the case where CP is successfully promoted in Malaysia, not only enterprises but also the society can enjoy benefits, which are summarised as follows:

- Reduction of the environmental pollution burden,
- Preservation of precious resources through decreased consumption of electric power and industrial water,
- Enhancement of industrial linkage through improved production management standard in SMIs,
- Promotion of CP consulting business and CP equipment supply business,
- Improved international competitiveness as an integrated effect of the factors mentioned above.

Thus CP should be strongly promoted as one of the important pillars in industrial development, as it contributes to strengthening industrial structure.

CHAPTER3

PROPOSED MEASURES FOR THE PROMOTION OF CLEANER PRODUCTION

CHAPTER 3 PROPOSED MEASURES FOR THE PROMOTION OF CLEANER PRODUCTION (CP) IN MALAYSIA

3.1 Summary

In this Study, measures for promotion of CP mainly in SMIs have been studied and are proposed on the following basis:

- It is expected that large industries can implement CP measures by themselves,
- It is expected that large industries can comply with the environmental regulations through command-and-control

Following are the set of measures proposed.

i) Development of National Strategy/Policy on CP,
ii) Awareness Campaign, Networking and Dissemination of Information,
iii) Access to CP Technology/Service,
iv) Incentives,
v) Strengthening the Regulatory-policy Framework, and
vi) Capacity Building.

3.2 Development of National Strategy/Policy

The national CP strategy or policy should be formulated to clarify the roadmap and responsibilities of related organisations to promote CP. A proposal of the National CP strategy is shown in ANNEX-4 in the main volume.

(1) Basic Framework of CP Promotion Measures

The overall scheme of strategy/policy for CP promotion is shown in Figure S-1.
Comprehensive methodologies should be worked out for the promotion of CP through (a) Regulatory policy framework on a long-term basis, (b) Incentive measures on a short- or mid-term basis, and (c) Measures for awareness raising, training, and information dissemination that call for activities on a short- term basis.

(2) Target or Benchmark

Sector based targets or benchmarks should be set up to provide industries with productivity improvement indices. Benchmarking is to be conducted based on industries' self-disclosure of basic data on the amount of input of raw materials and utilities, and output of products and waste.

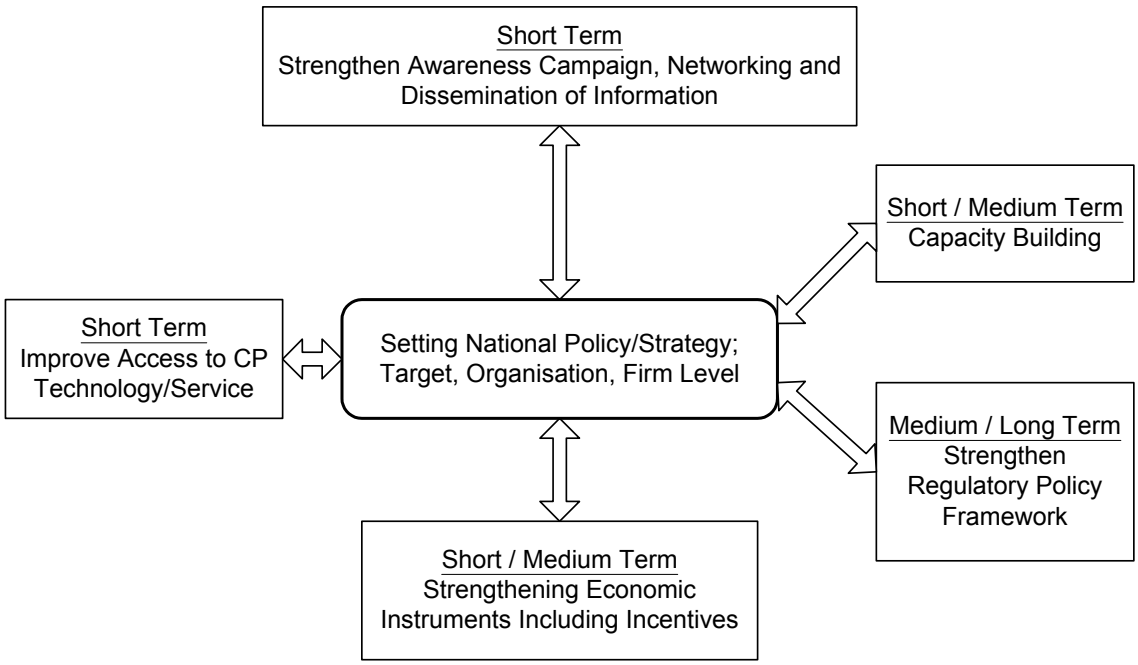


Figure S-1 Concept of Strategy/ Policy for CP Promotion

(3) Organisational Structuring

It is proposed to set up a National Focal point as a main driving body and coordinating agency at the policy level. In addition, it is proposed that a National CP Centre be created at the operational level for promotion of CP.

3.3 Awareness Campaign, Networking and Dissemination of Information

It is desirable that relevant organisations continue efforts to raise corporate awareness about CP or waste minimisation.

(1) Demonstration Programme

As one of the most effective measures that have an impact on corporate managers, a demonstration programme composed of a study tour to the demonstration model factory and a seminar to disseminate the results of the demonstration programme can play an effective role in an awareness campaign and should be stepped up continuously.

Funding is necessary in order to implement more demonstration projects. A funding scheme for demonstration projects should be worked out including those created through international cooperation.

(2) Campaign on Benefits of CP and Incentives

In order to raise corporate awareness about CP, which is generally limited, continuous efforts are needed by the various organisations concerned.
It is considerably effective to campaign on the benefits of good housekeeping practices as a cheap and fundamental basis for CP implementation. It should also be emphasised that losses in the production processes can be reduced to a certain extent through basic data collection and daily meticulous control of losses thus identified.
SMIDEC could provide information on incentives that should be available to assist SMIs with implementation of CP measures.

(3) Industrial Associations and NGO

Industrial associations can play a leading role in networking and disseminating CP information. In order to make full use of the function of industrial associations with regard to CP information dissemination, it is advisable that materials on CP case studies, incentives, and/or sector-based benchmarks be prepared and distributed through the respective networks.

Activities by NGOs are playing increasingly important roles for networking engineers in the industrial sector or consulting business. NGOs should enhance their networking activities especially through including industries.
It is proposed that SIRIM consider collabourating with NGOs in disseminating CP information through seminars/workshops.

(4) CP National Round Table

As one of the most effective occasions that appeal to wider people, establishing a CP National Round Table should be studied.

3.4 Access to CP Technology/Services

It is desired that various measures be implemented to provide industries with improved access to CP technology and services.

(1) Training

A range of training programmes should be developed addressing industries, CP auditors, and/or financing organisations.

(i) Training Programme for Industries

- Training Programme for Corporate Managers: should aim at convincing them of the benefits of CP by focusing on the presentation of successful demonstration projects.
- Training Programme for Engineers: should focus on basic technology related to productivity improvement, such as concept of CP, concept of unit consumption and material balance, benchmarking, standardisation procedures, and leadership role in QCC or small group activities.
- Training Programme for Operators: should cover concept of CP, good house keeping, e.g. 5S movement as a cost-effective CP measure, and Significance of basic data collection based on the concept of unit consumption.

(ii) Training Programme for CP Auditor

In order to develop CP auditors that can provide SMIs with CP consultancy services based on factory audits, it is proposed that a training programme for CP auditors be developed to include environmental laws and regulations, incentives for CP, concept of CP and end-of-pipe technology, case studies on successful CP projects, CP audit procedure, points for audit, and reporting.

(iii) Training Programme for Financing Organisations

In order for financing organisations to select appropriate CP projects and reject inadequate projects, it is necessary to provide them with CP training comprised of concept and benefits of CP, and typical CP investments.

(2) CP Audit

Incentives for CP audit such as incentives available under the existing SMIDEC matching grant scheme for factory auditing should be prepared and disseminated

(i) CP Audit Services

As the first step of considering CP, factories may contact a single window agency, which can furnish the factories with CP audit services that are cheap or practically free of charge.

(ii) Accrediting CP Auditor

In order to foster competent CP auditors or consultants, it is proposed that a system for accrediting CP auditors be created.

(iii) Registration of CP Auditor

In order to cope with an increasing number of requirements for CP audits, it is necessary to mobilise a large number of CP auditors.
It is suggested that a system of registering CP auditors be set up aiming at providing industries with high quality consultancy services in CP promotion.

(iv) ESCO (Energy Service Company)

It is expected that ESCOs be made use of for the promotion of CP in cases where the targeted factory has a clear goal for energy conservation. For that purpose, SMIDEC and SIRIM should recognise ESCOs as an integrated part of the CP- related technical service system.

3.5 Incentives

Regulations and incentives are basic two elements of CP promotion. Followings are incentive measures for the promotion of CP.

(1) Improve SMIs Access to SMIDEC Incentives

SMIDEC has incentives named ITAF, which is a grant scheme for consultancy services for promotion and rehabilitation of SMIs. Especially, ITAF2 is suitable for the application to CP promotion. Many SMIs simply lack of knowledge and/or awareness of incentives for CP investment. The measures to improve SMIs access to incentives for CP investment include promotion of incentive awareness campaigns through SMIDEC, MIDA, industrial associations, and financing firms using pamphlets, brochures and posters.
It is recommended that SMIDEC specify the inclusion of CP audits and investment into ITAF matching grants schemes. In addition, it is observed that the application forms to apply for incentives are slightly complicated and it tends to take long period for examination and judgment of application for them. These should be improved.

(2) Promote CP Investment by MIDA Incentives

It is important to make existing direct and indirect tax incentives more effective, as opposed to creating new incentives.

(i) Promotion of access to MIDA incentives

The followings are recommendations for SMIs to access MIDA incentives for CP promotion.

- MIDA together with SMIDEC should prepare a brochure on fiscal incentives for CP for inclusion into basic information booklets.

- Application forms for incentives for CP should be reviewed, studied and simplified where possible.
- The officials concerned should be trained to assist SMIs in completing these forms.
- The officials concerned should be trained to assist SMIs in obtaining fiscal incentives for CP investments.

(ii) Clarify the applicability of existing incentives to invest in CP

It is preferable to clarify the applicability of existing incentives to invest in CP. In order for fiscal incentives to attract investors, the enforcement of existing environmental regulations, and the registration system for taxes should be strengthened.

(iii) Inclusion of water project to MIDA incentives

In CP, the reduction of water consumption is an important issue. Therefore, MIDA incentives should be applicable to the investment which affects the reduction or the reuse of water. In addition, it should be specified in the brochures that MIDA incentives are applied to the project related to the reduction or reuse of water.

(3) Improve SMIs access to Bank Financing and Operation of the Existing Loan Schemes

It is important for CP investors to ensure easy and adequate access to institutional finances as opposed to creating new financing schemes. Bottlenecks in financing SMIs investments, including those for CP, are observed in the operation of existing loan schemes. The following are recommendations to promote CP investment by improving SMIs access to bank financing and improve the operation of the existing loan schemes:

- Provide adequate consultation for access to bank financing and help for SMIs in presenting their investment proposals to banks,
- Easy access to finance schemes for SMIs investment among various schemes,
- Raise bank credit officers' awareness of CP, and
- Support banks evaluation of CP projects properly

(4) Award System

To increase business interest in CP, awards could be given to individual engineers groups of employees or entities, which have achieved excellent results in promoting CP. It is considered necessary for government to publicly commend enterprises or individuals that have achieved excellent results in CP and that have made constant efforts in

implementing CP. Candidates for awards could also include manufacturers who have developed and used highly effective CP equipment during the year. This system will greatly boost the morale of people who have engaged in CP implementation.

3.6 Strengthen the Regulatory-policy Framework

(1) Wider Application of Contravention License

A contravention license is a license to pollute beyond the limits permitted by the provisions of the EQA. Contravention licenses are issued when there is an absence of technology to dispose waste efficiently and an effluent-related fee is charged for the license.

As SMIs especially need time to make their process comply with the effluent standards, application of contravention licenses is a good method for industry to pay attention to process improvement; i.e. CP rather than end-of-pipe approach as a quick solution. The wider application of contravention licenses is thus useful to promote CP – especially for SMIs.

(2) Environmental Audit and Environmental Manager

(i) Self-Environmental Audit

Environmental audits may be required and the results of audits should be submitted to the Government as described in EQA Section 33A. DOE enforcement officers visit factories to obtain samples of the discharges and emissions, to analyze for compliance, and to pursue operations effectiveness. This activity needs much manpower and budget to monitor a large number of SMIs. To reduce these requirements, environmental audits should be introduced aiming at more efficient enforcement and compliance to the law with wider application and modification.

(ii) Introduction of Environmental Manager System

It is important for a factory to have a designated environmental manager and to enable these managers to play a key role in promoting CP. The environmental manager is expected to fulfill the following roles.

(a) To investigate potential reduction of material and utility consumption and waste generation in the company and to examine the causes of the inefficiencies, and

(b) To investigate complaints by the owner or management relating to the efficient use of equipment;

In order to maintain and/or improve the quality of the environmental manager system, a certification system for the environmental managers and organising them are important.

(3) Promotion of Energy Efficiency

CP includes the concept of efficient use of energy. The regulations were drafted 6 years ago under the Electricity Supply Act and were not enacted. Regulations should be gazetted as soon as possible. The draft consists of: energy managed entities system, qualification system for energy managers, energy auditing, monitoring, reporting system for electricity control and recording, and standards for electrical appliances with a labeling system and for products using electricity. It is preferable to promote efficient energy use by the following schedule.

- Early gazettement of regulations,
- Expansion of scope of regulations to regulate fuels,
- Preparation of standards and guidelines for promotion of energy efficiency, and
- Wider application of regulations to other sector

(4) Economic Instruments

Economic instruments make the act of discharging pollution more costly offering an effective approach to environmental protection. The areas for which economic instruments can be applied include water pollution, water supply, air pollution, solid waste and scheduled waste. Among them water related economic instruments are considered to be appropriate for CP promotion to the industrial sector.

(i) EPU study on Economic Approaches to Sustainable Development (2000-2003)

EPU embarked on a three-year project to develop demonstration projects using economic approaches to achieve sustainable development. That project started in the second half of year 2000 and is due to run till mid-2003.

The demonstration projects that started early January 2001 are in various stages. The objectives of the projects are:

- To demonstrate the usefulness of economic instruments, and
- How to transform a carefully planned and designed proposal to introduce an economic approach into official government policy.

The demonstration projects are:

(a) To improve the safe and proper use of pesticides,
(b) A deposit refund system for pesticide containers,
(c) Management of lubricant waste oil,
(d) Local waste management and recycling project for Tioman Island, and
(e) The collection and treatment of used tires in Sarawak

It is obviously important that the Government adopts economic approaches as an important measure to improve environment based on these results of the study.

(ii) Promotion of Green Procurement

The government as well as private enterprises could implement green procurement. Such a policy will help stimulate suppliers and manufacturers to move towards more environmentally friendly products and services. A green procurement policy could greatly stimulate overall consumption patterns in the country.

(iii) Others

(a) Establishment of Environment Fund

Though an Environmental Fund is not presently in place, activation of such a fund would be useful to promote CP in the future. Provisions for setting up the fund is already stated in Sections 36B to 36 E of EQA.

(b) Promotion of Emission Trading for BOD

To get the 'market' to manage the environment is a strategy for reducing pollution.

(5) Solid Waste Management Act

The proposed Solid Waste Management Act should incorporate provisions for promoting waste recycling practices. The Act should serve as a guideline for those involved in waste management and provide encouragement for the public to minimise waste generation. With the implementation of this Act, some incentives can be incorporated for the public to recycle usable wastes.

(6) Environmentally Hazardous Substance

The EQA prescribes which environmentally hazardous substances are required to be reduced, recycled, recovered or regulated. Such prescribed products shall contain a

minimum percentage of recycled substances and include declaration of their recycled constituents, method of manufacture and disposal. Also the EQA specifies rules on the use of the label in connection with the sale of the environmentally friendly substance or product.

(7) Voluntary Approach

CP is promoted by strongly applying the voluntary approach described below.

(i) Environment Management System

Introduction of the ISO 14000 Series is expected to bring enhancement of environment management and production control, while possibly providing financial benefits and boosting international competitiveness.

(ii) Publishing Environmental Performance Data/Environment Performance Evaluation (EPE)

Making public the company's environmental commitment and performance data provides transparency on the company's activities. Corporate environmental reports that are published on a regular basis by some big companies, not only serve to inform the general public but also provide the possibility of benchmarking on environmental improvement.

(iii) Wider Application of Voluntary Agreements

This is a measure where the Government enters into negotiations or agreements with associations or firms to reduce or prevent pollution or to reduce waste in production processes and/or products. This is one suitable approach that could be taken, as the DOE has had a similar experience with the palm oil and rubber industries in the 1980s.

3.7 Role of Related Organisations

Table S-4 shows the role of each organisation in CP promotion and implementation.

Table S-4 (1) Role of Organization Related to CP Promotion (1)

◎: Main body ○: Cooperative body Time Frame S: Short-term M: Mid-term L: Long-term

Measures for CP Promotion	Related Activities	EPU	MOSTE	SIRIM	DOE	MITI	MIDA	SMIDEC	NPC	MECM	Energy Commission	Energy Centre	CP Consultant	Industries	Ind Associations	NGOs	Banker	Time Frame
National Strategy/policy	(1) Formulate a National Strategy/policy	◎	◎		○													S
	(2) Set up Benchmarks		◎	○	○	○												S/M
Awareness Campaign, Networking and Dissemination of Information	(1) Demonstration Programmes	◎		◎				◎					○	○				S/M
	(2) Campaign on CP Benefit and Incentives			◎	○			○							○	○		S
	(3) Networking			◎											◎	◎		S
	(4) CP National Roundtable			◎												○		S
Access to Technology/Services	(1) Training			◎			○	◎	◎					◎	◎	◎		S/M
	(2) CP Audit			◎				◎					◎					S/M
	(3) ESCO			○				○				◎						S/M

Table S-4 (2) Role of Organization Related to CP Promotion (2)

◎: Main body ○: Cooperative body Time Frame S: Short-term M: Mid-term L: Long-term

Measures for CP Promotion	Related Activities	EPU	MOSTE	SIRIM	DOE	MITI	MIDA	SMIDEC	NPC	MECM	Energy Commission	M Energy Centre	CP Consultants	Industries	Ind Associations	NGOs	Bankers	Time Frame
Incentives	(1) Improve SMIs Access to SMIDEC Incentives			○				◎							○			S/M
	(2) Promote CP Investment by MIDA Incentives						◎	◎							○			M
	(3) Improve SMIs Access to Bank Financing and Operation of the Existing Loan Schemes							◎							○		○	M
	(4) Award System		◎		○													S/M
Strengthen Regulatory-policy Framework	(1) Wider Application of Contravention License		◎		◎													S/M
	(2) Environmental Audit and Environmental Manager	○	○	○	◎								○	◎				S/M
	(3) Energy Efficiency Regulation										◎	◎		◎				S/M
	(4) Economic Instruments	◎	◎		○													M/L
	(5) Solid Waste Management Act		◎		◎													S/M
	(6) Environmentally Hazardous Substance		◎		◎													M/L
	(7) Voluntary Approach		◎	○	◎													M/L

3.8 Capacity Building

It is necessary to increase the capacity of the leading organisations for CP promotion.

(1) SIRIM

(i) National CP Centre

In order to facilitate efficient and effective implementation of such integrated measures and to provide industries in general and SMIs in particular with easy access to various services related to CP, it is proposed that the National CP Centre be established. SIRIM should play the central part of the National CP Centre by strengthening its Cleaner Technology Extension Service (CTES) and Cleaner Technology Information Service (CTIS).

(ii) Expertise

It is recommended that SIRIM develop CP audit skills regarding general items that do not go into details of individual processes. As for Specialised skills to audit a production process and work out measures specific to the process, SIRIM could outsource CP auditors through CP auditor registration system or international cooperation expertise

(2) MOSTE/DOE

(i) Strengthening Enforcement Capacity

For the purpose of strengthening the enforcement capacity of DOE officers in environmental auditing, it is advisable that guidance manuals be prepared describing procedures for notification to industries, frequency of environmental auditing and monitoring, follow-up compliance inspection and monitoring, and reporting on findings and corrective actions.

(ii) Pollution Prevention Partnership (P3) Committee

In order to enhance dialogue between the government and the private sector, it is advisable to establish a Pollution Prevention Partnership Committee represented by MOSTE, DOE and other related governmental organisations, SIRIM, industrial associations, and other stakeholders.

(3) SMIDEC

SMIDEC should play an important role as a contact point for SMIs on various incentives and should have appropriate capacity. It is proposed that training of SMIDEC officials be

conducted in order to facilitate a more thorough understanding that CP is a target of the incentives operated by SMIDEC and other financial institutions.

(4) Industrial Associations and NGO

As industrial associations can function more effectively than the government in collecting and disseminating data and information to and from industries, it is proposed that the linkages between the government and industrial associations be strengthened.

SIRIM should also strengthen its linkages with NGOs, which can mobilise the additional engineering resources required.

CHAPTER 4

ACTION PLAN

CHAPTER 4 ACTION PLAN FOR PROMOTION OF CP

4.1 Objectives

In this Chapter, action plans are proposed aiming at promotion of CP strongly supported by government thus encouraging efforts by the private sector.

The objectives of presenting action plans are to:

- Present material that will contribute to assisting the Malaysian side in formulating a CP promotion programme,
- Highlight important measures,
- Clarify which agencies should take actions, and
- Clarify targeted time-frame for each action.

4.2 Principle of Preparing Action Plans

Action plans were prepared by:

(a) Selecting measures from measures proposed in the previous Chapter based on the following criteria:
   - Select important items for formulating a CP programme,
   - Select items that need action on a short and/or mid-term basis, and
   - Eliminate items deemed low priority by the Malaysian side during the course of the Study.

(b) Clarifying organisations responsible for each action element, and

(c) Adding targeted time frame.

Timetable of the Action Plan is illustrated in Figure S-2.

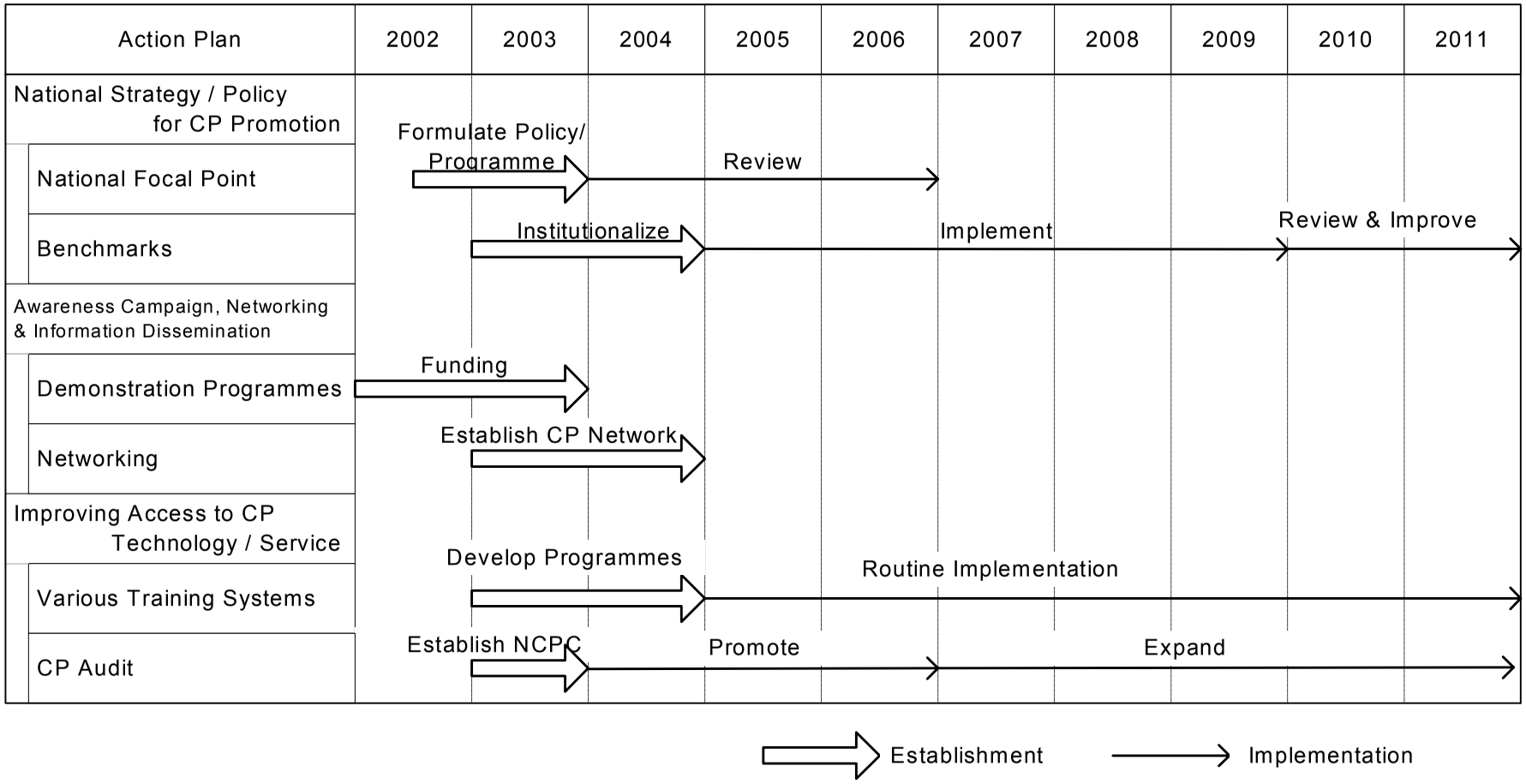


Figure S-2 (1) Action Plan for CP Promotion

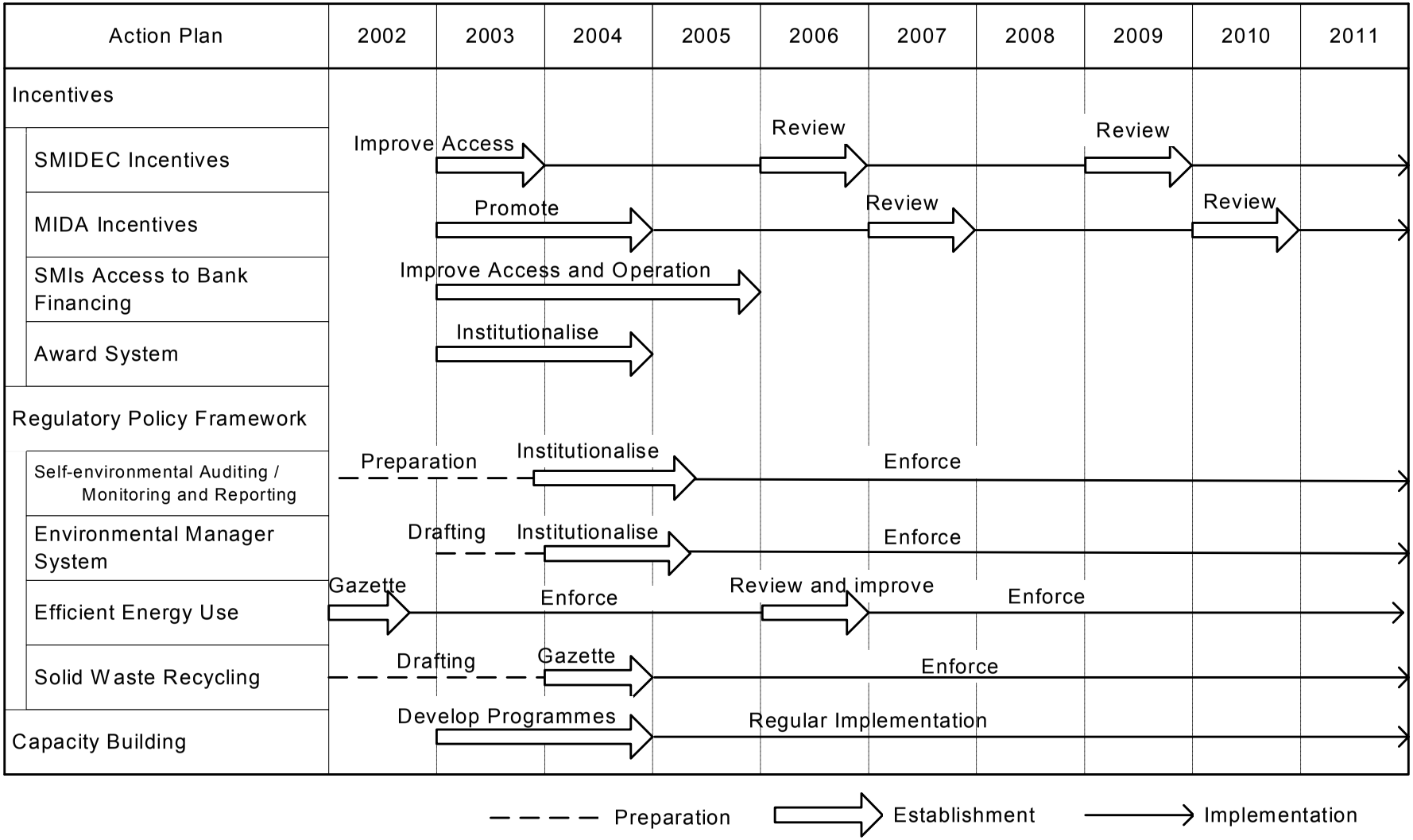


Figure S-2 (2) Action Plan for CP Promotion

4.3 Action Plan and Each Element

(1) Plan for National Strategy/Policy

(a) Element-1: Formulate a National Strategy/Policy

To clarify the roadmap and responsibilities for related organisations to promote CP, and to promote CP in an integrated manner, it is proposed that a national policy/strategy be formulated and incorporate into the Mid-term Review of the Eighth Malaysia Plan. The national policy/strategy is to include the strategy at policy and institutional level, mechanisms and measures for implementing CP, and Institutional set-up.
EPU is to take initiative.

(b) Element-2: Set up Benchmarks

In order to provide industries with productivity improvement indices, and to provide benchmarks as indicators of the National Strategy/Policy, benchmarks should be set up.
The following steps are to be pursued:

- MOSTE is to institutionalise regulations for self-monitoring and reporting systems,
- DOE is to collect basic data through the reporting system. Such basic data should cover the amount of input of raw materials and utilities, and output of products and waste.
- DOE and MITI are jointly to arrange and make public benchmarks in collaboration with SIRIM and/or Industrial Associations.

(2) Plan for Awareness Campaign, Networking and Dissemination of Information

(a) Element-3: Step up CP Demonstration Programmes

To raise corporate managers' awareness about CP, CP demonstration programmes should be stepped up.

- EPU and MOSTE are to prepare a new funding scheme for demonstration projects,
- Campaign for the CP audit scheme,
- SIRIM and DOE are to campaign for the CP audit and demonstration project scheme,
- SIRIM in collaboration with CP consultants is to conduct CP audits and demonstration projects.

(b) Element-4: Enhance CP Networking

In order to enhance the efficiency of awareness raising and information dissemination on CP, it is proposed that SIRIM, DOE, industrial associations and NGOs actively conduct the following:

- Establish a forum on a regular or non-regular basis where industries can freely discuss

with relevant agencies matters related to incentives available for CP adoption, and/or CP technologies and management method,

- Prepare and distribute materials on CP case studies, incentives and sector-based benchmarks through industrial associations, and
- Establish a Pollution Prevention Partnership (P3) Committee comprised of MOSTE, DOE, other related governmental organisations, SIRIM, industrial associations, and other stakeholders. The P3 Committee is to facilitate the exchange of opinions and information among the members on environmental regulations, institutions, incentives and/or CP related topics.

(3) Plan for Improving Access to Technology/Services

(a) Element-5: Provide Various Training Systems

In order to raise the level of technical knowledge on environmental protection and CP, and to improve the service level of consulting businesses and/or financing businesses, it is proposed that a consistent system of training programmes on CP be developed and implemented.

- SIRIM is to be responsible for training programme for industries (corporate managers, engineers and operators) and CP auditors in collaboration with EMAS, SMIDEC, NPC, industrial associations and NGOs,
- SMIDEC is to be responsible for co-organising training programmes for financing organisation.

(b) Element-6: Promote CP Audits

In order to facilitate corporate managers' better understanding of CP benefits, it is proposed that CP audits be promoted as follows:

- Define a single contact point to provide CP audit information,
- Market CP audit services,
- Campaign for the benefit of CP and CP audits, the function of NCPC as a single contact point for CP, and SMIDEC factory auditing incentives,
- MOSTE is to institutionalise CP auditor accreditation and registration systems,
- SIRIM is to conduct CP audits by mobilising registered CP auditors on a case-by-case basis.

(4) Plan for Improving Incentives

(a) Element-7: SMIDEC Incentives

In order to improve SMIs access to SMIDEC incentives to use a grant scheme for

consultancy services for promotion of CP, it is proposed that SMIDEC take the following improvements:

- Improve SMIs access to schemes of ITAF and Factory Audits. This scheme is available to use CP promotion,
- Clarify adoptability of existing incentives to CP investment,
- Evaluate proposals quickly and shorten the procedure to provide incentives,
- Prepare a brochure solely for CP promotion as annex information to existing ITAF brochures and Factory Audits,
- Assist SMIs in completing these forms by consulting with SMI applicants,
- Train officers to support SMIs,
- Advertise SMIDEC incentives actively for SMIs using CP brochures which are applicable to CP investments at seminars, work shops, etc., and
- Create co-work scheme with industry associations and NGOs for SMIDEC incentive awareness campaigns.

(b) Element-8: MIDA Incentives

In order to make tax incentives more effective, it is proposed that MIDA take the following improvements:

- Clarify adoptability of existing incentives to CP investment,
- Promote inter-government coordination activities to allocate budgets for preparation of MIDA incentives for CP promotion among MITI, EPU, MOSTE, etc.
- Include clear description of tax incentives for environmental and CP investments in existing brochures,
- Prepare easy access for SMIs to MIDA and assist SMIs in completing procedures and forms to apply for tax incentives by MIDA staff through face-to-face discussion, and
- Train officers to support SMIs.

(c) Element-9 Plan: SMIs Access to Bank Financing

In order to improve SMIs' access to bank finance for CP investors to ensure easy and adequate financing, it is proposed that financing institutions take the following actions:

- Provide adequate consultation for access to bank finance,
- Help SMIs with presentation of their investment proposals to banks,
- Provide easy access to variety of finance schemes available for SMIs investment,
- Increase bank credit officers' awareness of CP, and
- Create systems to help banks better evaluate CP projects.

(d) Element-10: Award for CP Promotion

In order to increase business interest in CP, it is proposed that an award for CP promotion be created.

- Introduce the award for CP after installation of NCPC,
- Give awards to individual engineers, groups of employees or entities in order to increase business interest in CP,
- Have Government endorse the award to make it prestigious
- Give the winner of the award a plaque, certificate, and the entitlement to use an award logo for publicity, and
- Commend enterprises, offices, groups, which achieve remarkable promotion of CP, by well-known measures.

(5) Plan for Strengthening Regulatory Policy Framework

(a) Element-11: Self-Environmental Auditing/Monitoring and Reporting System

In order to reduce pollutant load and enforcement efforts by DOE, it is proposed that DOE introduce and promote self-environmental auditing/monitoring and reporting by industry to Government. DOE is to:

- Activate and modify the EQA 33A to apply to industries,
- Prepare regulations to promote environmental auditing/monitoring and reporting,
- Formulate audit standards and guidelines,
- Classify specific requirements for auditing/monitoring and reporting,
- Provide training for auditing/monitoring and reporting,
- Establish periodical reporting system of monitoring data from industries to DOE,
- Compile and evaluate the data, and
- Prepare procedure for announcements of concern, and announcements of violation of regulations with the aim to promote adoption of CP.

(b) Element-12: Environmental Manager System

In order to establish responsibility for environmental concerns in factories it is proposed that an environmental manager system be introduced. DOE is to:

- Introduce an environmental manager system to large-scale industries at initial stage, which enforces industries to appoint an environmental manager.
- Educate and train managers and concerned personnel,
- Create and environmental manager certificate and qualification examination, and
- Organise an environmental managers association.

Environmental managers shall be responsible for environmental audits, monitoring and reporting.

(c) Element-13: Efficient Energy Use

In order to promote efficient use of energy through improvement of equipment, facilities, and plant operational technology as well as introduction and development of energy efficient equipment, it is proposed that the following programme be conducted under the direction of MECM.

- Short Range

- Gazette the existing draft of regulations on electricity efficient use and enacts the regulations as soon as possible,

- Long Range

- Establish energy manager system for factories and buildings,
- Formulate standards on efficient energy use,
- Prepare guidelines on efficient energy use,
- Arrange incentives for promotion of efficient energy use,
- Educate and train personnel concerned in efficient energy use, and
- Start energy audits.

(d) Element-14: Promote Solid Waste Recycling

In order to promote solid waste recycling to decrease the load of incinerators and landfill sites leading to environmental preservation, it is proposed that DOE promote the following:

- MHLG is to include efficient recycling in the draft of the Solid Waste Act,
- Promote voluntary activities and enforce compulsory requirements for solid waste recycling,
- Establish a waste database currently undertaken by MHLG,
- Set a clear target, and
- Clarify independent and separate activities of related parties; i.e. industries, households, local authorities, local communities and traders.

(6) Plan for Capacity Building

(a) Element-15 Capacity Building of Concerned Organisation

In order to increase the capacity of related organisations, it is proposed that SIRIM plan and coordinate the following capacity building programmes.

- Activate the NCPC,
- Establish a CP training centre in the NCPC,
- Make use of UNEP programmes.
- The centre is to organise and monitor capacity building programmes:
    - EMAS programmes for DOE officers,

    - Capacity building programmes for SIRIM,
    - Capacity building programmes for SMIDEC, and
- Implement the CP auditor registration system.

CHAPTER 5

OVERVIEW OF FACTORY AUDIT AND DEMONSTRATION PROJECT

CHAPTER 5 OVERVIEW OF FACTORY AUDIT AND DEMONSTRATION PROJECT

5.1 Overview of Factory Audit

(1) Factory Audit

Factory audits were conducted in two phases -- Phase I and Phase II. The Phase I Factory Audit was conducted for the purpose of selecting model factories and the Phase II Factory Audit was conducted for the purpose of preparing basic design data of CP introduction.

(i) Phase I Factory Audit

Phase I Factory Audit was conducted from December 2000 through February 2001, when the SIRIM and the Study Team surveyed twenty representative companies as shown in Table S-5.

Table S-5 Audited Companies at the first Audit

a. Metal Finishing and Electroplating Sub-sector		**c. Pulp and Paper Sub-sector**	
1)	Metal Polishing Industries Sdn. Bhd.	1)	Telic Paper Sdn. Bhd.
2)	Perusahaan TGB Sdn. Bhd.	2)	Lekok Paper Mill (M) Sdn. Bhd.
3)	E-Coat Sdn. Bhd.	3)	Versatile Paper Boxes Sdn. Bhd.
4)	Aceloy Sdn. Bhd.	**d. Textile Sub-sector**	
5)	Malaysian Electroplating Technology (M) Sdn. Bhd.	1)	South Asia Textiles (M) Sdn. Bhd.
6)	Chemobright Industries Sdn. Bhd.	2)	Berjaya Knitex Sdn. Bhd.
b. Food and Beverage Sub-sector		3)	Sykt Perusahaan Finetex Sdn. Bhd.
1)	Winner Food Industries Sdn. Bhd.	4)	Sykt Koon Fuat Industries Sdn. Bhd.
2)	Awra Food Processing Sdn. Bhd.	5)	M.K.K. Industries Sdn. Bhd.
3)	Cocoaland Industry Sdn. Bhd.	6)	Samtex Industries Sdn. Bhd.
4)	Universal Nutri-Beverage Sdn. Bhd.		
5)	Vit Makanan (KL) Sdn. Bhd.		

The following four factories were selected as model factories

a. Metal Finishing and Electroplating Sub-sector
   - Metal Polishing Industries Sdn. Bhd.
   - Perusahaan TGB Sdn. Bhd.

b. Food and Beverage Sub-sector
   - Winner Food Industries Sdn. Bhd.

c. Textile Sub-sector

- South Asia Textile (M) Sdn. Bhd.

(ii) Phase II Factory Audit

Phase II Factory Audit was conducted in March 2002, when the SIRIM and the Study Team carried out a detailed survey in the model factories for gathering operation status, overall and detailed material and energy balance data and for taking water samples. Gathered data were used for preparing tender documents.

(2) Present Status

SIRIM and the Study Team surveyed "Observation of pollution control condition", "Waste discharge, treatment and recycling" and "Measures for productivity improvement" of each factory. Outlines of them are described in each relevant chapter.

5.2 Selection of Model Factories

(1) Procedure for Selection of Model Factories

In order to select model factories from representative factories concerned, "Adjudication Table for Model Factory Selection" was used. Adjudication items are divided into three categories as follows:

(A) Expected Improvement
(B) Possibility of Improvement
(C) Willingness of the Factory

After adjudicating the factory's conditions and inputting proper figures into each item, the sum for each category is calculated as subtotal of (A), (B) and (C), and final adjudication point is calculated as follows.

Grand Total = (A) x (B) x (C) / 100

The larger the calculated grand total value, the greater the possibility to introduce CP equipment. Therefore, after adjudicating and inputting the proper figures into each item for all the factories, the factory that has the highest grand total value in the table will be selected as the candidate of a model factory.

The factor A, "expected improvement", is treated as a negative factor. Therefore, a bigger figure shall be input for the factory which its environmental impact is bigger.

In addition to the adjudication by "Adjudication Table for Model Factory Selection", it is necessary to consider the following criteria for the selection of a model factory for the

promotion of CP technology in Malaysia.

a. The factory is willing to demonstrate CP technologies and allows visitors to see them,
b. Cost for the equipment for the demonstration project in the factory will not exceed budgetary limits, and
c. Others.

(2) Selection of Model Factories in Metal Finishing and Electroplating Sub-sector

Based on a comparative study using an "Adjudication Table for Model Factory Selection", SIRIM and the Study Team re-audited Persahaan TGB Sdn. Bhd., Chemobright Industries Sdn. Bhd., and Metal Polishing Industries Sdn. Bhd. Finally, Persahaan TGB Sdn. Bhd. and Metal Polishing Industries Sdn. Bhd. were selected as model factories.

(3) Selection of Model Factory in Food and Beverage Sub-sector

Based on a comparative study using an "Adjudication Table for Model Factory Selection", SIRIM and the Study Team re-audited Cocoaland Industry Sdn. Bhd. and Winner Food Sdn. Bhd. Finally, Winner Food Industries Sdn. Bhd. was selected as a model factory.

(4) Selection of Model Factory in Textile Sub-sector

Based on a comparative study using an "Adjudication Table for Model Factory Selection", SIRIM and the Study Team re-audited Sykt Persahaan Finetex Sdn. Bhd. and South Asia Textiles (M) Sdn. Bhd. and Samtex Industries Sdn. Bhd. Finally, South Asia Textiles (M) Sdn. Bhd. was selected as a model factory.

(5) Selection of Model Factory in Pulp & Paper Sub-sector

No factory was selected as a model factory, because not much area for improvement was expected for this sub-sector as follows

- Telic Paper Sdn. Bhd. is operating its original oven dryers and they do not like to receive visitors.
- About Lekok Paper Sdn. Bhd., it was necessary to do a more detailed study on a strict control method of recycle water quality.
- It was also necessary to do a more detailed study on the treatment of ink washing water and wastewater treatment system for Versatile Paper Boxes Sdn. Bhd.

5.3 Outline of Demonstration Project

(1) Metal Polishing Industries Sdn. Bhd.

(i) CP Measures

The following five CP measures were selected and implemented.

- **Installation of a pressure controller for city water inlet (CP1)**

The city water inlet pressure increases during midnight and decreases during daytime. This pressure controller controls the outlet pressure and helps to keep a stable flow rate at all times.

- **Installation of area flow meters (CP2)**

This is to install area flow meters for five rinsing tanks in addition to CP1. The operators could control the water flow rate adequately all the times using these area flow meters.

- **Installation of a diaphragm pump (CP3)**

This is to install a diaphragm pump for the purpose of transferring over-flow rinse water from tank No.7 to No.4 for reuse.

- **Installation of a filtering unit (CP4)**

This is to install a filtering unit for the bright chromium tank in order to maintain a desirable suspended solid concentration in the tank.

- **Installation of an ion exchanger system (CP5)**

This is to install an ion exchanger system. This system can make full recovery of rinse water after bright chromium plating, and can help to improve the final products quality.

(ii) CP Investment

The total investment for the CP introduction resulted in RM216,000.

(iii) Performance Confirmation

- **Impurity ion concentration in rinse**

After the introduction of CP5, the concentration of Cr^{6+}, for example, in rinse water has been decreased from 4-5 mg/litre to 0.05 mg/litre.

- **Conductivity value in rinse water**

The water in rinsing tanks has become very clear and transparent, and their conductivity value has reduced from 1,000 μS/cm to 20μS/cm.

(iv) Reduction of Production Cost and Increased Running Cost

After the introduction of CP, wastewater treatment fee, city water and electricity consumption and labour cost were reduced. Consequently production cost was reduced by RM12,029 per month though some amount of running cost increased.

(2) Persahaan TGB Sdn. Bhd.

(i) CP Measures

The following six CP measures were selected and implemented.

- **Rearrangement of wiring between rectifiers and tanks (CP1)**

Connection of bus bars and anode stands and cathodes are rearranged adequately for lowering the electrolysis voltage.

- **Installation of newly designed anode stands (CP2), and**
- **Replacement of anode beam sets (CP3)**

By installation of new anode stands on both sides of each anodizing tank in addition to the rearrangement of wiring, a uniformity in film thickness and shortening of anodizing time can be expected.

- **Refreshment of cathodes (CP4)**

At the same time, the allocation of anodes and cathodes in the anodizing tanks are corrected.

- **Improvement of rinsing facility (CP5)**

This measure consists of the following 4 measures.

  - ✓ **Installation of shower system**

    To prevent contamination of anode beams, a shower system is installed at the second rinsing tank after anodizing.
  - ✓ **Installation of over-flow gutters beside rinsing tanks**

    Over-flow gutters and water supply pipes at the bottom are installed for all the eight rinsing tanks so that water will flow from the bottom to the surface.

- ✓ **Installation of water supply piping for rinsing tanks**
  A water-supply pipe is led into the bottom of each rinsing tank. Accordingly water will flow from the bottom to the surface.
- ✓ **Installation of air agitation pipes in rinsing tanks**
  To increase rinsing efficiency, air agitation piping at the bottom is installed for all the rinsing tanks.

- **Introduction of counter-current system (CP6)**

The water used in the third rinsing is sent to the second rinsing tank in order to reduce water consumption.

(ii) CP Investment

The total investment for CP introduction was RM400,000.

(iii) Performance Confirmation

- **Reduction of anodizing voltage (CP1, CP2, CP3, CP4)**

Before CP introduction, the voltages at the rectifier and inside the anodizing tank were around 17 volts. After CP introduction, the both voltages were around 11 volts. This meant that electricity consumption for anodizing was reduced by 35%.

- **Film thickness deviation (CP1, CP2, CP3, CP4)**

The thickness dispersion in one section is significantly reduced by CP introduction. Assuming that the film thickness difference in a section reduces from 35% to 10% of maximum thickness, electricity required for anodizing also reduces by 18.5%. It means that anodizing time can be reduced by 18.5%, where productivity also increased by 18.5%.

(iv) Reduction of Production Cost and Increased Running Cost

After the introduction of CP, electricity and water consumption and labour coat were reduced without an increasing of running cost. Consequently production cost was reduced by RM314,200 per year.

(3) Winner Food Industries Sdn. Bhd.

(i) CP Measures

The following three CP measures were selected and implemented.

- **Reform of rice washing system (CP1)**

A new rice washing machine is installed for the reduction of rice washing water. Present usage of water is about 8 - 10 times and water required for rice washing becomes 4 - 5 times.

- **Reform of noodle cooling system (CP2)**

Fresh water is sprayed onto noodles directly at the front where existing cooling baths are to be modified. Then, warmed water in the baths is recycled and sprayed onto noodles at the rear.

- **Improvement of well water (CP3)**

To decrease city water usage as much as possible, a chlorine dosing unit for sanitary treatment and a water softening unit for boiler feed water are added to the current well water system

(ii) CP Investment

The total investment for the CP introduction resulted in RM270,000.

(iii) Performance Confirmation

- **Rice washing machine**

The model factory operates the rice washing process once a day for around one hour treating 1.0 - 1.2 ton rice. Before CP introduction, it takes 60 minutes for washing 1000 kg rice using 13 - 15 m^3 water. After CP introduction, it takes 30 - 40 minutes for washing 1000 kg rice using 4 m^3 water. Therefore, both a reduction of laborious work time and a decrease of water consumption are attained.

- **Noodle cooling**

The water consumption is almost same or a little lower than the system before CP introduction. However temperature drops around 5℃ and the quality of noodles became better.

- **Well water improvement**

Residual chlorine concentration through NaClO dosing is under 0.1 ppm after passing through an activated carbon filterer. Bacillus count is ND (No Detected), therefore the treated well water can be enough good for usage in food production. Total hardness is

under 1 ppm (as $CaCO_3$) with no problem for boiler feed water usage.

(iv) Reduction of Production Cost and Increased Running Cost

The actual annual running cost saving was RM11,369 per year.

(4) South Asia Textile (M) Sdn. Bhd.

(i) CP Measures

The following CP measure was selected and implemented.

- **Increase of treated wastewater recycling ratio**

The factory was considering reusing treated wastewater in the washing process, and after several trial operations, the recycling ratio of the treated wastewater had increased to 30%. However, further increase of recycling was constrained by the presence of high iron ion concentration in the treated water. Through several laboratory scale tests, it was concluded that a coagulation method using some chemical agents could reduce the iron ion concentration from more than 5.0 mg/l to 0.1 - 0.05 mg/l.

(ii) CP Investment

The total investment cost resulted in RM305,000.

(iii) Performance Confirmation

- **Reduction of iron ion content in the treated wastewater**

Fe^{3+} and total iron ion concentration was higher than the target value during the test operation because pH value of treating water in the coagulation tank was higher and there was some amount of iron rust in the filter. After controlling pH value and cleaning of the filter, iron ion content was reduced to less than 0.1 mg/litre.

(iv) Reduction of Production Cost and Increased Running Cost

Necessary running cost mainly for chemicals was RM0.283/m^3-feed water. Using this running cost, total expected cost saving was calculated at the recycling ratio of 70% as follows.

- Reduction of consumption of city water: 72,000m^3/year
- Reduction of purchasing amount of city water: RM110,000/year
- Reduction of effluent amount of wastewater: 72,000m^3/year

5.4 Evaluation of CP Measures

(1) CP Measures for Model Factories and Investment

CP measures selected and executed for each model factory are summarised as shown in Table S-6.

Table S-6 CP Measures and Investment

Model Factory	CP Measures and Investment
Metal Polishing Industries Sdn. Bhd.	CP1 Installation of a pressure controller for city water inlet CP2 Installation of 5 area flow meters for city water line CP3 Installation of a diaphragm pump CP4 Installation of a filtering unit CP5 Installation of an ion exchanger system **Investment: RM216,000**
Perusahaan TGB Sdn. Bhd.	CP1 Wiring between rectifier and tanks CP2 Installation new designed anode stands CP3 Replacement of anode beam sets CP4 Refreshing cathodes CP5 Improvement of rinsing facilities CP6 Installation of counter-current system **Investment: RM400,000**
Winner Food Industries Sdn. Bhd.	CP1 Reform of rice washing system CP2 Reform of noodle cooling system CP3 Improvement of well water **Investment: RM270,000**
South Asia Textiles (M) Sdn. Bhd	CP1 Increase of treated wastewater recycling ratio **Investment: RM305,000**
	Total Investment RM1,191,402

(2) Purpose of Evaluating Profitability of CP Measures

CP measures are introduced to factories for not only decreasing industrial pollution but also making profits through lower energy consumption, reducing wastewater discharge and increasing productivity. In this case, it was carried out to check the profitability of CP measures in the selected factories when they reach a steady level of operation. When CP measures are spread to other factories, it is important for the factories to know the profitability of CP investment.

(3) Method of Evaluating Profitability

The following two methods to evaluate profitability were adopted.

(i) Return on investment (ROI) method:

This method is used to evaluate the profitability based on the ratio of return on the investment. A main ROI method is Internal Rate of Return (IRR) method that calculates the discount rate to let the accumulated present value of the annual net cash flow equal to the investment. This method is usually used to evaluate big and long-term projects.

(ii) Pay out time (POT) method:

This method is used to evaluate the profitability based on the period needed to recover the investment. POT is calculated as the period required recovering the investment through the accumulated annual cash flow earned by the project. POT method is generally used to evaluate small rationalising investments such as saving manpower or saving energy, and small capacity expansion investments.

(4) Calculated POT & IRR Value and their Evaluation

Investment, saved cost, increased cost, calculated POT and IRR values are shown in Table S-7. The evaluations for each model factory are summarised as follows.

(i) Metal Polishing Industries Sdn. Bhd.

In total, POT was 2.1 years and IRR was 51%. Therefore, it was judged that total CP introduction was a good investment.

(ii) Perusahaan TGB Sdn. Bhd.

The total investment in the model factory had a very good profitability where POT and IRR was 1.7 years and 60 % respectively. This means that any factory in the same situation as the model factory can recover their investment within 2 years if the factory borrows all required money from a bank. And any CP can be recommended separately to factories because each CP has a good profitability.

(iii) Winner Food Industries Sdn. Bhd.

The overall benefits of CP1, CP2 and CP3 did not give a good profitability, where POT was over 10 years and the company could recover only one third of the investment in 10 years at 4 % interest. However, It is thought that this type of rice washing machine is very effective for the companies that have larger production capacity than the model factory and need to install new wastewater treatment facilities. Moreover, these measures will be profitable to small companies like the model factory when the

government strengthens regulations on wastewater discharge in the future.

(iv) South Asia Textiles (M) Sdn. Bhd

Trial calculations for the profitability, POT and IRR, were made.

If the recycling ratio reaches 70%, this investment can be judged as sufficient, because POT is 3.7 years and production cost can be reduced by RM110,340 per year. However, when the recycling ratio reaches 60%, POT becomes 5.8 years, which is considered as insufficient.

Table S-7 POT and IRR Values for Model Factories

Model Factory	Investment	Saved cost	Increased cost	POT	IRR
	RM/y	RM/y	RM/y	Year	%
(1) Metal Polishing Industries Sdn. Bhd.					
a. CP1 to CP3	24,000	24,000	0	1.3	-
b. CP4	87,000	21,000	1,000	5.8	-
c. CP5	105,000	110,000	10,000	1.4	-
d. Total	216,000	155,000	11,000	2.1	51
(2) Perusahaan TGB Sdn. Bhd.					
a. CP1	94,00	92,000	0	1.4	-
b. CP2	14,000	92,000	0	0.2	-
c. CP3	151,000	77,000	0	2.7	-
d. CP4	123,000	46,000	0	3.6	-
e. CP5	13,100	3,600	0	2.0	-
f. CP6	4,000	600	0	2.5	-
g. Total	400,000	312,000	0	1.7	60
(3) Winner Food Industries Sdn. Bhd.					
a. CP1	166,000	5,000	-	10<	-
b. CP2	15,000	-	-	-	-
c. CP3	89,000	12,000	6,000	10<	
d. Total	270,00	17,000	6,000	10<	Negative
(4) South Asia Textiles (M) Sdn. Bhd.					
a. Recycle Ratio: 50%	305,000	81,000	51,000	10<	2
b. Recycle Ratio: 60%	305,000	121,000	51,000	5.8	16
c. Recycle Ratio: 70%	305,000	161,000	51,000	3.7	27
d. Recycle Ratio: 80%	305,000	202,000	51,000	2.7	38