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Working Party on Pollution Prevention and Control

OECD JOINT WORKSHOP ON EXTENDED PRODUCER RESPONSIBLITY AND WASTE MINIMISATION POLICY IN SUPPORT OF ENVIRONMENTAL SUSTAINABILITY
Paris, 4-7 May 1999

PART 2: Waste Minimisation through Prevention

This document is Part 2 of the final report of the compendium of the OECD Joint Workshop held on 4-7 May 1999. It contains the presentations and papers as presented at the Waste Minimisation part of the workshop.

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FOREWORD

Over the past two decades, OECD governments, the private sector and others have spent considerable resources on environmental protection and waste reduction. Yet, waste generation is still on the rise. This also represents inefficiency in the use of materials and energy. Statistics indicate that waste within the OECD has been increasing at a rate similar to that of economic growth.

To help OECD governments address the increase of waste and associated pollution, new policy ideas and concepts are being investigated and developed that could result in longer-term solutions and increase resource efficiency. Waste minimisation policy is one broad approach, among others, being examined by OECD. Other approaches being examined include the more specific policy concept of Extended Producer Responsibility (EPR). The policy guidance and information provided under the waste minimisation programme give governments an additional tool to help them tackle key environmental challenges such as waste and pollution.

The OECD work programme on waste minimisation began in 1994. The initial step was to compile information on existing policies and tools for waste minimisation in OECD countries. In 1995, the U.S. Government co-hosted with Canada and Mexico, OECD's first waste minimisation workshop in Washington D.C..

The second phase of the OECD Waste Minimisation Programme focused on the development of a common understanding of waste minimisation and its components (strict prevention, reduction at source, product re-use, recycling, and, when appropriate, energy recovery). The German government hosted OECD's second workshop in 1996.

The two phases of work resulted in a series of OECD publications covering specific waste streams, tools and policy approaches. An initial exploration of general waste minimisation evaluation, as well as national waste minimisation profiles of OECD countries, were also published.

During the third and final phase of the project, the OECD has decided to focus its efforts more squarely on the **prevention** component of waste minimisation. Since wastes are generated throughout the life of economic activities, this phase of work is adding a resource flow perspective to the initial waste minimisation approach and will comprise waste prevention policy design, target setting, implementation and evaluation. The overall aim of this project is to develop a Government Self-Assessment Guide on Strategic Waste Prevention.

The latest OECD workshop on Waste Minimisation was held in Paris, 4-7 May 1999. It was a joint event focussing on waste prevention and extended producer responsibility. The event was kindly hosted by the Ministry of Health and Welfare of Japan.

This document contains the waste prevention papers and presentations as presented at the workshop, an overall summary outcome, the workshop agenda, and the list of participants. The papers and presentations dealing with EPR (Part 1) are issued in a separate document [ENV/EPOC/PPC(99)11/PART1].

The OECD would like to express its appreciation to those persons who have prepared papers for the meeting and to those who have made presentations. In addition, the OECD would like to thank all those countries that have offered their financial support to OECD waste minimisation work over the years (Austria, Canada, Japan, Netherlands, Norway, Switzerland, and the United States). All general distribution waste minimisation documents can be found at the OECD Environment Directorate site on the World Wide Web: : http://www.oecd.org/env/efficiency/wastemini.htm.

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WELCOMING ADDRESS BY JOKE WALLER-HUNTER, DIRECTOR

OECD ENVIRONMENT DIRECTORATE

Good afternoon ladies and gentlemen. I would like to take this opportunity to add a warm OECD welcome to this workshop and to thank the Japanese Ministry of Health and Welfare for offering to host this event in such an agreeable location.

The Dilemma

It may be appropriate to start with a **reality check**. As many of you know, during the 1990's most OECD Environment Ministries started embracing "source reduction" and "pollution prevention" as key goals. This meant that as little waste as possible was to be disposed of, and this objective was to be achieved with a **priority focus** on prevention efforts, generally followed by recycling.

Unfortunately, it has become clear that *in practice*, there exists a persistent **prevention paradox**. Overall, 65% of municipal wastes in OECD countries are still going for final disposal; moreover, most public and private waste-related **investment** is directed to recycling, not prevention. Some estimates indicate that prevention accounts for a mere 10-20% of overall minimisation efforts.

The dilemma doesn't stop there. I must also report to you that despite nearly 30 years of environmental and waste policy efforts in OECD countries, the OECD-wide increase in waste generation is still in 1:1 proportion to economic growth. A 40% increase in OECD GDP since 1980 has been accompanied by a 40% increase in municipal waste during the same period. As you can see, consumer spending also follows these trends.

According to projections of our colleagues in the Economics Directorate, there is expected to be a 70-100% increase in GDP by the year 2020 in the OECD area. I would personally not like to imagine a world where municipal waste generation is also 70-100% higher then the already high levels of today.

As I am sure you can all appreciate, the scope of this dilemma is, indeed, much broader than the generation of post-consumer municipal waste. Large increases in consumer demand can imply also more wastes associated with upstream activities such as extraction, manufacturing and distribution. Indeed, wastes are generated throughout the life of economic activities, through the flow of material cycles.

Since the early 90's, increasing attention is being directed to also those wastes generated at the *front-end* of the materials cycle. For example, recent work carried out by the World Resource Institute for four OECD countries [Germany, Japan, the United States and the Netherlands] indicates that hidden material flows from mining, earth moving, and other sources account for as much as 75% of the total materials that these industrial economies use.

All these statistics beg the question: ***Why** do we have a waste dilemma*? While the reasons are multiple, here are four points, which I think merit special attention**:**

- Consumers and producers do ***not* always pay the true social and environmental costs** of the wastes they produce.

- **Increases in demand** often outstrip any gains in production efficiency.

- It is often **cheaper to use virgin materials** than to recycle materials.

- **No agreed waste prevention indicators** exist; and human psychology dictates that if something can not be measured, it's much less likely to get done!

Links to other Challenges

As I think we all can see, waste as an environmental issue takes many shapes and forms. This means that the problem must not be compartmentalised. Rather, it must be **carefully** integrated with decisions affecting all environmental media, and all economic sectors. Integrated resource management can provide a useful stage for framing solutions to the dilemma.

Once again, though, we need to be realistic. Appropriate change in resource inputs does not come automatically at either the country or company level. For firms, the initial cost of redesigning products and minimising resource use can be high, with timeframes for change sometimes long. And the immediate benefits of such actions are often more public than private. The result can be insufficient private sector investment and inadequate innovation. Our research is revealing that EPR and waste prevention strategies can be important levers for achieving efficiencies in materials and energy use throughout the value-added chain of products. That, in turn, can help minimise negative externalities that have not always successfully been taken into account with historic waste management approaches.

A broad approach will help avoid secondary effects, some of which are familiar, some newer.

Most of us are aware that landfills can give rise to groundwater contamination, increased truck transport to and from waste facilities, and public resistance to facility siting – the now familiar NIMBY syndrome.

On **a national and global level**, there are also noteworthy areas of concern stemming from the fact that, traditionally, policies have not addressed the association between waste generation and**:** climate change, deforestation, toxic substance releases, biodiversity loss, increased soil erosion, and other problems.

Taking climate change as an example, we know that since 1990 there has been nearly a 10% increase in *waste-derived* ***methane*** emissions, a significant point because methane is approximately 24 times more potent a greenhouse gas than carbon dioxide. Studies coming out of the U.S. clearly demonstrate a considerably higher GHG mitigation potential associated with waste **prevention**, in comparison to any other waste minimisation activity including recycling.

In my mind, these simple but important observations have two overarching policy implications: (1) preventing wastes in the first place can also prevent the need for large **financial outlays** to fix secondary problems; and (2) only by nurturing and applying an **integrated approach** can we really start to understand and confront important linkages and trade-offs.

OECD Work on EPR and Waste Minimisation

The OECD work on EPR and Waste Minimisation has a short but fruitful history starting in 1994.

You can see that although the history is short, Member countries have been quite active in stepping forward, offering resources and hosting workshops for our EPR and Waste Minimisation work. We in the Secretariat have also been quite busy in preparing what totals to 8 official reports split between EPR and Waste Minimisation. Some of these papers have been among the most popular Environment documents produced at OECD. I know many of you have already obtained your own free copies of some of these through our Internet site.

Resource Efficiency and Sustainable Development

Within the work programme of the Environment Directorate, EPR and Waste Minimisation are two of the components of a broad activity called Resource Efficiency**,** which in its turn, is part of the broader notion of the sustainable development of natural resources. As you know, the OECD as a whole has stepped up its work on sustainable development in a three years horizontal programme that will hopefully have a lasting impact. Decisions in OECD countries on how to manage natural resources, are key to sustainable development. Work is well underway, and the first results will be presented in an interim-report that will be made available to Ministers when they meet later this month. The OECD 2001 report on Sustainable Development will then go into more depth. This will also assist us to further define the concept of resource efficiency and the related notion of resource productivity. No doubt that an efficient management of the resources is supportive of sustainable development. But there are still many policy and technology questions to be answered, before we have a workable definition.

Such questions form part of the longer-term objectives of the Resource Efficiency work in our Environment Programme. Our Resource efficiency work currently groups a number of activities**,** ranging from the valuation of natural resources, to the already more operational business concept of eco-efficiency, where we are now looking more in depth at economic sectors like food, construction and governments, and the topics on the agenda of this workshop.

The implementation of cutting edge approaches, such as EPR and waste prevention strategies, is, I believe, fundamental to the attainment of increased resource efficiency and a more sustainable development

Some simple examples of how EPR and waste minimisation approaches can help promote resource efficiency and sustainable development include: (1) designing low-waste products and services that lead to reduced resource extraction and energy use upstream and throughout the lifecycle; and (2) addressing consumer-producer relationships, defining their respective roles to help achieve environmental objectives.

Defining Success: A Caveat

As with any policy or programme, there comes a time when its performance requires evaluation. It is here that I would like to inject a caveat. **We all need to be vigilant in how we define success**. If the measure of success of a waste prevention programme is given only in terms of wastes not disposed of downstream, then it may come as no surprise that such a programme looks expensive and perhaps even over-engineered. Only by taking into account the *full range of benefits* can governments and private organisations better understand **the cost-saving, and innovation-enhancing** potential of properly designed waste prevention programmes.

With respect to EPR, this fuller range of benefits can **include reduced upstream use of materials and energy use**, better communication along the product chain, involving all actions and ultimately a reduced need for public funds to finance waste management.

Finally

This brings me back to our Workshop.This joint EPR/WM workshop will be an important opportunity to consolidate our knowledge on these topics and hence assist with the subsequent development of ***OECD guidance to governments*****.** This OECD guidance will be developed on two levels: (1) ***strategic*****,** by formulating a waste minimisation **Policy Options and Self-Assessment Guide** that is cast within a framework of economy-wide material flows; and **(2)** ***operational***, by developing a **Guidance Manual** for those governments considering the development and practical application of Extended Producer Responsibility programmes. The rich experience acquired during the last four years of our work on EPR, Waste Minimisation and related projects will be used in the development of these products.

What do we want from the next three days of discussions? Hopefully, we will come out with a better understanding of what's likely to work best in waste prevention and EPR strategies, in the context of promoting both resource efficiency and sustainable development. But more specifically, we should have a better idea of the types of ***questions*** *that governments should be asking themselves* when designing, implementing and evaluating such strategies.

I wish you all success with the meeting and I look forward to seeing the conclusions.

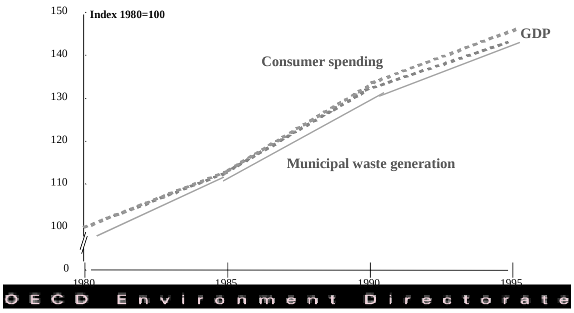
POWERPOINT PRESENTATION (Joke Waller-Hunter)

Joint Workshop on Extended Producer Responsibility *and* Waste Minimisation Policy

Joke Waller-Hunter, Director
OECD Environment Directorate

A DILEMMA

Trends in Waste Generation and GDP
OECD Countries



Why the Dilemma?

Reasons are multiple. Some key points include:

- environmental costs usually not paid by consumers and producers
- demand can outweigh efficiency gains
- virgin materials cheaper than secondary
- no agreed waste prevention indicators

OECD and EPR

Brief History

- **Phase 1 (1994-1996):** 70 personal interviews on legal/administrative approaches across OECD countries
  = Phase 1 Report
- **Phase 2 (1996-1997):** Commissioned report and Secretariat analysis on economic efficiency and environmental effectiveness of various approaches
  = Phase 2 case studies and synthesis Report
- **Phase 3 (1997-2000):** Series of multi-stakeholder workshops [Ottawa, Helsinki, Washington, Paris(Japan)]
  = EPR Guidance Manual to Governments

OECD and Waste Minimisation

Brief History

Phase 1 (1994-1996): Washington Workshop + Lead country Work (policies/tools/waste streams)
= Phase 1 Report

- **Phase 2 (1996-1997):** Commissioned reports and Secretariat analysis (concepts/approaches/country profiles/WM evaluation primer) + Berlin Workshop
  = Phase 2 case studies and synthesis report
- **Phase 3 (1997-2000):** Commissioned reports and Secretariat analysis (prevention targets, indicators and improvement strategies) + Paris (Japanese) Workshop
  = ***Policy Options and Self-Assessment Guide***

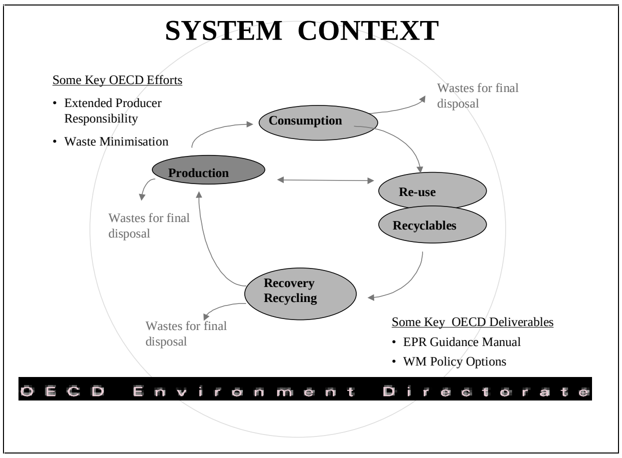
Sustainable Development: Tentative Outline of Analytical Report (2001)

- **Part A**. The Outlook for Sustainable Development
  - Challenges and opportunities on the economic, environmental and social sides
- **Part B.** A Policy Framework for Sustainable Development
  - Key Policy Principles
  - Measurement
  - Institutions and Decision Making
  - Enhancing Framework Conditions for Sustainable Development
  - Technology and Sustainable Development
- **Part C**. Policy Responses: Key Issue
  - The management of natural resources
  - Responding to climate change
- **Part D**. Policy Responses: Sectoral and Local Approaches
  - Energy
  - Transport
  - Agriculture
  - Local Approaches
- **Part E**. Globalisation and Sustainable Development
  - Trade, Investment and Sustainable Development
  - Strategies for Enhancing Sustainable Development in Developing and Non-Member countries

Resource Efficiency

What are components of the OECD Resource Efficiency activity?

- Approaches and Policies:
  - ***EPR***
  - ***Waste Minimisation***
  - Product Policies
- Natural Resource Evaluation
- Eco-efficiency: the practice



THE EVOLUTION OF WASTE PREVENTION INITIATIVES: A UNEP PERSPECTIVE

by Fritz BALKAU
Production and Consumption Unit
UNEP, Division of Technology, Industry and Economics
Paris, France

PLENARY SESSION

From their first objective of simply preventing the release of pollutants to the environment, the various concepts we know under such titles as waste minimization, cleaner production, eco-efficiency and green productivity have all developed further. The initial aim of such programmes was to introduce cleaner technologies. They gradually saw the need to incorporate also the notion of improved environmental management systems, and a variety of eco-tools and instruments. There has been a growing emphasis on the entire life-cycle of processes and products, and addressing improved resource productivity in addition to pollution prevention. Eventually it was realised that consideration must go beyond dealing only with production processes; we now understand the importance of also making consumption patterns (both domestic and industrial) more sustainable.

Simultaneous with this wider vision of prevention programmes came the realization that the actors have changed. In remediation programmes environmental specialists were the key players. But ‘prevention’ actions occur earlier in the life-cycle of a process, and we now understand better the important role of persons in engineering, finance, marketing, and business management. These sectors have not in the past understood that they have an environmental role, and their formal education and training has not given them the awareness, knowledge or skills to contribute effectively to a cleaner production approach.

It is also clear that more attention has to be given to the linkages between stakeholders, as in many cases only a concerted action will be effective. Thus effective recycling schemes depend on complementary actions between many different actors from product design through to residue disposal, with the actual recycling operation being somewhere in the middle. The role of governments in providing an enabling policy framework for company action on eco-efficiency and cleaner production is also well known. There are also benefits from strong links within industry, as for example in implementing supply-chain management concepts and extended producer responsibility.

International institutions such as OECD and UNEP are now evolving their programmes to reflect this change in perspective.

For example, recent high-level meetings of UNEP’s Cleaner Production programme recommended changes in orientation to maintain the relevance of the programme, to adapt to the evolving needs of countries, and to acknowledge the growing importance of voluntary initiatives. I want to briefly give an outline the changes we have made.

One example is the UNEP study of **financing mechanisms** for cleaner production to analyse past investment practice, see how lending policies of major banks reflect sustainable development principles, and identify mechanisms that favour rather than discourage cleaner production investments.

There has also been considerable work to promote and improve the use of various **environmental management tools** such as EIA, LCA EnTA and auditing. Much work has gone into benchmarking corporate tools such as environmental and social reporting, supply-chain management and green procurement. The systematic use of EMS has been promoted through the publication of a trainers kit, jointly with ICC and FIDIC. The concept of extended producer responsibility is a key element in this work.

UNEP has also commenced a series of activities to promote the concept of **sustainable consumption**. The activities are for the moment aimed at improving dialogue and consensus on the need for sustainable consumption, analysing the driving forces, and commencing to engage major stakeholders such as the advertising industry.

Associated with the sustainable consumption initiative are the activities on **product development** for sustainable development, on eco-design, and on green procurement.

In order to build commitment to such a broad range of initiatives also in companies and institutions, UNEP has prepared, after extensive consultation with key stakeholders, an **International Declaration on Cleaner Production.** Key individuals are invited to sign this Declaration to make public their commitment to the implementation of the prevention approach.

These activities continue to be supported by **traditional functions** of awareness-raising, compiling case studies, information exchange, training and capacity building. In a number of countries **National Cleaner Production Centres** ensure more effective delivery of these initiatives at the country level. Several centres have themselves catalyzed the establishment of further centres at the local level.

The evolution of the UNEP programme is similar to that found in other organizations, both at national and international levels. Taken together, the changes ensure that the implementation of the prevention principle keeps pace with the broader vision of sustainable development that is compatible also with the new CSD framework on ‘sustainable production and consumption’.

Given the scope of these changes, and their impact also on other policies of environmental, economic and social development, there is a great need to exchange experience and analyze the results. Forums such as this are essential if waste prevention programmes are to be better understood, and be actually implemented by governments and within the business sector.

POWERPOINT PRESENTATION [Fritz Balkau]

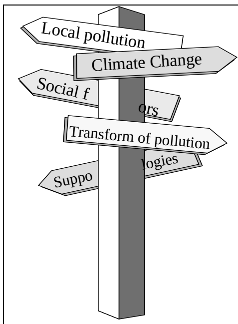
Global Perspectives on Assessing Technologies for Waste Prevention and Cleaner Production

F. Balkau and W. Zhao

For OECD Workshop on Extended Producer Responsibility and Waste Minimization Policy

Paris, 4-7 May. 1999

UNEP May 1999



When we select technologies for waste prevention and cleaner production, how do we make the technology choice wisely?

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Example 1. Chrome use in leather tanning

Under the regulatory pressure on the content of Chrome in the wastewater, technologies for increasing the fixation levels of chrome in the tanning path are introduced. As a result, the concentration of chrome in effluent is reduced. But the remaining chrome is in compound form that are very difficult to treat.

UNEP May 1999

Example 2. Cyanide use in gold ores extraction

Cyanide is used conventionally in gold extraction and is under pressure to be phased-out due to its high toxicity. But it is easy to treat and the technology for treatment is well developed. The alternative technologies such as pressure oxidation and the bio-leach technique may be less toxic and non toxic but there are other factors prevent them from been applied.

UNEP May 1999

Example 3. Water-based drilling mud in oil exploration

Water-based drilling mud is recently preferred comparing with oil-based drilling mud. However, it results in a significant increase in energy consumption. One should balance the risk of local pollution and global impact of additional energy use.

UNEP May 1999

Example 4. New lead alloys for improving efficiency of car-batteries

New lead alloys for car-batteries improve efficiency and reduce the weight of the batteries. But they interfere with the metallurgical processes during recycling and make it difficult to reclaim the lead.

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Example 5. Forgotten aspect in semiconductor manufacture

The large amount of ultra-pure water is required by the semiconductor manufacturing. The treatment of the sludge produced by the ultra-pure water production is not part of the main process. But its environmental impact should not be overlooked.

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Environmental management tools

- Environmental Impact Assessment
- Cleaner Production Assessment
- Risk assessment
- Life-cycle Assessment
- Eco-design
- Environment Technology Assessment

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Needs for Environment Technology Assessment

- Single-criteria decision making often leads to transformation of the environmental problems rather then preventing them
- ad-hoc approach to technology selection can not ensure optimal results
- Social factors can not be neglected if the waste prevention technologies are to be effective

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Main Steps of EnTA Procedure

- Examine the reason for the proposed technology
- Description of the technology
- System alternatives
- Future state of society assumptions
- Stakeholders - Parties at interest

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Main Steps of EnTA Procedure (cont'd)

- Identification of potential impacts
- Identification of relevant decision-makers
- Public policy issues
- Conclusions and recommendations

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Features of EnTA Process

- Evaluation is applied equally to the problem technology and the alternatives
- examines also the supply-chain and infrastructure needs
- examines all environmental impacts, including social aspects
- displays the options in a comparative fashion

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UNEP's input in the development and application of EnTA

- Developed EnTA primer and workbook to documents the development and descriptions of this assessment tool
- To perfect the methodology of EnTA by applying it on technologies in certain sectors
- To integrate EnTA into the environmental management "tool box"

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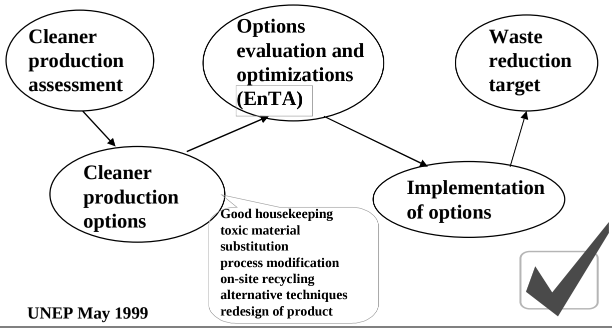
EnTA application to waste prevention at company level



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EnTA application to waste prevention at government level

- Assisting the implementation of waste prevention programmes
- Integration of social factors in technology choice for waste prevention
- Development of policy framework for technology import which incorporate environmental considerations

UNEP May 1999

Conclusions

The use of formal environmental technology assessment methodology for waste prevention and treatment technologies can avoid decisions based only on limited number of the environmental criteria and optimize the result of the waste prevention efforts.

UNEP May 1999

TOWARD A STRATEGIC FRAMEWORK FOR SETTING NATIONAL-LEVEL WASTE PREVENTION TARGETS

by
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WASTE MINIMISATION SESSION: 3

Introduction

The vast majority of OECD member countries acknowledge the existence of a waste management hierarchy and place waste prevention at the top of the hierarchy(1) While support for waste prevention is strong, it has proved somewhat difficult to devise effective ways to foster waste prevention. The adoption of targets has been a prominent feature of many efforts to foster environmental improvements. Perhaps the best known example of targeting involves the emissions of greenhouse gases. In the waste management area, targets have been an important element of efforts to improve national-level recycling, and to reduce the disposal of particular waste streams such as packaging.(2) Adoption of targets could enhance the status of waste prevention, and so foster its adoption. This paper addresses the development of a strategic framework for setting national-level, waste prevention targets. Discussion of a strategic framework is not meant to imply that there is a single set of goals which would be appropriate for all OECD member countries, or which would remain unchanged over time. Selection of targets, as well as the ways to meet them, may vary by country and change over time.

The paper builds on past OECD efforts, particularly the discussion of targeting at the 1996 OECD Workshop in Berlin.(3) The paper begins by reviewing key features of waste prevention which are relevant to target-setting. Next, the paper describes the **structure of waste prevention targets**. Setting targets involves a number of choices. The paper discusses these choices in detail, and indicates the different types of waste prevention targets which can result from different choices. As this discussion shows, the proposed structure for waste prevention targets provides a strategic framework for target- setting. Using the structure of waste prevention targets as a framework, the paper addresses a number of questions relevant to the process of waste prevention target-setting.

This paper does not complete the task of developing a strategic framework for setting national-level, waste prevention targets. Hopefully, the paper does provide a sufficiently detailed preliminary discussion of an initial framework, so that the setting of national-level waste prevention targets can go forward more easily, and be accomplished in a more coherent and informed fashion. With the accumulation of additional experience, the framework presented in this paper can be refined in the future.

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2 Prepared under contract and consultation with the OECD Secretariat.

Key features of waste prevention

OECD defines waste prevention [4] as any of the following three types of actions:

- **Strict Prevention (SP).** Strictly avoiding waste generation, by virtual elimination of hazardous substances or by reducing material or energy intensity in production, consumption and distribution.

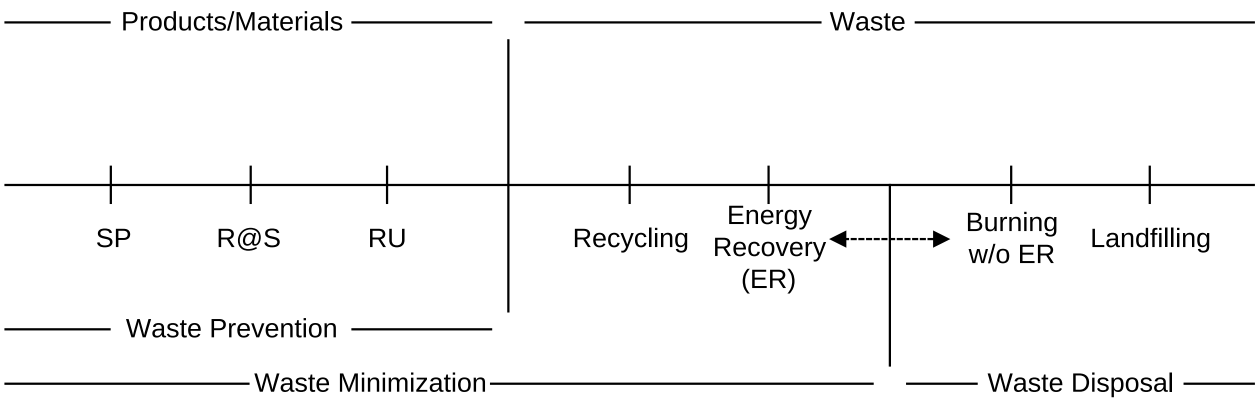
- **Reduction at Source (R@S).** Minimizing use of toxic or harmful substances; minimizing material or energy consumption.

- **Re-Use (RU).** Multiple use of a product in its original form, for its original purpose or an alternative, with or without reconditioning.

Waste prevention can be divided into actions resulting in the generation of less waste ("quantitative improvements") and actions resulting in less toxic hazardous material entering the waste stream ("qualitative improvements").

Waste prevention is itself part of a broader concept, waste minimization, which in turn is part of the materials management as well as the waste management hierarchy. These relationships are shown graphically in Figure 1 below. In the figure, specific options for dealing with waste are arranged along the second line from the top. The bottom two lines show the grouping of these options into waste prevention, waste minimization, and waste disposal. The chart separates between burning with and without energy recovery. However, as indicated by the dashed arrow, all burning might be included in minimization or in disposal. A key feature of waste prevention which distinguishes it from the rest of waste management is that it occurs before products and materials are recognized as waste. This feature is captured by the top line of the chart.

Figure 1. **Waste prevention in context**



Compared to the rest of waste management, waste prevention is complex and, in some ways, a bit elusive. There are a number of factors that contribute to this situation. Waste prevention is diverse in its focus. It addresses the tonnage, toxicity or hazard, and energy content of materials which may become waste. Waste prevention is also defined by changes such as avoiding, reducing or reusing materials. In general, it is more difficult to come to grips with changes than it is with absolute levels. Finally, waste prevention occurs before products or materials are identified or tracked as waste. Thus, when addressing waste prevention one often lacks basic data which is used to monitor other waste management activities. All of these factors need to be considered when setting waste prevention targets.

Setting waste prevention targets

WP target-setting requires three related choices. In making the choices required for setting a waste prevention target, there are numerous options to consider.

1. The **material stream(s)** subject to the target. To begin broadly, one could, for example, target the Total Material Requirements of the economy.(5) Moving to a narrower focus, one could target one of the broad waste streams—municipal solid waste, hazardous waste, industrial waste, etc.—on which OECD collects information.(6) Finally, one could target particular components defined either by product or material within one of the broad waste streams. Within Municipal Solid Waste (MSW) one could, for example, target either packaging or plastics.

2. The **procedure for measuring prevention** for the chosen streams. Initially, one must select a measurement unit. Here the choices include tonnage or tonnage weighted by a direct or indirect measure of environmental impact.(7) Next, one must decide whether to measure the absolute amount prevented, or the amount prevented relative to the number of persons, units of GDP, units of output, or some other numerare. Using the unit and approach selected one must specify a method for computing waste prevention.(8)

3. The **goal** to be met. Ideally, the goal will be expressed as a value of the chosen measure and the date by which it will be achieved. One can set goals based on historic levels, economic analyses such as cost/benefit analysis, technical considerations, or benchmarks derived, for example, from the best practice of waste prevention for the stream under consideration. Which of these choices will prove appropriate in a given circumstance will depend on the nature of the stream being considered, as well as the views of those setting the targets.

The range of choices involved in target-setting is summarized in Table 1 below. The choices shown in the three columns of the table can be made in a relatively independent fashion, resulting in a very large number of options for target-setting. There are many examples of waste prevention targets which illustrate the choices shown in Table 1. Some examples include the following:

- The U.S. EPA has set 1990 per-capita generation of MSW as a target for generation per-capita generation in 2005. This involves waste prevention because current per-capita generation is above 1990 levels.(9)

- To avoid an eco tax in 1995, Belgian beer containers had to be 95 percent reused.(10)

- The Dutch Packaging Covenant requires that, by 2000, all packaging colorants containing heavy metals be replaced by alternatives.(11)

Table 1. **Possible Choices for Target-Setting**

Stream	*Measurement Procedure*	*Basis for Goals*
Total Materials Requirements Municipal Solid Waste Packaging Plastics	Absolute amount; number of items, tonnage, tonnage Relative amount; per capita, unit of GDP or unit of output Weighted by hazard or energy Content of waste stream	Historic: % of past or current level (includes bans) Economic: based on Life-Cycle Analysis, Cost/Benefit ratio, etc. Technical; % of lowest feasible level “Benchmark”: % of level achieved by best practice

The requirements for setting waste prevention targets described above are rather rigorous. They could be modified in a variety of ways to make them less so. For example, one could simply identify stream(s) to be reduced, and require the reduction to be accomplished “to the extent reasonably feasible.” However, without the specification of a measurement procedure, and the identification of goals and dates by which they are to be achieved, the target as well as the basis for assessing progress in meeting it becomes quite vague. It is the author’s view that the three choices discussed—material stream(s), measurement procedure, and numerical goal—provide a useful minimum structure for a waste prevention target.

One could extend the definition of waste prevention targets by including a choice of the form of waste prevention (i.e., strict prevention, reduction at source, or reuse) that is required. While this may have merit in some cases, such as the requirement for reuse of beer bottles cited above, not all targets include this choice. Thus, the target-setting process proposed here does not include the choice of a specific form of waste prevention.

Questions on targeting

This section addresses a number of questions concerning the process of setting waste prevention targets. The questions raise issues addressed in past OECD and other research. These resources will be noted. Here, however, the focus will be on the contribution which the structure of target-setting discussed above can make in answering the questions.

1. Why and when do waste prevention targets have value?

Setting targets is useful because it makes waste prevention for a particular stream more visible. And, what is noticed often is what gets addressed. As was noted earlier, compared to other elements of the waste management hierarchy, waste prevention is complex and a bit elusive. Target-setting is one way to help waste managers and the public address certain well-defined waste prevention objectives and then evaluate the progress (or lack of it) associated with these efforts.

Setting a target is a particularly attractive option if a "reasonable" numerical goal can be specified. As indicated in Table 1, there is a wide range of approaches available for goal-setting.

2. What advantages do waste prevention targets offer, compared to targets for recycling or for reduced disposal?

Because they focus attention "upstream," before products and materials become waste, all waste prevention targets foster innovation. Product innovation can reduce weight, hazard or energy content, prolong life or foster reuse, all of which keep materials out of the waste stream. By the time products are available for recycling, innovation to keep them out of the waste stream is no longer an issue. Targets for reduced disposal foster both recycling and waste prevention. However, because recycling is a more firmly established activity than waste prevention, recycling and not waste prevention will often occur in response to targets for reduced disposal. Only waste prevention targets directly foster changes "upstream," leading to less waste generation in the first place.

There are often greater environmental benefits to waste prevention than any mode of waste management. This difference has been demonstrated, for example, in U.S. EPA studies which examined the greenhouse gas emissions impacts of recycling and waste prevention. For almost all materials, studies have shown that more greenhouse gas emissions are avoided if waste is prevented, rather than managed.[(12)] Ultimately, the preference for prevention targets rests on the preference for prevention which, as noted earlier, almost all OECD member countries place at the top of the waste management hierarchy.

3. How can waste prevention targets be set to promote innovation?

The ability to foster innovation can be considered when making each of the three choices that define a target. One might begin by selecting streams for target-setting where there is room for innovations. Next, one could select measurement procedures which rewarded all reductions in waste. Measuring waste prevention based on the difference between current waste generation and waste generation in a historical, reference year will capture all such effects.[(13)] Finally, one could adopt goals in ways that might stimulate those involved in innovation.

Innovation does not just happen.[(14)] Much innovation occurs within specialized units of certain firms. Further, not all "good ideas" actually make it to market. With this in mind one might set goals and take related actions which give innovations that foster waste prevention the best opportunity to make the grade to new products. For example, one might set a goal for reduction in office paper waste, and combine the adoption of that goal with an effort to promote the production and sale of copiers and printers which produce two-sided copies as their "default" mode. In the U.S. such promotions are referred to as "golden carrot programs" because they often provide a large lump sum payment when a Company's sales of the desired type of equipment reach a specified level.

Golden carrot programs are a specific instance of a market transformation program. There is a very large body of literature on the topic of market transformation, much of it developed as an adjunct of efforts to foster energy efficiency[15], which addresses the concerns raised by this question. This literature, suitably interpreted, can be very useful in the development of strategies designed to foster waste prevention efforts.

4. How can waste prevention target-setting be linked to other efforts to mitigate environmental problems?

Waste prevention can be situated as part of an overall approach to the environment. To do this one might situate waste prevention within a system of indicators for sustainable development. Research prepared for UNEP/RIVM provides a useful overview of options for this process.[16] OECD[17] and U.N.[18] studies provide examples of such indicator systems. With waste situated as part of a broad system of indicators for sustainability, one can set waste prevention targets as part of the process of target-setting for the entire indicator system. Alternatively, one can develop procedures for aggregating across the entire system of sustainability indicators[19] and simply set targets for the aggregate. Either way, the desired type of linkage is established.

When developing waste prevention targets, one can focus on streams for which waste prevention would help mitigate other environmental problems. For these streams, one can use measurement techniques that reflect environmental impacts. For example, for waste streams that pose environmental hazards, one could measure the stream based on “hazard” weighted tonnage. Finally, one can combine the setting of waste prevention goals with other environmental initiatives. For example, the improved copiers and printers discussed in response to question 3 can be energy efficient and provide double-sided copying as a default mode of operation. One can set goals for equipment and structure associated promotions to address both issues.

5. What considerations should inform government actions when developing waste prevention targets?

The three-part structure of waste prevention targets—steams, measures, and goals—provides a useful framework for target development. If governments operate within this framework when developing targeting proposals, it can help them structure what can be a difficult policy development process, to ensure that the resulting targets meet a country’s needs and objectives as well as possible.

The natural starting point for target development is the identification and prioritization of the waste streams for which targets might be developed. The OECD has addressed the issues and tools for this task.[20] Choice of measurement methods and goals can be as important as the selection of the streams for which targets are to be developed. When considering the measures to use, governments should take into account the ability of the measures to capture desired changes such as reductions in hazard, as well as the availability and cost of the data required for measurement. Finally, when setting goals, it is important to balance realism concerning the ability to meet the goals set against the desire for substantial improvement. The difficulty is often in judging where a balance might lie. If this becomes a key issue, one can develop goals based on the economic, technical or “benchmark” approaches noted in Table 1 above. Use of these approaches can provide a somewhat objective basis on which to set a specific numerical goal.

The three choices required to set a waste prevention target can often benefit from widespread input. Industry, government, non-governmental organizations, and “the public” may all have useful contributions to make. Recent research stresses the need to manage “stakeholder” processes, to ensure that they function effectively.[21] In order to keep the process coherent, it is useful to request that all inputs address one or more of the three choices required for target-setting. Finally, before initiating input on waste prevention targets, it is important to decide what the end product of the undertaking will be. If a report, set of recommendations, or other specific output is desired, it is important to structure the process so that the means by which the end product will be produced, and the timetable for producing it, is clear from the beginning.

6. What are the relative merits of different methods for achieving waste prevention targets?

All of the basic instruments — economic, regulatory, and informational — and both of the basic approaches — voluntary and mandatory — have merit as means of achieving waste prevention. Past OECD research has shown that the choice of instruments to foster waste minimization, of which waste prevention is a part, needs to reflect a nation's "socio-cultural" context and a wide range of other concerns.(22) The available research does not clearly support the choice of a particular type of instrument or approach to foster waste minimization. Some authorities suggest that, when dealing with any environmental issue, economic instruments provide the best option.(23) However, OECD research suggests that for strict prevention or reduction at source, regulatory and informational approaches may be preferable to economic approaches.(24)

It is useful to let target structure and the rationale supporting it guide the selection of instruments and approaches. In some cases, such as targets to reduce use of a hazardous material which has few substitutes, a regulatory approach involving a ban may be best. In targets for a material stream which does not have great hazardous content and where private sector innovation may be crucial to waste prevention, it may be best to adopt a voluntary approach and to structure the target so that it has an economic incentive at its core. Deposit-refund systems are an example of this approach.

Combinations of instruments can often be the best choice. For example, in the area of municipal solid waste, experience shows one can combine charges based on the weight or volume of waste set out for disposal and informational activities designed to promote on-site disposal through "back-yard composting," to greatly reduce the disposal of household organic waste off site.(25) Studies also show that such efforts can have negative costs (i.e., generate savings in solid waste managed expenditures).(26)

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20. See, for example, the initial paper in the volume cited in 8 above, and particularly the summary of Cross Cutting Issue 1.

21. Yosie, Terry F. and T.D. Herbst, 1998. *Using Stakeholder Processes in Environmental Decisionmaking: An Evaluation of Lessons Learned, Key Issues, and Future Challenges*. September.

22. See the discussion of Cross Cutting Issue 3 in the OECD volume cited in 8 above.

23. Baumel, William J. and W.E. Oates, 1988. *The theory of environmental policy*. Cambridge University Press.

24. See the table on page 140 of the OECD volume cited in 8 above.

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POWERPOINT PRESENTATION [John Stutz]

TOWARD A STRATEGIC FRAMEWORK FOR SETTING NATIONAL LEVEL, WASTE PREVENTION TARGETS

(Outline - Part a)

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March 23, 1999

Background

- The vast majority of OECD member countries place waste prevention (WP) at the top of the waste hierarchy.
- Development and adoption of targets has fostered use of other waste management options, such as recycling.
- Target setting is one way to make waste prevention a higher priority.

1

Objectives

- Review key features of WP relevant to target setting.
- Identify the **structure** of WP targets.
- Describe the different types of WP targets.
- Use the structure as a framework to discuss some questions relevant to the WP target setting.

2

Key Points From the Report

- Compared to the rest of waste management, WP is complex and a bit elusive. This needs to be considered when setting WP targets.
- Setting targets involves three choices: stream(s) to be addressed, measurement approach, and specific goal(s). These choices provide a framework for addressing many questions.
- Selection of target(s) and the ways to meet them may vary significantly by country.

3

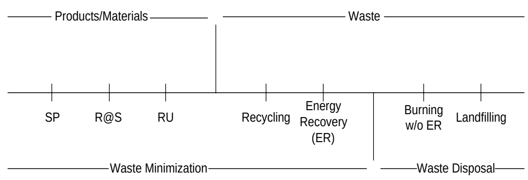
What is Waste Prevention?

OECD defines waste prevention as any of the following:

- **Strict Prevention (SP).** Strictly avoiding waste generation, by virtual elimination of hazardous substances or by reducing material or energy intensity in production, consumption and distribution.
- **Reduction at Source (R@S).** Minimizing use of toxic or harmful substances; minimizing material or energy consumption.
- **Re-Use (RU).** Multiple use of a product in its original form, for its original purpose or an alternative, with or without reconditioning.

4

How Does WP Relate to the Rest of Waste Management?



What Makes WP Complex and a Bit Elusive?

- Diversity in focus - tonnage, toxicity/hazard, energy content.
- Defined by change - avoid, reduce, reuse in place of new.
- Occurs before waste is identified (or tracked).

6

The Structure of WP Targets

WP target setting requires three related choices:

- The material stream(s) subject to the target.
- The procedure for measuring prevention for the chosen streams.
- The goal sought; ideally the value of the measure and the date it will be achieved.

7

Possible Choices for Targets

Stream	Measuring Procedure	Goal
Total Materials Requirements	Amount; Tonnage, Tonnage weighted by hazard or energy use	Historic: % of past or current level (Bans, % = 0)
MSW	Amount per capita, unit of GDP, unit of output	Economic: specified by cost, C/B ratio
Packaging		Technical; % of lowest feasible level
Plastics		Comparative: % of level achieved by best practice

8

Some Examples of WP Targets

- In 2000 half of Canada's packaging waste from disposal is to be met by reuse or reduction.
- The US EPA has set 1990 MSW generation per capita as the target for MSW generation per capita in 2005.
- To avoid an eco-tax in 1995, 95% of Belgian beer containers had to be reused.
- The Dutch Packaging Covenant requires that by 2000 all packaging colorants containing heavy metals be replaced by alternatives.

9

How Specific Should WP Targets Be?

- One can simply identify stream(s) to be reduced, in tonnage, toxicity/hazard or energy content, to the extent "feasible."
- Targets can specify the form WP is to take, or leave it open. The wider the compliance option, the greater the measurement challenge.
- Gauging progress requires use of some measuring system.
- Without numerical goals targets are vague.

10

Questions on Targeting

- When and why do WP targets have value?
- What advantages do WP targets offer compared to other targets for recycling or reduced disposal?
- How can WP targets be linked to the mitigation of other environmental problems?
- How can WP targets be set to promote innovation?
- What considerations should governments make when developing WP targets?
- What are the merits of different methods for achieving WP targets?

11

What Advantages Do WP Targets Offer for Recycling or Reduced Disposal?

- Recycling does not address the decisions that create waste, only WP operates "upstream" before things become waste.
- Prevention often provides greater environmental benefits. (Ex. - per ton of many materials WP avoids more GHG emissions than recycling.)
- WP targets foster the choice of prevention over recycling or energy recovery, targets. For diversion all waste minimization equally.?????
-

13

How Can WP Targets Be Linked to the Mitigation of other Environmental Problems?

- Situate WP as part of an overall approach to the environment.
- Select streams for which WP would mitigate other problems.
- Select options (ex. all WA or only reuse) for meeting targets with eye to environment externalities.
- Use measures that reflect environmental externalities (ex. count prevented tons weighted by energy content).
- Combine WP with other environmental initiatives (ex. "push" energy efficient copies that are "default duplex").

14

How Can Targets Be Set to Promote Innovation?

- Foster waste prevention over management whenever possible: include WP targets in other waste management efforts (ex. Canada includes WP in packaging waste diversion).
- Make innovation or "design element" in WP target development:
  - Specify streams so there is room for innovation, such as material substitution.
  - Bar undesirable materials with feasible alternatives, or weight their reduction heavily in meeting goals.
- Coordinate WP targets with other efforts to promote innovation (ex. "golden carrot" programs).

15

What Considerations Should Governments Make When Developing WP Targets?

- Use streams, measures, goals as an explicit framework for target development. Define "terms of discussion" at the outset:
  - Streams; breadth and focus of coverage, coherence (families).
  - Measures; ability to capture desired changes, availability/cost of data.
  - Goals; balance "realism" vs. "real improvement."
- Arrange for widespread input - industry, government, NGOs, "the public." Insist strongly that all address the framework.
- Decide at the start what "end product" - report, recommendations, etc. - is desired, and how/when it will be produced.

16

What Are the Merits of Different Methods for Achieving WP Targets?

- All the basic instruments - economic, regulatory and information - and approach - voluntary, mandatory - have shown some success.
- Target structure, and the rationale supporting it, should help guide selection of instruments and approaches.
- Consistency in instruments and approach with related efforts (ex. recycling, water/air emissions) is desirable.
- Selections of instruments and approaches are not mutually exclusive; combinations can often be the best choice.

17

RESOURCE FLOWS BROADENING THE FRAMEWORK FOR PREVENTING WASTE

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WASTE MINIMISATION SESSION: 3

1. Introduction

Waste prevention policies aim to reduce waste at the source and through reuse. So far, they focus primarily on single stages of the cycle of materials or on single types of waste. These policies reflect the reality that environmental problems have emerged and been addressed individually as, for example, mine tailings from extraction, hazardous waste from manufacturing facilities, greenhouse gas emissions from power-generating plants, or municipal waste largely from products. Extended Producer/Product Responsibility begins to build policy on recognition of the product cycle. However, no single set of physical accounts now provides the basis for taking a strategic approach to waste prevention.

With colleagues in four other countries, the World Resources Institute (WRI), based in the United States, is developing a system to account for the physical materials used by national economies[3]. The accounts provide a standard framework for tracking materials into, through, and out of economies at all stages of the cycle from extraction, processing and manufacturing to use, recapture, and discard. The intent is to use materials as the currency to help countries to track physical performance of economies as monetary accounts of inputs and outputs help track economic performance. The physical accounts have the potential to provide the big picture of resource flows needed to make strategic choices about where to focus prevention—on which materials and at which stages of the life cycle—and monitor progress.

2. The Key Elements of the Proposed Physical Accounts

WRI and its partners completed the first stage of their work on physical accounts in 1997. The report *Resource Flows: The Material Basis of Industrial Economies*[4] estimates material inputs for the economies of Germany, Japan, the Netherlands, and the United States. The second stage is scheduled for completion

[3] See www.wri.org/wri/sdis/indictrs for description of WRI work on indicators and a series of occasional emails about the second phase of the material flow work.

[4] Albert Adriaanse Stefan Bringezu, Allen Hammond, Yuichi Moriguchi, Eric Rodenburg, Donald Rogich, and Helmut Schutz, *Resource Flows: The Material Basis of Industrial Economies*. World Resources Institute, Washington, D.C., USA; Wuppertal Institute, Wuppertal, Federal Republic of Germany; Netherlands Ministry of Housing, Spatial Planning, and Environment, The Hague, Netherlands; National Institute for Environmental Studies, Tsukuba, Japan. April 1997.

in the fall of 1999. It will provide estimates of material outputs for five countries, the original partners plus Austria.

Materials. The framework assumes that economies are made up of material flows broken into product streams. The WRI database includes accounts for about 55 material flows, which are further divided into about 500 use streams. Thus the flow of arsenic is tracked in uses including wood preservatives, agricultural chemicals, glass, alloys, and other. The flows included make up about 95% of the weight of materials in the economy. The major categories of flows covered are industrial minerals, construction materials, metals, chemicals, infrastructure, fossil fuels, agriculture, forestry, and imports and exports of semi-manufactured goods.

Characteristics. The first WRI report presents the *quantity* of material inputs to the economy. Unlike dollars, of course, materials are not uniform. Therefore, the second phase characterizes each flow in three additional ways that relate to environmental impact.

- Material *quality* is the potential to interact with the environment physically and chemically over time once the material leaves the economy. Quality is rated as one of five categories: biodegradable, replicates geologic processes, chemically active or biologically hazardous, chemically processed, and heavy metals, synthetic and persistent, or radioactive materials.

- *Mode of release* to the environment determines the spatial scale at which effects will occur. The six release categories distinguish whether the release is contained, as in a landfill, or released directly to the environment and whether its form is a solid, liquid or gas.

- A material flow's *velocity* is the length of time the material remains in the economy: less than two years, two to 30 years, or more than 30 years.

Material units vary greatly in the type and severity of potential impact. This system of characterization allows users of the data to differentiate the flows by potential impact. As others further develop the physical accounts, they can apply other characteristics such as economic value, volume, or particular types of toxicity.

Stages of the materials cycle. (See figure 1[5]) The database covers inputs and outputs. Material inputs to the economy are production plus imports and recycled material, minus exports, equaling apparent use. Outputs to the environment are estimated for extraction, processing and manufacturing, dispersive use, discards from use, and recapture (recycle, remanufacture, reuse). The amount going to stock, such as the material entering infrastructure where it will remain for over 30 years, is also calculated. Stocks are important as potential sources of material, storage (sequestration of carbon), and liability, and because they alter the landscape.

Time, space, and economic scales. The database for U.S. material flows contains annual data starting with 1975 and going through 1996. The methodology, in concept, is applicable at any geographic or economic scale. While the WRI accounts are at the scale of national economies, accounts can also be developed for geographic levels from regional to continental to global or any economic level from individuals, households, and firms to sectors.

Indicators. A major goal of the WRI work with its partners is to develop indicators for the physical economy. The first report proposes a series of indicators for material inputs into the economy. As a

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5 Donald Rogich, Eric Rodenburg, and Christian Ottke, Characterizing the Physical Economy, Draft paper, April 1999.

summary indicator, the report suggests the Total Materials Requirement (TMR), that is the total use of natural resources the economy requires. One important finding: 55 to 75 percent of this requirement is “hidden”. Hidden resources, such as overburden from mining, do not enter the economy but that are moved as part of extraction, agriculture, or building infrastructure. The TMR can be used to measure the materials intensity of a country’s economy by dividing it by the Gross Domestic Product or by population. The report found the annual TMR ranges from 45 to 85 metric tons of natural resources per person in the four national economies included in the project.

Challenges. The proposed physical accounts are a prototype or release.0. They are structured so that others can build on them by refining terms, improving data, and applying additional characteristics. The limitations of the first accounts include the following.

- No set of terms to describe the flow of materials into, through, and out of the economy is widely accepted. While the accounts propose a language for flows, use of terms varies widely among professions and disciplines, governmental programs, and countries leading to often confusing debate.

- The accounts rely on extrapolating and interpolating existing data and on expert judgment. In many cases, data are lacking, uneven, or otherwise inadequate, particularly for applying characteristics to flows.

- The accounts are not geographically referenced. The tools to provide site specificity are rapidly developing, however.

- The accounts cover flows resulting from human activity; they do not include natural flows.

3. Opportunities to Use Physical Accounts in Strategic Waste Minimization Policy

Physical accounts provide a basis for decisionmakers and the public to take a unified approach to the relationship of resources and the environment. As they develop, physical accounts will support more strategic choices of waste prevention targets by providing a systematic view of material flows.

3.1 Some ways in which physical accounts broaden the approach to waste prevention

- The accounts focus on the *source* of waste. They provide a single framework to track the sources of outputs to the environment (whether as waste, releases, or dispersive use) as physical materials move through the economy.

- The accounts cover outputs at *all stages of material cycles* through the economy (extraction, production, and consumption, that is use and discard of products) and include recapture (recycling, remanufacture, reuse) and stock. They encompass and go beyond the many separate legal definitions of waste, pollution, releases, emissions, discharges, and transfers to propose a standard language based on material flows.

- The accounts are built on the assumption that any flow of material out of or into the environment has the potential for impact. However, the flows are characterized by quality, mode of release, and velocity which allows moving beyond quantity in setting prevention goals. Thus flows with *different potential to impact* the environment can be selected for prevention goals.

- The accounts track material *inputs* as well as outputs. They allow rough balancing of where material comes from and where it goes.

- By tracking all flows, the accounts increase ability to *identify substitution* among materials flowing through the economy.

3.2 Some starting points for setting prevention goals and measuring progress

The physical accounts will provide data for setting and tracking waste prevention goals for total flows in national economies, for individual material flows or categories of flows, for specific stages of material cycles, and for flows with specific characteristics.

- *Total flows in a national economy*. Using the framework, waste prevention as reduction in the intensity of waste generation can be measured for total material flows through the economy. Initial work for OECD demonstrates one way in which this can be done by applying a family of macro waste prevention indicators to the Total Materials Requirement for each of four economies[6]. The second phase data on outputs will provide an additional base for applying these indicators to measure prevention potential.

- *Categories of flows or individual material flows*. The accounts cover major material flows in economies. Thus they can provide a basis for selecting which waste streams to address with which policies. They will support setting priorities for prevention *among* material flows based on quantity as well as quality, mode of release, and velocity. Existing priorities such as greenhouse gases and persistent chemicals or wastestreams from particular sectors can also assessed within this broader picture.

- *Specific stages of flows*. Because the physical accounts cover all stages of the cycle, they will allow policymakers to identify specific stages at which waste prevention might most effectively be applied. A likely starting point for prevention aimed at reducing waste generation at the source is the first stage of the cycle-extraction. Goals set at this stage reduce material *entering* the economy and thus reduce waste generation throughout the cycle. Prevention at this stage is also likely to reduce the huge hidden flows. Because they do not enter the economy so are not priced and also frequently occur at a distance from users of products, these flows are often not considered in waste prevention.

- *Specific characteristics of material flows.* Waste prevention goals might be set to increase the length of time a material spends in the economy before it enters the environment (reducing its velocity). The initial physical accounts will provide the data to identify material flows with high velocity such as materials dissipated in the environment during use or discarded in less than two years. Depending on their characteristics, these flows might be good candidates for prevention goals.

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6 Toward Waste Prevention Performance Indicators. Prepared by Tellus Institute for the OECD. First draft report presented to the Ottawa Meeting of the OECD Expert Group on Waste Minimisation. December 7-8, 1998.

4. Strategic Waste Prevention Policy: Toward a Resource Framework Based on Material Flows

Physical accounts can help develop strategic waste prevention policy by encouraging institutional coordination, supporting work at the sectoral level, and informing public debate and action.

4.1 Encourage institutional coordination on waste prevention

The need to coordinate policies within and among institutions is increasingly recognized[7]. Strategic waste minimization policy will look for links to solving other environmental problems and encourage partnership among institutions that address different points of the material flow.

- *Attaining multiple environmental goals*. Physical accounts of material flows can be used to identify and realize synergies between achieving waste prevention and addressing other environmental issues such as climate change and loss of biodiversity.

- *Providing a basis for institutional cooperation across the material flow*. For example, the accounts might support interagency consultations on longer-term waste prevention policies among governmental agencies and others working at the extraction stage with those focused on minimizing and managing waste at the other end of the cycle..

4.2 Support waste prevention in economic sectors

A next step in WRI's work will be to develop physical accounts for sample sectors such as agriculture and forestry. As physical accounts are developed for economic sectors, they can provide the data for developing policies that address waste prevention at both production and consumption phases of the material flow. A new WRI report on consumption trends[8] covers the natural resource sectors of agriculture, forestry, and fisheries. It outlines opportunities for policies to prevent waste in use of fertilizer and wood fiber. Now under half of the nitrogen applied to crops world-wide is actually used by growing plants, for instance.

Sectors can also be combined with regions to provide physical accounts at a useful scale identifying policy options. The U.S. Geological Survey is documenting the flow of stone, sand, and gravel used in construction in the Rocky Mountain Front Range and the Mid-Atlantic[9]. These studies are aimed at giving policymakers tools for evaluating methods for sustaining resources for infrastructure.

4.3 Inform public debate and action on waste prevention

Standardized accounts of material flows can be used to stimulate public debate on the physical basis of the economy, that is how society uses resources. The accounts will provide a language and data to enable the

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7 See, for example, Robert T. Watson et al., *Protecting Our Planet, Securing Our Future*. United Nations Environment Programme, U.S. National Aeronautics and Space Administration, and The World Bank, November 1998.

8 Emily Matthews and Allen Hammond, *Critical Consumption Trends and Implications: Degrading Earth's Ecosystems*", World Resources Institute, 1999.

9 Natural Aggregates—Foundation of America's Future, USGS Fact Sheet FS 133-97, November 1997. Also see http://minerals.er.usgs.gov/minerals.

public and policymakers to distinguish types of materials cycles such as the grand cycles of carbon and nitrogen, the cycles of metals, and cycles of construction materials, for example.

Attention can turn to developing increasingly systematic waste prevention strategies that consciously enhance the characteristics of materials that society selects for different purposes and the kinds of material cycles needed to achieve economic, environmental, and social goals. Green chemistry, design for environment, EPR, and Energy Star programs are already beginning to take this approach. Indicators might track investments by business, communities, and governments in increasing the quality and reducing the quantity, velocity, and dispersion of material flows. Goals can be set and policies adopted to improve the character of priority material flows.

POWERPOINT PRESENTATION [Fran Irwin]

Resource Flows:
Broadening the Framework for Preventing Waste

Frances H. Irwin
World Resources Institute
Workshop on EPR and Waste Minimization Policy
OECD, Paris, May 4-7, 1999

Establishing Physical Accounts

- Physical accounts to parallel monetary accounts
- Use materials (resources) as currency
- Use framework of resource flows to track materials cycle
  - natural resources entering and moving through economy
  - wastes and pollutants leaving the economy at each stage

What Materials Do They Cover?

- 95% of weight of materials in the economy
- 55 materials and 500 product or use streams
- Major categories include:
  - non-renewable—minerals, metals, fossil fuels, petroleum
  - renewable materials—agriculture, animals, forestry
  - movements of earth from soil erosion, construction, mining, dredging

How Do They Characterize Materials?

- Quantity—weight
- Quality—five categories such as biodegradable or persistent
- Mode of release—contained? solid, liquid, or gas
- Velocity—time material remains in the economy (2, 30, more than 30 years)

Approach: Encourage others to apply characteristics such as toxicity, volume, economic value

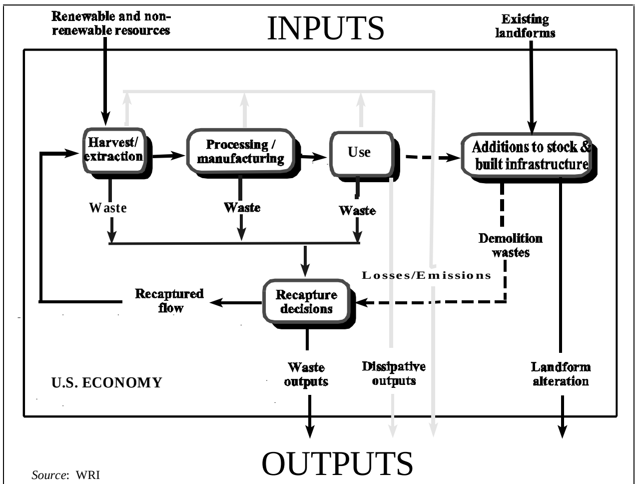
What Stages of the Materials Cycle Are Covered?

- Inputs: production, plus imports, minus exports equal apparent use
- Outputs: extraction, processing and manufacturing, use, recapture, stock
- Recapture: recycling, reuse, remanufacture
- Stock: over 30 years, such as infrastructure

What Time, Space, and Economic Scales Are Used?

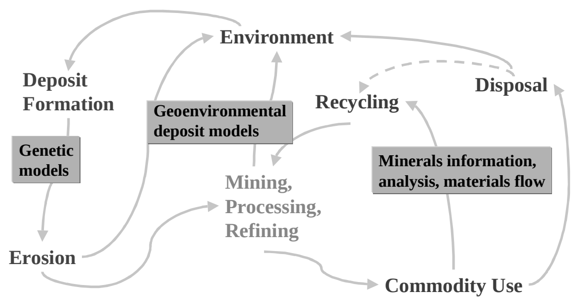
- Time—annual, starting with 1975 baseline
- Space—countries
- Economic—national economies

Approach: Develop methodology that can be used at other scales.



Source: WRI

Life Cycle Models of a Mineral Commodity



Source: USGS Fact Sheet FS-008-98, January 1998

Some Challenges in Developing Physical Accounts

- Terms
- State of data
- Geographic references
- Natural flows

Approach: Make initial database and assumptions widely available as Release zero.

Four Focuses for Waste Prevention Targets

- Total Materials Requirement for national economies
- Categories or individual material flows (i.e. metals or lead)
- Specific stages of material flows (i.e. extraction or dispersion)
- Material flows with specific characteristics (i.e. persistent, high velocity)

Encourage Coordination: Making the Links Along the Cycle

- Across environmental goals
- Across institutions working at different stages along the resource flow

Focus Policies on Priority Issues by Sector

- Agriculture - reduce waste in nitrogen fertilizer application by removing subsidies, moving to services
- Wood fiber- reduce waste through innovative processes, tax policy, increasing efficiency in using paper

Inform Policy Debate

- Targets and indicators based on physical accounts provide language to distinguish cycles
  - carbon and nitrogen
  - construction materials
  - heavy metals and persistent organics
- Base for developing, debating, and selecting mix of information, economic, and regulatory tools to achieve waste prevention

DUTCH PERSPECTIVES ON WASTE PREVENTION TARGET SETTING

by
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WASTE MINIMISATION SESSION: 3

Experiences on target setting

1. Introduction

The prevention of waste is the number one priority in the Dutch waste policy. Prevention is defined as the reduction of the amount (included reuse inside companies) or the hazardness of waste by reduction at the source. The processing of waste leading to a less volume of waste to be landfilled (e.g. incineration) or the reuse of waste is not considered to be prevention.

The policy begins to be more and more integrated in other preventive measures as the reduction of energy consumption, the use of water and the reduction of emissions to air, water and soil (cleaner production).

The fact that prevention is the number one priority in waste management policy is embedded in the Dutch environmental law and the Dutch National Environmental Policy Plan (NEPP). The implementation of this principle is done in several ways.

In this document is described what the experiences are with fixing targets to waste prevention on macro level and on the level of companies.

2. Targets on waste minimisation

Memorandum on waste prevention

The Memorandum on waste prevention was published in 1988. It was the first time that a policy for waste prevention was drawn up. Targets were set for 29 priority waste streams, e.g. used oil, car wrecks, batteries, plastics, paper, build and demolition waste. There was given lead to those waste streams for the way of disposal (prevention, reuse, incineration en landfill). The targets were aimed for qualitative and quantitative reduction (5 % for the year 2000 in view of the amount of waste in 1986). The number of 5 % was a best guess based on surveys and expert judgement.

To reach these goals a two way process of consultations was started between government bodies and industry in order to make implementation plans for the 29 highest priority waste products. In those plans both short-term and long-term measures were drawn up.

National Environmental Policy Plan (NEPP) 1 and NEPP +

In the first National Environmental Policy Plan, established in 1989, the target on waste prevention for the year 2000 was 5 % of the amount of waste in 2000.

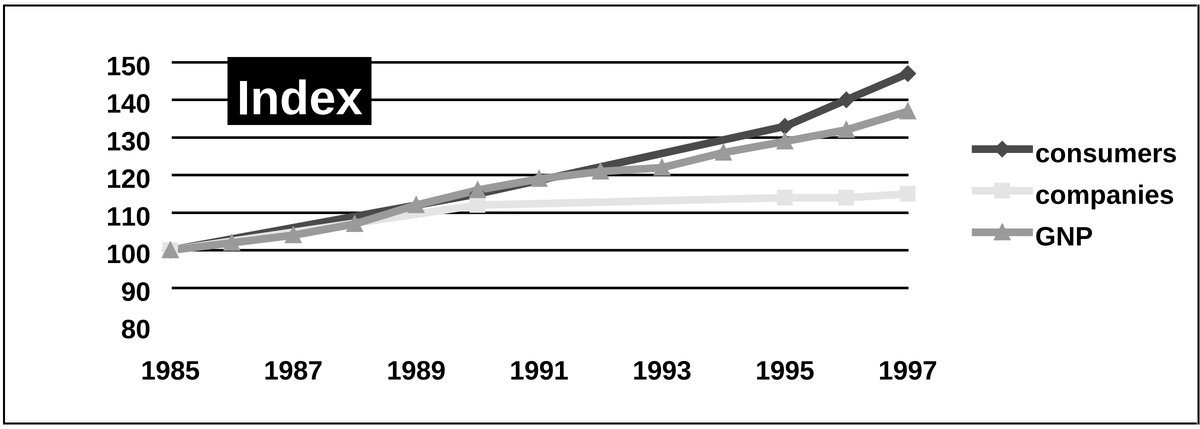
After discussion in Parliament the target for the year 2000 was raised till 10 % that will arise in that year.

National Environmental Policy Plan 2

The approach in NEPP 2 is the same as in NEPP 1. Extrapolating on the basis of a 2 % per year growth in the quantity of waste, there will be 60 million tonnes by the year 2000. The objective of 10 % prevention meant to prevent 6 million tonnes.

National Environmental Policy Plan 3

In the latest NEPP, published in 1998, there is no explicit goal set for the prevention of waste. This is done because of the lack of instruments to measure the amount of waste prevention. Nevertheless, the principle that waste prevention is the number one priority still makes part of the waste policy. In the NEPP is set that the amount of waste may not grow more than to the amount of 56 million tons a year in 2010. This means that the rise of the generation of waste must be substantial lower then the economic growth. This means a major effort on the area of prevention, because historical figures show that the growth in the gross national product and the growth in the amount of waste correlate to each other one to one (see Figure 1).



General conclusions on target setting on macro level

Measuring policy effectiveness where absolute quantities on a macro level are concerned proves difficult. The main reason is that it is not possible to measure the amount of waste that is not produced because of the waste prevention strategy. It is also impossible to draw a sharp distinction between autonomous structural effects and prevention efforts.

In the Netherlands, the setting of a 10 % target worked well. In discussions with Industry and Parliament, this target could be used as a motive to introduce preventive measures. Important was in this respect, that the target of 10 % was considered as ambitious but possible.

3. Possibilities of defining prevention targets on the level of companies

The approach of target groups

A study was executed of the potential for quantitative prevention of industrial waste. This study showed that the lion's share of the most promising waste prevention potential was covered with those branches of industry with which integral environmental tasks (prevention of waste and other elements of environmental protection) had been planned or concluded. These branches were therefore taken as a target group (e.g. chemical industry, dairy industry, paper and paper and paper goods industry). Based on the goals in the NEPP, every four years (in principle) these agreements are evaluated and reconsidered. The way of working is as follows. After the covenant is undersigned by all the covenant partners, an handbook or working book is made by the government in which the goals of the covenant are described and further detailed. For prevention for example, a list of possible measures is part of the handbook. Based on the handbook, every company has to draw up a company environmental plan, in which is described how the goals of the covenant will be realised. The competent authority (province or local community) has to approve the company environmental plan. After that is done, the company environmental plan is translated to the license of the company. A special organisation monitors the company environmental plans. The monitoring results are the basis for the evaluation of the covenant. In the negotiations about the goals with the different target groups, the 10 % goal is used as the basic goal. Based on expert judgement about the possible measures to prevent waste, the target for a specific target group is changed in a higher or in a lower figure. In a lot of cases, no specific target is set and is listed which measures should or could be taken to prevent waste. The notion that waste prevention is necessary and that 10 % prevention is an ambitious target, plays in this negotiation an important role.

In practice, it is difficult to show results in term of tonnage's of waste prevented this way. The main reason is, that it is difficult to determine the effect of the measures all over the target group. The statistical figures of the waste produced by the target groups however, show that the growth of the amount of waste is slowing down.

We think it is important and necessary to set goals for waste prevention on the level of target groups as mentioned above. For every branch, more or less, it should be possible to determine the targets for the main streams of waste. The basis may be the estimation of the summons of measures as a result of legal obligation or an agreement in a covenant (measures of good housekeeping and technical measures which can be taken in a cost effective way). Any way of target setting is a possibility to put the need of taking measures for prevention of waste on the (political) agenda. The non-measurability of these goals is, however important, not an argument for not setting the goal.

The approach of the small and medium sized companies

For small and intermediate companies, there is an other approach. Because of the large amount of these companies and the small size of the major part of them, it is impossible to work with covenants. For these companies, the obligation to prevent waste is put down in legislation. By a general administrative order, the small and medium sized companies are obliged to do everything that is reasonable to prevent waste. To help them with determining what kind of measures can be taken, a special brochure is made up for every part of this group in which examples of possible measures are described. Furthermore, on the national level, the provincial level and the local level, activities are undertaken to introduce and focus on prevention. For example, companies or advisors of companies can be subsidised to carry out a quick scan in which is determined what measures can be taken for prevention in a cost effective way. Also, a lot of demonstration projects are carried out to show that prevention is possible. This must lead to a change in knowledge, attitude and behaviour in respect to prevention, so that in most companies the prevention of waste will be a normal part of their production activities.

The next paragraph will deal with target setting and monitoring on the level of knowledge, attitude and behaviour.

4. Target setting and monitoring on the level of knowledge, attitude and behaviour of companies

Introduction

The greater part of the companies are the small and medium sized ones and they vary in many respects. Therefore target setting done for target groups as mentioned above is not possible. The target for these companies is to raise their knowledge of prevention options and to influence their attitude in order to change their behaviour. When this is reached you may expect that more and more prevention options will be taken.
On account of this fact targets are set and monitoring is executed on the level of knowledge, attitude and behaviour of these companies.

General

In 1995 the Prevention Implementation Strategy 1996 - 2000 has been drawn up by the ministry and the Association of municipalities and provinces. Key issues in this strategy are the cooperation between the different competent authorities, the application of a mix of stimulating and regulating instruments, the capability of self regulation of companies, the development of legislation and the integration of prevention in an integral approach (cleaner production).

One of the actions of this strategy is to determine and to monitor prevention targets on the level of knowledge, attitude and behaviour. In 1995 on this matter a baseline survey has been drawn up. This showed that the group of companies that up till now have few or no prevention options into practice is the largest. Goals were determined for the year 2000.

Next to targets for waste prevention a baseline survey was carried out on the implementation of “Cleaner Production” (CP). CP is a programme, which aims to stimulate the implementation of environmental measures in Small and Medium sized enterprises (SME) from a business perspective. The CP programme aims to integrate the different key areas of environmental policy (environmental management, prevention of waste and emissions, energy reduction, environmental product development and environmental technology).

The reason of monitoring “Cleaner Production” is the experience that many times companies do not make a difference between all kind of possibilities for environmental measurements. For instance when a environmental management system is introduced prevention of waste is included in the system. An other example is that many enterprises do not distinguish between prevention of waste in the meaning of avoidance of waste and separate collection in view of recycling or recovery. Besides most enterprises are not keen of being asked for environmental measurements so many times. By monitoring “Cleaner Production” it is possible to prevent a kind of tiredness of companies caused by gathering information (too) many times.

In contrast with the Implementation Strategy the CP programme contains no targets for the year 2000.

In December 1998 a monitoring is carried out to measure the change in knowledge, attitude and behaviour for CP as well as for prevention. It is the intention to repeat the monitoring of “Cleaner Production” every two years for the key areas mentioned above. In all probability there will be held no more separate monitoring on waste prevention (perhaps one time more in the end of 2000 to compare the results of the target objective set for the year 2000).

Summary and conclusions of monitoring “Cleaner Production”

Approach

The survey is undertaken by KPMG Environmental Consulting and NIPO. It is the first follow-up of the baseline survey of 1997, extended to include companies with more than 100 employees. The results can be compared with the baseline survey in order tot track progress in the attitude, interest and behaviour of companies and sectors in the area of Cleaner Production (CP). The survey also aims at identifying reasons for possible changes and at what the companies motivates to take environmental measures.

The CP programme uses a phase model. The model includes that a company passes trough four phases in the area of CP. These phases include:

- non-interest phase: companies which have no or limited interest in the environment;
- interest phase: companies which are interest in the environment but have not (yet) implemented environmental measures;
- implementation phase: companies which have implemented some environmental measures;
- routinizing phase: companies which have integrated implementation of environmental measures in their approach.

For the purpose of CP measurements, the phase model was translated into quantifiable parameters which regard to attitude, interest and behaviour. These parameters were checked trough telephone interviews with 1 470 companies within the 10 sectors at which the CP policy aims. The results were then extrapolated for the approximately 106,000 companies who belong to these sectors. The companies were classified into one of the four phases by translating the answers given, using a “key”.

Results

Figure 1 shows the distribution of companies over the CP phases in 1999 and 1997. The figure shows that almost half of the Dutch companies have at least started taking environmental measures. It is notable that almost 80 % of the companies with more than 50 employees are already in the implementation and routinizing phases. There is clearly a positive shift compared to 1997. The number of companies in the non-interest and interest phase decreased by 12 %.

The development applies almost all sectors and size classes. Larger companies are still ahead but smaller companies are clearly catching up. Considering the large number of companies with less than 10 employees (74 %) this is the most important reason for the national shift.

	1997	1999
non-interest	22	16
interest	41	35
implementation	22	30
routinizing	15	19

Differences between sectors remain. Sectors who are lagging behind, have partly made up for the difference with front runners. The overall picture is largely determined by the construction sector, road transport sector and the metal electronics-industry. These sectors represent 86 % of the companies surveyed and are relatively behind in implementing environmental measures compared with other sectors (construction materials, chemical and synthetics, paper and graphic food, wholesale trade in hazardous materials, wood and furniture, textile and leather).

Companies generally think positively about CP and are interested in the subject. A large majority is interested in CP and considers it a moral duty to be active with CP.

Companies think differently about the advantages and disadvantages of CP. Improved working conditions is named as the biggest advantage, followed by the reduction of waste and emissions and improving image. Companies are not convinced that CP improves their competitive edge, provides opportunities or reduces costs, but neither find that CP prices them out of the market. The administrative work associated with CP scored as biggest disadvantage.

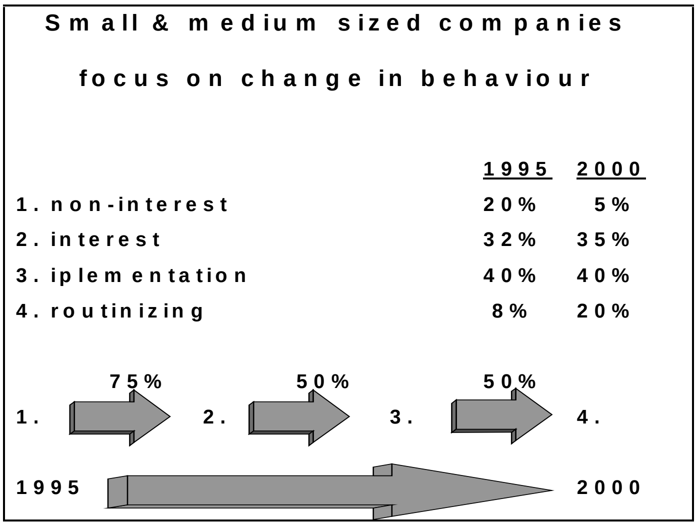
In the past two years, 70 % of the companies has enquired for environmental information, especially on waste issues. Companies indicate that they prefer to be informed about CP trough a brochure of folder (43 %), book of reference of guidelines (14 %), of trade journals (23 %).

At the size of a company increases more information is gathered, which results in taking more measures. There is correlation between attitude and interest with regard to a certain environmental topic and the implementation of measures regarding that topic. However, a positive attitude and interest do not always result in taking measures.

The influence of the production chain on companies has increased compared to 1997. Companies name the supplier or manufacturer more often as a source for environmental information and indicate that they influence the introduction of CP within their company.

The most frequent measures taken include good housekeeping (76 %), use of more environmentally friendly raw and auxiliary materials (69 %), reduced use of hazardous materials (76 %) and reduced energy consumption (63 %). On average, companies did not take more environmental measures than in 1997. Less than 20 % of the companies which did not take environmental measures has plans to do so in the next two years. This is a matter of concern because taking concrete measures results in the actual reduction of the environmental impact of a company. On this basis it is not expected that the number of companies in the implementation and routinizing phases will increase significantly in the next 2 years. The implementation of measures is considered to be a determining factor in the classification of companies into these phases.

As mentioned before there was also carried out a monitoring of waste prevention. In this table is shown the baseline survey of 1995 and the targets for 2000.



In the next table the results of 1995 are compared with 1999.

	1995	1999
non-interest	20	17
interest	32	5
implementation	40	62
routinizing	8	15

A comparison between the two tables show the chances.

Conclusions

The results of monitoring on the level of knowledge, attitude and behaviour show that on the whole there is progress. Still there is a lot to be done. We will think about possibilities of setting targets for the next years. We will continue to regulate and stimulate companies to take measures for prevention of waste and to monitor the level of knowledge, attitude and behaviour, because in our view this is the only possibility of monitoring on a macro level for most of the small and medium sized companies.

POWERPOINT PRESENTATION [Peter HERMENS and Ton van ROEMBURG]

DUTCH EXPERIENCES IN TARGET SETTING ON WASTE PREVENTION

INTRODUCTION

Definition of prevention

- reduction of the amount or the hazardness of waste by reduction at the source

RELATION between

- goal setting
- indicators
- measurability

Goal setting:
strong believe in the need of goal setting because:

- prevention on the political agenda
- determine goals for the short and long term
- framework for government bodies and enterprises

Goals:

- ambitious but possible

Goals:

- on macro level
- level of enterprises

Differences in goals:

- percentages or tons
- concrete options
- on the level of knowledge, attitude and behaviour

How

- survey and best guess
- trial and error

DOCUMENTS SINCE 1988

Memorandum on waste prevention

- published in 1988
- targets for 29 priority waste streams
- target: 5 % based on surveys and expert judgement

National Environmental Policy Plan 1

- target of 5 % raised till 10 %
- objective: to express more ambition

National Environmental Policy Plan 2

- continuation of the target set in NEPP 1

National Environmental Policy Plan 3

- criticism of the possibility of measuring the target of 10 %
- target in million tons a year
  - rise of generation of waste substantial lower than economic growth
  - major effort on the area of prevention

General conclusion target setting on macro level

- difficult to measure the amount of not-produced waste
- difficult measuring policy effectiveness

However:

- target on macro level as a motive to introduce preventive measures
- targets should be ambitious but possible

TARGETS ON THE LEVEL OF ENTERPRISES

Approach:

- **memorandum on waste prevention**
- **target groups**
- **small and medium enterprises**

Memorandum on waste prevention

- two way process between government bodies and industry
- implementation plans with targets for prevention, reuse, incineration and landfill
- goal for prevention: 5 %
- example: implementation plan for packaging waste, nowadays the Covenant on packaging waste with:
  - a target for incineration and landfill
  - implicit target for prevention and reuse

TARGET GROUPS

Integral environmental tasks (covenants)

- about 10 branches of industry
- prevention and other elements of environmental protection
- about 80 % of the potential of waste prevention

Handbook/working book - plan - permit

- goals for qualitative and quantitative measures (prevention on waste)
- basis for a company environmental plan (how to realise goals)
- after approval of the permit issuer: translation to the permit
- special organisation monitors the environmental plans

Negotiations about goals

- basic goal: 10 % goal or the limit of generation of waste in NEPP 3
- prevention options vary per branch:
  - good housekeeping measures
  - technical measures
  - if possible in percentages or in tons for the main stream of a branch (e.g. in case of hazardous waste)
  - measures certain to be taken or measures which need investigations

Conclusions

- mostly targets and options are not in percentages or in tons but on concrete measures
- difficult to determine the effect on the level of enterprise and branch

However : statistical figures show a decrease of the amount of waste

- target setting is a possibility to put waste prevention on the agenda
- non-measurability: not an argument for not setting goals on prevention l

SMALL AND MEDIUM ENTERPRISES

Features

- large amount of these companies, great variation

Target

change in knowledge, attitude and behaviour of companies

- by raising the knowledge, influence their attitude in order to change their behaviour
- in a way that prevention will be a normal part of production in their activities

Approach

- no covenants like target groups
- general obligation to prevent waste by general administrative order
- special brochure with prevention options
- lot of activities (information, subsidies for quick scans, and so on)

TARGET SETTING ON THE LEVEL OF KNOWLEDGE, ATTITUDE AND BEHAVIOUR

Approach for prevention on waste

baseline survey executed in 1995

- companies classified in four phases (non-interest, interest, implementation, routinizing) (interviews with using a "key
- basis defined for 1995 and goals set for 2000

	1995	2000
non-interest	20%	5%
interest	32%	35%
implementation	40%	40%
routinizing	8%	20%

Results of the monitoring in 1998 (December)

non-interest phase	17%
interest phase	5%
implementation	62%
routinizing	15%

Conclusions

- target non-interest and interest in 2000: 40% monitoring 1998: 22%
- target implementation and routinizing in 2000: 60% monitoring 1998: 77%
- targets enterprises: most of them feasible
- fair to believe the positive influence of the many efforts of government bodies and enterprises to work out prevention options

Approach for monitoring Cleaner Production

- same approach like monitoring on waste prevention
- five subjects (environmental management, prevention on waste and emissions, energy reduction, environmental product development and environmental technology
- main reason for monitoring CP: companies do not make a difference between all kinds of environmental measurements

Future

- next monitoring Cleaner Production 2000/2001
- separate monitoring on waste prevention probably for the last time
- discussions about new targets on the level of knowledge, attitude and behaviour

CONCLUSIONS

- targets on a national level offer value
- target setting works without measurability
- important relation between goals, indicators and measurability
- necessity to improve the measurability in order to:
  - follow the reality of targets
  - to determine new targets
- to continue with:
  - legal framework (licenses, general decrees)
  - all kind of stimulating measures

WASTE PREVENTION: A CONTRIBUTION TO WASTE MINIMISATION — GERMAN EXPERIENCES

by
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WASTE MINIMISATION SESSION: 3

In contrast to other countries, it has always been the aim of the German government to meet the targets of Waste Minimisation by Waste Prevention, at the earliest stage of industrial activities, as well as by Waste Recycling after suitable sorting or separate collection activities.

Steps in which waste prevention was carried out e.g. recycling and disposal, was first mentioned in the 1975 Waste Management Programme of the Federal Government. These steps were developed on the basis of reports from several working groups of important waste producing industrial branches, such as paper and pulp, plastics and metals. These preventative steps remained unlegislative up until 1986.

The Act on Prevention and Disposal of Waste, 27 August 1986, required waste prevention with special attention to the Federal Immission Control Act Article 5 (1) 3 for industrial wastes, and to Article 14 of the Waste Act itself for municipal wastes. An analysis of this Art. 14 proved that measurable prevention could be reached only by the multiple use of consumer products, for example by returnable bottles.

Consequently the German Packaging Ordinance mainly concentrated on the returnability of packages. All aspects of waste prevention during package production that didn't meet requirements, were included in Article 1 "waste management objectives". Thus, waste resulting from packaging should be avoided by ensuring that packaging is restricted in volume and weight to the minimum required for sufficient protection to the contents and marketing purposes. This requirement actually caused the industry to reconsider the aspects of waste prevention by changing the production lines.

The most important requirement of prevention was put in force on 14 May 1990, by the Federal Immission Control Act (BImSchG). Its article 5 (1) 3 clearly states that installations subject to licensing should be established and operated in such a way that waste is avoided, unless safely recoverable. The BImSchG didn't prescribe measures of waste avoidance. The targets of prevention could be reached either by production lines being careful with raw materials and minimising production wastes or by separate holding at source of clean materials and consequently returning those materials into the production.

Steps toward waste prevention has been put in more concrete terms by an Administrative Regulation for Prevention, Recycling and Disposal of Wastes acording to Art 5 (1) 3 BImSchG. Included under the heading of prevention are:

- use of such raw materials that can be processed free of waste or low-waste (for example the use of common salt (from boiled down brine) instead of rocksalt in chlor-alkali electrolysis).

- use of low-waste production schemes (for example dip coating instead of spray coating).

- circulating raw materials within the plant (for example circulation of moulding sand in foundries.

- return of materials within integrated processes (for example separate holding at source of sort and colour specific plastics, regranulating and reuse for the original purpose); and

- choice of low-waste techniques for gas- and waste water treatment.

The Administrative Regulation mentions explicitly that these options of waste prevention should only be chosen if they are technically and economically feasible. This means that a suitable technique must be available, that the principle of comparativeness must be kept, and that economical and ecological constraints must be taken into consideration.

Practical and legal experiences with the Act on Prevention and Disposal of Waste of 27 August 1986 resulted in the Waste Avoidance, Recycling and Disposal Act of 27 September 1994. Its Art. 4 requires that "waste must, primarily, be avoided, especially by reducing its amount and noxiousness. Measures for waste avoidance especially include: closed-cycle management of substances within plants, low-waste product design and consumer behaviour oriented to the aquisition of low-waste and low-pollution products". Specific means and techniques for waste prevention included into production schemes are not recommended because of systematic legal reasons. Article 22 describes the targets of product responsibility and among them questions of waste prevention. Art. 22, 1 explains that products should be designed in such a way, that their production causes at least as possible waste, and that the products themselves could be recycled in an environmentally sound manner.

Regarding the national politics in the field of waste prevention (waste avoidance or minimisation at source) we may distinguish two sectors:

- The owners and operators of installations subject to licensing are liable to operate and optimise their production lines in such a way that wastes are avoided or kept within the production as far as possible.

- Producers of those consumer goods that are mostly responsible for the amount and composition of municipal waste and whose producing installations are not subject to licensing, have to fulfil the targets of product responsibility and environmentally sound design of products. This includes low or non-waste production but the main purposes are: quality demands, longevity, repairability, minimisation of toxic components, reusability and high quality recycability.

Specific legal demands describing the low residue and low waste production on one hand and careful use of raw materials and of energy on the other, are not yet existent. For this purpose we have to discuss economical or other incentives, that as far as possible are internationally acceptable.

As a result, we have had strict regulations and good experience in waste prevention over a period of 10 years, for all installations and plants subject to licensing; mostly for all industrial branches producing industrial wastes, although not such clearly formulated requirements exist for the consumer products industry.

The practice has shown that waste prevention is not a superfluous issue of green politics. There are numerous examples of different industrial branches and production types that show convincingly the possibilities of production integrated waste prevention, and technical, as well as economical, advantages for the concerned industry. It makes economic sense (especially in countries with strict legislative demands on an environmetally sound waste management and with consequently higher costs of waste disposal) to introduce different measures of waste prevention.

Strict regulations:

- on high quality recycling, especially on energetical recycling;

- on the pretreatment of all types of wastes to minimize the natural carbon content before landfilling; and

- on no or low emission landfilling, including strict control and different measures for landfill gas and leachate cause costs and fees for waste disposal that make different activities of waste prevention attractive for the most of the waste producing industry.

So in many cases there is no demand for special legislative or administrative activities regarding waste prevention. To achieve nationwide strict regulations for the waste management scheme, it is essential to have environment friendly production, paying careful attention to the use of raw materials and energy, producing lesser amounts of waste.

A good example of the influence of waste management quality and costs, may be taken from waste minimisation by recycling. The recycling oriented deconstruction of buildings with its high demands on computer-based planning and material specific dismantling, and the overall feasibility of this type of deconstruction, depends decisively on the costs and the national or regional regulations on landfilling. Landfills without leachate, landfill gas control, and no further technical measures for minimisation of emissions, will automatically hinder the dismantling and recycling of buildings because of the general disposal of mixed demolition waste and the low disposal fee. Higher landfill fees may support even sophisticated recycling schemes, as we have seen in several activities of the German building and demolition industry.

There are many good examples for the technical and economical feasibility of suitable low or non-waste oriented production and of internal circulation of raw materials. Public knowledge on this depends on the company’s strict internal treatment of those activities. Specific knowledge on waste prevention, of careful use of raw materials and energy may be a crucial advantage against competitors.

One typical example may be given from the paper and pulp industry. Due to quality management, paper and cardboard production includes the partial removal of fibres and fillers. These fibres should be recovered within the paper or board production and fed back through the paper or board machine stock preparation. Ninety-eight per cent of the pulp is acceptable for the final product. Technical machinery is available and widely used; it includes the screening in stock preparation, the wet end save-alls and the wet and dry end broke handling.

Rejects from the screening of paper or board machine stock preparation should be returned in integrated mills to the pulping department, where reprocessing is done and the good stock will finally end up back in the machine and in the end product. Fibre and filler recovery is significant in terms of reduction in suspended solids loading. When the pulp discharges from the machine headbox to the wire and starts forming the paper web, a fair amount of fibres and fillers are not retained the first time, but are discharged to collection pits. This water may pass a filter, mostly consisting of a drum or disc filter to separate solids from the water stream. There are different technical equipments for efficient solutions to attain high recovery for different types and sizes of paper or board manufacturers.

Another way of waste minimisation may be the energetical recycling in an in-mill, coal-fired power plant, or an in-mill reject incineration plant. For example the rejects from production of Wellenstoff and Testliner have only a limited material recycling potential. Therefore they are often dumped in a landfill site. These rejects have a heating value in the range of 22-24 MJ/kg dry substance because of the high proportion of plastics. The in-mill incineration combined with power and steam generation is regarded as an environmentally sound solution. It has been shown in several plants that the co-incineration of such rejects together with brown coal or hard coal is a feasible solution.

The mentioned internal recycling schemes for fibres, fillers and rejects are used internationally in different combinations. They can be implemented without bigger problems, they are feasible, they save natural raw materials, they minimise waste water treatment and waste disposal problems, they minimise environmental impacts outside the paper mills; all together they are a good example for rational waste prevention. Strict regulations on waste water treatment and waste disposal help to implement and to improve these techniques. Nevertheless the public is seldom aware of these activities.

The waste preventing activities have decisively been improved in Germany by the above mentioned Federal Immission Control Act Article 5 (1) 3 for all installations subject to licensing. In the near future the IPPC and its Best Available Technique (BAT) Notes will improve even waste prevention.

It is obvious, that the public discussion on waste avoidance and waste prevention seldom or never takes into account the positive experiences of the metal, paper and pulp or chemical industry. In general discussions, prevention and recycling mostly takes place in the consumer products industry, and there it is mostly seen in packaging and plastics manufacturing industries.

Enormous potentials of waste prevention have been detected, and partially accomplished, in the plastics manufactoring and packaging industry. At this point, I do not refer to the recycling targets on the basis of the German packaging ordinance, but rather on the waste prevention goals of plastics manufacturing itself. Before 1980 we supported a research project, studying the production residues (wastes) of plastics manufactoring industry. Our research institute detected approximately 500 000 to 600 000 t/a, with most of these plastics free of contamination; either not at all mixed (or only slightly) with other plastic sorts. Within the next step of the project, recycling schemes for this amount of production waste had to be detected. When we wanted to implement these recycling schemes, we had to aknowledge that nearly all plastic wastes had disappeared. What had happened? The outcome of our research project had shown Industry the enormous potential of saving disposal costs by recycling these plastic materials whose quality could be improved by simple and cheap separation at source measures. Nowadays, we have learned that at least half of the whole amount is recycled inside the plastic manufactoring industry; that means the goal of waste prevention has been fulfilled.

Several papers have been published by Prof. Vogel from Vienna that showed the enormous potential of prevention in packaging production. It is surprising that the activities of the packaging industry have not been initiated by a strict legislative activity. They do not have the mandatory waste management targets formulated in Article 1 of the German Ordinance on Packagings. This caused the industry to consider whether their production lines had been optimised in terms of raw materials consumption in proportion to the packaging volume, in terms of materials selection and in terms of measurement, especially looking at the transport conditions. The industry may have been astonished on the big prevention potential. These prevention activities have been very useful for the final consumer, for the environment, but mostly for the producers themselves.

There is strong national and international discussion and competition between those who are more interested in waste prevention at source and those preferring separate collection or mechanical sorting with subsequent recycling schemes. Furthermore, we have a current and very intensive discussion with the operators of installed waste treatment plants, especially thermal treatment plants who would like to reduce prevention and recycling in order to use the waste for existing treatment capacities. The used and exchanged arguments mostly have an economical character, but should strictly be complemented by ecological and technical arguments.

Finally we must be aware, that depending on the used raw materials and the installed production schemes, only a specific amount of waste may be prevented or fed back into the production. The larger amount of waste still remains for recycling schemes. Nevertheless it is a question of sustainability to use low-waste materials, to use those materials economically, to reduce the energy consumption of the production lines and to produce as far as possible products with no or very low contents of hazardous materials. Prevention of waste is not in competition with recycling or disposal, but is an unavoidable addition to recycling.

We don't know exactly what contribution in terms of percentage of whole production or consumption can be gained by prevention. Whether it is 10 or 20 % by weight, this is not so important. We know over a period of more than 10 years that prevention within the production lines helps to use the raw materials and energy more carefully and that it sharpens the view for harmful or toxic components of industrial and consumer products and improves the recycability of those products. Most techniques are available; although if not, there are a lot of engineering bureaus specialized in this field. After careful revision of the production lines and proper planning of additive equipment, the prevention techniques do not increase the production costs, but in contrary help to stabilise or to minimise them. The obtained knowledge is, as far as we are concerned, top secret because it is today one of the key points in competition. Eco audit and the IPPC will support the idea of prevention continuously.

But finally we have to accept that waste prevention is only one, nevertheless important, contribution to waste minimisation. It never will replace a high quality waste recycling and never will make an environmentally sound waste treatment and disposal superfluous.

Within the mentioned limits there is no doubt on the importance of waste prevention. The question is how to propose and implement prevention without critising existing methods. Some measures have been tested and seem to be useful:

- Formulation of strict demands for treatment and final disposal for non-avoidable and non-recycable wastes in terms of emission minimisation and sustainability.

- To achieve these objectives internationally to minimise emission, intensive transports over long distances to the cheapest treatment and disposal plant.

- Advice and information of producing firms, especially the smaller and medium sized companies, in all aspects of better use of raw materials and energy, of environmentally better design of their products and in all aspects of emission minimisation.

- Consequent implementation of eco audit keeping in mind that audited firms should be rewarded for their efforts.

- Only if none of these measures are successful, should mandatory legislative activities be taken into consideration. These activities could regulate specific measures of waste prevention as well as the quality of recycling.

A FRAMEWORK FOR NATIONAL ENVIRONMENTAL PERFORMANCE EVALUATION

by
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WASTE MINIMISATION SESSION: 4

ENVIRONMENTAL PERFORMANCE EVALUATION

- **CONCEPT OF ENVIRONMENTAL PERFORMANCE**
- **APPROACH TO ENVIRONMENTAL INDICATORS**
- **INDICATORS AND PERFORMANCE EVALUATION**

Source: OECD

ENVIRONMENTAL PERFORMANCE

- **AN OECD METIER**
- **PEER PRESSURE**

- **JUDGE AND MAKE PROGRESS**
- **PROMOTE POLICY DIALOGUE**
- **STIMULATE ACCOUNTABILITY**

Source: OECD

ENVIRONMENTAL PERFORMANCE

- **HIERARCHY OF OBJECTIVES**
  - Aims
  - Goals
  - Targets
- **HIERARCHY OF PERFORMANCE**
  - Intentions
  - Actions
  - Results

Source: OECD

ENVIRONMENTAL PERFORMANCE - MAIN QUESTIONS

- **TO WHAT EXTENT ARE THE OBJECTIVES ACHIEVED ?**
- **ARE THE OBJECTIVES AMBITIOUS OR MODEST ?**
- **ARE THEY ACHIEVED IN A DURABLE AND COST-EFFECTIVE WAY ?**

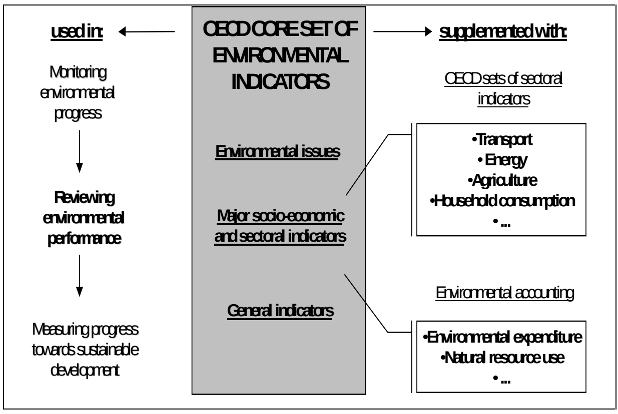
Source: OECD

ENVIRONMENTAL PERFORMANCE

- STRATEGIC GOALS
  - cost-effectiveness of environmental policies
    - controlling the pollution burden
    - managing natural resources
  - integration of environmental and other policies
    - economic policies
    - energy, transport
    - tourism, industry, agriculture, forestry
  - international co-operation

THE OECD APPROACH

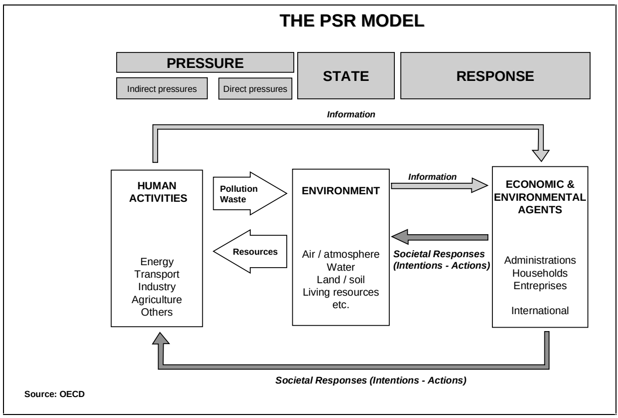
- A COMMON CONCEPTUAL FRAMEWORK
- CORE INDICATORS - OECD CORE SET
  - COMMON TO OECD COUNTRIES
  - COMMON TO VARIOUS INDICATOR SETS
- GUIDANCE FOR USING INDICATORS



A COMMON CONCEPTUAL FRAMEWORK

- PSR MODEL
- ISSUES OF CONCERN
- SECTORAL INTEGRATION

Source: OECD



ISSUES OF CONCERN

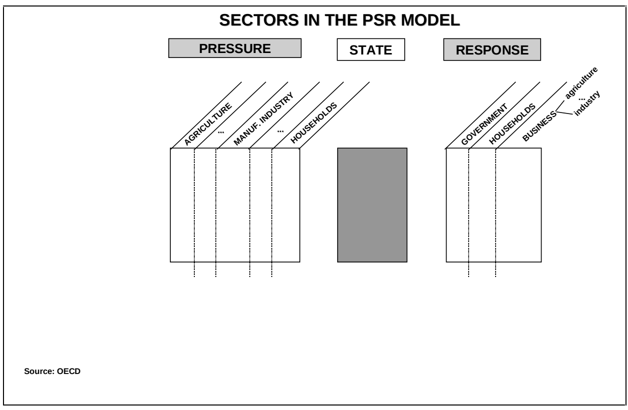
	PRESSURE		STATE	RESPONSE
	INDIRECT	DIRECT		
Climate change				
Ozone layer				
Eutrophication				
Acidification				
Toxic contamination				
Urban environment				
Biodiversity				
Landscape				
Waste				
Water resources				
Forest resources				
Fish resources				
Soil resources				
Socio-economic & sectoral indicators				

Source: OECD

OECD CORE SET - WASTE INDICATORS

PRESSURE		STATE	RESPONSE
INDIRECT	DIRECT		
CONSUMPTION LEVELS AND PATTERNS PRODUCTION LEVELS AND PATTERNS RESOURCE USE INTENSITIES	WASTE GENERATION TRENDS AND INTENSITIES MUNICIPAL INDUSTRIAL HAZARDOUS	EFFECTS ON water quality air quality land use soil contamination health	WASTE MINIMISATION / PREVENTION PRODUCT RE-USE RECYCLING RATES EXPENDITURE CHARGES RESOURCE PRICING

Source: OECD



SELECTION CRITERIA

- POLICY RELEVANCE
- ANALYTICAL SOUNDNESS
- MEASURABILITY

SELECTION CRITERIA

- POLICY RELEVANCE
  - representative picture
  - easy to interpret, transparent
  - responsive to changes
  - threshold or reference value
  - basis for international comparisons
  - national in scope

SELECTION CRITERIA

- ANALYTICAL SOUNDNESS
  - theoretically well founded
  - international consensus
  - link with economic models, forecasting, information systems

SELECTION CRITERIA

- MEASURABILITY

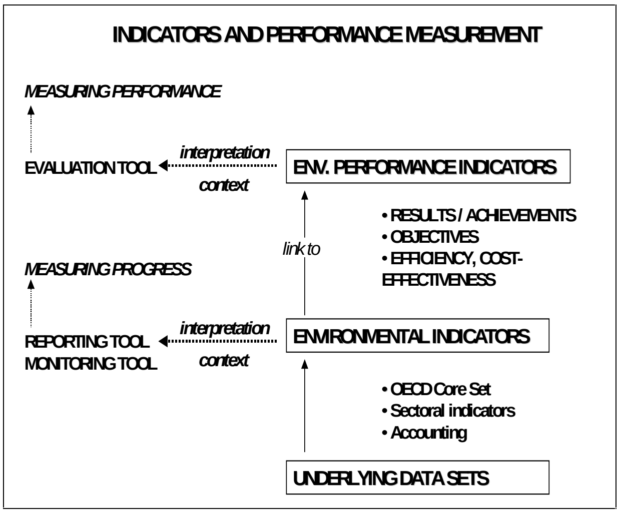
  UNDERLYING DATA:
  - readily available (cost/benefit ratio)
  - well documented, of known quality
  - regularly updated

USING ENVIRONMENTAL INDICATORS

- ONLY ONE TOOL
- TO BE INTERPRETED IN CONTEXT
- TO BE COMPLEMENTED WITH COUNTRY-SPECIFIC INDICATORS
- NO UNIQUE NORMALISATION

INDICATORS AND PERFORMANCE MEASUREMENT

- THREE TYPES OF INDICATORS
  - Performance indicators linked to quantitative objectives
  - Performance indicators linked to qualitative objectives
  - Descriptive indicators
- INTERNATIONAL VS. COUNTRY-SPECIFIC INDICATORS
- INTERPRETATION
- ASSESSMENT



WASTE INDICATORS AND PERFORMANCE

- **CORE INDICATORS**
  - WASTE GENERATION: TRENDS, INTENSITIES
  - WASTE MANAGEMENT AND DISPOSAL: RECYCLING, MOVEMENTS
- **COUNTRY-SPECIFIC INDICATORS**
  - COMPOSITION, SOURCE SECTOR
  - CONTAMINATED SITES
  - COSTS
- **META-INFORMATION:**
  - LIST OF WASTE MINIMISATION OBJECTIVES
  - LIST OF ECONOMIC/FISCAL INSTRUMENTS

TOOLS FOR EVALUATING PERFORMANCE IN WASTE PREVENTION

by
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WASTE MINIMISATION SESSION: 4

Introduction

Currently there are no widely accepted methods for evaluating performance in waste prevention. Development and adoption of standard indicators of performance in waste prevention could be an important step toward a widely accepted methodology. The purpose of this paper is to introduce a specific indicator of performance in waste prevention, **Progress in Waste Prevention**, and to illustrate the use of that indicator in a variety of situations. In addition, the paper will briefly discuss other methods for evaluating performance in waste prevention.

Use of Progress in Waste Prevention requires the measurement of waste prevention. There are two basic ways to measure waste prevention. One can measure **absolute** reductions. The alternative is to measure waste prevention **relative** to underlying growth in population, the economy, or some other factor. Both absolute and relative waste reduction are important. It is not the purpose of this paper to express any preference between the two. The paper will illustrate the use of both approaches. The paper will provide more examples of the relative approach because it has more variants, and because its application is somewhat more complex.

There are numerous possible uses for Progress in Waste Prevention. For example, one could track progress for streams of particular interest, such as packaging or MSW. Using the resulting data, one could compare progress achieved using different approaches. This might help identify the range of feasible reductions and the best methods for achieving them. Finally, one could set goals for waste prevention by requiring the achievement of "X percent Progress in Waste Prevention by year Y." (1)

To illustrate the use of Progress in Waste Prevention, this paper will use it to address three questions one might like to answer.

- Have recent waste prevention efforts reduced the generation of MSW?
- Does the recent report, *Resource Flows: A Material Basis of Industrial Economies,*(2) provide evidence of dematerialization?

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10 Prepared under contract and consultation with the OECD Secretariat.

- Has waste prevention occurred in beverage packaging?

In the process of answering these questions, the paper will illustrate the ways in which Progress in Waste Prevention can be developed and utilized[3].

Progress in waste prevention

The model for Progress in Waste Prevention is the well-known recycling rate[4]. A recycling rate generally expresses the amount of material recycled in a given year as a percentage of the amount of the material available for recycling in that year. Because it is a percentage, the recycling rate provides a useful basis for comparison. Using it, one can compare recycling of aluminum beverage containers with the recycling of glass beverage containers, or the recycling of aluminum beverage containers in one country with their recycling in another country.

This paper defines Progress in Waste Prevention in a manner analogous to the recycling rate. Assume that for some waste stream the annual waste generated, W, and the annual amount prevented, WP, are both known. (The examples which take up the major portion of this paper will provide numerous examples of ways in which these quantities can be developed.) The amount of waste available for prevention is simply W + WP. Define Progress in Waste Prevention (PWP) as the waste prevented, expressed as a percent of the amount of waste available for prevention. As a formula, this is simply:

$$\mathrm{PWP} = \left(\frac{\mathrm{WP}}{\mathrm{WP} + \mathrm{W}} \right) \times 100$$

There are numerous alternatives to the particular formula for Progress in Waste Prevention presented above. However, the formula chosen does provide a simple, easily applicable and useful method of developing Progress in Waste Prevention.

The following example shows how Progress in Waste Prevention can be computed in a particularly simple situation. In 1990, solid waste in the U.S. included about 32 million tonnes of yard trimmings. In 1996, the amount of yard trimmings had fallen to about 26 million tonnes.[5] What was the Progress in Waste Prevention for yard trimmings? To answer this question one needs to decide how waste prevention for yard trimmings will be measured. The simplest approach is to use the absolute reduction in tonnage, 6 million tonnes. With this approach, the Progress in Waste Prevention was 19 per cent (6 ÷ (6 + 26) = .188).

In this simple example, and in all of the other examples presented in this paper, waste prevention will be measured relative to a **base year**. Choice of the base year is not an absolute requirement, but it is a common feature of waste prevention measurement.

Waste Prevention for Municipal Solid Waste

This section shows how Progress in Waste Prevention can be developed based on relative waste reduction, rather than the absolute waste reduction used in the initial example. The discussion will focus on MSW in Japan, based on OECD data for the period 1980 to 1993.[6] To begin, tonnes of MSW will be the measuring unit. However, this will be modified in the course of discussion to address changes in hazard.[7] Finally, the example of MSW will be used to explain how one might forecast future Progress in Waste Prevention.

Relative waste reduction for MSW is usually based on waste per-capita or per unit of GDP. Table 1 below presents information on growth in Japan's MSW, population, and GDP. Notice that in Japan MSW has been growing significantly faster than population, but much slower than real GDP. Thus, for Japan, the choice to use GDP or population to analyze Progress in Waste Prevention is likely to have a significant impact. For purposes of illustration, the analysis in this paper is based on GDP. However, the methods illustrated will apply equally well to population. It is up to analysts familiar with a particular country and its situation to decide which type of calculation—population -or GDP-based—is most appropriate.

Table 1. **Growth in Japan's MSW, Population and GDP**

	Growth (%) 1980 – 1993
MSW	14.5
Population	6.7
Real GDP	70.1

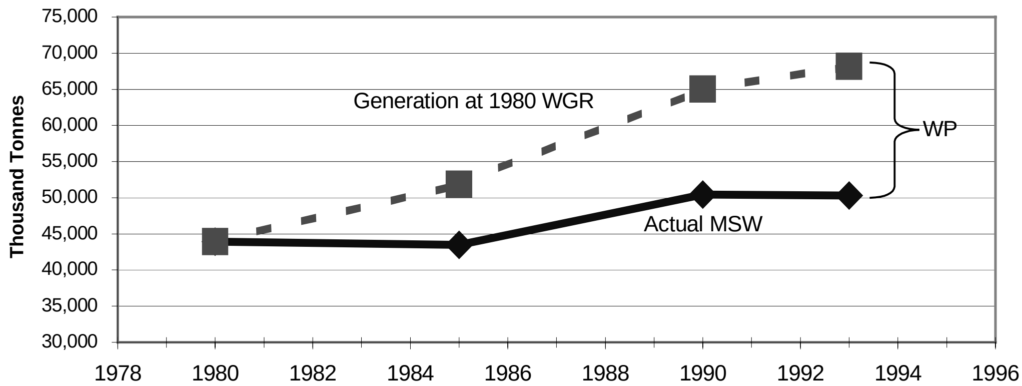
Table 2 below shows the details of the development of Progress in Waste Prevention for 1993. The base year for the calculation is 1980. The first two rows in the table provide data on MSW and GDP. The third row shows the **waste generation rate**, expressed as tonnes per unit of GDP. In order to develop Progress in Waste Prevention one needs to know two things: the amount of waste that was available for prevention in 1993, and the amount that was actually prevented. In order to determine these numbers, assume that there had been no waste prevention between 1980 and 1993. In that case, the waste generation rate in 1993 would have remained at its 1980 level—28.5. Using the 1980 generation rate, one can compute what waste generation in 1993 would have been, absent waste prevention. To do so one simply multiplies the 1980 generation rate, 28.5, times the actual GDP in 1993, producing 68,187 thousand tonnes of waste. Waste prevention in 1993 is the difference between the waste which would have been generated absent waste prevention, and the actual waste generation. As shown in the table, this amounts to 17,883 tonnes. Progress in Waste Prevention is the ratio of these two numbers expressed as a percent. For 1993 the value is 26.2 per cent, as shown in the bottom row of the table.

Table 2. **PWP for Japan's MSW – Details of the Calculation**

	1980	1993
MSW (Thousand Tonnes)	43,950	50,304
GDP (Billion US $)	$1,540	$2,389
Waste Generation Rate (WGR) (Tonnes per million US $)	28.5	21.1
Municipal Waste Assuming No Reduction in WGR Since 1980	43,950	68,187
Waste Prevention (Thousand Tonnes)	0	17,883
Progress in Waste Prevention	0%	26.2%

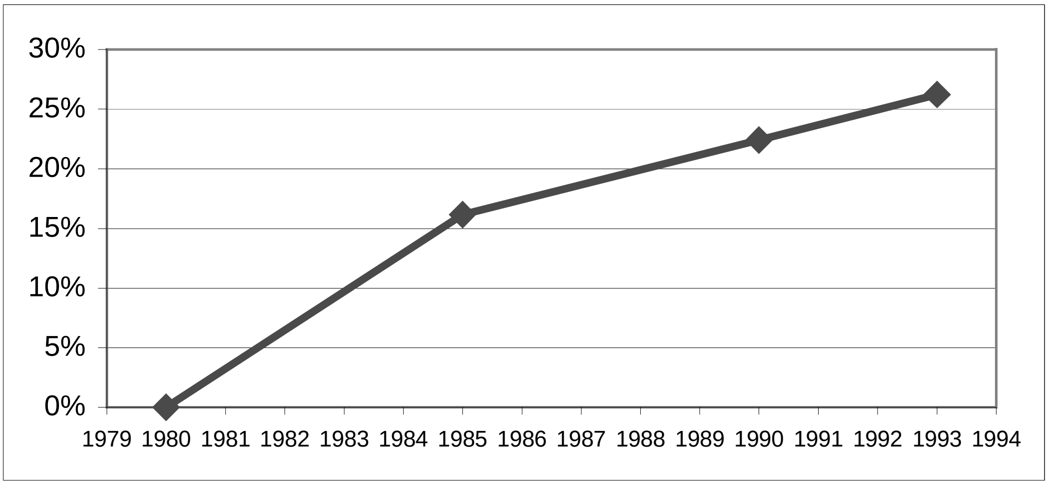
Table 2 only provides information on PWP for 1993. Figure 1 below shows the evolution of waste prevention for MSW in Japan for the entire period from 1980 through 1993. The solid line is actual generation of MSW. Only four data points are shown because OECD data are only provided at 5-year intervals. In addition to actual MSW, the figure shows the MSW which would have been generated if the waste generation rate had remained at the 1980 level. This higher, dashed line indicates the amount of waste which was available for prevention in each year between 1980 and 1993. The distance between the two lines represents the waste prevented.

Figure 1. **Evolution of Japan's Prevention of MSW**



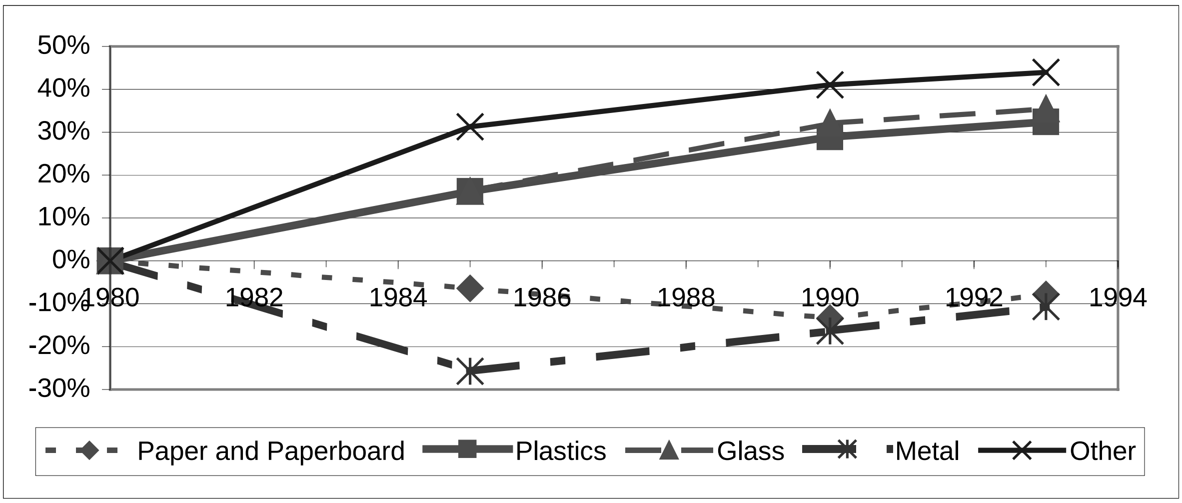
Using the data from Figure 1, Progress in Waste Prevention can be developed year by year. The result is shown in Figure 2 below. As one sees in that figure, Progress in Waste Prevention increased rapidly between 1980 and 1985, and has continued at a somewhat slower pace over the period from 1985 through 1993.

Figure 2. **PWP for Japan's MSW**



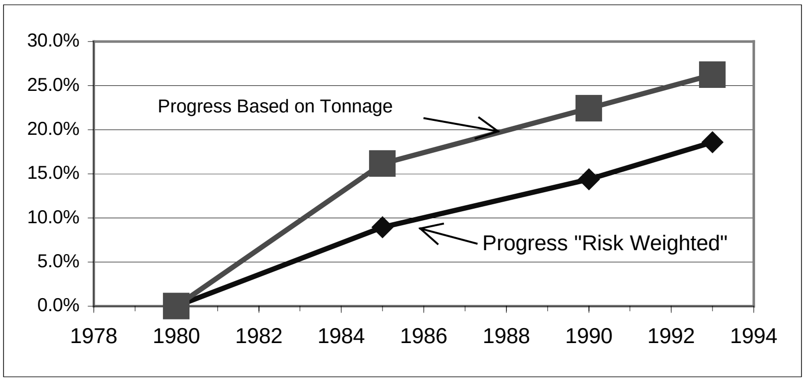
Graphs of Progress in Waste Prevention, such Figure 2, provide a simple, economical means of conveying a great deal of information. For example, in considering Progress in Waste Prevention for MSW in Japan, one can take into account the **material composition** of the municipal solid waste stream. OECD data permit one to decompose MSW into paper and paperboard, plastics, glass, metal, and "other" materials. Progress in Waste Prevention can be determined for each component of MSW. The results are shown in Figure 3 below. The figure indicates that the progress achieved in Japan has occurred in the areas of plastics, glass, and other materials. For paper and paperboard and for metals, there has not been progress.

Figure 3. **PWP for the Material Components of Japan's MSW**



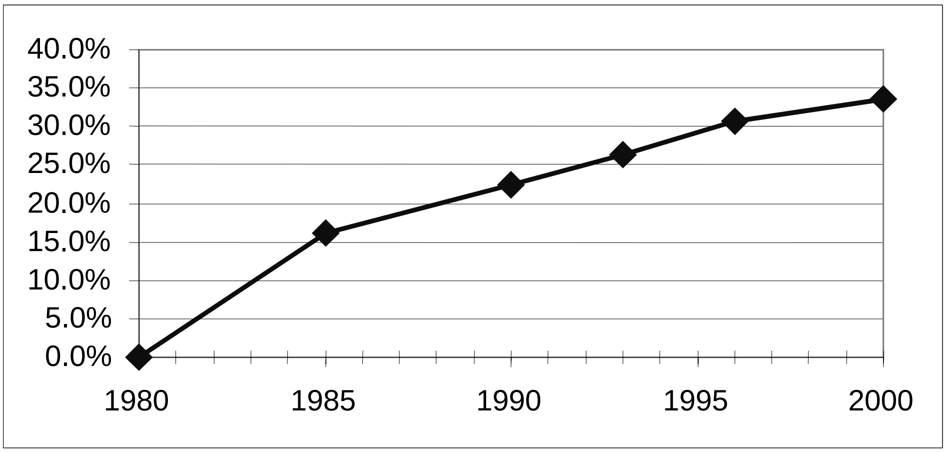
Thus far, discussion has focused on changes in tonnage. However, waste prevention does not just address tonnage. It also includes qualitative improvements in waste streams. The development of Progress in Waste Prevention for Japan's MSW can be modified to capture the effect of qualitative improvement. One way this can be done is by changing the way in which the MSW stream is measured: rather than measuring tonnage, one can measure "hazard weighted" tonnage, based on a hazard weighting system.[(8)] Here, the aim is not to promote a particular hazard weighting. Thus, a simple and somewhat arbitrary weighting will be used to illustrate the general procedure. Assume that hazards are weighted in the following way: glass 1.0; plastic 3.0; metal 2.0; paper and paperboard 1.5; and "other" 0.5. Using these weights, one can measure Japan's MSW as a weighted average tonnage and, using these weighted average tonnage figures, one can compute Progress in Waste Prevention exactly as was done for tonnage in Table 2. Figure 4 below provides a comparison of Progress in Waste Prevention, based on tonnage and on hazard weighted tonnage. As the figure shows, the hazard weighted progress is somewhat slower.

Figure 4. **PWP for Japan's MSW Based on Tonnage and Hazard Weighted Tonnage**



Finally, it is useful to point out how one can use the framework developed in this section to forecast Progress in Waste Prevention. To do so one simply computes Progress in Waste Prevention for future years, using the same approach as was applied for historical data. To do this, one needs to forecast both the actual waste generation and future waste generation based on the 1980 waste generation rate. In order to make the second forecast, one needs a forecast of GDP. For purposes of illustration, MSW generation has been forecast by extending the 1990 through 1993 growth rate for MSW to the period 1993 through 2000. GDP growth was addressed in two steps. For 1993 through 1996, actual growth shown in the OECD's data was used. For 1996 through 2000, total growth of one percent was assumed. (This is not meant as an expert forecast of GDP; it was simply used for purposes of illustration.) With these assumptions, Progress in Waste Prevention for MSW slows somewhat after 1993. However, as shown in Figure 5, progress does continue.

Figure 5. **Actual and Forecast PWP for Japan's MSW**



Dematerialization

One can extend the application of the methods for developing Progress in Waste Prevention described in this paper beyond the range of traditional waste streams. For example, this section uses data from *Resource Flows: The Material Basis of Industrial Economies* to address the issue of dematerialization. Broadly speaking, dematerialization refers to a delinking of economic growth as measured by GDP and the amount of physical materials required as the basis for economic activity. The methods used to address PWP can be applied, in an almost identical fashion, to develop **Progress in Dematerialization** (PD).

This paper addresses dematerialization for two reasons. First, there is broad interest in the extent to which economies can make progress in limiting their use of materials while continuing to expand.[(9)] Second, the fact that data on a range of countries is available from a single source makes the development of cross-country comparisons more opportune. The report cited above provides information on **Total Material Requirements** for the United States, Japan, The Netherlands, and Germany. (Germany is excluded here because the German data shift abruptly due to reunification.) Despite the common source, it must be noted that the development of data for different countries rests on data collection procedures and other factors which are country-specific. This may limit the true comparability of results obtained. Here, the purpose is not to argue that the results obtained are directly comparable; rather, it is to illustrate the analysis of Progress in Dematerialization.

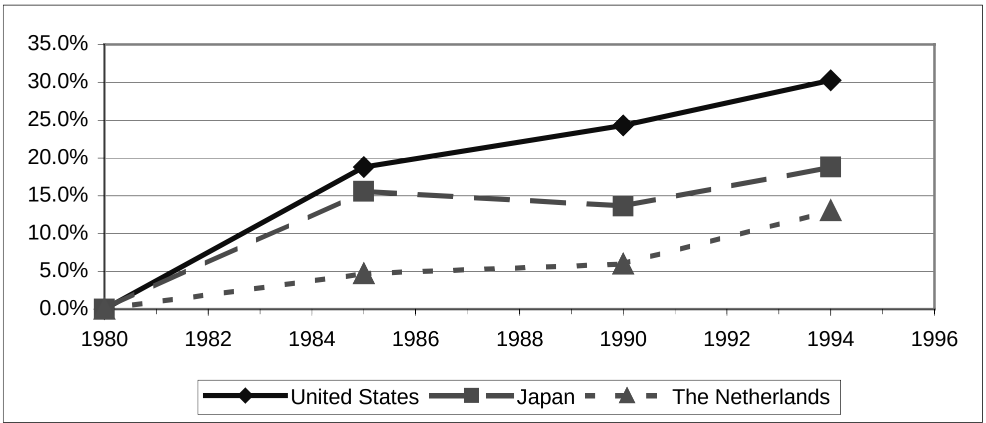
The basic computation of Progress in Dematerialization is illustrated in Table 3 below. That table addresses data for Japan because Japan was used in the earlier discussion of MSW. The calculation follows exactly the same format and procedure as for MSW. The key step is to develop the total amount of material available for reduction, by multiplying the material intensity for 1980 by the GDP in 1994. The difference between the amount available for reduction and the Total Material Requirement actually observed in 1994 provides the estimate of reduction in Total Material Requirements. Progress in Dematerialization is then computed as a percentage.

Table 3. **Progress in Dematerialization for Japan**

	1980	1994
Total Material Requirement (TMR) (Million Tonnes)	4,448	5,657
GDP (Billion US $)	$1,540	$2,389
Material Intensity (MI) (Tonnes Per thousand US $)	2.89	2.34
TMR Assuming No Reduction in MI Since 1980	4,448	6,969
Reduction in TMR (Million Tonnes)	0	1,312
Progress in Dematerialization	0%	19%

One can compute Progress In Dematerialization for all years subsequent to 1980 for which data are available. While this calculation could have been done annually, the computation was limited to 5-year intervals, as was done for MSW. Figure 6 below shows progress in dematerialization for each of the countries over the period 1980 through 1994. The countries have all achieved progress; however, the extent of progress has been quite different.

Figure 6. **PD for the three countries**



One can learn a bit more by dividing Total Material Requirements into components. Based on the data presented in the report cited, this paper considers three components of Total Materials Requirements: (1) natural resource commodities on which the economy places a price, (2) "hidden flows" of materials which are used or disturbed, but which do not enter the economy, and (3) the non-renewable resources consumed.

For each of these components of Total Materials Requirements, Progress in Dematerialization has been developed. This information is summarized in Figures 7, 8, and 9. These figures show that, depending on which component one considers, the countries exhibit different degrees of Progress in Dematerialization.

Figure 7. **PD in Natural Resource Commodities**

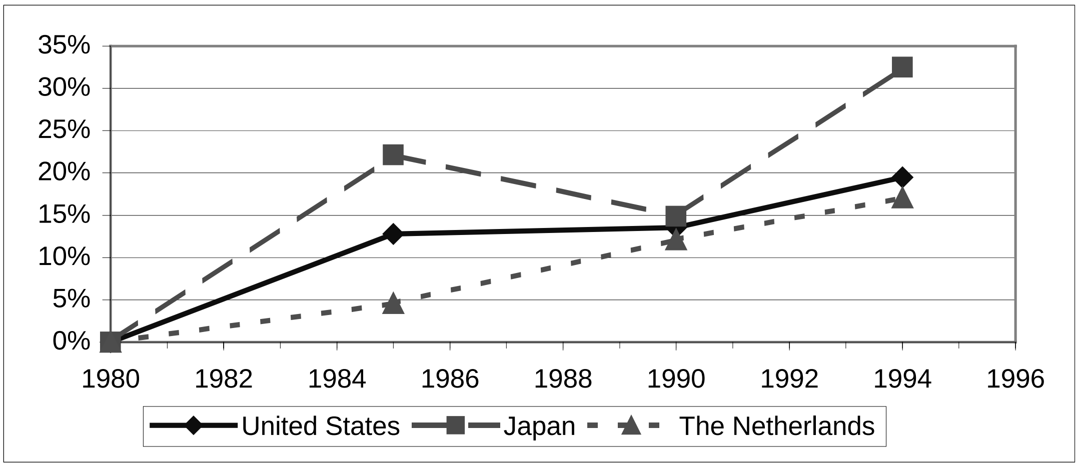


Figure 8. **PD in Hidden Flows**

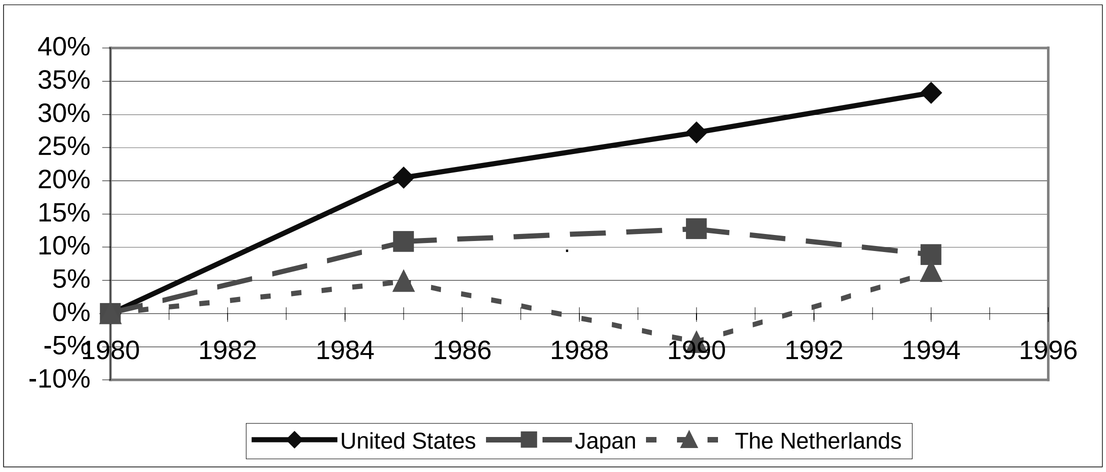
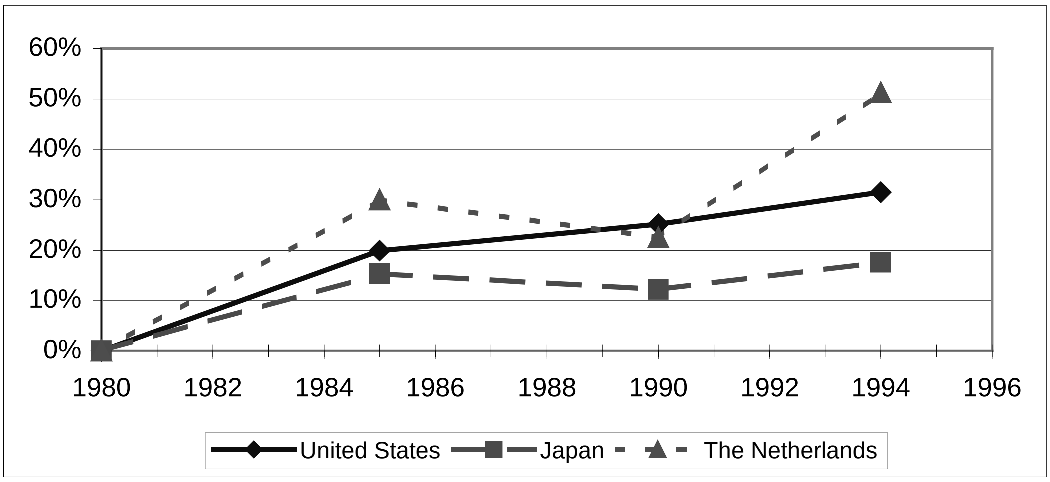


Figure 9. **PD in Non-Renewables**



Beverage packaging

Reducing waste from beverage packaging is a widespread concern. This is evidenced, for example, by the extensive use of deposit/refund systems for used beverage containers, as well as the focus on beverage packaging in producer responsibility programs.(10) From the standpoint of Progress in Waste Prevention, beverage packaging provides an interesting example because there are a number of different, useful ways to approach the analysis. Progress in Waste Prevention can be analyzed, based on the connection between beverage packaging waste and consumption. Progress in Waste Prevention based on this approach will indicate whether waste per unit of beverage consumed has increased, remained the same, or declined. An alternative approach focuses on beverage packaging waste per unit of GDP. This approach captures the effects of growth in the beverage industry compared to the economy as a whole. For beverage packaging, using both approaches yields some insight. Further, as was the case in previous examples, it is useful to decompose the beverage waste stream in components. Here, the discussion will focus on beer, soft drinks and liquor containers, as well as all beverage packaging waste(11)

Table 4 below shows the calculation of Progress in Waste Prevention for soft drink packaging. The table begins with data for 1980 and 1996 on both the tonnage of packaging and the consumption of beverages. Assuming that there were no reduction in the amount of packaging per liter consumed, the amount of packaging waste generated would have been approximately 3.2 million tonnes. However, the amount of soft drink packaging waste actually declined from about 2 million tonnes in 1980 to about 1.6 million tonnes in 1996. Thus, based on beverage consumption, Progress in Waste Prevention between 1980 and 1996 amounted to 51 percent.

Table 4. **Detailed Calculation of PWP for U.S. Soft Drink Packaging**

	1980	**1996**
Packaging (1,000 Tonnes)	1,961	1,572
Consumption (Million Liters)	23,905	38,971
Waste Generation Rate (WGR) (Tonnes per 1,000 Liters)	.08	.04
Packaging Assuming No Reduction in WGR Since 1980	1,961	3,197
Waste Prevention (1,000 Tonnes)	0	1,635
Progress in Waste Prevention	0%	51%

Progress in Waste Prevention for the period 1980 through 1996 can be computed based both on consumption and growth in GDP. Table 5 presents both of these results. The table also summarizes the changes in beverage consumption and waste generation for beer, soft drinks, liquor, and all beverages, on which the calculations were based. (GDP growth of 47 percent is reflected in the calculations as well.)

Table 5. **U.S. Beverage Packaging**

	Changes 1980-1996 (%)		**PWP (%)**	
Beverage	**Consumption**	**Waste**	**Per Unit Consumed**	**Per Unit of GDP**
Beer	20	18	1	21
Soft Drinks	63	-20	51	47
Liquor	-27	-26	1	51
All Beverages	49	8	27	27

The data in Table 5 provide some insight into the effects of various changes affecting beverage packaging waste. Consider, for example, soft drinks and liquor. As indicated by the PWP values based on consumption, there has been little change in the waste per unit of liquor consumed. In contrast, there have been major changes for soft drinks, particularly the replacement of heavy glass containers with lighter plastic. However, because the consumption of soft drinks has grown while that of liquor has declined, both streams have experienced declines in waste generation per unit of GDP.

Other performance evaluation tools

Thus far, discussion has focused on Progress in Waste Prevention. However, this is only one among many tools one might use to measure progress in preventing waste. For example, one can develop a different indicator by comparing annual waste prevention to waste generation in the base year. The resulting indicator, referred to as Relative Waste Prevention, is useful when setting targets for waste prevention based on a historical level of waste generation.[12]

One can abandon the notion that progress ought to be measured as a percentage. Instead, one can measure the absolute level of waste prevention.[13] One can also focus directly on the waste generation rate. Studies of dematerialization often emphasize the development of indices of material intensity. The simplest such index is the material intensity discussed in this paper. Weighted averages, such as those employed in the discussion of qualitative Progress in Waste Prevention, are also used. However, much more complicated expressions also find their way into this approach. For example, some studies emphasize the need to bring the economic dimension directly into the definition of material intensity. Attempts to move in this direction often make use complex mathematical formulas called divisia indices, which allow a sophisticated treatment of the economics involved in materials choice.[14]

Moving in a different direction, it is possible to evaluate performance waste prevention relative to different measures of the amount of waste which might potentially be prevented. An example of this approach is the so-called **Source Reduction Program Potential** (SRPP) methodology.[15] (In the U.S., source reduction corresponds roughly to what the OECD refers to a waste prevention.) The source reduction program potential methodology provides systematic procedures for estimating the amount of waste which might be prevented by programs addressing particular material streams. An index of Progress in Waste Prevention could be constructed based on this approach by taking the tonnage of waste prevented, divided by the tonnage of waste which potentially could be prevented, computed using the SRPP methodology.

Finally, it is possible to step back from the waste streams, and measure **proxies** for waste prevention. Proxies include such things as expenditures or level of effort on waste prevention programs, or the coverage which such programs have. The advantage of proxies is that they are often more easily and conveniently measured than is waste prevention itself. However, their analysis gives only an indirect indication of the level of waste prevention which may be taking place.

Notes and References

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5. Franklin Associates, Ltd., 1998. *Characterization of Municipal Solid Waste in the United States: 1997 Update.* Prepared for U.S. Environmental Protection Agency, Municipal and Industrial Solid Waste Division. May.

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POWERPOINT PRESENTION [John Stutz]

TOOLS FOR EVALUATING PERFORMANCE IN WASTE PREVENTION

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May 5, 1999

Background

- Over the past two decades OECD member countries have not produced any widely-accepted methods for evaluating progress in waste prevention (WP).
- Development and adoption of widely-accepted methods might foster better data development and improve the analysis of the data available.
- Indicators of progress could be an important component of such methods.

Objectives

- Introduce a simple indicator, Progress in Waste Prevention.
- Illustrate use of the indicator by applying in a variety of situations.
- Discuss other methods for evaluating performance in waste prevention.

Progress in Waste Prevention

- For some waste stream, denote the annual waste generated by W and the amount prevented by WP.
- W + WP is the amount of waste that could have been prevented.
- Progress in waste prevention (PWP) is the percent of the waste which was prevented.
- As a formula $PWP = \frac{WP}{WP + W} \times 100$

Progress in Waste Prevention: A Simple Example

- In 1990 Municipal Solid Waste (MSW) in the US included 32 million tonnes of yard trimmings. In 1996 the figure was 26 million. What was the progress in waste prevention?
- Measure WP by the reduction in tonnage from 1990 levels. (Many other definitions are possible.)
- WP is 6 million tonnes. Progress in Waste Prevention is 19% [6 ÷ (6 + 26) = .188]

Possible Uses for PWP

- Track progress in waste prevention for key streams and report the results to the public.
- Compare progress across countries and programs, to help identify the range of feasible prevention.
- Set the goals in WP targets as "X percent progress in waste prevention by year Y."

Three Questions One Might Like to Answer

- Have recent waste prevention efforts had a measurable effect on MSW)?
- Do the data in *Resource Flows: The Material Basis of Industrial Economics* provide evidence of dematerialization?
- Has waste prevention occurred in beverage packaging?

WP for MSW: Setting the Stage

- WP is defined by change - avoid, reduce, reuse in place of new. OECD data allow analysis of changes from 1980.
- Growth in municipal waste tonnage is driven by population and the economy.
- One reasonable view is that WP is occurring for MSW if the **waste generation rate**, measured in tonnes per unit of GDP, is falling.

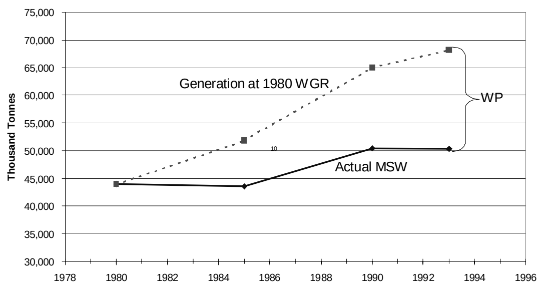
Growth in Japan's MSW, Population and GDP

	Growth (%) **1980-1993**
MSW	14.5
Population	6.7
Real GDP	70.1

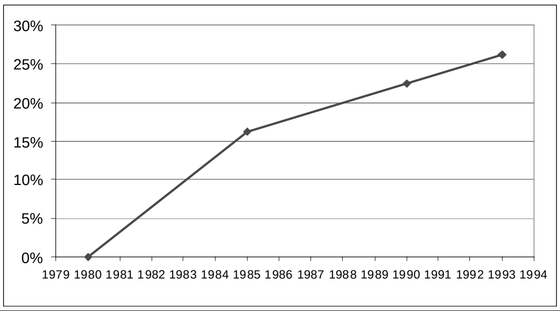
MSW Prevention in Japan

	1980	**1993**
MSW (thousand tonnes)	43,950	50,304
GDP (Billion US $)	$1,540	$2,389
Waste Generation Rate (WGR) (Tonnes per Million US $)	28.5	21.1
Municipal Waste Assuming No Reduction in WGR Since 1980	43,950	68,187
Waste Prevention (thousand tonnes)	0	17,883
Progress in Waste Prevention (%)	0%	26.2%

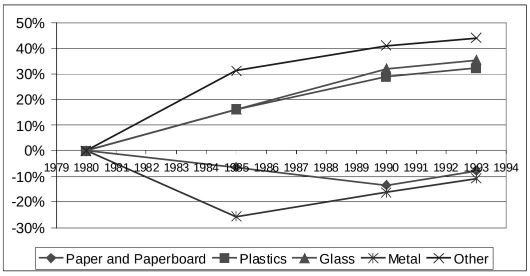
Evolution of Japan's Prevention of MSW



Progress in WP: MSW in Japan



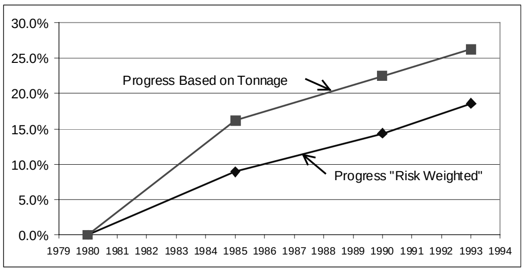
Progress in WP: Components of MSW in Japan



Accounting for Qualitative Improvement

- WP is not just changes in tonnage: it includes "qualitative" improvements such as elimination/reduction of hazardous/harmful substances.
- PWP can reflect qualitative improvement if tonnage is replaced by "risk weighted" tonnage.
- As an illustration the following risk weighting was applied to Japan's MSW: Glass 1.0, Plastic 3.0, Metal 2.0, Paper 1.5, and "Other" 0.5.

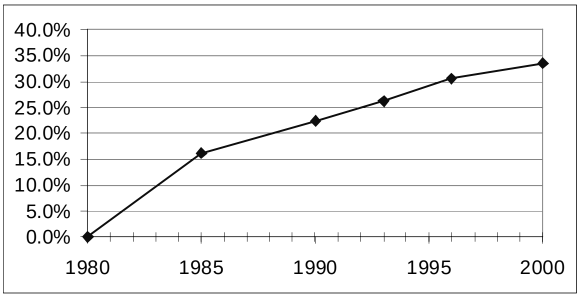
PWP for MSW: Tonnage vs. "Risk Weighted" Tonnage



Forecasting PWP: MSW in Japan

- In order to forecast PWP one needs forecasts of the waste stream and "the driver" (here MSW and GDP).
- Assume 1993-2000 growth in MSW occurs at the same rate as 1990-1993.
- OECD provides GDP through 1996. Based on recent experience and data from *The Economist*, assume 1% growth for 1996-2000.
- With these assumptions progress in WP for MSW slows considerably in Japan.

Forecast Progress in WP: MSW in Japan



Dematerialization

- *Resource Flows* provides data on the Total Material Requirements (TMR) for Japan, The Netherlands and the U.S.
- Focus on 1980-1994 to be consistent with other OECD data.
- The method used to develop PWP for MSW can be adapted to develop Progress in Dematerialization (PD) for TMR.

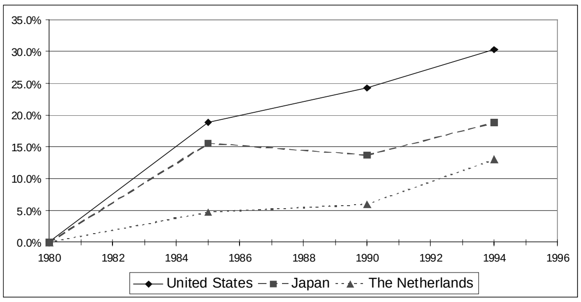
Progress in Dematerialization: Japan

	1980	1994
Total Material Requirement (TMR) (Million Tonnes)	4,448	5,657
GDP (Billion US $)	$1,540	$2,389
Material Intensity (MI) (Tonnes per thousand US $)	2.89	2.34
TMR Assuming No Reduction in MI Since 1980	4,448	6,969
Reduction in TMR (Million Tonnes)	0	1,312
Progress in Dematerialization	0%	19%

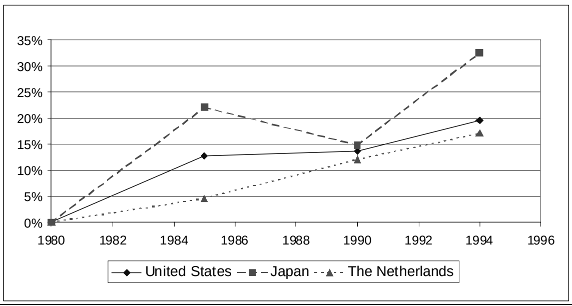
Comparative Analysis of Dematerialization

- All three countries show continuing progress in dematerialization (i.e., WP for TMR).
- Relative success in prevention changes if one focuses on (a) the natural resource commodities which enter the economy, (b) the “hidden flows” which do not enter the economy, or (c) the non-renewable resources consumed.

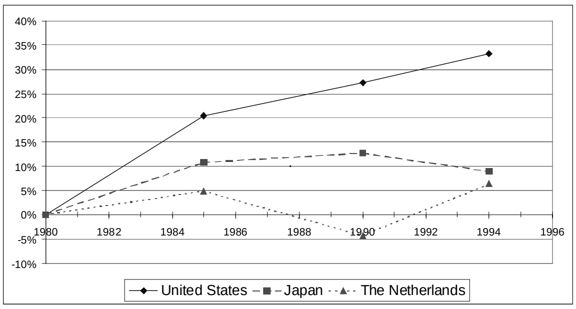
Progress in Dematerialization: Total Material Requirement



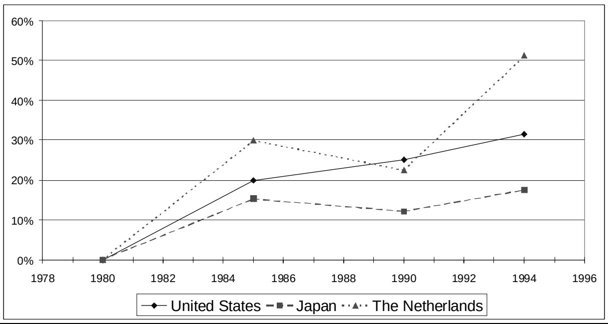
Progress in Dematerialization: Natural Resource Commodities



Progress in Dematerialization: Hidden Flows



Progress in Dematerialization: Non-Renewables



Beverage Packaging: Initial Comments

- Reducing waste from beverage packaging is a widespread concern.
- Beverage consumption has grown substantially. WP based on packaging waste per unit consumed takes this into account.
- Comparison of WP based on consumption with WP "per unit of GDP" brings in the size of the beverage industry.
- Considering types of beverages gives additional insight.

Reduction in US Soft Drink Packaging

	1980	1996
Packaging (1,000 Tonnes)	1,961	1,572
Consumption (Million Liters)	23,905	38,971
Waste Generation Rate (WGR) (Tonnes per 1000 Liters)	.08	.04
Packaging Assuming No Reduction in WGR since 1980	1,961	3,197
Waste Prevention (1,000 Tonnes)	0	1,635
Progress in Waste Prevention (%)	0	51

Progress in Waste Prevention: US Beverage Packaging

	Changes 1980-1996		Progress in WP (%)	
Beverage	Consumption	Waste	Per Unit Consumed	Per Unit of GDP
Beer	20	18	1	21
Soft Drinks	63	-20	51	47
Liquor	-27	-26	1	51
All Beverages	49	8	27	27

Alternative Performance Evaluation Tools

- Variants of the progress indicator - replace W + WP by waste generated in the "base year."
- The level of waste prevention (i.e., WP) rather than an indicator of progress.
- Waste generation intensities, such as waste per capita or unit of GDP, which address progress indirectly.
- Proxies for progress, such as portion of the economy covered by waste prevention agreements.

KEY CONSIDERATIONS FOR DEVELOPING WASTE PREVENTION EVALUATION TOOLS

by
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WASTE MINIMISATION SESSION: 4

Background

Within the context of its continuing work on changing consumption and production patterns, the Division for Sustainable Development (DSD) of the UN Department of Economic and Social Development is involved in issues related to various aspects of waste management and is interested in establishing closer cooperation with other organizations in this area. Waste management remains one of the priority areas for governments of both developed and developing countries, particularly in view of growing urbanization. This was emphasized again during the discussions of the Ad Hoc Inter-Sessional Working Group of the UN Commission on Sustainable Development (CSD) in New York in February 1999. A major contribution to waste management could be made by waste minimization and waste prevention through cleaner production, reductions in packaging, recycling and reuse, and consumer education and information. Dissemination of information on the effectiveness of various policy instruments should facilitate the wider application of such policies.

We are surveying and assessing policy instruments, particularly for use in developing countries. The main efforts of DSD in this area focus on:

- Policy assessment of efforts in dematerialization and waste minimization, including waste prevention and recycling.
- Impact of urbanization in developing countries, particularly on waste management problems, and use of simple indicators as a basis for decision making and information exchange on low cost policies.
- Further studies on cleaner production technologies and their transfer to developing countries.

Existing waste indicators

A work programme on indicators of sustainable development approved by the CSD at its third session in 1995 includes a set of indicators related to waste management. These indicators were developed by the UN Centre for Human Settlements (Habitat) as a lead agency in cooperation with several other organizations.[1] Unfortunately, none of those indicators deals directly with waste prevention, although they can be helpful in developing policies on waste prevention. This makes the work started by OECD on waste prevention performance indicators especially important.

Indicators that correspond to Chapter 21 of Agenda 21 (Environmentally Sound Management of Solid Wastes and Sewage-related Issues) include:

- generation of industrial and municipal solid waste (tonnes per capita per annum);
- household waste disposed per capita (kilogrammes per capita per day);
- expenditure on waste management ($US per unit of GDP);
- waste recycling and reuse (percent); and
- municipal waste disposal (tonnes per unit of GDP per annum).

Indicators included in the proposed Core Set of Indicators for Changing Consumption and Production Patterns[2] that are relevant to the issue of waste minimization are:

- Total Material Requirement (TMR) (tonnes per capita per annum); and
- Intensity of material use (tonnes per unit of production).

A separate set of indicators deals with hazardous waste. The lead agency in the development of these indicators is the Secretariat to the Basel Convention, UNEP. This set includes:

- generation of hazardous wastes (tonnes per unit of GDP);
- imports and exports of hazardous wastes (tonnes);
- area of land contaminated with hazardous wastes (km^2); and
- expenditure on hazardous waste treatment ($US).

As with the previous sets, these indicators do not directly deal with the issue of waste prevention or minimization.

Considerations for the choice of waste prevention/minimization indicators

Some of the criteria that were used for the selection of a core set of indicators for changing consumption and production patterns are also applicable when developing waste prevention/minimization indicators. We are particularly interested in the development and use of core indicators that would satisfy the following criteria. They should be:

- universally applicable and internationally comparable;
- national in scale or scope, with disaggregation for urban and sectoral levels;
- able to take into account and measure differences between cities of various sizes and non-urban areas;

- suitable for assessing progress towards waste prevention/ minimization;
- easily understandable;
- based on clearly defined and agreed definitions and conceptually well founded;
- feasible for implementation within the capacities of national governments;
- limited in number and adaptable to future developments;
- based on international consensus to the extent possible; and
- based on reliable and easily obtainable data.

A distinction should be made between primary and secondary waste indicators. Waste generation and waste reduction can be used as primary waste indicators, from which waste prevention related indicators are derived. Existing data for waste generation are the basis for the estimation of waste prevention.

The choice between waste prevention projections based on population or GDP as a driver involves both technical and political considerations. Since waste would be expected to rise with consumption levels as well as population, both of which are encompassed in aggregate GDP, GDP will be a better driver than a population. However, use of population as a driver may be more intuitively understandable and even set a higher standard of performance. This reasoning suggests that population might be considered as the primary driver for calculating waste prevention and GDP a secondary one.

Per capita data for waste generation and prevention allows comparisons among countries and localities and is more meaningful to most people than aggregate data. Per capita measures are good for awareness raising because they relate directly to individual and household behavior.

The main difficulty with measuring waste prevention or waste minimization is that it involves measuring something that has not occurred. Therefore indicators of waste prevention/minimization are most likely to be comparison indicators that would track changes in relation to a certain baseline. Different approaches could be used when choosing the baseline. One is to select a base year and then to measure progress (or lack of it) in waste minimization compared to this year. Another one is to project trends in waste generation based on historic data and then measure waste minimization as the difference between actual data and the projection. Yet another one is to select a target (or yearly targets) that is deemed necessary to achieve and measure progress towards that goal. A combination of these approaches is also possible.

In all cases, a major concern is availability of data. Further difficulties arise because of different definitions of particular terms in different countries, making it hard to compare on international scale. Even within countries (especially developing ones), inconsistencies between regions may make collection of data for nation-wide indicators all but impossible. On the other hand, creating disaggregated indicators (that may not be part of a core set) by waste stream, by industry, by locality, etc. can be a valuable tool in following progress in waste prevention/minimization and achieving measurable results.

Much of the policy attention to the issue of sustainability of industrial economies has been focused on wastes and pollution, on the back end of the materials cycle. The joint study[3] on resource flows by World Resources Institute (US) , Wuppertal Institute (Germany), Netherlands Ministry for Environment, and National Institute for Environmental Studies (Japan) showed that 55 to 75 percent of the Total Material Requirement arises from hidden flows. That means that more emphasis needs to be directed at the front end of the materials cycle. As stated in the above-mentioned report, policy incentives to reduce use of primary natural resources not only diminish extraction pressures but also waste and pollution. Decrease in material requirements and environmental impacts may also be achieved through policies that make natural resource use more efficient or increase recycling.

The TMR indicator cannot be considered as a waste prevention indicator *per se*, because it represents a complete physical account of the economy and includes material moved on-site and useful products as well as waste. Nevertheless, it may be useful in the framework of waste prevention performance evaluation tools as a measure of dematerialization of the economy. This indicator can be used for developing policies that impact all stages of the materials cycle, beginning with extraction, thus giving a complete account of the impact on the waste flow.

A possible conceptual framework that may be considered for the set of waste prevention indicators is Pressure (or Driving Force) - State - Response (PSR). Unfortunately, in indicator development efforts, this framework has been referred to more as a formality. If this framework is indeed chosen, proper indicators need to be developed for each part of the PSR system. The following clarification may be helpful.

The "state" is what directly affects environmental quality. In this case, that would seem to be the accumulated waste (e.g. total waste in landfills, perhaps relative to landfill capacity), or some other measure of the environmental impact of waste relative to waste management capacity. If waste is incinerated, then the "state" might be the cumulative stock of emissions or concentration of pollutants in air, water or soil. The "pressure" is waste generation and disposal, which in turn is driven by other pressure factors: waste generation intensity, population, GDP, etc. "Response" indicators (often non-quantitative) should be a measure of policy actions intended to reduce the "pressures" in the shorter term and thereby improve the "state" in the longer term. Some waste minimization indicators may well fit into the "response" part of the more general waste management indicators framework. Also, the effectiveness of the response actions may then be measured by changes in the pressure indicators, such as "waste prevention for various waste streams." A complete PSR system would need proper indicators of the "state" of the waste problem and "response" measures taken, as well as pressure variables.

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EVALUATING THE GREENHOUSE GAS IMPACTS OF NATIONAL WASTE PREVENTION ACTIVITIES: THE U.S. EXPERIENCE

by
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WASTE MINIMISATION SESSION: 4

Abstract

The U.S. Environmental Protection Agency (EPA) has initiated a Climate and Waste Program aimed at reducing greenhouse gas (GHG) emissions from waste management. The Climate and Waste Program utilizes a three pronged approach: (1) research and technical assistance, (2) program implementation, and (3) outreach and education.

Research and technical assistance provide the scientific underpinning for the Climate and Waste Program. Waste management affects most of the major categories of GHG emissions and sinks, including energy, forestry, industrial processes, and landfill methane, with many important effects occurring upstream of the point of disposal. EPA combined a life cycle analysis framework with the emission accounting guidelines established by the Intergovernmental Panel on Climate Change (IPCC) to estimate GHG emissions from materials in waste management practices.

EPA's program implementation efforts have included three programs: WasteWise, Pay-As-You-Throw (PAYT), and Waste Reduction Demonstration Projects. The WasteWise program encourages organizations to take cost-effective actions to reduce solid waste, and to quantify progress toward goals. EPA's PAYT team distributes information, provides training, and offers technical assistance to waste managers and to local planners across the US. EPA also supports over 30 state and local demonstration projects that emphasize innovative approaches to waste reduction and climate protection.

EPA conducts an outreach and education program to communicate the link between climate change and waste management. This program produces educational materials, maintains a website, prepares papers, and makes presentations to stakeholders.

The Climate and Waste Program is on track to meet its emission reduction goal of 5 million metric tons of carbon equivalent (MMTCE) by 2000, which puts the program on par with several other major U.S. initiatives to reduce GHGs. Much of the experience gained in the US is transferable to other nations interested in broadening their climate mitigation portfolios to include waste management.

Program Overview

As one of the elements of the U.S. Climate Change Action Plan,[11] the US Environmental Protection Agency (EPA) is implementing an innovative, three-pronged approach to address the link between waste prevention and climate protection:

1. EPA conducts research and provides technical assistance on waste management options and their impact on greenhouse gas (GHG) emissions. The research efforts have been the first to combine a life cycle analysis framework with the emission inventory guidance of the Intergovernmental Panel on Climate Change (IPCC). The principal products of this research are a set of emission factors which enable someone to measure the GHG impacts of choosing a particular waste management option for a particular material.

2. EPA operates national program efforts, such as WasteWise and Pay-As-You-Throw, that link waste reduction to climate change mitigation. These programs are designed to produce environmental benefits, with emphasis on waste and GHG emission reductions.

3. EPA conducts an outreach and education program on the linkage between climate change and waste management. This program produces educational materials, maintains a website,[12] prepares papers, and makes presentations to state, local, international, and industry stakeholders.

This program has proven to be effective in broadening the U.S. GHG mitigation portfolio. The remainder of this paper addresses the first two elements of the program, and in particular, how the research results can be used to measure progress of national waste prevention programs. We offer these findings in hopes that other countries attempting to establish similar programs may take advantage of our experience.

Research and technical assistance

Measurement and evaluation are important components of EPA's Climate and Waste Program. Like all other climate change actions in the US, this program is frequently evaluated to assure that it is effective at reducing emissions. EPA initiated a research program in 1994 to quantify the impacts of waste management practices on GHG emissions. These measurement methods help the program target the materials and management methods with large emission reduction potential. They also help to fulfill the requirements of the Government Performance and Results Act (GPRA), which requires all U.S. government departments and agencies to specify measurable program goals and to track their performance in meeting these goals.[13] The results of this research have been made available to state, local, international, and industry stakeholders.

The primary objective of the research effort is to provide the scientific basis for estimating GHG emission reduction benefits of various waste management actions. Climate change analysts have long recognized that landfills can be a significant source of methane emissions. Less widely recognized, but equally important, are other links between GHGs and waste management. For example, source reduction and recycling can indirectly reduce GHG emissions by reducing fossil fuel-related emissions in the raw materials extraction and manufacturing process, or by reducing the rate of timber harvest for paper and

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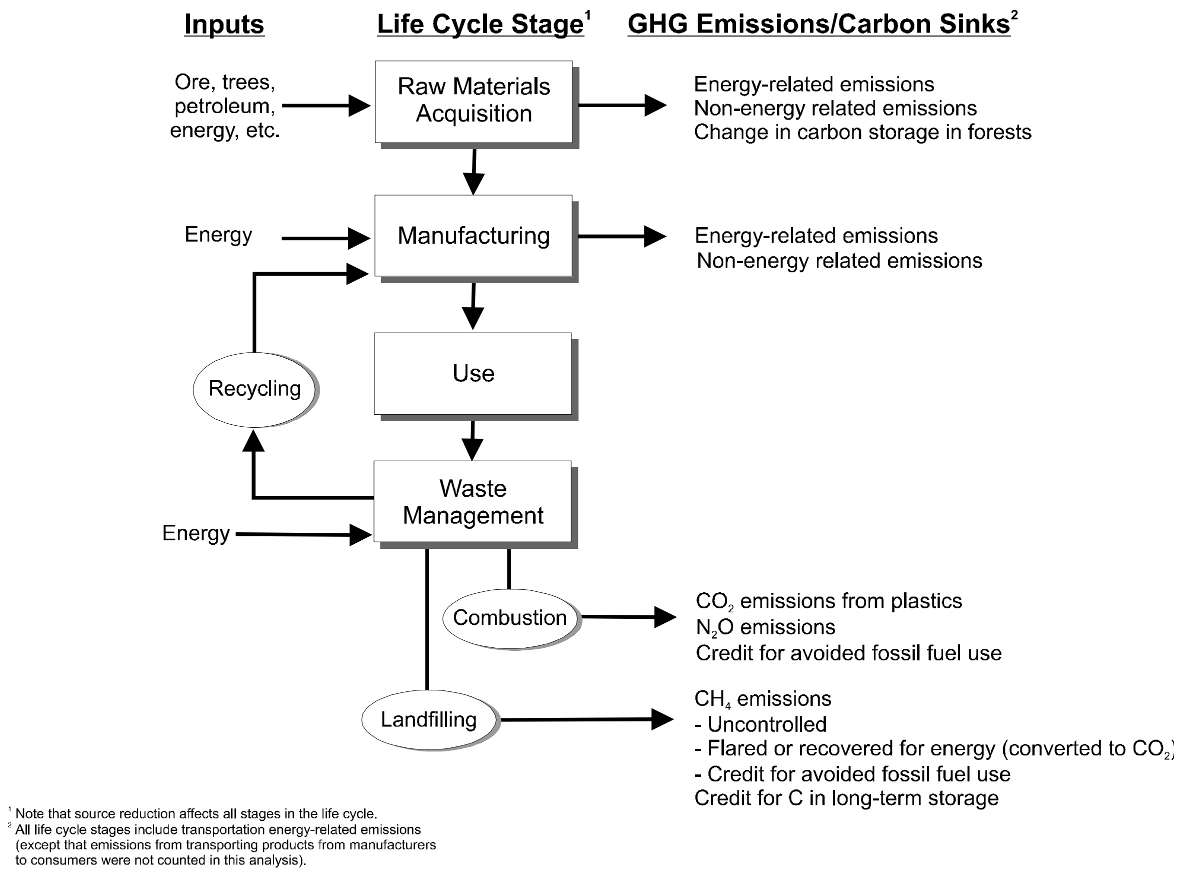
11 The Climate and Waste Program comprises Initiative 16 (Accelerate Source Reduction, Pollution Prevention, and Recycling) of the U.S. Climate Change Action Plan.

12 www.epa.gov/mswclimate/.

13 For more information on GPRA, see the "reports and guidance documents" section of the US Chief Financial Officer's GPRA home page at www.financenet.gov/financenet/fed/cfo/gpra/reports.htm.

wood products, thereby resulting in enhanced forest carbon storage. Our research indicates that in some cases the upstream materials management decisions (e.g., material use) can have a greater effect on GHG emissions than decisions at the downstream (waste disposal) end. Thus, to incorporate the full range of effects through a material's life cycle, a life cycle analysis methodology provides the most appropriate framework.

Figure 1
GHG Sources and Sinks Associated with Materials in the MSW Stream



For each material type, we examined those stages of the life cycle that have the potential to affect GHG emissions as materials are converted from their raw states to products, and then disposed as waste. Figure 1 shows the steps in the life cycle in which GHGs are emitted, carbon sequestration is affected, and electric utility energy is displaced (reducing utility GHG emissions).[14] GHG emission reductions from source reduction[15] and recycling materials in the raw material acquisition and manufacturing stage were compared to a baseline of acquiring raw materials and manufacturing products using the current mix of virgin and recycled inputs. Similarly, changes in forest carbon were estimated based on the projected stock

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14 EPA's Office of Research and Development (ORD) is performing a more extensive application of life cycle assessment for various waste management options for MSW. ORD's analysis will inventory a broader set of emissions (air, water, and waste) associated with these options. For more information on this effort, please see their project website at http://www.epa.gov/ docs/crb/apb/apb.htm.

15 The source reduction techniques we analyze involve using less of a given product without using more of some other product – e.g., making aluminum cans with less aluminum ("lightweighting"); double-sided rather than single-sided photocopying; or reuse of a product.

of carbon in forests and harvested forest products under existing recycling policies and projected market conditions. At each of the points in the life cycle, we also considered transportation-related energy emissions. We did not analyze the GHG emissions associated with consumer use of products but believe them to be negligible for the selected materials.

The IPCC has developed accounting methods for GHG emissions and sinks, to be used in developing national inventories of GHG emissions.[16] Several aspects of the methods have important implications for the waste sector, particularly the components dealing with the use of global warming potentials, treatment of carbon cycling in forests, and accounting for CO_2 emissions from combustion facilities using biomass fuels. Our approach integrates the IPCC accounting conventions within the life cycle framework to provide emission factors that are consistent with the conventions used in developing GHG inventories and evaluating GHG mitigation

The GHG emission factors represent U.S. national average estimates for waste management activities (source reduction, recycling, combustion, and landfilling) for 12 material types, including newspaper; office paper; corrugated cardboard; mixed paper; aluminum cans; steel cans; glass containers; high density polyethylene (HDPE) plastic; low density polyethylene (LDPE) plastic; polyethylene terephthalate (PET) plastic; dimensional lumber, and medium density fiberboard (MDF). These materials constitute nearly 42 percent of municipal solid waste generated in the US.

The emission factors are published in a report – *Greenhouse Gas Emissions from Selected Materials in the Municipal Solid Waste Stream* – widely distributed in the US and abroad.[17] The key results of this report – life cycle GHG emissions for source reduction, recycling, combustion, and landfilling – are provided in Table 1.[18] The values in the table indicate the net GHG emissions (i.e., emissions minus credits for (a) carbon storage and (b) displaced electricity emissions) associated with managing one ton of material using each of the listed management strategies. These factors are based on average U.S. conditions (e.g., average fuel mix for raw material acquisition and manufacturing using recycled inputs; typical efficiency of a mass burn combustion unit; national average landfill gas collection rates). GHG emissions are sensitive to several key factors that vary on a local basis, including the landfill gas recovery practices (if any), the characteristics of the energy sources being displaced by energy recovery (at combustors and landfill gas projects), and relative transportation distances. Thus site-specific emissions differ from those summarized here.

To apply these emission factors, one must specify both the baseline scenario (e.g., landfilling or combustion) and an alternative scenario (e.g., source reduction or recycling), and the amount of material that is managed in each scenario. Then, for both the baseline and the alternative scenarios, the tons managed are multiplied by the respective emission factors. The products represent the GHG emissions. The emission reduction (or increase) is the difference in the values for the two scenarios.

The primary application of the emission factors is to support climate change mitigation accounting for waste management practices. As well as measuring the progress of national programs (discussed in the next section), these factors have also been used by organizations interested in quantifying and voluntarily reporting GHG emission reductions. For example, utilities and waste combustion facilities participate in a voluntary reporting system managed by the US Department of Energy,[19] and have used these emission

16 IPCC. Guidelines for National Greenhouse Gas Inventories (three volumes), 1997. IPCC, Hadley Center Meteorological Office, Bracknell, England.

17 The full report is available on the Internet at http://www.epa.gov/mswclimate under the “Tools” section.

18 The values listed here reflect some additions and recent updates to those in the original report.

19 This reporting system is authorized by Section 1605 (b) of the Energy Policy Act of 1992

factors. The methodology presented in this report may also assist other countries involved in developing GHG emission estimates for their solid waste streams.[20]

Table 1
Net GHG Emissions from Waste Management Options (MTCE/Wet Tonne)

Material	Source Reduction: Current mix of mfgrg inputs	Source Reduction: 100% virgin mfgrg inputs	Recycling	Combustion	Landfilling: Without LFG Recovery	Landfilling: With LFG Recovery and Flaring	Landfilling: With LFG Recovery and Electric Gen.	Landfilling: Projected US Nat'l. Average
Newspaper	-1.00	-1.41	-0.94	-0.24	-0.13	-0.32	-0.36	-0.25
Office Paper	-1.12	-1.42	-0.90	-0.20	1.16	0.26	0.08	0.59
Corrugated Cardbrd	-0.86	-1.22	-0.78	-0.21	0.30	-0.10	-0.18	0.04
Mixed Paper								
Broad Definition	NA	NA	-0.73	-0.21	0.34	-0.09	-0.18	0.06
Residential Def.	NA	NA	-0.73	-0.21	0.29	-0.11	-0.20	0.03
Office Paper Def.	NA	NA	-0.93	-0.19	0.42	-0.06	-0.15	0.12
Aluminum Cans	-3.17	-5.94	-4.27	0.03	0.01	0.01	0.01	0.01
Steel Cans	-0.90	-1.23	-0.63	-0.53	0.01	0.01	0.01	0.01
Glass	-0.16	-0.18	-0.09	0.03	0.01	0.01	0.01	0.01
HDPE	-0.68	-0.77	-0.40	0.25	0.01	0.01	0.01	0.01
LDPE	-0.98	-0.98	-0.54	0.25	0.01	0.01	0.01	0.01
PET	-1.10	-1.28	-0.68	0.31	0.01	0.01	0.01	0.01
Mixed MSW as dispo	NA	NA	NA	-0.03	0.19	-0.03	-0.07	0.05
Dim. Lumber	-0.61	-0.61	-0.74	-0.25	-0.05	-0.17	-0.20	-0.13
MDF	-0.67	-0.67	-0.74	-0.25	-0.05	-0.17	-0.20	-0.13

Note that more digits may be displayed than are significant.

In order to make GHG emission factors presented in the report more readily accessible to stakeholders, EPA developed the WAste Reduction Model (WARM). WARM provides users with a spreadsheet tool to assess GHG emission reductions associated with solid waste management decisions. It incorporates key site-specific parameters to improve the accuracy of the emission factors for specific conditions.

Program Implementation[21]

The U.S. Climate Change Action Plan established an overall emission reduction goal of 109 million metric tons of carbon equivalent (MMTCE) by the year 2000. Of this goal, the EPA Waste and Climate Program is allocated a target of 5 MMTCE. EPA has been implementing three programs to help hit this target – WasteWise, Pay-As-You-Throw (PAYT), and the Waste Reduction Demonstration Projects – each of which are described below.

[20] Note that waste composition and product life cycles vary significantly among countries. Our research may assist other countries by providing a methodologic framework and benchmark data for developing GHG emission estimates for their solid waste streams.

[21] Information on specific activities included in EPA OSW's program implementation efforts, as well as WARM, may be found at http://www.epa.gov/mswclimate.

***WasteWise*[22]**

WasteWise is a voluntary program working with a variety of entities – American businesses; federal, state, local, and tribal governments; and institutions – to reduce municipal solid waste. Presently, the WasteWise program has over 900 partners across the United States, representing over 50 business, civic, and industrial sectors. The partners range from Fortune 1000 companies to small local governments.

The WasteWise program encourages organizations to take cost-effective actions to reduce solid waste. Organizations participating in WasteWise commit to achievements in three areas, including waste prevention, recycling collection, and buying or manufacturing recycled products. Partners track their progress in these areas over a three-year period and report annually on their accomplishments. EPA maintains a reporting system that stores information on the specific materials addressed by the partners' efforts, and the volumes of waste prevented or recycled as a result of these efforts.

The combination of written commitments and annual reporting enable EPA to quantify WasteWise program results in terms of GHG emission reductions using the material- and activity-specific emission factors developed through our research. Measurable results allow companies and organizations involved in WasteWise to report voluntary GHG emission reductions and publicize their activities to environmentally conscious customers. In addition, the ability to measure emission reductions enables EPA to enlist further support for the program based on the significant benefits of program activities in terms of climate protection.

Pay-As-You-Throw (PAYT) [23]

PAYT is a national program to encourage residential waste reduction. In communities with PAYT, residents are charged for the collection of municipal solid waste (MSW) based on the amount they throw away. This pricing approach causes residents to consider the amount of waste they generate; therefore the program creates a direct financial incentive to recycle more and generate less waste.

EPA's PAYT team distributes information, provides training, and offers technical assistance to waste managers and to local planners across the US. Through these and other efforts, EPA estimates that the number of communities using PAYT in the US has risen to over 4 000 (approximately 35 million residents).

Unlike partners of the WasteWise program, PAYT communities are not required to report annual results to EPA. Therefore, EPA measurement activities are limited by data availability and program results must be indirectly measured. Through academic research on PAYT activities nationwide, EPA has developed estimates of the effect of PAYT on typical communities' waste generation, landfilling, and recycling rates. Using these estimates, along with (1) assumptions on the change in proportions of specific materials source reduced or recycled, and (2) GHG emission factors by material type and activity, we can estimate the national GHG impact of PAYT.

Waste Reduction Demonstration Projects

The EPA Climate and Waste Program is currently funding more than 30 solid waste climate change grant projects. EPA headquarters staff work with regional offices to award grant funding to state and local governments and non-governmental organizations on a competitive basis. Awards are based largely on the

[22] Information on WasteWise can be found on the web at http://www.epa.gov/wastewise.
[23] Information on PAYT can be found at http://www.epa.gov/payt/.

ability to demonstrate GHG reductions through waste reduction activities and to communicate the benefits to peers.

Demonstration projects are often effective at reducing emissions and raising local interest. However, because they are demonstration projects they often require significantly longer “payback” periods than WasteWise or PAYT. Thus it is necessary to view benefits of these activities over a longer timeframe.

EPA has developed a database to track contact information, project descriptions, materials information (types and quantities), and GHG emission reductions attributable to these projects. Project results are provided on a semiannual basis by grantees. Project data are stored in the tracking system, along with material- and activity-specific GHG emission factors, enabling the calculation of emission reduction estimates.

Findings

The link between waste prevention and climate protection is stronger than commonly recognized. A life cycle approach is, in our view, the most appropriate foundation for establishing this link. Based on the US experience, environmental scientists and engineers in the waste management field would be well-advised to carefully review the IPCC accounting methods, and how they apply to sources and sinks for materials in the wastestream, when evaluating the nature and strength of the link in their countries.

GHG emission reductions that may be achieved through waste prevention programs are significant. Our 1997 estimate of emission reductions attributable to the EPA Climate and Waste Program exceed 2.8 MMTCE, and the program is on track to meet its 2000 target of 5 MMTCE (comparable to taking over 4 million cars off the road). When developing a GHG mitigation portfolio, national, state, local, and industry decision-makers should consider waste prevention as an effective technique that can often be accomplished at low cost (and sometimes with cost savings) and has the added benefit of lending the weight of climate change to waste reduction policies in effect or planned.

The WasteWise, PAYT, and Waste Prevention Demonstration Projects have accumulated several years of experience in “marketing” climate protection through waste programs, and have learned many lessons on how to persuade public and private sector waste managers to participate in these programs. There are also many lessons that apply in terms of measuring program benefits from a GHG perspective. Much of this experience is transferable to other nations interested in pursuing and measuring voluntary emission reduction efforts. Accordingly, EPA’s Climate and Waste Program is willing to share the benefit of the US experience with other countries designing programs to encourage GHG emission reductions through waste management activities.

POWERPOINT PRESENTATION [Anne Choate and J. Randall Freed]

Evaluating the Greenhouse Gas Impacts of National Waste Prevention Activities: The U.S. Experience

Anne Choate
ICF Consulting Group
(Contractor to U.S. Environmental Protection Agency, Office of Solid Waste)
May 5, 1999

Purpose

- Provide an overview of US EPA's Climate and Waste Program
- Discuss measurement approach for key program elements
- Share findings

Program Overview

- Research and technical assistance on waste management options and their impact on GHG emissions
- National program implementation
  - *WasteWise*
  - *Pay-As-You-Throw (PAYT)*
  - *Demonstration projects*
- Outreach and education

Research and Technical Assistance: Purpose

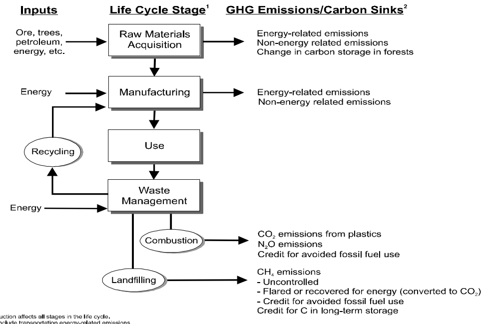
- Provide scientific basis for estimating GHG emission reduction benefits of waste management
- Target materials and management methods with large emission reduction potential

Research and Technical Assistance: Approach

- Incorporate the full range of effects through a material's life cycle
- Use IPCC accounting methods for GHG emissions and sinks
  - *GWPs*
  - *Carbon cycling in forests*
  - *CO_2 emissions from combustion*

Life Cycle Analysis of GHG Emissions

Figure 1
GHG Sources and Sinks Associated with Materials in the MSW Stream



[1] Note that source reduction affects all stages in the life cycle.
[2] All life cycle stages include transportation energy-related emissions (except that emissions from transporting products from manufacturers to consumers were not counted in this analysis).

GHG Emission Factors

- Emission factors developed for:
  - *12 material types and mixed MSW*
  - *Source reduction, recycling, combustion, and landfilling*
- Example application:
  - *GHG impact of recycling 10 tonnes of office paper. Baseline practice is landfilling.*
    - *Baseline: 10 t x 1.16 MTCE/t= 11.6 MTCE*
    - *Alternative: 10 t x -0.90 MTCE/t= -9.0 MTCE*
    - *Net change: -9.0 MTCE - (11.6 MTCE)= -20.6 MTCE*

Program Implementation: Purpose

- Meet the emission reduction goals established in the U.S. Climate Change Action Plan
  - *Overall goal - 109 MMTCE by 2000*
  - *EPA Waste and Climate Program goal - 5 MMTCE by 2000*
- Elements:
  - *WasteWise, PAYT, Demonstration Projects*

WasteWise

- Voluntary program; >900 partners
  - *Businesses*
  - *Federal, state, local, and tribal governments*
  - *Institutions*
- Encourages cost-effective actions to reduce solid waste
- Partners report accomplishments annually
- Quantifiable results

Pay As You Throw (PAYT)

- Economic incentive for residential waste reduction
  - *>4,000 communities (35 million residents)*
- EPA distributes information, provides training and technical assistance
- Measurement approach based on extrapolation from sample communities

Demonstration Projects

- >30 solid waste climate change grant projects
- Awarded to state and local governments and NGOs
- Longer “payback” period than other voluntary programs
- EPA tracks results and measures emission reductions

Findings

- Strong link between waste prevention and climate protection -- best estimated using life cycle approach and IPCC methods
- Waste prevention is a low-cost strategy that can broaden national, state, and local GHG mitigation portfolios

Findings

- Ability to quantify benefits increases support for program
- Potential for significant emission reductions
  - *In 1997, EPA Climate and Waste Program responsible for 2.8 MMTCE of emission reductions*
  - *On track to meeting US goal of 5 MMTCE emission reductions by 2000*

Program Results are Transferable

- Life cycle analysis/IPCC framework
- Measurement parameters
- Lessons from program implementation
- Program benefits of measuring waste prevention efforts in terms of GHG emission reductions

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QUANTIFYING THE AMOUNT OF MUNICIPAL SOLID WASTE PREVENTION (SOURCE REDUCTION) OCCURRING IN THE UNITED STATES

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WASTE MINIMISATION: SESSION 4 (Supplementary Document)

Introduction

The Municipal and Industrial Solid Waste Division of the United States Environmental Protection Agency (USEPA) is actively involved in evaluating national achievements in municipal solid waste (MSW) minimization. USEPA's research has focused on finding new ways to link source reduction to material flows and consumption patterns. MSW (household and commercial waste) generation is traditionally measured on a pounds per capita per day basis (ppd). In 1990, the per capita rate per day in the US was 4.5 pounds. In accordance with *The Climate Change Action Plan*, USEPA set a goal of reducing MSW generation to the rate of 4.3 ppd by the year 2000[24]. USEPA then further expanded this goal in response to the *US Government Performance Review Act*, by calling for the MSW generation rate to be held steady at 4.3 ppd until the year 2005[25]. USEPA's National Municipal Solid Waste Characterization Reports produce vital information on US waste flows and recycling rates. This data has proven instrumental in tracking and evaluating progress towards these reduction goals. While USEPA's MSW Characterization reports measure the amount of both waste generation and recycling in the US, they do not include measurements of the amount of source reduction which is occurring.

To address this need, USEPA has developed a methodology for quantifying the amount of MSW source reduction nationally. USEPA has applied this methodology in a report called the "*National Source Reduction Report*", which will be released by USEPA later this year.

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24 President William J. Clinton & Vice President Albert Gore, Jr., 1993. The Climate Change Action Plan. Action Number 16: "Accelerate Source Reduction, Pollution Prevention, and Recycling" October.

25 103rd Congress. 1993. US Government Performance Results Act. Public Law: 103-62 (08/03/93).

For the purposes of that report, source reduction was quantified for a single year (1996) relative to changes in waste generation from 1990 to 1996. The year 1990 was chosen as a base-line from which to evaluate source reduction achievement, in accordance with the 1989 release of USEPA's *Agenda for Action*, which places source reduction at the top of a recommended hierarchy of alternative integrated solid waste management strategies[26]. A number of preliminary findings from this report will be presented in this paper.

As will be revealed, the chosen methodology takes an important departure from the traditional per capita per day unit of measure, by utilizing economic data to understand MSW generation rates. As such, USEPA is taking an important step towards understanding waste prevention in the context of material flows, consumption patterns, and producer responsibility.

Review of Historical MSW Generation Data

In developing a methodology for quantifying source reduction at the national level, USEPA first began by examining the historical pattern of MSW generation in the US. Figure 1 provides a picture of average annual changes in the generation of MSW during the period of 1960 to 1996, using data from the *Characterization of Municipal Solid Waste in the United States: 1997 Update* (here-after, *1997 Update*)[27]. Examination of the data reveals that the average annual change in MSW generation was consistently positive from 1960 to 1994. MSW generation continued to grow for each time period between 1960 and 1994. However, starting in 1994 there were reductions in the amount of MSW generated. Figure 1 shows that after 1994, average annual change in MSW generation was negative for the first time in over thirty years.

Why the significant downturn in the growth of MSW and which components of the waste stream were being reduced? Much of this downturn was thought to be attributable to waste prevention and source reduction efforts. However, due to the lack of quantifiable data on source reduction, this could not be verified. The methodology described in this paper resolves this problem by providing a simple way to gauge the quantity and kinds of source reductions occurring in the US.

Explanation of Methodology Development

Dr. John K. Stutz, Director of the Solid Waste Group at Tellus Institute, has been instrumental in working with the US and other OECD member nations to devise standard indicators of performance in waste prevention. As explained by Dr. Stutz, one alternative to measuring waste prevention relies on quantifying these reductions relative to underlying socioeconomic measures, such as growth in population or the economy[28]. The following is an explanation of this methodology and how it has been applied in the case of the US.

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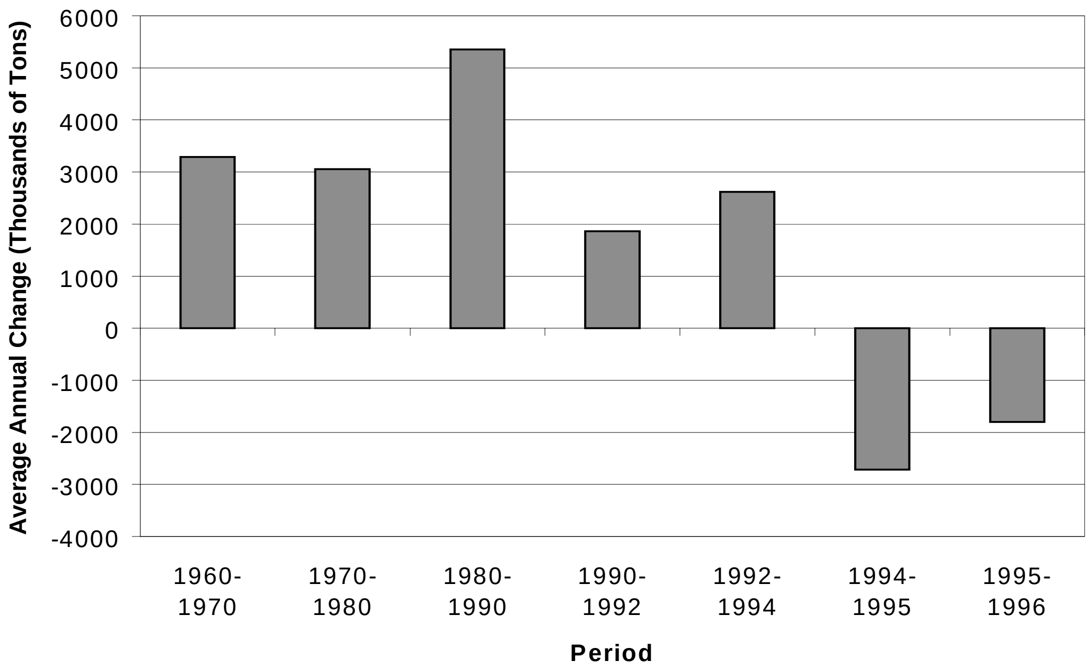
26 USEPA, 1989. The Solid Waste Dilemma: An Agenda for Action. Prepared by Solid Waste and Emergency Response. EPA/530-SW-89-019.

27 Franklin Associates, Ltd., 1998. Characterization of Municipal Solid Waste in the United States: 1997 Update. Prepared for U.S. Environmental Protection Agency, Municipal and Industrial Solid Waste Division. May.

28 Waste prevention measurement methods developed by Dr. Stutz are described in his paper, "Tools for Evaluating Performance in Waste Prevention" for presentation at this OECD workshop. See also OECD, 1995. Volume II: Which Policies, Which Tools? Washington Waste Minimisation Workshop. March 29-31, in particular the discussion of Cross Cutting Issue 2.

Figure 1. Average Annual Change in MSWGeneration



Note: Data in the *1997 Update* is limited to years 1960, 1970, 1980, 1990, 1992, 1994, 1995, & 1996.

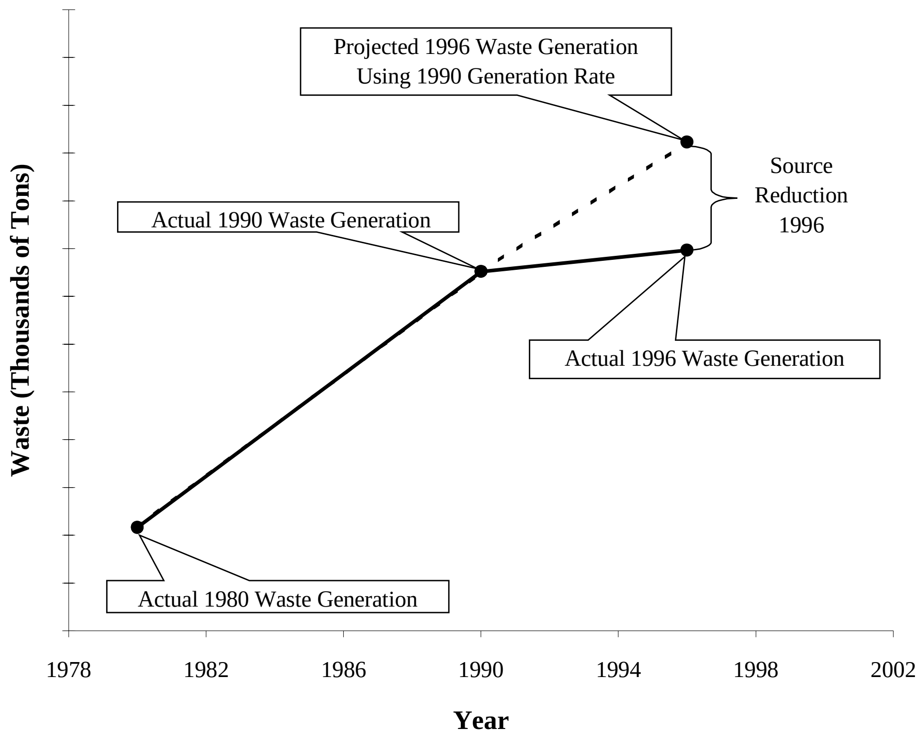
Approximating the quantity of waste prevented (i.e., source reduction), necessitates considering the amount of waste that would have been generated in the absence of any source reduction efforts. In other words, if people had not practiced waste prevention over this period, how much waste would have been generated in any given year?

Figure 2 helps to illustrate this point. In Figure 2, the annual tonnage of the waste stream is presented as a function of time with the solid line depicting historical waste generation. The dotted line depicts the waste that would have been generated if no source reduction had occurred, with the end point of this line representing a projection of the subsequent amount of waste that would have been generated in 1996. The projections of 1996 waste generation, depicted by the dotted line, are ultimately generated with the help of historical data. Source reduction then, is simply the difference between the actual and projected amounts of waste generated in 1996, as shown in Figure 2. This can also be expressed in the following form:

(1)	**Source Reduction in 1996**	**=**	**Projected 1996 Waste Generation**	**-**	**Actual 1996 Waste Generation**[29]

[29] Franklin Associates, Ltd., 1998. Characterization of Municipal Solid Waste in the United States: 1997 Update. Prepared for U.S. Environmental Protection Agency, Municipal and Industrial Solid Waste Division. May.

Figure 2. Illustration of Methodology for Quantifying Source Reduction



Note: Figure 2 is not shown to scale and is for illustrative purposes only.
Source: Tellus Institute.

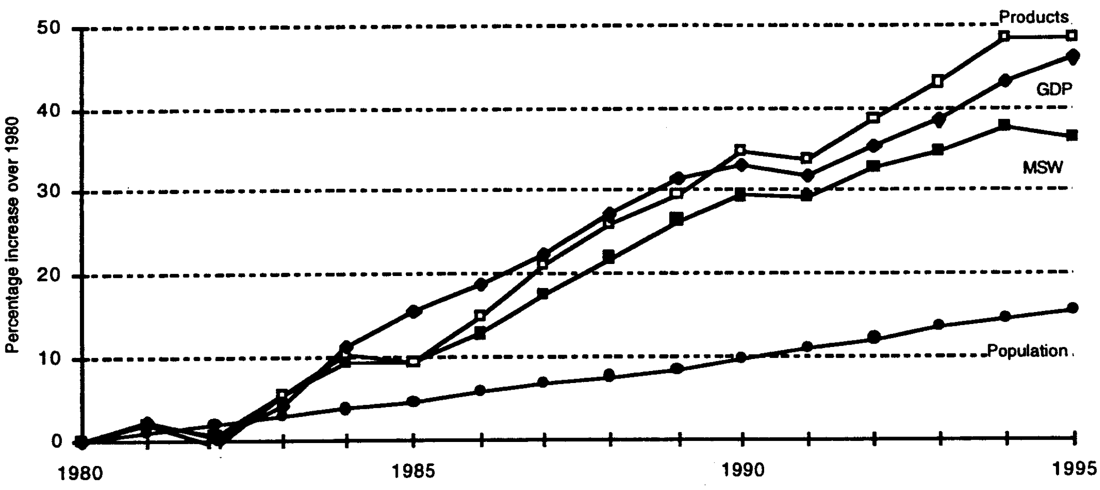
Coming up with a projection of what would have happened without source reduction (i.e., Projected 1996 Waste Generation) is difficult, because waste generation is constantly changing as the population and economy grow. Changes in packaging, increased consumption of fast-foods, changes in lawn and garden care, and countless other socioeconomic and lifestyle changes affect the annual quantity of MSW generated. Accordingly, central to USEPA's analysis is the assumption that, in the absence of source reduction, MSW generation would have grown from 1990 to 1996 in proportion to some driving or causal factors, such as increases in population, wages, and or consumer spending. Identifying these factors is critical, for it is the only way that the amounts of "Projected 1996 Waste Generation" may be extrapolated from historical data.

Consequently, USEPA together with Tellus Institute, evaluated several factors to determine which ones most closely followed the historical pattern of waste generation in the US. Of those examined, three leading candidates warranted further consideration: population (waste generated per capita), gross domestic product or GDP (waste generated per million dollars of economic activity), and consumer spending (waste generated per billion dollars spent). Figure 3 demonstrates the historical pattern of MSW generation relative to these three factors.

Using population as the driving factor assumes that the overall number of people drives MSW generation rather than the actions of those people. Using GDP, in contrast, assumes that waste generation is proportional to overall economic activity. Similarly, the choice of consumer spending assumes that waste generation is driven by the activities and expenditures of consumers. In the past, MSW generation has traditionally been evaluated on a per-capita basis. However, the analyses undertaken in this report clearly indicate that the economic measures evaluated bear a much stronger correlation to MSW generation than does population. The dramatic similarities among the historical patterns of MSW generation, GDP, and Consumer Spending, shown in Figure 3, make this abundantly apparent. Thus, for the US, reduction estimates that are based on GDP or Consumer Spending will be far more accurate than those based on population.

Figure 3. Historical Patterns of MSW Generation as compared to Population, GDP, and Consumer Spending

(which is a better predicoter of MSW?)



Notes:

1. The *1997 Statistical Abstract of the United States* served as the source for this socioeconomic data.
2. When analyzing these driving factors, the two economic measures (GDP & Consumer Spending) must be expressed in 'real,' or inflation-adjusted, dollars. Use of 'real' consumer spending as the driving factor, for example, ensures that the analysis reflects what is purchased rather than the effects of changes in price due to inflation.

Stutz has conducted similar analyses for Japan, where he compares historical data on MSW generation relative to population and GDP[30]. For his research, Stutz chooses GDP as the socioeconomic factor with which to evaluate the relative evolution of Japan's prevention of MSW. However, in the case of the US, Consumer Spending (officially referred to as Personal Consumption Expenditures (PCE) by the *US Statistical Abstracts*) was chosen over GDP as the factor that most accurately predicts, or drives, MSW generation. This conclusion is supported by detailed empirical and statistical analyses of waste generation in the US since 1960. These analyses were conducted by Tellus Institute on behalf of USEPA and will be fully covered in USEPA's upcoming *National Source Reduction Report*.

The link between consumer spending and MSW generation also makes intuitive sense given that consumer spending reflects the goods and products, including food and its packaging, which are purchased, used, and ultimately discarded as MSW. Furthermore, consumer spending, as explained below, is also linked to yard trimmings, though not as directly. Yard trimmings are a major component of MSW in the US. Consumer

[30] Stutz, John, 1999. "Tools for Evaluating Performance in Waste Prevention".

spending has grown from year to year, reflecting the increasing material well-being of the American population. And, material well-being is reflected in the purchase of seed, plants, fertilizer, and water which ultimately contribute to the generation of yard trimmings.

Final Methodology

Given the striking correspondence between historical changes in MSW generation and Consumer Spending in the US, it is reasonable to assume that, without the onset of source reduction, the relationship between MSW generation and Consumer Spending would have remained relatively constant from 1990 to 1996. What this means is that the ‘Waste Generation Rates for 1990 and 1996, measured as the ratio of MSW generation and Consumer Spending, can be assumed to be equal, such that:

$$(2) \quad \frac{\text{Actual 1990 Waste Generation}}{\text{1990 Consumer Spending}} = \frac{\text{Projected 1996 Waste Generation}}{\text{1996 Consumer Spending}}$$

If this is true, then the amount of “Projected 1996 Waste Generation” is simply a function of the changes in Consumer Spending from 1990 to 1996, expressed as:

$$(3) \quad \text{Projected 1996 Waste Generation} = \frac{\text{Actual 1990 Waste Generation}}{\text{1990 Consumer Spending}} \times \text{1996 Consumer Spending}$$

With a value for “Projected 1996 Waste Generation”, the amount of “Source Reduction in 1996" follows from formula (1):

$$(4) \quad \text{Source Reduction in 1996} = \text{Projected 1996 Waste Generation} - \text{Actual 1996 Waste Generation}$$

These three basic formulas form the sole basis for the chosen methodology. Substantial historical, empirical, and statistical data were relied upon for the above methodology and the result is a simple, yet reliable, approach for approximating the quantity of source reduction occurring in the U.S.

Preliminary Findings & Conclusions

With the use the above methodology and existing data, USEPA estimates that in 1996 alone, a staggering 23 million tons of MSW was prevented from being generated. Table 1 demonstrates how this number was derived based upon the above formulas (2, 3, and 4).

Table 1. Calculation of Source Reduction in 1996

Source Reduction Equation Components	1990	1996
Waste Stream: Actual Waste Generation (Thousands of Tons)	205,210	209,660
Driving Factor: Consumer Spending (Billions of Dollars)	4,132.2	4,690.7
Waste Generation Rate: Actual Waste Generation (Tons per Million Consumer Spending Dollars)	49.66	44.70
Projected 1996 Waste Generation: (Thousands of Tons)	Not Applicable	232,946
Source Reduction in 1996 (Thousands of Tons)	Not Applicable	**23,286**

Note:
The first row of Table 1 represents the data points 'Actual 1990 Waste Generation' and Actual 1996 Waste Generation' in Figure 2. The second row is data on consumer spending obtained from the *1997 Statistical Abstract of the United States*. The third row is the result of dividing the values for waste generation (the first row) by the values for consumer spending (the second row). Specifically, for the 1990 data, 205,210 thousand tons divided by 4,132.2 billion dollars yields a waste generation rate of 49.66 tons per million dollars. The'Projected 1996 Waste Generation' —232,946 thousand tons—is simply consumer spending in 1996 (4,690.7 billion dollars) multiplied by the ratio of 'Actual Waste Generation' and 'Consumer Spending' for 1990 (49.66 tons per million dollars). The last row of the table subtracts the 'Actual 1996 Waste Generation' (209 million tons) from the 'Projected 1996 Waste Generation (232 million tons) to compute'Source Reduction in 1996' (23 million tons).

Perhaps the greatest advantage of this methodology is its broad applicability. Not only can it be used to gauge overall reductions, but it can also be applied to individual elements of the waste stream as well. As a consequence, it can serve as a mechanism for distinguishing what kinds of reductions are occurring relative to the overall waste stream.

For example, with OECD data on the material composition of MSW in Japan, Stutz has been able to disaggregate overall MSW reduction estimates into 5 distinct product components including paper and paperboard, plastics, glass, metals, and "other" materials[31]. With this information, Stutz was able to assess the progress in waste prevention from 1980 to 1994 for each of these components, and thereby show that progress had been achieved in the areas of plastics, glass, and "other" material, yet not for paper and paperboard nor metals[32].

USEPA has also been able to conduct the same sorts of analyses, but on a much larger scale. This is because, in the US, a more refined delineation of the material composition of the waste stream exists. As a consequence, USEPA has been able to conduct more extensive analyses of its waste stream. The result has been delineation of the waste prevention for an unprecedented 47 different components of the waste stream. This has been made possible thanks to an ongoing commitment to the collection of MSW characterization and material composition data by the US over the last decade.

What this analysis of specific components of the waste stream has revealed is that, while many elements of the waste stream are experiencing source reduction, others may actually exhibit source expansion (e.g., a scenario in which more waste is produced in a given year relative to the growth rate in consumer

31 Ibid.
32 Ibid.

spending). For instance, corrugated boxes and nondurable commercial printing are two examples in the US waste stream that were identified as generating more waste relative to the growth rate in consumer spending. Such information would not be evident from analysis of waste prevention at an aggregate level. However, such analysis below the aggregate level of waste generation will require careful grouping of the elements of the waste stream to make combinations that make sense functionally. It may be more instructive, for example, to look at the amount of waste generated from the delivery of soft drinks to consumers via beverage containers, rather than looking at waste from glass, plastic, and aluminum containers individually. What is clear is that, without the thorough development of the subject methodology that has been outlined in this paper, such analyses would not be possible.

USEPA considers source reduction to be critical to overall waste diversion. In the future, USEPA intends to publish MSW Characterization Reports that will include source reduction in addition to generation, recycling, and disposal to give a more complete picture of the status of solid waste management in the US. The Agency feels that this will create more active interest in MSW source reduction among policy makers at all levels of government. USEPA's efforts at more fully quantifying all aspects of MSW generation will also permit better estimates of the amounts of energy savings, material savings, and global warming emission reductions attributable to source reduction.

WASTE PREVENTION AND RESOURCE EFFICIENCY - THE LINK TO CONSUMPTION PATTERNS AND SERVICES

by
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WASTE MINIMISATION SESSION: 5

Abstract

Understanding the linkages between waste prevention and resource efficiency can help to find political and public acceptance for them and practical tools for their implementation. The factor 10 goal (tenfold increase in resource efficiency in 50 years) can be adopted as a goal for waste prevention. Growth in production and consumption has until now outweighed the environmental benefits of efficiency increase. To prevent this in the future we need the complementary sufficiency approach.

It is necessary to promote also the resource efficiency of consumption patterns and services In order to achieve this there has to be more supply of eco-efficient services (repair, rental...) and counseling about their benefits. The waste authorities should ensure the availability of these services and counselling just as they do when it comes to recycling.

In Finland there are some widely spread practices and services that go hand in hand with resource efficiency targets: public libraries, reusable beverage and beer packages, voice mail, to mention some. In many cases it it possible to increase resource efficiency manyfold with appropriate consumption choises.

1. Combining the promotion of waste prevention and resource efficiency

Until now waste prevention has mainly been a concern of the waste management authorities. Their expertise has traditionally been in waste issues, and their main interest in waste prevention is to minimize the waste amounts generated. However, in recent years the discussion about sustainable production and consumption has brought up the necessity to use less natural resources. This has helped to focus more on the front end of the production-consumption chain and put emphasis on increasing resource efficiency. It would be beneficial to note the linkages between these two approaces and, as appropriate, combine the resources to promote them.

There is substantial new effort in dealing with eco-efficiency. Increasing resource efficiency is an essential part of the work on eco-efficiency. For instance, the European Union took the Eco-efficiency Initiative in the United Nations CSD meeting in New York, 21 April 1997. In the initiative it is noted as follows:

> It is imperative to increase the productivity of the available resources, while at the same time reducing the pressure on the environment. This means doing more from less resource and energy input. As important as solutions of a purely technological nature are changes in lifestyles and systems.
>
> Studies indicate that the magnitude of necessary changes, to be achieved by the middle of the next century, can roughly be estimated to an average tenfold increase of the resource productivity, as compared to the current level. As an intermediate step an increase in resource productivity, e.g. by a factor four in the next two or three decades, seems to be within reach.

In the Programme for the Further Implementation of Agenda 21, adopted at the 1997 United Nations General Assembly Special Session (UNGASS), it is also clearly noted that resource productivity is a key issue in eco-efficiency. According to the programme, actions in changing consumption and production patterns should concentrate on e.g. promoting international and national programmes for energy and material efficiency with timetables for their implementation, as appropriate. The document refers to studies suggesting the factor targets and encourages the Commission on Sustainable Development to explore policies and measures necessary to implement eco-efficiency.

These ideas have been acknowledged also in Finland. The Finnish Working Group on Eco-efficiency within the authority of the Ministry of Trade and Industry noted its report Eco-efficiency and Factors as follows:

> The factor targets related with eco-efficiency - reducing the material and natural resource inputs to a fraction compared with the quantities produced - tell us again and in a new way about the need to radically change over the long term production and consumption patterns in order not to exeed the ecological capacity of the globe. On the other hand, historical developments in both labour productivity and eco-efficiency tell us that seemingly impossible objectives can be realistic and within the reach of determined action. The response from the administration and business as well as non-governmental organisations point to an emerging interest in entering a path conforming to the factor targets. Thus eco-efficiency and particularly the factor approach tell us in a new way about the dramatic and inevitable need for change, especially in consumption patterns, which in many respects could, even from today's perspective, be achievable at long term.
>
> The eco-efficiency approach requires that particularly the industrialized countries should attempt to raise the productivity of natural resources as actively as traditionally labour productivity. (Summary of the report is available in English).

2. Resource efficiency of consumption patterns and services

It is necessary to consider not only the eco-efficiency of production processes, but also consumption and service sector. It is largely upon the experts to devise the technical innovations that are needed for eco-efficient production, but all consumers are to some extent in a position to choose the way they satisfy their needs.

In Finland there are some widely spread practices and services that go hand in hand with resource efficiency targets: public libraries, reusable beverage and beer packages, voice mail, to mention some. The Finnish Association for Nature Conservation has compiled a report on eco-efficient consumption, with funding from the Ministry of the Environment (summary available in English). The report examines ways of increasing resource productivity at the consumption stage. Waste prevention strategies were classified as described by Stahel (Annex 1).

The examples given in the report account for only a small fraction of the total quantity of resources consumed and waste and emissions generated in the entire Finnish economy. But, in each case given, there is ample potential to significantly increase resource productivity, in some cases by a factor of as high as several dozen. To build an eco-efficient economy (and to prevent waste generation) every sector of society must be studied analysing ways of maintaining the current level of prosperity at a significantly lower rate of resource consumption. Some results of the study are breafly shown below.

Product longevity

Product longevity starts with sound design: products must be designed to be long-wearing, durable and easy to service and repair, and possibly to renew at a later stage of their life cycle. Longevity is affected by factors such as the productÆs structural properties and the materials from which it is made. It is difficult to predict a productÆs lifespan in advance, and reliable testing methods have yet to be developed for this purpose. More information is also needed on the extent to which a productÆs life can be extended by maintenance, repairs and renewal.

Longevity can also be promoted by favouring reusable products. Reuse decreases the total number of products in use at any given time. Reuse of parts or components has a corresponding beneficial outcome. The amount of raw materials and energy consumed and the amount of waste generated declines per one use in proportion to the number of times that the product is reused.

- If disposable bottles or cans were used instead of returnable bottles, the number of new bottles/cans produced per year would rise from 31 million to about 1.15 billion.

- If disposable cases were used instead of returnable containers by Finnish wholesalers, the required 34 million cases would generate 20 000 tonnes of waste a year, i.e. 15% of the annual quantity of corrugated-board waste generated in Finland. About 170 000 plastic containers are removed from use annually, a combined total of 400 tonnes.

More efficient use of products

The function of products is to satisfy consumer needs and generate services. Using a service, however, does not entail that the consumer should necessarily buy the product. Eco-efficiency can be improved by replacing certain products with services, or by changing the entire concept, altering the whole way in which the service is produced.

The efficiency of product use can be increased e.g. through renting, lending or joint ownership. By sharing products, greater benefit can be derived per product, thus using a less natural resources. Consumers can satisfy their needs by securing the right to use certain products instead of buying them. The production of infrequently used goods could thus be reduced.

- If the library loans from Finnish public libraries would be replaced by selling a new book to each reader, about 80 million books would have to be produced yearly. This totals 32 000 tonnes of paper, the production of which would require e.g. 460 000 tree trunks (one trunk = about 70 kg of paper); 11 200 tonnes bleach or colorant; 1 100 tonnes binder; 3 700 tonnes other chemicals; 1 890 million litres water; 16 GWh electricity; and produce about one per cent of the annual quantity of fossil carbon dioxide emissions of the Finnish wood processing industry (about 90% of the industryÆs output is exported).

Replacing products with services

Certain products can be wholly replaced by services. It rarely makes any difference to consumers whether they purchase a product or a service, provided that their needs are satisfied. Services can yield the same satisfaction as products, though at a lower rate of resource consumption: favouring services instead of products is, thus, a means of promoting eco-efficiency. What this basically entails is a general shift in the focus of commercial enterprise from industrial production towards a more service-oriented economy.

- The number of consumers using telephone answering machines has fallen by hundreds of thousands, as more and more consumers are gradually switching to voicemail.

- An electric hand dryer in a public toilet expends five times more energy than a roller towel. Finnish consumers dry their hands on washable roller towels about 170 million times a year, thus reducing energy consumption by 0.5-4.5 GWh compared with the calculated equivalent of using other hand-drying alternatives. The waste generated from one roller towel is about 2 kilograms. The corresponding use of paper towels would produce 39 kilograms of waste.

- Courier services are handled both by car and bicycle in urban areas. The total amount of resources spent per kilometre by an automobile driven in city traffic is estimated to be about eight times that of a bicycle (1,27 kg/km versus 0,16 kg/km) (Mertz 1998). A car consumes as much as 90 times more energy per kilometre than a bicycle and takes up a significantly larger amount of space than a bicycle.

3. New challenges for waste policies

As I see it, there are many benefits in linking up waste prevention with resource efficiency.

a. Ambitious target setting

The factor 10 and 4 targets for resource efficiency seem to be more ambitious than the waste prevention targets until now. They could be adopted as such for waste prevention. They are not absolute reduction targets, but relative to the production, but this has at least in Finland been the case for waste prevention targets, too.

The Finnish target for municipal and industrial waste is that in the year 2000, the amount of waste shall not surpass that in 1994, and in 2005 it should be at least 15 % less than the amount in accordance with predicted growth rate without any reduction measures.

In Finland there has been slight movement towards inlcuding the eco-efficiency consideration in waste policies at least in theory, even if not yet so much in practice. The factor 10 goal and dematerialisation of the economy have been mentioned as new challenges in the National Waste Research and Development Framework Programme 1998-2002, for instance.

b. Possibilities for better co-operation with various stakeholders

Increasing resource efficiency can be more easily communicated to enterprises who understand it as a competitive issue than waste prevention. At least in Finland the concept has raised interest among the political parties, also where environmental or waste issues have not traditionally been popular. This may also help in creating co-operation with product designers.

c. New tasks, challenges and tools

Considering waste prevention from the point of view of resource efficiency certainly raises new challenges and tasks. The government should, for instance, contribute to ensuring the availability of the services and counseling related to waste prevention just as is being done when it comes to recycling. At the moment e.g. the Finnish national waste plan presents waste management infrastructure as targeted, but does not say a word about maintenance, repair, rental or shared use infrastructure.

From a new perspective it is possible also to develop new tools to promote waste prevention and to direct resources in an efficient way in order to decrease use of natural resources.

d. Positive messages for waste counseling

Waste prevention as such is a bit hard task for counseling. It does not sound appealing; people don’t know what it means and so they don’t actually miss advice about it. One problem is also that it is mixed with recycling. However, most of the people have a positive attitude towards saving natural resources when they easily can, and they often are interested to know where the nearby repair or rental services are located, for instance.

On the other hand, waste management authorities have fairly good resources for advisory services. According to the Waste Act all Finnish communes must offer waste counseling. The expences can be covered with income from waste fees. This can be of assistance to make the new eco-efficiency targets better known and contribute to their implementation.

Traditionally wate counseling has focused mostly on recycling and hazardous waste collection, but nowadays some new interesting experiences on waste prevention are emerging.

4. Sufficiency as a waste prevention strategy

Increasing resource efficiency does not necessarily lead to absolute waste prevention. In most industrialized countries, the improvement in efficiency per unit of production or per unit of GDP has been offset by increases in the volume of production and consumption, leading to continued increases in total energy and materials consumed. This has been reported e.g. by the United Nations (1999).

Sufficiency was presented as an ecological strategy by the Sustainable Europe Study carried out by the Wuppertal Institute for Friends of the Earth Europe in 1995. They described sufficiency as “having enough” or “not wanting more” or a “chosen socio-cultural saturation level”. They refer to authors who claim that to achieve a sustainable society, sufficiency is needed in addition to increased efficiency. One argument is that the required reduction in material input is so massive that it cannot be achieved by efficiency gains alone. Moreover, an “efficiency-revolution” needs sufficiency to move in the right direction.

Efficiency = getting the same services out of less material.

Sufficiency = getting the same (or at least adequate) welfare out of less services.

Hirschl (1998) proposes a simple algorithm for including the volume impact in measuring the total environmental impact of various forms of product use. First, he points out that the main indicator is performance of the product or service. The performance P can be measured in physical terms (e.g. passenger kilometres). It is related to the environmental impact E that occurs along the life cycle of a product or service. The smaller the E/P relation is, the greater the eco-efficiency of a product or service. The idea of this consideration corresponds to the idea of MIPS (material input per service unit) presented by the Wuppertal Institute, where the environmental impact is indicated by material input (MI) and the performance indicator is called service (S).

Hirschl then points out that the assessment of environmental impact must consider both the efficiency and the quantity aspects. Therefore, he divides the entire environmental impact into a performance-related impact and a volume impact. The performance-related impact represents the environmental effect caused by changing the way the performance is delivered. Additionally, the volume impact is only based on the altered demand for performance. The entire environmental impact E corresponds to the environmental impact per unit of performance (‘e’ representing the eco-efficiency of a considered strategy) multiplied by the number (level) of performance units demanded.

$$E = \underbrace{E/P}_{\text{eco-efficiency}} * \underbrace{P}_{\text{level of performance}} = e * P$$

(This corresponds to the material flow based consideration MI = MIPS * S; The more services you use, the bigger the efficiency increase has to be in order to achieve total reduction in resource consumption and waste generation.)

The demand of performance plays an important role in the general assessment of a new strategy. If the new concept creates additional demand for some services it may lead to negative environmental impact. The same is true if the use of existing products or services increase.

The concept of sufficiency can also be considered in connection with economical growth. If the economy is to grow, its relative resource efficiency increase should grow, too, in order to reach the same absolute reduction. As the physical limits to dematerialisation do not allow an ever increasing resource productivity, the chances of infinite “sustainable growth” can be questioned. Reducing material input even by a factor of ten is a great task, which may not be easy to exeed.

In order to reach remarkable absolute reduction in resource consumption and waste generation, also the waste authorities should contribute to the discussion about sufficiency. It is more difficult to promote than resource efficiency, since it deals more with our perceptions of the world and ourselves as part of it. The challenge is to increase the abilities to judge what the sufficient level of production and consumption is - at what point growing production and consumption has more negative than positive effects. In Finland we have used some games or plays in waste counseling that encourage people to ponder on what their idea of good life is and how that might be reached.

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ANNEX 1

Waste prevention strategies as described by Walter Stahel

I. The strategy of useful life extension

A. Design of durable products/components

B. Increasing using time of products/components

* reuse (of products/components for the same purpose again)
* repairing (to make broken products/components work again)
* service (to prevent the break-up of products/components)
* improvement (to modernize the product/component, for example updating)

C. Remarketing (different purpose than for the original product/component)

II. The strategy of use intensification

D. The design of eco-efficient products/components

* material-intensity (reducing the consumption of material during manufacturing and use)
* energy-intensity (reducing the consumption of energy during manufacturing and use)
* multipurpose (the product serves several purposes)
* standardization(components fit many products)

E. System solutions (changes in function)

* Producing the service/the profit in a different operational way (substitution)
* Avoiding unnecessary functions (producing the service in a simpler way without the need for extra service)
* Combining different strategies as a system solution

F. Solutions of sale and marketing increasing the productivity of natural resources

* The right to use instead of the concrete product (loaning, leasing, renting)
* Communal use and divided use (e.g. laundry, public transportation, hotel rooms)
* Providing the service instead of the product (e.g. telephone answering service instead of answering machine)
* Selling the results instead of the products(outsourcing)
* Incentives to returning (deposits, pre-paid returns)
* Guarantees
* Service availability (providing the service near the consumers thus avoiding the transportation)

GLOBAL PERSPECTIVE ON ASSESSING TECHNOLOGIES FOR WASTE PREVENTION AND CLEANER PRODUCTION

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WASTE MINIMISATION SESSION: 5

Introduction

Waste prevention programmes require a range of skills to be successfully implemented. Among these is an ability to correctly assess the environmental impact of existing and future technologies and products.

Waste prevention often approaches the issue of technology choice from the standpoint of resolving an existing problem. This may be effective in relieving the immediate situation, but is vulnerable to the creation of new problems that did not exist before. An ad-hoc approach to the selection of alternative technologies can lead to less than optimal results, and a tendency to simply transfer the environmental problem to another sector.

The problem of choosing the most appropriate alternative technology is compounded by the multitude of environmental impacts to be addressed, including now also social and cultural impacts. In fact, despite the ready availability of low-waste technologies some environmental problems remain unresolved because the social factors have not been adequately resolved. One of the best known examples of these intractable problems is the use of mercury in small-scale mining, but others exist also. The widespread failure of effective technology transfer to developing countries often has its origin in this neglect of social factors, and cleaner technology programmes on their own are thus only partially successful.

Technology choice in practice

Some common examples of the contradictions in current procedures of technology choice will illustrate the above. These examples concern well-know situations where the choices in the past have been made on simple criteria, but where the final result is nevertheless questionable from a total environment point of view.

i) The use of chrome in tanning processes is still under regulatory pressure, and efforts are being made to reduce the amount discharged by using high-uptake chrome formulations. Residual levels in effluent are indeed lower, but the remaining chrome is in complexed form which is difficult to treat, and the amounts discharged to the environment may actually rise.

ii) Conventional methods of extraction of gold ores use cyanide. While the toxicity of cyanide is indeed high, it is also an easy chemical to treat, it is biodegradable, and does not accumulate or persist in the environment. The pressure to phase out cyanide rests entirely on its toxicity, not on a comparison with alternative processes.

iii) The recent preference for water-based drilling muds in oil exploration over the traditional oil-based muds has resulted in a significant increase in energy consumption during drilling because the water-based muds are less efficient at lubricating the drillstem. It is necessary therefore to balance the risk of local pollution against global impacts of additional carbon dioxide from extra energy use.

iv) New lead alloys for car-batteries improve the efficiency of the battery, and reduce its weight, but interfere with the metallurgical processes during the recycling process. The more efficient battery is thus more likely to end up in the waste stream.

v) A forgotten aspect of semiconductor manufacture is often the large amount of treatment sludge produced at the plant during the production of ultra-pure water. As this is not part of the mainstream process it can easily be overlooked when evaluating the hazards of the manufacturing process.

Many more examples could be quoted to illustrate the inadequacy of single-criteria decision making. But more life-cycle based decisions are difficult if the impacts, options and choices are not systematically identified and compared.

To improve decision-making a range of assessment methodologies has been developed in recent years to provide better information for decision-makers, including those in waste management. Some such as EIA have become mainstream tools, while others such as life-cycle assessment (LCA) and Environmental Technology Assessment (EnTA) have yet to be routinely applied in day to day decisions of regulators or industry personnel.

In view of the importance of a sound assessment of waste prevention technologies, a brief description follows concerning the application of EnTA as a methodology for worldwide use.

Overview of Environmental Technology Assessment

EnTA is a process where the environmental implications of a technology are analyzed and assessed in a systematic manner, using a written procedure.

UNEP commenced work on the EnTA programme in 1993 under the guidance of an international advisory group. The EnTA Manual and Primer was published in 1995 and has since been used in a variety of international workshops, and several studies concerning different industrial technologies. The work is in part based on earlier experience with Technology Assessment in several national jurisdictions.

The main steps in the EnTA procedure are:

- Description of the technology.
- Potential impacts, including societal impacts.
- Alternative technologies, supporting technologies, and impacts.
- Societal descriptors and trends.

- Systems alternatives.
- Trends affecting technology options.
- Identification of stakeholders and decision-makers.
- Policy options for decision-making.

As in other assessment processes, the degree of sophistication of each of these steps is influenced by an initial scoping step, and thus depends on the objectives of the exercise. The assessment can be carried out in great depth, or be done in a simplified way to obtain only an overview of the main impacts.

A number of features in the EnTA process are designed to overcome the problems of the traditional ad-hoc selection of alternative environmental technologies. These include:

- the evaluation is applied equally to the problem technology and the alternatives;
- it examines also the supply-chain and infrastructure needs;
- it examines all environmental impacts, including social aspects;
- it displays the options in a comparative fashion.

In combination also with other eco-tools, UNEP is now promoting wider use of formal environmental technology assessment as a way of optimizing the application of waste prevention and cleaner production. The recent application to lead battery recycling for example has shown the power of this technique in bringing information to the decision-maker.

Although of considerable use as a stand-alone technique, EnTA should also be seen in the context of the wider family of assessment methods. As part of its activities to improve the use of environment management tool, UNEP has examined several other related assessment methods such as environment impact assessment (EIA) and life-cycle assessment (LCA). UNEP is now looking at how these can be presented as a complete ‘tool box’ to assist waste managers in government and in industry.

Application to waste prevention

By bringing information more systematically into the decision-making process, EnTA can assist in waste prevention programmes at both government and company level.

EnTA can be applied to waste generating processes at the conceptual level, thus assisting the design of better industrial processes, or in developing mitigation measures. By including social criteria in the methodology EnTA can assist in identifying possible health and safety impacts, as well as any unforeseen societal impacts. The early identification by governments of likely impacts can help in the formulation of appropriate protection policies and regulations.

EnTA is particularly helpful to waste minimization and cleaner production programmes by providing a more systematic basis for evaluating the various technology alternatives that may be proposed to resolve a waste or pollution problem. The formal methodology explicitly considers all possible environmental impacts, including also supporting technologies, and so reduces the possibility that some issues in the growing environmental agenda are overlooked.

Technology importers also gain by having a systematic procedure to evaluate the waste implications of industrial equipment, especially in countries where industrial waste disposal facilities are poor or non-existent. EnTA can do much to better align technology transfer practices with the concept of sustainable development.

Conclusions

Waste prevention decisions are often concerned with well-defined environmental problems, and frequently seek to avoid these problems through use of alternative ‘cleaner’ technologies. These alternatives may however be associated with negative impacts of a different type which were not present before, and which thus tend to escape attention. The use of formal environmental technology assessment methodology for waste prevention and treatment technologies can be useful in avoiding decisions which optimize only a limited number of the environmental criteria. Such methodology may also be a component of other decision-making processes, and should therefore be integrated into a larger environmental management tool box to assist the waste manager in making the best overall technology choice in his programme.

POSSIBILITIES OF WASTE PREVENTION IN MINING

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WASTE MINIMISATION SESSION: 5

What is mining?

A working definition of mining could simply be “the extraction of minerals from the earth”. The word “minerals” would cover a wide variety of naturally occurring substances like metals, lime, salt, construction materials, coal, oil etc.

In this presentation I will mainly concentrate on metal mining.

Of course minerals can only be mined where they are found and they are useless until they are converted to metals. The location of a mine is determined by geology. Metal minerals are excavated from the ground by open-pit mining or underground mining.

The mining method chosen depends on the type and grade of mineral or rock being excavated and the distance of the ore body from surface.

Human endeavour moves more material on the surface of the earth each year than the ice sheets of the last Ice Age. However, not all of it results from mining. Individual mining operations annually excavate from just a few tonnes to several hundred million tonnes.

Today, the main production of metals comes from open-pit mines and the size of mining units is becoming larger. It is interesting to realise that the entire world output of mined copper of 1949 could today be comfortably met from three mines. The same applies to nickel and chrome, and only a couple more would be needed for zinc. At the same time, the map of metal mining is changing and the volume is moving to developing countries while developed countries dominate the refining stage and the end use markets of minerals and metals.

Metals can also be produced from recycled materials. So, is mining still needed?

Consumption and production of most metals have doubled during the last 30 years. While metal demand can be expected to increase in developing countries as populations grow and living standards improve, there are indications that the growth of metal consumption is decreasing in industrialised countries. The life time of most metal products is long. For example, the life time of copper as a construction material is 30 to 50 years and a car is recycled in 12 years on average. Thus, the increasing metal demand cannot be fulfilled by recycling only. Recycling is a complement to primary production rather than a replacement, and it will remain so over at least the next fifty years for most products. Therefore, mining will always be needed.

Mining waste

Mining and mineral processing are waste producing operations. But why? This is quite natural. According to the laws of nature, matter can not be generated or destroyed. We can only change the form of its existence. But we have possibilities to influence the physical and chemical properties of the waste we produce. Mining is the largest waste generating operation in the world if all materials moved from the ground and not directly utilised are defined as “waste”.

In the mining countries, the amount of waste the mineral industry generates per year is 10 to 50 times the amount of municipal waste.

Main types of mining and mineral processing wastes are:

- topsoil; soil above the bedrock;
- overburden; soil and weathered rock overlying an ore body;
- waste rock; rock which does not contain desired minerals but has to be removed so that the ore can be excavated;
- tailings; fine-grained particles remaining after valuable minerals have been extracted.

As the mineral content of most ore bodies is relative low, large amounts of crushed rock and tailings are generated. Today, an average copper bearing ore contains 0.9 per cent of copper. This means that from one tonne of ore about 30 kg of concentrate and 960 kg of tailings are produced or one tonne of copper is obtained from 100 tonnes of ore. At the largest copper mines 200 tonnes of ore is needed. The rest is waste, mainly at the mine site but also at the smelter as slag or residues.

The amount of extracted surplus rock, “waste rock”, varies from 0.1 to 10 tonnes per tonne of ore depending on the minerals, type and size of the ore body and whether the mine is a surface mining “open-pit” or an underground mine.

The separation and concentration processes used for most metals do not extract all of the minerals present. Therefore, tailings always contain some quantities of metals and minerals. This may, in some cases, result in environmental problems.

Waste reduction policy in Finland

Finland is a country located in far north-eastern Europe. One third of the country lies above the Arctic Circle. Only five million inhabitants live on the area of 338,000 square kilometres. That is only 14 inhabitants per square km. By comparison France is 550,000 square km with a density of just over 100 people per square km.

Mining in Finland is small-scale. Today there are four metal mines in production compared to 12 metal mines in the 1970’s. Ore production is 3.4 Mt/year. This corresponds to a few days production of a large-scale copper or nickel mine. Altogether, some 35 Mt of rock is hoisted in the metal and mineral mining and some 15 to 20 Mt of waste rock and tailings are stored above ground.

The National Waste Plan, adopted in 1998, sets targets for a reduction in the amounts and harmful properties of waste, for waste recovery, for the prevention of risks and for further development of waste management. The targets are set for the years 2000 - 2005.

For municipalities, the overall targets are to reduce the amount of waste by at least 15 % and to raise the waste recovery level to 50 % by the year 2000 and to at least 70 % by the year 2005.

For industrial activities, in 2005, the amounts of wastes shall be on an average 15 % less than the amount in accordance with predicted growth rate without any reduction measures. The average recovery rate shall be increased to at least 70 % by the year 2005.

Mining is not included in the Plan. In the today's mining industry the amount of waste depends directly on the production. There are no short-term measures to reduce waste production, other than to close the mines.

Also the definition of "mining waste" is still unclear.

Technical possibilities of waste reduction

Topsoil and waste rock are stored and used in landscaping and constructions. Waste rock and cycloned tailings (coarse fraction) are used as mine backfill ; that is to fill the mined spaces (stopes) in order to support the rock. In some cases, up to 50 % of the tailings can be backfilled. Backfilling is increasingly considered as a means to minimise surface disposal of mine waste. In practice, tailings have no use outside the mine site because of their physical and chemical properties. Waste rock is locally used as construction material. However, long transportation distances prevent their use, especially if virgin stone is available.

In the future all mining wastes can be raw material of some minerals which today cannot be technically and economically refined or which have no market. A couple of examples. Tailings of the old Outokumpu Mine in Finland from 1930's to 1960's were processed twice in the 70's and 80's. First to recover gold, then cobalt. Today a Canadian company is constructing a new plant that will use some 250 Mt of tailings from former asbestos operations to produce magnesium.

Development

The mining industry worldwide has realised the necessity to improve its environmental performance and public image.

Numerous research and development programs are going on to improve mining technology. These include many environmental topics, such as:

- effective use of raw materials and energy;
- minimised production of waste material;
- minimised tailings storage above ground;
- as well as possible clean tailings to eliminate the need of costly tailings rehabilitation.

The Intelligent Mine Technology Program started in 1992, has been funded and carried out with the cooperation of Outokumpu company, mining equipment producers, universities and of the Technology Development Centre.

An intelligent mine is defined as an automated high-technology mine which is controlled in real-time to provide the best possible economical production according to the internal and external conditions. It is also a safe working place and en environmentally sound operation.

One sub-project was the concept of a “wasteless mine”. Mine planning and technology will be developed to enable large-scale backfilling during production. Waste rock dilution will be minimized and tailings to be stored above ground will be cleaned to environmentally safe material. One has to remember that somewhere there are economic limits.

Many of the results have already been applied but the first “intelligent mine” will be the expansion of Kemi open-pit chromium mine to an underground mine.

A similar technology program, Mining in 2015, has recently been introduced in Australia.

In open-cut coal mining the concept of continuous extraction and rehabilitation has been applied. The overburden is removed and the coal is mined. Overburden from the next stage is dumped in the mined out section. This continues successively. Topsoil is replaced and the mined area is continuously rehabilitated.

An Environmental Geotechnology Programme, coordinated by the Finnish Technology Development Centre, TEKES, is currently under way in Finland. This 5 year, USD 11 million programme is trying to find new possibilities to reuse or utilise of industrial by-products and wastes, including mining.

Conclusion

Statistically, mining is the largest waste producing operation if overburden, crushed rock and other stone materials are called “waste”. But mining is and will be needed as long as people need metals. Today there is a clear trend. Mining units will grow in size due to economy and the volume of mining is moving to developing countries. New developments in mining technology can make it possible to reduce the amount of mining wastes to be stored above ground and reduce their impacts on the environment or increase their use as construction material instead of virgin materials where transportation distance is reasonable.

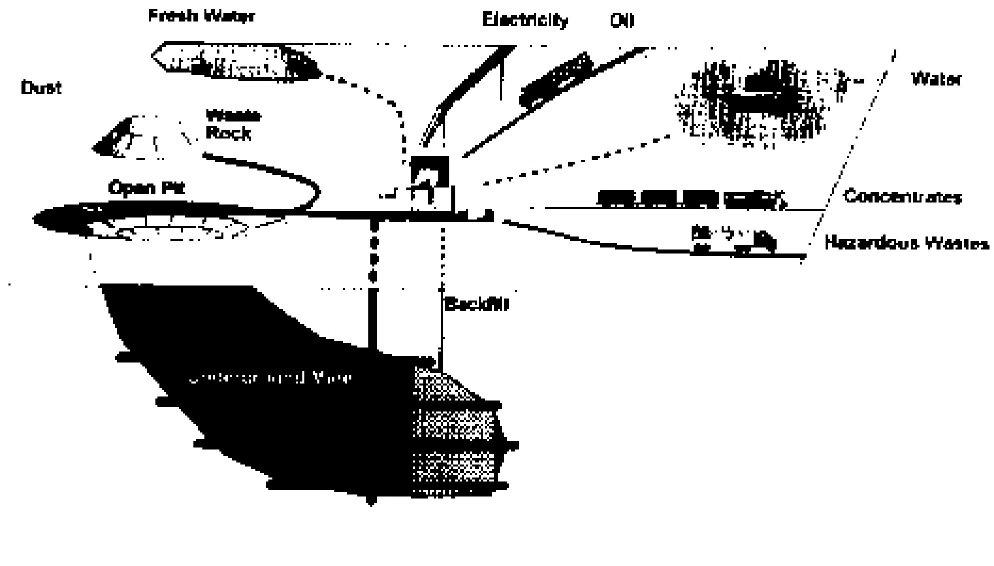
PRESENTATION [Matti Koponen]

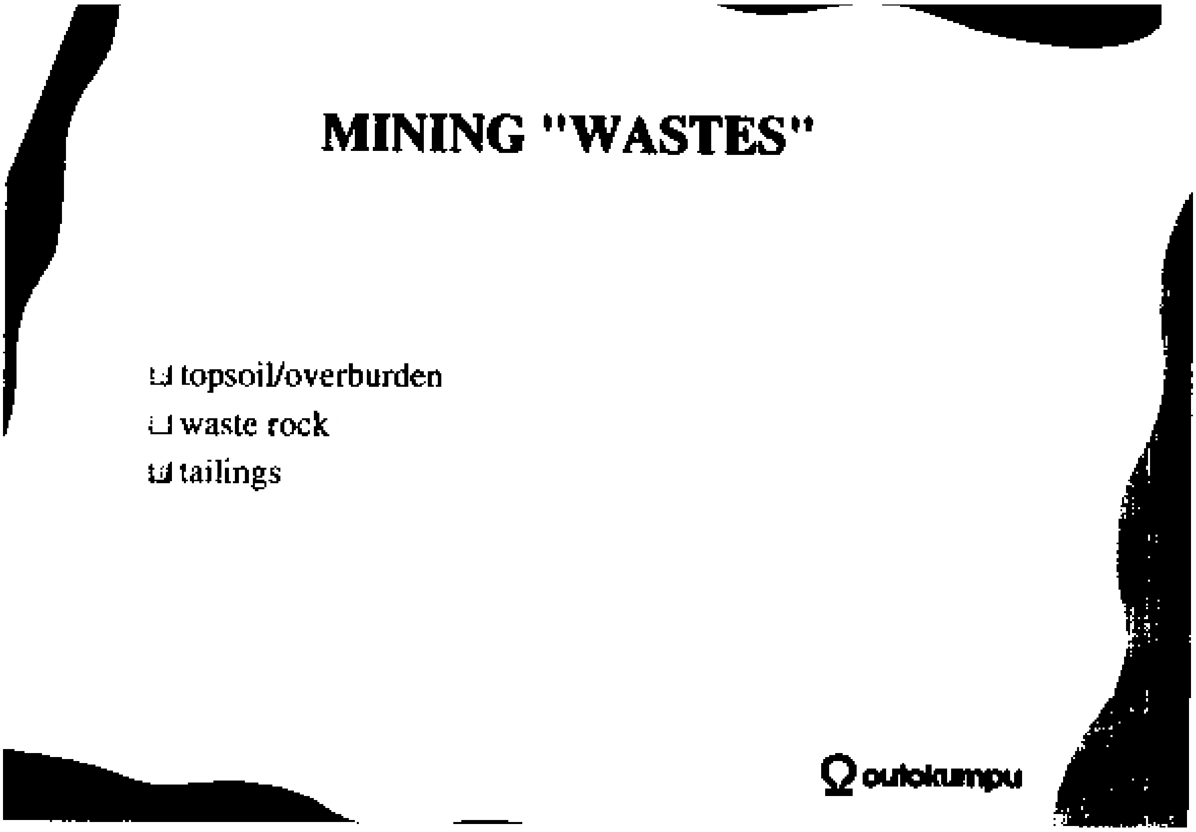
FIVE LAWS OF MINING

- minerals are sought, extracted and converted to metals because people need them
- minerals can be mined *only* where they are found, and cannot be mined *until* they are found
- minerals are useless unless they are converted to metals, and this must happen *somewhere*
- the environmental impact of mineral discovery is negligible, and extraction and treatment can be controlled within multiple land-use principles
- the extraction and processing of minerals is essential to our economic well-being

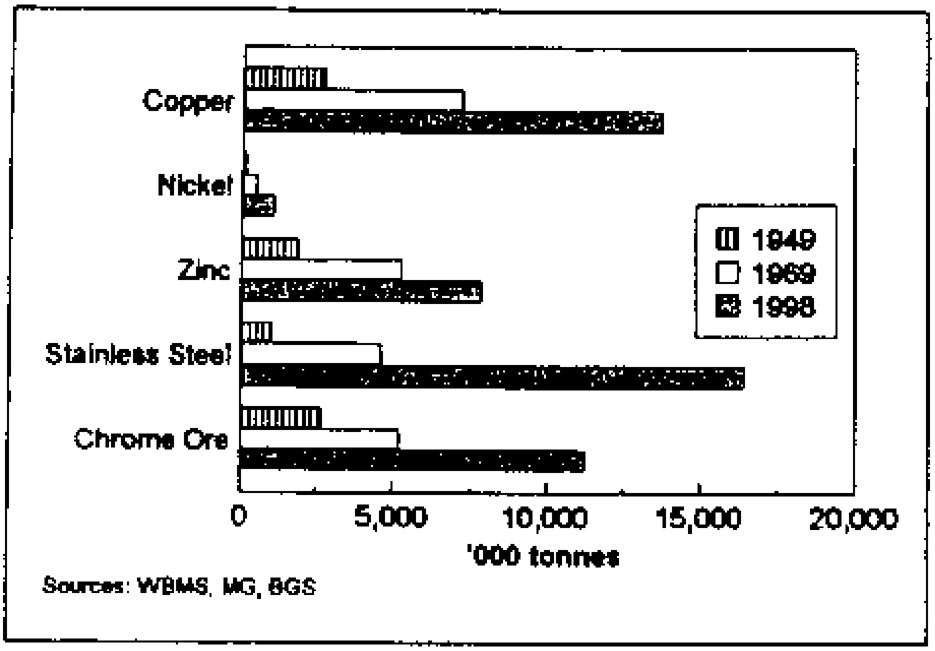
Ω outokumpu

OPENPIT & UNDERGROUND MINE

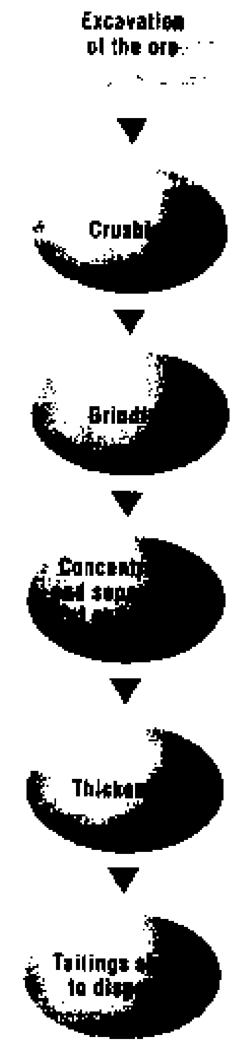




Global Production of Metals



WHAT ARE TAILINGS?



MINING IN FINLAND 1997

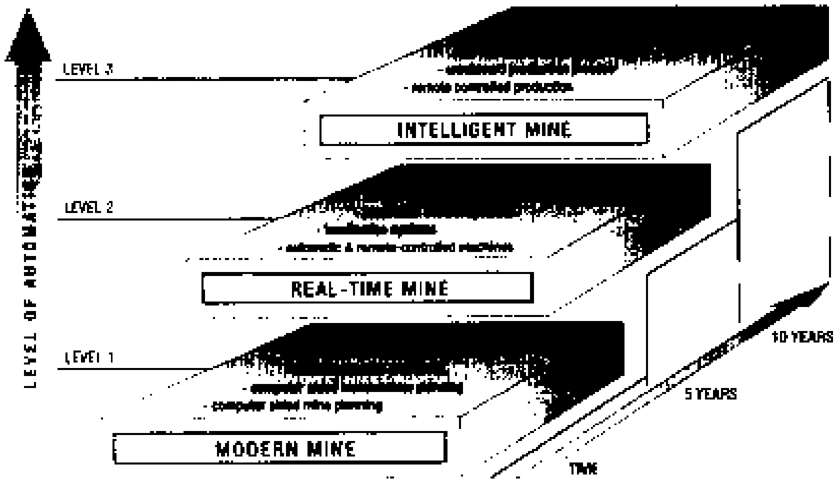
METAL ORES	*1 Chromite*		
	2 Zinc-copper		
	1 Nickel		
	2 Gold		
		3.4	*Mt*
LIMESTONE	*17*		
		3.4	*Mt*
OTHER MINERALS	*16*		
		9.7	*Mt*
	Ore or valuable rock	*16.5*	*Mt*
	Hoisted rock, total	*35*	*Mt*

National Waste Plan for 2005

- Overall targets
  - amount of waste -15 %
  - recovery level 70 %
  - mining not included
- Specific recovery targets
  - biowaste 75 %
  - glass 60 %
  - metal scrap 90 %
  - paper 80 %

outokumpu

Steps towards the Intelligent Mine



WASTE PREVENTION AND THE FRONT-END OF THE MATERIALS CYCLE: PERSPECTIVES FROM CANADA

by
Mark S. Winfield
Canadian Institute for Environmental Law and Policy,
Canada

WASTE MINIMISATION SESSION: 5

Introduction

The Canadian Institute for Environmental Law and Policy (CIELAP) is an independent, not-for-profit environmental law and policy research and education organization, founded in 1970 as the Canadian Environmental Law Research Foundation. The Institute has a long history of work in the area of waste management and, more recently, has undertaken a number of major projects related to mining and the environment[33].

Canada is an excellent case study for exploring the problems inherent in the question: how can we start to move away from the assumption of a continued expansion of the consumption of new metals and materials in view of the apparent need to promote dematerialization? Canada a major mineral exporter, but has also been subject to major costs associated with mineral development. The costs of remediating abandoned mines in Canada has been estimated by the Mining Association of Canada to be in the region of $6 billion. These costs are largely associated with dealing with abandoned mine wastes and tailings.

At the same time, Canada has made explicit commitments to waste reduction at the provincial and federal levels. Although the conflict between waste management policies intended to reduce consumption of new metals and materials, and mining policies designed to increase consumption of these materials is obvious, mining and waste management policies have been completely disconnected in the Canadian experience.

Mining, Materials and Sustainability.

Mining activities have enormous environmental impacts. These include the following[34]:

[33] For an overview of Environmental and materials policy issues related to mining see P.Muldoon and M.Winfield, *Brief to the House of Commons Standing Committee on Natural Resources Regarding Mining and Canada's Environment* (Toronto: Canadian Institute for Environmental Law and Policy and Canadian Environmental Law Association, April 1996).

[34] This outline is adapted from John E. Young, Mining the Earth (Washington, D.C.: World Watch Institute, July 1992), Table 5.

i) Excavation and Ore Removal

Excavation and ore removal may have such environmental impacts as:

- the destruction of plant, animal and fish habitat, human settlements, and other surface features (surface mining);
- land subsidence (underground mining);
- increased erosion, and the silting of lakes and streams, resulting in the destruction of fish habitat;
- waste generation (disposal of overburden);
- acid mine drainage (if ore or overburden contain sulphur compounds); and
- metal contamination of lakes, streams and groundwater.

ii) Ore Concentration

The environmental impacts of ore concentration may include:

- waste generation (tailings);
- organic chemical contamination (tailings often contain residues of chemicals used in concentrators;
- acid drainage (if ore contains sulphur compounds); and
- metal contamination of lakes, streams and groundwater.

iii) Smelting/Refining

The environmental impacts of smelting and refining operations may include:

- air pollution, including emissions of sulphur dioxide, arsenic, lead, cadmium, mercury, and other toxic substances;
- waste generation (slag); and
- the impacts of producing energy used in smelting and refining operations, such as the environmental effects of hydro-electric dams, and of fossil fuel extraction and use.

iv) Waste Generation

It is estimated, that the Canadian mineral industry generates 1 million tonnes of waste rock and 950 000 tonnes of tailings *per day*, totalling 650 million tonnes of waste per year[35]. This is more than twenty times the amount of municipal solid waste generated each year by all of the residences, industries, commercial establishments and institutions in Canada combined[36]. The typical rates of waste generation for the mining and smelting of major metals are as follows.

Table 1. Estimated Ore Production, Average Grade, and Waste Generation, Major Minerals, 1991[37]

Mineral	Ore (millions of tons)	Average Grade (per cent)	Waste (million tons)
Copper	1 000	0.91%	990
Gold	620	0.00033%	620
Iron	906	40%	540
Phosphate	160	9.3%	140
Lead	135	2.5%	130
Aluminum/Bauxite	109	23.0%	84
Nickel	38	2.5%	37
Tin	21	1.0%	21
Manganese	22	30.0%	16
Tungsten	15	0.25%	15
Chromium/Chromite	13	30.0%	9
TOTAL	3 200		2 700

These waste figures do not include the disposal of overburden.

It has been estimated that as of 1982 279,477 hectares of land have been disturbed, utilized and alienated by mining in Canada. Over 80% of this land is taken up by discarded materials (e.g. tailings, waste rock, overburden, and settling ponds)[38].

35 Government of Canada, The State of Canada's Environment (Ottawa: Minister of Supply and Services, 1991), pg.11-19.

36 Total municipal solid waste generation in Canada is currently estimated at 30 million tonnes per year.

37 Young, Mining the Earth, Table 6.

38 State of Canada's Environment, pg.11-19.

The scale of the environmental impacts of the mining industry requires that its role be examined in the context of the wider issue of environmental sustainability. It has been suggested, for example, that a 50% reduction in worldwide new materials consumption will be needed to arrest global environmental degradation, and that to achieve it, industrial countries need to aim for a 90% reduction.[39] The current rates of materials consumption are considered unsustainable, not so much due to shortages of materials themselves, but rather due to the extent of the environmental costs associated with their extraction and processing[40].

Dealing with the environmental damage caused by mining will require significant changes in the way in which minerals are used. It seems clear that the environmental damage from continued growth in new mineral production will eventually outweigh the benefits of increased material supplies, if it has not done so already[41].

A less destructive approach would be to maximize the conservation of mineral stocks already circulating in the global economy, thereby reducing both the demand for new materials, and the environmental damage done to produce them. The world's industrial nations, including Canada, are the leading users of minerals, and offer the most obvious opportunities for cutting demand for new materials. These nations need to move towards more materials-efficient economies, which will enable them to meet the needs of their citizens while using environmental resources less intensively[42].

Waste Management Policies

Canada has established national strategies and targets for waste reduction, particularly with respect to packaging wastes. The primary instrument in this regard has been the 1989 National Packaging Protocol (NAPP), which sought a 50% reduction in packaging waste by weight by the year 2000, measured against a 1989 base year. A number of provinces has adopted waste reduction targets of their own, reflecting the NAPP goals. The province of Ontario, for example, adopted a goal of 50% diversion of all municipal solid waste from disposal (defined as landfilling, incineration or energy 'recovery') by the year 2000, measured against the 1989 base[43].

There have also been some moves towards producer responsibility for packaging waste and household hazardous wastes at the provincial level, particularly in British Columbia[44]. However, these efforts have been much less ambitious than recent efforts in Europe[45]. In addition, there have been various efforts to promote recycling industries. These have largely focussed on weakening regulatory requirements applicable to recycling facilities, which has proved a dangerous path. A major fire, requiring the evacuation of several hundred residents, and generating large quantities of highly toxic combustion products, including doxin, occurred in Hamilton Ontario in July 1997 at a PVC plastic 'recycling' facility.

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39 For excellent summaries of these issues see: J.E. Young Mining the Earth (World Watch Paper 109) (Washington, D.C.: Worldwatch Institute, 1994); and J.E. Young, The Next Efficiency Revolution: Creating a Sustainable Materials Economy ((World Watch Paper 121) (Washington, D.C.: Worldwatch Institute, 1995).

40 J.Young, "The New Materialism: A Matter of Policy," World Watch, September/October 1994, pg.31.

41 Young, Mining the Earth, pg.41.

42 Ibid.

43 Current estimates indicate that the province will achieve a 32% diversion rate by 2000.

44 G.Jenish and M.Winfield, Recent Developments in Waste Diversion Policies in Canada (Toronto: CIELAP, May 1997).

45 M.Winfield and P.Vopni, Recent Developments in Waste Management Policies in Western Europe (Toronto: CIELAP, May 1997).

Minerals and Metals Policies

Canadian governments have adopted policies designed to facilitate and promote mineral development and consumption. At the federal level, the mining industry is subject to generous tax expenditures for exploration and development and capital costs. The industry is also subject to very limited federal environmental regulatory requirements. Regulations to control water discharges from metal mines were adopted by the federal government in the late 1970's[46]. However the regulations have not been updated since then. Most major mine developments have been subject to federal environmental assessments under the 1995 *Canadian Environmental Assessment Act*.

The past few years have been marked by major campaigns by the mining industry and the federal department of Natural Resources against what few federal environmental regulations that apply to mining developments. This has resulted in major initiatives by the federal government to weaken the federal environmental assessment requirements applicable to new mines.[47] In addition, the federal government has moved, through the January 1998 *Canada-Wide Accord on Environmental Harmonization*, to devolve most responsibility for the fulfilment of federal environmental assessment requirements, and enforcement of federal pollution control regulations applicable to mining to the provinces, which are strongly development-oriented. Major new tax expenditures for the mining industry were announced in the federal government's 1996 budget.

The Canadian government has also aggressively resisted, at both the domestic and international levels, to any effort to phase out the use of severely toxic metals and minerals, such as asbestos, mercury, cadmium, lead, and nickel. This has been seen in domestic legislation and policies stating that metals and minerals are not to be targeted for 'virtual elimination' (i.e. phase out of the use, generation and release) like other persistent toxic substances.[48] At the international level, these efforts have underlain Canada's approach to negotiations under the Basel Convention on the Transboundary Movement of Hazardous Wastes, and on the Heavy Metals Protocol under the United Nations Economic Commission for Europe Convention on the Long-Range Transport of Air Pollutants[49].

At the provincial level, public policies have historically been strongly oriented towards promoting mineral development. An open access regime to public lands for mineral development exists in most provinces and mineral exploitation is permitted to trump all other land uses on public and private lands[50].

Like the federal government, the provinces provide generous tax expenditures for exploration activities, the development of new mines, and capital costs. Many provinces also provide direct subsidies for mineral exploration and extensive indirect subsidies in the forms of publicly provided transportation infrastructure (e.g. roads and railways) and low cost energy supplies.

The provincial air and water pollution control requirements applicable to mines have tended to be very weak. Furthermore, there has been what some have described as a 'race to the bottom' among the provinces in past few years in terms of the environmental rules applicable to mining operations.

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46 *Metal Mining Liquid Effluent Regulations (MMLERS), 1977*, made under the *Fisheries Act*.

47 See Government of Canada, *Government Response to Report of the Standing Committee of the House of Commons on Natural Resources "Lifting Canadian Mining off the Rocks."*

48 See Government of Canada, *Toxic Substances Management Policy*, June 1995.

49 On federal policies regarding metals and minerals, See *Government of Canada Metals and Minerals Policy* (Ottawa: 1997).

50 On private lands this is the case where surface and mineral rights have been severed. For an overview of Canadian provincial environmental law and policy applicable to mines in Canada see C.Chambers, *Environmental Law and Policy Applicable to Metal Mines in Canada*, unpublished draft report, CIELAP January 1999.

In the province of Ontario, for example, since 1996 permitting requirements for mineral exploration on public lands have been eliminated, the mine closure provisions of the *Mining Act* weakened, including the elimination of requirements that realizable financial securities be posted in relation to mine closure plans, and regular exemptions provided from water pollution control regulations requiring that effluent not be acutely toxic to fish. Mine tailings and abandoned mine were explicitly exempted from water pollution control requirements in 1995. Major new subsidies for the mining industry were announced in March 1999. Similar changes have been undertaken by the British Columbia government, which had next strongest regulatory regime for mining activities at the provincial level.

Materials and economic policy debates

The past few years have seen a growing discussion within the academic community and non-government organizations regarding the extensive direct and indirect subsidization of metals and minerals extraction from both materials and general economic policy perspectives. Current government policies are seen to be designed to keep the prices of metals and minerals artificially low through a combination of externalized environmental costs and direct and indirect subsidies. This is intended to increase both domestic consumption and exports of new metals and minerals. Such policies are, of course, in direct conflict with waste management policies intended to reduce the consumption of new materials.

A 1995 study completed for the Canadian Council of Ministers of the Environment (CCME),[51] for example, concluded that the tax expenditures provided by the federal and provincial governments to support the development and production of basic materials introduce significant distortions into the materials market. In particular, they provide a bias against the use of recycled materials.

There are also growing concerns that the current policy framework with respect to mining and metals is reinforcing Canada’s economic dependence on primary commodity exports, and is a barrier to moving towards a more skills, knowledge and information based economy. A 1995 study of federal tax expenditures by the Institute for Research on Public Policy (IRPP) made the following observation:

> “the problem here is that current tax expenditures tend to favour capital intensive enterprises, especially those operating in the manufacturing and resource sectors. This is to the detriment of labour-intensive businesses (whether the labour is specialized or not) and notably those in the service sector. If we acknowledge that the health of Canada’s economy depends on its capacity to attract and develop relatively non-capital-intensive enterprises demanding highly specialized labour, then we must re-examine tax policies that indirectly disadvantage businesses in such sectors[52]”.

However, to date, these debates have had no impact on federal or provincial taxation policies regarding the mining industry.

It is important to note that mining communities in Canada tend to be geographically isolated, and highly dependant on mineral exploitation for their economic base. Consequently, they are very vulnerable to both shifts international commodity prices, and threats of closure by mining facilities. The industry has not hesitated to take the latter approach in dealing with local, provincial or federal governments. Policies intended to reduce new materials reduction will need to include transitional strategies for affected communities.

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51 J.Mintz and K.Scharf, A Comparison of Tax Incentives for Extraction and Recycling of Basic Materials in Canada (Winnipeg: CCME, 1995).

52 Leblanc and Vaillancourt, "Regional Distribution of Federal Corporate Tax Expenditures," pg.23.

Linking Materials and Mining Policies

A number of steps need to be undertaken to link materials and mining policies in Canada. These include:

- the removal tax expenditures and direct and indirect subsidies for mineral exploration, development and extraction;
- requiring that mineral extraction operations internalize of mine closure and remediation costs;
- require internalization of operating costs through requirements that effluent be non-acutely toxic, and persistent toxic substances, including heavy metals be virtually eliminated;
- revise land-use policies so that all uses are assessed on objective basis, mineral development does not trump all other uses. Establish open and public processes for making informed decisions about mineral development, and bar mineral development from protected areas;
- ensure environmental assessment and decision-making processes consider environmental, social, economic costs of mineral development; and
- develop transitional policies for mineral dependant communities.

GHG-EMISSION REDUCTION POLICIES: THE POSSIBLE FFECTS ON WASTE

by
Jan Pieters
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Paris, France

WASTE MINIMISATION SESSION: 5

GHG-emission Reduction Policies: The possible effects on waste

A Study on Technical Options, and the Choice of Instruments

Jan Pieters, OECD/ENV

WMP 6 May 1999: Session 5

04-May-99 06-05-199 WMP, session 5 1

Research Questions

- **Prevailing policies compared with more extensive use of pricing instruments (permits, taxes)**
- **Identifying the most promising (cost-effective) technical options**
  - **including materials cycles**
  - **taking interdependencies of technical options into account**
- **Identifying where international co-operation can facilitate domestic GHG-policies**

04-May-99 06-05-199 WMP, session 5 2

Outline of the Study

- **study on the choice of instruments and technical options for GHG emission reduction policies**
  - **integrated energy and materials systems modeling approach: Markal based MATTER-model (W-Europe)**
  - **Least cost combinations of approximately 400 technical options (under constraints) that satisfy various GHG reduction targets**
- **policy simulation:**
  - **Regulatory approach (“smart regulation”) versus**
  - **Pricing approaches**

04-May-99 06-05-199 WMP, session 5 3

Flows and Sectors

- **interrelated materials and energy flows (50%GDP)**
  - **electricity generation**
  - **iron and steel**
  - **aluminum**
  - **petrochemicals**
  - **building materials**
  - **transportation**
  - **agriculture and forestry**
  - **waste**

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Policy Simulations

- regulatory approaches
  - include negotiated agreements
  - include “smart regulation”, but
  - assume no cost increases for exposed sectors
- pricing approaches
  - internationally traded GHG permits, or
  - parallel tax increases, as a consequence
  - sheltered and exposed sectors face cost increases

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Preliminary Results (1)

- (of course) P-approaches are both more effective and more efficient than R-approaches
  - due to equality (P) / inequality (R) of marginal costs, between sheltered and exposed sectors
  - due to the fact that R-approaches violate the interdependencies of technical options (R-approaches lead to piece meal improvements)
  - governments pick the easy, not the most efficient ones
  - total costs of R-approaches are typically two (or more) times as high as total costs of P-approaches

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Preliminary Results (2)

- attaining significant GHG reductions will lead to drastic changes in substance flows through the economy,
  - both under P- and R-approaches
  - but more so under P-approaches (at the same level of GHG emission reductions)
  - these drastic changes will include:
    - change the supply of waste materials
    - change the optimal recycling and incineration practices

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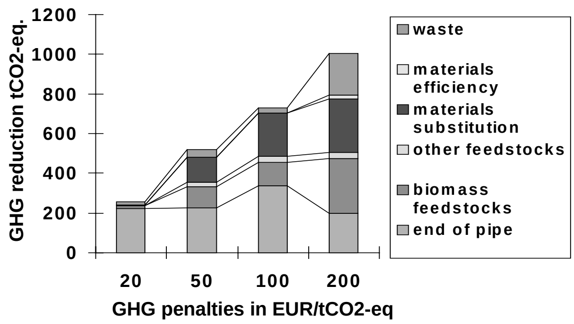
possible effects of GHG policies on waste (2030) P-approach



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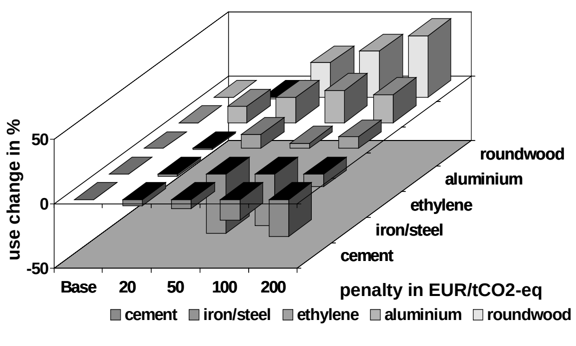
possible effects on materials use: P-approach



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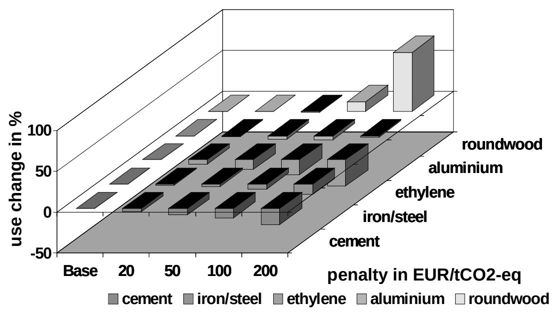
possible effects on materials use: R-approach



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possible effects on waste management (1)

material	waste management
• synthetic organic (plastics)	• less incineration • more recycling
• natural organic (including paper!)	• less disposal • more incineration with energy recovery

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possible effects on waste management (2)

level of GHG penalty	waste streams
up to 100 EUR/tCO2-eq	• slight decrease • no change in composition
200 EUR/tCO2-eq	• increase • plastic almost zero • paper more than double

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LINKING SOURCE REDUCTION AND EXTENDED PRODUCER RESPONSIBILITY

by
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WASTE MINIMISATION: PLENARY SESSION

The Organisation for Economic Cooperation and Development (OECD) takes an interesting and thoughtful step in combining discussions of extended producer responsibility (EPR) and source reduction (i.e., the prevention component of waste minimization). Both policy strategies aim to improve the environmental character of solid waste management by looking upstream in the product life cycle to production and consumption decisions. It is therefore important to ask how these two strategies relate and how they might be usefully integrated.

I will argue in this paper that EPR is a critical complement to source reduction because it provides individuated (targeted) incentives to producers to engage in design for environment (DfE) related to end of life (EoL) management—to use less material and design for recyclability. I use the very familiar example of packaging to illustrate my argument. In some cases, the incentives arising from EPR can bring about additional source reduction. In others, the incentives help facilitate the recycling of the products that are not amenable to further source reduction.

To make this argument it is important to distinguish between where the environmental *benefits* from source reduction and EPR accrue in the product life cycle and where the *leverage* for achieving those benefits lies. Despite the fact that source reduction and EPR are chiefly envisioned as strategies for improving waste management—or end of life (EoL) management, to express this in terms of product policy—both the benefits and leverage to achieve them lie principally upstream in the production portion of the product life cycle.

The benefits: Reducing upstream environmental harms

A variety of research suggests that the environmental benefits of diverting post consumer waste from final disposal (i.e., from incineration and landfilling) arise not in connection with the environmental effects of solid waste management, but in the upstream or production-related damages that are avoided (Schall 1992, Denison 1994). That is, the benefits source reduction and recycling are not primarily a matter of reduction of releases from state-of-the-art incinerators and landfills,[53] but rather of (1) the reduction of production-related releases (because source reduction has diminished the quantity of materials/products needed),

[53] One important exception to this is the generation of methane from landfills.

(2) the avoidance of damages associated with resource extraction (logging, mining, drilling) when fewer virgin materials are needed and (3) the energy savings frequently obtained when recovered materials and used in lieu of virgin materials[54].

The first and second of these benefits suggest that while source reduction is environmentally beneficial within the waste management system, its most significant benefits occur because less waste generation often entails less consumption and less production. It is for these reasons that I argue that the goal of policies related to post-consumer waste management is to realize these upstream environmental benefits.

The leverage: Design for environment

As argued elsewhere, the power of EPR arises in its ability to provide incentives for the (re)design of products and packages to enhance EoL management (Lindhqvist and Lifset 1998). Because EPR makes producers responsible for post-consumer waste, sometimes even for the literal take-back of products, it provides ongoing incentives for producers to minimize the quantity of materials introduced into commerce and to design for recyclability, re-usability, durability and related objectives in order to minimize their costs. DfE is thus added to the design considerations facing producers. It is done so in a manner that is more direct than the reliance on price signals from the cost of disposal traveling up the product chain from waste generator to consumer to producer.

EPR's capability to generate such specific incentives is a key complement to proposals to improve the environmental performance of infrastructure and related common elements in most product life cycles such as commodity chemicals, electrical power, and transport (Fonteyne et al. 1999). Making transport less polluting, for example, will clearly provide important life cycle environmental benefits for many products; combined with the targeted incentives for DfE that EPR can provide, such a strategy holds out the potential for significant gains.

The Problem: Unit versus aggregate source reduction

Producers have been remarkably successful at reducing the quantity of materials used *per item* (product or package). Famously, the quantity of aluminum or glass needed to produce a beverage container has declined by as much as 40% in the past two decades (Aluminum Association 1999, Glass Packaging Institute 1999). This is a testament to the power of market forces: manufacturers have a clear economic incentive to lower costs by reducing the quantity of inputs (raw materials) that they consume.

Yet, the overall effect of such incentives may be insufficient. Contemporary research on whether the global or national economies are dematerializing presents an ambiguous message. Dematerialization is "the absolute or relative reduction in the quantity of materials used and/or the quantity of waste generated in the production of an economic unit." (Cleveland and Ruth 1999, 16) Dematerialization can be discussed in per capita terms—the quantity of materials used per person—or in terms of economic output—the quantity of materials used per unit of gross national product (GNP). For the purposes of this paper, the differences between these two measures is not important. What is critical is the understanding that such indicators measure *unit effects.* Materials use can decline on a per capita or per GNP basis and still increase on an aggregate basis if the rate of increase in population or economic growth exceeds the gains in efficiency of materials use. As Wernick and his colleagues note in their review of trends in materialization and dematerialization (Wernick et al. 1997, 153).

[54] A significant fraction of the air pollution released in the production phases of the product life cycle are associated with energy consumption. Thus, the energy savings associated with manufacturing using recovered materials translate into reduction of air pollution.

> The tendency [in the economy over time] is to use more scientifically selected and artificially structured materials. ... These may be lighter, though not necessary smaller. The value added clearly rises with the choice of material, but so may aggregate use.

Similarly, Cleveland and Ruth note in their exhaustive review of dematerialization that (1999, 45)

> ...we should view with suspicion any gross generalizations about material use that are drawn from previous work, particularly the gut feeling that technical change and substitution inexorably leads to decreased materials intensity and reduced environmental impact.

Why is this understanding of dematerialization important to debates over source reduction and EPR? Because increased efficiency in the use of materials for packaging, for example, measured on a container or package basis do not capture aggregate affects. There are two ways in which this is important.

First, data on reductions in use of materials per package—the quintessential case of lightweighting—do not capture increases in the number of packages sold. Obviously, as the economy grows, more goods are sold[55] and therefore more packages are used to convey those goods. According to waste characterization information compiled for the U.S. Environmental Protection Agency, post-consumer packaging waste for beverage containers for the period 1980-1996 has declined when measured in terms of packaging/person/year (101 down to 93 lbs) and in terms of pounds of packaging per gallon of beverage conveyed (1.33 down to 0.97 gallons). During the same period, however, beverage consumption increased from 76 gallons/person to 96 gallons and the aggregate amount of beverage packaging waste has increased from 11 461 tons to 12 383 tons. (U.S. EPA 1998a, 101)

Less obviously, independent of matters of economic growth, the number of packages sold may increase if the number of single serving containers increases, especially at the expense of larger volume containers. Simply put, cans and bottles may be getting lighter, but the number of cans and bottles used to convey a particular quantity of beverage is probably increasing. Market forces do not provide clear signals to packaging producers to reduce *this* form of increased materials consumption (and waste generation) in as powerful a manner as such forces signal the economics benefits of lightweighting.

This is where EPR comes in. If the producer (however defined) faces the burden of the management of the discarded container, then the pressure for further source reduction is reinforced, because the producer then bears a portion of the cost of post-consumer waste management[56]. As population and the economy grows, a combination of source reduction and EPR can point us toward sustainability, insofar as these strategies institutionalize incentives to reduce both unit and aggregate source reduction[57]. Dematerialization *per unit* needs to progress fast enough to offset the countervailing increases in population or GNP.

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[55] Some growth occurs through the expansion of services and thus there is not a one-to-one correlation between economic growth and material throughput in an economy.

[56] Note that if a portion of the costs of waste management are transferred from the waste generator to the producer, then there will be some diminution of the incentives of the waste generator to engage in environmentally preferred activity such as recycling or altered purchasing habits. However, because the costs will be concentrated in the case of the producers (because of the relatively fewer number of actors) and diffuse in the case of the consumer/waste generator, the costs under EPR are more likely to stimulate changed behavior.

[57] A more precise analysis of these interacting factors can be found in the research literature on the IPAT equation (Impact = Population x Affluence x Technology). This literature attempts to parse the effects of population growth, changing consumption and technological change on environmental impacts. See, for example, Rosa and Dietz (1994).

Measuring the success of the remedy

Ironically, this discussion suggests that the all too familiar—and acrimonious—debates over the efficacy of the German Packaging Ordinance and other EPR schemes are the right debates to be having. This is because the Ordinance spawned a producer responsibility organization (the Dual System) that has a fee system directly encouraging producers to use less materials (because of the portion of the fee based on weight) and fewer packages (because of the portion assessed on a per container basis). In this regard, EPR stimulates source reduction that, the environmental improvement of waste management infrastructure cannot. Thus, the German system provides a particularly good case study for analysis. We know that the Ordinance produced a notable decline in secondary packaging as well as a broader reduction in overall packaging consumption (OECD 1997). Was this a one time effect? How much of the change in packaging consumption was due to non-programmatic effects such as the reunification of Germany? Have other packaging EPR schemes engendered similar source reduction effects?

Priorities for the next decade

Both source reduction and extended producer responsibility, if well designed, have the potential to increase resource efficiency by tapping the technological and logistical expertise of producers. But most EPR programs are new and little is known about their efficacy. What is desperately needed is more systematic data and analysis of these efforts. Both proponents and critics assess them using anecdotal information; little is transparent to many key stakeholders. In this respect, *better reporting and evaluation is a critical priority*. This is the case whether efforts are voluntary or mandatory (Harrison, 1999). Only then can we known if incentives discussed in this paper have actually been put in place and if they are realizing their potential for environmental improvement.

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POWERPOINT PRESENTATION [Reid Lifset]

Linking Source Reduction and Extended Producer Responsibility

Reid Lifset
School of Forestry & Environmental Studies
Yale University

OECD International Workshops
EPR and Waste Minimization Policy
Paris, France
May 4-7, 1999

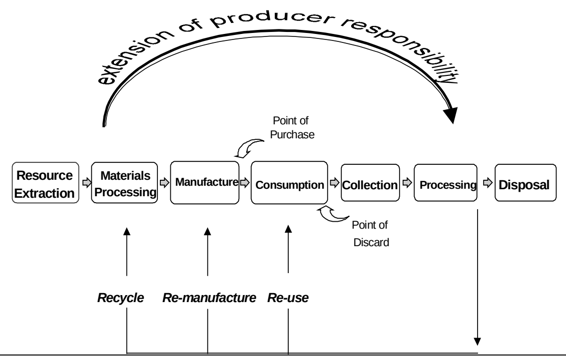
EPR and Source Reduction are Complementary Strategies

- Market forces provide some incentives for SR
- EPR augments those incentives
- EPR addresses EoL problems that SR does not remedy

Location of Benefits versus Leverage

- Benefits accrue *upstream*
- Leverage lies *upstream*
- Activities occur *downstream*

EPR, SR and the Product Life Cycle



Benefits of Source Reduction

Less Waste Generation

Less Consumption

Less Production

Dematerialization

- absolute or relative reduction in quantity of materials used and/or quantity of waste generated in production of an economic unit
- per GNP
  - per capita
- Unit dematerialization occurring for many products and materials
- Aggregate dematerialization - not clear

The example of lightweighting

- Beverage containers decline in weight
  - PET: 24%
  - Aluminum: 44% (20 yrs)
  - Glass: 40% (15 yrs)
- Packaging used to convey beverages declines on unit basis:
  - 25% over 16 years (lbs/gal conveyed)
- Beverages/capita increase: 76 →96 gal/person
- Total beverage packaging consumption increases: 11,461 tons → 12,383 tons

Dematerialization *per unit* needs to progress fast enough to offset the countervailing increases in population or GNP

Priorities for the Coming Decade

- Measure!
- Evaluate!
- Institutionalize!

OPENING ADDRESS

WASTE MINIMISATION, RECYCLING AND WASTE MANAGEMENT IN THE 21ST CENTURY

by Masaru TANAKA, Director
Department of Waste Management Engineering,
National Institute of Public Health, Ministry of Health and Welfare,
Japan

I would like to formally welcome you to the OECD workshop. It is my great honor to co-chair the EPR/Waste Minimisation workshop with Mr. Shantora. Originally the Japanese Ambassador to the OECD was planning to give a speech, but unfortunately, he could not come. Here, I would like to give a short speech at the occasion of the opening of the OECD joint workshop. This workshop, which is organised by the OECD, is hosted by the Ministry of Health and Welfare of Japan which has supported the EPR project since 1994 - phase 1-2 and 3. I would like to express my sincere appreciation to all of you who have come to this workshop. This is my fifth opportunity to attend an OECD workshop, including the waste minimisation workshop, Washington D.C. in March 1995 and the EPR workshops held in Ottawa in December 1997, Helsinki in May 1998, and Washington D.C. in December 1998. Gradually, my responsibility in these workshops has expanded. In the last workshop, I presented a paper. This time, my responsibility is the Chairmanship. The rewards have also expanded. I have met more friends, and it is so wonderful to meet you all.

The objectives of this workshop are:

- to provide input to the Guidance Manual being developed for OECD Member governments on implementing extended producer responsibility (EPR) programmes;
- to provide information for an OECD waste minimisation (WM) policy options framework, with strong emphasis on waste prevention; and
- to indicate future directions and the role of EPR/WM policies in the context of OECD work on resource efficiency.

First, I would like to start by reviewing the waste management practices and facing the problems they cause. Waste is generated as a result of living in good conditions. We need fresh water, fruit, drinks and all kinds of food to lead a healthy life; but they all come in containers and packages. Also we need magazines, newspapers, TVs, refrigerators, washing machines, air conditioners, and many more, in order to be able to enjoy life comfortably. But those will become household waste sooner or later.

The generation of waste should be controlled at the source by households and business enterprises, where the waste originates. Recyclable components of such waste are disposed of separately, to facilitate recycling. Municipalities and waste disposal agents, both of which dispose of waste, sort out useful components from the collected waste and put them in a recycling route. In some cases, material recovery is not an appropriate measure because of the technical and/or economical difficulty involved, accordingly, volume reduction by intermediate treatment like incineration should be promoted as a measure to prolong the remaining service lives of landfill disposal sites, and the energy derived from the incineration should be used for resource conservation. The residue of intermediate treatment is then subject to the environmentally sound final disposal.

"Waste minimisation", "waste prevention"or "waste reduction" is a concept widely used as the most desired method of waste management. The well-known "3R" (Reduce, Reuse & Recycle). This 3R hierarchy puts waste reduction at the top of waste management options. In Japan, also, waste minimisation has been recognized as the first policy objective in order to achieve better waste management and sustainable environment. However, the exact meaning of "waste minimisation", "waste prevention", "volume reduction" and distinctions among them are neither clearly defined nor understood. I will define "waste minimisation" as a broad concept to minimize the amount of waste that has to be discarded. The narrower definition of minimisation of waste generation at the source, will be termed "waste prevention". In the broad sense of reducing the generation of waste from domestic sources, usage of used materials at home, including household composting, is included within the domain of "waste prevention". From the viewpoint of waste managers, the reduction of the amount of waste that goes into final disposal is also important. Therefore, three policy options (Waste Prevention, Recovery of Materials & Volume reduction) may be discussed for waste minimisation. Furthermore, the extent of the discussions will be limited to municipal solid waste which comes under the responsibility of local governments.

Waste minimisation can be achieved at many stages during a life cycle of a product from production to final disposal. Different options of waste minimisation at each stage are currently in place or under consideration in many countries. Some of them, such as those for the first two stages, production and distribution stages, must be done by producers, namely manufacturers and distributors, and some require a change in consumer behavior, and all require some form of government intervention, directly or indirectly in the form of encouragement and promotion. Depending on the stage of life cycle, the target of government policies is: a) producers, b) distributors, c) consumers (both public and businesses), or d) central and local governments. All such policies must be considered, and evaluated because effectiveness of government policy is not uniform.

So let's examine legislative measures against the waste problem in Japan. The earliest actions related to waste disposal were public hygiene measures. A shift was subsequently made to environment preservation measures from public hygiene measures, to maintain urban functions and preserve a healthy living environment. Today, moreover, waste disposal has become significant for the purpose of global environment preservation. In 1992, the "Earth Summit" was held in Rio de Janeiro, Brazil. Agenda 21, the action plan for sustainable development was accepted. We have a national environmental basic plan which sets the goals to achieve. The goal is "Recycle Oriented Society"to conserve natural resources and minimize environmental damage. Along these same lines, the Package Waste Recycling Law was put into force in April 1997 and Home Electric Appliance Recycling Law will be put into force in April 2001.

Municipal authorities collect domestic waste, as well as bulky refuse also discharged from households. In addition, some small-scale business waste (such as restaurants' leftover food and gardeners'organic refuse) is brought directly to facilities run by the municipal authorities. Fifty million tons of municipal solid waste is discharged every year. Seventy-six per cent of this is incinerated. The rest of the waste is separated into non-combustibles which is simply disposed of at the landill in small sized municipalities. To prolong the service lives of landfill sites, many municipalities incinerate the entire quantity of combustible waste. Volume is reduced to 27 per cent of discharged waste.

Organic household waste is a major source of garbage; accordingly, home composting plays an important part in waste reduction. In most communities, voluntary citizen groups collect newspapers and magazines for recycling. Municipalities collect glass, metal and plastic bottles as recyclable items. Part of such waste is further screeened and recycled at the appropriate recycling facilities, while bulky waste (large-size items such as home electric appliances or furniture) containing plastics, glass and metal is crushed, after which different substances of value are sorted out and recycled.

Japan's present-day economy is supported largely by industrial activities in the automobile, electronic and other industries. Because of Japan's relative lack of natural resources, the greater part of the raw materials and energy resources necessary to these industries, such as petroleum, iron ore and other mineral resources, have to be imported from abroad. In 1992, Japan's dependence on imported energy was about 80 per cent. Such resources are not infinite. Petroleum deposits, for example, may only last for 46 years and natural gas for 65 years as calculated by dividing the confirmed quantity of deposits by the amount extracted annually. It is readily apparent, therefore, that the recycling of materials and resources is crucial to the 21st century for everyone on this planet. Effective control of natural-resource consumption calls for a shift to production methods that restrict waste generation and include recycling in the product cycle.

Recyclable waste is retrieved through both public and private routes in Japan. Municipal collection of waste (sorted at source) is the main form of public retrieval. Kitchen waste is turned into compost in a few municipalities and, metal and glass portions are recovered from the recyclable waste at sorting facilities in many municipalities. The amount of waste recycled in these ways by municipalities was up to 2.8 self-governing organisms in a local community, like a parent-teacher association of a school urges members of the community, to cooperate in its resource retrieval program. Participants bring recyclable waste to a certain place for pick-up by a retrieval agent.

About 2.4 million tons were collected for recycling by citizens'group. Thus voluntary private-sector activities make up a significant contribution to resource recovery in Japan. To encourage such voluntary recycling activities, some municipalities grant subsidies based on the collected quantity, lend or furnish equipments necessary for the resource recovery, provide information for collection agents, and make public-service announcements directed at community residents regarding recycling activities. The amount of waste recycled by municipalities was 2.8 million and this amount recycled by private routes is 2.4 million ton. Altogether 5.2 million is retrieved through both public and private routes. 5.2 million is about 10 per cent of waste discharged. In addition, a deposit system has been established for empty beer and rice wine bottles returned to liquor stores.

The recycling rates of these items have been rising since the enactment of the Law for Promotion of Use of Recyclable Waste (Recycling Law) in 1991. In 1996, the recycling rate is 53 per cent for old paper, 65 per cent for glass bottles, 70 per cent for aluminum cans and 77 per cent of steel cans.

Now the changes in the conditions surrounding waste disposal can be foreseen in the coming 21st century. Firstly, the necessity of recycling will be all the more acute for the predicted depletion of natural resources in the 21st century. More categories for separate collection will be demanded. Incentives must be found to motivate individuals and organisations to take on the increased responsibility of additional recycling categories. Close cooperation between citizens and administrative authorities will also be essential to ensure proper waste disposal. Secondly, various new recycling techniques will be developed. Among those new developments are a transportation vehicle designed to accommodate recyclables separated according to category, and another vehicle which sorts and presses collected empty cans while in transit. Many other new innovative recycling technologies will be developed. Lastly, much attention will be directed to the global environmental challenges. Widespread collection of separated recyclables and the public's keen awareness of threats to the global environment will cause the people to demand a waste disposal system that can reduce natural resource consumption and environmental damage. It is up to each of us to successfully tackle these challenges, and waste minimisation and recycling may be one of the best places to start with.

At the OECD, a new public policy called "Extended Producer Responsibility"(EPR), is being studied now as a major means for constructing a successful world-wide waste management system. In the past, the major responsibilities for manufacturers and distributors were the worker's safety at the production and distribution stages; prevention and management of pollution emission from the manufacturing process; and industrial waste management. Recently, however, Product Liability (the legal responsibility of a manufacturer for a product that is dangerous to the customer), has also become an important responsibility. EPR entails still wider responsibility or reassignment of responsibility to include management of a product after consumption. EPR is based on a new strategy for promoting the internalisation of all environmental and other "external"costs related to the entire life cycle of a product. So they tend to design for environment. Many of OECD member countries have introduced some form of EPR policy. Some cases show the success in terms of waste minimisation, avoidance of landfill disposal, and eco-design of products and changing of life style of consumers. Here we have experts in waste management, in economics and other fields. We are here to tackle the environment problem, especially the waste management problem, one of the most serious problems we may face in the coming twenty-first century. Using your knowledge and experience, we will find the solution or direction from the output of this joint workshop of EPR and waste minimisation. I look forward to a very fruitful workshop.

PRESENTATION [Masaru Tanaka]

OECD Joint Workshop on EPR and Waste Minimisation
May 4-7, 1999

Waste Minimisation, Recycling and Waste Management in the 21st Century

Masaru Tanaka

Director, Department of Waste Management Engineering
National Institute of Public Health, Ministry of Health and Welfare
Japanese Government

Objectives of the workshop

- to provide input to the Guidance Manual being developed for OECD Member governments on implementing extended producer responsibility (EPR) programmes;
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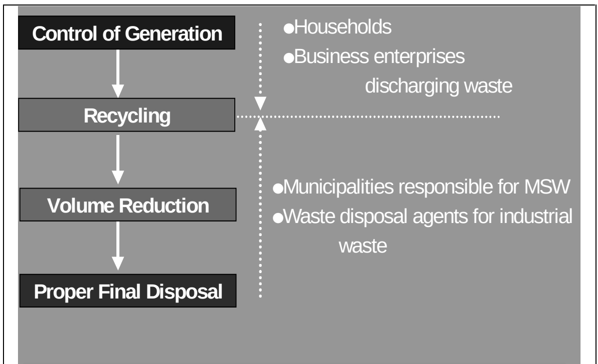

Figure 1 Basic Principle Underlying Waste Disposal

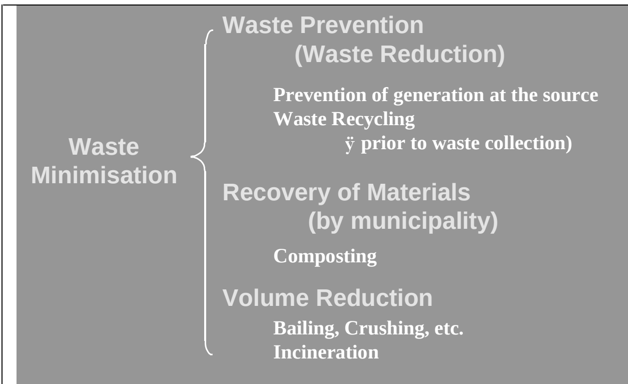

Figure 2 Different Policy Options for Waste Minimisation

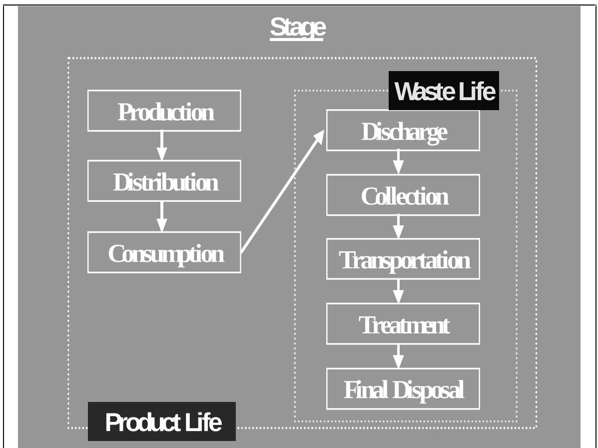

Figure 3 Products Life Cycle and Options for Waste Minimisation

Table 1 History of waste-related legislation

Year	Purpose	Law
1900	Public hygiene measure	ÑDirt Removal Law
1954	Living environment preservation	ÑPublic Cleansing Law
1970	Domestic environment preservation	ÑWaste Disposal and Public Cleansing Law
1991	Global environment preservation	ÑAmendment of Waste Disposal and Public Cleansing Law ÑLaw for Promotion of Resource Recycling and Reuse
1995	Extended Producer Responsibility	ÑLaw for Promotion of Separate Collection and Recycling of Packaging Waste (Package Waste Recycling Law)
1997	Proper disposal of industrial waste	ÑAmendment of Waste Disposal and Public Cleansing Law
1998	Extended Producer Responsibility	ÑLaw for Recycling Specific Home Equipment Into New Products (Home Electric Appliance Recycling Law)

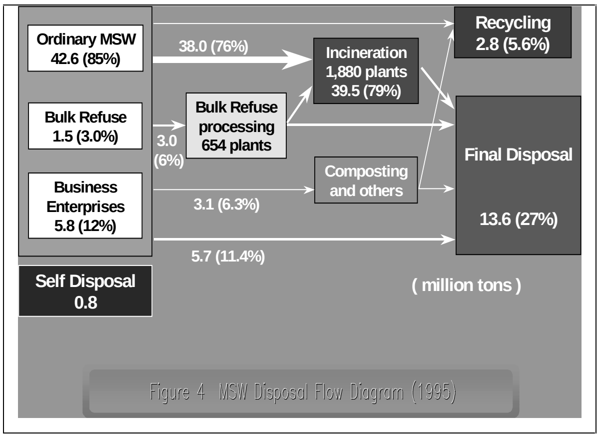

Figure 4 MSW Disposal Flow Diagram (1995)

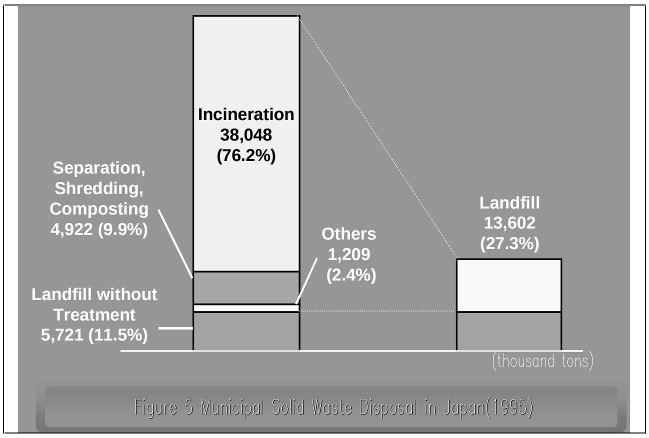

Figure 5 Municipal Solid Waste Disposal in Japan(1995)

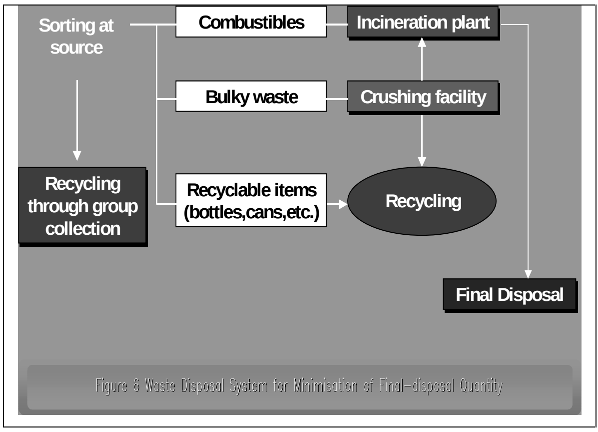

Figure 6 Waste Disposal System for Minimisation of Final-disposal Quantity

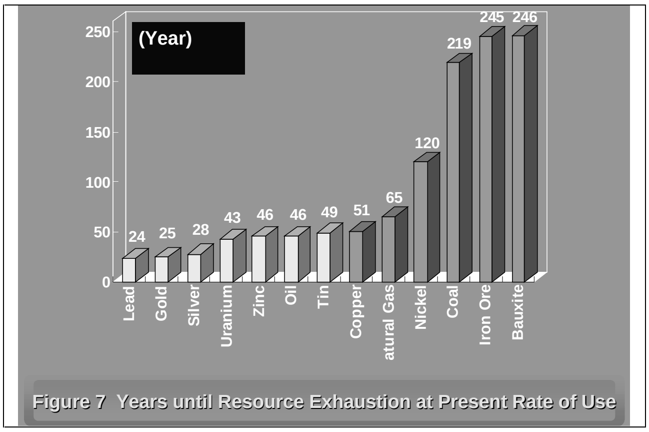

Figure 7 Years until Resource Exhaustion at Present Rate of Use

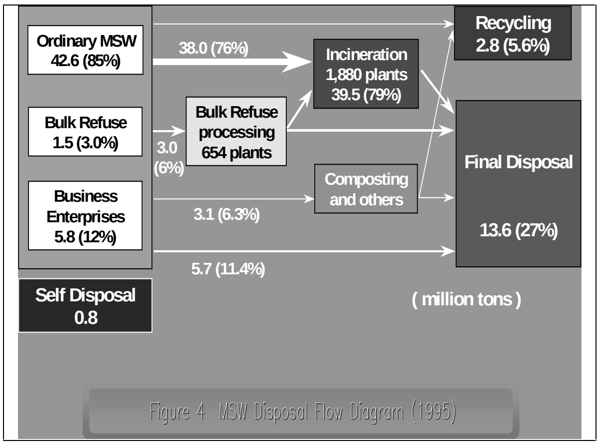
Ordinary MSW
42.6 (85%)
Bulk Refuse
1.5 (3.0%)
Business Enterprises
5.8 (12%)
38.0 (76%)
3.0
(6%)
3.1 (6.3%)
5.7 (11.4%)
Incineration
1,880 plants
39.5 (79%)
Bulk Refuse processing
654 plants
Composting and others
Recycling
2.8 (5.6%)
Final Disposal
13.6 (27%)
Self Disposal
0.8
(million tons)

Figure 4 MSW Disposal Flow Diagram (1995)

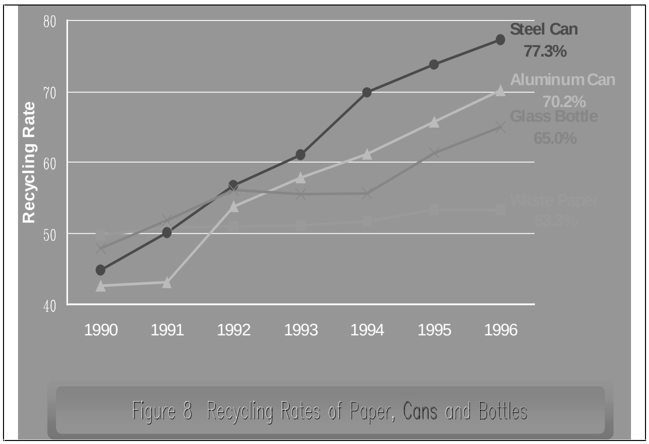

Figure 8 Recycling Rates of Paper, Cans and Bottles

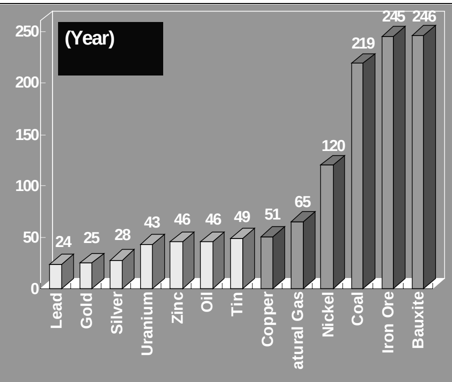

Figure 7 Years until Resource Exhaustion at Present Rate of Use

Table 2 Range of EPR

Production/ distribution stage	Consumption stage	Waste disposal stage
• Safety of workers • Prevention of the emission of a pollutant from a production process to the environment and general management • Financial and legal responsibility for full industrial waste control	Civil-law responsibility associated with a dangerous product	Financial and physical responsibility for post-consumption product management
← Scope of manufacturers' and distributors' responsibility in the past →		← Scope of the administrative authorities' responsibility in the past →
← Scope of EPR →		

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OPENING ADDRESS:

EPR AND WASTE MINIMIZATION POLICY - JAPAN'S PERSPECTIVE

by Yukio SHIOTA, Director
Planning Division,
Water Supply and Environmental Sanitation Department, Ministry of Health and Welfare,
Japan

Ladies and gentlemen, I am Yukio Shiota, Director of the Planning Division, Environmental Sanitation Department, Ministry of Health and Welfare, Government of Japan.

It is a real pleasure and privilege for me to participate in this important workshop and to have the opportunity of giving a key note speech.

I would like to express my deep respects to Dr. Tanaka, chairman of the EPR session and Dr. Shantora, chairman of the Waste Minimisation session.

Today , I would like to talk to you about some basic ideas relating to the topics of this workshop including the waste management policy of Japan.

1. Introduction

The 20th century was the century of industrialization. Particularly in the member countries of OECD, never-ending technological innovations and the expansion of production and economic activities combined to push up the peoples' standard of living to a remarkably high level. The environmental pollution which posed a social problem in the 1960's, however, induced the realization that economic activities should not be left uncontrolled and unregulated. It has brought about waste management and other problems, and harmony with the environment is now a major common objective of industrial and economic policies in various countries.

In the 21st century, which is only about one year ahead, measures taken by individual governments will no longer be effective against environmental problems. The problems will demand global-scale solutions. The waste management problem, among others, urgently calls for action. International cooperation will be needed to improve existing policies and develop effective and efficient new policies. It is hoped that OECD's studies of extended producer responsibility and waste minimization will result in valuable guidelines for the construction of a socio-economic system with a sound material cycle.

1.2 Significance of "Environmental Conservation" in Socio-economic System

At present, "environmental conservation" is a factor affecting every area of economic activity. In the past, it was a common perspective that the expansion of production and consumption was the force promoting economic growth, creating new employment opportunities and raising the standard of living. This perspective has not been changed completely yet,.

The significance of "environmental conservation" in this socio-economic system is not obvious. "Environmental conservation" is not an absolutely essential factor in product manufacturing cost. It is sometimes regarded even as an undesirable factor restricting free economic and consumption activities. Both manufacturers and consumers would be reluctant to have the "environmental conservation" cost added to the product price. They would be even more reluctant to pay an explicit "environmental conservation" cost apart from the product price.

Our socio-economic system is basically oriented toward the pursuit of benefits for individuals and business enterprises. Manufacturers were interested in cost reduction in their manufacturing processes and profit earning while consumers always sought useful low-priced products. As a consequence, a social structure characterized by mass production, mass consumption and mass waste discharge was formed through operations on the principle of free economic activities. We are still restrained by this system even now.

OECD proposed the Polluter Pays Principle (PPP) as a solution to the "pollution problem" presented by unregulated production activities and by their adverse effects on the living environment and human health. PPP penetrated OECD countries, contributing to the establishment of legal systems and the progress of self-regulating efforts in business enterprises in those countries. However, it only serves to prevent the adverse effects on the environment by manufacturing processes. The concept of "producer responsibility", though widely accepted in various countries, provides only the guarantee of the proper functions inherent in a product.

"Environmental conservation" should be supported by all members of the society. Each member is required to behave with due consideration given to the entire sequence from manufacture to waste discharge. The "environmental conservation" scene, characterized by an acute shortage of final disposal sites, the generation of dioxins from the incineration process and so on, is currently harder than ever. Prompt and effective measures should be taken to reduce and properly dispose of waste.

In OECD countries, therefore, all society members from producer to consumer should humbly comprehend the significance of "environmental conservation" in the society and economy and cooperate in drastically renovating the present socio-economic system and constructing a socio-economic system with a sound material cycle. Even if there happen to be some restraints and disadvantages in building a new system, they should be borne by all members of the society.

2. Extended Producer Responsibility

2.1 Significance of the Study of Extended Producer Responsibility

Extended Producer Responsibility is the concept that producers assume certain responsibilities in connection with the disposal of their products discarded by customers. Measures against the waste management problem should not be targeted at the disposal stage alone but should cover all aspects of the stream of material from production to discharge. The downstream action at the waste disposal stage should be properly reflected in the manufacturing stage (upstream). Manufacturers have the right to decide on certain product specifications and structure, and to select a particular material. They should be engaged in the disposal of discharged waste products to alleviate the difficulty in waste disposal and shift to the manufacture of products with less adverse effect on the environment.

How the concept of extended producer responsibility is to be reflected in an environmental policy and how it is to be materialized into a system are still under discussion in most countries. Trial- and- error efforts are being made currently. Even though waste reduction and recycling can be promoted in a short period by introducing a new system, the long-range effect is still not in prospect. There is no better solution based on common recognition in all OECD countries with respect to settlement of the conflict of interests related to a newly introduced system and the proper assignment of roles.

OECD's study of extended producer responsibility will involve a discussion of the scope of producer responsibility and the roles of the members of the society (in particular, the relationship between producers and municipalities) in the path toward a socio-economic system with a sound material cycle and will provide guidelines for the government's smooth and proper introduction of the new system.

Of course, the imposing of responsibility on manufacturers is not sufficient for the construction of such a socio-economic system. Cooperation and the performing of assigned roles by all members of the society are indispensable. It must be remembered that certain responsibilities should be assumed by all those concerned, including consumers.

2.2 Extended Producer Responsibility in Japan

Waste management in Japan involves difficulties attributable to the country's fast economic growth in the past and the growth of waste due to it, its hot and humid climate and the inevitable incineration process due to it, and a limited number of places suitable as new final disposal sites. Establishment at an early date of a drastic policy was demanded. In 1994, OECD was requested to start a study of extended producer responsibility, and the Japanese Health and Welfare Mininistry has made necessary contributions to the project . The success of this study is expected to bring a great benefit for OECD member countries.

To reduce the environmental load throughout the life cycle of a product in a consistent series of steps from manufacturing to the disposal of waste products, it is obviously essential to ask the manufacturers to participate in the disposal of waste products. The reason and the logic of producers' participation, however, are not firmly established and ripened yet. These must be described in detail in the OECD's study of extended producer responsibility

While the study was being made by OECD, Japan was establishing legal systems for waste reduction and recycling.

The Japanese legal systems prescribe various actions according to the characteristics of products or wastes. The Law for Promotion of Utilization of Recyclable Resources (1993), applicable to almost all industrial products, is intended as a statute for encouraging manufacturers to take action on their own. The Packaging Waste Recycling Law (1995) directs attention to cost internalization and disposal by third-party organizations (Producer Responsibility Organization). The Electrical and Electronics Equipment Recycling Law (1998) focuses attention on externalization of the disposal cost and disposal by individual manufacturers.

(1) Packaging Waste Recycling Law

In 1995, the Packaging Waste Recycling Law was enacted to promote the recycling of household packaging waste which was traditionally collected and disposed of by municipalities. This law prescribes the following functions of those concerned:

- Separate discharge by consumers.
- Separate collection and intermediate processing by municipalities including selection and washing which can convert the waste into a form for easy recycling.
- Take-back of packaging waste from municipalities for recycling by Package manufacturers and package-using enterprises.

Since packages are usually thrown away immediately after purchase and various packages are disposed of at the same time, the disposal cost is to be built into the product price.

As packages are circulated throughout the country and it is usually difficult to collect and recycle only the packages of a particular producer, a third-party organization's role is quite important.

The separate collection of metal cans, glass bottles and PET bottles among all kinds of packaging waste for recycling was started in April, 1997. The number of municipalities separately collecting waste has been steadily increasing, and this means an increase in recycling activities.

The law will come to full enforcement and be applied to all paper containers and packages such as decorative boxes and to all plastic containers and packages including wrappers in April, 2000. Preparations are currently under way.

(2) Specified Household Appliance Recycling Law (Electrical and Electronics Equipment Recycling Law)

The Specified Household Appliance Recycling Law was enacted in 1998 to promote the recycling of waste from household electrical appliances.

This law provides the following items.

- consumers are to discharge waste in a proper manner and put it on the recycling route;
- retailers are obligated to take back waste from consumers and hand it over to manufacturers; and
- manufacturers and importers are obligated to take back waste and recycle it beyond a certain performance level (50 to 60% by weight).

As home electric appliances are durable consumer goods serviceable for about 10 years from purchase to discharge and as this statutory system covers also items sold on the market and used by consumers before the enactment of this law and for other reasons, the retailers, manufacturers, etc. can charge consumers a fee at the time of waste discharge.

End-of-life household electrical appliances have been collected by municipalities as bulk waste, and a disposal fee and door-to-door collection have been adopted by about 30% of all municipalities. The practice of take-back of end of life electrical appliances by retailers in exchange for a new purchase has been also extensively adopted.

Since end-of-life electrical appliances are basically discharged from individual households and the manufacturer of a particular product can be identified, the manufacturer is obligated to recycle that product in principle. A third-party organization acts only in case of bankruptcy of the manufacturer or on commission from a small or medium business enterprise.

This law will be put into force in April, 2001. The expected recycling rate in the initial years is 60% for air conditioners, 55% for TV sets and 50% for refrigerators and washing machines. Although the law prescribes a certain heat recovery process, the recycling rates don't currently include the use as a heat source.

2.3 How To Fulfill Producer Responsibility

The concept of extended producer responsibility, centered around the engagement of the producer in disposal of their products discarded as waste, presupposes the internalization of the necessary disposal cost in the product price. As for an economic incentive for environment-friendly manufacturing with a due allowance for the necessary handling of discharged waste goods, it is not deniable that the internalization of the disposal cost, i.e., the manufacturer's disbursement of the cost, is most effective. However, is the internalization of the cost, that is, the manufacturer's fulfillment of an obligation to take financial responsibility, sufficient to solve the whole problem?

In Japan, the manufacture and sale of small-capacity P.E.T. bottles (500 ml?) and less), which could have increased the amount of P.E.T waste because of the convenience, were controlled by manufacturers on their own initiative. However, the output and sales of such bottles have been increasing since the establishment of the statutory packaging waste recycling system. The bottles for imported beverages, especially those for wine, are hard to recycle in Japan, but their imports have been remarkably increasing. The manufacturers and importers fulfill their obligation by bearing the disposal cost incurred and internalizing it in the product prices. How should this be evaluated?

It is essential to impose a procedural burden in some form on manufacturers to have extended producer responsibility duly fulfilled, as well as the financial burden derived from disposal cost. Hence the function and role of the third-party organization (PRO: Producer Responsibility Release Organization), which has been discussed regarding extended producer responsibility (EPR), should be so designed as to actually compel manufacturers to modify the manufacturing process and the product.

Of course, self-regulation with an adequate allowance for environmental conservation is demanded for manufacturers. Consumers should change their style of consumption. However, the waste management problem demands prompt action. Consideration should be given to the interrelations with the assurance of free economic activities. In some cases, it may be necessary to introduce a mechanism directly affecting the manufacturing stage. Also national governments will have to introduce policies for the promotion of environment-friendly trade activities, e.g., a policy for promoting wine exportation for bottling in the importing countries.

3. Waste Minimization

Because extended producer responsibility is associated with the construction of a socio-economic system with certain defined responsibilities and roles of those concerned down the series of steps from manufacturing to discarding of waste, waste minimization involves an evaluation of waste handling procedures to find an optimum disposal method or an optimum combination of methods for waste minimization.

3.1 Waste Minimization Efforts in Japan

In Japan, the Basic Environment Law was enacted in 1993, and the Basic Environment Plan was formulated the next year to comprehensively and systematically promote environment conservation based on the law. The following order of waste disposal priorities was established:

- Reduction of the generation of waste.
- Re-use of used products.
- Recycling into raw material.
- Promotion of environment-friendly use of heat recovered from incineration where the technological level makes such recycling difficult or not economically feasible.
- Proper disposal of generated waste.

Waste minimization can be accomplished in three different ways:

- Discharge stage: Control of the volume of waste at the generation stage by choosing long serviceable products, using products for a long period, etc.
- Intermediate treatment: Reduction of the waste to be disposed of, by raising the recycling rate.
- Final disposal: Reduction of the final-disposal volume by properly treating the waste to be disposed of.

Prior to any discussion of waste minimization, it is necessary to identify the stage on which attention is focused. With regard to the third stage, final disposal, the role of "incineration" as a disposal method is an important topic of discussion.

3.2 Significance of Incineration and Its Relation With Various Disposal Methods

The climate of Japan is hot and humid on the whole in comparison with those of other OECD members. In Japan, it was an important task to dispose of waste in a hygienic way so as to prevent the possibility of infection or the generation of bad odors. Accordingly, a waste disposal system traditionally built around incineration was established.

Nearly 90% of the total land space of Japan is mountains, and the population density is markedly higher in Japan than in other OECD members. Places suitable for landfill sites are extremely limited. The remaining capacity of the existing final disposal sites is only for several years. It is therefore absolutely essential to reduce the volume of waste bound for a landfill site.

There is a limit to waste reduction (control of waste discharge) and promotion of recycling. It is difficult to avoid landfill disposal for every kind of waste. Those wastes which absolutely demand landfill disposal require "volume reduction" prior to landfill disposal. Incineration is most effective as a method of reducing the volume of combustible waste. Incineration is not necessarily undesirable provided proper measures for the conservation of the living environment, including effective countermeasures against exhaust gases are taken.

It is imperative to find an appropriate combination of waste disposal measures (including recycling) according to the situation in the particular country for the purpose of waste minimization. A similar principle should be followed when an evaluation is conducted. When studying the waste minimization measures and proposing an order of priority, OECD should attach primary importance to proposing desirable alternatives with the foregoing matters taken into consideration.

3.3 Present Discussion in Japan

In Japan, all aspects of waste disposal are being discussed at present in connection with the proper organization for waste disposal and the assignment of responsibilities. In some instances, those kinds of industrial waste committed to the private sector for disposal in the past have been found difficult to handle by business enterprises in actuality. The possibility of public intervention in this field is also discussed. To propose figures indicating the extent of waste discharge control and the extent of volume reduction and recycling of generated waste, efforts are currently being made to formulate a national-level waste reduction plan.

4. Conclusion

The main points discussed in connection with a study of extended producer responsibility are:

- the way the manufacturer bears the cost of disposal of waste products discharged; and
- (which is more appropriate), a compulsory method or a voluntary method , when the concept of extended producer responsibility is incorporated into a policy.

At present, waste is of diverse kinds, and products are distributed and used in various ways. One method or one concept is not sufficient to overcome a particular problem. A national government formulating and introducing a policy should find the best combination of alternatives to harmonize “environmental conservation” with the socio-economic system in a form suited to the actual conditions in the country, such an optimal combination of policies is important for waste minimization purposes also. Thus it is necessary to study the best combination of disposal methods including control of waste discharge and incineration in order to reduce the final-disposal volume.

It is hoped that OECD will provide policy alternatives to the member countries through its studies on extended producer responsibility and waste minimization in order to cast light on the problems and key issues involved in the individual policy methods. These will contribute toward the governments’ effective policy formulation and smooth introduction of a new system.

Ladies and gentlemen, before closing my speech, I would like to express my hope that participants will have active discussions during this workshop and bring about useful results. Thank you very much for your kind attention.

SUMMARY OF WASTE PREVENTION DISCUSSIONS

This summary reflects general workshop observations, specific points of discussion, and cross-cutting issues and principles for strategic waste prevention

1. General Observations

The "waste dilemma", as introduced in the Opening Address by Joke Waller-Hunter, derives from the way economies function, in particular the level and structure of both production and consumption. The solution to the dilemma will therefore have to address this broader context.

Member countries and workshop participants agreed that the OECD should move ahead with its plans to produce a Self-Assessment Guide to assist governments with making strategic choices supporting waste prevention. The objective would be to promote de-coupling of waste from wealth while keeping in sight the three dimensions of sustainable development: social, economic, environmental.

Workshop discussions indicated that while the *concept* of waste prevention is far from new, the *capacity* for addressing this issue more systematically is increasing as a result of several national and international information-based developments.

Some of these developments include:

- The recent progression in our *understanding on economy wide material flows* (deriving especially from the work of the World Resources Institute and its partners).

- Work coming out of certain member countries concerning the quantifiable *interdependencies between waste prevention and other environmental priorities such as green-house gas mitigation.*

- The development of environmental *performance evaluation tools* to assist with the assessment of national waste prevention performance (being conducted by OECD).

- The *elevated recognition* that waste prevention policy must be considered according to the *life-cycle of activities and products,* starting with extraction. [We can not just focus on municipal waste, though politicians have often done so because of the high visibility of that realm].

- A slow but promising evolution of *cost accounting and information reporting activities* that can increase the chances of discovering what may otherwise be hidden savings (both material and economic) associated with preventive actions at the national, sector or firm level.

2. Specific Points

Below is a sampling of some key observations made during the discussions.

2.1 Strategic framework for national waste prevention target setting

2.1.1 Value of considering/setting waste prevention targets

- Increases visibility of waste prevention.
- Political commitment.
- Shows how for we are from sustainable economies.
- Injects incentives for generation of data to measure waste prevention progress.
- Attention focussing: moves away from singular focus on “diversion of materials from final disposal”. Attention is increasingly focussed upstream, including initial materials mobilisation/extraction.
- Increases accountability of actors.
- Could address efficiency gains or absolute gains in waste prevention; but reason for choice of target should be explicit. May be a basis for addressing the deeper question of “sufficiency”.
- Allows consideration of the contribution of different actors in the production-consumption chain.

2.1.2 Link of waste prevention targets to other environmental objectives (e.g., climate change, land use, public health)

- Use material flows data, look at waste prevention potential possibly according to material type, life-cycle stage, etc.
- Where appropriate, build off of and combine with existing methodologies (e.g., IPCCC guidelines + LCA approach = quantitative understanding of how waste prevention can contribute to greenhouse gas mitigation).
- More generally, need efforts for providing simple, readily available tools for considering links (including also risk assessment).

2.1.3 Link of waste prevention targets to other public policy objectives

- Need to consider waste prevention targets also in context of sustainable development more generally, so consider use of cost-benefit analysis, cost-effectiveness analysis. Need to consider triple bottom line: contribution to economic well-being, social equity, and environmental effectiveness (methods for doing this broad analysis still weak).
- How to best take into account pre-existing investment in infrastructure that may depend on a minimal supply of waste?
- How to assure that waste prevention “goes with the grain” of market transformation?

- Dialogue with key stakeholders maintaining an interest in other public policy objectives.
- Conditions for setting waste prevention targets: should be ambitious, but realistic, understandable, and should avoid competitive distortions. Both local and global imperatives could be referenced by waste prevention targets.

2.1.4 Stakeholder involvement in the setting of waste prevention targets

- Inclusive of those "feedback agents" that would be able to indicate whether policies and measures are moving in the right direction toward the target.
- Inclusive of those "hidden agents" that may not know that they actually have a longer term interest in attainment of waste prevention targets (e.g., consumer associations, insurance industry, accounting industry, material suppliers, energy ministries, business associations).
- Education of all agents (student, consumers, politicians, industry leaders) is key to elevate quality of stakeholder communications. Will also support longer-term increase in political will.
- Stakeholder dialogue should be based upon clear objectives of what is desired as an outcome of such discussion.

2.1.5 What type of prioritisation approaches to support waste prevention targets?

- Need a broad approach: prioritise and set targets based on what may solve multiple problems concurrently.
- Volume-, weight-, hazard-based.
- Need transparency as to why a certain approach for prioritisation approach was used.
- Use those that may reveal trade-offs.
- Realise the limits of in-depth analysis, e.g., basing priorities on exhaustive LCA may only waste time and money – need to have a basis for saying that a threshold level of data is sufficient for taking action. This also supports precautionary principle.
- Need to also be able to prioritise organisational (public and private) investment such that prevention is given preference. Targets and a performance evaluation system will assist with this.

2.2 Evaluating national waste prevention performance

2.2.1 Range of waste prevention evaluation tools and considerations

- Specific Indicators (based on a range of drivers: GDP, personal consumption expenditure, population; overall materials use). Indicators are only one tool for evaluation.
- Resource flow accounts as broad basis.
- Direct measures: intensity, tonnage.
- Indirect measures; proxies, e.g., change in knowledge, actions of different stakeholder groups.

- Well-documented case studies are needed, especially to spread the word about evaluation possibilities and their implications.
- Those that can assist with evaluating the interdependencies between waste prevention and the attainment of other resource conservation and public policy (e.g., employment) objectives.
- Normalisation/indexing/weighting factors (e.g., trying to achieve a better understanding of how the benefits associated with one dollar of waste prevention investment compares to the benefits of one dollar of investment for another sustainability investment).
- Need to be careful of the policy and organisation "lock-in" that may be promoted by tools that only look at relative prevention (the environment only cares about aggregate increases).
- Difficult question: we seem to have a better basis for evaluating the *physical basis* (e.g., actual wastes not generated, resources not used, materials not mobilised, energy not burned) of waste prevention than we do for evaluating the *policy basis* for waste prevention. How can we evaluate the performance of policy processes and policy strategies for waste prevention?

2.2.2 Use of waste prevention evaluation tools for communication purposes

- Need a balanced, "honest" presentation of results.
- A wide ranging reporting format with a diverse family of indicators and other evaluation tools may be best (minimise possibilities of misuse).
- Evaluation outcome should be adapted to the specific audiences (e.g., internal agency review, parliament, expert public, general public, international organisations).

2.2.3 Key implications of waste prevention evaluation results

- May be indicative of needs for policy re-orientation/adaptation.
- May be basis for generating a new level of support for waste prevention initiatives.

An important consideration that underpins any evaluation method is the issue of how data is generated in the first place, and in particular according to what objectives and what means (e.g., mandatory versus voluntary reporting). Data reporting requirements can be a burden for organisations, both public and private. If there are any new reporting requirements associated with the evaluation of progress toward waste prevention targets, then the net burden to organisations would, in idealistic terms, not increase. Old requirements would be phased out and replaced with those that reflect a more pro-active policy context. Also, in view of gaining support, it would be highly desirable if a reporting requirement can be linked to the benefits associated with such reporting.

2.3 Some key gaps/barriers to better waste prevention targets and evaluation tools

- Micro-macro linkages for both waste prevention target setting, and evaluation tools?
- Knowing what "The Right Target" is; science and technological research is key.

- What type of stakeholder dialogue necessary in order to achieve agreement on national level "Mega" (absolute improvement) waste prevention targets, as opposed to just "Mild" targets (efficiency improvements).
- Reality is that while many government policies are aiming toward prevention, integrated chain management, and multi-media approaches, many government programmes and activity offices are often structured by media or according to different stages of the materials life-cycle. A strategic approach would try to "cut- across" this problem.
- Our understanding of what is a socially equitable waste prevention target -- especially if a quantum leap of progress in absolute waste prevention is called for -- taking into account, for example, possible employment losses/shifts.

3. Cross-cutting Issues and Principles for Strategic Waste Prevention

3.1 Issues

- An *integrated approach* should dominate the process of how choices are made, and the basis for integrated decision making must be nurtured (methodologies, tools).
- *Investment*: both public and private investments should be in line with strategic waste prevention.
- *Implementation*: requires engagement of all appropriate stakeholders; can be fostered by targets, and may be evaluated broadly with a variety of tools such as indicators.
- *Institutions*: can evolve their decision making processes through increased inter-agency consultations supported by a bedrock of new data and methodologies (e.g., resource flow accounts).
- *Cost Internalisation*: make sure producers and consumers pay the social and environmental costs of the wastes they are responsible for generating. Consider also externalities from cross-border material flows.
- *Involvement*: the possible role of non-traditional stakeholders (e.g., consumer associations, insurance industry, accounting firms) requires closer consideration.
- *Information*: new, growing information may help to reveal the benefits of waste prevention actions, including cost-savings, and avoided costs. This could be in relation to both public and private actors.
- *Instruments*: an understanding of the mix of instruments/tools available, and their potential for increasing the understanding of secondary benefits or trade-offs of waste prevention requires systematic consideration.
- *Individual behaviour*: can depend on direction of public investment (not only money, but also political investment), tools that address consumer relationships with products and producers, etc.
- *Infrastructure*: Waste prevention policies should take into account the investment cycles of infrastructure.
- *Innovation*: processes to enhance innovation for waste prevention could be considered according to all the above points.

3.2 Principles

- *Good governance principle*: e.g., less waste = saved public (and private) resources.
- *Long-term vision principle*: create clear signals for stakeholders to plan future actions.
- *Sustainable materials use principle*: e.g., a regulatory distinction between "waste" and other materials does not always result in optimal environmental outcomes.
- *Producer responsibility principle*: Product manufacturers should bare a significant degree of responsibility for the product's environmental impact throughout the product's lifecycle.
- *Institutional co-ordination principle*: foster inter-agency consultation to promote policy integration.
- *Education principle*: promote waste prevention as part of all training and education activities.
- Impact-reduction principle: move from a volume or weight reduction to environmental impact reduction.
- *Substitution principle*: replace hazardous materials and processes (substances, products and production systems) with less hazardous ones, or with services where appropriate.
- *Efficiency principle*: getting the same service out of less material.
- Sufficiency principle: getting the same or adequate welfare out of less service.
- *Investment hierarchy principle*: move away from a public/private investment focus on financing resource intensive and end-of-pipe activities. Develop mechanisms that foster financing for broad waste prevention.
- *Principle of least-cost combination*: choose those actions and technologies that represent least cost avenues that can address waste prevention and other problems at the same time.
- *Principle of transition management*: e.g., develop plans to assure a smoother transition to a new reality if waste prevention targets imply new levels of technical or societal change.
- *Leverage principle*: identification/engagement of those actors with highest potential to influence overall waste prevention.
- *Commitment principle*: need as solid a commitment to waste prevention as possible from different stakeholders.

3.2.1 Other supporting principles

- *Precautionary principle*: a lack of scientific certainty should not be an excuse for inaction where a certain level of risk has been surpassed.
- *Polluter-pays principle*: the polluter should bear the cost of preventing and controlling pollution to ensure an acceptable environmental state.
- *User fees principle*: those who benefit from resources should pay the full cost of using the resource and its related services to present and future generations. Also known as "resource pricing".

ANNEX 1

AGENDA

Day 1

Tuesday, 4 May, 1999	Waste Minimisation through Prevention
Session 1 15:00-16:00	***Opening*** • Mr. Masaru Tanaka, Director, Department of Waste Management Engineering, National Institute of Public Health, Japan • Ms. Joke Waller-Hunter, Director, Environment Directorate, OECD
Session 2 16:15-18:00	***Policy Context*** • Mr. Alain Strebelle, Deputy Director of Products and Waste, Ministry of Environment, France • Mr. Yukio Shiota, Director General, Environmental Sanitation Department, Ministry of Health and Welfare, Japan • Mr. Ludwig Kraemer, Head, Waste Policy Unit, Environment Directorate, European Commission • Mr. Fritz Balkau, UNEP, Office of Industry and Environment
18:30	***Reception Hosted by the Japanese Ministry of Health and Welfare***

Day 2

Wednesday, 5 May, 1999	Waste Minimisation through Prevention
Session 3 9:30-13:00	***Strategic Framework for National Waste Prevention (WP) Target Setting*** **Objective** To discuss factors that governments could take into consideration when developing national waste prevention targets. **Speakers** **John Stutz**, Tellus Institute, *Toward a Strategic Framework for Setting National-Level Waste Prevention Targets* **Fran Irwin**, World Resources Institute, *Resource Flows: Broadening the Framework for Preventing Waste* **Ton van Roemburg**, Ministry of Housing, Spatial Planning & Environment, The Netherlands, *Dutch Perspectives on Waste Prevention Target Setting* **Eckhard Willing**, Federal Agency for the Environment, Germany, *German Perspectives on Waste Prevention Target Setting* **Discussion Points** • What is the value of considering/setting WP targets? • How to link WP targets to other environmental objectives (e.g., climate change concerns). • Stakeholder processes and prioritisation criteria to consider for setting targets? • Different instruments and approaches available for achieving WP targets?
Session 4 14:30-18:30	***Evaluating National WP Performance*** **Objective** To explore how the evaluation of waste prevention performance could be approached/used, for maximum policy relevance and environmental benefit. **Speakers** **Myriam Linster**, OECD, State of the Environment Division: *The OECD Framework for National Environmental Performance Evaluation* **John Stutz**, Tellus Institute, *Tools for Evaluating Performance in Waste Prevention* **Oleg Dzioubinski**, United Nation Commission for Sustainable Development, *Key Considerations for Developing Waste Prevention Evaluation Tools* **Anne Choate**, ICF (for U.S. EPA), *Evaluating the Contribution of Waste Prevention to Greenhouse Gas Mitigation* **Discussion Points** • What types of tools (e.g., indicators, cost/benefit analysis) exist for WP evaluation? • Practical examples of macro-level WP performance evaluation? • How can WP performance evaluation results be used in target setting, communication, and policy adaptation? • Possible links between WP performance evaluation and, e.g., material flows, consumption patterns resource efficiency?

Day 3

Thursday, 6 May, 1999	Waste Minimisation through Prevention
Session 5 9:30-12:30	***Improving National WP Performance*** **Objective** To consider approaches for strategically improving economy-wide waste prevention. **Speakers** **Eija Koski**, European Environment Bureau, *Waste Prevention and Resource Efficiency – the Link to Consumption Patterns and Services* **Wei Zhao**, UNEP Industry and Environment, *Global Perspective on Assessing Technologies for Waste Prevention* **Jan Pieters**, OECD, Economics Division, *Waste Minimisation Potential of Climate Change Policies* **Matti Koponen**, Nordic Mining Industry representative, Finland, *Front-end Issues: Waste Prevention Policy, Dematerialisation and Mining Operations* **Mark Winfield,** CIELAP, Canada, *Waste Prevention and the Front-End of the Materials Cycle: Perspectives from Canada* **Discussion Points** • Key principles and activities on which to base longer-term government strategies for large improvements in WP. • Barriers to, and trade-offs concerning, waste prevention? • Key policy levers for large waste reduction? • Key tools, both existing and prospective?
Session 6 14:30-18:00	***Summary of Discussions*** **Objective** To discuss and develop a draft outcome of preceding sessions for input into the final plenary. **Discussion Points** • Session-by-session summary. • Key observations concerning the *need* to promote strategic waste prevention policy? • Main themes that have emerged (during the workshop) as central to the development of strategic waste prevention policy options?

Day 4

Friday, 7 May, 1999	**Waste Minimisation through Prevention**
Session 7 9:30-11:00	***Joint WM and EPR Summary*** **Objective** To summarise WM/EPR sessions and identify links between the two areas. **Discussion Points** • WM/EPR links with respect to target setting, performance evaluation, and performance improvement • Possible tools for linking EPR and WM policies (e.g., facility permits, EMS, other)?
Session 8 11:30-13:00	***Future Directions and National/International Challenges*** **Objective** To explore and examine prospective directions and priorities for WM/EPR on national and international levels. **Speakers** Masaru Tanaka, National Institute of Public Health, Japan Vic Shantora, Environment Canada. Canada Reid Lifset, Yale University, United States **Discussants** Peter Hermens, Ministry of Environment, The Netherlands Gary Davis, University of Tennessee, United States **Discussion Points** • How to design policy to enhance the complementary role of EPR and WM? • How to use of WM/EPR to advance government efforts that promotes resource efficiency and sustainable development? • Key national and international priorities over the next 5-10 years? • Future Role of OECD in these areas?
Session 9 13:00-13:20	***Closing***

OECD INTERNATIONAL WORKSHOP
Extended Producer Responsibility and Waste Minimisation Policy in Support of Environmental Sustainability

4-7 May 1999

OECD Headquarters
Paris, France

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