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ENVIRONMENT DIRECTORATE
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Working Party on Pollution Prevention and Control

STRATEGIC WASTE PREVENTION

OECD Reference Manual

Fabio Vancini: Tel. +33 01 45 24 76 95; Fax: +33 01 45 24 78 76; Email: fabio.vancini@oecd.org

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FOREWORD

This Reference Manual on strategic waste prevention is part of OECD's on-going efforts toward assisting governments with actions that support increased resource efficiency and sustainable development.

Although the concept of waste prevention is broadly accepted, it is now apparent that ever-growing waste amounts, waste diversity, and associated risks, are heightening the need for governments to vigorously pursue waste prevention as an essential component of strategy for a sustainable future. As a decision-support tool, the Reference Manual takes a life cycle approach to waste prevention, integrates a product-oriented perspective, and explores potential links of waste prevention policy to economy-wide material flows. A central argument in the Reference Manual is that governments will have difficulties in achieving a significant de-coupling of waste generation from growth in Gross Domestic Product unless they direct rigorous attention to three core activities: 1) quantitative waste prevention target setting, 2) selection and implementation of appropriate instruments, and 3) evaluation of waste prevention programme performance in environmental, economic and social terms. Each of these activities is systematically considered in the Reference Manual using a flexible government "self-assessment" approach.

An important input to this work was the first-ever OECD workshop devoted specifically to waste prevention (Paris, 4-7 May 1999). Special acknowledgement is due to the Working Party on Pollution Prevention and Control (WPPPC) for the foresight it demonstrated in organising such an event. The need for the OECD to push forward with the creation and wide distribution of a waste prevention manual was clearly re-affirmed by workshop participants from twenty-one countries.

The principal author of this Reference Manual is Fabio Vancini of the OECD Environment Directorate. The Secretariat wishes to express its gratitude to the OECD Expert Group on Waste Minimisation and Delegates to the WPPPC for their support and comments during the development of these reports. Special thanks also go to John Stutz (Tellus Institute), Reid Lifset (Yale University, School of Forestry and Environmental Studies), and Fran Irwin (World Resources Institute) for their careful review and thoughtful input to the work. Jane Kynaston assisted with the graphics and final logistical production of the work.

The Secretariat would like to thank all those countries that have offered their financial support to OECD's work on waste prevention and waste minimisation over the years (namely Austria, Canada, the European Commission, Japan, the Netherlands, Norway, Switzerland and the United States.)

A condensed 30-page edition of the Reference Manual is separately available from the Secretariat.

This report is released under the authority of the Secretary General of the OECD.

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EXECUTIVE SUMMARY

Why waste prevention?

Waste prevention is a key element of a policy aiming for sustainable development, a long-term objective of all OECD countries. Well-designed and well-executed waste prevention strategies can support sustainability through:

- Fostering environmentally advantageous changes in production and consumption patterns.
- Inducing deployment of technologies that lead to less natural resource extraction and associated "hidden" material flows.
- Freeing up financial resources for other priorities by lowering waste management costs.
- Stimulating market demand for environmentally improved products and services through greener procurement practices.
- Minimising human and ecological health risks from avoided waste treatment and disposal.
- Reducing social conflict associated with siting new landfill and incineration facilities.
- Promoting co-operative approaches between stakeholders to meet waste prevention targets.

While it is true that the principle of waste prevention is universally accepted, the practice has a considerable distance to travel in achieving its full potential. OECD research reveals that even when conventional environmental and waste policy approaches have succeeded in attaining their own specific objectives, they have not been sufficient toward counter-acting a significant and growing waste burden. The following general trends are particularly revealing:

- Chemical products, and the wastes associated with their production and consumption, are substantially increasing in both complexity and amount, suggesting uncertain but seemingly growing risks to environmental and human health systems.
- "Hidden flows"-materials that support economic activities but do not actually enter the market place, such as mining wastes and eroded soil-can represent as much as 75% of materials used by OECD countries.
- There is a linked increase of Gross Domestic Product (GDP) and municipal waste generation in the OECD area - 40% growth in both factors since 1980.

– OECD-wide recycling has been increasing, but without countervailing efforts toward waste prevention, a near-doubling of municipal waste within the OECD area is conceivable within the next 20 years. In general, it is unlikely that recycling by itself will be able to contend with the ever-mounting waste challenge.

What are the benefits of waste prevention?

Waste prevention can produce environmental benefits throughout product life cycles. Most directly, preventing the generation of waste reduces the need for further investments and energy use to collect, store, process and dispose of what would have been waste. This translates into fewer collection vehicles with their related air pollution and, similarly, a reduced need for storage space, processing and disposal with the associated environmental releases.

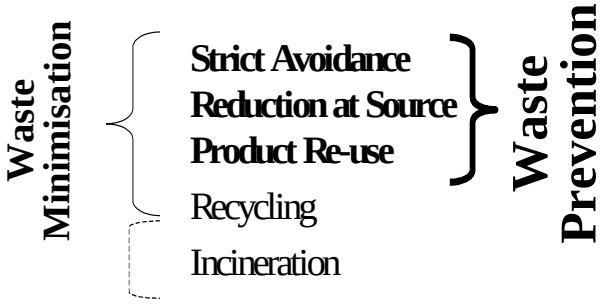
While communities and companies can save money via waste prevention, the benefits to be gained from waste prevention will also often be manifested "upstream". For example, the re-use of plastic cups not only reduces their discard into the municipal waste stream, it also reduces plastic consumption and therefore the need for plastic distribution, and ultimately plastic production (and oil extraction). Therefore, externalities associated with each link in the plastic chain are also reduced. This may be generalised as a cascading relationship: waste prevention → modified consumption → modified production → reduced pollution and waste generation throughout product life cycles.

A number of other interesting environmental benefits may also arise from waste prevention. For instance, the fact that waste-derived methane is a noteworthy contributor to global warming demonstrates that waste prevention can also support the mitigation of global challenges such as climate change. Taking into account the "hidden flows" mobilised during resources extraction activities, the overall environmental benefits to be gained from waste prevention are even further augmented

How did the OECD waste prevention project evolve?

In December 1998, the OECD refined the scope of its work programme on waste minimisation-which began in 1995-to squarely focus on the prevention component. A driving force behind this move was the recognition that adequate attention to waste prevention needs to be assured not only in principle, but also in the analyses and practical advice provided to governments. Current OECD work on waste prevention complements preceding efforts that established OECD-level waste minimisation terminology and provided a descriptive overview of waste minimisation activities within OECD countries, particularly with respect to material recycling and recovery efforts.

Waste prevention in the context of waste minimisation



In May 1999, the OECD Working Party on Pollution Prevention and Control (WPPC) held a major workshop on waste prevention (jointly with the extended producer responsibility project). Workshop participants from twenty-one countries agreed that although the concept of waste prevention is far from new, the capacity for systematically addressing it is indeed growing as a consequence of information-based developments. Examples of such developments include the progression in

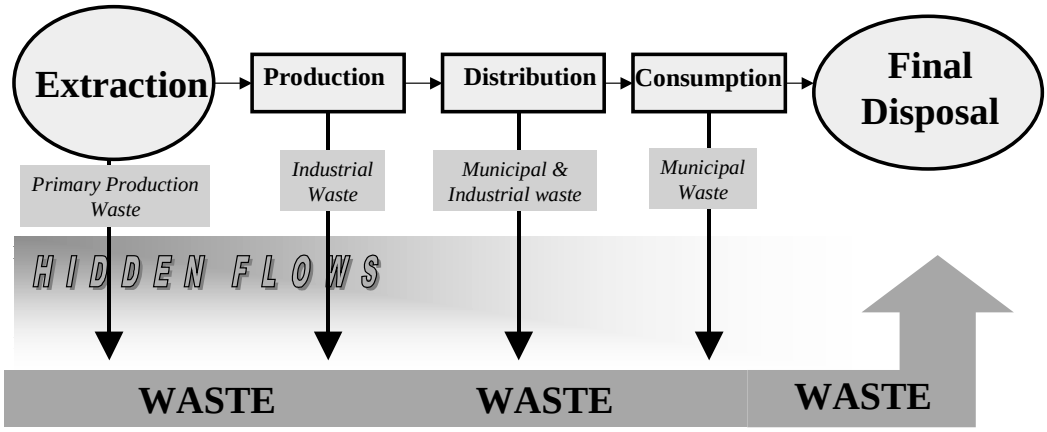
knowledge concerning the nature and scale of life-cycle material flows and associated waste prevention opportunities, and the elevated recognition of quantifiable "win-win" inter-dependencies between waste prevention and the mitigation of other challenges such as the release of greenhouse gases.

Workshop participants clearly re-affirmed the need for the OECD to push forward with the creation and wide distribution of a waste prevention manual.

What is the purpose and content of the Reference Manual?

The multi-faceted and often poorly understood nature of waste prevention accentuates the need for systematic decision-support tools that can assist governments with policy-relevant actions that are at once practical and strategic. This Reference Manual represents one such tool. It sets out to support government efforts toward developing, applying, and evaluating waste prevention policy programmes.

The Reference Manual works from the premise that each link in the chain of economic activity-extraction, production, distribution, consumption-represents potential leverage points for governmental actions to promote waste prevention. The life cycle of waste generation is depicted in the figure below.



Two inter-linked challenges comprise the functional scope of the Reference Manual:

- Waste generated as a consequence of the distribution and consumption of products, including municipal waste; and

- Other wastes generated anywhere in material and product life cycles independent of the directness of their relationship to municipal waste.

While municipal waste represents the "back end" of the waste challenge, there are at least three rationales for the Reference Manual's partial focus on this waste stream: 1) it is waste at the end of the useful life of products and therefore subject to incentives different from those wastes generated by industry. (Put simply, the costs of managing industrial wastes are borne directly by the waste generators, whereas the costs to generators of municipal waste are typically indirect or attenuated); 2) municipal waste deriving from product distribution may be of increasing concern given the growing use of electronic commerce, and, as further discussed below; and 3) the prevention of municipal waste can prompt the reduction of wastes elsewhere in the product life cycle. In general, the prevention of municipal waste entails modified consumption patterns and modified production with concomitant reduction of waste generation in the 'upstream' portions of the product life-cycle.

Double-sided photocopying, for example, not only reduces the discard of paper into the municipal waste stream, it also reduces paper consumption and therefore the need for paper production. In the resource extraction phase of the life cycle, this is what the notion of "hidden flows" is meant to capture.

The Reference Manual recognises that country-specific variables will undeniably influence how waste prevention efforts are conceived, applied and evaluated. OECD countries are faced with a variety of needs and priorities in the realm of waste prevention, necessitating that a "one-size-fits-all" approach be avoided. The Reference Manual is therefore meant to be used flexibly to help steer government actions across a range of contexts.

In the Reference Manual, "self-assessment" - at its core - refers to an internally directed method of review and verification. Self-assessment for waste prevention "comes alive" in the Reference Manual through detailed descriptions of how government-led review procedures can be applied to three core activities supporting waste prevention: (1) target setting, (2) instrument selection and implementation, and (3) environmental, economic, and social performance evaluation. Self-assessment prompts governments to ask themselves key questions in such a way that opportunities for waste prevention improvement become evident.

REASONS WHY GOVERNMENTS MAY WANT TO USE THE REFERENCE MANUAL

In addition to its role in supporting long-term waste prevention, a number of immediately practical reasons might inspire governments to use the Reference Manual:

- To assist with fulfilling agency, Parliamentary, or other needs for waste prevention policy and programme reviews;
- To help satisfy the expectations of external stakeholders that government institutions track the effectiveness of their activities toward waste prevention;
- To support the development of national, regional or local best practice agency guidelines for waste prevention; and
- To adapt it as a training device in waste prevention programme design and assessment.

Governments may find that the application of self-assessment to waste prevention is most useful when there is a solid appreciation of several issues that are fully described in the Reference Manual: the nature of the waste generation challenge*;* the elements, characteristics, and strategic aspects of waste prevention*;* and the activities surrounding the development and delivery of an operational waste prevention programme.

OUTLINE OF THE REFERENCE MANUAL

The Reference Manual is divided into two parts: *Part 1* provides users with a substantive overview of waste generation and waste prevention issues; *Part 2* discusses operational components of waste prevention policy efforts from a "self-assessment" perspective. Chapters 1 and 8 respectively provide the introduction and conclusions to the Reference Manual.

Part I - Overview of Waste Generation and Prevention

- Chapter 2 (Context) gives an overview of the growing waste generation challenge, its life-cycle characteristics, and its links to factors such as population, affluence, technology, and consumption. Global dimensions of the waste issue are also touched upon.

- Chapter 3 (Understanding Waste Prevention) delves into waste prevention: its definition, its characteristics, and its relation to conventional waste management policy approaches. The application of waste prevention to different materials, products, and industrial sectors is reviewed, and a conceptual OECD framework for strategic waste prevention is offered. Links of strategic waste prevention to other concepts, such as integrated product policy, eco-efficiency, and industrial ecology, are also considered.

- Chapter 4 (Waste Prevention Programmes) considers government programmes for waste prevention. It reviews the definition of a waste prevention programme, the role of prioritisation, the practical steps for planning and setting up a programme, and the operational components of a programme. Key considerations for assessing waste prevention programmes are also noted, and the potential input of different stakeholders to government waste prevention efforts is also considered.

Part II - Core Activities for Self-Assessment

- Chapter 5 (Strategic Target Setting) reviews the value of waste prevention targets and the types of choices that need to be made when developing strategic targets; proposes a framework for setting strategic targets, and considers a method for conducting cost/benefit analysis of chosen targets. A checklist of points to consider is also included for use when governments wish to establish waste prevention targets.

- Chapter 6 (Instrument Choice and Implementation) considers a range of possible instruments (economic, regulatory, suasive) for waste prevention; reviews a series of selection criteria; considers how to link instruments to four classes of materials in the economy; proposes a framework for matching instruments to waste prevention objectives. It also notes the broad 'waste prevention potential' of instruments. Finally, a checklist of points to consider for instrument choice and implementation is included.

- Chapter 7 (Evaluating Performance) addresses conceptual and practical considerations in waste prevention performance evaluation; proposes an evaluation framework based on environmental, economic and social aspects of waste prevention; considers the steps in performance evaluation; discusses the reporting of results; considers how performance evaluation relates to four classes of materials; and provides a checklist of points to consider in waste prevention performance evaluation efforts.

What are the conclusions of the Reference Manual?

A central argument in the Reference Manual is that governments will have considerable difficulties in achieving a significant de-coupling of waste generation from growth in Gross Domestic Product unless they direct rigorous attention to three core activities: 1) quantitative waste prevention target setting, 2) the selection and implementation of appropriate instruments, and 3) the evaluation of waste prevention programme performance in environmental, economic and social terms. Within this backdrop, the Reference Manual arrives at the following conclusions:

a. Growing population, increased affluence and intensified, ecologically damaging consumption all contribute to the waste burden as we know it today. While population and affluence are beyond the scope for waste prevention policy action, governments are realising that **perhaps the single most important reason contributing to the waste challenge** is the fact that producers and consumers have not been required to pay the full social and environmental costs of the wastes they are responsible for creating as a consequence of their consumption patterns. (In this connection, several considerations should be kept in mind. Many waste impacts, such as injuries due to litter and greenhouse gas emissions, are difficult to assign an economic cost. Waste prevention targets may reflect political decisions, not cost-benefit calculations, as has often been the case for hazardous wastes. Therefore, the conclusion given here is not meant to suggest that waste generators should be free to make waste at will if they are prepared to pay the "full cost".)

b. Waste is associated with potential threats to sustainability because of its quantity, its intrinsic hazard, and/or the risks and impacts linked to its generation, management, and final disposal. To successfully contend with these factors, waste prevention efforts should attempt to address the four **failures and barriers** associated with waste and materials policy. Though ubiquitous, these failures and barriers vary in severity from country to country:

- *Inadequate information:* such as lack of waste prevention indicators, lack of reliable data bases on waste arisings, or poorly conceived or non-existent product environmental information (e.g., eco-labels).

- *Lack of system analysis:* potentially resulting in policy measures that, e.g., promote the use of virgin materials over the use of secondary materials.

- *Lack of comprehensive cost-benefit approaches*: most traditional waste policy approaches have generally not required that waste management activities be fully costed and that overall net social costs be reduced.

- *Lack of environmental sensitivity*: Even with appropriate information in hand, consumers and other stakeholders may not necessarily be receptive to it due to low awareness.

c. There exist numerous examples of governmental endeavours that have successfully increased waste prevention **efficiencies** (less waste per unit of output at the firm level). *Cleaner production* and *eco-efficiency* initiatives have been instrumental in this regard. However, in view of trends concerning the scale of materials mobilisation, materials use, and ultimate waste generation, governments may wish to also focus more attention on reducing the **absolute** level of waste, since it is aggregate waste quantities that pose potential environmental threats (the carrying capacity of the environment does not expand with the economy or population). In doing so, it may be desirable to place priority attention on those waste and material streams characterised by higher intrinsic hazards or significant indirect effects from their extraction/use/management.

d. The successful promotion and application of waste prevention requires that governments take actions to **clarify the understanding** among relevant stakeholders as to what waste prevention entails, and what strategic waste prevention means from a policy planning perspective:

- ***Waste prevention*** refers to three types of practical actions, i.e., strict avoidance, reduction at source, and product re-use. As detailed in the Reference Manual (Annex 1), all societal actors including product manufacturers, businesses and institutions, and individuals and communities may express specific waste prevention behaviours. The practical value of waste prevention will be circumstance-specific and will depend on the characteristics of the material, product, waste stream or target audience in question. Governments can have an important communications role to play in directly addressing the persistent public confusion regarding the distinction between waste prevention and more visible and traditional activities such as recycling. An enhanced public understanding of waste prevention will increase political will for its promotion.

- ***Strategic waste prevention*** is a policy concept that concretely situates waste prevention within a longer-term resource management and sustainable development perspective. Strategic waste prevention works toward the reduction of absolute waste amounts, hazards, and risks, as appropriate, and is characterised by at least four aspects subject to continual refinement over time: a) a life-cycle perspective for identifying the policy intervention points linked with the highest waste preventing effects and system-wide environmental benefits. This would include attention to the fact that downstream waste prevention interventions can have upstream benefits, and vice-versa. Life-cycle waste prevention and overall environmental protection is likely to be further supported by the growing trend toward *product-oriented policies* (and, as a consequence, the analogous trend away from a singular focus on facility-oriented environmental policies); b) a material-differentiated approach that links waste prevention targets, instruments, and performance evaluation approaches to different types and classes of material flows; c) the substantive integration of social and economic aspects into environmental policy discussions on waste prevention; d) institutional mechanisms that facilitate co-operation across traditional institutional structures in ways that induce greater waste prevention, and overall policy synergy.

e. In forging a **domestically suitable policy path** toward strategic waste prevention, governments may wish to work along concurrent avenues that realistically take into account shifting priorities and constraints over time. Taking the need to engage industry as an example, a concrete policy approach might be considered according to three tracks, possibly coupled with quantitative targets: 1) promoting *good housekeeping* corresponding to operational processes, such as quality management, planning, maintenance, auditing, efficiency drives, etc, with time scales of 5 to 10 years; 2) leaving basic structures and technologies unchanged but *implementing additional substantial incremental* improvements with time scales from 5 to 20 years; and 3) devising institutional and other mechanisms for *achieving more fundamental "leap-frog" waste prevention improvements*-with time scales of over 20 years-resulting from long-term research and thus more fundamentally affecting industrial structure, consumption patterns, technology, and ultimately the scale of materials extraction and use. Notwithstanding the varying time scales for attaining results, it requires emphasis that progress in all three tracks can start now and that all three tracks entail vigorous attention.

f. The **application of waste prevention instruments across the product life-cycle** will require the attention of national, regional, and local governments. Intra-governmental collaboration will be important to maximise policy coherence. Consideration could for example be given to the establishment of a government-wide "implementation committee". The establishment of implementation partnerships with stakeholder groups might also be considered where appropriate. Assurance of sufficient institutional

funding and expertise will be necessary to ensure the consistency and efficacy of programme delivery and implementation.

g. **Leveraging stakeholder knowledge**. Governments may derive value in seeking out perspectives from those stakeholders affected by or interested in waste prevention policies and programmes. Potential stakeholder groups include business and industry, public interest groups, research institutes/academia, national sectoral ministries, and lower level environment agencies. As illustrated in the Reference Manual, stakeholders can inject useful perspectives as governments undertake self-assessment of their waste prevention efforts. The benefits to be derived from seeking the input of external agents should be balanced against practical constraints such as available time and resources.

h. **Benefits of government self-assessment for waste prevention**. With sufficient resources for and commitment to the application of self-assessment, governments may expect to create conditions that better promote reduced amounts and/or hazards of targeted wastes while better integrating environmental, economic, and social considerations. The self-assessment approach laid out in the Reference Manual can help ensure that waste prevention policies and programmes (particularly their targets, instruments, and performance indicators) *evolve with changes in waste generation drivers*, such as population, affluence, consumption behaviour, and technology. Additional benefits of adapting self-assessment procedures may include an elevated awareness of interested parties on the efficient functioning of the policies and programmes, and an increased governmental capacity to effectively communicate and collaborate with outside stakeholders.

i. **Modus operendi of government self-assessment for waste prevention**. In practice, the decision as to how government self-assessment for waste prevention policies and programmes will be carried out will depend on several context-specific factors. Requirements or needs for government performance reporting, the specific objectives of the self-assessment, resources available for the task, perceived urgency, and the expectations of the ultimate audience(s) are just some examples. Self-assessment may be continuous, or more periodic in its application.

j. **Developing and sharing practical experiences in waste prevention policy**. The current lack of extensive waste prevention policy experience suggests that OECD countries may benefit from pursuing intensified information exchange activities, undertaking in-depth case studies on the design, implementation, and evaluation of waste prevention programmes, and analysing synergies between waste prevention and efforts aimed at improving economy-wide resource efficiency, and waste management. It is proposed that the principles and approaches discussed in the OECD Reference Manual be used as the basis for launching such efforts.

CHAPTER 1

INTRODUCTION

1.1 Basic trends

OECD governments and the private sector have spent considerable resources on environmental protection and waste reduction over the last three decades. Over 35% of known public and private sector environment-related expenditures are directly linked to waste (OECD 1998). These investments have resulted in gains at, e.g., the facility level, but overall waste generation is, nevertheless, still on the rise. Statistics indicate that within the OECD waste generation has been increasing at a rate similar to that of economic growth.

Four Factors Contributing to "Waste Policy Failure"

- Inadequate information
- Lack of "systems thinking"
- Lack of economic cost-benefit thinking
- Lack of environmental awareness

The continuation of production and consumption patterns portends that a near doubling of OECD-wide municipal waste generation is conceivable within the next 20 years**.** This suggests that wastes and 'hidden flows' arising upstream during material extraction and product manufacturing are also likely to increase in absolute terms.

A high level of growth in certain industrial sectors making use of chemically new and complex materials suggests as-yet undefined hazards and risks from future wastes. This implies that waste and environmental policies are increasingly being challenged to keep pace with industrial capacities to innovate in materials use.

Of course, the extent to which all the above-noted trends is realised will depend on many factors, particularly the environmental and technological policy framework that governments design and activate. Nevertheless, at present many open questions persist about the scope and adequacy of existing waste prevention efforts to deal with what is an increasingly complex issue.

The waste challenge is not limited to OECD countries. Though reliable statistics are hard to come by, the UN Commission for Sustainable Development forecasts that the amount of waste produced in developing countries will double within just ten years, and that *global* waste generation may increase five-fold by 2025.

1.2 Purpose and structure of the Reference Manual

The development of this Reference Manual represents one of several endeavours being undertaken by OECD to further resource efficiency and sustainable development.

Waste prevention is a key element of a policy aiming at sustainability, a long-term objective of all OECD countries. Well-designed and well-executed waste prevention strategies can support sustainable development through:

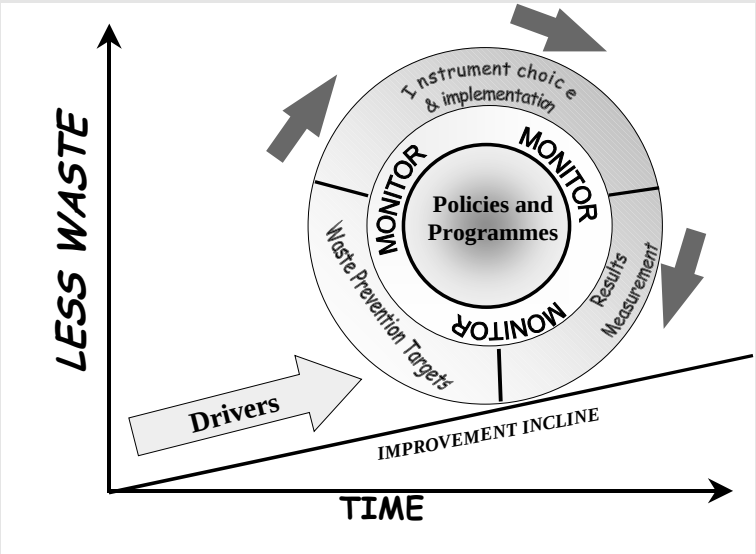
- Fostering environmentally advantageous changes in production and consumption patterns.
- Inducing deployment of technologies that lead to less natural resource extraction and associated "hidden" material flows.
- Freeing up financial resources for other priorities by lowering waste management costs.
- Stimulating market demand for reduced-waste products and services through greener procurement practices.
- Minimising human and ecological health risks from avoided waste treatment and disposal.
- Reducing social conflict associated with a decreased need for new waste management facilities.
- Promoting co-operative approaches between different stakeholders to meet prevention targets.

The intent of this Reference Manual is to assist governments when they develop, apply, and evaluate the overall performance of waste prevention policies and programmes. Part 1 of the Reference Manual provides users with substantive overview of waste generation and waste prevention issues; Part 2 discusses operational components of waste prevention programmes from a "self-assessment" perspective (Box 1-1).

Box 1-1
WHAT IS SELF-ASSESSMENT?

In this Reference Manual, self-assessment (SA) refers to an internally directed process of review and verification that can be used to systematically consider waste prevention target setting procedures **(Chapter 5)**, instrument choice and implementation activities (**Chapter 6**), and performance evaluation approaches **(Chapter 7).** Self-assessment prompts governments to ask themselves key questions in a way that opportunities for improvement become evident.

In the context of waste prevention policy programmes **(Chapter 4),** the application of SA is best realised when there is a solid appreciation of the waste generation challenge **(Chapter 2)**, coupled with an understanding of the elements, characteristics, and *strategic aspects* of waste prevention. **(Chapter 3).** With sufficient resources for and commitment to SA, governments can create conditions that better promote volume and/or hazard and risk reduction of targeted wastes and materials, and better integrate overall environmental, economic, and social considerations into the policy cycle.



As shown in the figure, self-assessment can be depicted as a vehicle that "rolls up" a waste prevention improvement incline over time. The figure shows that a monitoring system (see Annex 4) is a central component of SA. A self-assessment approach can help facilitate the adjustment of waste prevention targets, the selection of instruments, and the application of performance measures in ways that ensure that programmes and policies evolve with changes in population, GDP, consumption patterns, and technology.

As the large arrow in the figure shows, certain drivers will tend to "push" the self-assessment process-and hence waste prevention programme improvement-forward. Examples of drivers may include: Ministerial Decrees, Parliamentary decisions or other high-level government orders requiring systematic programme reviews; the recognised capacity of external stakeholders to pose questions about the functioning and outcomes of government activities; the need to justify new or existing programme needs; and the existence of funds that have been earmarked for the assessment of policies and programmes.

In practice, the decision as to how government self-assessment for waste prevention is carried out will depend on several context-specific factors. Requirements of needs for government performance reporting, the specific objectives of the self-assessment, resources available for the task, and the expectations of the ultimate audience(s) are just some examples. Self-assessment may be on-going, or more periodic in its application.

The two parts of the Reference Manual are broken down as follows:

PART I - Overview of Waste Generation and Prevention

- ***Chapter 2*** (Context) gives an overview of the growing waste generation challenge and its links to factors such as population, affluence, technology, and consumption. Global dimensions of the waste issue are also touched upon.

- ***Chapter 3*** (Understanding Waste Prevention) delves into waste prevention: its definition, its characteristics, and its relation to conventional waste management policy approaches. The application of waste prevention to different materials, products, and industrial sectors is reviewed, and a conceptual OECD framework for strategic waste prevention is offered. Links of strategic waste prevention to other concepts such as integrated product policy, eco-efficiency, and industrial ecology are also reviewed.

- ***Chapter 4*** (Waste Prevention Programmes) discusses government programmes for waste prevention. It reviews the definition of a waste prevention programme, the role of prioritisation, the practical steps for planning and setting up a programme, and the operational components of a programme. Key considerations for assessing waste prevention programmes are also noted, and the potential input of different stakeholders to government waste prevention efforts is also considered.

PART II - Core Activities for Self-Assessment

- ***Chapter 5*** (Strategic Target Setting) reviews the value of waste prevention targets and the types of choices that need to be made when developing strategic targets; proposes a framework for setting strategic targets, and considers a method for conducting cost/benefit analysis of chosen targets. A checklist of points to consider is also included for use when governments wish to establish waste prevention targets.

- ***Chapter 6*** (Instrument Choice and Implementation) considers a range of possible instruments for waste prevention; reviews a range of selection criteria; considers how to link instruments to different classes of materials in the economy; and proposes a framework for matching instruments to waste prevention objectives. It also offers an approach for considering the advantages, drawbacks, and waste prevention potential of instruments, and includes a checklist of points to consider for instrument choice and implementation.

- ***Chapter 7*** (Evaluating Performance) addresses conceptual and practical considerations in waste prevention performance evaluation; proposes an evaluation framework based on environmental, economic and social aspects of waste prevention; considers the steps in performance evaluation; discusses the reporting of results; considers how performance evaluation relates to three classes of materials; and provides a checklist of points to consider in waste prevention performance evaluation efforts .

- ***Chapter 8*** *(Conclusions)* provides a synthesis of overarching messages from the Reference Manual.

1.3 Audience and applications

The intended audience for the Reference Manual is government authorities having strategic oversight and/or operational responsibility for waste prevention policies and programmes. Stakeholders with an interest in waste prevention and resource efficiency may also find the Reference Manual of use.

The Reference Manual is meant to be used flexibly as a basis for improving waste prevention performance. It can be applied to a range of contexts. For example in addition to internal agency needs for programme performance reviews, the Reference Manual could be used to assist with reporting to:

- Ministerial offices or other high-level agency management outside the programme;
- Parliament or the interested public; and
- Other public or international bodies.

Additional reasons for using the Reference Manual may include:

- To assist with fulfilling stakeholder expectations that government institutions track the effectiveness of their programmes and policies.
- To support the development of national, regional or local best practice agency guidelines.
- Adaptation as a training device in waste prevention programme development and evaluation.

1.4 Benefits of self-assessment

When the results of a self-assessment are used by governments, a number of benefits may be realised, such as:

- The adaptation of waste prevention policies and programmes according to revealed improvement opportunities.
- Reduced waste generation and increased environmental quality.
- More effective budgetary allocation from the agency or parliamentary levels.
- Elevated awareness of personnel on the effective functioning of the programme.
- Increased capacity to effectively communicate with outside stakeholders on waste prevention, its benefits, and its implications.

PART I: OVERVIEW OF WASTE GENERATION AND PREVENTION

CHAPTER 2

CONTEXT

2.1 Historical perspective of the waste issue

Waste management as a government activity has existed in most OECD countries since the early part of the 20th century (Figure 2-1). Governmental action, which began at the local level, was largely a response to the laissez-faire disposal of all types of wastes into the urban environment. Hygiene and public health were the main drivers for government intervention.

With time, the regulatory and institutional mechanisms of waste management policy evolved. Waste management laws and specialised agencies were established to better confront the challenge. Governments started formally adopting the "waste hierarchy" (OECD 1976).

Private sector actions were an important government concern, though policies did not always provide optimal incentives for fostering waste prevention in industry. Indeed, policy interventions were often not enough to counteract the situation where private waste *generation* decisions were viewed as more convenient and "viable" than waste *prevention* decisions (Geller 1981). Private sector investments deemed to represent low financial risks in the context of stated regulatory requirements were generally the norm. Compliance was the main concern. (A true "beyond compliance" (Reinhardt 1999) anticipatory mentality was rare.)

To some extent, this may also be said of the public sector. The bulk of public investment during the last 20 years or so has been largely associated with "end-of-pipe" approaches (waste treatment and disposal technologies). The sheer scale of wastes generated necessitated considerable public financial outlays to *manage* the problem. In some countries municipal waste-related expenditures increased three-fold from 1972 to 1992, or an average annual growth of 5.8 per cent-considerably higher than average annual GDP growth rates (Rutledge and Vogan 1994).

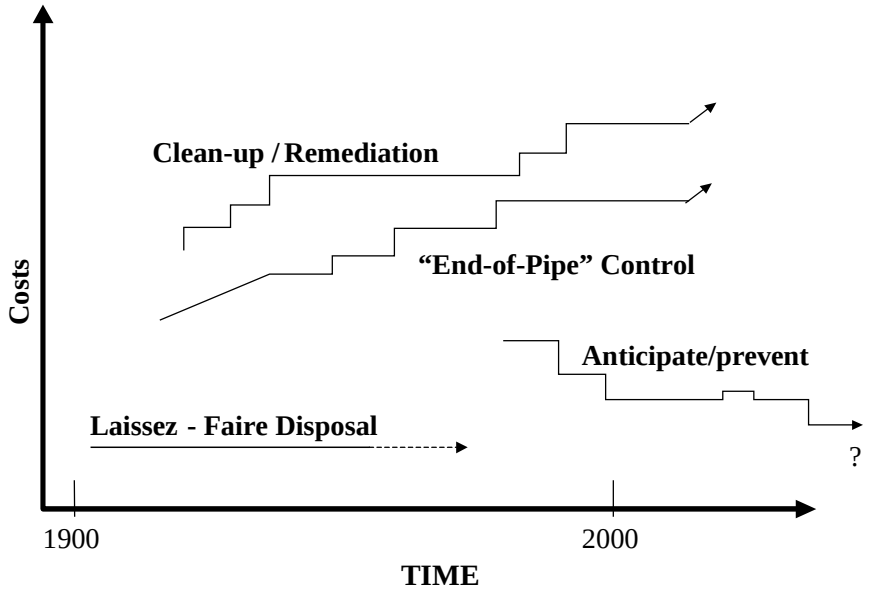
In short, most practical private and public sector efforts dealing with waste in the later part of the 20th century tended to have a persistent focus on: *(a)* more tangible industrial management priorities (e.g., compliance with stated regulatory requirements) and *(b)* more visible urban health problems such as municipal and other wastes. Much difficulty was experienced in *integrating* prevention procedures with the more pressing waste management imperatives of the moment.

The fact that different governmental structures have dealt, and continue to deal, with different parts of the waste puzzle according to source (e.g. municipal), type (hazardous), management methods (recycling,

treatment, incineration, disposal) or receiving medium (air, water, land) accentuates the integration challenge. This does not, however, mean that "partitioning" waste policy work is inherently undesirable. Indeed, at some level challenges and tasks must be sub-divided in order to get work done. The problem is the failure to establish administrative mechanisms that promote coherent and integrated approaches despite the ubiquitous pressures to separate the different elements of waste and environmental policy.

It is worthwhile to note that even other "non-waste related" environmental policies, while generally effective for their own purposes, posed challenges for waste management. End-of-pipe filters and emission control technologies for meeting air and water quality objectives tended often to result in more wastes from the residuals captured by those technologies.

Figure 2-1. Evolution of the Waste Issue: Conceptual Overview



Source: adapted from Jackson 1991.

Realising the limits of downstream, end-of-pipe approaches, during the early 1990's many environment administrations fully embraced "source reduction" and "pollution prevention" as general, overarching goals. This meant, among other things, that as little waste as possible was to be finally disposed of, and this objective was to be achieved with a priority focus on preventive efforts, generally followed by recycling.

OUTLOOK FROM NORWAY

"Recycling can not alone meet the growing waste amounts. In the last three years, the total waste amounts [in Norway] have grown 3 times more than the amounts for recycling. During the last 15 years the amounts have grown by 50%, and projections show the same growth in the future, due to high growth in consumption, and material input." - Statistics Norway (1998)

What can be said about the status of waste prevention today? Notwithstanding good intentions, it is apparent that, in practice, prevention has not been a priority. Overall, most present-day public and private waste-related investments are directed to waste recycling and treatment, not prevention. In addition, 65% of municipal wastes in OECD are still going for final disposal-officially the *least* preferred option for dealing with waste.

Moreover, although recycling rates for many materials have increased, trends indicate that recycling has not been (and most likely will not be) enough to contend with the increasing quantities and complexities of wastes.

As further discussed in section 2.3, growing population, increased affluence and intensified, ecologically damaging consumption all contribute to the waste burden as we know it today. While population and affluence are well-beyond the scope for waste prevention policy action, governments are realising that **perhaps the single most important reason contributing to the waste challenge is the fact that producers and consumers have not been required to pay the full social and environmental costs of the wastes they are responsible for creating as a consequence of their consumption patterns.** The incorrect pricing of waste management activities at the household level is a case in point. Typically, the collection and disposal services for municipal waste is paid for via general taxation, i.e., there is one fee, independent of the amount of wastes produced. Therefore, waste items have conventionally not carried a price tag for individual generators with the result that financial costs of waste disposal-as borne by waste generators-continue to be relatively low in comparison to their overall social and environmental costs. [A certain trend toward household user fees ("pay as you throw") systems may be changing this situation slowly though unintended consequences such as illegal dumping and can not be ruled out.]

The fact that producers and consumers have not been paying the full cost associated with waste generation raises a number of over-arching considerations. Many waste impacts, such as injuries due to litter and greenhouse gas emissions, are difficult to assign an economic cost. Waste prevention targets may reflect political decisions-not cost-benefit calculations-as has often been the case for hazardous wastes. In general, one should *not* therefore conclude that waste generators should be free to make waste at will if they are prepared to pay the "full cost".

Box 2-1
UNDERSTANDING "WASTE POLICY FAILURES AND BARRIERS"

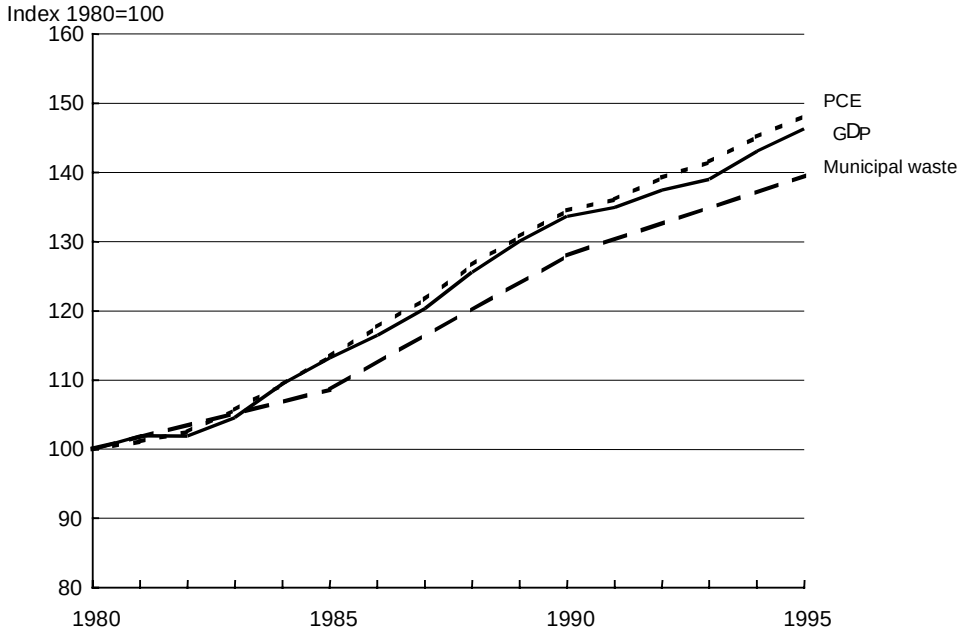
Waste management policies have been constrained by a series of failures and barriers (Pearce and Turner 1993). These failures and barriers are ubiquitous but vary in severity and extent from country to country.

1. **Inadequate information** - also known as "information faiilure". Examples exist on many levels. For instance, databases on waste arisings and disposal are deficient. Many countries lack a single database which is national, comprehensive and current. A general lack of accepted waste prevention performance indicators is another example (Waller-Hunter 1999). At the product level, non-existing or poorly conceived environmental labelling can also contribute to information failure.
2. **Lack of 'systems thinking'**- few countries have taken an overall systems perspective. Most countries reflect a patchwork of waste-related programmes at various geographic scales, points in the life cycle of materials, and kinds of waste. Solutions to problems are often piecemeal, and the risk for incoherence is high. In some countries, the regulation of new materials is much simpler and less costly than that of waste materials. For example, a manufacturer may have a difficult and expensive time disposing of used metal cyanide, but can easily buy new metal cyanide from a chemical manufacturer; the net effect is to favour the use of new materials over the re-use of old ones (Frosch 1995).
3. **Lack of economic cost-benefit thinking -** waste disposal authorities are often required to prove financial profitability, i.e., that for any management scheme, private costs are outweighed by private benefits/revenues . But the requirement *should* be that the introduction of such a scheme reduces overall net *social* costs (i.e., private plus external costs) of the system. The problem has been that the disposal option has not been fully costed/evaluated in social terms because of the failure in the market process itself.
4. **Lack of environmental awareness/sensitivity** - this refers to the lack of knowledge, sensitivity or appreciation of the waste generating and other environmental implications of actions at the household, corporate/industrial, or governmental level (e.g., product purchasing decisions). While incomplete information (see point 1) will tend to make individuals or organisations "less aware" about the implications of their actions, this does not by necessity lead to the conclusion that "good environmental information" will produce desirable results in a market where public or private consumers are not receptive to, and act upon, such information. Education, training, and information exchange will play a significant role in boosting environmental awareness/sensitivity of all actors.

2.2 A growing burden: OECD waste generation

In the OECD area, the de-coupling of increases in waste from increases in wealth continues to pose a formidable challenge. For the period 1980 to 1995, Figure 2.2 shows how the growth in municipal waste has closely followed increases in GDP and consumer spending (the absolute increase of all three factors has been around 40%). Total municipal waste production in 1995 was 485 million tonnes. On a per capita (relative) basis, the increase in municipal waste from 1980-1995 has been 25%, that is, from 410 kilograms per capita to 510 kilograms per capita. (OECD 1997).

Figure 2-2. Trend of municipal waste generation GDP, and private consumption expenditure (PCE)

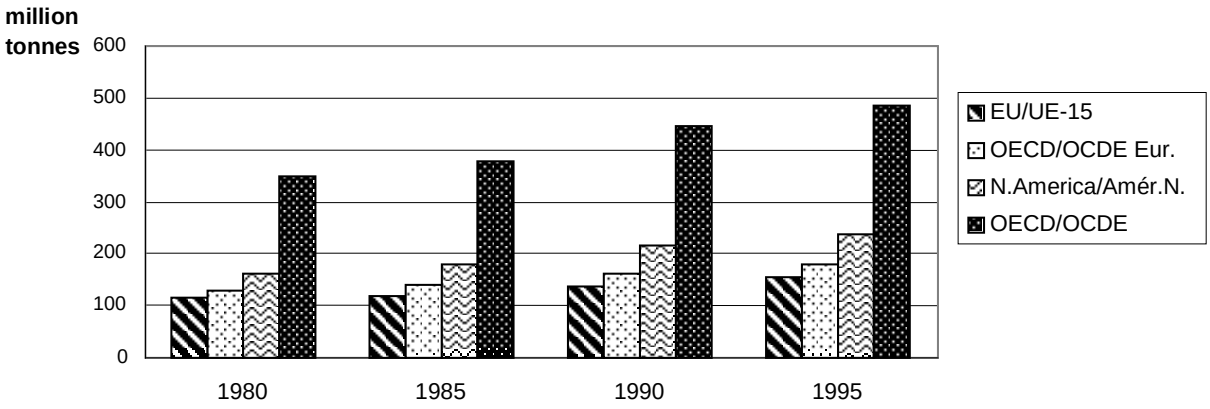


Source: OECD.

These OECD-wide statistics mask a fair amount of variability between countries and geographic regions. As an example, Figure 2-3 provides a regional breakdown of the increase in municipal waste. According to OECD data, the highest absolute increase (48%) of waste generation, but lowest relative increase (24%) has been experienced in North America, whereas the lowest absolute increase (34%) has been reported for the European Union countries-but these same countries had the highest relative increase (27%).

Efforts to apply the methods of "energy decomposition analysis"-a long established subfield of energy accounting-to materials consumption can help reveal in detail the source of consumption and waste generation growth in different countries (Lifset 2000).

Figure 2-3. Generation of Municipal Wastes from 1980 to 1995



Source: OECD.

Growing waste **amounts** are clearly an issue of concern. Though a minimal amount of waste is thermodynamically inevitable (Jackson 1996), inordinate amounts are indicative of inefficiency in the use of materials and energy. But efficiency should also be considered with respect to waste **hazards**, which may be independent of their mass quantity. Indeed, hazard reduction is an important part of waste prevention (see 3.1). When highly hazardous, even small amounts of waste may represent "inefficiency" toward achieving risk reduction, depending on how they are managed and what types of human and ecological exposures occur. (Freeman and Portney 1989).

It is not possible to develop trends in hazardous waste generation because of constantly changing definitions of "hazardous waste" within and between Member countries. Hazardous characteristics of wastes include, but are not limited to: human health toxicity, corrosivity, infectiousness, flammability, reactivity, explosivity, and eco-toxicity. While many countries refer to similar hazardous characteristics in their environmental legislation, there may be considerable differences in the testing procedures used to determine whether a waste actually exhibits one or more of the characteristics (Vancini 1994). Nevertheless, according to OECD Environmental Performance Reviews carried out now in almost all OECD Member countries, and as reflected in the OECD Environmental Data Compendium 1997, most Member countries experienced an increases in hazardous waste generation between 1985 and 1995. Very few countries reported a decrease or no change in hazardous waste generation during this 10-year period. (OECD 1991, 1997, 1998b).

At the household level, approximately 1% of waste generated is hazardous, though the *chemical diversity* of household hazardous waste seems to be on the rise (Box 2-2).

Box 2-2
HOUSEHOLD HAZARDOUS WASTE

Typically, 99% of the waste generated by the average households has little potential to cause harm if properly managed. The remaining 1% or so can be considered household hazardous waste (HHW). It comprises such materials as garden chemicals, paints and solvents, batteries, oils, and other items which, while typically present in very small quantities, could pollute groundwater, contaminate soil, or cause explosions or fires. We now use far more chemicals in our everyday lives and the range of ordinary materials which, when discarded, make up HHW has increased dramatically in the past twenty or thirty years.

Source: Warmer Bulletin 1996.

As a general rule, 10-15% of wastes produced by industry is likely to be hazardous (Biswas 1989). A high level of foreseen growth in certain industrial sectors may also suggest uncertain, but seemingly increasing, health and safety risks from waste hazards (Box 2-3).

Box 2-3
PRODUCTS, WASTES, AND RISKS

Do increasing numbers of chemically complex products suggest growing waste-related risks from the manufacture, use, and disposal of those products?

According to Jackson (1996), approximately 100,000 industrial chemicals are now in commercial use world-wide, and this figure is increasing at the rate of between 500 and 1,000 new chemicals each year. This growth has been driven in part by the increased role for new and complex chemicals in new and expanding technological contexts-such as electronics, agriculture, metal purification and metal plating, textiles and the food industry-and in part by the availability of petroleum derived by-products of an expanding oil industry. In the U.S., overall chemical production has expanded by 20% since the early 1990s (CMA 1999).

This expansion in the type of chemicals in use is likely to be further propelled by "combinatorial chemistry" techniques that allow the synthesis of 50,000 chemicals in a matters of weeks. Conventional synthesis techniques by contrast produce a few hundred new compounds in a year. The testing and regulatory challenge posed by this rapid increase in the rate of creation of new chemicals may be offset in part by use of computer-based methodologies for the estimation of risk based on the molecular modelling of substances (Rejeski 1999).

Some observers have noted that materials in municipal landfills in many cases are at least as hazardous as those in industrial landfills (which tend be operated according to higher environmental safety standards than municipal landfills)-primarily as a result of the use of toxic chemicals in commercial products (INFORM 1995). Others (Redclift 1996) note that by 2005 the number of chemical products being finally disposed of as wastes will be double what they were in 1990.

The human and environmental health implications of waste chemicals has been the subject of study by the World Health Organisation, the United Nations Industrial Development Organisation, the World Bank, and many others (Batstone, *et al* 1989, Murti 1989, Grisham 1986). Understanding the risks posed by discarded chemicals and hazardous wastes is often a difficult task (Kunreuther 1991).

OECD work on toxicity testing and exposure is helping develop the knowledge base that may, *inter alia*, foster reductions in waste-related risks. Better knowledge about the toxicity effects of chemicals can contribute to waste prevention strategies for those substances that would preferably be designed out of products and processes, or used only in ways that avoid exposures. In this connection, the high-production volume testing programme of the OECD is beginning to provide some much needed insights.

End-of-life products (such as packaging, electronics, and other complex products) are important components of waste. Food and other organic waste accounts for the largest share of what is often formally defined as "municipal waste" in OECD countries. Packaging contributes roughly one-third of the total quantity of municipal waste (OECD 1996a). The electronics industry-one of the major consumers of chemical products-has experienced exponential growth in sales over the past 25 years (OECD 1996a); in some countries a fair amount of post-consumer electronics are kept in storage, while other portions go to recycling/recovery or landfill. In Europe, the annual growth rate from waste of electric an electronic products is estimated to be 3-4%, and the content of hazardous substances in the waste stream to account for approximately 33% of the content of hazardous substances in municipal waste (EIONET 1999).

Bringing products to the market place relies on a sophisticated chain of activities that extends from extraction and production to distribution and consumption. Each and every activity that precedes the market introduction of products is associated with waste generation (Figure 2-4).

Figure 2-4. Life-cycle of Waste Generation

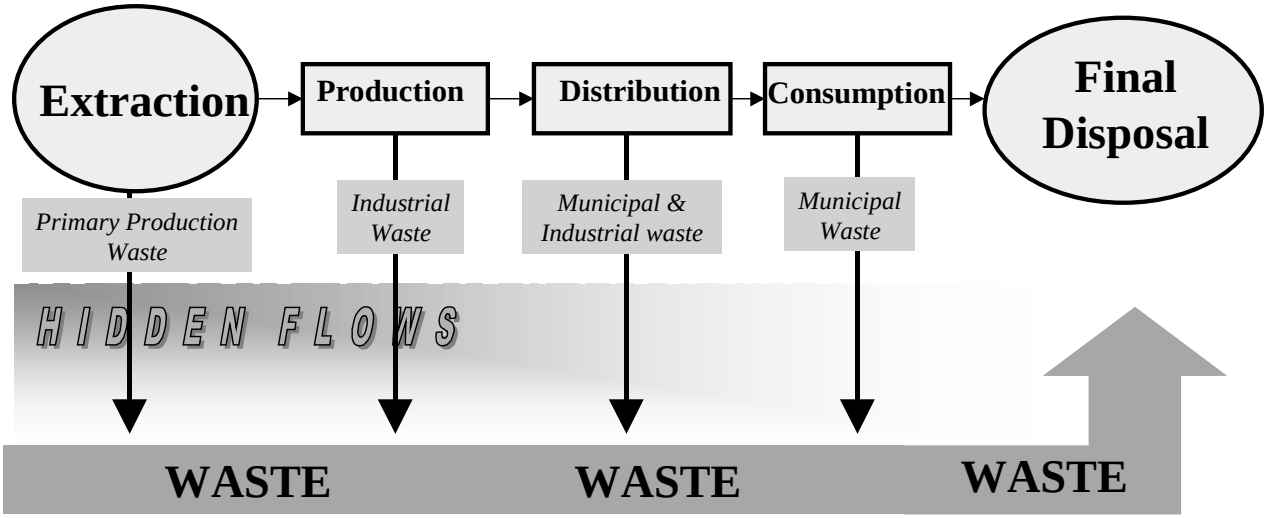


Figure 2-4 portrays how waste generation is linked to the life-cycle of products and materials. The "cradle-to-grave" linkages shown in the figure are merely illustrative of where wastes arise during economic processes. Other waste streams may exist that are not shown. Consider the consumption of finished goods. Municipal waste is part of the associated waste-however, it is far from all of it. In many OECD countries, for instance, municipal waste does not include the following wastes:

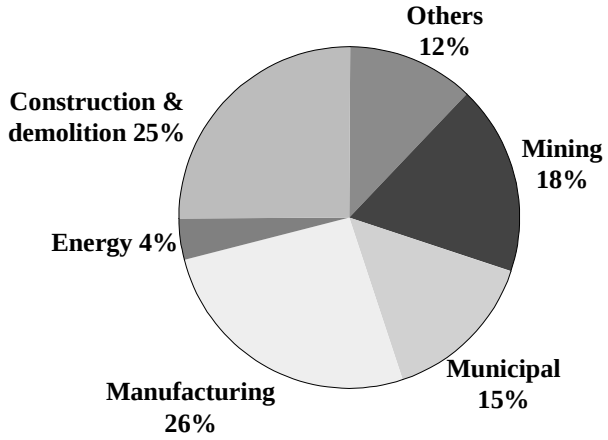
- Building materials from construction, renovation, and demolition projects (so-called "C&D "waste)
- Used vehicle parts and bodies

In the U.S., C&D waste alone adds about 135 million tons to the roughly 210 million tons of consumption waste in municipal waste. In general, material "stock" (that is, materials that enter the economy for a period of at least one year as durable goods, or infrastructure and buildings), will becomes "waste" after several years. This time element of certain material flows will sometimes have substantial implications for developing waste prevention strategies.

It is difficult to state accurately how much waste is being generated *overall* within the OECD area. There are many reasons for this. For example, the definitions of "waste" and estimation techniques are not the same across different countries, or even across time within the same countries. Also, overlaps between different classes of wastes (e.g., industrial and hazardous) introduce further sources of uncertainty in any estimates.

Nevertheless, in approximate terms it can be stated that in the mid-1990s the aggregated annual OECD generation of industrial, municipal, and hazardous waste was about 2.0 billion tonnes. The comparable grand total of waste generation, including mining and certain harvesting wastes, exceeded 4 billion tonnes in the mid-1990s (OECD 1997). The following pie-chart (Figure 2-5) provides a percentage breakdown by sector in for those OECD countries that are also members of the European Union.

Figure 2-5. Approximate Waste Generation in the European Union by Sector*



Source: OECD 1997a, NRCs 1998.
* Forestry and agricultural wastes are not included here; together these two sectors may account for up to 30% of overall waste in the European Union.

Not included in these figures are all the so-called "**hidden flows**", i.e., those portions of overall material requirements supporting an economy that never actually enter the market economy; in particular hidden flows refer to the natural resource use that occurs when providing commodities for the market-place. Examples of such 'non-visible', non-priced substances include those deriving from mining, forestry, earth moving, and other sources.

Simply enumerating all the waste streams linked to the material/product life cycle is a difficult task. Recent work by the World Resources Institute and others (WRI *et al*. 1997) has produced the concept of **Total Material Requirements (TMR),** which provides an indicator of the total materials that enter or are mobilised by the economic activity of a country. The fact that material flows have environmental consequences, and that environmental consequences are associated with material flows, makes TMR quantification relevant when discussing waste prevention and resource efficiency objectives. Examination of the components of TMR provides a rough measure of the types and magnitudes of materials that waste prevention programs might seek to address (Irwin 1999). As work on TMR develops, it has the potential to contribute information that highlights key intervention points where government action may have the

highest waste prevention effects. To date, WRI and collaborators have estimated TMR for four OECD countries: Germany, Japan, The Netherlands, and United States.

The emphasis on hidden flows is linked to considerations of the choice of emphasis regarding waste streams. Implicit in the notion of hidden flows is a life cycle, and perhaps a product-based perspective (Box 2-4). Hidden flows are not hidden if one is focusing on policy development related to mining or forestry. They are hidden from the consumer and waste manager. This suggests that, for hidden flows to be a cogent concept, an end-of-product life or municipal waste perspective must not be lost.

Box 2-4
DISSIPATIVE MATERIALS USE, MATERIALS ACCOUNTING, AND WASTE PREVENTION

The accounting of materials flows as done, for example, with the TMR reveals an important category of material flows with implications for waste prevention. **Dissipative** or **dispersive material flows** refers to uses of materials that are by their nature not feasible to recover. Adhesives, pesticides, paints and other surface coatings are conspicuous examples of materials whose use leads to dissipative release into the environment in a fashion that is very unlikely to be amenable to recovery and recycling. The zinc used to make galvanized steel and which is slowly released into the environment as the steel corrodes is an example of a dissipative use of a metal. Such materials are distinct from those that are not currently recovered-because of, for example, current market conditions-but could plausibly be so. The very notion of dissipative flows brings to light releases into the environment engendered by *product use* thus highlighting the fact that waste prevention applies to a variety of stages in the product life cycle.

The implications of dissipative uses for waste prevention are several. First, such uses typically do *not* show up as tonnage delivered to landfills. Thus, measurement systems that focus on *outputs* such as waste delivered to various types of facilities will not capture the effect of these materials flows. Only with a materials accounting framework that looks simultaneously at inputs and outputs and that attempts to construct materials balances can the extent of such dissipative flows be tracked. In this respect, a metric such as TMR that adds input-related perspectives to the output-related focus of waste statistics is needed. Second, because dissipative flows are, by definition, unrecoverable, they are good candidates for focusing on hazard-oriented waste prevention activities. Simply put, hazardous materials that are recoverable (such as the lead in lead-acid batteries) are *prima facie* less of a threat than those that cannot be recovered (lead in paint) (Socolow and Thomas 1997).

Finally, the hidden flows emphasised in the work of WRI and its collaborators include a significant component of dissipative materials flows. Mostly notably, soil erosion engendered in resource extraction activities is a dissipative release. In this respect, dealing with the mobilisation (and release) of such materials is doubly handicapped: it is a flow of materials that is not typically valued in the market and it is in most cases unrecoverable.

Waste prevention can help minimize dissipative materials flows in several respects. To the extent that waste prevention involves reductions in product and material consumption (as further discussed in Section 3.3), then the associated dissipative releases upstream in the product life cycle are reduced. If less is consumed, then fewer natural resources need be extracted from the environment and the concomitant hidden flows may be reduced as well. Hazard-oriented waste prevention, as noted above, can reduce the hazard associated with dissipative releases.

Source: Lifset 2000.

It has been estimated that "hidden flows" account for as much as 75% of the total materials required by OECD countries (WRI *et al* 1997). With respect, in particular, to mining operations, Winfield (1999) reports that the annual waste generation from these operations in some countries is more than twenty times the amount of municipal solid waste generated by all the residences, industries, commercial establishments and institutions in those countries. Koponen (1999) states that if all materials moved during mining are considered "waste," then mining would be the largest overall waste producing activity in the world.

Box 2-5
WASTE AND CLIMATE CHANGE

A Key Link

Waste is one of the largest contributors to methane emissions. Methane is significant because it is 21 times more potent a greenhouse gas than carbon dioxide over a one-hundred year time horizon. According to the **European Commission** (1996), in 1990 waste accounted for 32% of methane releases in Europe (the two other major sources are agriculture (45%) and energy (23%)). Since 1990 there has been a 10% increase in waste-derived methane emissions. Detailed studies coming from the **U.S. EPA**. clearly demonstrate the considerably higher greenhouse gas mitigation potential associated with waste prevention in comparison with other waste minimisation activities, including recycling (Choate *et al* 1999).

It is now widely understood that reducing the amount of materials mobilised **upstream** will help prevent wastes, and secondary problems, across the *entire* product and materials life-cycle. However, a significant gap exists between the acceptance of this principle and its practical application.

- → In the short-term, existing extraction operations can be fine-tuned for **relative decreases** in waste generation (OTA 1992, Foster 1998). The Finnish "intelligent mine" is one example (Koponen 1999) of such increases in waste prevention efficiencies.

- → In the longer-term, if OECD countries intend to pursue fundamental improvements for **absolute decreases** in waste generation at the front-end of material cycles, methods for adjusting the *scale* and *structure* of demand will require thoughtful attention (by, for example, considering costs and benefits of a more "service-oriented" economy).

Box 2-6
MINERALS EXTRACTION AND WASTE-RELATED CONCERNS

Objectives in the United Kingdom

The United Kingdom is promoting the "*best use of minerals*". According to the Department of Environment, Transport and the Regions, the government will *inter alia* *"… work with the construction industry to develop a strategy for more sustainable construction, including **targets** for efficient use of primary aggregates and greater use of recycled and waste materials. It will encourage a reduction in the overall quantity of material used and in the generation of waste, and will help to make sure that higher quality materials are not used when lower quality materials are available. It will look towards more use of alternatives to land (-derived) aggregates, such as marine sand and gravel. An aggregate tax will be introduced if the industry is unable to deliver an acceptably improved package of voluntary measures that address the significant environmental costs of aggregate extraction."*

Source: DETR 1999.

The capacity to achieve significant levels of waste prevention at the extraction stage is constrained by society's strong demand for primary materials. Brandsma (1997) reports that world demand for minerals and metals rose 120% between 1961 and 1990, while Koponen (1999) notes that during the last 30 years the extraction of metals has roughly doubled.

Short-term prospects for shifting to environmentally sustainable minerals demand do not appear very promising. For instance, a prospective study published by *Financial Times Energy* (Hefferman 1998) on the global minerals industry notes that there will be:

> *"... record levels of [mineral] exploration spending during the first decade of the next century ... future opportunities for explorers, investors, service companies, and suppliers in the industry are expected to be more plentiful than at any time in recent memory. Revised mining codes are making exploration in many developing countries more feasible, while new processing techniques are broadening the definition of ore and making formerly marginal deposits attractive to investment."*

There exist some interesting governmental efforts toward institutional collaboration that may facilitate increasingly coherent policy actions that concurrently address mining and life-cycle waste generation. For example, a recent workshop in the U.S. brought together experts from the Geological Survey (the public entity traditionally concerned with a *reliable supply* of mineral resources) and the Environmental Protection Agency (which traditionally focuses on the control and reduction of *damage* associated with the life-cycle of material flows). Sensitising supply-oriented agencies on how the use of natural resources influences the environment and quality of life seems to be a worthy endeavour (WRI 1999). Notwithstanding useful efforts such as these, it cannot be realistically expected that mineral agencies will be able to rapidly incorporate environmental sustainability into their day-to-day operations. Studies have shown (Engwall 1976) that it takes 10-15 years for a new set of values to permeate a whole organisation (and at least one generation for such value shifts to affect societies).

Increasing the *knowledge flows* between institutions that traditionally have had rather different purposes in the broad realm of materials management can be one useful way to start developing a more structured framework for sustainable materials management, and hence, *inter alia*, more coherent waste and environmental policy design.

2.3 Dynamics of waste generation

Taken broadly, waste generation can be viewed as an environmental "impact". There are multiple determinative factors that directly exercise an influence on the scale of environmental impacts. Commoner (1972) and others after him (Rosa and Thomas 1994, Jackson 1991, Wernick and Ausbel 1997), have used three such determinants:

- population
- affluence
- technology

It is useful to consider the dynamic nature of the waste generation process according to these three factors (Stutz 1999c, Lifset 2000).

2.3.1 Links to population, affluence and technology

From a conceptual standpoint, waste generation as an environmental impact [I], can be expressed as a function of population [P], affluence [A], and technology [T]:

$$[I] = [P] \times [A] \times [T]$$

IPAT is useful in part because it captures a key dynamic relationship:

> **If environmental Impacts are to fall, then beneficial changes in Technology must more than offset the combined effects of increases in Population and Affluence.**

It is important to emphasise that IPAT as used here is merely an indicative relationship. The nature and scale of both production and consumption patterns are two noteworthy factors that are "buried" in IPAT.

Waste generated per unit of GDP is an example of what is referred to as the **waste generation rate** or the **intensity** of waste generation. Such ratio-based (relative) rates can be expressed in a variety of ways: For example:

- Municipal solid waste (MSW) per unit of personal consumption expenditures (PCE).
- Tons of packaging per litre of beverage delivered.
- Hidden Flows per unit of Gross Domestic Product.

Waste prevention actions can directly affect these generation rates. For example, for beverage packaging, waste prevention may include developing lighter cans, switching from glass to plastic containers, selling in larger containers, and making greater use of returnable bottles. However, as IPAT makes clear, this will only result in less beverage container waste if the resulting reductions in the waste generation rate is sufficient to offset the growth in beverage container use that is influenced by increases in Population and Affluence.

In general, within the context of environmental sustainability, waste prevention requires consideration of not only the waste generation rate (a relative notion), but also: a) the aggregate level of waste generation, b) the hazards intrinsic to materials, and c) the risks and impacts related to materials mobilisation, use, and disposal, to create a full picture of the threats that waste prevention efforts can help mitigate. These points are further discussed as part of Chapters 3 and 7.

Box 2-8
DE-MATERIALISATION

As technological innovations allow products to shrink and packages to become lighter, it is often suggested that the economy is de-materialising, i.e., that economic growth and materials use are becoming de-coupled so that increases in economic activity do not lead to commensurate increases in waste generation. The evidence on this is mixed and the analytical complications in drawing such conclusions are multiple (Cleveland and Ruth 1998, Wernick *et al*. 1997). The trend toward de-materialisation as engendered by the use of advanced materials, miniaturisation of electronics and similar innovations is counter-balanced by population growth, increases in the rate of consumption, and increases in wealth. Consumer electronics may have dramatically reduced the size of computers, telephones and audio equipment, but the number of such products per household is increasing. Similarly, beverage packaging has shown significant progress in light-weighting, but the number of single service containers has also increased. The challenge facing waste prevention is not only the reduction of waste per person or per unit of GDP, but also the reduction of waste in aggregate.

Source: Lifset 2000.

2.4 Global dimensions of the burden: a glimpse

The waste burden is not just an OECD problem. While the literature is scarce with specific and verifiable data on non-OECD and global aspects of the challenge, there are some noteworthy observations that can be made.

The United Nations Commission for Sustainable Development forecasts that within just ten years the amount of wastes generated in developing countries may double. Beede and Bloom (1995) report that while industrialised countries account for a disproportionately high share of the world's waste relative to their share of population, developing countries account for a disproportionately high share of the world's waste relative to their share of world income. Koponen (1999) notes that most metal mining activities are moving to developing countries. Bartone and Berstein (1993) report that in most developing countries municipal waste management is a very resource-intensive activity, consuming between 20 and 50% of available operational budgets for municipal services, yet serving no more than 70% of the urban inhabitants. The World Resources Institute and others (WRI *et al* 1997) report that for industrialised countries, the smaller their size, the greater the percentage of material flows they will tend to have *outside* of their borders.

Additional observations on the global dimensions of the waste burden can also be made (Box 2-9).

Box 2-9. Global Dimensions of the Waste Burden

Factor	Observation
Population	By 2050 the global population is projected to be 50% larger than today (i.e., 9 billion people), and 95% of that growth is expected to occur in developing countries (Sewell and Morrison 1999).
Consumption	Consumers in certain rapidly expanding non-OECD economies are emulating the ecologically challenging consumption patterns of consumers in OECD countries.
Affluence	Some of the highest GDP growth rates in the world is taking place in countries outside the OECD, such as China, India, Brazil, and Indonesia. (OECD1997b).
Technology	The World Bank reports that "massive levels" of industrial investment will occur in developing countries (Hanrahan 1995). In principle, "leap-frogging" the dirty technologies of the past may be possible because many developing countries have fewer sunken costs in older "eco-unfriendly" technologies (Andrews and Socolow 1999).
Impact?	A five-fold increase in global waste generation is possible by 2025 (CSD 1997).

2.5 The prevention imperative

Sustainable development is based on principles such as responsible use of natural resources and protection of the environment. In this context waste prevention is recognised as a fundamental element of a policy aiming for sustainable development.

From an overview of the current waste challenge presented in this chapter, it is apparent that existing efforts going into waste prevention have not been sufficient in counter-acting the absolute growth in waste generation and associated hazards and risks. The urgency of waste prevention appears stronger than ever, and not just within the OECD area.

CHAPTER 3

UNDERSTANDING WASTE PREVENTION (WP)

3.1 Three elements of WP

Waste prevention encompasses activities that reduce both the **quantity** and the **hazardous character** of wastes. These activities are applicable on a life-cycle basis (see Figure 2.4 in Chapter 2).

The consensus understanding of waste prevention achieved by OECD countries (OECD 1998) can be broken down into three types of actions:

(a) Strict Avoidance

(b) Reduction at Source

(c) Product Re-use

Figure 3.1 below illustrates how these actions fit into the context of waste management efforts. Following the figure are the OECD definitions of each action, with illustrative examples. General approaches to waste prevention, and examples of waste prevention actions by different actors, are considered in Annex 1.

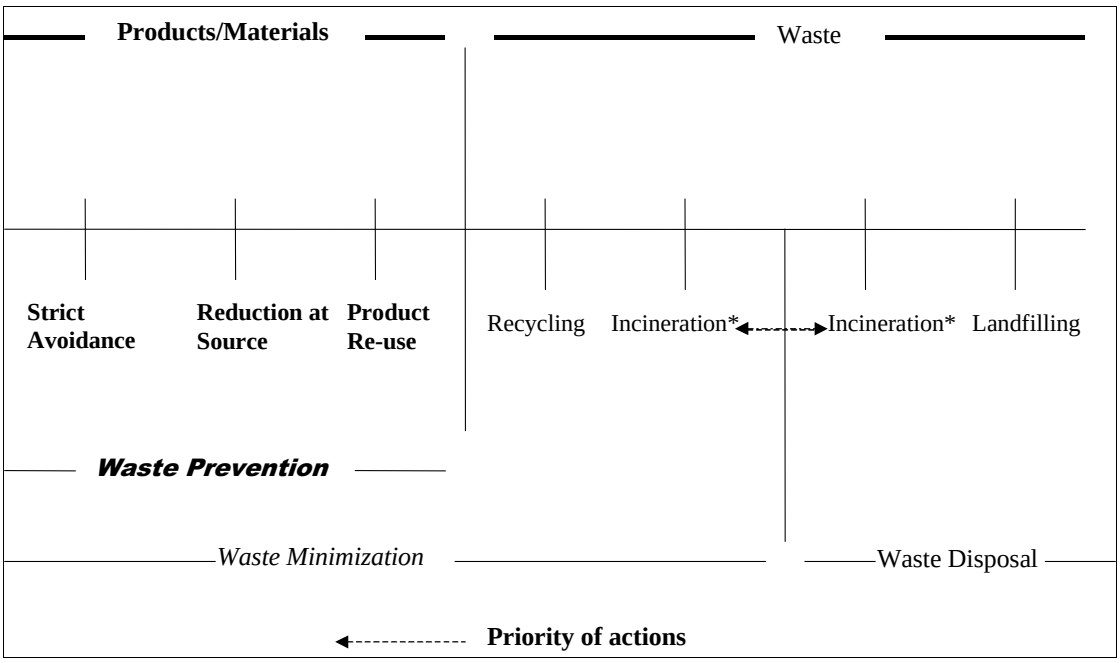
AVOIDING CONFUSION WITH RELATED TERMINOLOGY

According to terminological work undertaken at OECD, "waste minimisation" is a broader term than "waste prevention" in that it includes recycling and (if considered appropriate) incineration with energy recovery. As discrete activities, recycling and incineration are distinct from waste prevention. Every effort should be made to have a common understanding of terminology when discussing waste policy (Vancini 1997a). Terms should not be used loosely or interchangeably.

OECD Definition of *Waste Minimisation:*
"*Preventing and/or reducing the generation of waste at the source; improving the quality of waste generated, such as reducing the hazard, and encouraging re-use, recycling, and recovery."*

OECD Definition of *Recycling:*
"Using waste materials in manufacturing other products of an identical or similar nature."
Examples of recycling include industrial melting of one-way glass bottles for use in new bottles; recycling of collected newspapers for production of sanitary paper products; aerobic or anaerobic treatment of separately collected organic household waste to produce agricultural soil.

Figure 3-1. Waste Prevention in Context



Source: Stutz 1999a.

* The arrow in Figure 3-1 represents the fact that, in different countries, the incineration of waste is sometimes considered waste minimisation. While some countries require energy recovery for incineration to be considered waste minimisation, others classify incineration as waste minimisation even with no energy recovery. On the other hand, many countries never consider incineration to be a waste minimisation method, even if energy is recovered (OECD 1998a).

3.1.1 Strict avoidance

OECD Definition
Strict Avoidance involves the *complete* prevention of waste generation by virtual elimination of hazardous substances or by reducing material or energy intensity in production, consumption, and distribution.

Examples of strict avoidance include those that address:

- Hazard, such as:

Avoiding and/or substituting materials that are hazardous to humans or to the environment (e.g., through bans on PCBs and ozone-depleting substances, or virtual elimination of toxic organochlorines released in bleached pulp mill effluents).

- Quantity, such as:

Avoiding use of materials or stages of production/consumption (e.g., through eliminating interim packaging for cosmetics and toothpaste, or substitution of continuous casting for ingot casting at steelworks).

3.1.2 Reduction at source

OECD Definition
Reduction at source involves minimising use of toxic or harmful substances and/or minimising material or energy consumption.

Examples of reduction at source include those that address:

- Hazard, such as:

Reducing the use of harmful substances in products, in production and sales systems, and in consumption and disposal systems, and
Reducing the use of substances that hinder re-use or recycling (e.g. "Post-its" on paper, use of chlorinated solvents as cleansing agents).

- Quantity, such as:

Using smaller amounts of resources to provide the same product or service (e.g. reducing foil thickness, introducing re-use or refill systems, miniaturisation, resource-orientated purchasing and consumption); and using less resource-dependent construction principles and materials.

3.1.3 Product re-use

OECD Definition
Product re-use involves the multiple use of a product in its original form, for its original purpose or for an alternative, with or without reconditioning.

Examples of product re-use include those that address:

- Re-use after reconditioning, such as:

Refilling glass or plastic bottles after washing, and
Using empty adhesive barrels as oil barrels after reconditioning.

- Re-use without reconditioning, such as:

Using shopping bags more than once.

3.2 Characteristics of waste prevention

While it is important to include waste prevention as the preferred first step in waste policy, it is also necessary to recognise that it differs significantly from the other waste-related activities:

– Waste prevention occurs before products or materials are identified or recognised as waste.

– Waste prevention is potentially diverse in its *effects* on materials and products. It may impact the quantity, hazard, and energy content of materials and products that may become waste.

- Waste prevention is also defined by changes, such as avoiding, reducing, or reusing materials. In general, it can be more difficult to implement and measure these types of activities than more traditional waste management activities. Often, the activities that can bring about significant levels of waste prevention-such as product re-design and use-are not directly within the purview of the waste manager (Schall 1992).

- When addressing waste prevention, governments often lack basic data used to monitor waste management activities.

All these factors need to be taken into account when developing waste prevention programmes (Stutz 1999c). Along with other factors, those noted above pose new challenges for assessing waste prevention programmes (see section 4.5) relative to more traditional waste-policy programmes.

3.3 Environmental benefits of WP

Waste prevention can produce environmental benefits throughout product life cycles. Most directly, preventing the generation of waste reduces the need for further investments and energy use to collect, store, process and dispose of what would have been waste. This translates into fewer collection vehicles with their related air pollution and, similarly, a reduced need for storage space, processing and disposal with the associated environmental releases.

While communities and companies can save money via waste prevention, the benefits to be gained from waste prevention will also often be manifested upstream. For example, the re-use of plastic cups not only reduces their discard into the municipal waste stream, it also reduces plastic consumption and therefore the need for plastic distribution, and ultimately plastic production (and oil extraction). Therefore, externalities associated with each link in the plastic chain are also reduced. This may be generalised as a cascading relationship: waste prevention → modified consumption → modified production → reduced pollution and waste generation throughout product life cycles.

Research on waste prevention suggests that the upstream environmental impacts that may be avoided through the cascading effect of waste prevention are even larger than those arising in a solid waste management system with state of the art controls (Lifset 1999, USEPA 1998, Schall 1992). These analyses do not include a number of other interesting environmental benefits that may also arise from waste prevention. For instance, the fact that waste-derived methane is a noteworthy contributor to global warming demonstrates that waste prevention can also support the mitigation of global challenges such as climate change. Taking into account the "hidden flows" mobilised during resources extraction activities (see sections 2.2, 7.5, 7.6), the overall environmental benefits to be gained from waste prevention are even further augmented.

As the World Resources Institute notes, "such questions [about hidden flows] arise not from a fear of resource scarcity but rather from concern about the environmental consequences of resource extraction and use" (WRI *et al* 1997). This is congruent with growing concerns about the impact of human activities on the capacity of the natural environment to provide and maintain the ecosystem services that underpin economic activities (Daily 1997, Ayres 1992).

3.4 Experience with WP

The concept of waste prevention is not entirely new; neither is the practice. In the chemical industry the idea goes back 100 years when prevention was called "yield improvement" (CMA 1999b) i.e., making

more product with the same amount of raw material. In 1988 the Chemical Manufacturers Association adopted Responsible Care, an industry-wide initiative to improve health, safety, and environmental performance. Waste prevention as an imperative was integrated in its Codes of Management Practice.

At company level, waste prevention will normally result in the avoidance or reduction of costs associated with waste generation. These include but are not limited to:

- *Treatment and disposal costs*. The costs for managing wastes, which can range from treatment technology to landfill fees, are generally on the rise throughout the OECD area and thus represent significant avoided cost potential.

- *Raw material costs.* The generation of waste requires the consumption of raw materials upstream.

- *Labour and energy costs.* By the time raw materials become wastes, significant manpower and energy may have been used in transporting, handling, and processing it. Moreover, manpower and energy are needed to collect, process, and dispose of waste once generated (EDCO 1999).

It is indisputable that industry reduces wastes primarily to reduce costs, such as those just noted. Historically, however, waste prevention has been a by-product, not a focus, of altered industrial processes and activities (OTA 1986). Apart from some exceptions (e.g., landfill restrictions and bans), waste management costs have rarely been so high as to suggest alternatives.

WASTE PREVENTION AND HUMAN BEHAVIOUR

- Waste prevention in its most basic sense is an old behaviour pattern. Any culture concerned with survival in an environment of limited resources would be required to use materials in a frugal manner (Kaplan and Kaplan 1982). This meant repairing a damaged item rather than creating a new one, saving used materials for re-use, and producing objects and utensils that maximised efficient use of limited raw materials. To call waste prevention 'new' is to overlook basic adaptive traits of the human species.

- Still, in the context of current Western culture, waste prevention does present a radical departure from society's way of manipulating materials. The practice of producing the same product with far less materials, keeping toxic materials out, and simply consuming less, are not commonplace in Western government and industry, nor in the minds of many people (De Young et al 1993).

Outside factors that may trigger an increased likelihood of firm-level waste preventive actions include pressure from stakeholders, insurance inspections, citations for building code infractions, and fluctuations/ uncertainties in recycling markets (CCE 1999). Waste prevention actions can also be spurred by financial institutions requiring, *inter alia*, demonstrated commitment to waste prevention as a basis for judging the merits of borrowers. In general, to date many industries have taken practical actions to reduce wastes not so much as an environmental imperative, but as an economic and legal one.

Box 3-1
SUCCESS STORIES: SPREADING THE WORD

One way for governments to promote waste prevention is by spreading the word about the many success stories that exist. Two examples are provided here:

- An annual waste reduction contest among the employees at the Louisiana Division of the Dow Chemical Company has been held for many years. This contest has continued to find **"*significant, highly cost effective*"** energy and material-savings projects each year, ***"implying that even well-managed firms do not automatically optimise their use of resources***." The additional efficiencies squeezed out of the firm's plants suggest that great potential exists to improve the efficiency of the industrial sector, if imaginative leadership is provided, and if organisational and other internal barriers are overcome (Nelson 1994).

- The experience from 150 manufacturing companies in Poland, representing more than 20 branches of industry, is that *a "**20-40% reduction of wastes is possible with nil or minor investment**"* (where investment is required, there is usually no need for external financing, and the payback period is often within a few weeks or months). A further 30% reduction is possible through investments in technically proven and profitable equipment or process changes (OECD/CCET 1995).

Today, it is increasingly realised that waste prevention is only one component of good industrial and organisational management. Large firms with good management capabilities will normally take advantage of waste prevention clearinghouse information and make a special effort to leverage the benefits of voluntary approaches to the extent they can, but only as long as there is a clear incentive for them to do so. Incentives may comprise a mix of direct financial pressures and longer-term concerns about competitiveness, reputation, and market position (Hanrahan 1995). Waste prevention in industry is of course subject to the same financial pressures as other cost reduction endeavours: firms will tend to invest first in those projects that have the greatest payoff per dollar spent. As a result, some prevention projects with a positive payoff may nonetheless languish within corporations if more lucrative use of scarce capital exists (Boyd 1998).

Within industry, small and medium sized enterprises (SMEs) have experienced, and continue to experience, particular difficulties in systematically integrating waste prevention and other environmental actions into their overall management practices-largely as a consequence of their general lack of time, expertise, and money. Since SMEs account for over 95% of firms in the OECD area, their contribution to overall waste prevention must not be overlooked.

Table 3-1. Strengths and weaknesses of waste prevention at the municipal level

Strengths	Weaknesses
• Avoids unnecessary waste collection, processing, storage, and disposal • Offers significant potential for diverting materials from landfill • Avoids some need for secondary materials market Development • Contributes to greenhouse gas mitigation • Saves money and conserves natural resources • Involves actions at national, regional, and local levels	• Its contribution to waste diversion (relative to recycling) is difficult to assess • Public familiarity with specific actions is limited • Full cost-benefit analysis is complex • National and sub-national policy still evolving • Experience at the municipal level still limited • Environmental benefits may accrue primarily at production sites rather than in local waste management system

Source: adapted from NRTEE 1991.

3.5 WP in conventional waste policy

Most OECD governments have instituted, to varying degrees, waste programmes that directly or indirectly foster waste prevention (OECD 1998). However, the majority of these programmes are young, and thus experience with their implementation is rather limited.

In some countries-e.g., Netherlands, and New Zealand-there are no separate central laws focussing on waste (OECD 1998). Waste policy actions are taken pursuant to the framework provided by integrated national environmental laws. For most OECD countries, however, when programmes to *specifically* promote waste prevention have been used, they have tended, more often than not, to be cast within a national waste *management* policy framework. As can be inferred from Figure 3-1 above, waste management policy encompasses all actions contributing to: (a) overall waste minimisation (including recycling), and (b) waste disposal, including treatment and landfilling.

Box 3-2
POLLUTION PREVENTION AND WASTE PREVENTION

There exists a range of government environmental programmes outside the "waste policy" arena that will tend to also influence waste prevention. Broad government programmes aiming for "pollution prevention" or "cleaner production" can be useful in this regard. While such programmes may make use of tools that promote relative (per unit output) reductions in waste generation, absolute waste reductions may not always be achieved. For example, in some countries aggregate waste generation reported under PRTRs (pollutant release and transfer registers-often hailed as a broader prevention-promoting approach) increased by 6% from 1991 to 1995 (Greer and Van Loben Sels 1997).

In general, no individual pollution prevention or waste prevention tool is likely to promote an absolute reduction in waste without the aid of complementary tools and approaches (Vancini 1997a). Depending on the context, economic instruments-such as resource taxes and household user fees combined with landfill taxes-may be particularly useful for inducing overarching waste prevention effects across material and waste streams.

3.6 Implementing WP

3.6.1 Applying WP to different materials, products and industries

In practice, waste prevention will not have the same potential for all products or material streams. Taking packaging as an example, an overly rigid emphasis on certain forms of prevention may not be appropriate, given the important role that packaging plays in reducing food spoilage and product breakage.

Table 3-2 below provides further insights into the material- and product-based applicability of waste prevention versus other options. It considers substances that have, and have not, entered the marketplace. The table could be elaborated for domestic purposes to provide an overview of certain material and product policy concerns, and could help to strategically focus attention on where immediate prevention opportunities exist.

Table 3-2. Indicative application of prevention versus other approaches

MATERIALS or PRODUCTS examples only	RECYCLE Return/send to market place	COMPOST (1) Return to environment	PREVENTION Reduce use, Substitute, Optimise
. . . THAT *HAVE* ENTERED THE MARKETPLACE			
Household & industrial cleaners - hazardous character			Y / use non-hazardous
Household & industrial cleaners - non-hazardous character	Y		Y / reduce use
Food waste		Y	
Post-consumer wood products - treated with chemicals			Y / untreated wood
Post-consumer wood products - untreated	Y	Y	
Non-rechargeable batteries			Y / substitute
Rechargeable batteries	Y		Y / recharge by consumer
Glass	Y		Y / optimise thickness
Scrap Metal	Y		Y / optimise use
Asbestos			Y / substitute
Used tires	Y		Y/optimise durability
. . . THAT HAVE *NOT* ENTERED THE MARKETPLACE			
Harvesting / mining wastes	Y(2)		Y/optimise activities
Yard trimmings - chemically treated			Y/untreated yard waste
Yard trimmings - untreated	Y	Y	Y
Genetic material (i.e., bio-diversity) (3)			Y / optimise use
Sewage waste - non-hazardous	Y	Y	

Source: OECD, in consultation with Expert Group on Waste Minimisation.

(1) In some countries, at-home or on-site composting is considered waste prevention because the materials did not yet "reach the curb" (meaning they did not yet become a "waste"). A consensus guidance document for distinguishing waste from non-waste has been developed by OECD (1998e).
(2) There are increasing examples of using harvesting residues as a raw material-wheat straw used to manufacture medium density cardboard (MDB), various types of agricultural residues used to make paper. Some forms of mining waste may also be recycled, e.g., for road construction purposes.
(3) In a certain sense, this category is incommensurate with others since genetic material is valued for its informational rather than physical content (Lifset 2000). However, the importance of bio-diversity suggests that, for example, certain types of resource use or land management approaches could result not only in wasted physical materials, but also wasted (lost) bio-informational materials.

3.6.2 Relationships between waste prevention and recycling activities

Chapter 2 noted that recycling activities are, in general, increasing; but so are waste amounts. The potential contribution of waste prevention to overall waste minimisation has not been realised. While prevention will never make recycling obsolete, the application of both prevention and recycling will generally have a greater influence on overall waste reduction than the singular application of one or the other. For this reason it seems necessary to understand some of the links and differences between prevention and recycling (see text box in section 3.1 for OECD definition of recycling).

Links include:

- The contribution of prevention to overall waste minimisation (and diversion from landfill) is currently more difficult to measure than the contribution of recycling activities.

- High rates of prevention could result in less materials available for recycling.

- Both recycling and prevention contribute to economy-wide waste minimisation. Therefore, reduced recycling rates may *not* necessarily be cause for worry if prevention rates increase enough to more than make up for reduced recycling.

- Recycling, a highly visible activity, is particularly well established for metals, glass, and paper. It does not appear, however, that prevention is disproportionately well-established for any particular material type (with the exception of highly toxic and dangerous substances, which are often banned, and hence strictly avoided).

- Depending on the circumstances, the potential increase in the value of recyclable "waste" (as through so-called material exchanges) may act as a disincentive to waste prevention. However, by encouraging the use of secondary materials, materials exchanges often displace virgin materials.

- The applicability of recycling, prevention or other options requires that close attention be given to the specific characteristics of industries, materials, and products.

- Certain activities for prevention via light-weighting or material substitution may influence the recylability of products in a negative way, if not taken into account up front during product design.

- In some cases, waste prevention programmes at the national or sub-national level have used pre-existing recycling programmes as an institutional home for launching the prevention initiatives.

Box 3-3
INTEGRATING WASTE PREVENTION AND RECYCLING
A practical example

OECD countries generally agree that the best way to use less resources and minimise waste generation is first to prevent wastes, and then to recycle. If that is not practical, then the specific contextual factors need to be taken into consideration. In all cases, the goal is to use raw materials as efficiently as possible and to reduce waste in the process. An example can demonstrate how to integrate prevention with recycling for a better overall result (SRF 1997).

Considering office paper, it can be double sided-a waste prevention technique-or it can be recycled. A 10-page report could be double-sided on 5 sheets of paper, or single-sided copied on 10 sheets. Assuming that the average recycling rate for office paper is 40%, here is how the options compare:

	METHOD	Sheets Used	Sheets Recycled	Sheets Disposed	
1.	Recycle only (40% rate of 10 sheets, single sided copied)	10	4	6	
2.	Waste prevention only (double side copied)	5	0	5	
3.	Waste prevention ***and*** recycling (40% of 5 sheets)	5	2	3	←

The best method in this example is an integration of waste prevention with recycling.

Box 3-4
SYSTEM LEVEL EVALUATION OF WASTE PREVENTION

While waste prevention can be evaluated in terms of its relation to discrete activities such as recycling, it is also possible to undertake integrated assessment at the system level. The tangible effects of waste prevention are likely to affect various waste streams differently. This in turn means that the components of the solid waste system will be affected differentially. Put more simply, while some waste prevention may occur at the expense of recycling, other prevention will reduce the waste destined for incineration or landfill. Similarly, some waste prevention will reduce the need for collection (conventional and/or recycling), others not. Collection impacts are likely to be non-linear, that is, there will be no change in the need to send out waste collection trucks until waste prevention activities reach some threshold level. The implication is that both the benefits and the costs of waste prevention will be non-linear, and thus the use of metrics (i.e., ratios) may often be misleading because they imply that costs and benefits change linearly with reductions in waste generated.

The most direct way to deal with this difficulty is to model two (or more) versions of the system in question: the system with waste prevention in effect and the system without it in effect, and then compare the costs and benefits *for the systems as a whole.* This will capture interactive effects between, for example, waste prevention and recycling.

Obviously, systems level modelling is expensive and time consuming; however, it needs to be mentioned as a benchmark for good evaluation and decision making. Systems level modelling that captures not only solid waste management system level effects but also upstream effects (in production and resource extraction) are much more complicated, requiring rather elaborate modelling efforts. However, such modelling efforts are often the source of crucial insights for waste policy.

Source: Lifset 2000.

A fairly common problem that governments face is confusion about the **distinction** between waste prevention and recycling. This tends to be a special challenge at the consumer and household level. Certain market conditions may exacerbate this situation. For example, product environmental ratings (such as eco-labels) are not able to distinguish between degrees of overall resource efficiency associated with different products-and thus may hinder efforts to promote waste prevention as a preferable alternative to

recycling. In general, consumers need not only to have a variety of product choices that strengthen waste prevention, they also need to understand the meaning of waste prevention.

The following points may be useful when communicating the differences between prevention and recycling, possibly as part of an education/information campaign:

- While the recycling of substances ("secondary materials") will help avoid the need to extract comparable primary materials, recycling requires that the substances be collected, transported, and treated before re-utilisation. Energy is required for all these activities.

- Since recycling is itself a manufacturing process, it will be associated with its own residual wastes.

- In contrast, waste prevention requires little or considerably less transportation, processing, and energy use.

- Waste prevention can in many cases offer an inexpensive way of realising significant ancillary environmental benefits, such as mitigation of greenhouse gases.

Additional distinctions can also be pointed to. For example, enthusiastic consumer recycling behaviour does not necessarily entail a change in consumption patterns, whereas waste preventing behaviour often will (De Young *et al* 1991). Governments may use any of a series of non-technical, creative phrases for capturing the spirit of prevention (e.g., "prevention is the key to your intervention!"). Waste prevention could also be communicated as "*pre*-cycling" (as done in Berkeley, California), in order to help consumers and households understand that prevention happens before recycling.

3.7 Toward strategic waste prevention (WP)

3.7.1 Features of strategic WP

Traditional waste policy approaches have not always been crafted with the explicit intention of avoiding cross-media transfers, or of mitigating linked or secondary hazards and risks, be they of an ecological, economic, human health, or social character. In other words, the approaches have not always been comprehensive or sustainable. Even when effective in attaining their own specific objectives, conventional policy approaches have not been adequate to reduce the overall increase in waste generation. Moreover, as alluded to in Chapter 2, notwithstanding progress in *relative* waste prevention, increases in consumption (from growth in affluence and population) has translated into growth in *absolute* waste quantities. The practical implication of this is that large increases in absolute waste amounts are possible *even with* considerable success in relative waste prevention, such as might be obtained with cleaner production or eco-efficiency initiatives.

Given the above observations, a more comprehensive, *strategic* approach to waste prevention would work toward reductions in absolute waste amounts, hazards and risks while attempting to continuously improve at least four factors over time:

a) A life-cycle perspective for identifying the policy intervention points linked with the highest waste preventing effects and system-wide environmental benefits. This would include attention to the fact that downstream waste prevention interventions can have upstream benefits, and vice-versa. Life-cycle waste prevention and overall environmental protection is likely to be further supported by the growing trend toward *product-oriented policies* (and,

as a consequence, the analogous trend away from a singular focus on facility-oriented policies);

b) A material-differentiated approach that links different types of waste prevention targets, instruments, and performance evaluation approaches to different types and classes of material flows;

c) The substantive integration of social and economic aspects into environmental policy discussions on waste prevention. Methods toward this end are wide-ranging and can include increased integration of waste prevention policies with sectoral policies (e.g. mining, energy, and agriculture), and increased stakeholder consultation during programme design to assure "policy ownership"; and

d) Institutional mechanisms that facilitate co-operation across traditional institutional structures (Cleland-Hamnett and Retzer 1993) such that greater waste prevention and overall policy synergy are induced.

These "features" of strategic waste prevention reflect a summary listing of what seem to be the most noteworthy aspects that help assure waste prevention's role in contributing to long-term sustainable development. A fuller conceptual breakdown of strategic waste prevention is considered in section 3.7.3. Different countries will likely place differential importance on the various elements of strategic waste prevention.

Subsequent chapters in this Reference Manual demonstrate how strategic waste prevention can be operationalised according to recognised policy processes such as target setting, instrument choice and implementation, and performance evaluation (see chapters 5, 6, and 7 respectively). For instance, a waste prevention target for a major waste stream may be established several years ahead of its intended data of attainment in order to allow all relevant actors to organise themselves to meet the target; such waste prevention target setting approaches could be undertaken as part of or along side the more general environmental and sustainability planning that is common in many OECD countries (DCLTEP 1994, Janicke and Jorgens 1998).

As desirable as strategic waste prevention might sound, it will be of little value unless it can be put into practice. To be workable, it would seem that approaches toward strategic waste prevention need to: (1) reflect long-term objectives that are compatible with short-to-middle term actions; (2) narrow down practical actions to those embodying the greatest waste prevention opportunities; and (3) provide sufficient benefit for the cost of implementation.

Box 3-5
SOCIO-CULTURAL FACTORS AND WASTE PREVENTION PROGRAMMES

Country-specific factors will influence the process of (1) how strategic waste prevention targets are selected and (2) how instruments are chosen and applied. In his consideration of waste minimisation from a socio-cultural perspective, Bertolini (1996) devised a classification of cultures. Such a classification, while somewhat simplifying reality, could be useful when comparing waste prevention programmes in different countries. Four cultural categories are distinguished:

- A culture of "government by consensus" which is characterised by good Government-Industry relations, and in which advice, consultation, and persuasion are the preferred instruments.
- A "non-interventionist"/"liberal" culture, also characterised by good Government-Industry relations, which favours consultation and voluntary agreements as well as the use of economic instruments.
- An "adversarial culture" in which openly declared conflicting interests and positions have to be settled by a process of political arbitration, which will tend to result in legal and regulatory instruments. However, this does not exclude a basically liberal element and hence the use of some economic instruments.
- A culture of "planning and programming" (after due consideration of all points of view and the balance of power, even in a "corporatist" culture context) will opt for legal and regulatory approaches.

The deployment of strategic waste prevention policies by government is likely to face some *practical constraints*, including: (1) available resources (funding, personnel, expertise, information) for evaluating, instituting and carrying out the approaches; and (2) willingness of key players to get involved in more strategically oriented waste prevention efforts that may necessitate increasingly horizontal co-operation. The articulation of clear support at the highest levels of government will help overcome such barriers.

Over time, the attainment of strategic waste prevention would likely require the creation of new structures and the judicious transformation of others. This will, in the first instance, necessitate dedicated political initiatives, followed by carefully planned, stepwise actions.

Box 3-6
EVOLVING PERSPECTIVES ON WASTE PREVENTION

"*The initial aim of waste prevention and similar programmes was to introduce "cleaner technologies". Gradually, the need to incorporate also the notion of improved environmental management systems, and a variety of eco-tools and instruments was realised. 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 household and industrial) more sustainable. Simultaneous with this wider vision of prevention programmes came the realisation that the* ***actors have changed****. In remediation and clean-up programmes, environmental specialists were the key players. But preventive actions occur earlier in the life-cycle of a process, and we now understand better the 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 waste prevention approaches."* (emphasis added).

Source: Balkau 1999.

Box 3-7
WASTE PREVENTION AS A TRANSFORMATION PROCES: VIEW FROM THE NETHERLANDS

"Waste prevention differs substantially from conventional waste policies. Conventional waste management focuses on technological improvements in combination with financial-economic considerations. Waste prevention is concerned with a process of social change, which requires a change in behaviour and attitudes from government institutions, enterprises and citizens [for a related discussion of social dimensions of waste prevention, see section 7.5.3 and table 7.1 in this Reference Manual]. *While technical solutions certainly may enhance waste prevention within enterprises, more structural approaches are necessary to significantly minimise environmental effects of current production and consumption levels. Such approaches comprise changes in products, industrial processes (chain management) and systems (the Internet is an example of a system innovation). Resistance to these changes can be very strong at all levels. Important points to consider, therefore, are the following: a concerted effort from all stakeholders involved; government institutions with clear objectives; a programmatic approach that is structured but flexible; political support at the highest level; policy instruments to stimulate innovation and creativity."*

Source: Ouwens 1999.

3.7.2 Links to other concepts

Governmental authorities with responsibility for waste prevention programmes need to be conversant with a range of concepts that relate to waste prevention. These include, but are not limited to, eco-efficiency/cleaner production, industrial ecology, integrated pollution prevention and control, extended producer responsibility, and integrated product policy (Box 3-8).

The core or **principal commonality** between strategic waste prevention and the concepts in Box 3-8 is the emphasis on taking measures to reduce the life-cycle environmental impacts from economic activities, and hence to reduce the need for expensive clean-up technologies, disposal facilities, and environmental remediation. Moreover, while all the concepts rely to a certain extent on "known" ways of doing things (or at least on "known" ways of how things "should" be done), most seek to promote a fundamentally improved scale of change compared to more traditional environmental policy concepts.

Box 3-8
FIVE POLICY CONCEPTS SUPPORTING STRATEGIC WASTE PREVENTION

There are several evolving policy concepts that complement and (potentially) help drive strategic waste prevention. Here is a sampling:

Eco-efficiency (E2). Seven criteria for eco-efficiency are*: "(a) minimise the material intensity of goods and services, (b) minimise the energy intensity of goods and services, (c) minimise toxic dispersion, (d) enhance material recyclability, (e) maximise the use of renewable resources, (f) extend product durability,* and *(g) increase the service intensity of goods and services*" (World Business Council for Sustainable Development 1995). These ideas are not new, but eco-efficiency attempts to combine them in a way that promotes factor level improvements in value creation with minimal resource use and pollution and waste, and as an aid to communication between governments, business, and others. Eco-efficiency is sometimes used interchangeably with *Cleaner Production.*

Industrial Ecology (IE). A field that "*...systematically examines local, regional and global uses and flows of materials, and energy in products, processes, industrial sectors, and economies. It focuses on the potential role of industry in reducing environmental burdens throughout the product life-cycle." (Journal of Industrial Ecology 1997). IE exploits the ecology analogy by placing industrial activity in its environmental context and by drawing on nature as a model. One of the most important goals of IE is to make one industry's waste another's raw material-something that can be realised in many ways, such as through eco-industrial parks (e.g. in Kalundborg in Denmark (Frosch 1994), or as a response to the Zero Emissions Research Initiative in Japan (Suzuki 1997)).*

Integrated Pollution Prevention and Control (IPPC). *"IPPC is a method to take into account all environmental media simultaneously when attempting to reduce natural resource and energy use, exposure to hazardous substances and releases of pollutants by economic activities. Therefore, IPPC promotes the concept of economic progress with reduced consumption and pollution. To date, implementation of IPPC has usually been associated with the firm-level adoption of so-called integrated permits." (OECD 1996b)*

Extended Producer Responsibility (EPR). *An approach where the producers' physical and/or financial responsibility for a product is extended to the post-consumer (waste) stage of a product's life-cycle. Producers accept their responsibility when they design their products to minimise life-cycle impacts and when they accept legal, physical and/or economic responsibility for the environmental impacts that cannot be eliminated by design (OECD).*

Integrated Product Policy (IPP). Five IPP 'building blocks' include: *"(a) measures aimed at reducing and managing wastes generated by the consumption of products, (b) measures targeted at the innovation of more environmentally friendly products, (c) measures to create markets for environmentally sound products, (d) measures for transmitting information up and down the product chain, (e) measures which allocate responsibility for managing the environmental burdens of product systems" (European Commission 1998).*

In environmental terms, the most important **difference** between strategic waste prevention and other concepts is the **ultimate focus.** Strategic waste prevention squarely concentrates on reducing waste generation amounts and/or hazards while concurrently avoiding the transfer of problems to other environmental media, other material stages, or other points in time. Another distinction is that many of the concepts noted in Box 3-8 have been applied most tangibly at the firm or organisational level (IPPC, E2, IE), whereas waste prevention strategies (as well as IPP and EPR) *inherently* engage multiple actors, including consumers.

The fact that waste prevention occurs before materials and products are tracked and identified as wastes means that waste prevention may overlap with concepts that deal more directly with natural resource management. The fact that waste prevention is diverse in focus, and potentially addresses also energy content of materials, suggests a link to approaches that more concretely encompass energy efficiency (Geller 1981) and greenhouse gas mitigation.

Efforts to work at the **interface** of waste policy and the concepts noted in Box 3-8 are worthy of exploration. For example, with respect to EPR, the Netherlands pioneered the notion that the EPR principle can service as the *bridge* between product policy and waste policy-a perspective with clear links to strategic waste prevention and integrated product policy. Some observers have noted that when speaking of waste prevention, one almost automatically gets into matters of product policy (Kraemer 1999).

The optimisation of infrastructure (De Smets and Stalman 1995) may be a **shared challenge** for all the concepts**,** though to varying degrees. Even though all the concepts rely on some form of material- or product-based "life-cycle thinking", it is not immediately apparent how any of the concepts would specifically address the infrastructure-material "stock" providing e.g., electrical power, transport needs, processing chemicals-that is *shared* between the life-cycles of different materials and products. In preliminary and conceptual terms industrial ecology, strategic waste prevention, and eco-efficiency *may* offer more scope for taking the infrastructure aspect into account, though this is an issue that would seem to require further study.

3.7.3 Conceptual framework

As the previous section makes clear, strategic waste prevention is multi-faceted, having links to and being driven by the application of other evolving concepts. Strategic waste prevention requires the type of thinking that has not always characterised traditional waste policy programmes in many countries, localities, or organisations.

In terms of *What* strategic prevention may apply to, *How* it can be approached, *Who* could be involved, and other considerations, the following conceptual framework is offered (Figure 3-2).

Figure 3-2*

STRATEGIC WASTE PREVENTION
OECD Conceptual Framework

What ? **(physical scope options)**	***How ?*** **(possible approaches)**	***When ?*** **(policy programme aspects)**	***Who ?*** **(actors/stakeholders)**
Macro-level: Material inputs, and material outputs Product-based Material class-based Waste stream-based (municipal, industrial, commercial, hazardous)	Institutional arrangements Legal/voluntary/economic Knowledge creation (e.g., R&D) Participatory consultation Multi-factor assessments - economic, social, environmental Gov't resource mgmt. activities - e.g., procurement decisions Broader context: public policy reform	Strategic target setting Instrument choice & application Performance evaluation Programme and policy adjustment Other	National govt. Regional / local govt. Private sector (inc.waste mgmt. industry) Consumers Media Financial institutions Academia

Additionally, ***Where ?*** refers to the geographic or organisational scope to which a waste prevention programme is applicable: economy-wide, sector-level, firm-based, municipal-level, household-level. ***Why ?*** refers to the objective of attaining some or all of the benefits potentially associated with an envisaged or existing waste prevention programme.

* *Nota Bene:* The structure of Figure 3-2 is not meant to suggest that horizontal (row-by-row) inferences be drawn.

3.7.4 What path to strategic waste prevention?

The paths that countries may take toward the realisation of increasingly strategic waste prevention will be highly dependent on domestic factors, such as socio-cultural considerations (Box 3-5), structure of industry, nature of environment-technology interactions (Annex 2), level of industrialisation, perceived urgency of the waste problems, and others concerns.

> *"The secret to achieving … changes is to find the small step which is at the same time a strategic step because it will entail further steps toward a better reality. It is no use, therefore, to ridicule the imperfections of today's reality and to preach the ideal as the goal of our every-day life…"*
>
> -Gustav Heinemann 1969.

Are there, nevertheless, some avenues that might be explored for their general applicability and potential capacity to lead countries to the reduction of absolute waste amounts and related threats? Taking the need to engage industry as an example, one can identify core elements that may form part of a **concrete policy approach** to strategic waste prevention. Jansen (1998) has considered a phased policy process aiming to enhance the capabilities and planning horizons that business is accustomed to. His discussion was in the context of de-materialisation, but it may be adapted to strategic waste prevention.

It might be proposed that in designing an evolutionary approach toward strategic waste prevention, it is necessary to work along concurrent tracks, with various time-scales that realistically take into account shifting priorities and constraints over time:

- **Track 1 - "Care"**

  Promoting good housekeeping in industry corresponding to operational processes such as quality management, planning, maintenance, auditing, efficiency drives, etc, with time scales of 5 to 10 years.

- **Track 2 - "Adaptation and Improvement"**

  Leaving basic structures and technologies unchanged but, implementing incremental improvements with time scales from 5 to 20 years.

- **Track 3 - "Renewal"**

  Devising institutional and other mechanisms for achieving more fundamental "leap-frog" waste prevention improvements-with time scales of over 20 years-resulting from long-term research and thus more fundamentally affecting industrial structure, consumption patterns, technology, and ultimately the scale of materials extraction and use.

Notwithstanding the varying time scales for attaining results, it requires emphasis that progress in all three tracks can start now and that all three tracks entail vigorous attention. Moreover, each of these tracks could be coupled with quantitative *targets* as a function of time on the route toward increasingly significant waste prevention.

CHAPTER 4

WASTE PREVENTION (WP) PROGRAMMES

4.1 Basic definition of a WP programme

A "waste prevention programme" consists of a set of organised activities with a specific time schedule and budget to put waste prevention policies into action. A waste prevention programme would create conditions to reduce waste generation and ultimately to contribute to (environmental) sustainability goals.

Programmes for waste prevention may take different forms. They may draw from a wide range of instruments, target many different types of waste generators, and may or may not include quantitative reduction goals. Moreover, different national, regional and/or local waste prevention programmes can be created to explicitly complement each other, though in practice such co-ordination remains largely elusive.

4.2 Role of prioritisation

Government waste prevention efforts would ideally be cast within broader national plans for environmental protection and sustainable development (Janicke and Jorgens 1998). However, broad plans will not always be specific enough to guide the development of waste prevention programmes. Prioritisation exercises will have an important role in such circumstances.

Prioritisation may be applied at two levels:

- ***Policy level:*** to establish the broad objectives for waste prevention (e.g., a product policy focus, a concern for certain classes of wastes such as those of a persistent, bio-accumulative or toxic nature; an intent to institutionalise 'extended producer responsibility', as might be appropriate, across relevant industrial sectors).

- ***Programme level:*** for determining which specific material types, product categories or other issues shall be targeted by the programme(s), in order to maximise the benefits of programme resource allocation.

Criteria for WP prioritisation may incorporate the following considerations (OECD 1998):

(a) the increasing amount of waste generated;

(b) the increasing hazard of substances associated with production, products, and wastes to be disposed of;

(c) public pressure;

(d) the technical difficulty of recycling and disposal (and related costs);

(e) the availability of appropriate 'clean' technologies;

(f) equitable treatment of stakeholders;

(g) the improved recognition of overall environmental impact;

(h) other context-specific criteria and considerations.

The practical ranking and use of the above criteria will be highly dependent on the attendant circumstances. Moreover, their application and interpretation will depend on the level and availability of technical expertise. In addition, national or local risk-based preferences and perceptions-of the public and of the government-will tend to play an important role in determining how (and how carefully) an agency focuses its waste prevention programmes. For example, a concern for space availability will tend to put a premium on reducing bulky waste streams-such as construction, renovation and demolition wastes-going to final disposal. In a parallel fashion, an elevated concern about hazard dispersion may result in greater emphasis on products containing toxic substances.

Technical prioritisation systems for chemicals and waste minimisation in general have been the subject of several studies (U.S. EPA 1996).

4.3 Practical steps for planning and setting up a WP programme

When setting up a waste prevention programme the special characteristics of waste prevention itself (reviewed in section 3.2) must be kept in mind. Because of those characteristics, setting up a programme will be a bit different than setting up more traditional waste minimisation programmes, such as for recycling (SRF 1997). While the precise ordering and emphasis of each will vary, the steps to develop a successful waste prevention programme include:

- Having a national waste prevention policy plan with specific goals in place. A clear high level statement of policy is a good first strategic step in promoting waste prevention. Broad objectives may emphasise different themes (e.g., a product-policy focus; a concern for lowering material throughput). Setting specific goals-backed up by measurable, verifiable quantitative targets-with a clear plan to evaluate processes and impacts will help further spur waste prevention activities.
- Focussing on priorities and mapping out the programme. Determining the functional focus of the programme will rely on the application of context-specific prioritisation exercises. The practical design of the programme will also require that attention be given to the six ingredients of a waste prevention programme: 1) The particular instrument(s) chosen to

foster waste prevention, 2) Specific waste streams to be targeted, 3) Specific generators of concern, 4) Mandatory or voluntary quantitative objectives targets that are measurable, 5) Milestones and timeframes, 6) Means for evaluating performance.

- Getting Financial Incentives in Sync. It seems crucial to (attempt to) make sure that financial incentives created by other environmental and or government policies do not work at cross purposes with the goals of the waste prevention programme, e.g., paying local governments or private waste contractors according to the tonnage of recyclable material diverted from landfills.

- Securing Expertise and Manpower. Hiring new personnel for the programme may not always be possible. It may help to look into the feasibility of allocating responsibilities to existing staff dealing with recycling, cleaner production, or other waste-related programmes. This could help leverage existing contacts and expertise. At the local level, community volunteers may be helpful to assist with information dissemination and other public relations activities.

- Identifying Budgetary Resources. National governments may fund waste prevention programmes in a variety of ways, such as through general funds or environmental taxes. Municipal and local governments have additional possibilities, such as disposal tipping fees, budget transfers from federal or state government.

- Informing, Educating, and Gaining Support. A focussed and comprehensive information campaign/education programme will be critical to the success of any waste prevention effort. An information clearinghouse, Web pages, hotlines, or brochures with general and technical information could be quite useful. At the municipal and local level, government officials could reach out to residents and businesses through workshops, local newspapers, free videos, transit advertising (e.g. on trains, buses), and direct mail.

- Instituting Partnerships. Partnerships can be particularly useful for local and regional governments. This may involve formal internal agency or community-wide task forces, collaborating with other local agencies in the jurisdiction, and working with local business, universities and non-governmental organisations. Multi-level, national/regional/local government partnerships could also be forged to help assure that waste prevention activities at various geographic levels are mutually reinforcing to the extent possible.

- Delivering the Programme. Some national or municipal government bodies will launch a full-scale initiative when applying a programme. Others will start more slowly. In any case, it will be important not to overwhelm the targeted waste generators and other stakeholders all at once. A focussed message with clear milestones will be preferable. Part of programme delivery will include promoting accountability: 1) for efficient programme oversight within the government body, 2) for appropriate actions by lower level governments, where appropriate, and 3) by industry, consumers and other waste generators.

- Weaving in a Monitoring System. A well functioning monitoring system, will be fundamental to help underpin most of the efforts above. It will also be the basis for the eventual performance evaluation. As further detailed in Annex 4, waste prevention monitoring methods may include regular record keeping protocols, surveys and questionnaires, case studies, and participatory approaches.

4.4 Core operational components

Three key operational, *action-oriented* components of a waste prevention programme are:

(a) *Setting strategic targets*, to clearly identify an expected level of achievement according to an explicit schedule, possibly graduated according to short-, middle- and long-term targets.

(b) *Choosing and implementing instruments*, to determine and deliver the practical tools designed to help meet the objectives and targets of policies and programmes.

(c) *Evaluating performance*, to assess the extent to which objectives and targets have been attained.

A full description of each of these components is provided, respectively, in Chapters 5, 6 and 7.

4.4.1 Strategic target setting

The act of setting strategic targets allows governments to decide if waste prevention targets under consideration are likely to be sufficiently attractive to warrant the development of a comprehensive programme. Once established, publicising the targets will help clarify expectations for all relevant actors. Strategic target setting is further discussed in **Chapter 5.**

Box 4-1
EXAMPLES OF EXISTING WASTE PREVENTION TARGETS

- **Canada.** The National Packaging Protocol established specific milestone targets for the diversion of packaging waste from landfills, and provides that 50% of these diversions shall be achieved through new source reduction and new re-use initiatives. Relative diversion milestones are: 20% by 12/92, 35% by 12/96, and 50% by 12/2000 (CCCME 1998; NTP 1999).

- **Korea.** The Comprehensive Waste Treatment Plan of 1993, a voluntary programme, contains middle and long-term targets (1992-2001) for waste generation per capita. The plan includes a range of other targets, including those for technological development.

- **European Union.** The EU's 5th Environmental Action Programme states that the quantities of generated waste should be stabilised at EU average 1985 level.

- **Netherlands.** In the 1988 "Memorandum on Waste" targets were set for 29 priority waste streams, e.g., used oil, car wrecks, batteries, plastics, paper, construction and demolition waste. Targets aimed to reduce both hazards and amounts, 5% for the year 2000 in view of a 1986 baseline. In addition, the first two Dutch National Environmental Policy Plans (NEPP and NEPP 2) established quantitative targets for absolute waste prevention. NEPP 3, established in 1998 the objective that the amount of waste may not be more than 56 million tones per year by 2010 (Hermens and von Roemburg 1999).

- **United States.** The Waste Minimisation National Plan is a voluntary programme that has the major goals of reducing hazardous wastes. It focuses on reducing certain chemicals in wastes rather than the quantity of wastes as a whole The targets are to reduce the amount and toxicity of the most persistent, bio-accumulative and toxic constituents by 25% by 2000, and by 50% by 2005.

4.4.2 Instrument choice and implementation

Instruments are measures designed to help meet the objectives of policies and programmes. The act of choosing instruments could occur during or after targets are established. Instruments will normally be considered for their potential to help meet the targets, and based on how they compare to other selection criteria such as:

- environmental effectiveness;
- economic efficiency;
- innovative advancement;
- political acceptability; and
- ease of administration.

Multiple instruments may be used to target waste streams (Table 4-1). For instance, consider the objective of reducing household (HH) wastes. What types of instruments can governments use to help meet this objective? One approach might combine several instruments to try to reduce the municipal wastes that surface downstream: Raw Material Tax, Design for Environment (DFE), User Fees (pay-as-you-throw), and Deposit-Refund. Depending on the institutional context, the use of such instruments could fall under one broad 'waste prevention programme,' or may represent several smaller programmes. Instrument choice and application is further discussed in **Chapter 6.**

Table 4-1. Instruments Potentially Influencing Waste Prevention

REGULATORY	ECONOMIC	SUASIVE
Extended producer responsibility via product take-back (may also qualify as suasive)	User fees	Setting waste prevention targets
Liability assignment	Subsidy removal	Greener public procurement guidelines (may also qualify as regulatory)
Pollutant release and transfer registers (PRTRs, may also qualify as suasive)	Raw material charge	Design for Environment (DFE)
Disposal ban	Grants (R&D)	Technical assistance
Virgin material depletion quota	Deposit-refund	Education and information provision
Virgin material import ceilings	Landfill tax	Public-private partnerships for waste prevention
Facility standards/permits	Tax incentives	Corporate environmental reporting (may also qualify as regulatory)
	Advance treatment fee	Eco-labelling
	Material exchanges	Environmental Management Systems (EMS)

* *Nota Bene:* The structure of Table 4-1 is not meant to suggest that horizontal (row-by-row) inferences be drawn. **Table 6-2** provides further information on the noted instruments.

4.4.3 Performance evaluation

Evaluating results is also indispensable. Indicators and other tools for this task would ideally provide information on the practical implications of programme targets and the effects of the instruments that were chosen to help meet the targets. Though performance evaluation will likely centre on environmental results, a growing concern for sustainable development suggest that governments should be paying

increasing attention to the integration of economic and social aspects into waste prevention evaluation efforts. Performance evaluation is further discussed in **Chapter 7**.

4.5 Some basic issues in evaluating waste prevention performance

There are many reasons why the evaluation of waste prevention poses some new and interesting challenges to governments. For example, in addition to the special characteristics of waste prevention (section 3.2), experiences with waste prevention policies and programmes is much less developed than with traditional recycling and waste management activities.

Even once implemented, the environmental impacts of waste prevention activities will not be immediate. Government policies and programmes for waste prevention therefore need to be given a few years of operation to "mature" before their environmental results are evaluated. A range of drivers (population size, GDP, private consumption expenditure) may influence waste generation rates and it will therefore not always be possible to say that a particular waste prevention policy or programme was totally responsible for a given level of prevention of a specific waste stream. In general, most published experiences with waste prevention performance evaluation has focused on developing rather limited proxies that address particularistic-albeit important-concerns, such as avoided waste disposal costs for the public or private sectors.

OECD research to date has not revealed any waste prevention evaluation frameworks or methodologies that link to the three sustainable development pillars-environmental, economic and social performance. Chapter 7 will take a more detailed look at the challenges and opportunities in further developing waste prevention evaluation from a more integrated perspective.

Box 4-2.
MEASURING WASTE PREVENTION USING WASTE GENERATION DATA

Some points to keep in mind

Determining whether prevention has occurred for a particular waste stream can be accomplished with the aid of quantitative indicators derived in part from existing waste *generation* data (Stutz 1999b). However, when using waste generation data for estimating waste prevention performance or related purposes, certain caveats will apply (OTA 1986):

- Over time any waste generation data (national, regional, local, company level) will be subject to fluctuations in industrial activities, product mixes, and regulatory requirements (which determine what is counted as "waste" and "hazardous waste"); these factors can all strongly affect waste generation figures.
- Depending on the indicator chosen, increasing economic activity and production might mask waste prevention efforts that are occurring;
- Aggregated waste generation data which show a decline over time may result from a recession or from treatments that change waste volume, such as dewatering and waste stream separation, without any reduction in toxicity or level of hazard.

4.6 Potential for stakeholder input to government WP efforts

Government efforts in waste prevention may be boosted by seeking out perspectives from those stakeholders affected by or interested in waste prevention programmes. Stakeholders can provide input during target setting, instrument choice and application, and performance evaluation. As such, stakeholders can inject useful knowledge as governments undertake self-assessment of their waste prevention

programmes. However, the benefits to be derived from seeking the input of external agents should be *balanced against practical constraints* such as available time and resources.

The potential added value from different stakeholder groups to waste prevention programmes may be understood according to the following:

- Business and Industry.
  - expertise on practical implications of government waste prevention programmes;
  - perspective on firm and sector-level issues in implementing government waste prevention policies;
  - data on link between waste prevention and processes, products, investment, competitiveness, etc.
- Public-Interest Groups.
  - perspectives on concerns of civil society;
  - access to channels and networks for communicating with the public;
  - data on link between government waste prevention programmes and possible social impacts.
- Research Institutes / Academia.
  - know-how and expertise for modelling consequences of waste prevention programmes.
- Other National Government Agencies (e.g., for energy, natural resources, trade/industry) – national or sub-national.
  - perspectives on sector-based implications of the envisaged or proposed waste prevention programme;
  - unique insights on sectoral policy integration.
- Lower Level Environment Agencies, e.g., municipal.
  - perspective on environmental policy concerns and priorities;
  - understanding of operational requirements and constraints in implementing waste-related programmes;
  - ability to convene stakeholders at a more local level and arrive at common understanding of waste prevention initiatives.

PART II: CORE ACTIVITIES FOR SELF-ASSESSMENT

CHAPTER 5

STRATEGIC TARGET SETTING[1]

5.1 Introduction

Target setting has been a prominent feature of many efforts to promote environmental improvements. Perhaps the best known example of targeting involves the Kyoto protocol on climate change. In the traditional 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). It has already been noted, however, that, while support for waste prevention appears strong, it has proved somewhat difficult to devise effective ways to foster waste prevention in practice.

The fact that this Reference Manual discusses waste prevention target setting is not meant to imply that there is a single set of numerical 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, will vary by country and change over time. Preference for mandatory targets over negotiated or voluntary ones will also vary by country.

Strategic target setting, and the cost/benefit analysis it entails, provides a way for a government institution to decide if a possible waste prevention programme is likely to be sufficiently attractive from its perspective to warrant further consideration.

5.2 Value of waste prevention targets

There can be considerable value in setting waste prevention targets. Adopting waste prevention targets could:

- Make expectations and priorities for waste prevention-as applied to particular material/product streams-clear to relevant stakeholders.

- Promote the development of baseline data that will assist with the monitoring and evaluation of progress (or lack of it) toward the targets.

- Enhance the visibility and status of waste prevention generally.

1. This chapter draws on the contributions of John Stutz, (Tellus Institute, Boston, MA) as contractor to OECD.

Box 5-1
WASTE PREVENTION TARGETS VERSUS LANDFILL DIVERSION TARGETS

Waste prevention targets can inject a stronger set of waste prevention incentives than the more traditional landfill diversion (reduced disposal) targets used in many countries. In particular, prevention targets will tend to foster a higher level of innovation because they inherently focus attention upstream, before products and materials become waste. Innovation will be manifested by actions that reduce weight, hazard or energy content, prolong product life or foster re-use, all of which keep materials out of the waste stream.

The fact that recycling activities are more firmly established than prevention means that recycling will often occur in disproportionate response to targets that only focus on reduced disposal.

An "upstream/downstream" *two-way approach* to target setting would make use of both innovation-enhancing waste prevention targets along with the more conventional reduced disposal targets (OECD 1998f).

5.3 Waste prevention target parameters

Waste prevention target setting requires at least three related choices. For each choice, there are numerous options to consider. This section discusses these options, and indicates the different types of waste prevention targets that can result from different choices. The range of choices involved in target setting is summarised in Table 5-1, and explained below.

1. The **material stream(s) subject to the target.** To begin broadly, one could, for example, target the Total Material Requirements of the economy (WRI 1997). Moving to a narrower focus, one could target one of the broad waste streams—municipal solid waste, hazardous waste, industrial waste, mining and agricultural waste, etc.—on which OECD collects information. 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. Next, an agency would 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 unit of production. Using the unit and approach selected one must specify the most suitable method for computing waste prevention.

3. The **basis for the goal** to be met. Ideally, the goal will be expressed as a value of the chosen measure and the date by which it should be achieved. One can set goals based on historic levels, economic analyses, technical considerations, or benchmarks derived, for example, from the best practice of waste prevention for the waste 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 on the priorities of those setting or negotiating the targets.

The choices shown in the three columns of Table 5-1 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 5-1. Some examples include the following:

- The U.S. EPA has set 1990 per capita generation of municipal solid waste as a target for generation per-capita generation in 2005. This involves waste prevention because current per-capita generation is above 1990 levels (Franklin Associates 1998).

- To avoid an eco tax in 1995, Belgian beer containers had to be 95 per cent re-used.

- The Dutch Packaging Covenant requires that, by 2000, all packaging colorants containing heavy metals be substituted for by safer alternatives.

- The Finnish National Waste Plan requires 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 the predicted growth rate without any prevention measures.

- The Danish government's waste plan for 1998-2004, Waste 21, contains *inter alia* targets for stabilising the total volume of waste.

Table 5-1. Possible Parameters for Target-Setting

STREAM	MEASUREMENT PROCEDURE	BASIS FOR GOALS
Total Materials Requirements (TMR) and related measures (see Box 5-2) Industrial waste Mining waste Agricultural waste Municipal waste Packaging Plastics Other	Absolute amount; number of items, Tonnage Relative amount; per-capita, unit of GDP or unit of output Weighted by hazard or energy Content of waste stream Other	Historic: % of past or current level (including quotas/rationing and bans) Economic: based on Life-Cycle Cost Analysis, Cost/Benefit ratio, etc. Technical: % of lowest feasible level "Benchmark": % of level achieved by best practice Other

The requirements for setting waste prevention targets described above seem rather rigorous, but they could be modified in a variety of ways to make them more flexible. For example, one could simply identify the 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 targets as well as the basis for assessing progress in meeting them becomes dangerously vague. The three choices discussed—material stream(s), measurement procedure, and numerical goal—provide a useful minimum **structure** for waste prevention targets.

One could extend the definition of waste prevention targets by specifying 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 provisions in Belgium for reuse of beer bottles cited above) not all targets include this requirement. Accordingly, the target-setting process proposed here does not include the requirement to choose a specific form of waste prevention.

Box 5-2
TARGET SETTING ACCORDING TO DIFFERENTIATED MATERIAL FLOWS

To complement its work on material inputs to the economy (WRI *et al* 1997), the World Resources Institute and its partners will soon be publishing a report proposing a series of indicators for material outputs. Using these indicators could facilitate the setting of waste prevention targets for*:* Domestic Processed Output-total weight of materials, extracted from domestic environment or imported, used in the domestic economy that flow into the domestic environment; Domestic Hidden Flows-total weight of materials moved or mobilised in the domestic environment to provide commodities for economic use, which do not themselves enter the economy; or Total Domestic Output-the sum of Domestic Processed Output and Domestic Hidden Flows.

Targets could also be set for outputs associated with gateways, sectors, dissipative flows or stocks by using the proposed output indicators. Both Domestic Processed Output and Total Domestic Output can be disaggregated to show the quantity and major constituents that flow into air, land, and water. The two indicators can also be disaggregated to show the material output by the sector for industry, agriculture, energy supply, construction, transport, and households. Also tracked are dissipative flows-the quantity of materials dispersed into the environment as a deliberate, or unavoidable (with current technology) consequence of product use-and net additions to stock (the quantity of new materials used in infrastructure or new durable goods).

Source: Irwin 2000.

5.4 Framework for strategic waste prevention target setting

Setting waste prevention targets needs to be consistent with a government's overall waste prevention policy, and with the output of cost/benefit analyses. A strategic framework for target setting is therefore considered to encompass three inter-linked steps:

(a) **Identification of overall waste prevention programme approach.** In this step the waste generators to be targeted are selected, the products and materials of interest are identified, and the instruments to be used in the programme are specified. As discussed in Chapter 4, a life-cycle approach should be used to identify the most promising waste prevention opportunities. All this information needs to be organised to provide a reasonably complete technical description of the waste prevention programme which might be embarked upon.

(b) **Development of numerical goals.** Based on the technical description of the programme provided in step 1, an initial quantitative target can be selected. The basic choices for numerical goals have been described under section 5.3. The numerical goal should represent

what analysis suggests could be achieved if the programme goes forward. In addition, the likely cost of meeting the target needs to be estimated.

(c) **Analysis of costs and benefits**. The goal developed in step b quantifies the environmental benefit, [E], anticipated for the programme. Combining this with the corresponding cost [C], the anticipated cost-effectiveness [Ce] of the programme can be expressed using a ratio (van Soest *et al* 1998):

$$[Ce] = [E] / [C]$$

Box 5-3.
WASTE PREVENTION TARGETS: SOME GAPS

- Knowledge concerning what "The Right Target" is from a scientific and technological perspective.
- Knowing what type of stakeholder dialogue is necessary in order to achieve agreement on absolute waste reduction as opposed to relative waste prevention improvements.
- Our understanding of what a socially equitable waste prevention target is taking into account, for example, possible shifts in employment.

Source: OECD 2000.

5.5 Cost/benefit analysis of targets chosen

The analysis of costs and benefits is a fundamental part of strategic waste prevention target setting.

Calculating the expected environmental benefit [E], the cost of attaining the targets [C], and the envisaged cost-effectiveness [Ce], will allow the agency to evaluate a range of concerns which might bear on the decision as to whether to go forward with the programme:

[E] the level of waste prevention which the agency is seeking or committed to achieving.

[C] the resources available for implementing the programme.

[Ce] provides a basis for comparison with other programmes that might be alternatives to the one under consideration.

Any of these concerns might be crucial to the decision to go forward or not. It should also be noted that consideration of more than one approach to evaluate [E] and/or [C] may be appropriate. For example, it may be useful to consider the cost and cost-effectiveness of the programme for the government, the total public cost of undertaking and not undertaking the programme (including environmental externalities), and the total private cost to all the programme participants. Such approaches aspire to full-cost accounting and are routine in other fields, such as in the evaluation of energy conservation initiatives.

5.6 Checklist of points to consider

a. Can the programme targets be justified and explained in clear and simple terms to both internal and external stakeholders?
b. Do the waste prevention targets take a long-term focus? If so, are they accompanied by short-to-middle term milestones for achieving the targets?
c. Are the targets included within a national/sub-national environment plan, or sustainable development plan?
d. Are the waste prevention targets explicitly linked to the attainment of other environmental objectives, e.g., greenhouse gas mitigation?
e. Is progress toward the established targets measurable? Do stakeholders have incentives to measure and report their own progress toward the targets?
f. Does the government have the capacity to collect and analyse the data to demonstrate how the waste prevention programme as a whole is moving toward the targets?
g. Are the targets ambitious enough to initiate a change toward the absolute reduction of the amount and/or hazard of chosen waste streams?
h. To what degree are the targets considered realistic and feasible? Do the costs justify the benefits?

CHAPTER 6

INSTRUMENT CHOICE AND IMPLEMENTATION

6.1 Introduction

Instruments are measures/tools designed to help meet the objectives of policies and programmes. Instruments for waste prevention can help directly address the four core reasons for "waste policy failure" described in Chapter 2: inadequate information, lack of systems thinking, lack of cost-benefit thinking, lack of awareness. Since waste generation occurs throughout the chain of material uses and economic activities, a life-cycle approach to instruments application will help identify the points of incidence where they will have the highest waste preventing effects.

It is important for governments to have a method for selecting instruments that deliver their waste prevention potential to the greatest extent possible. Although the literature on environmental instruments is wide, there are no comprehensive and comparative assessments of waste prevention instruments. This chapter provides an overview of strategic and practical issues that governments may wish to take into account when considering instruments for achieving greater waste prevention.

6.2 Value of instrument assessment for waste prevention

Instrument assessment can serve a number of functions beyond the immediate need to know which instrument will best fill a waste prevention need. Systematic instrument assessment for waste prevention can:

- generate information to improve the administration of pre-existing policies influencing waste prevention;
- provide evidence on the functioning of policy and management processes, to ensure that they translate intentions into practice as effectively as possible; and
- contribute to better communication with targeted groups.

6.3 Range of instruments and assessment criteria

6.3.1 Potential instruments

Approximately two dozen instruments may influence waste prevention to varying degrees. These have been classified in Table 6-1 and described in Table 6-2 according to regulatory (command and control), economic (market based), and "suasive" (those used to persuade, exhort, educate).

Very few of the instruments are specifically employed for the sole purpose of achieving waste prevention. Though they may be crafted with waste prevention objectives firmly in mind, many instruments will also have complementary and/or secondary environmental benefits (Vancini 1997a), e.g., reduced material purchasing costs; decreased greenhouse gas emissions.

Table 6-1*. Instruments Potentially Influencing Waste Prevention

REGULATORY	ECONOMIC	SUASIVE
Extended producer responsibility via product take-back (may also qualify as suasive)	User fees	Setting waste prevention targets
Liability assignment	Subsidy removal	Greener public procurement guidelines (may also qualify as regulatory)
Pollutant release and transfer registers (PRTRs, may also qualify as suasive)	Raw material charge	Design for Environment (DfE)
Disposal ban	Grants (R&D)	Technical assistance
Virgin material depletion quota	Deposit-refund	Education and information provision
Virgin material import ceilings	Landfill tax	Public-private partnerships for waste prevention
Facility standards/permits	Tax incentives	Corporate environmental reporting (may also qualify as regulatory)
	Advance treatment fee	Eco-labelling
	Material exchanges	Environmental Management Systems (EMS)

* *Nota Bene:* The structure of Table 4-1 is not meant to suggest that horizontal (row-by-row) inferences be drawn. **Table 6-2** provides further information on the noted instruments.

Table 6-1 should not be viewed as an exhaustive listing of instruments since it is likely that with time new instruments or innovative variations of those already in existence will be developed. (Some noted instruments-e.g., pollutant release and transfer registers, corporate environmental reports, extended producer responsibility-were hardly known just ten years ago.)

6.3.2 Assessment criteria

Governments may employ a range of criteria to assess instruments in view of waste prevention policy objectives. At least five criteria (OECD 1998c) can assist with waste prevention instrument selection:

- *Environmental effectiveness:* the extent to which the instrument is expected to achieve established waste prevention objectives and/or the extent to which improvements in waste prevention occur from year to year. Components of environmental effectiveness may include changes in environmental quality, health risk reduction, and resource efficiency.

- *Economic efficiency*: the extent to which the instrument is expected to operate with minimum cost to society per unit benefit. Components of economic efficiency may include various domestic impacts (prices, employment, profitability and competitiveness, growth), as well as trade and international competitiveness.

- *Innovative advancement:* the extent to which the instrument is expected to stimulate technological and managerial innovation. This "dynamic efficiency" is essential to increasing environmental effectiveness and economic efficiency.

- *Political acceptability*: the extent to which the instrument is expected to enjoy political acceptance. Components of this consideration may include public participation, transparency, social equity, and conformity with international agreements.

- *Ease of administration*: the extent to which the instrument is expected to be feasible to carry out. Components of administration ease may include smooth integration with policies for other sectors, simplicity and flexibility of operation, effectiveness/compliance, and costs associated with monitoring, licensing, enforcement. Cost impacts and attributes should be considered both for governmental and private-sector entities.

6.4 Strategic linkage of WP instruments to four classes of materials

One way for governments to consider instrument choice is with reference to the material flows supporting economic activities (WRI *et al.* 1997). The question here might be: Is there a way to relate environmental instruments to different classes of materials such that waste prevention is fostered?

A first attempt to associate policy instruments with material flows has been made, though not with an eye toward waste prevention objectives (Steuer 1996). With inspiration from that initial attempt one might consider how a four-part material classification could be correlated to instruments supporting waste prevention. (N.B., The allocation of instruments to different material classes, as considered below, is merely indicative, and does not necessarily suggest that it would be desirable to apply all noted instruments concurrently, or to all materials within an individual class. For a discussion of how the Material Classes "rate" according three environmental criteria-absolute amounts to reduce, intrinsic hazards to reduce, and risks/impacts to reduce-see section 7.6).

- *Class I: Small volume flows* with potentially high impacts. This generally refers to hazardous substances such as heavy metals and toxics. Instruments such as design for environment/chemical substitution, bans, liability, and pollutant release and transfer registers might be considered useful to promote waste prevention and related environmental objectives. The key policy task here is to avoid any immediate risks, induce upstream changes, and empower the public with appropriate information when such substances are released into their immediate environment.

- *Class II: Medium volume flows* such as paper, steel, plastic, glass. All else being equal, this Class comprises materials with lower unit mass impact than Class I. Class II tends to be the current focus of much of waste and environmental policy, especially for recycling. Demand-side questions may be particularly important here in attaining greater levels of waste prevention. Demand for these materials can be modified through the use of a number of suasive instruments such as education, information campaigns, and eco-labelling. Waste prevention at the household level could be further complemented with instruments such as user fees, deposit-refund, and/or advance disposal fees. Since

Class II tends to comprise the majority of substances going to municipal landfills, disposal fees might also be considered as a means to indirectly foster waste prevention. Product take-back might be useful for inducing waste prevention throughout the production-consumption chain of materials in this Class.

- *Class III: Large volume flows* such as mining overburden, gravel, harvesting wastes, virgin fibre, etc with very low impact per unit mass, but with potentially significant overall impacts. This class essentially refers to hidden flows, as discussed in section 2.2. In general, few materials in this Class have been systematically considered in waste and environmental policy. Many of the risks and impacts associated with the mobilisation and use of materials in Class III may be indirect but noteworthy (e.g., habitat destruction, bio-diversity loss, soil erosion, air and water pollution, human health effects). Since Class III tends to be associated with high energy consumption, waste prevention instruments applied here could result in particularly interesting advances in increasing energy efficiency and reducing greenhouse gas emissions. In general, instruments applied to this Class will need to be applied with a long-term perspective. Waste prevention instruments for Class III might focus on, *inter alia*, attempting to alter the level of virgin material demand and relative substance prices through, for example, raw material charges and/or subsidy removal. Regulatory and suasive instruments may play a role in Class III to the extent that they promote the internalisation of negative environmental externalities and reduce materials mobilisation.

- *Class IV: Dissipative flows* such as solvents, adhesives, pesticides, and surface coatings are not typically viewed as wastes in the same manner as materials in Class I, II, and III. Such flows are typically associated with *product use*, but in some cases overlap with hidden flows categorised as Class III. Waste prevention instruments that reduce the intrinsic hazards of materials will lower the environmental and human health threats associated with Class IV. Instruments that reduce the overall quantity of products and materials consumed in the economy may also reduce the associated dissipative flows.

6.5 Waste prevention potential of instruments

Table 6-2 broadly compares instruments according to their basic function and their waste prevention potential. The term 'waste prevention potential' refers here to the capacity of the instrument to promote upstream changes *in those specific materials, products or processes* to which the instrument is applied.

Two aspects of waste prevention potential are distinguished here: a) scope, which refers to the organisational and/or geographic level to which an instrument applies. Scope could also be viewed as the potential "reach" of an instrument. Categories of scope include: economy-wide, sector-level, firm-based, local/municipal-level, household-level; b) strength, which refers to the maximum extent to which the instrument might be expected to influence waste prevention, within its given "scope". Strength is only applied to the *environmental* performance potential of the instrument. Strength does *not* refer here to other criteria such as economic efficiency or political acceptability described in 6.3.2. Strength is classified as either low, medium, high, or very high.

It requires emphasising that the existence of a certain level of waste prevention potential does not mean that it will necessarily be realised; it will depend on a number of factors such as interactions with other instruments, and level of experience with the instrument.

Table 6-2. Broad Comparison of Instruments: Functions and Environmental Effects

Instrument	Essential Function	Waste Prevention Potential (1)		Also Promotes Recycling?
		Scope	Strength	
Economic				
• User fees (also known as "pay-as-you-throw", or unit-based pricing systems)	Inject incentive to reduce waste at household level; reveal "true" disposal costs	Household and municipal	Med-High	Potentially (increased separation of recyclables from disposed materials)
• Subsidy removal	Increase relative cost of primary (virgin) material extraction / use	Economy-wide	Med -High	Potentially (increased recycling of comparable secondary materials)
• Raw material charge	See above	Economy-wide	Med -High	See immediately above
• Grants (R&D)	Develop and diffuse WP as per specific materials streams or products	Firm / sector	Med-High	Potentially
• Deposit -Refund	Increase capture and re-use of specific post-consumer products; refund=incentive	Sector and municipal	Med -High	Yes, when product is not re-used
• Landfill tax (2)	Charge according to weight or type of hazardous waste.	Municipal	Med -Low	Potentially (to increased diversion from landfill)
• Tax incentives ("tax breaks")	e.g., to invest in cleaner technologies	Firm / sector	Med	Potentially
• Advance Treatment Fee (e.g., Advance Disposal Fee, Advance Recycling Fee = ADF/ARF) (2)	Attempts to internalise (in product price) the environmental and social costs of product management at post-consumer stage	Household and municipal	Low-Med	Potentially (especially for Advanced Recycling Fee)
• Materials exchanges	Create a mechanism where secondary materials suppliers can fulfil market needs; *pima facie*, not waste prevention, but can help displace virgin materials use	Sector and municipal	Low-Med	Yes, explicitly
Regulatory				
• Extended Producer Responsibility via product take-back (may also qualify as suasive)	Inject incentives for product re-design and ultimate removal from municipal waste stream	Firm / sector or economy-wide	Med- Very high	Yes, often explicitly
• Liability assignment	Minimise damage from hazardous substances	Firm / sector	Med - High	Unlikely
• Pollutant Release and Transfer Registers (PRTRs) (may also qualify as suasive)	Public disclosure of waste generation and other environmental releases at micro-level	Firm / sector	Med - Low	Potentially (especially within production facilities)
• Disposal ban	Avoid externalities associated with land deposition of certain waste streams/products	Municipal	Med -Low	Potentially (to avoid the need for landfilling)
• Virgin material depletion quota	Specify level above which depletion of virgin materials will not be allowed, raising the costs of materials, thereby increasing the economic incentive to de-materialise	Economy-wide	Low-Med	Potentially (if quota stimulates secondary materials markets)

continued

• Virgin material import ceilings	Specify maximal level of virgin materials that can enter the country, raising the costs of materials, thereby increasing the economic incentive to de-materialise	Economy-wide	Low-Med	Potentially, but may also protects domestic virgin materials industry
• Facility standards / permits	Formalise environmental requirements at facility-level (industrial and hazardous waste)	Firm / sector	Low (for smaller enterprises) - Med	Potentially
Suasive				
• Setting waste prevention targets (may also qualify as regulatory)	Multiple: e.g., increase visibility of waste prevention , promote innovation, establish clear expectations	Economy-wide	Very High (3)	Not applicable
• Greener public procurement guidelines (may also qualify as regulatory)	Stimulate markets for lower-waste and environmentally advantageous products and services by promoting appropriate public sector demand	Municipal and economy-wide	Med- Very high	Potentially (e.g., fostering purchase of minimum recycling content in products)
• DfE (design for environment) assistance	Assist with conceiving and developing products associated with less waste, and less hazard	Firm / sector	Med-Very High	Potentially (design-for-recyclability as a variant of DfE)
• Technical assistance	Introduce incentives to "kick-start" or deepen a facility waste prevention programme, e.g., a waste prevention opportunity audit by publicly subsidised contractors is an example	Firm	Med-High	Potentially
• Education and Information provision	Disseminate best or desirable practices; applicable to all types of materials, products, and waste streams	Municipal and economy-wide	Med-High	Often
• Public-private partnerships (4) for waste prevention	Increase degree of private sector involvement in delivery of government waste prevention activities via, e.g., contractual provisions	Firm / sector, local, municipal	Med-High	Remotely-Potentially
• Corporate environmental reporting (may also qualify as regulatory)	Increase transparency of environmental implications of company activities (e.g., products, processes, wastes)	Firm / sector	Low-Med	Potentially
• Eco-labelling	Provide consumers with a basis for discriminating between specific products based on environmental attributes	Firm / sector and municipal	Low-Med	Remotely
• Environmental Management Systems (EMS)	Integrate environment into product, process and waste-management related decisions (used in private *and* public sector organisations)	Firm / sector	Low-Med	Potentially

Source: OECD in consultation with Expert Group on Waste Minimisation.

(1) See text for discussion of waste prevention potential.
(2) Taken together these damage-oriented tax based instruments show that taxes may be differentiated according to the different forms of treatment. For example, in Denmark, the highest tax is on final disposal (375 DKr/ton), lower on incineration (330DKr/ton and 280DK/ton with electricity or heat production), and none on waste for recycling.
(3) The strength rating for waste prevention targets assumes application via other instruments; also depends *inter alia* on whether the targets are voluntary or mandatory.
(4) Represents a range of instruments; for a helpful discussion of public-private partnership categories, see Gentry and Fernandez (1997). In waste prevention, such partnerships suggest new, pro-active roles for the traditional waste management industry (which, normally, relies on a steady *supply* of waste).

6.6 Matching instruments to needs

A wide range of contextual variables will influence how instruments are assessed for their appropriateness to particular needs. These variables may include, but are not limited to, administrative laws and procedures, available government resources, structure of industry, level of economic development, and trends in public values and democratic processes.

Independent of the context, one general way to assess instruments is to examine practices in other countries where certain instruments have been used in order to learn from experiences. There are two ways in which a cross-national comparison of instruments may be used. First, the practices of other countries may be used suggestively to indicate new alternatives and perhaps their likely success. Second, more analytically sophisticated (and more expensive) assessments may be undertaken as a means of examining which factors are statistically correlated with desired outcomes (Hoberg 1986).

There are, however, some limitations with the singular use of an approach that relies on examining experiences in other countries:

- there may be highly specific circumstances in the home country that will influence the functioning of the instrument(s) under consideration; and

- a narrow focus on this method precludes the assessment of newer or experimental instruments that may be associated with sparse or non-existent implementation experience elsewhere, but which may be more effective.

In practice, instrument assessment will normally involve broader considerations. As detailed below, there are four "framework factors" that may constitute a broader instrument assessment approach: *a)* appropriate level of government, *b)* narrowing of possibilities, *c)* selection and application, and *d)* a view toward reasons behind outcomes.

6.6.1 Appropriate level of government

In general, instruments requiring the greatest degree of domestic political consensus, addressing "upstream" materials use issues and/or what might be abnormally high levels environmental and human health risks, will fall within the purview of national government (Bernstein 1993; IWM 2000). Examples might include macro-level waste prevention targets (necessitating strong stakeholder convening capacities), complete domestic bans on certain highly toxic substances (potentially having important economic implications for manufacturers), or tax/subsidy policies associated with virgin material use (requiring negotiation with other sectoral ministries, notably those for economy, mining or natural resources). Programmes dealing more directly with "downstream" matters (household and municipal waste) are normally the responsibility of regional or local governments, though such levels of government can also play a crucial role in helping spur upstream demand for greener good and services, and for establishing their own waste prevention objectives and partnerships. Product-oriented waste prevention policies may require a suite of instruments, and may therefore necessitate an increasingly vertical integration of governmental actions from national to local level.

6.6.2 Narrowing the possibilities

The ultimate success of a waste prevention programme will depend on the extent to which the chosen instrument(s) correspond to the objectives and context. For instance, the preference to allow waste

generators (households, consumers, industry, government agencies) a large amount of flexibility may suggest a preference for instruments that are more voluntary or market-oriented in nature. On the other hand, a preference for greater predictability may point toward regulatory (mandatory) instruments (though regulatory instruments may also afford a certain degree of flexibility as long as their design specifies the ends and not the means).

A comparative assessment will be necessary for narrowing instrument possibilities (Table 6-2 could be used to get the process going). Local advantages and drawbacks will be associated with instruments under consideration. Tradeoffs will often be involved: for example, instruments that allow greater autonomy to stakeholders might improve the cost-effectiveness and equity of waste prevention (since different generators will experience different costs in meeting the same waste prevention objectives). On the other hand, administrative burdens on governments may rise if increased oversight becomes necessary to maintain the same level of assurance that targets will be met (OTA 1995).

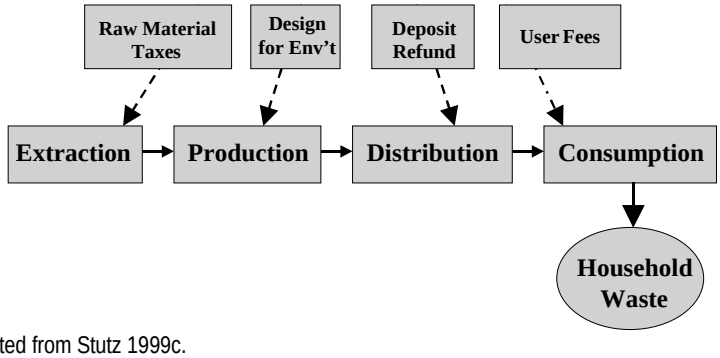
6.6.3 Selection and application

The selection of an instrument needs to be put into the context of the broader process of setting up an overall waste prevention programme (section 4.3). Criteria such as environmental effectiveness, economic efficiency, innovative advancement, political acceptability, and ease of administration (see section 6.3.2), will be useful for considering the relative merits of instruments. Choice will clearly be context-dependent, but even when all contextual factors have been laid out instrument choice will not necessarily be self-evident. An instrument that rates "best" on a comparative assessment will rarely be perfect on all counts (e.g., deposit-refund and household user fees, when used on their own, only very indirectly influence the upstream design stage of products-a stage offering key leverage for waste prevention). Moreover, some instruments may be associated with potential "distributional" effects which disproportionately impact certain social groups. In general, all relevant stakeholders should be involved during the discussions on choice and mode of instrument use.

Weaknesses in any particular instrument may be offset by selecting partner instruments that address the deficiencies. For example, to complement the capacity of user fees to incite waste prevention, complementary instruments may be selected and applied at various stages in the resource flow chain.

Figure 6-1 depicts a life-cycle instrument application approach that may help achieve household waste reduction targets by applying user fees and other tools upstream.

Figure 6-1*. A Life-Cycle Approach to Instrument Application



Source: adapted from Stutz 1999c.

The scheme noted in Figure 6-1 is one indicative approach that may be enhanced by the use of complementary downstream instruments. For instance, disposal fees and product take back requirements could also be included to further overall environmental effectiveness. The appropriate use of such complementary instruments has the potential for generating additional environmentally advantageous "spill-over" effects, e.g., environmental improvements that that cascade back up through each step in material/product chain (Lifset 2000, Vancini 1997b).

By their nature, multi-instrument approaches will concern many different social actors, including national, regional, and local governments. Intra-governmental collaboration will therefore be important to maximise policy coherence. Consideration could for example be given to the establishment of a government-wide "implementation committee". The establishment of implementation partnerships with stakeholder groups might also be considered where appropriate. In any case, assurance of sufficient agency funding and expertise will be necessary to support the consistency and efficacy of instrument implementation.

6.6.4 Understanding outcomes

Sometimes, instruments that appear well-suited to a particular waste prevention challenge may produce less-than-optimal results. Reasons for this may be either *external* to the instrument, or *intrinsic* to the way the instruments are applied. Two examples illustrate this.

At the macro-level, a quantitative waste prevention target calling for absolute reduction in waste generation may be only partially realised because efficiency gains in per-capita generation are offset by increases in overall production and consumption-a reason external to the instrument. *At the facility level,* operating permits may not result in the desired waste prevention effect when the permits are poorly written or loosely distributed-both intrinsic reasons. On-going programme monitoring (Annex 4) can help reveal reasons why instruments may not be delivering the desired level of performance.

In general instruments will tend to work best when they are used in a mix, in combination with waste prevention targets, when relevant stakeholders feel "ownership" for waste prevention programmes, when there is effective co-ordination within and between various government agencies, and when the means are available to governments for dedicated, on-going monitoring of instrument implementation.

6.7 Checklist of points to consider

a. Approximately two dozen policy instruments are available to enhance waste prevention, though waste prevention is rarely the only effect or focus of the instruments.

b. Five criteria may assist with instrument selection: environmental effectiveness, economic efficiency, innovative advancement, political acceptability, and ease of administration.

c. The capacity and authority to choose a particular instrument will vary according to the level of the governmental body (local, regional, national). Vertical integration of governmental actions may be important for some forms of (e.g., product-oriented) waste prevention policy.

d. To support strategic waste prevention, consideration could be given to how instruments would apply to different material classes.

e. Instruments should be selected in a way that best reflects programme objectives, helps assure the attainment of targets, and helps move toward strategic goals.

f. Are mechanisms in place to assure that stakeholders are consulted during instrument selection?

g. Are means available to government to monitor and evaluate the functioning of waste prevention instruments?

h. Is any information available on how instruments under consideration might interact with instruments already in use?

i. To what extent does the effectiveness of an instrument depend on conditions created by other government actions and institutions?

j. Are there any attempts to co-ordinate instrument selection and application within and between governmental bodies?

CHAPTER 7

EVALUATING PERFORMANCE

7.1 Introduction

This chapter provides governments with a basis for systematically thinking about how the evaluation of waste prevention policy programmes might unfold and be applied in ways that directly link to environmental, economic, and social considerations.

The main concern here is retrospective performance, i.e., how the success of past waste prevention efforts might be evaluated. Issues linked to future-oriented assessment are discussed in Chapter 5 (target setting) and Chapter 6 (instrument selection).

> Three decades of environment and waste policy efforts have not resulted in any widely accepted waste prevention evaluation frameworks or tools.

The fact that this chapter discusses waste prevention performance evaluation does not imply that one single approach will be applicable across countries or across time. Governments will ultimately need to adapt their waste prevention evaluation approaches according to specific objectives and changing needs.

7.2 Value of waste prevention performance evaluation

The evaluation of waste prevention performance is a potentially complex and expensive exercise. However, this observation needs to be tempered by the realisation of the benefits of waste prevention evaluation:

- It can increase the credibility of government actions meant to foster waste prevention;
- It can provide a basis for elevating awareness, stimulating accountability, and promoting policy dialogue;
- It can assist with the establishment of new waste prevention targets;
- It can indicate whether a more efficient allocation of government resources might be possible; and finally
- It can stimulate thinking about strategic waste prevention (Chapter 3).

7.3 Basic types of evaluation

Waste prevention evaluation may be undertaken on one of two levels: 1) ***Programme-specific basis***, in order to assess programme activities (processes) or programme impacts (external effects); and 2) ***Generic basis***, to consider the combined impacts of all policy programmes on the prevention of a particular waste stream.

7.4 Cross-cutting considerations

7.4.1 Baselines

To assess different types of performance impacts, a baseline will normally be required. A baseline provides a reference point or benchmark from which a given aspect of performance will be evaluated. Examples of baselines may include the measured waste amounts, the level/scale of government or private expenditures on waste prevention efforts, or the nature of stakeholder waste preventing behaviours-all at a pre-determined year. Measured changes between that year and a later year would generally indicate the realised "performance", or lack thereof, associated with the performance aspect in question. Importantly, the choice of baseline year from which performance is measured can fundamentally alter the apparent performance of waste prevention efforts.

7.4.2 Counter-factuals

Ideally, evaluation efforts would also incorporate a so-called counter-factual. A counter-factual gives an idea of what would have happened in the absence of waste prevention efforts. The establishment of a counter-factual will normally require that certain waste generation *drivers* be taken into account and controlled for (see section 7.7). Depending on how a counter-factual is constructed, a number of questions might be addressed that are relevant for the evaluation of waste prevention. Would waste amounts and hazards have decreased anyway? Would firms have independently instituted product take-back systems based on market forces alone? Would certain products have been engineered for easier re-use without governmental DfE (design for environment) assistance? Would consumers be demanding greener products without certain local waste prevention campaigns? In general, a counter-factual will normally require that factors contributing to an outcome, beyond certain waste prevention activities, be taken into account.

7.4.3 Additional key issues and challenges

- The impact of waste prevention policies and programmes will not be immediate. Waste prevention efforts need to be given a few years of operation to "mature" before their benefits are evaluated.

- It will often be difficult to say that a particular policy or programme was completely responsible for a given level of waste prevention.

- Where the pre-existing level of activity on waste prevention is high, the additional environmental benefit of further comparable efforts may be small.

- A requirement that companies report certain types of waste prevention data (e.g. toxics use) to public authorities may raise confidentiality concerns.

- It is possible to use waste generation data as a basis for evaluating past waste prevention, but such use should be informed by a realisation of its limitations (see section 4.5).

- Governments may wish to consider the most appropriate level of data aggregation when devising waste prevention measures. A high level of aggregation may be useful for understanding broad trends, but may hide poor performing regions/localities or sectors/firms.

7.5 Environmental, economic, and social performance for WP

OECD countries are attaching increasing importance to sustainable development as a means for fostering a better integration of environmental, economic, and social imperatives. It is proposed here that waste prevention evaluation be explicitly cast within such a framework.

To assist governments with operationalising this framework, this section will: a) define how environmental, economic and social themes might be specifically linked to waste prevention performance; b) consider waste prevention-related experiences under each theme; and c) provide a consolidated overview with examples of how each theme might be applied **(Table 7-1).**

7.5.1 Environmental performance

Description

The Environmental Performance of waste prevention policies or programmes may be considered according to at least *three criteria*: *a)* changes in absolute waste generation - e.g. municipal solid waste, Total Material Requirements, plastics, etc.; *b)* reductions in the intrinsic hazards of materials, products or wastes; and *c)* avoided environmental and/or human health risks and impacts from the prevented waste amounts and hazards. In order to develop a full appreciation of the environmental consequences of waste prevention, governments may wish to address all three factors, to the extent practicable, when conducting evaluations.

Some key observations:

- Environmental performance considerations will normally be at the core of waste prevention evaluation efforts. Ideally, such efforts would attempt to account for the life-cycle *system level* environmental benefits and effects of waste prevention (for a related discussion, see Box 3-3). Most experiences with waste prevention-related environmental evaluation has focused on developing rather limited proxies that address particular, albeit important, concerns, such as avoided waste disposal ("landfill diversion") associated with waste prevention. Importantly, landfill diversion by itself should not be used as a measure of waste prevention since diversion also captures non-prevention activities such as wastes that went for recycling and recovery (Vancini 1997a).

- The prevention of some wastes such as hidden and dissipative flows (see section 2.2, Box 2-4, and section 6.4) cannot be measured without some form of materials accounting that reconciles materials inputs and outputs on the relevant scale.

- There exist very few published environmental evaluations of waste prevention-related programmes. Canada's environmental review of its National Packaging Protocol is one. A joint effort between Environment Canada and Statistics Canada, the review reflects impressive attention to comprehensiveness as well as a rather easily understood reporting format. Monitoring, data verification, and accuracy of results are discussed (CCME 1998).

Other good published examples of programme-based environmental evaluation include those developed under the USEPA's "WasteWise" and "Climate Change and Waste" activities (Choate *et al* 1999, USEPA 2000).

- For generic evaluations (see section 7.3), preliminary efforts show that it is possible to develop broad waste prevention indicators that may be useful internationally. A draft indicator methodology has been developed by the Tellus Institute as contractor to OECD (Stutz 1999b). Similar efforts have been applied by U.S. national authorities in the context of municipal waste (Palmer and Garland 1999). (Work on OECD-level environmental indicators for waste prevention will continue in 2001.)

7.5.2 Economic performance

Description

The Economic Performance of waste prevention policies or programmes can refer to the quantitative cost-related aspects, as well as to the "dynamic" (innovative) effects. It can encompass benefits, savings, revenues, externalities avoided, and investments and other expenditures/income linked to waste prevention activities. Potential employment, trade, and competitiveness effects would also fall under this heading. Economic impacts could be considered with respect to government, the private sector, and consumers/households.

Some key observations:

- For governments, the calculation of waste prevention programme activity costs will include transaction and management costs associated with programme design, delivery, and adjustment. With respect to external impacts of a programme, avoided disposal costs associated with waste prevention is a common economic measure used by governments (DOE 1993). Additional public sector cost impacts might include avoided expenditures (i.e., benefits) associated with a reduced need for publicly funded waste management infrastructure as a consequence of waste prevention efforts.

- Regarding private sector cost implications, Annex 5 shows that there are many opportunities and challenges associated with company-based waste prevention costs/benefit evaluation. Governments may wish to keep these issues in mind when considering the desirability and usefulness of aggregating company-generated waste prevention evaluation measures.

- At the consumer and household level, the cost implications of waste prevention programmes will not always be immediately apparent. Waste prevention programmes that attempt to directly influence consumer or household costs through the price mechanism (e.g., with advance disposal fees, deposit refund systems, user pays schemes) may be more amenable to economic quantification than other programmes. In this context, consideration needs to be given to the fact that policy instruments are rarely employed for the singular purpose of inducing waste prevention, as noted in section 6-3. This can mean that consumer "costs" associated with a particular instrument may in reality also include costs related to waste *management*. The extent to which consumers might save money (e.g., reduced municipal waste management fees) resulting from waste prevention efforts should also be taken into account.

7.5.3 Social performance

Description

The Social Performance of waste prevention efforts addresses both the social/institutional drivers and outcomes of waste prevention. *Drivers* refer to the underlying patterns of knowledge, attitudes, behaviours, networks and political/ administrative mechanisms that are expressed/used by stakeholders in ways that may foster or detract from waste prevention. *Outcomes* may include effects on, e.g., equity, quality of life, environmental democracy and justice, as might be influenced by waste prevention activities. Potentially relevant stakeholders under a social evaluation perspective are both external (business/industry, consumers, non-governmental organisations, other government agencies) and internal (e.g., agency management). Most performance measures under this theme will be qualitative/descriptive.

Some key observations:

- Understanding the social and institutional performance of environmental policies and programmes is an area of significant and growing concern. Within this purview, the assessment of activities and tools that influence **consumption patterns** is highly relevant. Examples of such activities and tools include advertising, media, education and environmental policy instruments applied at the household level. These are key factors that can shape the opinions and actions of social actors in ways that may contribute to or undermine waste prevention efforts.

- With progressively effective methods for measuring changes in opinions and actions for waste prevention, governments would in principle be able to devise more effective and focused incentive programmes aimed at changing behaviour (De Young *et al* 1991, 1993).

- Social considerations may provide a strong lever for moving forward with waste prevention performance evaluation in an *overall* sense. Social and organisational consultation processes can be used to solicit a variety of stakeholder views relating to the environmental and economic dimensions of waste prevention discussed above (sections 7.5.1 and 7.5.2). Such consultation could provide useful insights into perceived and real impacts, as well as the level of tolerance with respect to potential trade-offs associated with waste prevention policies and programmes.

- Future OECD environmental work in the realm of "Social and Environmental Policy Integration" promises to provide new insights that hold lessons also for the social aspects of waste prevention and environmental sustainability.

Table 7-1. Waste Prevention Performance Evaluation: Indicative Framework

THEME	SPECIFIC FOCUS (examples)	PROGRESS MEASURES (examples)	DATA SOURCES (examples)
Environmental Performance	• National/regional/local local generation of waste amounts and/or hazards	- absolute measures: change in absolute waste amounts and/or hazards - relative measure: change in waste tonnage or volume per capita or per unit GDP volume	- Environmental agencies and institutes - National waste generation surveys (Franklin Associates 1998) - Statistical agencies (Statistics Norway 1998)
	• Waste generation and prevention implications for climate change impacts	- scale of greenhouse gas emission reduction attributable to waste generation/prevention trends	- International organisations (OECD, UNEP, World Bank) - Expert reports (Stutz 1999)
	• Other environmental (e.g. relationship to resource use) and/or human health risks and impacts	- landfill space saved - avoided soil and water contamination, air emissions from prevented waste; human exposure and effects measures	- National efforts (Choate *et al* 1999; USEPA 1999) - Multiple (specially commissioned efforts)
	• Total Material Requirements (TMR) and related measures	- changes in TMR (general or as might be attributed to specific waste prevention policies/programmes), possibly broken down by material type	- Research institutes (World Resources Institute and partner institutes)
Economic Performance	• For business/industry	- quantification of company-level waste prevention benefits as linked to a government waste prevention programme - quantifiable market and trade implications (e.g. sales revenues attributable to reduced waste products; increased export of waste prevention technologies) - waste prevention implications for recycling markets and infrastructure	- Industry and trade associations (e.g., Chemical Mfs. Assoc.) - Expert reports (CIWMB 1997; NAE 1999) -Corporate environmental and sustainability reports (CERES 1999) - Business research institutes (World Business Council for Sustainable Development, National Waste Clubs)
	• For consumers and households	- changes in price of products/services from cost-internalisation linked to waste prevention-related policies - household income savings from adjusted fees on municipal waste management	- National, Regional, and Local environment agencies - Surveys of household economic behaviour - Consumer associations - Trade associations
	• For government	- overall direct economic costs to society as a whole - overall cost of operating waste prevention programme (design, implementation, evaluation) - costs that could have been avoided with waste prevention programmes - short-term loss of municipal income from reduced waste available for recycling	- Systems-oriented analyses - Annual government budget reviews - Government auditor reports

continued

Social Performance	• Knowledge, attitude, and behaviour by certain stakeholder groups	- surveyed level of awareness and actions on how consumers may reduce household waste	-Surveys of household waste prevention behaviour surveys (De Young *et al* 1993)
	• Ease and willingness of consumer actions for waste prevention	- choice issues: trends in the number of reduced waste products *available for purchase* as alternatives to other products - quality of mechanisms and infrastructure: e.g., for facilitating "at-home" composting and product re-use	-Surveys of Small & Medium Enterprise (SME) waste prevention behaviour (Hermans and van Roemburg 1999)
	• Institutional collaboration for waste prevention (e.g. between environment and natural resource agencies; between national and local agencies)	- number and quality of joint initiatives and follow-up actions developed between government bodies on matters that may positively influence waste prevention	-Insights developed from intra-institutional consultation
	• "Distributional" and other effects	- capacity of lower-income households to pay user fees - firm-level: customer and employee satisfaction, degree of uptake of waste preventing technologies - stakeholder perceptions of government performance against stated government objectives, and specific stakeholder needs (e.g., for consultation and dialogue) - number and quality of government waste prevention programme outputs (information clearinghouses, web sites, brochures, fact sheets) and nature of user response to the outputs	-Insights developed from stakeholder consultations or from un-solicited stakeholder feedback

Source: OECD in consultation with Expert Group on Waste Minimisation.

7.6 Waste prevention performance evaluation in the context of four material classes

From the standpoint of strategic waste prevention, it is interesting to consider performance evaluation in the context of the four material classes discussed in section 6.4: Class I-*small volume flows* with potentially large impacts, Class II-*medium volume flows* with somewhat lower impact per unit mass, Class III-*large volume flows* with very low impact per unit mass but with potentially large overall impacts, and Class IV-*dissipative flows typically associated with product use* and which have varying levels of unit mass environmental impact.

Using environmental performance (see 7.5.1) as an example, it becomes clear that not all environmental performance criteria (absolute reduction in generation; intrinsic hazard reduction; risk and impact reduction) are equally applicable to all material classes, as shown in Table 7-2.

Table 7-2. Environmental Ratings of Material Classes

|-----*environmental performance criteria*-----|

MATERIAL CLASS	*Absolute Amounts To Reduce*	*Intrinsic Hazard To Reduce*	*Risks and Impacts To Reduce* (1)	Likely Time-Frame for Results
I	X	XXXX	XXXX	Short-term
II	XX	XX	XX	Short to middle term
III	XXXX	X	XXXX (2)	Long-term
IV	X	XX	XX	Short to middle term

Source: OECD in consultation with Expert Group on Waste Minimisation.

(1) Risks and impacts refer to those threats linked to absolute waste material amounts, to intrinsic material hazards, or indirect (but closely linked) threats from the mobilisation and use of materials.
(2) Many of the risks and impacts associated with Class III may be more indirect but significant (e.g. habitat alteration, bio-diversity loss, soil erosion, greenhouse gas emissions, air and water pollution, human health effects).

The "ratings" in Table 7-2 should be viewed as suggestive since each material class is not homogeneous (see section 6-4). It is nevertheless clear that there are some fundamental differences concerning the degree to which different criteria will express themselves in different material classes. A few other observations can be made:

- Given the fact that Class III (which includes non-market "hidden flows"-see section 2.2) is where materials are initially mobilised and enter the economy, achieving new levels of waste prevention performance in this Class may significantly contribute to an absolute reduction in waste generation and other environmental impacts on an economy-wide basis.

- Materials in Class III have been less systematically attended to in waste and environmental policy. It will not be possible to achieve or demonstrate fundamental changes in waste prevention for Class III within the normal political cycles of most OECD governments (see last column of table 7-2).

- Since waste prevention results for Classes I, II, and IV can be demonstrated more rapidly than for materials in Class III, this may have implications for the ease with which governments pursue Class III waste prevention.

7.7 Practical steps in WP performance evaluation

There is no single way to conduct a performance evaluation for waste prevention activities. An evaluation may be carried out in great depth, or be done in a more modest way to obtain an overview of what are considered the most important issues. The depth and breadth of the evaluation will depend on factors such as the expected use of the results, the resources available for the review, and the ease with which appropriate data may be generated.

All performance evaluations will require a high-level managerial commitment to the effort and a clear assignment of responsibility for carrying out the task. With those pre-requisites in place, evaluation efforts may then unfold according to the following steps:

1. *Clarify evaluation objectives.* At the outset, the objectives of the evaluation need to be specified. Evaluation objective may include: a) the need to assess progress toward quantitative targets and other goals, b) the need to respond to internal management needs, and c) the need to address expectations of external stakeholders.

2. *Do the evaluation.* Depending on the nature of evaluation objectives, several choices and questions may require attention in carrying out the effort. Key choices can include those dealing with geographic areas covered, types of waste generators considered, and drivers selected for the evaluation. Different choices will have different implications-for instance, an unrepresentative sampling of geographic areas or waste generators will hurt the government's credibility and will result in a poor outcome. A good representative sampling, on the other hand, may provide a cost-effective means of realising certain evaluation objectives.

> The evaluation of waste prevention needs to be put into the context of a range of recognised **drivers** (population size, GDP, and private consumption expenditure) whose influence may change over time. For example, if certain waste generation drivers fall, this could result in less overall waste even without any actual waste prevention efforts. Alternatively, if drivers increase, the additional waste created could offset the positive impacts of actual waste prevention

Concerning drivers, choosing and applying more than one may prove advantageous (see text insert). Ultimately, the basis for the evaluation will be data (see Annex 4). Governments may wish to consider two questions here: a) what data have been or can be collected accurately?, and b) what is the government's capacity to use and analyse the data? For certain types of evaluation, stakeholder consultation may be useful for generating relevant data that may otherwise be difficult to obtain.

3. *Communicate results.* Results should be reported according to a format appropriate to the intended audience(s). Section 7.8 reviews ways of breaking down and presenting evaluation results. If the evaluation reveals particular problems or challenges, strong consideration should also be given to communicating the steps that will be taken to redress the challenges.

4. *Respond.* Ensure that the results from the evaluation are fed back into decision-making processes. Adjustments to programme design or delivery should then be undertaken as appropriate.

7.8 Post-evaluation: reporting results

The reporting format chosen to communicate the results of a waste prevention performance evaluation will depend on the intended audience and the expected use that will be made of the report. General reporting elements and communication issues are discussed in Box 7-2.

Box 7-2.
COMMUNICATING EVALUATION RESULTS
Possible Reporting Elements

A written report on the evaluation of waste prevention performance efforts could contain several elements: 1) an explanation of the scope and context of the evaluation undertaken, 2) a description of core performance issues and results to date, and 3) a consideration of the implications from the evaluation, along with an indication of the next steps to be taken.

(1) Description of Scope and Context of the Evaluation Undertaken

If evaluation takes into account programme-specific impacts (external effects), consideration under this reporting element should be given to describing: waste prevention targets and other objectives, instruments employed, wastes, materials or products addressed, specific generators targeted (consumers, industries, government institutions), and any other relevant issues. If the evaluation takes into account programme-specific activities (processes), the focus might be on the e.g., net costs of operating the waste prevention programme, or changes in stakeholder knowledge, attitudes or on actions as a consequence of the programme.

If, on the other hand, the evaluation is generic (i.e., takes into consideration the combined effects of all programmes and policies on certain waste streams), a brief description of applicable waste prevention policies could be given, along with any other issues deemed relevant.

(2) Core Performance Issues and Results to Date

Themes covered: this can indicate whether the evaluation included environmental performance, economic performance, and/or social performance (see section 7.5 in text).

For each theme covered, the evaluation report should describe the specific areas of sub-focus and, where possible, the associated baseline measures, data collection, calculation and verification methods used, the progress to date *(= key item*), and the counter-factual (see text, 7.4.2). The accuracy of the results should also be noted.

(3) Implications from the Evaluation and Next Steps

This should include recommendations for programme or policy adjustment, including proposals for new or modified targets and instruments if appropriate, the need for modified monitoring procedures, the desirability of better consultation mechanisms, etc.

The emphasis placed on different reporting elements indicated in Box 7-2 may be adjusted according to the audience. For example, reporting to high-level agency management might place a premium on providing detailed recommendations for policy or programme adjustment in order to increase the effectiveness and efficiency of the efforts. Reporting to the public will likely require a different approach. If the intention is to make certain reports available via Internet or the media, greater emphasis might be placed on what the evaluation results means for the public-at-large or for particular stakeholder groups. For example, are any new targets or instruments being proposed that require actions on their part?

7.9 Checklist of points to consider

a. Are existing waste prevention evaluation approaches flexible enough to evolve with changing circumstances and priorities?

b. Can government bodies incorporate environmental, economic, and social considerations into their existing evaluation systems for waste prevention?

c. Have the objectives of the evaluation been clearly specified? Do the objectives take stakeholder concerns into account?

d. Are resources (money, expertise, data gathering capability) sufficient to meet the objectives of the evaluation?

e. What data can be collected for waste prevention evaluation purposes? Are monitoring and other data generation methods cost-effective? Can stakeholder consultation help fill major data gaps?

f. Can a baseline and counter-factual be established?

g. Are mechanisms in place to assure that performance evaluation results will actually be *used* by the government, e.g. for the adjustment of waste prevention programmes and policies?

CHAPTER 8

CONCLUSIONS

A central argument in the Reference Manual is that governments will have difficulties in achieving a significant de-coupling of waste generation from growth in Gross Domestic Product unless they direct rigorous attention to three core activities: 1) quantitative waste prevention target setting, 2) the selection and implementation of appropriate instruments, and 3) the evaluation of waste prevention programme performance in environmental, economic and social terms. Within this backdrop, the Reference Manual arrives at following conclusions:

a. Growing population, increased affluence and intensified, ecologically damaging consumption all contribute to the waste burden as we know it today. While population and affluence are beyond the scope for waste prevention policy action, governments are realising that **perhaps the single most important reason contributing to the waste challenge** is the fact that producers and consumers have not been required to pay the full social and environmental costs of the wastes they are responsible for creating as a consequence of their consumption patterns. (In this connection, several considerations should be kept in mind. Many waste impacts, such as injuries due to litter and greenhouse gas emissions, are difficult to assign an economic cost. Waste prevention targets may reflect political decisions, not cost-benefit calculations, as has often been the case for hazardous wastes. Therefore, the conclusion given here is not meant to suggest that waste generators should be free to make waste at will if they are prepared to pay the "full cost".)

b. Waste is associated with potential threats to sustainability because of its quantity, its intrinsic hazard, and/or the risks and impacts linked to its generation, management, and final disposal. To successfully contend with these factors, waste prevention efforts should attempt to address the four **failures and barriers** associated with waste and materials policy. Though ubiquitous, these failures and barriers vary in severity from country to country:

- *Inadequate information:* such as lack of waste prevention indicators, lack of reliable data bases on waste arisings, or poorly conceived or non-existent product eco-labels.

- *Lack of system analysis:* potentially resulting in policy measures that, e.g., promote the use of virgin materials over the use of secondary materials.

- *Lack of comprehensive cost-benefit approaches*: most traditional waste policy approaches have generally not required that waste management activities be fully costed and that overall net social costs be reduced.

- *Lack of environmental sensitivity*: Even with appropriate information in hand, consumers and other stakeholders may not necessarily be receptive to it due to low awareness.

c. There exist numerous examples of governmental endeavours that have successfully increased waste prevention **efficiencies** (less waste per unit of output at the firm level). Cleaner production and eco-efficiency initiatives have been instrumental in this regard. However, in view of trends concerning the scale of materials mobilisation, materials use, and ultimate waste generation, governments may wish to also focus more attention on reducing the **absolute** level of waste, since it is aggregate waste quantities that pose potential environmental threats (the carrying capacity of the environment does not expand with the economy or population). In doing so, it may be desirable to place priority attention on those waste and material streams characterised by higher intrinsic hazards or significant indirect effects from their extraction/use/management.

d. The successful promotion and application of waste prevention requires that governments take actions to **clarify the understanding** among relevant stakeholders as to what waste prevention entails, and what strategic waste prevention means from a policy planning perspective:

- ***Waste prevention*** refers to three types of practical actions, i.e., strict avoidance, reduction at source, and product re-use. As detailed in the Reference Manual, all societal actors including product manufacturers, businesses and institutions, and individuals and communities may express specific waste prevention behaviours. The practical value of waste prevention will be circumstance-specific and will depend on the characteristics of the material, product, waste stream or target audience in question. Governments can have an important communications role to play in directly addressing the persistent public confusion regarding the distinction between waste prevention and more visible and traditional activities such as recycling. An enhanced public understanding of waste prevention will increase political will for its promotion.

- ***Strategic waste prevention*** is a policy concept that concretely situates waste prevention within a longer-term resource management and sustainable development perspective. Strategic waste prevention works toward the reduction of absolute waste amounts, hazards, and risks, as appropriate, and is characterised by at least four aspects subject to continual refinement over time: a) a life-cycle perspective for identifying the policy intervention points linked with the highest waste preventing effects and system-wide environmental benefits. This would include attention to the fact that downstream waste prevention interventions can have upstream benefits, and vice-versa. Life-cycle waste prevention and overall environmental protection is likely to be further supported by the growing trend toward *product-oriented policies* (and, as a consequence, the analogous trend away from a singular focus on facility-oriented environmental policies); b) a material-differentiated approach that links waste prevention targets, instruments, and performance evaluation approaches to different types and classes of material flows; c) the substantive integration of social and economic aspects into environmental policy discussions on waste prevention; d) institutional mechanisms that facilitate co-operation across traditional institutional structures in ways that induce greater waste prevention, and overall policy synergy.

e. In forging a **domestically suitable policy path** toward strategic waste prevention, governments may wish to work along concurrent avenues that realistically take into account shifting priorities and constraints over time. Taking the need to engage industry as an example, a concrete policy approach might be considered according to three tracks, possibly coupled with quantitative targets: 1) promoting *good housekeeping* corresponding to operational processes, such as quality management, planning, maintenance, auditing, efficiency drives, etc, with time scales of 5 to 10 years; 2) leaving basic structures and

technologies unchanged but *implementing additional incremental* improvements with time scales from 5 to 20 years; and 3) devising institutional and other mechanisms for *achieving more fundamental "leap-frog" waste prevention improvements*-with time scales of over 20 years-resulting from long-term research and thus more fundamentally affecting industrial structure, consumption patterns, technology, and ultimately the scale of materials extraction and use. Notwithstanding the varying time scales for attaining results, it requires emphasis that progress in all three tracks can start now and that all three tracks entail vigorous attention.

f. The **application of waste prevention instruments across the product life-cycle** will require the attention of national, regional, and local governments. Intra-governmental collaboration will be important to maximise policy coherence. Consideration could for example be given to the establishment of a government-wide "implementation committee". The establishment of implementation partnerships with stakeholder groups might also be considered where appropriate. Assurance of sufficient institutional funding and expertise will be necessary to ensure the consistency and efficacy of programme delivery and implementation.

g. **Leveraging stakeholder knowledge**. Governments may derive value in seeking out perspectives from those stakeholders affected by or interested in waste prevention policies and programmes. Potential stakeholder groups include business and industry, public interest groups, research institutes/academia, national sectoral ministries, and lower level environment agencies. As illustrated in the Reference Manual, stakeholders can inject useful perspectives as governments undertake self-assessment of their waste prevention efforts. The benefits to be derived from seeking the input of external agents should be balanced against practical constraints such as available time and resources.

h. **Benefits of government self-assessment for waste prevention**. With sufficient resources for and commitment to the application of self-assessment, governments may expect to create conditions that better promote reduced amounts and/or hazards of targeted wastes while better integrating environmental, economic, and social considerations. The self-assessment approach laid out in the Reference Manual can help ensure that waste prevention policies and programmes (particularly their targets, instruments, and performance indicators) *evolve with changes in waste generation drivers*, such as population, affluence, consumption behaviour, and technology. Additional benefits of adapting self-assessment procedures may include an elevated awareness of interested parties on the efficient functioning of the policies and programmes, and an increased governmental capacity to effectively communicate and collaborate with outside stakeholders.

i. **Modus operendi of government self-assessment for waste prevention**. In practice, the decision as to how government self-assessment for waste prevention policies and programmes will be carried out will depend on several context-specific factors. Requirements or needs for government performance reporting, the specific objectives of the self-assessment, resources available for the task, perceived urgency, and the expectations of the ultimate audience(s) are just some examples. Self-assessment may be continuous, or more periodic in its application.

j. **Developing and sharing practical experiences in waste prevention policy**. The current lack of extensive waste prevention policy experience suggests that OECD countries may benefit from pursuing intensified information exchange activities, undertaking in-depth case studies on the design, implementation, and evaluation of waste prevention programmes, and analysing synergies between waste prevention and efforts aimed at improving economy-wide resource efficiency, and waste management. It might be proposed that the principles and approaches discussed in the OECD Reference Manual be used as an initial basis for launching such efforts.

REFERENCES

Abbot, J. and I. Guijt 1998. "Changing Views on Change: Participatory Approaches to Monitoring and the Environment." SARL Discussion Paper No. 2. July. ISSN 1560-2192.

Albertini A. and D. Austin. 1998. "Strict Liability as a Deterrent in Toxic Waste Management: Empirical Evidence from Accident and Spill Data". RFF Discussion Paper 98-16. www.rff.org. Resources for the Future.

Allenby. 1998. Chapter 17 in *Managing a Material World: Perspectives in Industrial Ecology*. Vellinga, P, F .Berkout, and J. Gupta. Kluwer Academic Publishers.

Andrews C. and R. Socolow. 1999. "Linking Industrial Ecology to Public Policy". Rutgers RU/EJBS Working Paper 4, and Princeton University CEES Report No. 310. Project supported by the National Science Foundation.

Arnold M. 1997. "The Road to Sustainability," World Resources Institute, Washington, D.C.

Ayres, R. 1992. "Cowboys, Cornucopians and Long-run Sustainability." *Ecological Economics*. 8:189-207.

Balkau F. 1999. "The Evolution of Waste Prevention Initiatives: A UNEP perspective". Paper presented at the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris (see OECD 2000).

Balkau F. and Zhao, W. 1999. "Global Perspectives on Assessing Technologies for Waste Prevention and Cleaner Production" Paper presented at the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris (see OECD 2000).

Bartone, C. and J.D. Bernstein 1993. "Improving Municipal Solid Waste Management in Third World Countries". *Resources, Conservation and Recycling*, 8, pp 43-45.

Batstone, R., J.E. Smith Jr., and D. Wilson (eds). 1989. "The Safe Disposal of Hazardous Wastes: the Special Needs and Problems of Developing Countries." World Bank Technical Paper number 93. Volume 1.

Beede D.N, and D.E. Bloom 1995. "The Economics of Municipal Solid Waste." *The World Bank Research Observer*. Vol. 10, no 2 August 1995. Pp 113-150.

Bennet, E. 1998. "Public-private Co-operation in the Delivery of Urban Infrastructure (Water and Waste)". December. UNEP/Yale Public-Private Partnerships Programme, New York and New Haven.

Berkout, F. 1999. "Aggregate Resource Efficiency". Chapter 11 in *Managing a Material World: Perspectives in Industrial Ecology*. Kluwer.

Bernstein, J.D. 1993. "Alternative Approaches to Pollution Control and Waste Management." UNDP/UNCHS/World Bank. Urban Management Programme.

Bertolini, G. 1996. "Conditions Which Favour or Discourage Waste Minimisation." Paper presented to the 1995 Washington Waste Minimisation Workshop. Volume II, Which Policies, Which Tools. OECD.

Biswas, A.K. 1989. "Environmental Aspects of Hazardous Waste for Developing Countries: Problems and Prospects." Chapter 22 in *Hazardous Waste Management*, Maltezou, S.P., A.K. Biswas and H. Sutten, Editors. Tycooly. UNIDO, Vienna.

Brandsma E.1997. "Main Sources and Types of Wastes and their Trends". Chapter 1 in *Changing Consumption Patterns: Waste Prevention and Minimisation* - Proceedings of an International Conference. 1997. Korea Environment Institute.

Boyd, J. 1998. "Searching for Profit in Pollution Prevention: Case Studies in the Corporate Evaluation of Environmental Opportunities". RFF Discussion Paper 98-30. Washington, DC: Resources for the Future.

CCE (Cornell Co-operative Extension) 1999. "The Waste Prevention Programme: Results of Technical Assistance on Waste Reduction to the Businesses of the Mid Hudsen Valley." June 1997 - 31 December 1998. Dutchess County Environmental Management. Council of the Cornell Co-operative Extension. New York State.

CCME (Canadian Council of Ministers of the Environment) 1998. National Packaging Protocol. Milestone Report. Task Force on Packaging. January. Winnipeg, Manitoba. http://www.mbnet.mb.ca/ccme.

CERES (Coalition for Environmentally Responsible Economies). 1999. "Sustainability Reporting Guidelines. Exposure Draft for Public Comment and Pilot Testing." Global Reporting Initiative. Boston, MA.

Choate, A. J.R. Freed, E. Lee, and H. Ferland. 1999. "Evaluating the Greenhouse Gas Impacts of National Waste Prevention Activities." Paper presented at the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris (see OECD 2000).

CIWMB (California Integrated Waste Management Board) 1997. "Profiting from Source Reduction: Measuring the Hidden Benefits." December. By J. Fox, R. German, W. Pratt and B. Shireman. http://www.stopwaste.org/srcred/.

Cleland-Hamnett, W. and J. Retzer 1993. "Crossing Agency Boundaries." *The Environmental Forum*. March/April 1993. Pp 17-21.

Cleveland, C. and Matthias Ruth. 1999. "Indicators of Dematerialization and Materials Intensity of Use." *Journal of Industrial Ecology*. 2(3): 15-50.

CMA (Chemical Manufacturers Association) 1999. Information based on data from the Bureau of the Census and United States International Trade Commission.

CMA 1999b. "Fact Sheet: Source Reduction and Recycling Lead to Pollution Prevention Efforts."

Cobb, A, H, 1996. Paper presented at the Berlin OECD Workshop: Building the Basis for a Common Understanding on Waste Minimisation. 16-18 October.

Coggins C. 1997. "Money from Muck: Toward Better Waste Management in Industry". Paper to Sheffield Regional Green Business Club. 26 February. University of Sheffield.

Commoner. D. 1972. "The Environmental Cost of Economic Growth", *Chemistry in Britain*. 8(2). Pp 52-65.

Cook S.W.and J.L. Berrenberg 1981. "Approaches to Encouraging Conservation Behaviour: A Review and Conceptual Framework." *Journal of Social* Issues. 37(2).

CSD (Commission on Sustainable Development) 1997. U.N. Secretary-Generals Report on Chapters 20 and 21 of Agenda 21 for the fifth session of the Commission on Sustainable Development, April 1997, New York (as reported in Brandsma 1997).

Daily, G. 1997. "Nature's Services: Societal Dependence on Natural Ecosystems". NY: Island Press.

Davis, G. 1999. "Principles for the Application of EPR." University of Tennessee.

DCLTEP (Dutch Committee for Long-Term Environmental Policy) 1994. "Decrease of Population Growth: A Condition for a Sustainable Future". Chapter 13 in *The Environment: Towards a Sustainable Future*. Kluwer Academic Publishers. Samsom H.D. Tjeenk Willink. The Netherlands.

Department of Environment 1993. "Externalities from Landfills and Incineration." A Study by CSERGE Warren Spring Laboratory and EFTEL. HMSO. London.

De Smets, B.and M. Stalmans 1996. "LCI Data and Data Quality: Thoughts and Considerations." *International Journal of Life-Cycle Assessment*. 1(2) 96-104.

De Young, R. *et al.* 1991. "Individual Source Reduction Behaviour: A Study on the Effect of Environmental and Economic Motivational Information." The SORED Master's Project. University of Michigan, Ann Arbor.

De Young, R. *et al.* 1993. "Promoting Source Reduction Behaviour: The Role of Motivational Information." *Environment and Behaviour*. Vol 25(1). January.

DETR (U.K. Department of the Environment, Transport and the Regions) 1999. "A Better Quality of Life". Chapter 8 - Managing the Environment and Resources. 17 May. London. http://www.environment.detr.gov.uk.

Dzioubinski, O. 1999. "Key Considerations for Developing Waste Prevention Evaluation Tools", Paper presented at the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris (see OECD 2000).

Eckstein, H. 1975. "Case Study and Theory in Political Science." In Greenstein and Polsby, ed., *Handbook of Political Science*. Reading, Massachusetts: Addision-Wesley co.

EDCO (Economic Developers Council of Ontario, Inc). 1999. "The Eco-Efficiency Resource Manual."

EIONET 1999. Second Annual EIONET Workshop on Waste. European Topic Centre on Waste. September. Vienna.

Engwall, L, 1976. "Response Time of Organisations." *Journal of Management Studies*. Vol. 13, pp 1-15.

Enquete Commission 1995. Enquete Commission of the German Bundestage on the "Protection of Humanity and the Environment. Prospects for Sustainable Management of Substance Chains and Material Flows." Economica Verlag.

EurEco and Witteveen & Bos, 1997. "Waste Minimisation and Cleaner Technologies." Final Report.

European Commission 1996. Strategy Paper for Reducing Methane Emissions. Communication from the Commission to the Council and the European Parliament. COM(96)557. Brussels.

European Commission 1998. "Integrated Product Policy: A Study on Analysing National and International Developments with Regard to Integrated Product Policy in the Environmental Field and Providing Elements for an EC Policy in This Area." Final Report. March. Brussels.

Feuerstein, M-T, 1986. "Partners in Evaluation: Evaluating Development and Community Programmes with Participants." Macmillan, TALC, ISBN 0-333-42261.9.

Fonteyne, J. P. White and K. Draeger. 1998. "Integrated Product Policy, Integrated Solid Waste Management, and Extended Producer Responsibility." Paper presented to the Second Meeting of the OECD Expert Group on Waste Minimisation. Ottawa. December.

Foster, S. 1998. "Mining and the Environment." Financial Times. FT Energy. London.

Franklin Associates 1998. "Characterisation of Municipal Solid Waste in the United States: 1997 Update." Prepared for USEPA.

Freeman A.M. III, and P.R. Portney 1989. "Economics and the Rational Management of Risk." Discussion Paper CRM 89-05, March. Resources for the Future. Washington, D.C.

Frosch, R.A. "Industrial Ecology: Adapting Technology for a Sustainable World." *Environment*. Vol 37(10). December.

Geller, E.S. 1981. "Waste Reduction and Resource Recovery: Strategies for Energy Conservation." Chapter 5 in *Advances in Environmental Psychology*. Vol III. (A. Baum and J.E,.Singer. editors. Erlaum Associates), Hillsday, New Jersey.

Gentry, B. and L. Fernandez 1997. "Evolving Public-Private Partnerships: General Themes and Urban Water Examples." OECD Workshop on Globalisation and the Environment: New Challenges for the Public and Private Sectors. 13-14 November. http://sdnhq.undp.org/ppp.

Gosling, L. and M. Edwards 1995. "Toolkits: A Practical Guide to Assessment, Monitoring, Review and Evaluation." STC Development Manual 5. London.

Greer, L., and C. Van Loben Sels. 1997. "When Pollution Prevention Meets the Bottom Line." *Environmental Science & Technology*. Vol 13(9): 418-422.

Grisham, J.L. 1986. “Health Aspects of the Disposal of Waste Chemicals. Report of the Executive Scientific Panel.” Pergamon. New York.

Guile B. and Cohen, J. 1997. “Sorting out the Service-Based Economy”. Chapter 5 in *Thinking Ecologically: The Next Generation of Environmental Policy*. Chertow, M.R. and D. C.Esty (editors). Yale University Press. New Haven.

Hanrahan, D. 1995. “Barriers to Cleaner Production.” World Bank presentation to the Workshop on Waste Minimisation and Cleaner Production. Sponsored by the Mexican Environment Agency. November. Mexico, D.F.

Heaton 1997. “Environmental Policies and Innovation: An Initial Scoping Study.” Report prepared for the OECD Environment Directorate and Directorate for Science, Technology and Industry. As referenced in OECD 1999b.

Hefferman, V. 1998. “Worldwide Mineral Exploration: Preparing for the Next Boom.” Promotional brochure. Financial Times. FT Energy. London.

Hermens, P. and T. van Roemburg. “Dutch Perspectives on Waste Prevention Target Setting.”, Paper presented at the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris (see OECD 2000).

Heinemann, G. 1969. Speech delivered to the German Bundstag, 1 July. As cited in Enquete Commission 1995.

INFORM 1995. *Toxics Watch*. New York.

Irwin, F 1999. “Resource Flows: broadening the framework for preventing waste”, Paper presented at the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris (see OECD 2000).

Irwin. F. 2000. Fellow. World Resource Institute. Washington, D.C. Personal communication with the author.

IWM 2000. Institute of Waste Management, Group on Waste Prevention.. North Hampton, United Kingdom. Chris Coggins and Paul Frith. Personal communication with the author.

Jackson, T. 1991. “Grasping the Nettle: Some Remarks on the Challenge of Auditing for Clean(er) production.” Invitational Expert Seminar: Environmental Auditing in Cleaner Production Strategies. 18-19 April. Trolleholm Castle, Sweden.

Jackson, T. 1996. *Material Concerns: Pollution, Profit and Quality of Life*. Stockholm Environment Institute. London.

Janicke M. and H. Jorgens 1998. “National Environmental Policy Planning in OECD Countries: Preliminary Lessons form Cross-National Comparisons.” *Environmental Politics*. Vol 17(2): 27-54. Summer.

Jansen, J.L.A. 1998. “Dematerialisation and Innovation: Opportunities and Barriers in The Netherlands.” Chapter 20 in *Managing a Material World: Perspectives in Industrial Ecology*. Vellinga, p, F .Berkout, and J. Gupta. Kluwer Academic Publishers.

Journal of Industrial Ecology 1997. Vol.1. No. 1. Back cover.

Kaplan S. and Kaplan R. 1982. "Cognition and Environment: Functioning in an Uncertain World." Praeger. New York.

Koponen, M., 1999. "Possibilities of Waste Prevention in Mining." Paper presented at the Joint Workshop on Extended Producer Responsibility and Waste Minimisation Policy. 4-7 May. OECD, Paris (see OECD 2000).

Koski, E. 1999. "Waste Prevention and Resource Efficiency - The Link to Consumption Patterns and Services". Paper presented at the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris (see OECD 2000).

Kraemer, L. 1999. Statement at the opening plenary of the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris (see OECD 2000).

Kunreuther, H. 1991. "Managing Hazardous Waste: Past, Present and Future." *Risk Analysis*. Vol 11 (1).

Lifset, R. 1999. "Linking Source Reduction and Extended Producer Responsibility". Paper presented at the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris (see OECD 2000).

Lifset R. 1999b. Statement at the closing plenary of the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris.

Lifset R. 2000. Editor-in-Chief of the *Journal of Industrial Ecology*. Yale University. School of Forestry and Environmental Studies. New Haven, Connecticut. Personal communication with the author.

Murti, C. 1986. "Health Implications of Hazardous Waste Disposal." Chapter 16 *in Hazardous Waste Management*, Maltezou, S.P., A.K. Biswas and H. Sutten, Editors. Tycooly. UNIDO, Vienna.

NTP (National Task Force on Packaging) 1999. Final Report. Draft. 22 November. Canadian Council of Ministers of the Environment. http://www.mbnet.mb.ca/ccme.

NAE (National Academy of Engineering) 1999. "Industrial Environmental Performance Metrics: Challenges and Opportunities." Committee on Industrial Environmental Performance Metrics. National Academy Press. Washington, D.C.

Nelson. K. 1994. "Finding and Implementing Projects that Reduce Waste", Chapter 28 in *Industrial Ecology and Global Change*. R. Socolow, C. Andrews, F. Berkout and V. Thomas (editors). Cambridge University Press.

Newton, J. 1990 "Setting up a Waste Minimisation Programme". *Pollution Engineering*. p. 75 April.

NRC (National Research Council) 1999. *Our Common Journey: A Transition Toward Sustainability*. National Academy Press. Washington.

NRCs. National (European) Reference Centres on Waste.

NRTEE (National Round Table on the Environment and the Economy) 1991. "The National Waste Reduction Handbook: An Introduction to Source Reduction and Recycling for Municipal Decision Makers." February. Canada.

OECD 1976. ´Recommendation of the Council on a Comprehensive Waste Management Policy." C(76)155(Final). Paris.

OECD 1991. *The State of the Environment*. Paris.

OECD 1995. *Environmental Policy and Technical Change*. Paris.

OECD 1996a. "Proceedings of the Washington Waste Minimisation Workshop". *Volume I. Five Waste Streams to Reduce*. Paris.

OECD 1996b. "Integrated Pollution Prevention and Control: The Status of Member Country Implementation of Council Recommendation C(90)164/Final". Paris.

OECD 1997a. *Environmental Data Compendium*. Paris.

OECD 1997b. *Evaluating Economic Instruments for Environmental Policy*. Paris.

OECD 1997c. *Sustainable Consumption and Production: Clarifying the Concepts*. OECD Proceedings. Paris.

OECD 1998a. *Waste Minimisation in OECD Member Countries*. Paris.

OECD 1998b. *Towards Sustainable Development-Environmental Indicators*. Paris.

OECD 1998c. *Extended and Shared Producer Responsibility. Phase 2. Framework Report*. Paris.

OECD 1998d. *Eco-efficiency*. Paris.

OECD 1998e. *Final Guidance Document For Distinguishing Waste From Non-Waste*. Paris.

OECD 1998f. "A Strategic Framework for Setting Performance Targets on Waste Prevention: Proposed Way Forward". Working Document #2 for 2nd Meeting of the OECD Expert Group on Waste Minimisation. 7-8 December 1998. Ottawa.

OECD 1999a. *Improving Evaluation Practices. Best Practice Guidelines for Evaluation*. OECD Public Management Service. Paris.

OECD 1999b. *Technology and Environment: Towards Policy Integration*. Committee for Scientific and Technological Policy. Paris.

OECD 1999c. *Proceedings of the OECD Workshop on the Integration of Socio-Economic Analysis in Chemical Risk Management Decision-Making*. London, 7-9 January. OECD Environmental Health and Safety Publications. Series on Risk Management No. 9

OECD 1999d. *Frameworks to Measure Sustainable Development*. An OECD Expert Workshop. 2-3 September. Paris.

OECD 2000. *Waste Minimisation through Prevention*. Papers, presentations and summary of the OECD Workshop on Extended Producer Responsibility and Waste Minimisation Policy in Support of Environmental Sustainability. 4-7 May 1999. Paris.

OECD/CCET 1995. *Best Practices Guide for Cleaner Production Programmes in Central and Eastern Europe*. Paris.

OTA (Office of Technology Assessment) 1986. "Serious Reduction of Hazardous Waste. Summary." Congress of the United States. Washington, D.C.

OTA 1992. "Managing Industrial Solid Wastes From Manufacturing, Mining, Oil and Gas Production, and Utility Coal Combustion." March. Congress of the United States. Washington, D.C.

OTA 1995. "Environmental Technology: Analysis of Selected Federal R&D Programmes." July. Congress of the United States. Washington, D.C.

Ouwens, C.D. 1999 "Preventie; een Nieuw Beleid". (Prevention: New Policy.). Paper presented to strategic conference on waste prevention, the Netherlands.

Palmer S. and G. Garland. 1999. "Quantifying the Amount of Municipal Solid Waste Minimisation (source reduction) Occurring in the United States." Paper made available for the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris (see OECD 2000).

Pearce D.W. and R.K Turner. "Market-based Approaches to Solid Waste Management." *Resources, Conservation and Recycling*, 8 , 63-90.

Peretz, J.H., R.A. Bohm and P.D. Jasienczyk 1997. "Environmental Policy and the Reduction of Hazardous Waste." *Journal of Policy Analysis and Management.* Vol. 16 No 4. 556-574.

Redclift, M. 1996. *Wasted: Counting the Costs of Global Consumption*. Earthscan Publications. London.

Reinhardt, F. 1999. "Market Failure and the Environmental Policies of Firms - Economic Rationales for 'Beyond Compliance' Behaviour". *Journal of Industrial Ecology*. Vol 3(1). Winter.

Rejeski, D. 1995. "The Forgotten Dimensions of Sustainable Development: Organizational Learning and Change." *Corporate Environmental Strategy*. 3(1): 19-29.

Rejeski, D. 1999. "Learning Before Doing: Simulation and Modeling in Industrial Ecology." *Journal of Industrial Ecology*. 2(4): 29-43.

Rosa, D. and T. Dietz 1994. "Rethinking the Environmental Impacts of Population, Affluence and Technology". *Human Ecology Review*. 1(2).

Rutledge G.L. and C.R. Vogan 1994 "Pollution Abatement and Control Expenditures, 1972-1992." *Survey of Current Business*. 74 (May): 36-49.

Schall, John. 1992. "Does the Solid Waste Management Hierarchy Make Sense? A Technical, Economic and Environmental Justification for the Priority of Source Reduction and Recycling." Program on Solid Waste Policy Working Paper #1. New Haven, CT: Yale School of Forestry & Environmental Studies.

Sewell. J.W. and K.M. Morrison. "We'll be 9 billion soon, so start getting ready". *International Herald Tribune.* 30-31 October 1999.

Siniscalco, D. 1999. "Towards Sustainable Development Indicators to Measure Progress. Conclusions of the Chairman." OECD Conference. 15-17 December. Rome.

Socolow, R. and V. Thomas. 1997a. "The Industrial Ecology of Lead and Electric Vehicles." *Journal of Industrial Ecology*. 1(1): 13-36.

SRF (Source Reduction Forum). 1997. Fact sheets. Alexandria, Virginia.

Stahel W.R. 1995. Handbuch Abfall 1. "Allgemeine Kreislauf- und Rnckstandswirtschaft, Intelligente Productionsweisen und nutzungskonzepte." Umweltministerium, Baden-Wnrttemberg.

Statistics Norway 1998. "The Cost Alternatives of Alternative Policies for Paper and Plastic Waste." Report authored by Annegrate Bruvall. Oslo.

Steurer, A. 1996. "Material Flow Accounting and Analysis: Where We Go at a European Level." Notes on London Group on Environmental Monitoring Meeting. Stockholm. 28-31 May. (As reported in Berkout 1999).

Stutz, J. 1999a. "Toward a Strategic Framework for Setting National Level Waste Prevention Targets", Paper presented at the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris. Prepared under contract with OECD (see OECD 2000).

Stutz J. 1999b. "Tools for Evaluating Performance in Waste Prevention", Paper presented at the OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation. 4-7 May. OECD, Paris Prepared under contract with OECD (see OECD 2000).

Stutz, J. 1999c. Director of the Solid Waste Group, Tellus Institute. Boston, MA. USA. Personal communication with the author.

Suzuki, Y. 1997. "Zero-emissions Communities Catch on as Dumps Fill to Brim". *The Nikkei Weekly*. 27 October.

Uphoff, N. and J. Langholz 1998. "Incentives for Avoiding the Tragedy of the Commons". *Environmental Conservation*. 25(3): 251-261.

USEPA (U.S. Environmental Protection Agency). 1996. "Chemical and Waste Prioritisation Systems Used in OECD Countries." Paper for the Washington Waste Minimisation Workshop. OECD.

USEPA. 1998. "Greenhouse Gas Emissions from Management of Selected Materials in Municipal Solid Waste." EPA#530-R-98-013. Washington, DC: USEPA.

USEPA 2000. Internet pages on climate change and waste programme, http://www.epa.gov/globalwarming/actions/waste/.

Van Berkel. R. *et al* 1997. "The Relationship between Cleaner Production and Industrial Ecology". *Journal of Industrial Ecology*. Vol. 1, no 1. Winter.

Vancini, F. 1994. "Nationally Designated Hazardous Waste Characteristics and Corresponding Testing Procedures in OECD Member Countries." OECD. Paris.

Vancini, F. 1997a. “Effective Approaches to Waste Minimisation.” Chapter 2 in *Changing Consumption Patterns: Waste Prevention and Minimisation*. Proceedings of an International Conference. December. Korea Environment Institute, Seoul.

Vancini, F. 1997b. “Thoughts on Extended Producer Responsibility, Innovation and Eco-efficiency.” Paper presented to OECD workshop on Fostering Eco-efficiency: the Role of Government. 3-4 September. OECD, Paris.

Van Soest, J.P., H. Sas, and G. de Witt. 1998. “Apples, Oranges and the Environment: Prioritising Environmental Measures on the Basis of their Cost-effectiveness.” Centre for Energy Conservation and Environmental Technology. Delft, The Netherlands. January.

Waller-Hunter, J. 1999. Opening Address. OECD Joint Workshop on Extended Producer Responsibility and Waste Minimisation Policy. 4-7 May 1999. Paris (see OECD 2000).

Warmer Bulletin 1996. “Household Hazardous Waste.” *Journal of the World Resources Foundation*. Number 50.

Wernick, I., R. Herman, S. Govind and J. Ausubel. 1997. “Materialisation and Dematerialization: Measures and Trends.” In Ausubel and Langford, eds., *Technological Trajectories and the Human Environment.* Washington, D.C.: National Academy Press.

White, A. 1999. “Sustainability and the Accountable Corporation.” *Environment*. Volume 41, Number 8.

Willing, E. “Waste Prevention: A Contribution to Waste Minimisation - German Experiences.” Paper presented at the Joint Workshop on Extended Producer Responsibility and Waste Minimisation Policy. 4.-7 May. OECD, Paris (see OECD 2000).

Winfield, M.S. 1999. “Waste Prevention and the Front-End of the Materials Cycle: Perspectives from Canada.” Paper presented at the Joint Workshop on Extended Producer Responsibility and Waste Minimisation Policy. 4.-7 May. OECD, Paris (see OECD 2000).

WBCSD (World Business Council for Sustainable Development), 1995. “Achieving Eco-efficiency in Business.” Report of WBCSD, Second Antwerp Eco-efficiency Workshop. 14-15 March. WBCSD, Geneva.

WRI (World Resources Institute), *et al* 1997. *Resource Flows: The Material Basis of Industrial Economies*. Washington, D.C.

WRI 1999. “Culture Change Among the Geologists.” Research Centre: Materials Ecology. http://www.igc.org/wri/matecology/email-04.html.

WRI 2000. “Measuring Up: Toward a Common Framework for Tracking Corporate Environmental Performance.” http://www.wri.org/meb/measure/mup.html.

Yapijakis 1992. “Lessons Learned from Successful Industrial Waste Minimisation Programmes.” Proceeding of the International Conference on Industrial Waste Minimisation. 2-4 June. Sponsored by the Waste Reduction Task Force of the Ministry of Economic Affairs and the Environmental Protection Administration. Taipei, Taiwan, R.O.C.

Yosie, T.F., and T.D. Herbst 1998. “Using Stakeholder Processes in Environmental Decision Making.” Ruder Finn and ICF Incorporated. September, Washington.D.C.

ANNEX 1

GENERIC STRATEGIES AND EXAMPLES OF WASTE PREVENTION BY DIFFERENT ACTORS

Some generic strategies for waste prevention (following Stahel 1995)

Strategy of long term use

- Design of durable products/components
- Increase "useful time" of products/components by re-using:
  - Repairing (to save broken products/components from the landfill).
  - Maintenance (to prevent the break-down of products/components).
  - Improvement (to modernise the products/component; for example, updating).
- Re-marketing (for different purpose than for the original product/component)

Strategy of more efficient use

- The design of eco-efficient products/components:
  - Material-intensity (reducing the consumption of material during manufacturing and use).
  - Multi-purpose (the product serves several purposes).
  - Standardisation (components fit many products).
- System solutions (changes in function):
  - Producing the service/ profit in different operational ways (e.g., substitution).
  - Avoiding unnecessary functions (producing the service in a simpler way without the need for extra service).
  - Combining different strategies as comprehensive, systems-oriented solutions.
- Sales and marketing approaches:
  - The right to use alternatives instead of the physical product (loaning, leasing, renting).
  - Communal use and divided use (e.g. laundry, public transportation, hotel rooms).

- Providing, when appropriate, 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).
- Service availability (providing the service near the consumers, thus avoiding transportation).

Examples of waste prevention by different actors (following NRTEE 1991)

The following examples, while not all-inclusive, provide some ideas of how different social actors may apply waste prevention measures.

Product manufacturers can: (1) enhance the quality and durability of a specific product; (2) reduce or eliminate disposable components of products; (3) reduce the quantity of materials used for packaging and distribution; and (4) promote the product's re-use/repair as opposed to early disposal. Sample actions in the area of packaging and distribution might include:

- Increasing packaging efficiencies.
- Lightweighting packaging materials.
- Re-using/re-manufacturing shipping pallets.
- Re-use shipping containers.
- Re-using shipping (wrapping and filling) materials.

Businesses and institutions can: (1) develop standards encouraging reduced volume, durability and re-use of purchased products; (2) implement co-operative purchasing or materials exchange programs; (3) develop waste prevention requirements for internal operations; and (4) promote increased employee/ constituent involvement in waste prevention options. Sample actions in the area of internal operations might include:

- Reducing paper consumption within the organisation.
- Re-using internal mail distribution envelopes.
- Promoting double-sided copying and printing.
- Using re-filled or re-manufactured toner cartridges.
- Promoting electronic mail and modem transmissions over hard copy document delivery.
- Replacing disposable cups with ceramic mugs.
- Replacing paper towels with air dryers.

Individuals and communities can: promote increased waste prevention through personal lifestyle changes that include selective product purchasing, product re-use, and decreased consumption. These activities may further be promoted through neighbourhood and environmental groups, public involvement programs, or the ballot box. Specific examples set by individuals might include:

- Using refillable or re-usable food and household product containers.
- Replacing disposable grocery bags with re-usable shopping bags.
- Composting food and organic wastes at home.
- Renting or sharing tools and other limited-use household items.
- Donating used clothing, furniture, and household items.
- Refusing unsolicited junk mail.

ANNEX 2

FRAMEWORK FOR UNDERSTANDING TECHNOLOGY DEVELOPMENT

*As noted in Chapters 2 and 5, technology-in addition to consumption behaviour and other significant factors-will play an important role in reducing the relative **rate** or intensity at which waste is generated. The development of technology is very complex and depends on many variables. This annex is intended to provide users of the Reference Manual with a basic overview of those variables that may interact to influence the technology component of the "IPAT" relationship as reviewed in section 2.3 of this Reference Manual. Further details on the framework presented below may be found in OECD 1999b.*

A framework of the relationship between environmental policy and technological change has been developed by the OECD (1999b). This framework, shown below, describes the interaction of private firms and public policy in seeking technological solutions to environmental problems. It consists of three components. The signs linking the three components in a formula suggest that the character of technological responses to environmental policy will be determined by both the initial contextual situation and the character of the public policy stimulus, in approximately equal measure. The main elements of this framework are:

1. ***A set of pre-existing technical, organisational and economic contextual variables*** facing developers and users of technology*:* these are the set of boundary conditions that may limit the technological response to environmental policy, as well as the nature of the innovative climate from which they spring.

2. The ***public policy stimulus*** of concern: this generally includes the body of laws, regulations, and institutions whose purpose is to improve environmental quality.

3. A range of possible ***technological responses***.

Contextual variables	+	***Public policy stimulus***		→	***Technological response***	
		Mechanism	*Character*		*Degree*	*Origin*
• Environmental problem • Technological context		• Regulations/ standards • Economic instruments	• Time frame • Stringency		• No innovation • Radical innovation	• Polluting sector/firm • New firm/ entrant
• Industry structure • Firm characteristics • Market and social factors		• Voluntary agreements • Producer responsibility • Information disclosure.	• Flexibility • Cost • Uncertainty		• Incremental innovation • Diffusion of technology • Continuing innovation	• Environment industry • Other

ANNEX 3

DECISION MATRIX FOR ASSESSING THE VIABILITY OF SUBSTITUTION AS A WASTE PREVENTION METHOD

Substituting non-hazardous substances for hazardous ones in products or processes is one type of waste prevention approach. However, tradeoffs may sometimes be involved in doing this.

For example, Allenby (1998) recounts the case of lead solders-a recognised toxic substance-substituted for by bismuth solders in the electronics industry. He notes how a life-cycle analysis indicates that bismuth has a higher mass rucksack*. Moreover, since bismuth is produced as a by-product of lead mining, an increase in the demand for bismuth might ironically lead to a higher supply of lead. He argues that if firms are to change their approach to production, they need clear economic incentives and good information. Governments will have a role here.

Below is a decision matrix for possible use by governments and others who are interested in systematically taking into account the possible advantages and disadvantages of substitution as a waste prevention approach in specific circumstances.

FACTOR	CURRENT SITUATION	OPTION 1	OPTION 2
Environmental risk of the substance in question			
Environmental risk of potential substitutes			
Health risk of the substance			
Health risk of substitutes			
Cost and benefit to producer of the substance			
Cost and benefit to user of the substance			
Cost and benefit to the producer of the substitutes			
Cost and benefit to society of the substance			
Cost and benefit to society of the substitutes			
Other factors (e.g. feasibility/desirability of government action)			

Source: Adapted from OECD 1999c.

ANNEX 4

MONITORING ISSUES

As noted in Chapter 1, the "self-assessment" of policy programmes is underpinned by monitoring. It will be impossible to have well-functioning self-assessment without committed and effective monitoring to support it. Monitoring relies on a *system* of organised actions (Gosling and Edwards 1995). This section reviews key considerations for operating a monitoring system.

Definition of monitoring system

A dedicated monitoring system comprises procedures for collecting and using information about the progress of programme activities and impacts. It encompasses regular, on-going observation and data collection as a basis for constantly modifying and improving a programme. The purpose is to help all the individuals involved in the programme to take appropriate decisions.

Practical data collection methods:

- Regular record keeping formats

  For example, using facilitative forms and diaries. It is important that individuals collecting data understand how the information will be used.

- Surveys and questionnaires

  These can be used, for example, to compare target audiences affected by the programme with those not affected, or to compare current data with the results of baseline studies carried out before the work began. Regular surveys can be used in a monitoring system to collect information to see how the targeted groups are affected by the programme over time, including if they have changed their knowledge, attitude, and behaviour (Hermens and Roemburg 1999).

- Case studies

  These might be used to examine the impact of a programme on particular subset of the group targeted by the programme. This can be a useful way to look into unexpected outcomes and indirect effects. The selection of the case study group should be done in an objective way, so as to avoid concentrating on those that may give a biased representation of the situation. Case

studies not only provide an opportunity for a detailed examination of a particular programme, but they can also be used to test hypotheses. If a programme thought to most likely lead to a particular result is examined and found not to do so, then this outcome suggests that the underlying assumptions may be mistaken. Analogously, a case can be chosen where a particular result is expected not to occur; if the unexpected outcome does indeed occur, here too a basic premise may be flawed (Eckstein 1975).

- Participatory approaches:

These approaches describe instances when those involved in or affected by a programme help with determining what information is chosen for monitoring. These approaches may be particularly relevant for municipal level and community based programmes (Abbot and Guijt 1998). Different stakeholders will have different perspectives to contribute (Section 4.6).

Addressing specific needs

A monitoring system provides the basis for addressing the following needs:

- Information needed to make day-to-day decisions about the work:
  - to provide an on-going picture of progress;
  - to make sure resources are used effectively and frugally;
  - to plan future work;
  - to identify critical problems and find solutions at an early stage;
  - to exploit improvement opportunities when they arise;
  - to provide records of events;
  - to provide an information base for future evaluations and studies.
- Information needed to be accountable:
  - to demonstrate good management of resources;
  - to show that the programme is as effective as possible in terms of working toward stated objectives;
  - to show what impact the programme has on different stakeholder groups;
  - to show how problems have been addressed;
  - to show what lessons have been learned.

Costs of a monitoring system

The costs of running a monitoring system can sometimes be high. They should be carefully considered and included in any programme budget, up front. Costs may comprise those associated with:

- designing the system: including staff time, workshops, training and may include hiring outside contractors or trainers;
- staff time in collecting and analysing information;

- the resources needed to develop, print, and distribute forms for data collection, and provide other materials as necessary;
- continuous training and supervision for data collection and analysis;
- training of managers to promote effective use for planning and policy development;
- modification of the monitoring system as necessary.

When trying to minimise cost of a monitoring system, it will be important to pose questions, such as:

- *What information can be collected accurately?*

This will depend on the skills of the individuals involved in monitoring, the possibility of standardising collection techniques, and the pre-existing availability of statistics, tools, and procedures that can be adapted to the needs.

- *Are existing data collection methods adequate?*

That is, the monitoring of selected waste streams, industry sectors, firms, etc. can be undertaken as benchmark or probe to see if other, perhaps less extensive efforts at data collection and monitoring (used elsewhere) are adequately capturing core activities and impacts. Without at least a few sources of well verified and detailed data, it will be difficult for governments to know if their assessments of benefit/cost ratio for more abbreviated forms of monitoring are on target.

- *Is there a capacity to respond to and capitalise upon the information generated?*

This will depend on the decisions and follow-up actions that can be reasonably undertaken from the programme, given the available resources.

How much monitoring is enough?

There is always an underlying danger of collecting too much information on every detail of a programme. The problems associated with this risk are:

- if too much data is collected it may not be measured or recorded and correlated accurately or selectively;
- there is no time or motivation to analyse or use a large amount of information;
- resentment on the part of individuals constantly asked for all kinds of information;
- if information is too detailed, it may be difficult to identify the important elements and/or trends;

In general, it is worth remembering that a streamlined monitoring system that works well is better than a more elaborate system that does not work well.

For national-level agencies with oversight responsibilities for sub-national agencies, it may sometimes be necessary to also monitor the work of those lower agencies. To assure that this task is carried out in an appropriate fashion, monitoring methods that might concurrently provide the lower-level agency with information that is also useful for their own purposes could be considered. When feasible, the sub-national agencies could be asked to provide input in developing the larger monitoring system to make sure it is also useful for them.

Finally, monitoring may come to mean new reporting requirements for those targeted by the programme. Governments should make genuine efforts to assure that any new reporting requirement is counter-balanced with a reduction in other administrative burdens placed on the targeted groups.

Applying monitoring to activities and outcomes

Programme activity considerations

Here, the focus would be on the programme process, or *how well* a programme has been developed and applied in practice. This focus can help shed light on the manner, and efficacy, with which key activities are being carried out. The development and use of programme "outputs"-such as guidance documents, hotlines, Web pages-could also be assessed.

Monitoring of programme activities can be a means for (Gosling and Edwards 1995):

- reviewing the programme on a regular basis;
- assessing whether activities are carried out as planned (according to certain programmatic milestones);
- identifying and dealing with problems and barriers to progress as they come up, and taking advantage of opportunities as they arise;
- assessing whether the way the programme is applied is the best to deal with the objectives;
- taking into account changes in external factors relevant to the programme (e.g., new knowledge, new technologies that may help with achieving specific objectives).

Programme impact considerations

Here, the review would consider the *effects/outcome* of the programme. The basic question is, "What progress is being made toward reaching stated programme objectives, and at what cost?" The assessment of unintended effects should also be included (Peretz, Bohm and Jasienczyk 1997). Impacts may be positive or negative. The review of impact should demonstrate what *changes* were brought about, and at what cost.

Monitoring of programme impacts can be a means for (Gosling and Edwards 1995):

- relating the programme to its overall purpose in public policy;
- identifying the need to modify programme objectives, as initially established;
- identifying the need for further information or research on the impacts;
- verifying the assumption that the programme will actually help achieve the stated objectives.

ANNEX 5

MICRO-MACRO LINKS: GOVERNMENT USE OF COMPANY-DERIVED WP EVALUATION MEASURES

Background

If governments intend to make use of industry-derived waste prevention data for aggregation purposes, it seems important that they understand the practical constraints that companies may experience when measuring waste prevention performance. This will provide a more realistic perspective of the usefulness and desirability of aggregating such measures on a regional or national level. This Annex reviews the specific types of challenges in this area associated with waste prevention evaluation at the micro-level, and briefly considers ways of increasing the coherence between micro- and macro-level performance measures.

Understanding micro-level challenges in waste prevention evaluation (OTA 1986)

Level of benefits may not always be certain

- Avoided Waste Management. Savings of all sorts can be assessed, including: 1) direct savings on handling, storage, transport, and treatment or disposal, and 2) indirect savings on the costs of regulatory compliance, legal advice, insurance, and managerial time. Basing estimates of direct savings on current costs may be misleading because waste management costs continue to rise. Estimates of both direct and indirect saving may also be difficult to make because they require anticipating future regulatory actions and their effect on waste management costs and practices. Accounting systems that do not impose waste management costs on specific waste generating activities may prejudice decisions against waste reduction.

- Reduction in Raw Material Use. Often there is a cost saving that is significant over time.

- Avoided Liabilities**.** Assessment of these is important, but can be very uncertain. For example, future cleanup costs for contaminated sites and future costs for regulatory non-compliance may be difficult to estimate. A company may have no records on which to base these costs and may not use probabilistic estimates, or may use high discount rates to minimise the effect of long-term costs-both of which bias decisions against waste prevention. Unless liability costs are imposed on a specific waste generating activity, decisions may be biased against waste reduction**.**

- Indirect Economic Benefits. These may be substantial, but hard to assess. They include improvements in materials, labour or energy productivity that reduce operating costs; reductions in costs associated with the presence of hazardous materials such as for worker exposures; more effective use of managers' time; the value of waste prevention in marketing and reputation enhancement, and financial transactions. If these benefits are not accounted for, decisions may be biased against waste prevention.

Evaluating prevented waste in the electronics industry

Company-wide environmental metrics for waste prevention can be developed by indexing waste generation to economic production volumes with a consistent methodology over multiple time periods. However, this may not always be easy. The electronics industry provides a good example as to the difficulties of finding good measures of performance at the micro-level.

In the electronics industry, most chemicals are used for 'non-consumptive' cleaning operations. Solvents used for cleaning may be discarded for contamination not directly related to production volume, or these solvents may be lost primarily through evaporation. Waste generation may not directly be related to production volumes. Moreover, electronic products have increasingly short lives, making products that are nominally the same very different from time period to time period.

If one considers the situation of a computer manufactured four years ago and compare that computer to one manufactured today, the function of the two machines may be radically different, but each is considered a single, equivalent unit for waste indexing purposes. The electronics industry manufactures products with orders of magnitude of performance increases from time period to time period, yet most indexing methodologies would not give credit to the improved performance and increased complexity of manufacturing.

Source: Cobb 1996.

Costs will vary

- Information. It is often necessary to spend money on a waste prevention opportunity audit as one means of acquiring appropriate information. Associated audit costs may be high for operations that generate many different kinds of wastes from a multitude of processes, and for firms that change their product mix frequently. For smaller firms with fewer resources these costs may be a significant obstacle. Although an audit may be avoided at the simplest stages of waste prevention (i.e., good housekeeping approaches), it will likely be necessary to attain further levels of waste prevention. It is also necessary to devote resources to acquire other types of information on waste prevention methods.

- Testing and R&D. Sometimes testing and even formal R&D are necessary to: 1) assess the technical and economic feasibility of specific waste reduction measures; and 2) identify possible risks to product quality posed by some waste prevention measures. These costs are likely to grow as a waste generator moves toward more involved and complex methods of waste prevention.

- Capital Investment. While implementation often involves very little capital outlays in the beginning, such outlays may become increasingly necessary as higher levels of waste prevention are sought.

- Operations and Production. Implementation may involve some operating and maintenance costs.

- Training. Spending on training for workers may be required so that they can implement and work effectively with new waste preventing processes. Identification and exploitation of waste prevention opportunities may require spending on management systems, including better accounting of costs, measurement of waste prevention, and administering incentive programmes for workers.

The need for coherence

Ideally, it would be possible to link firm and sector-level waste prevention metrics to regional and national-level evaluation systems, and vice-versa. The complexity of this task requires that a long-term perspective be taken.

Collaborative partnerships between industry and governments may help foster an increased coherence between macro and micro waste prevention performance measures. Part of the collaboration could evolve around the question of how current international initiatives to standardise company environmental and sustainability reports (CERES 1999, White 1999) might address waste prevention performance.

Macro-level metrics that reflect large increases in waste generation can provide important signals not only to policy makers, but increasingly also to corporate strategists, investors, and financial institutions. This point becomes apparent when one considers that waste generation is linked to increased greenhouse gas emissions and inefficient materials and energy use-all potentially significant competitiveness factors for companies and, ultimately, countries.

It is, however, important to realise that if macro-metrics are not grounded in micro-level measurements, then the credibility of both national policy-making, sector-based initiatives, and company environmental management approaches may suffer.

ANNEX 6

CROSS-CUTTING ISSUES AND PRINCIPLES

This Annex reviews broad issues and principles in support of strategic waste prevention. It is derived from discussions at the 4-7 May 1999 OECD workshop, Paris.

Cross-cutting issues for strategic waste prevention

- *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., material 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 overall 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), and can be influenced by policy instruments that address consumer relationships with products and producers.

- *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.

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 management 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 and environmental sustainability.

- *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 via a focus on, e.g., product conception, offering, design purchase, and use.

- *Commitment principle:* need as solid a commitment to waste prevention as possible from different stakeholders.

Other supporting principles

- *Precautionary principle:* a lack of total scientific certainty should never be an excuse for inaction where a certain level of threat has been surpassed.

- *Polluter-pays principle:* the polluter should bear the cost of preventing and controlling pollution to ensure an acceptable environmental state.

- *User pays 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".