Sustainable Materials Management

MAKING BETTER USE OF RESOURCES

OECD

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Preface

In the 20th century the world population grew 4 times, economic output 22 times and fossil fuel consumption 14 times. The total volume of material extracted or harvested worldwide reached nearly 60 billion metric tons per year in 2007, a 65% increase from 1980 and an estimated 8 fold increase over the last century.

The way economies use material resources determines to a significant extent what environmental pressures are being generated. In the near term sustainable development is threatened, not so much by the depletion of non-renewable resources such as minerals and fossil fuels, but rather by over-exploitation of renewable resources and the life-cycle impacts or externalities associated with material extraction, transport and utilization. These externalities include climate change, degradation of air, land and wildlife habitats, as well as depletion of natural resources including fresh water, biomass and topsoil.

Sustainable materials management can help to better manage those linkages. It supports sustainable decision-making by balancing the social, environmental and economic considerations throughout the life-cycle of a product or material, ensuring that negative impacts are not shifted from one life cycle stage to the next, and at the same time helping to improve resource security and competitiveness through better resource productivity.

The OECD's Working Party on Resource Productivity and Waste (and its predecessor the Working Group on Waste Prevention and Recycling) has been working on this important subject matter over the past few years. A number of seminal papers and reports have been produced, culminating in a Global Forum on the Environment focusing on Sustainable Materials Management in 2010 in Mechelen, Belgium.

This publication brings this significant body of work together and distils the key insights that have been gained for policy making. It will be of high interest to anyone, in policy-maker, business and academic circles, who grapples with the challenge of making our economies more resource efficient and laying the basis for more sustainable growth over the long-term. In this respect, the publication is also an important contribution in the framework of the OECD's Green Growth Strategy, which was recently adopted by the OECD Ministerial Council Meeting.

Simon Upton

Director, Environment Directorate

Acknowledgements

This publication brings together a significant body of work on Sustainable Materials Management (SMM) that has been developed in recent years by the OECD's Working Party on Resource Productivity and Waste and its predecessor, the Working Group on Waste Prevention and Recycling. The publication is based on reports developed by a number of authors:

- Chapter 1 on policy principles for SMM is drawn from an OECD report with the same title that was prepared by Dr. Lauren Heine (Lauren Heine Group, LLC, Bellingham, WA, US) and Mr. Marc Major (Clearwater Strategy, LLC, Los Angeles, CA, US).
- Chapter 2 on Setting and Using Targets for SMM is drawn from an OECD report with the same title that was prepared by Mr. Chris Petersen, Ms. Jennifer Cooper, Mr. Josh Hendry, Ms. Georgia Basso and Mr. Kevin Brady (Five Winds International, Ottawa, Canada).
- Chapter 3 on Policy Instruments for SMM is drawn from an OECD report with the same title that was prepared by Dr. Dominic Hogg, Alison Holmes, Duncan Wilson, Catherine Beswick and Lisa Eve (Eunomia Research and Consulting, UK).

The work has benefited considerably from the input of numerous experts and practitioners who provided valuable insights into this emerging topic. Experts that were consulted for the work on Setting and Using Targets included: Yuichi Moriguchi (University of Tokyo), Ron Nielsen (Eco-Efficiency Centre – Dalhousie), Ester van der Voet (Leiden University), Guido Sonnemann, Sonia Valdivia (both UNEP), Stefan Bringezu, Raimund Bleischwitz (both Wuppertal Institute) and Joseph Fiksel (Ohio State University). Those at the sub-national level who generously shared their experiences with targets were Christof Delatter (INTERAFVAL), Mark McDermid (Wisconsin Department of Natural Resources), David Lawes, Teresa Conner (both Ministry of Environment, British Columbia), Ichiro Nagase (Kawasaki City) and Tetsuya Doi (Niigata City). From the private sector, the following individuals shared their perspective and experience with establishing and using targets to drive their activities within their individual companies: Michiharu Yamamoto (Nippon Mining & Metals Co., Ltd.), Guy Boucher (Domtar), Michael Deane (Turner Construction), Edward Madzy and David DiMarcello (BASF), Karl Edsjö (Electrolux), and Markus Terho and Tarja Österberg (Nokia). Additionally, Angie Leith, Duncan Bury, Jay Illingworth and Derry Allen provided unique insights from their national and industry positions.

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The OECD's Working Party on Resource Productivity and Waste (WPRPW) and its predecessor, the Working Group on Waste Prevention and Recycling (WGWPR), provided extensive comments and input to the different reports.

At the OECD Secretariat, Peter Börkey oversaw the finalisation of the different reports, prepared this synthesis publication, and drafted the executive summary. Soizick de Tilly co-ordinated inputs from the Working Party and worked closely with the authors to finalise the different reports. Henrik Harjula launched the project and was involved in the earlier stages of the work. Sandrine Recurt and Šárka Svobodová provided secretarial support and Anthony Cox supervised the work and provided numerous inputs and advice.

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Acronyms

ACES	Atlantic Canada Electronics Stewardship
BERR	Department for Business, Enterprise and Regulatory Reform, now Business, Innovation and Skills, or BIS
BIM	Building Information Modelling
Cal/DTSC	California Department of Toxic Substances and Control
CBA	Cost Benefit Analysis
CCA	Climate Change Act
CCC	Committee on Climate Change
CCME	Canadian Council of Ministers of the Environment
CENIA	Czech Environmental Information Agency
CO_2	Carbon dioxide
DECC	UK's Department of Energy and Climate Change
DfE	Design for the Environment Program
DFID	Department for International Development
DMC	Domestic Material Consumption
ECF	Elemental Chlorine-free
EEBC	Electronics Environmental Benefits Calculator
EFTA	European Free Trade Association
EIO	Economic Input/Output Assessment (EIO)
EPA/USEPA	US Environmental Protection Agency
EPEAT	Electronics Products Environmental Assessment Tool
EPR	Extended Producer Responsibility
EPSC	Electronics Product Stewardship Canada
ESABC	Electronics Stewardship Association of British Columbia
ETS	EU's Carbon Emissions Trading Scheme
EU	European Union
EuP	Energy-using Products
FY	Fiscal Year
GCI	Green Chemistry Initiative
GDP	Gross Domestic Product
GEC	Green Electronics Council
GHG	Greenhouse Gas
GPP	Green Public Procurement
ICT	Information and Communication Technology
IEEE – SA	Institute of Electrical and Electronics Engineers – Standards Association
ITI	US Information Technology Industry Council

KIA	Kwinana Industrial Area
KIC	The Kwinana Industries Council
LAP	The Netherlands" (second) National Waste Management Plan
LCA	Life-Cycle Assessment
LEED	Leadership in Energy & Environmental Design
MFA	Material Flow Analysis
NGO	Non-governmental Organisation
NOx	Nitrogen oxides
NSDS	National Sustainable Development Strategies
OECD	Organisation for Economic Co-operation and Development
OES	Ontario Electronics Stewardship
PVC	Product Verification Committee
R&D	Research & Development
REACH	EU regulation concerning registration, evaluation, authorisation and restriction of chemicals
RoHS	Restriction of Hazardous Substances Directive (EU)
SCP	Sustainable Consumption and Production
SMCS	Sound Material-Cycle Society
SME	Small and Medium-Sized Enterprise
SMM	Sustainable Materials Management
SVHCs	Substances of Very High Concern
SWEEP	Saskatchewan Waste Electronic Equipment Programme
TCA	Total Cost Assessment
TEPA	Chinese Taipei's Environmental Protection Administration
TSCA	Toxic Substances Control Act
USGBC	United States Green Building Council
VAT	Value Added Tax
VROM	Dutch Ministry of Housing, Spatial Planning and the Environment
WBCSD	World Business Council for Sustainable Development
WEEE	Waste from Electrical and Electronics Equipment
WGWPR	Working Group on Waste Prevention and Recycling
WPRPW	Working Party on Resource Productivity and Waste

Overview and recommendations

Key messages

Sustainable Materials Management (SMM) is increasingly recognised as a policy approach that can make a key contribution to green growth. The way economies use material resources determines to a significant extent what environmental pressures are being generated and SMM can help to better manage this linkage. OECD countries are currently implementing a broad range of policies that are relevant to this approach.

The policy principles of SMM are the preservation of natural capital, the life-cycle perspective, the use of the full range of policy instruments and multi-stakeholder approach.

One of the key challenges of the SMM approach is to effectively address the environmental impacts that can occur along the life-cycle of materials, which frequently extends across political and geographic borders and involves a multitude of different economic actors.

The potential benefits of SMM for the economy, environment and employment are large. SMM approaches can help to improve competitiveness, contribute to addressing resource security concerns and create growth and jobs, in addition to making an important contribution to environmental protection and resource conservation.

A broad array of policy instruments can be used to contribute to SMM, and the challenge is to find the right mix of policies along the different life-cycle phases of materials. Traditional policy approaches are often too narrow as they tend to focus on only one point in the life-cycle. Going to the full life-cycle requires taking into account the transboundary nature of material flows and the diversity of economic actors that intervene in materials management. Whether and how traditional policy tools need to be combined and adapted to deal with this challenge needs to be carefully assessed.

Key lesson for policy makers is that SMM will require greater coherence of policies across sectors and environmental media. Achieving this requires co-operation across different parts of government, which is not current practice. SMM policies will also require enhanced partnerships between economic actors as well as an international perspective and further efforts for capacity development.

The need for action

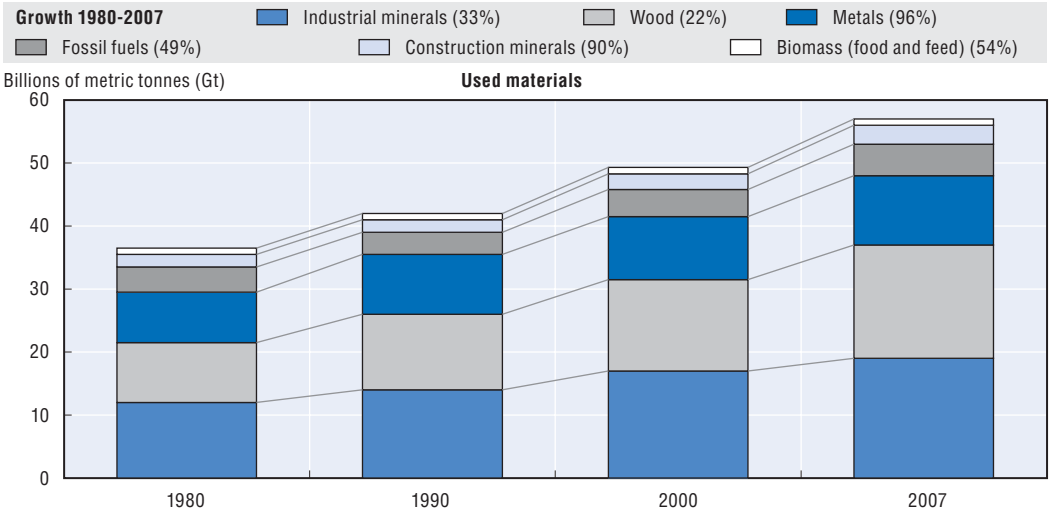
The size of the world economy is expected to double and world population to increase by one-third by 2030. With rising income and living standards, global consumption of fossil fuels, minerals, metals, timber and food crops is also increasing, generating pressures on natural resources and the environment. The total volume of material resources extracted or harvested worldwide reached nearly 60 billion metric tonnes (Gt) (OECD, 2011h) per year

in 2007, a 65% increase from 1980 and an estimated 8 fold increase over the last century (Figure 0.1).

Going for green growth and establishing a resource efficient economy is therefore a major environmental, development and macroeconomic challenge today. In this context, putting in place policies that ensure sustainable materials management building on the principle of the 3Rs – Reduce, Reuse, Recycle – is crucial. Sustainable materials management can help both to improve the environment, by reducing the amount of resources that human economic activity requires as well as diminishing the associated environmental impacts, and to improve resource security and competitiveness.

Historically, governments have focused on managing waste as a means of managing the impact of materials on the environment. While much success has been achieved with waste management policies, research has shown that waste management is often not the key process, nor is it the most efficient and effective process, for controlling material flows in the industrial and economic systems.

Figure 0.1. **Global extraction of material resources, 1980-2007**



Source: OECD (2011), *Resource Productivity in the G8 and the OECD – A Report in the Framework of the Kobe 3R Action Plan*, Paris.

Economic theory suggests that market failures such as environmental externalities, *i.e.* an environmental cost that is not transmitted through market prices, are often best addressed through economic instruments such as taxes and charges. This approach achieves an efficient use of environmental resources by all economic actors at the lowest possible cost to the economy. However, economic instruments can be challenging to implement due to political and social resistance to their introduction and the difficulty to determine the exact cost of the externality.

As a result, policy makers have often created policies that address specific materials, products, life-cycle stages or environmental resources, leading to a highly fragmented policy landscape. For instance, despite the introduction of the EU's Carbon Emissions Trading Scheme (ETS), climate change policy in EU member states is supported by a broad range of other, additional policy instruments, such as feed-in tariffs for renewable energy, subsidies for better insulation of buildings and CO_2 emission standards for vehicles. While

addressing complex environmental issues usually requires the use of a mix of different policy instruments, the inherent risk of a fragmented system is that it lacks integration and co-ordination between policies, leading to economic distortions and the potential shifting of the environmental burden from one medium to the other or from one phase of the life-cycle to the next, instead of an economy-wide reduction of environmental impacts.

Box 0.1. **OECD working definition for Sustainable Materials Management**

Sustainable materials management (SMM) is defined as "*... an approach to promote sustainable materials use, integrating actions targeted at reducing negative environmental impacts and preserving natural capital throughout the life-cycle of materials, taking into account economic efficiency and social equity*"[1].

The OECD has been exploring this new, integrated approach to materials management since 2004 and has focused its attention on the policies and instruments that can help to achieve SMM and contribute to implement the OECD Council Recommendation on Resource Productivity adopted in 2008. Policy studies on target setting, policy principles and policy instruments for SMM, as well as case studies for selected materials have been published (OECD, 2011a, b, c, d, e, f, g) and an OECD Global Forum on SMM in October 2010 proposed concrete steps and measures to put SMM in practice as well as drawing the linkages to other policy areas.[2]

Implementation of SMM policies and practices is a promising strategy for decoupling economic growth from natural resource consumption. Sustainable Materials Management therefore constitutes an important component of any green growth strategy. SMM policies will also indirectly reduce demand pressures on natural resources and therefore contribute to better resource security.

However, modern industrial supply chains often extend around the world, and SMM policies should ensure that environmental impacts are not merely shifted across international boundaries through mechanisms such as outsourcing. In this regard, SMM faces the double challenge of accounting for the full material impacts throughout the product life cycle, including mining, agriculture, and transportation, and of finding ways to influence the behavior of economic actors that operate in different jurisdictions.

Achievement of SMM is further complicated by the interdependence between material use and consumption of other natural resources, such as energy and water. Proposed policies must account for this interdependence to avoid unintended consequences. For example, many have proposed replacement of non-renewable materials such as petroleum derivatives with bio-based, renewable materials, yet these substitute materials may consume far greater amounts of water and other ecosystem services (A. Baral and B.R. Bakshi, 2010).

Box 0.2. **Background of OECD work on SMM**

The OECD has introduced work on Sustainable Materials Management (SMM) to emphasise integrated material, product and waste policies and to address environmental impacts over the whole life-cycle of materials and waste. As a starting point a workshop was held in Seoul, Korea, in November 2005 to explore the current understanding and the status of activities aimed at SMM in OECD member countries and to develop a working definition for SMM.

The participants also agreed to the following ***explanatory notes*** to the working definition:

- "*Materials*" include all those extracted or derived from natural resources, which may be either inorganic or organic substances, at all points throughout their life-cycles.
- "*Life-cycle of materials*" includes all activities related to materials such as extraction, transportation, production, consumption, material/product reuse, recovery and disposal.
- An "*economically efficient*" outcome is achieved when net benefits to society as a whole are maximised.
- A variety of policy tools can support SMM, such as economic, regulatory and information instruments and partnerships.
- SMM may take place at different levels, including firm/sector and different government levels.
- SMM may cover different geographical areas and time horizons.

A second Workshop on SMM in Tel Aviv, Israel, 2008, focused mainly on the SMM contributions of leading economic actors in the private sector, as well as those of NGOs and international organisations. The Workshop discussion made it clear that there has been a lot of activity recently at the level of business in moving toward more sustainable management of material flows and production processes which have considerably changed the management of products and materials, in particular, by assuming the holistic life-cycle approach and incorporating all three pillars of sustainability into business practices.

A third event, the OECD Global Forum on Environment focusing on Sustainable Materials Management, held in October 2010 in Mechelen, Belgium, discussed and endorsed a number of SMM policy papers and materials case studies that provide guidance to policy makers and illustrate the insights that can be gained from an SMM approach. The policy papers, focusing on SMM principles, using and setting targets and policy instruments are presented in the following chapters. The materials case studies are available from the OECD website at *www.oecd.org/env/waste*.

The benefits of SMM

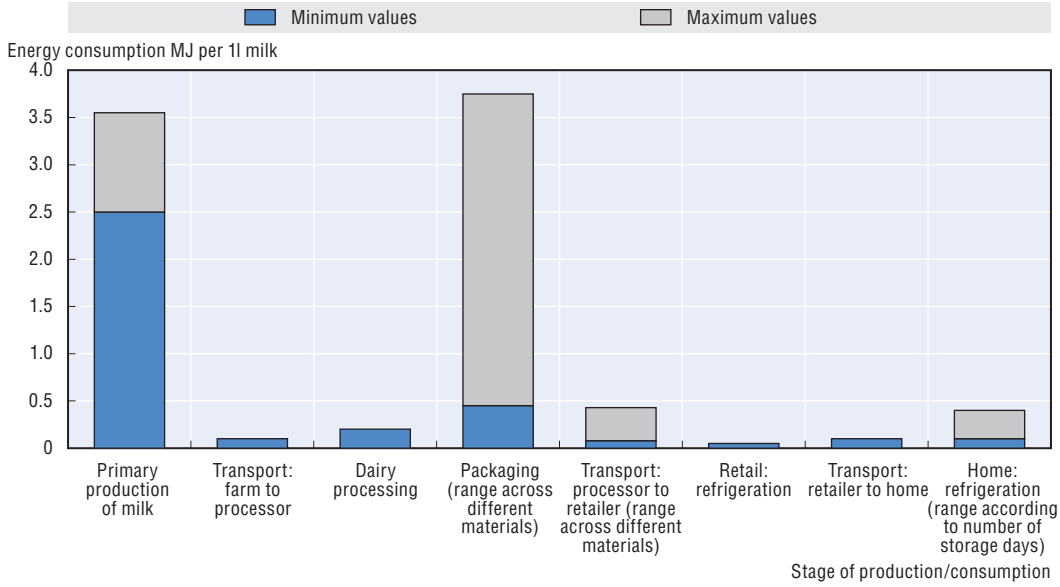
Reduce life-cycle environmental impacts and improve policy coherence

Sustainable management of materials helps to minimise environmental impacts by reducing the release of toxic substances to the environment and by limiting human exposure. It also helps to reduce pressures on resources by diminishing the quantities of materials that need to be extracted. Beyond this, SMM supports sustainable decision making by balancing the social, environmental, and economic considerations throughout the life cycle of a product or material, ensuring that negative impacts are not shifted from the production process to the consumption phase, or vice versa. SMM therefore encourages the consideration of the impacts of a suite of policies that affect a given target area, thereby

promoting consideration and possible identification of policy incoherence where this may be the case.

For example, a range of waste policies are supporting waste minimisation, such as encouraging consumers to buy food and other products in larger containers that minimise the amount of packaging waste per unit of food. While this is a useful approach, the parallel issue of minimizing food waste also needs to be taken into account. Food can have a significantly larger environmental footprint than the packaging that is wrapped around it, as some life-cycle studies suggest. In a one litre milk container, for instance, the milk can generate about five times as much CO_2 as the packaging material that contains it. Hence, when consumers buy large containers and end-up throwing away perished food products, the environmental impact may in many cases be worse than if they had bought smaller packages leading to less food waste, but slightly more packaging waste (Figure 0.2) (Foster, C. *et al.*, 2006).

Figure 0.2. **Energy consumption across the conventional milk production and consumption system**



Source: Foster *et al.* (2006), *Environmental Impacts of Food Production and Consumption: A report to the Department for Environment, Food and Rural Affairs*, Manchester Business School, Defra, London.

Another example of a policy coherence issue relates to Green Procurement and the potential double counting of externalities. When introducing green procurement, explicit attention needs to be given to the extent of internalisation of environmental costs so as to avoid that green procurement criteria are used to address environmental impacts that have already been internalised through other policies, such as a tax or an emission standard.

SMM can help to reduce dependency on raw materials

Concerns about access to resources have gained importance on the political agenda, since the prices for many resources have been taking steep increases and producing

countries have sometimes restricted the export of certain resources. Sustainable materials management can help to reduce these pressures by increasing the amount of production that can be achieved with every unit of material and by returning material that has reached the end of its useful life to the economy through reuse or recycling, in other words, reducing total primary material consumption and improving resource productivity.

Box 0.3. **Resource efficiency and resource productivity**

Resource efficiency and resource productivity have been defined as follows by OECD in its publication "Measuring Material Flows and Resource Productivity, Volume I, The OECD Guide", OECD 2008:

Resource efficiency: There is no commonly agreed upon definition of resource efficiency. It is understood to refer to the economic efficiency and the environmental effectiveness with which an economy or a production process is using natural resources. It is also understood to contain both a *quantitative* dimension (*e.g.* the quantity of output produced with a given input of natural resources) and a *qualitative* dimension (*e.g.* the environmental impacts per unit of output produced with a given natural resource input).

Resource Productivity: Resource productivity refers to the effectiveness with which an economy or a production process is using natural resources. It can be defined with respect to:

- the economic-physical efficiency, *i.e.* the money value added of outputs per mass unit of resource inputs used. This is also the focus when the aim is to decouple value added and resource consumption.
- the physical or technical efficiency, *i.e.* the amount of resources input required to produce a unit of output, both expressed in physical terms (*e.g.* iron ore inputs for crude steel production or raw material inputs for the production of a computer, a car, batteries). The focus is on maximising the output with a given set of inputs and a given technology or on minimising the inputs for a given output.
- the economic efficiency, *i.e.* the money value of outputs relative to the money value of inputs. The focus is on minimising resource input costs.

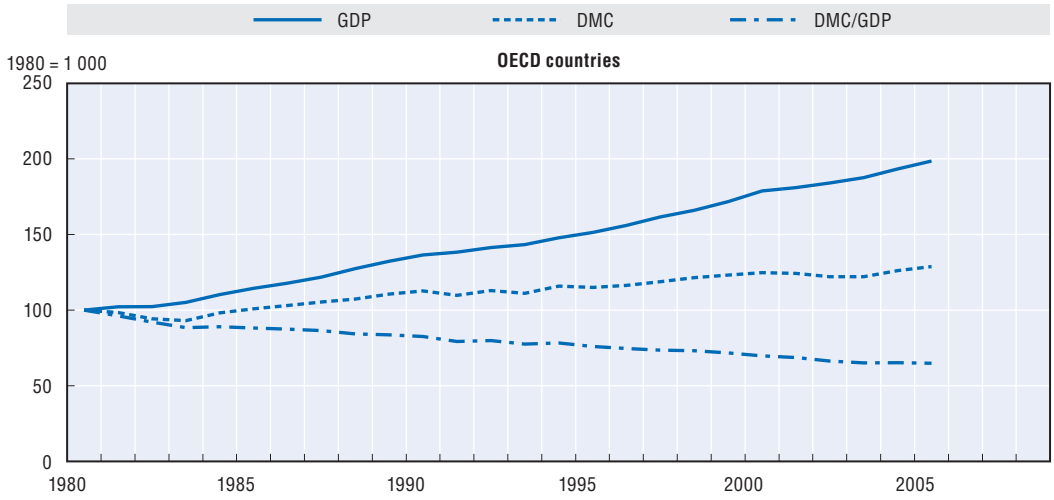
The concepts of resource productivity and resource efficiency are therefore largely identical in the way that they are used in this report.

Resource productivity has been improving throughout the OECD with a 42% increase between 1980 and 2008 (Figure 0.3). This can be at least partly attributed to a range of policies that OECD countries have put in place to improve resource efficiency and the recovery of materials from waste.

The OECD has established a set of environmental indicators which includes those used to illustrate resource productivity. Figure 0.3 illustrates the gradual decoupling of GDP and DMC over time, which is used as an indicator for resource productivity as OECD countries are producing an increasing amount of goods and services per unit of material mass input.[3]

In Japan, which is one of the most resource efficient OECD economies, a set of SMM policy measures in line with the 3Rs, Reduce, Reuse, Recycle philosophy that supports the implementation of the "Fundamental Law for Establishment of a Sound Material Cycle Society", has helped to increase the cyclical use rate of material. This rate compares recovered resources to total material input of the Japanese economy and has improved by

Figure 0.3. **OECD material consumption versus GDP**[1]



Notes: OECD figures do not include: Chile, Czech Republic, Estonia, Hungary, Poland, Slovak Republic, Slovenia and Israel.

1. Domestic Material Consumption (DMC) is a variable used in material flow accounting. DMC measures the mass (weight) of the materials that are physically used in the consumption activities of the domestic economic system (i.e. the direct apparent consumption of materials, excluding indirect flows). In economy-wide material flow accounting DMC equals DMI minus exports, *i.e.* domestic extraction plus imports minus exports. *Source:* OECD (2008) Measuring material flows and resource productivity: The OECD Guide

Source: OECD (2011), *Resource Productivity in the G8 and the OECD – A Report in the Framework of the Kobe 3R Action Plan*, Paris.

41% since 2000, reaching 14.1% in 2008. As a result of this and other efforts, Japanese material intensity[4] was 37% below the OECD average in 2005 (OECD, 2010).

Improved competitiveness at no or low cost

More sustainable and efficient management of materials also helps to improve competitiveness by reducing input costs. In the United Kingdom, potential input savings to firms from unexploited resource efficiency savings[5] with a pay-back period of less than one year were estimated at GBP 23 billion in 2009, with about GBP 18 billion of waste reduction and better materials management. Further savings of about GBP 33 billion with a payback of more than a year would be available, again with the lion's share (GBP 22 billion) in waste reduction and material management (DEFRA, 2011).

One global clothing firm identified that managing waste in its shoe manufacturing process cost it EUR 550 million per year. As part of a long-term programme of resource efficiency, streamlining of production and improved design of shoes reduced waste by up to 67%, energy use by 37% and solvent use by 80% along its supply chain.[6]

Contribute to growth and jobs

Measures that help to increase the productivity of resources can generate innovation and new and additional economic activity in areas such as waste collection and treatment or recycling, potentially creating growth and jobs.

In the EU core environmental industries active in the fields of pollution management and control, waste collection and treatment, renewable energy and recycling have a combined turnover of over EUR 300 billion; provide nearly 3.5 million jobs, and have

impressive global market shares of 30-40%. This sector is growing at annual rates of more than 8% in a global market predicted to reach four trillion euro by the middle of the decade and is offering many new and skilled green jobs.

More specifically, for the EU27 the number of jobs in the recycling industry is estimated at 1.8 million (Ernst and Young, 2006). The potential for additional jobs has been estimated by a recent study of Friends of the Earth that finds that across the EU27 up to 322 000 direct jobs could be created in recycling if recycling increased from 50% (embodied in current policies) to 70% for key materials. Including indirect and induced jobs, the total potential job creation would be about 550,000 (Friends of the Earth, 2010).

SMM policy principles

Work to develop practical guidance for policy makers who wish to improve the resource productivity of their economies and put in place sustainable materials management policies is currently ongoing at the OECD. This work has been carried-out through a number of reports, workshops and events, most recently a Global Forum on Sustainable Materials Management held in October 2010 in Mechelen, Belgium. These efforts have resulted in a number of policy papers and materials case studies.[7] The following summarises the main conclusions of this work to date.

Recent OECD work suggests that four broad SMM policy principles should be used as guidance for the development of SMM policies wherever possible (OECD, 2011c).

Principle 1 – Preserve natural capital

Natural resources and healthy ecosystems are essential to all life and provide the natural capital on which humans depend. Sustainable materials management can contribute to the preservation of natural capital and is needed to foster long-term sustainability. Policy principle 1 envisions leveraging the best available science, engineering, business and management practices to counter the trend toward incremental destruction and depletion of natural capital and its preservation now and for future generations. By modelling human use of materials as a system of material flows and environmental impacts, it is possible to outline broad strategies that would lead to the preservation of natural capital. Based on these strategies, policies and policy instruments specific to each country's unique circumstances can be developed. Strategies for SMM Policy principle 1 include:

- Improve information about material flows and environmental impacts.
- Increase resource productivity and resource efficiency (see Box 0.2).
- Reduce material throughput, particularly of high impact materials.
- Increase reuse/recycling of materials to preserve natural capital.
- Advance technologies for obtaining materials from natural resources that eliminate waste and toxics and support long-term ecosystem health (Eco-innovation).

Principle 2 – Design and manage materials, products and processes for safety and sustainability from a life-cycle perspective

It is at the design stage that decisions are made that determine impacts throughout the life-cycle. SMM policy principle 2 calls for maximising positive (and minimising negative) impacts to the environment and to human health and well-being through design. By managing for safety and sustainability at each life-cycle stage, efforts are made to

ensure that risks are not shifted from one stage in the value chain, or from one geographical region, to another. Economic and social outcomes are optimised while natural capital is preserved and materials are sustainably managed.

SMM policy principle 2 also calls for increased co-operation between actors across the life-cycle so that all actors are aware of the impacts of their actions and decisions on other phases of the life-cycle and can act accordingly. Three overarching material, product and process design strategies support SMM and they can be encouraged via government policies. They are:

- **Detoxification** supports SMM by eliminating the progressive build-up of chemicals and compounds produced by society that have harmful impacts on human health and environment, that cannot be properly or safely managed, or that are costly to manage from an economic or environmental standpoint. Detoxification is addressed through the application of green/sustainable chemistry and the process of chemical substitution.
- **Dematerialisation** supports SMM by reducing the throughput of materials, particularly those with high negative life-cycle impacts. Dematerialisation means doing more with less and refers to more efficient use of raw materials (resource efficiency) without decreasing the quality of the service they provide. In addition to resource efficiency, dematerialisation strategies also include material substitution and replacing products with services.
- **Design for value recovery** supports SMM by ensuring that products and materials are designed for reuse and recycling and that an effective model for recovery is in place (*i.e.* reverse logistics). Design for value recovery may be driven by product-related policies that promote for example extended producer responsibility (EPR) or "cradle-to-cradle" design. Cradle-to-cradle design strives to restore continuous cycles of materials with long-term positive effects on profitability, the environment and human health.

Box 0.4. **Preserving natural capital – the example of wood fibres**

A case study identifying opportunities for sustainable materials management of wood fibres (*i.e.*, pulp and paper products) was carried out, as this is one of the sectors that have substantial opportunities to reduce energy use, greenhouse gas emissions and water use throughout the fibre product life-cycle. The report finds the following opportunities to reduce environmental impacts that are generated at different stages of the wood fibre life-cycle:

- Reductions in energy use on the order of 20 to 30% could be achieved in conventional pulp mills with existing technologies. Chemical and thermo-mechanical pulp mills offer the greatest potential for energy savings. Paper drying is the most energy-intensive process across the life-cycle, consuming 15 to 25% of total energy.
- Increased and more efficient use of biomass energy – considered to have zero net greenhouse gas (GHG) emissions if sourced from sustainably managed forests – can further mitigate GHG emissions. Sustainable forest management practices and certification are essential to ensuring that biomass fuels remain carbon neutral.
- Chemical pulping can be roughly twice as water-intensive as mechanical pulping. Reductions in water use on the order of 25 to 50% are possible in conventional mills using technologies such as dry debarking, partial or full closure of certain water loops, washing system improvements and elemental chlorine-free (ECF) or enzymatic bleaching.

Box 0.4. **Preserving natural capital – the example of wood fibres** *(cont.)*

- At end-of-life, recycling paper products saves 7 to 19 GJ of energy per tonne of paper recycled and results in GHG emission reductions relative to the virgin manufacture of paper. Focusing on improving recovered paper collection efficiency, reducing the rates of contamination and developing new technologies and pulping processes can enable even greater efficiencies in the utilization of recovered paper.
- Although overall energy use is lower in recycling paper, GHG emissions from the manufacturing stage can be larger due to the fossil energy used in recycled mills compared to the low- or zero-carbon biomass energy used in virgin paper production. Even so, the GHG reductions from avoided fibre landfilling more than outweigh the additional GHG emissions from recycled paper manufacture and the overall GHG profile for recycling paper could be even more beneficial if biomass and other non-fossil fuel sources are used in the manufacture of recycled paper.
- Combustion facilities in OECD countries normally employ energy recovery systems, so fibre discards sent to these facilities can produce electricity for the grid, potentially displacing fossil electricity generation.
- Pulp and paper discards and residues that are sent to landfills generate GHG emissions in the form of methane and represent a significant portion of the GHG emissions associated with the pulp and paper life- cycle. Therefore, it is most important to divert paper which has high methane generation potential from disposal in landfills.
- Finally, across the entire life-cycle, source reduction of paper – in practices such as lightweighting packaging, double-sided printing and copying and paper re-use – offers a comprehensive approach to reducing the size of the environmental footprint.

Source : OECD (2011), *A Sustainable Materials Management Case Study: Wood Fibres*, Paris.

Principle 3 – Use the full diversity of policy instruments to stimulate and reinforce sustainable economic, environmental and social outcomes

To shift societies toward more sustainable materials management, governments can leverage a variety of policies and policy instruments including: regulations; economic incentives and disincentives; trade and innovation policies; information sharing; and, partnerships.

Each of these mechanisms has advantages and disadvantages and each can deliver benefits. However it is unlikely that any single mechanism is appropriate in all circumstances. Therefore, a multi-pronged approach, applying a diversity of policies and policy instruments, is more likely to influence all relevant players than a "one-size-fits-all" approach. Weaving these diverse policy mechanisms into combinations that reinforce each other can help to generate more effective, efficient and lasting outcomes. Integrated policies and policy instruments can successfully drive actors in the same direction and can accelerate progress – sometimes generating synergies. Policymakers can also reinforce the use of these instruments by upgrading measures of success toward SMM objectives – at both the systemic and organisational levels.

Principle 4 – Engage all parts of society to take active, ethically-based responsibility for achieving sustainable outcomes

Material flows involve and affect many stakeholders throughout the supply chain and often across vast geographical areas. Because of the complexity of SMM, outcomes can be improved by inclusion and engagement of many players across the life-cycle of materials use in collaborative efforts to create collective solutions. Stakeholder engagement can also facilitate socially acceptable and equitable solutions by engaging those affected and allowing them to participate in designing of systemic solutions. SMM outcomes can be improved by systematic cultivation of:

- Multilateral stakeholder engagement, responsibility and collaboration.
- Open information flows.
- An ethical perspective.

Box 0.5. **The example of critical metals in mobile phones – SMM policy recommendations**

Another sustainable materials management case study focused on identifying opportunities for better management of critical metals in mobile phones, *i.e.* Beryllium, Antimony, Platinum and Palladium. This work illustrates the important insights that can be gained from the SMM approach. The policy recommendations that emerged from this case study, suggest that there is a range of different policy instruments that could be used at different stages of the life-cycle:

- In the processing of the four critical metals recycling can save significant amounts of energy. Public policy should promote the link between energy savings, improved economics and reduced GHG emissions. To improve recycling yields and reduce exposure to workers, policies to manage risk include raising awareness and setting standards.
- Some mobile phone material has been identified as problematic for recyclers and manufacturers are starting to phase these materials out (*e.g.* Beryllium and Antimony). Design for recycling and reduced toxicity are conceptually desirable and may be influenced by relevant product or materials related policies (such as US EPA's Design for Environment (DfE) or well designed extended producer responsible (EPR)schemes) and collaboration between governments and industry.
- The collection of end-of-life mobile devices is a key challenge as collection rates are currently very low. In some countries Extended Producer Responsibility programmes have contributed to rising product capture rates. Given their diminishing life span, a deposit system for these devices or innovative leasing arrangements may also be good mechanisms for raising collection rates.
- Since the technical lifespan of a mobile phone is about ten years, promoting extended mobile phone use through policy ultimately supports sustainable use of materials. Government procurement contracts could play a role by specifying product durability requirements; alternatively, standard government policy could extend electrical and electronic equipment usage periods.
- A mix of policies and programmes is likely the most effective approach.

Source: OECD (2011), *A Sustainable Materials Management Case Study – Critical Metals and Mobile Devices*.

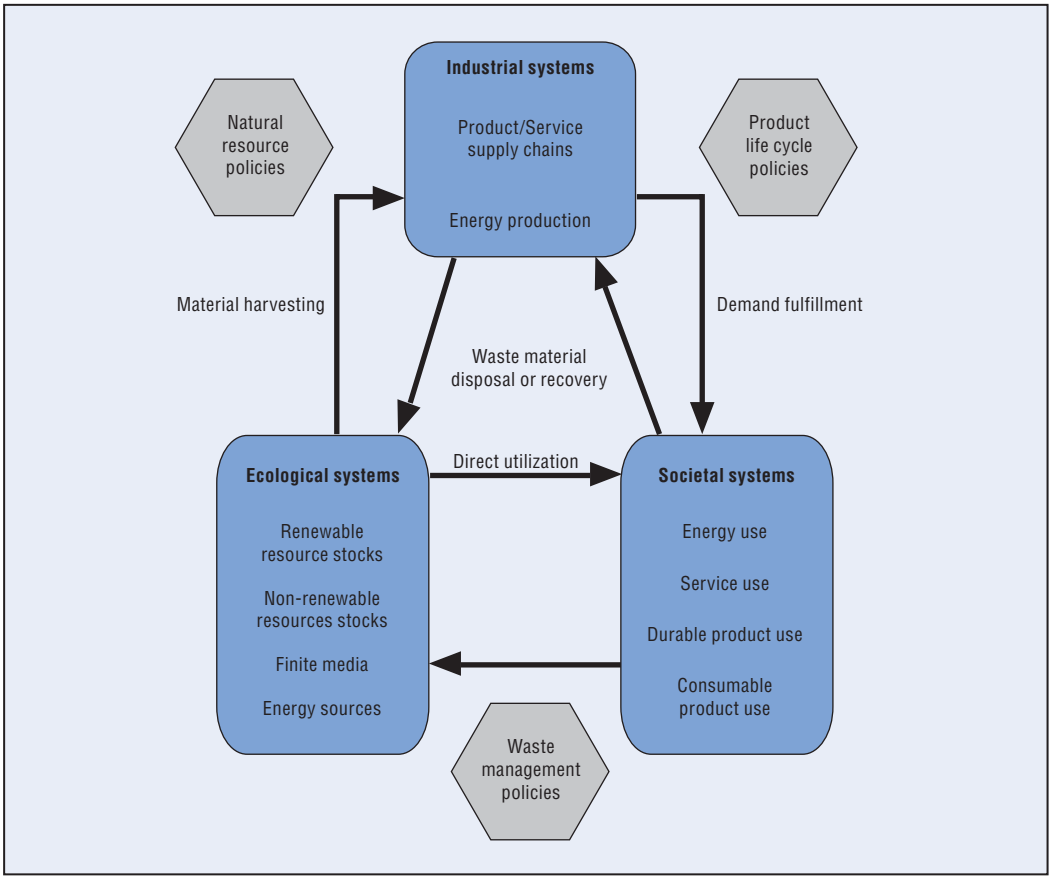
Policy instruments for SMM

Due to the broad scope of SMM, it is helpful to adopt a conceptual framework that represents the sources of materials, their pathways through the environment, and their eventual sinks. When viewed from the systems perspective in Figure 0.1, policy frameworks can be classified in terms of their **scope of application** with regard to material flow cycles:

- **Natural resource policies** (*e.g.*, Minerals and Metals Policy of Canada) address material flow cycles that link natural and industrial systems, including extraction, harvesting, and transport of raw materials as well as direct utilisation of natural resources (*e.g.*, water, land).
- **Product life cycle policies** (*e.g.*, EU Integrated Product Policy) address material flow cycles that link industrial systems and societal systems, including product development, transportation, energy production, supply chain operations, and waste recovery.
- **Waste management policies** (*e.g.*, Japanese Fundamental Law for Establishing a Sound Material-Cycle Society) address the flows of waste materials into natural systems, including disposition or recycling of industrial and municipal wastes, as well as non-point source pollution control.

Effective SMM policies that take a whole of life-cycle perspective need to address each of these policy areas.

Figure 0.4. **Systems view of material flow cycles and policy frameworks**



Source: OECD (2011c), Policy Principles for Sustainable Materials Management, Paris

A review of policies contributing to SMM objectives in OECD countries identified a broad range of policies and policy targets that are currently in use and that address different stages of the material life-cycle (see Figure 0.1 in Chapter Policy Instruments for Sustainable Materials Management with a summary of SMM policies and sample SMM targets across the OECD [OECD, 2011a, b]). The policies in use range from those focusing on a single life-cycle stage (such as feed-in tariffs to promote the development of renewable energy generation, which reduces fossil fuel use and diminishes material extraction) to policies that cut across different stages of the life cycle (such as zero waste or detoxification policies). However, these policy instruments have not all been designed with the SMM principles in mind.

From this overview of SMM policy approaches, a pattern emerges that shows OECD countries are increasingly focusing their policies across the life-cycle, with a progressive shift away from an end-of-life focus. Policy instruments for SMM are also increasingly used within broader packages and programmes in order to address material use across the whole life-cycle. A classification of policy instruments on this basis is difficult, however, because of the breadth of policies which can reasonably be held to fall under the SMM definition.

Some of the key considerations when establishing and implementing SMM policy approaches include:

- The need for a variety of aligned programmes, policies, and initiatives to take into account both a comprehensive SMM policy as well as objectives of specific elements within that. Given SMM's scope it will affect numerous ministries (*e.g.*, environment, economy, finance, labour), industries, environmental media (*e.g.*, air, water, land), which will likely require new partnerships and communication channels between previously independent groups.
- The need to understand the system in question to establish policy, select instruments or set targets. Understanding of the system includes factors such as: the time dimension (*e.g.*, differences in product design cycles); the inter-relationship and opportunities between SMM targets and other activities and objectives (*e.g.*, job creation linked to recycling infrastructure); as well as the aspects (*e.g.*, design, waste, recycling) or impacts that should be addressed by the policy.
- The potential for systemic change, or in other words the capacity of SMM policy makers to "change the rules" through new policy. This is determined by policy makers' authority, both in terms of jurisdictional control over policy implementation as well as their ability to monitor and enforce the policy. This is frequently complicated by market influence and material flows which often cross national borders. It is also important to understand who controls the strategic levers required (*e.g.*, the availability of technological solutions) to affect the change desired.

Given these considerations, it is therefore interesting to see that the more comprehensive SMM policy approaches that are being developed and implemented in various OECD countries have not readily translated into "hard" policy. The complexity of the SMM issue, including its potential to bring into play a large number of different actors, as well as impacts which may take place in other countries, suggests that they are more easily addressed through innovative approaches or a combination of approaches which go beyond the traditional policy tools and which, in some cases, may not easily be categorised as "hard" or "soft".

Key lessons for policy makers

Putting in place policies that promote sustainable materials management and improve resource productivity in the long term, necessitates:

- ***Greater coherence of policies*** relating to resource use and materials management. A key challenge will be to ensure the coherence of policies across sectors, materials and waste streams, *i.e.* to ensure that policies internalise externalities in a consistent manner across the board and avoid shifting environmental impacts across borders and from one phase of the life-cycle to the other. A specific example is that of Green Procurement, where explicit attention needs to be given to the extent of internalisation of environmental costs so as to avoid that green procurement criteria are used to address environmental impacts that have already been internalised through other policies, such as a tax or an emission standard.
- ***Enhanced partnerships*** with the private sector, research, and civil society. Governments need to provide the right incentives so that business and other parts of society can make effective contributions.
- ***Inclusion of social and economic objectives***, as well as environmental ones in SMM policy making in order to stimulate and reinforce sustainable economic, environmental and social dimensions.
- ***Engagement across departmental*** divides as well as including key SMM targets within the wider financial and budget setting process.
- ***Consideration of the full range of policy instruments and tools***. Conventional wisdom suggests that applying one policy to one addressee is the approach which is simplest to design, and most straightforward to implement. The sheer breadth of scope of SMM, which involves many different economic factors that are spread across borders, suggests that SMM action plans and programmes will need to have objectives affecting many sectors and hence, a need for more than one policy.
- ***Establishment of "good" targets*** has the potential to be effective in supporting SMM practices. "Good" targets are credible, supported by government and society, based on sound research, and set at an appropriate level based on the application of benefit-cost analysis) The main challenge for policy makers is to understand the attributes of effective target setting, which is complicated by the multi-national aspect and complexity created by the scope of SMM, and to incorporate these attributes into locally appropriate target-setting processes. tableau 0.1 provides an overview of SMM targets that are being used across the OECD and beyond.
- ***A good understanding of the material basis of the economy***, of international and national flows of materials and their relation to productivity and environmental risks. Material Flow Analysis (MFA), along with life-cycle analysis and other methodologies, contributes to that understanding (OECD, 2007).
- ***An international perspective*** with a common vision and differentiated solutions at the local, regional and global levels. Resource rich and exporting countries, resource poor and import dependent countries, developing and industrialised countries all have different needs. Good practices and technologies need to be shared and taken up where they are most appropriate. OECD countries have a particular responsibility in generating and disseminating good practices and technologies.

Table 0.1. **Sample SMM targets in selected OECD and non-OECD countries and regions**

	Resource extraction	Production	Resource productivity	Consumption	End of life
Japan	Target for resource productivity with respect to earth and rock material		Targets set in the Fundamental Plan for Establishing a Sound Material-Cycle Society	Top Runner Programme provides incentives for reduced energy use from non-industrial sources through a label indicating energy performance[1]	Targets set in the Fundamental Plan for Establishing a Sound Material-Cycle Society Programme looking at waste-related GHG emissions
Netherlands	Programme looking at impact on land use (goals due out late 2009)	Programme looking at pollution, GHG reduction and land use (goals due out late 2009)			Goals due out late 2009
Belgium (Flanders)	General objective to minimise use of finite resources	General objective to increase number of Flemish companies producing in an eco-efficient way by 2009 (based on 2003 ecoefficiency rates)	General objective to optimise use of renewable resources	Increase sustainable consumption in retail and government sectors by 2015, based on 2008 levels	Extensive, quantifiable targets for household and industrial waste, building projects, end-of-life vehicles, tires, WEEE, batteries and oil
Finland	Target looking at gravel and crushed stone used in earthworks	Material efficiency criteria and related programmes in development under the new waste management programme (targets due out in 2010)		Material efficiency criteria and related programmes in development under the new waste management programme (targets due out in 2010)	Extensive, quantifiable targets for municipal waste, manure and building projects
EU			Increase resource productivity at the same or greater rate than the 2.2% productivity improvement seen over the last 10 years		Extensive, quantifiable targets for household waste, end-of-life vehicles, WEEE, batteries and packaging
Chinese Taipei		No specific targets, but there are restrictions on manufacturing, import and sales of zinc-manganese batteries and alkaline manganese batteries that contain over 5 ppm of mercury			Quantifiable targets for household and industrial waste
Mexico	General objective to minimise use of finite resources	No specific targets, but producers of special management wastes and hazardous end-of-life products must develop specific waste management plans	General objective to increase use of recyclable and reusable materials in production		General goal to increase alternative end-of-life waste treatment (thermal/caloric or composting) and reduce waste to landfill by 2012

1. British Columbia Ministry of Environment (2009), *Design for Environment (DfE) Best Practices Lessons for British Columbia's Ministry of Environment*, p. 11

Source: This table is based on available data, however, there are likely to be additional targets and programmes addressing the various stages defined, as well as similar practices in other OECD countries. See additional detail and source information in Annex 2.A1: National SMM-Related Target Summary Tables.

Challenges and the way forward

A major challenge of sustainable materials management is the sheer breadth of scope that is implied by the whole of life-cycle approach that is at the heart of SMM. For any given material or product an SMM approach will need to address a large number of economic actors that are active along the value chain in different sectors of the economy (*e.g.*, miners, smelters, manufacturers, consumers, waste collectors and recyclers), as well as co-ordinating a number of different policy areas (*e.g.*, agricultural, mining, product standards, fiscal,

environmental). The geographic spread of actors and policies across different jurisdictions further adds to the complexity. Dealing with this situation requires a high level of co-ordination and co-operation between economic actors, different parts of government, as well as intergovernmental co-operation to deal with transboundary issues.

Furthermore, addressing the life cycle of products and materials is difficult to operationalise as a single policy, requiring the use of multiple instruments instead. If policies are developed with specific emphasis on some targeted material/product streams, the challenge becomes one of seeking to minimise distortions across product and material streams and the potential shifting of the environmental burden that this could induce.

A third challenge is linked to the significant need for detailed, good quality data that SMM policy making requires to avoid unintended effects. In order to effectively target policies, detailed information about the type and magnitude of environmental impacts along the material life-cycle is needed, such as is available from life-cycle assessments. This needs to be complemented with data about the costs of environmental damage through economic valuation and the application of cost benefit analysis.

SMM, therefore, requires both a high level of co-ordination between economic actors and different policy areas, as well as a significant amount of detailed data on environmental impacts and the valuation of these in economic terms as a basis for effective policy making.

What can governments do?

The above calls for a range of actions from governments, including:

- Additional efforts to improve data and especially to translate life-cycle data on environmental impacts into economic costs.
- The prioritisation of material flows according to their environmental impact and the development of pilot projects that would allow to test new SMM based approaches, such as in the "Chain-oriented Waste Policy" that is currently experimented in The Netherlands.
- The development of innovative frameworks and processes to co-ordinate policies between a larger number of ministries.
- Facilitate co-operation of economic actors along the value chain (raw material producers, manufacturers, retailers, consumers, waste managers) in order to find joint solutions towards closing material cycles.
- Foster innovation and make available the necessary financial means to support technological and non-technological innovation towards SMM.
- The development of initiatives for international co-operation on specific high profile material and product streams.

What can enterprises do?

The transition to SMM will also require a new approach to doing business that integrates life cycle thinking in the way that enterprises operate. New business models need to be developed that focus on the establishment of green supply chains, on finding low impact substitutes for high-impact materials, goods and services, as well as on redesigning material and value cycles in more sustainable ways. Industrial entrepreneurs ought to become life cycle managers, who assess the impacts of materials usage and seek to minimise these impacts.

How can the OECD assist governments in this task?

The OECD can assist governments in this task by:

- identifying key policy gaps and coherence issues as well as the policy measures that an SMM approach would need to undertake to address these for specific materials and products through a number of case studies on priority materials;
- analysing the benefits and the costs of SMM approaches, including the economic and administrative costs of additional planning and consultation;
- gathering the experiences that are being made with SMM approaches in OECD and non-OECD countries in order to develop policy guidance for SMM with a particular focus on policy instruments and mixes, as well as the governance arrangements that are required for effective co-ordination of policies across sectors and at the international level.

Notes

1. The OECD working definition includes the following explanatory notes:

   "Materials" include all those extracted or derived from natural resources, which may be either inorganic or organic substances, at all points throughout their life-cycles.

   "Life-cycle of materials" includes all activities related to materials such as extraction, transportation, production, consumption, material/product reuse, recovery and disposal.

   An economically efficient outcome is achieved when net benefits to society as a whole are maximised.

   A variety of policy tools can support SMM, such as economic, regulatory and information instruments and partnerships.

   SMM may take place at different levels, including firm/sector and different government levels.

   SMM may cover different geographical areas and time horizons."

2. See *www.oecd.org/environment/gfenv.*
3. It should be noted that domestic material consumption (DMC) does not take into account the hidden material flows linked to trade (also called indirect material flows) and unused extraction. If these were taken into account (but lack of data is preventing this for the moment at the OECD level) progress in resource productivity might show a different trend.
4. Material intensity is domestic material consumption per unit of GDP.
5. The DEFRA report defines resource efficiency as "any action or intervention that results in a reduction in overall material usage or greenhouse gas emissions that is either cost neutral or cost negative." The study focuses on four key resources: water, energy, waste and materials.
6. Ernst and Young (2006), Eco-Industry, Its Size, Employment, Perspectives and Barriers to Growth in an Enlarged EU, rapport établi pour la DG Environnement de la Commission européenne.
7. See *www.oecd.org/environment/gfenv.*

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Résumé et recommandations

Messages clés

Le rôle décisif que peut jouer la gestion durable des matières (GDM) dans la croissance verte est de mieux en mieux perçu. La manière dont les économies utilisent les ressources matérielles conditionne largement les pressions exercées sur l'environnement, et la GDM peut aider à mieux maîtriser cette équation. Les pays de l'OCDE mettent actuellement en œuvre un large éventail de mesures dans ce domaine.

Les grands principes au cœur de la GDM sont la préservation du capital naturel, la prise en compte du cycle de vie, le déploiement de toute la panoplie d'instruments disponibles et l'approche multipartite.

Un des principaux enjeux de la GDM consiste à parer efficacement aux incidences environnementales possibles tout au long du cycle de vie des matières, qui, bien souvent, ignore les frontières politiques et géographiques et concerne une multiplicité d'acteurs économiques différents.

L'économie, l'environnement et l'emploi ont beaucoup à y gagner. Les stratégies de GDM peuvent aider à améliorer la compétitivité, à résoudre les problèmes de sécurité d'approvisionnement et à dynamiser la croissance et la création d'emplois, tout en favorisant la protection de l'environnement et la conservation des ressources.

Des instruments très variés peuvent être mis au service de la GDM, la difficulté étant de les doser comme il convient aux différents stades du cycle de vie des matières. Les stratégies classiques obéissent souvent à une conception trop étroite en faisant porter les efforts sur un seul point du cycle de vie. Pour appréhender ce cycle dans son ensemble, il faut prendre en compte le caractère transfrontière des flux de matières et la diversité des acteurs économiques qui interviennent dans la gestion des matières. Face à ce défi, une évaluation rigoureuse s'impose pour voir si, et comment, les outils habituels doivent être associés et adaptés.

Pour les responsables de l'élaboration des politiques, il ressort avant tout que la GDM exigera une plus grande cohérence des mesures pour l'ensemble des branches d'activité et des milieux de l'environnement. Celle-ci suppose, entre les différentes composantes de l'administration, une coopération rompant avec les pratiques en vigueur. Les politiques de GDM appelleront aussi un renforcement des partenariats entre les acteurs économiques concernés, de même qu'une vision internationale et davantage d'efforts de développement des capacités.

Pourquoi il faut agir

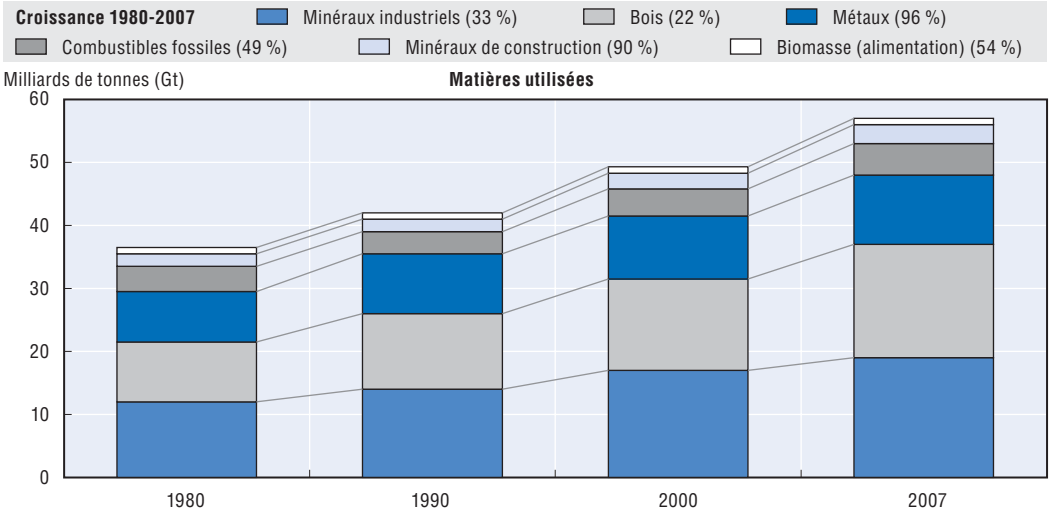
D'ici à 2030, la taille de l'économie devrait doubler et la population va sans doute augmenter d'un tiers. L'élévation des revenus et des niveaux de vie fait aussi progresser la consommation mondiale de combustibles fossiles, de minéraux, de métaux, de bois

d'œuvre et d'aliments végétaux, non sans exercer des pressions sur les ressources naturelles et l'environnement. Le volume total des ressources matérielles extraites ou récoltées dans le monde a avoisiné 60 milliards de tonnes (Gt) (OECD, 2011h) en 2007, soit 65 % de plus qu'en 1980 (graphique 0.1) ; il a été multiplié par huit au cours du siècle dernier.

Le passage à la croissance verte et l'instauration d'une économie sobre en ressources figurent donc aujourd'hui au premier rang des priorités pour l'environnement, le développement et la situation macroéconomique. D'où la nécessité de mettre en place des politiques assurant une gestion durable des déchets et des matières selon le principe des 3R : réduire, réutiliser, recycler. Moyennant une gestion plus durable des matières, il est possible d'améliorer non seulement l'état de l'environnement – en réduisant la quantité de ressources nécessaires à l'activité économique humaine et en atténuant les incidences écologiques –, mais aussi la sécurité d'approvisionnement en ressources et la compétitivité.

Jusqu'à une date récente, les gouvernements ont vu dans la gestion des déchets un moyen de maîtriser l'impact des matières sur l'environnement. Si les politiques dans ce domaine s'avèrent très concluantes, des travaux montrent que, bien souvent, la gestion des déchets n'est pas la panacée, ni la solution la plus efficace au meilleur coût, pour réguler les flux de matières dans les systèmes industriels et économiques.

Graphique 0.1. **Extraction de ressources matérielles à l'échelle mondiale, 1980-2007**



Source: OCDE (2011), *Productivité des ressources dans les pays du G8 et de l'OCDE – Rapport établi dans le cadre du Plan d'action 3R de Kobe*, Paris.

D'après la théorie économique, face à des défaillances du marché telles que les externalités environnementales, renvoyant à un coût pour l'environnement qui n'est pas répercuté par le biais des prix du marché, le remède passe souvent par des instruments économiques comme les taxes et les redevances. Les ressources environnementales peuvent alors être utilisées de façon rationnelle par tous les acteurs au moindre coût pour l'économie. Toutefois, la mise en œuvre des instruments économiques ne va pas de soi, en raison des résistances politiques et sociales qu'ils suscitent et des difficultés rencontrées pour déterminer le coût exact des externalités.

Aussi les responsables de l'élaboration des politiques ont-ils plutôt pris des dispositions au cas par cas, visant des matières, des produits, des étapes du cycle de vie ou des ressources environnementales précis, qui aboutissent à un grand morcellement de l'action publique. Par exemple, malgré l'instauration du système communautaire d'échange de quotas d'émission de gaz à effet de serre (SCEQE), la politique climatique menée dans les États membres de l'UE fait aussi appel à des instruments très divers, comme en témoignent les tarifs d'achat de l'électricité renouvelable, les subventions pour l'isolation des bâtiments et les normes d'émission de CO_2 applicables aux véhicules. Si les questions environnementales complexes nécessitent, en général, de recourir à une panoplie d'instruments d'action, un dispositif fragmenté présente toutefois un risque car le manque d'intégration et de coordination des mesures entraîne des distorsions économiques et peut déplacer les pressions vers un autre milieu de l'environnement ou vers l'étape suivante du cycle de vie, au lieu de réduire les impacts environnementaux à l'échelle de l'économie tout entière.

Encadré 0.1. **Définition de travail établie par l'OCDE de la gestion durable des matières**

La gestion durable des matières (GDM) est définie comme « … *une approche destinée à promouvoir une utilisation durable des matières, qui comprend des mesures visant à réduire les incidences négatives sur l'environnement et à préserver le capital naturel tout au long du cycle de vie des matières, sans perdre de vue l'efficience économique et l'équité sociale* »[1].

L'OCDE étudie cette nouvelle approche intégrée de la gestion des matières depuis 2004, en insistant sur les politiques et instruments qui peuvent aider à instaurer la GDM et donner effet à la Recommandation du Conseil sur la productivité des ressources adoptée en 2008. Elle a publié des travaux sur la fixation d'objectifs, les principes et les instruments en faveur de la GDM, ainsi que des études de cas portant sur des matières précises (OCDE, 2011a, b, c, d, e, f, g), et un Forum mondial de l'OCDE sur l'environnement consacré à la GDM en octobre 2010 a proposé des initiatives et mesures concrètes pour mettre la GDM en pratique et faire le lien avec d'autres domaines d'action[2].

Le déploiement de politiques et pratiques de GDM semble être une bonne stratégie pour découpler la croissance économique de la consommation de ressources naturelles. La GDM est donc incontournable dans toute stratégie de croissance verte. Les politiques de GDM devraient aussi atténuer indirectement les demandes à l'égard des ressources naturelles, et contribuer par conséquent à renforcer la sécurité d'approvisionnement en ressources.

Cependant, les chaînes d'approvisionnement industrielles s'étendent aujourd'hui sur toute la planète, et les politiques de GDM doivent faire en sorte que les impacts environnementaux ne soient pas simplement transférés au-delà des frontières par des mécanismes comme la délocalisation. À cet égard, la GDM doit relever un double défi : prendre en compte l'ensemble des incidences liées aux matières tout au long du cycle de vie des produits, exploitation minière, agriculture et transports compris ; et trouver des moyens d'influer sur le comportement d'acteurs économiques opérant sur différents territoires.

Écueil supplémentaire, l'utilisation de matières est indissociable de la consommation d'autres ressources naturelles, telles que l'énergie et l'eau. Les politiques proposées doivent tenir compte de ces liens d'interdépendance pour éviter des conséquences indésirables. Par exemple, beaucoup ont préconisé le remplacement de matières non renouvelables comme les dérivés du pétrole par des matières renouvelables biosourcées, mais celles-ci peuvent peser beaucoup plus sur les ressources en eau et divers services écosystémiques (A. Baral et B.R. Bakshi, 2010).

Encadré 0.2. **Contexte du travail de l'OCDE sur la GDM**

L'OCDE a commencé à travailler sur la gestion durable des matières (GDM) afin de mettre l'accent sur les politiques intégrées de gestion des matières, des produits et des déchets et afin de traiter les impacts environnementaux sur le cycle de vie complet des matières. Le point de départ de ces travaux a été un premier atelier de l'OCDE sur la GDM organisé en novembre 2005 à Séoul (Corée) avec l'objectif de faire le bilan des connaissances en la matière et des démarches de GDM dans les pays membres de l'OCDE, ainsi que de développer une définition de travail.

La définition de travail établie par l'OCDE comprend les ***notes explicatives*** suivantes :

- *Le terme « matières » comprend tous ceux extraits ou dérives de ressources naturelles, qui peuvent être soit des substances minérales ou organiques, à tous les points de leur cycle de vie.*
- *« Cycle de vie des matières » comprend toutes les activités liées aux matières tels que l'extraction, le transport, la production, la consommation, la réutilisation des produits/matières, la valorisation et la mise en décharge.*
- *Un résultat économiquement efficient est atteint lorsque les bénéfices nets pour la société dans son ensemble sont maximisés.*
- *Une variété d'outils de politique peuvent soutenir la GDM, tels que les instruments économiques, réglementaires et d'information ainsi que les partenariats.*
- *La GDM peut avoir lieu à différents niveaux, y compris dans les entreprises et les secteurs économiques ainsi qu'à différents niveaux de gouvernement.*
- *La GDM peut couvrir des zones géographiques et des horizons de temps différents.*

Un deuxième atelier, axé sur les contributions du secteur privé à la GDM, mais aussi sur celles des ONG et des organisations internationales, s'est tenu en 2008 à Tel-Aviv (Israël). La discussion lors de cet atelier a fait état des efforts considérables au niveau des entreprises pour la mise en place d'une gestion durable des flux de matières et des processus de production, ce qui a amené des modifications dans la gestion des produits et des matières, en mettant en œuvre une approche du cycle de vie complet et en incorporant les trois piliers du développement durable dans les pratiques au niveau des entreprises.

Une troisième étape a consisté en un forum mondial de l'OCDE sur la GDM, qui s'est tenu en octobre 2010 à Malines, en Belgique, et qui a examiné et approuvé un certain nombre de documents de politique de la GDM ainsi que des études de cas de matières, dont l'objet était de fournir des conseils aux décideurs politiques et d'illustrer les enseignements qui peuvent être acquis à partir d'une approche GDM. Les documents de politique, qui traitent des principes de la GDM, de l'utilisation et de la détermination d'objectifs, ainsi que des instruments politiques de la GDM sont présentés dans les chapitres suivants. Les études de cas de matières sont disponibles sur le site de l'OCDE à l'adresse *www.oecd.org/env/waste*.

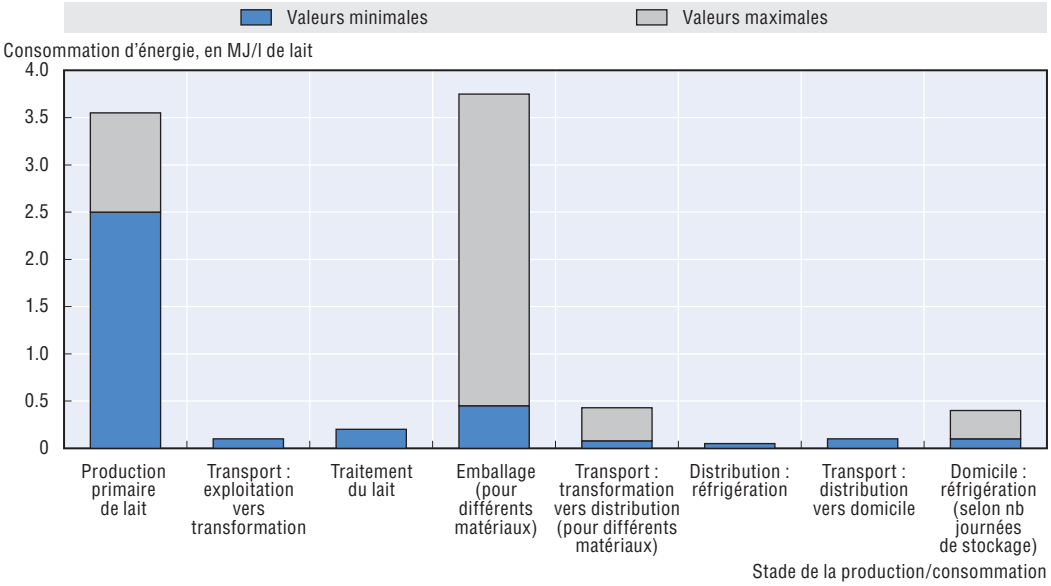
Avantages apportés par la GDM

Moindre impact environnemental tout au long du cycle de vie et plus grande cohérence de l'action publique

La gestion durable des matières permet de réduire les incidences sur l'environnement en diminuant les rejets de substances toxiques dans différents milieux et en limitant l'exposition humaine. Elle contribue aussi à atténuer les pressions exercées sur les ressources en faisant baisser les quantités de matières à extraire. En outre, la GDM peut servir à assurer la durabilité des décisions en équilibrant les considérations sociales, environnementales et économiques tout au long du cycle de vie d'un produit ou d'une matière, tout en évitant que les impacts négatifs ne soient transférés du processus de production au stade de la consommation, ou inversement. La GDM permet donc aux décideurs d'identifier l'incohérence éventuelle des politiques et d'y remédier.

Par exemple, diverses mesures vont dans le sens d'une moindre production de déchets, notamment en encourageant les consommateurs à acheter des produits, alimentaires et autres, dans des conditionnements plus grands qui réduisent proportionnellement le volume de déchets d'emballages. Si une telle approche est utile, il convient toutefois de prendre aussi en compte la question concomitante de la réduction au minimum des déchets. À en juger par certaines études sur le cycle de vie, les produits alimentaires peuvent avoir une empreinte écologique considérablement plus importante que les emballages qui les contiennent. Dans le cas d'un récipient d'un litre de lait, par exemple, le contenu peut générer cinq fois plus de CO_2 que le matériau d'emballage. Par conséquent, lorsque les consommateurs optent pour de grands conditionnements et finissent par jeter des aliments périmés, l'impact risque fort d'être plus dommageable pour l'environnement que s'ils avaient acheté de plus petits conditionnements en produisant moins de déchets alimentaires et un peu plus de déchets d'emballages (graphique 0.2) (Foster, C. *et al.*, 2006).

Graphique 0.2. **Énergie utilisée dans le système classique de production et de consommation du lait**



Source: Foster, C. *et al.* (2006), *Environmental Impacts of Food Production and Consumption: A report to the Department for Environment, Food and Rural Affairs*, Manchester Business School, Defra, Londres.

Un autre exemple d'un problème de cohérence des politiques concerne les politiques d'achats écoresponsable et la possibilité de double comptage des externalités. Lors de l'introduction d'une approche d'achats écoresponsable, une attention explicite doit être donnée à l'éventuelle internalisation des coûts environnementaux de manière à éviter que les critères d'achats éco-responsable soient utilisés pour traiter des impacts environnementaux qui ont déjà été internalisés par le biais d'autres politiques, telles qu'une taxe ou une norme d'émission.

Atténuation de la dépendance à l'égard des matières premières

L'accès aux ressources figure désormais au premier rang des préoccupations politiques, car le prix de nombreuses ressources a très fortement augmenté et les pays producteurs ont parfois restreint les exportations de certaines d'entre elles. La gestion durable des matières peut contribuer à atténuer ces problèmes en augmentant la quantité produite par unité de matière et en remettant dans le circuit économique, par la réutilisation ou le recyclage, les matières qui ont atteint la fin de leur vie utile, autrement dit en réduisant la consommation totale de matières premières et en améliorant la productivité des ressources.

Encadré 0.3. **Efficacité d'utilisation et productivité des ressources**

Les notions d'efficacité d'utilisation et de productivité appliquées aux ressources ont été définies comme suit dans l'ouvrage publié en 2008 par l'OCDE sous le titre *Measuring material flows and resource productivity – Volume I. The OECD Guide*.

Efficacité d'utilisation des ressources : aucune définition commune n'a été arrêtée. Cette notion renvoie à l'efficience économique et à l'efficacité environnementale avec lesquelles les ressources naturelles sont utilisées par une économie ou un procédé de production. Par ailleurs, elle revêt un sens à la fois *quantitatif* (quantité produite à partir d'un apport donné de ressources naturelles, par exemple) et *qualitatif* (impacts environnementaux par unité produite à partir d'un apport donné de ressources naturelles, par exemple).

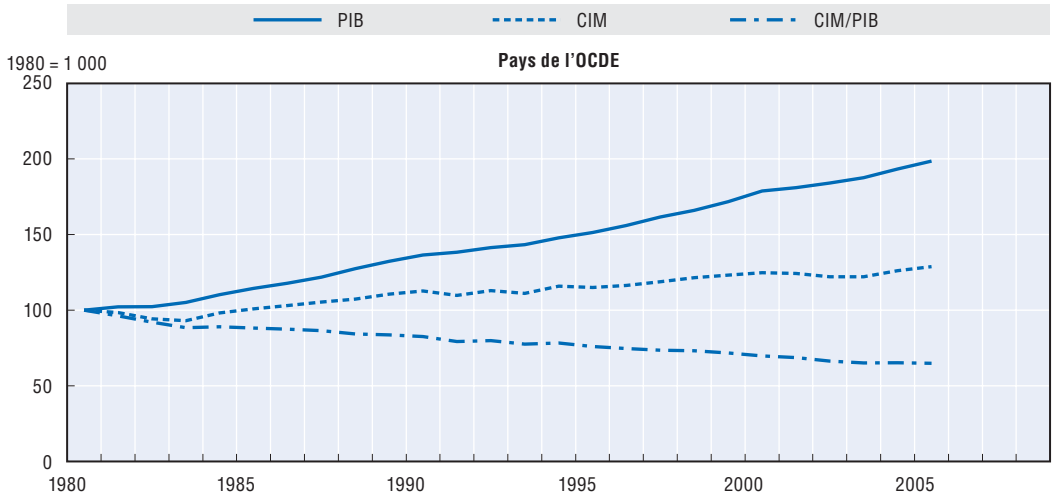
Productivité des ressources : efficacité avec laquelle les ressources naturelles sont utilisées par une économie ou un procédé de production. Elle peut être définie selon les critères ci-dessous.

- L'efficience économique-physique, c'est-à-dire la valeur ajoutée monétaire de la production par unité de masse des intrants utilisés. Il s'agit de découpler valeur ajoutée et consommation de ressources.
- L'efficience physique ou technique, c'est-à-dire la quantité d'intrants requise pour obtenir une unité de produit, les deux étant exprimées en termes physiques (minerai de fer nécessaire pour produire de l'acier brut ou matières premières nécessaires pour produire un ordinateur, une voiture, des piles/batteries, par exemple). Il s'agit d'optimiser la production, au moyen d'un ensemble déterminé d'intrants et d'une technologie donnée, ou de réduire au minimum les intrants pour obtenir une quantité donnée.
- L'efficience économique, c'est-à-dire la valeur monétaire de la production rapportée à la valeur monétaire des intrants. Il s'agit de réduire au minimum les coûts des ressources utilisées.

Tels qu'ils sont employés dans le présent rapport, les concepts d'efficacité d'utilisation des ressources et de productivité des ressources sont donc en grande partie équivalents.

La productivité des ressources s'est améliorée dans la zone OCDE, où elle a fait un bond de 42 % entre 1980 et 2008 (graphique 0.3). L'explication tient en partie aux diverses mesures mises en place par les pays membres pour accroître l'efficacité d'utilisation des ressources et la récupération de matières à partir des déchets.

Graphique 0.3. **Consommation de matières et PIB dans les pays de l'OCDE**[1]



Notes : Les données relatives à l'OCDE ne comprennent pas les pays suivants : Chili, Estonie, Hongrie, Pologne, République slovaque, République tchèque, Slovénie et Israël.

1. La consommation intérieure de matières (CIM) est une variable utilisée dans la comptabilité des flux de matières. La CIM mesure la masse (le poids) des matières physiquement utilisées dans les activités de production et de consommation du système économique intérieur (c'est-à-dire la consommation apparente directe de matières, à l'exclusion des flux indirects). Dans la comptabilité des flux de matières à l'échelle macroéconomique, la CIM est égale à l'extraction intérieure augmentée des importations et diminuée des exportations. *Source* : OCDE (2008), *Measuring material flows and resource productivity – Volume I. The OECD Guide.*

Source: Base de données de l'OCDE sur les flux de matières, Perspectives économiques de l'OCDE et Banque mondiale.

L'OCDE a créé une série d'indicateurs environnementaux parmi lesquels figurent ceux servant à illustrer la productivité des ressources. Le graphique 0.3 met en évidence le découplage progressif du PIB et de la CIM, indicateur de la productivité des ressources, les pays de l'OCDE produisant une quantité croissante de biens et de services par unité de matière utilisée[3].

Au Japon, l'un des pays les mieux placés de la zone OCDE en termes d'efficacité d'utilisation des ressources, plusieurs mesures répondant au principe des 3R (réduire, réutiliser, recycler), qui sous-tend la mise en œuvre de la « loi fondamentale pour l'édification d'une société fondée sur un cycle rationnel des matières », ont contribué à améliorer le taux d'utilisation cyclique des matières. Ce taux, qui rapporte les ressources récupérées à l'ensemble des matières utilisées dans l'économie japonaise, a augmenté de 41 % depuis 2000, pour atteindre 14.1 % en 2008. En 2005, notamment grâce aux efforts ainsi déployés, l'intensité matérielle du Japon[4] était inférieure de 37 % à la moyenne de l'OCDE (OCDE, 2010).

Compétitivité accrue pour un coût faible ou nul

Une gestion plus durable et plus rationnelle des matières aide aussi à améliorer la compétitivité en réduisant le coût des intrants. Au Royaume-Uni, les économies d'intrants que pourraient réaliser les entreprises grâce aux possibilités inexploitées de gains

d'efficacité d'utilisation des ressources[5], pour une période d'amortissement de moins d'un an, ont été estimées à 23 milliards GBP en 2009, dont environ 18 milliards au titre de la réduction des déchets et d'une meilleure gestion des matières. Pour une période d'amortissement de plus d'un an, il serait possible de réaliser des économies supplémentaires de l'ordre de 33 milliards GBP, également imputables pour l'essentiel à la réduction des déchets et à la gestion des matières (22 milliards GBP) (Defra, 2011).

Une multinationale a chiffré le coût des déchets liés à son activité de fabrication de chaussures à 550 millions EUR par an. Dans le cadre d'un programme à long terme visant à économiser les ressources, la rationalisation de la production et une meilleure conception des chaussures ont permis de réduire les quantités de déchets de 67 %, la consommation d'énergie de 37 % et l'utilisation de solvants de 80 % dans toute sa filière d'approvisionnement (Defra, 2011).

Rôle dans la croissance et l'emploi

Les mesures qui aident à améliorer la productivité des ressources peuvent favoriser l'innovation et susciter des activités économiques nouvelles comme la collecte et le traitement ou le recyclage des déchets, sources possibles de croissance et d'emplois.

Les entreprises à vocation environnementale de l'UE, exerçant des activités qui englobent la lutte contre la pollution, la collecte et le traitement des déchets, les énergies renouvelables et le recyclage, réalisent un chiffre d'affaires global de plus de 300 milliards EUR ; elles fournissent près de 3.5 millions d'emplois et se taillent une part de marché de 30 à 40 % à l'échelle mondiale. Ce secteur affiche un taux de croissance annuel supérieur à 8 %, sur un marché mondial qui devrait atteindre 4 000 milliards EUR d'ici au milieu de la décennie, et qui offre beaucoup de nouveaux emplois verts qualifiés.

Plus précisément, le nombre d'emplois dans l'industrie du recyclage est estimé à 1.8 million pour l'UE27[6]. D'après une étude récente des Amis de la terre sur les perspectives dans ce domaine, jusqu'à 322 000 emplois directs pourraient s'y ajouter à l'échelle de l'UE27 si le recyclage passait de 50 % (comme le prévoient les politiques en vigueur) à 70 % pour des matières clés. Compte tenu des emplois indirects et induits, quelque 550 000 emplois pourraient être ainsi créés au total (Friends of the Earth, 2010).

Principes d'action pour la GDM

Des travaux ont été engagés à l'OCDE afin de formuler des orientations pratiques à l'intention des décideurs soucieux d'améliorer la productivité des ressources dans leur économie et d'instaurer des politiques de gestion durable des matières. Ils se sont traduits par un certain nombre de rapports, d'ateliers et de manifestations, dont la plus récente a été un Forum mondial sur l'environnement consacré à la gestion durable des matières en octobre 2010 à Malines (Belgique). Plusieurs documents d'orientation et études de cas ont rendu compte des efforts déployés dans ce domaine[7]. Les principaux enseignements qui se dégagent pour l'instant de ces travaux sont récapitulés ci-après.

Les derniers travaux en date de l'OCDE incitent, dans la mesure du possible, à faire prévaloir quatre grands principes d'action pour l'élaboration des politiques de GDM (OCDE, 2011c).

Principe 1 – Préserver le capital naturel

Les ressources environnementales et les écosystèmes sont indispensables à toute forme de vie et constituent le capital naturel dont dépendent les êtres humains. La gestion

durable des matières peut contribuer à préserver le capital naturel et s'avère indispensable pour répondre à l'impératif de viabilité à long terme. Le principe d'action 1 vise à mobiliser les meilleures pratiques disponibles dans des domaines englobant la science, l'ingénierie, le commerce et la gestion pour enrayer la destruction et l'appauvrissement progressifs du capital naturel et assurer sa préservation, aujourd'hui et pour les générations futures. En modélisant l'utilisation humaine de matières sous la forme d'un système de flux de matières et d'impacts environnementaux, on peut définir des stratégies générales propices à la préservation du capital naturel. Ces stratégies permettent ensuite d'élaborer des politiques et des instruments d'action adaptés aux spécificités des pays. Des exemples de stratégies envisageables au titre du principe d'action 1 pour la GDM sont donnés ci-dessous :

- améliorer l'information sur les flux de matières et les impacts environnementaux ;
- accroître la productivité des ressources et l'efficacité d'utilisation des ressources (voir encadré 0.2) ;
- réduire la quantité de matières mises en œuvre, en particulier dans le cas des matières à fort impact ;
- accroître la réutilisation/le recyclage des matières pour préserver le capital naturel ; et
- affiner les technologies permettant de tirer des ressources naturelles des matières qui évitent la production de déchets et le rejet de produits toxiques tout en favorisant la santé à long terme des écosystèmes (éco-innovation).

Principe 2 – Concevoir et gérer les matières, les produits et les procédés dans une optique de sécurité et de durabilité tout au long du cycle de vie

C'est au stade de la conception que sont prises les décisions qui déterminent les impacts tout au long du cycle de vie. Le principe d'action 2 pour la GDM tend, par le biais de la conception, à porter au maximum les impacts positifs (et à réduire au minimum les impacts négatifs) sur l'environnement comme sur le bien-être et la santé des êtres humains. Une gestion soucieuse d'assurer la sécurité et la durabilité à tous les stades du cycle de vie vise à éviter que les risques ne soient transférés d'une étape de la chaîne de valeur ou d'une région géographique à une autre. Les résultats économiques et sociaux s'en trouvent optimisés, le capital naturel est préservé et les matières sont gérées de façon durable.

Le principe d'action 2 pour la GDM préconise aussi une coopération accrue entre les acteurs de l'ensemble du cycle de vie de façon que tous soient sensibilisés aux incidences de leurs actions et décisions sur les autres stades du cycle de vie et puissent agir en conséquence. Trois stratégies générales de conception des matières, des produits et des procédés vont dans le sens de la GDM et peuvent être encouragées par des politiques publiques.

- **Détoxication** – La détoxication contribue à la GDM en mettant fin à l'accumulation progressive de produits chimiques et de composés produits par la collectivité qui sont préjudiciables à la santé humaine et à l'environnement, impossibles à maîtriser de façon appropriée ou sûre, ou coûteux à gérer d'un point de vue économique ou environnemental. La détoxication passe par la chimie verte/durable et le remplacement de certains produits chimiques.
- **Dématérialisation** – La dématérialisation contribue à la GDM en réduisant la quantité de matières mises en œuvre, à commencer par celles qui ont des impacts négatifs importants au cours du cycle de vie. Autrement dit, il faut « faire plus avec moins » et

utiliser les matières premières de façon plus rationnelle (efficacité d'utilisation des ressources) sans sacrifier la qualité du service rendu. Outre l'efficacité d'utilisation des ressources, les stratégies de dématérialisation consistent aussi à remplacer certaines matières et à substituer des services aux produits.

- **Conception axée sur la valorisation** – La conception axée sur la valorisation contribue à la GDM en faisant en sorte que les produits et les matières soient destinés dès le début à être réutilisés et recyclés, et qu'un modèle efficace de valorisation soit en place (logistique inverse). La conception axée sur la valorisation peut être dynamisée par des politiques mettant en avant, entre autres exemples, la responsabilité élargie des producteurs (REP), « du berceau au berceau ». En allant de la production jusqu'à la valorisation des résidus, une telle démarche vise à rétablir des cycles continus de matières qui apportent des effets positifs à long terme en termes de rentabilité, d'environnement et de santé humaine.

Encadré 0.4. **Préserver le capital naturel : l'exemple des fibres ligneuses**

Une étude a été consacrée aux perspectives de gestion durable des matières (GDM) dans le cas des fibres ligneuses (produits de l'industrie des pâtes et papiers), car dans ce secteur les possibilités ne manquent pas de réduire la consommation d'énergie, les émissions de gaz à effet de serre (GES) et les quantités d'eau utilisées tout au long du cycle de vie des produits dans ce secteur. Elle met en évidence les solutions envisageables pour atténuer les incidences environnementales aux différentes étapes du cycle de vie des fibres ligneuses.

- Il serait possible de réduire de 20 à 30 % la consommation d'énergie liée aux technologies existantes dans les usines de pâte à papier conventionnelles. Les économies d'énergie peuvent être particulièrement grandes pour les procédés chimiques et thermo-mécaniques. Le séchage du papier, l'opération la plus gourmande en énergie sur l'ensemble du cycle de vie, représente 15 à 25 % du total des quantités utilisées.
- L'utilisation croissante, et plus rationnelle, de l'énergie tirée de la biomasse – sans émission nette de GES, en théorie, si elle provient de forêts gérées de façon écologiquement viable – peut encore faire baisser les émissions de GES. Les pratiques de gestion forestière durable et la certification correspondante sont essentielles si l'on veut que les biocombustibles restent neutres en carbone.
- Selon que la fabrication de pâte à papier fait appel à des procédés mécaniques ou chimiques, les quantités d'eau utilisées peuvent pratiquement passer du simple au double. Il est possible de réduire la consommation d'eau de 25 à 50 % dans les usines conventionnelles par divers moyens : emploi de techniques telles que l'écorçage à sec, fermeture partielle ou totale de certain circuits d'eau, amélioration du système de lavage et blanchiment sans chlore élémentaire ou enzymatique.
- Le recyclage des produits mis au rebut permet de réaliser des économies d'énergie allant de 7 à 19 GJ par tonne de papier recyclé et de réduire les émissions de GES par rapport à la fabrication à partir de fibres vierges. Des efforts axés sur l'amélioration de la collecte des papiers récupérés, la réduction des taux de contamination et la mise au point de nouvelles technologies et de procédés inédits de fabrication des pâtes peuvent apporter des gains d'efficience plus importants encore dans l'utilisation des papiers récupérés.

Encadré 0.4. **Préserver le capital naturel : l'exemple des fibres ligneuses** *(suite)*

- Bien que le recyclage du papier consomme globalement moins d'énergie, les quantités de GES rejetées au stade de la fabrication peuvent être plus grandes, dès lors que les usines utilisent des combustibles fossiles, que pour la production de papier à base de fibres vierges faisant appel à des biocombustibles – dont le bilan carbone est faible ou nul. Malgré tout, les réductions obtenues du fait que la mise en décharge est évitée viennent plus que compenser ces émissions supplémentaires de GES, et le recyclage pourrait être plus intéressant encore à cet égard si la biomasse et diverses formes d'énergie non fossiles intervenaient dans la fabrication du papier recyclé.
- Étant donné que les installations de combustion des pays de l'OCDE sont normalement équipées de systèmes de récupération de l'énergie, les rebuts fibreux envoyés à ces installations peuvent servir à produire de l'électricité pour le réseau, en remplaçant éventuellement des combustibles fossiles.
- Les rebuts et résidus de pâtes et papiers qui sont mis en décharge rejettent du méthane, et représentent ainsi une large part des GES émis sur l'ensemble du cycle de vie. Aussi importe-t-il de soustraire à la mise en décharge de tels déchets à fort potentiel d'émission de méthane.
- Enfin, d'un bout à l'autre du cycle de vie, la réduction à la source – alléger les emballages, imprimer et photocopier les documents recto-verso et réutiliser le papier, entre autres pratiques – est un principe général à retenir pour diminuer l'empreinte écologique.

Source : OCDE (2011), A Sustainable Materials Management Case Study: Wood Fibres, Paris.

Principe 3 – Utiliser toute la panoplie d'instruments disponibles pour susciter et inscrire dans la durée des retombées économiques, environnementales et sociales.

Pour faire adopter une gestion plus durable des matières, les pouvoirs publics peuvent utiliser des leviers très divers : réglementations ; mesures économiques d'incitation et de dissuasion ; politiques applicables aux échanges et à l'innovation ; mise en commun des informations ; et constitution de partenariats.

Chacun de ces mécanismes présente des avantages et des inconvénients et peut avoir des impacts bénéfiques. Toutefois, un mécanisme unique ne saurait convenir dans toutes les circonstances. Par conséquent, une approche diversifiée, empruntant à une vaste panoplie de mesures et d'instruments, a plus de chances d'influer sur tous les acteurs concernés qu'une solution toute faite. En associant ces divers mécanismes d'intervention pour jouer sur les complémentarités, on peut obtenir des résultats plus satisfaisants en termes d'efficacité, d'efficience et de durabilité. L'intégration des mesures et des instruments d'action permet d'orienter les acteurs dans la même direction et d'accélérer les progrès, en créant parfois des synergies. Les décideurs peuvent aussi étayer la démarche en améliorant les moyens d'évaluer le degré de réalisation des objectifs de GDM – au niveau tant systémique qu'organisationnel.

Principe 4 – Inciter toutes les composantes de la collectivité à agir de façon éthiquement responsable pour parvenir à des résultats durables.

Les flux de matières impliquent et affectent un grand nombre de parties prenantes tout au long de la chaîne d'approvisionnement et, souvent, dans de vastes zones géographiques. Étant donné la complexité de la GDM, il y a tout intérêt à intégrer et à faire

participer beaucoup d'acteurs, qui jouent un rôle à travers le cycle de vie des matières, à des efforts concertés pour imaginer des solutions collectives. Cette mobilisation peut aussi aider à dégager des réponses socialement acceptables et équitables en responsabilisant les intéressés et en les associant à la conception de solutions systémiques. Il est possible d'améliorer les résultats de la GDM en privilégiant dans tous les cas :

- la participation, la responsabilité et la collaboration des acteurs au niveau multilatéral ;
- les flux ouverts d'information ; et
- une perspective éthique.

Encadré 0.5. **Métaux critiques et téléphones mobiles – recommandations pratiques pour la GDM**

Une autre étude a été consacrée aux perspectives de gestion durable des matières (GDM) dans le cas des métaux critiques liés aux téléphones mobiles, à savoir le béryllium (Be), l'antimoine (Sb), le platine (Pt) et le palladium (Pd). La démarche axée sur la GDM s'avère riche d'enseignements. À en juger par les recommandations pratiques qui se dégagent de cette étude de cas, des instruments très divers pourraient être utilisés à différents stades du cycle de vie.

- Le recyclage des quatre métaux critiques permet d'économiser de grandes quantités d'énergie. L'action des pouvoirs publics devrait mettre en avant le lien entre les économies d'énergie, l'intérêt financier et la diminution des émissions de GES. Pour améliorer les rendements de recyclage et réduire l'exposition des travailleurs, les politiques de gestion des risques doivent passer par la sensibilisation des intéressés et la définition de normes.
- Certaines matières contenues dans les téléphones mobiles (Be et Sb, par exemple) s'avèrent problématiques pour les recycleurs et vont être progressivement abandonnées par les fabricants. La conception en vue du recyclage et d'une moindre toxicité offre une solution souhaitable et peut être influencée par certaines politiques concernant les matières ou les produits (par exemple la politique « Design for Environment (DfE)» aux Etats-Unis, ou des systèmes de responsabilité élargie des producteurs (RIP) lorsque ceux-ci sont bien conçus) et par la coopération entre gouvernements et entreprises..
- La collecte des appareils mobiles hors d'usage est un enjeu de taille car elle reste très limitée pour l'instant. Dans certains pays, les programmes de REP ont contribué à élever les taux de reprise. La durée de vie de ces appareils allant en diminuant, des systèmes de consigne ou des formules originales de location pourraient aussi contribuer à faire progresser les taux de collecte.
- Étant donné que la durée de vie technique des téléphones mobiles est de dix ans environ, toute mesure incitant à les garder plus longtemps revient à promouvoir l'utilisation durable des matières. Les contrats de marchés publics pourraient jouer un rôle en incluant des critères de durabilité des produits ; autre solution, les administrations pourraient systématiquement allonger les durées d'utilisation des équipements électriques et électroniques.
- L'approche la plus efficace consiste sans doute à associer plusieurs politiques et programmes.

Source : OCDE (2011), A Sustainable Materials Management Case Study – Critical Metals and Mobile Devices.

Instruments d'action pour la GDM

Compte tenu du vaste champ couvert par la GDM, il peut être utile d'adopter un cadre théorique dans lequel apparaissent les sources des matières, leur cheminement dans l'environnement et, le cas échéant, leur mode de disparition. Dans la représentation systémique du graphique 0.1, les cadres d'action peuvent être classés selon leur **portée d'application** en relation avec les cycles des flux de matières.

- Les **politiques axées sur les ressources naturelles** (politique des minéraux et métaux du gouvernement du Canada, par exemple) visent des cycles de flux de matières qui relient les systèmes naturels et industriels, englobant aussi bien l'extraction, la récolte et le transport de matières premières que l'utilisation directe de ressources naturelles (telles que l'eau ou les terres).
- Les **politiques axées sur le cycle de vie des produits** (politique intégrée de produits – PIP – de l'UE, par exemple) visent les cycles de flux de matières qui relient les systèmes industriels et sociétaux, englobant la mise au point de produits, le transport, la production d'énergie, les opérations de la chaîne d'approvisionnement et la récupération des déchets.
- Les **politiques axées sur la gestion des déchets** (loi fondamentale du Japon pour l'édification d'une société fondée sur un cycle rationnel des matières, par exemple) visent les flux de matières résiduaires qui entrent dans les systèmes naturels, englobant l'élimination ou le recyclage des déchets industriels et municipaux, ainsi que la lutte contre la pollution provenant de sources diffuses.

Pour être efficaces, les politiques de GDM qui appréhendent l'ensemble du cycle de vie doivent agir dans chacun de ces domaines.

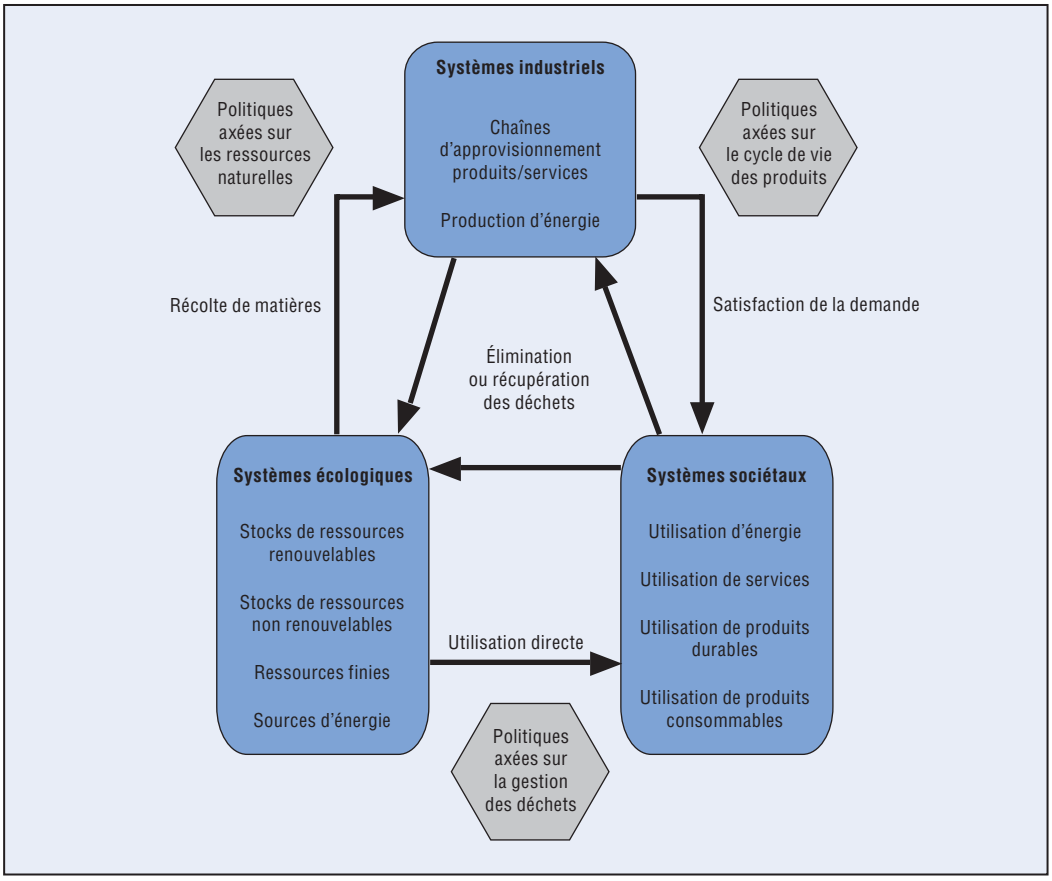
Un examen des politiques menées par les pays de l'OCDE dans l'optique de la GDM a fait ressortir un large éventail de dispositifs et objectifs actuellement retenus pour différents stades du cycle de vie des matières (voir graphique 3.1 pour le tableau récapitulatif des instruments de GDM dans la zone OCDE (OCDE, 2011a, b)). Selon le cas, les mesures se limitent à un stade donné (tarifs d'achat de l'électricité destinés à favoriser la production d'électricité renouvelable, de façon à réduire l'utilisation de combustibles fossiles et l'extraction de matières) ou prennent en compte l'ensemble du cycle de vie (politiques « zéro déchet » ou politiques de détoxication). Toutefois, elles n'ont pas toutes été conçues en référence aux principes de GDM.

Ce tour d'horizon permet de constater que les pays de l'OCDE tendent désormais à faire porter leurs politiques sur le cycle de vie tout entier, et non plus seulement sur la fin du cycle. Par ailleurs, les instruments mis au service de la GDM s'inscrivent peu à peu dans des panoplies et programmes plus vastes permettant d'envisager l'utilisation des matières du début à la fin du cycle de vie. Ils sont cependant difficiles à classer selon ce critère, en raison de la diversité des politiques qui paraissent relever de la GDM.

Certains des principaux aspects à envisager pour définir et mettre en œuvre des stratégies de GDM sont répertoriés ci-dessous.

- Nécessité de prévoir des programmes, mesures et initiatives à la fois diversifiés et compatibles pour que le caractère global de la politique de GDM et les objectifs de ses différents volets soient pris en compte. Étant donné le champ couvert par la GDM, elle concerne un grand nombre de ministères (dans des domaines comme l'environnement, l'économie, les finances et le travail), d'industries, de milieux de l'environnement (l'air,

Graphique 0.4. **Cycles des flux de matières et cadres d'action : représentation systémique**



Source : OCDE (2011c), Policy Principles for Sustainable Materials Management, Paris.

l'eau, les terres, etc.), d'où, sans doute, le besoin d'établir de nouveaux partenariats et canaux de communication entre des groupes jusqu'alors indépendants.

- Nécessité de bien cerner le système considéré pour définir l'action à mener, choisir les instruments ou fixer des objectifs. Entrent notamment en jeu : la dimension temporelle (disparité des cycles de conception des produits) ; les rapports et les synergies possibles entre les buts visés par la GDM et d'autres activités et finalités (lien entre la création d'emplois et l'infrastructure de recyclage) ; et les aspects (conception, déchets, recyclage) ou impacts sur lesquels il y a lieu d'agir.
- Possibilités de changement systémique. Autrement dit, il faut voir si les pouvoirs publics ont la capacité de « changer les règles du jeu » par le biais d'une nouvelle intervention. Tout dépend de l'autorité des responsables de l'élaboration des politiques de GDM, en termes à la fois de compétence pour la mise en œuvre et d'aptitude à assurer le suivi et le respect des dispositions. S'ajoute, dans bien des cas, le fait que les marchés et les flux de matières ignorent les frontières. Il importe aussi de savoir qui contrôle les leviers stratégiques indispensables (l'accès aux solutions technologiques, par exemple) pour susciter le changement souhaité.

Aussi est-il intéressant de noter que les stratégies de GDM les plus fouillées actuellement élaborées et mises en œuvre dans divers pays de l'OCDE n'ont pas

automatiquement pris la forme de dispositions contraignantes. La complexité des enjeux de la GDM, à commencer par le grand nombre d'acteurs différents potentiellement concernés, ainsi que les répercussions possibles dans d'autres pays, laissent penser qu'il est plus aisé de recourir à des approches originales ou à l'association de plusieurs démarches qui vont au-delà des moyens d'intervention classiques et pour lesquelles la distinction « contraignantes »/« non contraignantes » ne va pas toujours de soi.

Principaux enseignements à l'intention des décideurs

L'instauration de politiques visant à promouvoir la gestion durable des matières (GDM) et la productivité des ressources à long terme dépend des conditions ci-après.

- ***Plus grande cohérence des politiques*** relatives à l'utilisation des ressources et à la gestion des matières. Il faudra veiller à la cohérence des politiques visant l'ensemble des secteurs, matières et flux de déchets, de façon à internaliser systématiquement les externalités et à éviter le déplacement des impacts environnementaux au-delà des frontières et d'un stade du cycle de vie à un autre. Ainsi, dans le cas des marchés publics verts, il importe d'examiner de près le degré d'internalisation des coûts environnementaux pour éviter que les critères retenus ne s'appliquent à des impacts environnementaux qui ont déjà été internalisés par le biais d'autres mesures, telles qu'une taxe ou une norme d'émission.
- ***Développement des partenariats*** avec le secteur privé, le monde de la recherche et la société civile. Les pouvoirs publics doivent proposer les incitations voulues pour que les entreprises et les autres composantes de la collectivité puissent jouer un rôle constructif.
- ***Intégration des objectifs sociaux et économiques***, au même titre que les objectifs environnementaux, dans l'élaboration des politiques de GDM, afin de donner plus d'élan et plus de poids aux dimensions économique, environnementale et sociale du développement durable.
- ***Mobilisation interministérielle*** et prise en compte des principaux objectifs de la GDM dans le processus général de planification financière et d'établissement du budget.
- ***Prise en compte de toute la panoplie d'instruments et d'outils disponibles***. On tend généralement à considérer que la méthode la plus simple et la plus facile à mettre en œuvre consiste à envisager chaque problème isolément. Compte tenu du vaste champ couvert par la GDM, qui fait intervenir de nombreux acteurs économiques différents dans plusieurs pays, les programmes et plans d'action dans ce domaine devront être assortis d'objectifs touchant de nombreux secteurs, d'où la coexistence indispensable de plusieurs mesures.
- ***Fixation d'objectifs « judicieux »***, à l'appui des pratiques de GDM. Les objectifs doivent être crédibles, acceptés par les pouvoirs publics comme par la collectivité, scientifiquement fondés et fixés au niveau qui convient, selon une analyse coûts-avantages. Encore faut-il que les décideurs puissent cerner les éléments indispensables, alors que la tâche est rendue plus difficile par la portée internationale et la complexité de la GDM, et les intégrer à un processus de fixation des objectifs adapté à la situation locale. Le tableau 0.1 donne des exemples d'objectifs de GDM retenus à l'intérieur et à l'extérieur de la zone OCDE.
- ***Bonne connaissance de la base matérielle de l'économie***, des flux nationaux et internationaux de matières et de la manière dont ils s'articulent avec la productivité et les risques

Tableau 0.1. **Exemples d'objectifs de GDM dans quelques pays et régions à l'intérieur et à l'extérieur de la zone OCDE**

	Extraction des ressources	Production	Productivité des ressources	Consommation	Fin du cycle de vie
Japon	Objectif de productivité des ressources pour les matières terreuses et rocheuses		Objectifs fixés dans le plan fondamental visant l'édification d'une société fondée sur un cycle rationnel des matières	Incitations du programme Top Runner en faveur des économies d'énergie, passant par un label d'efficacité énergétique destiné aux sources non industrielles[1]	Objectifs fixés pour les émissions de GES liées aux déchets dans le plan fondamental visant l'édification d'une société fondée sur un cycle rationnel des matières
Pays-Bas	Programme relatif à l'impact sur l'utilisation des terres (diffusion des objectifs fin 2009)	Programme relatif à la pollution, à la réduction des émissions de GES et à l'utilisation des terres (diffusion des objectifs fin 2009)			Diffusion des objectifs fin 2009
Belgique (Flandre)	Objectif général : réduire au minimum l'utilisation de ressources finies	Objectif général : augmenter le nombre d'entreprises flamandes produisant conformément aux impératifs d'écoefficience à l'horizon 2009 (par rapport aux taux d'écoefficience de 2003)	Objectif général : optimiser l'utilisation de ressources renouvelables	Faire progresser la consommation durable dans le secteur de la distribution et dans les administrations publiques à l'horizon 2015, par rapport aux chiffres de 2008	Objectifs détaillés et chiffrés pour les déchets ménagers et industriels, les déblais, les véhicules hors d'usage, les vieux pneus, les déchets d'équipements électriques et électroniques (DEEE), les piles et les huiles usagées
Finlande	Objectif relatif aux graviers et pierres concassées utilisés dans le secteur du bâtiment et des travaux publics	Critères d'efficacité d'utilisation des matières et dispositions connexes en cours d'élaboration dans le cadre du nouveau programme de gestion des déchets (diffusion des objectifs en 2010)		Critères d'efficacité d'utilisation des matières et dispositions connexes en cours d'élaboration dans le cadre du nouveau programme de gestion des déchets (diffusion des objectifs en 2010)	Objectifs détaillés et chiffrés pour les déchets municipaux, les effluents d'élevage et les déblais
UE			Obtention d'un gain de productivité des ressources égal ou supérieur au taux de 2.2 % enregistré durant les 10 années écoulées.		Objectifs détaillés et chiffrés pour les déchets ménagers, les véhicules hors d'usage, les déchets d'équipements électriques et électroniques (DEEE), les piles et les emballages
Taipei chinois		Pas d'objectif spécifique, mais des mesures restrictives visent la fabrication, l'importation et la vente de piles zinc-manganèse et de piles alcalines au manganèse contenant plus de 5 ppm de mercure			Objectifs chiffrés pour les déchets ménagers et industriels
Mexique	Objectif général : réduire au minimum l'utilisation de ressources finies	Pas d'objectif spécifique, mais les producteurs dont les activités génèrent des déchets spéciaux ou des produits usagés dangereux sont tenus d'élaborer des plans particuliers de gestion des déchets	Objectif général : employer davantage de matières recyclables et réutilisables dans la production		Objectif général : développer d'autres modes de traitement des déchets en fin de cycle (traitement thermique/valorisation énergétique ou compostage) et réduire les volumes mis en décharge à l'horizon 2012

1. British Columbia Ministry of Environment (2009), Design for Environment (DfE) Best Practices Lessons for British Columbia's Ministry of Environment, p. 11.

Note : Ce tableau se réfère aux données disponibles, mais il existe sans doute par ailleurs des objectifs et programmes qui se rapportent aux différents stades indiqués, ainsi que des pratiques comparables dans d'autres pays de l'OCDE. Des précisions et informations complémentaires utiles sont apportées par le tableau récapitulatif en annexe.

environnementaux. L'analyse des flux de matières, tout comme l'analyse du cycle de vie et d'autres méthodes, contribue à apporter des éclaircissements (OECD, 2007).

- ***Perspective internationale***, moyennant une vision commune et des solutions différenciées aux niveaux local, régional et mondial. Les pays n'ont pas les mêmes besoins, selon qu'ils sont riches en ressources et exportateurs, pauvres en ressources et tributaires des importations, en développement ou industrialisés. Les pratiques et technologies exemplaires doivent être mises en commun, et adoptées là où elles répondent le mieux aux besoins. Il incombe plus particulièrement aux pays de l'OCDE de les favoriser et de les diffuser.

Enjeux et perspectives

Le vaste champ auquel renvoie la prise en compte de l'ensemble du cycle de vie, démarche qui sous-tend la gestion durable des matières (GDM), constitue un défi de taille. Pour chaque matière ou produit, la stratégie de GDM doit appréhender un grand nombre d'acteurs économiques intervenant tout au long de la chaîne de valeur dans divers secteurs (entreprises minières, entreprises de fonderie, industriels, consommateurs, entreprises de collecte et de recyclage des déchets, entre autres exemples) et faire le lien entre plusieurs domaines d'action distincts (agriculture, activités extractives, normes de produits, fiscalité, environnement, etc.). S'ajoute l'éparpillement géographique des intéressés et des politiques sur différents territoires. Dans ces conditions, une coordination et une coopération étroites s'imposent entre les acteurs économiques comme entre les composantes de l'administration, sans oublier la coopération intergouvernementale indispensable pour aborder les problèmes transfrontières.

Par ailleurs, la prise en compte du cycle de vie des produits et des matières ne saurait guère être assurée par une politique unique et passe plutôt par une multiplicité d'instruments. Si des mesures sont axées sur certains flux de matières/produits, la difficulté consiste alors à atténuer les distorsions affectant les autres flux, et à parer au déplacement des pressions environnementales qui peut en résulter.

Viennent ensuite le degré de détail et la qualité des données qui doivent étayer l'élaboration des politiques de GDM pour éviter les effets indésirables. Pour cibler efficacement les politiques, il faut disposer d'informations précises concernant le type et l'ampleur des incidences sur l'environnement à toutes les étapes, comme peut en apporter l'analyse du cycle de vie. Des données complémentaires sont nécessaires sur les coûts des dommages environnementaux, moyennant une évaluation économique et une analyse coûts-avantages.

La formulation de politiques de GDM efficaces suppose donc une coordination très poussée, tant entre les acteurs économiques qu'entre différents domaines d'action, ainsi qu'une grande quantité de données détaillées sur les impacts environnementaux, et sur leur évaluation en termes économiques.

Que peuvent faire les pouvoirs publics ?

Cette situation appelle les pouvoirs publics à prendre diverses initiatives, notamment comme suit.

- Redoubler d'efforts pour améliorer les données et, plus particulièrement, traduire en termes de coûts économiques les données concernant les incidences sur l'environnement tout au long du cycle de vie.

- Hiérarchiser les flux de matières en fonction de leur impact sur l'environnement et mettre au point des projets pilotes permettant de tester de nouvelles approches fondées sur la GDM, à l'instar de la politique des déchets visant l'ensemble de la chaîne actuellement expérimentée par les Pays-Bas.
- Concevoir des cadres et mécanismes novateurs pour assurer la coordination des politiques entre un plus grand nombre de ministères.
- Faciliter la coopération entre les acteurs économiques tout au long de la chaîne de valeur (producteurs de matières premières, industriels, distributeurs, consommateurs et gestionnaires de déchets) pour dégager des solutions communes en vue de boucler les cycles de matières.
- Promouvoir l'innovation et débloquer les moyens financiers nécessaires à l'innovation, technologique et non technologique, dans l'optique de la GDM.
- Imaginer des initiatives de coopération internationale pour des flux de produits et de matières emblématiques.

Que peuvent faire les entreprises ?

Le passage à la GDM suppose aussi une nouvelle conception des activités qui intègre la notion de cycle de vie au fonctionnement des entreprises. Il faut créer des modèles opérationnels visant à instaurer des chaînes d'approvisionnement « vertes », à trouver des solutions à faible impact pour remplacer les matières, biens et services à fort impact et à donner aux cycles de matières et de valeur une orientation plus durable. Les industriels doivent devenir des gestionnaires de cycle de vie, qui évaluent les effets de l'utilisation des matières et cherchent à les réduire au minimum.

Comment l'OCDE peut-elle aider les gouvernements ?

Pour aider les gouvernements à mener à bien cette mission, l'OCDE peut :

- mettre en évidence les lacunes et les problèmes de cohérence de l'action publique, ainsi que les mesures à prendre dans l'optique de la GDM pour y remédier, en ce qui concerne des matières et produits précis, par le biais d'études de cas consacrées à des matières prioritaires ;
- analyser les avantages et les coûts des stratégies de GDM, notamment les coûts économiques et administratifs liés aux démarches supplémentaires de planification et de consultation ; et
- rassembler des données sur les expériences de GDM menées dans des pays membres et non membres de l'OCDE afin d'élaborer des orientations visant plus particulièrement les moyens d'action et panoplies à retenir, ainsi que les dispositifs de gouvernance indispensables à une coordination efficace des politiques entre secteurs et à l'échelle internationale.

Notes

1. La définition de travail établie par l'OCDE comprend les notes explicatives suivantes :

   Le terme « matières » comprend tous ceux extraits ou dérives de ressources naturelles, qui peuvent être soit des substances minérales ou organiques, à tous les points de leur cycle de vie.

« Cycle de vie des matières » comprend toutes les activités liées aux matières tels que l'extraction, le transport, la production, la consommation, la réutilisation des produits/matières, la valorisation et la mise en décharge.

Un résultat économiquement efficient est atteint lorsque les bénéfices nets pour la société dans son ensemble sont maximisés.

Une variété d'outils de politique peuvent soutenir la GDM, tels que les instruments économiques, réglementaires et d'information ainsi que les partenariats.

La GDM peut avoir lieu à différents niveaux, y compris dans les entreprises et les secteurs économiques ainsi qu'à différents niveaux de gouvernement.

La GDM peut couvrir des zones géographiques et des horizons de temps différents.

2. Voir *www.oecd.org/environnement/fmenv.*
3. Il convient de noter que la consommation intérieure de matières (CIM) ne tient pas compte des flux cachés de matières associés aux échanges (appelés aussi flux indirects de matières) et de l'extraction inutilisée. Si ces éléments étaient pris en compte (ce qui, faute de données, n'est pas possible pour l'instant au niveau de la zone OCDE), la courbe d'évolution de la productivité des ressources pourrait être différente.
4. L'intensité matérielle correspond à la consommation intérieure de matières par unité de PIB.
5. Le rapport du Defra définit l'efficacité d'utilisation des ressources comme toute action ou intervention à l'origine d'une réduction de l'utilisation globale de matières ou des émissions de gaz à effet de serre, qui est neutre en termes de coûts, voire les fait baisser. Cette étude porte sur quatre ressources clés : eau, énergie, déchets et matières.
6. Ernst and Young (2006), Eco-Industry, Its Size, Employment, Perspectives and Barriers to Growth in an Enlarged EU, rapport établi pour la DG Environnement de la Commission européenne.
7. Voir *www.oecd.org/environnement/fmenv.*

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Chapter 1

SMM principles

This chapter proposes four broad SMM policy principles as guidance for specific governmental policies to shift the behaviour of economic actors and human societies toward meeting their material needs without destabilising natural systems. The chapter provides a description and rationale for each of the SMM policy principles along with suggested strategies for implementation and examples of national applications by OECD member countries.

Introduction and methodology

A systems view of material flow cycles

It is helpful to base SMM policy principles on a conceptual framework that includes the sources of materials and their pathways through ecological (natural), social and economic systems. Figure 1.4 presents a simplified systems view (Fiksel, J., 2006).

Ecological (Natural) Systems represent the biosphere and the source of natural capital from which materials are derived. Natural systems include:

- Renewable resource stocks such as forests and, fish biomass which can be depleted if the rate of exploitation exhausts the existing stock.
- Non-renewable resource stocks such as metals, which assuming suitable collection infrastructure can be almost infinitely recyclable, and fossil fuels (oil, coal, gas) which are available for extraction, but once the finite stocks are exhausted cannot be replenished, and need to be substituted with other forms of capital.
- Environmental media, including air, water, and land, the quality of which may be degraded. For example, land may be reserved as parkland, used for agriculture or other forms of development, degraded due to soil erosion, or contaminated by misuse.
- Physical renewable sources of energy, including solar, geothermal, wind and tidal energy.

Industrial systems utilise ecosystem services and derive materials from natural capital. Generated wastes that cannot be re-used are deposited back into the biosphere. Materials flow through supply chains that begin with extracted natural resources and end with the delivery of a finished product or service to society. Some materials end up essentially as stocks within long standing infrastructures like buildings, while others are rapidly consumed and disposed of. Energy production systems are similar to supply chain systems, but the end product is energy that is utilised within the industrial system or to fulfil societal demands, such as for residential or transportation uses.

Societal systems consume the products, services, and energy supplied by industrial systems, and generate waste that is either recycled back into industrial systems or deposited into the biosphere. Societal systems also consume ecosystem services and resource stocks directly (*e.g.* water). Products include both durable and non-durable goods. Durable goods (*e.g.* an automobile) are products that are used repeatedly over an extended period, possibly requiring ongoing consumption of supplies and energy. At the end of its useful life the entire product becomes waste, which is potentially recyclable. Non-durable consumer goods, also called consumables, (*e.g.* food) are used once and either wholly or partially consumed, with the remainder becoming potentially recyclable waste.

Project methodology

This chapter is based on a review of the literature and other public media drawing on public, private, NGO and academic sources for SMM-related principles and strategies,

tactics, guidelines and other resources related to SMM in OECD countries and beyond from which SMM principles could be derived. Over 350 individual principles related to SMM were analysed, and eventually narrowed down to four main SMM Principles.

Development of the SMM policy principles was based on consideration of the SMM working definition, on the literature review and on OECD member country input. The working definition of SMM spells out some basic criteria that should also be included in SMM approaches:

- actions should be integrated – recognising other initiatives (waste management; sustainable consumption and production, resource productivity, green growth strategies, etc.);
- actions should target environmental impacts (reduce) and natural capital (preserve);
- actions should cover the whole life-cycle of materials; and
- actions should take into account all three pillars of sustainability (including economic efficiency and social equity)

Part of this chapter also focuses on how these principles can be, and have been, applied in member countries. A questionnaire was presented to OECD countries and a few examples of national applications of SMM policy principles are briefly described to provide insight into the principles applied, the basis and objectives for its development, notable achievements and challenges. Insights from these member country applications may help to illustrate and clarify how the SMM policy principles may guide national policy development.

SMM policy principles

The four broad SMM policy principles are proposed to support the development of governmental SMM policies. The proposed main SMM policy principles are:

1. Preserve natural capital.

2. Design and manage materials, products and processes for safety and sustainability from a life-cycle perspective.

3. Use the full diversity of policy instruments to stimulate and reinforce sustainable economic, environmental and social outcomes.

4. Engage all parts of society to take active, ethically-based responsibility for achieving sustainable outcomes.

In the following sections, each of the individual SMM policy principles is discussed to clarify the meaning of the principle, why it was selected and how it might be applied. The need for improved information on material flows and associated life-cycle impacts and on the effectiveness and efficiency of SMM policies and instruments was identified as critical to SMM. Information needs are inherent and specific to each of the individual principles.

SMM policy principle 1: Preserve natural capital

- *Natural capital is the source of materials needed to support life. It is comprised of natural resource stocks (minerals and metallic ores, energy fossil fuels, soil, water and biological resources), land, atmosphere and ecosystems.*
- *Sustainable materials management can contribute to the preservation of natural capital. Natural capital can be preserved by increasing resource productivity, reducing material throughputs, and*

reusing/recycling materials to such a degree that depletion of natural capital is minimised and ecosystem services are maintained.

Principle 1, the preservation of natural capital, which is the source of materials needed to support life and to foster long-term sustainability, forms the overall basis for SMM. Natural resources and healthy ecosystems are essential to all human life and are a prerequisite for business as stated by WBCSD.[1] SMM policies can contribute to preserve natural capital, now and for future generations, using the best available science, engineering, business and management practices.

Natural capital includes energy, fossil fuels, soil, water, land, atmosphere, biological resources and ecosystems. Nature supports life by supplying provisioning, regulating and cultural benefits:

- Provisioning benefits include resources such as energy, fossil fuels, soil, water, land, atmosphere, biological resources and ecosystems that can be used to provide food, materials and energy.
- Regulating benefits include ecosystem services that sustain these resources by providing clean air, clean water, regular water flow, fertile soil, productive forests and fisheries, biodiversity, stable climate, processing of wastes and cycling of nutrients.
- Cultural benefits can be aesthetic, spiritual, educational and recreational (Millenium Ecosystem Assessment Board, 2005).

Together, these resources and services are considered natural capital – analogous to economic capital in the sense that they represent wealth. Preserving natural capital is a primary objective of SMM and should be considered in all SMM related policies. There are many approaches that may be applied concurrently and synergistically to provide an adequate supply of both renewable and non-renewable resources while protecting ecosystem health and ecosystem services in the service of society. Humans will continue to depend on the earth's natural resources for the foreseeable future. The challenge is to achieve a sustainable use of natural capital that does not create unsustainable associated impacts.

In its 2001 Environmental Strategy, the OECD has defined four criteria for environmental sustainability that align with SMM policy principle 1 to preserve natural capital for sustainable material flows:

- Regeneration: Renewable resources shall be used efficiently and their use shall not be permitted to exceed their long-term rates of natural regeneration.
- Substitutability: Non-renewable resources shall be used efficiently and their use limited to levels which can be offset by substitution by renewable resources or other forms of capital.
- Assimilation: Releases of hazardous or polluting substances to the environment shall not exceed its assimilative capacity.
- Avoiding irreversibility: Irreversible adverse effects of human activities on ecosystems and on biogeochemical and hydrological cycles shall be avoided. The natural processes capable of maintaining or restoring the integrity of ecosystems should be safeguarded (OECD, 2001).

A number of strategies are described below that may help in the development of policies and policy instruments that support SMM policy principle 1.

Improve information about material flows and the related impacts

Governments may want to have the best available information about material flows and associated impacts in order to set broad priorities for preserving natural capital. The further development of SMM indicators and benchmarks will help to monitor progress (OECD, 2008a). There is a growing toolbox of resources available for measuring material flows and impacts to support SMM. Material Flow Analysis (MFA) has emerged as one useful tool (OECD, 2008b). Accompanied by additional tools such as Life-Cycle Assessment (LCA), information can be gained that provides perspectives on not only the quantity of material flows but also on the impacts associated with the flows, relative to other flows and to the carrying capacity of the earth as a whole. There is no one tool that provides all the answers. Governments may draw from the entire toolbox to obtain measurements that best support their priorities for SMM (OECD, 2008c).

Material flows and the associated impacts can occur locally, nationally and globally. Material consumption can also be direct or hidden (*i.e.*, hidden material flows address materials that are extracted or moved, but do not enter the economy). Because of this complexity, any assessment of impacts from materials would need clearly defined parameters. Policymakers using the resulting data would want to ensure that impacts are assessed in a comprehensive way and that they are not unintentionally shifted to other regions.

Increase resource productivity and resource efficiency

Resource productivity and resource efficiency are measures that can be used to help assess the degree of decoupling of economic growth and industrial activity from the use of resources, *i.e.* getting more value for the resources used and using fewer resources for the same output (*i.e.* "doing more with less") (OECD, 2008b). According to the OECD Council Recommendation on Resource Productivity [C(2008)40], resource productivity is understood to contain both a *quantitative* dimension (*e.g.* the quantity of output produced with a given input of natural resources) and a *qualitative* dimension (*e.g.* the environmental impacts per unit of output produced with a given natural resource input) (OECD, 2008d). It recommends strengthening the capacity for analysing material flows and the associated environmental impacts to advance resource productivity and efficiency and collaborating globally to improve measurement systems. It also recommends taking action to improve resource productivity and efficiency at the macro, sectoral, and micro levels. Relative shifts in resource productivity or efficiency, *i.e.* occurring only within national boundaries, may not reflect impacts generated elsewhere in the chain.

Resource productivity and efficiency can be improved by optimising the rate at which materials are extracted from natural resources to achieve sustainable levels of material throughputs, as well as by reducing the throughput of materials with high negative environmental life-cycle impact. One way to achieve sustainable material throughput is to use less primary raw materials, water or energy in production processes. Another way is to manage renewable resources, *e.g.* forest products, in ways that do not exceed their rates of regeneration and that protect the health of their ecosystems. While natural resource policies do not fall within the scope of SMM, SMM does include policies such as government procurement that could lead to increased demand for sustainably harvested renewable resources. For instance, around 30% of the commercially exploited forests (or roughly 320 million hectares) in the world are certified for sustainable management, which represents about 10% of global forest area. Governments may invest expertise and/or

funding to support the development of legitimate standards and ecolabels for materials and products derived from sustainably harvested natural resources.

Improving resource productivity through production processes so as to use less inputs or more sustainable inputs (*e.g.* renewable, containing less toxic substances) can be achieved *inter alia* through technology improvement, eco-innovation, eco-design, material substitution and dematerialisation. Government could provide support for R&D, and incentives for investments in these areas. They may also encourage the development of regulatory and financial instruments focusing on a more sustainable use of resources.

Increase reuse/recycling to preserve natural capital

Re-injecting already used materials into the production system is an efficient way to minimise the demand for primary raw materials and resources and thus preserve natural capital. Governments can play an important role in advancing reuse and recycling and in identifying and guiding development of material recovery options. Governments may target the development of closed-loop systems for recovery and recycling of key materials, if open systems do not work satisfactorily, or result in additional negative environmental impacts; *e.g.* mandatory recycling of lead-acid batteries. Industry has automatic incentives to develop recycling systems for highly valued materials, but policies that would promote improved recovery and recycling infrastructure and practices could help recover additional streams of materials with marginal market value. In addition to commonly used instruments, such as advanced disposal fees, deposit refunds, landfill or incineration taxes or bans, and the use of extended producer responsibility (EPR), other more inventive and innovative tools or systems should be developed that could help society to consider waste as a resource, and thus could encourage material reuse and recycling.

Innovative technologies for SMM (Eco-innovation)

Eco-innovation may apply to any stage of a product or service life-cycle including the extraction of materials from natural resources. Eco-innovation technologies can help to preserve natural capital by increasing resource efficiency and productivity while reducing negative impacts. Governments can accelerate eco-innovation by investing in research and development in the academic and/or industrial sectors. Eco-innovations may range from improved efficiencies to entirely new technologies and feedstocks (OECD, 2009a). For example, research in part supported by government funding, has resulted in a commercial process for mining phosphorus from wastewater in the form of struvite (OSTARA, 2009). While this product cannot replace all uses of phosphorus, it can replace those that benefit from slow release phosphorus. The technology could potentially replace a significant amount of mined phosphate, with its associated negative impacts due to hazardous contaminants, while creating a revenue stream for wastewater treatment plants and tapping into a vast and renewable supply.

A major challenge to implementing Principle 1 reported by OECD member countries is the feasibility of decoupling industrial activity and economic growth and development from the depletion and degradation of natural capital. Incremental improvements are not enough (OECD, 2009b). For SMM, governments are faced with tracking the amount and impacts, both direct and indirect, of material flows; with prioritising flows and impacts based on national characteristics; and with integrating policies and policy instruments to accelerate improvements. Because SMM is very complex, it may require new tools and strategies for integration and collaboration. One strategy may involve new applications of

information technology (IT) to manage information about materials, material flows and impacts and to inform and engage stakeholders locally, nationally and internationally. IT is being applied to develop "Smarter Cities" that include "smarter" transportation, governance, water supplies, food supplies, and waste management, and gain more insight into supply chains and distribution logistics. "Smart" technology may be one tool to support radical efficiency increases and policy integration.[2]

SMM policy principle 2: Design and manage materials, products and processes for safety and sustainability from a life-cycle perspective

- *The life-cycle of materials includes extraction, processing, product design and manufacturing, transportation, product use, collection, reuse/recycling and disposal.*
- *The object of this principle is to maximise positive (and minimise negative) environmental, economic and social outcomes at every stage of the life-cycle.*
- *Increased co-operation between different actors in the life-cycle is critical, so that every actor is aware of the impacts of his actions and decisions on other phases of the life-cycle and acts accordingly.*

SMM policy principle 2 helps to define sustainable materials by calling for the design and management of materials, products and processes that are safe and sustainable over the full life-cycle. Life-cycle considerations include extraction, processing, product design and manufacturing, transportation, product use, collection, reuse/recycling and disposal.

According to architect William McDonough, "Design is the first signal of human intention". It is at the design stage that decisions are made that determine impacts throughout the life-cycle. SMM involves maximising positive (and minimising negative) impacts to the environment and human health and well-being through design. A focus on safety and sustainability at each life-cycle stage ensures that risks are not shifted from one stage in the value chain to another. Economic and social outcomes are optimised while natural capital is preserved.

While governments do not typically design materials, products or processes they can influence the design of safe and sustainable products. Procurement and investment policies, regulations and initiatives that inform decision-making are all tools to achieve this end. There are three overarching material, product and process design strategies which support SMM and which can be encouraged via government policies. They include: detoxification; de-materialisation, particularly of materials with high negative life-cycle environmental impacts (Geiser, K., 2001), and design for value recovery.

There is a certain circular logic in defining sustainable materials. They are materials that can be managed sustainably. Likewise, sustainable materials management is facilitated by the use of materials with certain sustainability characteristics such as:

- Low toxicity under all exposure scenarios throughout the life-cycle including manufacture using clean production, green chemistry and renewable energy
- Derived from renewable or repeatedly recyclable materials
- Designed for value recovery (energy, materials) including the design and implementation of an effective strategy for recovery and utilisation in "cradle-to-cradle" cycles (McDonough, W. and M. Braungart, 2002; Clean Production Action, 2009);

Detoxification

The principle of detoxification supports sustainable materials management by eliminating the progressive build-up of chemicals and compounds produced by society that have harmful impacts on human health and environment, that cannot be properly or safely managed and/or are costly to manage from an economic or environmental standpoint. In order to detoxify products, it is necessary to know the hazards and risks associated with the raw material options and to choose the safest alternatives. Detoxification is addressed through the application of **green/sustainable chemistry and the process of chemical substitution.**

Green Chemistry (based on the twelve principles of green chemistry) (Anastas, P.T, and J.C. Warner, 1998), and **Sustainable Chemistry**[3] are two terms that are commonly used to designate practices that aim at the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. These can be achieved by, among other things: *i)* using less hazardous and more sustainable feedstocks and reagents; *ii)* improving the energy and material efficiency of chemical processes; *iii)* using renewable feedstocks or wastes in preference to fossil fuels or mined resources; and, *iv)* designing chemical products for better reuse or recycling. An example of greener and more sustainable chemistry is the totally chlorine free (TCF) bleaching technologies used in the pulp and paper industry. TCF technologies involve no chlorine compounds and remove all but naturally present Adsorbable Organic Halides (AOX), dioxins and furans (OECD, 2008e).

Sustainable chemistry can also be achieved through **chemical substitution**, *i.e.* the replacement of hazardous substances in products or processes by other less or non-hazardous substances. As examples of chemical substitution, the replacement of CFCs as propellants by Hydrofluoroalkanes HFA-134a and HFA-227 which have no ozone-damaging potential or the replacement of organic solvents in paints by aqueous solvents. Chemical substitution thus can reduce environmental and health risks along the life-cycle of products while ensuring the same functionality.

Government, academia and industry should support initiatives that prevent or minimise risk and pollution at all stages of a product life-cycle. To achieve this goal, governments could support sustainable chemistry education as well as investment in research and development that leads to: eco-design of chemicals; materials and components that are durable and can be reused and recycled;[4] eco-innovation; and alternative technologies and chemical synthesis techniques that can address many issues simultaneously. Companies can also use the opportunity of innovation in sustainable chemistry to gain a competitive advantage over their competitors. Because the development of sustainable chemicals may require high investments from industry with possible returns in the long-term, governments can develop policy frameworks which encourage such investment.

Governments need not necessarily prescribe alternatives to chemicals of concern. They may help companies by developing tools and strategies to guide the identification of safer alternatives. For example, the USEPA's Design for the Environment (DfE) Programme has developed comparative hazard assessment methods and criteria for defining safer chemicals through their Partnership programmes.[5]

Finding comprehensive chemical hazard data can be challenging. The EU REACH Regulation and Canada's Chemicals Management Plan help with assessing and prioritising substances according to environmental and health risks, and serve as powerful drivers for

broader public access to chemical product information and hazard data to support safer alternatives.[6] Under REACH, substances of very high concern (SVHCs) will require substitution where there are viable alternatives and/or they will be granted time-limited authorisation for essential applications where no suitable alternatives exist. In the US, the California Green Chemistry Initiative (GCI) will create a green chemical product registry to inform consumers about the chemicals, and their associated hazards, in products sold in California. A variety of regulatory actions may be applied to products containing chemicals of concern. If the public disclosure feature of the California GCI is as effective as other public disclosure initiatives have been in the US (*e.g.* Toxics Release Inventory Programme), then a reduction in the use of hazardous chemicals in consumer products and an increase in the use of products with safer chemical profiles are likely.[7]

The initiatives noted above may also benefit other OECD countries through data sharing. OECD has already built a strong foundation to support movement to safer alternatives through the development of guidelines for the testing of chemicals,[8] and by providing information on the environmental releases and transfers of hazardous chemicals and pollutants through Pollutant Release and Transfer Registers.[9] Another programme managed by OECD that could support SMM through detoxification is the programme in Sustainable Chemistry, as described above.

Dematerialisation

Dematerialisation supports SMM by reducing the demand for and throughput of materials, particularly those with high negative life-cycle impacts, to preserve natural capital. Dematerialisation means doing more with less and refers to more efficient use of raw materials (and the use of less energy in the process) without decreasing the quality of the service they provide. Dematerialisation strategies include **replacing products with services** and **material substitution**. Replacing the individual purchase of farming or industrial tools, gardening or do-it-yourself tools or even of cars by a rental service may be an economically efficient and environmentally effective way to manage materials in some circumstances and thereby may decrease waste generation. Such services already exist, especially concerning high value materials, but on a limited scale.

Governments could take the necessary measures to support the development of such services, which may also result in job creation. Another example of dematerialisation can be found in packaging materials and involves "lightweighting" and eliminating wasted space. While dematerialisation may provide benefits, it is important to note that small efficiency gains can be quickly outpaced by overall growth. Innovation occurs in degrees, from incremental improvements to new designs that result in transformative performance using minimal materials with significant impacts on material use and subsequent throughput (OECD, 2009a).

Substitution of materials that are resource intensive and/or that have high negative life-cycle impacts with materials that have attributes of safety and sustainability across the life-cycle (*e.g.* low toxicity, sustainably harvested and renewable, reusable or recyclable) can be an effective dematerialisation strategy. Governments may establish policies that drive both resource efficiency and substitution. For example, the EU Packaging Directive uses a system of reporting and fees to prevent packaging waste by limiting the size of packaging relative to the product, limiting heavy metals in packaging materials and encouraging reuse and recycling by setting targets for member states. Other OECD member countries (i.*e.*, Japan, Korea, Canada, Australia, Turkey and the Netherlands) have set

Box 1.1. **The Soda Club System – an example of providing service with fewer materials***

Many people enjoy drinking carbonated water. The purchase and transportation of bottled carbonated water is energy and material intensive – even if the bottles are recycled or reused once they are empty. A product produced by the global Soda Club Group provides the same service – the provision of carbonated drinking water – but via a different business model. The Soda Club system involves the purchase of housing for a CO_2 canister, a bottle to hold the carbonated water and the lease of a CO_2 canister that can generate up to 110 liters of carbonated water per canister. Tap water can be used to fill the bottle. To carbonate the water, the bottle is attached to the CO_2 canister and then injected with CO_2. If one were to drink 24 liters of carbonated water each month, the total number of empty bottles generated each year would be 288. Fuel and energy costs from transporting bottles to and from stores could also be determined. The Soda Club system generates essentially no bottle waste as the bottles are reused (until they eventually fail), the water can be obtained from the tap, and the CO_2 canister can be returned to the point of leasing or via mail for refilling. This product provides an example of how innovation in product design and associated business models can provide the same service along with dematerialisation.

* *www.sodaclubusa.com/default.htm?r=0.*

packaging fees to help reduce packaging and to fund recycling. In the Netherlands, these fees have been tied to CO_2 emissions.

Design for value recovery

Design for value recovery supports SMM by ensuring that products and materials are designed for reuse and recycling (of energy and materials) and that an effective model for recovery is in place (*e.g.* reverse logistics). Design for value recovery may be driven by product-related policies that promote for example extended producer responsibility or "cradle-to-cradle" design (McDonough, W. and M. Braungart, 2002). **Cradle-to-cradle design** is a voluntary, leadership approach to product design. The purpose of cradle-to-cradle design is to restore continuous cycles of materials with long-term positive effects on profitability, the environment and human health.[10] Metaphorically, cradle-to-cradle products are viewed as "nutrients" cycling in "metabolisms".

Increased co-operation between different actors in the life-cycle

Increased co-operation and information exchange between different actors in the life-cycle is critical so that all actors are aware of the impacts of their actions, and to increase their involvement in creative solutions for systemic change. Governments may convene stakeholders to facilitate co-operation and the flow of information between actors across the life-cycle. SMM is aided by aligning information flows with the flows of materials in products and processes. Examples of information tools that could support SMM range from databases of chemical ingredients and products that include comparative hazard information and greener chemical alternatives to scorecards for products or packaging, product life-cycle inventory assessments and product "footprint" assessments. Design and management, like policymaking, are creative and dynamic processes with ever-changing conditions. It is expected that adaptation and continual improvement in information quality and quantity related to materials will continue to support the design and management of materials, products and processes for SMM. Governments can help drive

Box 1.2. **Examples of design for value recovery**

1. Products of consumption and biological nutrients in the biological cycle

Products of consumption are typically derived from renewable feedstocks and are designed to completely breakdown in the environment in a benign or even beneficial manner. Products of consumption illustrate the principle that "waste equals food". Their degradation can support life in ecosystems. Designing products to function as biological nutrients requires a detailed assessment of the material chemistry and its toxicity to potentially exposed organisms throughout its life-cycle. In general, they function as nutrients in natural systems and may be designed to degrade rapidly and completely in the aquatic environment or to become soil amendments. Products that have been designed as products of consumption include cleaning products, personal care products and fabrics.

2. Products of service and technical nutrients in the technical cycle

Products of service refer to products comprised of durable materials that can be recycled into high value uses. Using the metaphor of metabolism, durable materials are considered technical nutrients that can be recycled within technical metabolisms. A product designed to meet cradle-to-cradle design principles will be designed with a system for recovery and recycling as part of its business model. A product of service stands in contrast to a product of consumption in that it provides a service to the user but is not itself consumed. When the service is no longer provided, the product materials can be reused or recycled. Innovative leasing models have been developed to ensure that products of service are returned and its materials are recovered. Examples include cars, furniture, books and carpet.

the development of information resources and tools and metrics that identify the sustainability attributes of chemicals, materials, products and processes.

SMM policy principle 3: Use the full diversity of policy instruments to stimulate and reinforce sustainable economic, environmental and social outcomes

- *Policy instruments that can stimulate sustainable materials management include regulations, economic incentives/disincentives, trade and innovation policies, information and voluntary partnerships.*
- *Policies which reinforce each other usually achieve more efficient, effective, equitable and lasting outcomes than those that do not.*
- *Information offering feedback on the full range of policy impacts is critical, especially so that policies can be adjusted appropriately*

To shift societies toward more sustainable materials management, governments can leverage various mechanisms including **regulations**, **economic incentives or disincentives**, **trade and innovation policies**, i**nformation** and **voluntary partnerships**. Each of these types of mechanisms has advantages and disadvantages.

Regulations

Regulations such as legislations or prohibitions on taking certain actions or risks or requirements to pursue certain actions can target outcomes measured in absolute terms (*e.g.* a specific percentage reduction of waste to landfill), but often leave little flexibility for economic actors. Examples of SMM-related regulations include bans on landfilling certain

wastes and the Extended Producer Responsibility (EPR) regulations pioneered in Sweden and practiced in many OECD countries. EPR can be effective in promoting recycling. Policy instruments based on EPR can also be designed to drive eco-design at the beginning of the product lifecycle. However, if the instruments are focused only on improved recycling without driving initial eco-design, EPR may not generate the desired economic and environmental efficiencies (Tojo, N., 2004).

Economic incentives and disincentives

Economic incentives and disincentives can harness the power of the market to generate outcomes which are often creative and economically efficient. Outcomes from economic incentives alone, however, may not be sufficient to generate environmentally or socially meaningful results, because actors generally stop making improvements once the economic incentive to do so ends, whether or not sufficient social or environmental progress has been made. Examples of economic mechanisms employed by OECD governments include also disincentives such as increased fees on waste disposal; and incentives such as government procurement policies and a potential reduction in the value added tax (VAT) and tax for environmentally friendly products (all promoted by the government of the Czech Republic, among others). Additional examples include measures such as environmental investment subsidies and tax credits (*e.g.* by the government of the Netherlands, among others).

Trade and innovation policies

Other potent mechanisms to advance SMM include trade and innovation policie**s**, which promote technological advancement, economic efficiency and multilateral sharing of the fruits of innovation. For example, governments could create economic incentives for more sustainable product design and end-of-life material collection, remanufacturing and recovery. Strategies could include research and development incentives, building of collection infrastructure and promoting public education. While some materials – particularly certain metal scraps – have sufficient market value to merit collection already, strategies could advance the recycling of materials with more marginal value or promote a shift away from materials with negative life-cycle environmental impacts. Governments could also support institutes designed to build and share repositories of information related to sustainable material innovation, as in Japan, Finland, the US and other OECD countries. The EU supports developing and promoting innovative financing programmes for green technologies (European Commission, 2008), and creating ongoing research collaborations to help provide producers with consistent, reliable information about the environmental impacts of common components, materials and new technologies. Through trade policies that facilitate technology transfer, environmental, economical and social benefits can be distributed[11, 12].

Information sharing

Information sharing promotes alignment around definitions and metrics, as well as dissemination of best practices. In addition to the technology advancing programmes described above and stakeholder engagement and communication strategies described under Principle 4, many OECD countries also support common metric development and ecolabel programmes to facilitate consistent measurement, public education and promotion of products with superior material sustainability characteristics. In the US, the

Electronics Products Environmental Assessment Tool (EPEAT)[13] has been supported in part by government funding to drive recycling and to decrease negative life-cycle environmental impacts associated with electronic equipment. Additional consumer-facing strategies might include understanding and influencing consumer behaviour which produces unsustainable outcomes, for example by exploring ways to reduce their consumption of materials that are resource intensive or that have negative life-cycle environmental impacts and exploring marketing practices which encourage sustainable consumption habits.

Integrated economic/environmental analysis provides another source of information that can assist governments in designing efficient and effective policies to stimulate SMM. It can also provide a common basis for dialogue among stakeholders and facilitate information sharing to improve the communication, uptake and acceptance of SMM policies and principles. Such analysis encompasses a range of economic techniques based around cost-benefit analysis and cost-effectiveness analysis and is used to assess the potential impacts on social welfare from policy initiatives. Issues such as environmental valuation techniques, the distribution of costs and benefits over time and groups within society, and appropriate discount rates all play an important role in the use of cost-benefit analysis (OECD, 2006).

Partnerships

Partnerships can also deepen and accelerate the efforts of leaders who want to improve their performance while stretching the boundaries of current best practice. Belgium and the US, among other OECD countries, have many voluntary partnership programmes. The Belgian Public Waste Authority Transition Network is a partnership that has developed a long-term vision to innovate on a system level (not incrementally) and to create a "transition path" to more sustainable material practices. The Network's focus areas include closing material cycles, designing safe materials to circulate in closed cycles, increasing services (shifting from selling products to offering services) and creating more sustainable plastics.

Use a diversity of policy instruments

Because each mechanism can deliver benefits, but no mechanism is ideal under all circumstances, a multi-pronged approach applying a diversity of mechanisms is more likely than a single "one-size-fits-all" approach to influence all relevant players. Weaving these diverse policy mechanisms into combinations which would reinforce each other can help to generate more effective, efficient and lasting outcomes. Integrated policies and policy instruments can successfully drive actors in the same direction and can accelerate progress, and generate synergies. In all cases, open multidirectional information flows can facilitate sustainable outcomes by providing feedback on the full range of policy impacts. This helps to build the participation of critical economic actors and other stakeholders, to lower potential resistance to innovation, to increase idea generation and to allow appropriate policy adjustment over time.

Obstacles to Sustainable Materials Management

Presently, SMM is limited by certain systemic conditions. First, economic actors regularly apply limited information to make short-term decisions that optimise certain economic performance measures, but sub-optimise the overall systemic outcome – for

example, by generating unsustainable rates of resource depletion, or by causing social and ecological damage.

To rectify this situation, policymakers could work to adjust the framework that forms the stage for economic action to account for and encourage more sustainable materials choices. To begin, policymakers could consider upgrading measures of success at the systemic level that would encourage assessment of policies not only in terms of the short-term quantity of economic wealth generated, but in terms of overall tangible and intangible value created in the entire ecological-social-economic system over time. For example, Belgium and other EU countries recommend that policymakers move assertively to decouple economic advancement from growth in material and energy throughput.

Economic indicators such as Gross Domestic Product (GDP), though useful for the purpose of measuring undifferentiated economic activity, fail to distinguish positive economic activity (which generates human and environmental health and happiness) from negative economic activity (which generates human and environmental damage and misery). To improve metrics, policymakers could factor natural capital contributions into economic calculations, and price these to deter degradation or liquidation of natural capital. For example, a healthy and productive forest depends on services provided by nature; incorporating the value of these contributions along with the contributions of labour, fuel, planting, etc., would make cost-benefit calculations more accurate. Similarly, impacts that would diminish the productivity or resilience of natural capital could be included along with other costs.

Finally, in many circumstances those impacts and values which are directly quantifiable are not the only ones which are important. Devising additional metrics to measure the impact of the non-obvious and non-quantifiable would provide a useful tool for policymaking. Such measures could include rigorous value and opinion surveys, observational studies of human choices and happiness, alternative assessments of value (such as the value of forests, mountains and coral reefs for tourism and ecosystem services as opposed to just resource extraction), and the like.3.4 SMM policy principle 4. Engage All Parts Of Society To Take Active, Ethically-Based Responsibility For Achieving Sustainable Outcomes.

- *Relevant stakeholders include individuals, the private sector, government organisations at the local, regional, national and international levels and non-governmental organisations.*
- *The collaboration of all stakeholders is a practical necessity to achieve SMM. Each party also has an ethical responsibility to make everyday decisions that lead to sustainable environmental, economic and social outcomes, both at home and around the globe.*
- *Information that is clear, useful, timely and freely available (transparent) is critical for stakeholders to be able to make decisions that lead to a green economy and a sustainable world.*
- *Ethically based responsibility requires each stakeholder to avoid actions that will shift negative environmental impacts to future generations and to promote actions that improve the social well-being of all people now and for those generations to come.*

Material flows involve and affect many stakeholders throughout the supply chain and often across vast geographical areas. Because of the complexity and dispersion (in both space and time) of decisions and impacts associated with material flows, outcomes can be improved by the inclusion and engagement of many players in collaborative efforts to create collective solutions. No single actor or industry has the capability, or the responsibility to ensure more sustainable outcomes unilaterally; however, various groups

working together can achieve significant gains. SMM outcomes can be improved by systematic cultivation of:

- Multilateral stakeholder engagement, responsibility and collaboration.
- Open information flows.
- An ethical perspective.

Multilateral stakeholder engagement, responsibility and collaboration

Regular communication and collaboration among economic actors, government agencies, and the general public can improve the formulation and execution of SMM policies and decisions. Blending and balancing the best thinking from individuals, the private sector, non-governmental organisations and intergovernmental organisations at all levels can improve the quality of decision-making and enhance efforts at adoption, execution and adaptation.

Actors with a stake in sustainable materials management include individuals and organisations in the private sector, government at all levels, and non-governmental organisations. All parties have an ethical responsibility to make everyday decisions that lead to sustainable environmental, economic and social outcomes, both at home and around the globe. Stakeholders should be selected based on the specifics of the SMM challenge (*i.e.* material, product, process, region), but could include representatives from every stage of the life-cycle and value chain. It is also important to include individuals, typically from NGOs who can act as a voice for overall environmental well-being and potentially impacted ecosystems. While stakeholder engagement cannot displace the need for ethical and legal boundaries, it can optimise socially acceptable and equitable solutions by engaging those who are affected and allowing them to participate in the design of systemic solutions.

Governments may not be able to directly convene all stakeholder initiatives for SMM but governments may be able to encourage other stakeholders to form coalitions to address material-related challenges for SMM. Governments could provide guidance on how to engage and facilitate stakeholder coalitions consistent with ethical values such as transparency and inclusiveness. By encouraging multi-stakeholder coalitions to achieve SMM, governments are acting to encourage all parts of society to take active, ethically-based responsibility for achieving sustainable outcomes. Examples of initiatives that address SMM through multi-stakeholder coalitions that are supported in part by governments through participation or funding include the Business NGO Forum for Green Chemicals and Sustainable Materials and the Sustainable Packaging Coalition, both run by non-governmental organisations (NGOs) (Business-NGO Forum for Green Chemicals and Sustainable Materials, 2009; Sustainable Packaging Coalition, 2009).

Specifically, stakeholder engagement can contribute to:

- More creative, insightful and thorough SMM decision-making.
- More active participation, collaboration and innovation in SMM research, innovation and change efforts.
- Greater trust and broader support for decisions, resulting in better integration of changes into existing systems, and more durable change overall.
- Better insight into hidden material flows.
- Better insight into local conditions, allowing actions with increased local relevance.

- Early detection of problems and opportunities in markets and communities of operation.
- Clearer understanding of the needs of complex multistakeholder systems.
- Greater alignment with the spirit of democratic participation and empowerment.
- An increased likelihood of socially acceptable outcomes.

To increase stakeholder engagement and sharing of responsibility, governments could act to decentralise decision-making and to address SMM decisions where the impacts occur. Governments could also consider shifting from command-and-control models of regulation toward more policy governance through setting of goals and expectations and delegation of progress to economic actors using flexible methods to reach common targets. Expanded roles of governments could include conveners of multi-stakeholder networks to support policy development and execution, and roles as connectors and partners to promote better information and connectivity. For example, governments could promote linkages and partnerships where none existed before – possibly among economic actors representing different industries who could potentially meet each others" sustainable materials needs (*e.g.* through industrial symbiosis arrangements or through the international Freecycle network[14]) or among stakeholders who rarely interact but could benefit each other.

Examples of mechanisms OECD countries have instituted to support and encourage partnerships in support of SMM and other sustainability objectives include:

- The Dutch Material Chain Approach, designed to bring together different actors in material supply chains in order to improve SMM performance and to establish "*clear and consistent definitions and… measurable criteria*" and quantitative metrics.
- The US EPA's Design for Environment's Partnership programmes.[15]
- Finland's Material Efficiency Centre, designed to provide advice and services for businesses, consumers and the public sector on improving material efficiency.[16]

Open information flows

Limited availability of material-related information throughout the supply chain is a significant barrier to SMM. Many producers, particularly those in complex industries with dozens or even hundreds of suppliers, barely know the identities of the suppliers in their value chains, let alone the social and environmental records and capacities of those suppliers or the origins and content of products.

Sustainable long-term decisions can be more efficiently and effectively achieved when all relevant parties understand and correctly attribute economic, social and environmental impacts, costs and benefits across the value chain. A critical factor in support of this objective is the free flow of clear, useful and timely information designed to accompany and align with material flows. Only with this information in hand can policymakers, managers and other stakeholders in each stage of the life-cycle offer high-quality evaluations of SMM options and make long-term decisions which optimise sustainable use of materials. To improve information flows in support of SMM, policymakers could:

- Promote common standards, metrics and frameworks which give producers, consumers, managers and regulators a framework to determine what information is important.
- Create rules that support SMM but protect confidentiality where needed; information-sharing is most effective when all participating parties believe that such sharing will generate long-term advantage and will not put them at a competitive disadvantage.

- Create systematic feedback loops which ensure honest and regular multidirectional flow of information, questions and ideas to reveal impacts and opportunities which may be obscured by distance (in time or space) from the decision-making centre.
- Include policy review and self-correction mechanisms to adapt to evolving conditions.

Ideally, every actor in the value chain would have both the capacity to identify previously unknown social and environmental impacts of significance to the sustainability of the entire system and incentives to bring these impacts (and potential solutions) to the attention of others who could help meet the challenge. Policymakers could encourage such local empowerment, while taking care to create a playing field that does not penalise actions that provide accurate and transparent information. Examples of mechanisms to promote open information flow include:

- The Carbon Disclosure Project.[17]
- Whistleblower protection laws, which provide legal support and protection against retribution for individuals who report problems or crimes to authorities.[18]

Ethical perspective

Ethically based responsibility includes, for example, that negative environmental impacts are not shifted to future generations and that we guarantee a high level of wellbeing for every person on this planet. Policymakers could further enhance sustainable material management by building systems which recognise and promote fulfilment of all actors" ethical responsibility to make everyday decisions which lead to sustainable environmental, economic and social outcomes, both at home and around the globe.

Given that materials are a basic necessity for survival and wellbeing, policymakers could improve the equity and stability of the global economic system by providing a common ethical basis for economic activity. One example of efforts to move in this direction is the *OECD Guidelines for Multinational Enterprises* (OECD, 2008f). A small sample of ethically-based questions related to SMM includes:

- Should policies aim to guarantee access to materials so that basic needs are fulfilled for every person on the planet?
- Should policies aim to mitigate the effect of rising prices for material use on the gap between the rich and the poor – both within and among countries?
- Should certain types of resource harvest be limited, and if so, under what conditions?
- Should economic actors restore disrupted natural features and ecosystems during or at the completion of their operations?
- How should countries combine "Open" Trade with adequate environmental protection – promoting both national environmental standards and international co-operation to promote environmental norms that adequately protect global environmental quality?

One way to advance common ethical practices providing consistent answers to questions like these would be to work toward universal adoption by governments and economic actors of established frameworks for ethical conduct such as the UN Global Compact Principles, the *OECD Guidelines for Multinational Enterprises*, the Equator Principles for socially and environmentally responsible lending, the SA 8000 labour standards code, and others. Table 1.1 summarises many of the ethical principles instilled in such frameworks, which tend to emphasise the importance of human and labour rights, environmental quality, community development, good organisational governance, and

integrity of the rule of law. Policymakers could engage in discussion for the purpose of agreeing on an ethical perspective for making policies and decisions regarding SMM, and could then encode these ethical principles explicitly into national and international policies. Common challenges with ethical standards that could affect government policymakers include:

- Vagueness.
- Difficulty of enforcement if they are voluntary. Public exposure has created some change in a handful of cases, but violations that become high profile or that become the target of environmental and human rights campaigns are relatively few.
- Limited implementation. These standards have existed for years yet have been explicitly implemented by only a small fraction of economic actors worldwide.

A number of established ethical principles with particular relevance to SMM include:

- Polluter Pays Principle.
- Precautionary Principle.
- Right-to-Know Principle.
- Principle of Liability and Compensation for Victims of Environmental Damage.

These ethical principles have been embedded into numerous policies discussed in this and following chapters.

National application of policy principles

For each SMM policy principle, OECD member countries were invited to respond to the following questions:

1. Has your country developed or applied this/these principle(s) at any level of the government? (Please provide a maximum of five examples and any supporting documents or links to the examples.)
2. What is or was the basis for the development of the application of this/these principle(s)?
3. What are the indentified or expected challenges and what objectives have been set or achieved with this SMM policy principle?
4. Are there any other relevant national, regional or local examples that would illustrate the principles described above? If yes, please also explain what principle(s) this/these example(s) would illustrate. Please provide any supporting documents or links to the examples.

The outcome of this survey is summarized in the following sections.

National application of SMM policy principle 1 – Preserve natural capital

National application

Several OECD member countries have taken steps to apply Principle 1 by gathering information about material flows and the related life-cycle impacts and by setting broad national priorities.

Australia has set out to enhance individual and community well-being by following a path of economic development that safeguards the welfare of future generations, provides for equity within and between generations, protects biological diversity and maintains essential ecological processes and life-support systems. As with other OECD member

Table 1.1. **Selected international ethics-related standards: Survey of embedded principles**

Survey of embedded principles		UN Global Compact	OECD Guidelines for MNEs	Equator Principles	SA 8000[1]	GRI[2]	Other
Human Rights	Support and respect for protection of internationally proclaimed human rights	■	■	■			
Human Rights	Defense against complicity in human rights abuses	■					
Labour	Support of freedom of association and the effective recognition of the right to collective bargaining	■			■	■	
Labour	Elimination of forced or compulsory labour	■			■	■	
Labour	Abolition of child labour	■			■	■	
Labour	Elimination of employment and occupation discrimination	■				■	
Labour	Protection of workplace health and safety			■	■	■	
Labour	Prevention of mental, physical and verbal coercion and abuse				■		
Labour	Enforcement of rules against excessive working hours				■		
Labour	Payment of wages which meet legal and industry standards and are sufficient to meet basic needs of workers" families				■	■	
Labour	Encouragement of human capital formation, by creating employment opportunities, training opportunities, etc.		■			■	
Labour	Promotion of employee awareness and compliance regarding ethical policies and practices		■			■	
Labour	Protection from retribution employees who report malfeasance to management or authorities						
Environment	Adherence to Precautionary Principle	■					■
Environment	Adherence to Polluter Pays Principle						■
Environment	Adherence to Right to Know Principle						■
Environment	Adherence to Principle of Liability and Compensation for Victims of Environmental Damage						■
Environment	Protection and conservation of biodiversity, including endangered species and sensitive ecosystems			■		■	
Environment	Sustainable management of natural resources			■		■	
Integrity of the Rule of Law	Work against corruption in all its forms, including extortion and bribery	■				■	
Integrity of the Rule of Law	Compliance with and avoidance of exemptions to local environmental, health, safety, labour and finance rules		■	■		■	
Integrity of the Rule of Law	Avoidance of improper involvement in local political activities		■			■	
Business Practices	Adherence to good corporate governance and management principles and practices, including management systems		■		■	■	
Business Practices	Encouragement of business partners, suppliers and subcontractors to apply ethical principles of conduct		■				
Community	Encouragement of local capacity building through close co-operation with the local community		■				
Community	Application of self-regulatory practices and management systems that foster confidence and mutual trust between enterprises and the societies in which they operate		■				
Community	Protection of cultural property, heritage & indigenous rights			■		■	
Community	Contribution to economic, social and environmental progress to promote sustainable development		■	■		■	

1. SA 8000 is a global social accountability standard for decent working conditions, developed and overseen by Social Accountability International (SAI).
2. GRI is the **Global Reporting Initiative** (GRI). It produces guidelines and standards for sustainability reporting by all organizations, similarly to financial reporting.

countries, Australia noted the major challenge of breaking the strong link between waste generation and economic development.

Australia provided an example of applying SMM policy principle 1 by enhancing resource productivity, resource efficiency and recycling through successful "Industrial ecology" in the Kwinana Industrial Area (KIA) in Western Australia. Industrial ecology refers to the synergistic integration of materials use within and between industries – whereby one industry's waste may become another's feedstock or resource. The Kwinana Industries Council (KIC) was formed in 1991 to organise air and water monitoring for the industries in the KIA (Kwinana Industries Council, 2009). Since then, the KIC has expanded its responsibilities to manage industrial hazards programmes, air and watershed monitoring protection, and has co-ordinated industry efforts to reduce industry emission impact on the sensitive marine environment of the adjacent Cockburn Sound. The KIC consists of 12 major industries as full members and 30 other industries (predominantly medium sized operations and service providers) as associate members.

Finland has set out to decrease and manage in a sustainable way material and energy flows to develop long-term goals on how to use natural resources sustainably and to improve eco-efficiency. In doing so, they also are seeking to strengthen the co-ordination of natural resource policies. From the social and economic perspectives, they are striving to increase overall wellbeing and to create new business possibilities based on natural resources.

In April 2009, Finland completed a 3-year study on the environmental impacts of the Finnish national economy. Using the ENVIMAT model developed by the Finnish Environment Institute, the Thule Institute at the University of Oulu and MTT Agrifood Research Finland, the study was able to provide a comprehensive picture of the environmental impacts of the Finnish national economy and an approach for considering direct and indirect material flows. The study will be used to develop policies and targets for different sectors.[19]

Also in April 2009, a Natural Resource Strategy for Finland was developed and presented to the Prime Minister. The strategy, which was compiled by a group of experts and managed by Sitra (the Finnish Innovation Fund), supports an approach to natural resources that promotes competitiveness, wellbeing and environmental responsibility. Responsibility for implementing the strategy is shared between different ministries.[20] The national strategy resulted in the following vision and strategic goals:

1. Finland has a thriving bioeconomy generating high added value.
2. Finland utilises and recycles material flows effectively.
3. Regional resources generate both national added value and local wellbeing.
4. Finland takes initiatives and leads the way on natural resource issues internationally.

Sweden has set up 16 Environmental Quality Objectives along with three action strategies and a set of environmental indicators.[21] The environmental quality objectives are designed to promote human health; safeguard biodiversity and the natural environment; preserve the cultural environment and cultural heritage; maintain long-term ecosystem productivity; and ensure wise management of natural resources. The overall goal is that, "within one generation, the major environmental problems currently facing will be solved."

The Environmental Quality Objectives describe what quality and state of the environment are sustainable in the long term. There are also social and economic dimensions involved. The majority of the Objectives contain provisions for conserving and restoring natural capital. For example under Environmental Quality Objectives 9 and 16: "*Good-Quality Groundwater*" and "*A Good Built Environment*" there are interim targets for waste and extraction of natural gravel.

Observations, achievements and challenges

Although waste prevention measures have been put in place in many OECD countries along with measures to reduce material throughput to increase resource productivity and to step up reuse and recycling, these measures did not explicitly address the preservation of natural capital from a sustainable materials management perspective.

A number of the OECD countries noted the serious challenge of decoupling economic growth and development from the overall increase in consumption of natural capital. Finland noted that decoupling has been achieved for several pollutants, but overall consumption of natural resources and energy is increasing – particularly in the transportation sector. And certain toxics still cause problems. In Finland, as reported in other regions, eco-efficiency is improving, but it is not improving as rapidly as expected. Another challenge noted by Finland is the increasing importance of international natural resource policy and how to evaluate and prioritise impacts and objectives for natural capital based on national characteristics (*e.g.* climate, industry, etc.).

In Australia, the KIC achieves industrial waste reductions of approximately 421 600 tonnes per year. There are thirty-two by-product synergies and fifteen utility infrastructure synergies in the KIA. Feasibility work is underway on a further fifteen synergy opportunities. Information was not found on the role of government in setting up the KIC.

In Sweden, the Environmental Objectives have been successful in guiding the direction of the work of municipal and central authorities. However, the government is challenged to engage and motivate other actors in meeting the objectives, *e.g.* industry. The Environmental Objectives are ambitious and there are major challenges in reaching many of them within the set time limit. Sweden's priorities are to implement the policy measures already decided and to co-ordinate measures between them, to get maximum impact of each measure and to drive synergies.

National application of SMM policy principle 2 – Design and manage materials, products and processes for safety and sustainability from a life-cycle perspective

National application

In **Belgium,** SMM policy principle 2 is being incorporated into *policy planning* and *regulatory instruments*. The basis for these developments is the need for more upstream measures that decrease the amount of residual waste to be incinerated or sent to landfills.

The principle of *extended producer responsibility (EPR)* has been introduced for several waste streams such as WEEE, batteries and accumulators, waste oils, end-of-life vehicles, cooking oils, packaging materials and paper. These EPR schemes try to establish a link between different actors in the life-cycle of a product, starting from product design and ending with the collection and the recycling of the resulting waste. This link is established by giving financial and/or operational responsibilities to different actors in the life-cycle, with the original producer as main actor. While they have been successful in increasing

collection and recycling rates, they have been less successful in stimulating more eco-design.

As an EU country, Belgium has a tradition of developing waste management plans for different waste streams. Some of these plans go beyond just the waste phase. Gradually waste *policy planning* is trying to integrate more measures that address different phases of the life-cycle. The biggest challenge for policy planning with a strong life-cycle perspective is the limited influence of the planning authority. Material cycles occur on a transnational or even global scale, while an environmental authority has only jurisdiction over what is happening within its own territory. And even then they may be limited by trade rules to avoid distorted competition with neighbouring countries, etc.

Belgian waste policy is based on the *waste hierarchy* (prevention, reuse, recycling, energy recovery and finally landfilling). Policies that have proven to be the most successful are those that work on all levels of the waste hierarchy at the same time. For instance, landfill taxes or bans have a greater effect when they are combined with the introduction of pay-as-you-throw schemes, with selective collection schemes and with waste prevention measures. Basing policy on the waste hierarchy automatically helps to focus on the issue from a life-cycle perspective. The biggest challenge with this approach is the development of sufficient knowledge/data about the impacts that occur throughout the life-cycle and defining proper system boundaries and starting hypotheses for an LCA, etc., so as to be able to judge when the waste hierarchy needs to be overruled for obtaining the best environmental result.

Belgium is now trying to introduce a *chain management approach* in their policy development. The idea is to identify material cycles that have a great potential for lowering their environmental impact and then to bring together all of the different actors in that cycle to see what possibilities there are for more co-operation between the different actors in the chain and for a more coherent set of policy measures that work on different phases of the life-cycle. The main challenge is to find sufficient actors within a value chain that are prepared to sit together and co-operate. There is also the problem that it may be difficult to engage actors in the life-cycle from outside governmental jurisdiction.

Belgium has developed a software tool for use by designers that is easy to use for calculating the *"ecological rucksack"* of the products they design.[22] This tool helps to inform designers about the hidden impacts of the materials they use in new products. The main challenge is how to stimulate designers to make use of this tool. Their driver is most often price and quality requirements imposed by their customers – environmental issues may not be a high priority.

In the **United States**, national applications of SMM policy principle 2 include a number of *initiatives* that identify leadership in design for safety and sustainability of materials, products and processes from the life-cycle perspective and promote their advancement through public recognition or procurement. Examples include the US Environmental Protection Agency's (USEPA) programmes in Green Chemistry,[23] Green Engineering,[24] Design for the Environment[25] and Environmentally Preferable Purchasing.[26] Some of these programmes result in the development of tools and information resources that support design. Others result in public recognition – whether through high profile awards or through the labelling of individual leadership products to bring market advantage. Products labelled or identified through these government initiatives are supported to varying degrees by government procurement. *USEPA's Green Chemistry Program* promotes

green chemistry through the prestigious Presidential Green Chemistry Challenge Awards. This is the only Presidential level chemistry award in the US. USEPA also supports *green chemistry* through *educational* activities and research and development. Green chemistry is currently gaining significant momentum in the US outside of the USEPA, such as through the Green Chemistry Institute of the American Chemical Society, through state initiatives such as those in Michigan and California.

Box 1.3. **Definition of Green Chemistry**

"Green chemistry is a pre-emptive strategy that reduces the use of toxic substances before they contaminate the environment and our bodies. It is a marked departure from the past where society managed industrial and municipal wastes by disposal or incineration. Green chemistry seeks to dramatically reduce the toxicity of chemicals in the first place, rather than merely manage their toxic waste after use and disposal." (California Green Chemistry Initiative, 2009)

USEPA's Green Engineering Program works to incorporate green design concepts into chemical processes and products by providing tools and resources for engineers in academia and industry. A Green Engineering textbook, *Green Engineering: Environmentally Conscious Design of Chemical Processes* has been developed for instructing "green" thinking in engineering processes and applications. Software has been developed to provide chemical engineers with a suite of tools for assessing chemical hazards in process design. Continuing education courses and case studies to illustrate green engineering alternatives in chemical process design have been developed for industrial engineers.

USEPA's Design for the Environment Program (DfE) uses multi-stakeholder partnerships to engage with NGOs and industry to advance green chemistry in product design. The DfE Safer Product Labelling Programme promotes green chemistry and provides benefits to stakeholders throughout the supply chain by allowing manufacturers to submit product formulations for chemical profiling and assessment. Where formulators are successful in developing a product that uses low hazard chemicals, they are allowed to use the DfE-logo on that product. Where formulators are not successful, DfE will provide technical assistance to guide formulators to safer alternatives. The programme supports formulators in finding – and raw material suppliers in selling – safer ingredients. DfE has developed DfE Criteria for Safer Chemicals that help to identify low hazard chemicals within a particular functional use (*e.g.* solvent, fragrance, etc.). Information on the chemicals that meet DfE criteria and have been reviewed by a third party, is made publicly available via a database.[27] The programme also benefits institutional purchasers and consumers by use of the DfE logo which makes it easier to identify products comprised of chemicals that are safer for human health and the environment. The programme is popular with stakeholders from both industry and NGOs and there demand for its expansion. In the near term, Partnerships may address adhesives and children's products, such as markers.

DfE programmes are effective in part because they are based on multi-stakeholder input.[28] DfE has developed tools and approaches for comparative hazard assessment that inform decision making and that have been used as a basis for initiatives in the private sector.[29] When safer chemical alternatives have not yet been identified, DfE encourages best practices to minimise pollution, especially in the auto refinishing and spray

polyurethane foam industries. DfE also performs life-cycle assessment (LCA) studies. The DfE Lead-Free Solder Partnership conducted an LCA for tin-lead and leading lead-free solder alternatives for use in electronic products, allowing electronics manufacturers to choose materials that pose fewer impacts over the life-cycle of their products. DfE has recently begun the Lithium-ion Batteries and Nanotechnology Partnership, to conduct a LCA of current and future battery technologies that may be used in hybrid and electric vehicles.

The Energy Star:[30] *Portfolio Manager* is an interactive tool that allows one to track and assess energy and water consumption across a portfolio of buildings in a secure online environment. The tool can help set investment priorities, identify under-performing buildings, verify efficiency improvements, and receive EPA recognition for superior energy performance.

Observations, achievements and challenges

Belgium is strategically moving its waste management policy planning toward SMM. The challenges they noted in the brief descriptions of the applications may be helpful to other OECD countries seeking to explore similar initiatives. Perhaps by integrating elements of the voluntary initiatives in the US with elements of the regulatory and other policy initiatives in Belgium, policies may be optimised for SMM. For example, perhaps a DfE-type Partnership programme could recognise designers who use the "ecological rucksack" tool to design products with sustainability benefits.

In the US, success has been demonstrated with promoting the design of materials, products and processes for safety and sustainability from the life-cycle perspective through market-based measures such as Energy Star, DfE Partnerships, EPEAT, Green Chemistry, Federal Electronics Challenge and government procurement. It may be important to look closely at initiatives such as these that have been effective and popular across stakeholder groups by defining leadership activities and achievable objectives.

National application of SMM policy principle 3 – Use the full diversity of policy instruments to stimulate and reinforce sustainable economic, environmental and social outcomes

National application

Several OECD countries described the application of SMM policy principle 3 as the basis for government initiatives.

Belgium has developed a multifaceted strategy to promote SMM, including a Transition Network established by the Belgian Public Waste Authority to create a vision, pilot projects and transition paths to move Belgium toward a future with sustainable materials management. The explicit goal is not to create incremental improvements, but rather to shift the whole system toward closed material cycles, substitution of services for products, improvement of the sustainability profile of basic materials like plastics, and improved consumer awareness.

The Belgian policy approach includes the waste hierarchy to drive policies that address different stages of the life-cycle. To reinforce policy objectives, Belgium has leveraged various kinds of policy instruments concurrently, including:

- Regulations – *e.g.* Extended Producer Responsibility, landfill and incineration bans for specific waste streams, requirements for management of particular waste streams.

- Economic Incentives – *e.g.* Landfill and incineration taxes, extra fees for non-recyclable household waste, subsidies for local governments to adopt waste prevention and to invest in infrastructure for material collection.
- Information Sharing – Communication campaigns for stimulating waste prevention and separation at source.
- Trade and Innovation Policy – Setting up networks of reuse centres.
- Voluntary Partnerships – Stimulating inter-municipal co-operation in the field of waste management.

The Czech Republic applies a strategy for SMM which includes many information-related and economic incentive components. For example, the Centre for Waste Management maintains a database of the Best Available Technologies regarding waste recovery and disposal. The Czech Environmental Information Agency (CENIA) maintains information and statistics on many aspects of sustainability and the environment, for access by the general public. Other government agencies specialize in the evaluation and transfer of more sustainable materials technologies – for example, the Research Institute of Building Materials (VUSTAH) and the Technology Centre AS ČR.

The Czech Programme for Labelling Environmentally Friendly Products provides an ecolabelling scheme covering 61 categories of products or services. It is a relatively new programme but in 2008, there were 92 producers involved in this programme.

The Czech Ministry of the Environment has launched several research projects intended to provide producers with consistent, reliable information about the environmental impacts of common components and materials and with information on the environmental performance of new technologies. The intent is to aid producers in minimising the environmental impact of products. Efficiency, effectiveness and integration have been aided by initiatives to model waste management expenses under different scenarios.

The Czech Republic has implemented a number of economic instruments to support elements of SMM. As an example of an economic disincentive, the New Waste Act in the Czech Parliament proposes to increase fees on waste disposal. As examples of economic incentives, the Czech government is promoting green public procurement for public purchases and the Ministry of the Environment has worked to promote a potential reduction or abolition of the Value Added Tax (VAT) for products with environmentally-friendly features (*e.g.* superior energy efficiency, high recycled material content, etc.)

Sweden's Material Management Framework includes several policy instruments. The Environmental Quality Objectives incorporate both ecological (biodiversity, ecosystem productivity, natural resource management) and human (health, cultural heritage) considerations. The Environmental Code includes a provision requiring consideration of both economic costs and benefits when permitting and regulating facilities and activities which could negatively impact human health or the environment. To drive greater effectiveness, Sweden has adopted a policy approach that leverages a mix of instruments, including:

- regulations – *e.g.* Producer responsibility for various materials (paper, tires, cars, batteries, electronics, and lighting); ban on landfill of organic and combustible waste;
- economic Incentives – Deposit system for drinking containers; and

- information sharing – collaboration with other Scandinavian countries to support the Nordic Swan ecolabel, covering over 5 000 products in some 70 product groups.

Observations, achievements and challenges

A number of the OECD countries have demonstrated that using a full diversity of policy instruments can lead to success in stimulating and reinforcing waste management policies. Extending waste management policies to include SMM is still in the early stages. Several member countries noted that Extended Producer Responsibility (EPR) Programmes have been successful in increasing collection and recycling rates in some countries, but they have been less successful in stimulating more eco-design. EPR can be effective in promoting SMM if the policy structure drives redesign at the beginning of the product lifecycle; but if focused only on improved recycling without redesign, it can generate outcomes that may be less efficient, both economically and environmentally.

Some policy instruments appear to be effective and relatively simple to implement in support of SMM. These include environmentally preferable procurement for governments and the creation of research centres that drive resource efficiency. The modification proposals for the Value Added Tax (VAT) favouring sustainable innovations in the Czech Republic hold the potential to significantly increase economic actors" planning for and investment in SMM improvements.

As is true with many programmes, SMM is limited by insufficient budgets that limit the degree and level of innovation of government interventions and changes. It is also challenging for some to get sufficient co-operation from industry. One member country contributor suggested that to get the most co-operation from industry, it is helpful to communicate in a convincing way, "what's in it for them".

National application of SMM policy principle 4 – Engage all parts of society to take active, ethically-based responsibility for achieving sustainable outcomes

National application

Australia has drafted a National Action Plan for Education for Sustainability: *Living Sustainably*, which brings together representatives from academia, non-government organisations, youth, and local government with the aim of equipping all Australians with the knowledge and skills required to live sustainably. The intent of the plan is to:

- Promote sustainability throughout the national training system.
- Support whole-institution change for sustainability in universities.
- Form partnerships with industry bodies and professional associations to develop and deliver workplace learning for sustainability.
- Work with local governments to improve their capacity to engage in best practice community education for sustainability.
- Undertake research which will recommend effective approaches to achieve enduring, system-wide change.
- Embed sustainability within the community.

Belgium is now looking to introduce a chain management approach in their policy, to identify material cycles with high potential for reduced environmental impact and to bring together different actors in that cycle to identify opportunities for greater co-operation and a coherent set of policy measures that work in different phases of the life-cycle. It is still

early in the application of the chain management approach but stakeholder theory would suggest that it has good potential to achieve the desired outcomes.

The Belgian Public Waste Authority also initiated a transition network on sustainable materials management to bring together representatives of business, NGO, academia and government to undertake transition experiments toward sustainable materials management. This kind of network is an experiment in itself in finding new ways of governance. Instead of introducing regulations or subsidies/taxes from a top-down approach, the authorities sit together with different actors in society creating room for innovation and creating new coalitions and forms of co-operation.

The Czech Republic, like other EU countries, is working to build ethical principles into SMM policy and policy instruments. For example, the Polluter Pays Principle is embedded into EPR laws and the principle of collective responsibility is embedded into take-back regulations. The Czech Republic and other EU countries also work to build sustainability knowledge and capacity through consumer awareness-raising campaigns for sustainable consumption and production by:

- Providing public information campaigns and illustrations of good practises on WEEE and other solid waste issues.
- Co-ordinating school-based and other small-scale local collection activities.
- Setting up Earth Day celebrations and games.
- Developing competitions, projects, workshops and learning games to support the education of the general public and children to teach them about the proper disposal of waste.

The Netherlands has adopted a Material Chain Approach (Dutch Chain Approach) to achieve SMM as part of the national Future Waste Policy. This approach represents an overall movement toward SMM by considering life-cycle impacts of waste. Implementing the Material Chain Approach engages the government as a facilitator, bringing together different actors in the material chain in order to:

- Map environmental burdens in the whole material chain.
- Determine ways to improve sustainable material performance.
- Set improvement strategies, goals and targets for each priority stream.
- Draft a plan of action for each priority stream.
- Take action.
- Monitor progress.
- Establish definitions and measurable criteria and quantitative metrics.

Observations, achievements and challenges

Australia's education objectives are broad and ambitious and not surprisingly face several challenges. They are striving to co-ordinate consistent approaches to education for sustainability across all levels of governments. In addition, they seek to widen the scope of education for sustainability from formal education institutions to the broader community, including industry. They seek to further extend and integrate the education initiatives by establishing partnerships and strategic links within and between governments, industry and community sectors to catalyse progress.

In Belgium, a major challenge noted with the chain management approach is to find sufficient actors within a value chain that are prepared to sit together and co-operate. One member country noted that sometimes the carrot and stick method is effective for engaging stakeholders, *i.e.* by creating a situation that allows stakeholders to avoid the threat of regulatory measures or taxes by their willingness to collaborate and co-operate to find solutions. However, the challenge of engaging willing stakeholders can be complicated when the stakeholders are from other countries or otherwise outside of a government jurisdiction.

Conclusions

This chapter identifies four broad SMM policy principles ("framework conditions") that support a shift from waste management to materials management in support of sustainable development. Because SMM is a relatively new approach, there are limited examples of policies developed with a comprehensive SMM framework in mind. However, many OECD member countries have built on existing policy frameworks in areas such as waste management, environmentally preferable procurement and extended producer responsibility to progress toward SMM. While an evaluation of policy instruments related to SMM is covered in Chapter 3, this chapter contains a number of illustrative examples of national applications of individual SMM policy principles.

SMM opportunities

Applying SMM can generate benefits by encouraging policymakers to take a systems view of materials that flow among the economic, social and environmental systems and to optimise all three aspects of sustainability as they relate to materials. SMM supports a life-cycle view of impacts associated with materials use which can help policymakers to better predict and manage downstream and long-term consequences of actions, to avoid shifting problems from one stage of the value chain to another, or shifting impacts from the present to future generations. SMM also encourages multilateral participation in the creation and execution of policies and practices related to materials use. By encouraging processes that are broadly inclusive of stakeholders, governments can generate more ideas and develop policies that are locally-relevant and more likely to gain greater support from those who are responsible for executing them. Inclusiveness also tends to increase the equity of outcomes by giving a voice to everyone who is potentially impacted, before outcomes are generated.

One promising approach that directly supports SMM and multiple SMM policy principles is the Material Chain Approach being implemented by the Netherlands and considered by Belgium. This approach represents an overall movement toward SMM in which the government plays the role of convener and facilitator, bringing together different actors in the material chain and considering the life-cycle impacts of materials. The Belgian Public Waste Authority initiated a transition network on sustainable materials management to bring together representatives of business, NGO, academia and government to undertake transition experiments toward sustainable materials management. This kind of network is an experiment in finding new forms of governance whereby authorities sit together with different actors in society creating room for innovation via new coalitions and co-operation.

SMM challenges

Member countries have also encountered challenges in their pursuit of SMM objectives. These challenges provide learning opportunities and are fodder for innovative policies:

- *Decoupling growth in wellbeing from growth in material consumption* – No member country has reported complete success decoupling economic growth and development from increased consumption of natural capital. Some have reported success in reducing certain pollutants, increasing the percentage of waste diverted to landfill, and creating small-scale industrial ecosystems. Overall, however, consumption of natural resources and energy is still increasing. New strategies and synergies will be needed to accelerate decoupling.
- *Understanding material flows and impacts, particularly direct and indirect flows and international impacts* – Understanding of domestic and international material flows and their social and environmental impacts is still incomplete and inconsistent. Building better knowledge of material impacts, combined with open information sharing among member countries and economic actors could advance SMM and enable better decision-making. A growing set of assessment tools with the potential to support SMM (*e.g.* Flow Analysis [MFA], total cost assessment [TCA], economic input/output assessment [EIO], life-cycle assessment [LCA], ecological rucksack analysis, etc.) (OECD, 2008c) can provide insight into the complex SMM system. Governments could share best practices regarding each individual tool and its use in combination with the others.
- *Realigning regulations and incentives to ensure that behaviour which is economically rational is also sustainable* – To align the actions of economic actors with SMM objectives, governments could deliberately and systematically guide economic actors by taking a long-term view of actions, impacts, investments, and returns by focusing and communicating a vision for the whole ecological-social-economic system rather than maximising economic value in isolation.
- *Improving consistency of the life-cycle focus* – Product policies including Extended Producer Responsibility (EPR) could be refined to ensure that they not only fund and drive product recycling, but that they also encourage producers to address questions of design – improving SMM outcomes by eliminating toxicity and preventing waste throughout the life-cycle.
- *Advancing government-industry collaborations* – Aligning governments and industry around common objectives can leverage the influence, ideas, skills and experience of each to generate synergies that go well beyond improving efficiency. It may be fruitful to consider how to adapt the SMM policy principles for use by industry to encourage a focus on preserving natural capital, to improve material, product and process design, to integrate into business strategies and to engage in best practices for stakeholder involvement.
- *Promoting productive stakeholder engagement* – Collaborations among actors across material value chains could advance SMM by promoting potential synergies among actors who have not had the occasion to collaborate before to pursue a common goal. However, convening and engaging stakeholders can be expensive, time consuming, and sometimes frustrating. It is important to present stakeholders with clear ideas about what they will gain from participating and to host meetings that are planned thoughtfully to ensure that they are valuable for everyone, solicit equitable contributions

from all parties, and produce concrete outcomes and next steps. Policymakers could support research into best practices for creating and supporting multilateral collaborations and partnerships.

Notes

1. In 2001, WBCSD promulgated 10 messages by which to operate. Message 9 is the following: "Ecosystems in Balance – A Prerequisite for Business: Business cannot function if ecosystems and the services they deliver, such as water, biodiversity, food, fibre and climate, are degraded".
2. *http://www-935.ibm.com/services/us/gbs/bus/html/smarter-cities.html*.
3. Sustainable Chemistry aims at the design, manufacture and use of chemical products that are efficient, effective, safe and more environmentally benign across their life-cycle (see: *www.oecd.org/env_sustainablechemistry_platform/*).
4. *www.oecd.org/env_sustainablechemistry_platform/*.
5. *www.epa.gov/dfe/index.htm*.
6. *http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm*.
7. *www.epa.gov/triexplorer/*.
8. *www.oecd.org/department/0,3355,en_2649_34377_1_1_1_1_1,00.html*.
9. *www.oecd.org/department/0,3355,en_2649_34411_1_1_1_1_1,00.html*.
10. *www.epea.com/*.
11. *www.epea.com/*.
12. *www.oecd.org/document/16/0,3343,en_2649_37431_43442320_1_1_1_1,00.html*.
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15. *www.epa.gov/dfe/*, accessed October 2009.
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Chapter 2

Setting and using targets for SMM: Opportunities and challenges

Sustainable Materials Management (SMM) and the concept of addressing waste issues by looking at the value chain are well accepted components of sustainable consumption and production (SCP) and waste policy. However, both face a number of challenges in implementation including the establishment of effective targets. The purpose of this chapter is to explore the opportunities, challenges and important considerations faced by policy makers when setting and implementing SMM-related targets.

Introduction

Sustainable Materials Management (SMM) and the concept of addressing waste issues by looking at the value chain are well accepted components of sustainable consumption and production (SCP) and waste policy. However, both face a number of challenges in implementation including the establishment of effective targets. As such, the purpose of this chapter is to explore the opportunities, challenges and important considerations faced by policy makers when setting and implementing SMM-related targets.

There are three major learning objectives related to this topic: why and how countries generate targets; how these targets are used; and the key considerations for policy makers when considering setting and implementing targets.

It should also be mentioned that this chapter is explicitly focused on the underlying opportunities, challenges and considerations related to targets – not at promoting their wider use *per se* – as this is a policy question that ultimately needs to be decided upon by individual governments.

The research for this chapter consisted of five general inputs:

- existing OECD research related to SMM, particularly case studies completed for the OECD Front-Runners Experience on SMM, 2nd SMM Workshop, held in Tel-Aviv;
- literature from academia and think tanks looking at SMM-related policy topics and the use of targets in environmental policy;
- interviews with both national and sub-national representatives;
- interviews with experts in the field of SMM policy development; and
- interviews with companies from a variety of sectors that are demonstrating leadership in the area of target setting.

A complete list of the individuals interviewed and sources reviewed for this chapter are available in Annex 2.A3. In addition, specific concepts or comments attributable to a single source have been captured in the footnotes. It should be noted that it was not the purpose of this work to conduct a robust analysis of any one approach to SMM but rather to draw lessons from a variety of sources including individual programmes at various national and sub-national levels, as well as specific lessons from the private sector, to illustrate concepts rather than direct or inform collaboration.

The chapter begins by presenting a clear definition of targets and their various forms which – informed by practice – cover a spectrum from "hard" to "soft" targets. It then provides a summary of the drivers for setting targets related to SMM. Based on available information, it documents the current and emerging practices of OECD member states in setting and using SMM-related targets. And it provides insight into the key considerations policy makers will want to address when setting and implementing targets. The chapter concludes by summarising the key findings/conclusions from all of the research conducted. Within Annex 2.A1, readers will find summary tables of the SMM programmes

reviewed, a number of case studies on the private-sector experience in setting and implementing targets, and a list of data input sources.

Definitions

Targets

The standard definition of a target, "a goal to be achieved"[1], is insufficient to convey the variety of approaches used in SMM target setting. These cover the spectrum from vague qualitative targets with a great deal of flexibility (soft targets) to quantifiable targets with clear baselines, measures, accountability and dates for achievements (hard targets). We also observed the use of "strategic objectives" that act as overarching concepts to co-ordinate activities at a more specific level. Policy makers have used a variety of targets from across this spectrum in order to achieve their objectives. The following provides an explanation of the various terms used to define this spectrum and its elements:

Hard targets

These targets tend to have a short timeline (*e.g.* 1 to 5 years), a narrow scope (*i.e.* looking at a single product or material type), and have clear accountability. They are typically quantifiable in nature and include – as part of the target – descriptions of the measurement approach, a review process to ensure achievement and, in many cases, a clear articulation of the consequences of failing to achieve the target. Further, given the need to measure performance, hard targets are often focused on a single attribute and can be very specific in regards to which products, industries or segments of society are included in the target. Example: fixed recycling rates for a specific material supported by financial penalties for not achieving them.

Soft targets

Usually broader in nature (*e.g.* looking at building performance rather than insulation values), soft targets typically have a variety of timelines and no specific accountability. Where there is clear accountability, soft targets have a level of flexibility which hard targets do not; the level of expected performance (*e.g.* a 25% reduction) or timeline (*e.g.* by 2015) can change as new information and experience become available. Example: the Japanese Basic Law for Establishing a Sound Material-Cycle Society sets specific targets for various industrial sectors but, as part of both annual and five-year review cycles, allows for adjustments to these targets as new information becomes available.[2]

Voluntary targets

Related to soft targets, voluntary targets are those entered into by choice with the option of opting out. These targets are often related to some incentive (*e.g.* financial, training, reputation building) which makes meeting the voluntary target worth the effort. Example: the "Dutch chain-oriented policy pilot projects" involved companies from six pilot project categories (gypsum, zinc, carpet, food, expanded polystyrene, textile) that developed voluntary quantitative SMM targets, goals and plans which were then supported by the government.

Strategic objectives (goals)

In contrast to hard and soft targets, strategic objectives tend to be based on a broader set of considerations, more general concepts or longer timelines. They are primarily

qualitative in nature, and lack a clear description of either the measurement mechanism or consequences for failing to meet the objective or goal.

Strategic levers

This refers to the available methods and extent of influence a target-setting authority may have. As demonstrated throughout this chapter, this is an important concept given that the available strategic levers that exist for governments vary widely. For example, a jurisdiction may not represent a significant market for a specific product and therefore may have limited ability to influence its design, but it may be able to affect the recycling rate for that product.

Context and objectives of SMM policy and target setting

Much has been written about the need for SMM, including the OECD's "Report of the 2nd Survey on SMM-Related Activities in OECD Countries" (OECD, 2009). In general, underlying environmental issues are the key drivers for the justification by policy makers for establishing SMM policies and related targets. For example, one author stated that: *Increasing material flows contribute to many of the world's environmental and social problems. In the near term, sustainable development is threatened not so much by the depletion of non-renewable resources such as minerals or fossil fuels, but rather by over-exploitation of renewable resources and the life cycle impacts or "externalities" associated with material extraction, transport and utilization. These externalities include potential climate change due to global warming emissions; degradation of air, waste, land, and wildlife habitats in industrialized areas; and depletion of natural resources including fresh water, biomass, and topsoil. Hence, there is a need to explore the potential for achieving sustainable materials management (SMM). (Fiksel, J., 2006)*

The primary environmental drivers for national policies are domestically based and include reducing the life cycle impacts of materials. End-of-life issues such as access to landfill sites and impacts on land, water and wildlife tend to dominate. Global issues such as climate change and concerns regarding continued access to critical materials provide additional motivation in shaping environmental policy. Non-environmental drivers tend to be related to future economic considerations particularly related to the competitiveness of domestic firms.

Within the context of SMM, the rationales provided for public or private target setting seems to fall into the following broad categories:

- providing a future vision/inspiration for action;
- co-ordinating actions among various actors;
- providing a mid-term constraint as a bridge or means to encourage society to be prepared for a future expected reality;
- providing a metric of success against which progress can be measured; and
- as a signal of action on an issue.

Providing a future vision/inspiration for action

Targets and, more specifically, strategic objectives can be used to provide a long-term future vision/inspiration for action, often driven by both a desire to motivate action and then to co-ordinate that action, as just mentioned. In many cases, setting targets at this broad and encompassing level – either in terms of inspiration (*e.g.* zero waste) or timeline

(*e.g.* by 2050…) – requires an accepted level of flexibility. This is primarily due to the fact that a strategic objective can be set without a clear understanding of how it can or will be achieved. By allowing flexibility in the achievement of the targets, involved parties can move beyond discussions of how to achieve the target based on available information to a more direct conversation of the future state they would all like to work towards. In the private sector this is most clearly seen in bold statements such as "achieving zero waste" where it is not clear how they will be achieved in the foreseeable future (see Annex 2.A2). In the public realm, it is employed by governments when striving to provide some coherence to a wide number of activities, programmes and targets. For instance, in Japan there is an awareness of material security, or access to the materials required for the functioning of the economy, and a clear need to improve the country's ability to capture existing materials within its economy. Establishing longer-term objectives for material flows and material productivity has helped to create a future vision for the country and provided a springboard from which to act.[3]

There is also a clear difference between "what should be done" and "what can be done". In the climate change debate a clear "what should be done" goal is to keep the global temperature rise below 2 ^{o}C, but it seems very difficult to agree on "what can be done". In the SMM such a "what should be done" goal does not yet exist and may even be very difficult to agree on, given the wide variety of materials. In the SMM it may even be easier to agree on the "what can be done" when implementing the targets reflected in the working definition of the SMM. On the other hand, it would perhaps be advisable to agree at the OECD level only on the "framework conditions or principles" for the SMM and let countries agree on the specific targets or approaches which would fit to their national circumstances.

Co-ordinating actions among various actors

In the case of national targets, the drivers for establishing SMM-related targets appear to be first and foremost a co-ordinating mechanism. In the case of Flanders in Belgium, for example, there are a wide number of instruments being applied by a number of different actors (*e.g.* public authorities, industry groups) in different departments and levels within the government. Targets are used as an effective way to ensure that these individual parts (*i.e.* actors, departments and levels) are working in a co-ordinated manner towards a future vision.[4] The use of a target to co-ordinate activities can also be seen in the private sector where, depending on the objective and flexibility of the target, it may be set via a top-down process or bottom-up approach (see Annex 2.A2). The bottom-up approach involves looking at the information available and setting a target based on what is essentially known to be possible and is more common when establishing hard targets (*e.g.* reduce waste by 10%). The top-down approach entails establishing a vision for the future – often with limited understanding of how that will be achieved – and is more commonly used when establishing either a soft target or strategic objective (*e.g.* to be a leader).

Providing a mid-term constraint as a bridge or means to encourage society to be prepared for a future expected reality

SMM requires a long-term perspective. In both the Japanese and Dutch examples provided in this chapter, there are strategic objectives being set with a timeframe of between 5 and 40 years. However, given the length of these timelines, it can be difficult to spark activity in the near or mid-term. To address this, a number of governments and

private-sector firms set mid-range targets in order to motivate more immediate action. In many cases these mid-term targets provide accountability that does not exist with long-term/future vision-type strategic objectives due to an expected lack of control over strategic levers for the duration of the target process. An example of this would be establishing an initial target for resource efficiency improvements within 5-10 years although resource constraints are not expected to affect an economy for 15-20 years. This might be done to allow sufficient time for adjustments in production processes, education, etc. which would be needed to respond to this future state.

Providing a metric of success against which progress can be measured

A consistent motivator for establishing targets is to provide a mechanism for measurement, most often with the help of indicators. A number of individuals interviewed commented that targets provide a way to monitor the success (or lack thereof) of a programme, instrument or effort. In other words, they provide a marker of what success "looks like". With a set target in place, individuals are motivated to track and measure the impact of their activities and can readily establish whether or not they have achieved this mark.

A signal of action on an issue

An interesting take on targets was that they can also be used as a means of demonstrating action on a particular issue (*e.g.* reducing waste).[5] In both public and private scenarios, targets have been used to demonstrate that policy makers or companies are concerned about an issue and – through the process of setting a target – are then expected to take action towards it. If target setting is not followed by action, policy makers and companies can quickly lose credibility with stakeholders.

An inventory of current and emerging practice

Most OECD countries have some form of SMM policies, practices or targets in place. In some cases, long-standing policies are now elements of national programmes, in name or in practice, focused on SMM (*e.g.* incorporating waste policies and targets into more broad SMM policies). For the purposes of this chapter, we have distinguished between formal SMM policies – those with a clear framework, name and objectives – and informal SMM policies which lack this overarching structure but that may share many of the same implicit objectives (*e.g. integrating actions targeted at reducing negative environmental impacts and preserving natural capital throughout the life cycle of materials (OECD, 2007*). We have done the same for programmes and activities. This approach aligns with the findings of the OECD's Report of the 2nd Survey on SMM-Related Activities in OECD Countries.

In that survey, all 16 respondents indicated that they have "policies or programmes that explicitly address, or are relevant to, sustainable materials management" (OECD, 2009). Examples of these types of policies include regulating the management of problematic waste streams, increasing material/product efficiency and promoting their reuse and recycling, green procurement, and reducing energy use across the life cycle of products and services.

The clearest examples of formal SMM policies include Japan's *Basic Law for Establishing a Sound Material-Cycle Society* and the Netherlands" *National Waste*

Management Plan – Towards a Material Chain Policy. Both programmes involve certain key elements in their target setting, including:

- a clear and strong government commitment to sustaining the use of materials in both an environmentally and economically efficient way, thereby providing credibility to the targets;
- a broad strategic objective/vision for where the programme should aim to bring society, through government action;
- flexible or softer targets at higher and longer-term levels supported by harder targets for clearly definable activities; and
- application of a variety of policy instruments to address specific obstacles to improving the material use and recovery within their national borders (including a variety of target approaches).

Detailed descriptions of the targets within each programme reviewed can be found in Annex 2.A1. Additional information on the policies themselves is provided in Chapter 3 "Policy Instruments for Sustainable Materials Management". Table 2.1 provides a sample of the types of targets being implemented at various stages of the life cycle. This is followed by discussions of the key questions posed in regards to the motivation for, implementation of and experiences with SMM-related targets.

How did the idea of using SMM-related targets come to be accepted in the policy landscape?

As documented by the OECD's second survey, environmental reasons are the leading driver for action on SMM followed closely by economic drivers. Specific drivers cited include shortages of landfill sites, reduction of hazardous substances, resource conservation, cost savings from the efficient use of resources and increasing competitiveness of small and medium-sized enterprises (SMEs) (OECD, 2009). In regard to establishing national SMM-related targets, two items appeared to be key differentiators – an existing culture of target setting, and broad acceptance of the need for action.

The culture of target setting was seen as important in both Japan's and the Netherlands" description of why targets were established in relation to their programme. Specifically, in this context, there is an expectation that targets are explicit parts of various programmes. In other countries/contexts this expectation is not as strong and many programmes may be established without the similar need for targets to be explicitly stated within them. There may also be differences in the way in which the flexibility of targets are perceived, but demonstrating this was beyond the scope of the research of this paper.

As with other environmental policies (*e.g.* climate change policies, toxicity concerns) it was recognised that establishing both policies and targets was easier in cases where there was a clear and accepted need to do so. For Japan, this included the country's limited available space for landfilling and in the Netherlands it was the existence of sufficient data to demonstrate the need for action. The EU Waste from Electrical and Electronics Equipment (WEEE) Directive provides a further example, as it was driven by a clear need to address the implications of mismanaged WEEE. Once this need was broadly established, targets were part of political efforts to signal action on the issue.

In the case of Belgium (see section "Co-ordinating actions among various actors"), targets were also seen as a co-ordinating mechanism for the wide variety of programmes

Table 2.1. **Sample SMM targets in selected OECD and non-OECD countries and regions**

	Resource extraction	Production	Resource productivity	Consumption	End of life
Japan	Target for resource productivity with respect to earth and rock material		Targets set in the Fundamental Plan for Establishing a Sound Material-Cycle Society	Top Runner Programme provides incentives for reduced energy use from non-industrial sources through a label indicating energy performance[1]	Targets set in the Fundamental Plan for Establishing a Sound Material-Cycle Society Programme looking at waste-related GHG emissions
Netherlands	Programme looking at impact on land use (goals due out late 2009)	Programme looking at pollution, GHG reduction and land use (goals due out late 2009)			Goals due out late 2009
Belgium (Flanders)	General objective to minimise use of finite resources	General objective to increase number of Flemish companies producing in an eco-efficient way by 2009 (based on 2003 eco-efficiency rates)	General objective to optimise use of renewable resources	Increase sustainable consumption in retail and government sectors by 2015, based on 2008 levels	Extensive, quantifiable targets for household and industrial waste, building projects, end-of-life vehicles, tires, WEEE, batteries and oil
Finland	Target looking at gravel and crushed stone used in earthworks	Material efficiency criteria and related programmes in development under the new waste management programme (targets due out in 2010)		Material efficiency criteria and related programmes in development under the new waste management program me (targets due out in 2010)	Extensive, quantifiable targets for municipal waste, manure and building projects
EU			Increase resource productivity at the same or greater rate than the 2.2% productivity improvement seen over the last 10 years.		Extensive, quantifiable targets for household waste, end-of-life vehicles, WEEE, batteries and packaging
Chinese Taipei		No specific targets, but there are restrictions on manufacturing, import and sales of zinc-manganese batteries and alkaline manganese batteries that contain over 5 ppm of mercury			Quantifiable targets for household and industrial waste
Mexico	General objective to minimise use of finite resources	No specific targets, but producers of special management wastes and hazardous end-of-life products must develop specific waste management plans	General objective to increase use of recyclable and reusable mate rials in production		General goal to increase alternative end-of-life waste treatment (thermal/ caloric or composting) and reduce waste to landfill by 2012

1. British Columbia Ministry of Environment (2009), *Design for Environment (DfE) Best Practices Lessons for British Columbia's Ministry of Environment*, p. 11.

Note: This table is based on available data, however, there are likely to be additional targets and programmes addressing the various stages defined, as well as similar practices in other OECD countries. See additional detail and source information in Annex 2.A1: National SMM-Related Target Summary Tables.

which were being pursued at different levels of government involving a variety of actors, including regulatory bodies, state agencies, the public and the private sector.[6] This was also echoed by Japan, which stated that although "it regards voluntary targets taken by industry to be important, [the] government decided to have rather firm quantitative [national rather than industry-based] targets and take a variety of measures in an integrated manner to achieve set targets".[7] As previously described, these targets provided a consistent direction towards which all of the efforts within these jurisdictions were working, regardless of their specific focus and level of resource support (*i.e.* both specific small-budget programmes and cross-sectoral large-budget efforts).

Finally, targets were used to provide a logical consistent vision for society in the long term. A clear example of this is the "zero waste" concept in Chinese Taipei. This is a long-term goal with a variety of specific focus areas and intermediate goals, such as a 75% reduction in waste generation by 2020.[8]

What are the parameters embodied in these existing target-based policies?

In the countries reviewed for this chapter there is a wide variety of parameters or policy instruments used to achieve a policy's strategic objectives and more specific hard targets. The breadth of policy instruments used is extensive and beyond the scope of this work; however, examples of this approach are:

- When the region of Flanders in Belgium established waste separation targets, the government offered support to those municipalities which initiated waste prevention programmes. For example, initiatives such as home composting were supported through subsidies for the purchase of containers and by educating the public. The government also used "smart-taxes" in order to make landfilling more expensive than incineration and incineration more expensive than recycling.[9]
- The Swiss waste management system does not rely on targets. Their approach is clearly a results-based approach where the targets have been "replaced" with mandatory bring-in and take-back systems which are free of charge for consumers, complemented with a convenient collection infrastructure (over 10 000 collection points for WEEE) and a pay-per-bag system for the disposable waste fraction (all separate collection systems are free of charge for consumers).[10]

What are the experiences with these approaches to date?

Although the experience to date with setting targets related to SMM are generally qualitative due to the relative newness of the concept's application there are a few factors which appear to contribute to a target's effectiveness:

- government commitment;
- setting the targets at an appropriate level;
  - this is complicated by limited information on strategic levers and the complexity of the systems in question;
- a regular review process;
- an effective monitoring system to understand their impact; and
- adapting target based approaches to suit cultural differences or priorities.

Government commitment

The importance of government commitment can be seen in a variety of current and past experiences. Many of those interviewed commented on the failure of early environmental policies looking at similar issues and longer-term concepts to achieve their stated targets or objectives. In part, this was related to a relative lack of government commitment to those targets and objectives when compared to other policy priorities (*e.g.* education, health, economy). In current programmes, this commitment is demonstrated by:

- dedicating resources to the activities within the programme;
- linking performance to economic activity (*e.g.* meeting standards to acquire the CE mark certifying that a product meets health, safety and environmental requirements for EU market access);
- working collaboratively with a variety of stakeholders to clearly identify and address the obstacles to SMM in the most effective way (*e.g.* education, R&D investments, internalisation of environmental costs); and
- establishing and refining targets based on the best available objective information.

Setting targets at an appropriate level

The research indicated that targets can be very effective motivators and can drive changes in behaviour when they are set at the right level (*i.e.* that the required strategic levers are available and that policymakers can achieve the right balance between motivating action and what is possible). A challenge in achieving this is having the appropriate information. It is important to have a clear understanding of the strategic levers available to drive change. In the case of products, this may be related to emerging technologies or alignment with product specifications in other jurisdictions (*e.g.* RoHS, EPEAT). One example of this is the development and adoption of lead-free solder in electronics, which has been driven by both technological advances and emerging regulations in the EU. The concept of control emerged numerous times in the recounting of private-sector experiences, with interviewees emphasising the importance of focusing their hard targets on those areas where they had control over the outcome versus those where they only had influence. Domtar's experience with setting standards for forestry practices is a good example. The company set targets for their owned and leased properties prior to working with suppliers due to the relative levels of control which it held (see the Domtar case study in Annex 2.A2). Also, there is a clear difference between setting "minimum standards" (*e.g.* EU eco-design directive[11]) and "performance standards" (*e.g.* recycling target in the EU Framework Directive[12]). The Eco-design Directive establishes a framework for the setting of the EU eco-design requirements for energy-related products with the aim of ensuring the free movement of such products within the internal market, while the waste Framework Directive lays down a clear "hard target" of 50% by 2020 for reuse and recycling of at least paper, metal, plastic and glass from households and comparable sources.

Another challenge is in having insufficient data or experience to establish the appropriate scale for targets. Given the complexity of the systems being discussed (*i.e.* material flows through an economy) all interviewees pointed to life cycle concepts as the only way to really understand the opportunities for improvement and thus establish effective targets. This is further complicated by the non-linear rates of progress that tend to be S-shaped rather than straight (Rotmans, J., R. Kemp and M. van Asselt, 2001). For

example, Flanders in Belgium saw limited growth in their recycling rates throughout the early 1990s (close to 20%). Then, between 1994 and 2001, rapid growth in this rate was experienced as it climbed close to 70% where it has more or less remained.[13] This adds another layer of complexity to setting targets, as it is difficult to know where on this innovation curve one finds themselves or what the ultimate impact of a new technology may be on the environmental performance of an industry or system. To overcome this, policy makers have selected different targets from along the spectrum depending on the information available (*e.g.* hard targets where the system and opportunities for change are clear; soft targets where information is vague and impacts are uncertain).

It was noted by a number of interviewees that the establishment of targets can often lead to an improvement in data availability. This was most clearly demonstrated by the Kyoto targets, which have led to a substantial increase in the amount of climate-related data around the world.[14] This challenge of targets before data or data before targets is often addressed through incremental programme implementation. In the case of the Netherlands" Chain Policy approach, they have focused on applying the concepts to a few select industries so they can learn from the experience, such as the industrial response, before establishing clear targets.

In all of the policy frameworks reviewed there was variety in the types of targets used. In the case of Japan's Basic Law, there are hard national targets for the government to achieve and, in part, they reflect the vision for a sustainable Japanese society. However, these are not translated down to the level of individual activities.[15] Rather, individual activities and programmes are informed by the general direction provided by the government's strategic objectives and are based on a deeper knowledge of the specific industry or system under consideration and the options available to improve performance. This level of detail is simply not possible at a national level, or for longer-term targets, given the variety of inputs and variables that would need to be understood. (See Table 2.2 below for a summary of target types and their key advantages and disadvantages.)

Table 2.2. **Summary of target types and key advantages and disadvantages**

Type of target	Timeline	Focus	Accountability	Key advantages	Key disadvantages
Hard	Short (1-5 yrs)	Product or Material	Clear and enforced	Set a baseline Measurable Enforceable	Difficult to achieve agreement Information requirements Typically based on known opportunities
Soft	Short to Medium	Product System	Somewhat clear but flexible	Easier to achieve agreement Adaptable to new information Less stringent information requirements	Harder to enforce Less accountability Information requirements
Voluntary	Short to Medium	Product, Material or Product System	Various, generally clear but flexible	Easier to achieve agreement Adaptable to new information Less stringent information requirements Inspires action Flexible	Harder to enforce Less accountability Typically based on known opportunities
Strategic Objective	Long (10+ years)	Country or Market	Limited	Easier to achieve agreement Co-ordinate multiple programmes Inspires action Flexible Can be ambitious	Limited accountability Difficult to measure success

A regular review process

Acknowledging the evolving nature of the information required to set appropriate targets also implies the need for a review mechanism to incorporate new information as it becomes available – something which the Japanese and Dutch programmes have. In both cases, there is a review process for their broader objective targets as well as individual activities and programmes. Further, in cases where targets are not met they strive to understand the reasons for this failure and readjust targets when needed, incorporating lessons learned into future versions of the target. This flexibility was seen by interviewees as an important part of these programmes. In cases where flexibility is not possible due to a greater likelihood of actors being held accountable for achieving the targets – even if they were set at the wrong level (*e.g.* expected technological solutions did not emerge) – setting hard targets becomes exceptionally difficult.[16]

An effective monitoring system to understand their impact

Targets on their own are not sufficient to change behaviour; they require a clear support mechanism for their achievement and a monitoring mechanism to track and understand performance. In this way, targets provide a framework and measure of success for the activities and results being undertaken within a national or regional SMM strategy. This creates a challenge in its own right, as in certain circumstances data is simply not available to measure performance. In these cases policy makers have had to be careful not to use metrics or measurements that lead to unintended negative consequences. Corn-based ethanol is a good example. It has been supported as a means of reducing use-phase CO_2 emissions; however, over the life cycle it may lead to an increase in CO_2 emissions and may have negative social implications through increased food prices (C.D. Howe Institute, 2008). Therefore, in terms of monitoring the effects of targets and the ability to adjust them, the measurement mechanism or the policy instruments selected is critical. Interestingly, when speaking to sub-national representatives in Canada and Belgium, it was made clear that in these countries the government has punitive measures it can apply to industry or other actors but that these are rarely if ever applied. Rather, in most cases, issues of poor performance are addressed by developing an understanding of the obstacles to achievement and working collaboratively to overcome them.[17]

Adapting target-based approaches to suit cultural differences or priorities

Although national targets can be an effective way of driving changes in behaviour they are not the only means of creating change and effective programmes tend to respond proactively to opportunities wherever they may arise. As demonstrated in both the United States and Canada, there are sub-national programmes which have encouraged improved performance in a variety of areas without national targets (see the case study *Target Setting for Extended Producer Responsibility – Electronics in Canada* in Annex 2.A2). When considering these programmes, it appears that leveraging industry's preference for results-based management over regulation (*i.e.* allowing them greater say in the creation of programmes, activities and so on) has led to partnerships achieving what would have traditionally been stipulated in national targets. Sub-national representatives for both countries commented that, although there are specific areas where national targets would be effective, the focus provided at the sub-national level is required to understand the strategic levers which are available to drive change. As noted by one expert, an effective means of facilitating change is to achieve improvements in a sufficient number of companies so that you get to a

"tipping point" or level of acceptance in the industry, where the behaviour switches from being considered leading practice to being common practice.[18]

Key considerations in setting and implementing targets

Setting targets

In conducting the research for this chapter there was near universal agreement among the interviewees with the idea that good targets are desirable. The main challenge for policy makers is to set "good targets" (*i.e.* those which are credible, are supported by government and society, are based on sound research and set at an appropriate level). What defines a good target is its ability to engage the group responsible for its achievement to enthusiastically pursue it and achieve all possible improvements. The process of setting good targets has been described as more of "an art than a science" due to the numerous variables involved and the inability to accurately predict future events. Because of this, target setting must incorporate as much information as possible. In most situations, a number of unknown variables will exist and require judgement to determine their likely influence. In this section, the key issues which should be considered when striving to establish good targets and lessons learned from both private- and public-sector experience are reviewed.

Determining the objective of the target

The first consideration is the desired outcome that the target is trying to achieve. As described in previous sections, different types of targets are used to achieve different outcomes. For instance, if the objective is to provide co-ordination among a variety of actors, policy makers should likely consider setting strategic objectives. In contrast, if there is a specific activity that policy makers are trying to avoid or reduce (*e.g.* disposal of gypsum in landfills), hard targets are likely more appropriate.

The level of understanding policy makers possess in regards to the system they are trying to influence is an important factor when establishing targets, in particular when considering what types of targets to employ. It is also a critical factor in the credibility of targets (see Box 2.1 for the EU's approach to developing an understanding of systems).

This is particularly true when considering hard targets; the greater the hardness or lack of flexibility or greater accountability a target will have, the higher the expectation that policy makers can justify this additional level of constraint. In practice, policy makers have addressed this complexity in four ways:

- first, effective targets are based on a thorough review process with input from a wide number of informed sources;
- second, where information is not available or is limited, targets tend to be soft or strategic objective are used;
- third, policy makers focus on specific systems or actions within the whole, where information is relatively prevalent and credible targets can be set and will engage those responsible for their achievement; and,
- finally, policy makers address this challenge through the use of pilot programmes to develop a deeper understanding of specific systems and the inherent challenges and opportunities which they face in the application of strategic levers to achieve a specific target.

Box 2.1. **Methodology for completing preparatory studies**

The following is the process used in the EU to complete the preparatory studies for energy-using products. It was designed to provide a complete picture of the issues, challenges and opportunities related to a product category.

Task 1 – PRODUCT DEFINITION

- within a product group, what types of this product should be included and excluded?

Task 2 – ECONOMIC ANALYSIS

- market investigation and quantification of current stock of product in EU market and expected growth

Task 3 – CONSUMER PERSPECTIVE

- actual usage and local infrastructure

Task 4 – TECHNICAL ANALYSIS OF EXISTING PRODUCTS

- investigate whether existing standards/regulations for this product group can be used

Task 5 – BASE CASE AND ENVIRONMENTAL ASSESSMENT

- look at the product in all stages of its life cycle to quantify environmental impacts for each sub-group of products using the MEEuP tool (life cycle tool)

Task 6 – TECHNICAL ANALYSIS OF BEST AVAILABLE TECHNOLOGY (BAT)

Task 7 – IMPROVEMENT POTENTIAL

- BAT, options, impacts, long-term targets

Task 8 – SCENARIO ANALYSIS

- create an impact assessment/sensitivity analysis reflecting impacts on environment, market, and policy

Sources: Personal Communication, Dr. Constantin Hermann, PE International, 23 Sept. 2008; *http://ec.europa.eu/energy/demand/legislation/doc/2006_11_21_workshop_meeup_en.pdf.*

Areas that policy makers need to consider when establishing good targets include:

- The time dimension – for example, setting a target for improved design is different for a product which is redesigned on a regular basis (*e.g.* a personal computer) versus one that is redesigned less frequently or stays on the market longer (*e.g.* an oil tanker).
- The interrelationship between targets and other aspects of the current system being addressed by other programmes, policies or targets, and how establishing new targets can support the overall strategic objectives of the government – for instance, SMM programmes and targets likely want to incorporate or align themselves, wherever appropriate, with other economic or social targets (*e.g.* job creation through recycling infrastructure).
- Which aspects (*e.g.* design, waste, recycling) should be covered by the policy or target? Targets have been applied to different objectives and stages of the life cycle. Examples include:
  - ❖ Resource productivity:
    - In Japan, the government has established a target for economic activity per material of Yen 420 000 per tonne of material (excluding the input of rock and earth) by fiscal year (FY) 2015.

- Specific material streams (*e.g.* paper, e-waste, building materials):
  - In the Netherlands, the government is piloting a series of programmes looking at six specific material streams. In this pilot phase, companies from these material chains established voluntary quantitative targets, goals and plans – many of which were supported by the government.
- Materials Reuse:
  - In Flanders, Belgium they have established a series of household waste targets, including the collection of 5 kg per inhabitant of re-usable products by recognised re-use centres for the purpose of reselling.
- Waste Generation:
  - To encourage domestic composting in Flanders they have established a target of six active "compost masters" (*i.e.* compost promoters/advisors) per 10 000 inhabitants.
- 3Rs:
  - In the EU, there are a number of policies which work together to address resource efficiency. For example, the Directive 2000/53/EC on end-of-life vehicles sets out a target of 85% reuse and recycling of vehicles by weight by 2015.
- Waste management:
  - Given that a number of SMM-type policies and targets have either grown out of or incorporate existing waste management programmes; it is not surprising that there are a wide number of targets (*e.g.* hard targets for waste disposal per capita in Belgium).
- Product specific EPR programmes:
  - Where product capture rates are difficult to determine, other performance indicators can be used at the outset such as programme access, consumer awareness surveys, waste audits, web site traffic, etc.

- The level of difficulty in achieving the target (*e.g.* easy versus inspirational) is a difficult and complex issue. Ultimately, it is hoped that targets will encourage an improvement in a particular activity or area. The challenge is that targets which are too easy do not capture the extent of improvement possible, while those perceived as being too difficult will discourage actors and fail to engage them. Ideally, good targets strike a balance between these extremes, pushing the limits of improvement while maintaining the engagement of individual actors in the system that control the strategic levers of change. Achieving this balance was recognised by all those interviewed as a substantial challenge which is dependent on a number of variables. However, by incorporating the considerations provided here, policy makers can improve their likelihood of finding balance between the extremes.

These areas of consideration are also critical in achieving a sufficient level of understanding of the system in question. Although it is somewhat easier at a more specific level, it is practically impossible to have all the data and information one would want to establish a good target. Therefore, policy makers and their stakeholders will have to make decisions regarding how much information is sufficient prior to establishing a target. Examples of barriers to a complete picture of the system include:

- A lack of life cycle data, although this is starting to be addressed through an increased number of life cycle studies and efforts by a variety of sources to dramatically increase

the amount of life cycle data available (*e.g.* Wal-Mart, the European Commission's European Life Cycle Database[19]);

- A lack of data on other life cycle considerations (*e.g.* life cycle costing, social implications, toxicity, technical hurdles, environmental consequences of expanding, changing or improving technologies);
- The costs associated with data collection, which can be substantial;
- A lack of programme experience (*e.g.* recovery of end-of-life compact fluorescent lamps);
- The requirement for a variety of perspectives, which may have contradictory priorities;
- A lack of clarity on how markets and individuals will react to various policy instruments implemented to achieve the target; and
- Difficulty in understanding the practicality of various technological options.

While these are applicable to all targets, the challenges faced in developing SMM-related targets are particularly pronounced. This is the result of the sheer complexity of the system in question, which theoretically encompasses the ways in which all materials flow through a country and region. Therefore, it is not surprising that governments tend to select specific areas for action and progress in a step-wise fashion rather than attempting to set policies and targets which are all encompassing. (See Box 2.1 for a description of the Dutch pilot programmes.)

Box 2.2. **Application of the chain approach in waste policy in the Netherlands**

The following is a brief description of the process used in the Netherlands in piloting their Chain-Oriented Waste Policy and how they have used that process to understand the issues, challenges and opportunities available to inform their policy.

Initial Step – In 2007, they selected six waste streams in which to carry out pilots.

Pilots – Within each of these waste streams, they worked with highly motivated companies to achieve a substantial reduction of waste-related environmental pressure across the chain.

Reporting Progress – In May 2008, the companies presented their action plans and initial results.

Next Steps – The lessons learned from these pilots have provided the government with valuable insights into the operation of a chain approach in practice and into the preconditions which the government needs to create in order to enable companies to apply this approach successfully. These lessons have been incorporated into the Chain-Oriented Waste Policy Programme 2009-2012.

Understanding the capacity within the system to affect change

A final broad consideration when setting targets is the capacity of policy makers in areas such as authority, effect on strategic levers and technological solutions. This is an important consideration as there is a direct link between the credibility of accountability under a target and control over the strategic levers to achieve the desired outcome.

The case study for Turner Construction (see Annex 2.A2) provides a good example. It chronicles the company's selection of targets focused on improving the management of materials at their construction projects rather than setting goals for building a certain

percentage of environmentally preferable buildings. This was a conscious decision on their part based on the acknowledgement that they controlled their construction practices and, therefore, could create accountability for executing on this aspect but could not control whether or not their clients requested the construction of environmentally preferable buildings – even though they encouraged this practice.

Similarly, policy makers are constrained by a number of factors which should be considered and incorporated into the setting of targets. Examples of these include:

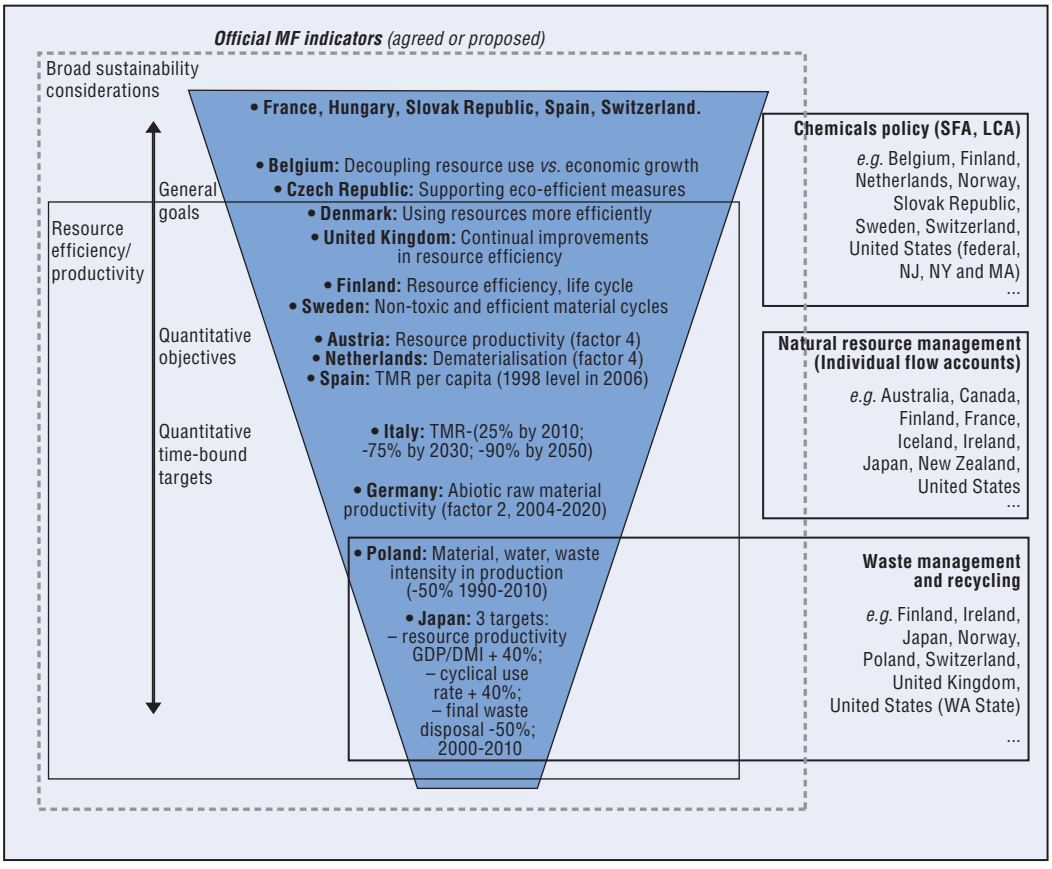
- Authority in regards to jurisdictional control over the system in question:
  - As with many waste policies, jurisdictional control may involve a number of actors (*e.g.* landfill policies at the municipal level, recycling rates set at the regional level). When considering setting targets which cross these boundaries, it is important to understand where authoritative control for the areas in question lies and incorporate this into the design process;
- Authority to monitor or enforce the targets:
  - A number of monitoring systems were identified, including strict reporting systems (*e.g.* EPR in Canada) and voluntary practices where stakeholder pressure enforces the targets (*e.g.* voluntary private-sector initiatives). When setting targets, it is important to consider where the authority to monitor and enforce the targets rests and what information will be required by the monitoring party to ensure accountability.
  - Authority to set targets or engage the actors required to set the targets (*i.e.* those controlling the strategic levers required for action).
  - As demonstrated by the Turner Construction example, it is important to understand who controls the strategic levers required to affect the change desired and whether one has the authority or influence to engage them. Another example would be small jurisdictions that may not have the influence to engage multi-national companies on adjusting the design specifications of their products (*e.g.* a municipality trying to convince electronics manufacturers to remove brominated flame retardants from their product).
- Cultural factors
  - Differences in cultural considerations are likely best illustrated by experiences at different private-sector firms. In engineering-type firms, for example, it is common to see clear targets that provide a measure of success. In others, actions can be driven by the specific target and by competition among individuals or business units. In these cases, the target is more about being a top achiever within a specific metric or combination of metrics, making a non-ambitious target somewhat irrelevant if there is a sufficient level of competition. For example, Turner Construction set a target for the number of Green Building trained professionals (*i.e.* Leadership in Energy & Environmental Design Accredited Professionals [LEED APs]) within the company, but this target was quickly surpassed as different departments competed with one another to have higher numbers of trained professionals.[20] While this scenario is difficult to generate in public policy, the EPEAT programme in the US followed this trend by generating a level of competition amongst producers to exceed minimum government procurement standards and strive for higher EPEAT ratings.[21] It has also been a factor in Wisconsin, where active engagement of forerunner companies has created a draw for improved performance across industries.[22]

Considerations when implementing targets

Once targets are set, the ease with which they are implemented is determined by four key items: *i)* An effective monitoring system; *ii)* An appropriate instrument mix; *iii)* A regular review process which incorporates lessons learned and new information; and *iv)* Awareness of the targets themselves.

- An effective monitoring system:
  - An important part of target setting is reaching agreement on how progress will be measured. This is necessary guidance for the parties responsible for achieving the target and those responsible for monitoring and reporting on progress (*e.g.* government bodies). This is also linked to the concept of accountability, as it is an important element in ensuring, as much as possible, that parties are held to the same standard. Further, monitoring progress is used in practice to ensure that the objective the target is striving to achieve (*e.g.* reduced waste in landfills from recycling programmes) is being met and that there are no unintended negative consequences (*e.g.* illegal dumping).
  - In many OECD countries, goals and objectives concerning the efficient management and sustainable use of natural resources and materials have been embodied in national sustainable development strategies (NSDS) or environmental action plans. In a few countries, time-bound quantitative targets have been defined. In general, these targets are not mandatory but are rather an expression of desired policy directions (OECD, 2008b). Examples of material flow information linkages to policy goals are presented in Figure 2.1.
  - Monitoring of waste separation targets in Flanders, Belgium demonstrates some of the best practice in this area. In this case, approximately 90% of municipalities established voluntary environmental agreements with the regional government. These agreements defined the approach to measurement and the efforts of the municipalities were monitored. Where targets are not met, the government has a legal right to take over waste handling within the jurisdiction and charge the municipality for it, although this has never been used in practice. Where targets are not met but have been pursued in good faith, they are reviewed and adjusted as appropriate. Further, as part of this monitoring, the government looks for anomalies and the impact of the programmes. In one case, in an effort to discourage household waste generation, a municipality raised the price of disposal substantially which led to an increase in illegal dumping. Through effective monitoring, this was caught and the policy mix was adjusted to address the issue.[23]
  - In the European Union (EU), the Parliament, the Council and the Commission have set in place a comprehensive system of around 60 legal acts aimed at ensuring that all waste in the EU is managed so as to prevent harm to human health or the environment. However, in many parts of the EU, implementation of the EU legislation and targets falls significantly short of obligations. These gaps of implementation have given rise to significant problems in many parts of the EU, most notably to illegal waste dumping and illegal waste shipments. In this situation, the protection of human health and the environment, which is the overarching goal of the EU waste legislation, is not achieved (Study on the Feasibility of the Establishment of a Waste Implementation Agency, 2009).

Figure 2.1. **Examples of material flow information linkages to policy goals**



- An appropriate instrument mix:
  - As demonstrated throughout this chapter, governments apply a wide range of policy instruments to achieve the desired target. A consistent trait among the policies reviewed was a willingness to apply the most appropriate instrument to achieve the target. In certain circumstances this implies a results-based approach with little involvement in the process of achieving targets (see Annex 2.A2, EPR in Canada Case Study, for an example of this approach). In others, it involves providing a framework for measurement (*e.g.* EPEAT in the United States) or supporting specific costs associated with adaptation (*e.g.* subsidising the cost of compost bins in Belgium). In the policies reviewed, government bodies were not dogmatic in regards to which policy instrument to apply to which challenge; rather, they drew from those available and sought input from a variety of stakeholders in order to apply the most appropriate mix.
- A regular review process:
  - The review process has proven to be a critical aspect of target implementation, as it assists policy makers with overcoming a number of the challenges, including: *i)* Dealing with the reality of imperfect information; *ii)* Achieving agreement on

targets; *iii)* Gaining credibility for the target; and *iv)* Applying an appropriate instrument mix. In Japan, the Basic Law for Establishing a Sound Material-Cycle Society has a number of review mechanisms that are seen as critical to the effectiveness of the programme. For example, progress against specific targets is regularly measured with indicators and documented in annual progress reports by companies and sub-national governments. Further, and perhaps more importantly, the entire programme – including the instrument mix, micro targets and strategic objectives – is reviewed every five years. In practice, this provides a formal mechanism to incorporate lessons learned over the previous implementation period; new research and better understanding of technological advances can be taken into consideration, and adjustments can be made to ensure progress towards the long-term objectives. Further, having a review process that incorporates a great deal of flexibility in adjusting targets based on available information has its advantages. Specifically, this allows greater freedom to those responsible for its achievement. They can commit to action based on the best information available today and know that there is an opportunity for greater refinement in the future as they learn from experience.

- Awareness of targets:
  - Awareness of the targets, including a clear understanding of the need to achieve them and who is ultimately accountable, is a critical aspect of target implementation. This can be achieved by active engagement in the setting of targets, maintaining transparency in the monitoring process and ensuring ongoing communication of progress among all stakeholders.

Lessons learned and conclusions

The key lesson of this chapter is that "good" targets can be effective in supporting SMM practices. The main challenge for policy makers who have decided to set targets is to ensure targets are "good" by making certain that they are credible, are supported by the government and society, are based on sound research and that they are set at an appropriate level. To do this, it is critical that policy makers understand the attributes of effective target setting and incorporate them into their target-setting process, particularly in regards to the target's appropriateness (based on the information available), flexibility and level. Given the complexities involved in the consideration of SMM policies, most policy makers who have established SMM-related targets have addressed these attributes by using hard targets in those areas supported by substantial information and where strategic levers to achieve the target are clear.

Additional findings of the chapter are centred on the justification for and practice of setting and implementing public and private sector SMM-related targets. These include:

- Underlying environmental issues, which are driving the justification for establishing SMM policies and related targets. This relates to both the environmental issues (*e.g.* increasing waste generation, limited space available for landfilling), as well as future economic considerations (*e.g.* availability of, raw materials and resources). In the private sector (see Annex 2.A2), similar concepts are driving behaviour but are translated into the business case for action and described in terms of cost savings (*e.g.* eco-efficiency), risk avoidance (*e.g.* social licence to operate) or emerging opportunities (*e.g.* technology for urban mining or recycling).

- Dynamics within a jurisdiction that can affect the ability to set and implement a target effectively at the national level (*e.g.* legal authority, resources and public support to act on an issue). In certain jurisdictions targets implicitly have a level of flexibility with actions being more important than specific results while in others this level of flexibility is not present and specific results are critically important.
- Available strategic levers to drive changes in behaviour. For example, smaller jurisdictions are more likely to generate action if they align efforts with those of larger actors or work with domestic producers to train and share best practices. In larger jurisdictions, more policy options are available as they have a greater influence on behaviour (*e.g.* the requirement to meet basic environmental criteria prior to receiving the CE mark for market access to EU). In many countries a mix of policy instruments are used to address a variety of strategic levers (*e.g.* educational programmes, government procurement programmes that favour environmentally preferable products and targeted recycling programmes).
- The implications of adding pressure to a system through economic or other policy measures, as these may lead to unintended consequences (*e.g.* a substantial increase in disposal fees in one municipality in Belgium led to a dramatic increase in illegal dumping of waste).
- The use of a detailed engagement process to develop better understanding of a system and what is possible within it. This is often done at a micro or specific level (*e.g.* through a product system, sub-national body or industrial sector) rather than national level, and relates to the idea of understanding strategic levers.
- The ability to access information on the full product system. This is likely why most programmes focus specific target setting at the micro level. An example of the challenges and technical hurdles faced can be demonstrated by comparing different materials. The quality of wood-based materials (forest products) can degrade over recycling cycles, whereas many metals can be recycled almost infinitely. It is, therefore, important to consider what the key sustainability issues are for each material stream – in this case, resource extraction for forestry versus recovery and recycling for metals.
- The cultural context of policies. For example, in the Netherlands and Japan there is greater opportunity for establishing national targets due to their culture of consensus-based decision-making, government structure, and resource and population base.
- The ability to measure progress towards the target. This was identified as a key challenge in the successful implementation of targets. Defining clear indicators of progress was seen as important both for establishing credibility of, and ensuring accountability for, the target.
- Other elements critical to implementation of the target – the credibility of the target; an effective monitoring system; an appropriate instrument mix; a regular, robust, review process; and awareness of the target itself.
- Governmental structures, geography and the distribution of infrastructure will influence the ability to set targets and the process by which targets are set and monitored. In federal jurisdictions with shared responsibilities for some environmental issues and discrete responsibilities for others setting targets can be complex process of consultation and negotiation.

In conclusion, this chapter demonstrates that targets can be an effective part of SMM policy when set at the appropriate level. The challenge for policy makers is in achieving this "appropriate level" given the complexity of the systems in question and the lack of complete information. The chapter identified a number of considerations for policy makers within the areas of understanding the objectives of the target, capacity for change in the system, and additional considerations when implementing targets. Developing an understanding of these within the system in question is seen as important in determining the potential effectiveness and appropriateness of different types of targets. Further it was found that a single definition of targets is not sufficient to address the variety of the characteristics which targets embody across the hard to soft spectrum.

Notes

1. Merriam-Webster Online Dictionary, accessed from *www.merriam-webster.com/dictionary/target*.
2. Interview with Yuichi Moriguchi, Director, Research Centre for Material Cycles and Waste Management, June 2009.
3. Interview with Guido Sonnemann, UNEP's Division of Technology Industry and Economics (DTIE), Sustainable Consumption and Production Branch, July 2009.
4. Interview with Christof Delatter, Director INTERAFVAL (Association of Flemish Cities and Municipalities), July 2009.
5. Interview with Christof Delatter, Director INTERAFVAL (Association of Flemish Cities and Municipalities), July 2009.
6. Interview with Christof Delatter, Director INTERAFVAL (Association of Flemish Cities and Municipalities), July 2009.
7. *Source:* Ministry of the Environment, Japan.
8. *Source:* Ministry of Environment of Chinese Taipei.
9. *Source:* Flemish Public Waste Agency, OVAM, Belgium.
10. Please see *e.g.*: WEEE Ordinance, *www.bafu.admin.ch/abfall/01472/01478/index.html?lang=en*.
11. *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:285:0010:0035:EN:PDF*.
12. *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:0030:EN:PDF*.
13. *Source:* Flemish Public Waste Agency, OVAM, Belgium.
14. Interview with Yuichi Moriguchi, Director, Research Centre for Material Cycles and Waste Management, June 2009.
15. *Source:* Ministry of the Environment, Japan.
16. Interview with Mark McDermid, Sector Specialist, Wisconsin Department of Natural Resources, Cooperative Environmental Assistance Bureau, July 2009.
17. Interviews with David Lawes and Teresa Conner, Ministry of Environment, British Columbia, Canada; and Christof Delatter, Director INTERAFVAL (Association of Flemish Cities and Municipalities), July 2009.
18. Interview with Mark McDermid, Sector Specialist, Wisconsin Department of Natural Resources, Cooperative Environmental Assistance Bureau, July 2009.
19. For more information on the EC's ELCD please visit *http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm*.
20. Interview with Michael Deane, Vice President and Chief Sustainability Officer, Turner Construction Company, July 2009.
21. For more information on EPEAT or "Electronic Product Environmental Assessment Tool" please visit *www.epeat.net*.

22. Interview with Mark McDermid, Sector Specialist, Wisconsin Department of Natural Resources, Cooperative Environmental Assistance Bureau, July 2009.

23. Interview with Christof Delatter, Director INTERAFVAL (Association of Flemish Cities and Municipalities), July 2009.

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- **Ester van der Voet** – Institute of Environmental Sciences (CML), Leiden University
- **Guido Sonnemann** – UNEP's Division of Technology Industry and Economics (DTIE), Sustainable Consumption and Production Branch
- **Sonia Valdivia** – UNEP's Division of Technology Industry and Economics (DTIE), Sustainable Consumption and Production Branch
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- **Raimund Bleischwitz** – Co-Director, Material Flows and Resource Management, Wuppertal Institute
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- **Derry Allen** – U.S. Environmental Protection Agency, Counselor, National Center for Environmental Innovation, Office of Policy, Economics and Innovation
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ANNEX 2.A1

National SMM-related target summary tables

Table 2.A1.1. **National SMM-related target summary tables**

Programme: Japan's Basic Law for Establishing a Sound Material-Cycle Society (SMCS)[1]	
Description: Japan has created its Law for Establishing a SMCS outlining clear quantifiable national targets for resource productivity, as outlined in its Fundamental Plan. This structure provides the overall vision for SMCS-related activities that are carried out through joint efforts of the government and other concerned parties.	
Overall objective: To establish a SMCS or a society in which the consumption of natural resources is minimised and the environmental load is reduced to the extent possible by: preventing or reducing the generation of waste; promoting proper recovery/recycling of products and materials when they have become recoverable/recyclable resources; and ensuring proper disposal of recoverable material resources that were not recovered or recycled.	
Summary of policy instruments: The Basic Law falls under the Fundamental Plan, which sets longer term targets. While there are quantifiable targets at the national level, a variety of policy instruments – including voluntary targets, as well as programmes related to waste management, recycling and green procurement – are used to encourage action at the micro level. The types of targets set at the national level include: resource productivity; use of specific material streams (*e.g.* paper, e-waste, building materials); reuse of materials; generation of waste (*e.g.* industrial, hazardous, municipal); 3Rs (reduce, reuse, recycle); and waste management targets for incineration and landfill. Targets also include several household/individual activities like reduction of municipal solid waste. National targets are kept consistent with public/private targets, such as National Waste Management Plan 2008 and Keidanren Targets for Voluntary Activities for Waste Reduction. Moreover, in addition to tracking national indicators, the government is also tracking industry-specific resource productivity and has set quantitative, industry-specific waste reduction targets. The thinking is that estimates from each industry sector will allow for a more accurate analysis of factors affecting change. The hope is to track resource productivity internationally in the future so cross-country comparisons can be made. Japan is also expanding its efforts to the international level in order to work with its neighbours on improving regional materials management. Targets are primarily established around two main dates: 2050 is the "Sustainable Year" around which long-term targets are based; 2015 is the "Milestone Year" and is the year regarded as the target in the Second Fundamental Plan for Establishing a Sound Material-Cycle Society. Extensive quantitative targets exist under this Plan, including those for reducing wastes, changing attitudes and awareness, and shifting business practices.	
Specific parameters being used	
Resource extraction: Limited information found. Data is collected on earth and rock resources with respect to resource productivity. Target of 87% effective use rate for reuse of construction-generated soil by 2012	**Resource Productivity:** (Gross Domestic Product [GDP] divided by the input of natural resources and others) ~ Yen 420 000 per tonne in FY 2015 (the Yen-per-tonne target increases over time, based on the idea that the annual GDP should remain adequate when using smaller inputs of resources). Resource productivity, excluding the input of earth and rock resources, is ~ Yen 770 000 per tonne in FY 2015.
Production: A target has been set to increase the utilization ratio of cullet in the manufacturing of glass containers to 90% before fiscal 2010 based on the "Law on Promotion of the Effective Utilization of Resources".	**Consumption:** Japan Top Runner Programme provides incentives for reduced energy use from non-industrial sources through a label indicating energy performance.[2]

End of life:
Final disposal amount (the amount of landfilling of waste from municipal solid waste and industrial waste) is ~ 23 million tonnes in FY 2015.
Sample industry-specific final disposal volume targets include:
- Iron and Steel Industry – 75% waste reduction by 2010 based on 1990 disposal levels.
- Construction Industry – 87% reduction by 2010 based on 1990 levels.
- Electrical power industry – 79% reduction by 2010 based on 1990 levels.

Cyclical-use rate (Volume of cyclical use divided by Volume of cyclical use + Natural resources input) is ~ 14-15% in FY 2015. The idea is that, over time, this indicator should increase when cyclical use is lengthened and the amount of final disposal is reduced.
Reduce waste-related greenhouse gas (GHG) emissions by 7.8 million tonnes, to be achieved by 2010
Recycle rate are 60% or over for nickel-cadmium batteries, 55% or over for nickel-hydride batteries, 30% or over for lithium batteries and 50% or over for sealed lead-acid batteries.

Other: Second Fundamental Plan defined targets directly concerning the reduction of waste generation. These indices are related to the "Reduce" component of the 3Rs, and the restriction of waste generation.
Cool Earth Partnership (2008) sets a 60-80% carbon-reduction target by 2050 based on current levels. Reducing waste through resource extraction, production, distribution and consumption are all components of achieving this target.
A target has been set to raise the recycling rate of paper manufactured in Japan to at least 62% by fiscal 2010, in accordance with the Law for Promotion of Effective Utilization of Resources.
A recycling rate of 95% of concrete mass and asphalt concrete mass by 2010 had already been reached.

Key Drivers for Target Setting: The Basic Law for Establishing a Sound Material-Cycle Society (2000) generated recognition that quantitative targets in waste management and recycling were important. Another key driver was the OECD's request in 2002 for Japan to develop these types of targets. As a result, quantitative targets were included in the Fundamental Plan for Establishing a Sound Material-Cycle Society (2003). Other key drivers include a limited domestic resource base, limited land available for landfill, and a tradition of target setting in other environmental policy areas leading to successful outcomes.

Target setting and review process: Stakeholders play an important role in the target-setting process by debating the rational, appropriateness and instruments for implementing targets – a process that is led by the government. The entire plan is reviewed every five years. In addition to government setting firm quantitative targets, industry is encouraged to set voluntary targets. Although a sanction programme (fines) does not exist for national targets, the government treats them as firm objectives rather than guidelines. Quantitative indicators are often used to set targets. For example, a 10% reduction in the 2000 levels of municipal solid waste (MSW) was used to set the current reduction target. Other target-setting indicators include the rate of shoppers" refusal of free plastic bags. Competition between municipalities is also employed, with the national government monitoring local governments who are charging for waste disposal and identifying those municipalities most active in promoting waste reduction and recycling. In the Second Fundamental Plan for Establishing a Sound Material-Cycle Society, progress toward quantitative targets is reviewed every year, with the target year of the plan being Year 2015.

Starting year: 2000

Review cycle: Varies. Annual targets have been established under the Second Fundamental Plan.

Scope of initiative: The single overarching programme provides a clear framework and direction to all national efforts in this regard.

Life cycle stages: All

Materials included: All

Specific waste streams: Packaging, home appliances, batteries, industrial wastes, WEEE, dioxins emitted from incineration of construction materials, food recycling and end-of-life vehicle recycling.

Experience: Targets on resource productivity have clearly helped to shift industrial activities from unsustainable ones to more sustainable ones. In cases where targets have not been met, the government works to understand what the obstacles to achievement have been and how best to address them. Finally, targets give good guidance for annual policy review as they clearly demonstrate "where we are at the moment".

Programme: Chain-oriented policy in the Netherlands

Description: The Netherlands instituted a new Chain-Oriented Waste Policy in response to limitations to environmental improvement gains under its traditional waste management programme. The Policy sets national-level quantifiable targets and identifies priority waste streams based on areas of high environmental pressure (*e.g.* air and soil pollution, waste generation). General quantifiable targets are set for priority waste streams. Targets will become more specific and measurable as further data is uncovered. Companies involved in the pilot project set voluntary quantifiable targets, goals and objectives. As the plan moves forward, both quantifiable targets set by the government and voluntary agreements between the government and companies will be used.

Overall Objective: The subtitle of the new National Waste Management Plan (LAP), "Towards a material chain policy" indicates the direction in which waste policy is moving. The general objective of waste policy is to restrict, as much as possible, the total environmental pressure of a chain (from obtaining raw materials to production and use and eventually waste, including reuse), with waste policy providing an optimum contribution to achieving this objective. The policy's aim is to realise actual reductions in environmental pressure in the most efficient and cost-effective manners. The ultimate goal is an integrated policy framework for the whole material chain.

Summary of policy instruments: The policy uses the chain-oriented approach, which sheds a more comprehensive light on waste choices and provides additional consideration of potential impacts. It establishes quantifiable, national targets around three main areas of focus: GHG emissions; diffusion of dangerous substances; and biodiversity loss. These targets are covered by a broader long-term vision: *"that, by 2050, the market will have found useful, eco-efficient applications for virtually all waste, detailed waste legislation and regulation will no longer be necessary, and European and other frameworks will ensure that waste policy has become part of industry, product and energy policy set."* Various planning periods are scheduled, with individual objectives steered towards reaching the overarching vision above. In late 2007, a concrete chain approach was launched with the project "Towards A Chain Approach in Waste Policy". Upon this launch, six pilot projects were started within individual product chains (gypsum, zinc, carpet, food, expanded polystyrene and textile) to test out the chain approach. In this pilot phase, companies from the six material chains established voluntary quantitative targets, goals and plans, many of which were supported by the government. After the pilot phase, the government identified seven priority waste streams to focus on for the National Waste Management Plan. Some quantifiable national-level reduction targets have been set for these seven streams within defined time periods. The policy aims to offer additional quantifiable targets when the environmental pressure in the chain is calculated. Current efforts are underway to weave sustainable procurement criteria into the chain approach policy. The goal is to encourage suppliers toward sustainable procurement. The policy also acknowledges eco-design standards and is seeking to expand the scope of eco-design to include energy-related products. Pilot programmes to simulate the application of this eco-design instrument were launched among small to medium-sized businesses.

Specific parameters being used

Resource extraction:	**Resource productivity:**
Production: The paper and cardboard industry has set targets for energy savings.	**Consumption:**
End of life: The process of collecting data on environmental pressure related to end of life for each of the seven waste streams is underway (*e.g.* the pilot project for gypsum seeks to double the recycling of gypsum from construction and demolition waste from 20% in 2008 to 40% in 2010, and ensure that the Netherlands becomes the European leader in gypsum recycling by 2015). Waste policy must contribute to the national goal of reducing CO_2 emissions by 30% by 2020 compared with 1990.	**Other:** Waste policy must contribute to the national goal of eliminating the threat to people and the environment caused by the diffusion of dangerous substances by 2020 and halting the loss of biodiversity by 2010. Seven priority streams within the framework of the chain approach, over the LAP planning period, are to achieve a reduction of the environmental pressure generated in each of the streams by at least 20%.

Key drivers for target setting: Key drivers include sufficient data to demonstrate large environmental pressure (LCAs conducted); a culture of targets leading to action by both politicians and other actors; targets that provide a sense of action without being overly prescriptive with regard to specific actions; priority waste streams identified by an outside consultancy; and the sentiment of moving beyond traditional waste management programmes to a chain approach. A desire to reduce environmental pressure in the waste stage by measures taken earlier in the chain and to deal with waste aspects and other environmental aspects much earlier in the material chain are also a consideration. A final key driver is the long-term vision that, by 2050, the market will have found useful, eco-efficient applications for virtually all waste.

Target setting and review process: National policy ambitions, around which quantifiable national targets are set, were informed by the significance of environmental pressure in the whole chain and the potential for achieving environmental gains. Additionally, voluntary quantitative and qualitative targets and goals are set within industrial sectors. Data is being collected and compiled on the environmental pressure that each waste stream contributes to end-of-life waste, greenhouse effect, pollution and land use. The overall objective is to reduce environmental pressure by 20%. Various programmes, as well as quantitative and qualitative goals, exist and are forming to facilitate this overarching goal. Target dates and the review process are being developed. Formulation of concrete goals will take place by late 2009 and implementation will be complete by late 2012. Monitoring will be conducted annually from 2009 to 2012, followed by an evaluation report produced in 2012 that will include decisions on project follow-up and next steps. Target setting and progress is a process that is informed by and employs the collaboration of companies, industries and other stakeholders from the chains in question.

Starting year: Chain approach started in 2007.	**Review cycle:** In development.
Target year: Various (overall vision-2050).	
Scope of Initiative: National level with particular focus on seven priority waste streams.	
Life cycle stages: All	**Specific waste streams:** Paper and cardboard, textile, construction and demolition waste, organic waste, aluminium, PVC and bulky domestic waste. (Priority streams were identified by an outside consultancy.)

Materials included: All

Experience: In late 2007, six chain pilot projects were started with the twin aims of gaining experience with a chain approach as the mode of operation and achieving a substantial reduction of waste-related environmental pressure in the chains involved. Companies from six material or product chains took on the task of reducing the environmental pressure in their chain. These highly motivated companies examined how they could close or further close the material cycle in an innovative way. In May 2008, the companies involved in the pilot projects presented their action plans and the first inspiring results.

Programme: Mix of policies and programmes related to SMM in Flanders, Belgium[3]

Description: In Flanders, Belgium there is no single overarching SMM policy but rather a variety of policies related to various life cycle stages including: production; consumption; waste collection, separation and recycling; as well as efforts to decouple consumption and environmental impact and a focus on specific waste streams. Within each of these, a variety of target approaches have been used – from vague voluntary targets without clear accountability in the area of sustainable consumption to hard targets for separation of waste. These are being drawn into a rather new initiative "transition towards sustainable material" which is working to develop a long-term vision for SMM within Flanders and to understand how best to achieve it.

Overall objective: The aim is that, by 2010, Flanders will have achieved far-reaching decoupling between economic growth, on the one hand, and impact on the environment and use of materials and energy on the other hand. Flanders wants to substantially improve its position compared to the best-scoring neighbouring countries (Pact of Vilvoorde).[4]

Summary of policy instruments: Flanders has implemented a variety of programmes to address various life cycle stages and impacts. These are generally set at the regional level and in the case of waste and materials management are implemented at the municipal level where waste collection is undertaken. Where data and understanding allow, targets are quantified, while in other cases they are stated in general terms and seen as strategic objectives for government policy rather than hard targets to be pursued. Where appropriate, implementation is backed up by clear accountability if targets are not met, however, the approach is generally to work with implementers to find solutions and overcome obstacles to achievement of the targets.

Targets can be found in legislation or in policy planning documents and, in most cases, are stricter than targets in European and international legislation or conventions. Generally, targets and objectives relate to traditional waste management issues (recovery, recycling and incineration with energy recovery) and there is a movement towards a life cycle approach in these areas. As such, targets are set to increase sustainable consumption in retail and government sectors by 2015 based on 2008 levels. The government is scheduled to adopt a sustainable public procurement action plan in 2009 with the aim of increasing sustainable public procurement. Areas that generate rapid results are the focus of this initiative (*e.g.* the purchase of vehicles for government use). Additionally, an eco-efficiency target has been set with the objective of increasing production efficiency within a set time period. However, the outcome will be difficult to evaluate because the target is rather broad and general. The government also set general objectives around the substitution of hazardous materials and the use of waste as a secondary resource. In contrast to these examples of general targets, extensive, specific, quantifiable and easy-to-evaluate targets are set for household and industrial waste, building, end-of-life vehicles, tires, WEEE, batteries and oil.

Specific parameters being used

Resource Extraction: General objective is minimum use of finite resources.

Resource productivity: General objective is optimal use of renewable resources.

Production:
General objective is to increase the number of Flemish companies producing in an eco-efficient way by 2009 (based on 2003 eco-efficiency rates).

Consumption:
Increase sustainable consumption in retail and government sectors by 2015, based on 2008 levels.General objective is to increase energy efficiency in the industry and service sectors by 2010, based on 2004 levels.

End of life:
A minimum of 95% of the weight of all the end-of-life vehicles has to be re-used or recovered by 2015.
A minimum of 85% of the weight of end-of-life vehicles has to be re-used or recycled by 2015.
Waste tires have to be collected separately. Re-usable tires have to be sorted out. Of at least 25 % of the collected tires, the tire tread has to be renewed. Of the collected tires where the tread cannot be renewed, 20% have to be recycled. The remaining part of the collected tires is incinerated with energy recuperation.

Industrial
The amount of industrial waste for final disposal must decrease by at least 20% by 2010 based on 2000 levels.
The production of industrial waste must take place at a slower pace than economic growth compared to 2002.

Household
The total amount of household waste generated is decoupled from consumption and is to remain at the same level or decrease compared to 2000 levels.

- 75% of the household waste is collected separately for recycling from 2010 onwards.
- 2% of prevention/year for the dry waste fraction (*e.g.* packaging, diapers, WEEE, batteries) to compensate for the economic growth;
- 6 active compost masters (1 per 10 000 inhabitants);
- 25% of households to do home composting in a qualitative way and keep more than 50% of their organic and biological waste out of the larger waste treatment process via home composting and low-waste gardening;
- 5 kg of re-usable products is to be collected per inhabitant by recognised re-use centres and sold again;
- the number of people participating in selective collection schemes remains, at minimum, at the same level as in 2005; the number of companies participating in selective collection initiatives increases.
- each municipality attains a maximum of 180 kg residual waste per inhabitant by 2010 and is responsible for achieving this target.

Other: General objectives include: maximum prevention of the generation of waste; maximum use of waste as secondary resource; and minimum environmental impact when treating waste.

Key drivers for target setting: Key drivers include: sufficient data to demonstrate a need; a culture of targets leading to action by both politicians and other actors; indication of a sense of action (politically); and all of the above without being prescriptive in regards to specific actions. An overarching goal to decouple economic growth and impact on the environment and use of materials and energy by 2010 is also a driver, as is the long-standing tradition of separate collection, recycling and composting.

Target setting and review process: Targets are generally set by experts in the Flemish administration in collaboration with the industrial sector and other stakeholders. However, in certain circumstances – such as when the public demands action on an issue – targets can be set by politicians. In some cases, municipalities are held directly accountable for reaching a target (*e.g.* residual waste generated per inhabitant).

Starting year: Various

Target year: Various

Review cycle: Various (*e.g.* five years for Waste Management Plan).

Scope of Initiative: No overarching policy framework, but programmes address decoupling, sustainable consumption, sustainable production, waste prevention, waste separation and recycling, and sustainable building and living.

Life cycle stages: All

Materials included: All

Specific waste streams: End-of-life vehicles, tires, WEEE, batteries, and oils.

Experience: Within the individual programmes, these targets have been effective in driving society towards more sustainable use of materials. This is based on the fact that the targets implemented were realistic, measurable, and based on both ecological and economic considerations. Further, it was stated that targets have to be supported by the public, supported by a mix of policy instruments to ensure their achievement, and need to be communicated and monitored. A final lesson is that focusing too much on achieving targets involves a risk of negative unintended consequences.

Programme: Mix of policies and programmes related to SMM in the EU[5]

Description: In the EU, there is no single overarching SMM policy but rather a variety of policies related to various life cycle stages, including: production; consumption; waste collection, separation and recycling; and a focus on specific waste streams. An emphasis is placed on recycling through the policies and associated targets. Targets are both quantitative and qualitative, particularly where policies are still developing. A central future goal is to understand the interrelationship of policies and targets in order to build synergies across existing policies and provide insights for future target development.

Overall objective: The long-term goal is for the EU to become a recycling society that seeks to avoid waste and uses waste as a resource. EU waste and recycling legislation, including the new framework for waste prevention adopted in 2008, is designed to reduce negative environmental impacts (notably reducing waste going to landfill), and encourage recycling. Increasing resource efficiency is also a main objective. The various policies around which targets are set have individual objectives (*e.g.* Directive 94/62/EC on packaging and packaging waste aims to prevent or reduce the impact of packaging and packaging waste on the environment and to ensure the functioning of the Internal Market).

Summary of policy instruments: The Framework for Waste Prevention was recently updated and adopted by Parliament in October 2008. It replaces the previous version which was established in 1975 and has set out the framework upon which specific waste policies have been built over time. The EU implemented a variety of policies that address various life cycle stages through quantitative and qualitative targets. Targets are set by the Commission. For member states, reaching the targets is a legally binding commitment between the member states and the Commission. Targets are primarily quantified and address particular waste streams (household waste, end-of-life vehicles, WEEE, batteries, packaging), life cycles stages and resource efficiency objectives. When not quantified, general qualitative language is used and benchmarks are encouraged. To date, targets relevant to resource efficiency have mainly been set at the latter stages of the life cycle (*e.g.* by 2020 member states must recycle 50% of their household and similar waste), and this has generally been done through legislation.[6] Targets primarily emphasise material reuse and recycling as end objectives, but targets around packaging and eco-design bring in waste reduction and design considerations. Regarding eco-design, the Directive 2005/32/EC on the eco-design of Energy-using Products (EuP) defines criteria for eco-design products. The Sustainable Consumption and Production (SCP) Action Plan proposes the expansion of the eco-design directive by focusing not only on "energy-using" products but also on all "energy-related" products, which includes products that impact energy consumption during use. Under the SCP Action Plan, benchmarks and requirements will be set based on leading products. Continuous improvement through updating these benchmarks is also a component of the programme.[7]

Eco-innovation benchmarks and targets under the SCP Action Plan are currently being discussed with an objective of developing tools and targets that will boost eco-innovation in the EU.

Specific parameters being used

Resource extraction:
No information found.

Resource productivity: No targets set but plans to develop them are in place. The general objective is to increase resource productivity at the same or greater rate than the 2.2% productivity improvement seen over the last 10 years. They have an understanding of how recycling targets have contributed to resource productivity improvements

Production: Data collected on amount of CO_2 emissions avoided due to recycling of metals, glass, paper and plastics.

Consumption: No information found.

End of life:

Vehicles

- 85% reuse and recycling of vehicles by weight by 2015.

WEEE component, material reuse and recycling

- 75% (for categories of products 1, 10)

(*e.g.* large household appliances, refrigerators, freezers)

- 65% (for categories of products 3, 4)

(*e.g.* ICT equipment)

- 50% (for categories 2, 5, 6, 7, 9) (*e.g.* small household appliances, lighting equipment)

Battery collection rates

- 25% by 26 September 2012
- 45% by 26 September 2016

Recycling rates, by average weight

- 65% recycling of lead-acid batteries and accumulators
- 75% recycling of nickel-cadmium batteries and accumulators
- 50% recycling of waste batteries and accumulators

Household waste

- 50% target for preparing for reuse and recycling of items such as paper, metal, plastic and glass from household waste by 2020

Construction and demolition

- 70% target for preparing for reuse and recycling and material recovery, including "backfilling" of non-hazardous construction and demolition waste by 2020

Other:

Key drivers for target setting: The key drivers are: sufficient data to demonstrate environmental significance; increasing resource efficiency; boosting recycling; an indication on a political level of a commitment to improvement through targets without being prescriptive in regards to specific actions. A focus on recycling and the objective of becoming a "recycling society" are also main drivers.

Target setting and review process: Targets are generally set by the Commission and acted on by Member States. Performance is monitored by the Commission and, if targets are not met, it can launch infringement procedures against Member States.

Starting year: Various

Review cycle: Various

Target year: Various

Scope of initiative: No overarching policy framework, but policies address recycling, sustainable consumption, sustainable production, waste prevention, boosting overall resource efficiency, and eco-design and innovation.

Life cycle stages: All, with a focus on the latter.

Specific waste streams: End-of-life vehicles, WEEE, batteries and packaging

Materials included: All

Experience: Overall resource productivity of the EU has been increasing over the last ten years and specific recycling targets have contributed to this improvement. Despite the fact that recycling has been increasing, there are still indications that overall waste generation has grown due to growth in consumption. This is a matter that is likely to receive attention in the future, in particular as part of the implementation of the Waste Framework Directive. Some concern exists over whether targets were initially set too low because many member states were quickly able to reach them. (The policies and targets are at different stages of implementation. Some correspond to targets set in legislation that have evolved over a number of years [*e.g.* the packaging directive]. Other targets have yet to be implemented, such as those recently set in the Waste Framework Directive.)

Programme: Mix of policies and programmes related to SMM in Chinese Taipei[8]

Description: In China, the Chinese Taipei's Environmental Protection Administration (TEPA) manages waste policy and has promoted various programmes. Within these programmes there are a variety of both hard, quantifiable targets and general guidelines. The Zero Waste Programme is one of their main endeavours. Source minimisation, resource recovery and recycling are the major principles for waste disposal under this programme. Future objectives are to formulate product policies that integrate extended producer responsibility and eco-design principles in an effort to lower the impact of products on the environment. TEPA works with local government and industries to meet targets and objectives.

Overall objective: To meet the goals of sustainable society and to respond to a growing concern over the environmental impacts of MSW incinerators, TEPA initiated a Zero Waste Policy for MSW in 2003. The policy reflects the shifting philosophy of waste management from end-of-pipe treatment to source reduction and resource reutilisation. The policy lays out four major strategies: source reduction, reuse, recycling and green consumption.

Summary of policy instruments: China has set national targets for waste reduction for various life cycle stages and waste streams. Some initiatives include quantifiable targets. Direct mandates are also frequently used (*e.g.* starting in 2007, untreated raw waste can no longer be disposed of in landfills except in certain specific rural areas), as are general objectives. Initiatives are implemented at both national and local levels. Where appropriate, implementation is backed up by clear accountability if targets are not met. Under the Zero Waste Programme, focus is on the elevation of: waste minimisation; resource recovery; resource recycling; waste collecting; waste disposal technologies; and final disposal. According to these seven measures, TEPA formulated the Programmes for General Waste Recycling and Resource Recovery, which include seven tasks: mandatory garbage sorting; all purpose kitchen waste recycling; reuse and recycling of bulk waste; reuse of the waste from household re-modelling; upgrading waste treatment facilities; sewage treatment; and replacement of unusable waste-collecting vehicles.
Waste management programmes have evolved in terms of focus and scope. The Resource Recycling Four-in-One Programme, established in 1997, helped increase the recycling rate of resources. From 2001-2003, programmes focused on promoting the recycling of kitchen and bulky waste. In an effort to align with trends of sustainable resources and zero waste, the Zero Waste Programme was launched in 2003. TEPA made waste sorting nationally mandatory in 2006. In 2006, they also issued Excessive Packaging Restrictions to regulate packaging amounts on a number of items. Additionally, TEPA restricted the manufacturing, import and sale of zinc-manganese batteries and alkaline-manganese batteries that contain over 5 ppm of mercury.
TEPA helps local governments meet targets by providing subsidies to cover education, promotion and recycling equipment. Local governments also provide bulky waste collection services and organise auctions of refurbished furniture to encourage the reuse of bulky waste. Eco-design and extended producer responsibility policies are expected to be developed in the future.

Specific parameters being used

Resource extraction: No information found.

Resource productivity: No information found.

Production: Restrictions on the manufacturing, import and sale of zinc-manganese batteries and alkaline-manganese batteries that contain over 5 ppm of mercury.

Consumption: No information found.

End of life:
Waste minimisation targets: decreased waste by 25% in 2007; 40% in 2011; and 75% in 2020.
List of 15 mandatory items for recycling.
As of 2007, untreated raw waste can no longer be disposed of in landfills, except in certain specific rural areas.
Increase reuse rate of incineration ash from 20% in 2006 to 80% in 2009.
Reduce industrial waste by 10% and reuse 85% of the collected waste by 2020.

Other: Industrial waste-collecting vehicles must have Global Positioning Systems (GPS) to ensure proper disposal of waste.

Key drivers for target setting: Key drivers include: demonstrated need; lack of prior waste management programmes or regulations; necessity of waste management programmes for global standing and public health; current trends in sustainability (*i.e.* zero waste); and concern over impacts of MSW incinerators.

Target setting and review process: Targets are generally set and reviewed by TEPA. Collaboration with industrial sectors occurs for the purposes of innovation and participation. TEPA developed the first online industrial waste registration and inspections system in the world. The system assists local governments in inspecting and controlling industrial waste. They mandate the use of industrial waste-collecting vehicles with GPS to ensure proper disposal of industrial waste. Moreover, they use a photo database to manage illegal dumping of industrial waste. Finally, environmental protection inspectors work with the police to inspect businesses and prevent illegal dumping.

Starting year: Various; 2003 for Zero Waste Programme.

Review cycle: Various

Target year: Various

Scope of initiative: No overarching policy framework, but programme address waste prevention, resource recovery and recycling, and waste disposal techniques including separation, eco-design and innovation.

Life cycle stages: All

Specific waste streams: Batteries, industrial waste, kitchen waste.

Materials included: All

Experience: Within the individual programmes, these targets have been effective at driving compliance and better waste management practices. In 2007, the daily non-recyclable garbage collected approached a 45% reduction rate compared to 1997. Incineration has replaced landfill as the principal means of waste disposal.

Programme: National Waste Plan in Finland[9]

Description: In April 2008, the Finnish government approved a new national waste plan to the year 2016. The plan describes how waste management in Finland should look in 2016 and how the goal will be achieved. The plan also contains a separate action plan for preventing the generation of waste. The 13 regional environment centres have each drafted their own regional waste plan.[10] Targets are due out in 2010. In general, Finnish waste discourse is shifting from waste prevention to material efficiency. As such, they have a national programme to promote sustainable consumption and production. The programme consists of a variety of policies related to material efficiency and sustainable purchasing. Targets are used within these policies, but many are still in draft form and have yet to be released.

Overall objective: The central objective of waste policy is to reduce the harmful health and environmental impacts of waste. In order to meet this objective, it is particularly important to:

- prevent the generation of waste;
- promote reuse of waste;
- promote biological recovery of waste and recycling of materials;
- promote energy use of waste not suited for recycling; and
- ensure that the treatment and disposal of waste does not cause any harmful impacts.[11]

Summary of policy instruments: Finland's waste policies are based in large part on EU legislation. Finland has implemented a variety of regional-level programmes to address life cycle stages, including waste collection, separation and recycling, and is in the process of developing programmes to address sustainable consumption and production. Targets are set at both national and regional levels. Where data allows, targets are quantitative; in other cases, targets are qualitative and put forth as broad goals and objectives at both national and regional levels. Where targets are specified, so are parties responsible for implementing them. Many of the targets for the new waste policy are in development and are due out in 2010.

General programmes exist around material efficiency, recovering methane from landfills, recycling, hazardous wastes, reducing negative health and environmental impacts associated with waste, increasing technical expertise in the waste sector and combating illegal waste shipments. With respect to increasing technical expertise, funding is being invested into measures and programmes to improve waste statistics, classification and monitoring.

The Service Centre for Material Efficiency was established in 2007. Material efficiency programmes at the product level have been proposed and are waiting for funding. Both government and non- governmental organisations will take part in writing material efficiency criteria. Programmes will include efforts to set minimum requirements for product durability, updatability, and reparability, and other material-efficiency features, and to promote repairable and updateable products. Many programmes are in the R&D stage under the new waste policy. For example, TEKES, a research and development (R&D) funding organisation in Finland, is also looking into launching a technology programme on material efficiency including public and private partnerships. Other programmes, like the producer responsibility system, are in development and waiting on more complete data to dictate direction, goals and targets.

Specific parameters being used

Resource extraction: By 2016, 5 % (3 to 4 million tonnes) of the gravel and crushed stone used in earthworks will be replaced by waste generated by industry and mineral extraction.

Resource productivity: No information found.

Production: Material efficiency criteria are being created, which will take life cycle efficiencies into account, including energy used in production.

Consumption: Material efficiency criteria are being created, which will take life cycle efficiencies into account, including consumption of natural resources during the products" life cycle.

End of life:

Stabilise the amount of municipal waste to 2.3-2.5 million tonnes annually (the level of the early years of this century) and then ensure that the trend will be downward by the year 2016.

By 2016, 50% of all municipal waste should be recycled as material and 30% used as energy. Not more than 20% of the total should be landfilled

All manure generated in connection with rural businesses would be recovered; 10% of this amount, or about 2.1 million tonnes, would be treated in biogas plants at farms. At least 10% of all sludge generated in rural areas and collected using septic tanks and cesspools would also be treated in these plants. By 2016, some 90% of all sludge generated in rural areas would be treated in wastewater treatment plants and the remaining 10% in biogas plants at farms.

By 2016, at least 70% of all construction waste will be used as material and energy.

By 2016, 100% of all municipal sludge will be recovered, either to be used as energy or for soil conditioning.

By 2016, a maximum of between 460,000 and 500,000 tonnes of municipal waste would end up at landfills and that, in 2016, landfills would number between 30 and 40.

Other:

Key drivers for target setting: Key drivers include: sufficient data and understanding of the issue; culture of targets leading to action; national and sector-specific targets providing motivation for action without being overly prescriptive in regards to specific actions. The general programme objective to reduce negative impacts associated with waste across the life cycle is also a main driver.

Target setting and review process: Targets are set and reviewed by national and regional offices. Additionally, in their material-efficiency agreements, industrial sectors set and commit to waste reduction and recycling targets. With regard to the review process, the monitoring will mostly be on the basis of the waste-sector statistics compiled by Statistics Finland. If necessary, separate surveys will be carried out in connection with the monitoring. The implementation of the Plan will also be monitored as part of the monitoring reports drawn up in accordance with the environmental and quality systems maintained by the individual sectors.[12]

Starting year: Various. A new National Waste Plan was approved in 2008. **Review cycle:** Various

Target year: Various. A new National Waste Plan runs to 2016.

Scope of initiative: National level, with particular focus on waste prevention and increasing material recycling and reuse.

Life cycle stages: All

Specific waste streams: Biodegradable wastes, industrial waste, batteries and hazardous wastes.

Materials included: All

Experience: Past waste legislation and targets have been an effective way of driving society towards more sustainable use of materials. Finland attributes waste management improvements to changes in EU legislation, specifically stricter waste management standards and requirements. Additionally, they attribute success to greater co-operation between municipalities within Finland. Targets implemented in Finland were measurable and achievable and results by industry sector were publicly reported, encouraging competition and good performance. Under the new waste management programme, targets are expanding into new areas including waste prevention and sustainable consumption. How they will be received and operate in practice remains to be seen, but the outlook is optimistic due to past experience and result from the generation recovery and treatment of waste in 2005.

Programme: Mix of policies and programmes related to SMM in Mexico[13]

Description: In 2009, the Mexican Ministry of the Environment (SEMARNAT) launched the National Programme for Waste Prevention and Comprehensive Management. The programme consists of a variety of waste management strategies. Overall, the programme's emphasis and strategies focus on the 3Rs initiative (reduction, reuse and recycling) with the central goal of changing consumption and production patterns and traditional practices of waste management throughout the country.

Overall objective: Mexico's waste and recycling legislation is designed to improve life conditions of people, create jobs and reduce negative environmental impacts by reducing waste going to landfills and encouraging reuse and recycling. Changing consumption and production patterns and traditional practices of waste management throughout the country is a central objective.

Summary of policy instruments: The National Programme for Waste Prevention and Comprehensive Management, established in 2009, sets out the framework for a shift in waste management policy across Mexico. This shift focuses on moving from a waste collection and final disposal model to a more comprehensive prevention and waste management approach incorporating legal and administrative frameworks, environmental education, technological development and training. The policy instrument planning phase was strengthened by the input of the corporate sector, namely mining and oil sectors. In addition to the National Programme for Waste Prevention and Comprehensive Management (2009), the National Waste Prevention and Comprehensive Management Law (2003) outlines guidelines, objectives and waste management targets. All targets of the Waste Prevention and Management Programme are aligned to, and are consistent with, the national objectives for the National Development Plan and the National Environment and Resources Management Programme, and they are all derived from the Waste Law. Indicators included in the National Environment and Resources Management Programme were developed by SEMARNAT staff, together with Japanese international co-operation agency (JICA) experts, and were aimed at assessing the effects of implementation of the programme. Waste management targets are generally qualitative in nature, although quantitative targets exist in other environmental management areas such as energy and water policies. Waste targets primarily emphasise material reuse and recycling as end objectives. Timelines are set for reaching targets. If the goals and targets are not achieved at the end of the set time period, a recommendation is made, and an analysis has to be produced in order to explain why targets were not met. Thereafter, new targets or re-organisation takes place (including consideration of the creation of new programmes). The programme has to be updated when the new administration begins. Generally, policy instruments are designed with the intent of diverting waste from landfills and creating more jobs in processing plants through commercial activities related to the recycling and reuse of materials and the alternative disposal of end-of-life products (composting thermal or caloric waste treatment).

Specific parameters being used

Resource extraction: No information found.

Resource productivity: No information found.

Production: General objective to increase the production of goods made of recyclable and reusable materials.

Consumption: No information found.

End of life: General goal is to increase alternative end-of-life waste treatment to include thermal/caloric or composting.

Other: Generators, producers, distributors, importers and exporters must develop management plans for special wastes and hazardous end-of-life products.

Key drivers for target setting: Key drivers include: sufficient data to demonstrate environmental significance delivered through the national diagnosis; limited landfill and other final disposal site space; and limited technical and financial resources for managing sanitary landfill at the municipal level.

Target setting and review process: Targets and programmes are generally set by the federal government and acted on by state and municipal governments within their respective action fields. Targets are reviewed by teams of national and international experts in waste management. Current socio-economic regional conditions and current trends in waste management are taken into consideration in target setting. Evaluations consist of yearly, semester and three-month reviews to measure target achievements.

Starting year: 2009

Review cycle: Various

Target year: 2012

Scope of initiative: Policies address recycling, sustainable consumption, sustainable production, waste prevention and boosting of overall resource efficiency.

Life cycle stages: All

Specific waste streams:
Special management wastes, WEEE, tires and oils.

Materials included: All

Experience: Mexico is experiencing an urbanisation process such that 70% of the population is located in ten large cities. This concentration has shifted consumption and waste-generation patterns so that solid waste is generated at a higher rate and is more heterogeneous in composition than in past years. Concern with regard to waste management generally exists around enforcement issues. With regard to the National Programme for Waste Prevention and Comprehensive Management, overall stakeholder feedback has been positive. This comprehensive waste management programme is the first of its kind in Mexico. It has created heightened expectations and strong, focused work on the side of local authorities and some recycling sectors. Stronger participation of the private sector is also expected in most projects in mid-size and major cities, as is major involvement of local authorities in the observance of environmental laws and regulations.

Notes

1. *Source:* Ministry of the Environment, Japan.
2. British Columbia Ministry of Environment (2009), Design for Environment (DfE) Best Practices Lessons for British Columbia's Ministry of Environment, p. 11.
3. *Source:* Flemish Public Waste Agency, OVAM, Belgium.
4. Interview with Christof Delatter, Director INTERAFVAL (Association of Flemish Cities and Municipalities), July 2009.
5. Interview with Christof Delatter, Director INTERAFVAL (Association of Flemish Cities and Municipalities), July 2009.
6. Council of the European Union, (October 20, 2008), "A new framework for waste management in the EU" Available from: *www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/misc/103477.pdf*.
7. Commission of the European Communities, (July 16, 2008) COM(2008)397 final, "Communication From the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions – On the Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan". Available from: *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52008DC0397:EN:NOT*.
8. *Source:* Environmental Protection Agency, Chinese Taipei.
9. Based on Finnish Ministry of the Environment (2009), *Towards a Recycling Society – the National Waste Plan for 2016*.
10. Ministry of the Environment – Finland – Waste Policies Website, accessed from: *www.ymparisto.fi/default.asp?node=17719&lan=en*.
11. Finnish Ministry of the Environment (2009), *Towards a Recycling Society – the National Waste Plan for 2016*, p. 9.
12. Finnish Ministry of the Environment (2009), *Towards a Recycling Society – the National Waste Plan for 2016*, p. 31.
13. Based on email exchange with César Rafael Chávez, Secretary of Development and Environmental Regulations, SEMARNAT México, September 2009.

ANNEX 2.A2

Private-sector case studies

In the framework of their corporate social responsibility activities, private sector companies are also frequently committing themselves to sustainable materials management targets. A number of high-profile case examples are provided here in order to add illustrative examples to the discussion in the chapter, including:

- **Nippon Mining and Metals Co**., Ltd., Japan.
- **Domtar**, Canada.
- **Turner Construction**, United States.
- **BASF**, Global (Head office Germany).
- **Nokia**, Global (Head office Finland).
- Target setting for extended producer responsibility – electronics in Canada.

Nippon Mining & Metals Co., Ltd.[1]

The Nippon Mining & Metals Group offers comprehensive products and services in the non-ferrous metals field, from resource development, smelting and refining to manufacturing and marketing of electronic materials, and recycling and environmental services.[2] According to their President and CEO, Masanori Okada, "Given that the earth's resources are directly used as our raw materials, in fulfilling our social mission we need to take aggressive measures to reduce our environmental impact and to encourage the formation of a recycling-oriented society".[3]

Key issues

To achieve this broad vision, the company has gone through a review process identifying their key material issues. The review involved identifying a broad list of challenges and these were then narrowed down by a combination of their importance to Nippon's business strategies and the level of stakeholder interest. This effort reduced the key priority issues from 28 to 7 and a final effort consolidated them into 3 key material issues: establishing a recycling-oriented society; development of environment-friendly technologies; and implementation of initiatives regarding climate change problems.

Framework

These material issues are addressed under a broad Corporate Social Responsibility Action Policy, which looks at the entire life cycle of their products. Policy objectives (*e.g.* recovering rare and precious metals and other similar materials from recycled materials,

and further developing "urban mines") are supported by detailed annual activity plans which follow the Plan, Do, Check, Act cycle. Further, Nippon Mining & Metals Group sets medium-term targets which, where appropriate, provide quantitative targets regarding energy savings, reductions in CO_2 emissions and final disposal of waste. These targets are evaluated on a yearly basis and revised periodically.

Experience

Looking specifically at the first material issue – establishing a recycling-oriented society – Nippon Mining & Metals Group has become active in the area of urban mines. They identified certain key obstacles, including: technological capability to extract materials from used products; collection infrastructure; and co-ordination across borders in terms of the movement of disposed articles out of Japan and achieving broad acceptance of its importance. One step in this direction has been the Hitachi Metal Recycling Complex, which will apply leading technology to the recovery of various metals such as gold, silver, copper, tin, zinc, bismuth, nickel and indium. Further, they have provided input and collaborated with other industry players in the value chain (like those in the IT industry) to address the above challenges.[4] Through these activities and public reporting of their progress by way of annual sustainability reports, they are making inroads towards addressing their key material issues.

Domtar[5]

Domtar is the largest integrated manufacturer and marketer of uncoated freesheet paper in North America and the second largest in the world based on production capacity.[6] The company has 15 pulp and paper mills in operation, and 16 converting and distribution operations including a network of seven sawmills located off site of their paper-making operations.[7] In terms of managing their resource (wood fibre) responsibly, Domtar seeks to maximise the use of recycled fibre, while striving to source all required virgin fibre from sustainable forests – even when they are not directly managed by Domtar.[8] Through these efforts, Domtar is establishing a leadership position in the forest products industry with respect to its sustainability efforts.

Key issues

Domtar recognised several years ago that there were many misconceptions around fibre management by the forest products industry. To get a better understanding of the impacts related to the industry, Domtar conducted a life cycle assessment on fibre management. For the company, this was seen as part of their risk management process and provided them with insights into the key impacts for their processes. For example, the key sustainability issue that emerged was proper management of the forests themselves to ensure the long-term viability of the wood fibre source. One of the main challenges for Domtar (related to managing their material in a sustainable manner) comes from the fact that approximately 80% of fibre comes from third-party suppliers.

Framework

Many of the company's sustainability issues fall under two key management areas – cost reduction and risk management. Targets and a focused effort on improving the eco-efficiency of their operations have been successful in reducing costs along with reducing emissions, water usage and other environmental impacts. On the business risk side, they

saw consumers moving away from, or complaining about, forest products as they believed the sector was depleting resources too fast – a clear risk for a forest product-based company.

Domtar chose to focus on the Forest Stewardship Council's (FSC's) approach to sustainably managing forests. They started out by setting targets for areas they had direct control over, setting out to have all their lands and lands licensed under them FSC-certified within two years. They then encouraged their suppliers to do the same. However, when dealing with suppliers that do not fall under their direct control, Domtar chose to use more qualitative targets. Working to see what type of certifications were appropriate, this process became more about engagement and being involved in the process, rather than forcing certification standards and targets on their suppliers. Domtar believes that once a better understanding of the key issues has been achieved through supplier education and better data becomes available, it will become easier to set the quantitative targets for areas not under their direct control. Beyond being a good corporate citizen, Domtar understands this is about managing risks and meeting customer demand for preferable products.

Experience

Setting targets to become FSC certified pushed Domtar to move in the right direction and created momentum from their own foresters to be further engaged. When they first committed to becoming certified, the standards were not fully established yet so they directly participated in the development of standards and committed to move on practical standards once they were defined. Now, Domtar continues to work to support the development of more certification standards that can be more broadly applied in their supply chain, specifically so that it is less cost prohibitive for smaller landowners and suppliers to achieve certification. Pushing targets related to the sustainable management of their material was made easier by a strong commitment from the senior management of the company to improve their sustainability performance. Also, previous experience with having many of their forests ISO 14000 certified provided something for the company to build upon.

Turner Construction Company[9]

Turner Construction Company is the largest "green building" construction company in the United States, completing over $3 billion in green building projects in 2008.[10] The company also offers a wide array of building services, from preconstruction consulting to design and build services through to building maintenance.

Key issues

In 2003, led by senior management, the company thoroughly explored the importance of the green building market. This review process included interviewing over 700 "market barometers" or key people in the market. The respondents indicated the positive performance of green buildings and said they were becoming increasingly involved with them, confirming Turner's focus on this market segment. With this validation of opportunity, Turner committed itself to the green building market and undertook a series of activities that included target setting.[11]

Framework

Green building as a key opportunity for the company was addressed under a broad-based approach to sustainability, which was announced in 2004. In addition to green building,

Turner Construction Company's sustainability approach also includes waste tracking initiatives, utilisation of Building Information Modelling (BIM) and recycling, GHG reduction and green purchasing initiatives.[12] The company referenced the United States Green Building Council (USGBC) and LEED rating system to set initial targets for many of the aforementioned initiatives.[13] Additionally, targets and initiatives are informed by annual Green Building surveys that identify key market issues and findings. Turner Construction Company sets concrete targets in areas where they have direct control, such as on-site waste management. In areas where they have less control (*e.g.* clients" requests for LEED buildings), the company sets more flexible targets with the objective of influencing, rather than mandating, desired behaviours.

Experience

In practice, Turner Construction Company's internal targets are set as "stretch goals" rather than mandatory objectives. The company's philosophy is to encourage reaching for targets but not to punitively punish not meeting them. They feel the real value lies in encouraging the right behaviour and learning. Behaviour is encouraged with both incentives and competition. For example, the company offers an incentive bonus for employees to become LEED AP-certified. Internal employee drive to achieve certification has surpassed this incentive, reflecting both an imbedded sustainability culture and the result of positive competition between departments to have the most LEED AP professionals. Turner Construction also produces a biannual report, showing performance and level of compliance with internal targets across business units in order to encourage best practice. In setting targets, the company uses LEED measurements as a benchmark.[14]

BASF the chemical company[15]

BASF is the world's leading chemical company with business segments in chemicals, plastics, performance products, functional solutions, agricultural solutions, and oil and gas. BASF has approximately 97 000 employees and serves customers in nearly all countries worldwide. In 2008, they generated € 62.3 billion in sales and income.[16]

Key issues

Every five years BASF conducts a global review, charting the future path of the company and industry. The review considers global macro trends but also considers local issues, including specific customer and product lines, and projects what needs to be done in order to be a viable company in the target year 10 to 15 years in the future. In the previous global review process (2003), with a target year of 2015, four strategic initiatives surfaced:

- earning a premium on BASF's cost of capital;
- forming the best team in the industry;
- helping customers be successful by creating solutions rather than just selling chemicals; and
- ensuring sustainable development; broadening an original focus on safety to problem solving for society.[17]

Framework

The four strategic initiatives arise out of a foundational framework of BASF's commitment to serve the global community, not only as a chemical company but as a company working to address larger global issues including health and nutrition, mobility and climate change.[18]

These four strategic initiatives ground practically all of BASF's activities. Specifically, every individual at BASF has personal goals related to each of these four initiatives and there is a corporate scorecard to track performance. Additionally financial targets are established by individual plants. BASF feels that a framework including personal goals encourages focus, accountability and progress.[19]

Experience

In practice, BASF sets and encourages firm targets both at the global corporate and individual levels. In 2005, they set fairly aggressive goals for 2012. By 2008, they had already reached many of these goals. They re-evaluated and set their 2020 goals based on this experience. Due to their size and global span, BASF sets goals globally but allows their regional entities to define the specific projects and targets to achieve the global goals. There is flexibility in local implementation that allows consideration for local market, environmental and social drivers.

BASF realises the utility in target setting for both inspiring innovation and showing leadership. For instance, setting targets and collecting data for their CO_2 emissions led them to track the CO_2 saved through use of their products by customers across the value chain. This measure highlighted the net-positive impact of their product portfolio which, in turn, provides solutions to problems in society dealing with energy savings, emissions controls and overall climate protection.

Nokia[20]

Nokia is the world leader in mobility, driving the transformation and growth of the converging internet and communications industries. Nokia produces a wide range of mobile devices with services and software.[21]

In 2007, Nokia's net sales were € 51.1 billion and operating profit was € 8.0 billion. At the end of 2007, the company employed more than 112 000 people and had production facilities for mobile devices and network infrastructure around the world, sales in more than 150 countries, and a global network of sales, customer service and other operational units.[22]

Key issues

As is the case with many electronics companies, Nokia has acknowledged the challenge of knowing all the substances in their products, as many components are sourced from lengthy or complex supply chains. Many electronics companies deal with this issue by creating a list of restricted substances and ensuring that none of these are in their products. However, this does not necessarily mean that all substances are known, rather that specific substances simply are not included in the products. Several years ago, Nokia made the ambitious objective to identify all the substances in their products, not just those that raise concerns.[23] It saw this as both a responsible approach as a company and as a potential cost-savings activity. Although the task took several years and extensive

resources, it has allowed Nokia to respond quickly to stakeholders who raise issues related to specific substances as new concerns arise.[24] This provides them with a competitive advantage, as other companies responding to similar concerns would be forced to try and determine if their products contained these substances on a case-by-case basis.

Framework

To achieve their ambitious objective, Nokia successfully set and achieved a series of targets related to the collection of information on the numerous substances in their products. After initial research into the area, they determined that they could almost immediately obtain the necessary data for 50% of their products.[25] For the first phase of this effort they set this as their target. Once this was achieved, they increased this target by 10% every half year. Targets were set in consultation with their material experts who would analyse products one by one (some containing up to 200 components and 15 materials each).[26] Nokia also consulted with their suppliers throughout this process, acknowledging that these companies are often the experts on their respective products and substances.[27] Every six months throughout the process, the suppliers would meet with Nokia to agree on a suitable target. Often the supplier positions were quite similar and Nokia would then suggest a target and work to get agreement from them.[28] The company also engaged with non-governmental organisations (NGOs) throughout the effort. Although the NGOs were not involved in the supplier meetings, Nokia worked with them to understand their concerns and communicate these to suppliers.

Through this extensive process, Nokia became the first mobile phone manufacturer to have full material declaration for all their mobile devices. The process also led to the development of the Nokia Substance List, which is made available on their website. Nokia describes this list as one which:

> *"… identifies substances that we have banned, restricted, or targeted for reduction with the aim of phasing out their use in our products. The list is divided into two sections, Restriction in Force and Monitored Substances. We work together with our suppliers in investigating alternative materials and solutions that will help us fully eliminate restricted or monitored substances from our total product line. The Nokia Substance List will be updated annually. In addition, we will give interim updates on individual substance phase outs as needed…"*[29]

Experience

Although a lengthy and extensive process, the effort by Nokia has positioned them as a leader in their industry for material and substance management. Target setting in this process played a key role in achieving success, which Nokia attributes to the fact that material experts, suppliers, NGOs and other stakeholders were included in the process. Some suppliers were concerned over their intellectual property rights related to their material usage, however, Nokia worked to address this through a variety of approaches. For example, it used incentives to motivate suppliers to comply with their efforts. Specifically, Nokia created a preferred supplier designation that it awarded to those suppliers able to meet their targets in a timely fashion.[30] Although these targets were not shared externally during the process, Nokia is currently working to determine the best way to set and make public similar targets wherever possible.[31]

Target setting for extended producer responsibility – electronics in Canada

Managing waste from electronics (e-waste) is a global issue, due in part to the volumes of materials in question. Various jurisdictions and electronics companies have established approaches to better manage these products and the numerous associated materials. In Canada, the concept of Extended Producer Responsibility (EPR) has come to the forefront of these approaches.

The Canadian response resulted in the electronic industry's establishment of Electronics Product Stewardship Canada (EPSC). The EPSC was founded by 16 leading manufacturers that decided to collaborate when they saw the potential for provincial regulations to move in the direction of those in the EU. Through negotiations with provincial authorities EPSC was engaged in the initial development of these industry-led programmes. Currently, the Atlantic Canada Electronics Stewardship (ACES), the Saskatchewan Waste Electronic Equipment Programme (SWEEP) and the Electronics Stewardship Association of British Columbia (ESABC) have staffed an office of Harmonization Coordination as of 1 January, 2009. A similar EPR programme was launched in Ontario in April 2009 through Ontario Electronics Stewardship (OES) although it is not formally part of the harmonization initiative.

The harmonization office's focus is on working to harmonise the operational, industry-led and regulated environmental stewardship programmes for end-of-life electronics to ensure their efforts are aligned.[32] ACES, SWEEP, and ESABCoperate as non-profit organisations and were formed by manufacturers, retailers, and other stakeholders to focus efforts around the collection and recycling of electronic waste. Each programme has tracked data related to a few key performance indicators, as shown in Figure B.1. A key focus of the effort is conducting research on appropriate performance measures that regulated and industry-led electronics stewardship programmes should be looking to include in order to encourage continuous programme improvement, to allow for comparative analysis on programme impacts and to satisfy regulatory requirements.

From a regulation perspective, waste in Canada is dealt with at a provincial rather than national level. However, there is a harmonised effort led by the Canadian Council of Ministers of the Environment (CCME). The CCME is comprised of the environment ministers from the federal, provincial and territorial governments. The Council seeks to achieve positive environmental results, focusing on issues that are national in scope and that require collective attention by a number of governments.[33] In June of 2007, the CCME endorsed the Canada-wide Principles for Extended Producer Responsibility.[34] The objective of the Canada-Wide Principles for EPR is to assist and support jurisdictions in the development of EPR programmes. The overarching goals of the principles are to minimise environmental impacts, maximise environmental benefits, promote the transfer of end-of-life responsibility for the product and/or material to the producer, and encourage design for environment (DfE). While recognizing differences in the legislative/regulatory framework and existing programmes among jurisdictions, CCME encourages regional or national co-operation in the development of EPR programmes. Specific measures undertaken by each jurisdiction are at their discretion, with the goal of effective, efficient, and harmonised implementation.[35]

CCME has also created an EPR Task Group which provides guidance on the development and implementation of EPR and product stewardship programmes. The Task Force is also engaged in the preparation of a Canada-wide Action Plan on EPR which has as

Table 2.A2.1. **Performance of selected EPR programmes for electronic waste**

Program Stats since program inception and as of March 31, 2009	SWEEP	ESABC	ACES	Totals
Program Launch Date	February 2007	August 2007	February 2008	…
Tonnes of regulated products collected and sent for responsible recycling and diverted from landfill or illegal export	3 778	16 826	2 632	23 236
# of obligated members registered (POPS and Remitters)	619	1,442	480	2 541*
Total Collection Depots Province-wide	71	97	35	203

Source: www.estewardship.ca/docs/programme-metrics.pdf.

its primary focus the development of harmonious EPR programmes for specific identified products with implementation on an agreed timetable.[36] The EPR Task Group's mandate is to:

- identify opportunities to harmonise, make consistent where appropriate, expand and improve EPR programmes;
- develop general guidance on EPR issues;
- identify and explore opportunities to forge strategies for new EPR initiatives; and
- facilitate EPR communications and information exchange among jurisdictions.

Various stewardship programmes at the provincial level have been established in response to the CCME's initiatives, as well as the provinces" and industry's acknowledgement that consumers are increasingly concerned with the environmental and social impacts of the products they use. In the province of British Columbia, the government has responded to this through the setting of specific targets for waste recovery rates of 75% across all sectors. However, in the case of electronics, it is more difficult to figure out recovery rates (due to their long lifespan), hence government and industry focus on public awareness instead. Recognising that the industry has the knowledge on how to best reduce their environmental impacts, the province supports" their effort in setting their own targets, but require that they submit an annual publicly available report on how they are performing relative to their own targets.[37] The provincial government of British Columbia also acknowledges that target setting is a key step to increasing industry performance but points out that these are likely most effective at a provincial, industry-specific level, rather than at a national level as waste management issues are typically not under national jurisdiction. British Columbia also notes that having the CCME play a harmonisation role by providing provinces with overall guidance is helpful to ensure a common approach throughout the country.[38]

Notes

1. Based primarily on comments from Michiharu Yamamoto, General Manager, CSR Department, Nippon Mining & Metals Co., Ltd. *via* email June 2009 and Nippon Mining & Metals Co. 2008 Sustainability Report available from *www.nikko-metal.co.jp/e/sustainability/index.html*.
2. Nippon Mining and Metals Co., Ltd. (2008), *2008 Sustainability Report*, p. 3.
3. Interviews with David Lawes and Teresa Conner, Ministry of Environment, British Columbia, Canada; and Christof Delatter, Director INTERAFVAL (Association of Flemish Cities and Municipalities), July 2009.
4. Comments from Michiharu Yamamoto, General Manager, CSR Department, Nippon Mining & Metals Co., Ltd. via email June 2009.
5. Primarily based on interview with Guy Boucher, VP Sustainable Development, Domtar, August 2009.
6. *www.domtar.com/en/corporate/overview/index.asp?location=SecondaryNav.*

7. For more information on EPEAT or "Electronic Product Environmental Assessment Tool" please visit *www.epeat.net*.
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9. Based primarily on comments from Michael Deane, Vice President and Chief Sustainability Officer, Turner Construction Company, via telephone, July 2009, and the Turner Construction Company Website accessed via *www.turnerconstruction.com*.
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37. Interview with David Lawes and Teresa Conner, Ministry of Environment, British Columbia, Canada, July 2009.

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Interview with Guy Boucher, VP Sustainable Development, Domtar, August 2009.

Interview with Michael Deane, Vice President and Chief Sustainability Officer, Turner Construction Company, July 2009.

Interview with Edward Madzy, Director, EHS Product Regulations/Product Stewardship, and David DiMarcello, Manager, Environmental Center of Expertise, BASF, August 2009.

Chapter 3

Policy instruments for sustainable materials management

This chapter seeks to identify current sustainable materials management policy instruments across OECD countries. A review of selected SMM policy instruments evaluates the extent to which the instruments are efficient and effective at achieving SMM. Lessons learned from existing policy implementation are then used to formulate conclusions and recommendations for the structure of future SMM policy instruments.

Introduction

The overarching goal of this chapter is to identify current policy instruments relevant to Sustainable Materials Management (SMM) and ascertain what may need to be done in order to improve both the effectiveness and the efficiency of these instruments. In order to achieve this goal, research has been undertaken in three distinct phases which have sought:

1. to provide an overview of SMM-related policy instruments currently being implemented across OECD countries in order to understand the range and type of policies which have been applied and to develop a methodology by which to select a range of SMM policies to become case studies;
2. to select a range of policies, varying by policy mechanism, country and life-cycle stage impact, to research at a much greater level of detail in order to gain a better understanding of the policy implementation and to gauge the extent of the impact. The intention is not necessarily to choose programmes, plans and policies which are successful, but rather to select case studies which, when analysed in more detail, can give hints as to how to design efficient and effective policy instruments in the field of SMM policy development across OECD countries; and
3. to draw together the transferable lessons learned from the case studies to formulate more general conclusions and make recommendations regarding the structure of an efficient and effective SMM policy instrument.

This chapter is a synthesis of this rather large body of work. It provides a summary of stages one and two described above, before discussing lessons learned more generally, and presenting our conclusions and recommendations for the future of SMM policy instruments.

Context

What is a policy?

A policy, in the context of this research, is considered to be an action taken by a government which changes "the rules" in some way, thereby affecting the way in which all actors targeted by the policy behave. For the avoidance of doubt, this does not include specific actions undertaken unilaterally by a company or an organisation under its own initiative.

Throughout this report policies are referred to as both "soft" and "hard". It is important to try to define what is meant by these terms to provide a consistent context for this report. However, it is likely that the distinction between the two terms varies considerably across OECD countries and because of this variation defining the two terms is difficult.

Nevertheless, in an attempt to make this distinction, a hard policy would include regulation and economic instruments to the extent that these apply to all (non-exempt) actors targeted by the policy. Within soft policies, we include approaches which

incorporate a voluntaristic element, including, for example, commitments from industry where there is no associated threat of a sanction. It is worth noting that this distinction can be somewhat blurred in cases where voluntaristic measures set de-facto standards in the market place. The literature also highlights a range of measures under the general heading of "voluntary approaches" to environmental improvement. These range from the purely voluntary, to those where a negotiated environmental agreement is established under the threat of the use of alternative "hard" policy measures by government (OECD, 1999).

Results from the recent OECD survey on SMM-related activities show that very few OECD countries have a formal definition of, or *policies* that *specifically* address, SMM. As the following section shows, there are many policies which have not been designed as SMM policies, but which, nonetheless, contribute, to achieving one part the overall objective of SMM: policies and programmes which set out from the outset to take a more encompassing view are still rare. The SMM concept brings together a broad array of considerations of a social, economic and environmental nature. The encompassing nature of SMM presents institutional challenges for governments. As section Conclusions and Recommendations suggests, one possible reason why comprehensive SMM policies may be difficult to develop is likely to be the difficulty experienced in aligning the views of multiple stakeholders regarding SMM, including different government departments with different responsibilities within SMM.

SMM policy instruments

In principle, "SMM policies" include all policies which contribute to meeting SMM objectives. The review of policies adopts this more general perspective.

In the case studies, however, we were asked by OECD to look specifically at policies, programmes and action plans which had adopted a more holistic (*i.e.* across the whole life-cycle) SMM perspective from the outset.

In principle, a coherent approach to SMM policy might, indeed, be expected to look at the management of materials across their life-cycle. However, it is recognised that policies currently in place usually focus on one particular part of a material's life-cycle because of the complications associated with "*expanding the policy approach to cover the whole life-cycle of materials*" (OECD, 2009a). Furthermore, there are good reasons to believe that there are few cases where one specific policy instrument could achieve all that might be desired of SMM policy, and that therefore, even a coherent "policy approach" to SMM will require, in any case, a range of policy instruments.

SMM is a relatively new approach. Policies, plans and programmes which have been introduced specifically to address SMM, or under the SMM policy framework, have not been in place for many years (and so, as will become clear, there is little by way of demonstrable track record to show whether they have been a success) (OECD, 2009a). Conversely, once this constraint on the search for policies is relaxed, we are left with a very broad research scope (as demonstrated by the review in this report) which includes policies which impact upon SMM, but are not labelled as such. It was felt that this more encompassing approach had to be taken due to the difficulties associated with identifying "SMM" labelled policies.

SMM policy instrument overview

Background

In a first phase of the work a review of policies used in OECD countries which have contributed to SMM objectives was carried-out, based upon a review of secondary sources of information, as well as information from the OECD (OECD, 2009a). The aim was not, to list every SMM-policy that exists, but to undertake a broad survey across a range of policies which are addressing aspects of SMM.

In addition, a questionnaire was developed and sent to the OECD Working Group on Waste Prevention and Recycling to complement this research. Seven completed questionnaires were received and the information was incorporated within the review.

This Chapter summarises the information that was gathered in this way.

Summary of literature review

The review (summarised in Figure 3.1) is structured using the material life-cycle stages. Any classification, however, of SMM policy instruments is difficult because of the breadth of policies which can reasonably be held to fall under the definition.

There appears to have been a recent shift from policy instruments that exert an impact across one or two stages of the material life-cycle, towards policy packages that adopt an approach which considers the whole life-cycle, shifting emphasis away from "end of life" policies, and giving a greater emphasis to upstream interventions. Increasingly, the intention seems to be that policies should, in future, become more cross-cutting, integrated and life-cycle focused in their nature (*e.g.* IPP, SCP and dematerialisation/waste prevention). Focusing on earlier stages in the material life-cycle is an approach which addresses the cause rather than the symptom, potentially leading to more efficient use of resources throughout the life-cycle, and elimination of hazards through environmentally informed design (Geiser, K., 2001).

Policy instrument assessment

The overall aim of investigating some SMM policies in greater detail was:

a) to evaluate the effectiveness and efficiency of the policies identified; and

b) in so doing, to identify key transferable lessons regarding, for example, the required institutional setting and the nature of implementation, for countries of a similar level of economic activity.

As noted previously, the objective was to examine policies, programmes and action plans that were rooted in an SMM perspective. Because these have tended to be more recent initiatives, however, in respect of the first of the above two points, evaluation has proved somewhat difficult owing to the short-lived nature of some of the policies reviewed. This problem was anticipated, and indeed, it was expected that the report might highlight challenges being faced by those developing the policies, plans and programmes under examination.

Case study selection

A number of case studies were identified in consultation with relevant stakeholders. Although two case studies in particular are highlighted as forward looking it must be

Figure 3.1. **Summary of SMM policy instruments**

Material Extraction	Transport	Production	Consumption	Recycling	Final Disposal

Vehicle Excise Duties *(e.g. UK, Sweden)*
Annual tax on road vehicles which is graduated based on CO_2 emissions. Encourages sustainable consumption of cars encouraging purchase of greener models.

UK Climate Change Act: *world's first legally binding framework to tackle climate change. Greenhouse gas emissions are a key externality associated with materials across the whole life-cycle.*

Zero waste policies: *discourage unnecessary use of raw materials, encourage sustainable product design and avoid final disposal through recycling, composting and energy recovery (e.g. Scottish Government).*

Biofuels *are increasingly used as an alternative to fossil fuels. Not only do they preserve fossil fuel resources but they emit less CO_2 therefore impact across the material life-cycle decreases. Policy instruments to encourage their use include the* ***United Nations Biofuels*** *&* *the* ***Biofules Directive****.*

EU Emissions Trading System: *the first international carbon dioxide trading system in the world aims to limit emissions in the most cost-effective way possible through national allocation plans. Emissions are a key externality associated with materials across the whole life-cycle.*

Green tax shift: *redistribution of taxes across taxable areas in order to impact upon market competition. Move away from taxation of positive actions (e.g. income) towards more negative actions (e.g. pollution).*

Renewable energy generation preserves finite fossil fuels. Plicy instruments include: ***feed-in tariffs*** *(Germany), tradable green certificates (under the* ***Renewables Obligation Order*** *in the UK).*	***Vehicle exhaust emissions standards*** *(e.g. EU) Aims to regulate air quality which is impacted upon through vehicle emissions.*

Aggregate taxes *(UK, Sweden, Denmark, Flanders, Italy) Discourage resource extraction, strengthen market and enhance quality of recycled/ substituted aggregates*	***Fuel taxes*** *(Most countries) Tax differentiation has been used to encourage more environmental options (e.g. to increase use of unleaded fuels)*

Figure 3.1. **Summary of SMM policy instruments** (cont.)

Material Extraction	Transport	Production	Consumption	Recycling	Final Disposal

Integrated Product Policy *is a policy toolbox which can include: SCP, grant funding, voluntary agreements, product standards, EMS, eco-design, eco-labelling, green public procurement, extended producer responsibility and waste and chemical legislation, and more. It is a concept which encompasses both existing policies and aides the development of new under the IPP framework. It aims to reduce the environmental impact of products throughout their life-cycle (e.g. Denmark, Sweden, US).*

Eco-innovation *can involve innovations in process design, product design or systems design. The* ***UK's White Paper, 'Innovation Nation' (2008) & Japan's draft plan entitled, 'The Innovation for Green Economy & Society (2009)*** *are eco-innovation plans. Policy instruments include:* ***EPEAT, France's and the UK's Reward-Penalty System*** *for encouraging consumers to trade-in older cars for newer more efficient models.*

EU Directive on Eco-Design for Energy-Using Products *currently strongly focuses on energy efficiency but is likely to broaden its scope to cover a wider range of product types.*

Green public procurement *requires a public authority to purchase products which have been recommended (often through eco-labelling). E.g.* ***Japan's Green Purchasing Law, Washington's paper recycling and conservation law, EU Directive 2004/17/EC&2004/18/EC, Canada's federal government green procurement policy.***

Pay-by-use *is an approach whereby a business or individual is subject to a waste collection fee, which is linked to a quantitative measure of waste. By making consumers more aware of the waste they produce research suggests they reduce the waste they produce, therefore impating across the whole material life-cycle (e.g. Germany, Italy, Ireland, France)*

Detoxification *curbs the use of chemicals within a process, through substitution or phase-out. This underlines the green chemistry concept which has been taken forward by the* ***US EPA (as part of the Design for the Environment programme), Australia (Green Chemistry Challenge Awards), Canada (Green Chemistry Medal) & Japan (Green & Sustainable Chemistry Network's Green Chemistry Awards).***

Lean manufacturing *(e.g. US) aims to eliminate waste through increased production efficiencies.*

EU Sustainable Consumption & Production *currently focuses on carbone missions and is likely to expand to include materials-based targets in the future.*

Dematerialisation *aims to reduce the amount of material in a product without compromising the quality (e.g. Germany & Netherlands)*

Figure 3.1. **Summary of SMM policy instruments** (cont.)

Material Extraction	Transport	Production	Consumption	Recycling	Final Disposal

UK Sustainable Clothing Roadmap *is part of the UK's programme for SCP. Roadmaps rely heavily on stakeholder involvement to aim to improve product sustainability. Finland's programme to promote SCP aims to increase eco-efficiency throughout the production chain under a ten year framework programme.*

Japan is working towards the development of a ***sound material-cycle society*** *in which 'resources are used efficiently; waste generation is minimized; unavoidable wastes are recycled as resources; and wastes for which no means of recycling can be found are responsibly disposed of'.*

Industrial Ecology *(IE) makes links between natural ecology and industrial processes in finding symbiosis between manufacturing waste from some companies, and using this as input to other processes, thereby reducing waste and natural resources (e.g.* ***Canada's Eco-Industrial Network and UK's National Industrial Symbiosis Programme****.)*

Trading Schemes: *the UK uses a Landfill Allowance scheme which trades in England only.*

Landfill bans *are based on either waste source, waste type or waste properties. The EU Landfill Directive ensures some bans are implemented – some countries go above & beyond this. Several bans also implemented across the States.*

Disposal levies & taxes *are applied to landfill and incineration workwide, but mainly in Europe. They encourage waste treatments higher up the waste hierarchy such as recycling and composting.*

A ***deposit-refund system*** *is a surcharge on a potentially polluting product which is returned when pollution is avoided. This has been applied widely for a large range of products.*

Extended Producer Responsibility (EPR) / Material/product stewardship *is a product-centered approach to environmental protection. It calls on those in the product life cycle - manufacturers, retailers, users, and disposers-to share responsibility for reducing the environmental impacts of products.*

Figure 3.1. **Summary of SMM policy instruments** (cont.)

Material Extraction	Transport	Production	Consumption	Recycling	Final Disposal

Product bans *insist that a product is no longer used and encourages substitution products/ materials and research into finding new alternatives. Examples of product bans include plastic bags (San Francisco, Tasmania, Maharashtra in India, Leaf Rapids in Canada & Modbury in Devon, UK),* ***the Montreal Protocol on Substances that Deplete the Ozone Layer, the Stockholm Convention on Persistent Organic Pollutants.***

Product levies *(e.g. Ireland's plastic bag levy, packaging tax in Denmark, Belgium & the Netherlands and tyre levies across Europe & North America) aim to reduce consumption which in turn impacts across the whole material life-cycle.*

Eco-labelling*, very often informed through Life Cycle Analysis, is a voluntary mechanism which indicates a product has met a required environmental standard (e.g.* ***European Flower, Nordic Swan, Energy Star, Canada's Environmental Choice Program****). They increase customer confidence and hence competitiveness.*

Minimum product standards *encourage increased quality in recycled products which increases confidence and can result I nrecycled products substituting virgin resources.*

Transition management *is a strategy which guides policy away from a focus on waste products/ materials towards overall sustainable materials management (e.g.* ***Belgium, US EPA's 2020 Vision: Sustainable Materials Management Roadmap & Dutch Chain-Oriented Waste Policy)****.*

Eco-Schools *in an international environment educational programme which requires schools, and their pupils, to work through the programme to achieve the* ***Green Flag award****.*

recognised that all of the case studies selected are "work in progress" and are therefore continuously developing.

The following selected Sustainable Materials Management policy instruments exemplify SMM policy implementation from across a range of OECD countries:

- **Japan's Sound Material-Cycle Society**

This is an integrated policy package based on principles of creating a sustainable material-cycle society. The policy's focus on circulating materials throughout the economy encompasses the whole material life-cycle.

- **UK Climate Change Act**

To the extent that materials embody energy, and that this is central to climate change concerns, so the Climate Change Act effectively addresses all aspects of SMM.

- **California's Green Chemistry Initiative**

The key aim is to reduce the hazardousness of chemicals thereby making environmentally benign products which are more easily reused, recycled, or disposed of, thereby addressing most elements of the life-cycle.

- **Electronic Product Environmental Assessment Tool (EPEAT)**

EPEAT stimulates research into product design and eco-innovation. The specific criteria for end-of-life product design included in EPEAT, including ability to deconstruct products for recycling, demonstrates a key element for a cradle-to-cradle policy instrument framework.

- **EU Sustainable Consumption & Production**

The EU SCP programme's overall aim is to focus on the whole material life-cycle. However, the Action Plan currently focuses on consumption and production issues.

- **Green Public Procurement (GPP)**

GPP has the potential to influence the entire life-cycle. However, as it stands it is likely to most greatly impact upon the production and consumption life-cycle phases.

- **Dutch Chain-Oriented Waste Policy**

The Chain-Oriented Waste Policy programme aims to address the environmental impacts acting across the whole material chain.

- **UK's Clothing Product Roadmap**

The UK's Clothing Product Roadmap intends to target all aspects of the industry's supply chain but where the actions actually fall is determined by the commitments set out in the action plan.

It is recognised that not all of the case studies represent "hard policy". Some of these are initiatives or programmes which are often implemented on a more voluntary basis. Where this is the case, section Conclusions and Recommendations will aim to make recommendations on how changes can be made to strengthen the policy implementation.

There are clearly some grey areas with regards to what would be classified as a true SMM-policy given both the developing nature of the concept and the vast scope which the concept could be deemed to cover (see Section SMM policy instrument overview). It is clear that some policies identified throughout the review would be considered as "transition" policies which are advancing towards what might be termed "fully developed" SMM policy.

Policy instrument assessment methodology

A summary of the way in which the methodology seeks to explore the environmental effectiveness and efficiency implications of SMM policy instruments is noted below.

a) What is the environmental effectiveness of this policy instrument?

- Identify the changes in the environmental issue that the policy sought to address – *e.g.* whether pollution levels, or use of natural resources, or use of energy had declined;
- Assess the costs of the policy to different actors;
- Clarify the other drivers that have been in place/implemented. An understanding of these different issues is needed to allow a fair judgement to be drawn as to the role of the policy itself;
- Assess what role the policy has played in changing, for example, levels of emissions/polluting product reduction or reductions in natural resource and material use.
- In some cases, valuable changes in technology or technique, and innovation, arise through the application of policies and parallel measures. An attempt will be made to identify these where they occurred.
- Did the policy set in train new incentives that led to illegal avoidance measures? If so, to what extent were these anticipated, and why were they not addressed?

b) What social outcomes follow from implementation of the policy?

The social equity and ethical dimension is recognised in the SMM policy principles as an important aspect of SMM. Where relevant, SMM policies should seek to influence such matters; and

c) Is the policy instrument efficient from the economic perspective?

Regarding efficiency, the design of the policy instrument needs to be taken into account. This includes whether the instrument has been based upon an analysis of external costs and benefits associated with the pollutant/resource under discussion (and indeed, whether this could be done).

Finally, the analysis will seek to understand whether there are general lessons which can be learned from the design and implementation of the policy of relevance to the development of SMM policies more generally.

Two complicating factors in respect of assessment of SMM policies are:

a) The broadening of the scope of policy, *i.e.* increasing from a focus on just one stage of the material life-cycle to a broader aim looking at several stages or the whole material-life-cycle; and

b) The additional number of policies which might be included – effectively a shift from a single "policy instrument" approach to a multi-policy/initiative approach – itself leading to an expansion of the problem of attributing specific outcomes to the policies being considered.

The first point might be expected to lead to a requirement for measures of sustainability, or suitable proxies, to be used in order to take account of the policy impact over the material life-cycle.

The second complicating factor is less straightforward to address. In a situation where there is just one policy which is being assessed it is vital to ask the question, "*what would have happened had the policy, or programme of policies, not been introduced?*". This is known as

the problem of the counterfactual. It involves looking at the background policy context and identifying other policies and ongoing/emerging trends which may have influenced the target/aim of the policy in question. This presents problems when evaluating relatively discrete policy interventions. It would be an immense challenge to understand the effects of a range of policy initiatives, each seeking to influence aspects of SMM.

The extent to which details of this nature can be unravelled is strongly dependent on the data available in a given case study context.

Case examples

Japan's Sound Material-Cycle Society

Japan has developed a policy package working towards a "*Sound Material-Cycle Society*" (SMCS). This policy package incorporates existing legislation and programs, and provides a framework (see Annex 2.A1) to develop new areas of work with the overall aim of reducing the impact of products during their life-cycle. The SMCS is largely a strategic and legislative tool, which takes are more holistic approach rather than targeting a specific sector or material.

Assessing the impact of the SMM instrument

In a recent review of SMM initiatives across the OECD, Japan stated that it will measure the effectiveness of the SMCS by means of life-cycle assessment, material flow analysis, economic input/output analysis, and cost-benefit analysis. However the Second Fundamental Plan reported that:

"there is insufficient information to enable evaluation of the reuse of CRs, due to delays in the development of statistics that would shed light on the effects of policies" (Japan's Ministry of the Environment Website, 2008).

A review of the data available in English shows varying levels of detail across the wide range of indicators mentioned in the Second Fundamental Plan. There are too many performance measures to carry out a complete analysis here. Therefore this section concentrates on the targets and goals at the higher levels, commenting on any data or monitoring information available, and indicating the current trend where this is clearly known.

Performance measures – high level targets

The Fundamental Plan for Establishing a SMCS describes three measures for performance with appropriate targets:

- Resource productivity (GDP/natural resources input) – the "inlet" phase. A target of 60% improvement from the 2000 level by 2015 (equivalent to a target of 420 000 yen per ton by 2015) has been set;
- Cyclical use rate – the "cycle" phase. A target of a 40-50% increase from a 2000 baseline to about 14-15% in 2015 has been set. This indicator appears to relate to the proportion of total material input to the economy which is kept within a productive use cycle. As such, it does not resemble a conventional recycling rate since the denominator is not "total waste" but "total material input" to the economy;[1]
- Final disposal amount – the "outlet" phase. A target of 60% reduction from 2000 to 23 million tonnes in 2015.

Background and context

A key driver for Japan to improve their material's management is the desire to become less reliant on imports. This stems from the oil crises of 1973 and 1978.

The Fundamental Law

The *"Fundamental Law for Establishing a Sound Material-Cycle Society"* was passed in 2000 and sets out the criteria of a SMCS and the key principles (Japan's Ministry of the Environment Website, 2008). The Ministry for Environment for Japan, which was established in 2001, has primary responsibility for this Law. The three principles of the Fundamental Law were:

a) Prevent products from becoming waste (later to represent the *reduce* of "*the Three Rs*");

b) Promote cyclical use of resources for which this is appropriate (so-called "circulative resources" – see below) (reuse/recycle); and

c) Ensure appropriate disposal.

The approaches of "discharger's responsibility" and "extended producer responsibility" were given considerable force through use of legislative tools. The concept of "useful waste" was introduced and these wastes are defined as "Circulative Resources" (CR) (Japan's Ministry of the Environment Website, 2008), which later became a key component in measuring and monitoring the impact of the Fundamental Law.

Initially, legislation heavily focussed on solid waste management because Japan's landfills for industrial waste had limited remaining void space, and opportunities for new landfills were limited. In 2004, the G8 Summit endorsed Japan's proposed "*3R initiative*", which aims to embed a waste hierarchy (reduce, reuse, recycle) approach to materials management.[1] Japan's 3R delivery strategy formed the basis for the Fundamental Plans discussed below.

Delivery – The Fundamental Plans

The (first) "Fundamental Plan" for establishing a SMCS was agreed in 2003 and provides a comprehensive and strategic delivery plan for the goals of the Fundamental Law. The First Fundamental Plan expanded Japan's base of waste management and other initiatives to incorporate a full range of sustainability issues and programs. A recent review resulted in the Second Fundamental Plan, which was agreed in 2008.

A more recent stimulus for this type of approach in Japan has been the state of the economy, with "*economic reasons*" and "*international competitiveness*" cited as among the reasons for implementing the measures (OECD, 2009a). A more sustainable approach to materials use and consumption is referred to as a way to address the current economic situation, as well as a means to achieve a SMCS. As a direct response to the economic downturn, Japan announced a draft plan called, "*The Innovation for Green Economy and Society*" in March 2009.[2] The plan aims to aid economic recovery through green innovation of the economy and society. This is in the preliminary stages, with goals outlined but not yet agreed.

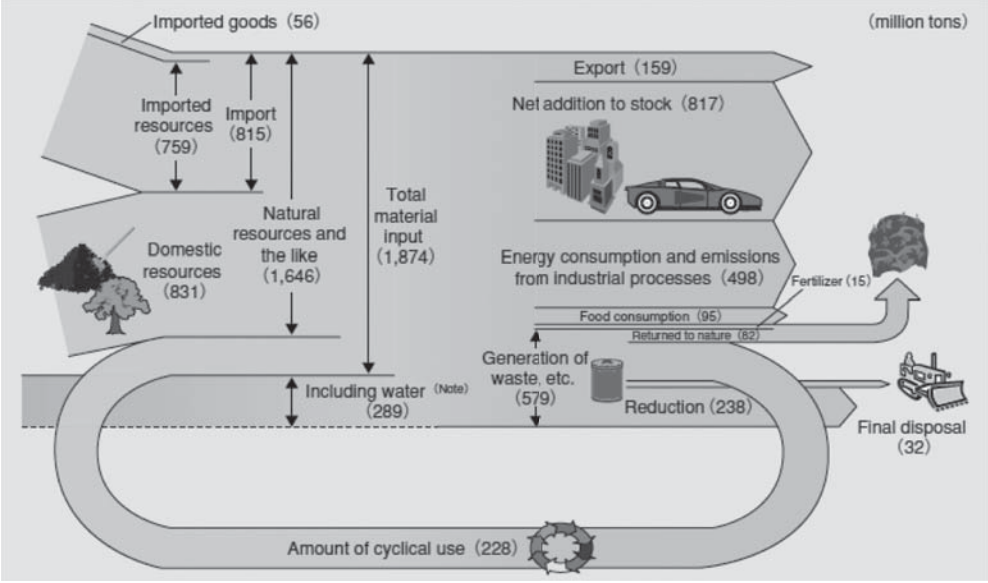
1. *www.gdrc.com/uem/waste/3R-index.html.*
2. Minister of the Environment, Dr. Tetsuo Saito (2009) The Innovation for Green Economy and Society, Presentation April 20th 2009, Available: *www.env.go.jp/en/focus/attach/090318-a3.pdf.*

Generally, the results for these three indicators show a positive trend, in some cases pre-dating the introduction of the SMCS policy. It is not yet entirely clear how the indicators will be measured and what is to be included within these.

All trends that contribute towards the overall final disposal amount are positive, and appear to be well monitored. It is not clear, however, how much of the reduction in final disposal has resulted from a shift from landfill to incineration, and how much is attributable to improved material efficiency and recycling. However between 1990 and 2005, greenhouse gas (GHG) emissions from waste disposal have grown significantly (30% over the period).

The overall Material Flow Accounts approach can be summarised in Figure 3.2 (which includes estimated figures from the 2005 financial year):

Figure 3.2. **Material flow accounts approach**



Supplementary indicators

Two supplementary targets were set in the Second Fundamental Plan relating to:

- Resource productivity, excluding the input of earth and rock resources; and
- Co-ordination with efforts directed towards a low-carbon society.

The first target is intended to adjust for the impact that non-metallic mineral resources have on resource input and productivity, and has been set at 770 000 yen per ton in 2015.

The second target will be measured by emissions reduction in the waste sector – a decrease of 7.8 million tons of CO_2 by 2010. Japan would prefer to measure progress as net changes in GHG emissions but it has commented that it is not aware of any internationally recognised standards for the calculation of such a figure. The observed increase in GHG emissions between 1990 and 2005 apparently relates to a shift in waste treatment technologies towards energy from waste, raising questions about the role these technologies should play in a SMCS approach. The Japanese Ministry for Environment recognises these issues and the importance of integrating "*initiatives aimed at the establishment of an SMC society with those aimed at the realization of a Low-carbon Society*" (Japan's Ministry of the Environment Website, 2008).

The Second Fundamental Plan addresses waste treatment and energy sources other than energy from waste, in an effort to further align their SMCS with a low-carbon approach.

Qualitative impact

Examples of double wins – environment and efficiency

It is estimated that as a result of the SMCS initiatives, the provision of SMCS – relevant goods and services was worth 28 trillion yen in 2005, and employed around 700 000 people. The recent expansion of the SMCS to "*The Innovation for Green Economy and Society*" aims to increase the impact in these areas (*i.e.* to use SMCS as a means of economic regeneration).

Trade and competition

Japan intends to foster a movement towards SMCS in East Asia and globally. To this end, it has held a series of productive meetings with nearby countries. China, South Korea and Singapore are shortly expected to agree an east-Asia SMCS vision with Japan (Japan's Ministry of the Environment Website, 2008).

Regionally, Japan is leading on SMM issues through its SMCS program, and this reinforces its status as one of the key economic and strategic powers in this region. Ensuring that its neighbours are undertaking similar environmental control measures will enable Japan to be more competitive in the international product market.

Lessons

Since the adoption of the Fundamental Law in 2000, progress has been made in many areas; in some cases targets have been set, and often achieved.

In 2009 the SMCS was expanded and the "*Innovation for Green Economy and Society*" is about to be launched, taking SMCS (and SMM) to another level. A key component of this new package of initiatives is that it accommodates (and constitutes a response to) the current economic situation, and also strengthens the emphasis on sustainability.

The strength of the SMCS approach is its inclusiveness and a commitment to the principles of sustainable development even in the face of an economic recession. This approach is accompanied by a wide range of targets and measures for performance – such as the use of GHG emissions to measure progress towards their SMM goals. A strongly regulatory approach has been taken, rather than relying on voluntary efforts and behaviour change, or upon conventional market-based instruments.

The weakness is that currently many of the targets and measures are not, or cannot, be quantified. In some cases this is because of a lack of international consensus as to measurement of the effects, and in others it is because of the ongoing development of the approach within Japan. It will be very interesting to watch Japan progress towards a more complete set of data with which they can truly assess its progress towards a SMCS.

UK Climate Change Act 2008

Background and context

On the 26th November 2008, a Bill considered to be quite revolutionary, the Climate Change Act, passed through UK Parliament (Crown, 2008). The Act set the most ambitious legally binding emissions reduction target to-date of any OECD country, which has received plaudits from policymakers at an international level, with the G8 leaders" discussions endorsing such targets. The target is supported by a framework which has been put in place to facilitate the changes required to meet the target.

The main aims underpinning the Act were:

a) to improve carbon management and help the transition towards a low-carbon economy in the United Kingdom; and

b) to demonstrate leadership internationally, signalling the UK's commitment to taking its share of responsibility for reducing global emissions in the context of ongoing international climate negotiations.

The Act includes the following key provisions (Department of Energy and Climate Change Website (2009):

- A **legally binding target of at least an 80% cut in greenhouse gas emissions by 2050** against a 1990 baseline, and a reduction of at least 34% by 2020;
- A carbon budgeting system to set the trajectory to 2050;
- Establishment of the Committee on Climate Change (CCC), an independent body to provide expert advice to the government, and report to Parliament on progress made in reducing emissions;
- Commitment from government either to include international aviation and shipping emissions by 31 December 2012, or explain to Parliament why it has not done so;
- With regards to the use of international credits the government must accept the need for UK domestic action in meeting the targets – the CCC will advise on this;
- Legislative measures will be taken to enable emissions reductions;
- The government must publish an adaptation report every 5 years to include the risks, and associated measures to be taken, of climate change;
- An Adaptation Sub-Committee of the CCC is to provide advice and scrutiny to the government's adaptation work;
- Guidance for companies to report GHG emissions will be provided by 1st October 2009 and government will review the contribution reporting could make to emissions reductions by 1 December 2010;
- New powers were included to support the creation of a Community Energy Savings Programme; and
- The annual reporting of the efficiency and sustainability of the government estate.

Institutional setting

The Department of Energy and Climate Change

The Department of Energy and Climate Change (DECC) was formed in October 2008 in order to bring together energy policy and climate change mitigation policy. Just one month

after DECC's formation, the Climate Change Bill was successfully passed through Parliament.

Committee on Climate Change

The Committee on Climate Change (CCC) was established in December 2008. The detachment of the CCC from the formal apparatus of government attempts to remove "party politics" from addressing the issue of climate change and obtain cross-party consensus.

The CCC is a high profile group made up of experts in climate change, science and economics. It is responsible for providing independent advice to the government, monitoring progress in emissions reductions, undertaking climate change research and engaging with representatives interested in climate change in order to share research and information.

The leverage held by the CCC was demonstrated when their recommendations regarding the requirement for Defra to publish carbon reporting guidance for businesses was included in the Climate Change Act at the very last minute. Government is required, through the Act, to discuss advice given by the CCC, as well as progress reports provided by them, in Parliament.

Framework

The framework laid out in the Act sets a high level route towards meeting the long-term target. The following sections – Carbon Budgets, Progress Reports and Targets- describe the three key mechanisms which formulate the main substance to the framework.

The "UK Low Carbon Transition Plan" (HM government, 2009a) was published on 15 July 2009 in conjunction with two further reports – 'The Low Carbon Industrial Strategy" (HM government, 2009a) and "Low Carbon Transport - A Greener Future" (HM government (2009b). It sets out a roadmap of more than forty climate change policies aimed at meeting the interim target associated with the first carbon budget (Carbon Trust, 2009). This helped to combat criticism regarding the lack of a specific strategy through which the targets would be met.

The policy debate has raised issues regarding the current price of carbon. There are differing opinions over whether or not a carbon price floor is required in order to reach the target. In 2009, the government issued advice regarding how the costs of carbon should be considered, and this differentiates between emissions from sectors inside and outside the EU-Emissions Trading Scheme (Department of Energy and Climate Change, 2009b).

Carbon budgets

The carbon budgets aim to provide an accessible benchmark by which progress towards the long-term goal can be monitored. They are set at 5-year intervals, beginning with the period 2008-2012, and define the UK's allowances of CO_2 and other GHGs for each period.

The first three carbon budgets have now been set and included in legislation since 1st June 2009. This has resulted in a legally binding interim target of 34% emissions reduction by 2020 (relative to 1990 levels). If this target cannot be met, this must be publicly explained by the government – a process that could prove to be humiliating in the event of failure.

Progress reports

The CCC is responsible for monitoring progress and writing the progress reports; the first of these was presented to Parliament in September 2009 and published in October 2009, in line with expectations (CCC, 2009). Following that, annual reports will be published.

Targets

The Treasury has included mandated emissions reduction targets in the Budget. The 2050 target is a minimum requirement, and therefore leaves scope for further emissions cuts if deemed necessary. The Act imposes a statutory duty on the Secretary of State, who is responsible for ensuring the United Kingdom reach the targets, and is answerable to Parliament if they are not met.

Financial implications of the Climate Change Act

The impact assessment of the latest Act puts the overall costs in present value terms at £324-£404 billion (£14.7-£18.3 billion annually) (Department of Energy & Climate Change, 2009c). However, the potential benefits amount to an estimated £457-£1020 billion. The benefits, in particular, are deemed to be dependent upon the extent to which the UK's efforts are part of global initiatives to reduce emissions.

Key findings

The Climate Change Act may not be considered a typical SMM policy instrument, although its relevance is clear when one considers that greenhouse gas emissions are a key externality associated with materials use at all stages of the life-cycle (albeit that they are more important for some materials than for others). However, its significance is wider than the issue which it seeks to address. Rather, its uniqueness lies in the way an environmental target has effectively been integrated within the annual UK budget, which has traditionally focused only on matters of a fiscal nature.

The current implementation of the Act, involving the formation of DECC, the CCC, carbon budgets, targets, progress reports and the framework demonstrate the significant attempts which have been made to formulate a coherent, pan-governmental approach. The amalgamation of the departments of energy and climate changes to form DECC, and the independent advice provided by the CCC are important institutional features.

The whole policy package may provide a model upon which to base future policies of an equally ambitious nature (for example, regarding other aspects of SMM) – consisting of an overarching strategy describing what is going to happen, and a framework and series of policy documents to describe how change is going to occur. In particular, to the extent that targets can be agreed upon, then integrating these within the financial budgeting process adds weight to the targets.

Any one of the elements would, individually, not have the same strength, but together, they show a huge amount of promise. Although a great deal of focus has been given to the targets, it seems reasonable to suggest that those alone would not necessarily generate the desired impact. It is thought the key elements are those which force the government to take the targets seriously, and these are:

- the legally binding nature of the targets;
- the associated requirement (on the relevant Minister) to publicly explain why, if targets are not met, they have been missed;

- progress reports being undertaken by an independent, high-profile and expert body – which upon completion will be discussed in Parliament;
- buy-in across government through carbon budgets being assigned to all major government departments; and
- cross-cutting support from all political parties (making the policy resilient to changes in government).

However, there is no substitute for strong political leadership in order to lead and guide a unified process of change which is required to meet the challenging emissions reduction target. Opinions are currently divided as to whether this process of change is being effectively conducted.

Whether or not this is the case, feedback suggests that the CCA is impacting within the government quite significantly, where the change is already noticeable in how departmental priorities are being revised (even if the effect on the government estate itself appears to be limited at present). A far less noticeable impact has been felt within the private sector so actual change on the ground is slower in happening, though a range of policy instruments are due to enter into force in the near-term which are expected to incentivise changes in behaviour to deliver outcomes. It should be recognised, however, that many leading industry figures have been in the vanguard of calls for a more "certain" trajectory in terms of emissions reduction so as to enable them to make strategic investments with greater confidence.

In some respects this outcome might be expected. The government should be seen to be setting a leading example – and since the transition plan has only very recently been published, with further policy documents to follow, it is most likely too soon to have actual change being implemented on the ground. Until hard policy is in place which addresses specific actors, the private sector will not be significantly impacted upon since they are not bound by the carbon budgets in the same way the government is. Measures such as the CRC Energy Efficiency Scheme will, however, require many actors currently not covered by the EU-Emissions Trading Scheme to participate in what will eventually become a trading scheme in its own right.

The long-term strategic approach provides businesses and individuals with the assurance and certainty regarding the government's commitment to take action that they require in order to invest, and commit to, the development of a low carbon economy (Aldersgate Group, 2009). However, the long-term framework has received criticism. Firstly, as the exact long-term effects of emissions are unknown, it is felt that more action should have been taken earlier. Secondly, too much importance could be placed on interim targets, and therefore interim solutions, which may or may not be capable of enabling the 2050 target.

Science may well suggest that more progressive targets could have been set. However, those laid down in the CCA and subsequent carbon budgets are thought to be challenging and are leading the way at an international level. There is also a great deal to be said for actually achieving the goals – which the UK government has yet to prove they are capable of doing. One commentator notes that the Climate Change Act is a unique policy package, but hand-in-hand with this must come the recognition that it is also an experiment where the exact outcome is unknown.[2]

California Green Chemistry Initiative

Background and context

California is the first US State to enact a green chemicals policy into law. This is an outcome of California's Green Chemistry Initiative, which was launched in 2007 and led by the California Department of Toxic Substances and Control (Cal/DTSC) (California Environmental Protection Agency, 2007).

Green Chemistry is the design of chemical products or processes that reduce or eliminate the use of hazardous chemicals (Anastas, P., Warner, J., 1998). It addresses the design, manufacture and use of efficient, effective, safe and more environmentally benign chemical products and processes (OECD Environment, Health and Safety Programme). It has gained momentum in the political and industrial spheres, as a more comprehensive solution to addressing the emerging ethical and environmental concerns of the chemicals industry.

In the US, chemicals regulation at federal level is the responsibility of the Toxic Substances Control Act (TSCA) of 1976. The weaknesses of this Act are well cited (National Academy of Sciences, 1984). A report published by the University of California summarised the shortcomings in three fundamental problems; the data gap, the safety gap and the technology gap. This creates a flawed chemicals market that favours existing technology and hampers innovation.

At State level, chemicals policy in California was somewhat fragmented before the enactment of the Green Chemistry Laws.* There are a handful of single chemical restrictions (*e.g.* mercury) and bans (*e.g.* Polybrominated Diphenyl Ethers), as well as attempts at source reduction and monitoring programs. These isolated measures are now viewed as too disjointed and controlling. California therefore wanted a new progressive, comprehensive and dynamic approach to chemicals policy.

* For details, see the Chemicals Policy Initiative database, Lowell Center for Sustainable Production, University of Massachusetts, Available: *www.chemicalspolicy.org/chemicalspolicy.us.state. database.php*.

Framework

The California Green Chemistry Initiative was initially framed by six policy recommendations (California Green Chemistry Initiative, 2008). These were informed by experts and stakeholders worldwide, including manufacturers, industry, environmental groups, academics, labour organisations, and the public.

More specific measures will be developed for each one of the policy recommendations. Two were enacted into law in September 2008:

- Assembly Bill 1879: Accelerate the Quest for Safer Products; and
- Senate Bill 509: Create an Online Toxics Clearinghouse.

A Draft Straw Proposal was released in April 2009, which provided a preview of the direction in which the development of the regulations is heading. These were reviewed by the first meeting of the Green Ribbon Science Panel.

The draft provides that Cal/DTSC will set rules for the evaluation and prioritisation of chemicals contained in consumer products for sale in California. This will be informed by the Toxics Information Clearinghouse portal, through which manufacturers have to report. Chemicals will be prioritised using a set of criteria. High priority substances will be subject to an alternatives analysis, to be undertaken by industry. Depending on the chemical's evaluation and its functional use, regulatory actions may include bans and restrictions.

Pending the release of the regulations, it is hard to assess the exact direction of Green Chemistry in California. As the Draft Straw Proposal is subject to change, assessments of the constituent provisions are purely speculative. But it is clear that chemical products will need to be supported with hazard data for their chemical constituents and products containing chemicals of high concern will require the publication of alternatives assessments.[3]

Institutional setting

The introduction of the Green Chemistry Initiative and ensuing laws has been attributed to strong environmental leadership, responding to an outcry from consumers, environmental groups, industry and academia. The State Governor and the Director of the Cal/DTSC are advocates of Green Chemistry and are said to have played a catalytic role for its implementation.

To support the Initiative, resources have been redirected within Cal/DTSC, showing a shift from end-of-life treatment towards more dynamic upstream interventions. This has funded the formation of the Green Ribbon Science Panel[4] and the California Green Chemistry Leadership Council,[5] as well as the work directly undertaken by the department.

Effectiveness

Until the revised Straw Proposal is released later this year, it is difficult to predict how the ambitions will be realised. There may be a requirement for considerable further changes beyond the laws before Green Chemistry becomes central to operations within California.

However, the enactment of the recommendations into law alone can be seen as a significant step moving towards "benign by design" products. Some success in aligning objectives and values has already been achieved through the collaborative and transparent process, engaging stakeholders from every sector.

Monitoring and compliance

The recommendations outlined in the Green Chemistry Initiative Final Report suggest the establishment of metrics to monitor the progress of the recommended activities (California Green Chemistry Initiative, 2008).

Some of the monitoring techniques suggested will be easier to implement than others. For example, the number of patents issued will be well documented, whereas assessing the chemicals avoided through alternatives analysis could be a complex challenge. Distinguishing the effects from, say, a downturn in economic activity, or an internal push for economic efficiency, is likely to prove difficult. The same can be said for metrics such as a reduction in chemicals waste; industries are likely to be already taking efforts to avoid unnecessary wastage because of the cost implications (not just in terms of costs of waste management, but also, the cost of wasted materials).

Life-cycle analyses and footprinting methodologies are also problematic because of the sheer degree of complexity involved in mapping out environmental impact. Methodologies would have to remain consistent for the purposes of comparative analyses. California is working on alternatives assessment guidance to help guide and harmonise its use.

In relation to compliance, the recommendations insofar as they impinge upon industry are largely limited to voluntary measures. With regards to information sharing

and transparency, the issue of competition may deter voluntary participation, which may necessitate use of incentives or penalties.[6]

Initial reactions

Anecdotally, the initiative is being backed by industry and other stakeholders.[7] Companies are becoming more willing to be transparent with regard to chemicals of concern because of benefits such as reduced exposure to employees, reduced risk of liability, and compliance with EU REACH regulations. Also it could help manufacturers to position themselves in a marketplace with growing concern for green credentials, as consumer decisions become informed by environmental concerns.

There are still some reservations regarding the cost implications of data gathering, identifying chemicals of concern, alternative assessments and trade secrets or confidentiality. It is not yet clear to what extent confidentiality can be protected and assured. One option is to use a third party to verify the characteristics of the constituent chemicals.

The laws have been criticised for failing to force producers to assess environmental and health implications of their products. As such the burden falls with Cal/DTSC to research existing chemicals and their alternatives. The laws have also been criticised for failing to support research and development of safe chemical products and processes (Renner, R., 2008).

Whilst the laws have only honed in on two of the six recommendations, all of them will come under consideration to see how they can be developed. It seems, however, that it remains a significant challenge to translate these recommendations into hard policy. In order for industries to make improvements to their operations, it is seen as a requirement to assess the environmental impact through some form of life-cycle analysis. It is not clear how one compels industry to undertake such an analysis, still less how one might compel them to act upon it given the complex nature of the information which might be expected in the case of some processes. Potentially, further consideration will need to be given to development of the remaining recommendations before they can materialise into policy.

Lessons learned

The California Green Chemistry Initiative is an attempt to build upon an emerging paradigm for the chemicals industry which has been given impetus at the federal level through voluntary initiatives and through proposed legislation and aspects of which are also being pursued internationally. The challenge for encouraging the development of green chemistry appears to be in developing *policies* which translate what are otherwise more voluntary measures into measures which require, or demand, that the chemicals industry changes the way in which it approaches its business.

The EU REACH regulations relate to substance registration and provision of information regarding the chemicals concerned (or of concern). The interesting feature of the California Green Chemistry Initiative is that it seeks to instil a more fundamental shift in the way in which products are developed within the State. However, the existing bills enacted do not, in and of themselves, lead to the outcomes that are sought, or foreseen, and much will depend upon the final form of the regulations. This still needs to address the

way in which the chemicals industry can be moved, through policy, to deliver on the policy recommendations, notably in respect of:

- pollution prevention;
- safer products; and
- the move to a cradle to cradle approach.

Indeed, some of the metrics which have been discussed to measure progress in respect of these are likely to take time to develop, and the degree to which suitable policy instruments could be designed to give these recommendations "teeth" will present a significant challenge to policy-makers.

Electronic Product Environmental Assessment Tool (EPEAT)

Background and context

Electronic Product Environmental Assessment Tool (EPEAT) is an environmental procurement tool for electronic products which was originally developed in the US and was officially launched in 2006.

The developmental process involved a cross-sectoral range of stakeholders and took three years, over which time criteria for what constituted a green PC/monitor/laptop and the system for identifying which products meet the criteria were decided upon by the various stakeholders.

The aim of the system is two-fold: firstly, to provide purchasers with the information required to evaluate the environmental impacts of electronic equipment and secondly, to encourage and inform manufacturers to design and produce products which meet specific standards.

EPEAT criteria

EPEAT is essentially a directory of products which are declared by their manufacturers (and later verified by EPEAT) to meet the environmental criteria contained in international public standard IEEE (Institute of Electrical and Electronics Engineers) 1680. The directory is easily accessible and allows those looking to purchase electronic products which fall within the EPEAT scope to assess their environmental credentials.

The IEEE 1680 standard contains 23 required environmental performance criteria, in addition to which there are 28 optional environmental criteria. The proportion of optional criteria met determines the EPEAT certification level which is either bronze (less than 50% optional criteria met), silver (more than 50% optional criteria met, but less than 75%), or gold (75% or more of the optional criteria met). No certification is given to products which do not meet the 23 required criteria.

Required and optional criteria cover various impacts across the product's life-cycle and are categorised as follows:

- reduction/elimination of environmentally sensitive materials;
- materials selection;
- design for end-of-life;
- product longevity/life-cycle extension;

- energy conservation;
- end of life management;
- corporate performance; and
- packaging.

The EPEAT certification also uses criteria shared with established standards including European Directives, the internationally recognised Energy Star rating, and ISO standards.

Scope

Product policy

The EPEAT is a product-focused system which is currently limited to PCs, laptops, workstations, thin client devices, and monitors. However, expansion to printers and other imaging devices (scanners, copiers, faxes), and to televisions, is currently being driven forward through an IEEE standards development process. The US Environmental Protection Agency (EPA) has also committed to partially funding development of performance standards for servers and mobile telephones.

Geographical coverage

EPEAT was developed in the US and was first widely used in the US and Canada. More recently, it has been launched across 40 countries in Europe (EU and EFTA), China, Japan, Chinese Taipei, Australia, New Zealand, Brazil, and Mexico. This widespread launch was mainly driven by purchaser demand.

EPEAT and the requirements of IEEE 1680 apply equally in each supported country – the same headline criteria exist for all countries. The reason for having different product registries in different countries is to enable manufacturers to register the products that are available in each country and to do so based on the environmental criteria that are met by the products available in that country. All EPEAT registered products must meet all 23 required criteria wherever they are registered, albeit some slightly varied because of country specific infrastructures and regulations (EPEAT Website).

Manufacturers

The EPEAT provides manufacturers both with the incentive and the guidance to develop environmentally preferable products. There are signs that this is taking place; the current participants include 40 manufacturers and 1269 registered products within the US, with over 6 000 individual product registrations across the non-US registry countries.

The fee to register products on the US and Canada registries is based on the manufacturer's annual sales of EPEAT covered product types. Fees are currently based on 2008 sales as shown in Table 3.1.

Manufacturers are free to choose whether or not they meet with the EPEAT requirements. However, their market will be restricted to the extent that some procuring organisations may be required to purchase EPEAT certified products.

Consumers

EPEAT is a user-friendly yet comprehensive tool designed to encourage greening consumer's electronics procurement. The system allows products to be compared based on

Table 3.1. **EPEAT fees (US and Canada)**

Band	Total sales for EPEAT-covered products (2008)	Annual fee
1	Over $10 B	$100 000
2	$1B-$10 B	$50 000
3	$100M-$1 B	$25 000
4	$10M-$100 M	$12 500
5	Less than $10 M	$1 500

environmental criteria and companies can be compared to check their overall product registration.

In February 2008 US federal government mandated procurement of 95% of their electronic products as EPEAT registered products. Alongside this many purchasers have set internal procurement standards for EPEAT – for example only purchasing those products with a rating of silver or above.

In 2007 almost 23% worldwide total sales of desktops and laptops were EPEAT registered.

Institutional setting

US EPA

The US EPA provided funding to underwrite the original stakeholder consensus process which developed the EPEAT standards. In addition, the US EPA provided a small amount of funding to the Green Electronics Council (GEC) to support the start-up of EPEAT. However, EPEAT is now self-sustaining through annual fees paid by manufacturers and remains under the Green Electronics Council.[8] The US EPA remains a key stakeholder and provides ongoing support to the development of the EPEAT system.

Information Technology Industry (ITI) Council

The Information Technology Industry Council (ITI) was an important stakeholder in the development process of the EPEAT. ITI is an industry trade association who, as part of their role, collate data submitted annually by the manufacturers regarding global unit sales of EPEAT registered products (submission of this information by manufacturers is a requirement) and forward it to the Green Electronics Council.

EPEAT Inc.

EPEAT Inc. is a separately incorporated not-for-profit corporation which has a Board of Directors which is responsible for ensuring that the corporation meets financial and legal requirements. However, the staffing and operation of the system is undertaken by EPEAT Inc's parent organisation, the Green Electronics Council.

The whole process is overseen by a stakeholder representative group, the Board of Advisors, who act on a consensus decision making process and although they do not hold legal authority over the Board of Directors it is their role to guide the Directors.

EPEAT Inc. is the legal vessel for the money received from manufacturers to register their products. These funds support all aspects of the operation of EPEAT.

Green Electronics Council (GEC)

The GEC is an unincorporated division of the International Sustainable Development Foundation, a 501(c)3 charitable non-profit organisation. They are responsible for managing the EPEAT system.

Product Verification Committee (PVC)

The Product Verification Committee is a panel of independent experts on contract to EPEAT who select the products and criteria for each verification process, assign specific verification investigations to independent investigators, review the investigation reports, make the final decisions of conformance or non-conformance on each investigation, and publish the final Verification Reports (see Section Electronic Product Environmental Assessment Tool (EPEAT) - Verification).

Institute for Electrical and Electronics Engineers – Standards Association (IEEE – SA)

The standards on which EPEAT is based (IEEE 1680 family) are published by the IEEE – SA. Like all public standards bodies, IEEE standards are developed by volunteers working on standards Work Groups (WGs). This structure is unique among eco-label organisations and allows EPEAT to avoid common concerns of conflicts of interest that other eco-labels face.

Verification

The EPEAT online registration ensures the process is relatively quick, allowing products onto the markets as "*EPEAT registered*" as quickly as possible. However, as a self-declaring system a reliable auditing process is required.

This system – called "self-declaration with after-market verification" – was approved by the EPEAT stakeholders and was thought to be especially appropriate (compared with a pre-certification verification process) for the rapidly changing and highly configurable electronic products. A pre-certification system would slow the introduction of products and configurations to the market and would not be sufficiently flexible to keep up with continuous product evolution and variability. The EPEAT verification system is transparent through published protocols and outcomes. Effectively, the scheme allows for random verification of products on the EPEAT register. The most recent verification report does highlight non-conformance events (the figure being a non-trivial 7 of the 38 completed investigations). Some of these were explained through "administrative error" implying that the product had been mis-declared by the registering company (EPEAT, 2009). Such events suggest there might be some considerable scope for companies to mis-declare so as to shift, for example, for silver into gold compliance categories. The verification report makes useful recommendations for how such errors might be more difficult to make in future. There appear to be no clear sanctions in the event of non-conformance, perhaps reflecting the voluntary nature of registration, but this does raise questions as to whether products might, at the margin, gain market share partly through mis-declaration of performance.

Environmental benefit

The Green Electronics Council publishes an annual environmental benefits report (Green Electronics Council, 2007), utilising a life-cycle assessment tool (Electronics Environmental Benefits calculator (EEBC) developed by the University of Tennessee Center for Clean Products). In 2007, it was suggested that 42.2 billion kWh of energy, 75.5 million metric tons of virgin material and 3.31 million metric tons of greenhouse gas emissions

were saved through the purchase of EPEAT-registered products. The report notes, however, that not all of these benefits are directly attributable to EPEAT itself. The methodology for benefits calculation is based upon a comparison of EPEAT and non-EPEAT products, and the volume of sales of EPEAT products.

Lessons learned

The EPEAT is a relatively new programme yet has seemingly made significant progress in its short history, at least in terms of the number of products registered, and the scope of country penetration. It is not entirely clear whether, and to what extent, the EPEAT system has itself driven forward the environmental performance of products relative to a counterfactual scenario. Some products which are registered will already have been meeting many of the standards, and indeed, in some product categories, there are very large numbers of "gold" registrations.

EPEAT may be a good example of an SMM policy instrument which has significantly expanded its geographical scope – a process which is necessary for all SMM policy in order to sustainably manage materials across all stages of their life-cycle in such a global market place.

The green procurement mechanism has seemingly increased competitive pressure within manufacturers which is further driving forward registrations under the EPEAT system.

The system of self-declaration ensures products can very quickly be EPEAT registered and updated – whereas the alternative, a pre-certification system, would slow the introduction of products onto the market and more importantly could misrepresent the product where ongoing changes have been made. However, the absence of pre-certification does bring with it some concerns regarding moral hazard (the producer can mis-declare and get away with it as long as they are not found out).

The Tool provides a generic framework for improving environmental performance of electrical appliances – although for each additional appliance extensive stakeholder discussions must be held regarding relevant criteria. It is felt this success is due to three key assets of the programme:

***a)* Harmonisation of standards**

The approach uses established standards and eco-labels such as the Energy Star, ISO standards and EU Directives. Using already recognised and effective performance standards creates familiarity and trust in a new system. This was partly driven by demand for continuity, and simplification of standards by both purchasers and manufacturers. Underlying strength is added to the system through association with public standard IEEE1680 which is organisationally entirely separate from EPEAT.

***b)* All encompassing approach**

A comprehensive focus across all environmental attributes of concern has been critical. Although this is a far more challenging way to reach consensus it results in a much stronger outcome when finalised.

***c)* Transparent process**

The criteria have been developed through an open, consensus based approach where all stakeholders can participate and feel ownership of the outcome. The results of verification investigations are made public via the EPEAT website and the possibility of

being publicly shamed for nonconforming helps to ensure that companies meet the required standards in order to avoid any adverse publicity.

Within the US another significant development was the public procurement mandate requiring Federal agencies to purchase EPEAT products only. It will be interesting to see if governments across other EPEAT using countries adopt similar standards in the future.

The key questions which remain regarding the level of EPEAT's success in environmental terms relate to the extent to which the scheme really drives innovation, or whether it merely drives registration (as a means to avoid exclusion from some procurement processes). Furthermore, a challenge will be to ensure that the standards are not "static" ones, and that innovation of a dynamic nature is encouraged. It would seem that in order for that to occur, (some of) the performance standards would need to be periodically tightened to keep pushing the envelope, and so as to prevent a situation where all registered products fall into the gold standard, thereby eliminating the product differentiation on environmental grounds that the scheme is designed to achieve.

European Union Sustainable Consumption and Production and Sustainable Industry Policy Action Plan

Background and context

This case study focuses on continuing efforts to develop policy within the SMM sphere by the European Commission. The European Commission has taken forward a number of major initiatives of relevance to SMM over recent decades. In particular, its initiatives in respect of waste management policy have demonstrated a strong desire to improve the management of waste in all member states through (amongst others) implementation of a series of producer responsibility Directives (*e.g.* packaging, WEEE, batteries, ELVs), and Directives aimed at improving the environmental performance of landfill and incineration. The Commission also establishes framework legislation, within which member states develop their own approaches to specific environmental issues. Article 4 of one such piece of legislation, the revised Waste Framework Directive (2008/98/EC), strengthens the resource efficiency and SMM agenda by ensuring that the waste hierarchy acts as a "priority order" in waste prevention, legislation and policy.* As demonstrated by the commitment to place more emphasis on waste prevention, and in the context of the recently recast Ecodesign Directive, the European Commission is becoming increasingly focused upon SMM policy with significant progress in waste either already made, or likely to occur as a consequence of initiatives already in place.

However, with SMM in mind this case study focuses on upstream issues such as consumption and production. Whilst it is recognised that this agenda is being considered against the backdrop of a well-developed waste policy, the emphasis here is on the efforts being made to make further progress (on consumption and production) and not on the policy initiatives already developed.

The European Commission is more commonly responsible for setting the framework within which policy can be developed by individual member states, than for specifying the exact nature of policy instruments itself. The principle of "subsidiarity" effectively holds that as far possible, member states decide exactly how they will meet the objectives/ requirements of European policy.

Background and context *(cont.)*

Given the European Commission's more likely position of setting frameworks, not specific policy, selecting the EU SCP Action Plan as a case study could be considered a slightly unusual choice. However, its inclusion is justified by two main reasons:

a) it enables the forward-thinking approach of the European Commission in this area to be considered; and

b) it raises questions concerning issues which might be faced in operationalising SMM policy in future.

* The amended hierarchy is: prevention; preparing for reuse; recycling; other recovery – including energy recovery; and disposal.

Sustainable Consumption and Production and SMM policy

Sustainable Consumption and Production (SCP) has been defined as:

"… a holistic approach to minimising negative environmental impacts from the production-consumption systems in society. SCP aims to maximise the efficiency and effectiveness of products, services, and investments so that the needs of society are met without jeopardising the ability of future generations to meet their needs" (EEA, 2007)

In practice SCP has become a broad-scope policy agenda that aims to ensure that the production and consumption of goods and services is at a level that the planet can sustain. As consumption (and consequent production to meet demand) is at the heart of economic activity, addressing it from a sustainability perspective is not only ambitious, but ultimately strikes at the core of how modern society and economies function. Because of the far reaching nature of the concept there is not universal agreement (notably at EU level) about what it encompasses, and large numbers of initiatives can potentially fall under the SCP banner (L. F. Mortensen and P. E., 2008).

Although there are many commonalities, SCP may have, depending on interpretation, a broader focus than Sustainable Materials Management. SCP in effect can encompass almost any element of sustainability as it engages with the production and consumption cycle, and in many contexts, it appears to be used as a synonym for "sustainability".

Outline of EU SCP Action Plan 2008

The Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan (The Action Plan), underpinned by EU legislative framework, is the key current EU document setting out co-ordinated planned policy initiatives on SCP (Commission of the European Communities, 2008).

The Action Plan contains three main parts:

a) a policy framework for smarter consumption and better products;

b) policies on "Leaner Production"; and

c) work towards global markets for sustainable products.

The intention in the document is to address products that have significant potential for reducing environmental impacts.

The Action Plan's stated aim is to create a virtuous circle:

- improving the overall environmental performance of products throughout their life-cycle;

- promoting and stimulating the demand for better products and production technologies; and
- helping consumers to make better choices through more coherent and simplified labelling.

Key member country responses/contributions

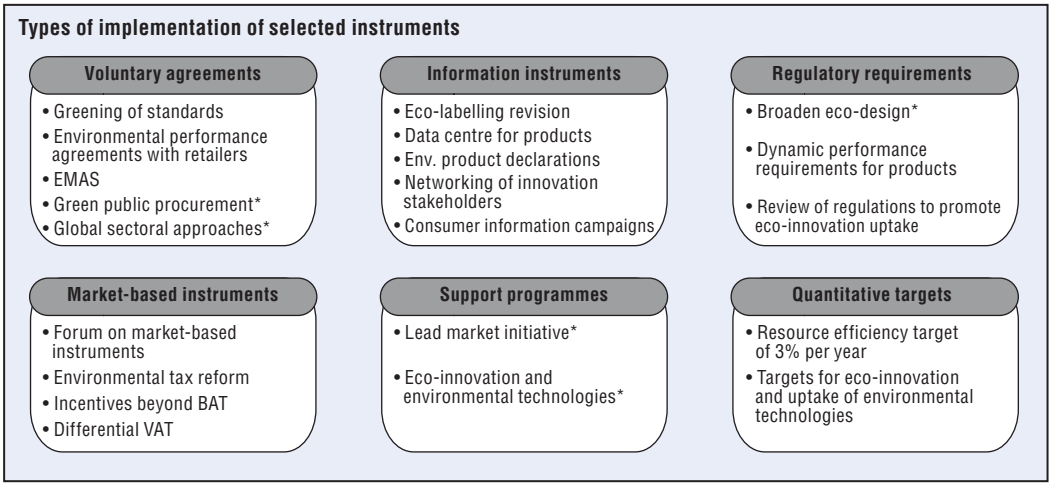
The Action Plan is a recent document, therefore it is too early to determine impacts from this policy. However SCP related principles and policies have been in place in many EU member countries for a number of years.

The extent to which SCP goals have been implemented and addressed by member states varies widely (Commission of the European Communities, 2008). Some of the key actions taken by member countries are listed in Figure 3.3.

Reviews of EU SCP

The Action Plan has been the subject of review by two key European groups funded largely by the EU. These are SCOPE2 – the Sustainable Consumption Resource Exchange – and ASCEE – Assessing the Potential of Various Instruments for Sustainable Consumption Practices and Greening of the Market. In addition, SCP in Europe was included in the *2007 State of the Environment Report – Europe's Fourth Assessment*, and was most recently the subject of an independent review by the European Environment Bureau, which has put together a high level "blueprint" for the purposes of promoting dialogue on the topic.[9]

Figure 3.3. **Instruments used by member states to address SCP**



Note: The symbol * indicates that characterisation particularly depends on final shaping of the instrument.

Summary of reviews

Whilst the reviews have all approached EU SCP from different perspectives, a number of themes do emerge:

- EU SCP policy has, to date, not been successful in creating widespread measurable change. Individual policy instruments have however shown some indications of being effective, but the level of effectiveness is hard to measure due to issues of "attributability";
- gains from efficiency have been largely absorbed by the "rebound effect";[10]

- the most effective instruments appear to have been harder regulatory and financial instruments – such as standards and taxes – as opposed to softer measures, such as labels;
- groups of policy instruments that support one another are likely to produce maximum effect; and
- the current Action Plan does not go far enough in addressing the social dimensions of consumption. Consumption takes place in social contexts and this needs to be accounted for in a range of policy measures from spatial planning through to transport policy.

These observations, generally made in good faith, probably also reflect the changing level of priority accorded by the Commission to SCP. This appears to be increasing, and as such, it might be considered that a more fully elaborated programme of policies on SCP should be considered very much as "work in progress".

Lessons

Our observations from the efforts to address SCP in the EU suggest the following lessons:

- SCP is still thought of, and driven through, the environmental sustainability agenda. In reality, however, consumption and production are core parts of the economic system, and so efforts to address these issues probably need to be tackled through mainstream economic policy to avoid marginalising the SCP agenda.
- The implementation of SCP has not (from what we were able to discern) been the mandate of a single EU central agency, and while much work has clearly been done by a range of agencies and organisations, it appears somewhat uncoordinated and fractured.
- As a complex issue, SCP is a time-consuming agenda to drive forward, with the appearance that whilst it (and other related policy areas such as Integrated Product Policy) has been on the policy agenda for many years and been the subject of many studies and reviews, policy objectives have only recently been translated into actions through the Action Plan. The Action Plan, has not yet, in turn, been translated into much by way of hard policies, though the Commission might point to the greater emphasis on waste prevention now enshrined in the Waste Framework Directive.
- While clearly a number of member states have been proactive in adopting the SCP agenda, these countries are more the exception than the rule. Whilst it could be argued that stronger central direction from the EU may be required if SCP is going to be more widespread and embedded in national policy and action across member states, the reality is that the Commission has to elaborate policy in the interests of all member states. What might be more likely to trigger stronger support for SCP policy would be elaboration and recognition of potential benefits which may flow from such policies.
- It would appear from the studies that have been reviewed here that there is a view that the most effective policy measures are the "harder" measures that promote change through legislation, incentives and regulation, as opposed to "softer measures" aiming to label, educate and inform. However, the reality is that both are likely to be required in different circumstances to address particular market failures which exist.

EU SCP Case Study: Green Public Procurement

Green Public Procurement

Green procurement aims to increase the uptake of greener products and services, and to encourage the development of more green products and services through innovation and technology development. Green Public Procurement (GPP) refers to the public sector undertaking this approach, and with the public procurement market in Europe worth over 1 500 billion euros a year (European Commission, 2004a) (16% of total EU GDP in 2004), the potential impact is significant.

Green procurement across the entire public sector could feasibly be achieved by requiring through EU regulation that environmental considerations are taken into account when procuring products or services.

GPP is defined as:

"Green Public Procurement is the approach by which Public Authorities integrate environmental criteria into all stages of their procurement process, thus encouraging the spread of environmental technologies and the development of environmentally sound products, by seeking and choosing outcomes and solutions that have the least possible impact on the environment throughout their whole life-cycle" (TAKE-5 Consortium (2006).

European Union Directives

Two public procurement Directives (2004/17/CE and 2004/18/CE) were adopted on 31 March 2004, and were introduced to consolidate and simplify the legal context. They also modernised existing European legislation applying to public procurement. The Directives cover a wide range of issues related to GPP, and are supported by the Handbook on Environmental Public Procurement (European Commission, 2004b).

Although the Directives apply only to public procurement contracts with estimated values above certain thresholds (as mentioned in the Directives), the European Court of Justice has ruled that the EC Treaty principles of equal treatment and transparency, as well as the free movement of goods, the freedom of establishment, and the freedom to provide services, also apply to contracts under these thresholds.

Assessing the impact of the SMM instrument

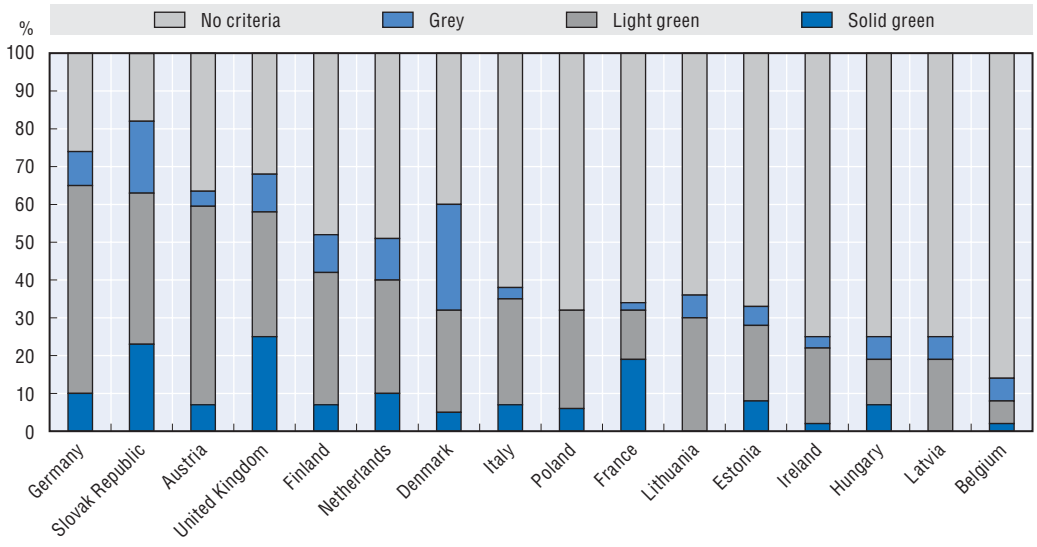
A review of public procurement markets in the EU was carried out by the European Commission in 2004. At this stage, "internal market rules" had been in place in the EU for about 10 years. General positive changes were observed in market transparency, increased cross-border competition, and price savings.

A 2006 review specifically targeting GPP found varying levels of performance amongst the EU member states. Figure 3.4 below summarises the results of the review.

Lessons

Barriers to EU-wide implementation of GPP. The main barrier to wider implementation of GPP appears to be the (incorrect) impression held by many public procurement agencies that they are already applying environmental criteria. In fact, the 2006 report for the European Commission showed that only 36% of tender documents across the EU public sector contained true environmental criteria. In comparison, Sweden and Germany had environmental criteria in more than 60% of public tender documents.

Figure 3.4. **Green Public Procurement approaches of different EU countries**



Notes: The overview of analysed tenders and criteria led to the following classifications used in the Figure:
1. "No criteria" means that no green specifications were found;
2. "Grey" means that attempts at green specifications were found, but these would not lead to a green purchase;
3. "Light green" means 1-3 clear specifications were found; and
4. "Solid green" means more than 3 specifications were found.

Source: TAKE-5 Consortium (2006), *Green Public Procurement in Europe.*

Although reference to environmental issues is made, this is too often vague and non-quantifiable and therefore cannot contribute to the procurement decision. Various reviews have concluded that further training on GPP is necessary to remedy this misconception.

Characteristic factors of successful GPP. The factors that make GPP more successful in the "Green 7" include:

- Strong political drivers and/or national guidelines;
- National programs;
- Information sources;
- Innovative procurement techniques; and
- Purchasing organisations apply environmental management systems. (European Commission, 2004a).

The fact that some EU countries have been so successful in achieving results through GPP suggests that the legislative and strategic environment in the EU provides strong support, and that the only barriers are likely to be internal to the member states.

Perceived barriers to GPP

- Cost – green products perceived as more expensive.
- Lack of knowledge, tools, information and training.
- Weak support from management and politicians.

Whilst these barriers were identified through a study into EU GPP, they are very likely to occur across the OECD. The first two areas could easily be supported through OECD initiatives to transfer examples of good practice (such as the Green 7 within the EU) and

produce guidance, detailed case studies, and mentoring programs. A particularly important point would be to clarify exactly what green procurement entails, and provide examples of what does and does not qualify under that definition. A more detailed action plan could be developed by referring to the 2006 review of GPP in the EU (referenced earlier in this report).

The outcome of the cost/benefit research carried out in 2007 provides a strong basis for arguing against the cost concerns, as well as providing encouragement for the use of life-cycle costing rather than consideration of just the immediate purchase price.

A strong OECD commitment to introducing GPP would go a long way to resolving the third.

Areas to focus on in expanding GPP. Certain sectors have been more successful in responding to GPP than others in the EU. In implementing a GPP program, it would make sense to focus on these "easy wins" early on and then apply the practices and experience developed to more difficult markets. In general, procurement of products lends itself more readily to GPP than services procurement. Areas considered easy wins:

- cleaning products and services;
- horticultural services;
- medical and pharmaceuticals;
- Energy;
- chemical products, rubber and plastic;
- food products and beverages, including restaurant/catering services;
- architectural, construction, installation and other related consultancy services;
- construction work and products/materials;
- sewage and refuse disposal services;
- sanitation and environmental services;
- office machinery;
- furniture and other manufactured goods;
- paper, printed material and printing services; and
- transport and communication services and equipment.[11]

One issue which GPP ought to have to consider over time is the extent to which existing policies already internalise externalities into the price of competing goods and services. As environmental policy develops, and as the number of initiatives seeking to internalise externalities in one or other form expands, so it will become increasingly difficult to understand which elements of environmental performance are, and are not, already internalised in prices being bid under a given procurement. Arguably, therefore, GPP ought to focus more on those actions which help to address outstanding market failures (where, for example, it is known that externalities are not reflected in market prices through existing policies).

Dutch Chain-Oriented Waste Policy

Background and context

The Netherlands has a strong history in waste management, characterised largely by end-of-pipe solutions (Parto, S., D. Loorbach, A. Lansink and R. Kemp). By 2006, recycling and recovery rates had reached 83%, which in part has been attributed to the "command and control" approach adopted by the government in 2001, following the centralisation of waste management.

Although the Dutch government has achieved a great deal of success with its traditional waste policy and naturally wants to continue to streamline and improve the existing frameworks and recognises that isolated sectoral policy instruments (*e.g.* landfill tax, landfill bans) are not effective enough to further reduce environmental pressure on a larger scale. The Netherlands' (second) National Waste Management Plan (LAP) 2009-2021, entitled "*Towards a material chain society*", describes the government's ambitions to minimize environmental pressure over the whole supply chain and to harmonise policy in different areas (*e.g.* natural resources, products/design, waste management, and concepts such as cradle-to-cradle) by means of a chain-oriented waste policy.

Fundamentally, a chain approach considers the entire material chain, as opposed to concentrating on "end-of-pipe" solutions. The overarching aim is to reduce the environmental impact of material chains throughout the life cycle in the most cost-effective manner, and establish a single integrated policy framework for the whole material chain.

As well as various targets relating to waste prevention, recovery and diversion from landfill, the LAP sets out an indicative objective to:

"Reduce the environmental impact for each of the *seven priority streams* which will be targeted in the context of chain-oriented waste policy by 20%."

The seven priority streams referred to were selected from the list of all 110 waste streams for which the Netherlands has a waste policy, on the basis of a life cycle assessment (LCA) over the whole chain. A critical element to this approach is the establishment of partnerships between stakeholders from different links in the chain, facilitated by government. Each material stream will submit an action plan, detailing measures by which to reduce the environmental impact of the material chain by 20%.*

* The 20% reduction in environmental pressure will be calculated in terms of end-of-life waste tonnages, volume of CO2 emissions, pollution from toxic substances, and land use. The ultimate aim is to establish more concrete and measurable goals, relating to specific impacts such as percentages of separate collection and waste prevention..

Institutional setting

The programme is led by the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM).

Priority streams

The provisions in the new LAP focus on the concept of co-operation throughout the supply chain. For each of the seven priority streams, the Dutch government wants to join forces with other stakeholders to encourage co-operation, innovation, a green corporate image and cost savings. It is not intended that the responsibility is shifted away from government on to industry sectors, but the Dutch government does attach value to a strong

innovative industry sector. There are concerns that this may undermine the recent progress in Dutch waste management that has been achieved through the "command and control" approach. Much may depend upon the nature of policies used to drive forward progress.

A key element to the integration of chain policy is to make separate policy areas more coherent across the whole material chain and to create more synergy between different policy areas. This means seeking out the most efficient location and means to reduce environmental pressure without shifts to other environmental aspects or other points in the chain.

Pilot projects

Pilot projects were launched in 2007, culminating in the submission of action plans in May 2008. Six chain pilot projects were started with the twin aims of gaining experience with a chain approach as the mode of operation and achieving a substantial reduction of waste-related environmental pressure throughout the pilot chains. It is inferred that the financial burdens of the pilot projects also fall with the participating companies; the government only offered a small financial contribution.

It is asserted that the pilot projects provided insights into the preconditions which the government needs to create in order to enable companies to apply this approach successfully (VROM, 2008). Companies are also reliant on the government for stimulation of the programme, in terms of facilitating partnerships and raising profiles. This also holds for supporting the reduction target tied to the selected material streams.

Effectiveness

The government will monitor and evaluate the programme. It is too early to evaluate the wider impacts of the programme but the pilot projects can be considered, as well as the initial reaction to the programme from industry, and any potential problems identified.

Pilot projects

On the basis of the action plans submitted, the pilot projects were deemed a success.[12] It is claimed these projects have facilitated the transfer of knowledge and expertise through newly formed partnerships, culminating in new innovative developments.[13] This has been attributed to the motivation of the participating companies and the active role played by pioneers within the pilot groups.

It is not clear, however, how the actions undertaken as part of the pilot projects can be distinguished from actions that would have been taken without the initiative in place. Companies were targeted in the pilot projects because of a proven track record in terms of sustainability. Therefore it could be argued that the measures taken would have occurred anyway, although perhaps not without the additional "push" from the programme.

Also, the focus of the pilot projects was much narrower, concentrating on discreet aspects of the material chains, with the intention to achieve rapid results from which to learn. In contrast, the work on the priority streams aims to take a much more holistic approach, impacting on the entire material chain and realising environmental benefits across the board.

Initial industry reaction

VROM's chain approach has been well received by industry.[14]

The Dutch Waste Management Association is of the opinion that it is an effective policy but cautions over specific considerations to ensure it accomplishes its goals. It calls for forums between players to establish "*clear and consistent definitions and… measurable criteria*" and indicators to provide a quantitative measure of environmental burdens. These partnerships are also important for sharing practical experiences with actors working in other links in the chain, for example to reduce environmental burdens through design. The Association also reiterates the warning of the LAP, that environmental pressures must not merely be shifted from one part of a material chain to another.

A principle concern for the industry is that waste policy does not leave Dutch companies at a competitive disadvantage in respect to other countries, particularly in the context of the current economic climate.

The main challenge facing the waste sector is perceived to be the pressures to rely on market forces to induce economic efficiency and long-term viability. There are concerns that relinquishing government control may undermine the significant progress made in the handling (though not elimination) of waste during the 1980s and 1990s. However, as mentioned above the chain approach does not intend to shift government control to the industry but merely promotes a more active role from industry in the entire material chain (not just the waste sector) and promotes better co-operation between government and industry.

Potential problems

A major concern is that policy having a positive effect in one area (*e.g.* designing products that can be recycled more easily) may have a negative effect in another (*e.g.* products being made from materials with more energy-intensive extraction methods). This is part of the rationale for the chain approach; by looking at the entire chain serves to mitigate against this potentially detrimental effect.

Another key concern is the financial burden of implementing such an approach. Whilst the material streams are assessed in terms of costs as well as environmental impact to ensure the most cost-effective action is taken, the research and development to arrive at such solutions will be costly and industry may look to government to provide the necessary funding. However, the approach aims to not only identify new solutions to minimise environmental pressure throughout the whole life cycle also that it must be appealing from an economic perspective, otherwise they would not be sustainable.

With regards to the 20% reduction target, by providing a goal to which industry can work towards, this would in theory help to drive innovation throughout the chain, targeting flows that can be dealt with most cost effectively. It is not a binding target and there are no penalties tied to non-compliance but more operational targets for specific projects are formulated in co-operation between stakeholders, which are made binding by agreements/commitment.

It is implicit that the environmental impact is measured in terms of LCA's (tonnes of end-of-life waste, volume of CO_2 emissions, pollution of toxic substances and land use possibly being the four most distinguishing environmental aspects). A key question may be how, where trade-offs are to be made, these will be dealt with in the performance assessment.

Lessons learned

Some tentative lessons are drawn from the Dutch Chain-Oriented waste policy in its current form. Until the programme progresses and more information become available, the comments remain somewhat speculative.

It is apparent that VROM wants to develop an integrated material chain policy. By this means, waste policy will be characterised by upstream measures, moving away from isolated end-of-pipe policies. However, if impacts across the whole of the chain are to be taken into account, the challenge is likely to arise in establishing who is responsible for how much of the change, and in seeking to incentivize any specific target, or make it enforceable. In this sense, the targets may be difficult to achieve unless it is clear who the target is addressing and what the consequences of non-compliance will be. The history of waste management in The Netherlands would suggest that the culture embraces targets as they are proven as an effective tool in waste policy, yet some of these targets have entailed similar organizations taking similar actions. The "stream" based policy suggests that actions of varying impact will be required by different actors in the supply chain, and the more that one part of the chain achieves, the less will have to be achieved by another.

The flexibility of the target was most likely decided upon because of the complexity of the system and the lack of accompanying information. Settling on a particular figure is somewhat arbitrary in this case because it is not a clearly defined activity and as such, the environmental impacts acting across material streams are not well documented. The LAP allows for revision once more information is obtained from the pilot projects, which will perhaps lead to a more clearly defined target. Therefore it is logical that the focus is initially on certain priority material streams, in order to feed these experiences back into the policymaking process.

The claim that the pilot projects lead to new innovation is impossible to verify given the lack of available information. Assuming this is the case, given that companies were approached for the pilots on the basis of their "green" credentials, the successes may be because these companies are more willing to take on the greener ideals. However, in order for any initiative to become accepted by the wider industry, there need to be pioneering companies that set the standards for others to follow, before a practise becomes a mainstream.

One lesson that is clear is that industry will ask for financial and administrative support from the government to facilitate more innovative solutions. Unfortunately, it was not possible in this instance to obtain information as to the extent of fiscal stimulation required.

UK Clothing Product Roadmap

Background and context

Product roadmaps have been introduced as part of the UK government's programme for sustainable consumption and production. Sparked by a recommendation from the Sustainable Production Roundtable (Sustainable Development Commission, 2006), roadmaps are seen as a novel way to drive change and to help meet EU commitments on Sustainable Consumption and Production.

***Background and context** (cont.)*

The aim is to improve the environmental performance (and understanding thereof) of ten priority products/product groups, by focussing on environmental, social and economic impacts at each stage of the life-cycle and building on existing initiatives to address those impacts. Roadmaps rely heavily on strong stakeholder involvement to produce voluntary action plans, which outline a range of commitments to enhance sustainability performance.

Clothing was selected on the basis of a high "per unit impact", coupled with rapid consumption (European Commission, 2006). The industry is characterised by low reuse and recycling rates and a lack of transparency and traceability means that consumer choices are driven by fashion rather than sustainability and longevity. Existing UK initiatives were found to be largely ineffective, such as the "Wash at 30 ^{o}C" campaign, which has been running for 5 years but has only been picked up by 28% of the UK population (ERM, 2007).

Being one of the most evolved roadmaps to date, there are some tentative lessons that can be drawn from its implementation.

Timeline

Sept. 2007: UK Clothing Roadmap project launched.

The Evidence stage was initiated, followed by the Stakeholder Engagement stage.

20 Feb. 2009: The Sustainable Clothing Action Roadmap was launched at the start of London Fashion Week by Defra Minister Lord Hunt.*

Sept./Oct. 2009: Proposed launch of a new action plan.

Feb. 2010: Initial deadline for the lead to be handed over to industry.

* The Sustainable Clothing Action Roadmap lists commitments made by UK based companies to increase sustainability in their operations. Further action plans to be released as new commitments are made.

Institutional setting

Government Departments

The UK Clothing Product Roadmap is led by Defra's Sustainable Products and Materials division. As it is initially being run by government as opposed to industry, the project warrants a greater degree of credibility and concerns over the initiative being significantly controlled by a group with a vested interest are likely to be dampened.

BERR (Department for Business, Enterprise and Regulatory Reform, now Business, Innovation and Skills, or BIS) and DFID (Department for International Development) are also involved, forming part of the stakeholder group. Defra approached these departments because of their potential interest in the project as a result of the cross-cutting nature of the roadmaps. The inclusion of DFID is particularly interesting as it suggests that concerns of a more "social" and "ethical" nature were being raised at an early stage in the development of the roadmap.

As the sustainability approach becomes part of the business case, the running of the roadmap would have to sit with industry. Defra will always have a participatory role, however, as one of the lessons learned is that industry needs to be continually pushed by government so that commitments become more challenging.[15] This may make the handover process itself one which will be interesting to observe.

Industry

Gathering input from a wide range of stakeholders was cited as a particularly effective way of focussing research and policy development.[16] Defra approached organisations that had a proven track record of integrating sustainability into their operations (*e.g.* high street retailers, designers, textile manufacturers, government departments and textile industry associations).

Organisations involved have the option to join The Clothing Action Plan Steering Group or one of the more specific Project Steering Groups, which inform the development of the programme. The latter consist of over 170 organisations that have an interest in the working groups. The Clothing Action Plan Steering Group is tasked with reviewing the project.

International relationships

The UK's clothing industry relies heavily on a global supply chain. China and India were identified as two of the biggest manufacturers of UK clothing: therefore work is underway between the Indian government and the UK government, and also with the China Roadmap Initiative.

Funding

Defra has funded both the co-ordination (*e.g.* stakeholder meetings, workshops and administration) and the underlying evidence studies.

Parties who have committed to an action are responsible for funding that action. It is felt that an important lesson to take from this is that whilst it can be problematic to persuade actions on the basis that they are self-funded, Defra have managed in this case. It seems to work as an instrument.

Effectiveness

Organisations committed to action under the roadmap are obliged to submit information by an agreed deadline for monitoring and reporting purposes. The agreed template includes business metrics, such as ethical and environmental impacts, the latter in line with conventional life-cycle analysis reporting. There are no formal penalties for failing to report but the credibility and visibility of the project (for example the launch at London Fashion Week) is thought to be enough to incentivise compliance.[17] Data will be compiled and disseminated by Defra, with a view to communicating the business case of integrating sustainability into operations.

Already, actions are starting to be delivered – five actions have been completed so far. Whilst it is too early to evaluate these, anecdotally, businesses have cited the observed improvements and the positive response amongst the industry. It has been suggested that as a market based initiative, it is more powerful than, say, implementing a law.

A significant issue confronting any attempt at evaluation will be distinguishing the actions undertaken as a result of the approach from what would have happened regardless. Companies were targeted because of a proven commitment to sustainability, and therefore are more likely to be those who continue to push sustainability at the core of their business. It is possible that companies may not have driven this forward without the conversations led by Defra, whilst it may also be the case that companies are more willing to go further in the knowledge that others are doing the same (the "I will if you will" philosophy).[18]

The action plan has been criticised for focussing too heavily on end-of-pipe issues, such as on the desirability of encouraging reuse and recycling. These actions have been defended on the basis that this will eventually encourage upstream interventions. In addition, most of the big players involved in the action plan actually committed to actions in most of the five areas. The actions taken up generally reflect where the organisation sits in supply chain.

The UK clothing plan has further been criticised for sidestepping overseas impacts. As only two textiles manufacturers are in operation in the United Kingdom, however, the underlying research inherently included external impacts. The end-of-life phase, particularly in respect of re-use, may also have an international dimension with much of the clothing collected for re-use being sent abroad to foreign markets.

The growing demand and supply of so-called "fast-fashion" in the United Kingdom exacerbates the overall impact of the industry. The action plan has been criticised for not adequately tackling this issue: actions falling under the "Consumption Trends and Behaviour" category are limited largely to Defra commitments to better understand and inform consumer behaviour. The Carbon Reduction Label, being implemented by Continental Clothing and Adili may only influence the behaviour of "greener" consumers. The perceived problem with this is that "*The green consumer alone cannot change the mass market*" (Sustainable Development Commission, 2007).

Unlike the Dutch approach, there are no overarching targets set. Actions are limited to individual companies, focussing on specific areas. Whilst there may be arguments against this more fragmented approach, tailored solutions can make for more realistic and achievable goals. Also, actions may contribute to the evidence base and exemplify good practise (*e.g.* the carbon labelling pilot).

Lessons learned

Significant emphasis has been placed on the work carried out with stakeholder groups. Input from industry has been said to focus the development of the project. To date, the roadmap seems to be working as an instrument whereby industry players make their own, self-funded commitments. A crucial element, however, is the facilitative/motivational role taken on by the government, triggering innovation and increasingly challenging commitments.

As mentioned above, some have suggested that a market based initiative is more powerful than, say, a law. But only companies with "green" credentials are involved at this stage,[19] which would suggest that they are more likely to respond positively than the mass market. Presumably, some more formalised policy would be expected to affect all the targets actors in the chain, irrespective of their "green" leanings. However, the nature of the issue may present some challenges in respect of setting harder policies. Broad-based targets, supported by sanctions for industry, do not appear to be appropriate because of the intricacies and global nature of the supply chain. It might also be difficult to ascribe accountability when there are so many players involved.

Time will tell if the pressure from the high profile nature of the programme will be enough to incentivise compliance to both seeing through the actions and reaching the monitoring deadlines, not to mention bringing more companies into the fold. Perhaps as

customer awareness and demand intensifies and sustainability becomes more mainstream, then competitiveness will compel the wider industry to conform.

This demand element is also key to reforming the market. It is not enough to just target manufacturing through policy measures. Influencing consumer behaviour would ideally be paramount. This is particularly prevalent with the clothing industry because the emergence of cheap, poorly constructed clothes serves to fuel behaviour typical of a "throw away" society. The UK recession seems to have exacerbated this effect, as consumers are looking for a "cheap fix", and waste treatment companies report a growing quantity of textiles in the waste stream. They have suggested that increasingly, items of clothing are purchased, worn once, and then thrown away as they are simply so cheap. More thought clearly needs to be invested in influencing lifestyle choices of the wider public and not just that of the "green consumer".

Conclusions and recommendations

Conclusions

This work has incorporated a review of policies relevant to SMM, as well as a selection of case studies, which were designed to illustrate examples of how countries were carrying forward a more integrated approach to addressing SMM. Most of the case studies describe relatively recent experiences.

The extensive review of SMM policies carried out as part of this work highlights the fact that the weight of experience, in terms of policies already in place, is with the "end-of-life" stage of the life-cycle. The review does suggest, however, that the emphasis of policy makers has been shifting, increasingly, towards a whole life-cycle approach, emphasising the effects of production and consumption on the environment, and perhaps less commonly, their social and ethical consequences. Managing materials sustainably across their whole life-cycle presents a challenge to policy makers. Sustainable materials management is a potentially far-reaching issue and a diverse range of policy instruments has been applied to address specific aspects of sustainable materials management. Through analysis of the case studies and review of the instruments in place, some key lessons regarding SMM *policy* and its implementation have been identified, from which more general conclusions and recommendations can be drawn.

Key principles

Our case studies have focused upon seeking to understand not so much the discrete interventions made – many targeting end-of-life management – but programmes, action plans, and policies which have a more wide-ranging effect (across the life-cycle). The desk review of policies, on the other hand, highlights a range of policies already in use which address specific aspects of SMM (*e.g.* taxes, allowance trading schemes, product levies and labelling requirements).

It is interesting to see that the more comprehensive approaches reviewed in the case studies have not readily translated into "hard" policy. The complexity of the SMM issue, including its potential to bring into play a large number of different actors, as well as impacts which may take place in other countries, suggests that they are more easily addressed through innovative approaches or a combination of approaches which go beyond the traditional policy tools and which, in some cases, may not be easily categorized as "hard" or "soft".

Much of the SMM activity under consideration in the case studies appears intended to address either environmental externalities or information failures. For example, green procurement policies might be considered as mechanisms through which procuring bodies seek to address the lack of internalisation of external costs. The approach suggests the fact that the "value" of some bidders' offerings might be obscured by the lack of internalisation of their relative environmental merits, and it is these which should be corrected for in the procurement exercise. The question arises, however, as to how this ought to be done. From a purely economic perspective, it could be argued that the procuring authority implicitly places a value on the "green" product in preference to the alternatives. The question which follows is whether this "value premium" reflects the actual environmental benefits of the green alternative.

Similarly, under EPEAT, which could be viewed as a means to overcome an information failure, it is uncertain how important the distinction between product ratings may be and as a consequence what, for example, is the premium one should pay for a product meeting the gold standard as opposed to a product meeting a silver standard, or one which is not registered? This may be a very difficult question to answer, but the fact that it is such a difficult question to answer strikes at the heart of the matter where the development of policy is concerned.

In general, it is surprising that there appears to have been very little by way of an attempt to value externalities and to discover whether the costs of SMM policies can be readily justified by the associated benefits. Indeed, the case studies give little indication that this has been a strong theme in the development of the policies examined with the possible exception of the work undertaken around the development of the UK's Climate Change Act.

Choice of indicators

The SMM policies discussed in case studies have tended not to be, in the first instance, market-based instruments, although they might be used as part of the suite of measures used to deliver SMM. Some of the case studies highlight the fact that indicators play an important role in the development of SMM policy (*e.g.* in the Japanese case study).

A key question, therefore, regarding SMM becomes "which indicators should be used?" Furthermore, because the identification of an indicator might not, in and of itself, lead to the desired outcome, a subsidiary question is "which policy, or policies, will be used to drive outcomes in the desired direction?".

The all-encompassing nature of SMM has led to the development of indicators that aim to directly measure sustainability of materials, *e.g.* the cyclical use rate used in Japan's Sound Material Cycle Society. Theoretically, this indicator is very fitting but the key problem here is the lack of availability of data with which to calculate the indicator itself.

Choice of targets

"Targets" may take many forms (OECD, 2009b). We distinguish targets from indicators in the sense that the former implies the setting of objectives for the future, whilst indicators may simply be used to track progress being made under a given measure.

Many of the case studies appear to see target setting as central to their success. From the case studies, there appears to be a trade-off between the nature of targets and the breadth of their coverage. One can see a contrast between the UK, economy-wide target for

GHG emissions, and the approach under EPEAT, where product standards are set for a wide range of different criteria affecting specific products.

It would seem likely that, to the extent that targets are used as the basis for SMM policies, this trend is likely to continue.

Measurability of targets and indicators

The lack of quantitative data available with which to assess the case studies, across the more wide ranging SMM policies, partly reflects the recent nature of some policies, but it also reflects the nature of some targets being developed.

Some targets and indicators being set are not straightforward to measure, and many will not have been measured in the past (for example, in the case of the Japanese and Californian case studies). Issues of implementation arise here, and it is clear that much deliberation should be given to the setting of a target and the elaboration of the associated indicator when introducing such policies. Unless the relevant data are required to be recorded, targets and indicators may have limited worth. In addition, to establish whether there has been a noticeable change arising from the policies used, these indicators need to be considered against a relevant time series for the indicator. Arguably, what the policy should be seeking is a notable deviation from past trends. It is not clear to what extent this will be taken into account in the review of indicators and targets, especially if there is a lack of quality trend data on which to base these at the outset.

The absence of any time series trends, therefore, makes it difficult to know whether a policy can be considered to have been successful or not (since one is, presumably, seeking to understand changes relative to re-existing trends, which may already be in a favourable direction). Of course, some "back-casting" may be possible in the case of some indicators where the data are available which enables such a calculation to be performed.

Voluntary mechanisms aim to encourage behavioural change and are typically reliant upon stakeholder involvement to encourage buy-in from an early stage (in-line with SMM Policy Principle 4: Engage all parts of society to take active, ethically-based responsibility for achieving sustainable outcomes (OECD, 2009c), which makes individuals/organisations assume a certain degree of responsibility. This has been the case for the UK Clothing Roadmap and possibly, in future, the Dutch approach. Whilst this approach may generate responses from stakeholders, setting targets under this softer policy framework might not always lead to especially challenging targets. This is made more likely if those negotiating with government are in possession of information which is not available to government itself (the problem of asymmetric information).

The use of expert groups/independent bodies

It is, perhaps, unsurprising, given the range of potential stakeholders and the range of interests which SMM may encompass, that many SMM policies reviewed tended to adopt an inclusive approach to the development of programmes, objectives and targets. Generally, policies have a greater chance of being implemented if there is buy-in from the parties concerned. This is strongly supported by the fourth SMM Policy Principle which suggests that SMM should, "Engage all parts of society to take active, ethically-based responsibility for achieving sustainable outcomes".

It is not straightforward to develop targets, which are expected to affect industry, in a vacuum. These targets will affect many actors in the economy and so have the potential to

be controversial. Without clear attempts to justify benefits with respect to costs, some form of consensus building may be necessary, and in many cases, it is unsurprising to see the case studies highlighting the role of independent expert groups. Generally, inclusion of an independent body in the institutional setting can, in the case of a public sector driven policy, ensure that a neutral position is maintained, and that the approach has a life beyond the next change in government.

Hard vs. *soft policy*

It is sometimes difficult to prove the extent to which voluntary mechanisms, or "soft policy mechanisms" are effective because of the difficulty in understanding the level of changes relative to what might have occurred in the absence of the policy. This is especially true in the absence of relevant trend information, or where the mechanism is voluntary, and so, does not cover all actors.

Probably because of the complex and cross-cutting nature of the SMM concept, a substantial number of voluntary policy mechanisms appear to be being implemented. A challenge will be to translate these into hard policies. The review of the EU SCP suggests that hard policies are having more of an effect than the softer policy measures. The attempt by California to execute this transition as part of the California Green Chemistry Initiative has proven to be complex. A recurring issue is that of accountability across a chain of key stakeholders – a problem which may well be a key reason underlying the decision to implement voluntary initiatives in the first place.

The UK's Climate Change Act presents an example of a target which has the weight of support behind it to be translated into hard policy, including incentives, targets and sanctions which are designed to drive changes in behaviour. A combination of mandated targets and reporting requirements, supported by a strong institutional setting, provide the framework for reducing emissions up to 2050. This target will be supported by a range of subsidiary policies designed to drive behavioural change such that these targets are achieved.

Effects outside the originating country

Where sustainable materials management addresses itself to product design, then there is clearly potential for such approaches to have an effect beyond borders because of the global nature of the market-place. Attempts to do this have been made in Japan with plans to extend their sound material-cycle philosophy across south-east Asia, by the UK Climate Change Act, which must consider aviation and shipping emissions in future, and EPEAT which has successfully expanded, albeit without a specific plan to do so, across forty countries.

Lessons learned from the EPEAT case study show that using established standards has been an influential factor in EPEAT's international success. Integration of accepted standards and labels is an efficient method of developing trust in a new system quickly.

Integration

Most SMM policies appear to have a focus, principally, on the environment. There is some movement to integrate the concept of SMM within broader considerations of the economy, but rather less has been made of the potential social consequences which are also central to SMM.

There is some concern that if SMM is perceived as being part of an explicitly environmental agenda, SMM may remain marginalised as an issue and may continue to be detached from the mainstream economic agenda. At present, for example, the EU SCP is largely propelled through the environmental agenda and whilst there is a desire to green production processes, there has seemingly been little focus upon influencing levels of consumption.

Integration of environmental issues into the more mainstream economic and financial discourse has been achieved through: the UK Climate Change Act (through the formation of DECC and centralised carbon budgeting which applies across all Departments); and mandated green public procurement which sets standards, as in the US, for minimum required environmental criteria which products being purchased must meet.

More generally, economic instruments which seek to internalise environmental costs might show promise for improving integration of SMM within the broader economic framework. Tackling such a broad issue as "part of" government, but one which does not ripple through the non-environmental (especially, financial and economic) government departments, is an approach to sustainable materials management which might be expected to gain more limited traction. Integrating the issue within the mainstream agenda, particularly of economic/finance ministries, is likely to be a more productive approach. This is especially true where it is expected that public procurement policy can play a major role in shifting markets through the purchasing power it is capable of exerting.

The "Life-cycle" beyond the environment

Some materials are of particular interest to SMM because of the issues that arise in their extraction/cultivation/production. Not all of the relevant sustainability issues are always "environmental" ones, with social issues being a prominent reason for the UK examining clothing through its roadmaps.

The other case studies are not so obviously concerned with social issues in the extractive phase. Indeed, there is perhaps a danger that a "life-cycle" perspective is conflated with "life-cycle assessment". Life-cycle assessment does not tend to concern itself with issues of social justice, or conflict. Even so, the role of commodities in provoking or sustaining conflict has become a major theme of international relations, whilst labour standards in some countries have become a cause for concern.

In the international context, one lesson of the UK approach is that being concerned about SMM across the life-cycle cannot simply be reduced to a technical life-cycle assessment. Issues of social justice, the rights of humans, the effects on biodiversity of extractive/harvesting phases and the potential role being played by some commodities in sustaining civil wars need to be accounted for in a truly wide-ranging approach to SMM. None of these issues are generally captured especially well in the somewhat location- and people-insensitive approach of life-cycle assessment.

Recommendations

It would be of some concern if some SMM policies were overlooked because they do not form part of a more encompassing "SMM approach'. There is no reason why a country could not be considered to be a leader in the area of SMM without explicitly recognising that what it had done was within a framework of SMM (though see Section Conclusions and Recommendations – Mainstreaming SMM). What is important is not the reason for the

action, but the outcomes achieved and the way in which those outcomes have been achieved. SMM is, after all, only one way of describing an approach which has various close "synonyms".

One key reason for not being so concerned about whether countries explicitly adopt an "SMM approach" or not is that SMM policy is, in any case, likely to be made up of a suite of policies working in combination. Typically, this suite will have started off as policies for waste management, and will include, in turn, policies for sustainable production and resource efficiency, and sustainable consumption).

It seems reasonable to argue that no single policy will deliver all that SMM seeks to achieve (and certainly, if there is such a policy, it has not been apparent from our review). Consequently, whilst the more encompassing approach is to be welcomed (and aligns with SMM policy principle 3): "Use the full Diversity of Policy Instruments to stimulate and reinforce Sustainable Economic, Environmental and Social Outcomes" (OECD, 2009c), policies are likely to need to be focused upon delivering specific objectives within a broader programme. It might be argued, however, that such a piecemeal approach might not gain as much traction, looking forward, as one which is mainstreamed across different government departments.

The following recommendations are intended to inform successful SMM policy development.

SMM policy is not "special"

It is important for policy makers not to lose sight of some of the more fundamental principles of public policy making. There is nothing "special" about SMM that would lead one to believe that the rules governing what makes "good" or "bad" sense from the perspective of public policy apply differently to SMM than to other issues.

From an economic perspective, the rationale for public policy intervention is usually premised upon the existence of market failures. These might relate to shortcomings in markets related to:

a) issues associated with the **absence of property rights**;

b) the presence of **environmental externalities** (positive and negative);

c) the presence of **other externalities**, including technological ones;

d) the prevalence of **search costs**;

e) the existence of **transaction costs**;

f) the problem of **imperfect information**;

g) the problem of **asymmetric information**;

h) this is similar to the issue of **consumption externalities**;

i) **government failure/issues of regulatory capture**; and

j) issues of **market power**.

It is generally accepted that these market failures have specific remedies related to the nature of the failure itself. Some market failures may be specific to a given product/service market, but others are clearly more generalised. For example, if emissions of NO_x are not internalised in one sector of the economy, it might well be the case that they are not internalised in others.

In principle, first best policies would involve internalisation of environmental externalities through the price mechanism, and addressing other market failures, for example an information failure, so that they improve the efficiency of the market mechanism. This would allow markets to allocate resources in line with the interplay of supply and demand. It is not obvious from the SMM policies identified that this methodology has been widely adopted. A sufficiently strong rationale should underlie the development of policy, and this rationale should be made clear. Policy makers should seek to inform their objectives and targets through appraisal of costs and benefits where possible.

Limitations to developing "First Best" policies. In practice, there are a number of obstacles to the straightforward application of first best instruments to address market failures, especially in the context of commodities and products which are widely traded across national boundaries, and where misaligned policies can cause complications. Notwithstanding this point, however, the principle ought still to guide policy development.

Where it is not possible to understand environmental costs, but where there are clearly gains to be made in environmental terms, this does not mean those gains should *necessarily* be foregone. Here, it seems that SMM policy development has sought to understand what might reasonably be possible, rather than what might be "efficient" in strict terms, often through dialogue with a range of stakeholders and through setting targets on the basis of such dialogue. This would appear to be an acceptable approach in the context of development of products, or acceptable standards for a given activity, though it may run the risk of lacking dynamism.

In other cases, such as in respect of climate change, it may well be that target setting is a more appropriate approach if the scientific evidence supports the view that the desired level of abatement is known with greater certainty than the associated damage costs. However, care needs to be taken to ensure that where a narrow-2 range of emissions or indicators is targeted that so-called "burden shifting" does not occur (where addressing one problem potentially worsens another to an unjustified extent).

In short, whilst SMM may constitute a new "way of addressing" environmental problems, the old rules regarding the design of policy instruments ought still to apply.

Recommendation 1:

SMM policy development is no different to policy development in other areas. The aim should be to address failings in the market, and as far as possible, the benefits of policy should outweigh the costs of its deployment.

Life Cycle Assessment and Cost Benefit Analysis

Much of the analysis undertaken in the context of SMM policies rests more on life-cycle assessment (LCA) than on an attempt to understand the costs of environmental damage through economic valuation, and application of principles of cost benefit analysis (CBA).

LCA approaches may help to identify differences in potential environmental impacts from different approaches to production, or to different consumption decisions. They are unlikely, however, to give an indication of the economic implications of these differences.

The reality is that at present, for many of the environmental issues being addressed through SMM policies (Green Chemistry being a good example), there are considerable difficulties to be faced in valuing the associated externalities.

Consequently, the basis for understanding how significant the environmental problems are from an economic perspective is rather weak at present. In the absence of such an understanding, it may be difficult for policy-makers to develop policies which are economically justifiable, and this might become more important over time as SMM seeks to become more entrenched within economic and financial decision making (as has happened in the case of carbon budgets in the United Kingdom).

It is worth seeking to understand where the linkages between life-cycle assessment and cost-benefit analysis are weakest. Most economic valuation studies are focused on the impacts of air pollutants, whilst rather few tend to allow for assessment of externalities, at the margin, of emissions to water, or to soil. If, in future, policies are to be designed which seek to address the impacts across the life-cycle of different activities, arguably, in the interests of ensuring that policy is designed with regard to the economic impact, there needs to be an improved understanding of the value of some of the life-cycle impacts which are being addressed. Economic consequences do not however emerge through a LCA. So, whilst a life-cycle approach is considered important, and might be deemed to be in-line with SMM Policy Principle 2 "Design and manage materials, products and processes for safety and sustainability from a life-cycle perspective" (OECD, 2009c) there is a strong argument for using both LCA and cost-benefit analysis (and other methodologies as relevant) to inform studies pertaining to SMM. This point is well made in an OECD study on methodologies relevant to SMM, which was produced in 2007 (OECD, 2008). From a policy-maker's perspective a CBA can help to understand the cost of implementing the policy relative to the benefits. Without this information in-hand a policy-maker would be insufficiently informed to have a true perspective regarding the economic implications of a policy.

Of all the case studies, possibly the only one where there has been consideration of external costs has been in the context of the UK Climate Change Act. Interestingly, the UK approach has shifted away from one that is based upon damage costs (which, where climate change is concerned, are highly uncertain) and has moved towards a target-based approach on the basis that high (and certain) levels of reduction will be required to stabilise climate. In this context, the social costs of carbon now being used to evaluate UK projects in respect of climate change are assumed to be related to the costs of the marginal abatement required to achieve a given level of reduction in emissions (DECC, 2009). Notwithstanding the critical views which have been levelled at some of the work underpinning the UK's approach, government has been able to argue that the costs of action are greater than the costs of inaction.

Generally, therefore, we note a reliance upon life-cycle assessment in current SMM policy making, but we also highlight the difficulties which need to be addressed in moving from life-cycle "problem identification" to economic "problem valuation". The emphasis on addressing impacts across the life-cycle through life-cycle assessment alone (as opposed to a "life-cycle-assessment-informed" assessment of environmental costs and benefits) raises the possibility that when policies are implemented, they might not be especially efficient from an economic perspective.

Recommendation 2:

There are limitations in the extent to which first best policies can be applied at present. In order to overcome some of these, it is recommended that a more focused effort is made to ensure that more work is undertaken to make stronger links between impacts identified as important in life-cycle assessment, and the valuation of these through economic techniques.

The nature of targets

Notwithstanding the above points regarding the difficulties of gaining buy in from industry where costs and benefits are not so clearly identifiable, it seems likely that target/standard based policies will continue to play a strong role in SMM policy in the foreseeable future (OECD, 2009b).

Indeed, if "addressing the life cycle" of products and materials is difficult to operationalise as a single policy, then in the absence of the use of market based instruments, one question becomes how one sets the relevant targets which one seeks to meet. Here, it seems that independent expert groups have a role to play in lending some objectivity to what might otherwise become a somewhat heated debate. Reliance upon such groups might become especially important in schemes such as the Dutch one if it is intended that the targets for a given "stream" are to be apportioned across parts of the supply chain.

There appears to be something to be said for ensuring that the nature, and range, of the targets is suited to the size of the entity being targeted. For example, where producers of specific products are concerned, it might be more appropriate to target a wider range of performance criteria, as with EPEAT. At the other extreme, where the addressee is the whole economy, it might be appropriate to target a small range of "macro-level" indicators. Climate change has been used in the UK context, though not specifically with regard to SMM. In principle, one could imagine that indicators such as Domestic Material Consumption could be targeted at the macro-level in future. In between this, sectoral level or material-based policies, such as in the Dutch case, could use a moderate range of indicators.

In general, one might suppose that the more heterogeneous is the range of actors/activities being included within the scope of the target, then arguably, the narrower the range of targets ought to be. It has to be recognised, however, that setting targets alone will not generally guarantee that they will be met.

Targeting what can be measured. In light of the above discussion, it seems entirely sensible to ensure that targets should relate to what can easily be measured. Although this might seem self-evident, it is not always a principle that is respected in practice. Concepts with theoretical appeal might not always be amenable to implementation, or at least, not without incurring significant administrative costs.

The potential for burden shifting. Targeting one specific effect raises the possibility that "burden shifting" will take place. For example, one may target reductions in GHGs, but actions may lead to an increase in emissions of other air pollutants. This may be an issue which affects the United Kingdom in the future. The use of carbon capture and storage on coal fired power stations provides an interesting example of a technology which could

reduce GHG emissions, but may lead to increases in emissions of other conventional air pollutants, such as oxides of sulphur and nitrogen, and particulate matter.

Care needs to be taken to monitor the "side-effects" of policy such that burden shifting does not occur to an unacceptable extent.

Revising targets and standards?. As noted above, SMM policy in its broad sense tends to be focused upon target setting with relatively little by way of market-based instruments, with the exception of the use of product labelling/categorisation to inform procurement decisions. One of the potential benefits of economic instruments is that they generate dynamic incentives for continuous improvement in product design.

The setting of standards for products may have the effect of limiting the incentive for further improvement if the standards are not revised with sufficient frequency. It seems relevant to distinguish between targets set for the longer term at the macro (economy-wide) level, and others being set on a relatively short-term horizon for products (especially those where the products themselves have shown a tendency for rapid technological innovation).

If targets and standards are to drive change, then those at the macro-level need to be sufficiently ambitious to drive change forward and make clear the direction of travel, preferably for the longer-term. This will give investors greater confidence to develop technologies and techniques which effectively respond to the targets being set. Arguably, these should be relatively ambitious, though periodic revisions at pre-determined dates may be desirable.

Those setting targets at the micro- or product level might be advised to ensure that a fairly automatic, and more frequent, mechanism for revision of the targets is in place (with the period between revisions arguably reflecting the nature of the products). EPEAT has recognised the fast-moving pace of the electronics market by allowing an online self-declaration registration system which allows products to become very quickly EPEAT registered. It is questionable however whether or not the criteria will evolve over time in order to continually raise the bar in this area of innovative design. Without such changes, EPEAT standards could become far too easily met.

Lessons could be drawn from Japan's Top Runner Program. This dynamic system uses the most efficient model on the market and then stipulates that the efficiency of this model should become the standard within four to eight years. This system does more to encourage continuous innovation and development across producers of the product concerned.

Recommendation 3:

To the extent that target-based measures continue to be seen as important:

- **In measures affecting the whole life-cycle or products/material streams, objective opinion from expert groups is likely to be important in setting targets (and apportioning targets across actors with responsibilities in different stages of the life-cycle);**
- **All targets should be readily measurable.**
- **Care should be taken to ensure burden-shifting does not occur to an undesirable extent;**

Recommendation 3: *(cont.)*

- **Macro-based targets affecting the whole economy should be small in number, sufficiently ambitious to drive change (and to give investors confidence that the change will be pursued strongly), and revised periodically over time through pre-announced reviews;**
- **Micro-based targets and standards affecting specific products can be larger in number, and should be revised frequently so as to provide a continuous driver for change.**

Standards in product-related policies

In terms of product standards, and perhaps sectoral ones as well, there is evidence that the actions of one country can affect the actions of others, particularly where the country taking action in respect of products is a major consuming country, or group of countries. There is a wide body of literature regarding the way in which markets can become "locked-in" to standards. To the extent that this effect might be anticipated to occur increasingly widely, then there may be an increasingly strong rationale for groups working at an international level to agree the appropriate scope for standards, if not, their appropriate level as well.

International co-operation could be sought in the development or implementation of certain SMM-related policies as a means of increasing their efficiency and success. This could be an area where the OECD itself could help support the initiative.

Recommendation 4:

There may be a role for the OECD in contributing to the development of product-based standards since the internationally traded nature of many products can lead to standards developed in one country becoming a *de facto* international standard.

Policy coherence

Conventional wisdom suggests that applying one policy to one addressee is the approach which is simplest to design, and most straightforward to implement. The sheer breadth of scope of SMM has the potential to lead to the opposite effect, and indeed, the literature review describes a quite complex web of policies.

If policies are developed with specific emphasis on some targeted material / product streams, the challenge becomes one of seeking to minimise distortions across product and material streams (because some are considered to be of greater priority than others).

Indeed, if SMM action plans and programmes have objectives affecting many sectors, then there is likely to be a need for more than one specific policy. This conclusion clearly aligns with the third SMM Policy Principle, "Use the full diversity of policy instruments to stimulate and reinforce sustainable economic, environmental and social outcomes" (OECD, 2009c). As such, it should be expected that approaches to SMM will be characterised by a range of policies rather than just one.

The challenge will most certainly be to ensure the coherence of these policies across sectors, materials and waste streams. This is a challenge which confronts those, such as

the United Kingdom, for example, seeking to meet climate change targets. Here, an overarching target is to be met, but with some sectors already included in a trading scheme (the EU Emissions Trading Scheme) and with others outside, there is already a situation in which different policy instruments are being used to address different sectors. Indeed, Guidance from government regarding the social costs of GHG emissions suggests that these should be valued differently depending upon whether the emissions take place from sectors inside or outside the EU Emissions Trading Scheme. Maintaining internal consistency of policy will not be entirely straightforward. Clearly, in the UK case, the situation might be greatly improved if all sectors were treated equally for the purposes of the relevant emissions (either through all sectors being covered by a trading scheme, or through application of a uniform levy on emissions across all sectors).

The case of public procurement. Through introduction of required minimum procurement standards, which are often demonstrated through eco-labelling systems such as EPEAT, Energy Star and EU Flower, standards can very simply be raised. If companies are producing products which are not compliant with the required minimum standard they are excluding themselves from a very significant share of the market – so there is a strong incentive to become compliant, or to register with a labelling scheme.

The EU green public procurement case study demonstrated that many countries were currently not implementing an effective system of green procurement, despite possibly thinking they were. The EPEAT case study provides an interesting insight into how a voluntary labelling system might become more significant in the context of mandated procurement requirements that are widely applied.

Public procurement is also a key means of mainstreaming SMM. Introducing sustainability requirements though a financial strategy will ensure that sustainability is considered across all Departments, regardless of their overarching roles.

Furthermore, although most commonly associated within the public sector, sustainable procurement can just as simply be applied in the private sector. As issues of sustainability rise up the mainstream agenda, no doubt some leading companies will have developed their own approaches to procurement. For many smaller companies, without the time to devote to understanding which product is better or worse than another, they will be further encouraged to follow the public sector's lead and implement minimum procurement standards where relevant information is made available in a clear and unambiguous manner.

Public procurement policies should, however, have to consider the implications of other policies already exerting an effect in the environmental domain. This is particularly important where policies are in place that already internalise a proportion of the external costs which green procurement criteria seek to make allowance for. For example, if the intention is to procure services which use less transport fuel, then if some of the externalities of fuel use are already internalised through a levy, the policy should not, strictly speaking, make allowances for the service using less fuel over and above the extent to which the externality has not already been internalised.

This matter is likely to become increasingly complex to deal with as the range of policies in place grows, and especially, given the free movement of goods and services across borders (with different policies in place). In principle, if green procurement policies are considered as means of correcting for the absence of mechanisms which internalise

environmental and social impacts, the more these are internalised in policy, the less justification there is for the application of green procurement (procurement will already have been "greened", so to speak).

Recommendation 5:

As environmental (and other) policies become more prevalent, so does the degree to which environmental costs are internalised by policy changes. SMM policies need to ensure that specific externalities are internalised in a consistent manner across the board. Furthermore, where some specific policies are concerned, such as Green Procurement, explicit attention needs to be given to the extent of internalisation of environmental costs so as to ensure that green procurement criteria are not applied to a procurement process that has already been "greened'.

Mainstreaming SMM

A challenge for all policymakers in the SMM field is that in order for a programme of policies to gain traction, then especially if the aim is to influence consumption as well as production, the approach benefits from the involvement of ministries of finance/economic development/trade and industry. Where policies are mainstreamed in this way, they have a greater chance of working across the economy, and across the life-cycle. In addition, as the Japanese example suggests, such mainstreaming also allows for economic benefits to be more clearly appreciated by finance ministries.

Government departments might have, traditionally, competing views regarding, for example, the application of environmental policies to specific key industrial sectors of the economy. Indeed, their *raison d'être* may imply that they should adopt (at least initially) opposing stances. Generating consensus across what are often divergent views is not straightforward. Consequently, such mainstreaming can be difficult to achieve.

A good example of what can be achieved in this respect is provided by the case study of the UK Climate Change Act. Here, arguably it has been the magnitude of the issue under consideration, as well as the high priority accorded to the issue by both the incumbent government and opposition political parties, that has led to the embedding of budgets for climate change gases alongside the annual budget statement generated by the UK Treasury. This leads to the high priority accorded to the target itself.

This type of approach could constitute a template for other SMM-related indicators/targets. To the extent that such a target, or targets, can be identified, setting annual targets alongside annual budget statements might be an interesting model.

Other mechanisms for such mainstreaming could include the use of instruments which have an economic element to them. Ministries of Finance tend to be far more involved in the design and implementation of tax policies than in, say, setting standards for specific products. As such, considering economic instruments as the basis for SMM policy might lead to better integration into mainstream policy development. Alongside this, however, would come the added complexities of generating consensus across Ministries regarding the desirability of a given course of action.

The need to address consumption as well as production

SMM policies are beginning to focus more strongly on the production and consumption stages of a material's life-cycle. The two are inter-related: consumption is a very powerful driver for change in production systems. As the demand for increased product sustainability increases over time, producers are encouraged to invest in research so as to develop innovative new production processes in order to supply their customers. In due course, this may become a driver for product differentiation among producers as they seek to derive a competitive edge in the market place. This will further encourage research and innovative product design.

Harnessing these drivers is central to the EU's approach to Sustainable Consumption and Production, although some have suggested that so far, the emphasis is more strongly on cleaner production than on changing consumer behaviour. The EPEAT study suggests that producers will enjoin in a race to the top, in terms of environmental performance, as long as there are benefits to them from doing so. In the EPEAT case, the benefits come through "not being excluded" from public (and private) procurement exercises where specific standards have been attained.

Consumer demand for more efficient energy-using products is becoming more prevalent because of the obvious cost savings to the consumer. The difficulty with certain material streams, such as clothing, is that these financial savings do not obviously apply (indeed the opposite may be true in some cases). Even if they did, the possibility of a rebound effect might mean that savings in one area lead to additional consumption in another,

It is difficult to separate this issue – of addressing consumption – from the matter of the choice of appropriate policies. First best policies – internalising environmental costs through levies – would affect product prices. This would be expected to affect demand for all products, with demand shifting in favour of those that are lower in cost once these externalities have been internalised.

In the absence of these instruments, demand for increased sustainability of products can be formalised through public procurement standards or through labelling to assist the purchasing decisions of consumers. Implementing minimum procurement standards can further drive producers to meet the required minimum, without which they would be excluding themselves from public sector spending.

In many areas of concern to SMM, sustainable procurement can play a major role. It seems important also to mention that private companies also wish to make their supply chains more sustainable. Many companies, however, have insufficient time and resources to investigate fully the consequences of all purchasing decisions. The role of sustainable public procurement, therefore, should be not only to guide public procurement to more sustainable consumption decisions, but also, to develop lists/criteria etc. which enable private companies also to shift their consumption patterns to more sustainable products and services. Informing the market and thereby helping to overcome information failures in the market, is what matters.

Non-environmental issues

Sustainability is often deemed to be synonymous with an environmental agenda, but whilst having environmental issues as a key component, it must be borne in mind that it includes social issues too. SMM therefore represents a more encompassing approach

Recommendation 6:

If SMM policies are to become integrated within the wider economic context, then:

- **Policy makers need to engage across what are often awkward departmental divides;**
- **There would appear to be merit in seeking to have included, within the wider financial and budget setting process, key SMM targets; and**
- **The use of market based instruments, specifically, measures designed to internalise environmental (and social) costs, is likely to attract more attention. These will also have an effect on consumption through their influence on demand.**

which is not amenable to measurement through, for example, Life Cycle Assessment alone. It is not coincidental that areas where precious commodities are extracted are commonly afflicted with civil war, human rights infringements and poor international relations. Well-known examples are those of oil and diamond extraction, but to a lesser extent, the same applies in the case of a far broader range of materials, including, for example, tropical timber. If SMM-policy is to be the truly "all-encompassing" approach it seeks to be, then SMM policy instruments should seek to account for both environmental and non-environmental issues. With the exception of the UK Clothing Roadmap, this has not been clearly demonstrated through the case studies examined. This final recommendation is reinforced through SMM Policy Principle 3: "Use the full Diversity of Policy Instruments to stimulate and reinforce Sustainable Economic, Environmental and Social Outcomes" (OECD, 2009c).

Recommendation 7:

The emphasis, thus far, has been on the environmental impacts of SMM. SMM policies need to have regard to social and economic issues, as well as environmental ones.

Notes

1. Some materials may be used as inputs to the economy, but they might not arise as waste for many years thereafter. Good examples are fridges, parts of buildings, and any other durable goods, for which there is a time lag between "production" and "end-of-life".
2. Personal Communication.
3. Following earlier drafts of this paper, the DTSC released its Draft Regulation for Safer Products in June 2010; after public comment.
4. The Panel consists of independent advisors with expertise in green chemistry/engineering, technological innovation and regulatory policy (*e.g.* academia, business, and non-profit organisations).
5. The Council includes the chief executives of the Cal/EPA boards, departments and offices; the Department of Public Health; the Department of Conservation; the Department of Homeland Security; the Department of General Services; the California Occupational Safety and Health Administration (Cal/OSHA); and other state agencies and departments.
6. The DTSC's Draft Regulation for Safer Products (published in June 2010 following early drafts of this report) provides for various penalties, fines, and enforcement actions depending upon the severity of the violations.
7. For example, Kaiser Permanente and Staples (Personal Communication).

8. The fees are based upon the sales of the types of product made by the company. It could be argued that the fees are slightly regressive in that they are a smaller proportion of total sales value as the total value of sales increases.
9. In addition to the reviews mentioned there have been numerous other studies on SCP and related topics in the EU. A number of these are noted in the bibliography.
10. This describes a phenomenon where efficiency gains lead to increases in consumption – largely as a result of efficiencies being reflected in lower prices – effectively cancelling out any environmental gains from more efficient production.
11. Published by the Green Public Procurement Group within the European Commission, based on various research.
12. Minister Cramer (2008), *Speech to the Fourth Waste Conference in Ede*, Available: *www.vrom.nl/pagina.html?id=37709*. The action plans have not been made available for this report. As such, it is not possible to analyse how the life-cycle approach has actually been adopted through the agreed commitments.
13. For example, the "Jeans for jeans" project was initiated through the textiles pilot, where old fibres from worn out clothes are used to manufacture new clothing.
14. Dutch Waste Management Association (2008), *Jaarbericht Annual Review.*
15. Personal communication.
16. Personal communication.
17. Personal communication.
18. Personal communication.
19. This is not to say that only minor players are involved; companies such as Marks & Spencer's, Sainsbury's and Tesco's have all made commitments under the Clothing Roadmap.

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