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Policy Tools for Sustainable Materials Management:

Applications in Asia

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Institute for Global Environmental Strategies

This report was written under a contract from the Commonwealth Scientific and Industrial Organization (CSIRO) as a background paper to the *Resource Efficiency: Economics and Outlook in Asia* (REEO) report. The REEO is an initiative by UNEP, a publication that takes stock of resource efficiency and trends in the Asia-Pacific region, identifies key sustainability challenges and makes policy proposals. CSIRO is the lead author for REEO, with background information and contributions provided by the Chinese Academy of Science, the Institute for Global Environmental Strategies (IGES) and The Energy & Resources Institute (TERI).

The report is written as a general overview of policy instruments and their applicability towards sustainable materials management. It summarises some of the available knowledge on these instruments, with an emphasis on their application in developing countries. It also provides a number of examples of how instruments have been applied at different life-cycle stages, including resource extraction, production and consumption, and waste management. Given the nature of the paper, being a background report to a publication on Asia, the examples provided are mainly, but not exclusively, from that region.

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1. Introduction

The total amount of physical resources used by humans has increased enormously over the past two hundred years and especially during the last few decades. This escalating material throughput has generated increasing scarcity of many resources, growing waste problems as well as widespread pollution. To promote sustainable resource management[1], governments need to identify prioritized resources and to set goals and targets. Once such targets have been set, what policy "tools" or "instruments" are available for achieving them and how can those tools be effectively implemented? These questions are the topic of this report.

The report provides an overview of the four major types of instruments available to policy makers for addressing the problems associated with the escalating use of natural resources. It presents different instruments, discusses their respective roles and their respective strengths and weaknesses, and shows how effective measures can be taken at different life-cycle stages: raw materials extraction, industrial production, consumption and waste treatment. The report argues that substantial reductions of resource consumption, which are needed in order to achieve a sustainable development, require comprehensive policy frameworks encompassing various kinds of instruments and combinations of instruments, and addressing all life-cycle stages.

1.1 The need for life-cycle perspectives in policy development

Figure 1 illustrates the three main intervention points for policies towards sustainable resource management. These are points where policy interventions can influence the amounts of resources used and/or the associated pollution and waste generation. However, it is important that policy makers consider the whole life-cycle when designing policies to promote sustainable resource management and address environmental impacts, in order to avoid problem shifting from one life-cycle stage to another, to target the most significant stage and to maximize effect.

Problem shifting can occur if policies are based on an analysis only looking at a part of a product's or a material's life-cycle without consideration of effects at other stages. For example, policies to promote multi-use packaging systems seem beneficial from a waste management perspective since they are likely to reduce waste volumes. But if these packages

[1] This report uses the terms *sustainable materials management* and *sustainable resource management*, since these concepts better reflect the ultimate goal of sustainability than do alternative notions such as *resource efficiency*.

are heavier and bulkier than single-use packaging, the transportation needs, and the related fuel consumption and emissions, may increase. Moreover, if the cleaning of the used packages requires large volumes of hot water and strong detergents, the overall environmental benefit of the system is not obvious. A life-cycle perspective aims at a holistic view and leads to more complete descriptions of the implications of different policy options. However, quantitative life-cycle assessments easily become highly complex and may not lead to clear-cut conclusions. Often they generate a need to address trade-offs among different policy objectives or to set priorities among different environmental impacts (e.g Bengtsson and Steen 2000).

Environmental impacts are typically not distributed equally over life-cycle stages; some stages are much more polluting or resource consuming than others and these patterns differ by product. For policies to be able to target the most significant stage, they need to be based on an analysis of how impacts are distributed over the life-cycle. An example is energy efficiency policies for household appliances which are used continuously, such as refrigerators. These products typically consume many times more energy during the use phase than during any of the other life-cycle stages. For such products it is therefore rational for energy policies to prioritize efficiency improvements in the use phase rather than focusing on the manufacturing stage.

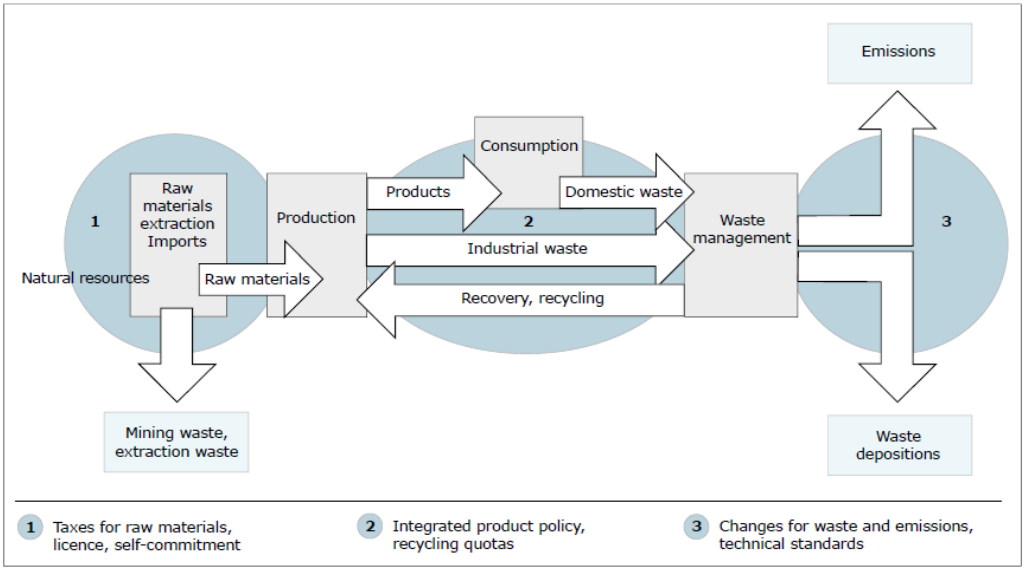
However, although a certain life-cycle stage is responsible for the majority of the overall environmental impact, it is not evident that policies should focus directly on that stage. For example, if hazardous substances in electronics are causing pollution and health risks from the end-of-life treatment, the most effective way to reduce these problems might not be through improved waste treatment and recycling practices. Instead, policies designed to stimulate product redesign and substitution of the problematic substances might be a more effective approach. Unless policies are based on proper analysis of products' life-cycles and the root causes of problems associated with these products, they can easily end up being misguided and ineffective

Policy frameworks addressing the use of resources and materials[2] thus need to be based on a life-cycle perspective in order to be truly effective. When developing and improving their policy frameworks governments are well advised to study key resources/materials from "cradle to grave" (or, where applicable, from "cradle to cradle") analyzing what policy instruments are currently used at each life-cycle stage, how these existing instruments

[2] In this report the terms "resources" and "materials" are used as synonyms. When other kinds of resources are discussed, such as human resources or financial resources, this is explicitly indicated.

complement each other (or whether there are conflicts between different instruments), and where there are gaps to be addressed. In this analysis it is important to look beyond the policies that are motivated by environmental concerns and to include also non-environmental policies that influence resource utilization. For example, a study of how to enhance the resource productivity of waste biomass would need to consider also the influence of various policies related with energy and agriculture. It is therefore essential to engage different line ministries in the process; over the longer term it might be needed to establish some form of cross-ministerial coordination mechanism to ensure effective policy making on sustainable resource management.

Figure 4.1 Intervention points for sustainable resource management



Source: Bringezu, 2002.

Figure 1. Intervention points for sustainable resource management.

2. The four main types of policy instruments

This section describes the four main groups of policy instruments starting with the traditional regulatory "command and control" instruments, and then continuing to the three main types of so-called new environmental policy instruments: market-based instruments, informational/educational instruments, and voluntary agreements. The key features of each group are briefly described and their respective strengths and weaknesses are presented. The section ends with a comparison, which sums up the main strengths and weaknesses of the main types of instruments, and a brief discussion of criteria for instrument selection.

2.1 Command and control instruments: compliance through regulation

Definition and Background

Command and control instruments (CCIs) have been used for a long time and they are the basis for national environmental policies all over the world. CCIs can mandate or prohibit specific behaviours or the use of a certain technology, define a level of environmental performance to be achieved etc. They are usually combined with some mechanism for monitoring of the regulated entities and a sanction for non-compliance. (e.g. Hotta 2004). Environmental CCIs can be divided into the following three general categories: 1) environmental quality standards, 2) technical/emission standards, and 3) restrictions and bans. *Quality standards* specify a minimum desired level of environmental quality, or the maximum level of pollution of a certain medium. An example is quality standards for urban air. In order to be effective such standards need to specify who is responsible for taking action in case the maximum pollution levels are exceeded. Some form of sanction against inaction would normally also be needed. *Technical/emissions standards* specify either mandatory technical equipment to be used in certain applications, or maximum levels of emissions or resource consumption for specific products or systems. For example, many countries require automobiles to be equipped with catalytic converters (a technical standard) and, in addition, they regulate maximum emission values for certain pollutants for vehicles (an emission standard). *Restrictions and bans* refer to the direct limitation of an undesirable behaviour or technology, or restrictions on the sale or use of certain products/substances with detrimental environmental and health impacts. An example is the prohibition of lead additives in gasoline or a ban of waste dumping.

Among these three types of CCIs, *Technical standards* are the ones with the most obvious applicability to resource efficiency and with potential to promote technological innovation

and change. Technology-based standards directly specify the methods or equipment to be used by the regulated entities, while performance-based standards specify the level of performance to be achieved. Technology-based standards can be for example building standards requiring certain types of insulation to be used for new constructions. Performance-based standards set targets to be achieved, for example on the maximum heating need per square metre living space of residential buildings, and a time frame for compliance, but do not specify in detail how to achieve those targets. Since performance standards provide greater flexibility they are typically better at generating innovation, but they need to be revised at suitable intervals.

CCIs can be implemented in isolation, but many policy problems require a set of policies. For example, a ban on waste dumping would normally be associated with a requirement on some specific actor to collect waste and ensure proper treatment. In addition, technical and performance standards may be needed in order to make sure that the waste treatment has limited negative impacts on humans and environment.

Strengths and limitations

There are several benefits of CCIs which explain their dominant position in environmental policy making. For governments, the setting of targets/standards is inexpensive and the goals for policy achievement are clear. These instruments have proven to be effective for addressing directly visible damages and point sources of pollution (Fiorino 1995).

On the other hand, industry tends to be reluctant to submit to command and control regulation. Their argument is often that uniform regulation ignores the unique situation of each company, including differences in abatement costs, and therefore leads to excessive overall costs. Such resistance has in many cases hindered the effective implementation of CCI based regulations. (Hotta 2004). Another concern over CCIs is that they are static in the sense that they only require compliance with certain targets and therefore provide no incentives for improvements beyond those targets (Stavins 2000). In addition, if CCIs are used to regulate only a few large entities, such as major industrial production plants, the compliance can easily be monitored, but if the number of regulated entities is very large, if for example individual households or SMEs are targeted, the monitoring costs can be excessive.

However, the shortcomings of CCIs and the difficulties of implementing them effectively do not imply that control regulation should be avoided or replaced with other instruments. What it means is that to effectively regulate impacts of products with globalized life-cycles and to increase their resource efficiency, it is important to have more comprehensive, dynamic and

flexible policy approaches. This can be achieved by introducing and using CCIs in a more flexible manner and/or by combining them with other types of instruments as discussed further on.

CCIs can be used at all three of the policy intervention points described in the introduction. At the stage of resource extraction, a quota system to control the volume of resource extraction, and requirements to restore mining sites into green areas are two examples. At the production and consumption stages, technical standards can be used for example to promote energy efficiency, to mandate the procurement of products made of recycled materials, or to ban the use of certain materials or designs that are difficult to treat at end-of-life. Examples at the waste management and recycling stage can be prohibition of waste dumping and inappropriate waste treatment, rules mandating waste separation by households, or emission standards for waste disposal sites and recycling facilities.

2.2 Economic instruments: creating market-based incentives

Definition and Background

Economic instruments (EI) work by encouraging certain behaviours and practices through economic incentives. Resource prices, as well as prices for products and services, set by the market do not properly reflect environmental and social impacts. Therefore, these prices send the wrong signals to the market players and encourage overexploitation, overuse and unnecessary pollution. One of the basic ideas behind EIs is that by adjusting prices through policy interventions, so that environmental and social costs are to some extent reflected in the prices of materials and products, the decisions made by producers and consumers can be brought more in line with overall societal objectives. Such internalisation of societal costs, which is based on the widely accepted polluter-pays-principle, can be achieved through taxes or use charges. In addition to internalising external costs, EIs can also be used for facilitating the adoption of cleaner and more resource efficient technologies and practices through subsidies, soft loans and tax reductions. A third type of EIs is tradable permit schemes, where market players are allowed to buy and sell permits to extract or use a specified amount of a resource or to emit a certain amount of a pollutant. Such permit schemes can be used in order to achieve a fixed environmental target, such as a maximum amount of air emissions, in a cost efficient way. The fourth and final type of EIs is deposit-refund schemes, which provide an economic incentive for the user of a product to return it to designated collection points at the end-of-life. Such schemes are commonly used for increasing collection rates of empty beverage containers for reuse or recycling.

EIs can be used to promote resource efficiency at all life-cycle stages, for example through tradable fishing quotas, tax reductions for fuel-efficient vehicles, and deposit-refund systems for reusable bottles. The number of applications of these instruments to the policy field of environment and resources has grown steadily since the 1970's. It is commonly argued that EIs are currently underutilised and that a more wide-spread adoption of these instruments would significantly contribute to enhanced efficiency and effectiveness of environmental policy making.

In contrast to the CCIs, which force all regulated entities to follow the same standards, the incentives and disincentives provided through EIs can generate different behaviours depending on each actor's specific circumstances (Stavins 2000). For example, the introduction of a water withdrawal charge is likely to affect different industries in different ways; those companies that can reduce their water use easily and at low cost are likely to do this, thereby saving money, while for those companies where it is technically complicated and expensive to reduce water use it may be rational to pay the full withdrawal charge instead of changing the production towards improved water efficiency. This flexibility can in some cases reduce the overall compliance costs quite significantly compared to a uniform regulation. From the regulator's point of view, who wants to protect the water resource from becoming over-used, it is the overall volume of water withdrawal that matters; from this perspective it doesn't matter which industry is making the largest reductions in consumption. For CCIs based policies to achieve the same level of cost-effective allocation of burden of compliance, the regulators would need to have access to detailed information on the internal cost structures of all the regulated companies (Stavins 2000), something that is normally not the case.

Strengths and limitations

The two most notable advantages of EIs over traditional regulation are their cost-effectiveness – as mentioned above – and their ability to provide incentives for innovation and improvement also beyond a certain level of performance (Stavins 2000). EIs can thus have a dynamic effect and provide continuous incentives, which the CCIs typically don't.

In order to generate the desired effects, however, economic instruments usually require sophisticated institutions to implement and enforce them. Charges and taxes need to be collected, and monitoring is needed to avoid free-riding. Tradable permits are especially challenging; to create a well-functioning market can require a fairly large administration, and

the regulated entities usually need training in how to utilise the permit market effectively. For pollution charges and taxes to have the desired effect, the government needs to be able to calculate the right levels; low levels mean that the environmental targets will not be reached while high levels put an excessive economic burden on the regulated entities. Such economic analyses are complex and require appropriate expertise. Besides, effects of EIs on environmental quality and resource consumption are not as predictable as under a traditional regulatory approach; assessments of their effects need to be undertaken and frequent revisions may also be required.

2.3 Informational instruments: enabling informed choices

Definition and Background

Informational policy instruments (IIs) have become more popular in recent years, partly because of the IT revolution which has decreased the costs of information dissemination. (Tietenberg 1998, in Sterner 2003). IIs are a very diverse group of instruments, but two basic kinds can be distinguished. The first group is where *the government provides information* to some actor group. This information can range from very general kinds, such as overall objectives signalling the direction and ambition of the government in a certain policy field, to highly specific and targeted forms, such as technical training for SMEs in energy efficiency. The second group of IIs is where *the government requires some actor to provide certain information* (information disclosure), such as data on emissions of toxic substances from production facilities or on energy consumption of certain products during the use phase. On a general level, IIs are intended to provide information about the environmental performance of certain products, services or systems in a standardized manner so that stakeholders, such as consumers and investors, can make better informed choices – avoiding less sustainable options to the favour of more sustainable ones (Jordon et al. 2003).

Strengths and limitations

One of the advantages of IIs the low implementation costs compared to the complex administration often needed in order for command-and-control regulations to work properly. However, the effectiveness of an II depends upon the actual behaviour of the intended information users (Karl and Orwat 1999). Therefore, these instruments are likely to be effective mainly in markets where consumers, investors, government officials and other key actors have high awareness on environmental issues. Without the existence of adequate background knowledge and basic sustainability values among the key actors, information on environmental performance is not likely to generate significant changes in behaviour. Another

factor often seriously limiting the effectiveness of information as a policy instrument is economic factors pulling in the opposite direction. When economic incentives are lacking, such as when more sustainable products and services are considerably more costly than comparable substitutes with higher environmental impact, information disclosure requirements by themselves cannot be relied upon to bring about changes towards sustainability.

In general, informational instruments cannot be expected to function as substitutes for other policy instruments, but should rather be regarded as supplements, which can enable stakeholders to improve resource efficiency and pollution abatement (Karl and Orwat 1999). However, there are cases where informational instruments by themselves have been effective; especially requirements for industry to disclose information on environmental performance to the public have led to significant improvements. Another area where IIs have been used with some success is for labelling of energy efficiency. In this case, consumers have an economic incentive to buy more efficient products so there may not be any trade-off between sustainability concerns and economic considerations.

2.4 Voluntary agreements: negotiated target-setting

Definition and Background

Voluntary Agreements (VAs) aim to promote environmental improvements through voluntary action. OECD (1999) defines VAs as "schemes whereby firms make commitments to improve their environmental performance beyond legal requirement". Two well known examples are the Responsible Care Program for chemical management developed by major chemical companies and the Zero Landfill programme of major manufacturers in Japan.

OECD (1999, 2003) distinguishes four types of VAs: 1) *Unilateral commitments* made by polluters or resource users; 2) *Private agreements* between polluters or resource users and those who are negatively affected; 3) *Negotiated agreements* between industry and a public authority. This negotiated kind of VA has a stronger legislative character than purely voluntary approaches. It is an agreement which can include legally binding obligations to follow an action plan established through negotiation between the government and an industrial sector or group of companies. The agreement can even involve sanctions for non-compliance in which case these agreements will resemble CCI based policies. However, the negotiation element makes these policies different from typical regulatory approaches (OECD 2003). An example of a negotiated binding agreement is the Japanese Top-runner

policy scheme, which aimed at improving energy efficiency of appliances and vehicles. Under this scheme, the government set efficiency standards and target years in close dialogue with industry. Non-compliers could be punished; 4) *Voluntary programmes*, in which "participating firms agree to standards (related to their performance, their technology or their management) which have been developed by public bodies."(OECD 2003).

Also management standards, such as the ISO 14000 series, can be understood as voluntary agreements of the first type. While such standards are not policy tools in a strict sense, they can be used by policy makers, for example by requiring that all major suppliers to governmental agencies be certified.

Strengths and limitations

Voluntary agreements are obviously more flexible than command and control regulation and compliance can be less burdensome than for certain market based instruments. They are therefore commonly favoured by the business sector. However, the literature on environmental policy instruments does not provide much evidence of VAs being particularly effective (e.g. OECD 1999 and 2003; Blackman 2009). In addition, there are concerns that VAs can give undue benefits to large market-leading companies by promoting their business models and technologies (e.g. Porter 1990). VAs are likely to be more effective in situations where there is a high possibility of command and control regulation or economic instruments being used. It is typically easier to make an industry make strong "voluntary" commitments if there is a widespread perception in that industry that mandatory policy tools are likely to be introduced unless significant improvements are made.

OECD (2003) argues that it is generally more effective to use command and control instruments with some flexibility, and based on discussions with the regulated industry or actor group, or to use market-based instruments, than to encourage VAs. Negotiated agreements with binding targets and a phase-in period can be a compromise and a way to increase acceptance compared to CCIs developed without involvement of the key stakeholders. As discussed more below, voluntary measures can play an important role for motivating additional efforts of companies that already have a high environmental performance, while legally binding measures may be the most effective for ensuring improvements of the majority of companies in a specific sector.

2.5 Selecting instruments

The previous four sections discussed briefly some of the advantages and limitations of each of the main types of policy instruments. This section introduces three generic criteria for instrument selection and summarises the pros and cons of different instrument groups against that background. It should be stated at the outset that there is no ultimate instrument, which scores best on all criteria; all instruments have their particular strengths and weaknesses. The purpose here is to highlight such differences among the major instrument groups, thereby making it easier for policy makers to select appropriate instruments to address a certain policy problem.

Criteria for instrument selection

Criteria for selecting environmental policy instruments can be divided into three broad categories (US Congress 1995).

- *Environmental results*. This group of criteria centres on the likelihood that the objective(s) of the policy will actually be achieved.
- *Costs and burdens*. These criteria concentrate on the costs associated with the policy for society as a whole (including costs for governments and public authorities, for regulated entities, and for others affected by the policy in question), as well as how these costs are distributed. These criteria also include the administrative burden on governmental institutions to ensure policy compliance.
- *Change*. This final group focuses on the adaptability of the policy and to what extent it provides incentives for technological innovation and diffusion.

Command-and-control instruments have their major strength on environmental results. However, uniform standards can lead to high compliance costs. Enforcement can also be burdensome, especially with a large number of regulated entities. Finally, regulations are often static and therefore provide weak incentives for change beyond the regulated level. Performance based instruments are likely to be better than technology based ones in the sense that they allow for different technical solutions and therefore stimulate innovation. However, performance based policies can be more costly to monitor.

Economic instruments have an advantage both in the lower expected compliance costs and in the incentives they provide for continuous improvement. However, the environmental result is generally less certain than in the case of command-and-control instruments. An exception to this could be a permit trading system with a fixed (or decreasing) number of permits. Policy design and enforcement may be burdensome, however environmental and resource taxes generate revenue to the government thereby lowering the costs of policy making.

Both information based instruments and voluntary agreements are generally less demanding for the government than command-and-control instruments and economic policy tools. Compliance costs are also low to moderate and these types of instruments can generate drivers for continuous change. However, the crucial drawback is that the environmental effectiveness is uncertain and highly dependent on case specific conditions.

There is no golden rule on how to select a suitable tool to a given problem. In each situation certain selection criteria are likely to be more important than others, depending on environmental, social, technological as well as political factors. However, when understanding the major strengths and weaknesses of different kinds of instruments, policy makers will be better equipped to make informed decisions and to combine instruments in ways that compensate for shortcomings of individual instruments.

Instruments in developing countries

Governments in developing countries typically have very limited resources and may therefore have difficulties in developing and implementing command-and-control based policies. As mentioned above, also economic instruments usually require a relatively high institutional capacity for effective implementation. It has therefore been proposed that developing countries should make wider use of information disclosure and voluntary agreements. However, recent research indicates that these instruments have been largely ineffective and that an undue emphasis on such approaches may be a diversion from the need to build appropriate regulatory capacity (e.g. Blackman 2009). Especially for voluntary agreements there is a lack of evidence that they would be effective in the context of developing countries. Information disclosure has generated some improvements, but success seems to be limited to a few cases where the conditions have been favourable.

3. Developing comprehensive policy frameworks

3.1 Diversifying the policy tools repertoire

The majority of environmental policies are based on command and control instruments (CCIs). Significant improvements have been achieved through such policies, especially for local environmental impacts. However, CCI based policies have also been successfully developed at the international level, for example in the phasing out of ozone-depleting substances and for reducing the use of hazardous substances in electronics. These instruments are likely to continue to be the corner stone of environmental and resource policies.

However, as mentioned in section 2, CCIs have a number of limitations and there are therefore good reasons for governments to use also other instruments – either instead of CCIs or as complements. The rest of this section discusses both how CCIs can be combined with other instruments for enhanced effectiveness and how they can be implemented in a way that can reduce compliance costs and resistance.

3.2 The importance of instrument mixes

Combining instruments for enhanced effectiveness

Policy instruments can be especially powerful when they are employed in combination (e.g. OECD 2007). Such policy mixes can for example combine an economic incentive with an enabling policy instrument which makes it easier for households or companies to change their behaviour in line with the new incentive. An example from the waste sector can be found in South Korea where a volume-based waste disposal charge was introduced in combination with the establishment of a convenient collection system for recyclables. In this case the disposal charge gave households an incentive to reduce the amounts of unsorted waste while the collection system provided them with a practical opportunity to actually do so. As a result of these policies and in contrast to most other developed countries, South Korea has managed to significantly reduce the amounts of municipal solid waste. At the same time the country has also seen a drastic increase in the collection of recyclables. Another example of how instruments can be combined is the German tax on electricity which aimed to reduce household consumption. When this tax was introduced the German government also developed enabling policies in the form of labelling systems which made it easy for consumers to identify energy efficient household appliances. (OECD 2002)

Other instrument mixes can aim at reducing the resistance among those regulated. This can be achieved for example by refunding money collected through environmental taxes and fees to the industry in question. An example of such a mix is the Swedish policy package targeting NOx emissions from energy sector and industrial boilers, which combined two EIs: a tax and a subsidy (Millock and Sterner 2004). This package required each company to pay emission fees based on its NOx emissions but it also returned most of the money collected through the fees to the industry, based on the amount of energy produced by each company. This refunding arrangement made it possible to introduce a quite high emission fee, which created a strong incentive for the companies to reduce their emissions per unit of energy produced. An emission tax, where the money collected would have gone to the treasury, would have been a significant burden to the energy industry and it might have affected its international competitiveness. There would have been strong opposition to such a tax and it would most likely have been very difficult to muster the necessary political support.

Environmental policy tools are typically used for shifting companies' or households' behaviour and consumption and production patterns into a more sustainable direction. This usually calls for a combined policy approach including both measures aiming to phase out undesirable products and behaviours, and measures to increase the market for more sustainable products or to provide incentives for more environmentally benign behaviour. Figure 2 illustrates this need for multiple policies to simultaneously increase the market share of frontrunners and decrease the share of laggards. In addition to shifting from less desirable products or behaviours – laggards – to better ones – frontrunners – there is a need for policies to stimulate technical improvements of individual products and innovations (Figure 2).

The three types of policy intervention will generally require different policy instruments. It is not likely that a policy which can effectively edit out an undesirable product from the market can also stimulate innovation of more sustainable products. In addition, different policy instruments may be required for stimulating technical improvement of existing products on the one hand, and more radical innovations at the systems level. Technical standards can be important tools for improving the performance of an established kind of product or process, but they typically don't provide any incentives for systems innovation. In order to create drivers for such more fundamental innovations, including changes in consumer behaviour, other policy approaches and instruments are required. For example, in addition to improving the fuel efficiency of automobiles there is a need to support a range of other developments, such as to stimulate new energy sources for private vehicles, to facilitate the dissemination of social innovations such as car sharing, to develop public transportation systems into viable alternatives to cars, and to reduce mobility needs through improved city planning.

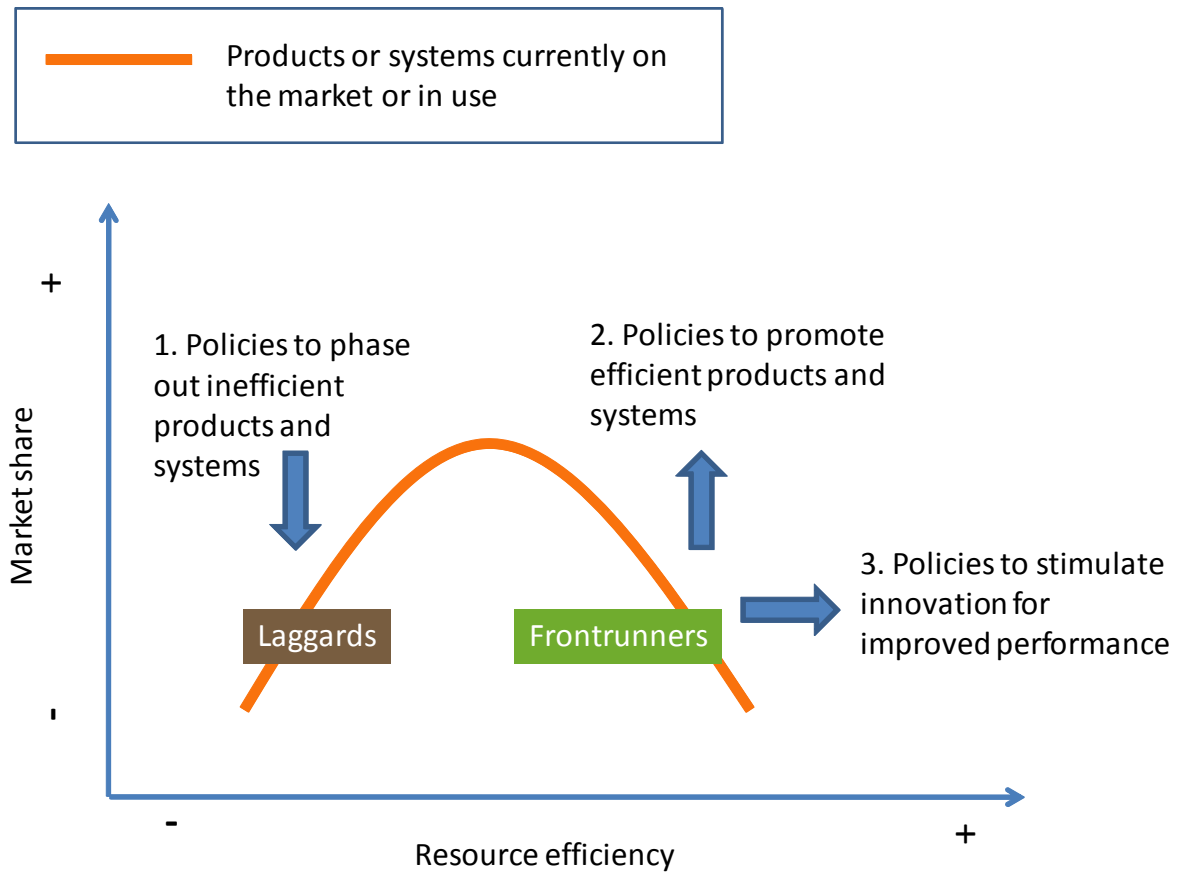


Figure 2. Three types of policy interventions aiming at improving the resource efficiency of products and systems.

Ensuring policy coherence

The section above discussed the benefits of policy mixes where different tools are used in combination for increased effectiveness. However, when developing and implementing new policies it is important to review and consider already existing policies and regulations. In some cases, the intended effect can be achieved by modifying an existing policy; for example, to reduce an existing tax for certain actors can be easier than to introduce a new subsidy scheme. An existing policy can also be in direct conflict with the one being developed; for example, subsidies to fossil fuels can seriously hamper efforts to increase energy efficiency. A patchwork of partly overlapping, and maybe even conflicting, policies is confusing for all stakeholders; it is difficult to enforce, and equally difficult to comply with. Policy makers should therefore make efforts to avoid creating such fragmented patchworks, for example through regular consultations with representatives of the main regulated entities and street level bureaucrats in charge of day-to-day policy implementation.

To effectively move society towards sustainable materials management, governments need to send coherent messages. Clear visions need to be established and communicated; consistent and well coordinated policies should create incentives and legal obligations towards that vision. This requires leadership from the highest political level and coordinated action by the governmental departments concerned.

However, it is not only policies developed and put into action at the national level that influence resource utilisation and efficiency. Policies at the sub-national levels (provinces and states, as well as municipalities) are also likely to play a significant role, although the power of different levels of government differs among countries. The role sharing between different levels of government, and the potential complementarily among instruments used at different levels are important to consider when designing effective policy frameworks.

3.3 Flexible implementation but firm long-term targets

New policies and changes in existing policies are likely to have different consequences for different companies and households. Some of the actors affected may be able to quickly adjust, while others may need longer time. For example, a manufacturer that is just about to renew the machinery is likely to be more flexible than one where a large investment has just been made. In order to be effective, and to reduce resistance, it is therefore desirable that policies leave room for some flexibility. This can be achieved in different ways.

The flexibility associated with economic instruments is often mentioned as an argument for a more widespread use of these kinds of policy instruments. Companies that can quickly and easily adjust their production processes and products need to pay less in taxes or charges. Those who have difficulties in adjusting, or where the costs of making adjustments are high, will have to pay more. Each individual company is free to calculate what changes would be most beneficial for them and to make their decision accordingly. A uniform regulation, requiring the same performance level of all companies in an industry, could entail higher overall compliance costs and would most certainly cause stronger resistance to its introduction.

However, it is possible to develop and implement also command and control instruments with a certain degree of flexibility. Involving the groups targeted by a proposed legislation (such as companies, consumer groups, farmers) in the drafting process can help build awareness, understanding and support. Consultation processes can also inform the policy design process

on the circumstances of targeted groups and on obstacles to compliance. By being provided the opportunity to influence the policy design and the implementation schedule, companies and others can be expected to feel a higher ownership of the process and thus be more likely to respond positively. Finally, consultation processes provide “early warning” to the affected groups and make it possible for them to start preparing for expected future legislation. Consultation processes take extra time, but the outcome can be better designed policies and more favourable conditions for successful implementation.

It can also be wise to announce planned policies well in advance so that the affected stakeholders have time to adjust. Similarly, a step-wise introduction can facilitate compliance and reduce related costs. Experiences from developed countries, for example in relation to automobile emission standards, show that clear long-term timelines with fixed tightening of performance standards can be an important driver of technological change. If future standards are set and announced several years in advance, industry has more time to innovate and invest. However, in order to be effective, long-term timelines and targets need to be robust to political changes. If there is some uncertainty whether an announced future policy will in fact be implemented or not, this can seriously reduce efforts (such as investments in product development and production facilities) needed for compliance.

4. Diversified policy approaches for different life-cycle stages

This section illustrates how a diversification of policy tools, mainly from traditional command-and-control measures to other instruments and combined approaches, can be beneficial. It provides a number of examples for each of the three points of policy intervention: resource extraction, production and consumption, and waste treatment and recycling.

4.1 Extraction of natural resources

Developing Asian countries mainly rely on command-and-control policy instruments, such as quotas and licences, in natural resource management (UNEP 2000). The application of other policy instruments, as complements, is expected to lead to more comprehensive and effective policy frameworks for promoting sustainable development by tackling environmental pollution and natural resource depletion.

Economic instruments in particular are increasingly being used in combination with command-and-control regulations for environmental management at the resource extraction stage. Economic incentives and disincentives to promote environmental conservation and resource efficiency are created through various economic instruments including charges/taxes and tradable permits (UNEP 2000). The following two examples from Central and South America show how such tools have been successfully implemented to water management. The third, longer, example shows a case in Indonesia where the policies implemented have not been fully effective. The Indonesian case illustrates the complex social reality for policy implementation and shows how interests and incentives of a wide range of stakeholders may need to be considered in the policy process.

Water Pricing in Mexico

Water pricing has been used in many jurisdictions for promoting water conservation. The funds raised through these charges have in some cases been earmarked for water pollution control programmes thereby contributing to additional protection of the local water resources. In Mexico City, for instance, an increase in water price for industrial users discouraged the establishment of water intensive industries in the region and encouraged water conservation by making water recycling more economically viable (Bernstein 1997).

Tradable water withdrawal rights in Chile

Chile's tradable water rights allow for market allocation of water due to freely tradable system has stimulated efficiency improvements in agricultural water uses as well as urban water and sewage system (Anderson and Farooqi 2003). In addition, the government has freed up resources to provide subsidies for poor urban water users and small farmers through efficiency gains from the water policy (O'Connor 1998).

Eliminating unsustainable logging in Indonesia

Loss of forest in Indonesia is responsible for 85% of the country's total CO_2 emissions, unlike in other countries where the bulk of emissions accrue from energy consumption (PEACE 2007). As such Indonesia is a leading country in test activities on Reducing Emissions from Deforestation and Forest Degradation (REDD). By government estimates a 50% cut in deforestation would bring revenues of between $2.5 and $4.5 billion a year through REDD (MoFor 2008). One of the demonstration projects, in Ulu Masen, is based in the province of Aceh in Sumatra – Sumatra accounts for approximately 56% of all the emissions from deforestation in Indonesia (MoFor 2008). For a period of 30 years, according to plans by the provincial government of Aceh, in an area of approximately 750,000 ha the project aims to develop and test carbon finance mechanisms to reduce legal and illegal logging, conserve biodiversity and contribute to the area's sustainable economic and social development. It would reduce deforestation by 85% by means of land use planning tools, increased monitoring and law enforcement, restoration, reforestation and through sustainable community logging (PDN 2007).

The policy package however, has not reflected the cultural, legal, and economic complexity of the situation. Some 130,000 persons live in communities adjacent to Ulu Masen (PDN 2007), and there is a high incidence of poverty in villages near to forest areas (EoA 2009). Although there have been efforts to inform the local communities who depend on the forest for its livelihood, research by the IGES Forest Conservation group shows that there is limited understanding of the project's implications on the local population, as well as limited understanding of the rights and responsibilities of communities within the project and the benefits they may stand to obtain. And while communities tend to agree with the goal of protecting the forest in the long term, there is concern about the recognition and protection of traditional community rights over natural resources. Lack of adequate and credible information is affecting local support for the project.

Illegal logging, targeting high value species, has traditionally formed a significant source of income for people around the forest. This makes it crucial for the project to provide both

strong monitoring mechanisms and alternative sources of income as incentives for local population to stop the logging. But the alternatives – mangroves, orchards, fruit farms - are not proven to be financially gainful enough to dissuade illegal logging. There are more reasons for deforestation that are not fully addressed by policy: there is still the need for housing construction which has traditionally used wood from the forest, and no encouragement has been given for substitute building material; market demand for hard wood – the type selectively illegally logged – is still high, making it gainful to keep on deforesting.

Further to these, there are also issues of weak governance affecting implementation and monitoring of the situation (PDN 2007). Illegal logging is done by timber barons, presumably in collusion with local police and military (EoA 2009). The national government and the provincial government are in disagreement on who should have overall authority over the project. At both provincial and national level, a number of government agencies have overlapping mandates, competing against each other adding confusion about their roles to a situation that is already unclear to other stakeholders.

The national government and the provincial authority are now engaged with stakeholders in adjusting the situation, one of the primary realizations being that a policy package must be multifaceted enough to reflect the complexity of the situation. It is clear that a single policy instrument will fall short of dealing with the complexity involved. The approach taken must provide appropriate incentives to several groups of stakeholders, some of whom with conflicting interests. The case also illustrates that policies that aim to decrease or eliminate a certain activity (logging) also need to consider how alternatives (other sources of income for local communities) can be supported. This becomes extra crucial when dealing with underprivileged groups, since these have few options available and limited capacity (due to low education level, limited access to bank loans etc.) to develop alternatives by themselves.

4.2 Production and consumption

Production and consumption systems are in a sense the engine of societies' material throughput. Product design, production processes, marketing and advertising, and factors influencing consumption patterns are all crucial for sustainable materials management. Production and consumption offer many important opportunities for policy makers to stimulate a more sustainable use of resources, and policy frameworks towards this end should therefore pay considerable attention to these stages.

A. Policies targeting production

Water quality control in Indonesia

A successful case of water pollution control using informational policy instruments in combination with voluntary agreements is the public disclosure policy of Indonesian PROKASIH and PROPER program. The PROKASIH (Clean River Program) started in 1989 aimed at cleaning up the heavily polluted rivers by identifying and controlling the most important sources of pollution (O'Connor 1998). At that time, water pollution control in Indonesia was mainly based on traditional command-and-control regulation (Afsah et al. 1996). In contrast, under the PROKASIH programme, companies were encouraged to commit themselves to reducing effluent concentrations by half within an agreed timeframe (O'Connor 1998). In order to ensure compliance, the government stated that it would announce the names of companies, which are not meeting the targets set in their agreements. Since 1995, the PROKASIH programme has been superseded by the PROPER (Program for Pollution Control, Evaluation and Rating), in which major industrial water polluters are ranked into five grades (gold, green, blue, red and black, from excellent to poor) depending on their environmental performances, and the ratings are disclosed to the public (Afsah et al. 1996). The PROPER program has received considerable attention as the first large-scale public disclosure program in developing countries.

As of 1994, over one thousand companies were participating in the programme and the participating facilities had significantly reduced their pollution discharges (O'Connor 1998). The policy had contributed to a reduction in emissions intensity, especially for firms with previously poor environmental records (Lopez et al. 2004). On the other hand, however, Garcia et al (2008) shows the effects of the public disclosure of PROPER rating depends on the initial level of environmental performance of the firms: the firms with bad environmental performance records had been given more pressure to improve their performance while the firms which had already taken the initial abatement steps had been given less incentive for further improvements. This outcome illustrates the point made in section 3.2 on the need for different types of instruments to address low performers and high performers respectively.

Adding resource efficiency drivers to industrial policies

In 2009, Japan introduced two programmes aiming at increasing the resource efficiency of industrial production facilities and the energy efficiency of household appliances while at the same time providing financial support to industry. These new programmes were developed as part of the revision of an existing law on industrial development and innovation. Under one of these programmes, companies achieving certain improvements in energy efficiency or

carbon efficiency can receive tax reduction measures, such as immediate depreciation of capital investment, financial assistance, and exemptions from certain regulations, such as the Commercial Code of Japan. The other programme offers similar benefits to companies producing appliances ranked among the top 20% most energy efficient.

This example shows how policies that basically have a non-environmental purpose, in this case to support industrial development, can be redesigned so that they also contribute to improved resource efficiency. There are many opportunities to add environmental criteria to non-environmental policies. However, for such integration to happen the ministries concerned need to have clearly expressed mandates to include environmental objectives in their policy development.

B. Policies towards resource efficient consumption

For the most part, governments have chosen not to directly regulate households' consumption, preferring to promote consumer education and consumer awareness. Such programmes ride on the assumption that consumer behaviour, if sustainable, will eventually force production to follow suit (EU no date). There is little evidence that such an approach has been effective (Sustainable Consumption Roundtable 2006). What has happened however is the birth of new markets, niche areas catering for the emerging green consumer class. Fair trade, organic foods, energy star products, etc, now appeal to niche groups, especially from the middle-class. In many cases, these schemes have not however led to a replacement of products with low environmental performance but rather an addition to the already existing options available to consumers. Achieving sustainable resource management requires radical improvements of the bulk of products, not only the development of separate niche markets, and this, in turn, requires complementary policies (GTZ et al. 2006; OECD 2002) It has been argued that ultimately the most effective way of achieving sustainable consumption is by ensuring that resource extraction, production processes, and products are sustainable (Hertwich and Katzmayr 2004; Jackson and Michaelis 2003).

Energy labels in Europe

A case in point is the European Union energy label, which rates household appliances from A (most sustainable option) to G (least sustainable) according to their energy efficiency. Because it is a mandatory label, there are no fridges, bulbs, or washing machines in the market with energy efficiency below the G grade. Thus consumers have a minimum sustainability option of G for their household appliances. Such "choice editing", taking out the worst options from the shelf (Sustainable Consumption Roundtable 2006), has proven effective, partly because it allows the government to set the minimum performance level and

then allows the market to figure out how to achieve those minimum standards. This labelling scheme is thus based on a policy mix of information to consumers about the label and the practical meaning of the ratings to their energy bills, mandatory minimum requirements for producer participation in the market, and penalties for failure to comply. There is evidence that the scheme has resulted in a reduction in appliances' energy consumption.

Yet this case also highlights loopholes in lack of comprehensive policy mixes. Although refrigerators and washing machines have become more efficient the total number of such appliances being produced and used has increased, thereby cancelling the efficiency gains brought about through the eco-label, the so called rebound effect. Approaching sustainable consumption as a technical exercise and forgetting the human dimension has yielded little result. In a similar vein, cars have become more fuel efficient over the last few decades, but the total number of vehicles on the road and the total volume of energy they consume have only been increasing. A way to address this problem could be to increase the fuel price through taxation. However, to reduce fuel consumption by simply increasing taxes on fuel or restricting private car use without providing viable public transportation as an alternative or facilities for bicycle use might backfire, since people would still have the need for mobility.

Green purchasing and green public procurement in Japan

Policies to promote green purchasing can be one of the keys to the development and more widespread consumption of resource efficient products and services. Purchasing can include consumption by citizens, by central and local governments (public procurement) as well as by companies. To make such policies work effectively, it is necessary to ensure interaction between national and sub-national government organisations, business and industry (both in their role as consumers and as producers), and consumer groups.

In 2000, Japan introduced its law on Green Purchasing which requires ministries and government agencies to develop purchasing plans, track annual purchase and report to the Minister of the Environment. This law also requires manufacturers to provide certain environmental information on their products. Starting in 2002, the Basic Guidelines for Green Purchasing, covering 45 types of products and services, have been revised annually (ADB and IGES 2008).

Japan also has a government-supported multi-stakeholder forum – the Green Purchasing Network (GPN) – which existed before the green purchasing law was introduced and which continues to be highly active. The GPN develops guidelines and databases to facilitate green purchasing and in the end of 2009, the network counted 2363 companies, 265 governmental

bodies, and 275 citizens' groups among its members.[3]

This case shows how the Japanese government is promoting green public purchasing through regulatory means while at the same time providing support to an information facility, which is providing tools that enable not only governmental bodies but also private companies, organisation and households to identify products and services with high environmental performance.

4.3 Waste management and recycling

In many developing countries, open dumping is the most common practice for waste disposal, which often leads to water contamination, foul odours, and other environmental, health and hygiene problems. Furthermore, recyclables and scraps which contain valuable materials are commonly recycled using environmentally unsound methods. In order to reduce the environmental problems associated with weak waste management and recycling in developing countries, it is necessary to improve policies, raise awareness of stakeholders, and support the introduction of environmentally sound and economically sustainable waste management technologies and systems. Many countries and local governments lack an integrated solid waste management strategy and are held back by other institutional constraints, insufficient human resources, and budgetary limitations. Part of the problem is that solid waste management and resource recovery are seldom high priority in national policy.

Framework legislations and national strategies

Developing countries share a need to raise the priority of environmental policies as well as policies for resource efficiency in general. To start with, the institutional capacities of central and local governments should be enhanced, especially in terms of improved coordination of financing, stakeholders, and infrastructures for smooth and effective transition from the stages of policy making into policy implementation.

The development of national policy frameworks or strategies on waste and resources is expected to be a key step towards sustainable materials management. The exercise of developing such strategies is expected to promote better knowledge of the current situation and estimations of future challenges, help to set national standards and targets for proper waste management and resource saving, set clearer mandates for central and local governments, and facilitate inter-agency and multi-stakeholder collaboration.

[3] www.gpn.jp: site accessed in December, 2009

In China the concept of Circular Economy has been a major component of developmental and environmental policies since the late 1990s. Through this concept, China has tried to shift its strategies for environmental management from the end-of-pipe approach to integrated life cycle management. The Chinese government started to promote the Circular Economy Policy through legislation, policy-making, regional planning, pilot projects and other methods. Since late 2005, a number of pilot projects such as Eco-Industrial Parks were initiated nationwide to demonstrate the concept of Circular Economy. One of the most important steps in promoting this policy is the Circular Economy Promotion Law which entered into effect in 2009. This law provides economic incentives for industrial activities with the aim to promote energy and water efficient technologies, infrastructure, and products. In addition, it defines legal responsibilities for different actors and provides sanctions for violation.

A number of Asian countries have developed similar framework laws, although in most cases with a less holistic perspective than the Chinese case. One example is the Philippines where the Ecological Solid Waste Management Act of 2000 stipulates that waste management should “maximize the utilization of valuable resources and encourage resources conservation and recovery”. In similar efforts, Bangladesh, Cambodia, Indonesia, Thailand and Viet Nam have developed national strategies on waste management and the 3Rs (reduce, reuse, recycle), which lays out the overarching objectives, key principles, and numerical targets for resource efficiency at the national level (UNCRD et al. 2009).

End-of-life management and waste treatment are complex issues where policy makers are typically trying to achieve multiple objectives. For example, for biodegradable waste it is likely that policy makers want to protect human health and water quality, minimize waste for landfill disposal, recover energy, recycle plant nutrients, limit greenhouse gas emissions, etc. In order to reach various objectives simultaneously it is necessary to introduce a number of specific regulations and instruments. In addition, as discussed in this section, it is often beneficial to have a unifying framework in the form of a national strategy, which lays down the basic principles, defines central concepts, identifies responsibilities of key stakeholders, and sets targets.

Policies for implementing Extended Producer Responsibility

One policy approach that has attracted considerable attention in recent years is Extended Producer Responsibility (EPR) (see e.g. Hotta et al. 2009). The concept was introduced in order to lessen the financial burden of local governments to collect and treat waste, especially waste that is difficult and costly to treat or recycle in a safe manner. This was achieved by

putting the financial responsibility for treatment or recycling on the producers of those products. The EPR approach can also create incentives for producers to redesign their products for easy end-of-life treatment.

Since EPR-based policies have managed to increase recycling rates and reducing landfill disposal in OECD countries, the EPR concept is now attracting attention from developing countries and countries with economies in transition. However, the establishment of EPR-based waste management and recycling mechanisms require a set of well coordinated policy instruments (Figure 3).

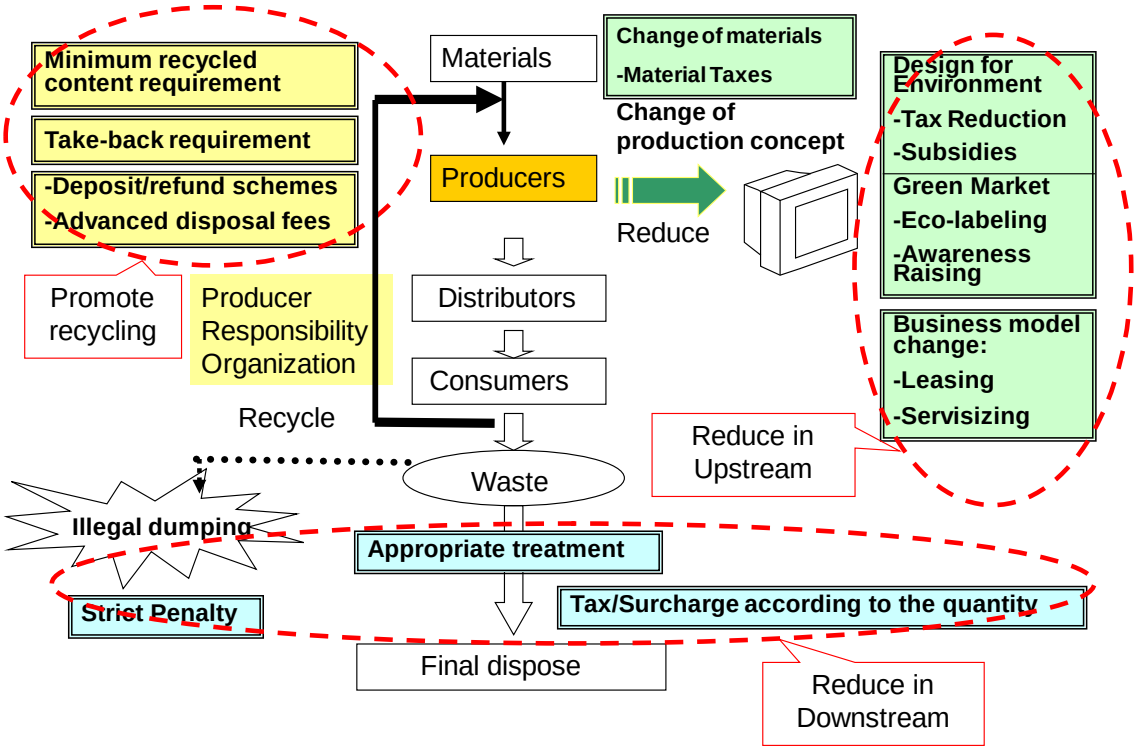


Figure 3. Policy instruments for EPR-based recycling of electronics
Source: UNESCAP and IGES (2006)

To promote resource circulation, several types of policy tools can be used. Take-back requirements for producers and minimum recycled content requirements are examples of command-and control instruments. Public awareness campaigns – an information tool – can be used for increasing collection rates from households. In addition, economic tools such as deposit-refund schemes can be used to further strengthen the collection of end-of-life products for recycling.

To reduce resource consumption and to promote design for the environment, market instruments such as tax reductions or subsidies can be used. Similarly, to establish markets for products including recycled materials, information tools such as eco-labels and awareness raising campaigns can applied be in addition to green public procurement policies. Also economic instruments such as subsidies or taxes may be helpful in shifting business models towards leasing and service provision as alternatives to the sale of products.

Combinations of policy tools can also be instrumental for establishing appropriate mechanisms for recycling and waste treatment. Technical standards for recycling as well as tax reduction for investments in certain equipment can promote environmentally sound treatment of recyclables. Treatment charges, such as a landfill tax, can provide incentives to reduce waste generation. However, the introduction of landfill taxes can increase illegal dumping and there might be a need to strengthen the monitoring and to increase the sanctions.

This example illustrates the need for policy makers to consider whole life-cycles of products and to regard these from a systems perspective. For complex policy problems related with products and materials, interventions at several life-cycle stages using multiple instruments are usually needed.

5. Conclusions: Towards more effective policy approaches

This report introduces the four main types of environmental policy instruments and illustrates how they can be employed for sustainable materials management based on a life-cycle perspective. Regulation based on command-and-control remains the basis for policy making on environment and resources, but other policy tools which allow for more flexibility in compliance are gaining ground. However, there is no such thing as the perfect policy tool; they all have their respective strengths and limitations and a careful matching of the policy problem at hand and the instrument (or instruments) to use is necessary. In addition, as argued throughout the report, instruments often need to be combined for effective implementation. Several examples are provided showing how such instrument mixes can be developed.

While policies addressing the resource extraction stage and products' end-of-life treatment have important roles to play in sustainable materials management, this report argues that the production and consumption stages should be the main focus of attention. For example, while polices targeting forestry directly are important, it is not until sustainable patterns of consumption of forest products have been established that a sustainable resource management for materials coming from the forest sector can be ensured.

The report recommends governments to conduct systematic assessments of how existing policies, including also non-environmental policies, influence materials management and resource efficiency. Key material flows need to be identified, appropriate targets need to be set and coherent and effective policy frameworks need to be put in place. When devising new policies it is important to consider what objectives can be reached by modifying existing policies and where new policies, or instrument mixes, are needed. A patch-work of overlapping and conflicting policies should be avoided and the combined effect of polices employed at different levels of government (national, provincial, municipal) needs to be considered.

The report observed that for most products and systems there is a spread in environmental performance and resource efficiency, ranging from laggards to frontrunners. Policies can play three different roles in relation to this distribution of products/systems: 1) editing out the worst ones from the market, 2) increasing the market share of the ones that are better than average, and 3) stimulate innovation towards even more sustainable solutions. It is argued that these three functions may require different policy instruments.

A review of policy tools found that *command-and-control instruments* are the most widely

used in environmental policy making. Despite the drawbacks of these instruments (lack of flexibility and adaptation to the circumstances of each regulated entity), they are expected to remain the cornerstone of polices towards sustainable materials management. The report argues that command-and-control instruments can be more effective if they are designed and introduced with some flexibility. Consultations with key stakeholders, prior notice, and step-wise introduction can be beneficial in this respect.

Economic instruments were found to have an important role to play, mainly due to reduced compliance costs and continuous incentives for innovation and improvement. However, the literature indicates that economic instruments are currently underutilized. It is assumed that one reason is that policy makers are not well familiar with these tools yet. It deserves to be pointed out that effective implementation of economic instruments requires appropriate institutional capacity. In this respect they do not significantly differ from command-and-control approaches. Environmental and resource taxes have the advantage that they generate revenue, an important point not at least in developing countries where public authorities are typically underfunded.

Voluntary agreements have sometimes been proposed as alternatives policies based on command-and-control or economic incentives. However, there is little evidence in the literature that such agreements have been particularly effective and that they could be successfully used instead of more traditional policy tools. In those cases where voluntary approaches have had positive effects there has generally been a credible “threat” from policy makers that harder tools may be used if significant improvements are not made.

Information disclosure and labelling have had effects in some cases where the circumstances have been favourable, particularly in situations where key stakeholders have a high level of environmental awareness and where the stakeholders have had also economic incentives to act on the information provided. These tools cannot therefore be recommended as an alternative to command-and-control and economic instruments in general. They can, however, play very important roles as complements to other instruments, for example by providing information to key actors on how to reduce costs when an environmental tax is introduced.

Both voluntary agreements and informational instruments have a role to play in the policy maker’s toolbox, but they should be regarded as complements to other tools rather than replacements. In developing countries, where regulatory capacity is typically low, there is a temptation to employ policy instruments that are easy and quick to develop, such as voluntary agreements. However, such an approach is not recommended since experience shows that

voluntary agreements are most likely to be effective when used as a complement to other instruments, and when the regulator has enough capacity to introduce other – stronger – instruments in case the objectives are not met through the voluntary actions.

There is unfortunately no silver-bullet that can ensure that ambitious environmental targets are achieved with only limited regulatory efforts. Effective and efficient policy making towards sustainable resource management requires adequate human and financial resources. There is no way around the need for governments to strengthen the capacity of related ministries and agencies to develop and implement appropriate policy frameworks and well designed policy mixes.

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