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UNIDO Green Industry

Policies for supporting Green Industry



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION



Green Industry

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UNIDO GREEN INDUSTRY

POLICIES FOR SUPPORTING GREEN INDUSTRY



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Vienna, May 2011

FOREWORD

The overarching objective of the United Nations Industrial Development Organization (UNIDO) is to reduce poverty through sustainable industrial development. We aspire for every country to have the opportunity to grow a flourishing productive sector, and to increase their participation in international trade, while simultaneously safeguarding their environment.

In a sense, therefore, meaningful industrial development must be green industrial development.

We in UNIDO launched our Green Industry initiative in order to provide the international community, national governments and the private sector with a platform for fostering the positive role of industry in achieving sustainable development.

The Green Industry vision grasps the potential for industries to decouple economic growth and revenues from excessive and increasing resource use and pollution. It foresees a world where industrial sectors minimize waste in every form, utilize renewable resources as input materials and fuels, and take every possible precaution to avoid harming workers, communities, climate, or the environment. Green industries will be creative and innovative, constantly developing new ways of improving their economic, environmental and social performance.

This “Policies for supporting Green Industry” identifies the policies and best practices that can make this vision a reality. It covers a broad range of policy instruments, with particular focus on the relevance of such policies to the development of industry.

I believe that this document will serve as an important starting point and ongoing reference source for governments as they seek to harness green industries for development. It will also act as a much-needed benchmark for relevant country assessments and programmes.

No country should be denied their potential to participate in the next industrial revolution – and the next industrial revolution will most certainly be green. It is my conviction that this policy paper will provide a solid basis for Green Industry for all.

Kandeh K. Yumkella

Director-General, UNIDO

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EXECUTIVE SUMMARY

INTRODUCTION

This report identifies the broad range of policy measures required by national or federal governments to promote and facilitate the greening of industries. It has been prepared as part of the United Nations Industrial Development Organization (UNIDO) Green Industry initiative, which focuses on ways that developing countries can green their industries and accelerate growth in their environmental goods and services sector. One of the key objectives of the initiative is assessing the effectiveness of governments in developing countries in supporting the greening of their industries through national strategies, policies and integrated governance structures.

The report focuses on Small to Medium Enterprises (SMEs) in the manufacturing sector. However, the issues raised are equally relevant for other industry sub-sectors (e.g. services and extraction sectors). Emphasis is placed on policies which impact sustainable production rather than consumption, although it is acknowledged the two concepts are inextricably linked.

The policies and initiatives identified in this report cover a broad spectrum of issues, involving multiple government and non-government stakeholders, underscoring the need for strong institutional integration, and a comprehensive mix of supporting policy initiatives.

GREENING INDUSTRIES – THE CONCEPT

Developing countries need to expand their industrial sector to alleviate poverty, deliver goods and services, create jobs, and improve standards of living. However, many countries face severe environmental degradation and resource depletion, which threaten opportunities for sustainable economic growth.

Green Industry promotes sustainable patterns of production and consumption i.e. patterns that are resource and energy efficient, low-carbon and low waste, non-polluting and safe, and which produce products that are responsibly managed throughout their lifecycle. The *Green Industry* agenda covers the greening of industries, under which all industries continuously improve their resource productivity and environmental performance. It also aims to create green industries, that deliver environmental goods and services in an industrial manner, including, for example, waste management and recycling services, renewable energy technologies, and environmental analytical and advisory services.

The greening of industries has become a core determinant of economic competitiveness and sustainable growth. Since resource inputs represent an important production cost for industries, improving efficiency gives industries a competitive advantage. The greening of industries also plays a role in poverty alleviation, through promoting energy security, health and safety, jobs, and reducing costs through increased productivity.

A POLICY FRAMEWORK FOR GREENING INDUSTRIES

The policy and practice measures identified in this report have been organized into five themes, which reflect the nature of policy instruments, the issues, and the players involved. The policies for each theme are summarized below.

An integrated framework to support the greening of industries

The greening of industries requires effective and coordinated governance regimes to champion and support the implementation of green industry policies and initiatives. Clear government commitment needs to come from the top, with supporting leadership throughout the public sector. Policy and institutional integration is paramount, and this can be supported by clear processes for integrating environmental, social, and economic goals, along with

national strategies for implementing goals across responsibility areas. Policy integration should take place both “vertically” between different tiers of government; and “horizontally”, between different sectors of government.

Governments can support the greening of industries through effective policy development and implementation. Consultation with business and other stakeholders is imperative during all policy development processes and governments can establish consultative bodies or taskforces which may include representatives from the community, non-governmental organizations (NGOs), industry, trade unions etc. Policy indicators are instrumental to policy development as a means of tracking progress against policy targets and to assess the effectiveness of implementation programmes. Finally, governments need to be innovative and think strategically in developing policies targeted towards the greening of industries.

Creating an enabling environment

The overall policy framework of a country has an important influence on the greening of industries, as it provides the environment through which industrial changes can take place.

Financial institutions are important for supporting new business opportunities and the development and dissemination of new technologies. Governments can use environmental financing as an instrument for promoting resource efficiency measures through financial institutions or independent funds.

Demand conditions play an important role in stimulating new market opportunities, and improving environmental practices amongst firms. Governments around the world are using green public procurement to pursue social and environmental goals, and as a means of creating demand for green products and services.

Governments should phase out environmentally harmful subsidies through subsidy reform processes, or transitional processes in cases of political or social resistance. Subsidies and protection measures lead to underinvestment in new and more efficient technologies.

Governments can harness the global benefits of resource efficient industries through international cooperation and trade and investment policies. Multinational enterprises are increasingly taking a pro-active approach to global environmental problems, which are often addressed by multilateral agreements. Trade agreements can help strengthen the enforcement of environmental laws, besides raising the level of industry standards.

The provision of infrastructure to support the greening of industries (e.g. wastewater treatment, recycling facilities, and sustainable energy supplies) should be a priority for governments. Mobilising resources for infrastructure development remains a considerable challenge for governments, and therefore, efforts should be made to leverage financing from private sector partnerships, Foreign Direct Investment (FDI), and country cooperation.

Finally, the greening of industries is encouraged through supporting local communities that are well educated about the environmental, social, and economic benefits of resource efficiency, cleaner production, and responsible life cycle analysis. Education and training for resource efficiency should be undertaken as a continuing commitment throughout the educational curriculum.

Supporting industry-led initiatives

Governments can positively influence the internal decision-making processes within enterprises through policies and incentives that promote improved production efficiencies and environmental management. Long-term partnerships between governments and business are important in fostering improved efficiencies and environmental management.

Government initiatives that promote capacity development in areas such as cleaner production, eco-efficiency, pollution control and lifecycle management are very beneficial for the greening of industries. Training and demonstration programmes are important for creating the skills required to implement resource-efficiency initiatives. Moreover, industry clubs or associations are a useful means of promoting policies and resource-efficient practices.

Industry-led initiatives such as eco-labelling, Environmental Management Systems (EMSs), standards, corporate social responsibility and environmental accounting can be promoted by governments through incentives and funding support. Policies should be designed to promote pro-active actions, rather than providing a means of avoiding compliance.

Governments can promote responsible life cycle analysis through initiatives such as Extended Producer Responsibility and through standards and assessments required for green supply chain networks.

Harnessing environmental technologies

Science and technology plays a vital role in encouraging manufacturing industries towards using sustainable patterns of production and economic growth. Since most developing countries make technological advancements by adapting and adopting pre-existing technologies, government assistance programmes should facilitate both the absorption and diffusion of new technologies. Capacity development and technology transfer can be achieved through the provision of information, demonstration projects, technical assistance programmes, workforce training, and the support of technical institutions (e.g. Cleaner Production Centres, Centres of Excellence).

Governments can facilitate knowledge transfer and the diffusion of environmental technologies through infrastructures such as science parks, clusters, incubators, global networks etc. Financial support instruments, such as Research & Development (R&D) grants, tax-breaks, and venture capital funds are important for supporting the development and widespread use of environmental technologies. Governments should support strategic R&D programmes linked to industry, as a means of providing science platforms to leverage new environmental technologies.

Finally, an integrated and strategic science system is needed to support the greening of industries, which includes coherence between environmental and innovation policies. Governments can employ techniques such as environmental scanning to keep abreast of new technological breakthroughs.

Instrument mixes to promote the greening of industries

No single instrument can effectively promote the greening of industries. Governments need to ensure that they have an optimal mix of instruments in place, which are supported by national strategies and integrated policy frameworks. Policy instruments need to be championed, designed, adopted and implemented by all levels of government – i.e. at the local, state, national and international levels and across all relevant policy sectors. Furthermore, instrument mixes should be flexible and broad-based, and should not overlap in their application.

Policy frameworks targeting the greening of industry should comprise a mix of market-based, regulatory, voluntary, and information-based instruments. Governments should consider Market-Based Instruments (MBIs) such as taxes, charges, tradable permits as least-cost policy instruments, which spur technological innovations. Moreover, successful implementation of MBIs requires a system of monitoring, revenue collection and enforcement. Regulatory policies (e.g. norms, standards and abatement policies) form the basis of most environmental management regimes. To be effective, regulatory policies should be flexible and well-designed so not to stifle technological innovations.

Voluntary Agreements (VAs) can be a useful tool for governments to help raise industry awareness, and can offer more ambitious goals than regulations, while lowering administrative and enforcement costs. However, it is generally accepted that VAs are most useful when used in combination with other policy instruments. Likewise, information-based instruments (e.g. eco-labelling, public disclosure) can strengthen the effectiveness of other policy measures, such as environmental taxes.

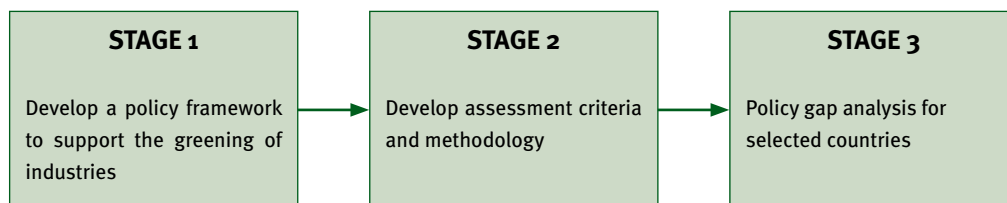
Environmental monitoring and reporting systems should be established to identify violations and to assess whether policies have been effective over the long-term. Indicators should form part of all monitoring and enforcement regimes, as a tool to simplify, quantify, and communicate environmental data. Effective compliance regimes should include a combination of promotion, monitoring, and enforcement tools, which are mutually supportive. Methods to promote compliance, such as education, training and outreach, are an important feature of enforcement and compliance regimes.

1. INTRODUCTION

This report outlines a policy framework to support the greening of industries in developing countries and countries in transition. More specifically, the report identifies the broad range of policy measures and considerations that should be adopted by national or federal governments to promote and facilitate the greening of new and existing industries. The framework is not intended to provide a “one size fits all” policy approach to supporting the greening of industries. Rather, it is intended as a benchmark so that gaps, weaknesses, and opportunities can be identified.

The report has been prepared as part of UNIDO’s Green Industry Strategy, which focuses on ways that developing countries can green their industries and expand their environmental goods and services sector. An important part of this Strategy is providing guidance to governments in developing countries on how their policy and institutional regimes can better support the greening of industries.

To support their policy guidance role, UNIDO has prepared a 3-stage policy programme to determine how well policies and institutions in selected countries support the greening of industries. This report comprises Stage 1 of a three-stage process outlined below.



It is acknowledged that some of the policies and initiatives outlined in this report may not be relevant to all developing countries. For example, some policies may not fit within a particular culture or value system, or stage of political or economic development. However, achieving a robust and effective management regime is an evolutionary process, which requires the ongoing commitment of governments, policy makers, industries, and communities in years to come.

This report draws extensively from existing literature, including publications from international agencies, such as the Organisation for Economic Co-operation and Development (OECD) and the Asian Development Bank (ADB).

1.1 FOCUS

The report focuses on SMEs in the manufacturing sector. However, the issues raised are equally relevant for other industry sub-sectors (e.g. services and extraction sectors). Furthermore, emphasis is placed on policies which impact on sustainable production, rather than consumption. It is acknowledged, however, that sustainable production and consumption are inextricably linked. Finally, the report focuses largely on policies that promote the greening of new and existing industries, rather than policies targeted towards expanding the environmental goods and services sector.

1.2 STRUCTURE

The policy framework presented in this report has been organized into five themes, which reflect the nature of policy instruments, the issues, and the players involved. Policy measures contained in one theme will inevitably intersect with others. The five themes are as follows:

- **An integrated framework to support the greening of industries:** This chapter covers the development of national strategies, institutional integration, policy implementation, and the potential role of transition management in greening industries.
- **Creating an enabling environment:** This chapter outlines some important “enabling conditions” that governments can influence to support the greening of industries. Measures include the removal of harmful subsidies, green procurement, financial support structures, harnessing the benefits of globalisation and trade agreements, resource-efficient infrastructures, support for local action, and developing the skill-base necessary to support the greening of industries.
- **Supporting industry-led initiatives:** This chapter outlines a broad range of industry-led initiatives supported by governments to promote efficiencies and environmental improvements. Initiatives include environmental management systems, eco-labels and certification, life cycle analysis, green supply chains, extended producer responsibility, corporate social responsibility, raising awareness and capacity development.
- **Harnessing environmental technologies:** This chapter discusses the role of governments in facilitating the creation and diffusion of environmental technologies. Emphasis is given to the importance of technical capacity, building a science base, financing technology development, technology diffusion, science networks, collaboration, and infrastructure.
- **Instrument mixes to promote the greening of industries:** This chapter outlines a range of policy instruments used by governments to promote sustainable production and sound environmental management. The instruments have been classified into MBIs, regulatory instruments, voluntary initiatives, and information-based instruments. Robust monitoring, compliance and enforcement regimes are discussed in the final part of the chapter.

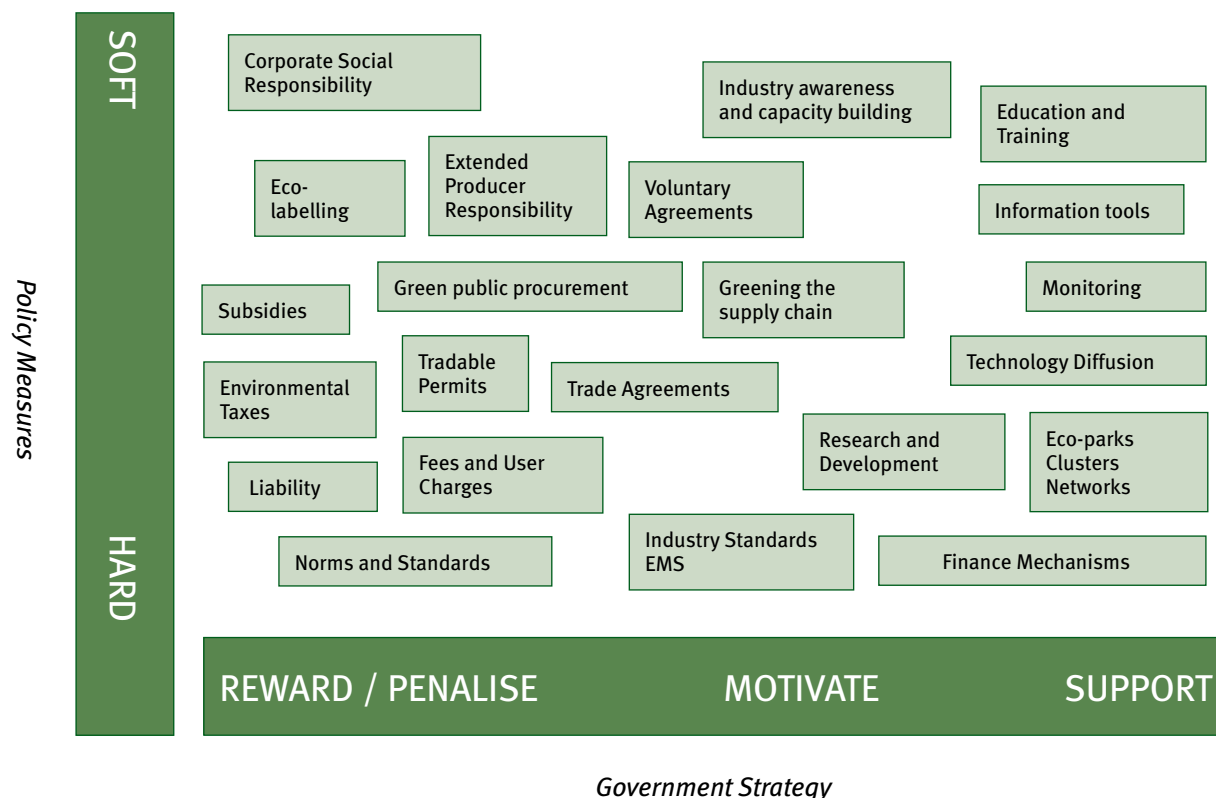
The final chapter summarizes the broad range of policy and practice measures outlined in the report. These policy and practice measures will contribute to Stage 2 of the green industry policy programme, which involves developing an assessment framework for reviewing policies and institutions in developing countries.

1.3 GREEN INDUSTRY POLICY

From a public policy perspective, the greening of industries is a cross-cutting exercise, which traverses a range of policy streams. These include industrial policy (e.g. technology development), environmental policy (e.g. resource conservation measures), and regional development policy (e.g. provision of local infrastructures). Within this policy context, UNIDO is exploring the notion of “greening” industrial policy, in which institutional processes promote the comparative advantage for resource efficient and low polluting sectors of the economy. For the purposes of this report, “green industry policies” refer to the broad range of government interventions which directly or indirectly support the greening of industries.

As illustrated in Figure 1 (below), the policies outlined in this report contain a mixture of hard and soft measures aimed at rewarding/penalising, motivating, and supporting SMEs. This illustrates the point that a broad policy mix which combines a “carrot and stick” approach, and broad-based awareness raising is necessary to achieve the overall goal of greening industries.

FIGURE 1: POLICY MATRIX FOR THE GREENING OF INDUSTRIES



Source: Adapted from CSCP, WI & GTZ (2007).

1.4 GREENING INDUSTRIES - THE CONCEPT

UNIDO's Strategy (A greener footprint for industry), describes green industry as a two-pronged endeavour to decouple resource use and pollution from industrial development and promote the growth of productive sectors and entrepreneurs in developing and transitioning countries.

- Greening of industries** – ensuring that all industries, regardless of sector, size or location, continuously improve their environmental performance. This includes commitment to and actions aimed at reducing the environmental impacts of processes and products through using resources more efficiently, phasing out toxic substances, substituting fossil fuels with renewable energy sources, improving occupational health and safety, taking increased producer responsibility and reducing the overall risks.
- Creating green industries** – stimulating the development and creation of industries that provide environmental goods and services. Green industry is a growing and diverse sector that covers all types of services and technologies aimed at contributing to reducing negative environmental impacts or addressing the consequences of various forms of pollution. This includes material recovery, recycling companies, waste management and treatment companies, as well as companies that transport waste. Further examples include engineering companies that specialize in wastewater treatment, air pollution control and waste treatment equipment. The sector also encompasses environmental and energy consultants, in addition to the providers of integrated solutions, for example, energy service companies (ESCOS) that offer design, implementation of energy saving projects, energy conservation, energy infrastructure outsourcing, power generation, energy supply, and risk management. A central segment of the sector is monitoring, measuring and analysis providers. Green industries also include companies that manufacture and install renewable energy equipment and companies that develop and produce clean technologies.

This dual approach promotes sustainable patterns of production and consumption i.e. patterns that are resource and energy efficient, low-carbon, low waste, non-polluting, safe, which produce products that are responsibly managed throughout their lifecycle.

While Green Industry approaches are relevant to all types of enterprises, of all sizes and in all sectors, UNIDO focuses on small and medium enterprises that engage in industrial processing, manufacturing and service providers. These small and medium industries are the most critical for the early stages of industrialization and are typically the largest job creators. This includes enterprises that process raw materials, converting raw materials into sub-products or products, including enterprises in the green industry sector.

1.5 THE CONCEPT OF DECOUPLING

The concept of “decoupling” is central to greening industries and sustainable economic growth. Essentially, the concept breaks the link between environmental ‘bads’ and economic ‘goods’. Decoupling occurs when the growth rate of an environmental pressure is less than that of its economic driving force (e.g. Gross Domestic Product (GDP)) over a given period (OECD, 2002). Decoupling can be relative or absolute. Absolute decoupling occurs when the environmental pressures are stable or decreasing while economic growth continues to increase. Relative decoupling occurs when environmental pressures are continuing, but at a lesser rate than the economic variable. Policy makers can use the decoupling concept to measure the effectiveness of resource and energy efficiency measures.

1.6 A SYSTEMS APPROACH TO GREENING INDUSTRIES

This report reflects an emerging school of thought that goes beyond life cycle assessment. In seeking to redesign technological processes and minimising negative impacts, a new “cradle to cradle” approach is starting to evolve that considers waste from one process as a resource for another process. This new approach has resulted in changes in the way policies and supporting infrastructures are designed and how science is conducted. Such change is characterised by a multi-disciplinary approach with a shift in focus towards “systems” of production and use.

The adoption of more integrated and systematic methods to improve sustainability performance has laid the foundation for new business models and approaches to management. Efforts to create closed-loop circular production systems have focused on revitalising disposed products into new resources for production (Figure 2).

FIGURE 2: THE EVOLUTION OF SUSTAINABLE MANUFACTURING CONCEPTS AND PRACTICES

| | | |
|------------------------|---------------------|---|
| Pollution Control | <i>Treat</i> ↓ | Implementation of non-essential technologies End-of-pipe solutions |
| Cleaner Production | <i>Prevent</i> ↓ | Modify products and production methods Process optimization; lower resource input and output. Substitution of materials: non-toxic and renewable |
| Eco-efficiency | <i>Manage</i> ↓ | Systematic environmental management Environmental strategies and monitoring, Environmental management systems |
| Life cycle Thinking | <i>Expand</i> ↓ | Extending environmental responsibility Green supply chain management, corporate social responsibility |
| Closed-loop production | <i>Revitalise</i> ↓ | Restructuring of production methods Minimising or eliminating virgin materials |
| Industrial Ecology | <i>Synergise</i> ↓ | Integrate systems of production Environmental partnerships, eco-industrial parks |

(Source: OECD, 2010)

The realisation that industrial systems can mimic biological ecosystems, in which one organism's waste is the source of food for another organism, has led to the concept of "industrial ecology". One of the strengths of industrial ecology is its "systems" view of patterns of production, consumption, and resource recovery – all perceived in their context in natural systems. One of the basic principles of systems approaches like industrial ecology is that planning for greater resource efficiency and reduced pollution must be integrated across resource flows, economic sectors, public and private activities, and both short and long-term time horizons (ADB & IGES 2008).

2. POLICY CONTEXT

2.1 INTRODUCTION

The purpose of this chapter is to “set the scene” for policy development and to provide context to the policy framework presented in this report. First, the socio-economic conditions in developing countries are discussed to highlight the relevance and demand of green industry policies and supporting institutions. A brief discussion outlining the benefits of greening industries follows, which includes economic benefits and links to poverty alleviation. Some of the challenges encountered by governments include issues such as market and policy failures, lack of resources, government and institutional failures, and industry resistance to policy changes. The final part of this section discusses the importance of greening industries to SMEs.

2.2 THE SOCIO-ECONOMIC CONDITIONS OF DEVELOPING COUNTRIES

Developing countries need to expand their industries to alleviate poverty, deliver goods and services, create jobs, and improve standards of living. Yet, the social and economic conditions in developing countries make the facilitation of greening industries a challenging undertaking. Compared to developed countries, most developing countries are characterised by conditions such as low standards of living, low levels of productivity, relatively high rates of population growth, dependence on primary exports, and rapid rates of urban growth.

The quality of economic growth, in the context of sustainable development, can mean different things in different countries and regions. For example, in the Asia and Pacific region there has been a combination of rapidly expanding economies and consumption pressures, as well as a natural resource base that is more limited than any other in per capita terms. Thus, a focus on meeting human needs and improving well-being with the lowest possible ecological cost is particularly relevant (ESCAP, 2008).

2.3 WHY THE GREENING OF INDUSTRIES?

While developing countries need to expand their industries, unsustainable economic growth is resulting in resource depletion and severe environmental degradation. In many countries, production and consumption patterns are outpacing the renewal capacity of natural resources and the capacity of local governments to manage waste products. The greening of industries by governments is a proactive way to decouple environmental pressures from economic growth.

2.3.1 Economic benefits

Since the late 1700s, economic upswings have occurred every 30-50 years which can be attributed to technical breakthroughs (e.g. steam engine, electricity, cars, radio/TV, biotechnology). Experts now suggest that the next (ongoing) industrial wave encompasses “green technologies”, with energy and resource efficiency at its core (Weizacker et al 2009). Given the limited supply of energy and other natural resources, there is a sound economic argument that *resource productivity* and *eco efficiency* should be at the fore of this new green wave.

For most industries, increasing resource efficiency in production is not a response to environmental concerns or objectives. It has become a core determinant of economic competitiveness and sustainable growth. Since resource inputs represent an important cost of production for industries, efficiency improvements can be a significant lever for competitive advantage (SERI, 2009). Moreover, reductions in production costs can result in lower prices for consumers.

Some of the economic arguments behind resource efficiency as a means of transforming and stimulating the economy are highlighted by the *Natural Edge Project* (refer Weizacker et al 2009). First, investments in resource productivity, such as building energy efficiency have a higher economic multiplier than general expenditure. This is because in addition to improving productivity, resource efficiency investments provide a tangible financial return on investment.

Second, investments in improving resource efficiency and recycling reduce the demand for energy, water and virgin resources, thus reducing the need to invest billions on new energy and water supply infrastructure and new extractive industries. For example, The International Energy Agency (IEA) estimates that if countries focused on boosting energy efficiency, they could not only provide a 10 per cent reduction in global demand by 2030 but also have saved US\$ 560 billion. There would also be lower investment requirements since it has been estimated that every US\$ 1 invested on the demand-side management of electricity can save more than US\$ 2 of investment in the power sector – or almost US\$ 3 in developing countries (ESCAP, 2008a).

2.3.2 Creating jobs

Jobs are created through the greening of industries. The number of green jobs is already on the rise with the most rapid expansion being seen in the renewable energy sector. For example, current employment in renewables and supplier industries stands at a conservatively estimated 2.3 million worldwide. Basic manufacturing industries such as steel, aluminium, cement and paper are starting to stimulate green jobs through scrap use, greater energy efficiency, and reliance on alternative energy sources. Secondary scrap-based steel production requires up to 75 per cent less energy than primary production. Worldwide, 42 per cent of steel output was based on scrap in 2006, possibly employing more than 200,000 people (Renner, Sweeney & Kubit, 2009).

The environmental goods and services industry is likely to expand significantly in the future. More stringent legislative requirements coupled with investments in infrastructure have created a growing demand for services and products directed towards cleaner technologies, reductions in environmental risk, and resource management (including recycling and resource recovery). The growing focus on resource efficiency, productivity and competitiveness will increase the demand for “next-generation” environmental services targeted towards renewable energy and resource efficiencies. For example, it is estimated that India alone could create some 900,000 jobs by 2025 in biomass gasification. Of this, 300,000 jobs would be with manufacturers of gasifier stoves (including masons, metal fabricators) and 600,000 would be in biomass production, supply chain operations, and after-sales services. Another 150,000 people might find employment in advanced biomass cooking technologies (The Energy and Resources Institutes, 2009).

2.3.3 Alleviating Poverty

The greening of industry has an important role to play in poverty alleviation. First, greater efficiency in resource use over the life cycle of goods and services results in improved productivity and consequently, reduced costs. Growth in consumer demand for sustainable products can provide sustainable producers in developing countries with access to new markets (e.g. environmental goods and services), job opportunities, and price premiums for their products – all of which can facilitate the transition towards a green economy. Moreover, the greening of industry can provide development opportunities in instances where labour intensity (and associated employment) replaces a high dependency on inputs or energy-intensive mechanised processes. Environmental sustainability initiatives can also be part of a wider shift towards socially and economically responsible production and consumption, which can further strengthen poverty alleviation benefits (UNEP, 2009).

The greening of industries is a means of promoting energy security in developing countries. Without access to ample, reliable and affordable energy, economies cannot develop. The IEA’s outlook to 2030 of global energy supply and demand trends estimates that 1.6 billion people (one quarter of the world population) have no access to electricity and that in the absence of vigorous new policies, 1.4 billion people will continue to lack electricity in 2030. Currently, four out of five of these people live in rural areas of the developing world, mainly in South Asia and sub-Saharan Africa (Mandil, 2003).

The greening industries can improve health conditions in developing countries through access to clean water (resulting from water supply infrastructures and protection programmes), clean energy (from decentralised renewable energy programmes), and improved nutrition from sustainable agricultural practices. Greening industries can also help build resilience to environmental risks by reducing direct harmful exposure to pollutants (e.g. those in air, water, food and solid waste) in developing countries.

2.4 THE CHALLENGES OF GREENING INDUSTRIES

Many countries face severe environmental degradation and resource depletion which threaten opportunities for sustainable economic growth and industry development. Patterns of industry often rely heavily on inefficient use of energy, water, and other resources while noxious emissions and effluents, along with other forms of pollution, go largely unchecked. The manufacturing sector alone accounts for a significant part of the world's consumption of resources and generation of waste. Worldwide, the energy consumption of manufacturing industries grew by 61 per cent from 1971 to 2004 and accounts for nearly a third of today's global energy use (OECD, 2010).

In recent years, countries facing environmental pressures are increasingly aware of these environmental problems and are making some noteworthy improvements to their environmental management and industry development regimes. However, many continue to face formidable political, institutional, and resource-based constraints in trying to foster the greening of industries and promoting sustainable economic growth.

The barriers faced by both developed and developing countries seeking sustainable growth are plentiful and complex, but can broadly be attributed to a combination of market and policy failures, poor resources, and weak political commitment and governance.

2.4.1 Market and policy failures

Market failure refers to situations where markets fail to price goods and services at their true costs to society as a whole. In other words, environmental costs are externalised and shifted from the polluter to the broader society. One of the reasons for these externalities is a lack of clearly defined and enforced property rights. In some cases, efforts are needed to define such rights, along with providing a low cost enforcement regime. However, even where complete property rights to a resource exist and markets are efficient, private-property rights do not always result in efficient resource use. Under certain circumstances, individuals and industries will overexploit resources they privately own, even when property rights are secure (Acheson, 2006).

While government intervention may be needed to correct market failures, government manipulation of market prices may also be a source of problems. Some of these price distortions include input subsidies (e.g. to encourage the use of fertilizer or irrigation water) and energy subsidies with predictable wasteful use. These price distortions lead to excessive consumption of energy and natural resources per unit of output. Reducing price distortions is an important step toward the greening of industries.

History shows that successful efforts to decouple economic growth from environmental pressures have been underpinned by effective policy which addresses a range of market, institutional and information failures. There is no evidence that markets and economic growth, on their own can achieve significant and lasting decoupling of growth from environmental pressures. (The Natural Edge Project, 2008).

2.4.2 Lack of resources

Human, technical and financial resources are often tightly constrained in many countries, which severely limits government efforts in promoting sustainable industries. Regulatory approaches to environmental management can place heavy demands on government resources. In developed countries, financing of environmental solutions is often through the private sector via the use of economic instruments. Enterprises and industries in developing countries do not have the resources or expertise to adopt new green technologies, despite the long-term economic and environmental advantages in doing so (OECD, 1992).

2.4.3 Government and institutional failures

Many countries are constrained by weak political commitment and lack suitable legal and policy frameworks when trying to address the environmental challenges they face. Natural resource management is generally not the primary goal of governments, and environment agencies lack power compared to finance, trade, and indus-

trial development ministries. “Grow now, clean up later” seems to be the approach taken by weak and under-resourced environmental regulatory institutions.

Governments are not always well equipped to deal with the cross-cutting and long-term nature of many environmental challenges. Environmental protection, innovation, public health, industrial growth, trade and investment are all seen as separate policy issues and their inter linkage is rarely understood or acted upon. Many governments, including those in the developed world, have failed to address the range of these issues in an holistic way creating a common vision of sustainable development, and more specifically, green industry. This leads to an unsustainable tension between environmental policies and industrial development.

2.4.4 Industry resistance and lobbying

Although evidence shows that much can be done to decouple business profits and overall economic growth from environmental pressures and pollution, many business leaders, politicians and decision makers assume that significant trade-offs are inevitable. As such, industries, businesses and political leaders have not made the necessary investments in infrastructure, industry, and policies etc. to underpin a sustainable economy (The Natural Edge Project, 2008).

Government efforts to introduce green industry policies are often undermined or influenced by business and industry group opposition, based on fears that environmental policies and regulation will harm business profit margins and competitiveness. This is especially true for companies who are “trade exposed” to competitors operating in low-cost regulatory environments. Political lobbying from unions and workers around potential job losses can also influence government policy processes.

2.5 Why Focus on SMEs?

As with their larger counterparts, SMEs can exert considerable pressure on the environment. This is true for both developed and developing countries. For instance, in the UK it has been estimated that they account for 60 per cent of total Co2 emissions from enterprises, and 70 per cent of all pollution (IEEP, 2006).

There are several reasons why SMEs may be slow or reluctant to adopt efficiency measures and improved environmental practices. First, SMEs are often unaware of their environmental impact or the environmental legislation affecting them. Further, many SMEs lack the in-house expertise to identify and even properly implement environmental technologies.

Second, SMEs often don't carry substantial assets or collateral and therefore have difficulty accessing conventional loans and credit. This lack of resources often leads to SMEs being risk-averse and less willing to invest in new environmental technologies; partly because the payback period of these investments is often over several years.

SMEs also tend to have a short-term economic perspective, which often results in the perception that environmental management is peripheral to core business. The way SMEs are organized and their operating procedures are significantly different from those in larger companies. SMEs are unlikely to have an environment division or a designated specialist responsible for environmental compliance and management in the company.

3. AN INTEGRATED FRAMEWORK TO SUPPORT THE GREENING OF INDUSTRIES

3.1 INTRODUCTION

The greening of industry by governments is a cross-cutting exercise which involves the complex interplay of environmental, economic and social factors. This interplay is deeply entrenched within the context of sustainable development. The emergence of sustainable development as an explicit aim has not only required greater levels of policy integration but strong institutional frameworks in the forms of new ministerial portfolios, inter-ministerial cooperation and cabinet level committees etc.

This chapter looks at best practice measures designed to support the development of an integrated framework to promote the greening of industries. In doing so, it draws on sustainable development as an overarching framework from which environmental, economic, and social objectives are considered. However, within the context of sustainable development, the greening of industries will inevitably cross into the domain of other important national-level strategies. Some of these strategies are specific to the greening of industries (e.g. national consumption and production strategies), and others more sector-based (e.g. education, energy, science strategies).

In fostering a holistic approach to the greening of industries, this chapter emphasises the need to encompass all levels of government in policy design, decision-making, and implementation. In other words, government policies and processes need to be integrated both vertically at the international, national and local level, as well as horizontally, across all relevant government sectors.

Meeting the challenges of sustainable development requires an overarching strategy or framework to achieve the necessary vertical and horizontal integration, clear processes for integrating environmental, social, and economic goals, and commitment at the highest political level.

3.2 HARNESSING POLITICAL WILL

Successful policy development for greening industries requires strong political commitment and policy leadership from influential sectors within the government (e.g. prime minister's office, finance ministers, economic development ministers), with supporting leadership throughout the public sector. The harnessing of political will ensures policies receive a prominent profile and adequate funding through the budget process. The incorporation of green industry policies into National Sustainable Development Strategies (NSDS) or national development plans is one way to ensure high-level commitment, although this depends on the level of prominence a country gives to such strategies.

The global recession has opened up new opportunities for governments to address the economic crisis and kick-start a move toward low-carbon "green" economies. The stimulus packages being rolled out in many countries are supporting the greening of industries through direct public spending on public transport, energy efficiency, alternative energy supply, water supply and sanitation systems, and pollution control. New investments being made today in energy production, buildings, and transport infrastructure will endure for decades to come.

Box 1. Leading the world - South Korea's Economic Stimulus Package

Around 80 per cent of South Korea's US\$ 38 billion fiscal stimulus package has been dedicated to green measures, the highest percentage in the world. Under full implementation, this represents an investment equal to 3 per cent of GDP. The Republic's commitment to greening its economy represents a fundamental shift in its approach to building the nation's prosperity.

In total, nearly one million green jobs will be created over the next four years, including:

- US\$ 7 billion investment in mass transit and railways - 138,000 jobs.
- US\$ 5.8 billion on energy conservation in villages and schools - 170,000 jobs.
- US\$ 1.7 billion on forest restoration stimulus - over 130,000 jobs.
- US\$ 690 million on water resource management stimulus - over 16,000 jobs.
- US\$ 10 billion investment on river restoration - 200,000 jobs.

The Republic of Korea is not the only nation to jumpstart green growth through its national stimulus packages. China, Japan, the United States, Brazil and others have launched similar efforts.

Source: Ban Ki-moon (14 April 2009) – *Korea Herald*, <http://hwwu.org/sg>

3.3 FOSTERING STRONGER INSTITUTIONAL INTEGRATION

Currently, many of the legal instruments and strategies adopted by governments are entirely sectoral in approach and are implemented by ministries focussing solely on their specific mandates. Thus, national ministries and regional and local agencies tend to work in relative isolation, despite the fact that they often introduce policies and invest in projects that have a major impact on the responsibilities and work of other agencies.

Policy integration is an uphill task even in developed countries, due to a long-standing lack of institutional coordination. In some instances, economic and sectoral policy incentives are still not promoting sustainable development patterns and practices – some even run counter to environmental objectives.

Governments can foster stronger institutional integration by decoupling the link between economic growth policies and environmental pressures, and think of potential win-win outcomes. The OECD (2008) suggests that the win-win potential is better exploited if environmental policy is transformed into sustainable development policy. This will ensure that policies for innovation, growth and sustainable development reinforce each other.

The way in which governments organize their strategies and policies around sustainable development, and more specifically green industry policies, sends strong signals about the priority they attach to it. The greening of industries requires clear processes for identifying integrated environmental, social, and economic goals; and strategies to determine how these goals are implemented across responsibility areas at all levels of government.

There is general agreement that practices leading to greater integration of objectives and actions across government should take place both “vertically”- that is between the international, national, and local tiers of government; and “horizontally” – that is between sectors of government.

3.3.1 Horizontal integration

Policies relevant to the greening of industries cut across the domains of multiple agencies. There are a variety of ways through which sectoral integration can take place within the government machinery. The most obvious is through overarching strategies and policy frameworks, which are supported by coordination mechanisms such

as inter-agency working groups, commissions of enquiry, task forces, joint research programmes etc. As with the case of sustainable development, inter-agency integration is sometimes carried out at the highest level, within presidents' or prime ministers' offices. Integration can also occur by establishing sector units within organizational structures (e.g. incorporating an environmental unit with an economic development ministry).

A key challenge for governments today is mainstreaming aspects of “green industry” policy into strategies and frameworks across relevant government portfolios – e.g. economic development, environment, health and safety, innovation, environment, and education. In many instances, government departments (e.g. environment and economic development) are preparing joint strategies, such as those addressing sustainable consumption and production.

3.3.2 Vertical integration

Vertical integration involves integration between international, national, state, and local tiers of government.

International level

Integration at the international level should be achieved through commitments such as *Agenda 21*, the *Johannesburg Plan of Implementation*, and the *Marrakech Process*. Both *Agenda 21* and the *Johannesburg Plan of Implementation* require governments to develop and implement policies and measures aimed at promoting sustainable patterns of production and consumption.

Multilateral Environmental Agreements (MEAs) are important instruments for international governance and environmental protection. Over 300 agreements have been negotiated since 1972, which have provided a platform for international cooperation to address common environmental challenges (UNEP, 2006). MEAs of particular importance to industry include the Kyoto Protocol linked to the UN Framework Convention on Climate Change (UNFCCC), Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, The Montreal Protocol on Substances that Deplete the Ozone Layer, and the Stockholm Convention on Persistent Organic Pollutants (POPs).

Once an MEA enters into force, it takes legal effect and implementation begins. While much of the “on-the-ground” implementation is done by parties at the national level through domestic legislative and administrative arrangements, MEA institutional bodies and/or agreed MEA mechanisms (such as reporting, verification or compliance mechanisms) often exist to support and ensure national level implementation.

Local level

Integration with local governments is necessary to ensure effective implementation of policies formulated at the national level. Local public services, such as town planning, waste management, and water supply are directly relevant to the greening of industries. Local governments therefore need to be active participants in the setting of consistent strategic goals and assessing the practicalities of policy implementation.

The growing move to devolve public-sector decision-making to local governments has increased the need for policy integration at the local level. Devolution holds numerous advantages in that it transfers the powers of industry development and resource management to those with the greatest understanding of local conditions and needs. Devolution does, however, present its own issues. Sometimes, national-level agencies are reluctant to relinquish their responsibilities, thus making it difficult for local governments to properly exercise their new-found responsibilities (ADB & IGES, 2008). Moreover, local governments often are not given the resources or information support needed to adequately take on their new responsibilities. A balance needs to be struck on what responsibilities are retained at the national level and what are devolved to local levels. Some factors that national governments can consider are outlined below:

- Building and strengthening the capability of local governments through oversight, implementation support, policy guidance, staff training etc.

- Establishing appropriate funding and reporting mechanisms.
- Clear allocation of responsibilities between levels of government to avoid friction, overlaps, redundancies, or lengthy procedures.
- Sharing information among national and local agencies in order to promote understanding interlinked responsibilities and facilitating coordinated decision-making.

3.4 NATIONAL STRATEGIES AND FRAMEWORKS TO PROMOTE THE GREENING OF INDUSTRIES

National strategies, programmes, and frameworks are the primary means through which government efforts to green new and existing industries will be integrated, resourced, coordinated and implemented. Policies and actions to support the greening of industries are incorporated into a variety of national-level strategies, including:

- High-level, cross-government strategies such as NSDSs, poverty reduction strategies, national development plans, national innovation strategies.
- Overarching legal frameworks (e.g. China's Circular Economy Promotion Law).
- Strategies that address the greening of industries more specifically such as national sustainable consumption and production strategies, and cleaner production strategies.
- Sector and issue-based strategies such as resource use, waste, energy, education, and health and safety.

Some countries incorporate policies relevant to the greening of industries within a national sustainable development framework (e.g. national sustainable development strategy, action plans etc). This ensures policies receive a higher profile and benefit from national processes and allocated funding. Other important strategies within the broader context of sustainable development are national programmes on sustainable consumption and production. These strategies integrate supply (production) and demand (consumption) activities in a coherent market strategy. In many cases, countries are in the process of incorporating sustainable consumption elements into revised cleaner production strategies (UNEP, 2008).

Some practice measures and country examples for the preparation of national strategies and legal frameworks, which support the greening of industries are outlined below.

3.4.1 National Sustainable Development Strategies (NSDSs)

More than 60 countries have prepared NSDSs, and they vary widely in terms of approach. For example, approaches differ in terms of whether the NSDS is 1) top-down or bottom-up; 2) horizontal or embedded in a single department; 3) underpinned by legislation; 4) linked to budget processes; 5) fully open to stakeholders; and 6) linked to local levels (OECD, 2008).

In most OECD countries, overall responsibility for implementing sustainable development strategies lies with the Ministry for the Environment, either directly or indirectly through a coordinating committee which it oversees. However, good practice is to assign overall coordination to a prime minister's office or equivalent; these have greater authority to demand inputs and resolve conflicts as compared with line ministries.

Another approach is to assign responsibility for national sustainability strategies to finance ministries, which can ensure that strategic management is linked to fiscal priority setting, national expenditure and revenue generation. Thus, Norway has placed responsibility for its sustainable development plan within the Ministry of Finance (OECD, 2008).

National sustainable development strategies should involve a range of ministries, departments and agencies. Some countries (e.g. Canada) have a bottom-up approach where individual departments formulate their sustainable development programmes in the absence of an overall strategy (see Box 2).

Box 2. Industry Canada: Sustainable Development Strategy 2006-2009

Industry Canada's Sustainable Development Strategy (SDS IV) builds on its first three strategies, which enables improved sustainability awareness and performance levels for both industry and consumers.

SDS IV is structured around three strategic outcomes (see below). The Strategy is implemented through an Action Plan.

- **Sustainability-driven technologies:**

Increased development, commercialisation, adoption and diffusion of environmental, energy and bio-based technologies.

This strategic outcome consists of a core group of action items designed to promote the development, commercialisation, adoption and diffusion of environmental energy and bio-based technologies.

- **Sustainability tools practices, research and awareness.**

Increased use by enterprises, industries, and institutions of sustainability and corporate social responsibility practices, and increased consumer awareness of sustainability issues.

This strategic outcome consists of a core group of action items designed to increase the adoption of sustainability tools and practices; and increasing consumer demand for products and services that are more sustainable.

- **Sustainability practices and operations within Industry Canada.**

Increased implementation of sustainable operations and practices, and integration of sustainable development principles into departmental planning, performance measurement and evaluation frameworks.

This strategic outcome consists of a core group of action items designed to broaden the Department's integration of sustainability policy decision-making, and improve its sustainable operations performance.

Source: www.strategis.gc.ca/sd

Many developing countries have integrated sustainable development considerations in their poverty reduction strategies. Some countries, such as Malawi or Senegal, have or are developing both an NSDS and a poverty reduction strategy. In such cases, the NSDS typically covers longer-term objectives, whereas the poverty reduction strategy concentrates on medium to short-term policies (UNDESA).

Some countries have implemented sustainable development elements into national development plans, rather than developing a separate strategy (e.g. Mexico).

3.4.2 NATIONAL STRATEGIES ON SUSTAINABLE CONSUMPTION AND PRODUCTION

More than 30 countries from around the world have developed or are in the process of developing national programmes on Sustainable Consumption and Production (SCP). These form a mixture of national frameworks, programmes, action plans, and strategies. Often, the programmes are incorporated into existing national strategies on sustainable development and poverty reduction.

There is no single policy method by which national SCP programmes can or should be instituted. UNEP (2008) has outlined some useful principles that should be observed when developing a Strategy.¹ These are:

- Obtain high-level national commitment and leadership.
- Initiate a stakeholder process.
- Define objectives, targets, indicators.
- Base the programme on comprehensive and reliable analysis.
- Build from existing national policies (e.g. integrated product policy).
- Integrate with existing national strategies.
- Develop sector or issue-based plans (e.g. resource efficiency or sustainable government procurement).

As SCP is an overarching objective of sustainable development, it is prudent, wherever possible, to incorporate SCP into a NSDS or national development plans. Countries with a NSDS, but without a SCP programme, may choose to include SCP as a priority area in future updates of the strategy.

Mauritius' SCP programme, "Achieving More with Less", was developed by the Ministry of Environment and the National Development Unit with support from UNEP (see Box 3).

Box 3. National Programme on Sustainable Consumption and Production (SCP) for Mauritius (2008-2013)

The framework of Mauritius' National Programme on SCP is based around seven strategic priority areas, which include:

- Sustainable energy consumption
- Sustainable water consumption
- Sustainable buildings
- Education and communication for sustainable lifestyles
- Integrated solid waste management and recycling
- Sustainable public service practices
- Increasing market supply and demand for sustainable products

The SCP programme comprises 44 projects under thematic priority areas listed above.

Mauritius' SCP programme reflects the cross-cutting nature of sustainable consumption and production and integrates objectives for economic development, environmental quality, public health, business sector development, energy and water savings as well as poverty reduction. The programme is both a dedicated programme on its own and a key component of the National Environment Strategy and National Environment Action Plan.

Source: www.govt.mu

3.4.3 LEGAL FRAMEWORKS THAT PROMOTE THE GREENING OF INDUSTRIES

Some countries promote their resource efficiency and environmental management strategies through integrated legal frameworks. Often, these frameworks include not only the legislation itself, but also the broader system of governance that determines the distribution of political and administrative authorities, as well as regulatory and enforcement instruments.

¹ See UNEP (2008) Guidelines for National Programmes on Sustainable Consumption and Production. Available at www.unep.org/publications.

Legal frameworks for greening industries should facilitate the integration of environmental, economic and development policies, and provide a framework and means for their implementation and enforcement.

Box 4. Circular Economy Promotion Law of the People's Republic of China

In August 2008, China passed the Circular Economy Promotion Law, which promotes initiatives related to reducing, reusing and recycling in production and consumption.

The Circular Economy (CE) approach to resource efficiency integrates cleaner production and industrial ecology into a broader system encompassing industrial firms, networks, or chains of firms, eco-industrial parks, and regional infrastructure to support resource efficiencies.

The CE initiative targets its actions at three levels:

1. At the individual firm level, the manager must seek much higher efficiency through the 3Rs of Cleaner Production.
2. Reuse and recycle resources in industrial parks and clustered or chained industries, so that resources will circulate fully in the local production system.
3. Integrate different production and consumption systems in a region so that resources circulate among industries and urban systems.

The law states that governments at all levels and across relevant departments should be responsible for organizing, coordinating and regulating the circular economy initiatives.

Source: ekh.unep.org

3.4.4 Sector and issue-based strategies: Resource efficiency action plans

Strategies aimed at improving resource efficiency are the focus of increasing worldwide interest. In Europe, for example, the European Union (EU) as well as some of its individual member States are working towards resource efficiency plans. Among the latest advances of the EU and part of its growth strategy 'Europe 2020' is the flagship initiative "Resource efficient Europe". A "Roadmap for a resource-efficient Europe" will be published in the second quarter of 2011. It aims to help decouple economic growth from resource use, support the shift towards a low carbon economy, increase the use of renewable energy sources, modernise the transport sector and promote energy efficiency.

Resources, in this context, are often interpreted in a broad sense, encompassing all natural resources, including biotic and abiotic materials, water, air, soil, energy, and partly even the systemic functions of ecosystems. Apart from achieving higher resource productivity, resource efficiency strategies are also devised to manage limited resource availability and decrease the environmental impacts resulting from resource use, i.e. to achieve an absolute decoupling of economic growth from resource use and its negative impacts.

Developing and implementing holistic and coherent national frameworks for greater resource efficiency is best done collaboratively between different experts and stakeholders from various backgrounds (see Box 5 for an illustration of the recent process in Austria).

Box 5. The process of establishing a resource efficiency action plan in Austria

In early 2011, Austrian legislature is expected to pass a Resource Efficiency Action Plan (REAP), which shall be implemented over the coming years, aiming to reduce resource consumption in absolute terms and drastically increase the Austrian economy's resource efficiency. Both goals will contribute to reducing waste, emissions and other ecologically harmful effects. Apart from these environmental benefits, REAP is also expected to help the economy. Given the continuous increase in resource prices, pioneering strategies are needed for companies to save money, innovate and find new market niches, for example in the area of "green jobs". A more careful and efficient use of natural resources also helps to ensure that current and future generations will have safe and adequate supplies.

The development of the plan was led by the Austrian Ministry for the Environment, which provided the guiding principles and coordinated the process of stakeholder involvement. The development started with a workshop involving different ministerial and business representatives to discuss the main features and overall aims of a resource efficiency action plan. A group of experts from different thematic areas was formed, drawing from the institutions responsible for the implementation of the REAP process, including several ministries such as Economics, Finance and Environment. Two further workshops were organized by the Ministry for the Environment with a broader range of experts from science and industry in order to discuss the aims of the action plan from a scientific and interdisciplinary perspective. These workshops shed light on the themes to be targeted by the action plan, areas of particular relevance for increasing Austrian resource efficiency, as well as effective measures and instruments to improve national resource efficiency. Following a final round table with participants from the Government, business community, civil society, and other stakeholders, the plan is now being finalised. It is expected to be adopted by the Austrian government in spring 2011, and the implementation phase should start in summer 2011, involving, inter alia, the establishment of a national resource efficiency network. The plan shall include realistic qualitative and quantitative targets for increasing resource efficiency in Austria.

Source: <http://lebensministerium.at/article/articleview/82975/1/25540>

In order to find the most effective means of improving resource efficiency, it is worth analysing which areas of consumption are linked to high resource use and thus have the greatest potential to improve resource efficiency. This may help to set targets to reduce the consumption of those particular categories as part of an effective integrated plan. Such studies have been conducted in the EU², but few developing countries have taken this step so far.

3.5 EFFECTIVE POLICY DEVELOPMENT

Policy development and design within governments is usually incremental and path dependent – i.e. shaped by what has already been accumulated. Policy can proceed in a linear fashion through a policy cycle, although this is the exception, rather than the norm. In political life, processes tend to be shaped by the actual problems, with each issue demanding attention in its own way. Moreover, problems are not always clearly defined, values and goals often conflict, time and information for analysis is limited and techniques for comparing options are often crude and unreliable. Causal links between policies cannot always be established, so a technically rational option may have disastrous and unanticipated consequences.

A good policy process, however, is the vital underpinning of effective policy development. Listed below are some measures that can lead to more successful policy formulation and implementation.

- Policies should provide relevant agencies with clearly-defined mandates, responsibilities and time-frames

² See for example Tukker, A., Jansen, B., 2006. Environmental Impacts of Products. A Detailed Review of Studies. *Journal of Industrial Ecology* 10, 159-182.

and be backed by adequate resources. Policy objectives should be clearly defined, specific and with measurable targets so that progress can be quantified.

- The implementation of new policies or changes to existing policies should be phased in gradually while providing time for affected individuals and industries to adjust.
- Consultation with stakeholders is paramount to all policy development processes. National or federal governments may choose to establish consultative bodies or taskforces which may include representatives from the community, NGOs, industry, trade unions etc.
- Agencies should have the institutional autonomy to develop their policies free from political lobbying or external pressures. The credibility of the agency and its policies depends on the public's perception of its independence.
- The systematic use of environmental policy evaluations should be integrated into the cycle of policy design to ensure good governance. This encourages transparency and accountability within public administration, besides being an important element of performance management.
- Governments should take advantage of strategic processes – e.g. at the beginning of an electoral cycle or annual priority setting exercises, to review, refine and implement new policy goals. Policies and strategies should be linked to government budget processes to ensure adequate resources.
- Policy harmonisation across countries should be achieved in cases involving cross-border issues, such as climate change.
- Policies should be enforceable and result in low compliance costs.

3.6 POLICY INDICATORS

Policy indicators serve a variety of purposes. They are a valuable tool for tracking progress against policy targets and objectives, are useful in assessing the effectiveness of implementation programmes, and can help understand social conditions, trends, and changes. To inform public policy in a meaningful way, indicators should provide information at both the macro-level (at the level of a country as a whole) and the micro-level (at the level of the individual producer and consumer).

In the context of sustainable consumption and production, indicators can demonstrate whether a society's consumption and production patterns are bringing about more socially equitable and environmentally sustainable development. In that regard, indicators of SCP are inextricably linked to broader sets of indicators on environment and sustainable development, including poverty reduction (UNEP, 2008a).

In their recent National SCP Guidelines, UNEP notes the general inadequacy of national efforts to measure progress on SCP policy and programme implementation. Developing countries need to overcome a variety of institutional, technical and political constraints when developing SCP indicators, such as inadequate resources, data reporting units, monitoring networks, and lack of political willingness. UNEP has developed a guidance framework to assist developing countries in measuring their achievement towards SCP objectives. This framework emphasises the need for developing countries to develop their own sets of indicators which are specifically tailored to their information needs, sustainability priorities, and national frameworks and strategies of their own country (UNEP, 2008a).

3.7 THINKING OUTSIDE THE BOX – THE ROLE OF TRANSITION MANAGEMENT

Pioneered by the Dutch government, transition management is an approach to orienting long-term change for sustainability. It is a novel perspective that involves stakeholders in developing a portfolio of experiments to explore future options and to accelerate the emergence and diffusion of more sustainable practices. The key ele-

ments of transition management can be described as long-term thinking (at least 25 years) as a framework for shaping short-term policy, thinking across different domains and at different levels, a learning philosophy that endorses “learning by doing”, and an open door of options (Rotmans et al, 2001).

Government can and should assume a leading role in transition management - not by acting as the great commander, enforcing change; but by inspiring a collective learning process and encouraging other actors to think along and participate. Governments can also generate stimuli to make the market more attractive to newcomers. They have a task in creating the right boundary conditions for market processes and tax policies. Local and regional governments also have roles to play in areas such as environmental planning, house building, and waste management.

Box 6. Transition Management in the Dutch Energy Sector

In the Netherlands, the concept of transition management was taken up by the Ministry for Economic Affairs, which is responsible for energy policy. Initial steps involved consultation with stakeholders, the development of long-range energy scenarios, and the selection of key themes to ensure a “clean, affordable, and secure” energy supply. Transition platforms were established around six themes – chain efficiency, green resources, new gas, sustainable mobility, sustainable electricity and the built environment.

Funding to try out novel practices in the energy field has been provided for dozens of transition experiments, proposed by different combinations of stakeholders. Other developments include the establishment of a “Trendsetters’ Desk” to assist innovative enterprises. In 2005, governance of the whole process was formalised through a top steering committee (Taskforce on the Energy Transition), and an inter-department coordinating committee that includes six Ministries. Examples of transition experiments developed in the energy sector include:

- **Energy efficiency in paper and cardboard production:** The intention is to dramatically reduce energy use in the paper and board sector to improve environmental performance and enhance the international competitiveness of the industry. Attention was paid to life cycle analysis of energy inputs, and incremental improvement of existing processes. The project included a contest between two teams (one led by an industry insider and another by a leading academic) to see who could reduce energy inputs most significantly.
- **Energy-producing greenhouses:** The intention is to develop new generations of glasshouses that will ultimately contribute to the country’s energy infrastructure. Ground-source heat pumps combined with photovoltaics help to dramatically reduce energy requirements as well as water and chemical use.

Today, there are hundreds of transition experiments across the Netherlands. Although the practical implementation of transition management has not always turned out as planned, it remains an impressive approach to stimulate innovation for sustainability.

Source: Meadowcroft & Bregha (2009)

3.8 GOOD PRACTICE MEASURES

Box 7. Good practice measures - an integrated framework

- The greening of industries requires *clear government commitment* from the top, with supporting leadership throughout the public sector.
- The greening of industries requires *clear processes* for integrating environmental, social, and economic goals, and *strategies* for implementing goals across responsibility areas.
- Policy integration should take place both “*vertically*”- that is between different tiers of government; and “*horizontally*”, between different sectors of government.
- The development of *national strategies, programmes, and frameworks* are important for integrating, coordinating and resourcing policy efforts.
- *Consultation with stakeholders* is paramount to all policy development processes. National governments may choose to establish consultative bodies or taskforces which may include representatives from the community, NGOs, industry, trade unions etc.
- *Policy indicators* should be developed to track progress against policy targets and to assess the effectiveness of implementation programmes.
- Governments need to be *innovative* and *strategic* in developing policies which promote the greening of industries.
- Policies should be enforceable, and result in low compliance costs.

4. CREATING AN ENABLING ENVIRONMENT

4.1 INTRODUCTION

The framework conditions of a country have an important influence on the greening of industries as they provide the environment through which industrial changes take place. A stable macroeconomic environment, for example, can influence the willingness and ability of firms to risk investments in environmental technologies, services, and new market opportunities.

Governments can influence framework conditions through measures such as creating the right demand conditions for firms; removing environmentally harmful subsidies; providing financing options; fostering global partnerships and trade; investing in resource-efficient infrastructures, and supporting local action. Moreover, measures which improve the level of basic technological literacy and advanced skills are important, as it determines a country's capacity to understand, implement, and adapt new environmental technologies. A robust and dynamic innovation system is a core framework condition for the greening of industries. The importance of harnessing environmental technologies is discussed in detail in chapter 6.

4.2 FINANCIAL SUPPORT STRUCTURES

SMEs in developing countries face a multitude of financial constraints in the development of industry. These include inadequate availability of working capital, banks insisting on collateral and third party guarantees, and a risk averse banking system for small projects etc. Furthermore, banks generally perceive small projects as being high risk due to non-disclosure by the borrowers and lack of reliable information on technology, markets, and investment potential.

Financial institutions play an important role in supporting the greening of industries and the development and dissemination of new technologies. Financial markets are starting to respond to sustainable development in more direct and creative ways such as targeted "green" funds, insurance markets, and the development of environmental policies and guidelines for considering environmental issues. Financial support ranges from loans for conventional large-scale projects (e.g. windfarm developments), to micro-credit loans supporting small-scale initiatives.

Governments can use environmental financing as an instrument to promote resource efficiency measures through financial institutions or independent funds. The terms of these loans and/or grants should be more favourable than what the market would offer. Such measures are usually initiated through government programmes or through donor agencies. (GTZ et al, 2006). The early involvement of local development banks has also proved instrumental in mobilising financial resources.

Favourable loans (such as soft or revolving loans) for improved resource efficiency have encouraged producers, especially SMEs, to adopt changes to make production more efficient. SMEs commonly have difficulty accessing conventional loans, as they are often family enterprises lacking the necessary collateral. Thailand, for example, has been active in providing loans to promote energy efficiency. The Energy Conservation and Promotion Fund (ECPF) and various Thai Banks offer loans which have a fixed interest rate of less than 4 per cent and repayment in a defined timeframe of seven years. Currently, 82 project loans have been approved or are under construction with leverages of US\$ 80 million in energy conservation investment (ADB & IGES, 2008).

Strengthening the capacity of the financial sector along with raising awareness of the greening industry concept is an important pre-requisite to fostering cleaner and more efficient production (OECD, 2000). Financial institutions need to be informed about environment-related credit risks. There is a clear commercial logic for a financial institution to ensure that a company is compliant with environmental laws and regulations and does not have hidden liabilities which may affect its future value and loan repayments.

Box 8. The Green Trust Fund

The State Secretariat for Economic Affairs (SECO) of Switzerland has established the Green Credit Trust Fund (GCTF) as a funding support instrument for SMEs investing in environmental improvements. Green Trust Funds have been set up in Columbia, Peru and Vietnam.

The fund provides the SME with financial support by partially reimbursing the investment costs depending on the level of environmental improvement achieved. The fund also provides additional support for SMEs with insufficient collateral by guaranteeing 50 per cent of the credit.

The green credits are provided by local banks, which are responsible for handling the credits and the possible reimbursement of the investment costs. Thus, the GCTF does not directly subsidise credits or provide direct, ex-ante subsidies for investments; instead, it relies on an incentive structure.

Source: www.seco-cooperation.admin

4.3 THE INFLUENCE OF DEMAND

Demand conditions play an important role in stimulating new market opportunities and improving environmental practices amongst firms. There are many facets of demand, including domestic and international demand conditions; government demand; and the role of consumers and suppliers.

Having high-quality links with international demand is important for stimulating environmental technologies amongst firms. Global markets consist of global consumers and firms need detailed knowledge of their requirements. Meeting these demands can stimulate the introduction of industry-led initiatives such as eco-labelling and environmental management systems. Demand created through supply chain linkages can also promote more resource-efficient and environmentally-friendly production practices (refer to section 5.7).

Governments can influence demand conditions through a number of ways. They can facilitate market access and influence framework conditions (e.g. competition policy). Moreover, governments can influence demand conditions through regulations that affect product standards and the processes by which products are made, such as safety, environmental and operating conditions for employees. Additionally, green procurement provides an avenue for governments to use their market power to influence shifts in production towards cleaner technologies.

4.2.1 Green procurement

Countries around the world are using green public procurement as an effective means to pursue social and environmental goals. In addition to creating demand for green goods and services, green procurement is an effective way of increasing the credibility of public authorities - particularly when it comes to encouraging industry and consumers to change their patterns of production and consumption.

However, governments do face some implementation barriers, such as unfavourable legal frameworks, lack of technical capacity, supply constraints, and unreliable information about the characteristics of particular products and services. Additionally, environmentally sound goods and services tend to be more expensive than the conventional options, and public authorities may find it difficult to justify the additional cost to tax-payers (GTZ et al, 2006).

Best practices based on the experience of successful countries have been documented by many of the organizations that promote green procurement. These practices relate to the management, strategic design and implementation of policies. These measures, as outlined by UNDESA (2007) are described in Box 9 below.

Box 9. Best practices for successful green procurement implementation.

- *Leadership and commitment from senior manager and policy-makers:* In the United Kingdom, one of the countries where implementation is most advanced, the establishment of a national multi-stakeholder task force on green procurement helped raise the profile of the issue and ensured high-level political agreement. The impact of green procurement policies can be enhanced by making them an element of broader sustainability policy.
- *Setting and agreeing on sustainability priorities:* setting targets such as reducing carbon emissions and priority expenditure sectors for action optimises the allocation of resources, and enables structured decision-making.
- *Mandatory green procurement requirements:* Emphasizing that this is a priority for government, and provide clear directives and expectations to politicians and procurement officials.
- *Public expenditure management frameworks:* These may need to be adapted to better support procurement policies (e.g. budget reforms that allow for better planning horizons).
- *Joint procurement by public administration authorities:* This can increase bargaining power and help reduce prices associated with relatively more expensive green technologies and products as well as administrative costs per contract. In many countries, local governments procure more than central governments.
- *Procurement tools are needed to provide guidance to decision making:* These might include clear guidelines and procedures, life cycle assessments, and evaluation of impacts (e.g. on SMEs).
- *Early engagement with the private sector and other stakeholders:* This helps to identify the scope for innovation and determine the extent to which local suppliers can respond to stricter standards.

Source: UNDESA, 2007

4.4 REMOVAL OF ENVIRONMENTALLY HARMFUL SUBSIDIES

The reform of environmentally-harmful subsidies has become a growing issue for governments throughout the world. Subsidies and protection create incentives for enterprises to remain inefficient and under-invest in new and more efficient technologies. Such policies create an economically and environmentally damaging culture of subsidy dependence. When an industry commits (locks-in) to a subsidy dependent mode of production, support for the status quo becomes politically attractive for governments. Hence, perverse subsidies continue to exist. For example, fuel tax rebates and artificially low energy prices stimulate the use of fossil fuels and greenhouse gas emissions.

Developing countries generally subsidise energy prices and tariffs – irrespective of whether they are producers or importers of fossil fuels. Worldwide, subsidies equate to about US\$ 100 to US\$ 150 billion annually, three quarters of which is in developing countries (ESCAP, 2008a). Many governments are now trying to reform their systems – gradually liberalising energy prices and removing cross-subsidies. As a result, final prices for fuels, except those of renewables, have increased and now better reflect the cost of production.

There are numerous obstacles faced by governments tasked with subsidy reform. Lack of political will is a key factor, which is often fuelled by intensive lobbying. Overcoming political resistance is even more challenging when the environmental consequences are less visible, and involve a time lag. The benefits on the other hand (e.g. employment, regional growth), can be more easily demonstrated. Concerns over industry competitiveness and income distribution are often cited by policy makers as major obstacles for reform. Lack of transparency also contributes to difficulties in generating pressure for subsidy reform (OECD, 2005b).

Transition support for reforms may be an attractive policy option, particularly for reasons of social choice, political economy, legal obligations, and moral duty. For example, industries may find that major efforts are required to convert processes based on energy, water, and raw materials subsidies so that they remain competitive when the subsidies are removed. Box 10 outlines the factors to be considered for a successful transitional subsidy reform process.

Box 10. Success Factors for Transitional Subsidy Reform Process

- *Good enabling environment:* including macroeconomic settings, the social security system, labour market programmes, and a well-funded education system.
- *A clear exit strategy:* where programmes are time-bound from the outset.
- *Clear and agreed objectives:* Consideration needs to be given to whether up or downstream industries should be included in adjustment measures or whether economy-wide measures are sufficient – i.e. careful consideration needs to be given to who gets assistance, who pays etc.
- *Policy coherence:* when designing several programmes for adjustment, these should be mutually consistent and integrated. A well-designed subsidy reform scheme would include coordinated and consistent entry and exit elements, and coherence with existing policies.

Source OECD, 2005b

4.5 BOOSTING COMPETITIVENESS

Consumers in markets are becoming more conscious about environmental issues in their purchasing decisions. Not only are consumers demanding more goods and services with environmental integrity, but they are also taking a much closer interest in the environmental credentials of the firms involved at all levels of the supply chain. Many countries are recognising the importance of sound environmental management as a competitive advantage and as a driver of economic development – both in terms of new business opportunities and as a spur to innovation.

Governments have a role in supporting industry sectors and businesses through the promotion of practices that enable them and other players to trade on the basis of sustainable and efficient business practices. Businesses, however, need to be able to see a clear value proposition in adopting sustainable practices. For example, understanding how consumer preferences are evolving in relation to sustainability issues in specific market segments and the resulting market opportunities.

At the firm level, governments can assist businesses requiring support services by ensuring that these are well signposted, high quality, adequately resourced, and integrated into mainstream business channels (e.g. standards, eco-labelling programmes). For example, The UK Department of Trade and Industry has a unit (“The Manufacturing Materials and Environment”) dedicated to providing business and marketing assistance to the environmental industries sector. Services offered by the team include:

- Market intelligence about the environmental goods and services sector;
- Flagging areas/opportunities where the environmental goods and services sector might be able to provide solutions to overcome environmental problems;
- Contributing evidence to Regulatory Impact Assessments and consultations;
- Help with engagement and consultation of the environmental goods and services sector stakeholders, trade associations, regional development agencies, their clusters and devolved administrations.

4.6 HARNESSING THE BENEFITS OF GLOBALISATION

The interaction between globalisation and the environment occurs at different levels, and the impact can be both positive and negative. Globalisation can promote more resource-efficient patterns of economic development by helping to concentrate production in countries that have a comparative advantage in energy and natural resource endowments. It can also help to promote the development and diffusion of cleaner technologies (OECD, 2008). International partnerships and networks are becoming an important means of disseminating information, and presenting trade and investment opportunities (see Box 11 below).

Multinational enterprises are increasingly taking a pro-active approach to global environmental problems, which are often addressed by multilateral agreements – e.g. investing in more energy-efficient production methods. A “green” corporate image and reputation is of growing importance for many companies and many apply the same high environmental standards and practices worldwide in all their plants, thus contributing to the globalisation of good environmental corporate practices. Large companies continue to push sustainable production upstream through global supply chains.

Growing international markets for environmental technologies provide a further incentive for governments and enterprises to re-visit their policies in this area. Recent data about the size of this market reveal the existence of large-scale opportunities for exporters of environmental goods and technologies. A study by the European Commission estimated the turnover of eco-industries in the EU at € 227 billion in 2004, with a growth rate of 7 per cent between 1999 and 2004 (OECD, 2008).

The quality of environmental governance at all levels is crucial for realising the potential environmental gains from globalisation. Moreover, policies and institutions must keep pace with globalisation trends, particularly in developing countries. This may require new and strengthened approaches to international environmental cooperation and better integration of environmental issues with trade and investment policies. For example, in the UK, the Government and businesses are working in partnership through the UK Trade and Investment’s (UKTI) *Low Carbon Marketing Strategy* to promote Britain as the destination of choice for low carbon trade and investment.

Box 11. The Asia-Pacific Partnership

The Asia-Pacific Partnership on Clean Development and Climate (APP) is a public-private partnership of seven countries – Australia, Canada, China, India, Japan, South Korea and the United States. Essentially, it brings together the private sector, governments and research institutions to address climate change and air pollution challenges. In doing this, the partnership is focusing on expanding investment, trade and diffusion of cleaner energy technologies and services in the following areas: renewable energy and distributed generation, buildings and appliances, power generation and transmission, steel, cement, cleaner fossil energy, coal mining, and aluminium.

Source: www.asiapacificpartnership.org

4.7 LEVERAGING BENEFITS FROM TRADE AGREEMENTS

The multilateral trading system has brought about unprecedented economic globalisation in recent decades. Countries have become more interdependent through the exchange of goods and services and flows of capital, information, and to some extent, labour. How economic globalisation and its governing institutions affect the environment, or more specifically the greening of industries, has been a point of contention amongst policy-makers and the like.

Arguably, trade poses both challenges and opportunities from an environmental perspective. On the one hand, trade can exacerbate environmental problems (e.g. the overexploitation of resources). On the other hand, trade agreements such as Regional Trade Agreements (RTAs) can help strengthen the enforcement of environmental

laws while raising the level of industry standards. For some countries, the negotiation of RTAs has been a driver of policy reforms, increased capacity development, and better cooperation amongst trade and environmental officials (OECD, 2000d).

For developing countries, there has been a long-standing contention that environmental requirements of trade agreements have the potential to inhibit trade in particular products (e.g. packaging and recycling requirements, ISO standards etc.). However, research carried out by the United Nations Conference on Trade and Development (UNCTAD) has shown that while some developing countries have suffered considerable export losses due to an inability to respond to developed country environmental standards and regulations, the effects are by no means always negative. Some exporters have profited from exploiting new markets created by product differentiation. Furthermore, people living in the exporting countries have often benefited from a cleaner environment (OECD, 2003).

A growing number of developing countries are accepting the inclusion of strong environmental commitments in trade agreements signed with developed countries, although, on the whole, few agreements include a reference to the environment. A major difficulty for developing countries is the need to negotiate the environmental aspects of agreements, while their own environmental management system is in its infancy (OECD, 2007).

4.8 INVESTING IN RESOURCE-EFFICIENT INFRASTRUCTURES

Infrastructures, such as water, sewerage, energy, transport, and communications are the foundation of sustainable economies. Around the world, infrastructures come under increasing pressures with growing populations, urbanisation and rising levels of production and consumption.

Well designed and managed infrastructure can influence efficiencies in resource-use for industries and the wider community. While traditional, centralised models of design still prevail in many countries, there is potential for developing countries to “leapfrog” older generation technologies to more advanced solutions with greater long-term resource efficiency, savings in costs, and environmental benefits.

Improving sustainability in infrastructure development requires explicit attention to eco-efficiency. That means achieving more with less consumption of resources (energy, water, land, and raw materials) and less production of pollution (such as CO₂, SO₂, nitrogen oxide emissions) over both the construction stage and subsequent use of infrastructure.

4.8.1 Public infrastructures

Developing countries need to invest in a range of infrastructures, including energy, transport, and water to improve standards of living and to support sustainable production measures.

Decentralised wastewater systems can reduce public investment, increase efficiency of water use, generate renewable energy and organic fertilizer, and avoid solid waste disposal of sludge. Thus they can resolve water, energy, and materials resource issues simultaneously. Such systems have been in operation in some European cities for over 20 years, demonstrating their ability to deal with issues of hygiene and public health (ADB & IGES, 2008).

Industrial solid waste, such as packaging materials, paper, resins, plastics, metals, boiler slag etc is being generated at increasing rates. Governments should be responsible for promoting cost-effective technologies to manage recyclable products and unrecoverable wastes. Analysing the relative economic costs of waste disposal versus reducing, reusing and recycling reveals many viable investment opportunities in resource efficiency. For example, in Japan, local governments are implementing policies geared toward the establishment of recycling based systems with the support of the Ministry of Economics Trade and Industry (METI). Kitakyushu City, the first METI-designated “eco-town enterprise”, is implementing programmes that will transform Kitakyushu into a “full-scale” recycling city (ADB & IGES, 2008).

There is a need for governments to invest in infrastructures that support the diversification of fuel options; to move away from heavy dependence on high carbon energy sources, such as coal, to cleaner natural gas, and ac-

celerate efforts to increase the share of renewable energy. A key issue for governments will be how to mobilise investment for energy infrastructure from the private sector, FDI, cooperation between countries, and alternative approaches to infrastructure development and planning. Clear energy policies, good governance and a strong regulatory and institutional structure need to be in place to attract investment for infrastructure development.

4.8.2 Financing infrastructures

Mobilising resources for infrastructure development remains a considerable challenge for governments. A key issue, therefore, will be how to mobilise investments from the private sector, FDI, cooperation between countries, and alternative approaches to infrastructure development and planning. Clear energy policies, good governance, and a strong regulatory and institutional structure are among the basic needs to attract investment for infrastructure development.

There is a clear need for expanded use of innovative financing measures, involving Public-Private Partnerships (PPPs) to respond to the heavy financing requirements of provincial and municipal governments for their infrastructure needs. These offer potential for unlocking capital and expertise, while fulfilling public service goals. They already exist in some large-scale projects, from major road building to power stations.

Although PPPs have provided a key vehicle for FDI into public utilities and infrastructure for developing countries, private investment has declined since the late 1990s. This decline, according to the OECD (2005c), is partly related to disappointment on the part of both investors and public authorities. One commonly heard complaint from host governments is that investors have reneged on their contractual obligations, especially regarding the coverage of services. Another complaint from enterprises is that public authorities have failed to provide an environment in which they can provide their services according to sound commercial principles.

Engaging in a PPP process requires governments to define clear legal and policy frameworks and ensure that government capacity to initiate and manage PPPs exists. Governments themselves need to establish themselves as credible partners with appropriate regulatory and oversight mechanisms.

Governments, however, cannot rely on private funds alone and will have to find new income sources themselves. This means diversifying by making more and better use of user fees, creating mechanisms for securing long-term financing for infrastructures as Canada and Switzerland have done, or exploring the possibilities offered by land value capture. Another route is to promote innovative variation of traditional financing mechanisms (OECD, 2007b).

Regulation can play an important role in closing the infrastructure gap. Private investments must yield a return, and much can be done to make the regulatory environment more attractive to private capital investors, while still upholding the standards of public servants.

Box 12. Canada's Green Infrastructure Fund

Through Canada's Economic Action Plan, the federal government will provide \$1 billion over five years for a Green Infrastructure Fund (GIF). This Fund supports sustainable energy generation and transmission, along with municipal wastewater and solid waste management infrastructure. Targeted investments in green infrastructure can improve the quality of the environment and will lead to a more sustainable economy over the longer term.

This fund will focus on green priorities such as green energy generation and transmission infrastructure, building and upgrading wastewater treatment systems, and improving solid waste management. Sustainable energy infrastructure, such as modern energy transmission lines, will contribute to improved air quality and lower carbon emissions.

Eligible projects are those that promote cleaner air, reduced greenhouse gas emissions, and cleaner water and fall within any of the following categories: wastewater infrastructure, green energy generation infrastructure, green energy transmission infrastructure and solid waste infrastructure, and carbon transmission and storage infrastructure.

The new \$1-billion Green Infrastructure Fund will be allocated based on merit to support green infrastructure projects on a cost-shared basis. The fund will focus on a few large-scale and strategic infrastructure projects. The merit of the projects will be based on assessment criteria such as eligibility, leveraging financial investments and project benefits.

Source: Infrastructure Canada - www.buildingcanada-chantierscanada.gc.ca

4.8.3 Infrastructures for industry

Many countries have established programmes to transform existing industrial parks or estates into eco-industrial parks, or eco-towns. The planners of eco-industrial parks apply principles and practices of industrial ecology to the park infrastructure and buildings. Most have started by implementing industrial symbiosis; seeking exchange of by-products among companies. Moreover, opportunities for cleaner production, technologies for renewable energy, advanced water management strategies, and ecological landscaping are provided. Resource efficiency is therefore embodied in the physical plant itself. Eco-industrial parks offer business opportunities (e.g. real estate development) and support for new or expanding environmental enterprises, as well as standard manufacture and service companies.

Eco-industrial clusters have become a new model for sustainable regional development. Located on the fringes of rural and urban areas, eco-industrial clusters are made up of firms wanting inter-firm networks for material productivity and reduced operating costs. The firms tend to comprise new industries, rather than traditional manufacturing sectors. There are four major sources of productivity gains and cost benefits that can be linked to eco-industrial clusters: (i) the effective use of raw and waste materials; (ii) access to knowledge and technology; (iii) employment generation, and (iv) complementary eco-product development (Anbumozhi, 2008).

Historically, it was considered that for industrial symbiosis to work effectively, the companies involved needed to be linked by close geographic proximity. This is no longer the case. Although low value/grade materials and heat are restricted by proximity constraints, higher value synergies have no such restrictions. Another misconception is that industrial symbiosis creates synergies involving a simple bi-lateral movement of materials, water, and energy. In reality, the process can be much more complex. For example, a national-linked programme may involve the identification of business problems in one region, the development of solutions in a second region, and benefits delivered to a third region.

What all synergies have in common, is that not only do they generate cost reductions and new sales for the companies involved, they also create significant environmental benefits such as reduced landfill and greenhouse gases. The economic activity generated has further social benefits with the creation of new business opportunities and jobs. Box 13 outlines a government-sponsored initiative based in the UK, which facilitates the exchange of resources within industries.

Box 13. UK: National Industrial Symbiosis Programme

The National Industrial Symbiosis Programme (NISIP) offers the support of practitioners, who work with members to create commercial opportunities through the trading of materials, energy, and water; and through sharing assets, logistics and expertise. Membership is free. Twelve regional- based offices operate throughout the UK, providing an advisory/broker/educator role.

Application Example: Contaminated HDPE Drum Recycling

Every year, millions of plastic HDPE drums are used in the UK to distribute materials to a range of sectors. Once empty, they are usually discarded - sometimes as hazardous waste if contaminated with industrial chemicals. This initiative, facilitated by the NISIP, has resulted in diverting thousands of drums from landfill disposal into a more sustainable recycling option. The end product made from single polymer plastic waste can be reused as a raw material in the production of other plastic goods. The achievements of this initiative include: 30,000 tonnes per annum of hazardous waste diverted from landfill; 60 tonnes per annum of CO₂ saved from landfill diversion; 2 tonnes per annum of CO₂ saved on transport emissions by diverting the waste to a solution provider closer to the site of waste generation.

Source: www.nis.org.uk

4.9 SUPPORTING LOCAL ACTION

Local authorities play a critical role in supporting the greening of industries. First, they control land-use policies, which determine where industries can locate, and in some instances set and control regulatory limits for extraction and discharges. Second, they provide key services and infrastructure such as water supply and waste removal to industries and the local population. Third, they are responsible for designing and managing public assets and operations such as buildings and facilities which can consume large amounts of energy. They can also exert significant influence over businesses and industries themselves.

As the main providers of key services such as water supply, waste removal, and in some cases electricity, local governments themselves benefit directly from resource and production efficiency measures and are hence very active in developing and implementing strategies and initiatives to promote resource-efficient industries.

Community-based organizations and NGOs play an essential role in local programmes, especially in the areas of public awareness and education. Additionally, international agencies play an important role in coordinating financial and technical support, and by fostering collaboration as a means to share ideas, experiences and knowledge (ADB & IGES, 2008).

Local initiatives, especially those that provide incentive mechanisms for local government, are most effective when they are supported by comprehensive national legislation and national programmes. Central governments can also support local development through recognising community-based institutions within their national governance systems; by strengthening capacity through partnerships and collaborations; and by providing resources such as finance, technical assistance and information. Box 14 provides a more detailed description of national-level support measures.

Box 14. Ways in which national governments can support local development

Approve laws, policies and procedures supportive of local development that:

- clarify the rights of individuals and the legal standing of voluntary associations and communities;
- recognise the role of communities in governance and service delivery;
- improve the legal, fiscal and governance framework for local government; and
- make sectoral policies and systems compatible with local government and community empowerment.

Foster local civil society by measures that:

- legitimise social capital and local collective action to enable citizen voice and choice;
- strengthen civic institutions supporting transparency and accountability; and
- promote societal values such as participation, equity, accountability, and local responsibility.

Enhance local capacity through investments that:

- reorient the local public sector to improve horizontal coordination and to promote participation;
- build social capital through community organisations and voluntary associations;
- strengthen local organizations, both public sector and non-governmental; and
- increase knowledge and skills to enhance the technical, administrative and adaptive capacities of local actors.

Provide resources for local development to:

- finance government budget allocations to decentralised public agencies and devolved local governments to increase the coverage and quality of local infrastructure and policy services;
- make grants to local governments, NGOs, and CBOs to finance local investments for improved services to households, economic actors and capacity building;
- provide technical assistance to local public sector and civil society organisations, increase the availability of information to local actors; and promote transfer of expertise among both local and national actors.

Source: Helling, Serrano, Warren (2005)

4.10 DEVELOPING THE SKILL-BASE

Governments need to ensure they have the requisite capability to assist in the transition towards resource-efficient and low carbon industries. This involves not only trained professionals with technical, management, and business knowledge, but society in general. Education and training for resource efficiency should be seen as a continuous task across the educational curriculum. In particular, it should endorse lifelong learning about both the environmental gains and economic opportunities associated with resource efficiency.

There are different stages of education/training in which the issue of resource efficiency can be integrated, which include (GTZ et al, 2006):

- *Primary and secondary school.* Primary education plays a key role in shaping mindsets toward environmental protection and the efficient use of resources. During this phase, individuals establish a value set that enables them to make informed choices in the future that can increase quality of life while protecting the environment and promoting resource efficiency.
- *Technical and vocational.* This training phase plays a crucial role in providing knowledge, methods and tools to adolescents that help them to design and implement practical solutions on resource efficiency as they enter the workforce.

- *Higher Education.* Universities prepare future decision-makers of society for their entry into the labour market. Such preparation includes training of future leaders, who play an important role in providing education at both primary and secondary levels. Relevant topics are engineering, management, economics and public administration.
- *Lifelong/on the job.* Education and training for resource efficiency are continuous processes that can be offered to employees and society at large. For example, training measures can be applied to employees to raise awareness about resource efficiency potentials.

There is no one single model for how resource efficiency measures can be integrated into education and training. The three main options include: specialisation (e.g. the creation of special careers devoted to resource efficiency), integration into standard curricula, and mainstreaming into all activities covered by different curricula. The choice of strategy or best combination depends on the nature and capabilities of the education system and the desired objectives to be achieved.

Integrating the topic of resource efficiency into educational curricula and vocational training centres can add additional costs to general education expenditures by governments. However, there exist a variety of options for cost sharing and mixed modes of financing (GTZ et al, 2006).

4.11 GOOD PRACTICE MEASURES

Box 15. Good practice measures - creating an enabling environment

- Environmentally harmful subsidies should be removed through *subsidy reform processes*, or transitional processes in cases of political or social resistance.
- Governments should practice *green public procurement* as a means of creating demand for green products and services.
- The greening of industries should be supported by *access to finance* and by strengthening the capacity and awareness of the finance sector.
- The *global benefits* of environmentally sustainable industries should be harnessed through international cooperations and trade and investment policies.
- The provision of *infrastructures* to support the greening of industries (e.g. wastewater treatment, recycling facilities, and sustainable energy supplies) should be a priority for governments.
- Governments should support *local action* through collaborations, resources, capacity building, and institutional support.
- Enhancing the *skill-base* through education and training programmes targeted at all levels is an important foundation for the greening of industries.

5. SUPPORTING INDUSTRY-LED INITIATIVES

5.1 INTRODUCTION

It is becoming increasingly clear that government policy-makers need to balance flexible “external” policy instruments (e.g. regulations, MBIs) which give the right incentives with “internal” management orientated policy instruments which are designed to increase the responsiveness of enterprises to these initiatives (OECD, 2001c). The shift toward softer policy measures (e.g. corporate image and values) has been driven largely by enterprises changing decision-making processes to better reflect improved environmental outcomes.

This chapter looks at how governments can positively influence the internal decision-making processes within enterprises. This can be considered a controversial exercise for governments; however, the basket of policy measures aimed at influencing and supporting internal decision-making processes is rapidly increasing. Partnerships between government and business are playing an increasingly important role in fostering improved production efficiencies and environmental management.

Many enterprises are now thinking about environmental impact throughout their product’s life cycle and are integrating environmental strategies and practices into their own management systems.

5.2 RAISING INDUSTRY AWARENESS AND CAPACITY DEVELOPMENT

Persuading industries to improve their environmental performance can be a challenging task. Industries, in particular SMEs, need to maintain their competitive edge and are therefore reluctant to adopt measures that may result in increased costs. Further, managers may have no accounting tools to identify the costs of waste and pollution because they are hidden in overheads. In some cases, industries are just simply unaware of the technologies and practices that exist. Fostering resource efficiency often requires a value chain approach, implying the need for coordination and cooperation of different enterprises. This may exceed the capacities of individual SMEs.

Building firm capability or “absorptive capacity” to enable companies to adapt and adopt new technologies is critical. This is particularly true for SMEs, as they often don’t have the resources to invest in creating their own technical solutions. Enterprises need to have the capacity to identify and access green solutions to be able to take advantage of the growing global knowledge pool.

Disseminating and demonstrating the benefits of environmentally sustainable and resource-efficient industries (e.g. lower energy inputs, raw material usage) is an effective way of fostering the adoption of new production methods. Governments may choose to work directly with individual companies or in partnership with organizations such as industry associations.

The introduction of “good housekeeping” procedures can yield immediate environmental and financial benefits for individual enterprises. Such activities are best supported by programmes that change the management of systems through training personnel, demonstrating the techniques for energy and raw material use, creating demonstration projects to reduce raw material, energy or water use, making limited funds available for small investments and providing resources to monitor and disseminate results. Some of these initiatives are relatively inexpensive ways to foster change (OECD, 2000).

Box 16. National Cleaner Production Centre – South Africa

The National Cleaner Production Centre of South Africa was launched in 2002, as a cooperative programme between South Africa and UNIDO with financial assistance from South Africa's Department of Trade and Industry (DTI) and the Governments of Austria and Switzerland. In 2006, the DTI took full custodianship of the Centre and is developing the Centre to reach its full potential as a national agency for the implementation of Cleaner Production (CP).

The Centre focuses primarily on SMEs in offering CP advocacy and techniques. Some of the sectors include: chemicals; agro-processing; automotive and transport equipment; metals and allied processes; pulp and paper; clothing and textile; leather and footwear etc.

The Centre offers a range of services including CP quick scans; audits; advocacy, CP assessment guidelines; production of training materials etc. The Centre is also expanding its operations to help facilitate access to incentive programmes and business opportunities in recycling. Capacity building in the African region is a core focus of the Centre, and activities include presentations, workshops, road shows, training events and regional and donor programmes. The Centre is also expected to roll out a national industrial energy efficiency programme funded by State Secretariat for Economic Affairs (SECO) in partnership with UNIDO.

Tools and measures that promote cleaner production and resource efficiency are also promoted by the Centre – e.g. Life Cycle Assessment, Corporate Social Responsibility, eco-labelling, and product labelling.

Source: www.ncpc.co.za

Cleaner production requires resource efficiency, and vice versa. Emphasis on resource efficiency has risen since the World Summit on Sustainable Development in Johannesburg in 2002, caused by a shift towards Sustainable Consumption and Production and its inter-linkages and in order to respond to increasing scarcity of water, fuels and other materials.

Several governments have responded to this shift, by broadening the scope of cleaner production centres or by establishing new agencies focused primarily on the promotion of resource efficiency. Like the cleaner production centres, their main target groups are SMEs, but in addition, they often address politicians and the media and act as mediator between business, research institutions, politics and the public. Some agencies even develop concepts for business sectors and initiate joint projects on a local or regional level. Though the agencies are mostly initiated by governmental bodies, they are often privately organized consultative bodies. Most of them have a stable funding source, whether through a foundation, governmental programmes or direct subsidies.

Box 17. Efficiency Agency in North Rhine Westphalia, Germany

The Efficiency Agency in North Rhine Westphalia (NRW), Germany, was set up in 1998 by the Ministry for the Environment in NRW. The Agency is a centre for small and medium-sized manufacturing enterprises. Its objective is the comprehensive strategic and technical improvement in the transition towards a more sustainable economy with a focus on resource efficiency.

The Efficiency Agency acts as adviser, facilitator, mediator and initiator. Its consultant services for small and medium-sized enterprises – often provided locally in the advised enterprises – include:

1. Tools for analysing options regarding improvements of resource efficiency within the production process and for optimising the use of operational resources at the enterprise level.
2. Services for optimising the product development process in terms of eco-design.
3. Management instruments for identifying resource-related cost reduction potentials.
4. Support regarding acquisition of funding.

Furthermore, the Efficiency Agency initiates joint projects and organizes knowledge transfer between political institutions (local to international), industry and research sectors through joint conferences, newsletters and publications, a best practice database, and networking. Among other things, it organizes the competition “Ressource.NRW” on resource efficiency improvements in NRW.

The Efficiency Agency is a private company with a stable basic funding from public programmes. Currently, a team of 20 employees are working at the headquarters and six local offices.

Source and further information: www.efanrw.de

Governments can promote targeted, high-profile demonstration projects in enterprises whose success will serve as a credible example to other enterprises in the sector. For example, the Hong Kong Government’s “Cleaner Production Partnership Programme” (launched 2008) funds up to 50 per cent of the costs of demonstration projects. Eligible factories are invited to team up with environmental service providers to conduct demonstration projects which highlight the effectiveness, costs and financial returns of cleaner production technologies through the installation of equipment or the modification of production processes.

Training facilities are important in creating the skilled capability needed to implement resource efficient strategies in enterprises. Hands-on training (including quality management, resource accounting, production monitoring etc.) provide industrial operators with the skills needed to implement change when they go back to their respective facilities. Governments can promote effective training initiatives by establishing them within government institutions or by funding external agencies such as industry groups or Cleaner Production Centres. The best programmes will facilitate industry-initiated activity.

Industry clubs or associations are a useful means of promoting resource-efficient practices. Governments can provide grants and other incentives to these associations to develop practical management tools for promoting resource efficiency, specific to SMEs and the issues and operations of a particular industry or sector (ADB & IGES, 2008).

Box 18. Canada's Enviroclub Initiative

The Enviroclub initiative was developed by three federal Government agencies (Canada Economic Development for Quebec Regions, Environment Canada and the National Research Council) to assist SMEs in improving their profitability and performance through enhanced environmental performance. An Enviroclub consists of a group of 10-15 SMEs, each of which carries out one profitable pollution prevention project.

The in-plant projects and the workshops are the essence of the Enviroclub concept, which reflects the notion of voluntary learning and the intention to learn if motivation and a 'real world' approach is provided. Participants are required to manage one in-plant pollution prevention project involving product and service changes, process technology improvement, input or raw material changes, operating improvements, or on-site reuse and recycling.

To complement the practical skills acquired through the experience of managing a project, the Enviroclub supports the sharing of experiences through supporting knowledge and networking among SMEs in the same region. Workshops are provided, which offer additional skills and knowledge on topics such as pollution prevention as a driver of competitiveness and profitability, selecting and implementing profitable pollution prevention projects, energy efficiency and greenhouse gas emissions, environmental emergencies, environmental management systems, and environmental performance as a marketing and communication tools.

Projects implemented in seven Enviroclubs resulted in annual savings of CAD \$5.1 million and multiple benefits including annual reductions in resource use such as water (536,000 m³), petroleum products (225 litres), wood (11,300m³), and emissions such as greenhouse gasses (17,100 tonnes equivalent CO₂), hazardous wastes (708 tonnes), and toxic substances (53 tonnes).

Source: Huppe, Turgon, Ryan, Vanasse, 2006

5.3 PROMOTING ENVIRONMENTAL MANAGEMENT SYSTEMS (EMSS)

Some governments are seeking to improve environmental decision-making within enterprises through supporting the development and implementation of Environmental Management Systems (EMSs). These systems identify ways and means for establishing, monitoring, and evaluating environmental objectives.

Governments have implemented a range of initiatives to encourage the introduction of EMSs. Many of these provide financial assistance and access to expertise, and sometimes link EMS adoption with permit requirements. In some countries, government agencies have made certification a legal requirement. For example, Danish Law requires a certified environmental management system for certain industrial sectors such as those dealing with solid waste and treating scrap (Christiansen, Kardel, 2004). Many governments themselves are leading by example by implementing their own EMS. Not only does this benefit their own operations, it also enables them to demonstrate to stakeholders that they practice what they preach.

Government also has a potential role in promoting EMS, by linking its adoption with permit requirements, and/or ensuring that future updates of EMS standards have an increased emphasis on resource efficiency and enhanced environmental performance (ADB & IGES, 2008).

Governments, should however, think carefully about the design of their incentives, to ensure they are sending the right signals to enterprises. An OECD study (2007c) examining targeted public policy initiatives, found that perceived reductions in inspection frequency and financial assistance were the driving factors of enterprises implementing EMS. This analysis suggests that companies with weak environmental performance could implement EMS in order to "signal" their good intentions to public authorities.

Developing countries face many challenges in implementing EMS, such as ISO14001. These include lack of appropriate infrastructure, unsound policies, and ineffective environmental regulations, as well as financial and human resource constraints (Massoud et al, 2010).

Box 19. Germany – Bavarian Environmental Agreement

This initiative comprises an agreement between the Bavarian State Government and the Bavarian business community which contains a list of measures aimed at decreasing the negative environmental impacts of industrial activity. Essentially, companies commit themselves to enhancing their environmental performance, and in exchange, they often obtain subsidies or are relieved of certain administrative obligations.

Assisting SMEs in obtaining an EMS is an important aspect of the Bavarian Environmental Agreement. The regional government subsidises the costs of an environmental audit by an independent consultant, and the introduction of an EMS. For the audit, the costs of the independent consultant are subsidised (up to 50 per cent) of the capped costs of the independent consultant. For the introduction of the EMS, the subsidies cover a certain percentage of costs for external personnel and the costs for validation and certification. All companies that have introduced the EMS are granted administrative relief relating to their duties/obligations (e.g. emission monitoring, reporting duties, inspections).

Outcomes of this initiative include industrial processes improvements such as the replacement of hazardous chemical substances by other substances, retention and reuse of by-products, use of process water instead of fresh water and use of waste products such as wastewater from specific chemical landfills.

More information: www.stmug.bayern.de

5.4 INDUSTRY-BASED STANDARDS

Industry-based standards can deal with the technical aspects of almost any product, service or process. They are nearly always voluntary but, when used, play a crucial role in the design, manufacturing, packaging and end-of-life stages. Standardisation is an excellent tool to facilitate international trade, competition and the acceptance of innovations by markets. Industry management standards, for example, can provide guidance for industrial facilities to integrate energy efficiency into their management practices, including fine-tuning production processes and improving the energy efficiency of industrial processes. Industry standards are often integrated into voluntary agreements or Environmental Management Systems such as ISO.

Governments can play a key role in boosting technological progress by defining and promoting standards for products made by firms and by facilitating quality control to help firms comply with standards.

5.5 PROMOTING ECO-LABELS AND CERTIFICATION

Eco-labelling and product certification can be an effective instrument that encourages sustainable consumption by providing consumers with information about the environmental impact of particular products and services. Companies are rewarded through public recognition, thus encouraging attitudes towards more pro-active environmental management. Eco-labels and certification can apply to the entire life cycle of a product, or a specific stage or step, such as labels for wood from sustainably managed forests (Forest Stewardship Council). Eco-labels are generally awarded by an impartial third party that authorises the use of the label on products in a certain product category.

Product labels have mushroomed around the world in recent years, especially in industrialised and emerging economies. There is a growing movement to harmonise the proliferation of eco-label programmes across the world with the Global Eco-labelling Network. Another important trend is the strong relationships that are begin-

ning to form between eco-labelling organizations and procurement programmes. For example, the Japanese Government established guidelines for green procurement and referenced the Eco Mark as one possible source of information. Local governments in Japan are now following suit (ADB & IGES, 2008).

The main idea behind these labels is to give consumers the opportunity to monitor and reduce their environmental impact. At the same time, firms become more aware of the resources used for their products. This transparency may induce them to become more resource efficient. However, eco-label schemes may prove ineffective in terms of changing producer behaviour in markets with low degrees of environmental awareness, although they might help to raise public awareness about public issues. Success with eco-labels will require extensive promotion and education at the retail level and strategies to reduce “green washing” – that is unregulated labels that mislead consumers into thinking they are buying green. Moreover, because sustainability-related issues are not at the forefront of buying criteria, eco-labels need to be made simple and readily understandable.

Box 20. Green Label – Thailand

The Thai Green Label Scheme was initiated by the Thailand Business Council for Sustainable Development (TBCSD). It was formally launched in August 1994 by the Thailand Environment Institute (TEI) in association with the Ministry of Industry.

The Green Label is an environmental certification awarded to specific products shown to be environmentally friendly compared to other products which serve the same function.

The Thai Green Label Scheme applies to about 144 products and services, excluding foods, drinks, and pharmaceuticals. Participation in the scheme is voluntary.

Source: www.tei.or.th/greenlabel



Resource-focussed product labels

Over the past 15 years, various methods have been developed to measure and assess the resource use and related environmental impact of production and consumption. Some of these methods focus only on a single category of environmental impact, such as the weight of materials “carried by” a product in the course of its life cycle (ecological rucksack) (Schmidt-Bleek, 2004), direct and indirect water use (water rucksack) (Chapagain and Hoekstra, 2004) or pressures from greenhouse gas emissions (CO₂ rucksack or carbon footprint) (Wiedmann and Minx, 2007). Other methods take an aggregation approach and combine different environmental categories into a single indicator. Some well-known aggregated indicators include material input per service-unit (MIPS), which aggregates the mass of all the material, water and air inputs required to produce a product or service (Schmidt-Bleek, 1994), and the Ecological Footprint which combines aspects of land use, material use as well as greenhouse gas emissions (Wackernagel et al., 2004).

As climate change is one of the most pressing environmental challenges of the 21st century, the measurement and reduction of greenhouse gas emissions is of great importance. The popular indicator Carbon Footprint, which is increasingly used for product labelling, applies the concept of life cycle wide measurement in accordance with ISO 14040/44 (BSI, 2008). By only considering greenhouse gas emissions, however, it does not consider other environmental categories, such as materials or water, and cannot measure trade-offs with these.

Therefore, more comprehensive measurement methods are needed. While the Life Cycle Assessment (LCA) method is generally useful, it focuses only on the negative environmental impacts of resource use, such as climate change, ozone, over-fertilisation and eutrophication, rather than on resource use per se. Moreover, LCA requires substantial investments in terms of monetary resources and time and is difficult to apply to entire product portfolios of large companies.

One of the first examples of a comprehensive set of indicators to measure resource use, which can be consistently applied from the level of products and companies to the level of sectors and countries, is a set of indicators elaborated by Friends of the Earth (FOE) and the Sustainable Europe Research Institute (SERI). This comprehensive multi-dimensional indicator set covers all main environmental input categories: non-renewable resources (measured by the abiotic material rucksack), renewable resources (biotic material rucksack), water (water rucksack) and land area (actual land use). Due to the high importance of climate change, the indicator set also includes the output category of greenhouse gas emissions (carbon footprint) (Giljum et al. 2011). This combination of indicators is increasingly being used for environmental product assessments and labelling in Austria, for example in the case of the label “Pro Planet” by the retailer REWE International in Austria (see Box 20).

Box 21. Pro Planet: an eco-label based on a comprehensive set of indicators

In 2010, the large retailer REWE International launched a new label in Austria, “Pro Planet”, which assesses the sustainability of selected conventionally produced food products. The label marks those products that cause least harm to the environment along their supply chain and that are produced under conditions that meet internationally recognised social standards.



REWE developed the label in a collaborative process involving an environmental NGO (Friends of the Earth Austria), a social and human rights organization (Caritas) as well as a scientific research institute (Sustainable Europe Research Institute). The label is based on an assessment using the FOE/ SERI set of indicators, specific indicators for measuring the sustainability of agricultural products (e.g. nitrogen balance, pesticide use intensity) and strict controls of social standards at the producer.

So far, the label has been given to a variety of fruits and vegetables (apples, grapes, strawberries, cabbage, Chinese cabbage, iceberg lettuce, onions, and radish). Future assessments may include other groceries as well as non-food products.

Source: <http://www.proplanet-label.at>

The increasing number of labelling initiatives around the world shows that improving information on the resource requirements involved in producing and using different products and services is an important element of a policy mix on improved resource use. Such measures to green industries in terms of their resource efficiency should promote a life cycle perspective and encourage acceptance of “extended producer responsibility” (Lenzen et al., 2007) (see section 5.8).

5.6 SUPPORTING LIFE CYCLE ANALYSIS

Industries generate products or outputs which degrade the environment in one way or another – either from manufacturing processes, their later use, or disposal. Current policies have tended to focus largely on point-sources of pollution, such as industrial emissions and waste management issues, rather than the products themselves and how they contribute to environmental degradation.

The concept of life cycle analysis or “Integrated Product Policy”, as coined by the EU, seeks to minimise environmental impact by looking at all phases of a product’s life cycle and taking action where it is most effective. The development of policies to support life cycle analysis can be viewed from the basis of four principles (EC, 2004):

- Pollution and waste reduction measures need to be identified throughout the entire product’s life cycle – from cradle to grave. This approach avoids shifting the environmental impact from one phase of the life cycle to another.

- Policy measures need to be flexible, working alongside the market where possible.
- The actions of all stakeholders are critical. The environmental impacts of products are affected by the actions of many different stakeholders, such as designers, industry, market people, retailers and consumers.
- Avoid setting final targets to be reached. Rather, stimulate an ethic of continuous product improvement.

Given the variety of products and number of people involved, there is no straightforward solution to this issue. Instead, a mix of tools covering both voluntary and mandatory measures is required. These may include economic instruments, substance bans, voluntary agreements, environmental labelling, and product design guidelines etc.

Box 22. European Commission: Environmental Impact of Products

The European Commission is conducting a three-phase project around Integrated Product Policy that involves identifying and stimulating action on products with the greatest potential for environmental improvement.

The first phase involves research to identify products with the greatest environmental impact from a life cycle perspective consumed in the EU. This analysis uses the following eight environmental impact categories: abiotic depletion, acidification, ecotoxicity, global warming, eutrophication, human toxicity, ozone layer depletion, photochemical oxidation.

The second phase involves identifying possible ways to reduce some of these impacts. In the third phase, the European Commission will develop policy measures for the products identified as having the greatest potential for environmental improvement at least socio-economic cost. A technical report for phase one has been completed.

Source: www.ec.europa.eu/environment/ipp/identifying.htm

5.7 GREENING THE SUPPLY CHAIN

In recent years, the idea of pushing environmental responsibility upstream to associated suppliers and vendors has gained favour as a strategy among environmentally-conscious companies. In this way, buyer companies seek to ensure that the environmental standards they have adopted internally are consistently maintained by their suppliers. Even without government regulation, this sort of inter-firm compliance regime offers advantages to supplying companies that adopt greener practices.

For both suppliers and their customers, a well-managed supply chain effort can go beyond mere cost-cutting; it can create business value in the form of higher quality materials or manufacturing processes, innovative new goods and services, protection of one's brand reputation, and enhanced customer loyalty.

Many large multinational companies have adopted green supply chain standards and enforce them through inspection and compliance regimes – e.g. requiring suppliers to use a certified EMS. It is important that standards adopted by multi-national companies are verified by independent and recognised organizations.

Some companies offer assistance to suppliers to help them achieve the more rigorous standards (see Box 22 below). SMEs in particular often need external support and capacity building to assist their participation in green supplier networks.

Box 23. Green Suppliers Network, USA

The US Department of Commerce, in collaboration with the US Environmental Protection Agency (EPA), established the Green Suppliers Network (GSN). The GSN works with large manufacturers to engage their small and medium-sized suppliers in low-cost technical reviews that employ “Lean and Clean” methodologies aimed at increasing productivity, reducing waste, and boosting profitability.

The initial pilot began in February 2001 with General Motors and the Saturn Corporation. Scale-up of the programme was officially launched in December 2003. Since then, the programme has been steadily expanding into other sectors with additional partners.

During the Green Suppliers Network review, suppliers use a process-mapping technique called “value stream mapping” that tracks inputs and outputs through an individual process or a complete product line. Value stream mapping serves as a critical tool during the review process and can reveal substantial opportunities to reduce costs, enhance production flow, save time, reduce inventory, and improve environmental performance.

Joining the network is free, but each technical review can cost suppliers around US\$ 7,500 per facility. Suppliers completing the review are, in turn, given a list of state and local resources and funding opportunities that can be used towards implementation. A US\$ 1,000 training credit is also available to small businesses who implement an environmental project within three months of completing the Green Suppliers Network review.

Source: www.greensuppliers.gov

5.8 EXTENDED PRODUCER RESPONSIBILITY

Extended Producer Responsibility (EPR) is an environmental policy approach in which a producer’s responsibility for a product is extended to the post-consumer stage of a product’s life cycle (OECD, 2001). The underlying principles of EPR policy are to shift the responsibility upstream towards the producer and away from municipalities, and to provide incentives to producers to incorporate environmental considerations in the materials selection and design aspects of their products.

Since EPR was first initiated in Germany in 1991, many OECD governments have decided to implement mandatory regulations, ordinances, directives or legislation for EPR. Germany’s Ordinance on the Avoidance of Packaging Waste (the “The Green Dot” programme), was the first mandated EPR programme, placing financial responsibility for collecting and reducing packaging waste on manufacturers. Other country examples include Sweden, Norway, Taiwan, and Switzerland which adopted legislation that requires manufacturers of electronic and electrical goods to provide free end-of-life care for their products through licensed handlers.

There are three types of voluntary approaches that can be used to implement EPR policy. The first type is government-based. Governments create a framework and leave the choice of whether to participate to the individual enterprises or industry sector. The second are negotiated agreements involving government, individual enterprises, or industry sectors. The Dutch Packaging Covenant is a well-known example of a negotiated agreement. The third type is an industry-based voluntary initiative. Industry-based voluntary agreements for the take-back of products are growing and include companies such as Dell, Nike and Xerox (OECD, 2001).

EPR can be implemented by a variety of policy instruments, including take-back programmes, minimum recycled content standards, energy efficiency standards, disposal bans and restrictions, advance disposal fees, virgin materials taxes, deposit/refund, and environmental labelling (Milanez, Buhrs, 2009). It is important for an EPR policy not to restrict trade flows as trade provides greater consumer choice and economic growth.

Box 24. Extended Producer Responsibility on South Korea

The Extended Producer Responsibility System (EPRS) was officially implemented in South Korea at the beginning of 2003 – replacing the deposit refund system which had been in place since 1992. Essentially, the Government sets the mandatory amount of waste that must be recycled by each producer. The manufacturers in turn collect and recycle their products after consumers use and discard them, or pay for the full cost needed for recycling. The aim is not only to promote recycling, but also to force manufacturers to improve product design so that waste generation is minimised and recycling becomes easier.

Products subject to the EPR scheme include electronic appliances like televisions, refrigerators, washing machines, tyres, lubricants, fluorescent lights; and packaging materials such as cans, glass bottles, and plastic bottles etc.

Source: <http://eng.me.go.kr>

5.9 PROMOTING CORPORATE SOCIAL RESPONSIBILITY

Corporate Social Responsibility (CSR) is a voluntary initiative whereby companies go beyond the course of duty to integrate social and environmental concerns in their day-to-day business operations and external interactions. In a broad sense, CSR can be defined as the overall contribution of business towards achieving sustainable development goals (UN, 2007).

CSR holds many direct benefits for businesses and society as a whole. In the case of promoting the greening of industries, businesses benefit from reductions in energy and waste bills and lower input costs. Employees also benefit from safer working conditions and increased training and capacity building. Although CSR is mainly promoted by large or multinational companies, it is relevant to all types of companies and in all sectors of activity. Its wider application in SMEs is of central importance, given that they are major contributors to the economy and employment.

Some governments use an interventionist approach to promote CSR, while others prefer to work within the context of market drivers, including consumer interest or societal pressures. Factors which may influence government action include resource and capacity constraints, the size of domestic markets for products affected by CSR concerns, the degree of export orientation of the economy in sectors affected by international CSR drivers, and the eagerness of companies wanting to implement change (UN, 2007). One measure of particular importance is for governments to promote CSR by implementing their own systems, and leading by example.

It is important to note that CSR is culture-specific. It varies according to political traditions, the nature of social dialogue, and the degree to which certain social and environmental issues are regulated by law. It is useful to have a common understanding about principles and importance of CSR, but ultimately, the practice of CSR has to be adapted to the particular circumstances of different nations and regions. Finally, it is important that CSR is verified by independent and recognised authorities.

Box 25. Corporate Social Responsibility in Denmark

CSR is promoted and managed by the Danish Commerce and Companies Agency which falls under the Minister of Economic and Business Affairs (Deputy Prime Minister). In May 2008, the Danish Government presented its Action Plan aimed at promoting CSR through 30 initiatives in the following four key areas:

- *Propagating business-driven social responsibility:* the Danish Government strengthens the reporting of CSR based on internationally recognised principles (UN Global Compact and UN PRI).
- *Promoting businesses' social responsibility through government activities:* The Danish Government intends to heighten focus on social responsibility in connection with state purchasing, investments and state-owned public limited companies.
- *Corporate sector's climate responsibility:* The Danish Government wants to underpin businesses' active role in meeting global climate challenges by reducing energy consumption and greenhouse gas emissions in their own and suppliers' businesses, while also contributing to the global climate solution.
- *Marketing Denmark for responsible growth:* The Danish Government wants to initiate targeted international marketing of Denmark for responsible growth. These activities aim to help Danish businesses reap greater benefits for their CSR work.

The Danish Government has also amended current legislation taking effect from 2009 that legally requires large businesses to take a position on CSR in their annual reports. Businesses are still free to choose whether or not they wish to work on CSR.

Source: www.CSRgov.dk

5.10 ENVIRONMENTAL ACCOUNTING

Environmental Accounting (EA) is a useful tool that assists decision-making in the private sector. Whether the goal is pollution prevention, or some broader notion of “corporate sustainability”, there is a widespread belief that sound environmental accounting helps firms identify and implement financially desirable environmental innovations.

Environmental Management Accounting (EMA) is a specific practice of environmental management to identify, collect, analyse and use two types of information for internal decision making: physical information on the use, flows and destinies of energy, water and materials (including wastes) and monetary information on environment-related costs, earnings and savings (Jasch, 2001). Material Flow Cost Accounting (MFCA), an EMA method for which an ISO standard has recently been established (see Box 26), focuses on tracing waste, emissions and non-products in companies. It may help to improve their economic and environmental performance by improving material productivity and thus reducing the relative consumption of materials, energy and water. MFCA is already being used by companies, especially in Germany and Japan (Kokubu et al. 2009).

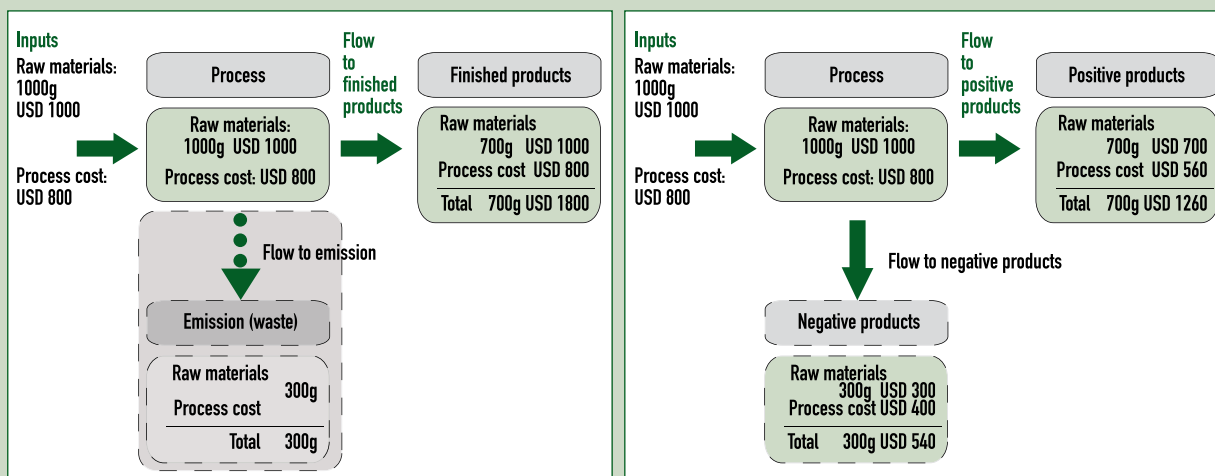
Box 26. ISO Standard 14051 on Material Flow Cost Accounting (MFCA)

ISO 14051 is part of the ISO 14000 family of environmental management system standards (EMS), including life cycle assessment (ISO 14040, ISO 14044), environmental performance evaluation (ISO 14031), and the greenhouse gas management standards (ISO 14064-1-3, ISO 14065).

With MFCA, organizations can identify emissions and waste within a process in both cost and physical terms (e.g. weight, capacity, and volume). Such information can motivate managers to enhance material productivity and reduce waste far more effectively than relying only on conventional production and cost accounting data.

Figure 3 illustrates the difference between conventional and material flow cost accounting. In the example, the production process yields a single product using 1,000g of raw materials at a cost of US\$ 1,000 plus the processing cost of US\$ 800. The costs are calculated using conventional cost accounting in the left hand side of the figure and using MFCA on the right hand side. In conventional cost accounting, the cost of that waste is usually ignored, even if this waste is visible in the factory. The costs for these resources and their processing are automatically included in the cost of output (finished products). In comparison, waste is considered to be another product (“negative product”) in MFCA, and hence has a cost allocated to it based on certain criteria (in this example weight). Here, the cost of the waste, as a negative product of 300 g, is calculated as US\$ 540, including US\$ 300 for the raw materials and US\$ 240 for the process cost. This is new information generated by MFCA that provides an incentive to management to reduce that cost, achievable by reducing waste.

FIGURE 3: A COMPARISON OF CONVENTIONAL COST ACCOUNTING (LEFT) AND MATERIAL FLOW COST ACCOUNTING (RIGHT)



Source: Kokubu et al. 2009: 17.

The implementation of MFCA does not require advanced computer-based information databases. Simple spreadsheet calculations and the use of a calculator are often sufficient – an advantage for small and medium-sized enterprises (Kokubu et al. 2009: 18).

Especially in countries with relatively low labour costs, material and energy use as well as related losses are a significant cost driver. Material and energy use are also directly related to the environmental impacts of organizations and their products. Thus, MFCA can be an important instrument for industries in developing and emerging economies to become more resource efficient.

Governments use a range of instruments to promote EA practices, which are largely dependent on the legal, economic, and cultural context of countries. Some of the approaches adopted by governments are listed below (Li, 2001):

- Regulatory approaches include developing specific regulations on accounting practice or integrating accounting requirements into existing standard setting and/or legal requirements.
- Developing guidelines to encourage industries to participate and adopt the EA principle in analysis and cost reporting.
- Providing either financial incentives or social recognition to motivate corporations to adopt EA.
- Providing information through educating and training related personnel, encouraging academic research, designing and supporting pilot projects, and establishing a network to share experiences and software development.
- Government organizations themselves take initiatives to adopt environmental accounting in their own practice.

These instruments are not stand-alone measures, but closely intertwined. Governments have only recently started to promote environmental accounting, and more insight needs to be obtained on adapting it to a country, culture and organization-specific manner. Information-based instruments should be a priority, as they have greater outreach and foster important learning and knowledge exchange processes (Li, 2001).

5.11 GOOD PRACTICE MEASURES

Box 27. Good practice measures - supporting industry-led initiatives

- *Long-term partnerships* between governments and business are important in fostering improved efficiencies and environmental management.
- Pollution and waste reduction initiatives need to be identified throughout the entire *product's life cycle*.
- Policies or initiatives should not shift environmental impact from one phase of a product's life cycle to another.
- Incentives for improved environmental management should be carefully designed in a manner which promotes *pro-active actions*, rather than providing a means of avoiding compliance.
- Policies, such as those promoting CSR and EA, should be adapted to the particular circumstances of different nations and regions.
- *Training facilitates and demonstration* programmes are important for creating the skilled capability required to implement resource-efficiency initiatives.
- *Industry clubs or associations* are a useful means of promoting policies and resource-efficient practices.

6. HARNESSING ENVIRONMENTAL TECHNOLOGIES

6.1 INTRODUCTION

Science and technology are central to transforming manufacturing industries towards sustainable patterns of production and economic growth. Enterprises and industries are becoming increasingly aware of the prospects that environmental technologies hold – not just in terms of improved environmental outcomes, but also the potential to reap economic rewards from increased efficiencies and new business opportunities. Some of the more attractive opportunities for sustainable investments lie in the developing world, sparked by the need to accommodate growing populations and increased industrial development.

For developing countries, capacity development and the diffusion of environmental technologies are particularly important areas for government assistance. Most developing countries are not at the cutting edge of science and innovations, and rely on technological advancements through the adoption and adaptation of pre-existing but new-to-the-market or new-to-the-firm technologies. However, technological improvements have been achieved over the past 15 years, which have been supported by a sustained policy of increased openness to foreign trade and FDI), plus increased investments in capacity development (The World Bank, 2008).

Additionally, governments can support the development of new environmental technologies by investing in the development of science platforms, from which environmental technologies can be leveraged. There is a need to foster partnerships with industry and end-users to ensure investments result in relevant and/or commercially viable technologies. Networks and technology transfer mechanisms remain important, particularly for developing countries that struggle to finance their own R&D programmes.

Finally, greater coherence between environmental and innovation policies needs to be established. Innovation policy has long underplayed the issue of environmental sustainability, largely because of the misperception that it has weak links with commercial interests. Governments should be promoting the role of environmental innovation through their science and innovation strategies.

6.2 DEVELOPING TECHNICAL CAPACITY

Knowledge and skills underpin the economic success and environmental performance of firms by providing the technological know-how or “capacity” to innovate and to adapt and adopt new technology solutions. More specifically, technical capacity facilitates the imitation and adaptation of foreign environmental technologies and improves the extent to which positive spillovers (e.g. resource efficiency) from FDI and trade accrue to the rest of the economy.

The principal challenge facing many low-income countries is not their access to technology, but their absorptive capacity, including physical, human, and institutional capacity; their limited financial resources; and the extent to which their social and political environment is supportive of entrepreneurship, investment, and technological progress. Some of the characteristics of technological learning in developing countries are outlined below in Box 28.

Box 28. Technological learning in developing countries

Listed below are some important features of technology and technological learning in developing countries:

1. Firms do not have full information on technical alternatives. They often function with imperfect knowledge of the technologies they are using.
2. Firms have to make conscious and significant efforts to understand the technologies they are using (the “know-how”). Even more effort is required to understand the “know-why”. Moreover, there is no uniform, predictable learning curve for a given technology.
3. The learning process is highly specific to the technology and industry in question. For example, some technologies may be more embodied in equipment. Others may have greater tacit elements.
4. Technological learning involves more than formal research and development. In fact, for many developing country enterprises, building technological capabilities at the level of the shop floor maintenance of machinery, inventory control, and other things, are more relevant capabilities.
5. The process of technological learning is ridden with externalities and interlinkages. It is driven by links with suppliers of inputs or capital goods, competitors, customers, consultants, and technology suppliers. Interactions with firms in unrelated industries, technology institutions, extension services, universities, business associations, and training institutions are also important.

Source: Lall, 2001

The speed with which a country absorbs and adopts technologies depends on many factors, including the extent to which a country has a technologically literate workforce; promotes an investment climate that encourages investment and permits the creation and expansion of firms using high-tech processes; provides access to capital; and has institutional capacity to promote the diffusion of technologies where private demand or market forces are inadequate (World Bank, 2008). Furthermore, countries tend to acquire technology more readily when domestic firms have their own in-house R&D programmes and when public research institutes and universities have close ties to industry.

Governments can play an important role in strengthening technical capacity of SMEs through various policy directives. Some of these include:

- Promoting technology literacy by delivering quality education to as many people as possible.
- In the case of market failures, assisting firms to learn to how to adapt, adopt, and market new technologies and services. Research institutions need to practice outreach, testing, marketing and dissemination activities.
- Facilitating access to finance. The capacity of firms or individuals to take advantage of a technology can be constrained by affordability and liquidity.
- Openness to external technologies through foreign trade, FDI, diasporas, and other international networks is critical for technological progress – for both low and middle income countries.
- Governments can integrate new technologies into their own operations, including the provision of environmental infrastructure etc.

6.3 BUILDING THE TECHNOLOGY BASE

Because of the long delay between scientific discoveries and their commercial application, decisions taken today on how much basic research to fund will have a large bearing on the technologies that become available a full generation from now. Basic and applied research clearly benefits private production and consumption. It also assists governments in carrying out their responsibilities in relation to environmental management. It is prudent for governments to ensure that policy and funding priorities are contributing sufficiently to building the necessary science and technology platforms from which future environmental technologies can be leveraged.

Equally important is ensuring that strategic R&D programmes are well connected to industry needs through the facilitation of research partnerships, industry co-funding programmes, and technology transfer initiatives (e.g. Australia's Cooperative Research Centres). Overcoming the tensions between the long-term research objectives of public research institutions and short-term interests of industry remains a challenge for all government partnership programmes.

Box 29. Australia's Cooperative Research Centres (CRCs)

The CRC programme is a government initiative administered by the Department of Innovation, Industry, Science and Research. The programme was established in 1990 as a demand pull, medium to long-term research programme. CRCs are incorporated or unincorporated organizations, formed through collaborative partnerships between publicly funded researchers and end-users. CRCs must comprise at least one Australian end-user (either from the private, public, or community sector) and one Australian higher education institution (or research institute affiliated with a university). Funding is provided for up to 10 years, with the possibility of an extension up to 15 years under exceptional circumstances.

There are currently 48 CRCs operating in the following sectors: environment (10), agriculture and rural based manufacturing (14), information and communication technology (5), mining and energy (4), medical science and technology (8) and manufacturing technology (7).

A CRC relevant to the greening of industries, currently in operation is the "Centre for Sustainable Resource Processing" (CSRP). The CSRP's main objective is to find technological solutions for eliminating waste and emissions in the minerals cycle, while at the same time enhancing industry performance and meeting community expectations. Key research themes are effective resource utilisation, materials efficiency, minimising energy consumption and greenhouse gas emissions, reducing process waste, and enhancing co-product values, reducing water consumption and impact for improving the control of minor elements and their dispersion.

Source: www.crc.gov.au

6.4 FINANCIAL INCENTIVES TO PROMOTE ENVIRONMENTAL TECHNOLOGIES

Financial instruments such as R&D subsidies, grants, and tax breaks are not only important for the creation of new and emerging technologies, but also for supporting the adoption and adaption of existing technologies. Most governments in developed countries provide direct grants or tax credits to support R&D carried out by businesses. Such support is justified by market failures and the benefits accrued to society in terms of additional "knowledge spillovers".

Direct support for private R&D occurs through a variety of instruments such as tax breaks for volume and increments in R&D, equity support measures such as venture capital funds, direct government grants etc. Whilst these instruments all impact on innovation to some degree, their effectiveness largely depends on their design and methods of implementation.

Indirect financial incentives, particularly tax measures, can be used to promote the uptake of new environmental technologies. For example, a scheme in the Netherlands allows for accelerated depreciation of investments and

facilities; and the Canadian province of Quebec provides a 20 per cent tax credit for environmental technology investments (OECD, 2000).

Governments can facilitate the growth of green enterprises and service industries through equity support measures, such as specialised venture capital funds that provide seed capital, green funds to guarantee bank loans, and investment guarantee funds etc. Government support, however, generally tends to be more broad-based, targeting general business start-ups rather than specific enterprises developing environmental technologies, products, or services (OECD, 2010). One example is the Carbon Trust, set up by the UK government in 2001. In addition to providing a range of services for reducing businesses' carbon emissions, they offer venture capital funds to support emerging clean energy technology businesses that demonstrate commercial potential.

R&D subsidies can play a useful supply “push” role in the development of new environmental technologies. However, their effectiveness as a policy instrument for promoting environmental technologies has shown mixed results. For example, studies have shown that subsidies result in windfall gains (Kemp, 2000). There is a strong argument that the use of subsidies is better restricted to environmental technologies for which a market does not yet exist; for example, technologies with long development times (as in the case of energy technologies), or technologies for which there are problems in appropriating the benefits of innovation by the innovator (e.g. when imitation is easy). R&D subsidy programmes may also be used to increase the number of technological solutions when there is uncertainty about environmental solutions (Kemp, 2000).

Box 30. Financing SMEs in India

The small-scale industries (SSI) sector plays a significant role in the Indian economy. With about 3.4 million registered SSI units in the organized sector, the sector is the second largest employer after agriculture, and contributes over 41 per cent of the total industrial production. At the end of March 2000, it employed about 19 million persons.

Traditionally, India has two sets of financial institutions that assist the SSI sector: (a) commercial banks which provide mainly short-term working capital, and (b) Development Financial Institutions (DFIs), which extend long-term credit for capital investments.

To overcome some of the financial constraints facing SSIs, the DFIs and commercial banks have introduced some innovative support mechanisms. Reflecting India's emphasis on technology and quality management, a special financial scheme known as the “Technology Development and Modernisation Fund” is jointly operated by the Small Industries Development Bank of India (SIDBI) and the Government of India. Concessional loans are provided for technology upgrading, modernisation, quality control and environment management projects in the small-scale industrial sector. Sector specific technology funds viz., leather, textile and jute are also available. SIDBI, the Government of India and the State Bank of India run Integrated Technology Upgradation and Management Programme called “UPTECH” programmes for technology development in identified clusters.

Assistance is provided for setting up technology parks and incubation centres, which have mainly been picked up by technology incubators related service providers. SIDBI has set up a technology bureau for small enterprises for exporting and importing technologies and for assisting in setting up joint ventures.

Source: Narain, 2001

6.5 ACCELERATING TECHNOLOGY DIFFUSION

Technological solutions already exist for many of the problems in the manufacturing and services sector; they just need to be diffused more widely among enterprises, and adapted to local circumstances. This requires a combination of effective transfer and diffusion mechanisms, along with increased capacity building within enterprises to enable the adoption and adaptation of new technologies.

SMEs in the manufacturing sector tend to have short-term priorities, whereas environmental problems and challenges are usually viewed as long-term. Consequently, opportunities for cost savings through production efficiencies and even new products and services receive low priority and little attention. Moreover, smaller enterprises often lack the in-house expertise or knowledge to address problems and opportunities in the environmental field.

An integral part of technology diffusion is informing and convincing enterprises of the benefits of environmental technologies in terms of greater efficiencies, cost savings, and reducing waste. Technology diffusion schemes are increasingly aimed at improving the managerial and technical abilities of smaller enterprises, including the capacity to identify, assess, and adapt new technologies on a continuing basis.

There are many types of environmental technology diffusion programmes on offer. The provision of information is at the core of most programmes, and this is increasingly being done through electronic networks such as the Internet (OECD, 1999). Demonstration programmes which show the technical feasibility and benefits of new environmental technologies are also popular. Technical assistance programmes provide more “hands-on” advice in diagnosing environmental problems and finding the appropriate technological solution. Governments are increasingly mounting “soft” diffusion activities which focus on workforce training and encouraging managerial and organisational changes within enterprises to improve their ability to assess and adapt environmental technologies. Institutions that provide technical support (e.g. Cleaner Production Centres) are important means of technology diffusion. Based on OECD analysis, listed below (Box 31) are some best practice measures for effective technology diffusion.

Box 31. Best Practices Ideas for Technology Diffusion

- *Give Effective Incentives:* An important, if not essential part of promoting technology diffusion of environmental technologies, is to give incentives to enterprises to adopt new technologies whose benefits may not be readily apparent. Environmental regulations, particularly product and performance standards, and market based instruments can be effective measures. Additionally, since the cost and unproven performance of new environmental technologies is often the greatest barrier to diffusion, direct and indirect financial incentives are no doubt the next most effective means of encouraging their adoption.
- *Target sectors and problems:* The most effective technology diffusion programmes tend to target *specific industrial sectors* and/or certain types of environmental problems. For example, in most cases, programmes promoting cleaner production are managed separately from programmes promoting energy efficiency. Some schemes target groups of companies of similar size with similar problems, such as the waste minimisation clubs in the UK. Many problems are plant-specific, emphasising the importance of environmental audits to pin-point particular problems and technical solutions.
- *Orient programmes locally:* Another aspect of providing information and other types of technology support is the ability to reach and interact with enterprises as close to home as possible. Being involved locally helps information and service providers become more familiar with special local programmes and needs. This also facilitates the use of intermediaries such as local research institutes and trade associations who can prove invaluable to disseminating technology.
- *Provision of Integrated Services.* The integration of information sources and technology diffusion services into a broad cooperating network is the best overall approach. Integration facilitates easier access to the different types of assistance that may be available, including information dissemination, technology demonstration, and technology supports. The range of services should also give sufficient attention to training workers and upgrading the innovative capacity of enterprises.

Source OECD, 1999

6.6 SUPPORTING KNOWLEDGE TRANSFER THROUGH NETWORKS, COLLABORATION, AND INFRASTRUCTURES

With growing competition, globalisation and the rapid advancement of knowledge, new technologies and innovations have a wide variety of sources; most of them outside the direct control of enterprises and industries. Partnerships, joint ventures, incubators, clusters, science parks and networks are all important means through which environmental technologies can be developed, nurtured, and dispersed. SMEs in particular, depend on external sources of information, knowledge, know-how and technologies to build their own innovative capability and to harness the benefits that new technologies have to offer.

Enterprises interact with a range of players within innovation systems. These include not only other enterprises, but institutions involved in the innovation process, such as universities, technical institutions, private and public research labs, providers of consultancy and technical services, regulatory bodies, etc. Governments have a role in fostering these linkages at the regional, national, and global levels.

Governments can facilitate SME linkages through a variety of ways. One way is to provide infrastructures, such as science parks, clusters, incubators, and networks etc. They can increase SME participation by facilitating and co-funding public-private partnerships for research, and also strengthen linkages with global networks.

The development of clusters and science parks through regional and local programmes is an effective way to stimulate knowledge exchange and cooperation among enterprises, as well as between enterprises and knowledge institutions. The development of these infrastructures can also be enhanced by providing appropriate policy frameworks in areas such as education, finance, competition and regulation (see Box 32).

Box 32. Science Collaborations and Infrastructures

Finland: Environmental Cluster Research Programme

The Finnish Environmental Cluster Programme is one of seven cluster programmes funded by the Government. The programme aims to improve the quality of the environment by promoting eco-efficiency, stimulating the development of new and environmentally friendly products, and encouraging entrepreneurship and the creation of new jobs. The programme targets the emerging environmental goods and services industry; one of Finland's fastest growing sectors.

The government provides seed funding for research on new environmental technologies to be carried out by consortiums of producers and suppliers, universities, and institutes. Collaborative projects enhance networking among researchers and users to facilitate innovation. Projects which aim at improving eco-efficiency through the application of life cycle techniques in agriculture, forestry, basic metals, and water management have been launched.

Italy: Turin Environment Park

The Turin Environment Park was founded in 1996 by the Piedmont Region, the Province of Turin, the Municipality of Turin, and the European Union. It differs from other science and technology parks in that it combines innovation technology with eco-efficiency. The Park's mission is to provide small SMEs with advanced solutions and innovative technologies in the fields of energy and the environment, through partnerships, special projects, specific training activities, and thematic events. The park's operations are divided into the following parts: scouting of green technology needs in the territory, research partnerships between public research institutes and enterprises, networking activities aimed at the growth of innovative networks, and the dissemination of information concerning best practices in areas of technological innovation.

Source OECD (2001a)

As most new technologies tend to originate in developed countries, with adaptations being implemented by developing countries, global networking programmes are becoming an increasingly important tool in promoting the greening of industries. Governments can facilitate connections with global networks by forming interconnecting national and local hubs of technology transfer, linking national networks of SMEs with similar needs and complementary capabilities, building global networks of intermediary organizations, and coordinating national support programmes.

Box 33. Technology Partnership Programme (TPP)

Established in 1994 by the Danish Technology Institute, the TPP comprises a global network of 20,000 technology experts covering approximately 850 technical areas. Through the TPP, members can draw on expert knowledge from all over the world when they are working on development projects that demand the best and state-of-the-art technology. Participating experts come from over 125 leading knowledge institutions from around the world (USA, Europe, Africa, Asia, Australia, and New Zealand), and 160 companies within Denmark and 70 abroad. Companies requiring technology assistance submit a request, which is then processed within a global network. Within two weeks time, companies seeking the assistance are connected to experts from the participating enterprises and knowledge institutions.

Whilst covering over 850 technical areas, the TPP is particularly useful for SMEs in the manufacturing sectors, which often lack the in-house capability to deal with technical problems. International partners include South Africa (joined 2002), Poland (joined 2003), Botswana (joined 2004), Lithuania (joined 2004), China (joined 2005), and New Zealand (joined 2005).

Application Example: Following the ban on the use of lead in 1999, the company Exhausto in Denmark sent a request to the TPP to assist them in finding an environmentally acceptable alternative to lead as a roof weathering surface. The result was the development of a new material "Perform", which is today sold as a common alternative to lead, and which has been patented in a large part of the world.

Source: www.technology-partnership.com

6.7 AN INTEGRATED AND STRATEGIC SCIENCE SYSTEM

If countries are to harness the benefits of environmental technologies, they need the support of an integrated and adaptable science system that can respond quickly to minimise environmental risks, whilst maximising economic opportunities. Science systems need to be broad based, with the ability to work across and beyond usual disciplines. Integration with economic and environmental policies is vital. Moreover, the role of environmental technologies as an enabler of resource and production efficiencies and new market opportunities should be reflected in science and innovation strategies.

The ability of countries to identify and monitor present and future challenges and trends through techniques such as environmental scanning, are becoming increasingly important. Box 34 below outlines a policy initiative that helps New Zealand's science system to identify future risks and opportunities.

Box 34. New Zealand's "Futurewatch" Programme

The Ministry of Research, Science and Technology in New Zealand has developed the policy initiative "futurewatch", which aims to build Government awareness about new scientific knowledge and technologies and the opportunities and risks that they present to New Zealand.

Futurewatch can be thought of as a kind of 'radar'; a way of systematically scanning the external environment for new knowledge. A key aim of the initiative is to find things that are new or unusual that may be signposts to important changes on the horizon. Another aspect is thinking about the impact of new science and technology in a broad way that brings in a range of perspectives, including those outside the science worldview.

Aspects of the work programme involve stimulating discussions and producing material that supports other government departments in factoring emerging science and technology into their policy work. Sometimes this will include alerts on important research questions, new opportunities for research or considerations of the role of new knowledge, innovation and the research, science and technology sector in issues of strategic importance to New Zealand.

Source: www.morst.govt.nz

Despite the increased sophistication of tools available, our understanding of the the factors determining resource efficiency is far from being comprehensive. However, it is well documented, even in this paper that factors and approaches are very diverse and the approaches span a broad range. This often leaves stakeholders wondering where to start and what to emphasise in order to have maximum impact unanswered. Given the diversity among different countries, particularly in their economic sectors and the variety of SMEs, it is obvious that each country has its own specific challenges and potential to minimise or manage resource consumption and to increase resource efficiency.

Box 35. Material Efficiency and Resource Conservation (MaRess), Germany

Even though Germany has a relatively broad scientific knowledge base for some time now, a coherent strategy with a well-grounded focus on concrete implementation to raise resource efficiency had long been missing. In order to close this gap, the project "Material efficiency and Resource Conservation" (MaRess) was framed by the environmental research plan launched annually by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and by the Federal Environment Agency.

The key project objectives were:

- Discovering ways how resource efficiency potential may be identified
- Developing approaches for resource-efficiency policies specific to target groups
- Collating and examining results from impact analysis on a general and economic level
- Expert monitoring of concrete implementation steps and of how the agenda is set, as well as the publication of the results.

The crucial target groups were businesses (e.g. companies, associations, trade unions), society (e.g. NGOs, foundations, sciences), politics (from municipality level to EU level) and media.

The project was designed in 14 work packages, including amongst others, the identification and potential analysis of innovative resource-efficient lead products, technologies and markets as well as the improvement of knowledge of already identified resource intensive sectors (metallic ores, retrieval of Platin group metals and resources bonded to infrastructure). According to the different target groups, some work packages consisted of analysis and development of innovative resource policy approaches to design framework requirements, instruments for the micro-economic level, consumer-oriented approaches, eco-design guidelines and policy recommendations. In other work packages, economic impacts were analysed with top-down methods and a model for bottom-up analysis were developed for the housing sector. Further, concepts for the resource efficiency network were elaborated, an integrated technology roadmap was developed and further communication possibilities were identified with regard to specific target groups.

The project was implemented by a consortium of 31 institutions (14 non-university research institutions, three companies, nine universities and five consulting services), lead by the Wuppertal Institute for Climate, Environment and Energy and implemented from July 2007 to December 2010. Results and documentation are accessible online.

Source: <http://www.umweltbundesamt.de/ressourcen/maress.htm>
<http://ressourcen.wupperinst.org>

While the majority of developed countries have access to data and a variety of analysis and appraisals on to resource consumption and efficiency, even basic data and assessments are still missing in most developing and emerging countries. Thus, an initial assessment which focuses on the macroeconomic level, analysing resource intensive activities, industries and fields of demand as basic knowledge and point of departure to narrow down the frame for identifying country-specific challenges is recommended.

6.8 GOOD PRACTICE MEASURES

Box 36. Good practices measures – harnessing environmental technologies

- *Strategic R&D programmes*, linked to industry, are an important basis for leveraging new environmental technologies.
- Building the *technical capacity* of countries is important for generating new innovations, and the adaptation and adoption of new environmental technologies.
- *Financial support instruments*, such as R&D grants, tax-breaks, and venture capital funds are an important tool for the creation and adoption of new environmental technologies.
- Instruments for *technology diffusion* are important for facilitating the widespread adoption of environmental technologies.
- *Research partnerships, joint ventures, clusters, incubators, science parks, and networks* are all important means through which environmental technologies are developed, nurtured, and dispersed.
- An *integrated and strategic* science system is needed to support the greening of industries, including coherence between environmental and innovation policies.

7. INSTRUMENT MIXES TO PROMOTE THE GREENING OF INDUSTRIES

7.1 INTRODUCTION

Until recently, most policy approaches for developing countries were copied from developed countries. These tended to be traditional command-and-control regulations that dictated actual technologies and acceptable pollution levels. In more recent times, developing countries have begun to amend these standards to make them more specific to their own circumstances. They are also trying new approaches, such as employing financial and economic measures to complement their regulatory regimes, promoting voluntary initiatives and utilising information-based measures.

Since the mid 1990s, there has been a significant effort by businesses to engage in resource efficiency measures through new and innovative policy instruments. This shift in business attitude has been supported by the development of a new policy mix, combining economic incentives, information strategies, and flexible regulatory regimes.

Governments may be reluctant to introduce new market-based or regulatory instruments due to concerns of increased costs to businesses and potential loss of jobs. The reality is that effective and well-designed policy mixes can lead to substantial cost savings and business opportunities for existing industries as well as opportunities to encourage new support industries- e.g. the environmental services sector.

There are a plethora of policy instruments on offer that support the uptake of resource efficiency measures across the entire production and consumption system. In general terms, policy instruments can be classified into four categories: market-based, regulatory, information-based and voluntary. Support for these instruments requires robust monitoring and enforcement frameworks.

The key message underlying this chapter is that no single instrument alone can effectively promote the greening of industries. Governments need to ensure that they have the optimal mix of instruments in place, which are supported by national strategies and integrated policy framework(s). Policy instruments need to be championed, designed, adopted and implemented by all levels of government – i.e. at the local, state, national and international levels and across all relevant policy sectors.

7.2 INSTRUMENT MIXES TO PROMOTE THE GREENING OF INDUSTRIES

A well-designed instrument mix can achieve enhanced environmental outcomes along with economic objectives. Most environmental instrument mixes currently in use have evolved from ad hoc decisions adapted to evolving challenges and political demands. This unsystematic process of policy development, has, in some instances led to poorly designed policy mixes resulting in inefficiencies, redundancies, and even conflicting purposes.

In many instances, instruments used to address a single environmental problem are likely to interact with other instruments in a broader package of policy measures - for example, those policies addressing the climate change, air pollution, energy and transport nexus. A coordinated approach is needed to ensure policy coherence, and to identify policies that are mutually reinforcing and to avoid those that are conflicting or duplicative (OECD, 2008).

The key challenge for policy makers is being able to combine policy instruments to achieve an optimal mix that promotes sustainable production and consumption outcomes, whilst operating within the bounds of political, cultural, and social constraints. There is no silver bullet to achieving this and most countries are still grappling with such a challenge. The OECD (2008) outlines several best practice measures that can contribute to the development of an effective instrument mix (see Box 35 below).

Box 37. Best Practice Measures for Selecting Effective Instrument Mixes

- *Flexibility*: Instrument mixes should be constructed in an economically efficient manner that provides flexibility and doesn't stifle innovation. This can be achieved by setting long-term targets that provide for long-term investment decisions by businesses and consumers – e.g. more efficient processing technologies.
- *Combining Instruments*: Combining information-based instruments (e.g. labels) with measures that more directly target the environmental externality (e.g. tax/regulation) can make both instruments more effective.
- *Avoid Instrument Overlap*: Some types of instrument overlap or combinations can be beneficial or mutually reinforcing (e.g. taxes and labelling schemes). However, overlap between other types of instruments (e.g. taxes and product standards) can hamper the proper working of the instruments involved or cause redundancies and unnecessary administration costs – e.g. overlaps between extended producer responsibility obligations for packaging waste and the statutory recycling targets set for local authorities.
- *Remove harmful subsidies*: The effectiveness of a given instrument mix will be tempered if subsidies are given to 'neighbouring' sectors of the economy, particularly when these sectors are major contributors to the environmental problem in question. For example, agricultural subsidies can be at odds with policies to control the extraction and quality of water.
- *Broad application*: Instrument mixes should be applied as *broadly* as possible – e.g. covering all relevant sectors of the economy and all countries. For "multi-aspect" environmental problems, policy-makers should supplement instruments that address total amounts of pollution with instruments that address the way a certain product is used, *when it is used*, *where it is used* etc.
- *Avoid transferring problems*: It is important to avoid transferring environmental problems between different media – e.g. limiting leakage of pollutants from waste landfills into ground water which results in an increase in air pollution from waste incinerators and compost plants.
- *Policy design*: It is important to formulate policy mixes carefully so that *preventative* rather than *end-of-pipe solutions* are encouraged.

Source: OECD, 2008.

The optimal choice of policy instruments will largely depend on local and national conditions. In most cases, policy mixes will need to address different challenges simultaneously, such as providing both rewards and penalties, while at the same time supporting businesses through collective incentives. Similarly, a combination of soft and hard policy measures should be considered – for example, the introduction of an environmental tax to stimulate resource efficiency can only be effective if producers have access to necessary financial, technological and knowledge resources to change behaviour in response to the tax.

Finally, consideration of the costs and benefits of the policy mix is important. While the costs for financial subsidies can be estimated easily, costs arising within enterprises and public administrations subject to different policy instruments can be difficult to accurately quantify (GTZ et al, 2006).

7.3 MARKET-BASED INSTRUMENTS

The use of Market-based Instruments (MBIs) to promote resource efficiencies has grown since the mid-1990s, especially in the areas of taxes, environmental charges and tradable permits. Arguably, the Scandinavian countries and the Netherlands, who were early starters on environmental tax reform, remain at the forefront of development (EEA, 2006).

MBIs offer a proactive approach to environmental protection. Essentially, they internalise the externalities i.e. they make the polluter pay. Environmental pollution and degradation is largely caused by the incorrect pricing of the goods and services we produce. MBIs, such as taxes, charges, subsidies, and tradable permits take into account the “hidden” costs of production and consumption in a cost-effective way.

Given the global economic crisis, the demand for least-cost instruments is increasingly relevant. To contain costs, governments should be optimising the use of MBIs, such as water pricing, emissions trading with auctioned permits, taxes on pollutants and waste charges.

MBIs provide a constant spur to innovate with new technologies. For example, MBIs such as emission taxes and tradable permits provide industries with the flexibility to use the most efficient and appropriate technology suited to their circumstances. In the long run, MBIs provide incentives for continual improvements beyond those demanded by regulatory instruments – e.g. fixed standards.

Instruments which are included under the umbrella of MBIs vary across literature. For the purpose of this report, MBIs include environmental taxes and charges, tradable permits, environmental subsidies and incentives, and liability and compensation schemes.

Box 38. Success factors for implementing MBIs

- **Knowledge:** Agencies responsible for implementing MBIs must have the technical knowledge necessary to formulate and implement MBIs. Polluters need to have the knowledge to respond appropriately.
- **Good governance:** The legal structure must define property rights adequately and establish authority to implement and enforce incentive systems.
- **Competitive markets:** If firms are operating under soft budget constraints, then they will not respond as effectively to fiscal incentives.
- **Financial and administrative capacity:** Agencies implementing MBIs must have the capacity to initiate, monitor and enforce programmes.
- **Flexibility in response:** Private sector and individuals should have a choice in their response.

Source: Sharp, 2002

7.3.1 Environmental taxes and charges

Environmental taxes may operate within the discharge limitations to make the polluting firm pay for the discharges from its facility, even though they may be within regulatory limits. Therefore, taxes help to ensure that prices reflect the negative environmental impacts and costs of various products and processes not included in the market price. Furthermore, placing a cost on the discharge of wastes and emissions creates an incentive for the producer to become more efficient, and reduce the intensity of resource use and pollution.

In the short term, taxes and charges provide incentives for polluters and resource users to change their behaviour. In the longer term, they encourage innovation and the development of new and more efficient production methods (OECD, 2008). Environmental taxes are generally more economically efficient than regulations, although they tend to provide less certainty with regard to environmental outcomes.

Material input taxes are a means to encourage a more efficient use of resources and foster eco-innovations for more material efficient production technologies and less material intensive products. The material input of economic sectors and industries is thus not only regarded as an indicator for resource use and its potential environmental impacts (e.g. damage to biodiversity, dust, noise, pollution) but it is also used as a taxable base. While most taxes target the output side of production (e.g. taxes or charges on emissions or waste), a material input tax would apply to each (physical) unit of virgin extraction. If this was applied to all categories of materials – biomass, abiotic materials, soil displacements, water and air (at combustion and chemical transformations) – at their first point of extraction, the tax would cover all resources required for production processes and thus

also the indirect resource use (“ecological rucksacks”) of products. A material input tax could either be uniformly applied to all kinds of materials as a quantity tax (e.g. in €/tonne) or be differentiated according to the toxicity of the different materials. Ideally, it would be harmonised at the international level in order to avoid tax evasion through the relocation of industries to non-taxed countries.

While theoretically effective, an extraction tax for all materials is technically and politically not yet feasible, especially not in developing countries, as many questions regarding the actual implementation remain open. Apart from the challenges this would pose for harmonisations and controls, it would also require environmental management systems and solid material flow accounts in companies around the world. At the current stage of knowledge and technology, such requirements would create an insurmountable trade barrier, especially for developing countries, and might encourage illegal resource extraction and the emergence of black markets. Introducing material input taxes in a single region or country would require rules for imported materials in order to avoid market distortions and a shifting of the environmental burden abroad. Again, this may act as a trade barrier and economic disadvantage for countries dependent on material exports.

Material input taxes are already being levied on a limited range of resources (usually on selected minerals) in some countries, notably Belgium (Flanders), Canada, Bulgaria, Denmark, France, Russia, Sweden, the Ukraine and the UK (EEA 2005, 2008) (see Box 37 on the Aggregates Levy in the UK). The explicit aims of the tax are to induce environmental benefits by making the price of aggregates better reflect the costs of environmental costs associated with quarrying and to encourage the use of alternative materials such as recycled materials and certain waste products.

Box 39. The Aggregates Levy in the UK

The Aggregates Levy is an environmental tax on the commercial exploitation of aggregate in the UK (defined for the purpose of the tax as sand, gravel and rock, with some exceptions), which came into effect in April 2002. It is based on the weight of the aggregate being extracted (on tonnage at the constant rate) and paid by businesses that commercially exploit aggregates in the UK. In order to protect international competitiveness, exports of aggregate are exempt from the levy and imports taxed on the first sale or use in the UK. The revenue generated from the tax is recycled in part to businesses via the reduction of national insurance contributions and via a special sustainability fund delivering environmental benefits to local communities affected by quarrying.

The levy is limited to aggregates and excludes substances such as clay, slate and shale and other industrial minerals because the volume of aggregates being extracted is greater than that of any other mineral. The taxation of minerals which are internationally traded would have far wider implications than for aggregates, which are mainly traded domestically. Many of the products that fall outside the scope of the levy, unlike aggregates, tend not to have recycled alternatives.

As a result of the levy, secondary and recycled aggregates have become more attractive. As the demand for virgin aggregates is largely inelastic, however, the levy may not have had a great effect on the overall level of demand.

Sources: http://customs.hmrc.gov.uk/channelsPortalWebApp/downloadFile?contentID=HMCE_PROD_008552
http://www.green-alliance.org.uk/uploadedFiles/Waste_Theme/Edward%20Lockhart-Mummary_Resource%20Decisions.pdf

Closely linked to environmental taxes are fees and charges for environmental services such as waste collection, water supply, wastewater treatment and energy supply. Environmental charges have been designed to cover (in part or in full) the costs of environmental services and abatement measures such as wastewater treatment and waste disposal.

On the whole, countries are making greater use of environmental taxes as their effectiveness has proved positive. For example, Austria, Denmark and the Netherlands are using different policy packages to reduce Co₂ emis-

sions. The use of market incentives such as taxes and subsidies in Denmark has been assessed to be a more effective policy intervention than other approaches such as voluntary agreements and subsidies (EEA, 2006).

The OECD (2008) notes that there is high potential for wider use of environmental taxes, although they need to be well-designed and their potential impact on international competitiveness and income distribution identified and addressed. For example, border tax adjustments are considered a means of addressing concerns about potential loss of competitiveness for trade exposed energy-consuming industries. The government pays exporters a rebate to offset the increased costs of production caused by a carbon tax or emissions trading scheme. OECD studies, however, show that effects of border tax adjustments can have a negligible effect on the international competitiveness of some heavy industries (The Natural Edge Project, 2008).

A significant constraint against the more widespread adoption of environmental taxes is that it is often not politically feasible to set taxes at sufficiently high levels to achieve the desired environmental goals. Governments often face resistance if taxation related to the environment is taken merely as a means of increasing its revenues. The successful implementation of environmental taxes requires a system of monitoring, revenue collection, and enforcement (ADB & IGES, 2008).

Box 40. Proposed Tax Incentives for South Africa

The South African Government has followed international trends and has recently proposed a tax incentive to curb climate change through carbon markets and energy efficiency measures.

In the draft Taxation Laws Amendment Bill 2009, an income tax incentive is proposed for any business that takes part in a UN Clean Development Mechanism (CDM) project. The incentive applies to the sale of carbon credits and exempts the sales revenues from income tax.

Additionally, the amendments open the way for businesses to obtain notional deductions for income tax purposes for energy efficiency savings based on energy efficiency certificates issued by the National Energy Efficiency Agency. In other words, investments in energy efficiency become tax deductible, provided an audited baseline had been certified for the company's energy usage prior to investments being made.

Source: allafrica.com/stories/200906040004.html

7.3.2 Tradable permits

Tradable permits have attracted growing attention in recent years as a supplement or alternative to environmental taxes. Although the use of tradable permits is a recent development, the instrument is now high on the political agenda of many countries.

The two key variables for emissions trading centre on whether the authorities set an upper limit (caps) on the total amount of substance (e.g. CO₂) that can be emitted; and how permits which emit pollutants are initially allocated to the various enterprises involved. Limits are set either as a maximum ceiling for "cap and trade" schemes, or as a minimum performance commitment for "baseline and credit" schemes. The limits can be determined either in terms of rights to emit pollutants (e.g. greenhouse gas emissions), or rights to access natural resources (e.g. water). Once a tradable permit is set up, enterprises are allowed to buy and sell permits amongst themselves which should facilitate greater cost-effectiveness and allow greater scope for technological innovation.

Cap and trade systems can combine a high degree of environmental certainty with economic efficiency. Their flexibility helps to reduce the costs of abatement, while their environmental effectiveness is high because the environmental objective is explicitly reflected in the number of permits that are issued. But the transaction costs can also be high, and decisions are needed on politically-sensitive issues such as which activities or sectors will

be covered, and the initial allocation of permits (OECD, 2008). Another challenge for governments is the complexity of establishing a functioning market in the permits.

Countries should design emission trading schemes in a way that provides connections to other national schemes, so that benefits can be maximised from a broad participative market (EEA, 2006).

Box 41. NOx trading in the Netherlands

In 2003, the Dutch Ministry of the Environment launched draft legislation that allowed for the trading of NOx emissions from industrial installations. These amendments provide a legal basis for various systems of emissions trading, in particular NOx and CO₂.

The trading scheme sets industrial emission targets of 55,000 ktonnes of NOx to be achieved by large industry sectors by 2010. This compares to 1995 base year emissions of 122,000 ktonnes.

The scheme is a baseline-and-credit type. Baseline emissions are calculated by multiplying the standard NOx emissions per GJ energy input by actual energy input over the year.

The NOx trading scheme applies to all industrial facilities with thermal capacity above 20MWh or those facilities with NOx emissions exceeding 50 tonnes per year. This covers around 250 facilities. A range of industrial sectors are covered by the scheme, such as petrochemical plants, refineries, thermal power stations above 20 megawatts capacity, steel and aluminium producers, cement factories, incinerators and saltpetre and phosphate producers.

Limited borrowing and bank credits are allowed by the scheme. Each facility may borrow a limited number of credits from its next year's allocation or bank a limited number of credits for use in the following year.

Source: Economicinstruments.com (hosted by University College Dublin and supported by UCD, the European and ESRI Japan).

7.3.3 Pricing

Pricing influences spending and investment behaviour and is a powerful tool for determining patterns of economic growth. Market prices do not usually reflect ecological costs, so while decisions made on the basis that market prices may be economically efficient, they may not be environmentally sound. Arguably, policies should be aimed at increasing the prices for raw materials and energy in a way that accounts for the external environmental and social costs related to resource use.

Energy prices are strongly affected by world demand and by both external geopolitical factors, including the policies of the Organisation of Petroleum Exporting Countries (OPEC) and the political situation in the Middle East. However, the prices within countries have generally been modified by government policy (ESCAP, 2008a).

Governments can consider how pricing can serve as an effective demand management tool. For example, the generation of electricity through clean coal, wind, solar, and nuclear power all cost more than building coal-fired power plants with no or minimal pollution controls. Power-generating companies cannot afford to build cleaner electrical generation unless governments and the public who need the electricity agree to higher prices as part of a social bargain to reduce environmental pollution from the electricity-generating sector (ADB, 2008).

Evidence shows that higher energy prices encourage the development of energy-efficient economic structures without precipitating economic disaster. Moreover, the economies of countries that have the highest energy prices, are in fact, the most stable in the world (ESCAP, 2008).

7.3.4 Environmentally-motivated subsidies

Subsidies are frequently used in policy making to achieve certain objectives, such as stimulating investment in green production technologies when there are positive adoption spillovers or complementing the use of other market-based instruments, such as pollution taxes. Subsidy support comes in different forms, such as tax provisions, loan guarantees, and charging below the cost price for public services, such as water, waste and wastewater collection.

Subsidies can result in inefficiencies and negative environmental effects (see section 4.4), and therefore, should be applied with care. If not time-bound, subsidies can get locked-in along with the (potential inefficient) practices or technologies that they support. Moreover, providing subsidies to encourage compliance with direct regulations can result in significant economic distortions and strategic behaviour among enterprises (OECD, 2008).

Environmentally-motivated subsidies are deemed not to violate the polluter-pays principle when:

- they do not introduce significant distortions in international trade and investment;
- they are limited to sectors which would otherwise have difficulties with complying with environmental requirements;
- they are limited to a well-defined transition period and adapted to the socio-economic problems associated with implementation of a country's environmental policy.

Subsidies should be structured so as to avoid a dependency by being time-limited or related to some level of technological maturity. They should also be well-targeted and performance-monitored to avoid unintended results such as the creation and involvement of interest groups who seek to profit from them (EEA, 2006).

7.3.5 Liability and compensation schemes

Liability schemes are a way of ensuring polluters pay adequate compensation for their environmental damages along with providing a means of prevention and reinstatement.

Three criteria are required to make environmental liability an appropriate policy measure. First, there is a need to identify one or more actors responsible for causing the harm or pollution. Second, damage needs to be concrete and quantifiable, and third, a causal link between the damage and the polluter needs to be established. This makes environmental liability suitable for cases where damage results from industrial accidents or from gradual pollution caused by hazardous substances or waste coming into the environment from identifiable sources. However, liability is not a suitable instrument for dealing with pollution of a widespread, diffused nature, where it is impossible to link the pollution to the polluter (e.g. effects of climate brought about by CO₂ emissions) (GTZ et al, 2006).

Some countries have found that enforcing strict liability – i.e. holding enterprises responsible for their actions, even if lawful, can incentivise preventative measures. However, the success of liability systems depends on the effectiveness of the enforcement and legal system in the particular country.

7.4 REGULATORY INSTRUMENTS

Regulatory or “command and control” instruments typically form the basis of environmental policy frameworks in both developed and developing countries. Regulations address a broad range of environmental problems and are particularly useful in addressing point sources of pollution; particularly when easily identified, monitored and enforced. They also provide certainty and clarity for administrators and businesses (GTZ et al, 2006). Flexible, well-designed standards and regulations can also be a short-term stimulus for innovation and technology diffusion by creating a demand for products and services. However, at the same time, poorly designed regulations can stifle technological innovation, particularly over the long-term.

Regulatory instruments can be less economically efficient than market-based instruments and often have significant information requirements for their design. They can also be complex to administer, although this depends largely on their design.

In practise, the distinction between direct regulations and economic instruments is often blurred as any system of economic instruments usually requires appropriate legislative or regulatory backing. Regulations, therefore, should form part of a mix of policy instruments. Finally, regulatory policies should be supported by an integrated overarching legal framework.

7.4.1 Norms and standards

Norms and standards are rules and targets set by public authorities that are subsequently enforced by compliance procedures. Norms and standards are applied to achieve various aims, including reducing emissions and waste, increasing resource or energy efficiency, reducing the use of toxic substances and protecting ecosystems (GTZ et al, 2006). Different types of standards and norms can be applied to environmental management, including emission standards or performance-based standards, ambient standards, technology standards, management and process standards, and product standards.

General performance standards which are not directed at particular technologies provide enterprises with stronger incentives to innovate than technical standards. Furthermore, standards that target an environmental outcome, rather than for example, specifying the technologies to be used, gives enterprises more flexibility in seeking low-cost abatement policies (OECD, 2008). An interesting example of how regulations can stimulate technological innovation is Japan’s Top Runner programme (see Box 40).

Box 42. Japan’s Top Runner programme for energy efficiency

The Top Runner Programme was launched in 1998 by Japan’s Ministry of Economy, Trade and Industry. Essentially, the scheme sets performance targets for enterprises based on the value of the most energy-efficient products on the market at the time, rather than fixed targets. Targets are periodically reviewed and aligned on the performance of the “best in the class”, which creates a benchmarking exercise. The flexible and dynamic way this standard setting has been devised creates positive incentives and competition among manufacturers to improve their product performance without the need for financial support or bias towards existing or outdated technologies. The programme is complemented by the e-Mark voluntary labelling scheme to help consumer choices at the point of sale.

The programme currently targets 21 product groups in the residential, commercial and transport sectors.

Source OECD, 2010

7.4.2 Substance, product or technology bans

Nowadays, still very few substances are subject to bans. In that context, they are viewed as less progressive instruments which largely favour end-of-pipe solutions. However, as in the case with other instruments, it is the

way a specific regulation is formulated that determines whether it will promote cleaner production or traditional abatement technologies. The most common form of ban relates to the use of particular toxic materials. These often take the form of restrictions under hazardous substances legislation. More definitive forms are the banning of an entire product whose production, use, or disposal has strong adverse impacts. For example, the Stockholm Convention focuses on eliminating or reducing releases of twelve persistent organic pollutants. In May 2009, at the Conference of the Parties (COP) new nine additional chemicals were added.

Bans of specified substances can be very effective if they can be enforced. For example, they can force a change in input material. However bans should not be used in a way in which “banned” substances are replaced by an even more harmful substance or process (Lindhqvist, 2001).

7.5 Voluntary Agreements

Voluntary Agreements (VAs) or Negotiated Environmental Agreements (NEAs) have been used to address a range of policy issues, including product related concerns, pollution and energy efficiency targets, and reporting requirements. VAs encourage businesses, industries or sectors to improve their resource efficiency and environmental performance beyond regulatory measures. VAs range from initiatives where participating parties set their own target and conduct their own monitoring and reporting, to initiatives where a contract is made between a private party and a public body or NGO (GTZ et al, 2006).

VAs can be useful for raising awareness and getting buy-in from business and industry on the need for action. Further, they can offer more ambitious goals than regulations, while lowering administrative and enforcement costs – thus enabling faster implementation. They also can shift businesses’ mindsets from reactionary, end-of-pipe and financial cost attitudes to more proactive and innovative behaviours.

However, the environmental effectiveness of VAs needs to be carefully assessed. The OECD (2008) has found little evidence of situations where such approaches have contributed to environmental improvements that are significantly different from what would have happened anyway. Furthermore, they can incite “free-riders”, and cannot deal with negligent or constant poor performers on their own. It is generally accepted that VAs are most useful when used in combination with other instruments such as economic instruments and regulations, or during a phase-in period for the use of another instrument (OECD, 2008).

Box 43. Danish Agreements on Industrial Energy Efficiency

The Danish voluntary scheme on energy efficiency in industry was launched in 1996 as part of the Green Tax Package. The main objective of the Package was to reduce the carbon dioxide (CO₂) and sulphur dioxide (SO₂) emissions from trade and industry. In doing so, it introduced negotiated agreements combined with CO₂ taxes and investment subsidies. The target group for the agreements is enterprises with energy intensive production processes. These enterprises can enter into a three-year agreement with the Danish Energy Agency qualifying them for a rebate on their CO₂ payment.

The agreements can be individual (covering a single firm) or collective (covering several enterprises within a sub-sector with similar production processes). However, in both cases, the agreement is signed by the individual enterprises. As the agreement is legally binding and the tax rebate is firm-specific, the problem of free-riding is not present. If enterprises do not comply with the terms of the agreement, their tax rebate is annulled. Thus, there exists a credible regulatory threat which gives enterprises a strong incentive for fulfilling the terms of their agreement.

Companies entering into a VA must implement an Energy Management System (EMS). The purpose of the EMS is to ensure that energy savings are achieved in daily operations, inefficient operations are identified, and that new possibilities for energy efficiency are continuously evaluated. The “energy audit” used to play a key role in the VA scheme; however, because of steep administrative costs imposed

by the audit, companies now do an “energy flow screening” which covers the most energy intensive parts of their production process.

The Danish experience with VAs shows that the administrative costs for the implementing authority can be significantly reduced over time as a result of learning-by-doing, continuous adjustments (revisions), and increased systematisation of the administration.

Source: Ericsson, 2006

7.6 INFORMATION-BASED INSTRUMENTS

Information-based instruments can include a range of activities and services such as environmental data collection and dissemination, development of indicators, environmental valuation, energy audits, education and training, eco-labelling or certification schemes, public disclosure of enterprises’ environmental performance, etc. If designed properly, these can complement and strengthen the effectiveness of other policy instruments, such as environmental taxes etc.

Governments can use a variety of measures to increase awareness about resource efficiencies and sustainable production. Increasing public awareness can involve measures such as campaigns, mainstream education, the use of media, and public participation during policy processes etc. It is important to note that information sharing is critical at the local, national, and international levels. Box 42 below highlights an international partnership initiative designed to disseminate knowledge about waste prevention and management.

Box 44. The 3R Knowledge Hub

As part of regional efforts to promote the 3R (Reduce, Reuse, Recycle) Initiative, the 3R Knowledge Hub was jointly established in 2006 by UNEP and the Asian Institute of Technology in Bangkok, Thailand with support from the Asian Development Bank. The hub aims to collect, create, and disseminate knowledge relevant to the 3Rs, specifically in municipal, medical, and solid waste management.

The hub also helps to develop broad guidelines and training programmes, along with encouraging nations to develop national integrated policy frameworks and national action plans to promote resource efficiency. The hub aims to promote to industry best practices endorsed by regulatory agencies, and where possible, works closely with trade and industry associations.

Source: www.3rkh.net

Information disclosure is becoming increasingly recognised as an important mechanism to stimulate better environmental and social practices amongst businesses. Responding to the growing pressure and expectations from customers, business partners, investors and the wider community, information disclosure is a means of identifying risks and opportunities. An increasing number of government departments and local authorities have begun publishing sustainability reports. Governments can make disclosure of non-financial performance mandatory for public agencies and private companies (e.g. Denmark, Portugal). Another government support measure is through guidelines that standardise the report contents (e.g. Austria, UK, Japan and Australia) (GTZ et al, 2006).

7.7 ENVIRONMENTAL MONITORING AND REPORTING

Monitoring systems have a variety of purposes for environmental management. First, compliance monitoring systems support the implementation of regulatory policies by detecting violations and providing evidence to support enforcement actions. Second, monitoring and reporting systems provide a means of assessing whether policies and environmental management have been effective over the long-term, and whether new ways need to

be developed to deal with emerging environmental issues. They can also help decision-makers identify where increased management, policy and/or funding is needed.

Inspections conducted by government authorities (or third parties contracted by the government) are the backbone of most compliance assurance programmes. A key benefit of an on-site inspection is that it can reveal operational and compliance problems that emission monitoring data alone won't show.

Indicators are an important feature of monitoring and reporting systems. In the case of monitoring the state of the environment, indicators simplify, quantify and communicate complex environmental data, and in doing so, provide information about the state of the environment. For example, quantitative indicators can also be used to determine efficiencies on the factory floor. Box 43 below outlines some useful qualitative indicators for assessing sustainable manufacturing operations.

Box 45. Indicators for Assessing Sustainable Manufacturing Operations

- Ratio of virgin materials to total material inputs in the production process.
- Ratio of actual/potential recycled materials.
- Ratio of renewable/fossil fuel sources.
- Materials productivity.
- Energy productivity.
- Waste disposal per economic output.
- Resource input per unit of end-user service.

Source ADB & IGES (2008)

An issue for many countries is that monitoring and information systems are often fragmented and dispersed amongst agencies. Efforts have been made to focus, streamline and increase the cost-effectiveness of the institutional frameworks for data collection and processing in many OECD countries.

There is a growing movement amongst governments to use industry self-monitoring, supported by citizens' monitoring/non-compliance detection. Self-monitoring can lead to clearer understanding for industry of their compliance status and provides easier data gathering to support regulatory reform. Citizens' monitoring (including the case of whistle blowers in the case of illegal activities) can also implement extensive state monitoring systems. Self-monitoring can, however, impose significant costs on business and on regulators. It is important that the requirements (parameters to be monitored and the mode and frequency of reporting) adequately reflect the nature of the operator's activity and the regulator's need (OECD, 2009).

7.8 ROBUST COMPLIANCE AND ENFORCEMENT REGIMES

Governments around the world continue to grapple with ineffective compliance and enforcement regimes, which hinder the achievement of environmental policy goals. The challenges are numerous. Defining appropriate levels of compliance is difficult. Detecting and taking action against non-compliance is complex and resource intensive. Additionally, the institutions assuring compliance need to be sufficiently independent and equipped to resist political pressure and corruption (OECD, 2009).

An effective compliance regime involves a combination of promotion, monitoring and enforcement tools which are mutually supportive. Knowledge of the factors that drive compliance behaviour in enterprises is crucial for the design and application of instruments.

Increased focus of strategic planning and performance assessment on environmental outcomes is a growing trend amongst governments. For example, countries such as the Netherlands, the UK and the US have developed performance

indicators to assess levels of compliance with regulatory requirements, and reductions on the negative impact on the environment.

Integration of environmental permitting and compliance monitoring regimes across sources of pollutants is a growing trend in some countries. Some countries are targeting compliance monitoring on facilities where potential environmental risks are the greatest and/or in situations where there is a higher risk of non-compliance. There is evidence that risk-based targeting results in higher rates of detection of non-compliance.

Compliance promotion targeted at SMEs is of growing importance. Promotional tools include the provision of assistance such as education, training and outreach, and incentives designed to promote observance of environmental requirements. Compliance promotion is particularly effective when it is difficult to cover a broad range of polluting sources with compliance monitoring and enforcement activities, where there is a lack of knowledge or lack of capacity to comply among the regulated community, and if there is cultural resistance to enforcement after the introduction of a new regulation.

There are a range of instruments used by governments to promote compliance, such as direct communication between inspectors and operators, benchmarking of environmental performance, dissemination of information, and through the adoption of environmental management systems (EMSs). The fear of adverse publicity for environmental offenders often acts as a strong deterrent to non-compliers. Public disclosures of violations can act as a powerful tool for governments, agencies, NGOs, and sometimes even courts, to obtain compliance.

The shift in emphasis on policies that promote resource efficiency and pollution prevention measures as opposed to targeting end-of-pipe solutions will ultimately ease the burden faced by many enforcement agencies.

Box 46. Innovative Economic Instruments to Deter Non-Compliance in China

In 2007, China's Ministry of Environmental Protection (MEP) and the China Banking Regulatory Commission jointly announced the "green-credit" initiative under which the environmental performance of loan applicants must be taken into account by the bank. Loan applicants with poor compliance records are required to pay higher interest rates, and serious violators are denied credit. The MEP has created a database of 15,000 environmental violations and made it available to commercial banks. Some foreign banks are also planning to work with the MEP on this initiative.

Also in 2007, the MEP and China's Minister of Commerce announced that enterprises with serious environmental violations would be subject to an export ban for one to three years. The two government bodies are expected to set up a database to collect information of exporters with poor environmental compliance records.

Early in 2008, the MEP launched a "green securities" scheme aimed at making it harder for polluters to raise capital and requiring listed enterprises to disclose more information about their environmental record. One element of the "green securities" programme is already in place; companies in sectors including thermal power, steel, cement, and aluminium need MEP approval before they can apply to the securities regulator to sell shares.

Source OECD, 2009

7.9 GOOD PRACTICE MEASURES

Box 47. Good practice measures: Effective Instrument Mixes

- Green industry policy should be supported by a *mix* of market-based, regulatory, voluntary, and information-based instruments.
- Instrument mixes should be *flexible, broad, and not overlapping* in their application.
- Governments should consider market-based instruments as a *least-cost* policy instrument, which spurs *technological innovations*.
- Successful implementation of market-based instruments requires a system of *monitoring, revenue collection and enforcement*.
- Regulatory policies should be *flexible and well-designed* so not to stifle technological innovations.
- *Environmental monitoring and reporting* systems should be established to identify violations and to assess whether policies have been effective over the long-term.
- *Indicators* should form part of all monitoring and enforcement regimes, as tools to simplify, quantify, and communicate environmental data.
- Effective compliance regimes should involve a combination of *promotion, monitoring, and enforcement* tools, which are mutually supportive.
- Compliance *promotion*, such as education, training and outreach, are an important feature of enforcement and compliance regimes.

8. A POLICY FRAMEWORK FOR THE GREENING OF INDUSTRIES

The policy framework outlined below summarizes the broad range of initiatives and good practice measures within the report, which directly or indirectly support the greening of industries. The policy framework is structured around five themes, which form the basis of this report: an integrated framework, enabling factors, industry-led initiatives, environmental technologies, and a mix of policy instruments.

AN INTEGRATED FRAMEWORK TO SUPPORT THE GREENING OF INDUSTRIES

| <i>Policy options</i> | <i>Practice Measures</i> |
|--|---|
| <ul style="list-style-type: none"> • National Sustainable Development Strategies. • National Development Strategies. • Poverty Reduction Strategy. • Sustainable Consumption and Production Strategies. • Regulatory Frameworks. • Integration into sector strategies (e.g. education, health & safety, science). • Inter-agency forums. • Ministerial committees. | <ul style="list-style-type: none"> • Commitment to the greening of industries from top levels of government. • Clear processes for integrating social, environmental and economic goals. • Policy integration across relevant government sectors. • Policy integration within different tiers of government. • Policy development which is innovative and strategic. • The development of clear, measurable and enforceable policies. |

CREATING AN ENABLING ENVIRONMENT

| <i>Policy options</i> | <i>Practice Measures</i> |
|---|---|
| <ul style="list-style-type: none"> • Providing access to finance through loans, grants, seed funds etc. • Removal of harmful subsidies. • Demand policies (e.g. public procurement) • International cooperations and trade and investment policies. • Promoting firm competitiveness and market awareness. • Provision of eco-efficient infrastructures such as wastewater, water, energy, recycling etc. • Supporting local action by empowering local authorities and community-based organisations. • Enhancing the skill base of society through education curricula and training programmes. | <ul style="list-style-type: none"> • Strengthening the capacity of the financial sector • Mobilising finances through public-private partnerships. • Subsidy reform processes, supported by an enabling environment, clear exit strategy, clear objectives, and policy coherence. • Procurement processes supported by leadership and commitment from senior managers. • Integration of environmental issues with trade and investment policies. • Provision of high quality support services, and market information. • Collaborations, resourcing, capacity building, and institutional support. • Targeting all levels of education: primary and secondary, technical and vocational, higher education, and lifelong/on the job. |

| INDUSTRY-LED INITIATIVES | |
|---|---|
| <i>Policy options</i> | <i>Practice Measures</i> |
| <ul style="list-style-type: none"> • Supporting facilities which raise awareness and build capacity (e.g. Cleaner Production Centres) • Promoting Environmental Management Systems. • Industry-based standards. • Eco-labels and certification. • Life cycle analysis. • Greening the supply chain. • Extended Producer Responsibility. • Promoting Corporate Environmental Responsibility. | <ul style="list-style-type: none"> • Enhancing firm capability through training facilities and demonstration programmes. • Leveraging the expertise of industry clubs and associations as a means of promoting policies for resource-efficient practices. • Government-business partnerships which seek to foster improved environmental management. • Identifying pollution and waste reduction initiatives throughout a product's life cycle. • Designing incentives that promote pro-active behaviours, rather than opportunities to avoid compliance issues. |

| HARNESSING ENVIRONMENTAL TECHNOLOGIES | |
|--|--|
| <i>Policy options</i> | <i>Practice Measures</i> |
| <ul style="list-style-type: none"> • Developing technical capacity • Building the technology base through strategic R&D programmes. • Financing environmental technologies through tax breaks, grants, seed & venture capital etc • Accelerating technology diffusion • Promoting effective knowledge transfer through networks, collaboration and infrastructures • An integrated and strategic science system supported by tools such as environmental scanning. | <ul style="list-style-type: none"> • Education, outreach, links to research labs. • Industry-led research partnerships, co-funding programmes, technology transfer initiatives. • Funding and incentive instruments which are carefully designed to avoid windfall gains. • Effective incentives, targeted sectors, locally oriented programmes, and integrated services. • Knowledge transfer facilitated through the formation of science partnerships, joint ventures, clusters, incubators, science parks, global networks etc. |

| INSTRUMENT MIXES TO PROMOTE THE GREENING OF INDUSTRIES | |
|--|---|
| <i>Policy options</i> | <i>Practice Measures</i> |
| <ul style="list-style-type: none"> • Environmental taxes and charges. • Pricing instruments • Tradable permits. • Environmentally-motivated subsidies. • Liability and compensation schemes. • Effective legal and regulatory frameworks. • Norms, standards, substance, product, or technology bans. • Voluntary agreements. • Information-based instruments. • Environmental monitoring and reporting. • Robust compliance and enforcement regimes. | <ul style="list-style-type: none"> • Policy mixes, which include market-based, regulatory, voluntary, and information-based instruments. • Instrument mixes which are flexible, broad-based, and not overlapping in their application. • A system of monitoring, revenue collection and enforcement to support the implementation of market-based instruments. • An integrated, overarching legal framework to support regulatory policy measures. • Flexible and well-designed policy measures so not to stifle technological innovations. • Environmental indicators to support monitoring and enforcement regime • Compliance regimes which combine promotion, monitoring, and enforcement tools. |

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