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Green Industry
for a Low-Carbon Future

A greener footprint for industry

Opportunities and challenges of sustainable industrial development

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

A Greener Footprint for Industry

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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
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List of abbreviations

CSR	Corporate Social Responsibility
ILO	International Labour Organization
ISO	International Organization for Standardization
MEA	multilateral environmental agreement
NCPC	National Cleaner Production Centre
NCPP	National Cleaner Production Programmes
OECD	Organisation for Economic Co-operation and Development
RECP	Resource Efficient and Cleaner Production
SAICM	Strategic Approach to International Chemicals Management
SMEs	small and medium enterprises
three Rs	Reduce, Recycle, Reuse
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific

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Executive summary

In Part I, the challenge posed to industry in the developing countries by the current economic turbulence is described. Industry's production systems are unsustainable. Only if they can produce more with less will they become more sustainable. Enterprises can also have negative impacts on their local environments. In response, there has been a rapid growth in legislation aimed at getting industry to "clean up its act", and the new environmental services sector has developed rapidly in the developed countries. Because enforcement of environmental legislation has been more lax in developing countries, such a sector is growing up only slowly there. In addition, in the developed countries, the environmental and social performance of enterprises has increasingly been used as a factor in deciding whether to do business with them, and this means that environmental demands are being made on enterprises. Enterprises in the developing countries wishing to enter into global value chains, or to retain their position in them, are recognizing that they must adapt to the environmental demands made of their products or of their manufacturing procedures, and to do this they need companies that can offer specialized services relating to the development and certification of various management systems and products.

For the developing countries, the response to the problems outlined lies in enabling output to continue to grow while minimizing growth in inputs of materials and energy, for example, by adopting "three Rs" strategies; reducing consumption of raw materials in production processes; switching to renewable sources of energy and materials; and redesigning products to contain fewer materials and consume less energy, water, etc. during use. Governments can play an important role in supporting awareness-raising, capacity-building, and the creation of industry-support institutions and of accreditation and certification bodies.

Enterprises also need to reduce their environmental impacts on their local environments. Here, governments have a key role to play, both by enacting laws and regulations and by enforcing them. They can also invest directly in publicly owned waste-management and pollution-control infrastructure, and encourage business creation in the environmental services sector, and they can support the establishment of institutions to assist enterprises to meet standards and certify that they do so, and to monitor the development of environment-related standards affecting trade, inform their industry of new standards, and assist it to meet these standards.

The development aid community has an important role to play in supporting governments in guiding their industrial development into sustainable pathways by assisting industry to overcome the barriers of lack of knowledge and skills, absence of an adequate external support system, fragmented and ineffective policy frameworks and difficulties in accessing finance. It can also support governments in eliminating gaps in the normative framework and in enhancing their enforcement of existing environmental laws and regulations, as well as in encouraging the growth of a recycling industry. Governments also need support for removing other financial disincentives to efficiency, and creating a strategic science and technology framework that encourages green innovation and the transfer, development and adaptation of environmentally sound technologies.

Initially, the development aid community can focus on areas where entrepreneurs can get an adequate financial return, even when the normative framework is defective. Examples are resource efficiency and cleaner production, the ability to meet environmental standards in the global market and recycling. As the gaps in the normative framework are eliminated, the focus of development aid can shift correspondingly.

In Part II, UNIDO's proposed Green Industry Initiative is outlined. Its main objectives will be to identify gaps in normative policy frameworks in terms of incentives, environmental laws and regulations and other policies which promote the greening of industry. The strategy also aims to remove gaps in the support system by promoting the establishment of specialized enterprises in the environmental goods and services sector, and by supporting entrepreneurs in assuming the risks of launching businesses in that sector; and to remove gaps in the industrial sector's knowledge and skills set by partnering with institutions of higher learning and assisting governments to develop green technical and managerial knowledge and skills in enterprises; and to develop public-private partnerships in the environment field.

With a view to the above aims, the Initiative should focus on the promotion of low-carbon paths to industrial development; efficient use of non-energy raw materials and of recycled industrial and non-industrial wastes; adoption of relevant products and technologies to meet international commitments or environmental standards; adoption of environmental and related management systems with a view to entry into global value chains; and creation of businesses that can offer services in these areas.

The outcome of the International Conference on Green Industry in Asia, organized by UNIDO, together with the Government of the Philippines, ILO, UNEP and UNESCAP in Manila, in September 2009, is described. The Manila Declaration and Framework for Action adopted by the Conference outlines steps to reduce the resource-intensity and carbon emissions of Asian industries and provides a mechanism for periodically assessing progress in implementing the Framework. UNIDO is proposing to undertake a series of activities to assist Asian countries wishing to implement it. These include the preparation of green industry policy guidelines, the preparation of country status reports on eco-efficiency, and other follow-up activities. In addition, green-industry pilot programmes will be initiated, both in Asia and in other regions. These will refer to low-carbon, low-water and low-materials pathways; reduction in the environmental footprint of a value chain; and designing the factory of the future.

PART I
THE CHALLENGE AND THE PROPOSED REPONSE BY THE UN SYSTEM

1. Introduction

These are challenging times for enterprises the world over. Not so long ago, enterprises were finding themselves faced with rapidly escalating prices for many of their major raw materials. The soaring oil prices were the most prominent example of this phenomenon, but the same upward price pressures were seen for a number of raw materials essential to industry: coal and natural gas, iron ore, copper and aluminium, to name only a few. Then, as the financial and economic crisis hit, prices tumbled, but only because banks stopped lending, consumers stopped buying, and world trade dried up. As a result, enterprises went bankrupt or closed down, and job losses mounted. One can expect that the bad news will continue to come in for some time to come. If enterprises are to survive such troubled times, they will need to strengthen their capacity to compete, to increase their productivity, to reduce their production costs, and to take advantage of new opportunities.

However, underlying this economic turbulence are trends that are far more troubling for the long-term health of our economies. At the global level, we have adopted patterns of use of materials and energy that are simply unsustainable. The amounts of materials and energy we are consuming are such that we are rapidly depleting the world's available resources. At the same time, this consumption is leading to increases in waste and pollution which, in quantity as well as in toxicity, are overwhelming the assimilative capacity of the world's ecosystem. At the country level, the situation is more nuanced. Patterns of consumption of materials and energy vary widely from country to country. The least developed countries are still not consuming enough to satisfy their basic needs, while the most developed countries are consuming far beyond these needs. What is urgently required is that the more developed countries change their patterns of consumption; they must decouple their consumption of materials and energy from their economic growth, so that they can continue to create wealth, but not at the price of increasing consumption. At the same time, it is imperative that the less developed countries not emulate these unsustainable growth pathways, but choose instead paths of economic growth that are fundamentally less materials- and energy-intensive.

In all of this, industry, as the prime manufacturer of the goods and services that societies consume, has the critical role to play. And one can only conclude that industry's production systems are fundamentally unsustainable: They do not permit the needs of present generations to be met without jeopardizing the ability of future generations to meet their needs. Only if production systems can decouple their consumption of materials and energy from their production (i.e., produce more with less) will they become sustainable. These systems are that much more unsustainable because many enterprises use more materials and energy than their production processes require, since they continue to use obsolete and inefficient technologies and fail to adopt proper management

systems. This is particularly true of industry in the developing countries.

While these unsustainable patterns of industrial development may not have been appreciated until quite recently, it has been recognized since the start of the industrial revolution that enterprises can have obvious, visible, and sometimes highly noxious, impacts on their local communities and environments. As a response to these manifest health and environmental impacts, the last 40 years have seen an unparalleled growth in environmental legislation aimed at getting industry to "clean up its act". This legislation has created many new opportunities for entrepreneurs, as it has created a demand for environmental goods and services that will allow enterprises to bring the impact that they have on the environment under control. As a result, a new industrial sector, the environmental services sector, has come into being in the developed countries, growing rapidly and creating many new jobs. Because enforcement of environmental legislation has been more lax in the developing countries, such a sector is growing up only slowly there.

In parallel, there has been a growing determination by different stakeholders in the developed countries to use the environmental and social performance of enterprises as a factor in deciding whether to do business with them. Individual consumers, through their purchasing decisions; major lending institutions and investors, through their lending and investment decisions; and government agencies, through their procurement decisions, are all making environmental demands on enterprises. The first to feel this pressure are often the transnational corporations and other large companies, but they in turn are exerting a similar pressure on their suppliers. As a result of the globalization of trade, many of these are now located in developing countries.

This paper explores in more detail these challenges and opportunities. In keeping with UNIDO's mandate, the focus is on industry in the developing countries. How can enterprises in these countries become greener and shrink their environmental footprint, while at the same time continuing to grow and deliver goods, services and jobs to their populations? What role should the governments of developing countries play in this process? Answers to these questions must take into account one overriding imperative: that industries in developing countries need to grow[1]. Industrial development is the only mechanism that will enable developing countries to reduce the level of poverty and hardship they face. This conclusion offers a strategy for the development aid community, which is designed to help developing countries bridge the gap between the present and the future.

2. The Context

A. Climate change and other global environmental threats

Ever since the beginning of the industrial revolution, it has been recognized that enterprises have impacts – sometimes severe impacts – on their environments: rivers and

[1] To some extent, the industrial development patterns which developing countries adopt will not be similar to those adopted by developed countries in the past.

groundwater, air quality, and local land use[2]. Broadly speaking, it can be argued that, since the start of the modern environmental movement in the 1960s, the developed countries have been managing the environmental impacts of industries more effectively.[3] The picture is less rosy in the developing countries, where environmental management is lagging behind industrial growth, the result being pockets of severe local pollution caused by industry. Nevertheless, the improvements seen in developed countries show that, in most cases, this is a problem that can be solved[4], and solving it could be a source of major business opportunities for enterprising companies. This issue is taken up again below.

Of much greater long-term impact are global environmental threats, which reflect the natural environment's growing inability to absorb the wastes that are the by-product of world economic growth. By their nature, these are much more difficult threats to tackle, being multi-country and multi-stakeholder in nature, and they are of much greater concern, since failure to tackle them can result in broad ecosystem – and consequent economic – collapse.

Climate change is the most prominent example of such threats. It is so dramatic because it has truly worldwide impacts and because it will require us to make fundamental changes to our economies, transforming them from the high-carbon economies they have been for the last two centuries – completely dependent on fossil fuels – into low-carbon economies. But there are other signs that the world's absorption capacity is being stretched to breaking point and that changes in our production and consumption patterns are required. Depletion of the ozone layer is one such example, and recognition of the problem more than 20 years ago finally brought the international community, through the Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol, to adopt mechanisms to phase out chlorofluorocarbons and other ozone-depleting substances.

Other families of chemicals have been recognized as posing global, and not just local, threats. The Stockholm Convention on Persistent Organic Pollutants, which entered into force in 2004, was designed to tackle the growing problem of such pollutants, which are chemicals so foreign to ecosystems that they cannot be broken down, and thus are able to spread worldwide. There are growing concerns about the continuing disposal into the environment of heavy metals, such as mercury, cadmium, chromium and lead, which by their very nature are indestructible and can be very toxic to ecosystems. In general, the last 40 years have seen a growing concern about the vast number of synthetic chemical substances that are being brought onto the market, that are internationally traded, and whose potential effects on ecosystems are in many cases little known. Far-reaching national and regional legislations have been put into place to control chemicals, and

[2] The impacts of industrial operations on workers were also recognized early on, and the growth of controls over these impacts has mirrored that of controls over industry's environmental impacts.

[3] However, while a good part of this success can be attributed to the implementation of cleaner production, recycling/reuse, and end-of-pipe treatment, as well as environmentally sound disposal practices, it should be recognized that it is also due in part to the shutting down of the environmentally most damaging industries – only to result in increased production in the developing countries.

[4] This is true only with continuous innovation where necessary.

through the Strategic Approach to International Chemicals Management (SAICM), adopted in 2006, there is the start of an international process to control them. Even plastics, that great symbol of prosperity, are being viewed with increasing alarm; their virtual indestructibility, their ubiquity, and their ability to interfere with environmental mechanisms are seen as posing an increasingly important threat to the global commons.

Recently overshadowed by climate change but nevertheless of growing concern is the coming global crisis in water. Population growth, economic development and urbanization are leading to increased water consumption. When all three occur simultaneously, as is currently the case, the result is very rapid increases in water consumption: While the world's population tripled in the twentieth century, the use of renewable water resources grew sixfold. The World Water Council estimates that, on average, the world has a level of water stress of 40%[5], with a highly variable distribution – the arid parts and most heavily populated parts of the world exhibiting water stress levels above 80%. Adding to current water stress levels is the fact that one of the more significant impacts of climate change is that regions that already receive little water will receive even less.

Industry is related to a greater or lesser extent to all these environmental impacts. Because human economies are intimately intertwined with global ecosystems, through the feedback loops established, they will have growing impacts on industry. Efforts by the international community to reverse ozone depletion has intimately involved industry, since it is both the producer of ozone-depleting substances and the prime consumer of them. For the same reasons, any attempts to control the manufacture and commercialization of chemicals will have a strong impact on industry. As for efforts by the international community to minimize climate change, they can be expected to have a very large impact on industry. Enterprises will almost certainly be required to find ways of drastically reducing their use of fossil fuels, or drastically reducing their use of electricity generated from fossil fuels. But the impact of climate change on industry will not stop there. Industries, along with the rest of society, will need to adapt to climate-induced changes by relocating out of newly flood-prone zones, making do with less water (see below), adapting to higher temperatures, and so on. And it can be expected that industry will become involved in making available the technologies and other goods and services that society will require to adapt to climate change. As for water, globally, it is estimated that 15% of worldwide water use is already industrial, and that level is set to grow with industrial development. It can be expected that industry will have to "run drier" than it has historically, especially since, in many areas of the world, climate change will have an impact on the availability of water[6].

Of less direct and obvious concern to industry are the international community's continuing efforts to slow down the world's increasingly rapid loss of biodiversity, the increasing pace of land degradation and desertification, the growing "desertification" of

[5] A measure of the proportion of water withdrawals with respect to total renewable resources of water available.

[6] Agriculture consumes a large amount of available water; therefore, there is a need to improve the efficiency potential of water.

continental shelves as fish stocks collapse, the accelerating disappearance of wetlands, and so on. Yet industry is actually being affected by these changes. Like the rest of our economies, if industries are to continue functioning, they need the ecosystem services the natural environment offers us – clean water, clean air, the mineralization of wastes. The ability of nature to go on offering us these services depends on the existence of a healthy, stable biodiverse environment. To the extent that containing these risks will require changes in production and consumption patterns, industry will find itself involved.

B. Trade and environment

Already since the early 1990s, multilateral environmental agreements (MEAs) have been concluded to control some elements of international trade for environmental reasons. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, which entered into force in 1992, controls the international trade in hazardous wastes; the Cartagena Protocol on Biosafety to the Convention on Biological Diversity, which entered into force in 2003, controls the international trade in living modified organisms; the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, which entered into force in 2004, controls the international trade in certain chemicals that have been banned or severely restricted nationally for health or environmental reasons.

In many ways, these MEAs were put in place to protect the developing countries from inappropriate trading practices by the developed countries. However, recent trends suggest that in the future it is the trade from the developing to the developed countries that will increasingly be subject to hurdles of an environmental nature. The earliest such hurdles flowed from the movement in the developed countries in the 1990s to adopt environmental management systems. This was undeniably a good move, since it recognizes that enterprises cannot properly control their environmental impacts unless they have in place formalized management systems for doing so. However, following in the path of the very successful ISO 9000 series of standards, it was further decided to establish various certifiable environmental management standards, ISO 14000 being the best known of these. During the same period, other certifiable management standards were created in the related field of worker health and safety. This work continues: ISO has just started the development of a new standard – ISO 50000 – in the field of energy management. All this has quickly got caught up in a generalized demand by civil society organizations that industry, especially multinational companies, become more socially and environmentally responsible, culminating in the growth of the Corporate Social Responsibility (CSR) movement, which covers all of industry's potential environmental impacts. In turn, this is now spinning off an international management standard on social responsibility, ISO 26000.

This growth in management standards in the environmental and related fields has been paralleled by a similar growth in environmentally-driven product manufacturing standards – energy efficiency standards, for instance, or standards banning the use in products of certain environmentally hazardous substances – as well as product standards in related fields such as consumer protection and food safety. Environmentally-related

product labelling requirements are also becoming popular, the latest move being to start requiring carbon footprint ("embedded carbon") data on products (a measure of how much energy went into the manufacture and transport of a product). Rather special forms of such product standards are those connected to fair trade, organic food and the like.

The popularity of environmental and related standards can clearly be ascribed to a desire on the part of enterprises to publicize their "environmental credentials" more believably through their certification of compliance with such standards. However, as in the case of ISO 9000, these standards have also become a means for companies, especially multinational companies, to control their suppliers and lessen the risks to themselves from actions taken by these suppliers (this concern became especially acute after Nike's public-relations disaster deriving from questionable labour practices by some of its suppliers). The net result is that enterprises in the developing countries wishing to enter international trade through global value chains find themselves being required to conform to a thicker and thicker web of management and product standards, a growing number of which are of an environmental or related nature.

It should be stressed that, although these standards, especially the management standards, have a strong element of public-relations interest – particularly in the developed countries, where consumers tend to be more environmentally aware – their application can undoubtedly bring great benefits to enterprises in developing countries, since the management discipline they impose can assist enterprises in running themselves more efficiently and therefore more profitably and competitively.

Much of what has been discussed so far in this section can be considered to refer to "private standards", i.e., standards that are not imposed by law but by enterprises, if suppliers want their business. However, there is a growing body of "public standards", i.e., national or regional laws and regulations, of an environmental nature that are having an impact on international trade. Because of concerns about public safety, many of the consumer and food-safety product standards mentioned above take the form of public standards, but more and more of the environmentally-related product standards are also public standards. A number of countries have imposed energy-efficiency requirements for products for at least a decade. A newer trend, especially in the EU, is to impose a legal responsibility on manufacturers to ensure that their products, once they become waste, are recycled and reused: Packaging was the first product type to be targeted in this way, although there are now similar requirements for waste electrical and electronic equipment and automobiles at the end of their lives. The commercialization of chemicals has also been the subject of some far-reaching legislation in the EU. In today's global economy, where thousands of kilometres separate the point of a product's consumption from the point of its production, as is often the case where developing countries are involved, such legislation can have very large ripple effects beyond national or regional boundaries.

C. The environmental services industry

In the developed countries, the elaboration of environmental legislation and its implementation over the last 40 years have led to the creation of a new industrial sector, the environmental services sector, which assists enterprises to assess, measure and manage their environmental impacts, as well as to manage the pollution and waste they generate and to dispose of it in an environmentally sound way. Specialized engineering companies have come into existence to design, install and operate environmentally sound technologies – from windmills to waste-water treatment plants, from biodigesters to incinerators – as have a host of environmental consulting firms specializing in an array of management or technical skills. Recent statistics suggest that the industry is worth around USD 300 billion annually in the developed countries alone[7]. The size of the sector in the developing countries is unknown, but is definitely much less for the time being.

The key to the phenomenal growth of the environmental services sector in the developed countries has been the rapid and continuing increase in the body of environmental legislation in these countries, but even more important is the consistent enforcement of this legislation. This legislation is driven by the "polluter pays" principle, that is, it internalizes into enterprises the environmental costs that they had previously been externalizing onto local communities and the environment. By definition, internalization increases costs for the enterprises and therefore there is a continuing incentive for companies to avoid or attenuate implementation of environmental legislation. Only proper enforcement of legislation, or, to put it in a more positive light, the creation of adequate incentives, can keep implementation on track and therefore maintain an economically viable environmental services sector. Precisely because both enforcement and the incentives package are generally weak in the developing countries (it is normally not laws and regulations that are lacking), the level of implementation of environmental laws is low. Therefore, an environmental services sector has not been able to develop in these countries to the extent that it has in the developed countries.

This having been said, there are certain environmental services which can thrive even in the absence of proper enforcement or incentives packages because they actually create value for companies rather than just forcing them to bear a cost, even under current economic conditions. An obvious example is cleaner production services, an area where UNIDO has been offering countries technical assistance for nearly 15 years. By definition, cleaner production creates value for a company by reducing its operational costs through the elimination of inefficiencies in the use of materials and energy, which in turn happens to have environmental benefits. As UNIDO's experience has shown, it is possible for environmental services providers (in this case, national cleaner production centres) to do business by offering cleaner production services to enterprises. Another example is in the area of environmentally-related barriers to global trade. More and more, enterprises in the developing countries wishing to enter into global value chains, or to retain their position in them, are recognizing that they must adapt to the environmental

[7] "The Global Environmental Goods and Services Industry", OECD. Data refer to 2000.

demands made of their products or of their manufacturing procedures, and to do this they need companies in their country that can offer specialized services relating to the development and certification of various management systems (environment, energy, health and safety, labour, food safety, etc.), as well as to the development and certification of products.

Another example of environmental services with an intrinsic value is waste recycling. Often, a waste without value to its generator can have value to a third party, which can use it as a raw material or can recondition it for reuse. The use of waste oil as a fuel is an example of the former; recycling of waste solvent is a good example of the latter. There are many opportunities here for companies to offer recycling-related services to enterprises, whether it be simply as "matchmakers" (through waste exchange, for instance), or as recyclers strictly speaking (which includes sophisticated business models like chemical leasing), or as manufacturers of recycling equipment, or simply as transporters of recyclable wastes.

It is also the case that the rising costs of primary inputs can create new business opportunities, for the developing countries as much as for the developed countries. Energy is a case in point, with renewable energy being a good example; market demand for affordable renewable energy is growing very rapidly, under the twin pressures of increasing energy prices and increasingly pressing concerns about climate change. An often-quoted example is that of Suzlon Energy, an Indian company founded in 1995, which is now the world's fifth-largest wind turbine manufacturer. China also has plans to enter this market. Biofuels are also an area where the developing countries see themselves as having a global comparative advantage. Brazil in particular, which has been developing its bioethanol industry for the last 30 years, is pursuing a strategy to promote this industry worldwide. For its part, Malaysia, which has invested heavily in palm oil over the last decades, sees biodiesel as a new market for its palm oil. Biofuel from algae is also being heavily researched, with some plants already coming on line. Developing countries as well as developed countries are involved in this race. It is clear that many developing countries see themselves as having a comparative advantage over the developed countries located at higher latitudes in biomass production, and therefore also in potential for biofuels and bioenergy in general[8].

A host of opportunities exist for the alert entrepreneur with respect to many other types of products with an environmental "brand". Staying with renewable energy, for instance, there are potential markets for solar water-heaters for commercial or residential use, or for solar cookers for use in rural areas. Many products are already available for water purification in the home. Small-scale digesters for producing biogas are available for commercialization. Opportunities also exist for providing products already on the market but redesigned to be more efficient in their use of materials and energy: compact fluorescent bulbs, more energy-efficient cars and appliances, more efficient water-using devices and so on. Products catering to new needs generated by adaptation to climate change and other environmental change represent yet another opportunity.

[8] Sources for biofuels should be sustainable, i.e., they should not compete with food.

Even when products become waste, they can generate business opportunities. For instance, the high costs of waste management in the developed countries are opening up business opportunities for enterprises in the developing countries. In many cases, it is more economical for waste collectors in developed countries to ship their waste to developing countries for reuse there rather than to manage the waste at home. For instance, there is already a very large trade from the developed countries to the emerging economies in scrap metals, which the latter use to manufacture goods that they then export back to the developed countries[9]. Even more humble waste products are the subject of global trade. For instance, one of the largest export products from the port of New York is waste paper, much of it going to China. There is also a growing trade in used computers and other waste electrical and electronic goods from the developed to the developing countries. There is a positive aspect to these developments: Developing countries obtain raw materials at cheaper prices than might otherwise be the case; developed countries keep their waste management costs in check; the environment is not loaded with as much waste as might otherwise be the case; and ecologically disruptive extraction of raw materials is minimized. However, it is important to note that there is also a darker side, namely, the dumping of what is essentially waste by the developed countries in the developing countries under the pretence that it is recyclable. Stories abound, for instance, of containers full of used computers being unloaded in developing countries with the claim that they can be refurbished and reused, when in actual fact very few of them can. A more subtle problem is the fact that the recycling of these wastes generates side-streams of toxic waste, which the recipient countries are not in a position to manage properly. Certain components in computers, for instance, are not recyclable and contain toxic materials; the inks removed from waste paper create a toxic waste stream. It was to control this kind of pernicious behaviour that the international community adopted the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, alluded to earlier.

D. The current financial and economic crises

The current financial and economic crises that have swept through the global economy have come to overlie the deeper malaise in the economy-environment relationship and the subsidiary industry-environment relationship that have been described above. There has been some discussion about whether or not the sudden and dramatic financial-economic crisis is in some way actually linked to the longer-term malaise, and specifically whether the sharp increase in financial instruments being wielded in the markets prior to the collapse were actually also fuelling a dramatic increase in the unsustainability of our patterns of consumption.

Be that as it may, it has been suggested by many that the large public spending programmes being touted as a means to revive our economies are also a golden opportunity to place our economies on more sustainable pathways of growth. It is true to say that many of the global and local environmental impacts described earlier are a reflection of incorrect investment decisions by the private sector, but these are themselves simply a reflection of poor or incorrect public policies or public investment strategies. It

[9] This is an interesting development, since in effect it "closes the loops" in global manufacturing.

follows that, if undertaken now – as part of broader stimulus packages – the needed green public investments, as well as implementation of necessary changes in policy that will encourage green private investments, could well "jump-start" our economies and place them on more sustainable paths of economic growth.

3. The response: Greening industry in developing countries

In the face of all these environmental challenges, but also keeping in mind the more immediate global economic crisis that industry is having to cope with, how are the enterprises in the developing countries to respond? How can they become greener and lessen their environmental footprint while at the same time continuing to grow and deliver goods and services, as well as jobs, to their societies? And how then should the governments of developing countries be responding?

The response must be two-pronged. On the one hand, recognizing the fundamental unsustainability of today's consumption patterns, industry in the developing countries must decouple its consumption of materials and energy from its production of them, so as to allow its output to continue to grow while minimizing growth in its inputs of materials and energy. On the other hand, recognizing that even the best run enterprise will still generate wastes and pollution, enterprises in the developing countries need to reduce their environmental impacts on the local environments in which they are located.

A. Decoupling resource consumption from production

Considering first the **production systems**, enterprises should adopt business strategies where they look to maximize resource efficiency and cleaner production. More simply, they should adopt "three Rs" strategies – Reduce, Recycle, Reuse. This requires them to first maximize the efficiency with which they use their energy and raw materials, adopting cleaner production, pollution prevention, green productivity or similar approaches. Experience gained through UNIDO's national cleaner production centres (NCPCs), as well as information from the broader literature, suggest that enterprises in the developing countries are often using three or more times more materials and energy than their equivalents in the developed countries. Therefore, not only is it necessary from an environmental point of view that the three Rs strategy be adopted; there is also a pressing economic case for enterprises to adopt it, especially in the current economic downturn, since greater efficiency in the use of materials and energy will reduce operating costs. Costs in respect of materials and energy account for between 40 and 60% of the operating costs of enterprises in the developing countries[10].

Governments can assist enterprises by supporting awareness-raising, capacity-building, the development and transfer of more efficient production technologies, and the creation of specialized industry support institutions such as the NCPCs. They can also reduce if not eliminate any existing subsidies on energy, water and other raw materials; the

[10] Herrndorf, "Greening SMEs in Developing Countries", 2006.

existence of these subsidies artificially reduces industry's input costs, making it more difficult for enterprises to make the economic case for efficiency.

Enterprises can also promote decoupling by switching from non-renewable to renewable sources of energy and materials. In the case of renewable energy, decoupling will come about when the electricity-production sector shifts to renewable sources of energy and offers the rest of industry green electricity. It will also come about when enterprises directly increase their use of renewable energy, for instance by substituting biomass for fossil fuels in boilers, using solar energy for certain forms of drying, and so on.

Governments have a very important role to play in creating the market conditions to allow the renewable-energy industry to grow. They also have an important role in ensuring that renewable materials – primarily biomass – are produced sustainably.

Enterprises must also maximize the recycling and reuse of the remaining wastes they generate; increased efficiency will not eliminate all wastage. In some cases, enterprises can recycle and reuse their wastes themselves, but often it will be others who recycle and/or reuse them.

Here, Governments have an important role to play, to create a vibrant market in recycled materials. Support for awareness-raising, capacity-building, the development and transfer of recycling technology, as well as entrepreneurship development, will be important government activities, as will the creation of a proper regulatory structure regulating the storage, transport and processing of recyclable wastes. The removal of subsidies mentioned above will also help recycling markets by supressing unfair competition from virgin raw materials. It should be noted that, in recycling, there will often be "crossover" between the industrial sector and other sectors of society, in the sense that waste paper collected from municipal waste, for example, can be used as a raw material in paper manufacturing enterprises, while certain types of industrial waste can be used in the agricultural sector as fertilizer.

Through environmentally sound **product design**, enterprises can assist in bringing about a broader decoupling throughout societies. At one level, enterprises can redesign their products so that they contain fewer materials (dematerialization). At another level, they can redesign them so that they consume less energy, less water, less detergents, etc. during their use. How important this is can be judged from the life cycles of certain classes of common products – automobiles, for instance, or many white goods – which consume far more materials and energy during their use than were consumed during their production. In these cases, it is more important that enterprises design an energy-efficient product than it is that they use an energy-efficient production process. This having been said, with regard specifically to enterprises in the developing countries, it is far from clear how much product design they actually carry out. In many instances, they either have designs forced on them (if they are part of global value chains, for instance) or they simply adopt pre-existing product designs. In many developing countries, there is very little product-design capacity at all, let alone environmentally responsible product design.

Governments have a very important role to play here to raise awareness in industry about the importance of product design and to create the necessary capacities and support institutions (in academia or elsewhere) to assist industry. As major purchasers of goods and services, governments can also play an important role through procurement policies that favour goods manufactured with the smallest environmental footprint.

Enterprises can bring about an even more fundamental form of decoupling by relinquishing the idea of being sellers of products and instead thinking of themselves as sellers of services. A moment's thought will show that, in most cases, we are not interested in the product we purchase *per se*, but in the service that the product renders for us. For instance, most of us are not interested in a washing machine *per se,* but in the service of washing our clothes that it performs. An enterprise that purchases a solvent is not interested in the solvent *per se,* but in its ability to clean metal surfaces. And so on. There are numerous cases where companies can build a solid business case for selling the services of their products rather than the products themselves. The environmental advantage of this approach is that it can diminish the number of products manufactured and the consumption of resources during their use, and it can increase the amounts of the products that are recycled at the end of their useful lives. There are already a number of cases where companies have adopted this approach. One in which UNIDO has been active in recent years is chemical leasing, in which, as the name suggests, the chemical manufacturer leases its chemical products rather than selling them.

Here, Governments can play a vital role in building awareness in industry about this approach and championing it. They could also use their procurement power to source services rather than products.

The use of **management systems** is the most effective means for any enterprise to ensure that it efficiently and continuously implements three Rs strategies. Certification of such systems by third parties increases their value to the enterprise. Which of the various possible standards an enterprise should adopt will depend on its specific business model. However, given the current trends in management system standards, adoption of a corporate social responsibility approach, which broadly embraces all aspects of environmental (and social) impacts, might be the best.

Governments can play an important role in supporting awareness-raising, capacity-building, the creation of industry-support institutions that can help enterprises implement management systems, and the creation of the necessary accreditation and certification bodies.

B. Reducing industry's impacts on the local environment

As mentioned earlier, even enterprises with very low materials and energy inputs will still generate wastes and pollution that can harm the local environment – and the enterprises' workers. Industry must therefore reduce to acceptable levels its environmental impacts on the local environment in which it is located (as well as its impacts on the health and safety of its workers). Broadly speaking, enterprises should first try to minimize their

excessive waste and pollution or otherwise neutralize their environmental impacts. Where this is not possible, enterprises should dispose of the wastes or release the pollutants in an environmentally sound manner.

Governments have always had a key role to play here, both in enacting the necessary laws and regulations and in enforcing them. Market-based instruments, such as taxes, also have a role to play. In the developing countries, it is often not the legislative framework that is weak; it is the enforcement capabilities. The continuing weakness of these capabilities has meant that an environmental services industry sector like the one that now exists in the developed countries has failed to develop properly, and the new jobs that could thereby be created have on the whole failed to materialize. Greater effort is required to substantially improve enforcement.

Governments can also invest directly in publicly owned waste-management and pollution-control infrastructure. The municipal waste-water treatment plants for cities and other urban centres are the most obvious example. Other examples are recycling centres, incinerators, or landfills for municipal wastes, which are often fully or partly owned by government entities. Such investments will often involve industry, either as the constructor of the infrastructure or as one user – municipal waste-water treatment plants will often treat industrial waste waters along with those from households and commercial establishments; enterprises can use the infrastructure for management of municipal waste for many of its non-hazardous streams. This infrastructure is often absent in the developing countries, with lack of funds being a primary reason, but lack of the necessary skilled personnel to run the infrastructure being another important reason.

Governments also have a role to play in creating the right market conditions to encourage entrepreneurs to create businesses in the environmental services sector. The need for government to encourage business creation in the fields of renewable energy, recycling, construction and consulting has already been referred to, but there are a host of other business opportunities in the environmental services sector waiting to be realized in the developing countries, with all the attendant employment opportunities this implies.

C. Confronting and profiting from environmentally-related standards in the global market

The basic steps for greening enterprises in the developing countries described above will stand them in good stead when they confront the immediate commercial challenge of attempting to enter – or remain in – world markets, and having to meet an increasing number of environmentally-related standards to do so. These standards require enterprises to reconfigure their products and/or processes to meet the requirements of their international customers or the laws of the countries to which they wish to export, and to certify that they have done so. In other words, they must be able to:

- Redesign their products so that they meet any pertinent environment-related product standards;
- Reconfigure their processes so that they meet any pertinent environment-related process (technology and management) standards;

- Certify that their products and/or their manufacturing processes meet these standards.

In this case, even more than in the last, the introduction by enterprises of formal management systems, certified by external parties, will greatly aid them, firstly to meet requisite standards on a continuing basis, and secondly to produce the evidence – through the certification process. This is particularly so where enterprises are meeting process-related standards; indeed, meeting a general management system standard like ISO 14000 or (in the future) ISO 26000 may actually be what is required by buyers. However, management systems can also be extremely useful for meeting product-related standards (as is primarily the case, for instance, with ISO 9000).

Those enterprises that manage to do this successfully will find it much easier to break into, or maintain their position in, global markets. In so doing, they will tap into new sources of growth.

As alluded to earlier, governments have an important role to play in supporting the establishment of the necessary supporting institutions for industry that can assist enterprises to meet the standards and certify that they do so. They also have an important role to play in monitoring the development of environment-related standards affecting trade, using the relevant international fora to ensure that the impacts of new standards on their industry are minimized, informing their industry of new standards that could impact it, and assisting them to meet these standards.

4. The role of the development aid community

What role can the development aid community play in assisting enterprises in the developing countries to adopt the above strategies? The answer to this depends on an understanding of the barriers that are preventing enterprises in these countries from applying these strategies. Four major barriers can be identified:

- *Lack of knowledge and skills*: Numerous enterprises are either not aware of the challenges that lie ahead, or they do not have the necessary skills to deal with them. They are also not aware of the business opportunities that environmental issues afford them.
- *Absence of an adequate external support system*: Even where enterprises are aware of the challenges that lie ahead, or of the business opportunities that these open up for them, they do not have at hand the necessary specialized industry-support institutions to assist them.
- *Fragmented and ineffective policy frameworks*: Government policies are not creating sufficient incentives to allow enterprises to take on and overcome the challenges ahead, or to take advantage of the business opportunities available.
- *Difficulties in accessing finance*: Banks fail to recognize the potential of investments for resource-efficient and cleaner production, and eco-efficiency initiatives. SMEs, too, have difficulty in obtaining access to conventional loans and credit. This lack of collateral often leads SMEs to be risk-averse and less willing to invest in new environmental technologies.

Governments have the primary responsibility for removing these barriers. However, they too often lack the skills, as well as the funds, that would enable them to discharge this responsibility effectively. So it is here that the development aid community can play an important role, first and foremost, by supporting governments in eliminating gaps in the normative framework. Many individual activities are being undertaken by enterprises and by governments (often supported by the development aid community), but all too often these do not lead to the necessary scaling up because the incentive structure is not there to drive the process.

The importance of environmental legislation has already been mentioned, in the sense of internalizing costs that enterprises are currently externalizing onto the local communities and the environment. Therefore, governments need support to establish new environmental laws and regulations where gaps are identified. However, as noted earlier, it is often not the laws and regulations that are lacking in the developing countries, but rather their proper enforcement. Thus, governments need support for strengthening their capabilities to enforce existing environmental laws and regulations.

It is also important to support governments in creating the conditions necessary for a normative framework to encourage the growth of a recycling industry. It is often said that wastes are simply misallocated resources, and developing countries can ill afford to bear the financial burden of misallocating their resources. As experience in the developed countries has shown, however, it is important that frameworks distinguish clearly between recycling activities and other, non-productive, waste-management activities.

One of the reasons for inefficiency in the use of energy and materials is that their cost to enterprises is distorted by subsidies (electricity and water are especially frequently subsidized). Therefore, there is a need to support governments in campaigns to remove as many of these subsidies as possible. Governments also need support for removing other financial disincentives to efficiency, in the form of taxes or fiscal policies discouraging enterprises from adopting green investments or green patterns of operation.

It is easier for enterprises to green themselves if they have the support of an integrated and strategic science and technology system that encourages green innovation as well as the transfer, development and adaptation of cleaner process technologies, recycling technologies, renewable-energy technologies, and other environmentally sound technologies. Thus, there is a need to support governments in creating this science and technology framework.

As has already been noted, the developing countries generally have poor product design capabilities. Yet it is critical for developing countries to be able to design green products that fit their needs. Thus, governments need support for creating the necessary normative framework to encourage the growth of a product-design community, with a focus on environmentally sound product design.

Enterprises can be encouraged to be greener in their operations if they are sited properly. Locating SMEs in industrial zones, for instance, means that there can be common waste-

water treatment and waste-management operations, which individual enterprises might not be able to afford. Proper siting can also allow groups of enterprises to practise industrial ecology, whereby wastes from one enterprise are fed to another enterprise as raw materials. Governments can be supported in changing zoning laws and other land-management laws to encourage patterns of siting of enterprises that encourage green investments and green patterns of operation.

As has been noted, global trading will increasingly require enterprises in the developing countries to comply with environmental product or process standards and certify that they do so. In this case, governments need support for creating the necessary normative framework allowing enterprises to obtain certifications of compliance with environmental standards locally. In addition, governments need support for ensuring that national stakeholders can take an active part in the development of these international standards, so that the specific conditions of the developing countries are properly taken into account.

Getting the right normative framework in place will greatly help to create the incentives that will naturally drive industry to become greener. However, the elimination of other gaps can make the incentive structure work even better. These can be broadly classified as gaps in the support system that industry needs, gaps in the financial support structures and in public-sector investments, and gaps in the knowledge- and skills-sets that industry needs. Here, too, the development aid community can support governments.

With respect to gaps in the support system, the development aid community could support governments in their efforts to make entrepreneurs aware of the opportunities that exist for new green businesses (responding to demands for technologies; infrastructure; or specialized consulting, laboratory or other services). Depending on the specific issues, this could involve anything from simple information campaigns to the running of demonstration or pilot projects. The next step would be for the development aid community to support governments in assisting entrepreneurs to build up the technical and commercial skills that they require to be able to take advantage of these opportunities. This could extend to assisting universities or other institutions of higher learning, or vocational training establishments, to establish new curricula. Where conditions require it, the need could be for the direct establishment of the necessary support institutions (e.g., accreditation bodies, or where markets are weak or small and a first-mover is required, or universities and research institutions to improve innovation and applied research).

As far as gaps in the financial support structure and public-sector investment are concerned, the development aid community could support governments in putting the banking sector in the position of being willing and able to support green investments by the private sector, or to invest directly in required infrastructure such as waste-water treatment plants and waste-management plants (these can be the green investments in stimulus packages).

Finally, there can be gaps in the industrial sector's knowledge and skills. Here, the development aid community can support governments in building up the necessary

technical – and just as importantly the necessary managerial – knowledge and skills in enterprises throughout the industrial sector.

Initially, the development aid community can focus on those areas where entrepreneurs can get an adequate financial return, even when the normative framework is defective and is not giving the correct price signals. Cleaner production is an obvious case, since implementing cleaner production reduces enterprises' operating costs. The ability to meet environmental standards in the global market is another one, since it opens up international markets (or keeps them open). Recycling is a third one, since entrepreneurs can make money by recycling wastes. As the gaps in the normative framework are eliminated, it will make financial sense for enterprises to focus on the other aspects of greening themselves and the focus of development aid can shift correspondingly.

5. Conclusions

Enterprises in the developing countries find themselves at a critical juncture. The current financial and economic crisis is putting intense pressure on them to be more efficient and more responsive to market demands if they are to survive. At the same time, long-term environmental trends, particularly climate change but also other trends, will require some fundamental changes to the way enterprises the world over do business. It is critical that industry in the developing countries, as one of the primary motors of development, continues to grow, but at the same time, governments in the developing countries have to ensure (as must those in the developed countries, but in different ways) that this growth is sustainable.

The development aid community has an important role to play in supporting governments in guiding their industrial development into sustainable pathways. UNIDO itself, conscious of the growing importance of ensuring green industrial growth, has recently launched a Green Industries Initiative. Part II of this strategy paper focuses on UNIDO's response in tackling the issue of greening of industries.

PART II
THE PROPOSED REPONSE BY UNIDO: THE GREEN INDUSTRY INITIATIVE

1. Focus areas of the Green Industry Initiative

In section 4 of Part I, we discussed the role of the development aid community as a whole in promoting green industry. Against the background of the recommendations made in Part I, and in the specific context of UNIDO's mandate, we propose that UNIDO could assist its ministerial counterparts through its Green Industry Initiative to:

- Remove gaps in the normative framework;
- Remove gaps in the support system;
- Remove gaps in the industrial sector's knowledge and skills set.

The general objective of such assistance would be to build up the necessary awareness, knowledge and capabilities in the relevant government bodies and relevant industry support institutions, so that they can, in turn, give the necessary assistance to enterprises and entrepreneurs in their countries.

A. Removing gaps in the normative framework

As already mentioned, it is an important requirement for the success of a Green Industry Initiative that an appropriate framework of incentive structures, environmental laws and regulations be put in place. These factors are key drivers to green industry and for the development of a green industry or an environmental goods and services sector. It is even more important to ensure that these measures are effective, especially by enforcing relevant laws and regulations consistently. However, in the UN system, UNEP has the primary responsibility for promoting this environmental normative framework. UNIDO's primary normative role is to assist relevant ministries to put in place effective policies, incentives and infrastructures that promote the greening of the industrial sector. More specifically, UNIDO could assist the relevant ministries to:

- Review/create the necessary normative framework to encourage the growth of a recycling industry;
- Remove perverse subsidies to the consumption of inputs of materials and energy in industrial processes;
- Remove financial disincentives to enterprises adopting green investments or green patterns of operation;
- Review/create the necessary normative science and technology framework to encourage green innovation as well as to transfer, develop and adapt cleaner process technologies, recycling technologies, renewable energy technologies and other environmentally sound technologies;
- Review/create the necessary normative framework to encourage the growth of a product-design community with a focus on environmentally sound product design;

- Review/create the necessary normative framework to allow enterprises to obtain locally certifications of compliance with environmental standards;
- Assist in the adaptation and introduction of policy instruments for resource efficiency.

UNIDO could also use its global forum function to work at the international level for the development of environmental standards with a global reach that would take into account the specific conditions of the industrial sector in developing countries.

B. Removing gaps in the support system

A good normative framework is a necessary, but not a sufficient, condition for promoting wide-scale adoption of green investments and green patterns of operation by enterprises. As was stressed in Part I, for enterprises to become truly green, they must have a variety of specialized enterprises in the green, or environmental goods and services, sector to support them. Such enterprises would include, among others: technology providers, providers of specialized infrastructure – landfills, recycling plants, destruction plants, centralized waste-water plants, etc. – specialized consulting services and laboratory services. In turn, entrepreneurs may need support to assume the additional risks of launching businesses in an emerging environmental goods and services sector. UNIDO could use its decades-long experience in assisting the growth of new enterprises to do the same for the environmental goods and services sector. More specifically, UNIDO would assist the relevant ministries to:

- Make entrepreneurs aware of the opportunities that exist for new green businesses;
- To build up the technical and commercial skills they require to be able to take advantage of these new opportunities. This could extend to assisting universities or other institutions of higher learning, or vocational training establishments, to establish new curricula;
- Directly establish the necessary support institutions, where conditions require it (for example, accreditation bodies for certification systems, or where markets are weak or small and a first-mover is required, or research facilities at universities to improve innovation and applied research).

C. Removing gaps in the industrial sector's knowledge and skills set

As has always been the case in any phase of industrial development, entrepreneurs and more generally those working in enterprises need to have the right knowledge and skills set in order to green their enterprises. A long-term requirement is that schools and the university system turn out graduates with the right basic skills, for instance, that universities offer courses in environmental engineering. UNIDO would partner – and has partnered – with universities and other institutions of higher learning to insert green industry considerations into existing curricula. However, a great deal of skills and knowledge are also acquired after schooling has been completed. Here, too, UNIDO would draw on its long experience in capacity-building to assist the relevant ministries to build up the necessary green technical and managerial knowledge and skills in enterprises

throughout the industrial sector, and to develop public-private partnerships in the environment field.

D. Building on UNIDO's existing strengths

To the extent possible, the assistance UNIDO offers must draw from, and build on, the work it has already carried out in this area and in related fields. It must also build on its experience in other related fields, such as entrepreneurship development, where the same basic approaches and tools can be applied with the necessary modifications. This would suggest that the Green Industry Initiative should focus specifically on putting the relevant government bodies and industry support institutions in a position to adequately promote:

- Low-carbon paths to industrial development[11];
- The efficient use of non-energy raw materials;
- The efficient use of recycled industrial and non-industrial wastes as a substitute for virgin raw materials;
- The adoption of relevant products and technologies to meet international commitments or environmental standards in global markets;
- The adoption of environmental and related management systems as a requirement for entry into global value chains;
- The creation of businesses that can offer services in all these areas.

2. Overall strategy of the Initiative

A. Launch of the Green Industry Initiative

A fundamental first step is to foster awareness among Member States of the advantages that can accrue to them by promoting green industries in their countries. UNIDO has already initiated this process of awareness-building by holding, together with the Government of the Philippines, the International Conference on Green Industry in Asia, in Manila, in September 2009.

The major outcome of the Conference was the adoption by 21 States in Asia of a non-binding Manila Declaration and Framework for Action. The document outlines the steps needed to reduce the resource-intensity and carbon emissions of Asian industries. It also provides a mechanism for periodically reviewing and assessing progress in implementing the framework for action directed towards achieving a low-carbon future. The Declaration encourages Asian countries to establish the appropriate institutional and policy framework conducive to a transition to resource-efficient and low-carbon industries. It calls for measures such as incorporating cleaner production policies into national development plans, and fostering a viable business environment conducive to investments in green industries. It also urges the promotion of increasing use of renewable energy and energy-efficient processes in the industrial sector, research and development programmes that will lead to green innovation, and investments and financing in low-carbon and resource-efficient manufacturing industries. Finally, it calls

[11] Industrial development paths that minimize the emissions of greenhouse gases per unit of industrial output.

for the establishment of a communications strategy to enhance awareness of green industries performance tools.

The technical discussions in the Conference focused on:

- Cleaner production: How knowledge, technology and finance can move Asian industry towards greater resource-efficiency and into low-carbon pathways;
- Eco-friendly products and environmental services: How knowledge, technology and finance can build up the necessary environmental services sector in Asia, as well as the ability to design, develop and market eco-friendly products;
- Growth and competitiveness: How Asian firms can become more competitive in international trade through increased resource-efficiency, and how they can participate in the new global value chains in the environmental services sector.

An important overall conclusion of the Conference was that the message of green industry needs to be carried to other regions.

B. Follow-up activities based on the Framework for Action of the Manila Declaration

On the basis of the Manila Declaration and Framework for Action, UNIDO is proposing to undertake a series of activities to assist Asian countries wishing to implement the Framework.

1. *Preparation of a normative policy framework*

UNIDO is preparing a normative policy framework for governments promoting the development of green industry in their countries. The framework identifies green industry policies and practice measures that will act as a benchmark for country assessments. The framework covers a broad range of policy instruments (e.g., environmental, industrial and regional development policies). However, in keeping with its mandate, UNIDO will focus on the relevance of such policies to the development of industry.

2. *Preparation of country status reports on eco-efficiency*

As a baseline upon which to assess future eco-efficiency trends in a country and monitor the effectiveness of policies adopted, UNIDO will undertake assessments relating to a selected number of countries in Asia. It will adopt a number of approaches. One approach will highlight the use and consumption of water, raw materials and energy in various industrial sectors. Another approach will focus on resource-efficiency, and the resource consumption of a country will be calculated over the past 30 years. This will be done by integrating imported and exported raw materials and products with the resource extraction framework in a country. On the basis of these results and findings, the resource-efficiency of a country can be assessed over a period of time.

These country status reports will also act as powerful instruments to raise awareness of the level of eco-efficiency in countries.

3. *Preparation of national green industry strategies*

Once the green industry policy guidelines have been completed, UNIDO will work with interested countries in Asia to formulate a national green industry strategy. Using the guidelines, a gap assessment will be conducted. The results of this assessment will be incorporated into a country's industrial development plans, and/or its overall development strategy.

C. Other follow-up activities

1. *Strengthening of existing NCPCs/NCPPs, and the start-up of new centres*

As has been outlined earlier, an important delivery mechanism for UNIDO's Green Industry Initiatives will be National Cleaner Production Centres (NCPCs) and other National Cleaner Production Programmes (NCPPs) that UNIDO has set up and which are part of its Resource Efficient and Cleaner Production (RECP) network. The capabilities of the NCPCs/NCPPs for delivering green industry services will be strengthened through the newly developed RECP strategy. This foresees strengthening the network through improved knowledge management, extending the network to include additional RECP stakeholders, and strengthening the management capacities of the centres. In particular, new and/or extended RECP activities are planned in Cambodia, China, India, Indonesia, the Lao PDR and Sri Lanka.

2. *Initiation of green-industry pilot programmes*

To build further awareness among Member States, a small number of green-industry pilot programmes will be launched, both in Asia as part of the follow-up to the Manila Declaration and Framework for Action, as well as in other regions, depending on the interest of countries in hosting such pilots and of potential partners in joining with UNIDO in such ventures.

In all cases, the pilot programmes will build on existing UNIDO programmes and concentrate more on bringing them together to offer an integrated package of services from UNIDO's most relevant environmental and non-environmental programmes. Recognizing that NCPCs will be among the industry support institutions that should be involved in such programmes, wherever possible, UNIDO pilot programmes will be based in countries where an NCPC already exists.

Similarly, UNIDO recognizes the importance of ensuring the correct normative framework in its programmes. All programmes will therefore contain a ***strong policy component***. The objective will be to work with the relevant government entities to put in place the necessary additions or modifications to the policy framework by the end of the project. The green industry policy guidelines will be a basis of all policy work.

To ensure high levels of visibility for the pilot programmes, ***a very strong global forum function*** will be woven into them. This will ensure that, from the outset, the activities and

results of the pilots will be given as wide an exposure as possible. Part of this global forum function will be a dynamic platform for the exchange of knowledge and experience enabling partners and peer groups to communicate amongst themselves.

As an important way of increasing the visibility of the pilot projects, the initial focus of the projects will be narrowed down to ***one primary challenge***.

On the basis of these considerations, it is proposed to launch five pilot programmes initially:

Pilot programme 1: Low-carbon pathways

This programme will primarily focus on **identifying and implementing low-carbon pathways to industrial development**. It will focus also on the interlinkages between the different environmental dimensions, e.g., carbon, water, materials, etc. In the context of the current round of negotiations leading to the post-Kyoto regime, this choice will give the whole exercise greater resonance. This choice might also allow UNIDO to make connections with the work it will be doing in the coming years as co-convenor for the UN system on technology transfer for climate change, as well as with some of the clusters that are being developed in UN-Energy.

Pilot programme 2: Low-water pathways

This programme will focus on **identifying and implementing low-water paths to industrial development**. It will also focus on the interlinkages between water and the different environmental dimensions, e.g., energy, materials, carbon, etc. In the context of the growing concerns about water, this would have a great impact and appeal, especially if the country chosen was already under water stress and was likely to become further stressed because of climate change. This too can be connected to the broader activities of the UN system on water through UN-Water.

Pilot programme 3: Low-materials pathways (three Rs strategy)

This programme will focus on **designing and implementing low-materials paths (three Rs strategy) as an integral part of a country's industrial development**. It will also focus on ways of reducing inputs of materials in industries. In some parts of the world, rapidly growing economies are causing acute waste-management problems. But these economies are also most sensitive to the availability of raw materials, a situation that a three Rs strategy is ideally suited to respond to.

Pilot programme 4: Reducing the environmental footprint of a value chain

This pilot programme will focus on a value chain rather than a country, working all along a global value chain **to reduce the overall environmental footprint of the chosen value chain**.

Pilot programme 5: Designing the factory of the future

This pilot programme will be more conceptual. It will focus on designing the **factory of the future**. The design remit of the programme will be to propose ways of designing a manufacturing plant in order to minimize its environmental footprint. It will focus on the agro-processing and related priority sectors of UNIDO.

To give the first three pilot programmes a good grounding in the specificities of the chosen countries, they will start with **a detailed country-environment assessment**. This will lead to an identification of the strongest barriers. On the basis of the assessment, a country-specific programme will be drawn up for implementation. Great care will be devoted to choosing the right set of indicators to make it possible to measure the impact of the implementation of the Green Industry Initiative[12].

D. Coordination of activities with UNEP, UNESCAP and ILO

UNIDO recognizes that promoting green industries is an important part of a broader strategy for promoting green economies and green jobs in general. This broader strategy requires the complementary competences of sister UN agencies so as to provide a coherent overall support structure. To this end, UNIDO proposes to hold an international conference on green industries together with UNEP, UNESCAP and ILO. A key aim of this conference would be to establish a coordination mechanism to ensure that the four agencies define and formulate their individual activities in a coordinated manner to best support the implementation in Asia of the Manila Declaration and Framework for Action, as well as their green-economy-related work in other regions. However, UNIDO will not confine its action solely to work with the UN agencies mentioned, but it will also coordinate with other bilateral and multilateral development agencies.

[12] The European Union has recently established an Eco-Innovation Observatory. The set of indicators which will be formulated would be able to assess a country's performance in terms of green industry and eco-innovation.

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