UNIDO GREEN INDUSTRY INITIATIVE

for Sustainable Industrial Development

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Green Industry

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Boxes and Figures

Main Points

1. Rapid industrialization has been and continues to be the main driver for income and job creation, and therefore accelerating development and poverty reduction in developing and transition countries is essential.

2. Green Industry is a pathway for protecting communities, vital ecosystems and the global climate from escalating environmental risks and emerging scarcities of natural resources.

3. Green Industry transforms manufacturing and allied industry sectors so that they contribute more effectively to sustainable industrial development. Green Industry is thereby the sector-strategy for the realization of Green Economy and Green Growth in the industry sector.

4. Green Industry is operationalized by scaling-up and mainstreaming proven methods and practices for reducing pollution and resource consumption in all sectors ('greening of existing industries') and expanding the supply of affordable, appropriate and reliable environmental goods and services ('creating new green industries'). This has proven to be good for business, environment and climate as well as for communities, for consumers, and for development at large in thousands of enterprises in developing and transition countries.

5. At its best, Green Industry unleashes the business and innovation potential arising from a process of continuous improvement in natural resource use efficiency, minimizing waste and reducing emissions.

6. The realization of Green Industry is central to resolving today's most pressing environmental challenges, including mitigation of greenhouse gas (GHG) emissions and adaptation to climate change, the environmentally sound management of chemicals and wastes, and the security of supply of water, energy and other natural resources. It is possible to realize Green Industry in tandem with income and job creation in developing countries, and to secure net contributions to poverty alleviation and sustainable industrial development.

1 THE NEED FOR GREEN INDUSTRY

Volatile energy, raw material and food prices, documented increases in climate variability, and a global decline in the health of ecosystems have brought issues of energy, productivity, and resource security increasingly to the forefront of the international political agenda (United Nations Millennium Ecosystem Assessment). At the same time, the international community continues to struggle with the challenges of widespread poverty and economic disparity. Policy makers, therefore, find themselves in the difficult position of wanting economic growth and its concomitant rise in living standards but in parallel, also needing to scale back the unrestrained resource consumption and consequential environmental damage that has been the main driver of past growth. Industrialization has been the main driving force behind the economic growth and dramatic increases in living standards seen in the past two hundred years in the developed world. It is responsible for the vast reductions in poverty seen there, and while further expansion may or may not be required to further redress poverty in that part of the world, there is widespread agreement that industrial growth is desperately needed in developing countries to alleviate poverty, deliver goods and services, create jobs, and raise living standards (Reinert, E. 2008; Chang, H.J. 2008; Dasgupta, C. 2011). In addition, there is wide consensus that economic and social development is an essential requirement for improved environmental protection (Dasgupta, C. 2011). Thus, it ought to be good news that many developing and transition countries are pursuing rapid industrial growth and are seeing rising output and falling poverty levels.

However, it is becoming increasingly obvious that the developed world's systems of production and consumption have contributed to rapid resource depletion, the degradation of ecosystems, and the threat of climate change (Stamm, A. et al. 2009; United Nations Millennium Ecosystem Assessment). Intensified competition for scarce resources, desertification, biodiversity loss, rising sea-levels, more frequent severe weather events, and freshwater shortages are manifestations of these trends. In a worst case scenario, these could lead to resource-related conflicts and wide-scale migration (UNIDO 2008). It has to be accepted that the current methods of industrial expansion have serious drawbacks and have to be implemented cautiously. However, despite the growing recognition of the risks and tradeoffs inherent in industrial expansion, unrestrained industrial growth remains the goal in many countries, and resource use, pollution, and degradation of the environment are only increasing in absolute terms (United Nations Millennium Ecosystem Assessment).

One reason for this is the lack of progress in improving resource productivity. While labour productivity has increased markedly in line with technological advances over the past 50 years, resource productivity has seen only a marginal increase. Similarly, technological progress has been seen primarily in relation to labour productivity. Limited focus has been placed on technological innovation for using resources more efficiently. The realization of the importance of resource productivity is increasing. Furthermore, it has been demonstrated that enhanced resource productivity addresses all three dimensions of sustainability – protection of the environment, promotion of economic growth, and social development (Bleischwitz, R., Welfens, P.J.J., and Zhong Xiang Zhang 2009: ch. 'Introduction').

The need for environmentally sustainable modes of production and a more efficient use of resources i.e. Green Industry, is becoming increasingly evident. This is especially so in the developing world, which has the unique opportunity of avoiding the environmental pitfalls that the developed world has fallen into in the course of its industrial development; it can use past experience to build a Green Industrial infrastructure at the very outset. This paper provides an insight into how an increased focus on Green Industry for sustainable industrial development in developing and transition countries can contribute to the attainment of global Sustainable Development (SD) objectives. The paper seeks to elaborate on the need for and value of approaches that target industry specifically, and to promote a more equitable access to the knowledge, technologies and production processes that are needed in developing and transition countries, in order to achieve SD there and elsewhere.

2 GREEN INDUSTRY: IMPLEMENTING SUSTAINABLE DEVELOPMENT

Progress towards SD rests on the simultaneous and balanced achievement of economic development, social advancement and environmental protection. While the concept of SD has been ensconced in policy circles for decades now, operationalizing this concept has proven to be a challenging task. The recent emergence of concepts such as Green Economy, Green Industry and Green Growth are reflective of the need for strategies or roadmaps to help achieve SDand shift current consumption and production patterns on to paths that are more sustainable in the long run, while keeping resource constraints and carrying capacity limits in mind. In the following paragraphs, the concept of Green Economy and Green Industry are examined in greater detail.

The United Nations Environment Programme (UNEP), in 2011, has defined a Green Economy as one "that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive." The Green Economy is a new model for economic development, one aimed at achieving improved human well- being and social equity while simultaneously diminishing environmental risks and reducing ecological scarcities (ibid.). Figure 1 below provides a simple representation of how Green Industry fits within a hierarchy of Green Economy and Sustainable Development.

In a Green Economy, economic growth and employment are driven by public and private investments that aim to reduce pollution and GHG emissions, enhance resource (energy, materials and water) efficiency, and prevent the loss of natural capital and ecosystem services (ibid.). Green Economy encompasses labour, capital, land, and natural resources, as well as economic processes such as production, trade, distribution and the consumption of goods and services. It requires major changes in agriculture and the provision of food, mobility and transport systems, public utility systems, commerce, business and industry, housing and urban development, education, science and innovation systems, and financial systems. Its attainment requires fundamental shifts in policy frameworks, support systems, and how natural resources and human well-being is valued (ibid.).

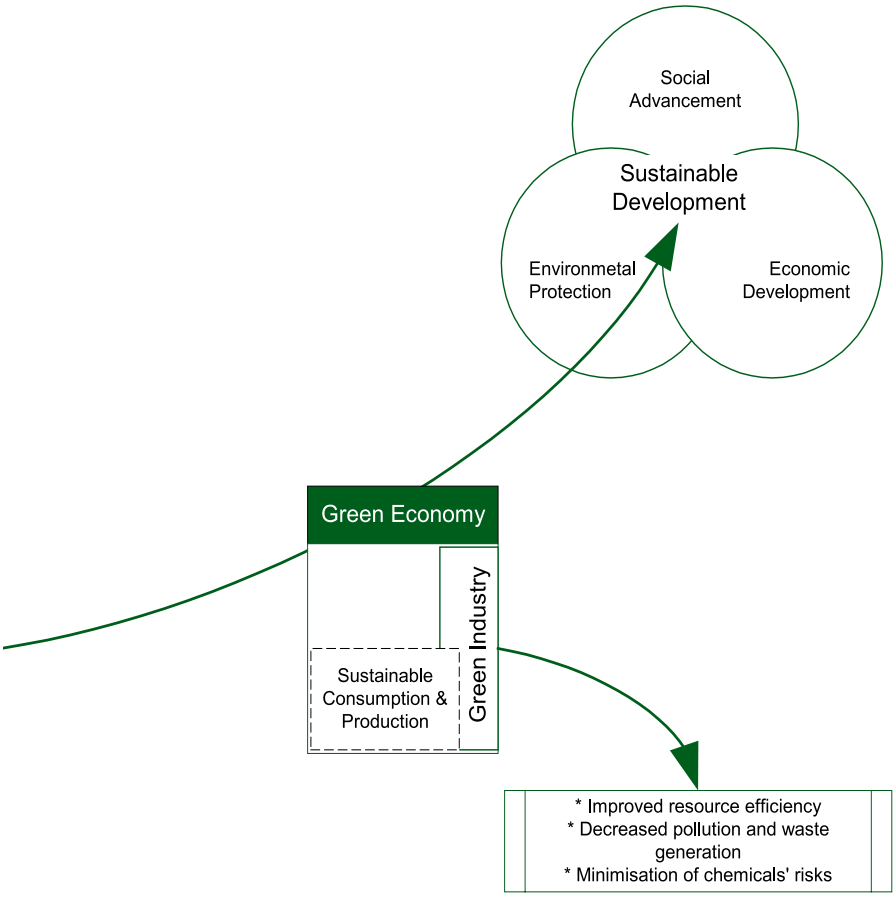


FIGURE 1: THE SUSTAINABLE DEVELOPMENT PATHWAY

The Green Economy rests on a systems perspective to develop solutions that integrate economic, social and

environmental considerations. Important features include improved valuation of natural capital, ecosystem services and full cost accounting, i.e., the internalization of externalities. Externalities are defined here as effects or impacts arising from the activities of a person or enterprise on others, which are not compensated. Thus, negative externalities arise when an enterprise pollutes the local environment to produce its goods and does not compensate the negatively affected local residents. Other important features of the Green Economy include the reconciliation of social goals, natural resource protection, and poverty eradication objectives with economic policy (UNEP, 2011). These reforms transform the economy into a more effective vehicle for advancing sustainable development.

Businesses and industries are central to economic growth as they are instrumental in the provision of food, transport, technologies, infrastructure, housing, and other goods and services. Green Industry is thus an important subset of a Green Economy and efforts towards achieving a Green Economy must include elements of Green Industry.

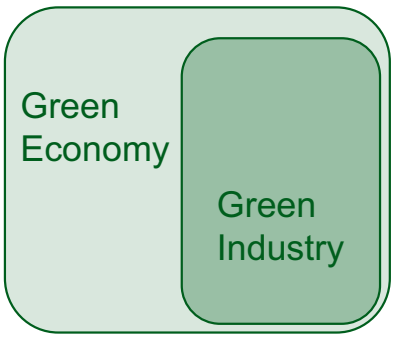
Globally, industry accounts for one-third of the total energy consumption and for almost 40 per cent of worldwide carbon dioxide (CO_2) emissions. The International Energy Agency (IEA) has shown that globally, industry will need to reduce its current direct emissions by about 24 per cent of 2007 levels, if it is to halve global emissions from 2005 levels by 2050. The need to reduce energy consumption and emissions from developing countries is especially evident, since global growth in industrial production since 1990 has been dominated by developing countries, especially China and India. Together, these countries accounted for over 80 per cent of increased industrial production during this period.

There is a great need as well as considerable potential for the pursuit of Green Industry in developing and transition countries. To ensure that the industrial progress of developing countries does not result in skyrocketing emissions and ecosystem degradation, it will be vital to pursue a different mode of development than the traditional high-energy, high-emission modes of industrialization. This means maximizing energy and water efficiency, substantial recycling, and applying improved consumption and production systems. In many cases, much can be done by simply applying existing technologies such as Best Available Technologies (BATs). The IEA estimates that applying BATs to the five most energy-intensive industrial sectors in the case of India (iron and steel, pulp and paper, chemicals and petrochemicals, cement and aluminum) could reduce the country's energy use by 10 to 25 per cent.

Green Industry is that component of a Green Economy that is centered on production and consumption. Policies relevant to Green Industry are similar to those relevant to a Green Economy but are industry specific, covering macro and micro interventions that require changes in policy and regulatory instruments, investment and business operations, and behavioural changes in society (UNEP 2011). These sorts of strategies, tools, approaches and institutional structures are already available in some places, and can form the basis for cost-effective measures to guide and expedite progress towards increased sustainability and in accelerating the transition of industry to a more sustainable footing.

Green Industry is, thereby, an effective point of entry for and a driving force in the transition to a Green Economy and ultimately, SD . Green Industry approaches focus on upgrading industry and increasing productive capacity without corresponding increases in resource use and pollution burdens. The goal is to enable industries in developing and transition countries to actively participate in developing the solutions needed for continuous improvement in their environmental performance. The next section looks at Green Industry in greater detail.

2.1 Green Industry Defined



Simply defined, Green Industry is industrial production and development that does not come at the expense of the health of natural systems or lead to adverse human health outcomes. Green Industry is aimed at mainstreaming environmental, climate and social considerations into the operations of enterprises. It provides a platform for addressing global, interrelated challenges through a set of immediately actionable cross-cutting approaches and strategies that take advantage of emerging industry and market forces.

Green Industry is therefore an important pathway to achieving sustainable industrial development. It involves a two-pronged strategy to create an industrial system that does not require the ever-growing use of natural resources and pollution for growth and expansion. As seen in Figure 1, these two components are (1) the greening of existing industry, and (2) the creation of new "Green industries".

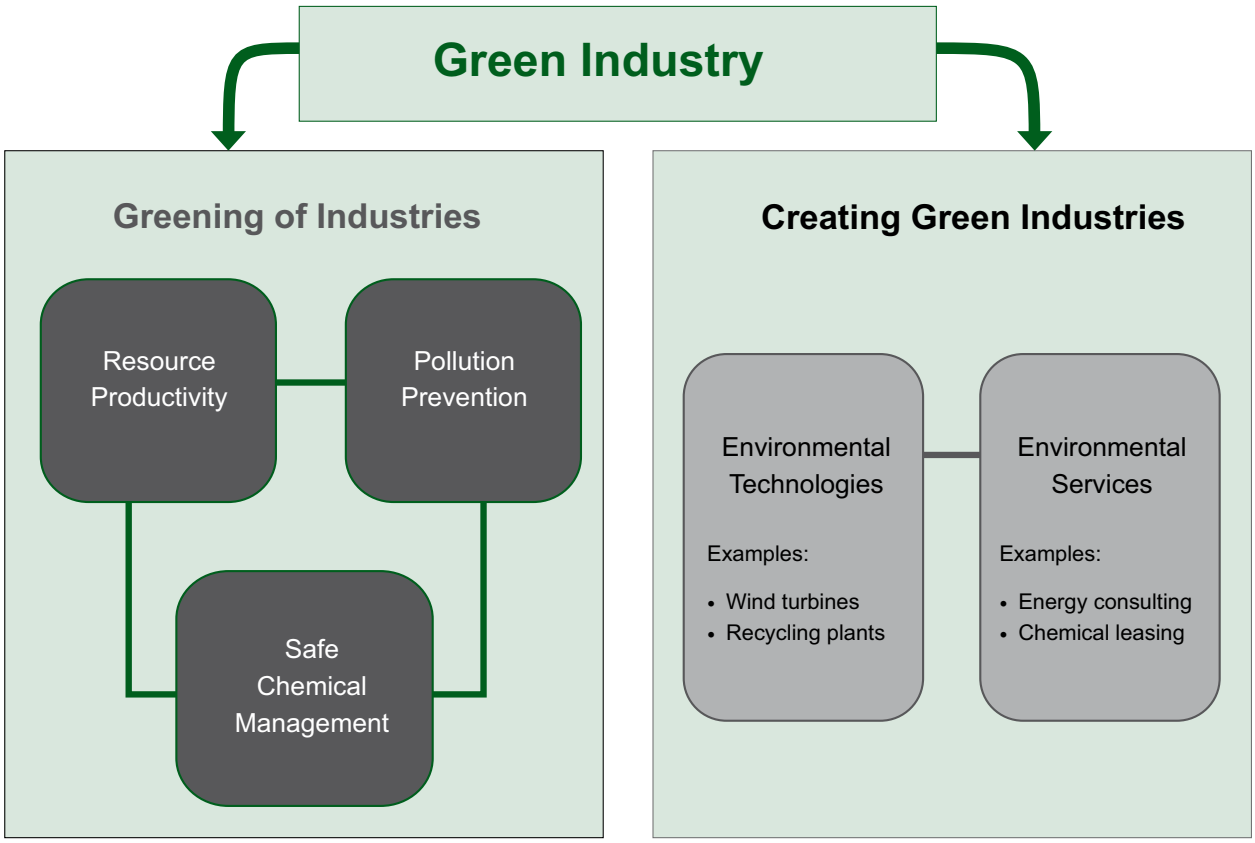


FIGURE 2: GREEN INDUSTRY – A TWO-PRONGED STRATEGY

The first element of Green Industry is fundamentally about the greening of all industry, with a long-term focus on continuously improving environmental performance regardless of sector, size or location. It includes commitment to and action on reducing the environmental impact of processes and products by:

- **improving production efficiency:** using resources more efficiently and optimizing the productive use of natural resources;
- **enhancing environmental performance:** minimizing environmental impact by reducing the generation of waste, emissions and environmentally sound management of residual wastes; and
- **minimizing health risks:** caused by environmental emissions, along with the provision of goods and services that support the occurrence of these environmental emissions

The second element entails the systematic encouragement and creation of key green industries constituting a diverse sector of the economy that covers all types of services and technologies. Supplying domestic needs with green technologies as well as servicing international markets is a major green industry goal. This would include companies that manufacture and install renewable energy equipment as well as a wide range of companies developing clean technologies for the industrial, transport, buildings and automotive sectors. Service industries, including growing material recovery companies, recycling companies, waste management and treatment companies, as well as companies that transport waste are also included. Other examples would include engineering companies that specialize in wastewater treatment, air pollution control and waste treatment equipment, as well as companies that provide monitoring, measuring and analysis services. Green industries also encompass environmental and energy consultants, in addition to the providers of integrated solutions. An example is energy service companies (ESCOS) that offer design and implementation of energy saving projects, energy conservation, energy infrastructure outsourcing, power generation, energy supply, and risk management. This highly heterogeneous sector of the economy is an essential part of the story in the greening of industry.

This two-pronged strategy aims to bring about an age of Green Industry, in which the production of goods ceases to negatively affect the natural environment and in which it will be possible to upgrade the living standards of the developing world without hurting the climate and environment.

Green Industry approaches are about promoting the transfer and implementation of best available environmentally sound technologies and environmental practices. While this obviously includes transfers of all types and in all directions, this paper will focus on the context of the developing world and the potential for Green Industry development there. A Green Industry technology is one which is incorporated or woven into the economic, social and environmental structures and best serves the interests of the community, country or region that employs it. For instance, technologies to improve water productivity in industry and prevent the discharge of industrial effluents would thereby protect water resources and reduce the harmful impacts of water pollution. Improvements in, for instance, energy efficiency can often be implemented fairly quickly and have a meaningful impact on climate change mitigation while reducing costs, increasing revenues and providing competitive advantage. Green Industry stimulates technological advances and innovation, as well as the development of new industries. It not only reduces environmental impacts but spurs innovation, thereby creating business opportunities and new jobs (IEA2009), while helping to alleviate poverty.

Another important aspect of Green Industry approaches is that they encourage companies to take extended responsibility for their operations and products, which can spur the design of more durable, reusable and recyclable products, often referred to as Design-for Environment (DfE). In many cases, businesses involved in Green Industry approaches have taken the lead in spreading awareness about sustainable production techniques and practices by providing guidance and assistance to other businesses in the sectors, value chains or communities where they are based. The benefits from DfE also extend to consumers, through improved access to sustainable products and services.

Making a significant impact on reducing pollution, including GHG emissions, will require

Industry Defined

In its broadest meaning, industry is an economic activity that produces goods or services. Primary industry involves the extraction or harvesting of raw materials or natural resources (primary commodities) i.e., activities that take place before processing. Primary industry includes quarrying, mining, farming, forestry and fishing. Secondary industry processes or manufactures the outputs of primary industry into other products. This includes the processing of raw materials (e.g. grinding wheat to make flour, sawing trees to make timber) and manufacturing (e.g. producing tires or TV sets). Tertiary industry is industry that provides services e.g. drycleaning, consulting, design, research, and software development. The knowledge-intensive segment of this industry is sometimes also referred to as quaternary. The industrialization process is typically seen as the expansion of secondary industry in economies that are dominated by primary activities i.e. moving from subsistence activities (e.g. small scale farming to cover the nutritional needs of a family unit) and selling raw materials (e.g. logs) to create value addition through processing, refining and manufacturing.

BOX 1: DEFINITION OF INDUSTRY

comprehensive changes in resource usage and waste treatment, and the development of a robust Green Industry sector will be absolutely vital for achieving this transformation. Green Industry also fundamental improves the health of the environment and its citizens, by the development of safer chemical substitutes and non-chemical based alternative processes.

2.2 The Green Industry Challenge: Decoupling

The growing recognition of the environmental burden of traditional modes of industrial production has spurred a growing movement around sustainable development, the Green Economy and a shift to Green Industry, but there is increasing consensus that the only way to ensure that economic growth is sustainable is to decouple it from resource use and pollution (Stamm, A. et al. 2009).

There are two types of decoupling: relative, in which production rises but increases in resource use and pollution do not rise as quickly; and absolute, in which production is able to increase while resource use and pollution fall (ibid.). It is also important to distinguish between resource and impact decoupling, since it is possible to decouple pollution from production but not from resource use; or to decouple resource use from production, but not from pollution. The decoupling discussed here will be in terms of both resource use and impacts.

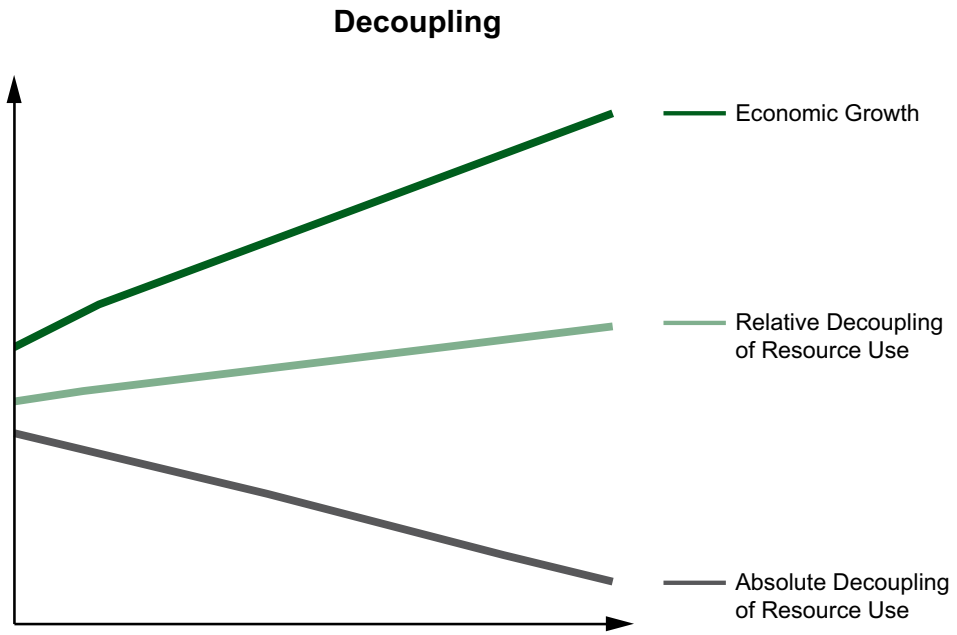


FIGURE 3: RELATIVE AND ABSOLUTE DECOUPLING

There has been much debate about if and how decoupling can be achieved (Stamm, A. et al. 2009; van der Voet, E. et al. 2004; Smith, M.,H., Hargroves, K., Desha, C. 2010). While relative decoupling is readily achievable via gradual increases to resource productivity, increased value creation, and shifts toward less resource-intensive economic activities; absolute decoupling could require changes to both how economic growth is defined and measured, and in how needs and wants are satisfied. This could include radical changes in terms of technology, production and consumption systems, and culture. Absolute decoupling — so-called 'Green Growth'— is obviously most desirable, since it would allow for reduced pollution and resource use and increased production. However, despite some progress in this area, no country in the world has achieved a sustainable situation in which high resource productivity and high levels of social and human development are combined with low or falling per capita resource consumption (Sustainable Europe Research Institute and Wuppertal Institute for Climate Environment and Energy 2010). While considerable technology-driven increases in efficiency are constantly being realized, these gains have always failed to translate into absolute decoupling because they have been outpaced by the growth of economic output and population (Stamm, A. et al. 2009). It is the interaction of these three variables (output, population and resource efficiency) that determines the degree to which decoupling occurs. Populations are expected to continue to grow for the foreseeable future in the developing world,

so there is little that can be done on that front. Therefore, it falls to output and efficiency to deliver absolute decoupling. But as stated above, the historical experience has been that while efficiency gains from technological innovation drive relative decoupling, they are insufficient for absolute decoupling. Thus, because developing countries need rising per capita output in order to fight poverty and raise living standards, it becomes essential that the type of economic output being created comes at a lower resource and environmental impact cost than it has traditionally. These two facets of decoupling, the role of technology and the type of output being produced, will be addressed in turn.

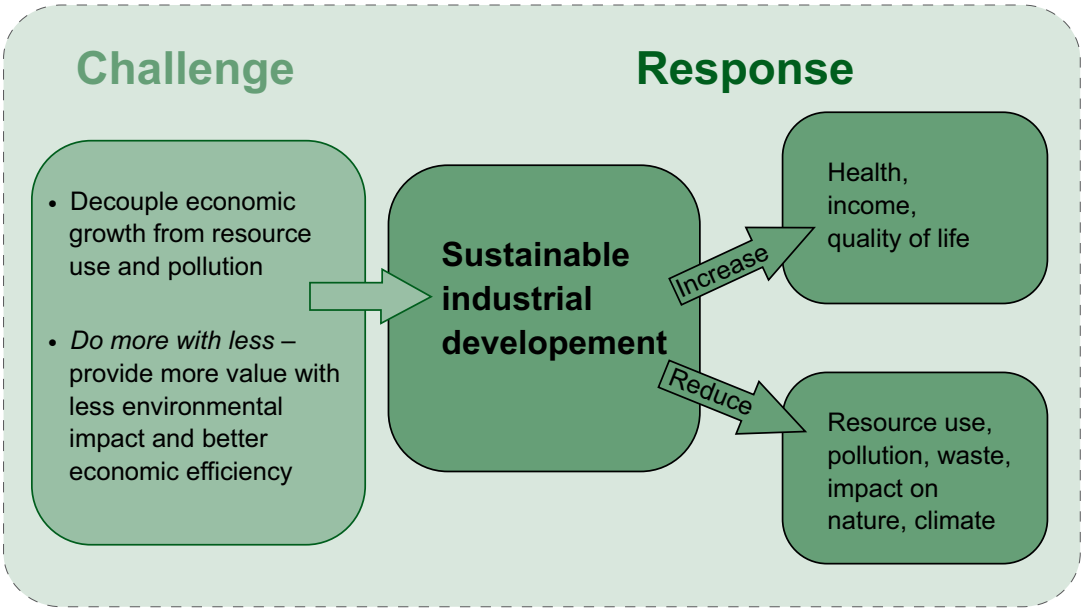


FIGURE 4: DECOUPLING ECONOMIC GROWTH FROM THE USE OF RESOURCES AND FROM ENVIRONMENTAL BURDEN

One clear reason for the historical failure of technological advance to deliver absolute decoupling is that the role of industry, particularly of manufacturing, has not received sufficient attention from policy makers. Gains in resource efficiency are typically in the best interests of industry, but often the very real economic rationale for decreasing environmental impacts is less acknowledged, and policy makers feel it necessary to intervene in order to ensure that technologies that minimize such impacts are employed. A lot of these policy interventions are command-and-control in nature, and while this type of intervention will remain an important component in working toward decoupling, there is also a great need for interventions and policies that encourage industry to take an active role in the necessary transformation of production technologies and methods. The greening of the economy and of industries will be an immensely complex task, and it will require the engagement of all industry and the creation of new Green Industries to inform, support, and drive initiatives for developing the technology to make industrial systems and processes more sustainable.

In addition to technological innovation, absolute decoupling requires a fundamental shift in the nature of economic growth as it stands today. As Box 2 details, this is partially an issue of measurement. But more fundamentally, it is about comprehensive changes in production and consumption patterns. Green Industry contributes to this by greening existing industries and by stimulating the creation of environmental service and environmental technology providers, i.e. businesses ranging from small-scale recycling operations to renewable energy technology companies. Absolute decoupling in developing countries will either succeed or fail based on the paradigm shift that does or does not occur in how value is created, and there are numerous innovative and successful enterprise-level examples of decoupling economic value creation from resource consumption based on Green Industry type initiatives. For instance, consumers paying for printing and copying services rather than purchasing equipment perform this function. Other examples include downloading music and software instead of purchasing compact disks or the possibility of renting carpets instead of buying them (see http://www.dtu.dk/upload/centre/cipu/pss/031-0210-fertigung.pdf). Besides creating new opportunities for economic growth and providing incentives for enterprises to improve recyclability and durable physical products, such product service systems ensure that consumers get the same, or even an improved, service or function. This breaks the

link between the need to use increasing quantities of resources and generate increasing amounts of pollution to cater to the needs and wants of consumers. However, the extent to which such enterprises can displace those that require increased resource use and pollution for increased production remains an open question.

Certainly, Green Growth is achievable in the long term. However, given the urgent nature of the current problematic environmental situation, it is vital that the transition happens quickly, as both resource use and environmental impacts are constantly spiralling upwards. Green Industry will be vital, both for spurring the technological innovation that Green Growth requires and for the deeper shift to sustainable production and consumption patterns that will be the ultimate determinant of when and how a Green Economy and Sustainable Development are realized.

Decoupling and measurement

Economic growth is measured in terms of growth in Gross Domestic Product (GDP) which refers to the market value of all final goods and services produced within a country in a given period. It is also often used as an indicator of a country's standard of living. However, it is an aggregation of the value of economic activities, and does not separate costs from benefits. For example, the depletion of natural capital is treated as an income (benefit) rather than the depreciation of an asset (cost). The GDP also does not provide a measurement of many factors important to the well-being of a society (e.g. quality of health care, access to education, and life expectancy). Furthermore, GDP does not provide insights into the distribution of wealth in a country or the value of voluntary or domestic work. The standard of living is also frequently measured by the level of income (e.g. Gross National Product or GNP per capita) or by the quantity of various goods and services that are consumed (e.g. number of television sets per capita). However, this measurement also fails to take into account other important factors such as quality of life (people's overall well-being). Quality of life is complicated to measure since apart from material well-being, it includes more intangible factors such as the quality of the environment and personal safety.

Numerous efforts have been made and more are underway to devise indicators that provide more comprehensive measurements of development (see for instance, *UNDPs Human Development Reports* at http://hdr.undp.org/en). Such measures are more likely to convey whether or not decoupling has been achieved.

BOX 2: THE RELATIONSHIP BETWEEN DECOUPLING AND HOW ECONOMIC GROWTH IS MEASURED

3 THE BENEFITS OF GREEN INDUSTRY

The development of Green Industry presents benefits on three fronts — economic, social and environmental. This section will describe what exactly a policy locale can expect to get when it elects to employ Green Industry as an approach to economic and industrial development.

3.1 Economic Benefits – More Innovation and Growth; Increased Resilience

Green Industry provides significant economic value by developing the skill-sets necessary for businesses to start working proactively on improving their environmental performance. Economic diversity is enhanced in developing countries through the creation of businesses that engage in new value-adding processes and produce a wider range of more sophisticated products (UNIDO 2010) by becoming green enterprises in developing countries to improve their performance and comply with sustainability standards and customer demands, thereby enabling increased access to global markets.

Improving environmental performance is associated with the generation of income and jobs through improved efficiencies in existing industries. This can occur, for example, through the recovery of valuable materials from waste streams and the subsequent creation of new products or production techniques that incorporate these former wastes, enabling access to new markets and improved market penetration. As enterprises become more efficient in their production and waste management processes, they are also less reliant on virgin materials, saving additional income. Further benefits from improved environmental performance include increased labour productivity due to improved working conditions, as well as increases in product quality, reduced likelihood of accidents, decreased risk of liability, restitution or remediation costs, and reduced insurance costs. Calculations show that investments in clean technologies typically have relatively short payback periods and lead to lower annual costs (von Weizsäcker et al. 2009; IEA 2010). This means that, after an initial cost, these investments help enterprises save money through decreased resource use or generate more money through improved productivity.

Sustainable production techniques have also been shown to have significant spin-off effects. Cost savings or new income flows can be utilized to drive enterprise expansion, create new jobs, and to invest in further resource productivity improvements. Experience shows that enterprises frequently utilize such cost savings or additional income to invest in environmental technologies, upgrades, and expansions, or to develop new green processes or products. By working proactively to improve environmental performances, enterprises are in a better position to meet the needs of a changing business climate. In particular, the expansion of manufacturing activities in low-income countries presents major opportunities for spill-over type effects. These include demonstration effects, capacity building of workers and managers, the generation of technological learning, and the provision of inputs and demand for other activities (Rodrik, D. 2007).

Additionally, sustainable production also provides impetus to the development of Green Industries i.e. green service and technology provision. The potential market for environmental goods and services is growing rapidly and could develop into a major source of employment, particularly for small- and medium-sized enterprises (SMEs) in developing countries.

For developing countries specifically, there is considerable potential for added value and employment opportunities along the agriculture value chain, an important sector in developing countries. While high-income countries add over US$200 of value by processing one tonne of agricultural products, developing countries add less than US$50. Furthermore, while 98 per cent of agricultural production in high-income countries undergoes industrial processing, barely 30 per cent is processed in developing countries. At the same time, agro-industries in developing countries generate 40 to 60 per cent of manufacturing added value, and agro-industrial products account for half of all exports from most developing countries. Post-harvest losses and waste levels are high, largely due to inefficiencies and lack of basic processing technologies (UNIDO 2008a). Green Industry approaches can transform and modernize these food production systems (e.g. by waste reduction through technology improvements, process optimization and the utilization of by-products). This improves food security, increases revenues and creates jobs.

Because Green Industry development counteracts dependence on the extractive sectors and unsustainable commodity export, it increases the resilience of developing economies, making them less vulnerable to global commodity price shocks. And especially where Green Industry targets the growth of small and medium enterprises (SMEs), in rural and remote settings, it can generate locally-rooted economic activity, making local economies more robust and resilient to various shocks and pressures from the global economy and regional economic forces.

In a number of respects, be it the development of new industries, increased efficiencies in existing industries, or spin-off effects, Green Industry presents significant economic opportunities and benefits, especially for developing countries. This is precisely the attraction of Green Industry approaches — that they are good, both for the economy and the environment, rather than one at the expense of the other.

Saving money while improving environmental performance

The global network of National Cleaner Production Centres has assisted thousands of companies in implementing sustainable production while saving costs and increasing revenues (UNIDO-UNEP 2010). Examples include:

- the centre in Peru that helped a small lead foundry to attain annual savings of almost US$ 19,000, as well as improved working practices and conditions. Even though the company focused mainly on decreasing energy use, the integrated approach that was used enabled increased materials recovery, decreased levels of hazardous substances in waste, and reduced GHG emissions;
- with the support of the centre in Kenya, a manufacturer of edible oils and soaps was able to expand its production capacity and improve production efficiency by using resource efficient and cleaner production methods. Annual benefits include more than US$623,000 in savings, which fuelled company expansion, including the creation of new jobs and new business ventures; and
- the centre in Sri Lanka helped a coconut mill to save over US$200,000 per year for an investment of less than US$5,000. Options identified by the centre enabled the company to simultaneously decrease waste quantities and reduce the amount of GHG emissions to almost zero through the utilization of waste for energy. The coconut mill has taken a leading role in greening the sector by helping other coconut mills to optimize processes and decrease waste.

Green Industry also includes approaches targeting specific issues such as water use and the generation of wastewater. The transfer of environmentally sound technology (TEST) approach, developed by UNIDO, is a need-driven systematic approach integrating preventive strategies into enterprises operation. TEST projects are tailored to the unique conditions of the industrial sector, as well as to the institutional framework of the country where they are implemented. TEST projects include capacity building of national partners, demonstration projects at pilot industries, and dissemination and replication at the national and regional level.

Examples include the GEF/Danube-TEST project implemented by UNIDO during 2001-2004 in five countries of the Danube river basin (Bulgaria, Croatia, Hungary, Romania and Slovakia), which resulted in four companies achieving ISO14001 certification by the end of the project, and three more since. More than 230 cleaner production solutions have been implemented in the 17 participating companies, complemented by US$1.7 million of investment in new technologies. These changes have brought estimated savings of US$1.3 million per annum for the companies, reinforcing their competitiveness. Total reduction of waste water releases into the Danube river are estimated to be 4.6 million cubic meters per annum, with most sectors reporting a 30 per cent reduction in water use after the introduction of cleaner production methods, and up to 90 per cent reduction after investment in new technologies.

While the impact of these enterprise-level achievements might seem limited in a global context, they clearly illustrate the opportunities connected to implementing Green Industry approaches. Given the number of small- and medium-sized enterprises that are operating in developing countries and the large number of enterprises that are being established every day, if Green Industry were to be mainstreamed and extended to these enterprises, the cumulative benefits would be vast.

BOX 3: EXAMPLES OF GREEN INDUSTRY INITIATIVES WITH ECONOMIC BENEFITS

3.2 Social Benefits - More Employment, Rising Incomes and Empowerment

There is growing consensus that efforts to accelerate sustained economic growth have to address the issue of human development in addition to economic issues of raised productivity levels, upgraded technology and integration into global value chains (Nelson, J. 2007). In the developed world, addressing human development is as likely to involve ameliorating inequality and reversing the erosion of social capital as it is redressing poverty per se, but in developing countries, human development most immediately requires reductions in poverty levels.

Evidence indicates that high growth rates are crucial for reducing poverty (ibid.; Stamm A. et al. 2009; OECD 2004). More than 300 million people have moved out of poverty in East and South-East Asia over the past decade as a result of rapid economic growth (UNIDO 2008; Stamm, A. et al. 2009). At the same time, empirical evidence shows a general correlation between rates of economic growth and the speed of depletion of natural capital (Stamm, A. et al.). Thus, if measures are not taken to ensure that industrial growth in developing countries is sustainable, then this growth will continue to contribute to depleting and degrading the natural capital that forms the basis for economic activities (UNIDO 2010c).

The development of the Green Industry sector creates significant employment opportunities for poor and marginalized groups as well as opportunities for improving working conditions by providing skills and technologies to upgrade informal sector activities (UNEP/ILO/IOE/ITUC, September 2008). Studies indicate that between one and two per cent of the urban population in developing countries, or over 15 million persons worldwide, are involved in urban material recycling, and this sector is highly reflective of the human development opportunities that Green Industry approaches present. Waste-management and recycling in the informal sector are an important source of income for many in developing countries, but income and working conditions are often poor. Green Industry would aim to not only bring this sector into the formal economic sphere, but to modernize its techniques and processes. New or enhanced systems for recycling and reuse of materials would ensure that valuable resources are not wasted, but would also offer opportunities for poverty reduction through the creation of new, formal income-generating industries and jobs with improved working conditions (Chalmin C. and Gaillochet, C. 2009). Conservative estimates indicate that, globally, economic activities associated with reuse of the water stream (from collection to recycling) represent a market of €300 billion (ibid.). Furthermore, as poverty and the lack of jobs and economic prospects for growing populations is linked to an increase in crime and illegal migration, the creation of Green Industries that provide jobs in both urban and rural settings is highly instrumental in deterring such trends.

Another example of a sector that holds potential for poor and marginalized groups by greening and formalizing an informal sector is heat sources for cooking. In many places, inefficient stoves and open fires are a predominant way of cooking food. However, these methods create high emissions of GHG. Producing and distributing hot plates and more efficient stoves to replace these traditional means offers significant potential as a source of employment and income for the poor, especially in rural areas, while also creating a new Green Industry (ILO 2010). With research and development (R&D) efforts at national or regional levels to determine how to best produce these new technologies from local materials and programmes to encourage production and distribution, it is likely that a locally-rooted industry producing and distributing stoves or hot plates could be created. This would help reduce poverty and emissions. It is these sorts of pro-poor and pro-environment outcomes that Green Industry policy should attempt to focus on. One can easily extend this example to the production of sustainable, locally-sourced building materials for the construction industry and other similar initiatives that could create a new industry that is both good for people and the environment.

The inclusive business development strategies embedded in Green Industry initiatives address the root cause of poverty – lack of opportunities for sustainable livelihoods – rather than simply addressing its symptoms. This means increasing the economic returns to the productive factors that the poor possess (e.g. raising returns to unskilled labour), as well as improving access to skills and technologies so as to stimulate entrepreneurship and increase productivity. This includes promoting the development of rural non-agricultural activities, like production in micro, small and medium-sized enterprises (Kniivilä, M. 2007). As outlined above, in many cases, developing new green businesses (and Green Industries) can simply involve formalizing already-existing informal economic activity. Vendors (of all sorts) provide a classic example of small to medium-sized enterprises

that are an important provider of employment for the poor (Women in Informal Employment: Globalizing and Organizing, 2011). Formalizing their businesses and providing other forms of assistance and support would allow many of these vendors to expand their operations, which would increase employment to increase productivity, which would minimize their use of environmentally destructive inputs; and to manage their inventories more efficiently, which could reduce transportation emissions.
The modernizing and greening of agro-industries and other vital developing world sectors is another way of enabling the poor to provide for themselves and raise their incomes. Many poor people living in rural areas are smallholder farmers, and finding ways to increase yields by combining their expertise with emerging green technologies. This offers considerable potential in trying to move away from high-emitting, and in many cases, increasingly expensive, agricultural inputs (United Nations, Economic and Social Commission for Asia and the Pacific. *A Feasibility Study on the Application of Green Technology for Sustainable Agriculture Development*)

The promotion of entrepreneurship among women is another key aspect in enabling the poor. The Grameen Bank is an important example of this. By gearing their micro-loans towards women (98 per cent of their borrowers are women), they increased the ability of these women to start and expand businesses, and have met with considerable success in promoting entrepreneurship among women throughout the developing world (Wahid, A. 1999). It is easy to conceive of similar initiatives that could be geared toward women, such as special programmes to provide them with the skills and knowledge necessary to start and successfully operate a business. Green Industry approaches significantly contribute to the reduction of poverty, especially when conceived with the human development aspect in mind. They do so by creating decent jobs and higher wages for people via the promotion of business investment, the fostering of technological upgrading and dynamism, and the improvement of human skills (UNIDO 2009b; UNIDO 2009c; UNIDO 2008).

However, it must be noted that reliable and affordable energy is a must for the above to be achieved. Energy poverty significantly retards economic development in many parts of the developing world. However, the decentralized and off-grid clean energy solutions provided by Green Industry can effectively address the issue of energy poverty, stimulating the growth of productive activities besides offering considerable potential for job creation

Building skills for green productive activities

In Guinea, UNIDO is implementing a Peace Building Fund project to counteract an escalation of conflict through the involvement of youths at risk in productive activities. This is done by providing hands-on training and basic technologies for recycling plastics, paper, and metals. This contributes to stability, creates jobs, builds local capacity, develops entrepreneurial skills, promotes resource efficiency, and helps solve environmental problems associated with land filling and dumping of waste. It also helps other enterprises to be cleaner and more resource efficient by providing access to materials that can replace virgin raw materials. (United Nations Peace Building Fund - http://www.unpbf.org/index.shtml)

Access to clean energy

Through the UNIDO/UNEP/GEF project 'Renewable energy-based electricity generation for isolated minigrids in Zambia', three rural mini grids based on solar, biomass and small hydro power technologies are being set up to enhance national manufacturing capacity based on renewable energy technologies. Private partnerships have been stimulated through the involvement of communities, utilities, investors and businesses. At the same time, the project is contributing to the establishment of a legal, institutional and policy framework to promote further deployment of renewable energy.

Meanwhile, similar initiatives, such as the above mentioned project are enabling the spread and uptake of information communication technology in rural areas, thereby providing a green solution for bridging the digital divide, i.e. contributing to ensuring universal access to modern technologies.

BOX 4: EXAMPLES OF GREEN INDUSTRY INITIATIVES WITH SOCIAL BENEFITS WITH ECONOMIC BENEFITS

in rural areas, while contributing to climate change mitigation. (UN Energy 2005). These systems also create opportunities for the introduction of modern technologies (e.g. information and communications technologies) into rural regions of developing countries. For poor communities with no regular access to reliable energy services, enhanced electrification or the availability of clean fuels based on renewable sources of energy reduces poverty, improves health conditions and increases standards of living.

It has been demonstrated that Green Industry affords the opportunity to pursue economic ends without doing so at the expense of other important spheres, in this case, the social context. Traditional industrial development usually involved considerable social upheaval, but properly conceived Green Industry approaches can provide work and raise standards of living while complementing and reinforcing existing social networks. Indeed, the decentralized nature of many Green Industry approaches ensures that poverty can be reduced where it is found, rather than by spurring migration to manufacturing centres, as was the traditional outcome. The development of locally-rooted solutions to economic, social, and environmental problems helps avoid fostering a culture of dependency in areas where development is needed. The result is more dynamic local and regional economies in which participants are more empowered and engaged in the creation and development of their economies and societies.

3.3 Environmental Benefits– More Efficient Resource Use; Less Waste and Pollution

Projections indicate that global industrial production will increase by a factor of four between now and 2050 (UNIDO 2010d). Globally, the industrial sector uses more energy than any other end-use sector, currently consuming more than one third of the world's total delivered energy (http://www.unido.org/index.php?id=1000474). Nearly a third of all CO2 emissions are attributable to manufacturing (International Energy Agency 2007). Similarly, manufacturing accounts for almost 20 per cent of global water use (World Business Council for Sustainable Water Development 2009) and most of the raw materials used (according to a UNIDO-commissioned pilot study under the Green Industry Programme, by the Sustainable Europe Research Institute and Wuppertal Institute for Climate Environment and Energy in 2010 on 'Resource use and resource efficiency in emerging economies'). Current industrial production systems are characterized by wide-scale inefficiencies with regard to the use of materials, water and energy. Less than 10 per cent of the resources extracted or harvested end up in final products, as per this study. Many enterprises, particularly in developing countries, use more materials, energy and water than production processes require because of obsolete and inefficient technologies and inability to adopt proper management systems (UNIDO 2008a). Globally, more than billion tons of waste (including industrial and municipal waste) is produced each year, approximately 10 million tons per day. However, less than a quarter of this waste is recovered or recycled (Chalmin, C. and Gaillochet, C. 2009).

Improved resource efficiency, i.e. using energy, materials and water more effectively, allows resources to be conserved. By reducing the demand for raw materials by using them more efficiently, impacts associated with extraction and harvesting are decreased (Peck, M. and Chipman, R. 2007). For instance, the recycling of waste materials back into industrial production reduces requirements for the extraction and processing of virgin natural resources, which can carry a considerable environmental burden; it saves much of the energy used for extraction and processing, reduces the amount of waste and pollution (ibid.), and decreases the need for investments in end-of-pipe treatment systems. Using scrap steel is associated with 60-70 per cent lower overall energy consumption, with recycled aluminium coming in at 95 per cent, paper 65 per cent , and plastics 80-88 per cent. In some cases, recycled materials also decrease energy requirements in production processes. For instance, recycling glass lowers overall energy consumption by 70 per cent, water use by 50 per cent, and also leads to decreased pollution, with reductions of 20 per cent in emissions and 50 per cent in water pollution (von Weizsäcker et al. 2009). Calculations indicate that the cost of inefficiency from waste, i.e. non-product output, can be as high as 10-30 per cent of the total cost of production as for instance at e.g. GTZ–Profitable Environmental Management (http://www.gtz.de/de/dokumente/en-instruments-of-prema.pdf). By decreasing waste and inefficiencies in all forms, enterprises can reduce environmental impacts while making considerable savings.

There are also significant environmental benefits to be realized when companies employ DfE. Green products typically offer increased functionality and ease of use, longer life spans, easy disassembly or recyclability, and improved materials sourcing and production, which can all reduce the environmental impact associated with

their production and use. Businesses are in a position to influence all stages of life cycles of products and services. The decisions taken by businesses largely determine the environmental impacts that products will have since product or service design determines 80-90 per cent of the life cycle economic and ecological costs (Hawken et al. 1999). The life cycle of a product includes the extraction or harvesting of materials, transport, processing, production, sale, use and disposal. DfE and sustainable production means that businesses take steps to increase resource efficiency and decrease environmental burdens throughout the life cycles of products. This involves shifting from linear systems to more efficient closed loop systems and less resource intensive and wasteful ways of providing functions and services. Decreased impacts can be achieved by using renewable or recycled resources, by decreasing the quantity of resources used, and through improved product or service design (e.g. through extending the lifetime of products or by making appliances more energy efficient).

Green Industry is a prerequisite for moving towards Sustainable Consumption and Production (SCP). The UN Commission on Sustainable Development (CSD) is working for the effective follow-up of the United Nations Conference on Environment and Development. The CSD has recognized that SCP is a core element of Sustainable Development and, in 2011, the focus is on identifying and implementing policy options that have emerged in the context of a 10-year framework programme on SCP. Green Industry approaches create the conditions needed for industries to work proactively towards greening their operations and creating products and services that enable 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 consumer behaviour, choices and lifestyles are crucial factors, SCP can only take place if industries take an active role in minimizing resource use and its negative impact (including the elimination of hazardous substances and decreasing pollution and waste) throughout the life cycles of their products and services. Green Industry will be one of the major drivers of the shift towards SCP.

Ensuring that productive activities do not damage communities and the environment

Artisanal or small-scale gold mining in developing countries is a poverty-driven activity and the miners often suffer from social marginalization. With increases in the global price of gold, the numbers of these miners are on the rise as is the environmental and health damage that their activities cause.

UNIDO's *Mercury programme* demonstrates ways to eliminate mercury emission from Artisanal and Small-Scale Gold Mining operations through the introduction of more efficient and cleaner gold recovery techniques including gravimetric concentration, amalgamation in close-circuit and burning of the amalgam in closed vessels, allowing recycling of mercury. In addition, a recent addition to the programme has been the promotion of fair-trade initiatives for the gold market. This programme provides guarantees of reduced environmental contamination and impact on health, increased earnings through recycling and more efficient techniques as well as a high selling price through the fair-trade concept. These latter aspects are important for the poor rural population involved in the activity and for the natural environment that their activities affect (for more on the Global Mercury Project see http://www.unido.org/index.php?id=1000770).

BOX 5: EXAMPLES OF GREEN INDUSTRY INITIATIVES WITH ENVIRONMENTAL BENEFITS

4 OPPORTUNITIES PRESENTED BY GREEN INDUSTRY

In addition to the economic, social and environmental benefits outlined above, Green Industry also presents opportunities to impact two persistent environmental problems — climate change and chemical pollution. This section will outline what exactly Green Industry offers in redressing these problems and what can be expected on these fronts for countries and regions pursuing Green Industry development strategies.

4.1 Climate Change Mitigation and Adaptation

Climate negotiations are still far from delivering a global agreement that can ensure the level of GHG emission reduction that is needed to stabilize the climate. The IEA states in the 'Energy Technology Perspectives 2010' that according to the United Nations Intergovernmental Panel on Climate Change (IPCC), reductions of at least 50 per cent in global CO2 emissions compared to 2000 levels will need to be achieved by 2050 to limit the long-term global average temperature rise to between 20C and 2.40C. However, recent studies suggest that climate change is occurring even faster than previously expected and that even the "50 per cent by 2050" goal may be inadequate to prevent dangerous climate change.

While the Cancun Agreements set governments more firmly on the path towards a low-emissions future and support enhanced action on climate change in the developing world, the pledges made by parties are thus far inadequate to limit global warming. While the provision of reliable and affordable energy is a necessary prerequisite for industrial development, this must be ensured without further damage to the climate.

Industries are the largest end-users of energy and are major contributors to CO2 emissions. Almost a third of the world's energy consumption and 36 per cent of its CO2 emissions are attributable to manufacturing industries (IEA 2007). Industrial systems are designed to deliver products in a way that typically prioritizes reliability over energy efficiency. Furthermore, industrial production systems are subject to variations with regard to the scale of product output or changes in the types of products that are produced. This means that even systems which have initially been designed to be energy efficient may turn out to be inefficient if production volumes or composition change. The energy efficiency of industrial systems does not only depend on the efficiency of individual equipment but on how this equipment functions together in a system. The potential for improving energy efficiency in industry is considerable and industrial CO2 reduction potential is in the region of seven to 12 per cent of current global CO2 emissions (ibid.). The relative gains to be made in developing countries are considerable, as a significant quantity of processes and infrastructure in these countries could be made more efficient.

Industry also contributes to climate change through non-energy GHG emissions. Non-energy GHG emissions are emissions that occur during manufacturing but are not the result of combusting fuel for energy; instead, they come from activities such as the use of solvents or chemical treatments. Approximately 10 per cent of the direct and indirect industrial CO2 emissions are process-related emissions that are not due to fossil energy use (ibid.). In addition, industry gives rise to other GHG emissions (e.g. methane, nitrous oxide, and CFCs, which are gases that have higher global warming potentials than CO2). Trends indicate that non-energy GHG emissions from industrial processes, agriculture and waste are increasing at a rapid rate in developing countries (Masanet, E. and Jayant S. 2009; Jolley, A. 2006). These trends are expected to increase unless there is an increased uptake of low-carbon processes and technologies (e.g. emissions saving waste technologies).

Green Industry fosters the ability of businesses to take a leading role in developing and applying low carbon and climate resilient technologies, products, processes and approaches. Saving resources decreases costs for businesses and decreased resource use protects them from future price hikes. By working proactively on decreasing GHG emissions, enterprises are in a better position to deal with possible future regulations, participate in trading schemes, and to comply with demands from markets and customers — climate change can not only be mitigated via Green Industry initiatives, but in a way that makes economic sense for the industries involved.

As outlined above, there is growing consensus that the most effective and quickest way to reduce GHG emissions is to focus on improving resource productivity by switching to more sound methods of production that embody Green Industry approaches. This can be done by:

- dematerializing products: developing new products that require less resources (water, materials and energy) over their life cycle;
- increasing process efficiency: reducing the intensity use of energy, materials, chemicals, and water in production processes;
- minimizing process emissions: adopting clean technologies to decrease non-energy GHG emissions;
- switching to low-carbon inputs: using renewable and other low-carbon sources of energy and materials; and
- closing the material loop: recovering materials for reuse as feedstock for energy and input materials (UNIDO 2010b). For additional information on benefits (including GHG mitigation) related to reuse and recycling see section 6.

Focusing on energy efficiency in particular offers the largest and most cost-efficient GHG emissions reduction. In industry, energy efficiency is about optimizing the use of energy during and beyond the production process. This means getting the most value or energy service out of each unit of energy. Energy efficiency in industry can be achieved by a range of measures. These include fixing leaks and improving insulation; improving the performance of equipment (e.g. replacing or upgrading motors); optimizing systems (ensuring that the energy delivered to the system is used effectively) changing or eliminating processes; changing routines (including control and maintenance); and designing products that require less energy to make and less energy to use. While systems optimization and redesign of processes and products may initially require more effort than simply upgrading equipment, experience shows that these approaches lead to higher levels of efficiency and lower GHG emissions. Furthermore, payback periods for system optimization projects are typically short (REEP/UNIDO Training Package). However, industrial energy use differs from other end-use sectors, since considerable quantities of energy and carbon are stored in products. Consequently, efficiency improvements on a life-cycle basis including recycling, energy recovery, and the efficiency of materials use will be an important part of the effort to improve energy efficiency (IEA 2007). Energy efficiency offers a valuable focal point for efforts to reduce GHG emissions, in the developing and developed world.

There is also often a correlation between industrial strategies to reduce non- CO2GHG emissions and the improvement of energy productivity. For example, by replacing conventional refrigerants with substances that are more climate-friendly, considerable energy savings are also attained (von Weizsäcker et al. 2009). For example, in India, a new method for producing climate-friendly refrigerators has been developed. Based on the production of one million household refrigerators, GHG reductions over the product life-time are in the range of two to three million tons CO2 equivalent from improved energy efficiency and 0.5-1 million tons CO2 equivalent from use of more climate-friendly refrigerants according to the 'CDM Methodologies for Manufacturing of Climate Friendly Refrigerators' project supported by the Swiss State Secretariat of Economic Affairs (SECO) and UNIDO. Thus, we see that efforts around energy efficiency and reduced GHG emissions are complementary to one another.

Similarly, addressing the issue of waste by employing waste minimization or zero waste approaches, diverting solid waste away from landfills (e.g. recycling and/or energy recovery), and improving waste management technologies and wastewater treatment not only decreases non-energy GHG emissions but contributes to the more productive use of resources. Additional benefits include the stimulation of technological development and business development (e.g. small-scale recycling businesses or other green industries). Increased recycling also decreases the need for the extraction or harvesting of raw materials and associated energy requirements and GHG emissions. Industrial symbiosis and urban-industrial cooperation offer further opportunities to develop viable low-carbon business solutions, utilize resources more efficiently, and decrease emissions.

Improving resource productivity also contributes to the process of adaptation to the likely impacts of climate change. Reducing the dependence on increasingly scarce fuels and materials will contribute to making economies and industries more resilient to future increases in resource prices. New green business models, products and markets contribute to diversification and increase value addition, enabling economies to move away from reliance on climate-vulnerable economic activities. Green Industry strategies achieve desirable outcomes with regard to climate change without imposing costs on industry; indeed, they prepare developing-country industry to participate in and lead the industries of the future, and strengthen these countries' ability to deal with whatever climate change does come.

Mitigation of climate change through standards, on-the-ground assistance and implementing multilateral environmental agreements

Since 2007, UNIDO has been active in promoting and supporting the development of an international management system standard for energy through awareness-raising initiatives and expert meetings. Since February 2008, when the International Organization for Standardization (ISO) established Project Committee 242 – Energy Management, UNIDO has been supporting the development process of ISO 50001 – Energy Management standard, providing technical inputs in drafting the new standard and facilitating the participation of developing and emerging countries in the process through industrial surveys and regional workshops.

Motor systems account for more than 50 per cent of industrial electricity use worldwide. About 40 per cent of fossil fuels consumption in industry is for steam production. The optimization of energy performance of motor systems, steam and other systems is a focus area of UNIDO's approach to industrial energy efficiency. Within the scope of its China Motor System Energy Conservation Programme, UNIDO assisted the Government of China in controlling the growth of greenhouse gas emissions and to preserve energy through motor system efficiency improvement. UNIDO established a methodology to promote efficiency improvements in factories throughout the country, and trained local experts to implement those measures. Within two years, more than 1,000 factory personnel were trained, 38 industrial plant assessments were conducted and nearly 40 million kWh in annual energy savings identified (UNIDO 2009: http://www.unido.org/fileadmin/user_media/Publications/Pub_free/UNIDO_and_energy_efficiency.pdf)

During the period 2011-2014, UNIDO will be delivering training on and helping enterprises with the implementation of energy management system and energy system optimization in more than 20 emerging economies and developing countries.

The GHG emissions from industrial village enterprises constitute a major share of China's overall GHG emissions. The project 'Energy Conservation and GHG Emissions Reduction in Chinese Township Village Enterprises' promotes the removal of the barriers to improving energy efficiency in this sector and has led to a market transformation and the widespread dissemination of energy-efficient technologies foundries, cement, coking, and brick making. In the eight pilot-demonstration projects implemented, a GHG reduction of 193,192 tons CO2 per year has been achieved.

UNIDO assists developing countries in complying with their international obligations through the phase out of the production and consumption of ozone depleting substances. Support provided ranges from the formulation of national phase-out plans and adjusting legislation, to the development and promoted uptake of alternative solutions such as hydrocarbon technologies in refrigeration and non-chemical alternatives to pesticides. Green Industry approaches in this area contribute to establishing national capacity by strengthening and establishing institutions and through technology transfer including know-how, training, quality control, and cost analysis. UNIDO-led Montreal Protocol projects have led to 359 million tons of CO2-equivalent reduction, and a phase out of more than a third of the total consumption of ozone depleting substances in developing countries (UNIDO, Montreal Protocol Branch 2011).

BOX 6: EXAMPLES OF GREEN INDUSTRY APPROACHES' EFFECT ON GHG EMISSIONS

4.2 The Sound Management of Chemicals

Chemical substances and their derivatives are widely used in many development and economic sectors. Chemicals are essential for converting materials into products, improving the safety of products, treating water to avoid the spread of diseases, improving agricultural productivity, treating diseases and for promoting health. Globally, over the past half-century, there has been an accelerated release of artificial chemicals into the environment. Many developing and transition countries are importing increasing quantities of chemicals and products containing chemicals while local chemicals industries continue to grow. This trend is expected to continue in line with economic growth, population growth, industrialization, and urbanization. The use (and misuse) of chemicals can cause accidents, often with far-reaching impacts; pollute the environment and damage the health and well-being of workers and communities (Magash, A 2010), and such risks are likely to increase — the global chemical industry has grown steadily in production, trade, and consumption over the past 35 years, and much of the future growth, which is projected to be substantial, will involve increasing production and consumption in the developing world. This shift, which is already underway, is attributed to the rise of multinational chemical companies, lower labour costs in the developing world, and importantly, "a less regulated production environment in developing countries." It is imperative that the growth in the chemical industry that will take place in the developing world takes place in a safe and sustainable manner, so that negative impacts to the environment and human health from the industry's operations can be minimized (Manda, N. and Mohamed-Katerere, J. : Ch 11).

In response to the risks associated with the production, use and dispersal of chemicals, a number of international conventions and treaties have been established. These include the Stockholm Convention for the elimination or reduction of the release of Persistent Organic Pollutants (POPs); the Rotterdam Convention for ensuring that international trade of hazardous chemicals does not harm human health and the environment; and the Montreal Protocol for the protection of the ozone layer by phasing out the production of numerous substances associated with ozone depletion. To accelerate progress and cooperation, the Strategic Approach to International Chemicals Management (SAICM) policy framework was established to foster the sound management of chemicals and to ensure that by the year 2020, chemicals are produced and used in ways that minimize significant adverse impacts on the environment and human health.

Green Industry approaches work to ensure more responsible production using chemicals, i.e. using chemicals safely, avoiding over-use, phasing out and substituting hazardous substances, and improving practices for handling and managing chemicals, besides introducing measures aimed at decreasing risks and reducing accidents. Green Industry approaches help ensure that products are safe and do not pose a risk while using, decommissioning or disposing. These approaches promote the application of best practices along global value supply chains, stimulating research and development towards new pathways of eco-effective chemicals; new uses for existing benign chemicals; and the implementation of new business models. Typical benefits from improved chemicals management include improved working conditions, enhanced work safety, improved productivity, reduced costs, and decreased risks and liability. By focusing on identifying and capturing the benefits from improved chemicals management for enterprises, responsible production becomes a business opportunity rather than a cost.

Additionally, improved chemicals management also has an impact on energy use and GHG emissions. Currently, the chemical and petrochemical sector accounts for more than 30 per cent of total global industrial energy use (including feedstocks). Achievable energy efficiency measures for the sector are in the range of 35 per cent, with corresponding CO2 emission reductions of 20-35 per cent, based on unchanged current fuel use and feedstock mix (IEA 2009). The opportunities to improve the management of chemicals and simultaneously generate new industries, businesses and economic activity are many. Chemical Leasing can illustrate this. It is a new business model that provides benefits both for the users and the providers of chemicals by changing the basis of payment. Typically, industries pay suppliers on the basis of the quantity of chemicals provided, which means that the supplier is interested in selling increasing quantities of chemicals. In the new model, the chemical supplier is paid for the service rendered by the chemical and not for the amount of chemical provided. Hence, to reduce costs, the supplier will try to reduce the amount of chemicals used and increase the recycling rate. Typical additional benefits include improved processes, decreased emissions, increased safety and enhanced product quality. This example typifies how the chemical supplier, the user, and the environment can benefit from the improved management and use of chemicals. Opportunities for the creation of new solutions and green industries in the area of sound chemicals management range

from remediation of polluted sites, water treatment, new process development, and chemicals that do not cause environmental and climate damage. Green Industry approaches present the unique opportunity to have better management of chemicals and improved environmental and human health without net economic cost.

Promoting sustainable management of chemicals

Since 2001, UNIDO has helped more than 40 countries to develop national implementation plans for the Stockholm Convention (UNIDO 2003). To ensure that knowledge and experiences are shared, regional best practice networks and forums have been set up. One such network is the Regional Network on Safe Pesticide Production and Information for Asia and the Pacific. This network promotes environment-friendly technologies, ranging from promoting the use of appropriate personal protective equipment or the development of safe bio-pesticides to giving assistance to industries to enable them to meet safety standards.
Further hands-on support to industries is provided via the global network of National Cleaner Production Centres that work directly with enterprises to help them use chemicals in a more sustainable way. This includes making sure that enterprises do not use more chemicals than needed, phase out hazardous substances, improve safety, redesign processes and products and implement new business models such as Chemical Leasing. Effective implementation also depends on capacity building and the establishment of methodology to deal with specific substances, for instance, the management of mercury products. To address this issue, a project has been initiated in Uruguay to decrease the environmental and health risks associated with products containing mercury, particularly mercury lamps. Key activities include a comprehensive assessment of releases, risks and alternatives, as well as an analysis of distribution channels and waste management practices. In common with other projects, it is expected to pave the way for the development of integrated chemicals policies.

Promoting the implementation of the Montreal Protocol

UNIDO has taken a leading role in the provision of cost-effective services to eliminate ozone depleting substances (ODS). Since 1993, UNIDO has implemented over 1,217 Montreal Protocol projects, which contributed to the phase out of 69,302 ODP tons of annual consumption and production of ODS in small, medium-sized and large enterprises in the industrial, agricultural and refrigeration-servicing sectors. So far, Montreal Protocol projects implemented by UNIDO have yielded 359 million tons of CO_2 equivalent., while the total phase out accounts for more than a third of the consumption in the developing world. These projects also contribute to eco-labelling and International Organization for Standardization (ISO) certification to allow better access to new markets.

Access to markets through green process changes

Improved chemical management is an increasingly important precondition for accessing markets. Mounir Miku is a tomato farmer in Agadir, Morocco. He and other growers have traditionally used a pesticide called methyl bromide for their tomato crops. Recently, they were informed that methyl bromide is known to deplete the ozone layer and that the Montreal Protocol demands the phase out and ban of methyl bromide by 2015. At the same time, Mounir was informed that the European Union (EU) — traditionally one of the largest export markets for food products from Morocco — banned the use of methyl bromide as of March 2010. The farmers therefore urgently needed an alternative to methyl bromide that would allow them to continue growing and exporting their tomatoes. As an implementing agency of the Montreal Protocol agreement, UNIDO stepped in to help provide the needed support to make the necessary changes and find alternatives. With UNIDO's help, Mounir was able to change to an eco-labelled ozone free pesticide.
In this way, UNIDO has also trained more than 150,000 farmers in different countries in the use of non-chemical alternatives to methylbromide. Training centres were established to assist farmers to adhere to new ozone friendly technologies. UNIDO helps companies acquire new technologies and also look at safety issues and maintenance (UNIDO 2011), and the methyl bromide programme is ensuring improved access to new markets by helping enterprises to eliminate the use of this toxic substance (UNIDO Times, March 2011).

BOX 7: EXAMPLES OF GREEN INDUSTRY APPROACHES' EFFECT ON THE MANAGEMENT AND USE OF CHEMICALS

5 BARRIERS

While there is a compelling case that Green Industry generates sustainable industrial development benefits in each domain — economic, environmental and social — its widespread adoption is not necessarily a straightforward proposition. This section will outline the barriers that exist to the meaningful uptake and development of Green Industry in developing countries.

5.1 Lack of Resources

There is no argument over the fact that new infrastructure will need to be put in place for the full transition to a Green Economy to occur . This will, more often than not, involve significant up-front costs. In many cases, developing countries will lack the resources required to support the development of Green Industry in their countries — be it a lack of technology, knowledge and expertise, or simply a matter of insufficient capital. Without financing and the transfer of knowledge, skills and technologies to the developing world, the global transition to a Green Economy will take place at a very slow pace. The need to address environmental problems grows every day, and therefore, a serious push is needed on the part of developed countries to facilitate and aid developing countries in making their transition to a Green Economy, if serious damage to ecosystems and climate is to be avoided.

5.2 Institutional Inertia

Government, industry and/or labour organizations will, in some cases, have a natural tendency toward maintaining the status quo. Addressing environmental problems requires commitment, focus, and major political wherewithal on the part of governments, and some developing countries may have political systems that are not equipped to deal with the challenge Green Industry presents, or may simply be over-burdened with other pressing issues to the point that there is no political capital left to direct toward Green Industry. It will take engagement, assistance, and in some cases, pressure, from developed as well as other developing countries to spur the needed change in some countries.

Industries in these countries may themselves be resistant to change. Although Green Industry is in the long-term best interests of the industrial sector as a whole, there will inevitably be winners and losers. Lobbying efforts on the part of industries that perceive themselves to be threatened will be intense, and this is why it is important that industry is brought on board as a partner in Green Industry initiatives. Not only is the engagement of industry important because of the valuable insight and leadership industry can provide, but it is also essential that it is not made an opponent because of its ability to slow or block the efficacy of important Green Industry initiatives. The same goes for unions, which may perceive jobs to be threatened by the new policy landscape.

5.3 Market and Policy Failures

Market failures can distort market prices and send the wrong cost information to economic actors, serving as a barrier to the development of Green Industry. Market failures can come in the form of externalities, they can be due to market power, or they can be the result of misguided government intervention. If markets and policies are not properly calibrated, they can hamper attempts to encourage and support Green Industry initiatives. Effective policy that addresses failures inherent in markets and seeks to intervene only in ways that are prudent (e.g. not offering perverse subsidies to fossil-fuel industries) will be essential for the success of Green Industry initiatives.

Moving Towards Green Industry

Greening is about continuous improvement; it is not an end-state. Greening an enterprise or an industry is not a one-off action, it is a continuous process of sometimes incremental and sometimes radical changes that lead to increasingly improved performance. Accordingly, ensuring conditions that promote the greening of industries and the creation of green industries is a process that cannot be achieved by an isolated intervention, single policy or instrument.

Green Industry is properly understood as a sector-strategy for the realization of Green Economy and Green Growth in the industry sector, and the transition to Green Growth will require not only long-term commitment, but also the innovative use of a wide range of approaches, and the utilization of synergies among different types of interventions and instruments. Furthermore, to effectively address emerging challenges and changing conditions, new ways of promoting progress need to be continuously developed. This includes the use of complementary, integrated approaches that create incentives for businesses and promote proactive industrial actions and business-driven solutions; raising awareness about possibilities and benefits; providing access to the mobilization of knowledge, know-how, and technologies; and promoting predictable enabling framework conditions. This requires broadbased changes in policy frameworks and support systems including science, education and financing, as well as changes in businesses themselves. This section will outline the pre-conditions that must be in place, the different types of policy interventions that are available, as well as some practical, actionable policies that can be pursued to meaningfully develop Green Industry and shift to a Green Economy. This presentation of the concrete policies available to promote Green Industry is intended to serve as a rough outline of the options available. For a more comprehensive discussion of these tools, see the UNIDO publication 'Policies for Supporting Green Industry'.

Prior to the use of any specific policy instruments, it is essential that there be governance structures and enabling conditions in place that give a jurisdiction the institutional capacity to carry out successful Green Industry policy-making. In some cases, these require reform of governance structures or the creation of new bodies or committees to oversee the policy-making process. Without strong and robust governance structures in place, attempts at creating enabling conditions and instituting effective Green Industry policy will likely miss their mark. With effective governance structures and enabling conditions in place, various types of instruments can be employed by policy-makers' to implement their vision. These fall into four main categories, as given below.

Command and control: this involves direct intervention in market outcomes on the part of policy makers; it can take the form of compulsory technological standards or the ban of specific methods, materials or processes; the drawback of this type of intervention is that it stifles innovation on the part of the industries being regulated, since (for example) they have little incentive to develop a superior technology if they are going to be forced to adopt some other type.

Market based: these types of policies involve setting benchmarks or compulsory targets but then leaving it up to industry to figure out what is the best way to achieve them (e.g. cap-and-trade); so long as the policies are correctly calibrated, this type of policy can lead to the same outcomes as command-and-control intervention, but without stifling innovation.

Voluntary: sometimes, there is considerable advantage in not compelling industry to behave one way or another, and instead encouraging market actors to take the initiative in developing solutions to the problems policy makers wish to solve; this could mean stepping aside and letting industry take the lead, or providing a framework or benchmarks for those that wish to participate in the voluntary initiative.

Information: the importance of policy that seeks to develop, gather and disseminate information should not be underestimated; government itself or independent bodies set up by government can act as an effective contact point for industry actors wishing to learn more about particular types of green processes, methods or technologies.

As stated above, these types of tools are most effective when used in concert. It will seldom be the case that Green Industry is best facilitated by one type of policy alone, and the synergies that exist between these various types of interventions (or non-interventions) should be exploited by policy-makers.

The impetus for a shift to Green Industry must come from both state and industry actors. As will be presented in the table below, there are a wide variety of actions that governments can and should undertake to spur the transition to Green Industry, as well as a range of actions unique to industry. However, a key area that requires both the support of government and industry is broad-based technological support. Without strong facilitation on the technology front by government and active participation by industry, Green Industry efforts are likely to stall. This key area of importance highlights the significance, further exemplified below, of the active engagement of all relevant stakeholders in the different spheres of Green Industry policy.

Governments need to develop broad-based policy as well as targeted measures to support Green Industry. However, to be successful, they must also recognize the importance of industry actors both by consulting with industry on policy-making and in providing support for industry initiatives. Government's provision of a broad policy framework, coupled with industry initiative and government engagement of industry provides the way forward in realizing the desired outcome of Green Industry and a Green Economy.

As outlined in the UNIDO publication 'Policies for Supporting Green Industry', the overall policy framework for Green Industry contains five components. First, government must ensure it is providing 'An Integrated Framework for Supporting the Greening of Industries.' It must also work on 'Creating an Enabling Environment;' and developing 'Instrument Mixes to Promote the Greening of Industries;' as discussed above, government and industry must cooperate on 'Harnessing Environmental Technologies;' and lastly, there must be 'Industry-Led Initiatives' for the push to Green Industry to be successful. The following table outlines these components of the overall policy framework, describing the actions that each component entails, the options available for achieving them, and providing a real-world example for each. It is important to note that many of the policy option described in the table are not mutually exclusive; in fact, a synergistic application of them will be integral to their success.

Policy Framework Component, Policy Type, and Main Actor(s)	Description	Policy Options	Example
An Integrated Framework for Supporting the Greening of Industries **Involves:** Governance and Institutional Capacity **Main actor:** Government	This encompasses policies that serve to coordinate and organize the efforts of various government and stakeholder actors. Given the complexity and enormity of the task of setting effective Green Industry policy, it is essential that a coordinating framework for the different initiatives and efforts that will comprise a country's effort to move toward Green Industry is in place. In order to succeed, these policies require engagement and commitment at the highest government levels.	In many cases, these types of policies involve setting up a high-level strategy, be it regarding sustainable development, poverty reduction, sustainable consumption and production, or other related topics. It can also involve setting up regulatory frameworks or coordination bodies such as ministerial committees or inter-agency forums, and developing integrated, high-level sector strategies.	Ontario's Green Energy Act is a strong example of an integrated policy framework because it is a sweeping piece of legislation that synergistically employs a number of different measures in order to achieve its aims, which are to foster a culture of conservation and to develop a strong renewable energy sector in the province. In order to achieve these goals, it has set aggressive conversation and local content targets, streamlined environmental approval processes, instituted a feed-in-tariff programme, and established a new Renewable Energy Facilitation Office to aid in the development of the sector[1].
Creating an Enabling Environment **Involves:** Enabling Conditions, Acts and Regulations **Main actor:** Government	There are many things that policy makers can do to create the conditions under which Green Industry will grow and thrive. Providing a stable policy environment and accurate, timely flow of information to industry and other stakeholders is a cornerstone of any Green Industry policy.	Much can be done to provide an enabling environment, including market-based measures such as providing access to finance, removing harmful subsidies, and demand policies. Governments can also pursue international agreements and trade policies, provide eco-efficient infrastructures, and serve as a source of information. Additionally, measures to support local action and to promote the skill base of the labour force can be important enabling conditions.	In 2009, the Council of Australian Governments put in place a 'Green Skills Agreement' which will be used to promote a sustainable and low-carbon economy through the expansion of vocational education and training for people and businesses. By consciously upgrading the skills and knowledge of its labour force and businesses, the Council is building substantive capacity to facilitate the country's transition to Green Industry[2].

Policy Framework Component, Policy Type, and Main Actor(s)	Description	Policy Options	Example
Instrument Mixes to Support the Greening of Industries **Involves:** Various Policy Instruments - Command-and-control, Market-based, Information **Main actor:** Government	There are a number of different specific market interventions that can be effective at encouraging the development of Green Industry and there is a growing body of research on the efficacy of these different tools. In some cases, they can be immensely powerful in seeking to steer industry and markets to a desirable outcome regarding the state of Green Industry. Which type of interventions and what combinations are ideal will vary with each policy context.	By definition a wide variety of policy options are included in this category. They include environmental taxes; tradeable permits; environmentally-motivated subsidies; regulatory frameworks and compensation schemes; voluntary agreements; and strong regulation, among many others. What is most essential is that these instruments are used in concert effectively, and that great care goes into the overall design of the mix of instruments and policies.	Germany has had success with its eco-tax, a market-based instrument in place since 1999. It was used to shift the tax burden away from labour to the use of environmental resources, primarily by increasing prices paid for oil and electricity. Revenues from the tax have been used to fund renewable energy initiatives. The policy has reduced fuel use, lowered emissions, fostered growth in renewable energy and created green jobs[3].
Harnessing Environmental Technologies **Involves:** Enabling Conditions, Various Policy Instruments, Industry Engagement and Voluntary Action **Main actors:** Government, Industry	As outlined in the section on decoupling, technology will be a major factor in the move toward Green Industry. Government can greatly facilitate technological development and uptake on the part of industry by supporting R&D to develop new technologies or acting to support the spread of existing technologies. Openness to change on the part of industry is also important.	This category of policy can involve direct government involvement in the form of strategic R&D programmes and the development of technical capacity, or indirect involvement via finance for environmental technologies, and measures to improve knowledge transfer and technology diffusion. Acting toward an integrated and strategic science/R&D system is another important policy option for governments to consider.	In the biofuel industry in Brazil, subsidies were provided to encourage development of the technology, and communication of policy objectives and time spans were clear. Industry was seen as a partner and the Government was careful not to pick winners, allowing the industry to develop organically, but with Government assistance that was gradually withdrawn. Today, Brazil is the world's most competitive producer of renewable fuels[4].
Industry-Led Initiatives **Involves:** Voluntary Action by Industry **Main actor:** Industry	As discussed above, command-and-control type intervention and the creation of a conducive policy environment are not sufficient for the development of Green Industry; industry itself must also be actively involved. The items in the neighbouring column are not 'policy options' per se, but rather different types of initiatives that industry can take on and that policymakers can encourage	Some options that industry could consider in taking initiative on the Green Industry front include standards such as eco-labels or benchmarks; using life cycle analysis to move toward SCP; extending producer responsibility for products and materials and for environmental impact in general; and promoting environmental management systems and support facilities for firms in the industry.	The Environmental Farm Plan Initiative in Canada's Atlantic provinces is a long-standing industry-driven project to help farm families develop a practical plan for operating in an environmentally responsible manner. Its objective is to ensure the health of the environment and the communities in the region, as well as realize the marketing benefits tied to a 'Green Industry.' It is a prime example of industry helping lead the way toward the greening of its operations[5].

1 Ontario Power Authority (2010); 2 Grey E. and Talberth J. (2011); 3 Ibid.; 4 Green, Duncan; 5 EFP Initiative (1996)

Promoting Green Industry through establishing National Capacity

A central instrument for Green Industry is the global network of National Cleaner Production Centres. These centres, established by UNIDO and UNEP, are part of a global network spanning over almost 50 developing and transition countries. The centres not only ensure that national capacity is in place and is being continuously strengthened, they are also practical examples of green public-private partnerships with boards composed of the business sector, government and civil society representatives, with financing from national government contributions, fees for business-advisory services and technical assistance and innovation projects (UNIDO-UNEP 2010a The global network of centres is increasingly involved in South-South cooperation, whereby more experienced centres support newly established centres or where centres develop skill-sets in specific areas that are then shared with other centres. The centres are actively involved in regional round tables of sustainable consumption and production. The global network was formalized and awarded legal status in 2010/2011, thereby improving preconditions for knowledge management, experience exchange and intensified cooperation. The centres have transitioned from projects to key national and international actors constituting an effective platform for the implementation of projects and initiatives (UNIDO-UNEP 2010).

BOX 8: AN EXAMPLE OF THE VALUE OF NATIONAL CAPACITY FOR GREEN INDUSTRY INITIATIVES

6 UNIDO'S GREEN INDUSTRY INITIATIVE

UNIDO is a specialized and efficient provider of services in support of the challenges of reducing poverty through productive activities, promoting the integration of developing countries in global trade through capacity building, and improving access to energy while fostering environmental sustainability in industry. In line with this mandate, UNIDO has developed a Green Industry initiative to place sustainable industrial development in the context of global Sustainable Development challenges and contribute to the transition towards a Green Economy. The initiative was launched in 2009 during the International Conference on Green Industry in Asia. The Conference was held in Manila, Philippines, from 9 to 11 September and co-organized by UNIDO and the Government of the Philippines, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and the United Nations Environment Programme (UNEP). Senior government officials from 21 countries in the region unanimously adopted the Manila Declaration on Green Industry in Asia and Framework of Action, which calls upon governments, the private sector and international organizations to collaborate in fostering the development of green industry. UNIDO follow-up to the Conference includes the drafting of national Green Industry strategies and the preparation of national eco-efficiency profiles and of a Green Industry policy package. This has since been mainstreamed into UNIDO's projects and activities (UNIDO 2010a).

The initiative is focused on enabling developing countries to achieve equitable economic growth that does not harm the environment and the climate, by creating conditions that allow industries to reduce pollution and resource use significantly, while continuing to provide goods and decent employment. To this end, UNIDO is actively involved in fostering awareness; in bringing forth commitment and development; in supporting the implementation of strategies, the development of action plans, the preparation of frameworks, studies, and investigations, and the implementation of projects. The Green Industry initiative sets out to help developing countries take advantage of the opportunities associated with more sustainable industrial development and the growing global demand for green solutions. This is achieved by working closely with national governments and other key stakeholders to mainstream Green Industry into public policy and institutions; and governance mechanisms in businesses and markets and among consumers and communities. It also involves the promotion of technology development and transfer, demonstration projects, capacity building and training, the establishment of support institutions and improving access to financing mechanisms. For an overview of the interrelated facets of Green Industry policy, see Box 2 at the end of this section.

As part of this Green Industry initiative, UNIDO has developed a clear set of actionable strategies and approaches that can be utilized to accelerate progress towards an inclusive, low-carbon, safe, and resource efficient green economy through promoting business-driven solutions. This comprehensive framework of strategies, instruments, programmes and approaches are intended to remove gaps in the policy framework, in the support system and in the industrial sector's knowledge and skill- sets. Furthermore, UNIDO has initiated a series of country status reports on resource use to serve as a baseline for monitoring progress. Following this, UNIDO will initiate working with countries to formulate national Green Industry strategies. As outlined above, the normative policy framework for governments identifying effective policies and best practices developed by UNIDO are presented in a guidance document on the development of Green Industry (UNIDO 2011, Policy Frameworks for Supporting the Greening of Industries; UNIDO 2008).

While UNIDO's Green Industry approaches are relevant to all types of enterprises, of all sizes and in all sectors, primary focus is placed on SMEs that engage in industrial processing and manufacturing, as well as on service providers. These SMEs are the most critical for the early stages of industrialization and are typically the largest job creators. They make up over 90 per cent of business worldwide and account for between 50 and 60 per cent of employment (UNIDO 2002).

Interventions by different units and branches of UNIDO at headquarters and in the field are coordinated for synergies and an effective comprehensive approach. Activities in targeted sectors are linked to provide a comprehensive package tackling multiple priorities. This approach promotes inter-sectoral collaboration within UNIDO as well as with other United Nations agencies, national stakeholders, and other development partners. UNIDO has forged partnerships and continues to work closely with the Food and Agriculture Organization (FAO) of the United Nations and the International Fund for Agricultural Development (IFAD) on agri-business development; with the United Nations Development Programme (UNDP) on private sector development and field representation; with the United Nations Environment Programme (UNEP) on cleaner production and implementation of multilateral environment agreements; with the United Nations Conference on Trade and Development (UNCTAD), the World Trade Organization (WTO), the International Trade Centre (ITC) and the Executive Secretariat of the Enhanced Integrated Framework (EIF) on trade capacity-building; and with the World Bank on environment and energy. Furthermore, as part of the United Nations system, UNIDO also participates actively in system-wide initiatives and coordination mechanisms at the global, regional and national levels, and seeks synergies with bilateral aid agencies, private enterprises, civil society and academia (UNIDO 2008).

The Green Industry initiative is highly integral to UNIDO's overarching objective to promote industrial development for poverty reduction, inclusive globalization and environmental sustainability, and has the potential to act as a rallying point for UN inter-agency coordination towards sustainable development.

Facets of Green Industry policy (UNIDO 2010a)

Resource efficient and cleaner production: this requires a holistic system-based approach to decouple economic growth from accelerated environmental degradation and resource use via environmental and energy management systems; product life cycle optimization and process optimization; the development and uptake of clean technologies (e.g. renewable energy technologies); improved resource use, decreased pollution, waste minimization and zero waste strategies; and closed loop systems and industrial symbiosis (UNIDO-UNEP 2010).

Energy efficiency in industry: this involves a systematic and focused approach on continually improving energy performance and productivity and reducing environmental and climate change impact through the implementation of energy management system standards, the optimization of energy systems (steam, motors, compressed-air, etc.), energy efficient design and cost-effective, incremental technological innovation (UNIDO 2009e).

Corporate social responsibility and responsible production: this refers to the environmentally sound management of chemicals and (hazardous) waste, and the substitution and/or minimization of the use of hazardous substances (such as ozone depleting substances and persistent organic pollutants or POPs) for improved risk management and the enhanced safety of workers, communities and consumers; it includes sustainable value chain management, environmental management, reporting, communication, eco-labelling, etc. (Nelson, J. 2007).

Low carbon and/or climate resilient production: this involves the use of innovative approaches for enterprises and value-chains to mitigate climate changes through the increased use of renewable energy. These approaches prevent carbon loss from value chains, and prompts process changes, the elimination of non-energy GHG emissions, besides improving the ability of industries to adapt to the impacts of climate change (UNIDO, 2010b; UNIDO 2009e; UNIDO 2009a).

Inclusive business development: this enables the development of productive activities, the creation of new jobs through targeted training, capacity building, cluster development, the development of new green business concepts and improved access to resources (including financing and technologies); assistance in business development projects would be particularly targeted towards vulnerable groups such as women, youth, and people in post-conflict areas (Nelson, J. 2007).

Sustainable agriculture and agribusiness: this includes the promotion of agricultural productivity, food safety, and decreased environmental burdens (including GHG emissions) through improved access to environmentally friendly concepts, practices and technologies, and the decreased use of potentially hazardous chemicals.

Sound chemicals management: this entails preventive approaches and business models to assist enterprises in reducing the risk and impacts associated with the use of chemicals; it includes control and management of hazardous chemicals to increase overall safety and protect the environment, workers and communities (UNEP 2009); it also includes substitution, which is the replacement or reduction of hazardous substances in products and processes with less hazardous or non-hazardous substances, or by achieving an equivalent functionality through technological or organizational measures; an important aspect of chemicals management is the development of green chemistry, i.e. the development of safer and more resource efficient chemical products and processes.

Clean energy for productive uses: this involves promoting renewable energy and technology solutions to meet the energy needs of local industries, particularly in rural areas, and to sustainably address the issue of energy poverty.

BOX 9: FACETS OF GREEN INDUSTRY POLICY

7 SUMMARY OBSERVATIONS

A low-carbon and resource efficient pattern of industrial development can reconcile the urgent need to protect the natural environment and climate with the urgent need for rapid industrialization to create jobs and wealth and thereby alleviate poverty. Using resources more productively is central to achieving a range of policy objectives including climate change mitigation and adaption, environmental protection, security of resources and food, poverty reduction through the creation of jobs, stimulating economic activity and boosting competitiveness. However, so far, the transition to resource efficient industry has been slow. There are still a number of barriers to the deployment and diffusion of environmentally sound technologies and expertise, including a lack of awareness, inflexibility, the absence of appropriate policies and regulatory frameworks, and insufficient investment in the infrastructure needed for new technologies. Green Industry provides cost-effective approaches that help developing countries to move towards resilient industrial development pathways that enable the improvement of living conditions and the creation of wealth, without damaging the environment, communities and the climate.

There are significant opportunities for utilizing the Green Industry approach to assist developing and transition countries in dealing with pressing social concerns while, at the same time, ensuring that these countries enjoy Green Growth. Developing countries with emerging and expanding industrial infrastructure have a particular opportunity to increase their competitiveness by applying resource efficient best practices from the outset in new industrial facilities, rather than following the slower path of first investing in traditional infrastructures and then upgrading. It is frequently argued that by utilizing available modern technology and by commercializing new knowledge, developing and transition countries could leapfrog several stages of development and rapidly attain a higher degree of industrialization. However, it is critical that the technologies, practices and production methods deployed in these countries are sustainable and adaptable (i.e., do not hamper the growth in resource efficiency). If the current window of opportunity for integrating sustainable production approaches and technologies in the necessary industrial upgrading and development of these countries is missed, then these countries will face high costs and losses in the future due to the need to clean up pollution, replace technological bases, and make up for missed business opportunities, resource scarcity, depleted ecosystems, and an inability to compete on the global market.

While numerous enterprise-level achievements have been realized and technologies and approaches to improve resource productivity have been developed, a lot remains to be done. Wide-scale replication and upscaling is still needed. This requires addressing gaps and barriers, creating both national and international enabling framework conditions, intensifying technology transfer, enhancing South-South cooperation, strengthening innovation systems, and building national capacity. UNIDO's Green Industry initiative provides a firm foundation for supporting developing countries in their effort to address these issues.

Intensified national and international efforts are needed to effectively respond to the scale and scope of the interrelated and increasingly urgent global challenges. There is a need to move beyond a win-win rhetoric and take action. Green Industry plays a key role in the progress towards a Green Economy in which industries are not only part of solution to the global economic, environmental and social challenges, but a driving force.

Definitions

Cleaner Production: *"The continuous application of an integrated environmental strategy to processes, products and services to increase overall efficiency and reduce risks to humans and the environment"* UNEP (2002). This can be applied to industrial processes, to the products themselves and to various services (UNIDO-UNEP 2010).

Decoupling: the OECD defines decoupling as "breaking the link between "environmental bads" and "economic goods." Decoupling occurs when the growth rate of an environmental pressure is less than that of its driving economic force (e.g., measured in GDP) over a given period. Decoupling can be either absolute or relative. Absolute decoupling occurs when the environmentally relevant variable is stable or decreasing while the driving economic force is growing. Relative decoupling occurs when the growth rate of the environmentally relevant variable is positive, but less than the growth rate of the economic variable (OECD 2002; Stamm, A. et al. 2009).

Chemicals management: this is the development of preventive approaches and business models to assist enterprises to reduce the risk and impacts associated with the use of chemicals. It includes safe and responsible production and chemicals substitution.

Chemicals substitution: replacement or reduction of hazardous substances in products and processes by less hazardous or non-hazardous substances, or by achieving an equivalent functionality via technological or organizational measures.

Energy efficiency: encompasses changes that result in decreasing the amount of energy used to produce one unit of economic output (e.g., the energy used per unit of GDP) or to achieve a certain energy service (e.g., lighting, heating). Measures to increase energy efficiency include technological, organizational and behavioural changes.

Lifecycle approach: addresses the entire lifecycle of a product, process, or activity (e.g., service), including research and development; extracting and processing raw materials; manufacturing, transportation and distribution; use, reuse, and maintenance; and recycling and final disposal. It is a tool for conducting a systematic, cradle-to-grave (or cradle-to-cradle) analysis to estimate the environmental consequences of alternative materials, designs, manufacturing processes, product use patterns, and end of life alternatives (Weiser, G.M. and Magraw, D.B. 2005; UNEP 2009).

Low carbon production: in industrial terms, low-carbon production describes continuous net reductions in GHG emissions per unit of service or product delivered. These low-carbon industries are crucial for addressing adaptations to the potential impacts of climate change, including social, environmental and economical change (UNIDO 2010b).

Industry: industrial production, in which raw materials are transformed into finished goods on a large scale. Manufacturing includes all intermediate processes required for the production and integration of a product's components.

Manufacturing industry: refers to those industries which are involved in the manufacturing and processing of items and indulge in either creation of new commodities or in value addition.
Industry processing raw materials: an industry in which raw materials are treated or prepared in a series of stages, e.g. using chemical processes. Process industries include oil refining, petrochemicals, water and sewage treatment.

Industrial symbiosis/ecology: the central idea of industrial ecology is to optimize the flow of materials and energy between different industries so as to optimize resource use, create new products and decrease pollution.

Innovation: innovations include new and improved products, processes, and business or organizational models. In regard to developing countries, this also includes the first use of new technology in the domestic context (Dahlman, C. 2007).

Inter-generational equity: the present generation has a right to use and enjoy the resources of the Earth, but is under an obligation to take into account the long-term impact of its activities and to sustain the resource base and the global environment for the benefit of future generations of humankind. (Weiser, G.M. and Magraw, D.B. 2005).

Internalization of costs (polluter pays principle): the use of market and/or regulatory instruments to ensure that persons who are responsible for pollution, or for production or processes that may ultimately lead to pollution, bear the full environmental and social costs of their activities, and that those costs are reflected in the market price for goods and services (ibid.).

Resource efficient and cleaner production: Applies to integrated and preventative strategies, processes, products and services, by increasing product efficiency and reducing the risk to humans and the environment. This is achieved through Product Efficiency, Environmental Management and Human Development (UNIDO-UNEP 2010).

Resource productivity: is the measurement of how effectively resources are used i.e., how much product output is produced per unit of energy, water or material used (UNIDO-UNEP 2010b).

Responsible production: is the improvement, control and management of hazardous chemicals thereby increasing the overall safety, reducing chemical emergencies and protecting the environment and society (UNEP 2009).

Sustainable consumption and production: is "the production and consumption of services and products that respond to basic needs and bring a better quality of life, while minimizing use of natural resources and toxic materials as well as the generation of wastes and pollutants over the whole life-cycle of the product or service, so as not to jeopardize the needs of future generations" (UNEP 2002).

Sustainability: the concept of sustainability means that development efforts, including those aimed at protecting health and the environment, should be undertaken in a manner that "meets the needs of the present without compromising the ability of future generations to meet their own needs." (Bruntland, G. ed. 1987).

Technology transfer: the process by which expertise or knowledge related to technology is passed from one user to another for economic benefit (including mitigation of future costs related to damage to the environment). It includes technology acquisition, adaptation, dissemination, and use in diversified local settings (Ockwell et al. 2008; Dahlman, C. 2007).

Zero waste: managing products and processes to systematically reduce and eliminate the levels of waste materials, by reusing and recovering the resources through recycling, composting and energy recovery (Zero Waste International Alliance - http://www.zwia.org/)

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