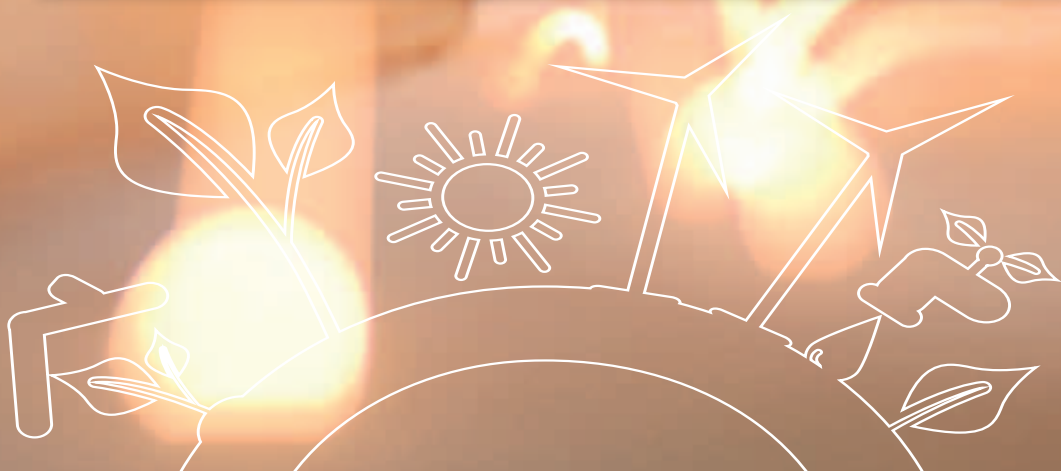


Manufacturing



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Acronyms

APEC	Asia-Pacific Economic Cooperation
BAU	Business-as-usual
COMESA	Common Market for Eastern and Southern Africa
CSR	Corporate Social Responsibility
EAC	East African Community
EC	European Commission
EGS	Environmental Goods and Services
ETAD	Ecological and Toxicological Association of Dyes and Organic Pigments Manufacturers
EMS	Environmental management systems
EU	European Union
GCO	Global Chemicals Outlook
GDP	Gross Domestic Product
GER	Green Economy Report
GHG	Greenhouse gas
GOTS	Global Organic Textile Standard
GRI	Global Reporting Initiative
ICT	Information and communication technology
IEA	International Energy Agency
IGPN	International Green Purchasing Network
IISD	International Institute for Sustainable Development
IPM	Integrated pest management
IRP	International Resource Panel
ISO	International Organization for Standardization
MVA	Market Value Added
MW	Megawatt
NCPC	National Cleaner Production Center
NDRC	National Development and Reform Commission
NTB	Non-tariff barrier
OECD	Organisation for Economic Co-operation and Development
RSL	Restricted Substance List
RTA	Regional Trade Agreement
SADC	Southern African Development Community
SAICM	Strategic Approach to International Chemicals Management
SCP	Sustainable Consumption and Production
SME	Small and medium-sized enterprise
TEEB	The Economics of Ecosystems and Biodiversity
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNGP	United Nations Global Compact
UNIDO	United Nations Industrial Development Organization
WBCSD	World Business Council for Sustainable Development
WTO	World Trade Organization

5 Manufacturing

5.1 Introduction

The Rio+20 Conference set out a basis for governments and industry to move towards greener manufacturing. In particular, world leaders reaffirmed that promoting sustainable patterns of consumption and production is one of the overarching objectives of sustainable development. They also reiterated that fundamental changes in the way societies consume and produce are indispensable for achieving global sustainable development.

Countries at Rio+20 strengthened their commitment towards accelerating this shift with the adoption of the 10-Year Framework of Programmes on Sustainable Consumption and Production (10YFP)¹ (UN 2012, paragraph 226). The Rio+20 Outcome Document also reaffirms the aim to achieve by 2020 sound management of chemicals throughout their life cycle and of hazardous waste in ways that lead to minimisation of significant adverse effects on human health and the environment, as set out in the Johannesburg Plan of Implementation (UN 2012, paragraph 213).

In addition, UNEP and the United Nations Industrial Development Organization (UNIDO) launched the Green Industry Platform at Rio+20. This provides a global framework for bringing together governmental, business and civil society leaders to secure concrete commitments and mobilise action in support of the green industry agenda, i.e. greening the manufacturing process and creating green industries for production of goods and services for domestic use or export.

This chapter identifies how the transition to a green economy presents trade opportunities for the manufacturing sector in developing countries. For developing countries, facilitating green manufacturing processes can stimulate innovation and enhance international competitiveness, translating into opportunities for increasing trade and global market share. Furthermore, manufacturing green products in specific sectors can enable developing countries to tap into growing international markets for sustainable products.

This chapter first analyses cross-sectoral processes through which green trade opportunities can be realised, including:

- Greening supply chains, including transport;
- Embedding sustainability as a core business strategy, including by investing in renewable energy in industrial applications;
- Utilising energy-efficient technologies throughout business processes;
- Manufacturing environmental goods and providing environmental services;
- Investing in renewable energy in industrial applications;
- Promoting the complete disassembly, recovery and re-use of individual product components (remanufacturing); and
- Considering emerging opportunities such as 3D manufacturing and product-service systems.

Second, the chapter focuses on certain specific manufacturing sectors where opportunities exist for generating gains from trade while reducing environmental impacts. These sectors include chemicals; Information and Communications Technologies (ICT) and electronics; and textiles, clothing and footwear.

5.2 Environmental and economic context for greening the economy

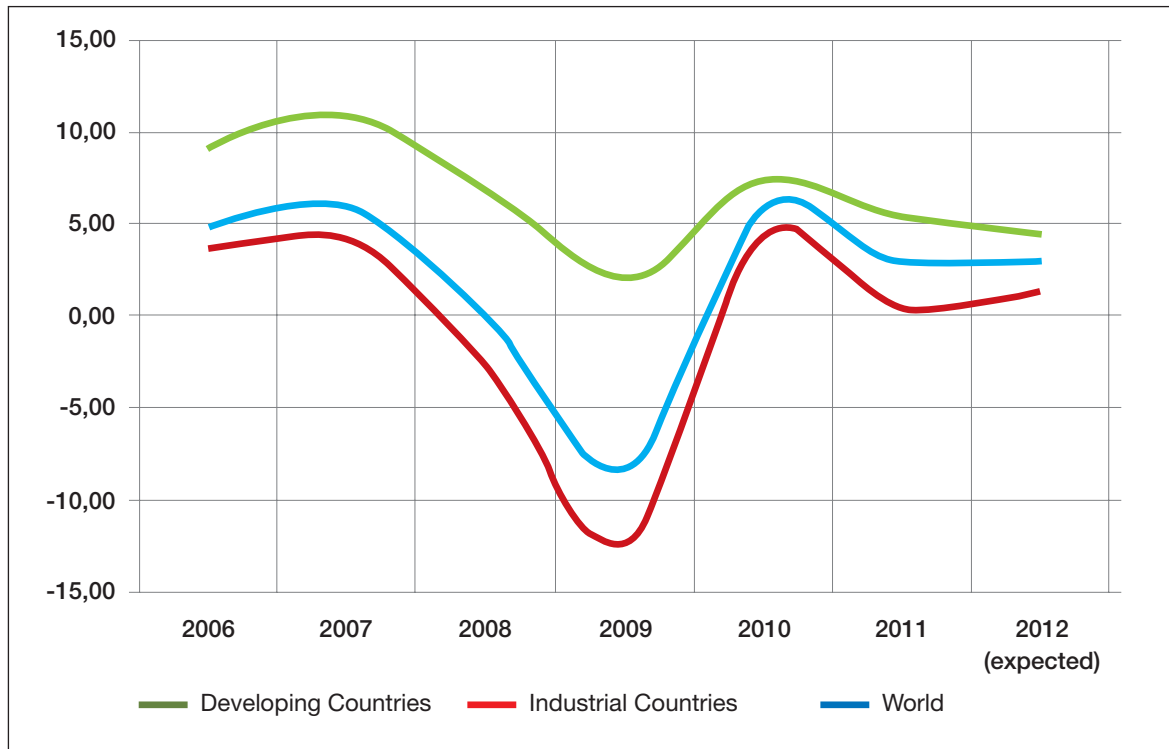
5.2.1 Manufacturing and trade

Manufacturing is one of the main engines of growth in developing countries (Szirmai 2009). According to estimates by UNIDO, Market Value Added (MVA) in industrialised countries was expected to grow

1. The 10YFP is a global framework of action to enhance international cooperation to accelerate the shift towards Sustainable Consumption and Production in both developed and developing countries. For more information, see <http://www.unep.org/resourceefficiency/Portals/24147/scp/10yfp/document/Brochure%2010YFP%20071212%20Final.pdf> and UNCTAD (2012).

by 1.4 per cent in 2012, while growth in developing countries was anticipated to be 4.5 per cent in 2012 (UNIDO 2012). Figure 1 illustrates the evolution of MVA since 2006, contrasting developments in industrialised and developing country contexts.

Figure 1. Estimated annual growth rates of world Market Value Added by years



Source: UNIDO 2012

According to the UN Conference on Trade and Development (UNCTAD), the overall distribution of products exported from developing countries has changed significantly over the last 20 years. In the past, basic commodities accounted for 75 per cent of global exports. Nowadays, an estimated 70 per cent of developing countries' exports are manufactured goods. Emerging Asian economies surpass others in industrial exports, while most African countries have scarcely contributed to the rise in exports of manufactured goods. For example, African exports of manufactured goods represent a mere 30 per cent of total African exports, in comparison with 20 per cent in 1980 (UNCTAD 2008).

Electronics, machinery, automobiles, chemicals, clothing and furniture, among others, make up the largest share of world trade in manufactured goods. A significant portion of this trade involves not the end product itself, but the various component parts that are traded in the supply chain of manufacturing products. As such, global demand for manufactured goods comprises not only the consumer demand for end products but equally the demand for component parts, primarily by other industries, forming global supply chains.

From the point of view of job creation, the growing volume of trade in environmental products is an opportunity for countries specialised in basic commodities to expand their manufacturing industries, integrate in more complex value chains and increase the value added of their products (UNEP 2008). That in turn is an opportunity to create green jobs and increase workers' skills, considering that along with extractive industries and construction, manufacturing accounts for 23 per cent of global employment (UNEP 2011a).

In light of these considerations, there is an immediate need to put in place supportive measures to guarantee that a transition to a greener economy is fair and creates social and economic benefits, particularly in developing countries.

5.2.2 Challenges facing manufacturing

There are many challenges facing the global manufacturing sector, particularly related to its sustainability. These include:

- **Resource scarcity:** Scarcity of fresh water, energy sources, minerals and metals threatens the future economic growth of many manufacturing sectors.
- **Resource inefficiency:** Inefficient uses of scarce resources entail economic losses and accelerate resource depletion. According to the World Business Council for Sustainable Development (WBCSD), by 2050, resource efficiency will need to increase by a factor of 4 to 10 in order to meet targets for sustainable levels of resource use (EC 2011).
- **Pollution:** Industrial facilities release greenhouse gas (GHG) emissions, particulate matter, sulphur dioxide, nitrogen dioxide, lead and chemicals. These accelerate not only climate change and atmospheric pollution, but they also degrade ecosystems and cause health risks. Manufacturing accounts for up to 17 per cent of air pollution-related health problems. Pollution also has an economic effect and incurs economic costs: Estimates of gross air pollution damage range from 1 to 5 per cent of global gross domestic product (GDP) (UNEP 2011a).
- **Hazardous substances and waste:** Global output in the chemicals industry has grown from US\$ 170 billion in 1970 to over US\$ 4.1 trillion today, with a steady shift in the production, use and disposal of chemical products from developed countries to emerging and developing economies, where safeguards and regulations are often limited. Poisonings from industrial and agricultural chemicals are among the top five leading causes of death worldwide, contributing to over 1 million deaths annually and 14 million Disability Adjusted Life Years (UNEP 2013).
- **Energy consumption:** The manufacturing industry accounts for about 25 per cent of global energy consumption (IEA 2011). As industrial production expands, it will put increased pressure on energy supplies.

Box 1. The Economics of Ecosystems and Biodiversity

- The Economics of Ecosystems and Biodiversity (TEEB) is a global initiative focused on drawing attention to the economic benefits of biodiversity. Its objective is to highlight the growing cost of biodiversity loss and ecosystem degradation. TEEB presents an approach that can help decision-makers recognise, demonstrate and capture the values of ecosystems and biodiversity, including how to incorporate these values into decision-making.
- The TEEB in Business and Enterprise report (TEEB 2012) highlights what is called the “impacts and dependencies” of the manufacturing industry on biodiversity and ecosystem services, reflecting the footprint of facilities and the pollution arising from production processes, as well as the role of suppliers of raw materials or semi-finished goods. These linkages are often complex and sector-specific. In the case of direct impact and dependency on biodiversity, the industries most implied include the pulp and paper industry as well as the textile and leather industry. If one considers high dependence on specific ecosystem services, this points to a wider range of industries. What they face is dependencies that pose risks associated with operations, markets, finance, regulations and reputation. A clear operational risk is that of increased scarcity and cost of natural resources.

5.2.3 The transition to a green economy

Box 2. Key messages from the Green Economy Report

- By 2050, projections indicate that industry can practically “decouple” energy use from economic growth, particularly in the most energy-intensive industries.
- Green investment will increase employment in the manufacturing sector. For example, investments allocated to energy efficiency are expected to create an additional 2.9 - 5.1 million jobs by 2050.
- Green manufacturing strategies can help alleviating key resource scarcities, including shortages in conventionally recoverable oil reserves, metal ores and water. For example, remanufacturing operations worldwide already save about 10.7 million barrels of oil each year.
- Tracking progress will require governments to collect improved data on industrial resource efficiency.
- Developing countries have a strong potential to leapfrog inefficient technologies by adopting cleaner production programmes, particularly those that provide support to smaller companies, many of which serve global value chains.

Source: UNEP 2011a

The GER (UNEP 2011a) describes green manufacturing as follows:

“Green manufacturing differs from conventional manufacturing in that it aims to reduce the amount of natural resources needed to produce finished goods through more energy- and materials-efficient manufacturing processes that also reduce the negative externalities associated with waste and pollution. This includes more efficient transport and logistics, which can also account for a significant percentage of the total environmental impact of manufactured products”.

In broad terms, green manufacturing involves the re-design of products, production systems and business models, as well as extended producer responsibility in the form of take-back or reversed supplies, resource-efficient and clean production, remanufacturing, and recycling on a significant scale.

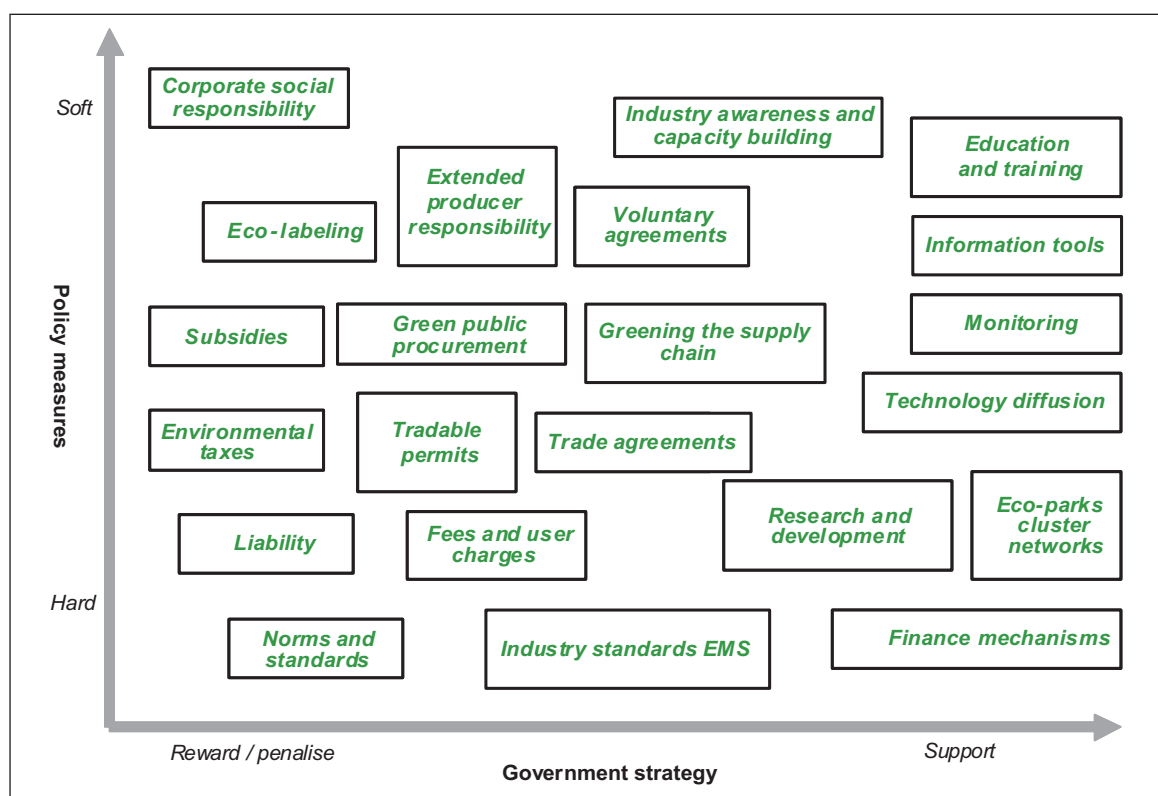
Regulators can use a wide range of measures to orient or discipline the behavior of private actors, so as to promote compliance with sustainability criteria along the supply chain. As depicted in Figure 2, these measures can be “soft”, i.e. leaving private actors with the ultimate choice of full or partial compliance, or more coercive, i.e. imposing certain materials or the use of specific production methods.

Within the realm of these interventions, those that are aimed at sustainable consumption and production are considered as key elements to respond to the challenges laid out above (UNEP 2010). Overall, these include extending the life of manufactured goods through greater emphasis on repair, recondition, remanufacture and recycle. Together, these constitute the core of “closed-loop manufacturing,” whereby the functional life of products is extended (UNEP 2011a).

Further, as illustrated in Box 3, a “circular economy” can build integrated, closed-loop manufacturing systems in which the by-products of one industrial process become the resources for another.² This approach enables even rapidly industrialising economies to decouple environmental impacts from economic growth and to improve their long-term competitiveness.

2. For further information on related concepts, see Sheng, F. (2010).

Figure 2. Policy matrix for the greening of industries



Source: UNIDO 2011

Box 3. The circular economy and Chinese development policy

A circular economy is an economy that balances economic development with environmental and resource protection. It puts emphasis on the most efficient use and recycling of its resources and environmental protection. A circular economy features low consumption of energy, low emissions of pollutants and high efficiency of resource use throughout the economic activity. It involves applying cleaner production in companies, eco-industrial park development and an integrated resource-based planning structure for development in industry, agriculture and urban areas.

The Chinese Government embraced the circular economy concept as its national development model in the 11th Five-Year Plan (2006-2010). The National Development and Reform Commission (NDRC) in China is in charge of leading the circular economy strategy at the national level, providing a range of legislative, political, technical and financial measures such as subsidies and tax breaks. For example, the NDRC has committed to expand China's national remanufacturing industry over the next five years. Current figures estimate that remanufacturing in China could increase from two billion Yuan (approximately US\$ 320 million) in 2011 to 40 billion Yuan (approximately US\$ 6.5 billion) in 2015, which amounts to roughly five per cent of China's manufacturing industry.

Source: UNEP 2012a, Xinhua 2011

Green manufacturing is a core component of a circular economy and can lead to lower raw material costs, production efficiency gains, reduced environmental and occupational safety expenses, little or no waste or pollution, and improved corporate image (Atlas and Florida 1998). Increased trade in non-hazardous recyclable materials could also play a role in the circular economy by reducing the demand for raw materials and by aiding a more efficient use of increasingly scarce resources.

An additional tool for a transition to a green economy in the manufacturing sector is green purchasing. In its "Green Purchasing and Green Public Procurement Starter Kit", the International Green Purchasing Network

(IGPN) defines green purchasing as “the purchase of any product and service that results in a lesser environmental impact while performing a similar function, and while demonstrating social responsibility and ethics, at its comparable price” (IGPN 2010). UNEP contributed to enhancing the sustainability of public procurement through green purchasing strategies by the compilation of eight illustrative national level case studies (UNEP 2012b).

Box 4. International Trade and Resource Decoupling

The International Resource Panel (IRP) was launched by UNEP in November 2007. Hosted by UNEP’s Division of Technology, Industry and Economics, IRP aims at providing independent, coherent and scientific assessments of policy relevance on the sustainable use of resources and their environmental impacts over the full life cycle, to better understand how to “decouple” economic growth from environmental degradation.

The global challenge is to meet the needs of nine billion people in 2050 in terms of energy, land, water and materials supply, while keeping climate change, biodiversity loss and health threats within acceptable limits. The transition process towards a green economy, where patterns of consumption and production are sustainable and enable all citizens to have access to resources while preserving the quality of the global commons, can effectively address this challenge. The links between human well-being, economic growth and environmental degradation can be broken by decoupling economic activity from resource consumption (“resource decoupling”) and from environmental impacts (“impact decoupling”). According to the IRP (2012), the decoupling of future economic growth and the rate of natural resource use is “the most promising strategy for ensuring future prosperity” (IRP 2012).

The global extraction of natural resources amounts to an annual 60 billion tonnes and, without decoupling, would predictably increase to an annual 140 billion tonnes by 2050. In addition, intensified global trade implies an increase in physical trade flows and growing environmental pressures associated with trade activities. In 1970, around 5.4 billion tonnes were internationally traded, increasing to 19 billion tonnes in 2005. Environmental degradation directly and indirectly linked to international trade makes up a significant share of total environmental pressures. This includes direct pressures, in particular due to impacts of transportation, and indirect (or embodied) pressures that also augment with growing trade volumes.

Although most often associated with higher environmental pressure, trade can also make an important contribution to global decoupling when guided by appropriate policies. The UNEP report “Decoupling Natural Resource Use and Environmental Impacts from Economic Growth” (UNEP 2011b) highlights the following key policy principles to inform the policy interface in supporting decoupling:

1. Trade could contribute to reducing global resource use through exploiting transport and physical or geological potentials in a way that minimizes negative environmental impacts;
2. Trade negotiations could consider the full value chain of the commodities being traded, agreeing prices that incorporate environmental factors and social costs that are now considered ‘externalities’; and
3. Trade agreements between countries whose economies are based on exporting primary resources could be accompanied by side agreements that assist these countries in diversifying their economies, including through adding value domestically and supporting impact decoupling.

Such measures could support developing countries in diversifying their economies so that they can reduce dependence on the export of a small number of commodities, support the development of domestic markets, and overall promote sustainable economic development.

Source: UNEP 2011b

In this context, there is growing evidence that systemic ‘eco-innovation’ for sustainability offers an historic opportunity to put decoupling into practice. Eco-innovation focuses on new ways to address environmental problems, while simultaneously promoting economic activity. Eco-innovation is central to helping manufacturers become greener and, at the same time, more resource efficient and competitive (see Box 5).

Box 5. UNEP project on resource efficiency and eco-innovation

From 2012 through 2015, the UNEP project on Resource Efficiency and Eco-Innovation in Developing and Transition Economies will promote Resource Efficient and Cleaner Production (RECP). In detail, the project facilitates the continuous application of an integrated environmental strategy to processes, products and services in order to increase the productive use of natural resources and reduce risks to humans and the environment. Furthermore, it enhances “safer production”, namely ensuring the safety and health of workers in facilities that manufacture, store, handle or use hazardous substances, and facilitates the prevention of accidental releases into the environment and surrounding community.

The project will fund activities in more than 40 developing countries to promote eco-innovation. Priority sectors are agri-food, metals and chemicals, while the planned outputs include an eco-innovation manual and eco-innovation training and workshops.

Source: Clark (2012)

In recent years, the manufacturing industry has focused on investments in sustainable manufacturing processes alongside more traditional expenditure on technological advancement and Research and Development (R&D). Investments in sustainable manufacturing have ranged from minimising pollution to accounting for the manufacturing lifecycle.

There are many obstacles, however, that need to be overcome to encourage more companies to switch towards greener manufacturing processes or developing greener products. These include a lack of necessary tools, insufficient management commitment and skills, shortage of funding, and an overall lack of awareness by both producers and consumers.

5.3 Trends and trade opportunities existing across the manufacturing industry

Greening manufacturing production processes can stimulate innovation and enhance international competitiveness, translating into early opportunities for increasing exports and market share for economic actors in all countries. Manufacturers that are able to implement more resource efficient approaches and life cycle management are likely to have a competitive advantage over global competitors that continue a business-as-usual (BAU) scenario.

The competitive advantage gained through sustainability extends beyond consumer choices. For instance, a study by AT Kearney found that companies that are listed on the Dow Jones Sustainability Index or Goldman Sachs' SUSTAIN Focus outperformed industry averages during economic downturns (Strandberg 2009). The 2011 Sloan Management Review by the Massachusetts Institute of Technology found similar results, demonstrating that companies implementing sustainability at the core of their business strategy not only perform better in strong markets than companies half-heartedly (or not-at-all) adopting sustainable practices, but that they are also more resilient during economic downturns (MIT 2011). Furthermore, a study by Weber Shandwick (2012) found that 60 per cent of a company's market value is attributable to its reputation and over two-thirds of US consumers avoid products made by companies they do not like and check labels to ascertain the identity of the parent company.

The following subsections describe some of the key actions that can be undertaken to create value from compliance with sustainability criteria in production, transport and consumption, with international trade as a crucial driver for these actions.

5.3.1 Greening supply chains

Within the manufacturing industry, a well-managed supply chain optimisation can create value in the form of higher quality materials or manufacturing processes, innovative new goods and services, protection of product and brand reputation, and enhanced customer loyalty.

In this vein, many large multinational companies have adopted green supply chain standards and implemented them through inspection and compliance regimes, such as requiring their suppliers to use a certified environmental management system (EMS).

Industry-based green standards can play a crucial role in the design, manufacturing, packaging and end-of-life stages of a product. Industry management standards, for example, provide guidance for integrating resource and energy efficiency practices into production processes. Such industry standards are often integrated into voluntary environmental management systems, especially those that can be certified under the International Organization for Standardization (ISO) 14001 family of standards.

Companies increasingly demand participation in ISO standards within their supply chains and firms that position themselves accordingly are expected to be at a competitive advantage for export opportunities. Thus, greening enterprises in developing countries is an important means to face the immediate commercial challenges of remaining in key world markets. Specifically, these enterprises have to meet an increasing number of environmentally-related production standards to secure export markets. These standards require enterprises to reconfigure their products and/or supply chain processes to meet the requirements of their international customers or laws of the countries into which they wish to export, and to obtain the respective certification. In other words, enterprises must be able to:

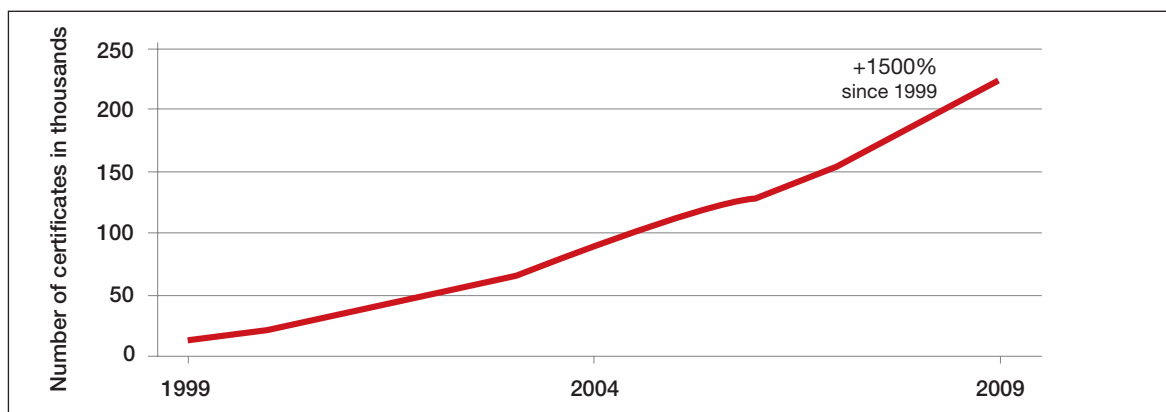
- Redesign their products so that they meet any pertinent environment-related product standards;
- Reconfigure their processes so that they meet any relevant environmentally-related process (technology and management) standards; and
- Certify that their products and/or their manufacturing processes meet these standards (UNIDO 2009).

Implementation of green management systems, certified by independent parties, would help developing country manufacturers comply with requisite standards and to verify their performance against those standards. This is especially relevant in instances where enterprises are meeting process-related standards. In addition, management systems can be useful for complying with specific product-related standards, such as quality management standards, e.g. ISO 9000. ISO 50001, which concerns standards related to energy efficiency, is explained in section 5.3.3.

As of 2009, there were over 230,000 companies in 159 countries with ISO 14001 certified environmental management standards, a significant increase from 1999 (see Figure 3). Over 50 per cent of ISO 14001 companies were based in East Asia compared to 40 per cent in Europe and only three per cent in North America (ISO 2009).

For companies in developing countries, ISO 14001 certification can be an important way to demonstrate environmental responsibility and thereby increase export opportunities. Hence the Egyptian Ministry of Trade and Industry, for example, has encouraged firms to become ISO 14001 certified by paying 85 per cent of the consultancy and certification costs of certified companies (Massoud et al. 2010). Furthermore, an empirical study by the OECD found that the adherence to international standards in most cases leads to a positive effect on export performance for the respective country (Swann 2009).

Figure 3. Increase in number of ISO 14001 certifications



Source: UNEP 2011c

In 2011, a new ISO standard was released: ISO 14006: 2011 Environmental Management Systems — Guidelines for Incorporating Eco-design. This is a non-certifiable guidance standard that deals with how product aspects can be included in manufacturers' environmental management systems (ISO 14001). Since most products cause significant environmental impacts through their use, these eco-design guidelines are an important tool for the transition to a green economy.

There are many other benefits that can result from eco-design, including economic benefits, e.g. through increased competitiveness, cost reduction and attraction of financing and investments; promotion of innovation and identification of new business models; reduction in liability through reduced environmental impacts and product knowledge; and improved public image (both for the organisation and the brand). Such benefits can also lead to global trade opportunities when measured against competing international companies.

It is important, however, that standards adopted by multinational companies are verified by independent and recognised organisations. Some companies offer assistance to suppliers to help them achieve more rigorous standards. In order to take advantage of sustainable trade opportunities, small and medium-sized enterprises (SMEs) in developing countries often need external support and capacity building. This will enable them to participate in and contribute to green supplier networks on a substantive and sustainable basis (UNIDO 2011).

Besides compliance with sustainability product and process standards, there are a number of strategic opportunities for supply chain de-carbonisation (see Figure 4).

Figure 4. Greening opportunities along the manufacturing supply chain



Source: Adapted from APO 2012

Finally, as international trade in the manufacturing industry is largely based on region- or country-specific specialisation and development of products, transportation will continue to play a vital role in the industry.

Transportation enables the movement of raw materials and component parts necessary for the manufacturing process, while also delivering the end product to domestic and international customers. Remarkably, an estimated 37 per cent of worldwide emissions relating to trade are caused by the transport of materials and goods (Avetisyan et al. 2010). As such, greening of transportation throughout the manufacturing process is critical in greening the overall supply chain (Banister and Button 1993).

Measures for greening the transportation sector include the use of alternative fuel sources and an increase in fuel efficiency. Both measures directly contribute to lowering the use of and emissions from fossil fuel based transportation modes. In addition, international consensus and cooperation will be crucial facilitators for achieving global targets of emissions reductions in the transportation sector.

The typology of traded goods also has an effect on the quantity of emissions released in the atmosphere in trade-related transport. According to data produced by Carnegie Mellon's Green Design Institute, carbon emissions (in tonnes of CO₂) per dollar of value is far greater for goods such as extracted resources like coal, compared to high-value goods like consumer electronics (WEF 2009).

5.3.2 Embedding sustainability as a core business strategy

Manufacturers can draw on different approaches to remain competitive and increase market share and export opportunities. These approaches include greening production methods for existing products and changing the actual end products to meet the growing consumer and business demand for more sustainable products.

Considering the first approach of greening production processes, there are many cross-sectoral trade opportunities generated by industries using sustainable approaches to production. The global economy has untapped opportunities for increasing production while using less material and energy resources. These opportunities can be realised by increasing resource efficiency through methods such as, among others, combined heat and power plants (CHP) and closed-cycle manufacturing (i.e. repair, renovation, remanufacturing and recycling). Manufacturers could also use more renewable energy in industrial applications.³ Environmentally sound and safe alternatives to the use of hazardous chemicals in production processes are likewise an important element (UN 2012a, paragraph 220).

In many cases, these measures could reduce extraction and processing costs and also lead to a more sustainable economic growth model.

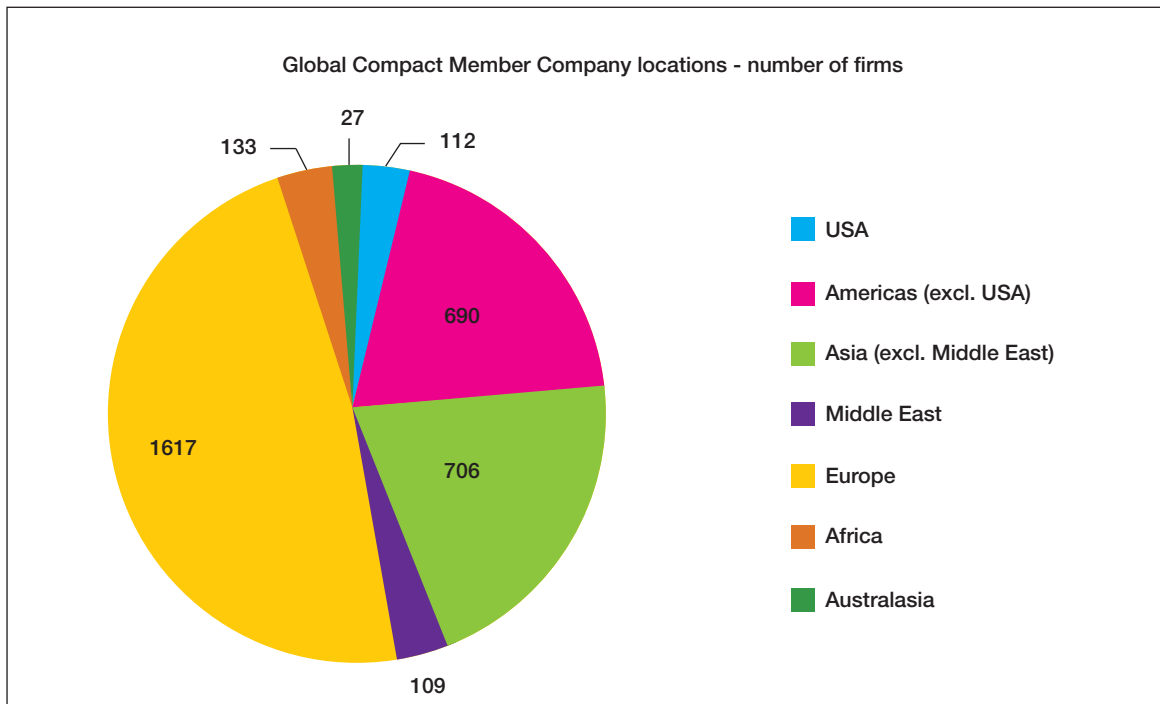
With respect to the second approach, greening through a change of end product, opportunities exist to develop new green markets for products that are either energy-efficient (e.g. hybrid vehicles), or help to decrease GHG emissions (e.g. wind turbines). Manufacturers are increasingly emphasising the environmental performance of their products to meet increasing consumer expectations towards the sustainability of their purchases and to meet increasing demands of international and national environmental regulations. Energy-efficiency labelling and green-manufacturing labels are becoming a common feature of manufactured consumer products (APO 2012). For particular information on greening products in the chemicals, electronics and textiles industries, see section 5.4.

Businesses can develop a competitive advantage by integrating environmental and social considerations into their business models/operations leading to improved business performance to spur innovation and to improve economic results.

Corporate social responsibility (CSR) policies, which can include the adoption of ISO 26000, are becoming increasingly prevalent in the private sector. Over 8,000 businesses worldwide have committed to the ten principles of the UN Global Compact (UNGC) that cover areas such as human rights, labour standards and environmental protection (Wharton 2012). Figure 5 shows the global distribution of firms that have signed up to the UNGC and reveals the strong take-up by firms in developing countries.

3. An analysis of the use of renewable energy in the manufacturing industry is beyond the scope of this report. However, readers may wish to consult the UN report on "Renewable energy in industrial applications: an assessment of the 2050 potential" (UNIDO 2010).

Figure 5. UNGC member company locations



Source: Kimbro and Cao 2011

Furthermore, the increasing interest in CSR has been accompanied by the publication of voluntary nonfinancial corporate reports that communicate the social and environmental impact of corporations. The Global Reporting Initiative (GRI) has provided a comprehensive sustainability-reporting framework that is widely used around the world. While only 44 firms followed the GRI guidelines to report sustainability information in 2000, the number grew to 1,973 by 2010 (Ioannou and Serafeim 2012).

The importance of CSR practices was specifically acknowledged at Rio+20 (UN 2012, paragraph 47) and led to the formation of the “Group of Friends of Paragraph 47”, as illustrated in Box 6 below.

Box 6. UNEP and the Global Reporting Initiative (GRI)

Paragraph 47 of the Rio+20 Outcome Document outlines the importance of corporate sustainability reporting and encourages companies, where appropriate, to integrate sustainability information into their reporting cycle. The Paragraph further encourages industry stakeholders to facilitate action for the integration of sustainability reporting, thereby building on existing frameworks and paying particular attention to the needs of developing countries.

The “Group of Friends of Paragraph 47” (Brazil, Denmark, France, Norway and South Africa) will investigate possible ways for advancing best practice and governmental action on corporate sustainability reporting with the technical advice of UNEP and the Global Reporting Initiative. In addition, this partnership will focus on building capacity in developing countries, thereby expanding on what already exists in terms of policy and practice.

In support of this initiative, UNEP Finance Initiative (UNEP FI) has been calling for more meaningful corporate sustainability information to be used for financial decision making. UNEP FI co-convenes the Sustainable Stock Exchange Initiative which explores the role of stock exchanges in promoting this issue. In addition to the “Group of Friends of Paragraph 47”, UNEP FI also supports the International Integrated Reporting Council, a global coalition developing a framework for financial and sustainability corporate reporting in order to open new ways of communicating businesses’ value creation.

Source: GRI 2012, UNEP FI

The reporting guidelines of the Global Reporting Initiative have been supplemented by sector specific guidelines developed with the mining and metals, automotive manufacturing, telecommunications, apparel and footwear industries. Reporting on strategic management approach by these industries provide an opportunity for investors and other stakeholders to discuss with management what greening the relevant industry entails (UNEP 2011a).

5.3.3 Resource and energy efficiency

The Rio+20 Outcome Document embraced more efficient energy use (UN 2012, paragraph 127). Developing countries with emerging and expanding industrial infrastructure have an opportunity to mitigate GHG emissions, while increasing their competitiveness through the application of energy-efficient best practices. Bypassing less efficient, more expensive and more polluting technologies and industries, and moving towards more sustainable and advanced ones, could enable developing countries to produce goods at a lower cost due to less energy use. Overall, this technological leapfrogging would, in the long term, provide them with both a price advantage and a green advantage in the export sector.

In addition, energy efficiency can be enhanced by updating electricity infrastructure through the use of smart energy grids. However, while the means exist to enhance energy efficiency, these technologies face a number of barriers in the marketplace, such as a lack of public awareness and viable financing models. Furthermore, projects may have high internal rates of return, but have thus far failed to attract investors or commercial banks. Investment in energy-efficient technology is also hampered by the fact that many companies and small-scale users in developing countries may struggle to afford the high initial investment.

Improved energy efficiency is one of the most cost-effective ways to reduce global GHG emissions, enhance energy security and reduce the amount of money spent on energy. For most industries, increasing energy efficiency in production, therefore, is not just a response to environmental concerns or objectives; it has become a core determinant of economic competitiveness and sustainable growth (Giljum and Polzin 2009). Box 7 describes some of the potential gains from an energy-efficient world.

Box 7. The efficient world scenario

The 2012 edition of the International Energy Agency's World Energy Outlook presents the results of an Efficient World Scenario, which shows what energy efficiency improvements can be achieved simply by adopting measures that are justified in economic terms. Greater efforts on energy efficiency would cut the growth in global energy demand by half. Global oil demand would peak before 2020 and be almost 13 mb/d lower by 2035, a reduction equal to the current production of Russia and Norway combined. The accrued resources would facilitate a gradual reorientation of the global economy, boosting cumulative economic output to US\$ 18 trillion by 2035, with the biggest gains in China, Europe, India and the United States.

Source: IEA 2012

Many countries and jurisdictions are implementing resource efficiency policies, a trend which is likely to drive demand for goods produced efficiently and sustainably. For example, the European Union (EU) has recently produced a roadmap towards a more resource efficient Europe, as set out in Box 8 below.

Box 8. EU roadmap for a resource efficient Europe

Strategies aimed at improving resource efficiency are the focus of increasing interest worldwide. The EU is working towards resource efficiency plans and recently launched its flagship initiative "A resource-efficient Europe", which is part of the growth strategy 'Europe 2020'. A "Roadmap for a resource-efficient Europe" published in 2011 aims to help decouple economic growth from resource use, support the transition towards a low carbon economy, increase the use of renewable energy sources, modernise the transport sector and promote energy efficiency.

Source: EC 2011

In order to find effective means of improving resource efficiency, it is worth analysing which areas of consumption are linked to high resource use and thus yield the greatest potential for improving resource efficiency. This may help to set targets for reducing consumption in those particular categories as part of an effective integrated plan. Such studies have been conducted in the EU, while only a few developing countries have, as of yet, initiated related activities (UNIDO 2011). There are, nevertheless, examples of companies in developing countries that have successfully introduced resource efficiency measures, as illustrated in Box 9.

Box 9. Caborca in Mexico

The Caborca company is based in Leon, in the Mexican state of Guanajuato. It is a medium-sized, family-owned company, which manufactures cowboy boots and employs 250 people. Caborca decided to invest in meeting the requirements of the EU ecolabel.

Caborca hired a consulting team, trained by UNEP in the framework of the project "Enabling developing countries to seize ecolabelling opportunities". The team undertook an inventory of the factory and introduced a number of resource efficiency measures such as sourcing new materials, better natural lighting by changing the design of the roof, and techniques for reducing the consumption of materials, which minimised waste and decreased associated costs, with savings across the board.

According to the management of Caborca, the process of adhering to the EU ecolabel requirements decreased production costs, thus significantly improving bottom-line benefits. Although there were some upfront costs in finding suppliers of sustainable materials, these costs were recovered because materials with more sustainable features turned out to cost an average 8 per cent less. It is expected that the costs of materials would continue to decrease as more supplier companies enter the supply chain.

Caborca has also reduced the costs related to worker safety equipment due to the phasing out of toxic materials. Furthermore, the management invested in renovating the factory premises and the introduction of other measures to improve the work environment. Interviewees noted that workers have become happier and more productive as a result.

The management of Caborca mentioned the company's initial hesitation towards participating in such an activity given the financial risks that it might entail. However, the whole managing philosophy of the company has changed with pronounced emphasis on the social well being of employees, the minimisation of resource use, and on marketing the company as a green forerunner. Ecolabelling acted as the door-opener for these changes and the company plans to launch a new line of ecological boots, for sale in Mexico, the United States and European markets in 2013.

Source: UNEP 2012c

Opportunities for improving the efficiency of industrial facilities are substantial, even in markets with mature industries that are relatively open to competition. In terms of the global potential for increased energy productivity, the McKinsey Global Institute has determined that 65 per cent of all available positive return opportunities for investment are located in developing regions (UNIDO 2011).

Most energy efficiency gains in industry are achieved through changes in how energy is managed in an industrial facility, rather than through the installation of new technologies. Energy management systems, like the ISO 50001 Standard, provide a framework for understanding significant energy use and offer applicable best-practice lessons (Matteini 2011).

In brief, ISO 50001 is a system management tool that provides a framework to develop policies to foster energy efficiency within organisations. Consequently, ISO 50001 can provide organisations with a competitive advantage through efficiency savings and improving their brand image vis-à-vis competitors. Since its publication in 2011, implementation of and certification under ISO's new energy management standard is gaining pace around the world. As of January 2012, about 100 organisations in 26 countries had already achieved certification.

5.3.4 Environmental goods and services

Due to increased consumer and business demand, the environmental goods and services (EGS) sector is likely to expand significantly in the future. More stringent legislative requirements, coupled with investments

in infrastructure, have created a growing demand for services and products directed towards cleaner technologies, reductions in environmental risk and resource management (including recycling and resource recovery). Anecdotal research by the OECD has shown that the trade in environmental goods and in environmental services often go hand in hand. For example, there is a fast-growing set of services provided by companies that specialise in monitoring, repairing and even remotely operating renewable-energy facilities such as wind turbines and biogas turbines (GGKP unpublished).

The growing focus on resource and energy efficiency, productivity and competitiveness will increase the demand for “next-generation” environmental services targeted towards renewable energy and resource efficiency. For example, it is estimated that India alone could create some 900,000 jobs in biomass gasification by 2025 (World Watch 2012).

The following case study on trade in environmental goods in Southern and East Africa illustrates how trade in certain types of environmental goods presents margins for regional growth.

Box 10. Trade in environmental goods in Southern and Eastern Africa

To date, trade in environmental goods in Southern and East African countries has been limited. Although there has been significant growth in the trade of environmental goods by some countries, their overall share in world trade is negligible. In 2010, countries in the East African Community (EAC), Common Market for Eastern and Southern Africa (COMESA) and Southern African Development Community (SADC) accounted for only 2.19 per cent of global imports and 0.67 per cent of global exports of environmental goods.

A study by Tralac examined the potential to increase trade in environmental goods in the region. In the absence of international consensus on a list of products that would fall within the definition of “environmental goods”, the analysis was based on a list of 153 products that a group of WTO members, known as the “Friends of Environmental Goods and Services”, proposed in 2007 in the context of the Doha Round of multilateral trade negotiations.

Within each product category, different importers and exporters have been analysed with a focus on Egypt, Kenya and South Africa as exporting countries and Angola, Egypt, Kenya, Libya, South Africa and Tanzania as importing countries.

In an additional category of specific “single-use” environmental goods (wind turbines, solar PV, solar water heaters, biofuels, hydraulic turbines, insulation materials, heat pumps, compact fluorescent lamps (CFLs), electric and certain hybrid vehicles and thermostat), the potential bilateral trade opportunities between South Africa and the Democratic Republic of Congo (DRC), Egypt, Ethiopia, Kenya, Tanzania, Uganda and Zambia were analysed.

Analyses of intra- and inter-regional trade patterns and tariff data of various countries in COMESA, the EAC and SADC show that countries in the region are currently not fully exploiting potential trade opportunities in environmentally friendly goods among each other. The analysis found that only in a small fraction of the trade and tariff patterns analysed, the lack of bilateral trade could be attributed to high tariffs (above 20 per cent Most Favoured Nation (MFN) applied rates).

The results of the data analyses show, indeed, that tariffs have not been the main barrier to trade in environmental goods in the region. The fact that the lack of bilateral trade cannot, in most cases, be attributed to high tariffs, is indicative of the importance of non-tariff barriers (NTBs) as an obstacle to intra-regional trade. These NTBs can include:

- Subsidies on fossil fuels and other conventional energy sources;
- A lack of financial, institutional and manufacturing capacities;
- Technical specifications; and
- Local content requirements.

To facilitate technological development and the diffusion of environmentally sound technologies, existing and potential NTBs need to be assessed, monitored and, where they are not necessary, eliminated to enable countries to harness the potential benefits associated with increased opportunities in the international market for environmental goods.

The analysis also shows that potential exists for Egypt, Kenya and South Africa to increase exports of various environmental goods to countries in the region, especially those products which can be imported duty-free by Angola, Egypt, Kenya, Libya, South Africa and Tanzania, irrespective of the category of environmental goods analysed. Given the value of global imports and exports and the low tariff applied by some countries on the importation of certain goods, there is great potential to increase intra-regional trade.

The analyses further show that Egypt can increase exports of solar PV devices to Kenya, South Africa and Tanzania, which are imported duty-free by the respective countries, whereas Kenya could increase exports of various products, including boards and panels, towers and lattice masts and centrifugal pumps. South Africa has the potential to increase exports of a variety of products to Angola, Egypt, Kenya and Libya.

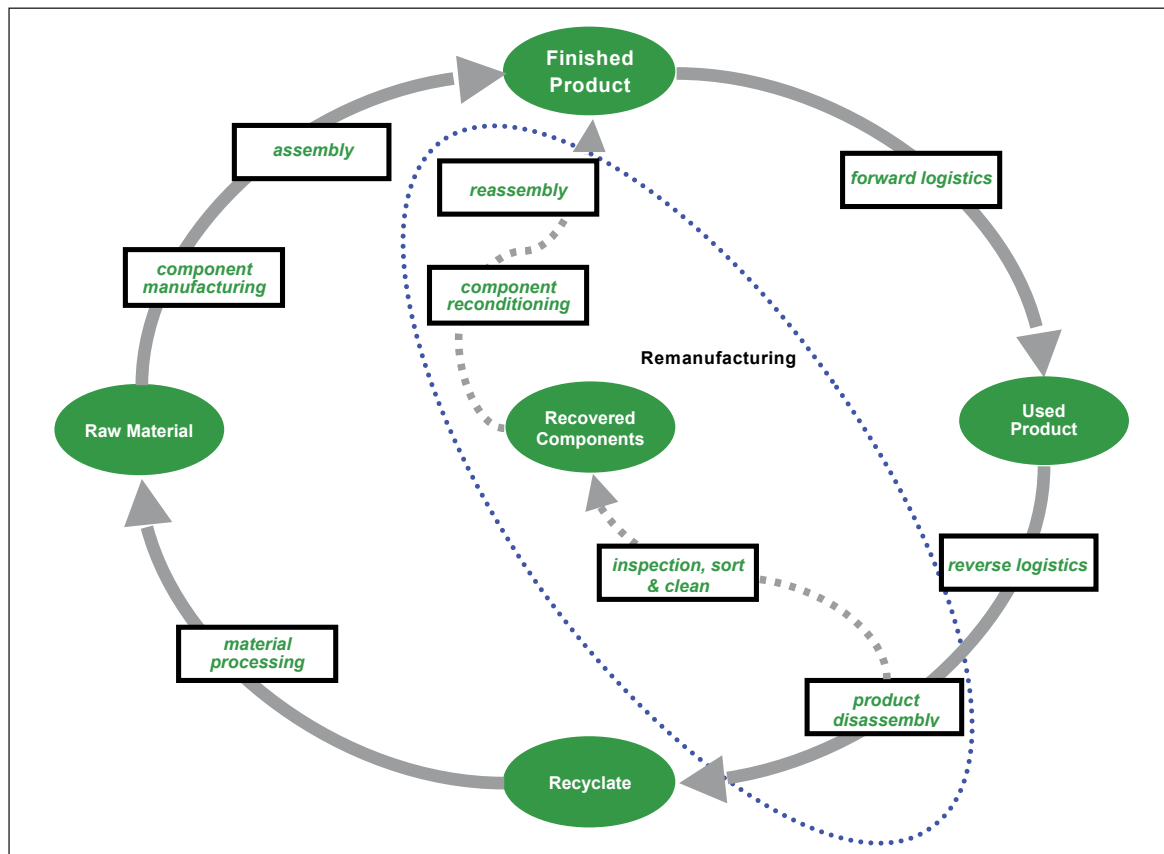
Source: Willemien Viljoen, Researcher, Trade Law Centre for Southern Africa (Tralac)

For further information on EGS, see the Introduction and the Renewable Energy chapter.

5.3.5 Remanufacturing

Remanufacturing is the process of bringing used products and individual product components to a 'like-new' functional state (Ijomah et al. 2004). It recovers a substantial proportion of the resources incorporated into a used product in its first manufactured state, at low additional costs, thus reducing the price of the resulting new product. Remanufacturing is often considered an environmentally preferable end-of-life option in comparison with material recycling or manufacturing new products. This is because, by reducing GHG emissions from product manufacturing or disposal, remanufacturing alleviates the depletion of natural resources, helps reduce global warming and enhances chances to close the loop for safer handling of toxic materials (Sundin and Lee 2011). Figure 6 shows a typical functioning of a remanufacturing loop.

Figure 6. Remanufacturing



Source: Adapted from Shumon et al. 2010

Remanufacturing operations require smaller capital investments than manufacturing operations since no new parts are produced and most of the work has already been undertaken by the original equipment manufacturer. Thus, a large untapped market exists for product remanufacturers (Nnorom and Osibanjo 2010). Michaud and Llerena have observed that:

“...any product can be remanufactured if it can be disassembled and cleaned, if its components can be repaired or replaced so that the original function and performance level are kept, if there is enough demand for the product, and if the whole process is economically viable” (Michaud and Llerena 2006).

Remanufacturing offers potential for new national business ventures within developing countries and new export opportunities. Given the minimal financial and material input into production, remanufacturing services provide lower prices to consumers, typically in the order of 30 to 40 per cent less than comparable new products (Shumon 2010).

The major obstacle to remanufacturing is that strategies for extending the useful life of manufactured products hinge on the active cooperation from original equipment manufacturers. Since no comprehensive end-of-life tax on product disposal exists, the environmental costs of waste disposal from equipment manufacturing are levied on society. This creates incentives for original equipment manufacturers to build obsolescence and replacement into their business model in order to save costs from value chain modernisation. Remanufacturing contributes towards fostering incentives for value chain modernisation by creating new business models that focus on services instead of products (WBCSD 2012). End-of-life or waste disposal taxes on manufacturers can enhance this ‘incentive effect’ of remanufacturing by making component re-use and recycling attractive tools for cost saving.

Remanufacturing is becoming increasingly significant, particularly in areas such as motor vehicle components, aircraft parts, compressors, electrical and data communications equipment, office furniture, vending machines, photocopiers and laser toner cartridges, wind mills and agricultural equipment. Several countries, including China, as illustrated in Box 3, are making remanufacturing a key part of their industrial strategy. Remanufacturing operations worldwide are already saving approximately 10.7 million barrels of oil each year (UNEP 2012d) – they also save significant volumes of water and raw materials. For example, re-using existing metal components preserves virgin natural resources and avoids GHG emissions caused by smelting metal castings. Remanufacturing also prevents metal and plastic components from ending up in landfills. Thus, for governments, remanufacturing is a way to clean up municipal waste, save energy in domestic industries and create jobs (Steinhilper 1998, IEIF 2012).

Another advantage of remanufactured goods is that they can meet the criteria for new goods without additional quality and safety requirements that sometimes apply to refurbished goods. Indeed, in the 2011 Asia-Pacific Economic Cooperation (APEC) Ministerial Meeting, 11 countries including Australia, Japan, Singapore and the United States, agreed in principle to refrain from implementing import restrictions on remanufactured goods, and to apply the same trade measures to such products as they would to new goods (APEC 2011).

Trade in remanufactured products is growing in many developing countries. To boost trade volumes, African companies are seeking to market their remanufactured goods more widely as evidenced by the growing intra-African and increased exports of remanufactured goods. For example, “EbTech Solutions” in Kenya advertises and offers remanufactured toner cartridges at 60 per cent of the price for new toners, and the company ships the goods in Eastern Africa. Also, “ICC Toner”, an Egyptian-US joint venture, remanufactures cartridges in Egypt for export to the United States (UNECA 2010). Box 11 also illustrates remanufacturing in the ICT sector in Nigeria. Above all, there is much untapped growth potential for global trade in remanufactured items.

4. For a list of these companies, see http://www.nigeriafonet.com/Directory/compu_internet.htm.

Box 11. Nigeria – remanufacturing in the Information and Communication Technologies (ICT) sector

Remanufacturing is growing across Africa, most prominently in the production of remanufactured PCs and printer consumables. There has been an increase in intra-African trade of remanufactured goods with some companies increasingly seeking to market their remanufactured goods worldwide (UN ECA 2010).

Nigeria acts as regional frontrunner in remanufacturing, as many national industry sectors are utilising some form of product refurbishment or remanufacturing. As of 2009, 11 out of the 45 Community Microsoft Authorized Refurbishers (MAR) for personal computers were located within Nigeria. This authorisation programme allows refurbishers to re-install Windows for eligible recipients. A secondary PC pilot programme has been launched in four countries including Nigeria, which allows refurbishers to pre-install Windows on refurbished PCs (MAR 2009). Companies in these countries can export products to meet growing demands from neighbouring countries in West Africa. Furthermore, some Nigerian companies are involved in the refilling and sale of refilled printer and ink cartridges. Others are active in importing refurbished computers, photocopiers and printers.⁴

Remanufacturing is a reasonable alternative regarding the end-of-life management of electronics, particularly for devices with short lifespan such as mobile phones (Nnorom and Osibanjo 2010). Remanufacturing of mobile phones and computers in Nigeria, especially within the free trade zone (FTZ), can trigger future green investments in the sector. This will create jobs, meet local demand for cheap electronics and increase prospects for manufacturing exports.

Source: Nnorom Innocent Chidi (PhD), Senior Lecturer, Department of Industrial Chemistry, Abia State University Uturu, Nigeria

5.3.6 3D manufacturing

A new manufacturing process that could lead to the greening of international supply chains is additive manufacturing, also known as 3D printing or 3D manufacturing. 3D manufacturing, which forms part of the “digitalization of manufacturing” (The Economist 2012), provides an opportunity for developing countries to innovate and decisively participate in the development of a nascent international market.

Broadly speaking, 3D manufacturing is defined as the process by which physical objects are joined together and developed, usually layer upon layer, based on a digital prototype design.⁵ Once relegated to the domain of science fiction, 3D manufacturing is emerging as the new frontier in manufacturing with potentially radical effects on patterns of global trade and development. The ability to design a product in one country and transmit it to another for output promises to level at least a fraction of the global labour market and to unlock the creativity of inventors and entrepreneurs all over the world (Hoyle and Neil 2012).

The process of 3D manufacturing converts raw materials such as metal, ceramic or plastic more directly to finished products, avoiding many of the intermediate steps. Managed properly, fewer materials should be needed and waste can be minimised. Further, since 3D printing allows products to be designed and printed with local materials (including recycled materials), developing countries could reduce their reliance on expensive material imports. In addition, developing countries could create their own, more appropriate products domestically and reap the profits from production. This could help develop the basic infrastructure for future trading opportunities (Campbell et al. 2011).

Industries increasingly draw on 3D manufacturing for the development of end-use parts. Some 6,500 industrial additive manufacturing production units were shipped to manufacturing customers in 2011, nearly twice as many as in 2005 (McKinsey 2012). As the technology underpinning 3D manufacturing improves, and the cost of 3D printers (including their input materials) decreases, this new manufacturing process has the potential to dramatically impact traditional manufacturing and trading models by:

5. ASTM F2792-12 a Standard Terminology for Additive Manufacturing Technologies, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard can be obtained from ASTM International.

- Reducing or eliminating assembly lines and supply chains, as ‘final’ products are produced in one singular process rather than by the assembly of multiple aggregate parts, originating from multiple processes and locations;
- De-globalising the production and distribution of products by moving the production process closer to the customer (Campbell et al. 2011): Products’ digital design and raw materials are shipped around the world, rather than the product itself, as the production takes place at the required location.
- Eliminating inventories as products are manufactured on-demand;
- Reducing the carbon footprint and overall energy utilisation within the manufacturing process;
- Decreasing packaging waste associated with shipment of manufactured goods; and
- Reducing the need for manual labour within the manufacturing process, potentially leading to significant industry unemployment.

3D manufacturing can provide several opportunities and challenges to developing countries. For instance, it may not be feasible to buy components to repair existing products such as an irrigation pump or a vehicle within developing countries, particularly in rural regions. Thus, a telecommunication centre or another public place equipped with a 3D printer, a scanner and the internet could support the localised manufacturing of products and components. This could range from simple medical aids and replacement components for agricultural vehicles, to parts for generators, pumps or valves (Campbell et al. 2011).

On the other hand, the fact that 3D manufacturing requires much lower input of manual labour could pose significant challenges to developing countries (The Economist 2012). Production jobs currently account for around 40 per cent of manufacturing employment, with most of the remainder in professional occupations (Sissons & Thompson 2012). While leading to a decrease in production jobs, the digitalisation of manufacturing through, inter alia, 3D printing increases demand for professional services of designers, engineers, technicians, software programmers and other such occupations. This re-orientation of the manufacturing sector, towards professional service provisions, could shift many manufacturing processes back to developed countries (The Economist 2012). In order to address labour market challenges from digital manufacturing and avoid outflux of manufacturing jobs, developing countries need to partially re-focus their manufacturing sectors towards the provision of services and the enhanced education of skilled labour.

5.3.7 Product-service systems

Another opportunity for business to tap into the growing market for sustainability is through “product servicising”, also known as integrated product-service offering or a product-service system (PSS). Trade opportunities in relation to PSS arise from the cross-border leasing of manufactured goods. A PSS can be defined as the result of an innovation strategy shifting the business focus from designing and selling physical products to selling a system of products and services which are jointly capable of fulfilling specific client demands (UNEP 2002).

Innovative PSS can improve eco-efficiency over BAU approaches whilst simultaneously meeting the product’s economic functions. Examples of green servicising include leasing and sharing arrangements such as car-sharing and lifecycle solutions for IT equipment; functional procurement; and efficiency services such as chemical management services, resource management, and energy services companies (EPA 2009). Research shows that PSS is environmentally and economically beneficial in comparison to traditional product sales (Lindahl et al. 2013).

Box 12 outlines the essential differences between product selling systems (traditional product sales) and PSS through exemplification:

Box 12. Traits of traditional product sales v. Product-Service System (PSS) sales

Traditional product sales (selling tangible goods)	Innovative alternatives: PSS (selling functionality)	
Consumer buys a vacuum cleaner to clean house/office	Consumer rents a vacuum cleaner to clean house/office	Consumer buys a service from a company to clean house/office (Company determines suitable equipment and methods based on consumer's needs)
The consumer owns, uses and stores vacuum cleaner. Consumer is responsible for maintenance and the 'quality' of the cleaning	Company retains ownership of vacuum cleaner and is responsible for maintenance. Consumer is responsible for use and 'quality' of cleaning	Company owns, maintains and stores the cleaning equipment including vacuum cleaner. Company is responsible for 'quality' of the cleaning
Initial investment for consumer could be considerable	Consumer costs are spread out over time	Consumer costs are spread out over time
Consumer ultimately disposes of vacuum cleaner and buys replacement	Company responsible for disposal and has incentives to prolong use and product recyclability	Company responsible for disposal and has incentives to prolong use and recyclability of cleaning equipment

Source: UNEP 2012e

As Box 12 demonstrates, PSS is a novel product conception that moves away from the product being the end result of the manufacturing process to one where the product is sold to the consumer in its functionality of being a 'service'. This provides the customer with the utility of the product, while allowing the manufacturer to retain ownership. In so doing, the manufacturer has the ability and the incentive to design products that are more easily recycled or remanufactured at the end of their lifecycle, leading to more sustainable manufacturing processes. Additionally, the consumer only pays for the product on an as-needed basis, reducing both waste and costs (UNEP 2012e).

Shifting from a products-based system to PSS enables a company to move progressively towards a new manner of interacting with its clients. What a company or an alliance of companies conceive, produce and deliver, are not simply material products; rather, this shift to a PSS provides a more integrated solution to customer demand, thus producing less waste, and overall, a more sustainable outcome (UNEP 2002).

In the example in Box 12, the company selling a full cleaning service instead of a vacuum cleaner is able to extend its relationships with the customer beyond the sale of the product. The new servicing relationship includes the continuous provision of services, for example maintenance, which leads to a better understanding and knowledge of customer needs. In addition, the company can assume a role in the end-of-life of the vacuum cleaner by remanufacturing the machine or recycling its materials.

For developing countries, PSS may represent a more promising and environmentally sound path to economic development. It enables countries to bypass the development stage associated with individual ownership of goods (UNEP 2012e).

Companies like Dell, HP, IBM and Orange, for example, are leasing out some of their products instead of selling them. Hence, the consumer is allowed to upgrade machines without the cost of purchasing new machines. With existing supply chains in developing countries, these companies can move operations to developing countries and consumers can benefit from these services (Westervelt 2007). Thus, rather than accepting absolute ownership and responsibility through product purchase, customers initiate a continuous dialogue with the company, involving the regular assessment and satisfaction of customer requirements.

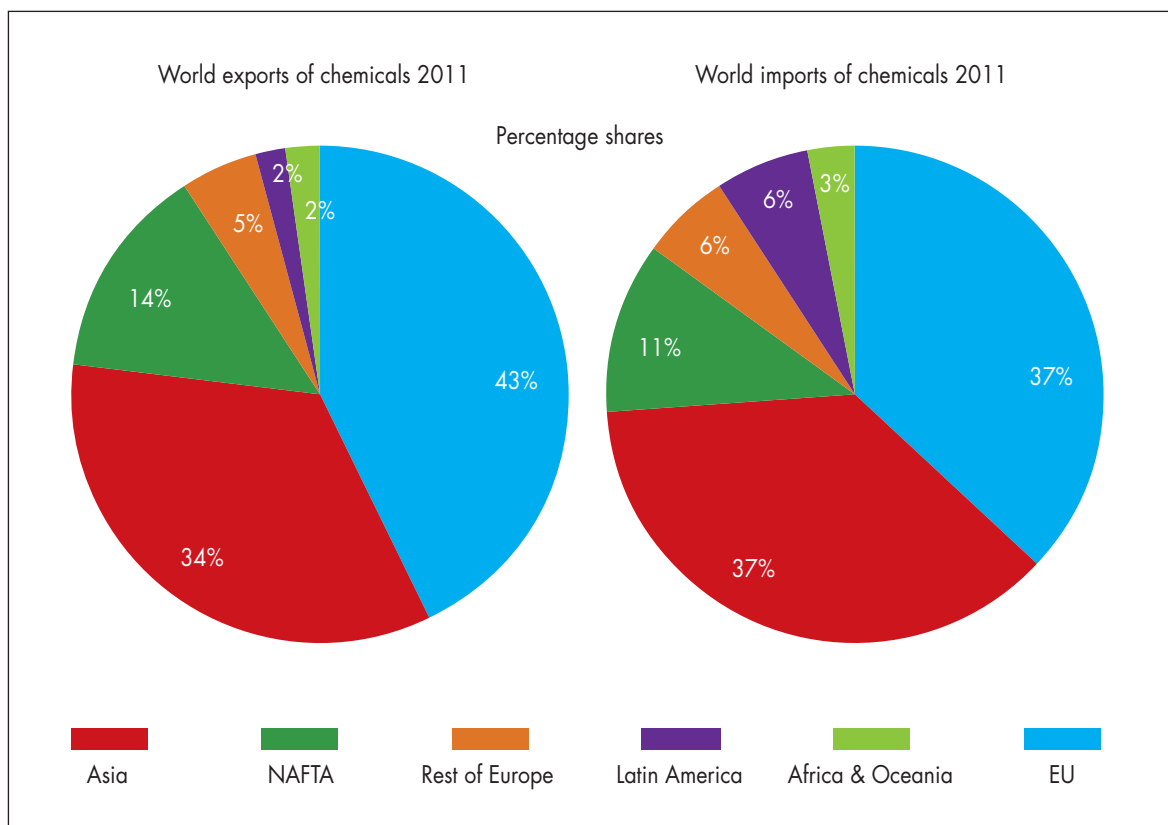
5.4 Trends and trade opportunities in specific subsectors

The manufacturing sector comprises a variety of industries. Their relative importance in terms of greening potential varies by country context. Below is a brief analysis of some of the key industries that offer potential for increasing exports of green products. There are many other trade opportunities arising from more sustainable manufacturing in various sectors such as automobile, pulp and paper, iron and steel, cement, aluminium, mining, renewable energy, food and beverage industries, and handicraft. Some of these sectors are described in the other chapters of this report.

5.4.1 Chemicals

Chemicals play an important part in the world economy and are used in industry, agriculture and incorporated into products that are traded around the globe. Although the number of chemicals on the global market is not known, it is estimated that there are more than 140,000 chemicals on the EU market today; only a fraction has been thoroughly evaluated to determine their effects on human health and the environment, according to UNEP’s Global Chemicals Outlook report (UNEP 2013). UNEP warns that synthetic chemicals are fast becoming the largest constituents of waste streams and pollution, thereby increasing the exposure of humans and habitats to chemical hazards.

Figure 7. World Trade in Chemicals in 2011



Source: CEFIC 2011

Global chemicals sales are projected to grow at an annual 3 per cent until 2050, according to the Organisation for Economic Cooperation and Development (OECD 2012). The OECD countries as a group still account for the bulk of world chemical production. However, production in developing countries is increasingly significant. The OECD notes that, while annual global chemical sales doubled over the period 2000 to 2009, the share of OECD member countries decreased from 77 to 63 per cent and the share of the BRIICS’ economies (Brazil, Russia, India, Indonesia, China and South Africa) increased from 13 to 28 per cent (UNEP 2013, OECD 2012).

The chemicals industry is faced with the urgent challenges of avoiding the production of certain harmful chemicals, and promoting their substitution with greener chemicals to harness its potential in greening the economy. Given the global trend away from the use of environmentally hazardous chemicals, some approaches can translate into export opportunities, particularly for early actors. Hence, sound management of chemicals can deliver major economic benefits and support the transition to a green economy. The benefits of action of sound chemicals management far outweigh the mounting costs of inaction.

The *Global Chemicals Outlook* highlights the growing chemical intensification of the economy. This intensification includes a shift of chemicals production and use from developed to developing countries and countries with economies in transition. The penetration of chemicals into all aspects of production and consumption, and the increasing dependence of the economy on products from the chemical industry, is a growing concern. The failure to manage chemicals soundly, notably safely, will result in huge economic costs. Human health and the environment are already being seriously affected by the current arrangements for managing chemicals and hazardous wastes. According to the *Global Chemicals Outlook*, "...it is necessary to consider policy approaches to ensure that chemicals are produced and used in ways that minimize effects on health and the environment...chemicals in industry, in agriculture and in products – presents its own set of challenges for sound management of chemicals" (UNEP 2013).

Fortunately, some of the challenges facing the chemicals sector are starting to be met. For example, in addition to regulatory drivers such as the EU's Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) (EC 2006), some companies are considering that the use of green chemistry⁶ can lead to advancements in innovation, spur economic development and exports, reduce risks to human health and the environment, and deliver compelling returns on investment. Furthermore, using greener chemicals can create value drivers along the supply chain, which can increase the worth of a product by improving its perception.

Major economic gains can be reaped through chemical recycling, the development of safer substitutes, recovery of valuable materials, and sustainable agriculture practices, such as integrated pest management (IPM). In potato farms in Ecuador, for example, IPM was introduced to tackle high pesticide poisoning rates. As a result, IPM plantations yielded equal potato production with less production costs than plots using chemical pesticides; the measure also significantly reduced reported cases of pesticide-related neurological problems (UNEP 2012f).

In many developing countries, in particular in emerging economies, safer chemical and non-chemical alternatives are already available. Some 45 countries have National Cleaner Production Centres (NCPCs) that dispense training and technical assistance in sound chemical practices to small and medium-sized enterprises (SMEs) (Egler 2012). These programmes have been instrumental in reducing the use of those chemicals of high concern, such as ozone-depleting substances, mercury, lead and chlorinated solvents. For example, the South African NCPC provides programmes tailored for the chemical industry while the NCPC in Ethiopia offers a dedicated programme for tanneries (Asfaw et al. 2007). In Egypt and Morocco, NCPCs have promoted new business models like chemical leasing. Green chemistry in Africa is also making rapid advances. It has caught the attention of a number of African chemical producers and the industry is actively pursuing opportunities to exploit resources in their countries, such as sunlight for photochemistry or biomass to produce chemicals (UNEP 2006).

The chemical market in Africa is primarily targeted at meeting local needs rather than being export-orientated. Nevertheless, the import and export of chemicals is on an upward swing. Chemical innovation can support the development of new enterprises and new greener export-oriented products and services. In developing economies, there are many firms that already successfully export greener products such as natural fibre products, organic produce and bio-based formulations. This trend is expected to continue, given the increasing demand for chemicals by Africa's growing economies. For example, Box 13 illustrates the example of a Kenyan company that is exporting a product made from a natural herbal extract that fights drug-resistant malaria.

6. The use of green chemicals in manufacturing processes is an emerging phenomenon that is likely to further increase in the future. Sustainable or green chemistry can therefore become a key driver shaping the world's trading environment. The term green chemistry is defined as: "The design, development, and implementation of chemical processes and manufactured products to reduce or eliminate substances hazardous to human health and the environment". The concept was further defined during the 1990s by Dr. Anastas (US Environmental Protection Agency) and chemistry professor John C. Warner (University of Massachusetts, Boston) when they came up with the 12 principles of green chemistry. These include: waste prevention; safety (low toxicity, minimise accident); using renewable raw materials or feedstock (source of starting material for a chemical reaction); increasing energy efficiency; using safer solvents and reaction conditions; and designing bio-degradable chemicals so that they do not accumulate in the environment (EPA 2012).

Box 13. Botanical Extracts EPZ Limited (BEEPZ)

BEEPZ is based at the Export Processing Zone (EPZ) in Athi River, Kenya. The primary business is the production of artemisinin to fight drug-resistant malaria. BEEPZ was created to develop a sustainable supply chain for quality artemisinin at a price that makes life-saving artemisinin-based malaria treatments affordable to the people who need them most.

The product is based on a herbal extract and is grown and processed locally in East Africa according to international quality standards. Since 2008, the company has been ISO 9001 certified. BEEPZ ships to global producers for further processing and thus is part of a global effort to combat malaria.

Source : BEEPZ 2012

5.4.2 Information and communication technologies and electronics

The information and communication technologies (ICT) and electronics sector currently accounts for nearly two per cent of global CO₂ emissions, roughly the same level as the airline industry. Total emissions from the ICT and electronics sector are expected to increase by 50 per cent by 2020 (Arnaud 2012). Further, due to the relatively short life cycle of ICT and electronics products and the lack of solutions for end-of-life disposals, the sector faces increased energy use and a growing dispersal of toxic chemicals. In greening their manufacturing processes and products, ICT and electronics producers will need to reduce GHG emissions and limit the use of harmful chemicals.

In support of greening the sector, there is a strong growth in voluntary certification schemes both in developed and developing countries. Key examples of ecolabels for ICT and electronics products include:⁷

- Good Environmental Choice Australia (GECA)
- China Environmental Labelling
- EU Ecolabel
- EcoMark (Japan)
- Korean Ecolabel
- EcoLogo (North America)
- Green Label (Thailand)
- Electronic Product Environmental Assessment Tool (EPEAT) (USA)

A UNEP report in 2007 on ecolabelling in Africa found that the market for such goods is growing and that labelling increasingly provides producers with a competitive advantage in international markets (Janisch 2007).

Over the past few years, there has also been growth in energy-efficiency standards and mandatory labelling programmes for ICT and electronic products. These standards and programmes have targeted household appliances, equipment and lighting. In the EU, for example, a key driver of the energy efficiency design of products is the Directive on the Ecodesign of Energy-Using Products (2005/32/EC) and then, as of 20 November 2009, its replacement the Energy-Related Products Directive (2009/125/EC). These Directives put in place a framework for mandatory implementing regulations on the reduction of energy consumption and other negative environmental impacts for manufacturers at the design stage. These implementing regulations determine measures to improve the energy performance of products and appliances including boilers, light bulbs, televisions, fridges, washing machines and air-conditioners (EC 2009).

In Japan, the Top Runner programme is a regulatory scheme that aims to improve energy efficiency of products such as household and office appliances and vehicles. Under the Top Runner programme, the

7. For a comprehensive list of eco-labelling schemes world wide, please see <http://www.ecolabelindex.com/ecolabels/>.

manufacturer with the best efficiency model of production sets the new benchmark for the following year. Manufacturers are then obliged to meet this standard within a four to eight year period (Nordqvist 2006).⁸

Many of the energy efficiency labelling programmes in the ICT industry are mandatory, such as the EU Energy Label. Therefore, in order to export to a specific market, a label may be required to be clearly displayed on the appliance at the point of sale. Figure 8 sets out examples of energy efficiency and labelling programmes around the world.

Figure 8. Examples of energy efficiency and labelling programmes

Country	Programme Name	Target Products
Australia	Energy Rating Programme: Australia	Electronics, energy
China	Certification Centre for Energy Conservation Products (CECP)	Energy
China	China Energy Label	Electronics
EU	EU Energy Label	Washing machines, tumble dryers, washer-dryers, dishwashers, ovens, refrigerators, freezers, lamps and air conditioners
EU	EuP	Electronics, other energy related products
EU/US	Energy Star	Computers, monitors, printers and fax machines
Japan	Energy Saving Labelling Programme: Japan	Appliances, electronics
Canada	Office of Energy Efficiency (OEE)	Automobiles, appliances

In the past 20 years, developing countries in East Asia have become increasingly important manufacturers in the ICT and electronics sector. Many companies in this region are already using their experience to develop greener products for export. Boxes 14 and 15 illustrate key examples, in China and India respectively, of developments in the ICT industry towards more sustainable products.

Box 14. UNEP project on electrical appliances in China

The UNEP project “Enabling Developing Countries To Seize Ecolabel Opportunities” carried out a national level project to increase the uptake of ecolabels in the electrical appliance sector, in particular television systems, in China. Due to rapid technological changes and the rising volumes of export, the electrical appliance sector in China is regarded as a prime sector for benefiting from the use of the EU Ecolabel for exports to Europe. By the end of UNEP project activities in 2012, the EU Ecolabel online catalogue (available at: <http://ec.europa.eu/ecat/>) included a large number of products from Chinese companies, as compared to none at the project’s beginning.

The project found that there is a growing awareness of the EU’s ecolabel within China’s business sector. However, the absence of mutual recognition between the Chinese and EU ecolabels poses a significant challenge for promoting the EU’s ecolabel for products manufactured in China. This inter-regional incompatibility of ecolabels needs to be addressed to further harness opportunities in the trade of ecolabelled products.

Source: UNEP 2012c

8. This was highlighted at Rio +20. See UNCSD (2012).

Box 15. Wipro: “the world’s greenest electronics company”

Wipro is India’s third-largest software exporter and also exports hardware, such as personal computers and laptops. According to the 18th Guide to Greener Electronics, published by Greenpeace in November 2012, Wipro was ranked as “the world’s greenest electronics company”.

How did Wipro achieve this result? Several factors have helped the company become a large export-oriented business. On the energy efficiency and costs reduction front, Wipro has committed to reduce its absolute GHG emissions by an overall 44 per cent by 2015, the highest reduction commitment among leading Indian and international companies. The company aims to achieve 85 per cent of its emissions reduction through renewable energy use.

Moreover, the company has undergone significant improvements in product design, with all of Wipro’s new products currently meeting the latest Energy Star compliance standards, while 52 per cent of products exceed Energy Star 5.0 standards. Wipro also fares reasonably well at phasing out hazardous chemicals from its products, stating that 80 per cent of its products are free of polyvinyl chloride plastic (PVC) and brominated flame retardants (BFRs), although the company missed its goal of being 100 per cent PVC/BFR-free by 2012.

On the waste management front, Wipro continues to receive by Greenpeace the maximum score for its effective take-back policy and performance on the collection and recycling of post-consumer e-waste. It provides a convenient take-back service to its customers through 17 direct and 300 authorised collection centres, the highest in India by any PC manufacturer.

Source: Greenpeace 2012

5.4.3 Textiles, clothing and footwear

The textile industry is concerned with the design and manufacture of clothing as well as the distribution and use of textiles. Textile industry sectors include fibre production (natural and synthetic), raw weaving, dyeing, finishing and printing and final make-up into garments (carpets, fabrics, etc.). Natural fibres include animal wools and cellulose products such as cotton and flax. Synthetic fibres include rayon, acrylic, polyester, polyurethane, polyamide and others. Leather articles are also defined as textile goods (UNEP 2011d).

The global textiles and garments industry is an important component of world trade flows, especially for some developing countries where clothing accounts for a large proportion of exports (infoDev 2008). In 2004, world exports of textiles were valued at US\$ 195 billion and exports of clothing were valued at US\$ 258 billion, representing a respective 2.2 per cent and 2.9 per cent of total global merchandise trade (WTO 2012a).

Developing countries account for approximately half the world’s textile exports and nearly three-quarters of the world’s clothing exports (UNCTAD 2005). Trade patterns in textiles and garments are similar although the textiles business tends to be capital-intensive, while garment making is labour-intensive and usually relies on a low-cost workforce (infoDev 2008).

A distinctive feature of the clothing industry is the group of countries highly dependent on garment exports, whose absolute value of exports, however, is not high in terms of the overall global garment trade. In 2004, clothing provided more than 40 per cent of total merchandise exports for Bangladesh, Cambodia, El Salvador, Lesotho, Mauritius and Sri Lanka (WTO 2012a), whereas their small relative share in global garment trade is highly disproportionate to the national importance of this sector.

However, the textile, clothing and footwear sector faces many sustainability challenges related mainly to pollution and discharge of toxic substances. In particular, textile manufacturing is a very resource-intensive process, requiring significant amounts of water and chemicals to turn fibres into yarn, then into textile fabrics. This process releases toxic substances, including heavy metals such as lead, chromium and mercury into the environment and water systems. Thus, it is important that more sustainable methods and business practices are introduced across the textile, clothing and footwear sector. This can be accomplished by:

- Recycling textile products/inputs;
- Using eco-leather;
- Promoting certification and standards for production methods that conform with ecolabelling regimes worldwide;
- Improving production efficiency;
- Becoming more energy-efficient;
- Reducing water consumption and waste generated; and
- Using fewer chemicals or replacing hazardous chemicals with greener ones.

Textile manufacturers are undertaking environmental initiatives that target the energy efficiency of production methods, renewable energy sources and waste recycling (Environmental Leader 2009). One example is the system of Restricted Substance Lists, which the garment industry has developed to enforce restrictions on certain chemicals within their supply chains (UNEP 2011d).

The export market for eco-friendly textile products is increasing in importance, following the liberalisation of the textile market in 2005.⁹ Assisting this export growth opportunity are the development and use of industry and supplier-driven certification schemes. These are seen to offer a potential market advantage for those seeking to maintain and enhance exports to developed countries by providing evidence of sound ecological processing.

9. The Multifibre Arrangement ended on 1 January 2005 and the sector was fully integrated into the rules of the General Agreement on Tariffs and Trade (GATT). See WTO (2012b).

Increasingly, many actors/brands in the textiles sector are raising the visibility of diverse topics of product sustainability and CSR in relation to their products. Different actors stress different elements, but, in general, a widespread dialogue on sustainability is underway. Some of the existing certification schemes are set out in Box 16.

Box 16. Examples of certification schemes

- **bluesign®**
The declared objective of the independent bluesign® standard is to offer a reliable and proactive tool for the entire textile production chain from raw material and component suppliers to textile manufacturers, to retailer and brand companies, and to consumers.
- **Oeko-Tex**
Oeko-Tex is an international testing and certification system for textiles regarding limiting the use of certain chemicals that may be harmful to consumers. It also serves as an additional quality assurance tool for the manufacturer.
- **Global Organic Textile Standard (GOTS)**
GOTS is the leading textile processing standard for organic fibres. It aims to define world-wide recognised requirements to ensure organic status of textiles throughout the life cycle of the product, from harvesting the raw materials through environmentally and socially responsible manufacturing, to labelling.
- **EU Ecolabel**
The EU Ecolabel is a voluntary scheme jointly developed between representatives of industry, commerce, environmental and consumer organisations, and trade unions. It is found throughout the EU as well as in Norway, Liechtenstein, and Iceland (EC 2012). The ecolabel is reserved for use by manufacturers that exhibit the lowest environmental impact in their production and processing methods, based on the entire life cycle of the product, from the extraction of raw materials to the finished product.
- **Ecological and Toxicological Association of Dyes and Organic Pigments Manufacturers (ETAD)**
ETAD member companies coordinate their efforts to minimise adverse impacts of organic colorants on health and the environment.
- **The Worldwide Responsible Accredited Production (WRAP)**
WRAP certifies compliant manufacturing and service facilities to a 12-point labour and environmental code. The programme looks at RSLs as part of its certifications.
- **China Environmental Labelling**
This scheme is managed by the Chinese Government and is a voluntary third-party certification system based on labelling procedures developed in OECD countries. So far, China's labelling programme has increased consumer awareness of labelled products and encouraged some enterprises to adopt cleaner technologies in products that are closely related to consumers' health.

Source: Jimin and Qing 1999

Over the last two decades, consumers, particularly those in developed economies, have become increasingly concerned with the environmental impacts of their purchasing decisions, and have increasingly demanded environmentally-friendlier products (Jahnke 2000). Demand for eco-friendly textile, clothing and footwear products is particularly rising. Consequently, consumer preferences for natural fibres such as organic cotton, wool, hemp and silk are providing new income opportunities in developing countries. For example, the International Institute for Sustainable Development (IISD) estimated that the production of goods compliant with major voluntary standards systems is now reaching significant levels of market penetration, already accounting for over 10 per cent of global production (Potts et al. 2010). The Oeko-Tex Standard reported an increase in certified production companies of about 20 per cent in 2011 alone.

The increasing demand for eco-friendly textiles, clothing and footwear creates export opportunities for manufacturers in developing countries that green supply chains and produce green products, as illustrated below in Box 17.

Box 17. Mauritius – greening export-orientated manufacturing

Since its independence in the late 1960s, Mauritius has recognised the importance of an export-oriented strategy as a driver for economic growth and to generate foreign exchange. However, Mauritius' export-oriented textile and clothing manufacturers realised in recent years that they could not compete on international markets while remaining heavily reliant upon conventional technologies that are fossil fuel and water intensive.

In 2008, the Mauritian Prime Minister, partly out of recognition of the need to revitalise the economy to remain competitive and within the objectives of transitioning to a green economy, announced the Maurice Ile Durable project (<http://www.gov.mu/portal/goc/mpu/file/ile.pdf>). Essentially, this is an overarching mechanism to finance projects aimed at the preservation of natural capital and the promotion of renewable energy sources in both consumption and production at the household and business level. A key component of the scheme has been the creation of investment-related risk-transferring mechanisms (from private to public).

In 2010, the Mauritius Export Association (MEXA), the national association of private exporters, introduced the Blue Carbon Award, with the aim of enhancing the recognition of companies adopting green economy practices.

These public and private initiatives, by creating incentives for innovating towards the use of more energy-efficient technologies, have enabled companies in the textile and clothing manufacturing sector in Mauritius to remain competitive in international markets. For instance, RT Knits Ltd has focused its efforts on reducing energy and water consumption and realised a drop in fuel consumption by 30 per cent while also improving the working conditions of 1,600 employees. Likewise, Tamak Ltd has pursued green policies by focusing on ecobuilding, which has allowed the company to save about 20 per cent on electricity costs. Tamak Ltd is also working with the Mauritius government to perform audits on the building to help further reduce energy consumption.

Management in several companies decided that adopting a sustainable model through energy-efficient practices and technologies would provide the edge they required to maintain long-term competitiveness in international markets. Indeed, greening the export-oriented textile and clothing sector has produced impressive results in terms of improved efficiency and sustainability. While the government incentivises green practices, early business adaptors have made the transition to greener production as part of a business strategy, rather than for political or reputational reasons.

Source: Riad Sultan of the University of Mauritius

Eco-friendly creations are also starting to be seen on fashion runways. Even large fashion retail chains, such as H&M, have raised public awareness of the eco-fashion sector (Dörre 2008). Levi's made headlines with its offer of eco-jeans made from organic cotton and dyed with natural indigo (Osborne 2006). Emerging economies also account for an increasing share in demand for eco-friendly textiles, particularly among Chinese and Indian consumers (National Geographic 2009).

Many developing countries have already harnessed opportunities emerging from new niche markets, such as for eco-leather products (Janisch 2007), as illustrated in Box 18.

Box 18. UNEP project on ecolabelling in the footwear industry in Kenya and Ethiopia

As part of UNEP's project on "Enabling Developing Countries To Seize Ecolabelling Opportunities", as set out in Box 14, UNEP also considered opportunities to use the EU Ecolabel in the footwear industry in Kenya and Ethiopia.

In Kenya and, to a certain extent, in Ethiopia, the footwear industry contains a high percentage of workers in the informal sector. This means workers are dispersed and ecolabels cannot be easily applied, as they are based on evaluation within more organised production systems. In Kenya, there is not a single enterprise large enough and interested in applying to the EU ecolabel and there is a lack of developed infrastructure. In Ethiopia, on the other hand, the footwear sector enjoys strong government support, being one of the strategic sectors of the industrial development programme orientated toward quality improvement and trade expansion.

In Ethiopia, the issue of tanneries not complying with the requirements of chemical oxygen demand (COD) levels remains a challenge. In Kenya, the government needs to understand the structural problems of the industry. In both cases, government support is critical to adopting the EU's ecolabel in order to secure increased footwear exports.

Source: UNEP 2012c

5.5 Enabling conditions

The sections below outline the main categories of policy tools that governments and private actors may use to harness trade opportunities that arise from the transition to a green economy assessed in this chapter. It is important to recall that green economy strategies and ambitions vary significantly based on a country's circumstances, their national endowments as well as political and economic conditions and priorities. The mix of policy tools, and the timeframes for their implementation, will consequently vary from one country to another. The list below offers concrete suggestions for actions from governments, the private sector, and other stakeholders to create enabling conditions conducive to trade opportunities that arise from or are associated with a transition to a greener economy in the manufacturing sector.

5.5.1 Public investment and spending

- **Foster green public private partnerships.** Investing in green partnerships can promote the implementation of green manufacturing, for example, through the promotion of sound chemical management policies and strategic cooperation between the business community and government (UNEP 2012d).
- **Invest in a skilled workforce.** Education and training investments should be made to develop a workforce capable of applying novel, more resource-efficient technologies and production systems in new or changed industries. Engagement of unions, employers and labour market institutions will ensure that the creation of trade opportunities in a green economy is fair and decent (UNEP 2011a).
- **Support green manufacturing initiatives.** Institutional support can include financial support and loans and the provision of goods and services. It can also involve the implementation of appropriate systems for efficient and more responsible uptake of resources, waste recovery, recycling and distribution. The increase of voluntary initiatives by manufacturing industries over the last decade has illustrated a growing willingness to measure and communicate relevant performance with investors and other stakeholders.

5.5.2 Business strategies

- **Green existing industries.** The manufacturing sector can, regardless of size or location of facilities, continuously reduce the environmental impacts of manufacturing processes and products through:
 - Taking increased producer responsibility;
 - Meeting all environmental standards set by the government;
 - Performing a material, energy and water audit;
 - Using energy and other resources (more) efficiently;
 - Substituting fossil fuels with renewable energy sources;
 - Phasing out toxic substances including heavy metals, obsolete pesticides and insecticides, and asbestos;
 - Promoting the sound management of chemicals;
 - Improving occupational health and safety;
 - Looking for superior solutions to waste minimisation;
 - Establishing environmental management systems;
 - Upgrading and green retrofitting;
 - Obtaining certifications such as ISO 9001, ISO 14001 and ISO 50001;
 - Using Life Cycle Analysis tools; and
 - Minimising emissions through the concept of industrial ecology.¹⁰
- **Encourage manufacturers and service providers to disclose their carbon footprint.** Manufacturers can be encouraged to provide verifiable and easily available, comparable and understandable information on the carbon footprint of their products and/or services and to support the public dissemination of this information (WEF 2012).
- **Identify opportunities to collaborate on the use of sustainable transportation processes and technologies.** Collaboration with actors in other parts of the value chain, including both suppliers upstream and customers downstream, can help to develop and scale up the use of sustainable transportation processes and technologies (WEF 2012).
- **Create new green industries.** Stimulating the development and creation of manufacturing industries that deliver green products can help build up new capabilities in green sectors. This includes companies that manufacture and install renewable energy equipment and companies that develop and produce clean technologies.
- **Advocate and ensure suppliers' adherence to green codes of conduct.** In response to growing consumer demand for sustainable business practice, multinational companies are increasingly developing and implementing codes of conduct for their suppliers. Some of these codes are directed towards manufactured goods such as clothing, toys and industrial products. A number of EGS have been developed to ensure responsible business practices and labour relations of suppliers within developing economies (Jenkins 2001). By demonstrating adherence to such codes of conduct, businesses in developing economies can significantly improve their export opportunities. Principles that often inform the development of these codes can be found in the UN Global Compact's ten principles (UNGC 2012).

5.5.3 Market-based instruments and reform of harmful subsidies

- **Implement market-based incentives for green products.** Domestic tax policies could be adopted that offer tax rebates for green products, while applying fees to products that do not meet the standards. A "feebate" system (i.e. one that awards fees or imposes rebates, depending on the criteria) could be constructed in which rebates and fees are scaled according to the eco-efficiency,

10. For more information see the presentations and background papers presented at the "Third meeting of the 3R regional forum", 5-7 October 2011, see UNCRD (2011).

durability and environmental-friendliness of a product. Such a system has been used in the energy sector, but the concept has not yet been implemented in the manufacturing sector (UNEP 2012d).

- **Facilitate the use of economic and financial instruments for green chemicals.** Economic instruments can be used to internalise the environmental, health and social costs of chemicals use and create financial incentives for developing sound chemicals management strategies, eliminating hazardous chemical and waste and promoting safe chemical use in all economic sectors. Further, the financial sector could evaluate the inherent risks of chemicals in the activities and corporations in which it finances, and collaborate with other stakeholders to mitigate those risks (UNEP 2012f).
- **Reform harmful subsidies.** According to the International Energy Agency (2011), global fossil fuel subsidies amounted to US\$ 523 billion in 2011 and thus exceeded subsidies to renewable energy resources six-fold. OECD countries alone spend an annual US\$ 400 billion in subsidies, often supporting environmentally harmful technologies (OECD 2005). The subsidies on fossil fuels and other environmentally harmful technologies create a global abundance in cheap and mispriced hydrocarbons. To accelerate the growth of more sustainable methods and thereby encourage increased trade in green manufactured products, countries need to eliminate subsidies that benefit carbon-intensive industries. Financial resources that thereby become available could be used to enhance the development and use of environmentally sound technologies.

5.5.4 National regulatory frameworks

- **Develop national strategies and frameworks for greening manufacturing.** National strategies, programmes and frameworks are a primary means through which government efforts to green new and existing industries can be integrated, resourced, coordinated and implemented. Policies and actions to support the greening of industries can be incorporated into a variety of national-level strategies, including: high-level, cross-government strategies such as National Sustainable Development Strategies; overarching legal frameworks (e.g. China's Circular Economy Promotion Law); strategies that more specifically address the greening of industries, such as national sustainable consumption and production strategies; and sector- and issue-based strategies, such as resource use, waste, energy, education, and health and safety (UNIDO 2011).
- **Undertake green regulatory reform.** Regulatory reform, combined with market-based approaches, can pave the way for green manufacturing industries to innovate and compete on a fair basis. Policy action is often required, for example, to enable efficiency improvements in energy use through the greater use of cleaner technologies, like combined heat and power plants. Recent history shows that the introduction of taxes can be a strong driver for cleaner technology innovation and enhanced energy efficiency (UNEP 2011a). Furthermore, the public sector can assist in fostering demand for domestic and imported green products and technologies through sustainable public procurement (SPP). Public procurement accounts for 1.5 – 30 per cent of GDP in a given country and, if fostering environmentally sound developments, can be an important facilitator of sustainable trade (UNEP 2012b).

5.5.5 International frameworks

- **Promote new international resource efficiency standards.** These standards will help to avoid competition from countries not bound by the same resource efficiency gains. In this respect, international cooperation needs to ensure that developing countries have an active role in setting these standards.
- **Harmonise international standards and establish equivalencies.** Ensure that international standards and labelling schemes for sustainable products, due to their complexity and/or diversity, do not effectively exclude developing country producers from international markets. Establishing equivalencies between standards, for example, will further reduce barriers for exporters.
- **Foster export of second-hand energy-efficient technologies.** Countries could include more energy-efficiency and minimum health and safety requirements in the work of ISO's technical committees on cross-border trade of second-hand goods. Developing countries could also be encouraged to set minimum energy performance standards and remove trade barriers on the import of used and new equipment (EGEE 2007).

- **Open up trade in remanufactured goods.** Since remanufactured goods are not the same as used goods, economies should not restrict their importation based on grounds commonly used to prohibit or limit trade of used goods (APEC 2011).
- **Develop trading conditions for sustainable chemistry.** International and national chemical control activities could be strengthened by legislation to address the gaps in current chemicals-related. Sound chemicals management should be mainstreamed into multilateral and bilateral economic assistance programmes (UNEP 2012f). For example, the Rio+20 Outcome Document, under paragraph 214, calls for the implementation and strengthening of the Strategic Approach to International Chemicals Management (SAICM).
- **Leverage benefits from trade agreements.** Trade agreements such as Regional Trade Agreements (RTAs) can help strengthen the enforcement of environmental laws while raising the level of industry standards. For some countries, the negotiation of RTAs has been a driver of policy reforms, increased capacity development, and better cooperation among trade and environmental officials (UNIDO 2011).

5.5.6 Enhancing dialogue and capacity building

- **Promote the circular economy.** Large manufacturers can play a key role in taking greater responsibility for the management of materials throughout the supply chains and across the product lifecycles to ensure the greening of overall production processes. The main objective should be to make manufactured goods last longer through emphasis on re-design, repair, reconditioning, re-manufacturing, recycling and leasing. Extended Producer Responsibility laws, refundable deposit schemes and an improved functioning of markets for secondary raw materials are promising starting points.
- **Promote green manufacturing training.** Education and training, including for government officials and the private sector, in areas such as cleaner production could contribute significantly to making the manufacturing sector more sustainable.
- **Assist manufacturers requiring green certification.** Many companies in developing countries may require support to attain a certification for their products and assist them in accessing international markets for green products.
- **Build the capacity of certification bodies.** Increasing exports of green products places high demand on certification bodies that must service these exports with certificates and forward inspection reports. Certification agencies in exporting countries must also respond to queries from importers, authorities or certification bodies in importing countries, and may be required to seek direct accreditation for specific export markets. In order to become efficient service providers, bodies must invest into training staff and establishing procedures.
- **Organise trade fairs for green products.** Trade fairs and exhibitions of green products for exports and sustainable merchandise are important venues for raising awareness among consumers in both developed and developing countries, profiling green products for export and reaching new markets.
- **Facilitate the development of sustainable international supply chains.** A major rationale for value chain facilitation is to link suitable stakeholders including manufacturers, producer organisations, processors, buyers, certification agencies, and financial intermediaries. Facilitators are available to mediate between the different interests of the chain actors and ensure that the concerns of all relevant stakeholders are taken into consideration (IFOAM 2010).
- **Create energy-efficiency loan guarantee funds in developing countries.** Developed countries could provide funds through multilateral banks, such as the International Finance Corporation, to enable them to guarantee energy-efficiency loans. These banks could also provide technical assistance to develop a pipeline of bankable energy-efficiency projects (EGEE 2007).

This chapter has illustrated the manifold challenges and opportunities at the intersection of the manufacturing industry, trade, and the transition to a green economy. The manufacturing industry significantly contributes to environmental degradation and the primary challenges for greening the sector are industrial efficiency and innovation. Furthermore, while manufacturing is foremost a domestic concern, international trade can have

a significant impact on manufacturing, not least through decisions about responding to export demand for green manufactured products and about how products can be manufactured in order to enhance competitiveness globally.

There are several trade opportunities for promoting a green economy in manufacturing, including increased economic efficiency, and thus global competitiveness, improved relationships between suppliers and purchasers, and better and new market access through providing greener goods and services. These opportunities can be realised by one or several of the following methods: greening supply chains (including transport), implementing energy-efficient technologies throughout business processes, manufacturing environmentally friendly and ecolabel goods, promoting EGS, investing in renewable energy in industrial applications, promoting remanufacturing and considering emerging opportunities such as 3D manufacturing and product servicing.

However, before developing countries can fully benefit from these opportunities, many challenges, particularly relating to the lack of responsible investments and infrastructure in many manufacturing sectors, need to be overcome. Investing in a skilled workforce capable of applying novel, more resource-efficient technologies and production systems in new or existing industries is one critical element for future economic growth. At the same time, governments need to facilitate the development and creation of manufacturing industries that deliver green products so as to help build up new capabilities in all economic sectors. At the international level, opening up and promoting trade in environmental goods, remanufactured goods, and energy efficiency technologies can lead to greater exports of these products.

5.6 Further Resources

5.6.1 Websites for additional information

Green Economy Report: Chapter on Manufacturing:

http://www.unep.org/greeneconomy/Portals/88/documents/ger/7.0_Manufacturing.pdf

Global Chemicals Outlook: Synthesis Report for Decision-Makers:

http://www.unep.org/pdf/GCO_Synthesis%20Report_CBDTIE_UNEP_September5_2012.pdf

UNEP Finance Initiative: A New Angle on Sovereign Credit Risk: E-RISC - Environmental Risk Integration in Sovereign Credit Analysis (2012):

http://www.unepfi.org/fileadmin/documents/ERISC_Phase_1.pdf

UNECE: Promoting Energy Efficiency Investments for Climate Change Mitigation and Sustainable Development (2012-2014):

http://www.unece.org/energy/gee21/promoting_eei.html

United Nations Conference on Trade and Development (UNCTAD), Commodities Section:

<http://unctad.org/en/Pages/Statistics/AboutUNCTAD-Statistics.aspx>

The Global Apparel Value Chain: What Prospects for Upgrading by Developing Countries:

http://www.unido.org/fileadmin/media/documents/pdf/Services_Modules/Apparel_Value_Chain.pdf

DESA Department of Economic and Social Affairs:

<http://www.un.org/en/development/desa/climate-change/energy-efficiency.shtml>

ILO/WTO. (2011). *Making Globalization Socially Sustainable*. Available at:

http://www.wto.org/english/res_e/booksp_e/glob_soc_sus_e.pdf

The OECD Sustainable Manufacturing Toolkit (designed to help businesses around the world, particularly supply chain firms and small and medium-sized enterprises, develop a more viable, socially responsible business approach and make the most of green growth opportunities):

<http://www.oecd.org/innovation/green/toolkit/48704993.pdf>

OECD-WTO Database on Trade in Value added:

http://www.wto.org/english/res_e/statis_e/miwi_e/miwi_e.htm

Trade in value added: concepts, methodologies and challenges (joint OECD-WTO note):

<http://www.oecd.org/sti/ind/49894138.pdf>

Trade Policy Implications of Global Value Chains (OECD):

<http://www.oecd.org/sti/ind/tiva-policy-implications.pdf>

APEC: Concepts and Trends in Global Supply, Global Value and Global Production Chains:

http://publications.apec.org/publication-detail.php?pub_id=1283

WEF: The Shifting Geography of Global Value Chains: Implications for Developing Countries and Trade Policy:

http://www3.weforum.org/docs/WEF_GAC_GlobalTradeSystem_Report_2012.pdf

ISO Energy Management Standards:

http://www.iso.org/iso/home/news_index/news_archive/news.htm?refid=Ref1537

Business for Social Responsibility:

<http://www.bsr.org/>

Global Reporting Initiative:

<http://www.globalreporting.org>

Remanufacturing Studies at Boston University:
www.bu.edu/reman/

Textile Exchange — a business network of the organic fibre and textile industry:
www.textileexchange.org

The Ecological and Toxicological Association of Dyes and Organic Pigments Manufacturers:
<http://www.etad.com/>

The Higg Index of the Sustainable Apparel Coalition:
<http://www.apparelcoalition.org/>

The Sustainable Energy for All Initiative:
<http://www.sustainableenergyforall.org/>

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