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IMPLICATIONS OF THE GLOBALIZATION PROCESS ON THE METALLURGICAL INDUSTRY

Issue paper*

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I. *Introduction*

The production of ferrous and non-ferrous metals including mining operations, causes major pollution and environmental damage. All major production processes in this industrial sector are major consumers of natural resources and energy, while creating very large waste and pollution streams, land degradation and health hazards.

The United Nations Conference on Environment and Development adopted Agenda 21 as a covenant for a global partnership that includes all areas of sustainable development. It is a guide for business, government policies, and personal and community choices into the next century. Agenda 21 stresses that population, consumption and technology are the main driving forces of environmental change. It calls on governments and the private sector to adopt national strategies for sustainable development.

To facilitate that environmental considerations are effectively integrated into strategies for sustainable development in the metallurgical industry, the Consultation will focus on determining the more suitable ecologically-friendly orientations for the long-term evolution of this sector, within the drastically changing international conditions brought about by the political and economic globalization process.

Long term, the challenge is to create a sustainable materials economy based on maximum recycling and minimum ore extraction.

The greater immediate environmental challenges in this sector are the control of air pollution in particular COx, SOx and NOx, solid waste disposal and recycling, and waste water treatment.

In terms of tonnage, the iron and steel industry is by far the largest polluter. In 1994, world production of crude steel was 724 million metric tons down from a peak of 786 million tons in 1989. Conventional integrated steel produce 0.5 tons of solid waste per ton of crude steel, whilst mini steel mills generate 20 Kgs respectively. Its main pollution streams are air emissions, collected dust, slag furnace and waste water. Aluminium is the second largest polluter. In 1994 world production was about 20 million tons. A major problem is the disposal and treatment of red mud as waste of alumina production, which accumulate untreated over the years at the rate of 3.5 tons per ton of alumina. Copper and zinc come thereafter. Their main pollution streams are air emissions from smelters and waste water.

This paper addressed the above concerns by giving a brief overview of the forces driving the globalization process, the main structural changes taking place in the iron and steel and aluminium industries, and the role that environmental management and legislation are playing in this sector.

II. *Main factors of the globalization process*

Based on the work done at UNIDO for the ongoing "Global Forum on Industry: Perspectives for 2000 and Beyond" and the world hearings on development held by the General Assembly of the United Nations, the main factors and trends driving the globalization process are the following:

A. *World economy: main trends*

The main wide ranging changes in economic policy, the roles of the state and markets are the following:

- the broad diversity of development experience in countries listed as developing countries has eroded past belief on its alikeness. Some fare better than industrialized countries, other have joined or plan to join the OECD. These trends have blurred the North-South distinctions of the past;

- the spread and speed of the process of market-driven globalization. Globalization refers to the increasing integration of world markets of goods, services capital, technology and to a lesser extent, labour. Its effects are global in the dissemination of ideas, culture, lifestyles and environmental problems. Market liberalization and technological development are two key driving forces behind globalization, supported by telecommunications and mass transportation;

- an important consequence of globalization was the erosion of the autonomy of governments and the increasing importance of private sector actors that operate globally, such as TNCs, financial institutions and intermediaries, and NGOs. With the multitude of private sector actors and the large sums of money many of them command, the possibility of individual governments to formulate and implement policies effectively has declined;

- the globalization process breeds more uniformity at the cost of cultural diversity and increases environmental stress. Attempts to escape the effects of globalization can lead to xenophobia, the revival of nationalism and increased protectionism;

- growing awareness that the protection of the environment is a precondition for human survival on this planet, and that development is about the betterment of human condition.

- the recognition that the market is a relatively efficient instrument for promoting economic growth, in which the state and market can be reinforcing partners. Government has a key strategic role in providing physical and social infrastructure and the sound macroeconomic management that creates an enabling environment for the private sector. The government becomes the

facilitator for market-induced changes, it is concerned with institutional and human resource capacity building, transparency, continuity and consistency in its operations and in general it provides good governance;

- the counterpart to good domestic policies is Government participation in regional and international agreements regarding trade, finance, production and other adjuncts to development. Therefore, market-led globalization has been preceded by positive collaboration and agreements between states to enable the process to take root;

- market-driven globalization has given benefits in terms of market access and financing to a large number of countries. However, the globalization of markets, in particular financial markets, have subject national economies to pressures and significant fluctuations in their national currencies due to rapid movements of capital flows. Recessionary economic impulses spread faster as result of the opening of domestic markets and the increasing importance of trade for development. Markets provide plenty of opportunities, yet not every country can benefit in the same way. This creates a growing gap within the developing countries;

- irrespective of global trends, factors such as good governance, transparency and continuity in policy-making were key to reassure markets and individual actors about the goals and interventions to address development issues. Successful development models have several key factors in common: attention to human capital formation, prudent macroeconomic management, export-led industrialization, infrastructure and institution building, limited social unrest, and government support of an entrepreneurial climate.

- nation building, security and political stability are still matters of contention yet they are taken for granted by the prevailing paradigm of development. Markets have to be created before they can respond to price signals, human and physical resource capacities have to be established for national institutions to be viable, and for the foundations for nation building to be in place. Environment, population and gender-sensitive issues are unlikely to respond to market signals which do not capture the long-term aspects of their relationships.

B. ***Industrial trends***

- During the next decade a global market for industrial products and services will become a reality. Companies will come under growing pressure to adjust to it, competing with a dynamically increasing number of producers made possible by the lowering threshold for entry into the markets in many industries, including the metallurgical sector;

- the globalization of industrial activities enabled by the world economy trends, can be turned into opportunities only if the recipient company and country

effectively use potentially available investment and technology flows. An essential part of this process will be a variety of the strategic alliances that at present are mainly practised in the developed countries: alliances for sharing information and know-how, and for developing production and other commercial ventures;

- globalization of industry has taken off by the rapidly growing numbers of private sector actors, and the range and combinations of inter-company and inter-institution relationships in various countries, production areas and services. This process is accelerating;

- the main driving forces of industrial globalization are foreign direct investment (more than portfolio investment), trade liberalization in products and services, domestic liberalization of policies on foreign investment and technology transfer, and international deregulation of capital markets and business services. These combine with national assets including production capacity and technological capability, and national factor endowments such as natural resources and domestic markets. Technology transfer and non-equity participation in commercial ventures and strategic alliances are growing considerably in the 1990s;

- international cooperation is leading to: a greater integration of the world production systems, with access to global resources and markets and fuller use of local comparative advantages; easier access to new technologies, with possibilities of almost immediate use after development, and access to know-how, skills and organization; and broader availability of private finance through foreign direct and portfolio investment, access to capital markets and to national institutional investors like private pension funds and others;

- the possibility of ushering in a proactive approach in relation to the globalization of industry, whereby government policies interact with business plans to make flexible adjustments to strengthen industrial competitiveness.

III. *Main changes taking place in the iron and steel and aluminium industries*

A. *Iron and steel industry*

- The sharp increases in energy prices brought about by the major oil shocks in the 1970s and the strong international competition than ensued in the 1980s, spurred the steel industry to achieve large increases in process and product efficiencies. The later changed the yield between crude steel and steel products stable for many years, whereby 1 ton of crude steel yielded 0.78 ton in 1974 and increased to 0.84 ton in 1990 and 0.86 ton in 1994. This change was recently reflected by a major shift for realistically measuring steel apparent consumption from tons of crude steel which is exclusively used by the steel industry, to tons of steel products ready for sale to better reflect the increased efficiency and productivity of this industry. Current steel products

are lighter, stronger, longer-lasting and better adapted to consumer needs than they were two decades ago;

- steel producers have varying transformation yields some as high as 0.89 ton of product per ton of crude steel, but many steel works are significantly below the world average. Hence, productivity improvement has more immediate potential to increase production than building new capacity. High construction costs for new greenfield plants and steady levels of metal consumption, make it economically more feasible to meet demand by enhancing existing facilities than by building new ones;

- in the 1980s, it became apparent that the demand for ultralow carbon and clean quality steel was becoming a main requirement for the 1990s and beyond. This trend requires the highest possible refining efficiency on steelmaking processes;

- the need to minimize energy consumption is achieved when the yields of products at every stage of the process are maximized under continuous plant operation conditions, and when product quality requirements are met at each process stage thus eliminating the need to rework or recycle products;

- the technological development of the steel industry was characterized by the dominance of integrated steel production joined later by electric arc furnaces, which accounted for 60% and 32% of world production of crude steel in 1994. In the 1960s, the mini steel mills proved that light products could be produced cost-effectively in smaller units with lower capital cost per ton installed, while allowing flexible production scheduling;

- in the 1990s, technological developments concern direct reduction, thin lab casting, compact strip production and other processes that posses to integrated steel a second challenge after the mini-mills. They require smaller units at lower investment and production cost, and enables the use of alternative cheaper coals. These developments will facilitate the entry into the market of a number of steel producers from developed and developing countries;

- longer term, these new technologies coupled to eco-efficient and cleaner production methods are offering a number of major incentives, including reduced investment costs and plant sizes, use of cheaper raw materials, improved recycling, opening of new markets in combination with other industrial materials, etc;

- most integrated steel producers have over-engineered equipment and higher investment cost, which translates into higher production cost and underutilized capacity. Public sector ownership in many of these mills, which projects were largely determined by engineers, explain why in most cases they have been money loosers. For instance, in the US in the 1980s, integrated producers had a -2% return of investment versus a 5% profit for mini-mills;

- cooperation with municipal authorities at major cities on recycling of metal products, is becoming cost-effective. Recycled metals are becoming the growing major part of total metal supply. For instance, in the US aluminium, copper, iron and steel, lead and zinc are the major recycables that are drastically changing the US production of metals. In 1994, the value of these scrap metals was over $12 billion, and it exceeded the value of these metals as mined, by around 10%. The ratio of scrap use over total consumption of metals varied from 40% for zinc to 82% for aluminum. Many countries lack similar recycling capabilities which redress would provide a cost and environmentally-effective major source of metal supply;

- the long-term outlook for this industry may include the following:

  • on-site total processing of waste streams from metallurgical operations;
  • new cleaner technologies that produce very little or no waste, using almost exclusively recycled metals;
  • development of new markets by close working cooperation between metal consumers and metallurgical producers, resulting in vastly improved and cost-effective processes and metallurgical products tuned to the evolving requirements of the former. Final products will be designed for recycling;
  • a mainstream participation in the incoming next efficiency revolution, the creation of a sustainable materials economy;
  • metallurgical mills will be fully automated with computer based sensing instruments controlled by expert systems, fuzzy logic and artificial intelligence, operating under virtual reality conditions;
  • direct reduction will become the primary mode of making steel;
  • human resource development and training will become the key issue in the evolving metallurgical industry, for its staff will be confronted with high level demands on science and technical skill;
  • vastly improved and less complex technologies to recover metals from waste streams of steel mills and non-ferrous smelters, that is cost-effective for the generator and processor of waste. Improved technology and more cost-effective metal recycling from municipal waste collections.

B. ***aluminium industry***

- the world production of aluminium that grew fourfold in the last 30 years, was combined with a fundamental geographical redistribution of production, reduction of energy consumption and improvement of its environmental impact on all three main areas of the primary aluminium industry: bauxite mining, alumina and aluminium production;

- in the bauxite-alumina industry plant sizes are increasing while the number of plants is diminishing. In the future, it is expected that only bauxite deposits directly linked to profitable alumina plants will be operated, except in some cases of very favourable geological/mining conditions;

- recent smelter expansions and new plant construction have been concentrated in areas with access to low-cost electric power and labour. In addition, aluminium provides excellent conditions for its recycling, which helps to conserve landfill space and to save a substantial amount of energy;

- developing countries well endowed with raw material, energy resources and growing domestic markets, are gradually increasing their role in the primary aluminium industry;

- conventional production processes invented long ago, are still today the most economic methods of converting bauxite into alumina and then into aluminium. Evolutionary refinements have been the main source of improving these technologies;

- in the future, it is expected that secondary aluminium based on reprocessing aluminium scrap recycled from municipal and other wastes, should grow more in developing countries for in industrialized countries the rate of recycle is over 80%;

- past trends of alloying aluminium with other metals to improve its mechanical properties has become the norm now. In the future, it would be alloyed with other materials as well.

IV. ***Environmental management and legislation***

- the increasing cost of energy and the introduction of stricter environmental legislation are forcing the metal industry to closely monitor its levels of containment of pollutants which are required by law, to continue to improve operational efficiency and to minimize their impact on the environment, and to invest in cleaner technologies including the shutting down of older plants or parts thereof, and to identify areas for further technical improvements in the newer plants;

- environmental management requires not only suitable equipment and cleaner energy efficient technologies, but a committed management and a well trained and motivated personnel. In addition, care should be given to the availability of good quality raw materials, and cleaner energy/power sources, the reduction of pollutants at the source and the effective disposal of waste in an ecologically-friendly manner;

- comprehensive legislation and regulatory programmes at national level compatible with international standards affecting environmental protection and trade are required. These impacts should be measured at all levels of production and recycling operations. Currently, governments maintain good working relationships with metallurgical companies on account of their contribution to the national economies through negotiated compliance emphasizing self-monitoring of their environmental performance, and the

promotion of environmental management strategies to foster waste minimization, pollution prevention and cleaner energy-efficient production. Flexible guidelines like technology-based standards could be incorporated in formal licenses that specify the levels of containment of pollutants which are required. The objective would be to accommodate the sensitivity of receptors and the vintage of the installed plants to give adequate time to older plant operators to introduce cleaner technologies;

- given the long working life of metallurgical plants on which statutory environmental objectives are likely to vary, negotiated voluntary agreements are more likely to favour efforts to recycle pollutants rather than the installation of end-of-pipe solutions which over time would become inadequate. Safe recycling solutions should be rapidly widespread to operating companies for adoption as the industry norm, to which authorities will expect all plants to adhere in time Voluntary agreements tend to facilitate the rapid adoption of safe and new recycling opportunities when they become available;

- coordinating the issuing of licenses for air, water and hazardous waste emissions is a first step towards an integrated, multi-media permitting transfer of pollutants from one medium to another, which would hold steel producers, smelters and refiners as whole entities thereby eliminating opportunities to transfer pollutants across media. This would encourage waste minimization. Further, regulations for gathering and reporting information on pollutant releases to the environment, will have the effect of stimulating efforts to reduce wastes;

- to ensure that environmental considerations are fully integrated into development of the metallurgical industry, it is necessary to strengthen national capabilities on environmental impact assessment for application to new developments and expansions of existing facilities. Properly trained regulators will then check the compliance of the industry's self-monitoring systems;

- on environmental management practices at plant level, only with major global producers there is a regular transfer of international experience and exchange of information among metallurgical plants in various countries and regions. The transfer of this know-how relies on the active participation of local managers and technical staff, which adapt this know-how to local conditions and feed it back to their international network enriched with local experience for use elsewhere. On this basis, there are major opportunities for the introduction of pollution prevention and cleaner technologies and the environment services needed to make it successful;

- a problem arose in the last 20 years, when public sector metallurgical plants were constrained in obtaining financial and other resources to maintain updated operations. As a result the technical capacity of mines and metallurgical plants were substantially reduced with major neglect of their environmental impact. The deteriorating financial situation of many public sector metallurgical

companies coupled to large government deficits and international debt, prevented the development of mine and plant technologies, and replacement of worn out equipment and proper execution of daily maintenance and housekeeping while inflating the payroll. The environmental situation was by default not a focus of management. Privatization and the involvement of international companies in the management of the metallurgical industry is changing the situation albeit slowly;

- in many developing countries there are not yet regulatory programmes to effectively control pollution caused by the metallurgical industry or its use of natural resources. The existence of suitable legislation and regulations is a must for promoting the sustainable development of this industry, and to minimize its environmental damage. It is a main barrier to sustainable development;

- in general, legislation provides the framework for controlling the environmental impact of the metallurgical industry. Regulations address standards for air, land and water quality with a realistic timetable for achieving these standards. Licensing procedures are needed for key activities of the mining and metallurgical industry in order to define the levels of allowed pollutants. Policy measures should include:

  • a pollution prevention approach through the introduction of cleaner production, waste minimization and recycling of pollutants; and
  • a scheme towards regulations which take an integrated approach with permit schedules for multi-media transfer of pollutants as alternative to single medium licences, which encourage the transfer of pollutants from one medium to another by the use of en-of-pipe pollution control technologies rather than cleaner production to minimize waste at source.