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## CHAPTER 8

### INDUSTRY: PRODUCING MORE WITH LESS

	paras
(opening paragraphs untitled)	1-4
I. Industrial Growth and its Impact	5-6
1. The Changing Structure of World Industry	7-11
2. Response to Pollution and Resource Degradation	12-22
II. Sustainable Industrial Development in a Global Context	23
1. Industrialization in the Third World	24-30
2. Declining Role of Energy and Raw Materials	31-36
3. Promises and Risks of New Technologies	37-44
4. The Use of Economic Instruments	45-50
III. Strategies for Sustainable Industrial Development	51-52
1. Establish Environmental Goals, Regulations and Standards	53-56
2. Make More Effective Use of Economic Instruments	57-60
3. Ensure a Constructive Response from Industry	61-64
4. Increase Capacity to Deal with Industrial Hazards	
4.1 Chemicals	65-71
4.2 Hazardous Wastes	72-77
4.3 Industrial Accidents	78-84
5. Strengthen International Efforts to Help Developing countries	85-93

#### Tables

	page
8-1 Share of Manufacturing Value Added in GDP, by Economic Grouping and Income Group	2
8-2 Composition of the Merchandise Trade of Developing Countries	4

## CHAPTER 8

### INDUSTRY: PRODUCING MORE WITH LESS

1. Industry<sup>1/</sup> is central to the economies of modern societies and an indispensable motor of growth. It is essential to developing countries, to widen their development base and meet growing needs. And though industrialized countries are said to be moving into a post-industrial, information-based era, this move must be powered by a continuing flow of wealth from industry.
2. Many essential human needs can be met only through goods and services provided by industry. The production of food requires increasing amounts of agrochemicals and machinery. Beyond this, the products of industry are needed to maintain modern living standards. Thus all nations need and rightly aspire to efficient industrial bases to meet changing needs.
3. Industry extracts materials from the natural resource base and inserts both products and pollution into the human environment. It has the power to enhance or degrade the environment; it inevitably does both.
4. Industrial development can be described as generally sustainable when what it takes from the environmental resource base remains within that base's capabilities to provide adequate resources for both the present and the future, and when it widens rather than limits future possibilities for human progress. But industry also consumes non-renewable resources. Thus its 'sustainability' will always be a relative, changing concept, based on its ability to continually improve the efficiency with which it uses resources and energy. In essence, it must always strive to produce more with less.

# I. INDUSTRIAL GROWTH AND ITS IMPACT

5. As recently as 1950, the world manufactured only one-seventh of the goods it does today, and produced only one-third of the minerals. Industrial production grew fastest between 1950 and 1973, with a 7 per cent annual growth in manufacturing and a 5 per cent growth in mining. Since then growth rates have slowed, to about 3 per cent yearly between 1973 and 1985 in manufacturing and virtually no growth in mining.<sup>2/</sup>

6. That earlier, rapid growth in production was reflected in the rising importance of manufacturing in the economies of virtually all countries. By 1982, the relative share of value added to GDPs by manufacturing (the 'manufacturing value added', or MVA) ranged from 19 per cent in developing countries as a whole to 27 per cent in developed market economies, and to 51 per cent of net material product in centrally planned economies. (See Table 8-1)<sup>3/</sup> If the extractive industries are taken into account, the share is even higher.

Table 8-1				
Share of Manufacturing Value Added in GDP, by Economic Grouping and Income Group (percentage)				
	1960	1970	1980	1982
Developing countries	14.2	16.6	19.0	19.0
Low income	11.2	13.8	15.0	15.0
Lower-middle income	11.0	13.5	16.4	16.6
Intermediate income	10.6	14.4	17.1	17.6
Upper-middle income	19.4	21.6	24.1	23.3
High income	17.2	16.2	17.2	17.9
Developed market economies	25.6	28.3	27.9	27.1
Centrally planned economies*	32.0	42.4	50.5	50.8
* Figures refer to the share of manufacturing value added (estimated) in net material product. Source: UNIDO, <u>World Industry: A Statistical Review 1985</u> , Vienna, 1985.				

### 1. The Changing Structure of World Industry

7. But in recent years this trend has been reversed: manufacturing has declined in importance relative to other sectors of the economy. In many countries, this decline has been in progress since 1973. This is most noticeable in the case of developed market economies, but the share of MVA in GDP has also declined in nearly half the 95 developing countries surveyed by UNIDO.<sup>4/</sup> This may reflect the growing interaction between industry and all fields of science and technology and the increasing integration of industry and services, as well as industry's ability to produce more using fewer resources.

8. The relative importance of industry as an employer has been declining for some time in developed countries. But the shift in jobs towards the service sector has accelerated sharply over the past 15 years with the increasing adoption of new processes and technologies. Economists continue to argue over whether the advent of an information-based economy will further depress employment in industry or will expand job opportunities overall.<sup>5/</sup> But one important consequence of industry's growing reliance on new, efficient, labour-saving technologies is that developing countries can no longer count as much on their cheaper labour to lure foreign investment to their industries.

9. Most developing countries started at independence with virtually no modern industry. Then during the 1960s and 1970s their industrial production, employment, and trade consistently grew faster than these sectors in the developed market economies. By 1984, the developing countries accounted for 11.6 per cent of world MVA (still well short of UNIDO's "Lima target" of 25 per cent adopted in 1975). The centrally planned economies of Eastern Europe had raised their share of world MVA from 15.2 per cent in 1963 to 24.9 per cent in 1984.<sup>6/</sup>

10. The international trade in manufactured goods, which has consistently grown faster than has world manufacturing output, is one of the factors underlying the changing geography of industrialization. Many developing countries, particularly the newly industrialized countries (NICs), have shared in this growth and made spectacular progress in industrialization. Taking the Third World as a whole, exports of manufactured goods have grown steadily relative to primary exports, rising from 13.3 per cent of their total non-oil exports in 1960 to 54.7 per cent in 1982.<sup>7/</sup> (See Table 8-2.)

TABLE 8-2								
Composition of the Merchandise Trade of Developing Countries								
	Exports				Imports			
Item	1960	1970	1980	1982	1960	1970	1980	1982
billions of dollars								
Primary commodities	24.6	45.2	452.4	369.4	11.1	16.8	166.3	165.7
Non-oil	17.0	26.9	107.3	92.5	8.2	12.1	79.4	73.4
Petroleum	7.6	18.3	345.1	276.9	2.9	4.7	86.9	92.3
Manufactures	2.6	9.5	100.6	111.8	17.1	39.0	288.1	296.3
Total	27.2	54.7	553.0	481.2	28.0	55.8	454.4	462.0
Total non-oil	19.6	36.4	207.9	204.3	25.1	51.1	367.5	369.7
per cent								
Primary commodities including oil	90.4	82.6	81.8	76.8	38.8	30.1	36.6	35.9
Non-oil	62.3	49.2	19.4	19.2	28.4	21.7	17.5	15.9
Petroleum	28.1	33.4	62.4	57.5	10.4	8.4	19.1	20.0
Manufactures	9.6	17.4	18.1	23.2	61.2	69.9	63.4	64.1
Share in non-oil exports					Share in non-oil imports			
Primary commodities (non oil)	86.7	73.9	51.6	45.3	32.7	23.7	21.6	19.8
Manufactures	13.3	26.1	48.4	54.7	68.3	76.3	78.4	80.2
Source: UNIDO, <u>Industry in a Changing World</u> , United Nations, New York, 1983.								
For 1982, WCED estimates based on UN, <u>1983 International Trade Statistics Yearbook</u> , Vol.I, N.Y., 1985.								

11. In general, developing-country industrial production is diversifying and moving into more capital-intensive areas such as metal products, chemicals, machinery, and equipment. And heavy industries, traditionally the most polluting, have been growing in relation to light industries. At the same time, the share of industries involved in food products, and to a lesser extent in textiles and clothing, has fallen significantly.

## 2. Response to Pollution and Resource Degradation

12. The developed world began to take serious steps to limit industrial pollution in the late 1960s. Many developing countries also recognized the need to tackle the problem before it got out of hand. Governments established "environmental protection" policies and programmes, and agencies to administer them. They initially focused on regulatory measures aimed at reducing emissions. Later they considered a range of economic instruments - such things as taxation, pollution charges, and subsidies for pollution control equipment - but only a few countries introduced them.

13. Industry itself has also responded to public and government concern. Expenditures on pollution control measures began to rise rapidly in some of the highly polluting industries; corporations began to develop their own environmental policy and control units. Guidelines and codes of conduct were developed covering safety of products and plant operations, trade practices, technology transfer, and international cooperation.<sup>8/</sup> National and international industry associations have also developed guidelines and voluntary codes of practice.<sup>9/</sup>

14. Both governments and industry were initially deeply worried about the costs of proposed environmental measures. Many predicted that they would depress investment, growth, jobs, competitiveness, and trade, while driving up inflation.



15. Such fears proved misplaced. A survey of OECD countries indicates that the benefits generated by environmental measures over the past two decades, including health, property, and ecosystem damages avoided, have been significant. More important, these benefits have generally exceeded costs.<sup>10/</sup>

16. And the costs have not been as high as many feared. One methodology to estimate the cost of pollution abatement in industry compares expenditures on new plants and equipment that have pollution control facilities to hypothetical expenditures on new plants without such features. Studies using this comparison in the United States found that pollution abatement expenditures for new plant and equipment for all manufacturing industries in that country in 1984 amounted to \$4.53 billion, or 3.3 per cent of total new expenditures. The chemical industry spent \$580 million (3.8 per cent) on such equipment.<sup>11/</sup> Similar studies in the Japanese steel industry found that new investment in pollution control equipment reached as high as 21.3 per cent of total investment in 1976 and even today remains around 5 per cent.<sup>12/</sup>

17. Overall expenditures on environmental measures, public and private, were quite small at the beginning of the 1970s - perhaps 0.3-0.4 per cent of GDP. They increased gradually to some 1.0-1.5 per cent of GDP by mid-1970s, depending on the country. In a few nations, they had reached 2.0 per cent.<sup>13/</sup>

18. Costs and benefits have naturally varied among industries. Firms involved in food processing, iron and steel, non-ferrous metals, automobiles, pulp and paper, chemicals, and electric power generation - all major polluters - have borne a high proportion of the total pollution control investment by industry. Faced with such

costs, many of these industries developed a broad range of new processes, cleaner technologies, and more environmentally efficient products.

19. And many benefited financially from this effort.

Some firms which a decade ago established teams to research and develop technologies to meet new environmental standards are today among the most competitive in their fields. They have plants that use energy and resources more efficiently, and thus more economically.

20. Cleaner and more efficient production processes and pollution control technologies have progressed rapidly in some industrialized countries. Waste recycling and reuse have become accepted practices in many industrial sectors. Technologies to scrub sulphur and nitrogen compounds from smokestack gases - thus decreasing acid pollution - made remarkable advances in a relatively short time. New combustion techniques now being developed both raise combustion efficiency and reduce pollutant emissions. Burners which release few nitrous oxides, fluidized bed combustion, and many other new technologies hold great promise for the future.<sup>14/</sup>

21. In fact, pollution control has become a thriving branch of industry in its own right in several industrialized countries. High-pollution industries such as iron and steel, other metals, chemicals and energy have often led in expanding into the fields of pollution control equipment, de-toxification and waste disposal technology, measurement instruments and monitoring systems. Many have found new opportunities for investment, sales, and exports. Looking to the future, a growing market for pollution control systems, equipment and services is expected in practically all industrialized countries, including NICs.

22. There are, of course, gaps in this progress. In many countries, particularly in the developing world, emission standards, their enforcement, and environmental monitoring are inadequate. Few countries use economic instruments effectively to prevent pollution before it arises. The frequency of accidents releasing toxic substances is a growing global concern, and in the few years over which this Commission worked, major accidents of this type have occurred in Mexico City; Bhopal, India; Chernobyl, USSR; and Basel, Switzerland. The accumulation of hazardous wastes threatens present and future generations, as does the introduction of inadequately tested chemicals and technologies. Much remains to be done.

## II. SUSTAINABLE INDUSTRIAL DEVELOPMENT IN A GLOBAL CONTEXT

23. If industrial development is to be sustainable over the long-term, it will have to change radically in terms of the quality of that development. But this is not to suggest that industrialization has reached a quantity plateau. Today, world industrial output would have to be increased by a factor of 2.6 to produce enough goods to raise Third World per capita consumption of manufactured goods to present developed country levels.<sup>15/</sup> Given expected population growth, a fivefold to tenfold increase in world industrial output would be needed to achieve this parity by the time the world population has stabilized sometime in the next century. Such growth has serious implications for the future of the world's ecosystems and the natural resource base.

1. Industrialization in the Third World

24. The growing populations and high proportions of young people in Third World countries bring large increases in the labour force. Agriculture will not be able to absorb such numbers. Industry must provide these expanding societies not only with employment but with products and services produced by industry. They will need massive increases in basic consumer goods and a concomitant build-up of industrial infrastructure - iron and steel, paper, chemicals, building material, and transportation. All this implies increases in energy and raw material use, industrial hazards and wastes, accidents, and resource depletion.

25. The developing countries' share in world production of iron and steel rose from 3.6 per cent in 1955 to 17.3 per cent in 1984, when four countries - China, Brazil, South Korea and India - produced more than 10 million tons of steel each, comparable to the level of production in many medium-sized industrialized countries.<sup>16/</sup> As this industry is contracting in many industrial countries, it is expected to expand by 38 million tons between 1982 and 1990 in the developing world. Latin America is expected to account for 41 per cent of this rise, Southeast Asia for 36 per cent, the Middle East for 20 per cent, and Africa for 1.3 per cent.<sup>17/</sup>

26. Many developing countries still depend heavily on their exports of minerals and other commodities, mostly in unprocessed or only intermediately processed forms. In the case of several major minerals such as aluminium and nickel, a few transnational corporations control the whole industry from mining through final processing.<sup>18/</sup> Some countries have been moderately successful in increasing the share of refined products in their exports. Yet most

of these "manufactured" goods are processed further in the developed country that imports them. Thus in 1980, only 39 per cent of all Third World exports of manufactured goods were ready for final use, while 43 per cent of the total exports by the developing countries that year were unprocessed.<sup>19/</sup> This ratio should improve as developing nations move into the further stages of processing.

27. Paper is a basic, manufactured consumer good based on a renewable natural resource. Between 1950 and 1980, developing countries increased their production and consumption of paper and paperboards by about 20-fold and 10-fold, respectively. But they continued to import paper, as demand always exceeded domestic production. However, the ratio of production to consumption has consistently improved, with total developing-country production reaching 22.5 million tons (about 13 per cent of world total) in 1980.<sup>20/</sup> Developing country demand for pulp and paper should continue to grow rapidly with increasing populations, education, literacy, and incomes. This demand will also increase pressures on forests.

28. The expected growth in basic industries foreshadows rapid increases in pollution and resource degradation unless developing countries take great care to control pollution and waste, to increase recycling and reuse, and to minimize hazardous wastes. These countries do not have the resources to industrialize now and repair the damage later; nor will they have the time, given the rapid pace of technological progress. They can profit from the improvements in resource and environmental management being achieved in industrialized countries, and so avoid the need for expensive clean-ups. Such technologies can also help them to reduce costs and stretch scarce resources.

29. Industrial structure in developed countries is expected to change radically with the increasing use of new technologies and with the relocation of some basic, traditional industries like paper, metals and chemicals to developing countries. Developing countries can use elements of this revolution for their own advancement. They could industrialize by skipping some of the more damaging steps in the gradual development of industry in developed countries and mitigate some of the negative impacts of this process on society and on the environment .

30. Economies of scale are no longer always the primary consideration. New technologies in communications, information and process control make possible the establishment of small-scale, decentralized and widely-dispersed industries, thus reducing levels of pollution and other impacts on the local environment. Such dispersed industries could relieve big cities of some of their population and pollution pressures. They could provide non-farming jobs in the countryside, produce consumer goods which cater to local markets and help to spread environmentally sound technologies.

## 2. Declining Role of Energy and Raw Materials

31. Industrial growth is widely seen as inevitably accompanied by a corresponding increases in energy and raw material consumption. In the past two decades, however, there appears to have been a fundamental change in this pattern. As growth has continued in the developed market economies, the demand for many basic materials, including energy and water, has levelled off; in some cases, it has actually declined in absolute terms.

32. Energy consumption per unit of GDP in OECD countries has been dropping at a rate of 1-3 per cent every year since the late 1960s. Between 1973 and 1983, these

countries improved energy efficiency by 1.7 per cent annually.<sup>21/</sup> Industrial water consumption per unit of production has also declined. Older pulp and paper mills typically used about 180 cubic metres of water per ton of pulp; those built during the 1970s, however, used only 70. With advanced techniques which keep water circulating within a closed system and with proper staff training, use rates could be lowered further to 20-30 cubic metres per ton of pulp.<sup>22/</sup>

33. An integrated steel mill uses about 80-200 tons of water for every ton of crude steel. However, since only about 3 tons of water per ton of crude steel are lost, mostly by evaporation, recycling can greatly reduce consumption.<sup>23/</sup> Closed water circulation systems are not unique to the steel industry or to developed market economies. Between 1975 and 1980, the USSR chemical industry output increased by 76 per cent, but the total consumption of fresh water remained at the 1975 level.<sup>24/</sup> Between 1981 and 1986, Soviet industrial output increased by 25 per cent but industrial water consumption remained constant.<sup>25 /</sup>

34. Declines in consumption of other raw materials began much earlier. In fact, the amount of raw materials needed for a given unit of economic output has been dropping over this entire century, except in wartime, for practically all non-agricultural commodities.<sup>26/</sup> A recent study of consumption trends of seven basic materials in the United States bears this out,<sup>27/</sup> as do studies in Japan. In 1984, for every unit of industrial production, Japan consumed only 60 per cent of the raw materials it used for the same volume of industrial consumption in 1973.<sup>28/</sup> These efficiency trends do not result from a decline in manufacturing in favour of service industries, for over these periods the output of the manufacturing sector continued to grow. The productivity and efficiency of

resource use are constantly improving, and industrial production is steadily switching away from heavily material-intensive products and processes.

35. The two oil price hikes of the 1970s shocked many countries into saving fuel costs by promoting conservation measures, switching to other fuels, and raising overall energy efficiency. All of this also reduced pollution and helped firms to maximise profits. These events demonstrated the importance of energy pricing policies that reflect a more realistic cost of resources, taking into account their current stock, depletion rates, availability of substitutes, and any unavoidable environmental damage associated with their extraction or processing. They also demonstrated the potential of similar pricing policies for other raw materials.

36. Some have referred to these processes as the increasing "de-materialization" of society and the world economy. Yet even the most industrially advanced economies still depend on a continued supply of basic manufactured goods. Whether made domestically or imported, their production will continue to require large amounts of raw materials and energy, even if the developing countries progress rapidly in their adoption of resource-efficient technologies. To sustain production momentum on a global level, therefore, policies that inject resource efficiency considerations into economic, trade, and other related policy domains are urgently needed, particular in developed countries, along with strict observance of environmental norms, regulations, and standards.

### 3. Promises and Risks of New Technologies

37. Along with opportunities for raising productivity and living standards, for improving health, and for



conserving the natural resource base, the new technologies also bring new hazards, threaten environmental degradation, and could induce subtle but irreversible changes in the social, cultural, and economic fabric of nations or even of the world community. Skillful environmental planning can forecast some of these new hazards and mitigate their effects.

38. Information technology based chiefly on advancements in microelectronics and computer science is of particular importance. Coupled with rapidly advancing means of communication, it can help to improve the productivity, energy and resource efficiency, and organizational structure of industry. Information technology is already affecting international trade and investment patterns.

39. New materials such as fine ceramics, rare metals and metal alloys, high-performance plastics, and new composites allow more flexible approaches to production. They also contribute to energy and resource conservation, as in general they require less energy to manufacture and, being lighter, contain less matter than conventional materials.

40. Biotechnology will have major implications for the environment. The products of genetic engineering could dramatically improve human and animal health. Researchers are finding new drugs, new therapies, and new ways of controlling disease vectors. Energy derived from plants could increasingly substitute for non-renewable fossil fuels. New high-yield crop strains and those resistant to weather and pests could revolutionize agriculture. Biological methods of pest control will become more common. Biotechnology could also yield cleaner and more efficient alternatives to many wasteful processes and polluting products. New techniques to treat solid and liquid wastes could help solve the pressing problem of hazardous waste disposal.<sup>29/</sup>

41. Advances in space technology, now the almost exclusive domain of developed countries, also hold promises for the Third World, even for agriculture-based economies. Weather forecasting services provided through a satellite and communications network can help farmers in deciding when to plant, water, fertilize, and harvest crops. Remote sensing and satellite imagery could permit optimal use of the Earth's resources, facilitating the monitoring and assessment of long-term trends in climatic change, marine pollution, soil erosion rates, and plant cover.

42. These new technologies and the Green Revolution blur the traditional distinctions between agriculture, industry, and services. and they make it possible for developments in one sector to more radically affect those in another. Agriculture has become virtually an "industry" in developed countries. Agriculture-related services - especially for regional weather forecasting, storage, and transport - are becoming ever more important. New techniques of tissue culture and genetic engineering could soon generate new plant strains able to fix nitrogen from the air, a development which would drastically affect the fertilizer industry, but would also reduce the threat of pollution by agrochemicals.

43. The chemical and energy industries are moving increasingly into the seeds business, providing new seeds that meet specific local conditions and requirements - but which may also need specific fertilisers and pesticides. Here research and development, production, and marketing need to be carefully guided so as not to make the world even more dependent on a few crop varieties - or on the products of a few large transnationals.

44. Yet new technologies are not all intrinsically benign, nor will they have only positive impacts on the environment. The large-scale production and widespread use of new materials, for example, may create hitherto unknown health hazards (for example, the use of gallium arsenate in microchip industry.)<sup>30/</sup> More risky research might be carried out and products manufactured where safeguards are weak or where people are unaware of the dangers. The need for caution in introducing a new technology is reinforced by the experience of the Green Revolution, which, despite formidable achievements, raises concerns over dependence on relatively few crop strains and large doses of agrochemicals. New life forms produced by genetic engineering should be carefully tested and assessed for their potential impact on health and on the maintenance of genetic diversity and ecological balance before they are introduced to the market and thus to the environment.<sup>31/</sup>

#### 4. The Use of Economic Instruments

45. Pollution is a form of waste, and waste of resources in industrial production is a symptom of inefficiency. Industries which recognize pollution as such, and account for it as a cost factor of production, are motivated to reduce the levels of pollution and waste they generate. Thus to some extent efficient industries can be expected to regulate their production of pollution and waste if and when they see that their efforts bring increased profits or improved productivity.

46. "Prevention is better than cure" is now a widely accepted motto among the world's leading industries.<sup>32/</sup> The belief that pollution prevention pays is becoming an essential element of strategic planning for industrial policies and projects in both government and industry. It requires integrating environmental considerations, fully

and at the earliest stages of development, into the processes of industrial planning and management.<sup>33/</sup>

47. However, the improvements that industrial enterprises can achieve through voluntary efforts are severely limited. Air and water have traditionally been regarded as "free" goods, but the enormous costs to society of past and present pollution show that they are not free. Treating them as such transfers economic benefits from those who bear the damage costs of pollution to those who enjoy cost-free air, water and other environmental resources. Today manufacturers are expected to take responsibility for a larger and larger proportion of these "external costs". This new cost equation is prompting many firms to review their approaches to pollution control.

48. In this regard, OECD in 1971 agreed upon the Polluter Pays Principle (PPP).<sup>34/</sup> Essentially an economic efficiency measure, PPP is designed to encourage industries to reflect environmental costs in the prices of products. This principle places the costs of pollution prevention or clean-up on the industry, and ultimately - through the price-setting mechanism of the marketplace - on the consumer of those products. It thus gives industry economic incentives to use production methods that are less polluting and gives consumers incentives for conservation. Since it means government intervention in the functioning of the market, the PPP can also be applied through government regulations and price controls in centrally planned economies.

49. This is how various environmental regulations and other economic instruments for better resource management - such as taxation, pollution or waste charges, energy and other resource pricing, and subsidies or low-interest financing of pollution control equipment - are supposed to

work. They are meant to encourage industry to integrate environmental considerations into planning and decision-making processes by establishing a minimum of norms and standards to be followed by all industries concerned. They are also meant to provide a fair system of incentives and disincentives to industries to prevent or minimize pollution.

50. International cooperation to harmonize environmental measures, including a broader application of PPP to international investment and trade, is needed if these efforts are to be accepted by industries that compete in international markets. Few governments will force an industry into an uncompetitive position. Countries may adopt strong environmental measures, but they find it difficult to enforce them if other governments do not apply similar measures to the same industries.

### III. STRATEGIES FOR SUSTAINABLE INDUSTRIAL DEVELOPMENT

51. Resource and environmental considerations must be integrated into the industrial planning and decision-making processes of government and industry. This will allow a steady reduction in the energy and resource content of future growth by increasing the efficiency of resource use, reducing waste, and encouraging resource recovery and recycling. It will guide industry in its adaptation of new technologies. It will also help industry to play its proper role in improving human resources while improving existing work patterns. In general, it will permit government and industry to shift to more cost effective "anticipate-and-prevent" approaches - though curative measures will still be needed to cope with the backlog of environmental damages already inflicted.

52. An integrated approach to industrial development planning and management will require an emphasis on:

- \* the incorporation, at the most effective and least costly stage, of measures to prevent adverse effects on health and the environment;
- \* improved resource management, particularly in areas where the continuing or anticipated erosion of natural resource base is critical, and in environmentally sensitive areas;
- \* pollution abatement and waste minimization in all branches of industry, globally, especially where rapid industrialization in or near major population centres poses critical public health and safety problems;
- \* improved environmental and risk assessment methods as well as risk management capabilities involving plant siting, design, and choice of products or technology;
- \* increased international cooperation between governments and between government and industry to address transboundary, regional, and global environmental problems related to industry; and
- \* increased technical, financial, and institutional assistance to and among developing countries, aimed at improving their capacity to assess their natural resource base and the sustainability of industrial projects or technologies, as well as to deal with pollution, accidents, and other industrial hazards.

1. Establish Environmental Goals,  
Regulations, and Standards

53. In dealing with industrial pollution and resource degradation, it is essential that industry, government, and the public have clear benchmarks. National governments must therefore

- \* establish clear environmental goals and enforce environmental laws, regulations and standards on all industrial enterprises, irrespective of ownership or size.
- \* give priority in formulating such policies or regulations to public health problems associated with industrial pollution and hazardous wastes.
- \* improve their environmental statistics and data base relating to industrial activities.

54. The regulations and standards should govern such matters as air and water pollution, waste management, occupational health and safety of workers, energy and resource efficiency of products or processes, and the manufacture, marketing, use, transport, and disposal of toxic substances. This should normally be done at the national level, with local governments being empowered to exceed, but not to lower, national norms. In formulating environmental regulations, it is important that flexible systems are adopted without specifying a particular process or technology.

55. Environmental regulations can seldom be comprehensive enough to take all factors or interests into account. Hence governments should require an environmental resource sustainability assessment for all major investments as an integral part of licensing,

funding, or other permit-granting procedure. The technical assistance that may be required in developing countries for this purpose should be provided. The assessment should be made public to allow affected parties an opportunity to comment before a governmental decision is made.

56. Regulations to control the impacts of industrial activity across national boundaries and on the international commons are also needed. Existing or future international conventions dealing with transfrontier pollution or management of shared natural resources should enshrine certain key principles:

- \* the responsibility of every state not to harm the health and environment of other nations,
- \* liability and compensation for any damage caused by transfrontier pollution, and
- \* equal right of access to remedial measures by all parties concerned.

## 2. Make More Effective Use of Economic Instruments

57. Economic policy instruments can supplement regulatory standards to induce industries to emphasize energy and resource efficiency, recycling, and waste minimization, and generally aim to prevent pollution rather than cure it after the fact.

58. Economic instruments such as user charges, fiscal levies, liability legislation and similar measures to back up regulatory standards can all help in the implementation of the Polluter Pays Principle. Whether these are passed on to consumers or borne by the industry



will depend on the market situation. But in general, governments and industry should adhere to the principle that polluters and producers of hazardous products and wastes should bear the cost of preventing or cleaning up the environmental harm which they cause.

59. Economic incentives to reduce pollution can be enhanced by other measures. Energy and water pricing policies, for example, can push industries to consume less. Product redesign and technological innovations leading to safer products, more efficient processes, and recycling of raw materials can also be promoted by a more effective, integrated use of economic incentives and disincentives, such as investment tax breaks, low-interest loans, depreciation allowances, pollution or waste charges, and non-compliance fees. In using such economic instruments, however, great care will be needed to ensure that international trade aspects are taken into account.

60. Sometimes the way in which other policy objectives are promoted has the unintended effect of reducing the effectiveness of environmental programmes. For example, subsidies on raw materials or water supply or energy to promote the development of industry in remote areas may well dilute the pressure to conserve resources. Governments should examine whether existing economic policies, instruments, or subsidies provided to various industry-based programmes and projects contribute effectively to the promotion of environmentally sound and resource-efficient practices.

### 3. Ensure a Constructive Response from Industry

61. Industry's response to pollution and resource degradation should not be limited to compliance with regulations. It should accept a broad sense of social responsibility and ensure an awareness of environmental

considerations at all levels in the enterprise. Towards this end, all industrial enterprises, trade associations and labour unions should establish company-wide or industry-wide policies concerning resource and environmental management, including compliance with the laws and requirements of the country in which they operate.

62. International trade associations can play a major role in setting standards and disseminating information. They should establish and make widely available sectoral guidelines for assessing the sustainability and potential hazards of new facilities, for developing accident contingency plans, and for selecting pollution control or waste treatment technologies.

63. With limited resources at their disposal, small and medium-sized industries often find themselves unable to afford the changes necessary to meet environmental regulations and product controls. Small-scale businesses such as metal working, machine tools, printing, and tanning and dying are frequently among the worst offenders of environmental regulations in any country. New technologies, especially micro-electronics, already allow small industries inexpensive means to control an entire production process. Energy-saving biological systems may be well suited to the needs of small and medium-sized industries for pollution control or waste disposal.

64. Small and medium-scale enterprises, making up the largest segment of industry in most nations, need information and may in some cases require financial and technical assistance from the public sector. Management and worker training can help them to incorporate cleaner technologies and environmental planning into work patterns. Governments should encourage cooperative efforts among smaller firms - for example, in joint research and development on environmental issues and joint use of pollution control or waste treatment facilities.

#### 4. Increase Capacity to Deal with Industrial Hazards

##### 4.1 Chemicals

65. The chemical industry is one of the most dynamic sectors in most countries, including many developing ones; and chemicals represent about 10 per cent of total world trade in terms of value.<sup>35/</sup> Some 70,000-80,000 chemicals are now on the market - and hence in the environment.<sup>36/</sup> The figure is only an informed estimate because no complete inventory has been done. Some 1,000-2,000 new chemicals enter the commercial market each year, many without adequate prior testing or evaluation of effects.

66. According to a US National Research Council sample of 65,725 chemicals in common use, data required for complete health hazard evaluations were available for only 10 per cent of pesticides and 18 per cent of drugs. No toxicity data existed for nearly 80 per cent of the chemicals used in commercial products and processes inventoried under the Toxic Substances Control Act.<sup>37/</sup> This situation is now beginning to change as governments move gradually from a system of post-market testing to one of pre-market testing of all new chemicals.

67. By 1986, more than 500 chemicals and chemical products had been banned altogether or had their uses severely restricted in the country of origin.<sup>38/</sup> In developed countries, an increasingly interdependent and effective system of chemical control agencies share test results and notify each other of new restrictions on chemicals. A ban in one country is thus often quickly followed by similar action in other developed countries. But few, if any, effective restrictions exist on the export of banned chemicals and chemical products to other countries.

68. While most developed countries are now tightening their regulatory systems, most developing countries have no effective control over this trade. Many are simply unable to establish such systems because of institutional and financial limitations and a shortage of professional staff.

69. In order to correct this, all governments, particularly in the major chemical producing countries should:

- \* agree that no new chemicals will be placed on the market until the health and environmental impacts have been appropriately tested and assessed in accordance with internationally agreed guidelines, laboratory practices, and procedures;
- \* reinforce efforts to obtain international agreement on selection for priority testing of existing chemicals, on criteria and procedures for their assessment, and on a system for international sharing of the tasks and the resources required;
- \* strictly regulate the export of banned or severely restricted chemicals to other countries, in particular to developing countries, by requiring prior notification of the intent to export; the provision of all available information concerning health, environmental, and other effects of the chemicals, as well as methods for safe use and disposal; and the prior consent of the importing country government.

70. Consumer awareness should be built up. Governments should encourage the establishment of information centres on chemical products used by consumers and strengthen the international networks of information exchange, assessment, and data banks that are now evolving in the UN and other organizations.<sup>39/</sup> Another essential step is the adoption and enforcement of regulations on the packaging and labelling of chemicals whose use may be potentially harmful to ensure that clear directions are provided in common local languages. Consumer unions and other NGOs should take the lead in collecting and distributing comparative risk information on ingredients in consumer products such as cleaning agents and pesticides.

71. The chemical producer and user industries, as the source of the risks associated with chemicals and as the greatest beneficiary of their use, should bear the responsibility for ensuring (and the liability for not ensuring) that its products meet the highest standards of safety, have the fewest adverse side-effects on health and the environment, and are handled with appropriate care by workers and users. This will require the fullest possible disclosure of information about the properties and production processes of chemical substances and on comparative risks, not only to the regulatory authorities but also to the workers, consumers, and residents of the community in which a chemical industry operates.

#### 4.2 Hazardous Wastes

72. Developed countries generate about 90 per cent of the world's hazardous wastes. All estimates have a wide margin of error, given considerable differences in definitions of "hazardous waste", but in 1984 some 325-375 million tons were generated worldwide,<sup>40/</sup> around 5 million tons of this in the newly industrialized and developing areas of the world.<sup>41/</sup>

73. In OECD member countries alone, thousands of waste disposal sites exist, many of which are likely to require some form of remedial action. Clean-up is expensive: Estimates include DM 17 billion for the Federal Republic of Germany, more than Gld 3 billion for the Netherlands, \$20-100 billion for the United States, and at least DK`400 million for Denmark.<sup>42/</sup> A large number of potentially hazardous sites may also exist in concentrated industrial-urban areas in centrally planned economies as well as in developing countries. Clean-up costs are so high that at present no insurance policies would adequately cover such operations. Some form of government intervention is required through regulatory action or financial support.

74. Waste management in developing countries suffers from a variety of problems. The frequent and heavy rains of the tropics leach wastes into the soils under landfills or even cause them to overflow. With little or no pre-treatment of wastes, this could contaminate water supplies or cause local people to be directly exposed to the wastes. Land-filling generally occurs close to industrial estates that are surrounded by poor neighbourhoods or shanty towns.<sup>43/</sup> These dangers point up the need for land use planning in developing countries, and the more urgent need to actually implement and enforce such plans.

75. The overriding policy objective must be to reduce the amount of waste generated and to transform an increasing amount into resources for use and reuse. This will reduce the volume that otherwise must be treated or

disposed of through incineration, land disposal, or dumping at sea. This is first and foremost a problem of the developed countries. But it is also a problem of newly industrializing and developing countries, where rapid industrialization is bringing the same severe problems of hazardous waste management.

76. The amount of wastes crossing national frontiers is increasing and is likely to continue to do so. Between 1982 and 1983, wastes transported in Western Europe for disposal in another country virtually doubled, reaching some 250,000-425,000 tons (1-2 per cent of the total hazardous wastes generated.)<sup>44/</sup> This increase may be attributed partly to the availability of relatively low-cost, legal, land-based disposal facilities in some countries. For example, about 4,000 shipments of hazardous wastes went from the Netherlands to the German Democratic Republic in 1984. The Federal Republic of Germany sent about 20,000 shipments to German Democratic Republic the preceding year. International transport of wastes meant for disposal at sea, either by incineration or dumping, amounted to about 1.8 million tons in 1983.<sup>45/</sup>

77. Some countries have recently proposed what amounts to a commodity trade in hazardous (including radioactive) wastes. Strengthened international cooperation in this area is vitally important, and several international bodies have taken up the matter.<sup>46/</sup> An international agreement currently being developed by OECD is to be based on three important principles: equally strict controls on shipments to non-member countries; prior notification to and consent from the country of final destination, whether member or non-member country; and a guarantee of existence of adequate disposal facilities in the recipient country.

UNEP has drawn up extensive draft guidelines.<sup>47/</sup>  
Governments and international organizations should actively support these efforts to achieve an effective international regime to control the transfrontier movement of hazardous wastes.

#### 4.3 Industrial Accidents

78. Accidents involving toxic chemicals and radioactive materials can occur in plants in all regions. According to a survey carried out by the U.S. Environmental Protection Agency, 6,928 accidents of varying severity occurred at U.S. plants between 1980 and 1985 - an average of five a day.<sup>48/</sup>

79. In 1984, liquid gas storage tanks exploded in Mexico City, Mexico, killing 1,000 people and leaving thousands more homeless. Only months after the Bhopal tragedy in India, which killed over 2,000 people and injured 200,000 more, an accident at a U.S. plant in West Virginia operated by the parent company of the Bhopal facility resulted in emergency evacuation of the community residents and some health problems. The accidental release in 1976 of the highly toxic and mutagenic chemical dioxin at Seveso, Italy, and the ensuing saga of drums of contaminated soil being passed around Europe, showed that in developed countries, too, regulations can be evaded and minimum safety standards breached.

80. In early November 1986, a fire at a warehouse of a chemicals manufacturer in Basel, Switzerland, sent toxic fumes into France and West Germany and released toxic chemicals into the Rhine, causing massive fish kills and affecting the vital water supply in countries downstream, all the way to the Netherlands. Scientists investigating the Rhine agreed that it could be years before the damaged riverine ecosystems would be to their former status.<sup>49/</sup>



81. Thus, Mexico City, Bhopal, Chernobyl, and Basel - all occurring within the short lifetime of this Commission - raised public concern about industrial disasters. They have also demonstrated the likelihood of significant increases in the frequency and magnitude of industrial accidents with catastrophic consequences.

82. These events point to the need to strengthen national capabilities and the framework for bilateral and regional cooperation. National and local governments should:

- \* survey hazardous industrial operations and adopt and enforce regulations or guidelines on the safe operation of industrial plants and on the transport, handling, and disposal of hazardous materials;
- \* adopt land use policies or regional development plans that would require or provide incentives to industries that have a high pollution or accident potential to locate away from population centres, and that would discourage people from moving close to plants and waste disposal sites;
- \* ensure that plant workers are provided with full information about the products and technologies they handle, and given adequate training in safe operational procedures and emergency preparedness;
- \* involve local governments and community residents in major siting decisions and emergency preparedness planning.

83. In many cases the consequences of accidents spill over national borders. Hence the governments of countries with hazardous industrial facilities should work with other countries bordering on or downstream from those facilities to

- \* agree on criteria for selection of sites for such facilities, which would then be subject to pre-construction consultation, joint review, and emergency preparedness planning among the countries affected;
- \* jointly prepare emergency preparedness plans for existing plants and sites;
- \* start negotiations for an international treaty providing for prompt notification and mutual assistance in case of toxic chemical accidents;
- \* agree on the minimum distance from an industrial site that would be subject to the risk management process.

84. Industrial accidents and their consequences are to a large extent unpredictable. In order to reduce uncertainties, governments, international organizations and industry itself should promote further development of technology/risk assessment methodologies, establish data banks on such assessments conducted, and make them easily available to all countries.

#### 5. Strengthen International Efforts to Help Developing Countries

85. Pollution-intensive, resource-based industries are growing fastest in the developing countries. These governments will thus have to substantially strengthen

their environmental and resource management capabilities. Though about 110 developing countries have established environmental agencies of some sort,<sup>50/</sup> most lack resources, staff, and effective political power. Even where environmental policies, laws, and regulations exist, they may not be consistently enforced. In most nations, environmental protection takes a low priority in government policies and programmes.

86. Many developing nations have begun to build up the educational and scientific infrastructure, but their technical and institutional capacity for making the most of imported or new technologies remains small. Some countries thus continue to depend on outside technical and managerial skills for the maintenance of industrial operations. For lack of capital, they often find that a new industry can only be started with the support of foreign aid, commercial loans, a direct investment, or a joint venture with a transnational corporation. These foreign institutions do not always attach highest priority to ensuring sound environmental management or to providing the cleanest and safest technology to the local industry.

87. Furthermore, the problems of developing-country governments are compounded by the vagaries of the international economic system, such as high debts, high interest rates and declining terms of trade for commodities. These do not encourage hard-pressed governments to spend high proportions of their meagre resources on environmental protection and resource management. (See Chapter 3.)

88. The developing countries themselves will eventually have to bear the consequences of inappropriate industrialization, and the ultimate responsibility for

ensuring the sustainability of their development rests with each government. They must define their own environmental goals and development objectives, and establish clear priorities among competing demands on their scarce resources. They will also need to search for more self-reliant means of industrial and technological development. The choices are theirs, but they will need all the assistance - technical, financial and institutional - that the international community can muster to help them set an environmentally sound and sustainable course of development.

89. Natural resources are, and should be recognized as, the national endowment of each country, and terms of access to these resources should reflect this concept. Resource management policies in developing countries can prevent overexploitation through the use of improved lease terms, trade agreements, export regulations, and codes of conduct, with industry's acceptance of obligations to ensure that renewable resources be allowed to regenerate and to restore land damaged by resource extraction or use.

90. Large industrial enterprises, and transnational corporations in particular, have a special responsibility. They are repositories of scarce technical skills, and they should adopt the highest safety and health protection standards practicable and assume responsibility for safe plant and process design, and staff training. The transnationals should also institute environmental and safety audits of their plants measured against standards at other subsidiaries, not just against those of other local companies, which may have less stringent requirements. These audits and their follow-up should be made available to governments and other interested parties.

91. Particular care is required in contingency planning for accidents. The views of non-governmental organizations and the local community should be sought in planning new industrial facilities. The relevant national and local authorities must be fully informed about the properties, potentially harmful effects, and any potential risks to the community of the technology, process, or product being introduced. The necessary information should be disclosed to the nearby residents in an easily understandable manner. The enterprises must cooperate with the local government and community in contingency planning and in devising clearly defined mechanisms for relief and compensation to pollution or accident victims.

92. Many developing countries need information on the nature of industry-based resource and environmental problems, on risks associated with certain processes and products, and on standards and other measures to protect health and ensure environmental sustainability. They also need trained people to apply such information to local circumstances. Public agencies are already involved in this effort. International trade associations and labour unions should also develop special environmental training programmes for developing countries and disseminate information on pollution control, waste minimization, and emergency preparedness plans through local chapters.

93. Regional organizations can promote R&D activities on environmentally sound technologies and their adaptation to local conditions, including environmental monitoring and assessment techniques, plant and process design, and policies governing the siting of industrial plants and projects. They can also encourage close working relationships between individual companies and regional institutions so as to provide training, technical assistance, and finance to local industries.

## NOTES AND REFERENCES

- 1/ As will be noted later in this chapter, the conventional classification of economic activities into 3 sectors - namely primary (agriculture and mining), secondary (manufacturing) and tertiary (commerce and other services) - has become increasingly ambiguous. Economic activities now exist that cut across all 3 sectors. Furthermore services has begun to occupy an important place of its own in developed economies. In this chapter, however, the term "industry" will be used in the traditional sense to include mining and quarrying, manufacturing, construction, electricity, water and gas.
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