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BARRIERS FACING THE ACHIEVEMENT OF ECOLOGICALLY SUSTAINABLE INDUSTRIAL DEVELOPMENT

Working paper No. II

Prepared by

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INTRODUCTION

1. In working paper No. I, entitled "The road to ecologically sustainable industrial development", the concept of ecologically sustainable industrial development (ESID) was discussed. Working paper No. I included a proposal to adopt a slightly more complete definition of ESID than the one offered by the World Commission on Environment and Development: patterns of industrialization that enhance economic and social benefits for present and future generations without impairing the basic ecological processes. It was suggested in working paper No. I that industrialization contributes to the enhancement of benefits if it is directed towards:

(a) Limiting industrial pollutants within a critical load beyond which they would adversely affect human beings and nature (eco-capacity), thus ensuring the quality of human life and the proper management of natural assets;

(b) Maximizing industrial output from a given level of resource input (efficiency), thus ensuring the appropriate use of human, renewable and non-renewable resources and minimizing waste;

(c) Ensuring that all countries have and continue to have a fair chance to participate in the industrial process, thus sharing the wealth generated by industrial activity (equity).

2. Following from the definition and characteristics of ESID provided in working paper No. I and summarized above, the present working paper looks at barriers to achieving ESID. Section I contains a description of information deficiencies that limit people's understanding of the environmental consequences of unsustainable development practices. Section II presents an examination of access to cleaner production technologies needed to attain ESID.

3. Sections III-IV provide a discussion of specific barriers that are preventing the introduction of cleaner production programmes from achieving ESID. These barriers are those most relevant to industry itself (section III), those resulting from inappropriate or non-existent government action (section IV), those resulting from international conditions (section V) and those resulting from the absence of citizen participation in societal decisions (section VI).

4. Finally, section VII contains a summary of the barriers hindering the achievement of ESID.

5. A word about the limitations of the present working paper are in order at this point:

(a) The literature on barriers to achieving sustainable development and to technology transfer in particular is vast. This working paper is not a survey of that literature; instead, it identifies some of the major barriers to achieving ESID-related objectives, which admittedly will require considerable transfer of information from the North to the South;

(b) There is no unique way to classify barriers to achieving ESID. Consequently, the barriers listed in one section could have as easily been put in another;

(c) Many of the specific barriers are encountered in developed as well as developing countries. An attempt has been made in the present working paper

to take this into account and to focus on the problems encountered by developing countries because the purpose of the Conference on ESID is to assist industry in developing countries in understanding ESID-related requirements and in formulating appropriate policies and strategies.

6. While this working paper highlights barriers to the adoption of cleaner technologies in developing countries, it must be noted that developed countries have not adopted such technologies as quickly as they could. Four brief examples from Denmark and the United States of America, countries with the financial resources and technical and scientific talent to implement cleaner production programmes, underscore this point:

(a) Waste reduction: The United States Office of Technology Assessment (OTA) estimates that 50 per cent of all environmentally harmful industrial wastes could be eliminated with the technology that was available in 1986 and that another 25 per cent with additional research and development (R and D); 1/

(b) Pollution abatement expenditures: It is evident that the diffusion of cleaner technologies is still limited. In 1985, about 20 per cent of the United States expenditure for pollution abatement was for process modifications. This percentage has remained more or less constant in previous years. Thus, the remaining 80 per cent was of "end-of-pipe" pollution control character, which means a fairly limited penetration of cleaner technologies; 2/

(c) Energy intensity: In 1985, energy intensity (the ratio between the energy consumption and industrial output) in the industrial sector was higher in the United States than in several other countries of the Organisation for Economic Co-operation and Development (OECD) (France, Germany and Japan), in spite of the existence of energy conservation technologies that could markedly improve the situation; 3/

(d) Cleaner technologies: Even in Denmark, only about one third of industry has adopted "clean" technologies. 4/

Thus, the opportunities for improvement in the adoption of cleaner production technology are poorly utilized, even in developed countries.

I. ENVIRONMENTAL INFORMATION DEFICIENCIES

7. Only recently has society come to realize that pursuing environmentally unsound practices will in the long run undermine the achievements of economic growth. Although the World Commission of Environment and Development reached some consensus on this issue, there are still many parties pursuing unsustainable practices because they are not convinced that their actions will have long-term detrimental consequences. They are not convinced that practices such as discharging mercury into regional seas or releasing particulate matter in densely populated areas will significantly affect human health and the environment, as there are non-systematic or inadequate data on the status of environmental degradation and the linkage of pollutant discharge to that degradation.

8. Environmental information deficiencies include limitations on the nature and extent of environmental degradation (physical indicators of resource depletion as well as air, water and land pollution); limited understanding of the proximate and underlying causes of, and hence feasible remedies for,

environmental degradation; limited understanding of the physical consequences of resource depletion and environmental degradation; and insufficient measurement of the economic losses resulting from environmental degradation.

9. Admittedly, there are some data on the nature and extent of environmental degradation. One can turn to the Environmental Data Report 1991/92 5/ of the United Nations Environment Programme (UNEP), World Resources 1990-1991 6/ of the World Resources Institute for a global overview, to the OECD publication The State of the Environment 7/ and to State of Environment in Asia and the Pacific 1990 8/ of the Economic and Social Commission for Asia and the Pacific (ESCAP) for a regional overview and to certain country reports, primarily from developed countries, for a general assessment. What is really missing are systematic data on the contribution of industries, primarily in developing countries, to environmental degradation in different geographical areas, data that are specific enough to result in the modification of industrial activities.

10. For some pollutants, such as conventional air and water pollutants, there is a reasonable understanding of the relationship between pollutant discharge and environmental deterioration and of the measures needed to reduce that impact. For other pollutants, such as toxic heavy metals and persistent organic pollutants, much less is known about their impact on the environment, particularly on aquatic ecosystems, and about the most cost-effective measures needed to reduce their environmental impact. For global pollutants, primarily greenhouse gases, there is considerable uncertainty about the degree and extent of their impact and the measures needed to slow down that impact.

11. In most situations, there is limited understanding of the physical consequences of resource depletion and environmental degradation. The scientific community does not know the extent to which the cumulative loading of acid deposition will affect the productivity of aquatic and terrestrial ecosystems, such as forests, and how in turn those changes will alter hydrological regimes, nor does it understand the long-term impact of heavy metal accumulation in regional seas, such as the Mediterranean.

12. Lastly, there is insufficient measurement of the economic losses or damage resulting from environmental degradation. In some developed countries, such as Germany and the Netherlands, environmental damage has been estimated at 1 per cent and 5 per cent, respectively, of gross national product (GNP). 9/ Estimates of environmental damage in developing countries are not yet available, except for selected natural resource losses such as soil erosion and deforestation. The estimates of natural resource losses range from 0.4 per cent to 9.0 per cent of GNP. Such estimates are especially needed for urban areas in several developing countries with severe air pollution problems. There are few quantitative estimates of the excess morbidity and mortality or monetary estimates of the medical costs and pain and suffering associated with these problems.

II. ACCESS TO CLEANER PRODUCTION OPTIONS

13. While the lack of information on, high costs of and limited access to clean technologies are often cited as key obstacles to ESID, these factors may be less critical than commonly supposed, at least for certain types of industry and certain levels of environmental protection. Further, there are many cleaner production options that involve simple ("good-housekeeping") measures that cost little but can be very beneficial to the environment. In

this section, the barriers to cleaner production technologies and technology transfer will be discussed, along with obstacles to new and emerging technologies.

A. Access to existing cleaner technologies

14. The accessibility of technologies for cleaner production processes is of the utmost importance to developing countries wishing to achieve ESID. These technologies are essential for meeting emerging global environmental concerns, as well as for dealing with local environmental pollution resulting from conventional pollutants.

15. Barriers that limit access to technology and the transfer of environmentally sound technology include lack of information and misconceptions about technology; suitability of technology to developing countries or to certain types or sizes of industry; existing limitations of some technologies; costs of technology; lack of skilled personnel; uncertain legislative and regulatory climate; and cultural factors. Other factors, which are discussed later, include problems with the existing international patent system; the slow rate of new investment in developing countries, which lowers the rate of diffusion of new technologies; a slanted approach to clean technology transfer as implying high-tech end-of-pipe technology; and the tendency of technology transfer to hinder the development of endogenous technological capacity.

1. Lack of information and misconceptions about technologies

16. Often information on environmentally sound technologies exists, but getting the information to the decision maker in the right place and at the right time in the most useful form can often be a problem. Thus, while the information may be available, vehicles for communicating the information may not be adequate. 10/ Sales material and instruction manuals written for and in the North, for example, are often not suitable for use in the South. This problem can be particularly acute for small-scale industry and/or for industries employing significant numbers of women. It is well known, for example, that women's access to technology, credit and training is limited compared with that of men, and this may lead to women utilizing fewer clean technologies since they lack the information and means to push for and secure more modern equipment.

2. Suitability of technology to developing countries

17. Misconceptions about technologies can also present problems. For instance, many clean technologies were designed to suit conditions in developed countries. Thus, many of the technologies exported to developing countries may not be easily adapted to the conditions, infrastructure and environment in developing countries. There is also a paucity of R and D in developing countries on solutions suited to those countries. To illustrate, certain process technologies may need continuous inputs for optimal production functioning and may break down if a batch approach is used; however, in many developing countries, batch-feedstock is a more realistic possibility than continuous feeding for several types of production activities. 11/ Thus, identifying good means of communicating cleaner technologies, as well as communicating the critical factors needed by developing countries to make informed choices, must take place to ensure effective technology transfer.

3. Limitations of existing technologies

18. The availability of cleaner production options, which cover both source-reduction and pollution-control equipment, also depends on the level of ESID sought. In working paper No. I, it was pointed out that the transformation of industrial processes in the direction of ESID must be incremental. Technology exists and appears to be available for meeting ambient standards, generally speaking, through "good-housekeeping" measures and basic pollution-control technology, as well as pollution-prevention measures.

19. Many cleaner production options for meeting ambient standards exist already; others have to be developed. Two examples of key processes from the pulp and paper industry - wood pulping and agricultural residues pulping - illustrate this point. In wood pulping, almost all stringent limits can be met by implementing modern technology. Discharges of chlorinated organic compounds from bleaching and malodorous sulphur compound emissions from kraft pulping, however, cannot be reduced by available technology to meet stringent ESID norms. It is expected, though, that by the year 2000 it will be possible to achieve a sustainable level of bleaching discharges.

20. In agricultural residues pulping (straw, bagasse), cleaner production choices are more limited owing to specific properties of these raw materials (e.g. high silica content), and not all clean production options developed for wood pulping are applicable to agricultural residues pulping. By the year 2000, it will not be possible to reduce biochemical oxygen demand (BOD) and suspended solids in agricultural residues pulping as drastically as in wood pulping. 12/ This implies that cleaner production technologies, even more than pollution-control technologies, to a large extent have to develop or be adapted endogenously.

21. Thus, the availability of cleaner production options for significant reduction in pollutants beyond that needed to meet ambient standards can be questioned, but there is some evidence, as presented in working paper No. I, that significant reductions are possible. The move to where the full attainment of sustainable practices is achieved, by total loadings standards as described in working paper No. I, remains, and will continue to remain, an open-ended task. In this regard, the major difficulty is obtaining information to initiate and implement recycling and remanufacturing.

4. Costs of acquiring technology

22. Section III, especially the subsection on costs of acquiring cleaner production technology, provides useful insight on costs of technology transfer as well. Capital costs of new, cleaner technology processes are frequently greater than "polluting" technologies. The present economic problems of developing countries, compounded by large debt burdens, may make it difficult for them to secure resources for (a) acquiring cleaner technologies or (b) building their own endogenous capacity for assessing, adapting and developing environmentally sound technologies. 10/ It should be pointed out, however, that a number of simple "good-housekeeping" measures can be adopted and implemented at very low cost, such as preventive maintenance schemes to avoid leakages and break-downs and the proper handling and use of chemicals.

5. Uncertain legislative and regulatory climate

23. The absence of a legislative framework or, more commonly, the lack of enforcement or enforceability of existing legislation hinders technology

transfer, creating uncertainty for prospective investors and discouraging foreign or national investment in technology. Uncertain political situations and policies on nationalization and privatization can also militate against the transfer of technology through foregone foreign investment or joint ventures. 11/

6. Lack of trained personnel

24. Education and training may be the most important requirements for successful technology cooperation. Countries with adequate numbers of well-educated managers and workers have been more successful in mastering transferred technology. 13/ The human resource base must be able to analyse, assess, acquire, absorb, master and develop cleaner technologies. Maintenance of highly capital- or skill-intensive technologies is impossible without the associated technological know-how and human resources. 14/

25. Even in developed countries, production engineers do not take easily to the idea of incorporating clean technology into original industrial process designs, partly because it requires a sophisticated understanding of the interaction between technological and environmental systems. Engineering education and training are only now changing so that basic engineering courses, as well as engineering design and research, reflect the ESID approach.

7. Cultural and religious factors

26. Countless books have been written about what happens if technology is imposed wholesale on a completely different culture without regard for important cultural values and characteristics. As one example, changes are needed in Islamic countries to adjust to the holy month of Ramadan with dawn-to-dusk fasting, necessitating, for example, changes in production and shift schedules. 11/ Another example, one that has already been mentioned, is the need to involve women more by exposing them to more information on clean technologies.

B. Access to new and emerging technologies

27. Technological advances in fields such as biotechnology, microelectronics, solar energy and recycling, which cut across industrial sectors, have much to contribute to ESID. Biotechnology can provide ecologically sound products and processes and help the bioremediation of wastes and toxic substances and the conservation of biodiversity. Its processes require far less energy than thermo-chemical processes, e.g. for leaching metals or for manufacturing chemical products. Materials engineering reduces the consumption of materials, thereby helping to conserve natural resources and ensuring savings in energy consumption, as well as in wastes and emissions. The advantages of solar energy, from an ecological point of view, need no elaboration. What then are the barriers to the diffusion of these new and promising technologies?

28. Technologies in these fields are often skill-intensive, quickly commercialized and, because of continuing advances, quickly obsolescent. Considering the market size and the investments needed for R and D and for production, developing countries need to be selective and to apply the new technologies in those areas where they are best suited. For this purpose, developing countries must strengthen their technological capabilities over the long term.

29. The various barriers to the utilization of technological advances are basically not different from those discussed so far, though issues of patent protection and access are even more hotly debated. Moreover, awareness of the potentials and implications of the technological advances is lacking in many developing countries and a policy framework for the assessment and introduction of the advances does not exist.

30. In biotechnology, for example, the building up of capabilities in advanced techniques such as genetic engineering is important. Knowledge in the field of biotechnology is being increasingly privatized. The capacity for efficient commercial-scale bioprocessing is lacking in many developing countries. Regulations relating to biotechnology safety are environmentally essential, as in the case of other chemical processes, but excessive and cumbersome controls could become a barrier to production and trade within and between countries.

31. Production of new materials in developing countries faces constraints of market size, but advanced techniques of materials engineering can be applied to new as well as traditional materials, including biomass and other local resources. Increased attention needs to be given to testing and evaluating new materials and to setting up standards. Composite materials generally result in less use of materials but the recyclability of some of the composites is in question. The materials field as a whole can be channelled more and more in the direction of ESID.

32. Microelectronics provide products and processes that save energy and replace mechanical parts. Monitoring and control of pollution are rendered easier. It is applicable over a wide range of industries. The capacity of developing countries to produce software for various applications is a constraint. The production of microchips involves the use of toxic materials and it is now well recognized that adequate safeguards are necessary. The use of microchips, however, poses no environmental problems.

33. In the case of solar energy, particularly with solar photovoltaics (PV), the costs are coming down. Since 1973, the price of PV electricity production has decreased from $US 15 per kilowatt hour (kWh) to $US 0.30 per kWh. 15/ (The newest solar thermal power stations already compete with new coal- or oil-fired plants.) Larger market size for PV cells would reduce the costs further and make it a viable energy option not confined to isolated sites and applications. Market surveys could be a starting-point but the main emphasis has to be on expanding the size of the market by development of appropriate products and systems. Hence, more attention has to be given to design and also to the production of balance of system components (auxiliary equipment) connected with solar photovoltaics. The capacity for building PV systems is therefore of particular importance. This gives special scope for systems engineers and engineering and design consultants, who are generally in short supply in developing countries.

34. Energy supply that does not damage the environment can in the long term only be based on renewable energy sources. Hydrogen can be used for the production of heat and electricity and as a transportation fuel. Its use, however, is still much at the research stage and requires technical development for cost reduction, especially if it is linked with solar energy. Its use would also require changes in energy delivery systems.

35. Micro-electronics is not the only emerging technology viewed as having a large potential for energy conservation: the next generation of heat-pumps,

super heat-pumps, will be able to recover low-grade heat, which is currently being wasted; 16/ chemical vapour deposition, a technique for layering thin coatings of materials on surfaces, might greatly decrease the cost of solar power, improve the energy efficiency of homes and offices and increase the speed of computers; 17/ and there are prototype cars that are five times more fuel-efficient than other cars. 18/

36. Absence of sustained funding over the long term for both research and application has been a barrier for many new technologies. This is especially true for solar and other renewable energy technologies where investment in research has fluctuated with world oil prices.

37. Recycling technologies exist in large measure but their cost-effectiveness and the organizational efforts to collect waste are factors to be considered. Increasingly, biodegradable materials are being used for packaging. New technologies for recycling plastics, notably polystyrene, are currently under development, primarily to reduce the amount of plastic packaging material going into landfills. In general, however, the recycling/reuse issue is one of scale and organization, as well as of technology. The exception to this statement may be in the area of design and disassembly of vehicles, appliances and machinery. There, the recovery efficiency and quality of all kinds of materials can be improved to permit the remanufacture of generic components, such as gearwheels, axles and engines. This change calls for genuinely new technologies. Their systematic development has only recently commenced.

38. The use of advanced technologies in the service of ESID in a forward-looking context is therefore an area that needs increased attention. International cooperation in a range of generic and precompetitive research is needed to harness technological advances for the development and application of environmentally sound technologies.

III. INDUSTRY BARRIERS

39. Within the industrial community, a number of barriers hinder acceptance and adoption of ESID. These barriers include attitudinal obstacles, labour barriers, patent and property rights, the need for better trained personnel, costs of acquiring technology, and costs of operating and using technology.

A. Attitudinal barriers

40. Changes in attitudes of the entire industrial community, not to mention Governments and the public, are essential for effecting the shift from short-term thinking towards a longer-term sustainability outlook. Industry's attitudes, like those of the rest of society, once laboured under simplistic thinking, seeing a dichotomy between jobs or the environment rather than seeing them as inextricably linked. In terms of environmental protection, industry and Government both saw dilution as the solution to pollution.

41. The limitations of the dilution approach quickly became evident to industry and Government alike. Pollution control, or focusing on end-of-pipe technology, was the next orientation and this approach has preoccupied government environmental agencies and industry alike for years. Even with sophisticated pollution-control equipment, there are still wastes to be disposed of at high costs, filters and scrubbers to be cleaned and so on.

42. Another shift in industry's attitudes is currently taking place, driven by the recognition that pollution prevention is the solution. This way of thinking recognizes that reducing resource waste has both economic and environmental benefits. 19/ It requires that corporate decisions incorporate a total ("cradle-to-grave") life-cycle approach into the design of products and production processes.

43. This comprehensive ESID or cleaner production approach has been pioneered by a few firms and has been found invaluable from a business as well as an environmental standpoint. One firm estimated that by using that approach, it saved nearly $US 506 million in a 15-year period. 20/ So why are more industries not adopting the approach?

44. Looking at the tanning industry, found in many developing countries, two attitudinal barriers must be overcome to encourage adoption of cleaner production techniques: the first is simple resistance to changing what works ("if it isn't broken, don't fix it") and the second is a limited perception of the environmental harm caused by tanning. If a tanner is consistently producing a quality of leather that satisfies his or her customers, he or she may be reluctant to make changes to comply with environmental demands. 21/ Furthermore, traditional tanning is a mixture of art and science, and adoption of a low-waste technology may radically alter the traditional process with which the tanner is comfortable. Since many tanneries are marginal operations, some tanners may feel that, by adopting such a technology, they may be jeopardizing their entire operation.

45. Knowledge among tanners of the actual environmental harm caused by tanning also appears to be quite limited. Tanning in most developing countries is a family operation, run by people with little formal education using skills passed down from one generation to the next. The elders may have little perception of environmental protection concerns. 21/

46. In 1982, a United States researcher on waste reduction presented what he saw as the principal obstacles to waste reduction. Specifically, he suggested that 60 per cent of the obstacles were political, with technical obstacles constituting only 10 per cent of the stumbling blocks. Of the political barriers 20 per cent were attributable to bureaucratic resistance and 10 per cent to human conservatism (see table). 22/ Thus, the reluctance to change, even after new processes or technologies have proven successful, underlines the importance of not underestimating attitudes and the role that they play in hindering change or speeding acceptance.

47. The attitudes of women in industry deserve mention here. Since close to 200 million women are employed in industry, especially in light industries (electronics, food processing and textiles) and in low-paid, unskilled jobs, their attitudes toward ESID and potential as change agents must be considered. As low-skilled workers, they are among the most likely to be directly exposed to toxics and on the front line in terms of their role in taking action to cause or limit environmental damage. If their creativity can be mobilized, some great strides can be made - with the adoption of fundamental steps such as monitoring and "good-housekeeping" practices. Furthermore, as women play a crucial role in most societies in socializing current generations and educating future generations, giving women information on ESID approaches and the means of promoting ESID could be especially effective.

Obstacles to waste reduction

Obstacle	Share (percentage)
Political in nature	
Bureaucratic resistance	20
Human conservatism (resistance to change)	10
Piecemeal legislation	10
Media sensationalism	10
Public ignorance and misinformation	10
Total	60
Financial in nature	
Disposal "subsidies"	10
Scarce money	10
Entrenched disposal industry	10
Total	30
Technical in nature	
Lack of centralized reliable information	5
Lack of assistance with the application of waste reduction approaches to individual needs/uses	5
Total	10

Source: D. Huisingh, "Cleaner technologies through process modifications, material substitution and ecologically based ethical values", Industry and Environment, vol. 12, No. 1 (January-March 1989), p. 5.

B. Patent and property rights

48. Patent rights constitute another barrier that is frequently cited, albeit in general terms. Reportedly, the price set for patents can be too high for the local market in developing countries. But information is lacking on how serious and widespread a problem this can be in hindering the adoption of cleaner technology or the transfer of technology. One reason that the barrier of patent protection may not be as serious as previously thought is that few of the environmentally sound technologies under patent protection actually restrict their availability in developing countries. 10/ An exception to this may be in the biotechnology area, where companies are patenting processes and technologies to protect their investments.

49. Some technology development, including the development of cleaner technologies, is undertaken by public R and D institutions. These public domain technologies may only require multilateral and bilateral exchanges and

clearing-house mechanisms to ensure their timely transfer. 10/ According to an ongoing OECD survey of trade barriers to the adoption of eight clean technologies, intellectual property rights are rarely an obstacle to the diffusion of clean technologies. 23/

50. Nonetheless, the rationale advanced for patent protection cannot be dismissed; inventors must be adequately rewarded so that incentives exist for sustained effort in new R and D. The balance between an incentive system that promotes R and D and rewards inventors and a system that ensures developing countries access to cleaner technologies must be considered. 8/

C. Labour barriers

51. Although many cleaner technologies are not very advanced, their potential impact on labour can hinder a firm from making the change. For example, replacing the transportation of red mud from aluminium production by trucks with a pipeline to the storage area can have significant social disadvantages; the resulting unemployment of a number of truck drivers may be seen as socially untenable for the business in question. 24/

52. In the case of a modern pulp and paper mill capable of meeting present environmental norms and of adjusting to more stringent ESID norms by the year 2000, the fact that such a mill will employ a much smaller workforce is a definite obstacle to the construction of such mills in developing countries. The new mills would consolidate the production at several small mills, resulting in loss of employment and community disruption.

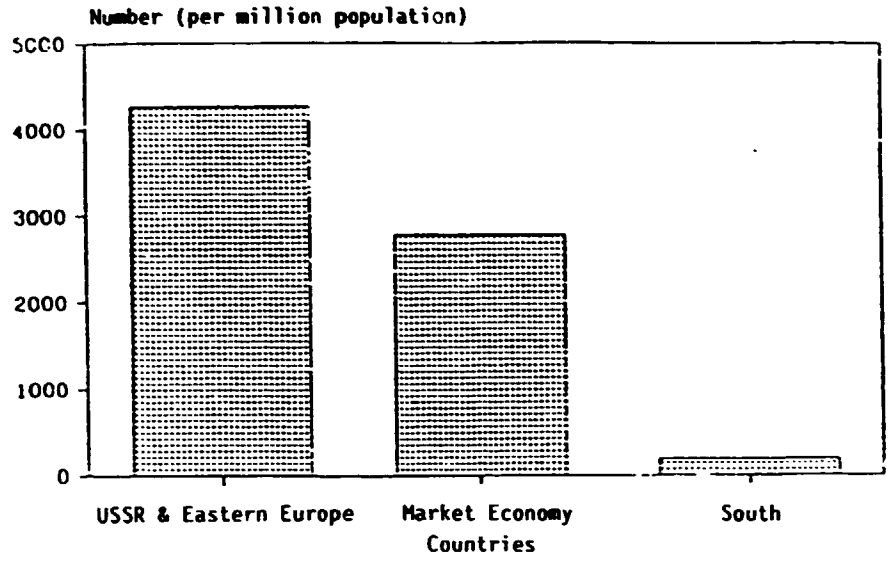
D. Lack of trained personnel

53. Another barrier faced by industries interested in adopting cleaner technologies is the lack of trained personnel to analyse, adapt, operate and maintain newer technologies. As indicated in section II, many cleaner production technologies are skill-intensive. Sometimes training can make the difference between a cleaner technology being profitable or not. In aluminium production, the use of burnt lime for reducing caustic soda losses (mud causticizing, complex causticizing etc.) requires special operating and analytical skills. The processes are usually profitable only within a narrow range. Insufficient amounts of lime do not have the expected effect; too much may cause extra alumina losses. Reluctance to pay proper attention to these processes (especially during afternoon and night shifts) can nullify all positive results of the causticizing. Workforce training and incentives are essential. 24/

54. The need to build up capabilities in advanced techniques such as genetic engineering is also vital. But there are few microbiologists in developing countries and they require advanced training.

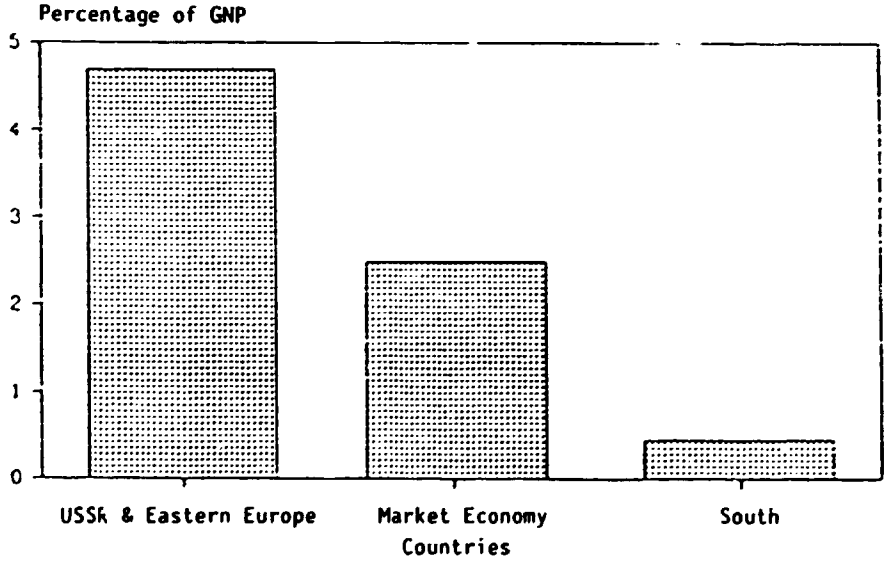
55. A serious impediment, particularly for developing countries, is the absence of a critical mass to assess and adopt cleaner production techniques. Although there are no specific data on the scarcity in this particular area, there are data on the absence of commitment in developing countries to science and technology. As evident in figures I and II, expenditure on R and D as a percentage of GNP and the number of scientists and engineers per million population are much lower in developing countries than in either planned or market economies.

Figure I. Number of scientists and engineers per million population in the North and in the South



Source: The Challenge to the South: the Report of the South Commission, forthcoming.

Figure II. Expenditure on R and D as a percentage GNP in the North and in the South



Source: The Challenge to the South: the Report of the South Commission, forthcoming.

E. Lack of quality control

56. The lack of quality control procedures in some firms can be an obstacle to achieving full benefits from a clean technology. When a laboratory is not directly under the jurisdiction of plant management, it appears that control

methods degrade. One example of the link between quality control and "good-housekeeping" measures is alumina production: it has been found that simply more careful operation and maintenance can save 1-2 per cent of caustic soda consumption. 24/

F. Costs of acquiring cleaner production technology

57. The costs of acquiring cleaner production technology, especially capital costs, can be prohibitively high in the case of certain technologies, smaller enterprises, older plants and certain industries (see section II). The perceived costs, however, are often not as high as the actual costs, particularly when other operating and pollution control costs are taken into account. And some cleaner production options simply require adoption of "good-housekeeping" measures.

58. With virtually no new investment and with the involvement of thoughtful and creative managers and workers, a number of "low-tech" changes are possible. For example, a textile mill at Bombay, India, increased the collection rate of the caustic soda from its mercerizing wash waters from 75 per cent to 85 per cent and the recovery rate from 81 per cent to 90 per cent by more efficient washing, better filtration, correcting leakages and seapage, and other corrective measures. Net savings of 415 kg of caustic soda per day resulted in an estimated savings of 684,750 rupees per year. 25/

59. Considerable strides have also been made in containing pollution from leather tanning simply by adopting measures that require little or no capital investment such as:

(a) Strict process control, including avoidance of overdosing of chemicals;

(b) Water conservation at all stages of wet processing;

(c) Introducing reuse-recovery-recycle systems that can save expenditure on chemicals and, in turn, pay for the simple equipment needed to run them, such as collection pits, pipes and pumps.

60. It is believed that strict process control, "good-housekeeping" measures and cleanliness, the introduction of recycling of some floats, and predominantly aqueous finishing, together with simple treatment of wastes, may result in the elimination of nearly 50 per cent of the total pollution load discharged into the environment, with only a marginal investment. 26/ This illustrates that cost need not be a barrier to adopting cleaner production techniques. Additional examples are discussed in working paper No. III.

61. For some small-scale businesses, however, such as family tanners, the cost of introducing cleaner technology is a very real barrier. The price of the special drum for "hair" recovery with the necessary auxiliary equipment may be as much as twice the price of a conventional drum. 21/ As another example, the much-touted high chrome exhaustion tanning method requires expensive specialty chemicals, normally proprietary products. 21/ In the pulp and paper industry, price fluctuations of chemicals such as caustic soda and chlorine may act against the implementation of clean production options. As caustic soda prices increase more rapidly than chlorine, some mills tend to reduce caustic soda changes, thus increasing residual lignin and using more chlorine in bleaching. 12/

62. Another financial barrier is higher interest rates on borrowed capital in developing countries. Tanners in developing countries may have much more capital tied up in work-in-progress because they frequently experience delivery delays and shortages and, consequently, need to keep higher stocks of chemicals and machinery spares. 21/ Thus, obstacles such as higher interest rates and more "tied up" capital further hinder the adoption of newer, cleaner technologies.

63. Cost need not always be an obstacle. Some multinational corporations have transferred technology at no cost to manufacturers in developing countries. The Industry and Environment Bureau of the International Chamber of Commerce cites a case where a small company in a Gulf State, which was electroplating designs on aluminium cans, had difficulties with trace metals in the wastewater. The Bureau, through its contacts, found a member that had developed a system to handle the trace metals and passed it on to the Gulf manufacturer at no cost. 27/ Thus, where there is no commercial conflict of interest, technologies can be offered at little or no cost.

64. Import duties on chemicals and machinery can be another barrier to the use and maintenance of cleaner production technology. Duties vary tremendously from country to country and can run as high as 100 per cent. 21/ Regulations pertaining to import duty on imported equipment present serious economic barriers to the adoption of cleaner technologies in developing countries. In India, the import duty for paper machinery is 40 per cent. There are similar restrictions in Brazil. 12/

65. Efficient alumina plants, which extract nearly all available aluminium oxide content, require both better facilities (capable of applying a higher digestion temperature) and a more sophisticated process control system. Both involve capital costs ranging from $US 10 million to $US 100 million, depending on plant capacity, which represent a very real economic barrier to the adoption of cleaner production. The replacement of worn-out equipment after 20-30 years of operation, however, offers a good opportunity for such modernization. Such changes are long overdue in older plants in China, India and some other developing countries. 24/

66. Though larger firms may be able to afford some cleaner production technologies, smaller firms, which are more common in developing countries, may not. For instance, in China, the budget for a pulp and paper chemical recovery system for a large-capacity mill is estimated to be $US 4.5 million. Many smaller mills simply cannot afford such an investment. 12/ One way to overcome this problem is for small- and medium-scale enterprises to undertake joint efforts in areas such as resource recovery and waste treatment.

G. Size and maturity of firms

67. One of the difficulties most often cited in the literature is related to the characteristics of firms and the structure of industry. In particular, a firm's absorptive capacity for technical change is seen to be related to the size and maturity of the firm and industry in question. A firm in the early stages of its growth cycle tends to be flexible in its choice of production methods and, hence, can be receptive to new processes. As the firm becomes mature, however, it becomes moulded to certain established manufacturing practices. As a result, the production system becomes more inflexible and technical changes tend to be marginal. For instance, paper and pulp in France, leather tanning in the Netherlands and sugar refining in the United Kingdom of Great Britain and Northern Ireland are all mature industries that

have shown some resistance to new process technologies and that have preferred "end-of-pipe" approaches to pollution abatement. Resistance to technical change caused by the ossification of industry structure, however, may be less relevant in a large number of developing countries, where most of the manufacturing industries are either at embryonic stages of development or are yet to be developed.

68. The size of firms may affect significantly their capacity to absorb new technologies regardless of the stage of development. The small size of firms may prevent them from adopting clean technologies, even if they are aware of such opportunities, since they cannot afford the capital outlay, the modernization required, or the attendant risks of using new technologies. They are not capable of undertaking any large-scale R and D and, hence, become technically dependent on outside sources. Such limitations of small- and medium-sized firms are likely to be even more serious in developing countries. 14/ As an example, many of the cleaner production technologies for pulp and paper were developed primarily for larger mills. Scaling down would result in lower efficiency, such as heat consumption and chemical recovery efficiency. 12/

IV. GOVERNMENT BARRIERS

69. At the national level, there are several barriers to the adoption of ESID-related measures. These barriers include policy failures, legislative/regulatory failures, and problems caused by government management of enterprises.

70. Failure to pursue ESID-related actions, strategies and activities is attributable to many factors, many of which are often intertwined and mutually reinforcing. At the national or government level, it is important to distinguish between policy and legislative/regulatory failures.* Policy failures are government interventions, such as misdirected industrial policies and resource pricing distortions, in reasonably well-functioning markets. Legislative/regulatory action is needed where markets do not function adequately. The absence of market prices for environmental services and resources is one such example.

A. Policy failures

1. Industrial policy

71. Most developing countries have, over the last 40 years, pursued a policy of industrialization, in which industrial activity has received subsidies of various kinds, ranging from protection, in the case of import substitutes, to incentives, in the case of exports. Much of the production that takes place in this framework is inefficient, in the sense that it entails higher true costs than the same products produced in developed countries. Government controls the technology used in the sector, indirectly through its protectionist and subsidy policies and more directly through its regulation of the

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*This distinction and the discussion that follows are based on T. Panayotou, "Economic incentives in environmental management and their relevance to developing countries", Environmental Management in Developing Countries, proceedings of the Conference on Environmental Management in Developing Countries, Paris, 3-5 October 1990.

activities of transnational corporations. The overall "success" of such industrialization programmes has been mixed, with high growth rates in export-oriented sectors and relatively low rates in import-substitution- oriented sectors. Although higher industrial growth rates have been found in some countries, in almost all of them the capacity of the sector to absorb labour has been limited. In India, industrial output rose by 6.7 per cent per annum in the period 1968-1984, while employment rose by only 2.9 per cent per annum during the same period. 28/

72. The environmental implication of this is that, with a growing population, much of the environmental damage with which developing countries are faced is related to the unsustainable use of natural resources by a population that does not have access to alternative income-generating activities. It would be unfair to lay all the blame for environmental degradation in the agricultural sector on the inability of the industrial and other sectors to create employment opportunities, but there is something to this argument, as has been pointed out by a number of writers.* Hence, the question that should be asked is whether the whole policy of ESID does not need to be seen in the light of a need to maintain higher employment in the economy and to stabilize population growth, thereby relieving the pressure on the resource base. This need is met not only by developing a highly capital-intensive, "modern North-based" industrial sector. There will always be a role for such a sector, but it needs to be accompanied by a labour-intensive industrial sector, where the benefits are in part the avoided environmental damage caused by an over-populated and underemployed rural economy that colonizes marginal land or puts pressure on the Government to permit the exploitation of forest land for agriculture.

73. A number of developing countries have adopted policies that make it difficult for a local firm to license foreign technologies, with the aim of stimulating local entrepreneurial creativity to find substitutes. The results, however, are mixed. The rapid growth in industry and in exports in East Asia shows that flexible protection of the domestic market is not inconsistent with export success. In several Latin American countries, however, industries sheltered by heavy and indiscriminate protection have no incentive to look for export markets. As clean technologies may be developed further once they have been introduced, there may well be a case for countries making exceptions in their protection policies for some of these technologies.

2. Sectoral policy

74. Governments may also hinder ESID by targeting or emphasizing certain sectors for special support (through fiscal, trade or other reductions or incentives) without considering the environmental implications of such support. Sectoral policies that do not take into consideration the environment may result in Governments failing to close down inefficient industries or to require appropriate environmental processes and controls on new industries. In many cases, these sectoral policies tend to support the most polluting

*See, for example, A. Markandya, "Technology, environment and employment", ILO Working Paper No. 216, Geneva, 1991, and D. W. Pearce and J. Warford, "Environment and development", World Bank mimeo. Although this link between a lack of employment opportunities and environmental damage has been made many times, it is only fair to point out that there are few detailed studies to support the proposition and, in general, the quantification of the links is virtually non-existent.

industries. Most of these growth sectors are industries that are highly resource-intensive, using large quantities of water, energy and raw materials, and concomitantly highly pollution-intensive, creating a diversity of pollutants and industrial wastes, including toxic chemicals. The following four industrial sectors grew twice as fast in developing countries as a whole compared with developed countries in the period 1980-1985: iron and steel; nonferrous metals; nonmetallic minerals; and chemicals. 29/ Because of the rapid growth of these industries, arising in part from explicit government support for such industries, industrial development in the countries concerned may become ecologically unsustainable more quickly than expected.

3. Pricing policy

75. Government pricing policies (e.g. subsidies, taxation, overvalued currency) may lead to distortion in the behaviour of industries, which in turn contributes to both government financial burdens and environmental degradation. A classic case is the underpricing of wastewater-related services and energy resources. For example, many industrial establishments discharge their wastewater into public treatment systems. These systems do not charge industry for using their services, according to many surveys, including a recent one by UNIDO (ID/WG.507/9 (SPEC.)). As a result, industry uses too much water in its production processes, forcing the public treatment works to build unnecessary capacity. In the energy area, for example, China and Egypt have low levels of power tariffs, which have not been adjusted for three decades. 30/ Consequently, the energy intensity is higher in these countries than it needs to be and the discharge of energy-related pollutants is greater than it needs to be. Another case is the use of accelerated depreciation for end-of-pipe pollution-control equipment. This tax advantage discourages the use of process change, which builds permanent pollutant reduction into the production process.

B. Legislative/regulatory/coordination failures

76. Several problems hinder implementation of ESID within and across government institutions in developing and developed countries. These include poor integration of environmental and economic policies, legislative shortcomings, poor enforcement capability and poor environmental management.

1. Poor integration of environment and economics

77. The segregation of government economic and development policies and agencies from their environmental policies and agencies presents a serious barrier to ESID implementation. Even in environmentally conscious developed countries, economic planning takes place without consideration of the environmental implications of such planning. Another barrier is the relative weakness of many environmental protection agencies. Without a voice in the formulation of national economic plans, environmental agencies are in no position to ensure the integration of environment and economics. Environmental agencies themselves, as well as environmental legislation and regulations, will also need reform and change, as many are oriented towards "single-media" effects (e.g. air pollution) and pollution control rather than towards "multi-media" effects (e.g. air, water and soil pollution) and pollution minimization. 31/

2. Inappropriate strategy

78. Even functioning environmental management agencies in developed and developing countries can create obstacles to ESID by making pollutant reduction costs higher than they need be. First, they tend to be "single-medium"-oriented, regulating air, water and waste discharges separately from industrial facilities. They discourage "multi-medium" pollutant reduction plans because their legislative statutes are "single-medium"-oriented and comprehensive pollutant reduction plans are difficult for their current organizational structures to assess. Secondly, they tend to encourage end-of-pipe rather than source reduction and recycling/reuse as the way to reduce pollutant discharge. End-of-pipe technology is the known solution that environmental (civil) engineers learn in universities; it provides visible evidence that a plant has made an effort to reduce pollutants. Thirdly, they tend to require all industries of a similar type to meet uniform discharge standards regardless of the surrounding ambient conditions and unique circumstances (such as size and production costs) that would allow cost-effective reductions. All of these factors contribute to making pollutant reduction costs much higher than they have to be to achieve ambient standards. Even though OECD data show that spending on pollution control is a small percentage of GNP, in the range of 1-2 per cent, such spending could have been even lower if environmental management agencies had pursued over the past 20 years an integrated pollution prevention strategy that had focused on cost-effective pollutant reductions. 32/

79. In the enforcement arena, when standards are enforced and fines are large enough, companies will often invest in new technologies (since the cost of complying is less than the cost of being in violation). But without adequate enforcement, a significant incentive is missing for inducing firms to adopt cleaner technology. Thus, standards that are not enforced, often because of a lack of personnel, are another serious obstacle to Governments carrying out their responsibilities for implementing ESID. 33/

80. Many developing countries have failed to create regulatory regimes to implement their legislation. A world-wide survey by the World Health Organization (WHO) in 1985 highlighted the lack of the basic elements of a regulatory programme. 34/ Of the 59 moderately to rapidly industrializing countries, only 10 had most of the key programmed components, 29 had some and 20 had little or none. Not one of the 76 less industrialized countries had any significant institutional capacity in environmental management. A survey by UNIDO in 1990 of industrial wastewater management in seven African countries showed that, although all seven had some form of legislation or statute, only one had the essential elements of a regulatory programme (ID/WG.507/9 (SPEC.)).

C. Government-managed enterprises

81. Major industrial enterprises in developing countries are often nationalized public companies with a record of political rather than economical management resulting in a history of chronic losses and of serious environmental degradation. Many Eastern European enterprises are also wrestling with the negative effects of poor public management, although information on this problem is just beginning to emerge. These sectors watch carefully for problems associated with public sector management and especially the apparent reluctance of such groups to take environmental considerations.

V. INTERNATIONAL BARRIERS

82. At the international level, at least three barriers impede the implementation of ESID: the financial crisis of developing countries, compounded by the failure of developed countries to bear their share of ESID implementation; the terms of international trade; and the inherent limitations of sovereign States.

A. Financial crises

83. In the 1980s the financial conditions of developing countries deteriorated because of high interest rates and volatile exchange rates, the reduced volume of net resource flow to these countries, the sharp drop in commodity prices leading to further decline in their terms of trade, and an increasing level of protectionism.

84. Real interest rates (excess of nominal rates over expected inflation) in major industrial countries increased sharply between 1979 and 1982: long-term interest rates increased from -0.3 to 7.5 per cent per annum and short-term interest rates rose from 0.7 to 6.8 per cent per annum. After reaching a peak in 1982, real interest rates have fallen slightly. They have, however, remained until now at a historically high level, i.e. significantly above the range of average real long-term rates for major industrial countries in the period 1952-1965 (1.5-3.0 per cent per annum). This contrasts sharply with the period 1976-1979, when this rate was only 0.9 per cent per annum. 35/

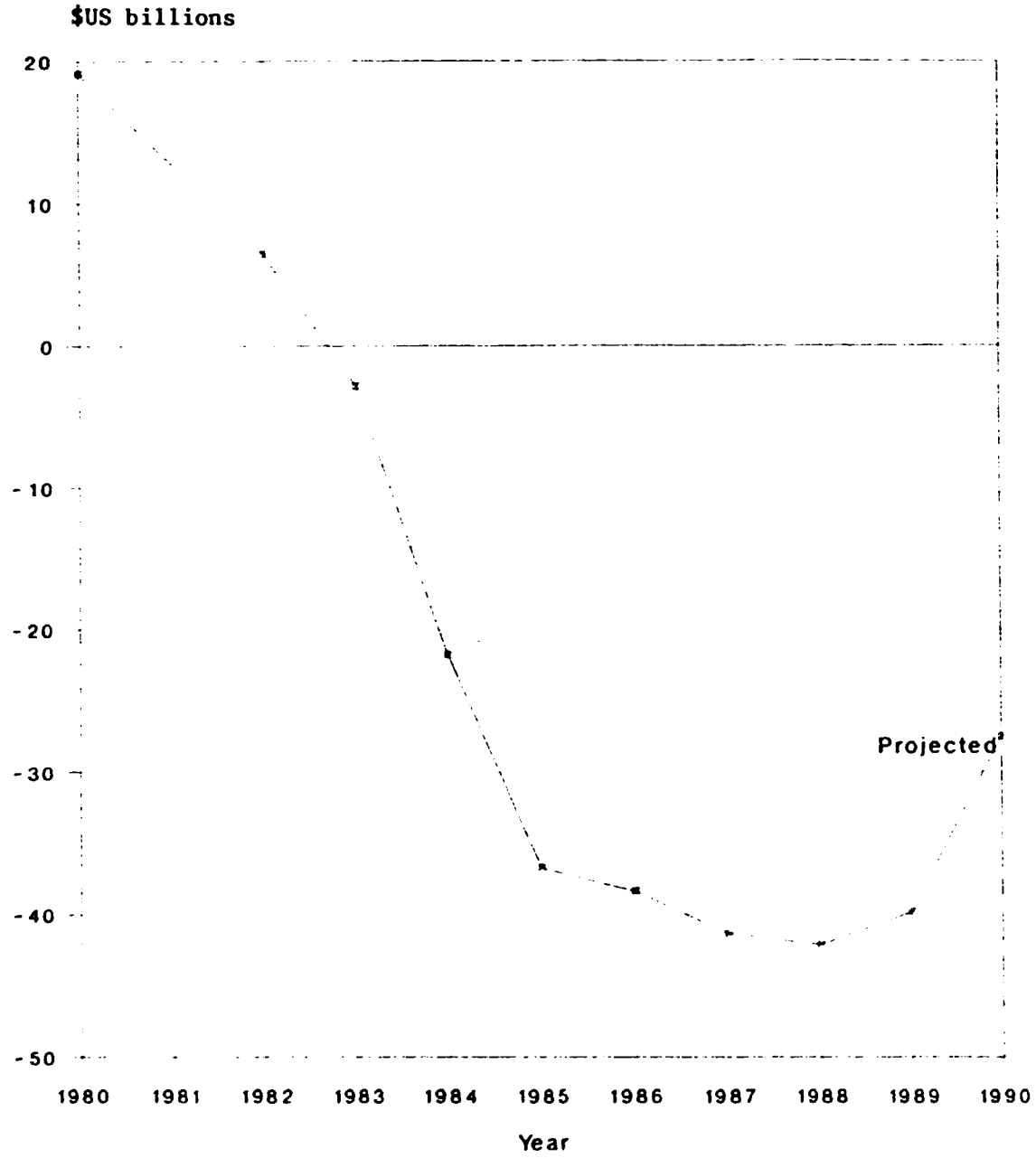
85. Increased interest payments, accompanied by drastically reduced debt-related flows (disbursement of loans minus principal repayments), resulted in an extremely negative trend of debt-related transfers (debt-related flows minus interest payments on long- and short-term debt) for developing countries in the 1980s. Whereas in 1980 debt-related transfers were still significantly positive ($US 19.1 billion), in 1983 the debt service repayments of principal and interest charges of developing countries already exceeded loan disbursement. Debt-related transfers have remained negative for developing countries as a whole since then; the total volume of such transfers amounted to $US 250 billion for the period 1983-1990. 36/ Although by far the most significant was the negative transfer from developing countries to commercial banks in industrial countries in the North, there was even a net transfer from current borrowers to the World Bank in 1988 and 1989. Figure III illustrates the trend of net transfer on debt-related transfers by developing countries in the period 1980-1990.

86. Direct foreign investment in developing countries also declined in the first half of the 1980s, while the outflow of profits remained consistently higher than the inflow of new investments until 1986. From 1987 on, however, transfer of financial resources channelled through direct foreign investment again became positive for developing countries as a whole, as the continued interest of foreign investors in investing in Asian countries was supplemented by renewed interest in Latin America.

87. To sum up, the reversal in the direction of debt-related transfers and the only slight recovery of direct foreign investment transfers in recent years, combined with practically stagnating official development assistance in the 1980s, resulted in a sharp fall in aggregate net transfers to developing countries in that decade. Whereas aggregate net transfers of long-term resources were positive for the South as a whole until 1983, they were negative for every year from 1984 to 1989. For Latin America alone, the total

volume of such transfers amounted to over $US 110 billion in the period 1984-1989. 37/ If data for short-term interest payments were to be included, negative aggregate net transfer figures would be significantly higher.

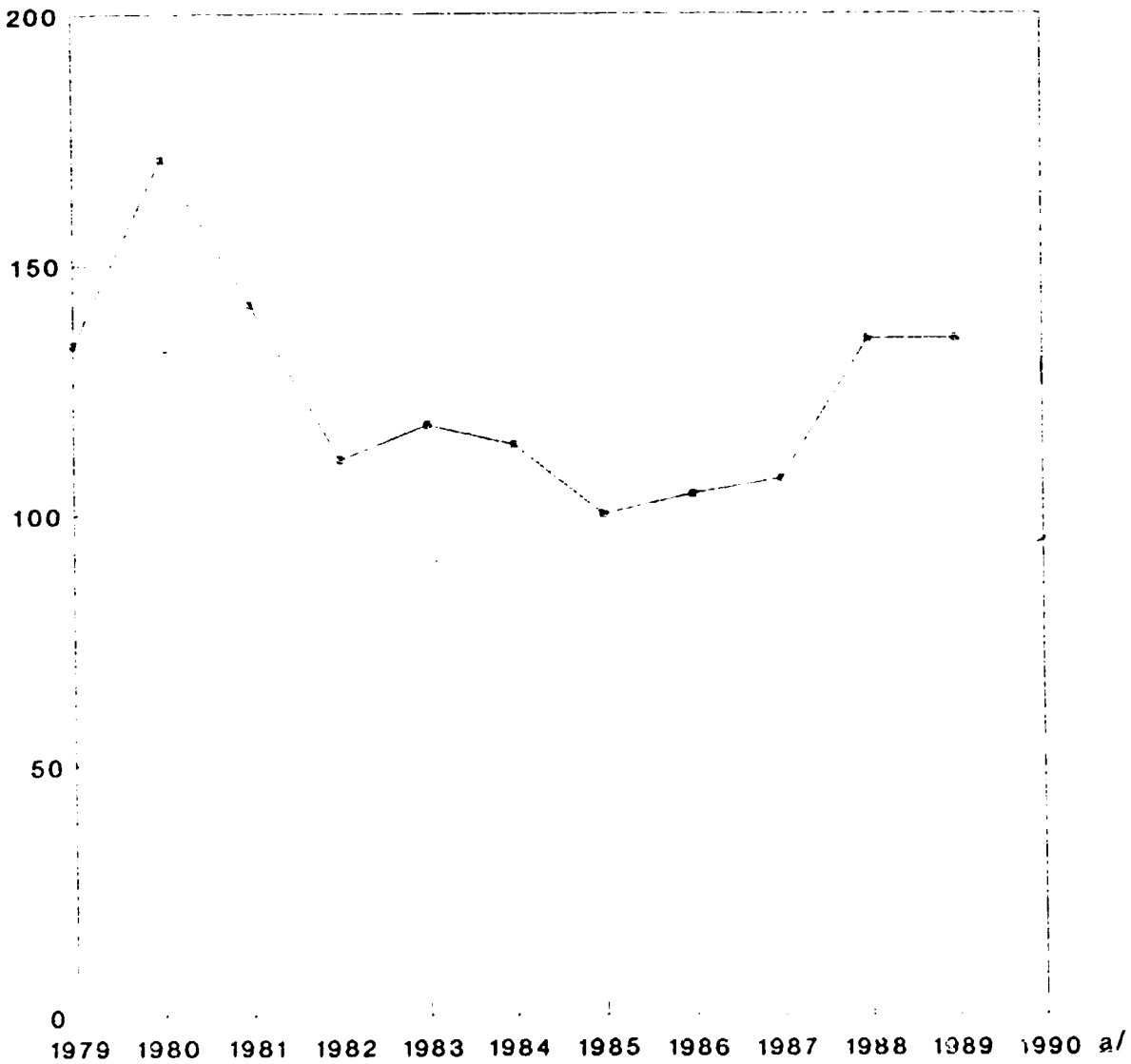
Figure III. Net debt-related transfers, developing countries, 1980-1990



Source: World Bank, World Debt Tables 1990-91: External Debt of Developing Countries; Volume 1. Analysis and Summary Tables (Washington, D.C., 1990), p. 126.

88. Commodity prices also declined in the 1980s (see figure IV). In 1990, the prices of non-fuel commodities exported by developing countries (combined index) were 25 per cent lower than in the beginning of the 1980s, whereas the fall in food commodities was even greater: 36 per cent. 38/ As a result of declines in commodity prices and increases in manufacturers' prices, the terms of trade of developing countries as a whole have deteriorated significantly since 1980. There have been, however, differences between the various regions of the South. While the terms of trade of selected developing countries in Asia have not actually changed much, they have dropped to around 25 per cent in the case of developing countries in the western hemisphere and in sub-Saharan Africa and to about 50 per cent in the case of Middle Eastern countries.

Figure IV. Price indices of prime commodities, 1979-1990
(1985 = 100)



Source: UNCTAD Commodity Yearbook 1990 (United Nations publication, Sales No. E.90.II.D.9), table A.1.

a/ First seven months only.

B. Trade policies

89. There are several trade barriers that may impede the achievement of ESID: tariff and non-tariff barriers, production and export subsidies, and trade agreements. One of the basic issues underlying trade and the environment is the way environment policies can result in trade distortions and trade policies can lead to negative environmental results.

1. Tariff and non-tariff barriers

90. Tariff and non-tariff barriers, whether intentional or not, can impede the transition to ESID. For example, restrictions on market access (the quota system) can force countries to increase the production of pollution-intensive or natural-resource-intensive goods because they cannot capture other product markets. Faced with domestic and external financial problems, many developing countries resorted to pollution-intensive sectors in the 1980s. Increased protectionism in OECD countries reduces market access for non-traditional goods from developing countries and hence prevents their diversification into more ecologically sustainable activities.

91. Another set of trade restrictions may be imposed by OECD countries in their demand for "green" characteristics in products. 39/ Some members of the General Agreement on Tariffs and Trade (GATT) want to set up a special committee to look at environmental trade issues. They are opposed by some developing countries that fear that environmental protection may become one more reason for excluding some products.

92. There are more and more cases that illustrate the above-mentioned problem. One such case is the controversy between Mexico and the United States over the import of tuna from countries that catch 25 per cent more dolphins than United States fishermen. GATT has tended to oppose attempts by any one country to impose production standards on the production process of its trading partners. Measures are emerging, however, that will affect production processes. The Montreal Protocol on Substances that Deplete the Ozone Layer, adopted on 16 September 1987, allows countries to ban not only the imports of chloro-fluorocarbons (CFCs), but also products either containing them or manufactured by processes using them.

93. Tariff and non-tariff barriers in OECD countries are partly responsible for unsustainable patterns of commodity trade contributing to increases in deforestation, desertification, wetland degradation and unsustainable land use. Tropical timber is a frequently highlighted case: limited access to the processed woods markets in developed countries have contributed to developing countries' increased production and export of unprocessed timber to earn foreign exchange. 14/

2. Production and export subsidies

94. All Governments take measures to enhance the competitiveness of their goods and services in international markets through subsidies for production and export. This can also cause environmentally unsound distortions, by encouraging greater production in certain sectors rather than in others that are environmentally more sound. Developed countries continue to subsidize certain sectors such as shipbuilding, mining, steel, textiles and automobiles, even though these are sectors where developing countries could establish a comparative advantage and, through the use of cleaner production processes, could pursue more environmentally sound alternatives.

95. Despite general principles adhered to by most GATT members, subsidizing is still practised, leading to price and market distortions. These include export credits and guarantees, tied (conditional) aid and offsets. Export supports are common in such sectors as steel, transport equipment and construction, resulting in overcapacity and an uneven geographical distribution of output.

3. Trade agreements

96. Most trade agreements fail to treat the environmental factor adequately. This is true of bilateral agreements involving automobiles, steel and textiles and of voluntary export restraints, voluntary restraint agreements and orderly marketing agreements. It is also true of free trade agreements (common markets, regional agreements etc.) where concerns have been raised about the environmental impact of trade liberalization measures. While free trade agreements can improve overall levels of trade, they can also lead to the movement of pollution-intensive industries to environmentally sensitive geographical areas and can limit the use of economic measures for environmental management. They can also result in the weakening of environmental regulations and standards. In the case of the United States, while the "fast-track" authority sought by the President will allow for more flexibility in trade negotiations, it can also reduce the likelihood that environmental issues will be scrutinized appropriately.

97. Preferential trade agreements between developing and developed countries, for example, the Generalized System of Preferences, the Africa-Caribbean-Pacific/European Economic Community (ACP/EEC) Convention signed at Lomé on 8 December 1984 and the United States Caribbean Basin Initiative can also divert trade in environmentally unsound directions and cause environmentally unsound structural adjustment in developing countries.

98. Finally, trade-related investment measures (TRIMs) and trade-related intellectual property rights (TRIPs) need to be assessed in terms of their environmental implications. TRIMs can impede investment in ESID by discouraging foreign investment through exchange restrictions, local input requirement and profit repatriation restrictions; however, they can also be used by Governments to encourage environmentally sound investments.

C. Limitations of sovereign States

99. Sovereign States may ignore regional and global externalities that result in damage being done outside their borders. They are reluctant to take the measures needed to achieve ESID if such measures will infringe on their sovereign powers or will require them to incur a substantial portion of the costs to protect a resource of international importance.

100. This situation is all too evident from the difficulties associated with achieving global and regional agreements. Admittedly, some progress has been made, as evidenced by the Montreal Protocol, which required some last-minute concessions to developing countries before it could be ratified. But will developed countries be willing to contribute between $US 20 billion and $US 40 billion so that a similar agreement may be reached on greenhouse gases? 40/

101. Even among industrialized sovereign States, there are few examples of successful regional environmental accords that have actually resulted in pollutant reductions. It took Canada and the United States over 20 years to

reach an agreement on reducing acid deposition even when pollutants from each of the countries were affecting the other, and it will take them another 20 years to achieve a significant reduction in the pollutants in question. In Europe, there is now an agreement to reduce by 1993 sulphur dioxide emissions by 30 per cent (based on 1980 emission levels), but clearly additional reductions are needed.

VI. COMMUNITY PARTICIPATION

102. There is an emerging recognition of the importance of community participation to ensuring that societal decisions move the process of industrialization towards ESID. For too long, government authorities and large industrial organizations have controlled the direction of industrialization. Consequently, they have been able to ignore the consequences of their actions on the environment, such as the displacement of populations or the exposure of communities to excessive health risks from pollution.

103. To counter this situation, particularly in developed countries, citizens have organized non-governmental organizations (NGOs) to challenge centralized governmental organizations and large industrial organizations. These NGOs demand that Governments enact and enforce environmental laws and question the business practices of large industrial establishments. They have succeeded to a large degree in influencing government decisions, as evidenced by the enactment and enforcement of more stringent environmental laws. They have succeeded to a lesser degree in influencing industry, but this situation is changing, as evident in the statements of business leaders at the Second World Industry Conference on Environmental Management, held at Rotterdam from 10 to 12 April 1991.

104. Industry is responding to environmental concerns for various reasons: in the United States, citizens now have much more information on pollutant discharge as a result of the Toxic Release Inventory; and in Europe, there are strong green consumer movements, such as the Blue Angel labelling programme in Germany. Even a well developed green movement, however, can go only so far unassisted, according to a recent assessment of the green movement. "Neither green consumers nor green investors are substitutes for government intervention. Their influence is too random, too poorly informed, to provide consistent pressure on companies to take the most cost-effective steps to be cleaner." 41/

105. NGOs are only now emerging in some developing countries and often are not as powerful as NGOs in developed countries. Nonetheless, linkages between government institutions and NGOs are improving in developing countries, and rapid progress was made in the late 1980s. In Indonesia and the Philippines, strong government policies support the activities of NGOs. One barrier to stronger community involvement in developing countries appears to be a lack of government policies explicitly providing support to NGOs.

VII. SUMMARY

106. The mere abundance of barriers to ESID and the difficulty in judging their relative importance must not itself become a barrier. Although information deficiencies hinder efforts to find the most cost-effective paths to ESID, the evidence of the seriousness of environmental degradation at the

global, regional and local levels calls for an immediate start for a fundamental restructuring of industrial activity.

107. The transition has to start from within industry. Comprehensive waste-reduction or pollution-prevention programmes engaging employees at all levels have proved profitable for small and large companies in the North as well as in the South. Starting with low- or no-cost measures such as "good-housekeeping", raw material substitution or process modification, such programmes have the potential to by-pass the financial constraints common in all developing countries.

108. Governments have to make sure that pollution prevention is profitable. Environmental agencies should pursue a multi-media pollution-prevention approach as opposed to the more common single-media end-of-pipe strategy. Enforcement of environmental regulations is crucial.

109. Any kind of government measure to protect or stimulate domestic markets or subsidize export sectors must be flexible, so that it does not to deprive industry of incentives and foreign technologies necessary to achieve ESID.

110. Although existing technologies offer vast possibilities for moving towards ESID, attention also has to be given to new and emerging technologies such as biotechnology or solar energy, which offer solutions to many environmental problems. Many new and emerging technologies are skill-intensive. Developing countries with a shortage of skilled personnel must therefore be cautious and selective in their choice of application of these technologies. A noteworthy point is the close relation between expenditure on R and D in solar energy and world oil prices. It shows that the lack of market prices for environmental service is the fundamental barrier to ESID. For example, a global carbon tax could do a lot to pave the way for a clean renewable energy technology.

111. All the problems associated with technology transfer in general are also barriers to ESID, since many of the technologies needed for long-term sustainability will have to be transferred. The strengthening of technological capabilities to assess, adapt and develop technologies to suit local conditions is vital to developing countries in the long run.

112. Patent protection is undoubtedly needed as an incentive for sustained efforts in new R and D. Although frequently cited as a barrier in general terms, there is little evidence that the current patent system is a major barrier to the transfer of clean technologies.

113. The move towards ESID is incremental. It has to start from within industry and it needs the support of Governments and the public and international cooperation. The difficulties encountered in achieving and implementing global environmental agreements is perhaps the most serious barrier to ESID.

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