



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org



06182



Distr.
LIMITED

ID/WG.1/50/5
5 February 1975

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

Expert Group Meeting on the Study of
Synthetic versus Natural Products

Vienna, Austria, 16 - 20 September 1974

STUDY ON SYNTHETIC VERSUS NATURAL PRODUCTS
FIELD PROJECT ON THE RUBBER INDUSTRY
AND ITS IMPACT ON THE ENVIRONMENT

prepared by

the Secretariat of UNCTAD

CONTENTS

	<u>Page</u>
I. POLICY ORIENTATION	1
II. THE OPTIMUM LEVEL OF POLLUTION CONTROL	2
A. Cost analysis	2
B. Marginal analysis	3
C. Qualifications	5
III. POLICY MEASURES	9
A. Planning ahead	9
B. Taxation	6
C. Subsidization	8
D. Environmental quality standards	10
E. Measures for transfrontier pollution	11
F. Aid to developing countries	12
G. Trade policy	12
IV. GUIDELINES FOR POLLUTION CONTROL POLICY	

I. POLICY ORIENTATION

1. As in other areas of economic policy, pollution control policy involves choices between options. These choices are between goods and services, resources conservation for future use, and preservation or improvement in the quality of the environment. The choices are economic decisions because they depend on how society is to allocate its resources in order to best meet its wants.

2. On the national level, pollution control costs raise additional problems of inflation, level of national income, growth of public expenditure and effect on private expenditure, and loss of income and employment in high polluting industries. On the international level, there are problems of effects on prices and competition in foreign trade, balance of payments, and exchange rate changes.

3. The basic cause of the environmental problem is economic in nature. It is the failure of the economic system to allocate its resources to provide for the quality of the environment. This failure arises because, in the absence of appropriate policies, producers do not have to pay for damage to the environment. This is due to the common property nature of the environment where rights of producers and the public are not defined. Hence those who are harmed have difficulty in obtaining compensation.

4. The responsibility then falls on the government to formulate and carry out policies for the improvement of the environment. Policy-makers must have criteria for determining the best level of pollution control and choosing the policy measures to implement this level. The level of pollution control and types of measures used are important to industries since they determine pollution control costs and changes in the competitiveness among industries.

5. The next section of this paper is a theoretical explanation of the optimal level of pollution in terms of pollution control costs and reduction in damages from pollution. Following this, is a section on policies and the advantages and disadvantages of each. Finally a summary of policy guidelines is given.

6. This paper is relevant for the near future. It should be noted that for a long term study of pollution control policy, there is a serious problem of population growth and pollution from production to meet the greater wants of a larger population.

7. Regarding the rubber industry, it is expected that pollution control costs of synthetic rubber will be passed on, wholly or in part, as price

increases. If these costs are not passed on entirely, returns on investment in synthetic rubber will decline from what they otherwise would have been. Then, new investment and production would be less than otherwise would occur, other factors not changed. Since natural rubber prices follow synthetic rubber prices to some extent, the increase in synthetic rubber price due to pollution control costs, can be expected to raise the natural rubber price from where it otherwise would be, assuming other factors do not change. This price increase for natural rubber would be offset to some extent by pollution control costs of natural rubber although these costs are thought to be small. If this price increase for natural rubber is greater than the pollution control cost per unit of natural rubber, the natural rubber industry will have a higher rate of return than otherwise would have occurred, and consequently greater new investment and higher production.

8. Price increases for natural and synthetic rubber can be expected to reduce the total quantity of rubber demanded as consumers generally substitute other goods for rubber products.

9. The effects on production and consumption of rubber of both types are likely to be more pronounced as time goes by since producers and consumers have more opportunities to respond to the price changes.

II. THE OPTIMUM LEVEL OF POLLUTION CONTROL

10. In this section, two methods of finding the optimum level of pollution are given. Both methods start from the same basis and arrive at the same conclusion, one by analysis of aggregates, the other by incremental analysis.

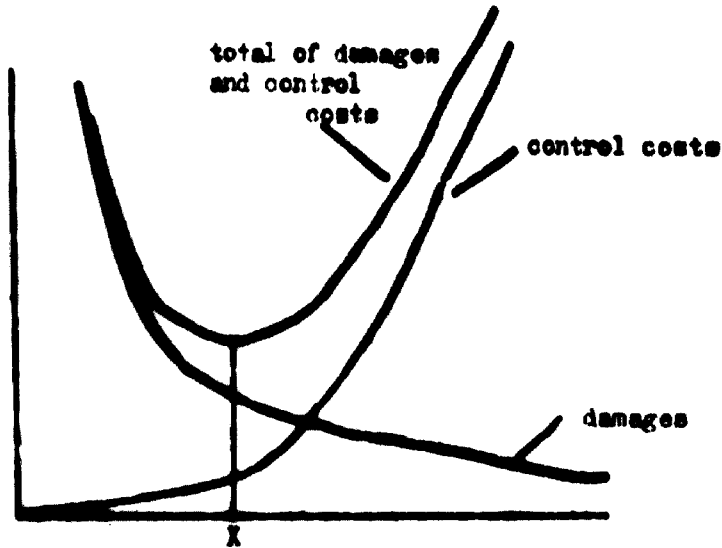
A. Cost Analysis

11. Pollution costs society in two ways. Firstly, there is the damage done to people's health, their recreation and enjoyment, and to other flora, fauna and natural resources.

12. Secondly, pollution control uses resources which could be used in production of other goods and services. Pollution control costs are for depreciation of plant and equipment, cost of invested funds, operating costs, and administrative costs of industry or governments.

13. The problem of finding an optimum level of pollution control is to minimize the total of damages and control costs.

14. In graph 1, damages and control costs are plotted for each level of pollution control, going from 0 per cent at the intersection of the axes to 100%. Damages and control costs are added and the minimum point of the total is shown as X%.)

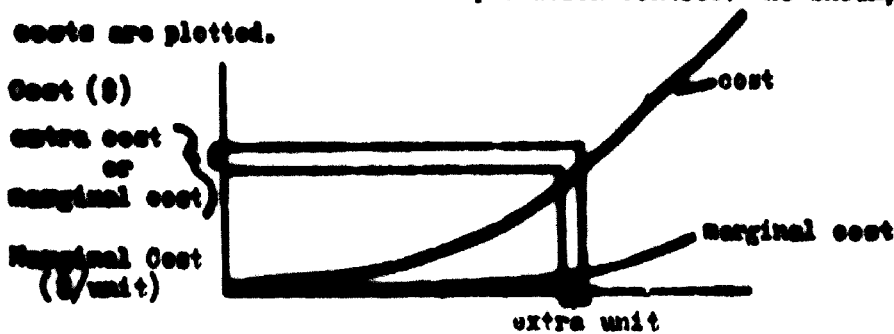


Percent of Emissions Controlled
Graph 1: Minimizing the total of damages and control costs

B. Marginal analysis

15. Control costs and damages can be analyzed in terms of extra costs and extra value of a unit of pollution reduction.

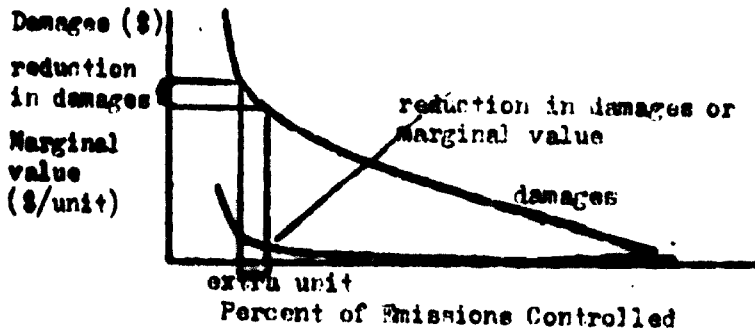
16. Extra cost, or marginal cost, is illustrated in graph 2 as the increase in cost of add another unit of pollution control. As shown, the marginal costs are plotted.



Percent of Emissions Controlled
Graph 2: Cost and Marginal Cost

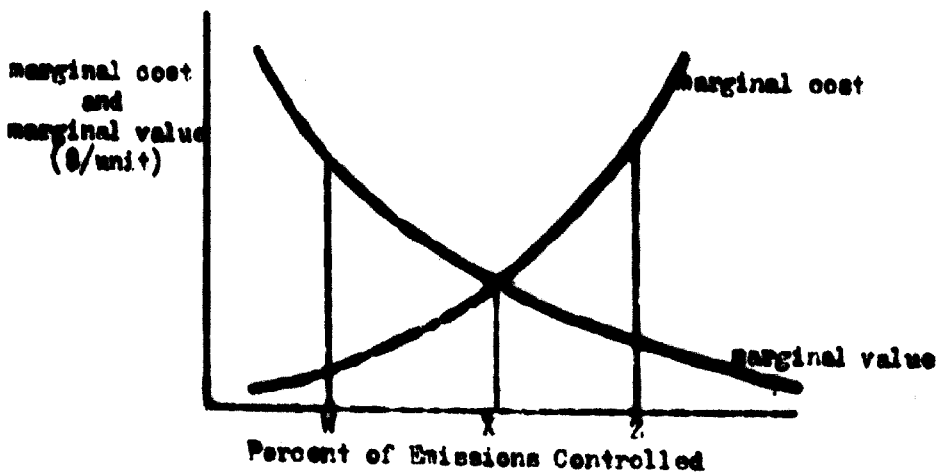
e) A more complete discussion of the optimum level of pollution and relationship between emissions, environmental factors and damages is given in: A. Myrick Freeman, III, Robert H. Haveman and Allen V. Kneese, *The Economics of Environmental Policy*, London: John Wiley and Sons Inc., 1973, pp. 83-93. This book is also a good general text on environmental policy.

17. Damages are the loss due to pollution. The value of an extra unit of pollution control is the reduction in damages. In graph 3, damages and the reduction in damages are plotted. Reduction in damages can be called the marginal value of pollution control.



Graph 3: Damages and Marginal Value

18. An economic optimum is reached where units of pollution control are added until the marginal cost equals the marginal value of the last unit added. As illustrated in graph 4, marginal cost equals marginal value at X%. If pollution control is less than X such as W, the value of an extra unit is higher than its cost and society would benefit from higher pollution control. If pollution control is greater than X, say at level Z, the value of the last unit is less than its cost and society would benefit by reducing pollution control and using freed resources in other production.



Graph 4: Optimum Level of Pollution Control

19. Pollution control less than X allows industry to produce more cheaply, but the public bears more damages than at the optimum. In effect, the public is subsidizing industry.

20. Pollution control greater than X means that the public is better off but that industry is overburdened with pollution control expenses and, in effect, industry is subsidizing the public.

C. Qualifications

21. The above discussions of the optimal level of pollution control does not take account of additional problems of transfrontier pollution and income redistribution effects of pollution control.

22. A problem of transfrontier pollution occurs when pollution in a nation is optimal but the pollution in the air or water is excessive when it crosses into another nation by their optimal level of pollution.

23. A further problem of transfrontier pollution is encountered where pollution control in a nation reduces damages in another nation at a cost to the first. Thus, the first nation is in effect subsidizing the latter.

24. These problems of transfrontier pollution also occur between regions in a nation.

25. A further problem occurs when pollution control benefits higher income groups and costs are borne uniformly by all groups or more heavily by lower income groups. This situation is the equivalent of redistributing income from lower to higher income groups. In international trade between developed countries and developing countries, the same situation will occur. Improvement in the environment of the developed countries would be partly financed by the purchases of the developing countries.

III. POLICY MEASURES

26. As discussed in the preceding section, the optimal level of pollution control is where the marginal cost equals the marginal value. A number of policy instruments can be used independently or in combinations, to control pollution. They are discussed in this section.

A. Planning ahead

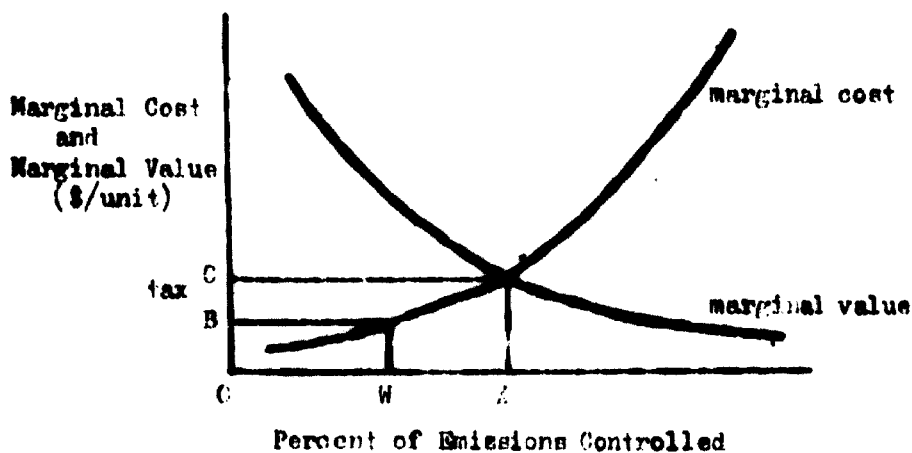
27. Of special note to developing countries is the advantage of planning ahead for pollution control, since costs are lower if pollution abatement

is planned in designing facilities rather than carried out after construction. Thus by planning ahead, a higher level of pollution control can be had.

28. A basic part of planning ahead is to establish pollution control levels and other regulations. This eliminates management uncertainties and delays in planning for pollution control.

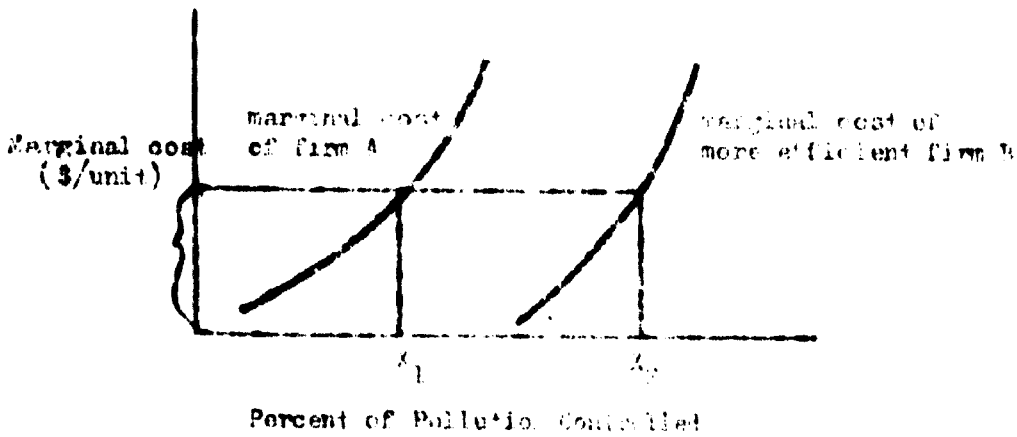
B. Taxation

29. Taxation is widely but not universally recommended by economists for pollution control. As shown on graph 5, tax can be set at C on every unit of pollution up to level X. No tax would be charged for pollution beyond level X. Since marginal cost is less than C up to level X, it is profitable for industry to engage in pollution control to level X. For example, at level W tax would be C but the cost of controlling an extra unit of pollution would be only B. Thus profit can be increased by C-B when the extra unit of pollution control is undertaken.



Graph 5: Taxation for Pollution Control

30. The advantages of taxation are that it gives industry the widest choice of ways to control pollution by using different raw materials, changing the production process, recycling and reclaiming pollutants or introducing end-of-line techniques. Thus industry can seek the least costly ways of controlling pollution. Also each firm can control its pollution to the point where the marginal value of pollution control equals the marginal cost. More efficient firms have an incentive to control pollution at a higher level than less efficient firms. This is illustrated in graph 6 at levels X_1 and X_2 .



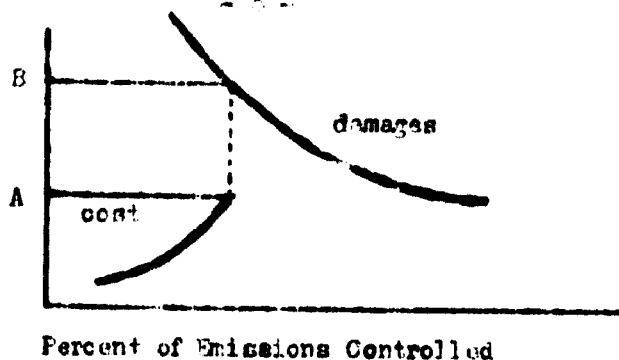
Graph 5. Taxation and Efficiency of Pollution Control

31. The difficulties of taxation are (a) that extensive information is required on marginal cost and marginal value of pollution control, and (b) that there may be high administrative costs for metering pollution, surveillance of emissions, and difficulties in collecting tax revenues.

32. Another way of taxation is often recommended. It is to tax industry by the marginal value of pollution control. It is true that industry will try to control pollution to level X as in graph 5, since the tax would be more than the marginal cost at all levels of pollution control less than X. However, at level X, industry would be asked to pay a tax of amount C in addition to bearing costs of pollution control. This tax of C is unjustified since marginal cost equals marginal value at level X without an additional tax. Thus this method brings about an unjustified transfer of income from industry to the public. This method is often recommended because it requires information only on the marginal value of pollution and does not need information on marginal cost of pollution control.

33. Where there is no known way to control pollution a tax can be levied to equate damages with cost to the industry. In this way, industry can compensate the public for damage which cannot be controlled. As shown in graph 7, a tax of B-A will make total damages equal total cost to the industry.

Damages
and costs
(\$)



Graph 7: Tax on Pollution where Control is limited

34. An industry may have beneficial effects as well as damages. For example, natural rubber promotes soil conservation in newly forested areas and it provides rural employment whose social value in rural welfare may be higher than earnings indicate. Similarly, industrial employment of urban workers in synthetics may provide employment to people who otherwise might face severe problems, hence the social value of this employment would be higher than earnings. In cases such as these, pollution damages should be reduced by the benefits and the adjusted damages would be used in the analysis.

35. Pollution tax revenues become part of the general tax revenues. It is not necessary that pollution tax revenues be used for environmental spending, although some related expenditures are discussed in the next section on subsidies.

36. Another important kind of taxation is a charge for providing public waste treatment. This type of taxation differs from the above mentioned taxes. It is a burden-sharing device and is conceptually similar to a cost of pollution control, even though the service is run by the government.

C. Subsidisation

37. It is possible to pay a subsidy to industry to control pollution. The subsidy would be the same amount as the tax, O , in graph 5. So long as the subsidy is greater than the marginal cost, it is profitable to control pollution.

38. Economists do not recommend subsidies, with certain exceptions. The disadvantages are:

- a. The subsidy provides an incentive to produce more pollution and for firms to enter to profit from producing waste at a cost to general tax revenues and to the environment.

- b. The subsidy may not be passed on to consumers and may only add to stockholders income.
 - c. To prevent the subsidies from becoming a general subsidy of industry, specific treatment processes must qualify for subsidies. This excludes more general changes in: type of raw materials, production process and, recycling or reclaiming pollutants. As a result, subsidies may distort the choice of pollution control techniques and pollution control may not be the least costly to society.
 - d. In international trade subsidized production gives a competitive advantage over non-subsidized goods. For this reason, the OECD nations have negotiated the "Pollution Pays Principle" which says that pollution costs generally should not be subsidized and that such costs should be paid by industry as are other costs of industry, with some exceptions.
39. There are exceptions to the general conclusion that subsidies are not to be used. When exceptions are made, they should be specifically defined. They include:

a. Adjustment assistance

Certain industries and their workers will suffer from lost income and employment due to pollution control regulations. This is especially so where they are located in rural areas, small towns and industry towns or otherwise where labour and capital have lower returns in alternative employment. In order to compensate the losers with some of the gains to the public in improving the environment, certain types of adjustment assistance can be paid by the public out of general revenues. These include: technical assistance in producing other products, low interest loans or loan guarantees for other production, unemployment compensation, retraining and relocation grants, pensions for those too old for retraining or relocation and financial aid to towns who lose tax revenue because of loss of industry. Since adjustment assistance is intended to be for a transitory period, these measures should have definite time limits.

b. Income redistribution

Some types of pollution control, for example abatement of discharges into recreational water courses, benefit the wealthy more than the poor, and the costs may be shared equally or even a larger proportion

paid by the poor than the rich. In such cases, the argument has been made that pollution control should be paid out of general tax revenues since the rich pay relatively more taxes and thus cost would be borne more equitably. Subsidies then can be used to avoid inequitable income redistribution effects.

c. Regional development

Where pollution control costs hold back regional development, subsidies can be used to further development.

d. Research grants

Research on techniques of pollution control, measurement of damages and costs, administrative studies and other studies on pollution control should be supported by governments.

40. A distinction should be made between subsidies paid from general tax revenues and subsidies financed by special charges levied on industry. The latter is not a true subsidy and is conceptually the same as a cost to the industry.

41. In situations where certain firms have the capability to control pollution at less cost than other firms, it is possible to tax all firms and subsidize the more efficient firms thereby minimizing total pollution control cost. This is satisfactory in the short run but in the long run the subsidy should be phased out and taxes raised to promote replacement of plants by plants with pollution control of the more efficient type.

D. Environmental quality standards

42. In view of the difficulty in quantifying damages and costs and finding the optimum level of pollution control, a number of pollution control agencies have resorted to use of standards. In setting standards, policy-makers should follow insofar as is possible, the principles of optimization discussed in Part II. Where monetary measures are difficult to assign, as an example for deaths due to pollution, physical measures such as the number of deaths can be provided and policy-makers can assign their own valuations.

43. Emission standards give pollution limits which cannot be exceeded. They are usually stated as concentrations of residuals in discharge of air or water at the point of discharge. Or they may be expressed as pollutants per plant. Ambient standards refer to limits on concentrations of pollutants in a given geographic area which may include a number of industries. A third type of standards are those pertaining to product use or disposal.

44. Economists have mixed views about standards. Disadvantages are:

a. It is difficult to justify standards without information on the marginal value and marginal cost of pollution control.

b. There is no incentive to control pollution beyond the standard set. Where firms differ as to efficiency in pollution control, a standard for all firms will result in more costly pollution control than taxation or other policies that promote most efficient pollution control.

c. Enforcement of standards is a criminal matter, subject to legal rights and safeguards. The court process can be costly and lengthy permitting pollution to continue uncontrolled in the interim. In the end, fines levied may not compensate for damage done. Taxation is an administrative matter and generally it is more easily handled in cases of delinquency.

45. Advantages of pollution control are:

a. Standards provide objectives for development planning in developing countries.

b. Standards allows a wide range of choice in ways to control pollution and firms can seek the least costly pollution control for a given standard.

c. In some developing countries enforcement of pollution control standards may be easier than collecting taxes.

d. For dangerous pollutants or irreversible effects a ban on emissions is easier than other measures.

B. Measures for transfrontier pollution

46. Where pollution crosses national boundaries, the receiving nation suffers damage from the pollution of another nation. The problem is especially troublesome where the incoming air or water pollution is considered excessive by the receiving nation. In some cases, compensation for damages can be paid by the polluting nation to the receiving nation, although the former may argue that the standards of the latter are too high.

47. An alternative to compensation would be a special tariff on imports of pollution producing products from the polluting nation. Compensation is preferable to a special tariff because of the danger of such tariffs becoming overly large as protective devices for domestic industries.

F. Aid to developing countries

48. Developed countries should give aid for pollution control in developing countries because of humanitarian interest, protection of endangered wildlife species, preservation of scenic places and other interests in natural resources.

49. There is another cause for aid in that environmental improvement in developed countries will raise the prices of their goods sold to developing countries. Thus the reduction in pollution damages in developed countries will be partly paid by the developing countries. It can be said that developed countries were subsidizing the sales to developing countries by bearing the damages of pollution from production of goods sold to the developing countries. By implementing pollution control, prices for goods from developed countries reflect their true cost of resources used including the environment. Since developed countries had formerly subsidized sales by bearing pollution damages, and since they no longer subsidize sales in this way after pollution control, compensation to the developing countries by the developed countries is needed to keep the general level of aid the same as before.

G. Trade Policy

50. The optimum level of pollution control need not be the same in all countries. Desired levels may differ because of differences in the capacity of the environment to assimilate pollution, location of population, degree of industrialization or social preference between environmental improvement and use of resources in production of goods instead of pollution control. As regards the last factor, poor countries might prefer more goods and less pollution control to less goods and more pollution control under stricter measures of developed countries. Poor countries then would choose lower pollution control levels than richer countries.

51. If pollution abatement measures in developing countries are less stringent than those of developed countries, developing countries will have a competitive advantage in lower production costs. Developed countries should not apply an import tariff or otherwise aid domestic industry to offset the difference in pollution control costs, provided the lower pollution control level in developing countries is justifiable.

52. Lower pollution control costs in developing countries than in developed countries would encourage high polluting industries to relocate in developing countries. Developing countries should have policies on establishment of high polluting industries, taking into account:

- a. the damage done by extra pollution of the new industry.
- b. reducing damage for benefits of the new industry in increased income and employment, and in exchange earnings or savings.
- c. pollution control planning in the new industry to equate adjusted marginal damages with the industry's marginal cost of pollution control.

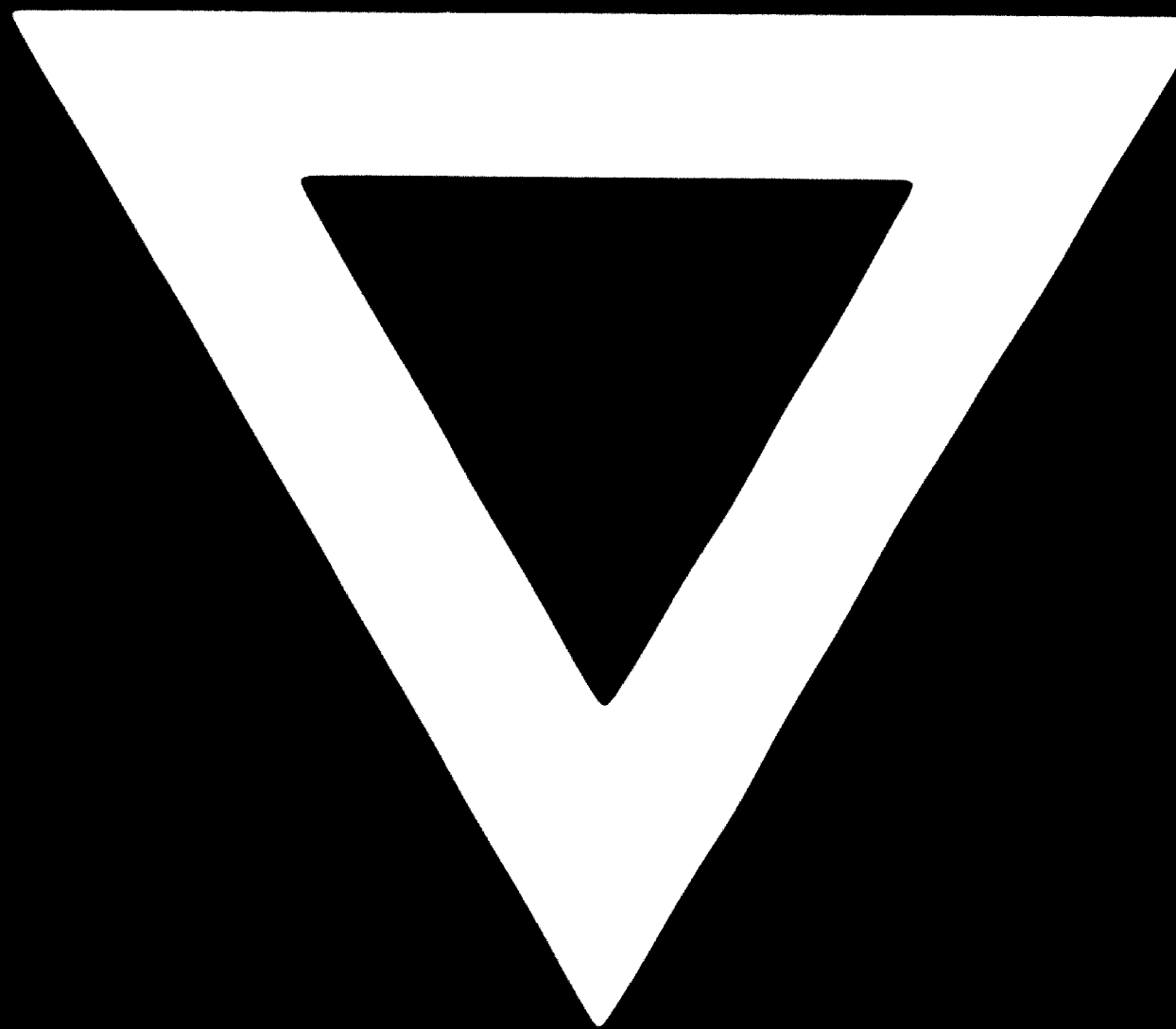
IV. GUIDELINES FOR POLLUTION CONTROL POLICY

53. In summarizing the section on policy measures, the following policy guidelines are given:

- a. Developing countries should decide on their pollution control policies for the future to enable industry to plan ahead for pollution abatement and thereby have less cost than if pollution control is undertaken after plant construction.
- b. Taxation and/or standards can be used as policies depending on information available and general governmental policies on regulation of businesses.
- c. Subsidies should be avoided with exceptions for:
 1. adjustment assistance
 2. income redistribution
 3. regional development
 4. research grants
- d. Taxation and standards should be enforced by the government agencies concerned. A deposit, bond or promissory note programme could be used where the firm must show proof of compliance or failure will result in forfeiture of a sum of money. Licensing can also be used to insure compliance when violators are denied a license.
- e. In cases where a nation suffers from pollution of another nation, compensation should be paid. This is preferable to a special tariff which might be abused as a protective device.

- f. Developed countries should give aid to developing countries for humanitarian and other interests, and as compensation for price increases brought about by pollution control costs. This aid should be spent on security, damages and control costs of pollution, and studies of effective government administration.
- g. Where a nation's policy measures justifiably lead to lower pollution control costs than in another nation, the latter nation should not levy a special tariff or otherwise aid its domestic industry to offset the difference in pollution control costs.
- h. Where a nation's pollution control cost differs from that of another due to unjustifiable policies in one or both nations, efforts should be made to improve policies so that there is no disruption in international trade and investments.
- i. Developing countries should have policies on establishment of new high polluting industries which take account of the damage of extra pollution from the new industry, the benefits of the industry and the pollution control to be exercised by the industry.





75.08.11