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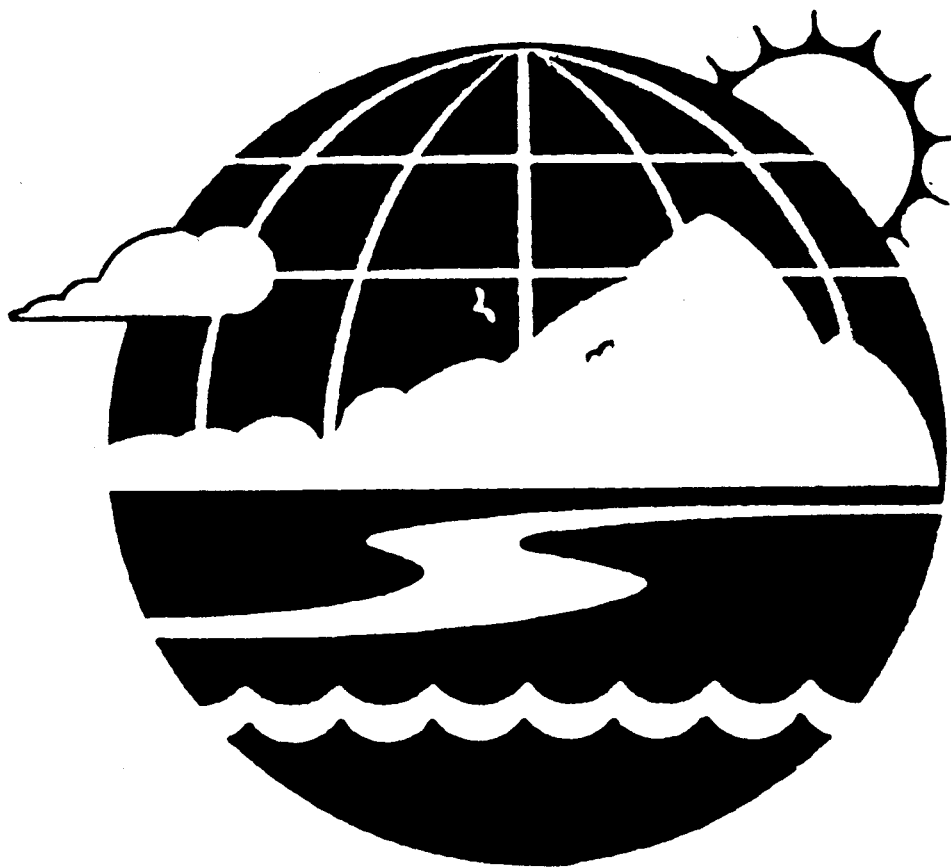
The U.S. Environmental Protection Industry: A Proposed Framework For Assessment

THE U.S. ENVIRONMENTAL PROTECTION INDUSTRY:

A Proposed Framework for Assessment

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SUMMARY

This study defines the goods and services that constitute environmental protection activities in the United States. The U.S. input-output (I-O) table serves as the basis for the definition of environmental protection activities developed in this study. The U.S. environmental protection input-output tables identify the sectors that receive the revenues associated with purchases of goods and services to comply with environmental regulation as well as the sectors that demand environmental protection goods and services. The input-output framework also allows for the development of a measure of the importance of environmental protection activities relative to the U.S. economy. Finally, employment associated with environmental protection activities can be estimated.

This study finds that the EP industry is much like the tourism industry in that the purchases associated with complying with environmental programs consists of a diverse collection of products and services. Just as the tourism industry consists of parts of the hotel and restaurant industries, the EP industry includes parts of the construction, chemicals, energy, and engineering services sectors. Also, just as tourism does not account for all economic activity in the hotel and restaurant industries, EP activities do not account for all purchases of construction, chemicals, energy, and engineering services. Because EP activities consist of the activities of several economic sectors and the activities of these sectors are not uniquely for EP, this poses difficulties for developing a Standard Industrial Classification (SIC) code for the EP industry. This complicates measurement of the size of and employment in EP activities as well.

The results also show that EP activities constituted between 0.64 and 0.80 percent of Gross National Product (GNP) between 1977 and 1991 and during this time. In 1991, the EP industry was roughly the size of the following industries: Aircraft and Parts (SIC 372) and Primary Metal Industries (SIC 33). Value-added for these industries in 1991 was $49,046.3 million and $46,605 million, respectively. Value-added for EP was $46,646.6 million. Employment directly attributable to EP activities increased from 678 thousand in 1977 to 741 thousand in 1991. In 1991, direct EP employment was comparable to employment for the Aerospace industry, which employed 745,600 individuals.

Using the I-O framework, it is also possible to estimate employment indirectly attributable to EP activities. As an example, consider an industrial plant that has installed a scrubber to abate its emissions of air pollution. The plant will *directly* employ individuals to operate the scrubber. In addition, the plant will purchase electricity to run the scrubber and individuals will be employed in the production of electricity. Likewise, the electric power plant

will purchase coal to produce electricity, and individuals will be employed to mine coal. The individuals employed in producing the electricity to run the scrubber and the individuals employed in mining the coal used to generate the electricity needed to operate the scrubber constitute *indirect* EP employment. The multiplier used in this study does *not* capture employment associated with household income generation and the resulting expenditures (i.e., "induced" effects). If individuals indirectly employed are also counted, employment increased from 1.3 million in 1977 to 2.0 million in 1991.

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1.   OVERVIEW

1.1.   *Purpose of the Study*

This study identifies the production and service activities that constitute environmental protection (EP) activities in the U.S. economy. The identification of these activities is accomplished through the use of an input-output (I-O) accounting framework. The U.S. I-O table, published by the Bureau of Economic Analysis (BEA, U.S. Department of Commerce), is adjusted to isolate EP activities from other economic activities. The resulting EP I-O tables characterize the sectors whose output is used to comply with environmental regulations as well as the sectors that demand EP goods and services.

This study does not attempt to measure or draw conclusions about the net economic impacts of environmental regulation. Rather, it focuses on defining and measuring the amount of resources devoted to EP activities.   The composition of EP activities in the United States is assessed. The size of EP activities relative to the U.S. economy is estimated for five years: 1977, 1982, 1985, 1988, and 1991. These figures are disaggregated by environmental medium (i.e., air, water, and solid waste). Estimates of the amount of employment attributable to EP activities are also presented for these five years.

1.2.   *Principal Findings*

This study finds that the EP industry is much like the tourism industry in that the purchases associated with complying with environmental programs consists of a diverse collection of products and services. These include: construction, chemicals, energy, and engineering services.   The results also show that EP activities constituted between 0.64 and 0.80 percent of Gross National Product (GNP) between 1977 and 1991 and during this time, 1.53 to 2.12 percent of GNP was required to support EP activities, with the latter range of numbers being measured as direct plus indirect EP value-added. Employment directly attributable to EP activities increased from 678 thousand in 1977 to 741 thousand in 1991. If individuals indirectly employed are also counted, employment increased from 1.3 million in 1977 to 2.0 million in 1991.

1.3.   *Outline of the Report*

This report consists of five additional sections and two appendices. Section 2 discusses the contribution of this study and Section 3 outlines the framework used for defining EP activities. Section 4 describes the goods and services that comprise EP activities in the United States. Section 5 presents estimates of the size and composition of U.S. EP activities for 1977,

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1982, 1985, 1988, and 1991. These estimates are presented both in total and by environmental medium (i.e., air, water, and solid waste). Section 6 presents estimates on direct and indirect employment associated with EP activities for 1977, 1982, 1985, 1988, and 1991. The Appendix A lists the concordance between the economic sectors in this study and the sectors in BEA's I-O tables and Appendix B describes the peer review process.

2.   CONTRIBUTION OF THE STUDY

2.1.   *The EP "Industry"*

Recently, policymakers have shown interest in quantifying the impacts of environmental regulation on sectors providing EP goods and services, and more generally, in defining an environmental protection "industry" (Brown, O'Leary, and Browner, 1993). The I-O approach applied in this study is a consistent framework for defining an environmental protection "industry" as well as for estimating its size and the number of individuals employed in environment protection activities.

Several approaches to estimating the size of and employment in the EP industry have been taken, and each approach results in a different estimate. For example, the *Environmental Business Journal* (EBJ) measures the size of the EP industry by estimating the revenue received by each of 13 industry segments (EBJ, 1994). In 1990, EBJ estimated that the EP industry was a $122 billion industry. Another measure is given by total annualized costs of EP, as reported by EPA in *Environmental Investments: The Cost of a Clean Environment*. This cost-based approach yields an estimate of a $115 billion in 1990. Finally, the Organization for Economic Co-operation and Development (OECD) estimates total U.S. production of EP goods and services at $80 billion for 1990 (OECD, 1992).[1]

Discrepancies in estimates of the size of the EP industry stem from at least two factors. First is the general lack of agreement regarding which activities to "count" as EP. As a example, BEA (see Farber and Rutledge, 1989) counts none of the expenditures for water supply that are for water treatment as EP.[2] The EBJ, on the other hand, includes *all* revenues associated with water supply in its definition. For 1991, EBJ (1994) reports revenues of $21.1 billion for the water utilities segment of the EP industry.[3]

Obviously, which activities to include in an EP industry definition is an important consideration. However, this is not a focus of this study. This study follows EPA's definition of EP activities as used to compile date for *Environmental Investments: The Cost of a Clean Environment* as closely as possible, since this definition is derived from the data sources used in this study. It is important to note that the I-O framework is flexible enough to accommodate other definitions of EP activities.

The second factor contributing to discrepancies in estimates of the size of the EP industry is more relevant to this study. This factor relates to the method used to calculate the size of the

EP industry. As mentioned above, the EBJ estimates revenue received by sectors providing EP goods and services, while the EPA reports total costs of EP. In practice, the revenue-based and the cost-based approaches to defining the EP industry will generate different estimates. First, not all environmental costs involve company to company transactions. Some pollution abatement activities are performed within the polluting industry and costs associated with these activities do not become revenues for companies providing EP goods and services. Also, some environmental control costs do not involve out-of-the pocket expenditures (e.g., depreciation).[4] Second, the costs of pollution abatement include expenditures for items that are not part of the "EP" market (e.g., electricity required for the operation of pollution control equipment). Again, expenditures on these items do not become revenues for companies providing EP goods and services.[5] Finally, companies like engineering firms provide services besides EP. While these companies receive the revenues associated with EP expenditures, the total revenues of these companies overstates the amount received for EP goods and services.[6]

Besides leading to different estimates of size of the EP industry, it is questionable whether it is even appropriate to measure the size of the EP industry in terms of either total EP costs or total EP revenues. Typically, the size of an industry is measured in terms of its contribution to Gross National Product (GNP), which is given by its total value-added.[7] Using the I-O framework, it is possible to derive a measure of the EP industry's contribution to national product or its total value-added. Computing value-added associated with EP yields a measure of EP activities that is comparable to measures of the size of the national economy and other industries. Note that using a value-added measure will yield a smaller estimate of the size of the EP industry than reported in *Environmental Investments: The Cost of a Clean Environment*, since value-added is only a component of total costs.

Estimates of employment in the EP industry vary more widely than the estimates for the size of the EP industry. The EBJ (1993) estimates that 1,006,374 individuals were employed in sectors providing EP goods and services in 1990, while the OECD (1992) estimates employment at 800,000. Finally, Management Information Systems (Bezdek, 1993) estimates that U.S. environmental spending created 4,000,000 jobs in 1992 (1.9 million directly and 2.1 million indirectly).

2.2.   *Integrated Environmental and Economic Accounting*

The EP I-O tables also serve as a foundation for developing integrated environmental and economic accounts. The United Nations has proposed the System for Integrated Environmental and Economic Accounting (SEEA) as a special satellite system that is closely related to the core System of National Accounts (SNA). Diagram 1 provides a schematic representation of the SEEA, and illustrates its relationship with the core SNA and the development of methods to measure environmental impacts.[8]

The SEEA are comprised of four parts, labelled I, II, III, and IV in the diagram. Part I describes production and consumption activities and the accounts of nonfinancial assets. This

includes the I-O table from which EP activities are separated from the rest of the production activities in the economy. In addition, part I contains information regarding changes in the stocks of natural assets. Part II describes the physical relationships between the natural environment and the producing sectors of the economy. Part III represents economic cost of actual or potential deterioration of environmental and natural resource assets associated with economic activities. Constructing part III of the SEEA requires that a monetary value is placed on the use of the environment. Part IV represents information derived from extending the nation's production boundary to incorporate the economic functions of the natural environment. For example, a nation's production boundary might be extended to include the value of wetlands in mitigating floods, filtering water for drinking, and serving as a nursery for commercial fish.

   This study represents an application of the SEEA, since it disaggregates the U.S. I-O table into environmental and nonenvironmental components. This is represented by part I in Diagram 1. It would be possible to build upon the framework set forth in this study, and develop the other parts of the SEEA.

2.3. *Improved Modelling of the Economic Impacts of Environmental Regulation*

   Application of general equilibrium (GE) models to environmental policy has become quite popular. However, when using the models to estimate the impacts of specific environmental regulations, researchers have had to make simplifying assumptions. These simplifying assumptions stem from the fact that data on the exact inputs used by each industry for purposes of pollution abatement are not published. Without information on the inputs to pollution abatement processes, CGE modelers have made simplifying assumptions about which goods and services are purchased to comply with environmental regulation. These assumptions could influence the accuracy of CGE model results in at least two ways. First, even though an industry may bear a relatively large regulatory burden, the burden may be offset if its output is used in pollution abatement activities (see Nestor and Pasurka, 1995a). The framework set forth in this study, if institutionalized, would provide information necessary for explicit modelling of pollution abatement processes and lead to improved GE modelling of environmental policy.

Diagram 1: System for Integrated Environmental and Economic Accounting

Core system

Satellite systems

System of
National
Accounts
(SNA)

I.
Environment-
related
disaggregation
of conventional
national accounts

III.
Additional
valuation
of the economic
use of the
environment

IV.
Extensions of
the production
boundary of the
SNA

II.
Physical data
on
environmental-
economic
interrelationships

Description of
economic
activities

Source: U

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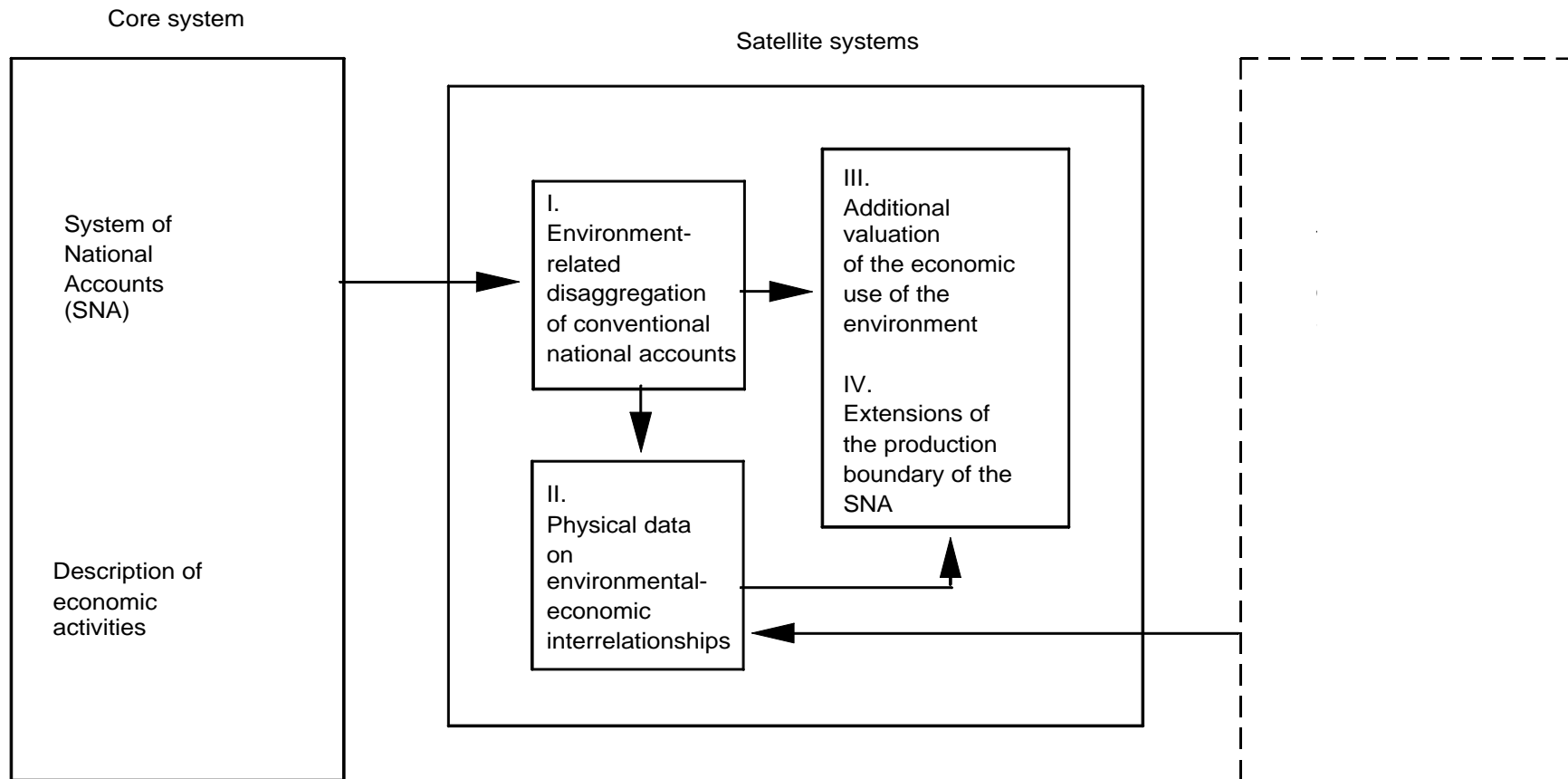
3.   FRAMEWORK FOR DEFINING ENVIRONMENTAL PROTECTION ACTIVITIES

3.1.   *General*

        This study makes use of an I-O accounting framework for identifying the production and service activities that comprise EP activities in the U.S. economy. Before describing the methodology used to construct the EP I-O tables, however, it is helpful to review relevant I-O concepts and how these concepts relate to national income accounting.

        Diagram 2 shows a schematic representation of one type of I-O matrix, the transactions table. A transactions table records the value of sales and purchases among producing and consuming sectors of the economy. In Diagram 2, the typical entry (X_{ij}) records the sales by the producing sector in the ith row to the producing sector in the jth column. X_{ij} is the amount of intermediate input I used to produce output j. For example, if the industry in the ith row is woodpulp and the industry in the jth column is paper, then reading across the row X_{ij} is the dollar value of the product that the woodpulp industry sells to the paper industry. Reading down the column, X_{ij} is the dollar value of the input that the paper industry purchases from the woodpulp industry.

        Y_i is the total final demand for the output of the sector in the ith row and includes personal consumption expenditures, gross private domestic investment, net exports, and government purchases. The output of the ith sector is X_i, which is computed by summing the quantities sold as inputs to other producing sectors (X_{ij}) and Y_i. The row total, then is equivalent to total demand (intermediate and final).

        The columns of the I-O matrix describe the purchases made by each sector. Note that, in Diagram 2, these purchases include payments to primary inputs (V_j), or value-added. Primary inputs include payments to labor and proprietor's income among other elements. The sum of the column entries (X_j) is equivalent to total costs of production.

        It is useful to think of the I-O tables as representing detailed information underlying national income and product computations. The total of all final demands in the economy is equal to GNP. Adding up total value-added in the economy yields total charges against GNP, which are equal to GNP. Diagram 2 also illustrates how GNP and charges against GNP are calculated within the I-O format.

3.2.   *EP Activities in an I-O Framework*

        EP activities are defined by disaggregating the U.S. I-O tables into EP and non-EP components. This requires a scheme for classifying the various types of EP activities. The U.N. (1993) provides some guidance, proposing that environmental protection activities be classified

Diagram 2: Input-Output Transactions Table

	TO / FROM	1	2	. . .	n	Y	X
		PRODUCING SECTORS				**FINAL DEMAND (GNP)**	**TOTAL OUTPUT**
PRODUCING SECTORS	1	X_{11}	X_{12}	. . .	X_{1n}	Y_1	X_1
	2	X_{21}	X_{22}		X_{2n}	Y_2	X_2
	.	.			.	.	.
	.	.			.	.	.
	.	.			.	.	.
	n	X_{n1}	X_{n2}	. . .	X_{nn}	Y_n	X_n
VALUE ADDED (CHARGES AGAINST GNP)	V	V_1	V_2		V_n		
TOTAL OUTPUT	X	X_1	X_2		X_n		

into the following five categories: external EP activities, internal EP activities, fixed capital formation for EP, household EP activities, and government EP activities.

External EP activities refers to establishments in which EP constitutes the main or secondary production activity. These activities can be either marketed or non-marketed. The key identifying characteristic of external EP activities is that they are delivered to other establishments, or a third party. External EP activities are represented as separate rows and columns in an I-O matrix. In Diagram 3, the entries depicted by the shaded column (n+1) represent the dollar value of the products purchased as intermediate inputs from other sectors in the economy by the external EP activities sector. The corresponding shaded row in Diagram 3 represents the dollar value of the external EP activities that other industries purchase for use as an intermediate input.

Internal EP activities are for the establishment in which they are produced. Internal EP activities are ancillary activities analogous to administration or research and development activities. Internal EP activities are measured by inputs purchased for and combined as pollution abatement activity by a polluting industry and includes intermediate inputs and value added. Internal EP activities are not separated from the main activities of an establishment, and in the I-O framework, are accounted for by separating out that portion of total inputs used by polluting industries for pollution abatement. This adjustment is reflected by X_{ij}^{EP}, which represents intermediate inputs used for EP activities, in Diagram 3. The residual, X_{ij}^{NE}, represents intermediate inputs used for non-EP activities.

The category **fixed capital formation for EP** represents the accumulation of fixed assets for EP and corresponds to gross private domestic investment in the I-O format. As an example, the purchase of a scrubber represents the accumulation of capital for air pollution abatement.

In addition, two other types of EP activities are performed in the United States. These are **EP activities performed by households and government**. Household and government EP activities are like EP investment activities in that they are represented by an adjustment to final demand in the I-O framework.

Household, investment, and government EP activities are embodied in final demand, depicted by the adjustment Y_{j}^{EP} in Diagram 3.

Diagram 3

The I-O Framework Modified to Display the EP Industry

TO / FROM	1	2	. . .	n	(n+1)	Y	X
1	$X_{11}^{NE}+X_{11}^{EP}$	$X_{12}^{NE}+X_{12}^{EP}$	. . .	$X_{1n}^{NE}+X_{1n}^{EP}$	$X_{1(n+1)}$	$Y_1^{NE}+Y_1^{EP}$	$X_1^{NE}+X_1^{EP}$
2	$X_{21}^{NE}+X_{21}^{EP}$	$X_{22}^{NE}+X_{22}^{EP}$		$X_{2n}^{NE}+X_{2n}^{EP}$	$X_{2(n+1)}$	$Y_2^{NE}+Y_2^{EP}$	$X_2^{NE}+X_2^{EP}$
. . .	.	.		.	.	.	.
n	$X_{n1}^{NE}+X_{n1}^{EP}$	$X_{n2}^{NE}+X_{n2}^{EP}$	. . .	$X_{nn}^{NE}+X_{nn}^{EP}$	$X_{n(n+1)}$	$Y_n^{NE}+Y_n^{EP}$	$X_n^{NE}+X_n^{EP}$
(n+1)	$X_{(n+1)1}$	$X_{(n+1)2}$	. . .	$X_{(n+1)n}$	$X_{(n+1)(n+1)}$	Y_{n+1}	X_{n+1}
V	$V_1^{NE}+V_1^{EP}$	$V_2^{NE}+V_2^{EP}$	. . .	$V_n^{NE}+V_n^{EP}$	V_{n+1}		
X	$X_1^{NE*}+X_1^{*EP}$	$X_2^{NE*}+X_2^{*EP}$	. . .	$X_n^{NE*}+X_n^{*EP}$	X_{n+1}		

3.3. *Specific Activities Included and Data Sources*

The BEA input-output table, "The Use of Commodities by Industries" forms the basis of this report. It is assumed that EP activities are embedded in the tables as currently published. Other sources of information (survey data, engineering data, and information published by other U.S. federal agencies) are used to disaggregate EP activities from other economic sectors in the I-O tables. Also, to simplify calculations, it is assumed that all inputs purchased for EP purposes are domestically produced.[9]

3.3.1. External Environmental Protection Activities

External EP activities constitute the component best defined by existing data sources. Sectors that provide external EP activities are included the benchmark (540 sector) I-O tables.[10] The primary difficulty in identifying external EP activities is that the 540 sector I-O tables are not sufficiently disaggregated. The external EP sector consists of the following three activities: water supply (that portion of water supply that is for water treatment, including drinking water), sewerage systems, and solid waste management services. Water treatment, which EPA has determined to constitute 12.4 percent of water supply expenditures, is included because EPA includes water treatment expenditures when measuring the costs of EP.[11] Ideally, external EP activities would include remediation services. However, these are not included in this report due to lack of information.

3.3.2. Internal Environmental Protection Activities

For manufacturing sectors, U.S. Department of Commerce (Bureau of the Census), *Current Industrial Reports* (MA-200), reports data on "materials and supplies" and "services and other costs" used for pollution abatement. These are used to approximate expenditures on intermediate inputs. To allocate the broad category of "materials" expenditures to the specific intermediate inputs, it is necessary to follow the same procedure as Ketkar (1980, 1983a, 1983b, 1984). In Ketkar's work, engineering studies and information obtained from surveys of polluting industries are used to compute the percentage of total operating costs allocated to the input categories of: electricity, labor, solid waste collection, equipment leasing, chemicals, depreciation, etc. Because the MA-200 reports data on labor and depreciation at the 4-digit SIC industry level for manufacturing sectors, these are used directly. For nonmanufacturing sectors, the data are less detailed. Data reported for manufacturing industries are used to derive internal EP expenditure patterns for nonmanufacturing. The fuel premium for low sulfur coal for electric utilities is treated as an increase in the purchase of coal.

The BEA (in the *Survey of Current Business*) and the EPA (in *Environmental Investments: The Cost of a Clean Environment*) report expenditures by business for abating the pollution from motor vehicles.[12] For these expenditures, there is a durable goods and nondurable goods and services (current account) component. The nondurable component consists of a fuel economy penalty, a fuel price penalty, and an inspection and maintenance credit. All of these expenditures are classified as intermediate input expenditures. The durable component is classified as EP investment and is discussed below.

Another component of internal EP activities is indirect business taxes. The 1980 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) introduced environmental excise taxes on the petro-chemical, inorganic chemical and petroleum industries to provide a source of funds for Superfund. After its expiration, the Superfund Amendment and Reauthorization Act of 1986 (SARA) reimposed the excise taxes. The environmental excise tax is paid by the petroleum and the chemical industries (see Boroshok, 1993). In addition, an additional tax on fuel is imposed for the Leaking Underground Storage Tank Trust Fund. These are classified as internal EP expenditures as well.

3.3.3. Household Environmental Protection Activities

Households perform two types of EP activities. The first type is associated with household expenditures on motor vehicle air pollution abatement. These include: expenditures on emission devices (e.g. catalytic converters) and the cost of operating these devices such as: fuel economy penalty, fuel price penalty, and the maintenance cost. The second type of household EP activity is related to the expenditures associated with the repair and maintenance of septic systems.

3.3.4. Investment Activities for Environmental Protection

Investment activities for EP are represented as the accumulation of fixed assets for EP. For households, initial purchase of septic tanks, septic systems, and connectors to public sewer systems are classified as investment. These are classified as investment expenditures since the purchase of housing is classified as investment. Business investment expenditures for pollution abatement include the initial expenditures for motor vehicle pollution abatement devices. Also included are the capital expenditures for air, water, and solid waste pollution abatement as reported BEA, EPA, and the MA-200. For each four-digit industry and each medium, investment expenditures for EP are reported in total. Thus, capital expenditures must be disaggregated into specific I-O categories (e.g., construction, installation, equipment, etc.), as is the case for intermediate materials inputs.

3.3.5. Government Environmental Protection Activities

The final component is EP activities performed by governments. Five categories of activities in the U.S. I-O tables embody government EP purchases: state and local government purchases for sewerage, state and local government purchases for sanitation, state and local government purchases for highways, state and local government purchases for water, state and local government purchases for natural and agricultural resources and recreation. All state and local government purchases for sewage and sanitation are counted as EP expenditures. Only the percentage of state and local expenditures for highways which pertains to highway erosion abatement are included (which was .83 percent in 1982, for example). Following EPA, the portion of expenditures by state and local government purchases for water that are for water treatment are classified as EP expenditures (18.4 percent). Also following EPA, 20 percent of natural resource expenditures are included as EP expenditures.

3.4. *Limitations*

The decomposition of the U.S. I-O tables into EP and non-EP components depends upon a number of simplifying assumptions. For external EP activities, the assumptions required to isolate "environmental" water supply, sewerage, and solid waste management from the I-O tables are crucial to the estimates of EP activities derived in this report. The estimates for both internal EP activities and EP investment are driven by the expenditure patterns used to allocate capital and operating and maintenance expenditures for air, water, and solid waste abatement to specific I-O categories. These expenditure patterns were derived from dated and, oftentimes, incomplete engineering studies. Further, due to data unavailability, data from manufacturing sectors were used to estimate pollution abatement operation and maintenance expenditures for non-manufacturing sectors.

The procedure for decomposing the U.S. I-O tables into EP and non-EP components was applied to the 1977 and 1982 benchmark I-O tables (U.S. Department of Commerce, BEA, 1984 and 1991), since at the time this report was prepared, these were the most recent economic census years for which benchmark I-O tables had been compiled.[13] Updating the 1982 EP I-O tables to estimate the composition and levels of employment for 1985, 1988, and 1991 required

assuming that the expenditure patterns for the various pollution abatement processes remained constant over time.

The construction of the U.S. EP I-O tables required information from a number of different sources. Even within federal sources, there were significant discrepancies. For example, both BEA and EPA report operation and maintenance expenditures for sewerage. However, for 1982, BEA reports expenditures of $5,159 million (Rutledge and Vogan, 1994, p. 48) and EPA (EPA, p. F-7) reports expenditures of $4,792 million. Since it was not possible to always reconcile such discrepancies, preference was given to that source that most closely matched the data contained in the published I-O tables.

Due to data limitations, it is not possible to distinguish between end-of-pipe pollution control and production process changes (pollution prevention) within the I-O framework. Hence, all capital expenditures for EP activities are treated as end-of-pipe pollution control. Finally, the measurement of foreign trade in EP equipment presents an additional set of difficulties. These difficulties and the actual measurement of EP trade are the subject of a separate report *International Trade in Environmental Protection Equipment: An Assessment of Existing Data* (U.S. EPA 1993). In this study, the focus is on the domestic portion of the U.S. I-O tables.[14]

4.   COMPOSITION OF EP ACTIVITIES

It is possible to use the EP I-O tables to identify the sectors that demand EP goods and services. Table 1 shows the distribution of demand for all EP activities as well as by medium for 1991. It is generated by summing down the column of the EP I-O table for each industry.[15] The EP I-O tables also identify which goods and services are purchased to perform EP activities (i.e. the goods and services that serve as inputs to EP activities). Table 2 shows the inputs to EP activities for 1991, and is generated by summing across the row of the EP I-O table for each industry. illustrates that EP activities are intermediate input intensive. Construction, utilities, and services comprise the bulk of total EP costs.

Table 1

Demand for EP Activities by Sector for 1991
(millions of dollars)

Sector	Total	Air	Water	Solid Waste
Agriculture, forestry, fisheries	884.5	8.2	103.7	772.7
Utilities and Mining	7,309.7	2,763.8	1,993.7	2,552.2
Construction	554.8	52.0	128.7	374.1
Food, beverages and tobacco	1,235.9	167.0	822.2	246.7
Textiles, leather, wood, paper, and products	2,518.5	668.0	1,092.2	758.2
Chemicals and allied products	3,543.9	698.6	1,544.8	1,300.4
Petroleum refining	3,696.1	1,479.7	815.6	1,400.8
Rubber, plastic, stone, clay and glass products	1,719.2	526.2	499.5	693.4
Primary metals	2,083.3	919.6	643.9	519.8
Manufacturing products	1,799.6	260.6	692.1	846.9
Machinery and transport equipment	1,839.6	342.0	533.0	964.6
Non-EP services	6,813.6	358.1	2,630.1	3,825.4
External EP Sector	1,931.2	0.0	31.7	1,899.5
Other industry	0.0	0.0	0.0	0.0
Households	13,452.9	0.0	9,622.0	3,830.8
Investment	0.0	0.0	0.0	0.0
Government	284.7	0.0	284.7	0.0
Exports	4.6	0.0	4.6	0.0
Total Demand	49,672.1	8,244.0	21,442.8	19,985.4

Note: Household, investment, and government demand include only purchases from the external EP sector.

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Table 2

Inputs Purchased for EP Activities by Sector for 1991
(millions of dollars)

Sector	Total	Air	Water	Solid Waste
Agriculture, forestry, fisheries	25.3	0.0	20.1	5.3
Utilities and Mining	6,364.3	2,210.3	2,549.4	1,604.6
Construction	10,254.5	466.4	9,073.4	714.7
Food, beverages and tobacco	3.4	0.0	0.9	2.5
Textiles, leather, wood, paper, and products	429.9	104.3	48.6	277.0
Chemicals and allied products	2,138.4	76.7	1,014.7	1,047.0
Petroleum refining	1,570.8	94.4	123.0	1,353.5
Rubber, plastic, stone, clay and glass products	1,117.7	448.0	621.1	48.7
Primary metals	0.2	0.0	0.0	0.2
Manufacturing products	933.5	0.0	84.7	848.8
Machinery and transport equipment	1,121.3	89.0	187.5	844.8
Non-EP services	6,257.2	1,801.8	2,651.1	1,804.3
External EP services	1,931.2	0.0	21.4	1,909.8
Other industry	52.2	0.0	0.2	52.0
Total Intermediate Inputs	**32,200.2**	**5,290.8**	**16,396.3**	**10,513.1**
Labor	11,077.2	1,304.0	3,036.3	6,736.9
Indirect business taxes	1,609.8	0.0	49.9	1,559.9
Other value added	4,785.0	1,649.2	1960.3	1,175.5
Total value added	**17,472.0**	**2,953.2**	**5,046.5**	**9,472.3**
Total Cost	49,672.1	8,244.0	21,442.8	19,985.4

Note: Excludes inputs to EP activities purchased as final demand, with the exception of external EP activities.

5.   SIZE OF THE EP INDUSTRY RELATIVE TO THE U.S. ECONOMY

Using the I-O framework, it is possible to derive a measure of the size of the EP industry relative to the national economy. This measure consists of computing value-added associated with EP activities and is analogous to using value-added for a specific industry to compute its contribution to national product. The value added for EP activities is simply the sum of value added for internal, external, household, investment, and government EP activities.

As an alternative measure, one might want to compute the total share of GNP required to support EP activities. This is given by the sum of direct and indirect EP value-added. Indirect EP value-added is derived using I-O techniques. The derivation of the formula for computing direct and indirect EP value-added is taken from Nestor and Pasurka (1995b).

Table 3 lists both direct and indirect plus indirect EP value added in current dollars and EP value added as percentage of GNP for 1977, 1982, 1985, 1988, and 1991. Both direct value-added and total value-added have increased in absolute terms as well as a percentage of GNP. As a frame of reference, in 1991 direct EP value-added was roughly the size of value-added for the following industries: Aircraft and Parts (SIC 372) and Primary Metal Industries (SIC 33). Value-added for these industries in 1991 was $49,046.3 million and $46,605 million, respectively.[16]

Table 3

Measures of the Size of the EP Industry

Year	Direct Value-Added (millions of current dollars)	Direct Value-Added as a Percent of GNP	Direct + Indirect Value-Added (millions of current dollars)	Direct + Indirect Value-Added as a Percent of GNP
1977	14,124.9	0.71	30,436.4	1.53
1982	20,593.1	0.64	50,802.5	1.58
1985	28,692.2	0.68	72,404.1	1.74
1988	37,754.5	0.74	96,766.0	1.93
1991	46,646.6	0.80	121,625.2	2.12

6.   EMPLOYMENT ASSOCIATED WITH EP ACTIVITIES

6.1.   *Computation of Direct Employment*

6.1.1. Direct Employment Associated With External EP Activities

Employment in external EP activities consists of employment for water treatment, sewerage services, and solid waste management services. The water treatment component of the water supply industry has both a private and a public element. Private water supply (SIC 494) employment is taken from *County Business Patterns* while employment associated with water supply provided by government enterprises is taken from the *Public Employment* (U.S. Department of Commerce, Bureau of the Census). Total water supply employment is multiplied by 12.4 percent (the percentage of water supply expenditures that are for water treatment) to estimate water treatment employment. Employment related to sewerage services is taken from the *Public Employment.* Private solid waste management services corresponds to SIC 495 and employment data are taken directly from the U.S. Bureau of Labor Statistics (1991 and 1993).[17]

6.1.2. Direct Employment Associated With Internal EP Activities

To estimate employment associated with internal EP activities, it is assumed that the composition of the labor used for EP by an industry is identical to the composition of the labor force used by that industry for producing its marketable good or service. Total payments for labor for both manufacturing and non-manufacturing is obtained from the input-output tables. Total employment for each industry is obtained from *Employment, Hours, and Earnings, United States, 1909-1990* (U.S. Bureau of Labor Statistics, 1991) or *Employment and Earnings, 1989-1992* (U.S. Bureau of Labor Statistics, 1993), supplemented by *County Business Patterns* (U.S. Department of Commerce) and the *Statistical Abstract of the United States* (U.S. Department of Commerce). This information is used to compute an average cost per employee for each industry. Total payments to labor for EP divided by the average cost per employee multiplied by gives an estimate of the number of individuals employed by each industry for purposes of performing internal EP activities.

6.1.3. Direct Employment Associated With Household EP Activities

Employment associated with household EP activities is measured as the amount of labor required to produce the goods and services purchased by households and used in these activities. For each good and service used in household EP activities, a non-EP employment-output ratio is formed by dividing non-EP employment by gross industry output. Non-EP employment is simply total industry employment less employment used directly in EP activities. Gross industry output is taken directly from the I-O table. The value of each good and service used in household EP activities is multiplied by its corresponding non-EP employment-output ratio to obtain an estimate of direct employment associated with household EP activities.

6.1.4. Employment Associated With Investment Activities for EP

The procedure for estimating direct employment in investment activities for EP is identical to the procedure for estimating employment associated with household EP activities.

6.1.5. Employment Associated With Government EP Activities

The direct employment associated with (government) sewerage and EP water supply is estimated using the same procedure as for household and investment EP activities. Direct employment for the remaining three government EP activities consists of two components. The first component is the employment required to produce the goods and services used in these activities, and is computed using the same procedure as for sewerage and EP water supply (and household and investment EP activities). In addition, governments employ individuals to perform these EP functions. Data on the number of government employees for highways, water, and natural resources are taken from *Public Employment.* Of the total, 0.83 percent of employment for highways in 1982, 20 percent of employment for natural resources, and all employment in sanitary services are counted as EP employment. These percentages correspond to the percentage of highway expenditures that are for prevention of erosion, and the percentage of natural resource expenditures counted by EPA as EP expenditures.

6.2.   *Computation of Indirect Employment*

Using I-O techniques, it is also possible to estimate employment indirectly attributable to EP activities or equivalently, the employment that arises as a consequence of "multiplier effects." Multiplier effects occur because EP activities require inputs and employment is associated with the production of these inputs. The production of the inputs to EP activities also requires inputs and this generates employment and so forth. As an example, consider an industrial plant that has installed a scrubber to abate its emissions of air pollution. The plant will *directly* employ individuals to operate the scrubber. In addition, the plant will purchase electricity to run the scrubber and individuals will be employed in the production of electricity. Likewise, the electric power plant will purchase coal to produce electricity, and individuals will be employed to mine coal. The individuals employed in producing the electricity to run the scrubber and the individuals employed in mining the coal used to generate the electricity needed to operate the scrubber constitute *indirect* EP employment. The multiplier used in this study does *not* capture employment associated with household income generation and the resulting expenditures (i.e., "induced" effects). For a detailed discussion of I-O multipliers and the distinction between "direct," "indirect," and "induced" effects, see any standard I-O textbook, such as Miller and Blair (1985). Formal derivation of the multiplier used in this study is provided in Nestor and Pasurka (1995b).

6.3.   *Total Employment in EP Activities*

Estimates for direct and direct plus indirect employment associated with EP activities in 1982, 1985, 1988, and 1991 are reported in Table 4. Table 4 shows that direct employment increased in absolute terms between 1977 and 1991, fluctuating between 0.64 and 0.79 percent of total U.S. employment.   In 1991, direct EP employment was comparable to employment for the Aerospace industry, which employed 745,600 individuals.[18,19] Total EP employment has increased both absolutely and as a percentage of U.S. employment.

Between 1982 and 1991, the principal source of employment growth was in the external EP sector. Employment in internal EP activities was stable during this time. Note that the increases in EP employment (as a percent of U.S. employment) were smaller than the increases in value-added (as a percent of GNP). The source of this discrepancy is in the external EP and government EP activities sectors. Between 1982 and 1991, value-added for external EP activities rose 203 percent, while employment increased 55 percent.   Since it was assumed that the ratio of labor payments to gross output for each sector was constant after 1982, this is one explanation why increases in value-added that are larger than the increases in employment in the external EP services sector. In addition, value-added for government EP activities (i.e., payments to labor) increased 191 percent, while employment in government EP activities decreased roughly one percent. For government EP activities, it was assumed that the ratio of labor payments to the value of government purchases for sanitation, highways, and natural resources was constant after 1982. This is one explanation why payments to labor increased more rapidly that employment associated with government EP activities.

Table 4

Employment in EP Activities

Year	Direct Employment (Number of Individuals)	Direct Employment as a Percent of Total U.S. Employment	Direct + Indirect Employment (Number of Individuals)	Direct + Indirect Employment as a Percent of Total U.S. Employment
1977	678,359	0.79	1,267,082	1.48
1982	640,181	0.69	1,433,502	1.54
1985	659,067	0.65	1,591,940	1.58
1988	698,348	0.64	1,796,027	1.65
1991	741,186	0.66	1,965,818	1.76

NOTES

1. For a detailed review of estimates of the size of the EP industry, see Parker, Blodgett, and Aguirre, 1993.

2. Even among government sources, there is no agreement regarding which activities as for EP. In contrast to BEA, EPA includes 12.4 percent of operation and maintenance expenditures and 18.4 percent of capital expenditures in its definition of EP expenditures.

3. The *EBJ* estimate includes revenue of private and publicly-owned water utilities for water supply (conversation with Dan Noble on May 18, 1995). The *EBJ* value excludes revenue of POTWs (publicly-owned treatment works).

4. At this point, the distinction between "costs" and "expenditures" warrants clarification. The term expenditure is usually refers to tangible out-of-the pocket expenses while cost is a broader economic concept. For example, depreciation typically is not referred to as an expenditure because no transaction is associated with this expense. Depreciation is, however, a cost.

5. In addition, environmental fees, taxes, and penalties do not count has EP industry revenues.

6. For a detailed discussion of the complications and idiosyncracies of various estimates of the size of the EP industry, see the OTA (1994) report, *Industry, Technology, and the Environment: Competitive Challenges and Business Opportunities* (pp. 75-79 and 97-99).

7. Total costs of an industry consist of two components: value added and intermediate inputs. Value added consists of compensation of employees, indirect business taxes, and property-type income (e.g. depreciation). Intermediate inputs consist of those goods and services which are purchased from other industries and used by an industry in the production of its own product (e.g. steel purchased by the auto industry). GNP is equal to total value-added for the economy and thus, an industry's contribution to GNP is given by its value-added.

8. For an in-depth description of the SEEA, see United Nations, 1993.

9. Additional details are provided in the companion report, *The U.S. Environmental Protection Industry: The Technical Document* (U.S. EPA, 1995).

10. Benchmark input-output table refers to input-output tables constructed for those years in which an economic census takes place.

11. BEA does not count expenditures related to water treatment as EP expenditures.

12.   Throughout this report, "BEA data" will refer to data reported in *Survey of Current Business* while "MA-200 data" will refer to data reported by the U.S. Department of Commerce (Bureau of the Census) in "Pollution Abatement Costs and Expenditures" *Current Industrial Reports*, unless otherwise noted. Also, unless otherwise noted, "EPA data" will refer to data reported in *Environmental Investments: The Cost of a Clean Environment*.

13.   The 1987 benchmark I-O table was published as this report was being completed (see U.S. Department of Commerce, BEA, 1994).

14.   The United States International Trade Commission has published *Global Competitiveness of U.S. Environmental Technology Industries: Municipal and Industrial Water and Wastewater*.

15.   This table can be generated for 1977, 1982, 1985, and 1988 as well. Due to the simplifying assumptions used in constructing the updated EP I-O tables (e.g., fixed expenditure patterns) it is dangerous to use the tables to make comparisons over time.

16.   U.S. Department of Commerce, Bureau of the Census (1991).

17.   SIC 495 also includes private sewerage services. For the purposes of this study, it is assumed that output and employment related to private sewerage services are zero.

18.   U.S. Department of Commerce, Bureau of the Census (1991).

19.   The Aerospace Industry consists of: Aircraft and Parts (SIC 372) and Guided Missiles, Space Vehicles and Parts (SIC 376).

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APPENDIX A

CONCORDANCE BETWEEN ENVIRONMENTAL PROTECTION INDUSTRY
AND BEA INPUT-OUTPUT SECTORS

Concordance Between Environmental Protection Industry and BEA Input-Output Sectors

EP Industry I-O Sector	BEA I-O Sector[1]	Description
1		**Agriculture, forestry, and fisheries**
	01	Livestock and livestock products
	02	Other agricultural products
	03	Forestry and fishery products
	04	Agricultural, forestry and fishery services
2		**Utilities (Gas and Electric) and Mining**
	05	Iron and feroalloy mining
	06	Nonferrous metal mining
	07	Coal mining
	08	Crude petroleum and natural gas
	09	Stone and clay mining
	10	Chemical and fertilizer mining
	68.0100	Electric utilities
	78.0200	Federal electric utilities
	79.0200	State and local electric utilities
	68.0200	Gas production and distribution utilities
3		**Construction**
	11	New construction
	12	Maintenance and repair construction

Concordance Between Environmental Protection Industry and BEA Input-Output Sectors
(Continued)

4		**Food, Beverages, and Tobacco**
	14	Food and kindred products
	15	Tobacco manufactures
5		**Textiles, leather, wood, paper, and products**
	16	Broad and narrow fabrics, yarn and thread mills
	17	Miscellaneous textiles and floor coverings
	18	Apparel
	19	Miscellaneous fabricated textile products
	20	Lumber and wood products, except containers
	21	Wood containers
	22	Household furniture
	23	Other furniture and fixtures
	24	Paper and allied products, except containers
	25	Paperboard containers and boxes
	26	Printing and publishing
	33	Leather tanning and finishing
	34	Footwear and other leather products

Concordance Between Environmental Protection Industry and BEA Input-Output Sectors
(Continued)

6		**Chemicals and allied products**
	27	Chemicals and selected chemical products
	29	Drugs, cleaning and toilet preparations
	30	Paints and allied products
7		**Petroleum refining**
	31	Petroleum refining
8		**Rubber, plastic, stone, clay and glass products**
	28	Plastics and synthetic materials
	32	Rubber and miscellaneous plastic products
	35	Glass and glass products
	36	Stone and clay products
9		**Primary metals**
	37	Primary iron and steel
	38	Primary nonferrous metals

Concordance Between Environmental Protection Industry and BEA Input-Output Sectors
(Continued)

10		**Manufacturing products**
	39	Metal containers
	40	Heating, plumbing and fabricated structural metal
	41	Screw machine products and stampings
	42	Other fabricated metal products
	53	Electrical industrial equipment
	54	Household appliances
	55	Electrical lighting and wiring equipment
	56	Radio, TV and communication equipment
	57	Electronic components and accessories
	58	Miscellaneous electrical machinery and supplies
	62	Scientific and controlling instruments
	63	Optical, ophthalmic and photographic equipment
	64	Miscellaneous manufacturing

Concordance Between Environmental Protection Industry and BEA Input-Output Sectors
(Continued)

11		**Machinery and transport equipment**
	43	Engines and turbines
	44	Farm and garden machinery
	45	Construction and mining equipment
	46	Materials and handling machinery
	47	Metal working machinery
	48	Special industry machinery
	49	General industry machinery
	50	Miscellaneous machinery, except electrical
	51	Office, computing and accounting machines
	52	Service industry machines
	59	Motor vehicles and equipment
	13	Ordnance and accessories
	60	Aircraft and parts
	61	Other transportation equipment

Concordance Between Environmental Protection Industry and BEA Input-Output Sectors
(Continued)

12		**Nonenvironmental Services**
	65	Transportation and warehousing
	66	Communications, except radio and TV
	67	Radio and TV broadcasting
	69	Wholesale trade
	74	Eating and drinking places
	70	Finance and insurance
	71	Real estate and rental
	68.0301	Water supply and sewerage systems ("nonenvironmental")
	68.0302	Steam supply, sanitary services, and irrigation systems ("nonenvironmental")
	72	Hotels, personal and repair services
	73	Business services
	75	Automobile repair and services
	76	Amusements
	77	Health, education, social services, nonprofit organizations
	78.0100	U.S. postal services
	78.0300	Commodity credit corporation
	78.0400	Other federal government enterprises
	79.0100	Local government passenger transit
	79.0300	Other state and local government services ("nonenvironmental")

Concordance Between Environmental Protection Industry and BEA Input-Output Sectors
(Continued)

13		**External environmental protection sector**
	68.0301	Water supply and sewerage systems ("environmental")
	79.0300	Other state and local government services ("environmental")
	68.0302	Steam supply, sanitary services, and irrigation systems ("environmental")
14		**Other industry**
	80	Noncomparable imports
	81	Scrap, used and secondhand goods
	82	Government industry
	83	Rest of the world industry
	84	Household industry
	85	Inventory valuation adjustment

[1] From "The Use of Commodities by Industries" table.

APPENDIX B

DOCUMENTATION OF PEER REVIEW PROCESS

B.1.   Description of Review Process

Drafts of the reports *The U.S. Environmental Protection Industry: The Technical Document* and *The U.S. Environmental Protection Industry: A Proposed Framework for Assessment* were subjected to both an inter- and intra-agency reviewed. Representatives from the following Agencies were contacted for comment: Bureau of Economic Analysis, Congressional Budget Office, Department of Commerce, Office of Technology Assessment, and the U.S. International Trade Commission. Within EPA, representatives from the following offices were contacted: Office of Air and Radiation, Office of International Activities, Office of Prevention, Pesticides and Toxic Substances, Office of Solid Waste and Emergency Response, and Office of Water. Upon receipt of comments, EPA staff made an attempt to address and incorporate all comments, to the maximum extent possible. Specific comments and responses are listed below.

In addition, the analytical methods used were documented in an academic paper, which was submitted for peer review to the journal, *The Review of Income and Wealth*, a journal specializing in national income accounting and input-output concepts. The paper, "Environment-Economic Accounting and Indicators of the Economic Importance of Environmental Protection Activities," was accepted for publication after two revisions.

B.2.   Specific Comments and Responses

Comment: [The report should] note (or footnote) additional complications and idiosyncracies of various estimates [of the size of the EP industry] beyond the discussion definitions and the example of water supply.

Response: Endnote 3 in Chapter 2 of *The U.S. Environmental Protection Industry: The Technical Document* and endnote 6 in *The U.S. Environmental Protection Industry: A Proposed Framework for Assessment* were added.

Comment: The point that data is the limiting factor [to measuring the size of the EP industry] should be made explicit for policymakers.

Response: Although data are a potential source of the discrepancy in different estimates of the size of the EP industry, it is not the primary source of the discrepancy. Rather, the report points out that it is the lack of a consistent definition of the economic activities that constitute environmental protection activities that is the primary source of the different estimates.

Comment: In addition to internal corporate activities and purchase of nonenvironmental commodities, environmental costs in the form of fees, taxes, and penalties paid to government do not count as EP industry revenues.

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Response: Endnote 2 in Chapter 2 of *The U.S. Environmental Protection Industry: The Technical Document* and endnote 5 in *The U.S. Environmental Protection Industry: A Proposed Framework for Assessment* were added.

Comment: While disentangling [revenues from] environmental goods and services from nonenvironmental goods and services can be difficult and may in practice account for some discrepancy between cost and revenue based estimates of the EP industry, it is not a theoretical reason for such a discrepancy.

Response: The report does not claim that the difficulty in acquiring such data is a "theoretical reason for such a discrepancy." The report discusses the difficulties of actually measuring the size of the environmental protection industry.

Comment: In distinguishing value-added from revenues or costs of EP, it might be useful to have a more concrete example of how value-added is only a component of total costs in [*The U.S. Environmental Protection Industry: A Proposed Framework for Assessment*].

Response: Endnote 7 was added to *The U.S. Environmental Protection Industry: A Proposed Framework for Assessment*.

Comment: Perhaps a more important example than adding the value of game animals can be found to illustrate the SEEA's modification of national income accounting.

Response: The example was changed to the value of wetlands in mitigating floods, filtering water for drinking, and serving as a nursery for commercial fish.

Comment: Are government expenditures on vehicle emissions control and other environmental activities (e.g., precipitators at a municipal utility or military base clean-up or environmental monitoring) treated somewhere or are data not available?

Response: As stated in the report(s), this study uses the BEA definition of environmental protection expenditures with some modifications in order to accommodate EPA's definition of environmental protection costs. Some of BEA's expenditure information is excluded due to lack of information regarding which goods and services are purchased as a consequence of these expenditures. For example, regulation and monitoring expenditures are excluded from this report.

Comment: The report may benefit from a comparative assessment that clearly indicates why one approach [to measuring the EP industry] may be better over others.

Response: The preferred approach depends on the type of question that is being asked so it is
              not possible to compare approaches without reference to the research issue.
              Section 2 of *The U.S. Environmental Protection Industry: A Proposed
              Framework for Assessment* details the reasons that input-output framework is
              appropriate for this study.

Comment: The discussion of Table 1 [in *The U.S. Environmental Protection Industry: A
              Proposed Framework for Assessment*] is insufficient.

Response: The text describing the table was revised.

Comment: [The report] needs to clarify that water related EP expenditures include drinking
              water.

Response: The text under 3.3.1 in *The U.S. Environmental Protection Industry: A Proposed
              Framework for Assessment* was altered to make this point.

Comment: The format of the reports [should be] described in a preface or other appropriate
              introductory material.

Response: The acknowledgments section of the reports describes the relationship between
              the two reports.

Comment: The report could be improved by collection of primary data.

Response: Such data would have been useful in constructing the EP input-output tables for
              this report. However, the cost collecting primary data was not within the EPA
              budget allocated for this project.

Comment: The reports could be improved by more clearly describing the objective of the
              analysis.

Response: Section 1.1 of *The U.S. Environmental Protection Industry: A Proposed
              Framework for Assessment* was revised to address this comment.

Comment: The report [should] highlight all assumptions in a list or table.

Response: Appendix G, "List of Important Assumptions" was added to *The U.S.
              Environmental Protection Industry: The Technical Document*.

Comment: Are any air pollution services provided by the [external] EP industry?

Response: As indicated by the detailed discussions of what is included in the external EP
             sectors in Chapters 2 and 3 of *The U.S. Environmental Protection Industry: The
             Technical Document* no air pollution control services are provided by the external
             EP services sectors.

Comment: (Regarding Table 1 in *The U.S. Environmental Protection Industry: A Proposed
             Framework for Assessment*) The table needs a discussion of units and whether
             the information is based on a revenue, cost or value-added approach.

Response: The text describing the table was revised and the omitted units (millions of
             dollars) were added to the table.

Comment: The report needs a more complete discussion of the model to accompany
             derivation of the mathematical formulae.

Response: The derivation of the input-output multipliers is presented in "Environment-
             Economic Accounting and Indicators of the Economic Importance of
             Environmental Protection Activities" which will appear in the September 1995
             issue of *The Review of Income and Wealth*.

Comment: The report needs to make clear that there are two parts to disaggregating the
             input-output tables: 1) identifying environmental protection expenditures which
             reduce pollution and 2) identifying defensive expenditures to reduce the effects of
             pollution.

Response: Endnote 5 in Chapter 2 of *The U.S. Environmental Protection Industry: The
             Technical Document* was added.

Comment: How are federal contributions to SRFs treated?

Response: Federal state revolving fund (SRF) subsidies do not appear to be counted as
             environmental protection expenditures by the Bureau of Economic Analysis.
             Hence, there is no explicit accounting of SRFs in the input-output tables in this
             report.