United States International Trade Commission

Air and Noise Pollution Abatement Services:

An Examination of U.S. and Foreign Markets

Investigation No. 332-461
USITC Publication 3761
April 2005

U.S. International Trade Commission

COMMISSIONERS

Stephen Koplan, Chairman
Deanna Tanner Okun, Vice Chairman
Marcia E. Miller
Jennifer A. Hillman
Charlotte R. Lane
Daniel R. Pearson

Robert A. Rogowsky
Director of Operations

Karen Laney-Cummings
Director of Industries

Address all communications to
Secretary to the Commission
United States International Trade Commission
Washington, DC 20436

U.S. International Trade Commission

Washington, DC 20436
www.usitc.gov

Air and Noise Pollution Abatement Services:
An Examination of U.S. and Foreign Markets

Investigation No. 332-461

Publication 3761

April 2005

This report was principally prepared by the Office of Industries

Project Team

Jennifer Baumert, *Project Leader*
jennifer.baumert@usitc.gov
Eric Forden, *Deputy Project Leader*
eric.forden@usitc.gov

Judith Dean, *Economist*

Staff assigned:
William Chadwick, Lisa Ferens, David Ingersoll, Dennis Luther, Christopher Mapes, Erick Oh, Robert Randall, and Ben Randol

Office of Operations
Peg MacKnight

With special assistance from:
Lynette Gabourel and Cynthia Payne

Primary Reviewers
Alan Fox and Mark Paulson

under the direction of
Richard Brown, *Chief*
Services and Investment Division

ABSTRACT

As requested by the United States Trade Representative (USTR), this report examines global markets for air and noise pollution abatement services and trade in these services markets for the purpose of providing information that would be useful in conducting trade negotiations and environmental reviews. The report indicates that demand for air and noise pollution abatement services is driven largely by government regulation and enforcement efforts, and to a lesser extent, by international treaty obligations, public sentiment, and private-sector financial resources. The majority of air pollution abatement services are reportedly delivered in conjunction with air pollution control equipment, with European, Japanese, and U.S. firms being the dominant suppliers of such services and equipment. Emissions trading, a financial service associated with air pollution abatement, is a newly emerging market that is gaining acceptance in developed countries. The market for noise pollution abatement services is small, as such pollution is often addressed through product standards, environmental and labor regulation, scheduling, and zoning restrictions.

Table of Contents

Table of Contents–*Continued*

Table of Contents–*Continued*

Page

Appendices

Boxes

Figures

Tables

ITC READER SATISFACTION SURVEY

Air and Noise Pollution Abatement Services: An Examination of U.S. and Foreign Markets

The U.S. International Trade Commission (USITC) is interested in your voluntary comments (burden less than 10 minutes) to help assess the value and quality of our reports, and to assist in improving future products. Please **return survey by facsimile (202-205-2359) or by mail** to the USITC, or visit the USITC Internet home page (*http://reportweb.usitc.gov/reader_survey/readersurvey.html*) to electronically submit a Web version of the survey.

(Please print; r*esponses below not for attribution):*

Your name and title: _____

Organization (if applicable): _____

Which format is most useful to you? ❑ CD-ROM ❑ Hardcopy ❑ USITC Internet site

Circle your assessment of each factor below: **SA** = strongly agree, **A** = agree, **N** = no opinion, **D** = disagree, or **SD** = strongly disagree.

Value of this report:					
▶ Statistical data are useful	SA	A	N	D	SD
▶ Other non-numerical facts are useful	SA	A	N	D	SD
▶ Analysis augments statistical data/other facts	SA	A	N	D	SD
▶ Relevant topic(s)/subject matter	SA	A	N	D	SD
▶ Primary or leading source of information on this subject	SA	A	N	D	SD
Quality of this report:					
▶ Clearly written	SA	A	N	D	SD
▶ Key issues are addressed	SA	A	N	D	SD
▶ Charts and graphs aid understanding	SA	A	N	D	SD
▶ References cite pertinent sources	SA	A	N	D	SD

Other preferred source of information on this subject: _____

Specify chapters, sections, or topics in report that are most useful: _____

_____

_____

Identify any type of additional information that should have been included in report: _____

_____

_____

Suggestions for improving report: _____

_____

_____

Please update your mailing and electronic addresses below (voluntary)-

Mailing address: _____

City, state, and zip code: _____

E-mail address: _____

OMB No.: 3117-0188

FOLD

UNITED STATES
INTERNATIONAL TRADE COMMISSION
WASHINGTON, DC 20436

OFFICIAL BUSINESS
PENALTY FOR PRIVATE, USE $300

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 12840 WASHINGTON, DC

POSTAGE WILL BE PAID BY ADDRESSEE

U.S INTERNATIONAL TRADE COMMISSION
500 E STREET, SW.
WASHINGTON, DC 20277-2840

ATTN:
OFFICE OF INDUSTRIES
Air and Noise Pollution Abatement Services:
An Examination of U.S. and Foreign Markets

EXECUTIVE SUMMARY

Demand for air pollution abatement services and equipment is driven largely by government regulation and enforcement activities and, to a lesser extent, international obligations, financial resources, and public sentiment. In most countries, air pollution regulations limit emissions on a range of air pollutants. Regulatory regimes and enforcement measures in developed countries are typically more stringent, compared to developing countries. Evidence indicates that as incomes grow, regulatory stringency increases, driving demand for air pollution goods and services. In developed countries, while air pollution regulations have generally been passed at the national level, implementation and enforcement action is being devolved to subnational governments. By contrast, developing countries tend to enact, implement, and enforce air pollution control regulations at the national level. This distinction may impact the provision of goods and services, as providers may be forced to comply with several different sets of standards among states, rather than just one set of regulations at the national level.

Noise pollution abatement also is driven by government regulations. In most countries, noise pollution is typically a low priority issue, although laws and regulations in this sector tend to be more advanced in developed countries. Noise pollution is often addressed by product standards and/or environmental and labor laws.

Air pollution abatement goods and services are frequently supplied to customers as part of a single transaction, with goods accounting for the majority of the sale. In addition, a significant share of the services provided to abate air pollution are classified in industries other than the core air pollution abatement services sector, such as engineering and construction. Markets for air pollution abatement goods and services in developed countries tend to be highly competitive and are supplied by several hundred small, private-sector firms. By contrast, developing countries are reliant upon imports of such goods and services, often resulting in a limited selection in terms of technology, cost, and suitability for pollution control requirements. Nonetheless, many developing-country markets, including China, India, Poland, and Turkey, are considered to offer good prospects for growth.

The United States, the European Union, China, and Japan are the largest consumers of air pollution abatement services and equipment accounting for approximately 28 percent, 18 percent, 15 percent, and 6 percent of this combined market, respectively. U.S. firms are estimated to be the dominant suppliers of air pollution abatement services in the world market, while firms from the European Union are likely the dominant suppliers of core air pollution abatement equipment. Overall, there are few trade barriers in either developed-or developing-country markets directly related to air pollution abatement services. Tariff rates on air pollution abatement equipment in developed countries tend to be lower than such tariffs in developing countries. There are no discrete data on investment in the air pollution abatement services and goods sectors.

Emissions permit trading is a market-based alternative to the traditional command-and-control approach to air pollution abatement, under which regulatory authorities compel polluters to install cleaner technologies or attain source-specific emissions reductions. Although command-and-control regulations remain the principal means of addressing air pollution, emissions permit trading is gaining acceptance as a method for reducing air pollution, primarily in the United States and Europe. The primary approach to

emissions trading is the "cap and trade" approach. Under such an approach, a regulatory authority establishes a desired "cap" on the overall amount of a specific air pollutant emitted by a group of installations during a compliance period. Emissions allowances are allocated among affected installations, with the total number of issued allowances equaling the desired cap. At the end of the compliance period, each installation must possess allowances sufficient to cover its emissions during the period. Installations whose emissions fall below the initial allowance allocation may sell excess allowances on an emissions market. Similarly, installations whose emissions exceed the initial allowance allocation must purchase additional allowances in the emissions market. With the exception of the U.S. Acid Rain Program, emissions trading markets are in the early stages of development, and thus, it is unclear what effect these programs will have on the overall market for air pollution abatement goods and services. The European Union Emissions Trading Scheme, which was launched in January 2005, is the most prominent scheme focused on reducing greenhouse gases. Other schemes include the United Kingdom Emissions Trading Scheme, the New South Wales Greenhouse Gas Abatement Scheme, the NO_x Budget Trading Program, and the Chicago Climate Exchange.

The global market for noise pollution abatement services, which is largely confined to testing, measurement, and modeling activities, is extremely small. Providers of such services are almost entirely composed of small, specialized engineering and/or consulting firms. Equipment related to the provision of such services includes measuring and testing equipment, associated computer equipment, and computer software. There are no discrete data on trade and investment in the noise pollution abatement services market. However, the reportedly unprofitable nature of the noise pollution abatement services and equipment markets, combined with the tendency for such services to be provided by local suppliers, suggest that there is likely very little, if any, international trade in noise pollution abatement services.

ACRONYMS AND CHEMICAL SYMBOLS

AAU	Assigned amount unit
APC	Air pollution control
ATDS	Automotive Testing and Development Systems
BACT	Best available control technology
BNA	Bureau of National Affairs
BP	British Petroleum
CAA	Clean Air Act (United States)
CAIR	Clean Air Intersate Rule
CBOT	Chicago Board of Trade
CCAD	Comisión Centroamericana de Ambiente y Desarrollo
CCAP	Climate change agreement participants
CCX	Chicago Climate Exchange
CDC	Centers for Disease Control and Prevention
CDM	Clean Development Machanism
CEPA	Canadian Environmental Protection Act, The
CER	Certified emission reductions
CFC	Chlorofluorocarbons
CFI	Carbon Financial Instruments
CH_4	Methane
CICA	Centro de Investigacion Contaminacion Ambiental
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CONAMA	Conselho Ncaional de Meio Ambiente (Brazil)
CPC	Central Product Classification
DEAT	Department of Environmental Affairs and Tourism (South Africa)
DOE	Department of Energy
DP	Direct participants

EAS	EnriroSafe Australia
EBI	Environmental Business International
EC	European Communities
ECX	Eurpean Climate Exchange
EEA	Energy and Environment Analysis, Inc.
EEX	European Energy Exchange
EFET	European Federation of Energy Traders
EGAT	Electricity Generating Authority of Thailand, The (Thailand)
EIA	Energy Information Administration
EPA	Environmental Protection Agency
ERU	Emissions reduction units
ESP	Electrostatic precipitator
EU	European Union
EU-12	Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, and the United Kingdom
EU-15	EU-12 and Austria, Finland, and Sweden
EU-25	EU-15 and Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia
EU-ETS	EU Emission Tradeing Scheme
EUA	European Union allowance
EXAA	Austrian Energy Exchange
FGD	Flue gas desulfurization
FIC	Foreign Investment Committee, The (Chile)
FIRB	Foreign Investment Board
FTA	Free Trade Agreement
GAO	General Accounting Office
GATS	General Agreement on Trade in Services
GCR	Global Competitiveness Report, The
GDP	Gross domestic product
GHG	Greenhouse gases
GWP	Global Warming Potential
H_2O	Water

H_2SO_4	Sulfuric acid
HAPS	Hazardous air pollutants
HFCs	Hydroflurocarbons
HS	Harmonized System of Product Classification, The
HTK	Hotaka Engineering
IAP	Indoor air pollution
IBAMA	Brazilian Institute of the Environment and Renewable Natural Resources (Brazil)
ICE	Centro Nacional de Planificacioin Electrica
IETA	International Emissions Trading Association
INPI	National Institute for Industrial Property (Brazil)
IPE	International Petroleum Exchange
ISDA	Internal Swaps and Derivatives Association, Inc.
ISO	International Organization for Standardization
JI	Joint Implementation
LINCOS	Little Intelligent Communities
MARPOL	Protocol of 1978 Relating to the International Convention for the Prevention of Pollution From Ships, 1973 (Korea)
MERCOSUL	Mercado Comum do Su, The
MFN	Most-favored-nation
MMA	Misisterio do Meio Ambiante, The (Brazil)
MVR	Montly Violations Reports
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standard
NAP	National Allocatoin Plan
NBP	NO_x Budget Trading Program
NEMA	National Environmental Management Act (South Africa)
NGO	Non-Government Organization
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOM	Normas Officialas (Mexico)
NO_x	Nitrogen oxides
NSW Scheme	New South Wales GReenhouse Gas Abatement Scheme

O_3	Ozone
OECD	Organization for Economic Cooperation and Development
OSHA	Occupational Safety and Health Act of 1970, The (United States)
PCV	Positive crankcase ventilation
PEMEX	Petroleos Mexicanos (Mexico)
PERS	Porous elastic road surface
PERT	Pilot Emission Reduction Trading (Canada)
PFCs	Perfluorocarbons
PM	Particulate matter
PM_{10}	Particles with a diameter of 10 microns or less
$PM_{2.5}$	Particles with a diameter of 2.5 microns or less
PPDA	Atmosphere Prevention and Decontamination Plan for the Metropolitan Region
PROPER	Program for Pollution Control, Evaluation and Rating
PRTR Law	Pollution Release and Transfer Registry Law (Japan)
R&D	Research and development
RECLAIM	Regional Clean AIr Incentives Market
RECOPE	Refinadora Costarricense de Petróleo
RFG	Reformulated gasolines
RGGI	Regional Greenhouse Gas Initiative
RWDI	Rowan Williams Davies & Irwin, Inc.
SAIC	Science Application International Corporation (Mexico)
SCR	Selective catalytic reduction (United States)
SEMARNAT	Ministry of the Enviroment and Natural Resources (Mexico)
SESMA	Servicio de Salud Metropolitan del Ambiente (Chile)
SF_6	Sulphur hexaflouride
SO_2	Sulfur dioxide
SO_3	Sulfur trioxide
SO_x	Sulfur oxides
STPS	Ministry of Labor and Social Security, The (Mexico)
TRI	U.S. Toxic Release Inventory
UK	United Kingdom

UK-ETS	United Kingdom Emission Trading Scheme
UKA	United Kingdom allowances
UKA	United Kingdom allowance
UNCTAD	United Nations Conference on Trade and Development
UNFCCC	United Nations Framework Convention on Climate Change
USDOC	United States Department of Commerce
USFCS	U.S. Foreign Commercial Service
USITC	United States International Trade Commission
USTR	United States Trade Representative
VOC	Volatile organic compounds
WHO	World Health Organization
WITS	World Integrated Trade Solution
WRI	World Resources Institute
WTO	World Trade Organization

CHAPTER 1
INTRODUCTION

Purpose

On July 12, 2004, the U.S. International Trade Commission (Commission or USITC) received a request from the United States Trade Representative (USTR) to conduct two investigations[1] and provide two reports that would examine discrete segments of the environmental and energy services industries. The first investigation is to focus on air and noise pollution abatement services, and the second is to focus on renewable energy.[2] The findings of this investigation, *Air and Noise Pollution Abatement Services: An Examination of U.S. and Foreign Markets* (Inv. No. 332-461),[3] are presented in this report. As requested by the USTR, this report provides an overview of U.S. and foreign markets for air and noise pollution abatement services; examines trade and investment in these markets, including barriers affecting such trade and investment, if any; and where possible, discusses existing regulatory practices that generate demand for the subject services.[4] The report provides information on both developed-[5] and developing-country[6] markets for air and noise pollution abatement services, and includes examples—as appropriate—from those economies with which the United States has established, or is in the process of negotiating, a free trade agreement.

As requested, the report also includes, to the extent possible, information on trade and market conditions for those goods related to the subject environmental services. Air and noise pollution abatement services are frequently economic complements to air and noise pollution abatement goods. For example, many air pollution abatement projects are unique applications that involve services such as engineering consulting to design unique equipment, which then may be fabricated and installed by the same or another firm. Within these industry sectors, goods include a wide variety of equipment and mechanical devices that reduce, prevent, capture, or destroy pollutants before they are released into the atmosphere. Examples of such equipment applicable to air pollution include scrubbers, which remove harmful gases and particulates from exhaust gases; incinerators (or thermal oxidizers), which use intense heat to destroy organic contaminants; filter collectors, which trap and remove particulates from an exhaust stream; and catalysts, which cause chemical reactions that break the pollutants down into

[1] As identified under section 332(g) of the Tariff Act of 1930.

[2] See appendix A.

[3] The *Federal Register Notice* pertaining to this investigation can be found in appendix B.

[4] Such regulatory practices may include national and subnational environmental regulations, as well as multinational conventions or agreements on environmental issues that may have an effect on the air and noise pollution abatement services markets.

[5] For the purposes of this report, "developed" countries include those considered by the World Bank to be high-income economies. World Bank, *2003 World Development Indicators* (World Bank: Washington D.C., 2003).

[6] For the purposes of this report, 'developing' countries include those considered by the World Bank to be low- and middle-income economies. World Bank, *2003 World Development Indicators* (World Bank: Washington D.C., 2003).

less harmful by-products. Goods applicable to noise pollution include engine mufflers, highway noise barriers, and ear plugs and other hearing protectors.

Air Pollution Abatement

The worldwide market for air pollution abatement services has increased steadily in recent years, registering, according to one industry source, an average annual growth rate of approximately 6 percent during the period 1994-2004, and reaching an estimated $2.4 billion in 2004.[7] The worldwide market for air pollution abatement goods is estimated to have experienced similar growth (7 percent) during the same period, although the overall market size for goods is considerably larger, reaching an estimated $49.4 billion in 2004.[8] The United States is the world's largest producer and exporter of air pollution control equipment and services, followed by Japan and Germany. Together, the United States, Japan, and the EU account for an estimated 85 percent of world trade in the overall pollution control industry.[9] Looking specifically at air pollution abatement goods and services, industry sources indicate that Germany, Japan, and the United States are major exporters.[10] In general, developing countries are most frequently importers of air pollution abatement goods and services, while large developed countries are typically exporters. Consumers of air pollution control equipment vary by market, but generally, electric utilities, by far, purchase the largest share in many markets. Other significant clients include the chemical, pharmaceutical, and plastics industries; petroleum refining; pulp and paper manufacturing firms; incinerators; and large-scale foundries.[11]

Air pollution abatement services focus on the reduction and control of a variety of pollutants such as sulfur oxides (SO_x),[12] nitrogen oxides (NO_x),[13] lead, carbon monoxide (CO), ozone (O_3), particulate matter (PM), hazardous air pollutants, greenhouse gases

[7] Generally, data provided by the McIlvaine Company are based on industry estimates. The McIlvaine Company, e-mail received by Commission staff, Dec. 29, 2004. A fuller discussion of all the data presented in this report is found under the heading *Methodological Approach,* which concludes this chapter.

[8] The McIlvaine Company, e-mail received by Commission staff, Dec. 29, 2004.

[9] Includes goods and services in pollution control sectors in addition to air and noise. Sandeep Singh, "Trade and Environment Set to Lock Horns at WTO," *The Financial Express,* Feb. 3, 2003, found at *http://www.teriin.org/features/art183.htm,* retrieved Jan. 27, 2005.

[10] The McIlvaine Company, *World Air Pollution Control Revenue Forecasts,* p. 9, document sent to USITC staff via e-mail, received Jan. 4, 2005.

[11] Environmental Business International, Inc. (EBI), 1996, found at *http://www.ebiusa.com,* retrieved Jan. 6, 2005.

[12] SO_x, oxides of sulfur, includes primarily sulfur dioxide (SO_2) and sulfur trioxide (SO_3). SO_2 forms when sulfur (all fossil fuels contain sulfur) is burned. The resulting fine particulate matter pollution can inhibit visibility, lead to acid rain, and adversely affect human health.

[13] NO_x, oxides of nitrogen, includes primarily nitrogen dioxide (NO_2) and nitric oxide (NO). NO_2 is a respiratory irritant, and also a precursor to ozone (smog) formation. The main source of NO_x emissions are combustion sources, such as cars, power plants, and industrial engines. U.S. Environmental Protection Agency (EPA), found at *http://www.epa.gov/region09/air/permit/defn.htm,* retrieved Dec. 28, 2004.

(GHGs), and myriad indoor air pollutants.[14] Demand for such services is expected to increase in regions experiencing increased instances of air pollution, and where the public has expressed concern regarding environmental conditions as they relate to health and quality of life.[15] Such factors combine to spur legislation and other actions that serve to ameliorate air pollution, which, in turn, often spur demand for air pollution abatement goods and services. Air pollution policies may be established at the national or subnational levels, and may take the form of emission limits on individual industrial polluters, processes, or vehicles; air quality threshold goals and objectives; or economic instruments such as energy and pollution taxes, or emissions trading schemes.[16]

Noise Pollution Abatement

The global market for services related to noise pollution abatement is believed to be small, as it is essentially confined to various testing, measuring, and modeling activities that might be done by outside contractors or consultants. Anecdotal information suggests that the worldwide market for noise pollution abatement goods and services has grown in recent years. However, quantitative information covering these industry segments is generally limited and incomplete, precluding precise statistical analysis.[17]

The Centers for Disease Control and Prevention (CDC) reports that noise has become one of the most pervasive environmental pollutants in today's society, requiring increased attention. However, noise restrictions are difficult to manage and enforce because noise pollution is much more subjective than many other environmental pollutants. For most, a loud fireworks display is usually considered an enjoyable event, but the same audience would probably consider the same noise a nuisance if trying to sleep. Criteria that are not subject to personal opinion[18] are generally the most useful when crafting laws, ordinances, and standards relating to noise control. Thus, when possible, noise control policies usually are based on objective performance standards,

[14] Greenhouse Gases (GHGs) allow sunlight to reach the earth's surface, but restrict infrared energy (heat) from escaping into space. The six greenhouse gases addressed by the Kyoto Protocol are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6). Each gas has a different global warming potential and longevity in the atmosphere.

[15] Industry representatives, interviews by USITC staff, Bangkok, Seoul, and Tokyo, Nov. 2004.

[16] Generally, emissions trading allows an entity that wishes to release emissions in excess of their allotted level to buy unused polluter entitlements from other enterprises emitting below their allotted levels. Emissions trading may lead to increased demand for air pollution abatement goods and services. For example, industry representatives expect the EU Emissions Trading Scheme (EU-ETS) to create demand of air pollution abatement services and equipment, as the newly restricted firms move to avoid fines and other penalties. Technically speaking, the regulatory measures requiring emissions reduction are the industry driver, while programs such as the EU-ETS are more-or-less byproducts of the laws.

[17] Industry representatives, interviews by USITC staff, Tokyo and Seoul, Nov. 2004.

[18] One established benchmark comes from the Deafness Research Foundation, which reports that prolonged exposure to noise above 85 decibels can cause hearing loss. The World Health Organization (WHO) reports that noise pollution negatively affects health and well-being and is considered a serious health problem worldwide. In addition to hearing loss, other health effects of noise include stress, anxiety, poor concentration, and loss of productivity.

which may specify maximum noise emission levels for certain types of equipment, such as motorcycles, and for the performance of specific activities, such as building construction. Other controls include measures such as local ordinances that restrict certain noises to certain times of day. Regulations relating to noise pollution exist at the national, state, and local levels, and may be directed toward the source of the offending noise, the path of noise transmission, and the targeted observer.[19]

Air and Noise Pollution Abatement Services in the World Trade Organization (WTO)

The air and noise pollution abatement services industries, as discrete segments of the overall environmental services sector, have received special emphasis in the WTO, as the reduction or elimination of barriers affecting trade in environmental services has been identified in the Doha Ministerial Declaration[20] as one of the principal goals of the present negotiating round. Industry representatives believe that as trade in the environmental service sector expands globally, exporters, importers, and the environment itself may benefit from increased competition that generally reduces costs, increases service quality, improves efficiency, and/or introduces environmental services that were previously unavailable.[21] Environmental issues also have become increasingly tied to international trade and investment activities, such that the potential environmental impact of a trade agreement is increasingly likely to be evaluated by the participating national governments and considered as a critical element of the agreement under consideration.

Scope

For the purpose of this study, air and noise pollution abatement services are defined to include control services of indoor or outdoor air pollution originating from stationary or mobile sources; services related to the trade of air pollution emission rights; services related to the monitoring, assessment, or control of acid rain; services related to the study of the relationship between air pollution and climate; noise pollution abatement and control services; testing and monitoring of air or noise pollution; and other services incidental to air and noise pollution abatement. The USTR specified this definition of the air and noise pollution abatement services industries in its request letter. Other researchers may arrive at different, but equally valid, definitions of air and noise pollution abatement services.

One of the characteristics of the definition utilized in this investigation is that it is largely based on the World Trade Organization's (WTO) *Services Sectoral Classification List*[22] (also known as the W/120), which is used by most signatories to the General Agreement

[19] Solutions may involve protecting the recipient, increasing path length, blocking the path, or reducing the noise at the source.

[20] World Trade Organization (WTO), *Ministerial Declaration: Adopted on 14 November 2001*, WT/MIN(01)/DEC/1, Nov. 20, 2001.

[21] Industry representative, interview by USITC staff, California, May 11, 2004.

[22] WTO, MTN.GNS/W/120, July 10, 1991.

on Trade in Services (GATS) as a basis for their schedules of specific commitments.[23] The W/120 divides environmental services into four subgroups, most of which are identified by corresponding Central Product Classification (CPC) codes: sewage services, CPC 9401; refuse disposal services, CPC 9402; sanitation and similar services, CPC 9403; and other environmental services, which is often presumed to include, *inter alia*, cleaning services of exhaust gases (CPC 9404) and noise abatement services (CPC 9405).[24] Many of the activities included in the USTR definition are classified in CPC 9404 and 9405. However, some of the services listed by the USTR are classified as other environmental protection services not elsewhere classified (CPC 9409), or are outside the environmental services division of the CPC.

Air and noise pollution abatement services can be broadly segmented into core and cluster services (figure 1-1).[25] Generally, core services are unique to pollution abatement, while cluster services may be supplied in numerous services subsectors, in addition to the subject core service sector. For example, engineering services, which are peripheral to abatement services, may also be integral to numerous other environmental services, as well as to fields completely outside the scope of environmental activities, such as roller chain production. Based on the information gathered for this study, it seems that a significant proportion of the services provided to abate air and noise pollution are classified in the "cluster" rather than the core. The Organization for Economic Cooperation and Development (OECD) suggests that the benefit of developing a core/periphery approach to environmental services is that future GATS negotiations in this area could be undertaken using the core classifications, while still giving attention to the related, but separately classified, services that are key to their delivery; *i.e.*, the periphery.[26]

Methodological Approach

To gather information for this report, the Commission conducted in-person and telephone interviews with industry representatives, government officials, and academics, and consulted a wide range of secondary sources in a search for both quantitative and qualitative information. In recognition of the pronounced variation among air and noise pollution abatement service providers, an attempt was made to collect information from diverse parties. During the course of this investigation, Commission staff conducted interviews with representatives of air and noise pollution abatement service providers

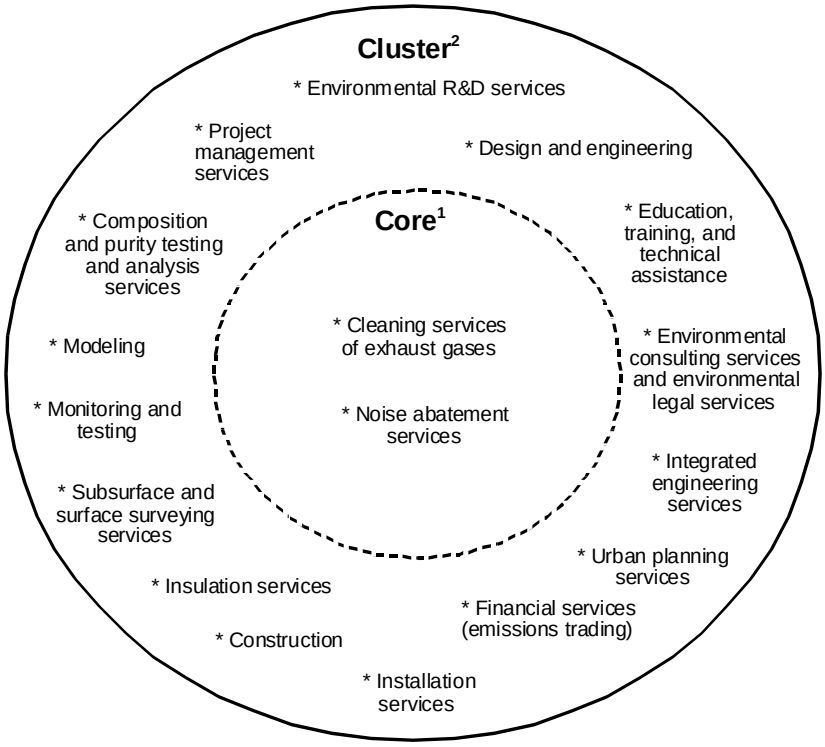
[23] The terms and conditions under which WTO signatories accord market access and national treatment to foreign firms are provided within national schedules of specific commitments.

[24] For more information regarding GATS commitments on cleaning services of exhaust gases (CPC 9404) and noise abatement services (CPC 9405) as well as a discussion of recent developments in the WTO as they relate to these service segments, see appendix C.

[25] While industry segments can be differentiated for classification purposes, most data used in this report includes both core and periphery services, as data collection capabilities currently do not allow a more narrow examination.

[26] Organization for Economic Cooperation and Development (OECD), *Environmental Goods and Services: The Benefits of Further Global Trade Liberalization*, 2001, p. 24.

Figure 1-1
Air and noise pollution abatement services: Core and cluster services



[1] The core includes services that are specifically classified as enviromental services in classification schemes.
[2] The periphery includes services that are not specifically defined as environmental services in classification schemes, but which are integral to the cleanup or protection of the environment.

Source: WTO, "Communication from the European Communities and their Member States, GATS 2000: Environmental Services," S/CSS/W/38, Dec. 22, 2000, found at *http ://www.wto.org/,* retrieved June 20, 2003; and USITC staff estimates.

and goods suppliers, government officials, industry and trade associations, and educational facilities, in numerous locations including Bangkok, Brasilia, Brussels, London, Rio de Janeiro, San Jose, Santiago, Sao Paulo, Seoul, Tokyo, and Warsaw,[27] as well as the United States.[28] The Commission endeavored to interview representatives of large, multinational firms as well as those of small firms. In total, 78 interviews were conducted, in addition to formal and informal discussions with U.S. Foreign Commercial Service and State Department personnel at the U.S. embassies and consulates visited during the course of staff fieldwork. Representatives of 26 government agencies, 14 larger firms, and 38 small firms and associations were interviewed. Secondary sources consulted by Commission staff included industry journals and websites, U.S. and foreign

[27] Specific travel destinations were chosen based on a number of criteria, including market size and development, export potential, and the USTR's request for information on both developed- and developing-country markets, as well as on countries with which the United States has established, or is in the process of establishing, a free trade agreement (FTA).

[28] Commission staff conducted interviews in Chicago and over the telephone. A public hearing on this investigation, which was scheduled for October 20, 2004, was canceled, as no party had requested to testify. See appendix B for more details regarding this hearing.

government publications, and other publications and websites such as those available from the World Bank, the WTO, and the OECD.

For this report, the Commission reviewed and incorporated quantitative data from two principal industry sources, Environmental Business International, Inc. (EBI) and the McIlvaine Company,[29] as well as data from the United Nations (table 1-1). EBI is a strategic market research, publishing, and consulting firm that focuses on the environmental products and services industry. EBI publishes little discrete data on air pollution abatement services, although some market data are available for the United States. Specifically, EBI indicates what portion of two industry segments--"Environmental Testing & Analytical Services"[30] and "Environmental Consulting & Engineering"[31]-- is accounted for by air pollution control activities. EBI publishes both market data (worldwide) and trade data (U.S.) for air pollution abatement goods and equipment, which are included within EBI's "Air Pollution Control Equipment"[32] industry segment.[33] EBI does not track market or trade data on noise pollution abatement services, goods, or equipment.

EBI data are largely based on industry surveys and reports from publicly traded companies. The firm surveys air pollution control (APC) equipment manufacturers annually, collecting data on revenues and growth by type of product, type of customer, geography, and pollutant. Efforts are made to obtain data on the top 50 companies, while the remainder of companies are analyzed by selective surveying and economic modeling. All results are reconciled with secondary sources, and discussed and confirmed through interviews with APC company executives.[34] Data on foreign market revenues are generated using data from secondary sources, which are adjusted so as to conform to the definitions and methods used to generate U.S. data.[35]

McIlvaine data reflect consumption and trade in various air pollution abatement services and goods markets.[36] McIlvaine consumption (market) data include the aggregation of supplier sales, cross-referenced against aggregations of individual country data, end user data, and industry data.[37] McIlvaine bases its estimates on information regarding the likely air pollution abatement projects of industry consumers. These estimates are then

---

[29] The data used in this report supplied by the McIlvaine Company was contracted for by the Commission specifically for Commission purposes.

[30] Service industries that provide testing of "environmental samples" (soil, water, air, and some biological tissues).

[31] Encompasses services including engineering, consulting, design, assessment, permitting, project management, and monitoring.

[32] Firms that produce equipment and technology to control air pollution, including vehicle controls.

[33] Environmental Business International, Inc. (EBI), found at *http://www.ebiusa.com/Segments.html*, retrieved Jan. 6, 2005.

[34] EBI, e-mail response to questions posed by USITC staff, received Jan. 6, 2005.

[35] From EBI, *EBI Market and Industry Research Methods*, p. 25, found at *http://www.ebiusa.com/*, retrieved Aug. 4, 2004.

[36] McIlvaine data is comprised solely of the consulting, engineering, and monitoring sectors within the overall air pollution abatement industry.

[37] The McIlvaine Company, *World Air Pollution Control Revenue Forecasts*, p. 9, document sent to USITC staff via e-mail, received Jan. 4, 2005.

Table 1-1
Data sources: Air and noise pollution abatement

	Goods			Services		
Data Source	***Industry coverage***	***Geographic coverage***	***Type of data[1]***	***Industry coverage***	***Geographic coverage***	***Type of data[1]***
McIlvaine	McIlvaine defined	Worldwide	Market & trade data for air pollution abatement	McIlvaine defined	Worldwide	Market & trade data for air pollution abatement
EBI	EBI defined	U.S./ worldwide	Market (worldwide) and trade (U.S.) data for air pollution abatement	EBI defined	U.S.	Market data for air pollution abatement
United Nations' COMTRADE data system	OECD Environmental Goods List	Worldwide	Trade data for air and noise pollution abatement	([2])	([2])	([2])

[1] Market data are comprised of consumption and production values of goods/services in a particular country; trade data are comprised of import and export statistics.
[2] Not available.
Source: Complied by the Commission.

adjusted based on knowledge of industry, and, in the case of historical data, are verified using information on projects that were completed. McIlvaine data on services are based on a fixed percentage of the goods values, and reflect air pollution abatement consulting, engineering, and monitoring activities.[38]

McIlvaine data on imports and exports of air pollution abatement goods and services are estimates, based on the individual product's trade characteristics.[39] Trade data are based on known sales of large multinational companies and typical distribution of those sales in a particular consuming country. McIlvaine's methodology is to examine the value of the foreign projects of major firms, and subtract the value of those goods or services which will likely be provided locally.[40]

A third source of data utilized within this report is the United Nations' COMTRADE data system. COMTRADE provides an additional outlook on trade in equipment. Under the COMTRADE system, goods are classified according to 6-digit HS numbers. In analyzing these data for the purposes of this study, HS numbers relating to air and noise pollution abatement equipment were selected based on the OECD environmental goods

[38] The McIlvaine Company, telephone interview with USITC staff, Jan. 7, 2005
[39] Government generated data is not used due to the lack of specificity. The McIlvaine Company, *World Air Pollution Control Revenue Forecasts,* p. 9.
[40] The McIlvaine Company, telephone interview with USITC staff, Jan. 7, 2005

list, as included in *Environmental Goods and Services: An Assessment of the Environmental, Economic and Development Benefits of Further Global Trade Liberalisation*.[41]

Organization

This report presents an overview of the global market for air and noise pollution abatement services. Chapter 2 provides a review of extant literature pertaining to air and noise pollution abatement. Chapter 3 examines factors that affect supply and demand for air and noise pollution abatement services in the global marketplace. Chapters 4, 5, and 6 present discussions on air pollution abatement, emissions trading, and noise pollution abatement, respectively. These chapters largely follow a similar format, beginning with a market overview, followed by an examination of the trade and investment environment, and concluding with a discussion of future prospects. Chapters 3 and 4 include tables that present information on selected countries. As noted above, country markets examined in these chapters were selected in light of the USTR's request for information on both developed- and developing-country markets, as well as information on countries with which the United States has established, or is in the process of negotiating, a free trade agreement. These markets include Brazil, Chile, and Costa Rica.[42] The report concludes with a summary of current trends within the global market for air and noise pollution abatement services, including a discussion of trade and investment trends.[43]

[41] OECD, Joint Working Party on Trade and Environment (COM/TD/ENV(2000)86/FINAL), found at *http://www.oecd.org/searchResult/0,2665,en_2649_201185_1_1_1_1_1,00.html*.

[42] Overviews of these national and regional markets for air and noise pollution abatement services are included in appendix D.

[43] This conclusion is followed by several appendices, including a submission filed in connection with this study which can be found in appendix E, and a glossary of key terms which can be found in appendix F.

CHAPTER 2
LITERATURE REVIEW

The demand for, and supply of, air and noise pollution abatement services ultimately derives from a society's desire to limit pollution and maintain a healthy environment. Two primary motivations lead a pollution generator to purchase pollution abatement services and equipment: compliance and performance. Compliance addresses effectively meeting regulations, while performance involves the efficiency with which regulations are met.

As noted in chapter 1 (figure 1-1) there are numerous services that are not specifically defined as environmental services in differing classification schemes, but are nonetheless integral to the abatement of air or noise pollution. Most of the recent empirical literature relating to such services has focused on the design, efficiency and effectiveness of these services in reducing air pollution.[1] Researchers have studied monitoring and testing, permit trading (a type of financial service), and design and engineering of abatement technologies (an environmental research and development service) due to the prominent role they play in abating air pollution. These studies examine a wide range of industries, countries and air pollutants. This chapter reviews some of this extensive literature in order to provide a context for why and how markets for such services have developed, and why the ability of such services to flow freely across political boundaries is important.

Monitoring and Testing

Air pollution monitoring and testing yield critical information for the design and enforcement of environmental regulation. Industrial emissions testing, for example, helps determine a firm's compliance with environmental regulations. Continuous monitoring yields information regarding compliance on the part of specific industries over time. Ambient testing helps determine the extent to exposure and risk due to both outdoor and indoor air pollution. The role of monitoring and testing in air pollution abatement, and its significance in the global market for air pollution abatement services, are discussed in more detail in chapters 3 and 4. This section reviews empirical analyses of the effectiveness of monitoring, testing and enforcement activities. According to Foulon, et al. (2002), these analyses tend to be recent and limited in number and scope. However, two issues have been examined: the impact of monitoring and enforcement activities on environmental performance, and the impact of public disclosure programs on compliance.

[1] No recent empirical assessments of noise pollution abatement services are available.

Impact of Monitoring and Enforcement on Environmental Performance

Foulon, et al., cite three studies that specifically examine the impact of monitoring and enforcement on industrial air pollution abatement. Gray and Deily (1996) study the effect of inspections and enforcement (both Federal and state) on compliance, using data from U.S. integrated steel plants between 1980 and 1988. They find that increased enforcement significantly increases compliance with air pollution regulations at the plant level. At the same time, firm compliance reduces the extent of monitoring and enforcement services directed towards that plant. Fewer inspection or enforcement efforts were directed towards plants that were expected to be compliant, were in attainment areas, or were expected to close. The authors also found that a firm's compliance decision was largely unaffected by firm characteristics such as size or diversification, but was affected by the future viability of the plant and the cost of becoming compliant.

Focusing on the U.S. paper and pulp industry, Nadeau (1997) tests whether Environmental Protection Agency (EPA) monitoring and enforcement reduce the duration of plant-level noncompliance with air pollution regulations. In his analysis, enforcement includes any administrative, civil, judicial or penalty actions in response to non-compliance, while monitoring includes both inspections and testing. Nadeau examines 277 instances of noncompliance involving 175 plants. He finds that a 10-percent increase in monitoring activity reduces the duration of noncompliance for paper and pulp plants by 4.2 percent, while a 10-percent increase in enforcement led to a 4- to 4.7-percent reduction in the duration of noncompliance. Nadeau concludes that EPA monitoring and enforcement are effective in improving environmental performance.

Dasgupta, et al. (2001) examine the impact of inspections and enforcement on compliance with air pollution regulations in China's Zhenjiang province. Based on the Zhejiang field inspection procedures, the authors note that the expected penalty a noncompliant firm faces depends upon the probability of inspection and the effective levy imposed. Using plant-level data from many industries over the period 1993-1997, they find that cumulative inspections have a significant impact on emissions of total suspended particles, but the effective levy does not. Variation in environmental performance across plants is statistically better explained by variation in cumulative inspections, rather than variation in the environmental levies plants face. They also find that citizen complaints have a positive impact on the number of inspections.

Advances in the design of monitoring and testing equipment and methodologies can increase the impact of these services on environmental performance. Both Dasgupta, et al. (2004) and Ezzati, et al. (2002) argue that the design of effective indoor air pollution (IAP) reduction strategies in developing countries has been hindered by lack of information on IAP exposure in households.[2] Because monitoring in villages is costly, exposure analyses have had to rely on indirect indicators, such as biofuel consumption,

[2] IAP from burning dung and other biofuels is a major cause of acute respiratory infections in developing countries. Dasgupta, et al. (2004) note that acute lower respiratory infections are responsible for perhaps 20 percent of the 12 million deaths of children under 5 in these countries annually. Ezzati, et al. (2002) state that conservative estimates of global mortality in 2000 due to IAP from solid fuels are between 1.5 and 2 million deaths–most of whom are women and children.

time spent cooking, or housing type. However, these indirect indicators have been shown to be poor proxies, since actual exposure is influenced by the interaction of all these factors, as well as by location of cooking, ventilation, and air flow. Recent advances in technology have made it possible to measure actual pollutant concentrations in village households with air samplers and real-time monitors.[3] Using data on particulate concentrations from villages in Bangladesh, Dasgupta, et al. find that IAP exposure does not vary much with type of biofuel, but varies significantly with the amount of ventilation and the type of walls in a house (mud vs. other types). Ezzati, et al. find that studies which account for temporal and spatial characteristics of pollution concentration, as well as individuals' time and activity, yield much larger estimates of women's exposure to IAP than those which omit these characteristics.

Impact of Public Disclosure Programs

Monitoring and testing services also may be used to disseminate information on environmental risk and compliance to the general public. Despite the benefits of a shift toward market-based approaches to pollution abatement, Tietenberg (1998) notes that industrial countries' systems are still burdened by the large number of pollutants to be controlled. Many developing countries face additional problems due to the costliness of monitoring and enforcing even market-based regulations (Blackman and Harrington, 2000). Disclosure of information assists the general public in becoming a catalyst for compliance with environmental regulations.

Tietenberg (1998) outlines four steps for making such public disclosure an effective tool in pollution abatement. Specifically, methods must be established to detect environmental risks, assure reliable information, disseminate the information, and provide avenues to act on the information. Environmental testing is a key input in the first step, as the means to ascertain the extent of air pollutant emissions, the degree of exposure to various risks from these pollutants, and the consequences of such exposure. Monitoring of pollution sources is critical for disseminating up-to-date information to the public and for measuring response to public pressure.

The U.S. Toxic Release Inventory (TRI), enacted by Congress in 1986, is a well-known example of public disclosure of environmental information. The TRI provides annual information on firms' emissions or use of listed chemicals (above certain thresholds), including the name of the firm, the amount and frequency of toxic release, and the medium into which it is released. Tietenberg (1998) notes that the TRI seems to have reduced toxic emissions into the environment. He cites EPA data indicating that total emissions fell by about 44 percent and air emissions fell by about 40 percent in the 8 years following implementation of TRI. Hamilton (1995) and Khanna, et al. (1997) find evidence that company stock prices respond negatively to disclosure of TRI information. Both Konar and Cohen (1997) and Khanna, et al. find evidence that such stock market effects result in reductions in emissions.

[3] PM_{10} and $PM_{2.5}$ refer to particles with a diameter of 10 microns or less, and 2.5 microns or less, respectively. These air samplers measure 24-hour average PM_{10} concentrations. Real-time monitors record PM_{10} and $PM_{2.5}$ at 2-minute intervals for 24 hours.

Launched in the mid-1990s, Indonesia's Program for Pollution Control, Evaluation and Rating (PROPER) rates the environmental performance of Indonesian factories with respect to air pollution and other pollutants, and assigns a single rating by color. Ratings for 187 facilities (spanning 14 industries) were made public in June 1995, and firms were then given a 6-month grace period in which to improve their performance. Afshah and Vincent (1997) reported that by December 1995 the number of blue (compliant) ratings rose by nearly one-fifth. In a more recent assessment, Afsah, et al. (2000) find evidence that PROPER has led to significant reductions in emissions by firms that were initially noncompliant. They argue that the effectiveness of PROPER in stimulating abatement is largely due to the transmission of better information to plant managers about their own emissions and abatement opportunities. However, they also argue that this information would not necessarily translate into significant environmental improvements without the public pressure that results from disclosure.[4]

Foulon, et al. (2002) test statistically the relative importance of public disclosure and traditional enforcement in improving environmental performance. They examine the response of the Canadian paper and pulp industry to declining stock prices, resulting from the disclosure of environmental information by the Canadian Ministry of Environment. They compare this to the response of the industry to environmental penalties and fines. Foulon, et al. find that public disclosure has a stronger impact on both emissions level and compliance than does the traditional enforcement imposed by the government. However, more stringent standards and penalties also lead to significant reductions in emissions. The authors conclude that making use of public disclosure of environmental information may help reduce the costs of achieving compliance, since public dissemination of information already collected by regulators is relatively inexpensive. However, because their results show that both public disclosure and penalties and fines significantly affect emissions level and compliance, the authors argue for the use of both approaches as complementary methods to achieve environmental objectives.

Permit Trading

Tradable permit systems are rapidly gaining acceptance as a method of air pollution abatement. These systems specify an aggregate amount of emissions allowed, allocate permits for specific amounts of emissions to polluters, and allow trade of permits among polluters. Polluters that exceed the limits imposed by their permits face penalties. Firms that find abatement relatively inexpensive will have an incentive to reduce emissions below their allowance level, and will sell excess permits to those firms which find abatement relatively costly. In theory, such permit trading will achieve the target amount of abatement in the least costly way.

[4] Another long-standing disclosure program is South Korea's Monthly Violations Reports (MVR). These reports list firms which are in violation of national environmental regulations, and have been published monthly since 1989. According to Hong, et al. (2003), the MVR publicized 7,000 violations spanning 3,400 companies between 1993 and 2001. The impact of such disclosure, however, has yet to be analyzed.

The most widely studied successful tradable permit systems are the U.S. Acid Rain Program (or "SO_2 allowance program"), the Los Angeles Regional Clean Air Incentives Market (RECLAIM), and the U.S. Lead Phasedown. The EU Emissions Trading Scheme to control greenhouse gases began in January 2005. There are also systems in developing countries, such as the new trial system in Tiayuan, Shanxi province, China (Morgenstern, et al. 2004). Chapter 5 presents a detailed discussion of permit trading in practice, in the U.S. SO_2 Program, the European Union Emissions Trading Scheme, the United Kingdom Emissions Trading Scheme, and the Chicago Climate Exchange.[5] This section reviews some of the conclusions from the large body of research on these and other permit trading systems[6] regarding efficiency in design, effectiveness in practice, and extension to greenhouse gas abatement.

Efficiency in Design

This chapter discusses two types of permit trading systems—"cap and trade" programs and credit programs. All of the surveys noted above argue that cap and trade programs appear to be more effective in reducing air pollution than credit programs. A cap and trade program has an aggregate absolute emissions baseline, whereas a credit program establishes individual baselines for each polluter. This implies several advantages for the cap and trade program relative to the credit program. Specifically, previously established technology-based standards for each polluter are not required, aggregate emissions will not increase as the number of polluting firms increases, and reductions in emissions are more certain, since they are measured against an absolute baseline, rather than against the hypothetical level the firm would have emitted without regulation (Tietenberg 2001, Stavins, 2003a).

There is a broad consensus that the initial allocation of permits needs to be based on historic use (grandfathering), and that the initial permits need to be distributed free of charge, in order to ease implementation of the permit trading system, and to gain firms' cooperation. These practices may encourage compliance, but they have several downsides. One problem is that existing firms have an incentive to inflate historic use to enlarge their initial allocation of permits. There is some evidence that grandfathering has led to overallocation (Tietenberg, 2003). Goulder, et al. (1999), argues that SO_2 costs in the Acid Rain program would have been 25 percent lower if licences had been auctioned instead. Another problem is that new firms, where new is defined as those firms established after the initial distribution of permits, must pay for all permits they receive. This might retard development of plants that use the latest technologies.

Another key finding is that flexibility in permit trading– both geographically and over time– and flexibility in technology choice, are critical for a successful program. The EPA Emissions Credit Trading (begun in 1977) performed poorly in part because all individual trades required prior government approval. This led to increased uncertainty on the part of firms, and decreased use of the trading mechanism. In essence, the fewer impediments to efficient trading, the more the permit market will facilitate lowest-cost achievement of the abatement objectives. Geographic concentration of permits could

[5] As a general rule, permits from one permit trading program are not tradable on other trading programs. For more information or permit trading, please see Chapter 5 (Emissions Trading).

[6] This section draws heavily on a number of recent surveys: Teitenberg, 1999, 2001, 2003; Stavins 2003a, 2003b; UNCTAD 2001; Davies et al., 2001.

occur, possibly leading to unacceptably high concentrations of pollution in a particular location ("hot spots"). Although some programs (e.g., RECLAIM) place restrictions on permit trading to avoid such concentration, Teitenberg (2001) argues that a better response is to address the individual circumstances which give rise to the most severe hot spots. The approach taken in the U.S. Acid Rain program is to allow unrestricted permit trade, but to require firms to assure that trades do not lead to violation of National Ambient Air Quality Standards (Teitenberg 2003).

Banking allows firms to save unused emissions allowances and use them in the future, while borrowing allows firms to access future allowances for use in the present. Banking/borrowing is useful if firms must make major investments to achieve compliance. It is also useful if the environmental damage generated by pollutants increases when emissions are concentrated in time. Rubin (1996) finds that under such circumstances (and if firms' future emissions allowances are shrinking), banking will actually help reduce firm abatement costs and environmental damage by giving firms more flexibility in the timing of emissions. All of the surveys cite evidence that extensive use of banking in the U.S. Acid Rain program and in the Lead Phasedown program led to earlier reductions in emissions and lower compliance costs.

Technological choice also contributes to lower abatement costs and increased effectiveness of permit programs. Stavins (1998) notes the importance of the lack of scrubbing requirements in the SO_2 allowance program. Firms were free to reduce SO_2 emissions by switching to more low-sulfur coal. For many firms, this was a lower-cost alternative to scrubbers. Fuel-switching also may have spurred technological improvements in scrubber performance and rail transport.

Effectiveness in Practice

The objective of the U.S. Lead Phasedown program (begun in 1982) was to reduce the lead content in gasoline to 10 percent of its previous level. In 1985, banking of credits was introduced. Stavins (2003a) notes that this was done in part to give small refineries more flexibility, since their compliance costs were thought to be high. Firms did make extensive use of trading and banking, where banking itself generated an estimated cost saving of $250 million (EPA, 1985). Kerr and Newell (2003) test the impact of the Lead Phasedown program on firms' technology choice. Examining a sample of 378 refineries from 1971-1995, they find evidence that increased regulatory stringency regarding lead did result in greater use of lead-reducing technology. Firms with lower compliance costs were more likely to adopt efficient technology relative to firms with higher compliance costs, and this ratio was higher under a tradable permit system than under an alternative performance standard.[7]

The U.S. Acid Rain program is considered the largest and most successful cap and trade program in the world (UNCTAD, 2001). It was initiated under the Clean Air Act Amendments of 1990, with the objective of reducing emissions from large electric power units by 10 million tons below 1980 levels. There has been extensive trading in SO_2 allowances, with trading increasing over time, and extensive use of banking (Stavins, 2003a). Much research has been devoted to analyze the impact of this program (e.g., Burtraw et al., 1998; Burtraw and Mansour, 1999; Ellerman et al., 1997, 2000;

[7] Other recent detailed studies of the Lead Phasedown include Kerr and Maré (1997) and Nichols (1997).

Ellerman, 2003; Joskow and Schmalensee, 1998; Montero, 1999; Schmalensee et al., 1998; Stavins, 2003b). The broad consensus of this research is that permit trading not only generated large cost-savings over alternative performance requirements, but also generated large improvements in human health, due to reductions in local SO_2 and particulate concentrations. According to Kruger et al. (1999), advances in information technology, which allowed continuous emissions monitoring via the web, contributed to the success of the program.

In a recent major study of permit trading in the United States, Davies, et al. (2001) argued that further reforms were needed in four key areas: efficiency, flexibility, decentralization, and integration. The authors note that some states have improved efficiency recently, with one-stop shopping, guidance for permit applicants, and internet usage. Less progress has been seen on flexibility. Some permits may prevent the use of the most efficient abatement techniques because the permit specifies the technology to be used rather than a standard to be met. Some states do offer more flexibility (greater choice in abatement method or expedited permiting) to facilities that agree to achieve a superior environmental performance. However, in some cases the facility must already have a management system in place in order to participate. Davies, et al. call for better EPA oversight of an already decentralized permit system, and for reforms which would integrate pollution control for air, water, and land.

In 2005, the EU launched the EU Emissions Trading Scheme for greenhouse gas abatement. The proposed system has been strongly influenced by the U.S. SO_2 program (Teitenberg, 2003). Kruger and Pizer (2004) note that initially, the scope of the system will be limited to CO_2 emissions from production and processing of iron and steel, minerals, energy, and pulp and paper. They currently estimate that more than 12,000 installations will be included in the program, covering nearly half of EU CO_2 emissions. This system will allocate initial allowances largely free of charge, and will include banking and borrowing provisions. Teitenberg (2003) notes that individual countries, such as the United Kingdom and Denmark, created their own national trading programs and that even some individual companies such as British Petroleum set up trading systems to help units within the company achieve their goals.[8] In the United States, some companies, states, and municipalities have adopted voluntary caps on CO_2 and methane, with the Chicago Climate Exchange facilitating trading to achieve those objectives.

Teitenberg (2003) discusses some specific problems which arise when designing an international permit trading system to control greenhouse gases. Most existing permit trading systems address only one or two pollutants. Thus, lessons from existing programs may have limited application to the integrated system controlling six greenhouse gases envisioned in the Kyoto Protocol.[9] Efficient monitoring and enforcement– critical to a successful permit trading system– will be more difficult due to differences in monitoring capacity across countries, as well as inherent difficulties in monitoring certain sources of greenhouse gases. Setting the caps will require agreement among countries, which is made more difficult by the lack of consensus among scientists regarding assessments of risk and degradation from climate change. Developing countries may not have adequate knowledge of abatement technologies, or access to those technologies, to take advantage of the cost-minimizing incentives generated by

[8] See footnote 1, table 5-1.

[9] For more information on the Kyoto Protocol see p. 3-11.

permit trading systems. The Clean Development Mechanism (CDM), which extends emissions credits to industrialized countries that finance emissions reductions in developing countries, may help meet this concern.

Toman (2004) notes that most of the research modelling greenhouse gas abatement has focused on three key issues: revenue recycling, time flexibility, and geographic flexibility. The net cost of an auctioned permits system differs depending upon how the income generated by the system is spent (e.g., rebated to consumers (lump sum), used to cut other tax rates, used to finance other public spending, etc.). Toman argues that there is now a consensus that cost-efficiency is improved if the revenue is used to reduce existing distortions from other taxes. Timing of reductions in CO_2 emissions also affects costs. Toman notes that there is some agreement that gradual reductions are more cost-effective, but little agreement on the merits of including borrowing in the system. Geographic flexibility provisions (such as the Kyoto Clean Development Mechanism) have been modelled by many researchers. According to Toman, there is now much evidence that such flexibility could provide substantial cost-savings in meeting greenhouse gas emissions reductions.

Abatement Technology

In theory, environmental regulations on air pollution raise the cost of emissions to firms, increasing firms' incentive to abate this pollution. Increased demand for abatement equipment and techniques may stimulate the development of better abatement technologies. Alternatively, it may stimulate innovation in production technology so that firms' production processes become less polluting. Environmental regulations may also raise the rate at which these technologies spread throughout an industry. However, the extent to which environmental regulation affects technology choice, innovation, or diffusion may depend upon the form which such regulation takes. Chapter 4 discusses in more detail the specific technologies and methods used to achieve compliance with regulations on specific air pollutants. This section reviews recent evidence on the impact of air pollution regulation on technological innovation and diffusion, and the extent to which the form of regulation affects the technological response.

Impact of Environmental Regulations on Technological Innovation and Diffusion

In their recent survey, Jaffe, Newell and Stavins (2003) find mixed evidence regarding whether increased environmental stringency stimulates technological innovation or diffusion. Part of the difficulty is that, ideally, the researcher wants to measure the relationship between innovation or diffusion and changes in the implicit price of air pollution resulting from environmental regulation. However, because this implicit price is not observed, researchers must use indirect indicators such as energy prices, pollution abatement costs, and indices of the stringency of environmental regulations. Pizer et al. (2002), for example, examine the impact of higher energy prices on the rate of diffusion of four new energy-efficient technologies[10] in the steel, paper and pulp, plastics, and petroleum refining industries, from 1991-1994. They also examine the role of plant and

[10] The four technologies examined are computerized climate controls, computerized process controls, waste-heat recycling, and adjustable speed motors.

firm characteristics on the adoption rate. They find that energy prices, plant size, and financial health of the firm all have a significant positive effect on the rate of adoption of these new technologies. However, increases in energy prices that significantly reduce the financial health of the firm could reduce the rate of adoption of new technology.[11]

Lanjouw and Mody (1996) examine the correlation between pollution abatement expenditures and the growth in environmental patents during the 1970s and 1980s in the United States, Germany, and Japan, as well as a number of developing countries. The environmental innovations they examine include improvements in abatement technologies and changes in production processes which lower emissions. These innovations span nine different areas of pollution abatement or environmental protection.[12] The authors find strong correlations between rising pollution abatement expenditures and growth in environmental patents as a percent of total patents in all three industrial countries, especially with respect to water pollution, air pollution, and alternative energy. There is also some evidence of correlation between environmental stringency and patents in developing countries, though these were typically foreign patents registered in developing countries.

More recently, Popp (2004) uses patent data from the United States, Germany, and Japan to examine the relationship between increased stringency in SO_2 and NO_x standards and innovation in, and diffusion of, air pollution control equipment. Rather than use a proxy for the implicit price of air pollution, Popp examines specific technological innovations to reduce SO_2 and NO_x emissions from coal-fired power plants, and patenting trends across these three countries. He finds that in each of the three countries, tighter standards led to more domestic patenting, but that domestic inventors did not generally respond to increased environmental stringency in foreign countries. Popp also finds evidence that transfer of technology is indirect. Technologies which had undergone significant advances abroad were nonetheless further adapted prior to adoption in the domestic country.

Other studies have been less positive about the link between environmental regulation and technological innovation. Gray and Shadbegian (1998) examine the impact of water and air pollution control on 227 U.S. paper and pulp plants between 1972 and 1990. They use an index of regulatory stringency to proxy the price of air pollution across U.S. states. The authors find that new plants in states with more stringent regulations are more likely to choose cleaner technologies. However, using a smaller subset of 68 plants, the authors find that plants with high abatement costs (over the entire period) tend to invest less in capital equipment used in the production process itself. Firms also appear to shift production investment toward plants which face less stringent regulations.

Jaffe and Palmer (1997) test whether changes in environmental regulatory compliance costs (capital costs or operating costs) are associated with higher levels of innovative activity in U.S. regulated industries, using the 1973-1991 Pollution Abatement Control Expenditures data. Innovative activity is proxied by private spending on research and

[11] Boyd and Karlson (1993) also find a positive response between energy prices and new technology adoption in the U.S. steel industry.

[12] These areas of pollution abatement or environmental protection included: industrial and vehicular air pollution control, water pollution control, hazardous and solid waste disposal, incineration and recycling of waste, oil spill cleanup, and the use of alternative (non-fossil fuel) energy sources.

development (R&D) and by the number of successful patent applications by domestic firms in an industry. They find that, controlling for industry-specific characteristics, lagged environmental compliance expenditures are positively associated with R&D expenditures, but not with successful patent applications.

Type of Environmental Regulation and Technological Innovation and Diffusion

Jaffe, Newell, and Stavins (2003) point out that different types of environmental policy instruments can affect the rate and direction of technological change differently. For example, technological standards tend to inhibit the development of new technologies that may embody greater control over emissions. This is because, in contrast to emissions standards, no incentives exist under technological standards to exceed control targets or to adopt new technologies. The empirical evidence to date suggests that market-based instruments for environmental protection– such as environmental taxes and permit trading systems– are likely to have significantly greater positive effects on innovation and diffusion of cleaner technologies than traditional command and control regulations. As was discussed above, Kerr and Newell (2003) found evidence that new technology adoption by low-compliance cost firms relative to high-compliance cost firms under the U.S. Lead Phasedown program was much higher under the tradable permit system than under alternative performance standards.

In his recent survey, Burtraw (2000) argues that much of the significant cost saving in the U.S. SO_2 tradable permits program can be attributed to innovation in the electricity sector. This innovation has taken place at the firm, market, and regulatory levels as well as in process innovation by fuel producers and electricity generators. Burtraw argues that the tradable permits system allowed firms the necessary flexibility to speed up existing technological advances and facilitate their adoption. The system led to competition among abatement technologies, thereby contributing to a decrease in compliance costs. For example, the system allowed the adoption of low sulfur coal rather than mandating the adoption of specific scrubber technologies. It also led to the development of fuel-blending, which has lower costs than scrubbing. Burtraw also notes that there is some evidence that the permit trading system encouraged innovation in scrubber technology as well (Keohane 2000).

Popp (2001) provides additional evidence on the effectiveness of tradable permits in promoting improvements in scrubber technology. He examines data on steam-electric power plants and data on patents to test the impact of the 1990 Clean Air Act Amendments on SO_2 pollution control technologies. Popp points out that regulation prior to 1990 did encourage innovations in scrubber technology, but that there is no evidence that these innovations improved scrubber efficiency in controlling pollution. After the permit system was implemented, the number of patents related to SO_2 control decreased. However, the evidence suggests that the post-1990 innovations actually improved abatement efficiency.

References

Afsah, Shakeb and J. R. Vincent(1997) "Putting Pressure on Polluters: Indonesia's PROPER Program," Case Study for the HIID 1997 Asia Environmental Economics Policy Seminar, Washington, DC: International Resources Group. (Available at *www.worldbank.org/nipr*)

Afsah, Shakeb, A. Blackman, and D. Ratunanda (2000). "How Do Public Disclosure Pollution Control Programs Work? Evidence from Indonesia," RFF Discussion Paper 00-44.

Blackman, Allen and W. Harrington (2000). "The Use of Economic Incentives in Developing Countries: Lessons from International Experience with Industrial Air Pollution," *Journal of Environment and Development*, 9(1): 5-44.

Boyd, G. and S. Karlson (1993). "The Impact of Energy Prices on Technology Choice in the United States Steel Industry," *Energy Journal*, 14(2): 47-56.

Burtraw, D. (2000). "Innovation Under the Tradable Sulfur Dioxide Emission Permits Program in the U.S. Electricity Sector," RFF Discussion Paper: 00/38.

Burtraw, D., A.J. Krupnick, E. Mansur, D. Austin and D. Farrell (1998), "The Costs and Benefits of Reducing Air Pollution Related to Acid Rain," Contemporary Economic Policy 16:379-400.

Burtraw, D. and E. Mansur (1999), "The Environmental Effects of SO2 Trading and Banking," *Environmental Science and Technology* 33(20):3489-3494.

Dasgupta, S., H. Wang, B. Laplante, and N. Mamingi (2001). "Inspections, Pollution Prices, and Environmental Performance: Evidence from China," *Ecological Economics*, 36(3): 487-98.

Dasgupta, S., M. Huq, M. Khaliquzzaman, K. Pandey, D. Wheeler (2004). "Indoor Air Quality for Poor Families: New Evidence from Bangladesh," World Bank Policy Research Working Paper 3393.

Davies, T. , R. Hersh, A. Alicea, and R.Greenspan Bell (2001). *Reforming Permitting*. Washington, DC.

Ellerman, D., R. Schmalensee, P. Joskow, J. Montero and E. Bailey (1997), *Emissions Trading Under the U.S. Acid Rain Program: Evaluation of Compliance Costs and Allowance Market Performance* Cambridge, MA: MIT Center for Energy and Environmental Policy Research.

Ellerman, D., P. Joskow, R. Schmalensee, J. Montero and E. Bailey (2000), *Markets for Clean Air: The U.S. Acid Rain Program* (Cambridge University Press, New York).

Ellerman, A. D. (2003), 'The U.S. SO2 Cap-and-Trade Program," Proceedings of the OECD Workshop 'Ex Post Evaluation of Tradable Permits: Methodological and Policy Issues. Paris: Organization for Economic Cooperation and Development.

Ezzati, M. and D. M. Kammen (2002). "The Health Impacts of Exposure to Indoor Air Pollution from Solid Fuels in Developing Countries: Knowledge, Gaps, and Data Needs," RFF Discussion Paper 02-24.

Foulon, J., P. Lanoie, and B. Laplante (2002). "Incentives for Pollution Control: Regulation or Information?" *Journal of Environmental Economics and Management* 44, 169-187.

Goulder, L. H., et al.. (1999). "The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-Best Setting ," *Journal of Public Economics* 72(3):329-360.

Gray, W. And M. Deily (1996). "Compliance and Enforcement: Air Pollution Regulation in the U.S. Steel Industry," *Journal of Environmental Economics and Management* 31, 96-111.

Gray, W. and R. Shadbegian (1998). "Environmental Regulation, Investment Timing, And Technology Choice," *Journal of Industrial Economics*, 46(2).

Hamilton, J. T. (1997). "Taxes, Torts, and the Toxics Release Inventory: Congressional Voting on Instruments to Control Pollution" *Economic Inquiry* 35(4):745-762.

Hong, Jong Ho; Laplante, Benoit; Meisner, Craig (2003). "Public Disclosure of Environmental Violations in the Republic of Korea," World Bank Policy Research Working Paper 3126.

Jaffe, A. and K. Palmer (1998). "Environmental Regulation and Innovation: A Panel Data Study" *Review of Economics and Statistics*, 79(4).

Jaffe, A., R. Newell, and R. Stavins (2003). "Technological Change and the Environment," in K. Maler and J. Vincent, eds., *Handbook of Environmental Economics*, Vol. 1. Boston: Elsevier Science.

Joskow, P.L., R. Schmalensee and E.M. Bailey (1998), "Auction Design and the Market for Sulfur Dioxide Emissions," *American Economic Review*.

Keohane, N. (2000). "Environmental Policy Instruments and Technical Change: Sulfur Dioxide," Unpublished manuscript. Cambridge, MA:Harvard University Department of Economics.

Kerr, S. and R. Newell (2003). "Policy-Induced Technology Adoption: Evidence from the U.S. Lead Phasedown," *Journal of Industrial Economics.* 51(3).

Kerr, S. and Maré, D., 1999, 'Transaction Costs and Tradable Permit Markets: The United States Lead Phasedown' (Manuscript, Motu Economic and Public Policy Research, New Zealand).

Khanna, M., W. R. H. Quimio, et al. (1997). Toxics Release Information: A Policy Tool for Environmental Protection. Urbana-Champaign, Department of Agricultural and Consumer Economics, University of Illinois.

Konar, S. and M. A. Cohen (1997). "Information as Regulation: The Effect of Community Right to Know Laws on Toxic Emissions." *Journal of Environmental Economics and Management* 32(1): 109-124.

Kruger, J. and W. Pizer (2004). "The EU Emissions Trading Directive:Opportunities and Potential Pitfalls," RFF Discussion Paper 04–24.

Kruger, J. and B. McLean (1999). *A Tale of Two Revolutions: Administration of the SO2 Trading Program. Draft Report.* Washington., DC: U.S. Environmental Protection Agency.

Lanjouw, Jean O. and Ashoka Mody (1996), "Innovation and the International Diffusion of Environmentally Responsive Technology," *Research Policy*, 25, 549-71.

Montero, J. P. (1999). "Voluntary Compliance with Market-Based Environmental Policy: Evidence from the U.S. Acid Rain Program" *Journal of Political Economy*, 107(5): 998-1033.

Morgenstern, R.D., P. Abeygunawardena, R. Anderson, R.Greenspan Bell, A. Krupnick, J. Schreifels, C.Dong, Wang Jinan, Wang Jitian, and S. Larsen (2004). "Emissions Trading to Improve Air Quality in an Industrial City in the People's Republic of China," RFF Discussion Paper 04-16.

Nadeau, L. (1997). "EPA Effectiveness at Reducing the Duration of Plant-Level Noncompliance," *Journal of Environmental Economics and Management* 34: 54-78.

Nichols, A. L., 1997, 'Lead in Gasoline', in Richard, Morgenstern ed., *Economic Analysis at EPA.* Washington, DC: Resources for the Future.

Pizer, W., W. Harrington, R. J. Kopp, R. D. Morgenstern and J. Shih (2002). "Technology Adoption and Aggregate Energy Efficiency," RFF Discussion Paper 02-52.

Popp, David (2004). "International Innovation and Diffusion of Air Pollution Control Technologies: The Effects of NOX and SO2 Regulation in the US, Japan, and Germany," NBER Working Papers 10643.

_____ (2001). "Pollution Control Innovations and the Clean Air Act of 1990," National Bureau of Economic Research Working Paper: 8593.

Rubin, J. D. (1996), "A Model Of Intertemporal Emission Trading, Banking, and Borrowing," *Journal of Environmental Economics and Management* 31(3): 269-286.

Schmalensee, R., P.L. Joskow, A.D. Ellerman, J.P. Montero and E.M. Bailey (1998), "An Interim Evaluation of Sulfur Dioxide Emissions Trading", *Journal of Economic Perspectives* 12(3):53-68.

Stavins, R. N. (1998). "What Can We Learn from the Grand Policy Experiment? Lessons from SO2 Allowance Trading." *The Journal of Economic Perspectives* 12(3): 69-88.

_____. (2003a). "Market-Based Environmental Policies: What Can We Learn from U.S.Experience (and Related Research)?" RFF Discussion Paper 03–43.

_____. (2003b). "Experience with Market-Based Environmental Policy Instruments." *Handbook of Environmental Economics*, Volume I, eds. Karl-Göran Mäler and Jeffrey Vincent, pp. 355-435. Amsterdam: Elsevier Science.

Tietenberg, T. (1998). “Disclosure Strategies for Pollution Control,”*Environmental and Resource Economics* 11:587-602.

_____. (1999). “The Tradable Permits Approach to Protecting the Commons: What Have We Learned?” Manuscript available at *http://www.colby.edu/personal/t/thtieten/* .

_____. (2001) (editor). *Emissions Trading Programs*. Volume 1. *Implementation and Evolution*. Volume 2. *Theory and Design*. International Library of Environmental Economics and Policy. Aldershot, U.K.; Burlington, Vt. and Sydney: Ashgate.

_____. (2003) "The Tradable-Permits Approach to Protecting the Commons: Lessons for Climate Change," *Oxford Review of Economic Policy*, 19(3), pp. 400-19.

Toman, M. (2003). “Understanding the Design and Performance of Emissions Trading Systems for Greenhouse Gas Emissions: Proceedings of an Experts’ Workshop to Identify Research Needs and Priorities,” RFF Discussion Paper 03–33

UNCTAD (1998). *Greenouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidlelines for Verification, Reporting & Accountability*. Geneva: UNCTAD.

U.S. Environmental Protection Agency (1985). *Costs and Benefits of Reducing Lead in Gasoline, Final Regulatory Impact Analysis*. Washington, D.C.: EPA.

CHAPTER 3
FACTORS AFFECTING SUPPLY AND DEMAND

This chapter identifies and analyzes the principal factors which affect service providers' willingness or ability to supply air or noise pollution abatement services and equipment, as well as those factors which may motivate consumers to purchase such services and equipment, as observed in the countries selected for special emphasis. This chapter also addresses the link between the demand for air and noise pollution abatement equipment and demand for related air and noise pollution abatement services.

Factors Affecting Supply

This section examines the macro-level factors affecting supply of air and noise pollution abatement equipment and services across countries. Air pollution abatement goods and services are frequently supplied to customers as part of a single transaction, with goods accounting for the majority of the value of the sale.[1] Although there are few trade provisions directly affecting the supply of such goods and services, a limited number of foreign markets have been cited as posing some difficulty for U.S. and other foreign suppliers.[2] The supply of goods and services related to noise abatement in a particular market is influenced by the cost of these products in slightly different ways. In those cases that require sound dampening materials or structures, the cost of the materials and any related design, engineering, and construction services required for their installation directly effects the noise abatement choices available in a market. In those cases, such as construction equipment, where noise abatement has been addressed by product redesign or higher product standards, the likely higher cost incorporated may effect the selection of construction equipment available in the market and indirectly effect noise levels. For more detailed discussion regarding how equipment and services are proliferated in the air and noise pollution abatement sectors, see chapters 4 and 6, respectively.

In many industries, including air and noise pollution abatement, a ready supply of product must be available in order to sustain the market.[3] However, in developing countries, access to appropriate environmental goods and services is often hindered due to cost issues and trade barriers. In the developed markets, virtually all types of air and noise pollution control equipment are available across the technological and cost spectrum (see table 3-1 at the end of the chapter). Consequently, equipment selection is

[1] See chapter 4, "Market Size and Characteristics."

[2] See chapter 4, "Trade and Investment."

[3] OECD, *Environmental Goods and Services, An Assessment of the Environmental, Economic, and Development Benefits of Further Global Trade Liberalization,* COM/TD/ENV(2000)86/FINAL, Oct. 3, 2000.

more likely to be dictated by regulation than by cost or supply.[4] In the developing world, however, many countries are heavily reliant upon imports of such goods, and therefore may have limited selection in terms of technology, cost, and suitability for pollution control requirements.[5] In certain countries, such as Korea, technologically advanced equipment is generally available for import from the United States, Japan, or Europe, but smaller companies are often unwilling or unable to bear the cost of high-end imported equipment, and purchase less advanced equipment that is domestically produced.[6] The supply of goods and services can be further hindered when foreign manufacturers and services providers are reluctant to enter or expand into certain developing markets for fear of intellectual property violations. For example, joint ventures are generally considered to be an effective method of market penetration, but in Korea's air pollution abatement sector, some equipment manufacturers shy away from such arrangements for fear that local partners will copy their technology.[7] The supply of air and noise pollution abatement services in developing countries also may be hindered by nontariff measures such as visa, employment, and licensing requirements, which can prevent qualified foreign providers of services from participating in such markets.[8]

Factors Affecting Demand

It is important to note the close relationship[9] between the demand for environmental equipment and related services. Customers typically purchase air pollution control equipment in response to specific regulatory requirements. In most cases, they also require consulting, engineering, construction, installation, and/or monitoring services in order to tailor the equipment to their specific needs and realize full compliance – purchases of the services are a function of purchases of the goods. In effect, the equipment and services are typically supplied as an "integrated package"[10] and are not usually provided independent of one another. As such, manufacturers of environmental equipment are becoming more vertically integrated, increasing their combined offerings of systems and services.[11] Consequently, as regulatory environments become more

[4] Industry representative, telephone interview by USITC staff, Dec. 23, 2004. According to this U.S. industry representative, while technologically advanced equipment is readily available in the U.S. market, only a fraction of power plants have scrubbers because the law does not require it. Conversely, all power plants in Japan are fitted with scrubbers as dictated by law.

[5] OECD, *Environmental Goods and Services, An Assessment of the Environmental, Economic, and Development Benefits of Further Global Trade Liberalization*, Oct. 3, 2000.

[6] Industry representative, interview by USITC staff, Seoul, Korea, Nov. 15, 2004.

[7] Ibid.

[8] United Nations Conference on Trade and Development (UNCTAD), *Strengthening Capacities in Developing Countries to Develop Their Environmental Services Sector*, TD/B/COM.1/EM.7/2, May 12, 1998.

[9] OECD, *Environmental Goods and Services, An Assessment of the Environmental, Economic, and Development Benefits of Further Global Trade Liberalization*, Oct. 3, 2000.

[10] UNCTAD, *Strengthening Capacities in Developing Countries to Develop Their Environmental Services Sector*, May 12, 1998.

[11] OECD, *Environmental Goods and Services, An Assessment of the Environmental, Economic, and Development Benefits of Further Global Trade Liberalization*, Oct. 3, 2000.

stringent and demand for air and noise pollution equipment rises, demand for air and noise pollution control services will also likely increase.

Demand for air and noise pollution abatement services is largely driven by regulation and enforcement, financial resources, international obligations, and public sentiment. In most cases, regulation is the principal driver[12] of demand for environmental equipment and services, including air and noise pollution abatement services; monitoring and enforcement tend to improve compliance with such regulation (chapter 2). The evolution of environmental laws in general, and air and noise pollution laws in particular, varies significantly in the focus countries, with developed countries having a relatively longer regulatory history than their developing country counterparts. For example, several European countries, Japan, and the United States, enacted basic air pollution control laws as early as the 1950s and 1960s.[13] However, such laws materialized more recently in Korea, Mexico, and Thailand in response to increased economic development and industrialization.

Countries typically maintain some national-level legislation pertaining to air pollution, with responsibility for enforcement often falling to states or territories. This may impact the provision of goods and services as providers may be forced to comply with several different sets of standards among states, rather than just one set of regulations at the national level. In the United States, the principal law pertaining to air pollution is the Clean Air Act,[14] which gives both the Environmental Protection Agency (EPA) and state governments the authority to enforce standards and implement controls. Japan maintains a similar structure, with the Air Pollution Control Law[15] serving as the overarching legislation. While Japan's Ministry of Environment has some enforcement authority under this law, provincial and local governments hold the principal enforcement responsibility.[16] Moreover, it is not uncommon for local governments in Japan to enact more stringent air pollution control measures than those set at the national level.[17]

Canada and Australia also maintain air pollution laws under which both national and sub-national governments hold enforcement authority, but the evolution of this legislation differs from that of similar legislation in the United States and Japan. In Canada, the provinces traditionally accounted for most of the country's air pollution regulations with little federal involvement. However, in 2000, the Canadian Environmental Protection Act[18] entered into force. The legislation established national pollution control standards and gave the office of the federal environment minister the authority to enforce air pollution abatement measures. It is reported that a lack of harmonization among provincial standards presents challenges for industry, but the establishment of the Canadian Council of Environment Ministers in 1989 aimed to

---

[12] Ibid.

[13] For example, the United Kingdom enacted legislation in 1965 (Clean Air Act); Japan enacted legislation in 1968 (Air Pollution Control Law); and the United States enacted legislation in 1963 (Clean Air Act) and in 1967 (Air Quality Act).

[14] 42 U.S.C. s/s 7401 et seq. (1970), "The Plain English Guide to the Clean Air Act," EPA-400-K-93-001, Apr. 1993, found at *http://www.epa.gov* retrieved Jan. 7, 2005.

[15] "Air Pollution Control Law," Law No. 97 of 1968, found *at http://www.env.go.jp/en/lar/nlaw/index.html*, retrieved Dec. 7, 2004.

[16] Industry representative, interview by USITC staff, Tokyo, Japan, Nov. 4, 2004.

[17] Ibid.

[18] Information on the Canadian Environmental Protection Act, 1999 can be found at *http://www.laws.justic.gc.ca*.

clarify priorities and eliminate duplication.[19] In Australia, air pollution regulations evolved in a similar manner. In the 1980s and 1990s, each of the territories enacted environmental legislation that included some provisions regarding air pollution control. In 1998, the Government of Australia established national standards for key air pollutants under the National Environment Protection Measure for Ambient Air Quality.[20] Although enforcement principally remains in the hands of local governments, greater harmonization and cooperation with national authorities is required under the new legislation. In the European Union, air pollution is regulated by national laws that must conform to EU-wide standards. While there is no single "key" piece of legislation in this regard, the European Union has issued a series of directives pertaining to, *inter alia*, ambient air quality assessment and management; limits for sulphur dioxide (SO_2), nitrogen oxides (NO_x), particulates, and lead; emissions from motor vehicles; and emissions ceilings for atmospheric pollutants.[21] These directives work in tandem to provide a framework for air pollution control and abatement. Environmental laws in each of the EU-15 member states reportedly conform to these EU directives, and the 10 newly acceded member states are currently working to harmonize their environmental laws with these directives.[22] However, it is reported that the degree of enforcement varies throughout the European Union.[23]

In most cases, air pollution legislation in the developing countries covered in this report is evolving. Almost all of these countries have enacted laws pertaining to specific pollutants, and enforcement is typically the responsibility of the national government. In Mexico, the Ministry of the Environment and Natural Resources (SEMARNAT) issues official standards for air pollution and acts as the principal regulator. To date, standards have been established for carbon monoxide (CO), lead, nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter.[24] Korea's key law pertaining to air pollution is the Air Quality Preservation Act of 1990.[25] This law establishes air quality standards for certain pollutants, and assigns responsibility for enforcement to the Ministry of Environment.[26] However, both the Mexican and Korean governments plan to relinquish authority for the regulation and enforcement of air pollution control standards to local governments.[27]

---

[19] Industry representative, telephone interview by USITC staff, Sept. 22, 2004.

[20] Information on Australia's National Environment Protection Measure for Ambient Air Quality can be obtained from the Environment Protection and Heritage Council, at *http://www.ephc.gov.au*.

[21] European Union website, found at *http://www.europa.eu.int*, retrieved Nov. 10, 2004.

[22] Industry representatives, interviews by USITC staff, Brussels, Belgium and Warsaw, Poland, Oct. 29 and Nov. 2, 2004.

[23] World Economic Forum, "Enforcement of Environmental Regulations," *World Competitiveness Indicators 2005*.

[24] BNA, "Mexico Overview," found at *http://esweb.bna.com* retrieved Sept. 22, 2004.

[25] Information on Korea's Air Quality Preservation Act can be obtained from the Ministry of Environment, at *http://eng.me.go.kr*.

[26] Because it is believed that current standards are not effectively bringing pollution under control in the heavily populated Seoul area, the more stringent Special Law on Air Quality for Seoul Metropolitan Area will come into effect in 2005. Industry representative, interview by USITC staff, Seoul, Korea, Nov. 16, 2004.

[27] Government representative, interview by USITC staff, Seoul, Korea, Nov. 16, 2004.

Air pollution regulations in Thailand and South Africa are evolving more slowly than in Mexico and Korea. In Thailand, the National Environmental Quality Act[28] governs air pollution issues, but it is reported that weak enforcement mechanisms and a lack of implementation have limited the efficacy of the law.[29] The regulatory environment in South Africa is likely the least developed of the subject countries. At present, the Department of Environmental Affairs and Tourism is working towards the implementation of its National Environmental Management Act,[30] the purpose of which is to direct the development of environmental regulations.

Emission standards for hazardous air pollutants are being developed in several countries, and could lead to an increase in demand for air and noise pollution abatement goods and services. For example, standards for emissions of mercury from power plants are under consideration in the United States, Canada, and the European Union. Mercury emissions controls are likely to be instituted broadly in economically dynamic developing countries such as China and India, which are heavily dependent on coal for power generation.[31] Nevertheless, continued reliance on coal for fuel in many developing countries will likely result in increased total global emissions of greenhouse gases– particularly CO_2– through 2025.[32]

Mobile-source pollution is largely controlled through governmental product standards regarding vehicle design, such as catalytic conversion and positive crankcase ventilation (PCV) systems for internal combustion engines. In the United States, fuel efficiency standards, requiring manufacturers to increase average miles per gallon across the entire fleet, are also regulated.[33] Additionally, fuel choices such as alternative blends[34] and de-sulfurized diesel standards[35] are employed by regulators to control emissions. Zero emission (electric and hydrogen) and hybrid (partial fossil fuel-fired) vehicles are also

---

[28] Information on Thailand's National Environmental Quality Act can be obtained from the Ministry of Natural Resources and Environment, Department of Environmental Quality Promotion, at *http://www.deqp.go.th/english*.

[29] Government representative, interview by USITC staff, Bangkok, Thailand, Nov. 11, 2004.

[30] Information on South Africa's National Environmental Management Act can be obtained from the Department of Environmental Affairs and Tourism at *http://www.environment.gov.za/*.

[31] Industry representative, interview by USITC staff, Chicago, Dec. 3, 2004, and "Global Surge in Use of Coal Alters Energy Equation," *Wall Street Journal*, Nov. 16, 2004, p. A1.

[32] DOE, EIA, *International Energy Outlook 2004*, p. 5.

[33] Nathanson, *Basic Environmental Technology*, pp. 450-452. Of the major vehicle-producing countries or regions besides the United States, only in the European Union are vehicles produced that are designed not primarily for export. Unlike the United States, the European Union has no specific vehicle fleet miles per gallon standards. Others, including Brazil, China, and Japan, have discussed but not enacted so-called "café standards" on vehicle fleet mileage per gallon..

[34] Examples include higher octane, unleaded, and reformulated gasolines (RFG) with oxygenated fuel additives in jurisdictions with seasonal ozone concerns.

[35] The U.S. EPA implemented diesel standards in 2001 that require the use of de-sulfurized diesel fuel. The EPA took this action so that pollution control devices, such as catalytic converters, can be installed on diesel fuel engines. The changes will be phased in through 2010. Nathanson, *Basic Environmental Technology*, p. 452.

being developed and marketed, with significant governmental research support.[36] Mobile sources are also commonly required to undergo regular emission standards testing to ensure proper engine performance and minimize vehicular pollution. In the United States, such testing is prescribed by the states and may involve regular visits to testing facilities for compliance testing.[37]

Though air pollution regulations exist in most of the subject economies, the stringency of such regulations and the ability of governments to monitor and enforce these laws differs widely. A comparison of per capita income levels and industry perceptions regarding the stringency of national air pollution regulations demonstrates the positive relationship between the two factors (figure 3-1). In other words, air pollution regulations are generally considered to be more stringent in high-income countries and less stringent in countries with lower per capita income levels. The correlation between per capita gross domestic product and stringency of air pollution laws is measured at 0.83,[38] indicating a strong positive relationship between economic welfare and regulatory enforcement. Evidence indicates that as incomes grow, regulatory stringency increases, driving demand for air and noise pollution goods and services. In developing countries such as Thailand, Poland, and Chile, air pollution regulations exist but may be perceived to be weak or erratically enforced, and therefore noncompliance may be more common than in high-income countries. However, high-income countries are likely to have greater cause for stringent enforcement of air pollution regulations, as they tend to emit more airborne pollutants than their developing-country counterparts.[39] In a comparison of gross domestic product and carbon dioxide (CO_2) emissions (figure 3-2), a distinct positive relationship is observed between national income and emissions, which registered a correlation coefficient of 0.84.[40] There are certain exceptions, as

[36] According to some industry sources, as much as $20 billion over the past ten years has been spent by the U.S. Government in research support for fuel alternatives. See Patrick J. Michaels and others, "Meltdown: The Predictable Distortion of Global Warming by Scientists, Politicians, and the Media," Cato Institute, 2004.

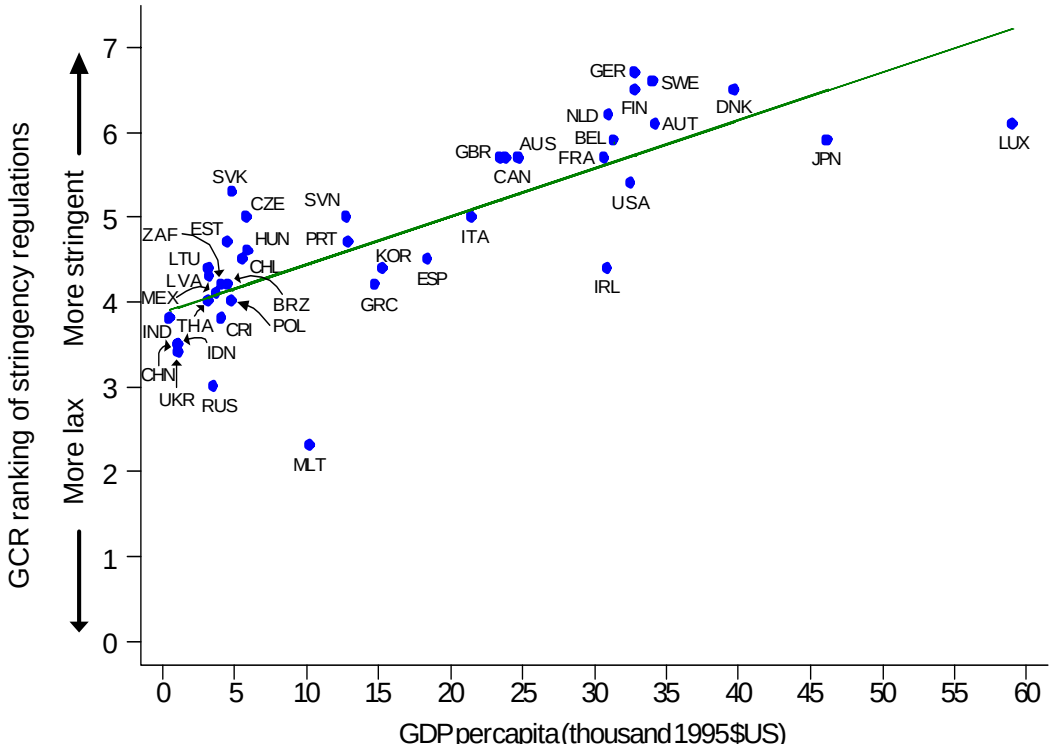
[37] Some states require annual testing, although others do so only at the time of purchase or the first instance of state licensing.

[38] The correlation coefficient is based on comparison of per capita GDP and air pollution regulation stringency ratings of 100 developed and developing countries, as identified in the World Economic Forum's *The Global Competitiveness Report 200*3*-2004*. Note that figure 3-1 is based on a subset of 40 of these countries and therefore, this coefficient is not directly comparable to the results presented in figure 3-1.

[39] U.S. Department of Energy, Energy Information Administration, "World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1980-2002," found at *http://www.eia.doe.gov/pub/international/iealf/tableh1co2.xls*, retrieved Dec. 27, 2004.

[40] The correlation coefficient is based on comparison of GDP and CO_2 emissions for 172 countries. Note that figure 3-2 is based on a subset of 43 of these countries, showing the relationship between GDP per capita and CO_2 emissions per capita. Therefore, this coefficient is not directly comparable to the results presented in figure 3-2.

Figure 3-1
GDP per capita and industry perceptions of air pollution regulations,[1] by country,[2] 2003



[1] Data on air pollution regulations were derived from the World Economic Forum's *The Global Competitiveness Report 2003*-2004 in which executives of international firms were polled on the stringency of air pollution regulations in selected countries. On a scale of 1-7, a rating of 1 denotes lax regulations compared with most other countries, while a rating of 7 indicates that regulations are among the world's most stringent.

[2] Countries displayed in the figure include the 35 selected for special emphasis in this study (EU member states are represented individually), as well as any additional nations among the 20 largest emitters of carbon dioxide in 2002, as identified in the U.S. Department of Energy, Energy Information Administration, "World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1980-2002," found at *http://www.eia.doe.gov/pub/international/iealf/tableh1co2.xls*, retrieved Dec. 27, 2004. These countries include Australia (AUS), Austria (AUT), Belgium (BEL), Brazil (BRZ), Canada (CAN), Chile (CHL), China (CHN), Costa Rica (CRI), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (GER), Greece (GRC), Hungary (HUN), India (IND), Indonesia (IDN), Ireland (IRL), Italy (ITA), Japan (JPN), Korea (KOR), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), Malta (MLT), Mexico (MEX), Netherlands (NLD), Poland (POL), Portugal (PRT), Russian Federation (RUS), Slovakia (SVK), Slovenia (SVN), South Africa (ZAF), Spain (ESP), Sweden (SWE), Thailand (THA), Ukraine (UKR), United Kingdom (GBR), and United States (USA). Stringency ratings were not available for Cyprus, an EU member state, or for Iran and Saudi Arabia, the 16th and 19th largest emitters of carbon dioxide, respectively.

The regression line in Figure 3-1 is the result of estimating the following equation using ordinary least squares (OLS) on the 40 observations in the table:

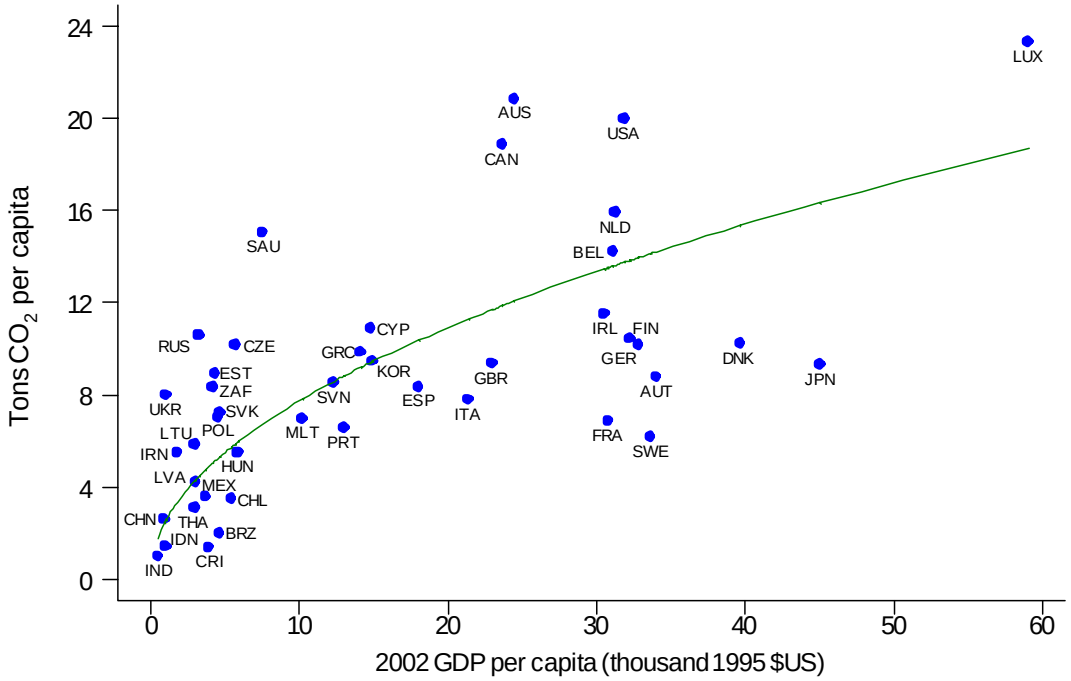
$$\text{Stringency}_i = \beta_0 + \beta_1 (\text{GDP} / \text{pop})_i + \varepsilon_i$$

The regression yields an adjusted R^2 of 0.6197. It should also be noted that the estimated coefficient β_1 is 0.0568 and that the 95 percent confidence interval is 0.0425 to 0.0711. This is consistent with our hypothesis that stringency rises with GDP per capita.

Coefficient	Estimate	Standard error	*t* statistic	P > | *t* |	95 percent confidence interval	
β_0	3.8750	0.1591	24.36	0.000	3.5530	4.1971
β_1	0.0568	0.0071	8.04	0.00	0.0425	0.0711

Source: GDP data obtained from the World Bank. GDP figure for Malta is from 2002.

Figure 3-2
Per capita GDP and CO_2 emissions, by country,[1] 2002



[1] Countries displayed in the figure include the 35 selected for special emphasis in this study (EU member states are represented individually), as well as any additional nations among the 20 largest emitters of carbon dioxide in 2002, as identified in the U.S. Department of Energy, Energy Information Administration, "World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1980-2002," found at *http://www.eia.doe.gov/pub/international/iealf/tableh1co2.xls*, retrieved Dec. 27, 2004. These countries include Australia (AUS), Austria (AUT), Belgium (BEL), Brazil (BRZ), Canada (CAN), Chile (CHL), China (CHN), Costa Rica (CRI), Cyprus (CYP), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (GER), Greece (GRC), Hungary (HUN), India (IND), Indonesia (IDN), Iran (IRN), Ireland (IRL), Italy (ITA), Japan (JPN), Korea (KOR), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), Malta (MLT), Mexico (MEX), Netherlands (NLD), Poland (POL), Portugal (PRT), Russian Federation (RUS), Saudi Arabia (SAU), Slovakia (SVK), Slovenia (SVN), South Africa (ZAF), Spain (ESP), Sweden (SWE), Thailand (THA), Ukraine (UKR), United Kingdom (GBR), and United States (USA).

Note.--The regression line is the result of estimating the following equation using ordinary least squares (OLS) on the 43 observations in the table, weighted by population:

$$(CO_2 / pop)_i \sqrt{pop_i} = \beta_0 \sqrt{pop_i} + \beta_1 \sqrt{(GDP / pop)_i} \sqrt{pop_i} + \varepsilon_i \sqrt{pop_i}$$

The regression yields an adjusted R^2 of 0.6754. It should also be noted that the constant β_0 is estimated to be 0.101 (101 kg/capita) and the 95% confidence interval is -1.328 to 1.531, so we cannot reject the hypothesis that the intercept is equal to zero, consistent with the assumption that pollution is related to economic activity.

Coefficient	Estimate	Standard error	*t* statistic	P > | *t* |	95 percent confidence interval	
β_0	0.1015	0.7078	0.14	0.887	-1.3278	1.5309
β_1	2.4182	0.2572	9.40	0.000	1.8987	2.9377

Source: GDP data obtained from the World Bank. Emissions data were obtained from the U.S. Department of Energy, Energy Information Administration.

some of the subject developed countries, such as France, are heavily reliant on nuclear, hydroelectric, or renewable energy and subsequently have lower CO_2 emissions.[41]

Some developing markets reportedly place relatively little emphasis on noise pollution, generally focusing first on higher-priority environmental issues such as water and air pollution.[42] In many cases, noise pollution (such as that caused by air traffic, motor vehicles, factories, etc.) is addressed in general environmental or labor laws. Additionally, noise pollution is often regulated by governmental bodies that focus on issues other than the environment. For example, Thailand does not have a law specifically addressing noise pollution, but the Public Health Act of 1992 and the Factory Act of 1992 address the control of certain types of noise pollution. Similarly, in Mexico, noise pollution and abatement regulations are found within comprehensive labor standards established by the Ministry of Labor and Social Security, though no national law directly addressing noise pollution is believed to exist.

Noise pollution legislation tends to be more specific in the developed countries examined in this report, but such legislation can also include myriad components. In the United States, the Noise Control Act of 1972[43] serves as the principal piece of legislation on ambient noise, while the Occupational Safety and Health Act of 1970[44] regulates noise from industrial activity. However, standards for noise pollution from transportation sources are established by the Department of Transportation, and those for residential areas are established by the Department of Housing and Urban Development. State agencies also play a role in the enforcement of noise regulations in the United States.

As one example of a regulation that addresses a specific noise issue, efforts in the United States, under the Aircraft Noise and Capacity Act of 1990, to abate aircraft noise focused on a 1999 deadline to remove certain noisy, and generally older, aircraft from commercial and corporate fleets.[45] Some engineering and manufacturing firms developed so-called hush kits that enabled the older Chapter 2 aircraft to be certified as compliant with the newer more stringent Chapter 3 regulations. Thus, airlines could extend the economic life of some older aircraft by installing noise abatement equipment or making other modifications. However, as the airlines, and other operators added newer quieter Chapter 3 aircraft to their fleets the demand for these noise abatement goods and services diminished.

Much like national air pollution regulations, participation in regional and multinational environmental agreements also spurs demand for air pollution abatement equipment and services. Perhaps the most ambitious multinational agreement addressing air pollution is the United Nations Framework Convention on Climate Change (UNFCCC) and the

---

[41] A further comparison of CO_2 emissions and thermal electricity generation reinforced the interdependence between the two factors, yielding a correlation coefficient of 0.99.

[42] Korean industry representative, interview by USITC staff, Seoul, Korea, Nov. 15, 2004.

[43] 42 U.S.C. 4901-4918. Information on the Noise Control Act can be found at *http://www.nonoise.org/epa/act.htm*.

[44] 29 U.S.C. 651 et seq. (1770). Information on the Occupational Safety and Health Act can be found at *http://www.epa.gov*.

[45] Sher & Blackwell, European and US Developments in Noise Regulations, found at *http://www.sherblackwell.com/resources_noise.htm/*, retrieved Mar. 16, 2005, p. 2.

subsequent Kyoto Protocol to the Convention.[46] The UNFCCC was established in 1992 as a forum through which to address problems associated with worldwide greenhouse gas emissions. Under the Convention – to which 197 nations are signatories, including all of the countries examined in this report – developed countries agreed to stabilize greenhouse gas emissions at 1990 levels by the year 2000.[47] However, the commitments were nonbinding and as 2000 approached, the anticipated progress had not materialized. In 1997, the Conference of the Parties established the Kyoto Protocol, a legally binding agreement that requires, *inter alia*, industrialized countries to reduce emissions of 6 major greenhouse gases[48] to pre-1990 levels during the 2008-2012 period. In order for the Kyoto Protocol to enter into force, it required ratification by industrialized countries whose collective CO_2 emissions account for at least 55 percent of world totals in 1990. In November 2004, Russia ratified the agreement and thus elevated the group of 128 ratifying countries above the 55 percent threshold. As such, the Kyoto Protocol entered into force on February 16, 2005,[49] at which time member countries became legally obligated to meet the emissions control targets to which they have committed. In order to achieve these targets, countries will have to pursue strategies that are likely to combine more stringent air pollution control mechanisms, cleaner fuels, and energy efficiency programs. As a result, the most dramatic increase in demand for air pollution abatement equipment and services among the subject countries will likely occur in the European Union, Japan, and Canada,[50] the second-, fourth-, and fifth- largest emitters of CO_2 from fossil fuels among industrialized countries in 2002, and the top three emitters of CO_2 among those countries that have undertaken mandatory emission control targets under the Kyoto Protocol.[51] The United States, the world's top emitter of CO_2 from fossil fuels, has signed but not ratified the Kyoto Protocol, and therefore has no legal obligation to reduce greenhouse gas emissions.[52]

---

[46] Information on the United Nations Framework Convention on Climate Change and the Kyoto Protocol to the Convention can be obtained at *http://unfccc.int*.

[47] European Commission, "The Kyoto Protocol and Climate Change – Background Information," Memo/02/120, May 31, 2002, found at *http://europa.eu.int,* retrieved Dec. 16, 2004.

[48] Reductions in carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) will be relative to 1990 levels, while reductions in hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) will be measured against either 1990 or 1995 levels. European Commission, "The Kyoto Protocol – A Brief Summary," Aug. 19, 2004, found at *http://europa.eu.int,* retrieved Dec. 16, 2004.

[49] The treaty entered into force 90 days after ratification by the requisite number of countries.

[50] While all of the subject countries except for Australia, Costa Rica, and the United States are parties to the Kyoto Protocol, parties that are not considered to be industrialized do not have specific reduction targets at this time.

[51] The United States was the largest emitter of CO_2 from fossil fuels in 2002 among both industrialized and developing countries, followed by the EU, China, Russia, Japan, India, and Canada. U.S. Department of Energy, Energy Information Administration, "World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1980-2002," found at *http://www.eia.doe.gov/pub/international/iealf/tableh1co2.xls*, retrieved Dec. 27, 2004.

[52] The alternative approach proffered by the U.S. Government is directed to reducing greenhouse gas emissions in proportion to economic growth, termed greenhouse gas intensity, by 18 percent from 2002 levels by 2012. DOE, EIA, *International Energy Outlook 2004*, p. 15.

Prior to the Kyoto Protocol, the Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987)[53] emerged as the most prominent international agreements addressing ozone depletion. These agreements required ratifying countries to curb production and use of chlorofluorocarbons (CFCs) and other ozone depleting chemicals such as halons and methyl bromide. Although the agreements did not necessarily stimulate demand for air pollution abatement equipment and services *per se*, as they effectively served as bans on particular products, they established certain standards for the formation and implementation of future international environmental agreements such as the UNFCCC and Kyoto Protocol.

Lastly, although public sentiment lacks the legal weight of the aforementioned regulations and agreements, it is reportedly a driver of demand in air and noise pollution abatement markets.[54] Air quality is consistently ranked as a high environmental priority[55] by many people throughout the world, regardless of economic development. As such, those who experience or fear the effects of diminishing air quality are often mobilized to hold governments and/or companies accountable[56] until change is enacted. Similarly, citizens who feel the direct effects of noise pollution are likely to pressure state and local governments into action.[57] As noted in the literature review of this report (chapter 2), disclosure of information on pollution levels has been found to motivate the general public to demand environmental compliance by polluters. In Japan, for example, companies that violate air pollution laws do not typically receive heavy financial penalties; rather, violations are made public and the company is subjected to widespread scrutiny.[58] The importance of public sentiment in Japan is reportedly strong enough to serve as an enforcement mechanism for environmental regulations, resulting in a rise in demand for environmental goods and services as polluters take responsibility for abatement activities.[59]

---

[53] United Nations Development Programme, "The Vienna Convention and the Montreal Protocol," found at *http://www.undp.org/seed/eap/montreal/montreal.htm*, retrieved Dec. 16, 2004.

[54] Industry representative, interview by USITC staff, Tokyo, Japan, Nov. 4, 2004.

[55] Industry representative, interview by USITC staff, Bangkok, Nov. 11, 2004.

[56] Industry representative, interview by USITC staff, Bangkok, Nov. 11, 2004.

[57] Ibid.

[58] Industry representative, interview by USITC staff, Tokyo, Japan, Nov. 4, 2004.

[59] Ibid.

Table 3-1
Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
Australia	In 1998, the national government, along with state and local territories, established national standards for key air pollutants under the National Environment Protection Measure for Ambient Air Quality.[1] Australia's key legislation regarding noise pollution is the Noise Control Act 1975,[2] which advocates prevention, abatement, and minimization of noise and vibration and places regulatory authority with the national EPA, Waterways Authority, and local governments. The Noise Control Regulation 1995 addresses noise levels for motor vehicles; and the Environmental Planning and Assessment Act 1979 encourages preemptive noise abatement through effective planning.	UN Framework Convention on Climate Change (1992) and its subsequent Kyoto Protocol (1997)[3] (signed but not ratified) Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987)[4]	Virtually all key air and noise pollution abatement technologies are believed to be available across the cost spectrum, either from domestic or foreign suppliers.	Owing in large part to the prevalence of ground contamination and water salinity issues, air pollution control is not presently considered to be among Australia's top environmental management issues.[5]

See footnotes at end of table.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
Brazil	In 1981, Brazil enacted a national environmental policy under Law 6,938, which established liability for polluting activities and authorized prosecution by federal and state district attorneys. The Ministerio do Meio Ambiante (MMA), created in 1992, oversees this national policy, and its Conselho Nacional do Meio Ambiente (CONAMA) establishes air quality standards and determines fines for violations. Under CONAMA's national air quality monitoring program, which is administered by the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), limits on emissions were established, along with a monitoring network to analyze air quality on a continuous basis.[6] Vehicular air pollution is severe in the urban areas of Sao Paolo and Rio de Janeiro, areas which tend to be the focus of CONAMA's regulatory activities. However, enforcement outside of these urban areas is typically weak.[7]	UN Framework Convention on Climate Change (1992) and its subsequent Kyoto Protocol (1997) Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987) Brazil participates in several commissions of the MERCOSUL.	Most key air and noise pollution abatement technologies are available from either domestic or foreign sources.	Air pollution in Brazil is overwhelmingly due to vehicular emissions in the urban areas of Sao Paolo and Rio de Janeiro, since 90 percent of Brazil's electricity needs are met by hydropower.[8] Potential market drivers include, *inter alia*, stricter legislation, community pressure, and migration toward better overall environmental practices.[9]

See footnotes at end of table.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
Canada	The Provinces in Canada account for most of the legislation and regulation regarding air and noise pollution control. The federal government provides broad measures and some specific regulation in certain areas. There has been some debate and disagreement about the efficiency, e.g., industry must meet two sets of standards, and Canada has established Canadian Council of Environment Ministers to attempt to set priorities and to minimize overlap and duplication.[10] The Canadian Environmental Protection Act (CEPA), in force since 2000, is the key framework legislation covering air pollution. CEPA provides the federal environment minister with the authority to order elimination of toxic substances from the environment.[11] The Clean Air Agenda (2000), is a federal 10-year plan focused on reducing transboundary emissions, as well as emissions from major industrial sectors and transportation.[12] Noise pollution is addressed in federal health and labor legislation. The Ministry of Health and the Ministry of Human Resources Development both address noise pollution in the work place. Noise pollution from transportation sources is sometimes addressed in individual regulations.[13]	Convention on Long-range Transboundary Air Pollution (1979)[14] Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987) 1991 Agreement Between Canada and the United States on Air Quality and its 2000 Protocol on Ozone UN Framework Convention on Climate Change (1992) and its subsequent Kyoto Protocol (1997) 1993 North American Agreement on Environmental Cooperation 1998 Canada-Chile Agreement on Environmental Cooperation 2001 Stockholm Convention on Persistent Organic Pollutants	Virtually all key air and noise pollution abatement technologies are believed to be available across the cost spectrum, either from domestic or foreign suppliers.	While Canada has an economy that includes a broad range of industrial activities, the largest sources of emissions of many of the air pollutants are primary energy production, electricity production, and selected areas of mining and manufacturing. These areas include chemicals, fertilizers, pulp and paper, mining, smelting and refining of aluminum and steel, cement, lime and glass. This concentration affects the demand for processes and equipment to treat the air pollution produced by these sectors and industries.

See footnotes at end of table.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
Chile	The Servicio de Salud Metropolitano del Ambiente (SESMA), an arm of the cabinet-level Ministry of Health, develops emissions standards, monitors air quality, and implements pollution reduction programs throughout Chile.[15] In 1996, a Supreme Degree signed by the Chilean President identified Santiago and its surrounding areas as an "air pollution saturated zone." Subsequently, the government began providing incentives for private industry to clean up its activities and created the Atmosphere Prevention and Decontamination Plan for the Metropolitan Region (PPDA), which establishes legally-enforceable limits on industry pollution.[16]	UN Framework Convention on Climate Change (1992) and its subsequent Kyoto Protocol (1997) Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987) The recently-implemented U.S.-Chile FTA requests that the Chilean government enforce Chile's domestic environmental regulations.[17]	Key air and noise pollution abatement technologies are available from either domestic or foreign sources.	Air pollution in Chile is predominantly a product of vehicular emissions and copper mining, as over half of the country's electricity needs are being met by hydropower.[18] Chile is the largest producer of copper in the world, and its copper mining and smelting operations in the Santiago area have contributed to high levels of sulphur dioxide and particulate matter.[19] Vehicular air pollution in Santiago has become severe, with the number of vehicles in the city having reached 1 million.[20]

See footnotes at end of table.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
Costa Rica	The key piece of air pollution legislation is Ley Organica del Ambiente (1994). Other major air laws include Nos. 731, 5395, 7223, 7554, and 8219 - which establish metropolitan air quality standards, establish material transport, storage, and use laws, and tangentially affect the operation of cement plants and boilers.[21] There are now 120 regulations on the environment. Major decrees for air include Decreto 26789 (which established vehicular and fuel requirements) and Decreto 31849, Reglamento general sobre los Procedimientos de Evaluación de Impacto Ambiental, of 2004, which defines a procedure for monitoring ambient air quality.[22] The biggest source of noise is automotive. There are no noise regulations beyond vehicular.[23]	UN Framework Convention on Climate Change (1992) and its subsequent Kyoto Protocol (1997) Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987)	All key air and noise pollution abatement technologies are believed to be available, either from domestic or foreign suppliers. Significant international presence, in the form of corporate[24] and NGO involvement,[25] ensures a high international market presence.	To date, there is no legal mechanism to require companies to do their own air quality measurements.[26] All testing is being developed and performed at the behest of governmental forces, by private and university labs.[27] Only one lab, Lambda, is certified, but three others are going through the process.[28] Thus, market consumption is small, but the opportunity is large. To date, the vast majority focus on ambient air quality - few point source standards have been developed, as manufacturing activity is small (over 60 percent of Cost Rican GDP is services-oriented), most energy is renewable (very little fossil fuel energy), and water, wastewater, and solid waste issues are of higher priority.[29]

See footnotes at end of table.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
EU	Community Legislation in the area of air pollution abatement is principally aimed at cutting emissions from industrial activities and road vehicles. In 1996, the Council Directive 96/62/EC (Ambient Air Quality Assessment & Mgmt) was passed. Requires establishment of limit values, alert thresholds, monitoring/reporting processes, and corrective action for the multiple pollutants. Other significant directives include: • Directive 2001/81/EC, National Emission Ceilings for Certain Atmospheric Pollutants. • Directive 2001/80/EC, Limitation of Pollutants from Large Combustion Plants • Dir 70/220/EEC set limit values on carbon monoxide, hydrocarbons, nitrogen oxides, and particulates for motor vehicles with diesel and petrol engines.[30] Enforcement of environmental regulations in EU member states is perceived to be relatively consistent and fair as compared to other countries.[31] Air pollution regulations are considered to be relatively stringent as compared to other countries.[32]	UN Framework Convention on Climate Change (1992) and its subsequent Kyoto Protocol (1997) Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987) Convention on Long-range Transboundary Air Pollution (1979)	The market for air pollution abatement services and equipment in the EU is highly competitive. Moreover, most air pollution abatement services and equipment are sourced/ manufactured to EU specifications. As a result, key technologies and equipment are widely available at a competitive cost.	There is strong public support for measures that reduce air pollution and/or improve air quality. The adoption/implementation of required EU air pollution standards will drive the market in the Accession countries.[33]

See footnotes at end of table.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
Japan	To meet future commitments (e.g., Kyoto Protocol), laws and standards have been revised and strengthened.[34] Recently revised diesel engine emission restrictions and by 2005 will have the world's strictest diesel emission standards under the *Law Concerning Special Measures for Total Emission Reduction of Nitrogen Oxides and Particulate Matter from Automobiles (diesels) in Specified Areas*.[35] Other key air legislation includes: *Air Pollution Control Law* (1968); *Basic Environmental Law* (1993); *Pollution Release and Transfer Registry Law* (PRTR Law) (1999); *Special Implementation Law on the Dioxin Family of Chemicals* (2000)[36] Regulatory standards and ordinances exist for noise generated by various sources. Key legislation is *Noise Regulation Law*. Although there is limited use of criminal prosecutions or economic instruments (fines) to ensure compliance, a firm's public image serves as the main incentive to operate in an environmentally responsible manner.[37]	UN Framework Convention on Climate Change (1992) and its subsequent Kyoto Protocol (1997) Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987) 1988: GoJ enacted the *Ozone Layer Protection Law.* June 2001: GoJ enacted the *Law for Ensuring the Implementation of Recovery and Destruction of Fluorocarbons concerning Specified Products* (Fluorocarbons Recovery and Destruction Law). May 2002: Japan revised the *Law Concerning the Promotion of the Measures to Cope with Global Warming.*	Virtually all key air and noise pollution abatement technologies are available across the cost spectrum, either from domestic or foreign suppliers.[38] Japanese supplied air and noise pollution abatement goods and services are generally more expensive than those of U.S. or European competitors.[39]	In 2000, production of air pollution control equipment in Japan trailed production of both waste treatment equipment and water pollution control equipment by wide margins.[40] During 1990s emphasis shifted from pollution clean-up, to prevention and reduction. Complaints about noise declined over the last ten years, but began to increase in FY 2000, and have since increased steadily.[41]

See footnotes at end of table.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
Korea	Korea's key legislation regarding air pollution is the Air Quality Preservation Act of 1990 (amended in 1999).[42] In 2005, the Special Law on Air Quality for Seoul Metropolitan Area is slated to come into effect requiring more stringent control of NOx and SOx emissions.[43] Air quality standards are reportedly becoming increasingly stringent, which will create stronger demand for air pollution control equipment and services. In 2005, NOx emissions standards are expected to rise country-wide.[44] Korea's key legislation regarding noise pollution is the Noise and Vibration Control Act.[45]	Korea is a member of several multilateral and bilateral agreements and conventions that address air pollution abatement issues, including: International Convention for the Prevention of Pollution From Ships, (MARPOL, 1973 and modified in 1978.)	Technologically advanced air pollution control equipment and air pollution control equipment used by large companies and/or for large projects is typically imported from the United States, Japan, and – to a lesser extent – Europe. Less complex equipment is manufactured domestically at relatively low prices, and is often the choice of small and medium companies.[46]	During the late 1990s, the Asian financial crisis restricted investment in environmental projects, including air pollution abatement projects. Following that period, Korea's air pollution abatement services market grew moderately but has recently leveled off.[47] Concerns about intellectual property violations prohibit some foreign manufacturers of air pollution control equipment from establishing joint ventures with Korean firms.[48]

See footnotes at end of table.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
Mexico	The Ministry of the Environment and Natural Resources (SEMARNAT) is the principal regulator of air pollution, issuing *Normas Officialas* (NOM) official standards.[49] Air emissions are governed by the Regulations on the Prevention and Control of Air Pollution (D.O.F. 11/25/88). There are NOMs on carbon monoxide, lead, nitrogen dioxide, ozone, sulfur dioxide, and total suspended particulates. Pollution from mobile sources is regulated by Official Mexican Standards, based on the type of vehicle (new or used), the classification and weight of the vehicle, and the type of fuel used. SEMARNAT is responsible for establishing and enforcing federal laws, regulations, and standards on air pollution until this responsibility is transferred to the Mexican states and Federal district. The timeline for such a transfer is unknown. SEMARNAT has a "Single Environmental License" system to streamline application, reporting, and enforcement of all air, water, etc. pollution control abatement measures for industrial operations. (D.O.F. 4/11/97, revised 4/9/98). The Ministry of Labor and Social Security (STPS) is responsible for noise pollution and abatement regulations which are primarily directed toward industrial workers' exposure to noise.	UN Framework Convention on Climate Change (1992) and its subsequent Kyoto Protocol (1997) (signed but not ratified) Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987) North American Agreement on Environmental Cooperation	It is believed all key air and noise pollution abatement technologies are available across the cost spectrum, either from domestic or foreign suppliers.	While Mexico's iron, steel, and foundry industries – which tend to be heavily polluting – are relatively small, there are a substantial number of mining smelters in operation. A new air quality monitoring program was recently introduced. Industry is struggling to keep up with increased costs of compliance; particularly in the mining industry.[50]

See footnotes at end of table.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
South Africa	Department of Environmental Affairs and Tourism (DEAT) is the central policy formulating and coordinating body. DEAT Law Reform Program issued National Environmental Management Act (NEMA, Act 107 of 1998), targeting development of regulations 1999-2002; still ongoing. Fragmented legislation;[51] ineffective enforcement;[52] insufficient involvement / empowerment of people.[53] Environmental Conservation Act 73 of 1989 defines disturbing noise as that which exceeds the ambient sound level by 7 dBA or more.[54] According to DEAT, noise pollution (defined as coming from traffic, construction, mining, commercial recreation, and industrial) is "escalating with little practical regulatory structure to control."[55]	UN Framework Convention on Climate Change (1992) and its subsequent Kyoto Protocol (1997) (signed but not ratified) Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987)	Availability of technologies is increasing due to new regulatory and environmental education plans.[56] Less advanced technologies are often chosen due to cost considerations.	Industry is facing challenges keeping pace with increased costs of compliance, particularly in the mining industry.

See footnotes at end of table.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
Thailand	Environmental regulations are largely in place and recent regulatory policies have attempted to provide time-bound enforcement mechanisms, yet the lack of effective implementation, compounded by widespread corruption limits effectiveness. Instances of warnings, fines, and plant closures demonstrate a will to enforce, although overall enforcement remains uneven.[57] Key legislation on air pollution is the National Environmental Quality Act (1992). Environmental regulations are often included in laws not directly related to the environment including, for example, the *Public Health Act of 1992,* the *Factory Act of 1992,* and the *National Economic and Social Development Plan.*[58] Existing standards include: air quality (CO, NO_2, SO_2, total suspended solids, particulate matter, ozone, lead); emission standards for mobile and point sources (including new and existing power plants, incinerators, steel industry); noise and vibration standards (including ambient noise, mining and quarry, motor vehicle, and motorcycle).[59]	UN Framework Convention on Climate Change (1992) and its subsequent Kyoto Protocol (1997) Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987)	Virtually all key air and noise pollution abatement technologies are available, most of which are purchased from foreign suppliers (Japanese, U.S. European).[60] The private sector is expected to become increasingly involved in funding environmental infrastructure projects on a “privatized” basis, as the national government is no longer able to fund projects at past levels, due to the continuing economic slowdown.[61]	The Royal Thai Government (RTG) has supported the pollution control equipment market by lowering tariffs to 5% or less on assembled imports, providing tax incentives to new overseas industrial investors, and providing low-cost, affordable loans to local manufacturers to purchase equipment. The RTG also supports an ISO 14000 series of international standards and has initiated the "Polluter Pays Principle."[62] Thailand is a developing country and often places more emphasis on economic development than on environmental issues. There is insufficient financing for environmental projects and laws include few penalties for violators.[63] The market for systems that improve indoor air quality has grown in several industries including electronics, pharmaceuticals, and health care.[64]

See footnotes at end of table.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

Country	Regulatory environment	Major International obligations	Availability of key technologies	Other factors affecting supply and demand
United States	The key legislation on air pollution is the Clean Air Act (CAA), as amended, particularly those amendments passed in 1990 which vastly expanded the number of hazardous pollutants regulated; refined or established standards, controls, and permit processes; and strengthened EPA and State enforcement authority. Under the CAA, most States have submitted detailed regulatory implementation plans to EPA, which are enforceable at federal and state levels.[65] The principal legislation on ambient noise is the Noise Control Act of 1972, as amended, which required EPA to establish maximum noise levels to protect public health and welfare, and to conduct research on the effects and control of noise. The Department of Transportation sets regulations to control noise coming from *inter alia* aircraft, vehicles, and highways.[66] The Occupational Safety and Health Act of 1970 (OSHA) set noise emission standards for businesses. The Department of Housing and Urban Development established residential guidelines for noise.[67]	UN Framework Convention on Climate Change (1992) and its subsequent Kyoto Protocol (1997) (signed but not ratified) Vienna Convention for the Protection of the Ozone Layer (1985) and its subsequent Montreal Protocol on Substances that Deplete the Ozone Layer (1987) North American Agreement on Environmental Cooperation Agreement Between Canada and the United States on Air Quality Convention on Long-range Transboundary Air Pollution (1979) and its protocols Stockholm Convention on Persistent Organic Pollutants (2001)(signed but not ratified)	Technologies developed domestically and abroad to abate air and noise pollution are readily available in the U.S. market.	Beginning in 1995, a national market-based cap and trade program to enable power plants to reduce emissions of sulfur dioxide, a major contributor to acid deposition, resulted in a 32-percent reduction by 2003 in sulfur dioxide emissions as reported for such plants in 1990.[68]

[1] Information on Australia's National Environment Protection Measure for Ambient Air Quality can be found at *http://www.deh.gov.au*.
[2] Information on Australia's Noise Control Act of 1975 can be found at *http://www.epa.nsw.gov.au*.
[3] Information on the United Nations Framework Convention on Climate Change and the Kyoto Protocol to the Convention can be obtained at *http://unfccc.int*.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

[4] United Nations Development Programme, "The Vienna Convention and the Montreal Protocol," found at *http://www.undp.org/seed/eap/montreal/montreal.htm,* retrieved Dec. 16, 2004.
[5] U.S. Commercial Service, "Environmental Technologies Australian Market Brief," Mar. 2004, found at *http://www.buyusa.gov/australia/en/pol.html*, retrieved Jan. 7, 2005.
[6] BNA, "Brazil Overview," found at *http://www.esweb.bna.com/*, retrieved Sept. 2004.
[7] Government representative, interviews with USITC staff, Sao Paolo, Dec. 16, 2004.
[8] Ibid.
[9] U.S. Foreign Commercial Service (USFCS), "Brazil: Pollution Control," July 2004, found at *http://www.focusbrazil.org.br/ccg/reports/pollution.pdf*, retrieved Sept. 2004.
[10] Industry official, telephone interview with USITC staff, Sept. 22, 2004.
[11] Bureau of National Affairs, "Country Profile: Canada," found at *http://esweb.bna.com/*, retrieved Sept. 22, 2004, p. 4.
[12] Ibid.
[13] Canadian Centre for Occupational Health & Safety, Noise–Occupational Exposure Limits in Canada, found at *http://www.ccohs.ca,* retrieved Sept. 14, 2004.
[14] Information on the Convention on Long-range Transboundary Air Pollution can be found at *http://www.unece.org.*
[15] BNA, "Chile Overview," found at *http://www.esweb.bna.com*, retrieved Sept. 2004.
[16] USFCS, "Chile Air pollution Control Equipment Report," found at *http://www.stat-usa.gov/*, retrieved Sept. 2004.
[17] USFCS, "Chile Country Commerical Guide GY 2004," found at *http:www.stat-usa.gov/*, retrieved Sept. 2004.
[18] U.S. Department of Energy, Energy Information Administration (EIA), "Chile," Country Analysis Brief, July 2002, found at *http://www.eia.doe.gov/emeu/cabs/chile.html*, retrieved Jan. 2005.
[19] U.S. Department of Energy, EIA, "Chile: Environmental Issues," Country Analysis Brief, July 2002, found at *http://www.eia.doe.gov/emeu/cabs/chilenv.html*, retrieved Jan. 2005.
[20] Ibid.
[21] ENLACE, available at *http://www.enlace-cri.org*.
[22] Ibid.
[23] Government sources, interviews by USITC staff, Costa Rica, Dec. 6-10, 2004.
[24] For example, SwissContact, which was been contracted by the government to help develop emissions control strategies, through 2004, and alternative energy sources, ongoing. USITC staff interview, San Jose, Dec. 6, 2004.
[25] For example, ENTEBBE, which is a Central American regional environmental issues NGO, strives to develop public awareness of emerging environmental issues through its Proyecto CENTAIRE. USITC Staff interview, San Jose, Costa Rica, Dec. 10, 2004.
[26] Government sources, interviews by USITC staff, Costa Rica, Dec. 6, 2004.
[27] Industry sources, interviews by USITC staff, Costa Rica, Dec. 6 and 9, 2004.
[28] Ibid.
[29] Government sources, interviews by USITC staff, Costa Rica, Dec. 6, 2004.
[30] European Union website, found at *http://www.europa.eu.int/*, retrieved Nov. 10, 2004.
[31] World Economic Forum, "Enforcement of Environmental Regulations," *World Competitiveness Indicators 2005*.
[32] Ibid.
[33] Industry representatives, interview by USITC staff, Warsaw, Nov. 2, 2004.
[34] Government officials, interview by USITC staff, Tokyo, Nov. 4, 2004.

Table 3-1—*Continued*

Factors affecting supply and demand in the air and noise pollution abatement services and goods industries

[35] Industry representative, interview by USITC staff, Tokyo, Nov. 5, 2004.
[36] Industry representative, interview by USITC staff, Tokyo, Nov. 4, 2004.
[37] Industry representatives and government officials, interviews by USITC staff, Tokyo, Nov. 4-8, 2004.
[38] Government officials, interviews by USITC staff, Tokyo, Nov. 4-8, 2004.
[39] Industry representatives, interviews by USITC staff, Tokyo, Nov. 4-8, 2004.
[40] Industry representatives and government officials, interviews by USITC staff, Tokyo, Nov. 4-8, 2004.
[41] Government official, interview by USITC staff, Tokyo, Nov. 4, 2004.
[42] Information on Korea's Air Quality Preservation Act can be obtained from the Ministry of Environment, found at *http://eng.me.go.kr*.
[43] Ibid.
[44] Government representative, interview by USITC staff, Seoul, Nov. 16, 2004.
[45] Information on Korea's Noise and Vibration Control Act can be obtained from the Ministry of Environment, found at *http://eng.me.go.kr*.
[46] Industry representative, interview by USITC staff, Seoul, Nov. 15, 2004.
[47] Ibid.
[48] Ibid.
[49] BNA, "Mexico Overview," found at *http://esweb.bna.com* retrieved Sept. 22, 2004.
[50] According to the Chief Inspector of Mines, as reported in "Most Small Miners Unable to Comply with Health and Safety Act," Mining e-News, Feb. 2004.
[51] Department of Environmental Affairs and Tourism (DEAT) Business Plan 01 April 2004 - 31 March 2005, p. 4, available at *http://www.environment.gov.za/AboutUs/Business%20Plan/DEAT%20Business%20Plan2004-2005draft28am.pdf*.
[52] *National Environmental Management: Air Quality Bill*, Republic of South Africa, p. 29, available at *http://www.environment.gov.za/*.
[53] *South Africa's Economic Transformation: A Strategy for Broad-Based Black Economic Empowerment*, available at *http://www.dti.gov.za/bee/bee.htm*.
[54] DEAT
[55] Ibid.
[56] Ibid.
[57] Government officials and Industry representatives, interviews by USITC staff, Bangkok, Nov. 10-12, 2004.
[58] Industry representative, interview by USITC staff, Bangkok, Nov. 12, 2004.
[59] Ministry of Natural Resources and Environment, found at *http://pcdv1.pcd.go.th/Information/Regulations/air_noise/EmssionStandards.cfm*.
[60] Government officials and Industry representatives, interviews by USITC staff, Bangkok, Nov. 10-12, 2004.
[61] Government officials, interviews by USITC staff, Bangkok, Nov. 10-11, 2004.
[62] Ibid.
[63] Government officials and Industry representatives, interviews by USITC staff, Bangkok, Nov. 10-12, 2004.
[64] Industry representative, interview by USITC staff, Bangkok, Nov. 12, 2004.
[65] Bureau of National Affairs, *Country Profiles: United States*, found at *http://esweb,bna.com/*, retrieved Sept. 23, 2004.
[66] U.S. Environmental Protection Agency (EPA) and U.S. Department of Transportation, various websites.
[67] Acoustical Society of America and Nathanson, "Noise Pollution and Control," ch. 14, p. 468.
[68] EPA, *Acid Rain Program 2003 Progress Report*, EPA 430-R-04-009, Sept. 2004, found at *http://www.epa.gov/airmarkets/cmprpt/arp03/summary.html*, retrieved Nov. 15, 2004, p. 3.

CHAPTER 4
AIR POLLUTION ABATEMENT SERVICES AND EQUIPMENT

Air pollution is generally defined as an attribute of general air quality, in large part rooted in industrial activity and fossil fuel consumption. Stationary sources of outdoor air pollution– primarily fossil-fuel burning power plants, industrial plants, mining and refining activities,[1] and refuse incinerators[2]– emit particulate matter (PM), sulfur oxides (SO_X), and nitrous oxides (NO_X), and, in the case of coal-burning power plants, mercury, arsenic, lead, and other trace elements. Mobile sources of outdoor air pollution– mainly highway vehicles but also aircraft, trains, vessels, and farm and recreational vehicles– are responsible for the majority of carbon monoxide (CO) pollution in most industrialized countries[3] and lead pollution in less-developed countries. Among stationary sources of air pollution, residential and municipal heating systems, power plants, and refuse incinerators generate significant CO and carbon dioxide (CO_2) emissions through the burning of coal, petroleum, and natural gas, or their derivatives such as coke, heating oil, or propane.[4] Energy production also generates a large volume of PM from the burning of solid fossil fuels. Solid and liquid fuels generally contain sulfur, which becomes gaseous compounds (SO_X) when burned. The evolving gases and the ash also contain trace elements that originate in the source fuel and are emitted into the atmosphere upon consumption of the fuel.

Certain manufacturing industries– such as mining, refining, metal working, and chemical production– often employ on-site power generation facilities or consume fuels as part of their processes. Thus, manufacturing industries use emissions safeguards similar to those employed by the energy industry. However, manufacturing industries' bulk generation of carbon gases is significantly lower than for the energy industry.[5] Moreover, like the energy industry, manufacturing industries generate particulate matter and sulfur, particularly in metal refining and melting operations, because of the use of

[1] Jerry A. Nathanson, "Air Pollution and Control," *Basic Environmental Technology*, 4th ed. (Upper Saddle River, New Jersey and Columbus, Ohio: Prentice Hall, 2003), p. 443; and industry representative, interview by USITC staff, Chicago, Dec. 2, 2004.

[2] Nathanson, *Basic Environmental Technology*, p. 443.

[3] Motor vehicle exhaust accounted for approximately 60 percent of U.S. CO emissions in 2002. Coupling motor vehicles with off-road and nonroad sources, land transportation sources accounted for 82 percent of CO emissions that year. In U.S. cities, motor vehicle exhaust has accounted for almost 95 percent of CO emissions since 1990. See Nathanson, *Basic Environmental Technology*, p. 450; and the U.S. EPA, "National Air Quality and Emissions Trends Report, 2003 Special Studies Edition," chapter 2, pp. 9-12, found at *http://www.epa.gov/air/airtrends/aqtrnd03/*, retrieved Feb. 4, 2004.

[4] Nathanson, *Basic Environmental Technology*, p. 415; and government and industry representatives, interviews by USITC staff, Warsaw, Poland, Nov. 2-3, 2004.

[5] World Resources Institute (WRI), "Climate and Atmosphere–United States," EarthTrends country profiles, found at *http://earthtrends.wri.org/*, retrieved Dec. 22, 2004.

metal smelters and high-temperature furnaces. The chemicals and the mining and refining industries produce a wide array of additional possible effluents depending on source materials, products, and processes.[6]

During the past century, three major "smog" events near industrial centers,[7] combined with increasing knowledge regarding the health effects of air pollution, have led most major industrialized nations to develop legal and regulatory protocols for the control of ambient air quality, largely targeting the sources of air pollution emissions. Historically, the control of emissions related to acute[8] respiratory events was addressed, notably emissions resulting from incomplete fossil-fuel combustion products such as PM, CO, and SO_X. The list of emissions subject to control has expanded over time to include hazardous air pollutants (HAPs)[9]– elements such as lead, arsenic, and mercury, and chemicals such as dioxins– all of which were found to have potential chronic[10] health effects. More recently, greenhouse gases such as CO_2, nitrogen dioxide (NO_2), and methane[11] as well as ozone (O_3) depleting substances (such as many aerosols and other synthetic hydrocarbons) are being monitored and, in some cases, controlled. Emissions of six pollutants (volatile organic compounds (VOCs), NO_X, CO, lead, sulfur dioxide (SO_2), and PM_{10}[12])[13] are generally recognized worldwide as appropriate to measure

---

[6] Nathanson, *Basic Environmental Technology*, p. 443.

[7] These events resulted in many deaths and injuries from inhaling polluted air in the Meuse Valley, Belgium, in 1930, in Donora in western Pennsylvania in 1948, and in London, UK, in 1952. For a historical background, see Nathanson, *Basic Environmental Technology*, p. 408, and The Fluoride Action Network, found at *http://www.fluoridealert.org/meuse.htm/*, retrieved Mar. 22, 2005.

[8] As related to medicine, acute is defined as "reaching a crisis rapidly." Merriam-Webster Inc., *Webster's II New Riverside University Dictionary* (Boston, MA: Houghton Mifflin Co., 1984).

[9] In the United States, 188 pollutants are specified as HAPs in the 1990 Clean Air Act Amendments, which updated and expanded the scope of the original 1963 Act and subsequent versions.

[10] As related to medicine, chronic is defined as "subject to a habit or disease for a lengthy period." *Webster's*.

[11] Methane is the principal component of natural gas, which is a mixture of approximately 75 percent methane (CH_4) with other hydrocarbons, such as ethane, propane, and butane. Methane is also naturally generated in coal mines and from anaerobic decomposition of plant and animal matter. From "*Chemical of the Week,*" found at the University of Wisconsin's Science is Fun website, at *http://scifun.chem.wisc.edu/chemweek/methane/methane.html*, retrieved Jan. 7, 2005.

[12] PM_{10} refers to particles with a diameter of 10 microns or less. Larger particles are not considered respirable and are much less likely to emit from industrial processes, due to their greater settling and capture potential. A standard proposed for PM-2.5 awaits successful development of control mechanisms. Little historical data exist on which to determine appropriate emission levels.

[13] The United States has established a National Ambient Air Quality Standard (NAAQS) for pollutants– namely, CO, SO_2, PM, lead, NO_2, and O_3. Ozone is not emitted, but results from a chemical reaction that occurs between other emissions– notably volatile organic compounds (VOCs), such as freon, and nitrogen oxides– which are subject to air pollution control. U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, found at *http://www.epa.gov/air/criteria.html*.

and control with respect to air quality.[14] Indoor air pollution focuses on mold, radon, asbestos, and other contaminants in buildings. The list of pollutants under review and ultimately subject to control is constantly increasing, albeit often without uniformity across countries, as knowledge and scientific advancements increase pollution detection, evaluation, and control.

Technologies and Methods[15]

Air pollution abatement services principally entail the detection, measurement, and management of air pollution emitted from sources or formed in the atmosphere. Services include monitoring, assessment, and control of indoor or outdoor air pollution originating from stationary or mobile sources;[16] services related to the trading of air pollution emission rights; services relating to the monitoring, assessment, or control of acid rain; services related to the study of the relationship between air pollution and climate; and services incidental to air pollution abatement.

In general, the minimization of pollution at the source, through fuel substitution and/or changing the production process, reduces emissions faster and more cost-effectively in the long term than purchasing and maintaining costly air cleaning and disposal equipment.[17] For example, most coal-fired power plants now use low-sulfur coal exclusively, and most new facilities use natural gas. During the last 50 years, the nonferrous mining and refining industries have converted almost all smelters into "flash" smelters, which require little to no fossil fuel. Similarly, many nonferrous manufacturing furnaces[18] have been converted from coal-, wood-, or coke-fired operations to natural gas-fired operations, and in some cases, older furnaces have been replaced with electric-arc or the latest electric induction furnaces.[19]

If alternative fuel selection or process changes are not feasible or sufficient, air cleaning equipment often can be installed to meet emission reduction requirements.[20] The diversity of possible effluents gives rise to a variety of pollution control devices.[21] Particulate control devices are incorporated with smokestacks, which allow particulates

---

[14] Energy and Environmental Analysis, Inc. (EEA), "Breathing Easier About Energy - A Healthy Economy and Healthier Air," Introduction and Methodology, Jan. 2002, found at *http://www.cleanairprogress.org/research/energy_report_2.asp*, retrieved Dec. 27, 2004.

[15] Information on technologies and methods is derived from a variety of sources, as noted, especially Nathanson, *Basic Environmental Technology*.

[16] Most services pertaining to mobile source air pollution abatement involve monitoring and assessment services, and are not contractually tied to and associated with the purchase of goods such as vehicle exhaust systems.

[17] Nathanson, *Basic Environmental Technology*, p. 443.

[18] Notable exceptions are the pulp and paper industry, which utilizes wood to generate energy, and the primary production of steel, which uses coal to provide the carbon component of steel, and much of the heating energy. Downstream ferrous manufacturing, however, is converting to alternative energies where possible.

[19] Gustavo E. Lagos and others, Ed., *Plenary Lectures, Economics and Applications of Copper, Vol. I-VI, Proceedings of the 5th International Conference, Copper/Cobre 2003 (Santiago, Chile)*, Canadian Institute of Mining, Metallurgy and Petroleum, Quebec, Canada, 2003; and W. Trinks and others, Ed., *Industrial Furnaces, 6th Edition*, J. Wiley & Sons, 2003.

[20] Nathanson, *Basic Environmental Technology*, p. 443.

[21] Nathanson, *Basic Environmental Technology*, p. 443.

to fall back down and be consumed or captured. Advances on this concept led to the creation of gravity settling chambers of many sizes and orientations.[22] Technological improvements and the limitations and cost of space led to the development of air cyclones that speed up air movement and essentially centrifuge the particles to the exterior of the chamber for capture; the development of cloth filters for use at the point at which particulates exit from these chambers; and electrostatic precipitators, which induce an electrical field to preferentially attract charged particles. In parallel, wet scrubbers, which treat the gaseous/particulate stream with water or other liquids in spray or atomized form, were developed for use in industries where slurries are common, such as the mining industry, where the scrubber slurry can be recycled back to the process for metal recovery.[23]

Gaseous and vapor control devices utilize either absorption or adsorption in techniques analogous to particulate scrubbers, although on a much larger scale.[24] Vapors– such as most VOCs– are more readily condensed into liquids or adsorbed onto solid surfaces.[25] Typical technologies include cold chamber condensation such as cooling towers and refrigerated "chill" units, and contact with multiple types of adsorption media (see appendix F), such as activated charcoal.[26] Gases do not readily condense and thus must be incinerated, treated chemically, or placed in contact with liquids.[27] One notable technique is absorption, which involves passing gas through a liquid, such as water, to capture the gases produced through combustion. An example is the ammonia produced through fertilizer manufacturing.[28] Another technique is the common installation of acid-production plants at many smelting and manufacturing facilities since the Clean Air Act. The introduction of new smelting and metal melting technologies, which can produce high grade SO_2[29] gases, has enabled the development of acid plant technologies. Sulfuric acid plants bring the gases into contact with an acidic water to create a

[22] Nathanson, *Basic Environmental Technology*, pp. 443-444.
[23] Nathanson, *Basic Environmental Technology*, pp. 444-447.
[24] Nathanson, *Basic Environmental Technology*, p. 447.
[25] Nathanson, *Basic Environmental Technology*, pp. 447-448.
[26] Nathanson, *Basic Environmental Technology*, p. 448.
[27] Nathanson, *Basic Environmental Technology*, p. 447.
[28] Recent modifications involve variations on cross- or co-current flows and packed media chambers. The media are generally thermoplastics or other inert materials, although ceramics and some metals are used. Nathanson, *Basic Environmental Technology*, p. 448.
[29] Flash smelters, first developed by Outokumpu (Finland) in the 1930s, are noted for their high concentration of expelled gases, which aids in economic gas cleanup. The first installation in the United States was the Phelps Dodge Hidalgo facility in Playas, New Mexico, which began operation in 1974. Since then, most operating nonferrous smelters have been installed with or upgraded to varied flash smelting technologies in order to sufficiently capture sulfur, as required.

salable sulfuric acid product.[30] In facilities where the gases are not concentrated, such as power plants, flue gas desulfurization (FGD), which adsorbs the sulfur content of the gas with either regenerable chemical media or lime, has become the dominant technology.[31] Finally, incineration is used primarily for VOCs and gaseous hydrocarbons, whereby the gas is fed into a combustion chamber and re-ignited.[32] For information on companies providing various air pollution technologies and goods, see "Key Suppliers and Consumers" later in this chapter.

Market Size and Characteristics

Industry representatives indicate that services such as technical research and development, installation, and maintenance, are often included as an integral part of the purchase price of air pollution control equipment.[33] The integration of the price of such services may account for 10 percent to 30 percent of the price of air pollution equipment.[34] Based on this information, together with existing data on air pollution control goods, reasonable estimates of services values can be ascertained in the absence of data published by government entities.

One industry source estimates[35] that world-wide consumption of engineering, consulting, and monitoring services[36] in connection with air pollution abatement totaled $2.4 billion, while consumption of air pollution abatement goods totaled $49.4 billion, in 2004. During 1994-2004, the market for such services and goods was estimated to grow at an average annual rate of 7 percent. In 2004, consumption of outdoor air pollution goods

---

[30] Sulfuric acid (H_2SO_4) is essentially SO_3 plus water (H_2O). Sulfuric acid plants clean and de-water a high concentration SO_2 flue gas effluent, catalytically convert it to SO_3, contact it with a high grade sulfuric acid-water mix in an absorption tower, and dilute it with lower-grade process streams to create a salable product for transport. See "The Acid Process," at *http://www.enviro-chem.com/plant-tech/3rdtier/acidprocess.html*, for a detailed summary of acid plant technology.

[31] Nathanson, *Basic Environmental Technology*, pp. 448-449. Flue gas desulfurization (FGD) is a process that became available in the 1970s, and has two types: wet and dry. An explanation of wet FGD can be found at *http://www.worldbank.org/html/fpd/em/power/EA/mitigatn/aqsowet.stm*, retrieved Feb. 4, 2005. A dry FGD plant explanation can be found at *http://www.mhi.co.jp/mcec/product/fgd.htm*, retrieved Feb. 4, 2005.

[32] Nathanson, *Basic Environmental Technology*, pp. 449-450.

[33] Industry representatives, interview by USITC staff, Chicago, Dec. 3, 2004; and telephone interviews by USITC staff, Jan. 2005.

[34] Equipment such as wet scrubbers and associated pumps and metal work is well established and, accordingly, services in connection with this equipment center on marketing, sales, delivery, installation, and maintenance. The employment of other more advanced or proprietary technologies and equipment, such as flash smelters and converters, acid plants and other contact media technologies, electrostatic precipitators, and FGDs, entails additional services such as engineering and construction management.

[35] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.

[36] Estimates for air pollution abatement services include engineering, consulting, and monitoring exclusively, as estimates are not available for other services in connection with air pollution abatement. An indeterminate portion of these estimates constitute part of the core air pollution abatement services discussed in chapter 1, while the remainder constitute part of the peripheral services.

and services accounted for $44.2 billion (85 percent), while goods[37] to abate indoor air pollution accounted for $7.6 billion (15 percent). Gaseous control systems, components, chemicals, and services accounted for approximately three-fifths of the value of outdoor air pollution abatement goods and services consumed in 2004, while particulate control accounted for the remainder.

The same industry source estimated that the United States consumed 28 percent of the total value of air pollution abatement goods and services consumed in world markets in 2004 (see table 4-1 at the end of this chapter). The 18 principal consuming Member States of the European Union[38] together consumed approximately 18 percent of such goods and services. Other major country markets included China (15 percent); Japan (6 percent); Canada and the Republic of Korea (3 percent each); and Brazil, India, and Taiwan (2 percent each). During 1994-2004, growth in average annual consumption of air pollution abatement services and equipment surpassed the world average of 7 percent in China (14 percent) and Canada (9 percent), equaled 7 percent in the United States and Korea, and lagged at 5 percent or less in Germany, Japan, and the United Kingdom.

Another industry source[39] estimates that in the United States, firms principally engaged in producing air pollution control equipment generated revenues totaling $19.1 billion in 2003,[40] and firms mainly engaged in engineering and consulting services on air quality generated $1.2 billion.[41] Revenues earned by U.S. air pollution equipment firms grew very rapidly in the 1970s (over 1100 percent for the decade) owing largely to the Clean Air Act's extension in 1970. Rapid market growth continued during the 1980s (144 percent) and the 1990s (72 percent), followed by virtually no growth during 2000-2003. Revenue growth during the 1970s coincided with the period in which the United States was perceived as the world's most stringent regulator of air pollution.[42]

---

[37] McIlvaine Co. did not estimate consumption of services with regard to indoor air pollution abatement.

[38] Industry estimates of consumption are available for 18 Member States of the European Union – Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Poland, Portugal, Slovakia, Spain, Sweden, and the United Kingdom. As these 18 countries accounted for an estimated 84 percent of air pollution abatement services and goods consumed in Europe in 2004, USITC staff observes that the combined estimates for the 18 countries provide a considerable, although slightly underestimated, representation of consumption in the entire European Union. Foremost consumers of air pollution abatement goods and services in the EU include Germany (4 percent of world consumption), the United Kingdom (3 percent), and France, Italy, and Spain (2 percent each).

[39] Environmental Business International Inc. (EBI). See ch. 1, page 1-6.

[40] EBI, *Environmental Business Journal*, vol. 17, No. 9/10, 2004, p. 3. Estimates are not separately reported for goods and services, and may include estimates for revenues generated other than in connection with air pollution abatement.

[41] EBI, *Environmental Business Journal*, vol. 17, No. 11/12, 2004, p. 2. Estimates include revenues generated solely in connection with the provision of air pollution abatement services.

[42] Industry representative, interview by USITC staff, Chicago, Dec. 3, 2004; and McIlvaine Co., *U.S. Industry Market Leadership in Asia's Air Pollution Control Sector*, report prepared for the United States-Asia Environmental Partnership, Jan. 2001, p. 17, found at Internet address *http://www.usaep.org/*, retrieved Dec. 3, 2004.

Asian countries, led by China, India, Korea, and Taiwan, are currently considered the most rapidly growing markets for air pollution abatement goods and services.[43] Industry sources cite these economies' rapid economic growth[44] and accompanying construction of infrastructure that significantly increase air pollution levels and, hence, the need for air pollution abatement technologies, equipment, and services.[45]

Numerous countries have implemented regulations limiting emissions of certain gases. Domestic regulations are making more of these countries competitive in world markets. One of the key technologies worldwide so as to limit gas emissions is flue gas desulfurization (FGD). Germany and Japan require FGD by all domestic fossil fuel power plants.[46] In response, German and Japanese air pollution abatement firms have developed this technology at home and are top suppliers in foreign markets, including in the U.S. market. By contrast, the United States requires not a particular technology but an emissions result. As industry can meet U.S. requirements by switching to alternate fuel sources, only about one-fourth of U.S. power plants currently employ FGD technology, although other large U.S. industrial consumers such as refineries continue to implement FGD systems among other air pollution abatement technologies.[47] Moreover, implementation of FGD has not occurred in any new U.S. power plants within the past 15 years.[48] As a result, U.S. firms do not have as extensive experience in developing FGD technologies and are less competitive in many world FGD markets than their German and Japanese counterparts.[49]

The market for indoor air pollution abatement goods and services is a small fraction (about 15 percent) of the total estimated air pollution abatement market, and little information about the indoor air pollution abatement market is available for most countries analyzed in this report. An industry source estimated that the United States accounted for one-fourth (about $2 billion) of the total world market for indoor air pollution abatement goods in 2004.[50] During 1994-2004, estimated world growth for the indoor air pollution abatement goods market averaged 10 percent per year, slightly faster than the rate for goods associated with outdoor air pollution abatement (6 percent). Industry sources cited Korea as an example of having a growing market for

---

[43] Industry representative, interview by USITC staff, Chicago, Dec. 3, 2004; and McIlvaine Co., *U.S. Industry Market Leadership in Asia's Air Pollution Control Sector*, pp. 20 and 25.

[44] China's and India's economy grew by 9 percent and 8 percent, respectively, in 2003, while Taiwan's increased by 6 percent in 2004, and Korea's grew by 6 percent in 2002. U.S. Department of State, Background Notes, found at *http://www.state.gov/r/pa/ei/bgn/*, retrieved Feb. 26, 2005.

[45] Industry representative, interview by USITC staff, Chicago, Dec. 3, 2004; and McIlvaine Co., *U.S. Industry Market Leadership in Asia's Air Pollution Control Sector*, pp. 20 and 25.

[46] Industry representatives, interviews by USITC staff, Chicago, Dec. 3, 2004, and Brussels, Belgium, Oct. 28, 2004.

[47] McIlvaine Co., "Refinery Air Pollution Control Market to Double by 2009," press release, Aug. 2003, found at *http://www.mcilvainecompany.com/*, retrieved Sept. 22, 2004.

[48] Industry representatives, interviews by USITC staff, Chicago, Dec. 3, 2004; and telephone interviews by USITC staff, Jan. 7, 2005. The EPA lists FGD as a best available control technology (BACT) and currently is studying wet FGD for mercury control.

[49] Industry representative, interview by USITC staff, Chicago, Dec. 3, 2004.

[50] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.

indoor air pollution equipment and services owing to rising concerns pertaining to levels of indoor air pollutants, primarily VOCs, in high-technology industrial operations.[51]

Key Suppliers and Consumers

Many hundreds of private-sector firms supply air pollution abatement services, equipment, and technologies in competitive world markets.[52] Most firms are small in terms of revenue[53] and supply a narrow range of abatement services or goods. The relatively few large suppliers of air pollution abatement goods tend to provide multiple types of equipment, technologies, and services in numerous markets world wide.[54] Europe, Japan, and the United States are home to most of the large air pollution abatement equipment firms, which also provide services in conjunction with the sale of goods. Major European-owned providers include ABB Environmental (Switzerland), Alstom (France), Durr Environmental (Germany), Enviro Technology Services (United Kingdom), Haldor Topsoe (the Netherlands), Hamon (Belgium), Johnson Matthey (United Kingdom), KWH (Germany), and Siemens (Germany).[55] Major Japanese-owned firms include Ebara, Hitachi Zosen, Horiba,[56] Hotaka Engineering (HTK), and Mitsubishi Heavy Industries. Key providers of air pollution abatement goods and services in North America include U.S.-owned firms Babcock & Wilcox, Babcock Power, Donaldson, GE (including recently acquired BHA Group), Thermo Electron, and Wheelabrator, and Canadian-owned firm Marsulex.[57]

As noted in chapter 1, services provided in conjunction with air pollution abatement goods and services include design, engineering, and consulting services. Like firms that provide "core" abatement goods and services, these firms vary markedly by size and breadth of operations. U.S. firms include Bechtel, Black & Veatch, Burns & McDowell, CH2M Hill, Parsons, Sargent & Lundy, Shaw, TRC, URS, and Washington Group.[58] Several of these U.S. firms also provide construction, design, engineering, and

[51] Industry representative, interview by USITC staff, Seoul, Korea, Nov. 15, 2004.

[52] Estimates on total world market shares for individual companies that provide air pollution abatement services and goods are not available.

[53] For example, industry sources consider that small environmental consulting and engineering firms and small air pollution control equipment producers may generate revenues totaling less than $20 million per year, while large firms generate revenues exceeding $100 million. EBI, *Environmental Business Journal*, vol. 17, No. 11/12, 2004, p. 4; and EBI, *The Economic Contribution of the California Air Pollution Control Industry*, report, Oct. 2004, e-mailed to USITC staff, Dec. 14, 2004.

[54] EBI, *Environmental Business Journal*, vol. 14, No. 3/4, 2002, p. 3.

[55] The compilation of leading companies is based on information provided by McIlvaine Co., e-mail to USITC staff, Jan. 4, 2005; EBI, *The Economic Contribution of the California Air Pollution Control Industry*, report, Oct. 2004, e-mailed to USITC staff, Dec. 14, 2004; and various company web sites.

[56] Horiba is a global leader in vehicle and other engine emissions testing equipment and maintains a technical center in Michigan for testing.

[57] Industry representative, interview by USITC staff, Chicago, Dec. 3, 2004.

[58] McIlvaine Co., "U.S. Air and Water Consulting Industry is Concentrated in a Few States," press release, Apr. 2003, found at *http://www.mcilvainecompany.com/*, retrieved Sept. 22, 2004.

procurement services in connection with air pollution abatement systems.[59] Industry sources perceive that U.S. firms have a competitive advantage over European and Japanese firms based on experience in the provision of environmental consulting services.[60] Monitoring and testing services and equipment, such as that used in continuous emissions monitoring of stationary source pollutants, are also provided by foreign firms such as Environnement (France),[61] and U.S. firms such as PerkinElmer, Spectrum Systems Inc., and Thermo Electron.[62]

Principal consumers of air pollution abatement services and goods are fossil fuel-burning electric power plants; industrial consumers in the chemical, metals, pharmaceutical, pulp and paper, cement, glass, and refining industries; construction and transportation equipment manufacturers; waste incinerators; and the mining and agricultural industries.[63] Electric power plants reportedly accounted for about two-fifths, by far the largest share, of stationary air pollution control equipment consumption in 2001.[64] Additional consumers include public-sector owners of air pollution monitoring and testing equipment and facilities; public-sector property owners responsible for assessing, obtaining, and managing outdoor and indoor pollution abatement services, systems, and equipment; and private-sector building owners and managers concerned with indoor air pollution abatement and control.[65]

Related Equipment

The Organization for Economic Cooperation and Development (OECD) classifies air pollution devices for control of industrial emissions into seven categories:[66] air-handling equipment, catalytic converters, chemical recovery systems, dust collectors, separators and precipitators, incinerators and scrubbers, and odor control equipment. The McIlvaine Company lists 97 separate devices currently approved to abate air pollution at U.S. industrial sites.[67] Many devices can be grouped into functional classifications

[59] Industry representative, interview by USITC staff, Chicago, Dec. 2, 2004.

[60] McIlvaine Co., *U.S. Industry Market Leadership in Asia's Air Pollution Control Sector*, p. 29.

[61] Industry representative, interview by USITC staff, Chicago, Dec. 3, 2004.

[62] Company information from various sources including corporate web sites and descriptions of member firms provided by industry associations, including the Institute of Clean Air Companies.

[63] Industry representatives, interviews by USITC staff, Chicago, Dec. 2, 2004, and Warsaw, Poland, Nov. 2-3, 2004; and U.S. Departments of State and Commerce, "Air Pollution Control Equipment," industry sector analyses, various country markets, found at *http://www.stat-usa.gov/*.

[64] EBI, *The Economic Contribution of the California Air Pollution Control Industry*, report, Oct. 2004, p. 50, e-mailed to USITC staff, Dec. 14, 2004.

[65] Government and industry representatives, interviews with USITC staff, Warsaw, Poland, Nov. 2-3, 2004.

[66] OECD, Com/TD/ENV(2000)86/Final, Annex 2: Environmental Goods, p. 65.

[67] McIlvaine Co., "Industrial Emitters Equipment Sample, EPA Equipment Type Search," found at *http://www.mcilvainecompany.com/webtofc.html*, Nov. 19, 2004.

such as the OECD categories (box 4-1). However, many devices have multiple functions or address multiple pollutants. For example, a water blanket, such as that found in a cooling tower, not only serves to provide odor control, but also captures and traps process energy, gases, vapors, and particulates and returns them for processing. Likewise, process piping changes, such as bottom filling, serve to reduce exposure to air but can also improve process efficiency by increasing the time for emission-reducing reactions to occur.

Trade and Investment

Official trade and investment data on air pollution abatement services are not separately reported by industrialized countries. Additionally, official trade data provide little insight regarding exports and imports of air pollution abatement goods, or investment in this industry segment. The Harmonized System of Product Classification (HS) does not characterize or differentiate between goods on the basis of whether or not they are used for air pollution control. Moreover, individual countries' official trade data reported to and published by the United Nations are not detailed enough to specifically identify such trade in air pollution control goods. In the absence of an established international list of environmental goods equipment, the OECD identified 19 HS classification headings that include air pollution control goods, although only a small portion of the goods classified in such headings pertain to traded air pollution control goods.[68] In 2003, world exports and imports of all products within the 19 HS categories, not simply those related to air pollution control, totaled $42.8 billion and $44.4 billion, respectively,[69] with U.S. exports and imports accounting for $6.5 billion (15 percent) and $6.2 billion (14 percent), respectively.

One industry source estimated that total world exports of air pollution abatement services[70] amounted to $430 million in 2004.[71] The principal countries exporting air pollution abatement services in 2004 included the United States (49 percent), Japan (31 percent), and Member States of the European Union[72] (17 percent). Leading import markets for such services in 2004 included China (22 percent), the United States (19 percent), and the EU (18 percent).

---

[68] Import and export data for selected countries as reported by the United Nations for the following headings at the 6-digit level of product detail, which is the most specific product detail available but not conducive for identification of trade in air pollution control goods; specifically. HS 252100, 252220, 281610, 701990, 841410, 841430, 841440, 841480, 841490, 841780, 841960, 841989, 842139, 842199, 842490, 851410, 851420, 851430, and 851490. Air pollution control equipment HS numbers were identified by the OECD in "Environmental Goods and Services: An Assessment of the Environmental, Economic and Development Benefits of Further Global Trade Liberalisation," Joint Working Party on Trade and Environment (COM/TD/ENV(2000)86/FINAL), Oct. 5, 2000, found at *http://www.oecd.org/searchResult/0,2665,en_2649_201185_1_1_1_1_1,00.html*. Data was retrieved from the WITS database on Dec. 17, 2004.

[69] USITC staff did not attempt to reconcile the data on world exports and imports of these products, as retrieved from the WITS database.

[70] Estimates for services trade include outdoor air pollution abatement services and exclude indoor air pollution abatement services.

[71] McIlvaine Co., estimates provided to USITC staff via e-mail, Feb. 3, 2005.

[72] McIlvaine Co. provided trade estimates for 18 of the 25 individual EU Member States. See footnote 38 in this chapter, p. 4-6.

Box 4-1
U.S. EPA-listed Industrial Emitters Equipment,[1] sorted by OECD classification[2]

Air-handling Equipment
- Control of Percent O_2 in Combustion Air
- Barometric Condenser
- Conversion to Pressurized Tank
- Conversion to Variable Vapor Space Tank
- Direct Flame Afterburner
- Direct Flame Afterburner, Heat Exchanger
- Flue Gas Recirculation
- Flaring
- Low Excess, Air Firing
- Staged Combustion
- Steam or Water Injection
- Use of Fuel with Low Nitrogen Content
- Vapor Recovery System
- Venturi Scrubber

Catalytic Converters
- Catalytic Afterburner
- Catalytic Afterburner, Heat Exchanger
- Catalytic Oxidation, Flue Gas Desulfurization
- Catalytic Reduction
- Miscellaneous Control Devices
- Modified Furnace or Burner Design
- Process Change
- Process Enclosed
- Process Gas Recovery
- Reduced Combustion, Air Preheating

Chemical Recovery Systems
- Activated Carbon Adsorption
- Air Injection
- Alkalized Alumina
- Ammonia Injection
- Chemical Neutralization
- Chemical Oxidation
- Chemical Reduction
- Dry Limestone Injection
- Liquid Filtration System
- Molecular Sieve
- Nitrogen Blanket
- Ozonation
- Packed-gas Absorption Column
- Sulfur Plant
- Sulfuric Acid Plant, Double Contact Process
- Sulfuric Acid Plant, Contact Process
- Tray Type Gas Absorption Column
- Wet Limestone Injection

Dust Collectors
- Annular Ring Filter
- Centrifugal Collector, High Efficiency
- Centrifugal Collector, Low Efficiency
- Centrifugal Collector, Medium Efficiency
- Dust Suppression by Water Sprays
- Dust Suppression Chemical Stabilizers/Wetting Agents
- Fabric Filter, High Temperature
- Fabric Filter, Low Temperature
- Fabric Filter, Medium Temperature
- Gravel Bed Filter
- Gravity Collector, High Efficiency
- Gravity Collector, Low Efficiency
- Gravity Collector, Medium Efficiency
- Mat or Panel Filter
- Metal Fabric Filter Screen, Cotton Gins
- White Paint

Separators and Precipitators
- Electrostatic Precipitation, High Efficiency
- Electrostatic Precipitation, Low Efficiency
- Electrostatic Precipitation, Medium Efficiency
- Dynamic Separator, Dry
- Dynamic Separator, Wet
- Mist Eliminator, High Velocity
- Mist Eliminator, Low Velocity
- Multiple Cyclone W/o Fly Ash Reinjection
- Multiple Cyclone with Fly Ash Reinjection
- Refrigerated Condenser
- Single Cyclone
- Spray Tower
- Tube and Shell Condenser
- Wet Cyclonic Separator

Incinerators and Scrubbers
- Alkaline Fly Ash Scrubbing
- Ammonia Scrubbing
- Fluid Bed Dry Scrubber
- Gas Scrubber, General
- Impingement Plate Scrubber
- Dual Alkali Scrubbing
- Sodium Alkali Scrubbing
- Sodium Carbonate Scrubbing
- Wellman-Lord/Sodium Sulfite Scrubbing
- Wet Lime Slurry Scrubbing
- Wet Scrubber, High Efficiency
- Wet Scrubber, Low Efficiency
- Wet Scrubber, Medium Efficiency

Odor Control Equipment
- Bottom Filling
- Conservation Vent
- Conversion to Floating Roof Tank
- Submerged Filling
- Underground Tank
- Water Curtain

---

[1] McIlvaine Co., "Industrial Emitters Equipment Sample, EPA Equipment Type Search," found at *http://www.mcilvainecompany.com/webtofc.html*, Nov. 19, 2004.
[2] OECD, Com/TD/ENV(2000)86/Final, Annex 2: Environmental Goods, p. 65.

According to estimates by the same industry source, global exports of air pollution abatement goods totaled $16.8 billion in 2004.[73] The principal exporters of air pollution abatement goods included EU Member States (30 percent, especially Germany at 16 percent), the United States (27 percent), Japan (25 percent), and China (8 percent). Principal import markets for such goods in 2004 included China (21 percent), the EU (19 percent), and the United States (15 percent).

In 2004, U.S. exports and imports of air pollution abatement services were estimated at $213 million and $83 million, respectively, resulting in a $130-million trade surplus.[74] U.S. exports and imports of goods pertaining to air pollution control were estimated at $4.6 billion and $2.5 billion, respectively, yielding a $2.1-billion trade surplus.[75] During 1994-2004, the estimated average annual growth rate in U.S. exports of air pollution abatement services (9 percent) outpaced the rate of increase in U.S. exports of such goods (6 percent).

Industry sources in the United States and Japan indicate that China is the most promising market for air pollution abatement equipment and services, because of anticipated growth in the construction of power plants,[76] and semiconductor, chemical, and motor vehicle production.[77] Estimates of China's growth potential are consistent with industry estimates of the substantial growth in trade during 1994-2004 in China's imports of air pollution abatement services and goods as well as its exports of such goods. During 1994-2004, China's imports of both air pollution abatement services and goods increased at the most rapid rate of any country (13 percent annually, on average), about twice the estimated growth rates of U.S. imports of such services and goods. According to one U.S. industry source, China has not developed the capability to export air pollution abatement services.[78] Additional markets considered likely for future export growth include Taiwan, Korea, India, Poland, Turkey, and the United Kingdom.

The U.S. market is open to imports as well as foreign investors. Numerous European, Canadian, and Japanese firms have acquired U.S. firms or established affiliates in the United States, and some maintain manufacturing and engineering operations in the U.S. market. Examples include ABB Environmental Systems (Switzerland), Alstom (France), Hamon Research-Cottrell (Belgium), Hitz America (Japan), KWH (Germany), Marsulex Environmental Services (Canada), and Mitsubishi Power Systems (Japan). In addition, affiliates of two leading vehicle emissions testing firms from Canada and Spain operate under contract to government transportation authorities in several U.S. states.

---

[73] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 28, 2004, and Jan. 7 and 11, 2005.

[74] McIlvaine Co., estimates provided to USITC staff via e-mail, Feb. 3, 2005.

[75] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 28, 2004, and Jan. 7 and 11, 2005.

[76] McIlvaine Co., "Huge Power Plant Scrubber Markets in U.S. and China," news release, Oct. 2003, found at *http://www.mcilvainecompany.com/*, retrieved Sept. 22, 2004; and industry representatives, interviews by USITC staff, Tokyo, Japan, Nov. 4-8, 2004.

[77] McIlvaine Co., "Thermal Air Pollution Equipment Market Growth Concentrated in Certain Industries and Markets," news release, Nov. 2003, found at *http://www.mcilvainecompany.com/*, retrieved Sept. 22, 2004; and industry representative, interview by USITC staff, Chicago, Dec. 3, 2004.

[78] McIlvaine Co., estimates provided to USITC staff via e-mail, Feb. 3, 2005.

Appendix C includes a summary of selected countries' commitments with respect to according foreign service providers full or partial market access and national treatment for cleaning services of exhaust gases under the WTO General Agreement on Trade in Services (GATS).[79] Industry sources provided additional information concerning possible barriers to trade in air pollution abatement goods and services. A limited number of foreign markets have been cited as posing some difficulty for U.S. and other country exporters for various reasons. In Asia, intense competition in Japan among domestic suppliers and a perceived preference in several countries for Asian-manufactured goods reportedly may inhibit growth in exports of air pollution control equipment to certain Asian economies by non-Asian sources.[80] In Germany, monitoring equipment reportedly must be approved by a single German testing organization, which is a costly process,[81] and, like Japan, the home market is characterized by intense competition among indigenous firms.[82] A U.S. supplier of high-value air pollution abatement goods with a majority of sales in foreign markets stated that tariffs and use fees up to 42 percent on its goods in India have led the firm to transfer partial manufacturing from its U.S. plant to lower-cost operations in China in order to serve the Indian market.[83] The firm stated that similarly high tariffs in Brazil led the firm to manufacture there under license rather than export, but that repatriation of royalties is impeded by Brazilian currency export requirements.

In the principal developed markets– the United States, the European Union, and Japan– which produce and consume the largest world shares of air pollution abatement goods and services, tariff rates applied on an MFN basis or bound in the Uruguay Round average less than 2 percent for the products classified in the 19 HS headings identified by the OECD as containing air pollution abatement-related goods. Tariffs imposed by developing markets are higher on average. The tariff rates levied in developing countries range from zero to 14.8 percent with regard to applied MFN tariff rates and zero to unbound for Uruguay Round bound rates.

---

[79] The schedules indicate a country's commitment as to the extent to which national or subnational laws provide for according market access and national treatment to foreign firms in regards to specific services, or which apply to all services, in the four modes of supply: cross-border supply (mode 1), consumption abroad (mode 2), commercial presence (mode 3), and presence of natural persons (mode 4). Limitations scheduled under the GATS may constitute nontariff barriers to foreign air pollution abatement equipment and services firms. Highlights of these limitations are also included in table 4-1 at the end of this chapter.

[80] Industry representatives, interviews by USITC staff, Chicago, Dec. 2, 2004, and Seoul, Korea, Nov. 2004.

[81] Industry representative, interview by USITC staff, Chicago, Dec. 3, 2004.

[82] Industry representatives, interview by USITC staff, Brussels, Belgium, Oct. 28, 2004.

[83] See appendix E.

Table 4-1
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
Australia	In 2004, estimated consumption of air pollution control engineering, consulting, and monitoring services was valued at $28 million. The market for air pollution control equipment was estimated at $515 million in the same year.[1] Estimated consumption of air pollution goods and services in Australia during 1994-2004 increased at a 4-percent average annual rate, which is slower than the world average of 7 percent.[1] Air pollution control is not presently considered to be among Australia's top environmental management issues.[2]	Private companies are the primary providers of air pollution abatement services. Key suppliers include:[3] Air Pollutions Systems (Australia) Baltec Systems Pty Ltd (U.S.) Clean TeQ (Australia) Ecotech (Australia) Entech Group (Australia) ERM (Multinational) EnviroSafe Australia (EAS) Pty Ltd (Australia) PPK Environment & Infrastructure Pty Ltd (U.S.) Stack-Air (Australia) Solutions@Enviro Pty Ltd (Australia) Synergetics Environmental Engineering (Australia) United Air Specialists Inc. (U.S.)	The principal consumers are within private industry, especially in the manufacturing, refining, mining, and electricity generation industries. State-owned utilities are also consumers of air pollution control equipment and services.[4]	Australia is a net importer of air pollution control services, with imports and exports estimated at $5 million and $3 million, respectively, in 2004.[5] Australia is a net exporter of air pollution control equipment, with exports and imports estimated at $357 million and $192 million, respectively, in 2004.[6]	Australia maintains no trade barriers that specifically apply to air pollution abatement services.[7] Prospective foreign investors must obtain investment approval from the Foreign Investment Review Board, which may deny specific foreign investments on the basis of national interest.[8] The U.S.-Australia Free Trade Agreement eliminates the 5 percent tariff on air pollution control equipment.[2]

See footnotes at end of table.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
Brazil	In 2004, the estimated consumption of air pollution abatement engineering, consulting, and monitoring services in Brazil totaled $56 million. The market for air pollution abatement goods in Brazil totaled an estimated $1 billion.[1] Estimated consumption of air pollution goods and services in Brazil during 1994-2004 increased at an average yearly rate of 5 percent, which is slower than the world average of 7 percent.[1]	There is a relatively low concentration of firms, most of which are Brazilian-owned. In 2002, Brazilian-owned firms represented $764 million (or about 75 percent) of the $1 billion overall market for pollution control equipment and services in Brazil.[9] However, there is no information regarding the percentage of Brazilian-owned firms that supply air pollution abatement and related services specifically.	Leading industrial consumers of air pollution abatement services and goods in Brazil include steel and iron, chemicals/petrochemicals, pulp and paper, cement, and glass producers.[10]	In 2004, air pollution abatement services trade for Brazil was estimated at $11 million in imports and negligible, if any, exports.[5] Brazil exported an estimated $2 million and imported $493 million in air pollution abatement goods in 2004.[6]	Concerns have been reported regarding Brazil's intellectual property environment. Brazil's industrial property law, which took effect in 1997, provides for withholding patent protection on technologies incorporated in goods imported into Brazil.[11] Additionally, Brazil's patent office, the National Institute for Industrial Property (INPI), is faced with a backlog of patent applications that may prevent firms from gaining protection in a timely manner.[8]

See footnotes at end of table.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
Canada	In 2004, estimated consumption of air pollution abatement engineering, consulting, and monitoring services and air pollution control goods in Canada totaled $92 million and $2 billion, respectively.[1] Estimated consumption of air pollution abatement services and goods in Canada during 1994-2004 increased at an average annual rate of 9 percent, which is faster than the world average rate of 7 percent.[1] It is believed that the market is not highly concentrated.	Private-sector firms are the principal providers of services and equipment related to the abatement of air pollution. The domestic market in Canada includes the following firms that primarily provide equipment: Rowan Williams Davies & Irwin Inc. (RWDI); Albarrie Canada Limited; Engine Control Systems; Kvaerner Chemetics International; Yugo-Tech Conversion Gas Systems	Leading industries that consume air pollution services and goods in Canada include electricity generation, chemicals/petrochemicals, fertilizer, pulp and paper, aluminum and iron mining and smelting, cement, and lime and glass.[12] The full range of technologies and equipment for air pollution abatement are available and utilized in Canada.	Canada imported an estimated $24 million in air pollution abatement services, as compared to negligible, if any, exports in 2004.[5] Canada exported an estimated $131 million and imported $849 million in air pollution abatement goods in 2004.[6]	Canada has scheduled full GATS commitments for construction services, engineering services, technical testing and analysis, and related scientific and technical consulting services provided through modes 1, 2, and 3, except for professional accreditation issues such those noted below for engineers. With regard to the provision of engineering services through modes 1, 2, and 4, most provinces limit accreditation to permanent residents, while Quebec limits accreditation to citizens. With regard to the provision of engineering services through modes 1 and 4, Saskatchewan limits accreditation to residents. With regard to the provision of services through modes 1 and 2, Manitoba requires a commercial presence for the accreditation of consulting engineers.

See footnotes at end of table.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
Chile	In 2004, estimated consumption of air pollution control engineering, consulting, and monitoring services and goods in Chile totaled $8 million and $135 million, respectively.[1] Estimated consumption of air pollution services and goods during 1994-2004 increased at a 5-percent annual rate, on average, which is slower than the world average of 7 percent.[1]	Only a few firms appear to manufacture air pollution control equipment in Chile, thus implying that the concentration of firms is relatively high. Most air pollution control equipment appears to be supplied by private-sector North American and European firms, which have a reputation for high technology and quality.[13]	The primary industries that consume air pollution goods and services in Chile include mining and smelting, pulp and paper, cement, and glass.[13] Key services consumed in Chile include technical services and related construction and engineering services, while key equipment and technologies include: high efficiency systems; thermal oxidation and destruction; ultra-pure internal environments; absorbers and scrubbers; filters; nitrogen dioxide control; and destruction of particulate matter and microorganisms.[1]	In 2004, air pollution abatement services trade for Chile was estimated at $1 million in imports and negligible, if any, exports.[5] Chile imported an estimated $66 million in air pollution abatement goods, and exports were negligible, if any, in 2004.[6]	In general, Chile's services trade and investment environment is relatively open. However, the ability of foreign firms to invest in service industries may be contingent on employment generation, the terms of compensation, and the use of local inputs. The Foreign Investment Committee (FIC) of the Ministry of Economy– the Chilean agency responsible for approving foreign investment and setting contract terms and conditions– must approve investment projects valued above $5 million or which are related to activities normally provided by the government or carried out through public service.[8]

See footnotes at end of table.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
Costa Rica	Industry estimates on the size of Costa Rica's air pollution abatement market are not available. The market is small, owing to the country's small industrial base,[14] very low fossil fuel use in electricity generation,[15] and the relatively lower priority allocated to air pollution abatement among environmental management issues.[14]	Domestic and foreign-owned suppliers of air pollution equipment and services include:[16] ABB, Anderson, APEX, Electromatico, ENERAC, General Electric, Horiba, Siemens. Laboratories that test ambient air quality include: Laboratorios Lambda and Centro de Investigación Contaminación Ambiental (CICA) of the Universidad de Costa Rica,[15] using equipment provided by U.S. or European equipment firms. Other entities that supply consulting and certain other related air pollution abatement services in Costa Rica include: SwissContact, Central American Alliance for Sustainable Development, ENTEBBE.	Principal consumers include RECOPE, the government-owned refinery; ICE, the government-owned electricity company; and cement plants.[16]	Costa Rica is likely a net importer of air pollution abatement goods and services, and a net recipient of foreign direct investment with regard to such goods and services.[16] Industry estimates of such trade and investments are not available.	Costa Rica maintains no known trade barriers that specifically apply to air pollution abatement services.[17] Nevertheless, Costa Rica's Schedule of Commitments under the General Agreement on Trade in Services (GATS) does not make commitments with regard to professional services such as engineering services. Thus, Costa Rica can maintain or impose measures that may affect market access or national treatment in any mode of delivery of such professional services related to air pollution abatement.

See footnotes at end of table.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
EU	In 2004, estimated consumption of air pollution abatement engineering, consulting, and monitoring services in the EU totaled $445 million.[1] The market for air pollution abatement goods was estimated at $9 billion. Estimated consumption of air pollution abatement services and goods during 1994-2004 increased at an average annual rate of 5 percent, which is slower than the world average of 7 percent.[18]	Leading equipment providers include:[19] Alstom (France), Mitsubishi (Japan), Durr Environmental (Germany), Hamon & Cie (Belgium), GE Energy (U.S.), Fisia Babcock (Italy), MegTec (U.S.). Leading services providers include: Cambridge Environmental Research Consultants (UK) environmental modeling software, testing, and monitoring; ENSR International (U.S.) full service consulting firm; Haden Drysys Environmental (UK) design and project management; Linhoff March (UK) engineering and design; Reeco-Stroem (Denmark) engineering and design.[18]	Leading consumers of air pollution abatement services and goods include power generation plants, oil refineries, iron and steel plants, and manufacturers of a wide variety of consumer and industrial goods, as well as entities in the public sector. Key consumers of air pollution abatement equipment and services will be the 5,000-6,000 companies, in five sectors, that are required to reduce CO_2 emissions in conjunction with the EU emissions trading scheme and/or Kyoto Protocol. Equipment and services related to the abatement of CO_2 emissions and services related to the monitoring, analysis, and verification of CO_2 emissions will be important as large-scale emitters of CO_2 make preparations to comply with obligations associated with the EU emissions trading scheme and/or the Kyoto Protocol.[20]	In 2004, estimated imports of such services totaled $77 million, while exports totaled $74 million.[21] Estimated exports of air pollution abatement goods totaling $5 billion exceeded imports totaling $3 billion.[6] Numerous large non-EU-owned firms maintain commercial operations in the EU to supply air pollution control services and goods, which includes facilities that manufacture such equipment for consumption in EU Member States and for export.	There are few, if any, measures affecting trade and investment in the EU air pollution abatement services market in particular. Products entering the EU must comply with basic product/industry standards (i.e., safety standards, electrical standards, technical/ISO standards). Tariffs on goods, which affect air pollution equipment, are low (1.7 -5.0 percent).

See footnotes at end of table.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
Japan	In 2004, estimated consumption of air pollution abatement engineering, consulting, and monitoring services and air pollution control goods in Japan totaled $134 million and $3 billion, respectively.[1] Estimated consumption of air pollution goods and services in Japan during 1994-2004 increased at a 3-percent average annual rate, which is slower than the world average of 7 percent.[1]	Large Japanese suppliers are believed to account for about 80 percent of the air pollution abatement market in Japan. Such firms typically provide an integrated package of equipment and services. Foreign firms tend to supply the Japanese market chiefly by negotiating cross-licensing agreements in order to transfer technologies, with finished products manufacturing and services provided by Japanese firms.[22] Key suppliers include: Mitsubishi Heavy Industries; Ebara Corp; Hitachi; Hotaka Engineering Co. Ltd (HTK), Itochu Ltd., and Matsushita Ecology Systems Co.[23] Many of the large Japanese industrial conglomerates have an environmental component.	Principal consumers of air pollution abatement goods and services in Japan are believed to be energy companies, industrial entities (such as petrochemical plants), and vehicle manufactures.[24] Examples of principal air pollution abatement technologies used in Japan include: -flue gas treatment systems (includes SO_2, NO_x, VOC, and dioxin removal); - dust collection systems (includes electrostatic precipitators and fabric filters); and - ash handling systems.	Japan exported an estimated $132 million and imported $14 million in air pollution abatement services in 2004.[5] Japan exported an estimated $4 billion and imported about $709 million in air pollution abatement goods in 2004.[6] National and prefecture governments provide environmental investment incentives through tax supports, low interest loans, subsidies, and grants. Such support is unlikely to be granted to foreign firms. For example, the Government of Japan provides incentives to firms to develop dioxin controls. Japan is a main supplier of air pollution control equipment and services to many Asian countries, such as Vietnam and Korea, which reportedly often prefer to purchase from Asian firms.[24]	A Ministry of the Environment survey, published in July 2001, reports 28 percent of local government administered incinerators and 86 percent of privately operated incinerators will be non-compliant with the *Law Concerning Special Measures Against Dioxins*, Jan. 2000. Existing incinerators will either have to cease operations, be replaced, or be rebuilt to bring them into compliance.

See footnotes at end of table.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
Korea	In 2004, estimated consumption of air pollution control engineering, consulting, and monitoring services in Korea totaled $74 million.[1] The air pollution control equipment market was estimated at $1 billion.[1] Estimated consumption of air pollution abatement goods and services in Korea during 1994-2004 increased at a 7-percent average annual rate, the same pace as estimated for the world.[1] The air pollution abatement market is believed to be leveling off as a result of slow economic growth and a lack of big environmental projects.[25] Air quality measurement is currently stagnant but believed to be poised for growth as the Korean Government plans to transfer some environmental control to local governments.[25] Volatile organic compounds and odor control markets are believed to be future growth markets.[25]	Private companies are the primary providers of air pollution abatement goods and services. Key suppliers include:[26] Bechtel (U.S.), Black & Veatch (U.S.), Daelim Engineering (Korea), Dongbu Corporation (Korea) Hyundai Heavy Industry (Korea), Hyundai Precision & Industry (Korea), Korea Cottrell (Korea), Korea Power Engineering (Korea), Koryo Incineration Industry (Korea), LG Construction (Korea), Man GHH (UK), SK Construction (Korea), Samsung Engineering (Korea), Speco Ltd. (Korea).	The principal consumers are within private industry, especially in the steel, cement, glass, auto manufacturing, petrochemical refining, waste incineration, and electricity generating industries.[27] Public sector consumption is largely concentrated on air quality monitoring and surveillance.[1] All power stations, cement plants, incinerators, etc., are equipped with continuous monitoring systems that send real-time emissions data to the Ministry of Environment.[28] Examples of air pollution control equipment used in the Korean market include:[25] - Indoor air quality monitoring systems - Stack sampling systems - Air quality management systems - Electrostatic precipitators - Dust management systems	Korea is a net importer of air pollution abatement services, with imports estimated at $15 million and exports at $5 million in 2004.[5] Imports of air pollution abatement equipment, predominately from U.S. and Japanese firms and estimated at $497 million, outweighed exports of $341 million in 2004.[6] Korean Government and industry are exploring export opportunities for environmental goods and services, to include air pollution abatement, to China, Indonesia, Malaysia, Philippines, Thailand, and Vietnam.[25]	Foreign engineering and consulting firms can only participate in the market as licensor or joint venture partners. Intellectual property issues may deter some foreign companies from establishing joint ventures in Korea.[25]

See footnotes at end of table.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
Mexico	In 2004, estimated consumption of air pollution abatement engineering, consulting, and monitoring services in Mexico totaled $27 million, and the market for air pollution abatement goods was estimated at $527 million.[1] Estimated consumption of air pollution abatement services and goods in Mexico during 1994-2004 increased at a 6-percent average annual rate, which is slightly slower than the world average of 7 percent.[1] The estimated market for industrial air pollution testing services was $10 million in 2000.[29] Demand for auto emissions testing equipment was estimated to be $100 million in 2002.[30]	Mexico had 60 accredited environmental testing laboratories in 1998, only 5 of which had significant geographical range.[29] Non-locally accredited U.S. and other foreign testing laboratories active as export suppliers included: CH2M Hill Companies, Ltd.; Environmental Resources Management (ERM Group, Inc., multinational); Science Application International Corporation (SAIC).[29]	Large industries regulated include auto body coating, cellulose plants, desulfurization plants for sour natural gas and condensates, fuel service stations, glass manufacturing, hydraulic cement plants, oil refineries, and sulfuric acid plants.[31] Petroleos Mexicanos (PEMEX), the Mexican Government-owned firm with a legal monopoly on Mexican oil and gas production, is considered a leading consumer of air pollution abatement goods and services.[29] Mexican firms import parts and components and assemble and manufacture auto emissions testing equipment sold to more than 150 emissions testing stations operating in the Mexico City area.[32]	In 2004, air pollution abatement services trade for Mexico was estimated at $5 million in imports and negligible, if any, exports.[5] Mexico exported an estimated $2 million and imported $254 million in air pollution abatement goods in 2004.[6]	With regard to maintenance and repair of equipment and instruments, foreign investment is limited to 49 percent of the registered capital of an enterprise. With regard to construction and related engineering services, foreign investment is limited to 49 percent of the registered capital of an enterprise. Mexico has scheduled full GATS commitments on consultancy and technical services for engineering.

See footnotes at end of table.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
South Africa	In 2004, estimated consumption of air pollution abatement services in South Africa totaled $22 million. The market for air pollution abatement goods in South Africa totaled an estimated $381 million.[1] Four key sources of air pollution emissions in South Africa include: transportation — the sector accounts for 45 percent of national NO_x and VOC emissions;[33] energy — accounts for about 88 percent of energy used, especially in housing areas, such as Soweto, where 80 percent of pollution is coal exhaust; mining — mine dust and emissions account for a substantial amount of SO_2 and 35 percent of CO_2 emissions; and chemical processing.	Significant domestically-owned technology and services providers include:[34] BESC, CSIR, EcoServ, Greenland Science, Lenntech, Minnovex, Mintek, MVTI, Tecnica. Significant foreign-owned firms include:[35] AMIRA (Australasia multinational), CSIRO (Australia). Examples of air pollution abatement technologies specifically developed for use in South Africa center on off-gas control for furnaces (Enviroplas) and chemical systems to collect and control dust (Regen 2000).[33] Approximately 81 environmental consulting firms have been identified by South African Government sources. It is not known which of these firms provide services specific to air pollution abatement.[33]	Major consumers include very large mining, refining, chemical and steel manufacturing, and electricity generating industries.[36]	In 2004, air pollution abatement services trade for South Africa was estimated at $5 million in imports and negligible, if any, exports.[5] South Africa exported an estimated $24 million and imported an estimated $174 million in air pollution abatement goods in 2004.[6] Principal foreign sources of imports and investment in South Africa's air pollution abatement market are believed to be Australian and Australasian firms.[35]	South Africa's Schedule of Commitments under the General Agreement on Trade in Services (GATS) accorded full market access and national treatment with respect to the provision of exhaust gas cleaning services provided in delivery modes 1, 2, and 3.[37] A limitation on market access for modes of supply 1 and 2 states that for architectural services on projects in which the building plan covers at least 500 sq. meters, a locally registered architect must be used.[37] South Africa's Schedule of Commitments under GATS also indicates a national treatment limitation in mode 3 for imposing limits on local borrowing by South African-registered companies having non-resident shareholders of at least 25 percent.[37]

See footnotes at end of table.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
Thailand	In 2004, estimated consumption of air pollution abatement engineering, consulting, and monitoring services in Thailand totaled $13 million. The market for air pollution abatement goods was estimated at $273 million.[1] Consumption of air pollution abatement services and goods in Thailand during 1994-2004 increased at an average annual rate of 6 percent, which is slightly slower than the world average of 7 percent.[1] The United Nations reports that Bangkok's air is some of the most polluted in the world, mostly due to vehicle emissions.[38] Industry sectors identified as growth markets include air pollution abatement consulting services and monitoring equipment.[39]	The environmental consulting and engineering market is comprised of domestic firms and foreign-based companies with local offices or representatives. Foreign firms are generally selected for large-scale projects, while domestic firms tend to supply the remainder of projects. Numerous small and mid-size domestic firms (mostly equipment suppliers) compete in the market.[40]	The Electricity Generating Authority of Thailand (EGAT) is a major consumer of SO_2 scrubbers. Industrial firms and construction industries are also leading consumers of air pollution control services and goods.[41]	In 2004, air pollution abatement services imports for Thailand were estimated at $2 million, and services exports were negligible, if any.[5] Thailand imported an estimated $146 million and had negligible, if any, exports in air pollution abatement goods in 2004.[6] The predominant foreign suppliers of air pollution services and equipment in Thailand are U.S. and Japanese firms. In 1999, the United States supplied an estimated 90 percent of Thailand's imports of air pollution monitoring services and monitoring equipment, which accounted for an estimated 46 percent of consumption.[42]	Local and national government agencies reportedly exercise concurrent jurisdiction, formally and informally, over environmental concerns, including air pollution abatement, which introduces uncertainty to market development.[41]

See footnotes at end of table.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

Country	Size and nature of market	Suppliers of services and equipment	Consumers of services and equipment	Trade and investment	Measures affecting trade and investment
United States	In 2004, estimated consumption of air pollution abatement engineering, consulting, and monitoring services in the United States totaled $658 million. The market for air pollution abatement goods was estimated at $13.9 billion in the same year.[1] Nevertheless, revenues earned by U.S. air pollution equipment firms were virtually unchanged during 2000-2003.[43] Estimated consumption of air pollution goods and services in the United States during 1994-2004 increased at a 7-percent average rate per year, equal to the rate estimated for the world in the same period.[1]	The U.S. air pollution abatement market principally consists of firms that supply services and goods to abate stationary sources of air pollution. Major U.S. providers of air pollution abatement goods and services include Babcock & Wilcox, Babcock Power, Donaldson, General Electric (includes recent acquisition BHA), Thermo Electron, and Wheelabrator. The air pollution abatement design and consulting industry, largely concerning power plants, is led by Bechtel, Black & Veatch, Burns & McDowell, CH2M Hill, Parsons, Sargent & Lundy, Shaw, TRC, URS, and Washington Group.[44]	Air pollution abatement services and goods are principally provided to the following industries: electric utilities; chemical, pharmaceutical, and plastics; pulp and paper; and petroleum refining.[45] Key air pollution abatement technologies and equipment utilized in the U.S. market include:[46] fabric filters (baghouses); electrostatic precipitators; scrubbers; selective catalytic reduction (SCR); electro-catalytic oxidation; sorbent injection; flue gas desulfurization; catalytic converters; and infra-red sensors.	The United States exported an estimated $213 million and imported an estimated $83 million in air pollution abatement services in 2004.[5] The United States exported an estimated $4.6 billion and imported an estimated $2.5 billion in air pollution abatement goods in 2004.[6]	In its Schedule of Commitments under the GATS, the United States included the following limitations to full market access and/or national treatment: with regard to the supply of certain services through mode 4: in construction and related engineering services, Michigan requires contractors to maintain an in-state office; in engineering and integrated engineering services, citizenship is required for a license in the District of Columbia and in-state residency is required for a license in various states. With regard to the supply of architectural services through mode 3, two-thirds of the officers, partners, and/or directors of an architectural firm in Michigan must be licensed in the state as architects, engineers, and/or land surveyors.[47]

[1] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.
[2] U.S. Department of Commerce (USDOC), U.S. and Foreign Commercial Service, "Environmental Technologies Australian Market Brief," Mar. 2004, found at *http://www.buyusa.gov/australia/en/pol.html*, retrieved Jan. 7, 2005.
[3] Australian Environment Directory, found at *http://www.environmentdirectory.com.au*.
[4] USDOC, U.S. and Foreign Commercial Service, "Air Pollution Control Equipment," Dec. 7, 2000.
[5] McIlvaine Co., estimates provided to USITC staff via e-mail, Feb. 3, 2005.
[6] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 28, 2004, and Jan. 7 and 11, 2005.
[7] World Trade Organization (WTO), General Agreement on Trade in Services (GATS), *Australia: Schedule of Specific Commitments*, GATS/SC/6, Apr. 15, 1994.
[8] U.S. Trade Representative (USTR), *2003 National Trade Estimate Report on Foreign Trade Barriers*, found at *http://www.ustr.gov/*, retrieved Sept. 2004.
[9] USDOC, U.S. and Foreign Commerical Service, "Brazil: Pollution Control," July 2004, found at *http://www.focusbrazil.org.br/ccg/reports/pollution.pdf,* retrieved Sept. 2004.

Table 4-1—*Continued*
Characteristics of selected country markets for air pollution abatement services and goods

[10] Government representative, interview by USITC staff, Rio de Janeiro, Dec. 20, 2004.
[11] U.S. Government representative, telephone interview with USITC staff, Feb. 8, 2005.
[12] Government of Canada, Natural Resources Canada, "Large Final Emitters," found at *http://www.nrcan-rncan.gc.ca/lfeg-ggef/english/industry_en.htm*, retrieved Feb. 4, 2005.
[13] USDOC, U.S. and Foreign Commercial Service, "Chile Air Pollution Control Equipment Report," found at *http://www.stat-usa.gov/*, retrieved Sept. 2004.
[14] Government representative, interview by USITC staff, Costa Rica, Dec. 2004.
[15] Industry representative, interview by USITC staff, Costa Rica, Dec. 2004.
[16] Industry representatives, interviews by USITC staff, Costa Rica, Dec. 6-10, 2004.
[17] WTO, GATS, *Costa Rica: Schedule of Specific Commitments*, GATS/SC/22, Apr. 15, 1994.
[18] Information on services suppliers was primarily from *Environmental Expert*, found at *http://www.environmentalexpert.com/*, retrieved Nov. 2004.
[19] Information on equipment suppliers was primarily from McIlvaine Co., e-mail to USITC staff, Jan. 4, 2005; EBI, *Environmental Business Journal*, vol. 15, No. 11/12, 2003, p. 3; and *Environmental Expert*, found at *http://www.environmentalexpert.com/*, retrieved Nov. 2004.
[20] European Union, "EU Emissions Trading," Nov. 18, 2004, found at *http://www.europa.eu.int/*, retrieved Jan. 6, 2005.
[21] McIlvaine Co., estimates provided to USITC staff via e-mail, Feb. 3, 2005. Estimates for EU trade as compiled from estimates provided by McIlvaine Co. include intra-EU trade as well as trade with non-EU countries.
[22] Industry representative, interview by USITC staff, Tokyo, Nov. 4, 2004.
[23] Information on suppliers provided by McIlvaine Co., e-mail to USITC staff, Jan. 4, 2005; Environmental Business International, Inc. (EBI), *Environmental Business Journal*, vol. 15, No. 11/12, 2003, p. 3; and industry representatives, interview by USITC staff, Tokyo, Nov. 4, 2004.
[24] Industry and government representatives, interviews by USITC staff, Tokyo, Nov. 4-8, 2004.
[25] Industry representative, interview by USITC staff, Seoul, Nov. 15, 2004.
[26] U.S. Commercial Service, "Air Pollution Control Market for U.S. Exporters," May 7, 2001, found at *http://www.statusa.gov/*, retrieved Oct. 6, 2004.
[27] U.S. Commerical Service, "Air Pollution Control Equipment," Aug. 28, 2002, found at *http://www.statusa.gov/*, retrieved Oct. 6, 2004
[28] Government representative, interview by USITC staff, Seoul, Nov. 16, 2004.
[29] U.S. and Foreign Commercial Service, Mexico: Pollution Control Equipment, market research report, Feb. 1, 1999.
[30] U.S. and Foreign Commercial Service, Mexico: Automotive Parts/Service Equipment, market research report, Oct. 7, 2003.
[31] Bureau of National Affairs (BNA), Mexican Environment & Safety Laws and Regulations, Mexico Overview, found at *http://esweb.bna.com/*, retrieved Sept. 22, 2004.
[32] The three main Mexican firms importing such air pollution abatement goods include Comercial Auto Industrial, S.A. de C.V., Herramientas Quintana, S.A. de C.V., and Automotive Testing and Development Systems (ATDS). U.S. and Foreign Commercial Service, Mexico: Automotive Parts/Service Equipment, market research report, Oct. 7, 2003.
[33] Government of South Africa, Department of Environmental Affairs and Tourism, found at *http://www.environment.gov.za/*, retrieved Sept. 27, 2004.
[34] USITC staff experience and Government of South Africa, Department of Environmental Affairs and Tourism, found at *http://www.environment.gov.za*/, retrieved Sept. 27, 2004.
[35] USITC staff experience.
[36] Infomine-Africa, found at *http://www.infomine-africa.com/*, and South African Sources, found at *http://www.southafrica.globalsources.com/*, retrieved Jan. 28, 2005.
[37] GATS, *South Africa: Schedule of Specific Commitments*, GATS/SC/78, Apr. 15, 1994.
[38] United Nations Commission on Sustainable Development, *Thailand: Country Profile; Implementation of Agenda 21: Review of Progress Made since the United Nations Conference on Environment and Development, 1992*, Apr. 7-25, 1997, found at *http://www.un.org/esa/earthsummit/thai-cp.htm*.
[39] Industry representative, interview by USITC staff, Bangkok, Nov. 10, 2004.
[40] Government representatives, interviews by USITC staff, Bangkok, Nov. 11, 2004.
[41] Industry representative, interview by USITC staff, Bangkok, Nov. 12, 2004.
[42] USDOC, U.S. and Foreign Commerical Service, market research reports, Mar. 1, 1998.
[43] EBI, *Environmental Business Journal*, vol. 17, No. 9/10, p. 2.
[44] McIlvaine Co., "U.S. Air and Water Consulting Industry is Concentrated in a Few States," press release, Apr. 2003.
[45] EBI, *Environmental Business Journal*, vol. 17, No. 9/10, 2004, p. 5.
[46] Institute of Clean Air Companies, found at *http://www.icac.com/.*
[47] GATS, *United States: Schedule of Specific Commitments*, GATS/SC/90, Apr. 1994.

CHAPTER 5
EMISSIONS TRADING

Introduction

Emissions trading[1] is a market-based alternative to the traditional "command and control" approach to air pollution abatement, under which regulatory authorities compel polluters to install cleaner technologies or attain source-specific emissions reductions.[2] The primary approach to emissions trading is the "cap and trade" or "allowance" approach. Under the cap and trade approach, a regulatory authority establishes a desired "cap" or limit[3] on the overall amount of a specific air pollutant emitted by a group of installations per compliance period.[4] Emissions allowances[5] are allocated among affected installations, with the total number of issued allowances equaling the desired cap.[6] At the end of the compliance period, each installation must own a quantity of allowances sufficient to cover the amount of a pollutant that it emitted during the compliance period.[7] Allowances may be bought and sold by installations, so that if an installation generates fewer pollutants than its allowance covers, it may sell the

[1] The purpose of this chapter is to provide a survey of emissions allowance trading. However, emissions transactions also occur through so-called "project-based" activities. Under such arrangements, entities participate in the financing of a project which reduces greenhouse gas emissions, as compared to estimated emissions in the absence of such abatement measures. In return for their investment, these entities receive emissions reduction "credits" of varying quality; such credits may or may not qualify for recognition under a formal emissions reduction scheme. Frank LeCocq, World Bank, "State and Trends of the Carbon Market 2004," June 2004, p. 9.

[2] United States General Accounting Office (GAO), "Air Pollution: Overview and Issues on Emissions Allowance Trading Programs," GAO/T-RCED-97-183, July 1997.

[3] Such a limit could be legislated by a country's central government or agreed to as part of a climate treaty between signatory countries. In either case, the goal is to achieve a specific environmental effect.

[4] EPA, "Cap and Trade Essentials," found at *http://www.epa.gov/airmarkets/*, retrieved Oct. 2004.

[5] Emissions allowances are government-authorized rights to discharge a specific quantity of pollutant, usually allocated on the basis of historical pollution activity. Allowances are generally denominated in unit (i.e., ton) increments, with the overall cap measured in total units. EPA, "Types of Trading," found at *http://www.epa.gov/airmarkets/*, retrieved Oct. 2004.

[6] EPA, "Cap and Trade Essentials," found at *http://www.epa.gov/airmarkets*/, retrieved Oct. 2004.

[7] Sources are required to measure and document emissions of the specified type. EPA, "Types of Trading," found at *http://www.epa.gov/airmarkets*/, retrieved Oct. 2004.

remaining allowances at the prevailing market price. Similarly, if an installation generates more pollutants than its allowance covers, it must purchase additional allowances.[8]

Theoretically, the overall system is economically efficient because affected sources may choose whether to sell or purchase allowances depending on their respective marginal abatement costs, as discussed in Chapter 2. Firms with marginal abatement costs that are lower than the prevailing market price of an allowance have an incentive to reduce emissions below mandated levels, freeing up allowances that can be sold to a firm whose marginal abatement costs exceed the prevailing market price of these allowances.[9] In the end, emissions trading reportedly allows firms to collectively achieve compliance with emissions standards at the lowest possible overall cost, because abatement measures are undertaken by firms with the lowest abatement costs (box 5-1). By contrast, "command and control" abatement methods compel all firms, irrespective of their relative abatement costs, to meet similar reduction standards,[10] reportedly resulting in higher overall costs.[11]

---

[8] An alternative emissions trading approach is the credit approach, under which fixed limits are usually imposed by a regulatory authority on certain sources of a particular pollutant, typically based on historical activity. A source is required to meet its imposed limit, though it may reduce its pollution levels below this limit and sell the corresponding pollution "credits" to other sources. Sources not subject to imposed limits may voluntarily limit emissions levels and, like regulated sources, sell corresponding credits to other sources seeking to meet imposed limits. Under this approach, there is no guarantee that emissions will be reduced, since there are a larger number of excluded sources and no overall emissions "cap" is established. Although the decision to generate credits is voluntary, certification of these credits requires an administrative process. Canada's Pilot Emission Reduction Trading (PERT) is an example of a credit approach. See the Tradeable Permits section of the literature review for more information. LECG, "Emissions Trading Market Study," Report to the Ontario Ministry of Environment, found at *http://www.ene.gov.on.ca/programs/4707e.pdf*, retrieved Oct. 2004; and United States Environmental Protection Agency (EPA), "Types of Trading," found at *http://www.epa.gov/airmarkets*/, retrieved Oct. 2004.

[9] Although firms with high marginal abatement costs are allowed to exceed individual emissions targets by purchasing surplus allowances on the market, these surplus allowances are created by reducing emissions elsewhere in the system, thereby maintaining the integrity of the overall cap. Typically, firms that do not possess allowances sufficient to cover pollutant emissions during a given compliance period are subject to fines or other penalties.

[10] GAO, "Air Pollution: Overview and Issues on Emissions Allowance Trading Programs," GAO/T-RCED-97-183, July 1997.

[11] For example, the European Union estimates that the European Union Emissions Trading Scheme will allow Kyoto compliance at an annual cost of €2.9-3.7 billion, compared to annual compliance costs up to €6.8 billion without the scheme. European Union, "EU Emissions Trading," Nov. 18, 2004, found at *http://www.europa.eu.int*, retrieved on Jan. 6, 2005.

Box 5-1
Emissions trading vs. command-and-control: Examples of potential cost savings

Purpose
To illustrate the theoretical cost savings achievable under an emissions trading scheme, as compared to traditional command-and-control pollution abatement techniques.

Assumptions
- Both Company A and Company B historically emit 100,000 tons of pollutant per year
- Both Company A and Company B are required to reduce emissions to 95,000 tons per year
- Company A's marginal abatement cost =$5 per ton
- Company B's marginal abatement cost = $15 per ton
- Allowance market price = $10

Analysis
Scenario 1 (Command-and-control regime)
- Company A's Total Cost: $ 5 per ton x 5,000 tons: $ 25,000
- Company B's Total Cost: $15 per ton x 5,000 tons: $ 75,000
- **Total Cost for Company A & Company B: $100,000**

Scenario 2 (Emissions Trading Scheme)
- Company A and Company B face 3 choices:
  (1) Reduce emissions by 5,000 tons
  (2) Purchase 5,000 allowances on the market
  (3) Combination of both strategies
- Company A and Company B conduct cost/benefit analyses:
  - Since Company A's marginal cost of abatement is lower than the market price of an allowance ($5 per ton vs. $10 per ton), it decides to meet its emissions target by reducing emissions by 5,000 tons. Total cost: $25,000
  - Since Company B's marginal cost of abatement is higher than the market price of an allowance ($15 per ton vs. $10 per ton), it decides to meet its emissions target by purchasing 5,000 allowances in the emissions market. Total cost: $50,000
  - **Total Cost for Company A & Company B: $75,000**

Scenario 3 (Emissions Trading Scheme)
- Since Company A's marginal cost of abatement is lower than the market price of an allowance, it decides to reduce emissions by 10,000 tons. Total Cost: $50,000. Company A uses 5,000 tons to meet its emissions target, but sells 5,000 tons in the emissions market at $10 per ton. Sales Proceeds: $50,000 (*Company A's Net Cost: $0*)
- Since Company B's marginal cost of abatement is higher than the market price of an allowance, it decides to meet its emissions target by purchasing 5,000 allowances in the emissions market. Total Cost: $50,000
- **Total Cost for Company A & Company B: $50,000**

Source: European Union, "*How Will Emissions Trading Benefit Companies and the Environment,"* EU *Emissions Trading*, Nov.18, 2004 at *http://europa.eu.int,* retrieved on Jan. 6, 2005.

Market Segments

Although academic research and experimentation related to emissions trading dates back to the 1970s, emissions trading has only been considered a practical tool for air pollution abatement since the early 1990s. Actual experience with emissions trading began with the Environmental Protection Agency's launch of the U.S. Acid Rain Program in 1995. Since that time, several other programs have been established (table 5-1), including both government-mandated programs and experimental private-sector initiatives. This chapter will discuss four prominent emissions trading schemes currently in operation: the U.S.

Acid Rain Program (U.S. SO_2 Program), the European Union Emissions Trading Scheme (EU-ETS), the United Kingdom Emissions Trading Scheme (UK-ETS), and the Chicago Climate Exchange (CCX). Discussion will principally focus on the two most active trading schemes, the U.S. Acid Rain Program and the EU-ETS. Information on two smaller, regional trading schemes is presented in box 5-2.[12]

The U.S. Acid Rain Program (U.S. SO_2 Program)

The U.S. Acid Rain Program was established pursuant to authority in Title IV of the 1990 Clean Air Act Amendments and is administered by the EPA.[13] Congress provided authority for the program as part of legislation to address concerns about the adverse effects of sulphur and nitrogen oxide pollution. The goal of this program– a cap and trade approach to emissions trading– is to reduce the environmental hazards posed by acid rain by limiting the amount of SO_2 emitted, while simultaneously allowing each affected source to develop its own emissions control strategy. Participation in the program is mandatory. The program took effect in 1995 and initially covered 263 large electric power plants in Eastern and Midwestern States.[14] In 2000, the overall number of SO_2 emissions allowances[15] for these large plants was reduced, and smaller, cleaner oil-, coal-, and gas-fired plants were included in the program.[16] Under the program, total SO_2 emissions by new sources and existing sources that generate more than 25 megawatts are capped at 9.5 million tons, with the cap decreasing to 8.95 million tons in 2010.[17] Sources that emit SO_2 in excess of their allowance are fined approximately $2,500 for each surfeit ton of SO_2. According to the EPA, the Acid Rain Program is in part responsible for annual SO_2 emissions reductions of 50 percent since 1980. The EPA also attributes a 40-percent reduction in scrubber costs during the 1990s to the Acid Rain Program.[18] As discussed in Chapter 2, the broad empirical consensus is that the program has been less costly than alternative emissions limitations and has brought about significant improvements in human health.

---

[12] These include the New South Wales Greenhouse Gas Abatement Scheme (Australia) and the NO_X Budget Trading Program (U.S.).

[13] Clean Air Act, 42 U.S.C. 7401, 7651b.

[14] EPA, "Cap and Trade: Acid Rain Program Basics," found at *http://www.epa.gov/airmarkets/*, retrieved Oct. 2004.

[15] Under the U.S. Acid Rain Program, one allowance is an authorization to emit one ton of SO_2. Allowances are determined by prior emissions rates and historical fuel consumption. EPA, "Cleaning the Air: The Facts About Capping and Trading Emissions," found at *http://www.epa.gov/airmarkets/*, retrieved Oct. 2004.

[16] EPA, "Cap and Trade: Acid Rain Program Basics," found at *http://www.epa.gov/airmarkets/*, retrieved Oct. 2004.

[17] In 1980, U.S. sources emitted 17.3 million tons of SO_2. EPA, "Cap and Trade: Acid Rain Program Basics," found at *http://www.epa.gov/airmarkets/*, retrieved Oct. 2004.

[18] EPA, "Cleaning the Air: The Facts About Capping and Trading Emissions," found at *http://www.epa.gov/airmarkets/*, retrieved Oct. 2004.

Table 5-1
Comparison of emissions trading schemes[1]

	U.S. SO_2 Program[2]	EU emissions trading scheme	UK emissions trading scheme	Chicago climate exchange
Country/Region	United States	European Union	United Kingdom	United States
Type	Cap-and-Trade	Cap-and-Trade	Cap-and-Trade	Cap-and-Trade
Pollutant Coverage	SO_2	CO_2	CO_2 only or All greenhouse gases (GHGs)	All GHGs
Participation	Mandatory	Mandatory	Voluntary	Voluntary
Sector Coverage	Power plants	Power generation plants, oil refineries, iron and steel plants, & manufacturers of pulp/paper, cement, glass, lime, bricks, & ceramics.	Determined by firm participation; the UK-ETS excludes power plants.	Determined by firm participation
Start Date	1995 (1st Phase) 2000 (2nd Phase)	2005	2002	2003
Compliance Period	Ongoing	2005-07 (1st Phase) 2008-12 (2nd Phase)	Direct Participants (DPs): 2002-06 Climate Change Agreement Participants (CCAPs): 2002-10	2003-06
Emission Reduction Target	The cap is currently set at 9,500,000 tons, as compared to 17,300,000 tons in 1980. This amount is scheduled to decrease to 8,950,000 tons by 2010.	8 percent of 1990 level by 2012 (EU Kyoto Protocol commitment); individual EU Member States' targets vary, based upon commitments under the *Burden Sharing Agreement*.	4,028.176 tons CO_2e[3] from 1998-2000 baseline by 2006; overall reduction target of 12,084,528 tons CO_2e over 5-year period.	Each Member must reduce emissions 1percent below 1998-2001 baseline in 2003, 2 percent in 2004, 3 percent in 2005, and 4 percent in 2006.
Compliance Mechanisms	~$2,500/ton for excess emissions	2005-07: € 40/ton 2008-2012: € 100/ton	DPs: forfeit financial incentive CCAPs: forgo tax discount	Contractual obligation
Financial Incentive	None	None	DPs: portion of £215M incentive CCAPs: Energy tax rebates	None
Unit Traded	SO_2 Allowance = 1 ton of SO_2	EU Allowance (EUA) = 1 ton of CO_2	UK Allowance (UKA) = 1 ton of CO_2e	Carbon Finance Instrument (CFI) = 100 metric tons of CO_2e

See footnotes at end of table.

Table 5-1—*Continued*
Comparison of emissions trading schemes

	U.S. SO_2 Program[2]	EU emissions trading scheme	UK emissions trading scheme	Chicago climate exchange
Links to External Schemes	No	No	No	No
Allowance Allocation Method	Allowances allocated at a rate of 1.2 pounds of SO_2 per million British thermal units of heat input, multiplied by the installation's average fossil fuel consumed during 1985-1987; the total number of allowances is capped at 9.5 million. Installations established since 1995 must purchase allowances on the market or via an annual auction.	Each country specifies its allowance allocation in an individual National Allocations Plan (NAP); allocation will be free of charge; a small portion of allowances will be available for auction to new entrant firms.	DPs committed to emissions reductions, via auction, in exchange for a portion of a £215 million incentive fund. No allocation for CCAPs; CCAPs can use the UK-ETS to meet individual targets and/or sell voluntary emissions reductions.	Emissions allowances will be issued based upon the targets detailed above.
Banking & Borrowing of Allowances	-Banking allowed -Borrowing not allowed	No year-to-year limits on banking or borrowing during Initial Phase; 24 of 25 EU States will not allow Initial Period allowances to be banked or borrowed to/from the Mandatory Phase.	No year-to-year limits on banking or borrowing during 2002-2006; possible limits into 1st Kyoto compliance period (2008)	-Banking allowed -Borrowing not allowed
Monitoring/Registry	Required	Required	Required	Required

[1] This table covers four prominent emissions trading schemes currently in operation; Denmark's cap and trade emissions trading scheme, covering the electricity sector, was phased out in 2003. Internal pilot schemes at British Petroleum (BP) and Royal Dutch Shell have also been phased out.

[2] Several local-level emissions trading initiatives are at the discussion/planning or initial implementation stage in the United States, including Massachusetts and New Hampshire programs as well as the newly announced 9-state Regional Greenhouse Gas Initiative (RGGI). In 2003, Senators Joe Lieberman and John McCain proposed a greenhouse gas cap-and-trade system for the United States. The bill, which was introduced on October 30, 2003, was defeated by a 55-43 vote in the U.S. Senate.

[3] Carbon dioxide (CO_2) equivalents (CO_2e or CO_2 eq.) provide a universal standard of measurement against which the impacts of releasing (or avoiding the release of) different greenhouse gases can be evaluated. Every greenhouse gas has a Global Warming Potential (GWP), a measurement of the impact that particular gas has on 'radiative forcing'; that is, the additional heat/energy which is retained in the Earth's ecosystem through the addition of this gas to the atmosphere. The GWP of a given gas describes its effect on the climate relative to a similar amount of carbon dioxide. In practice, most transactions involve CO_2 or methane, since these gases are reportedly large contributors to climate change. Carbon dioxide and methane are also relatively easy to monitor. International Emissions Trading Association (IETA), "What are carbon dioxide equivalents (CO2 eq)?" found at *www.ieta.org*, retrieved on Dec. 8, 2004 and Richard Rosenzweig, Matthew Varilek, Ben Feldman, Radha Kuppalli, and Josef Janssen, The Pew Center on Global Climate Change, "The Emerging International Greenhouse Gas Market," Mar. 2002, pp. iv, v, and 17.

Source: Compiled by the Commission from several sources including, *inter alia* Point Carbon, the European Union website, the Chicago Climate Exchange, and the United Kingdom's Department for Environment, Food, and Rural Affairs.

Box 5-2
Regional emissions trading schemes

New South Wales Greenhouse Gas Abatement Scheme

The New South Wales Greenhouse Gas Abatement Scheme (NSW Scheme) was launched on January 1, 2003. The Scheme imposes mandatory greenhouse gas benchmarks on all NSW electricity retailers and other parties, which must abate the emission of greenhouse gases resulting from the consumption of electricity in New South Wales, Australia. During 2003, very little trading was reported. Similarly, in the first six months of 2004, 1.5 million tons of CO_2 equivalent were traded in approximately 25 trades. Pricing data are not currently available for this market.[1]

NO_X Budget Trading Program

NO_X Budget Trading Program (NBP) was established in 1998 under the EPA's NOx State Implementation Plan Call, which sets a cap on state-wide emissions by large electric generating units and other large combustion sources in 22 Northeast states and the District of Columbia from May 1 to September 30. Under the program, the EPA allocates NO_X allowances to each participating state, which in turn distributes allowances to power generation sources in their jurisdiction. State participation in this program is voluntary.[2]

[1] New South Wales Government (Australia), "Overview of the New South Wales Greenhouse Gas Abatement Scheme," found at *http://www.greenhousegas.nsw.gov.au,* retrieved Nov. 29, 2004; Franck Lecocq, World Bank, "State and Trends in the Carbon Market 2003," p. 23, found at *http://www.worldbank.org*, retrieved Nov. 29, 2004; and Franck Lecocq, World Bank, "State and Trends in the Carbon Market 2004," p. 32, found at *http://www.worldbank.org*, retrieved Nov. 29, 2004.

[2] EPA, "EPA's NO_X Budget Trading Program," found at *http://www.epa.gov/airmarkets/fednox/index.html*, retrieved Jan. 5, 2005.

It has been argued that there is little empirical evidence to suggest that the Acid Rain Program has spurred demand for air pollution abatement equipment and services, and there is a paucity of information on the impact of allowance trading on technological change (Stavins, 1998).[19] The program appears to have had an impact on scrubber use, although assessing the net effect on demand is difficult. Some electricity-generating installations utilized more intensely previously deployed scrubbing equipment, while others appear to have purchased new equipment for the purposes of upgrading scrubber performance and reducing SO_2 emissions. Older installations with weak scrubbing capability may simply have purchased allowances on the open market rather than incur the high cost associated with substantial upgrades in pollution abatement performance. Evidence suggests that some installations actually disposed of relatively-costly spare "absorber modules," since they were able to cover periodic emissions overages with banked or purchased allowances.[20] Finally, some installations were able to achieve emissions targets by altering production processes.[21]

Since the Acid Rain Program was predicated on SO_2 emissions limits, installations engaged extensively in fuel switching and blending.[22] In this way, installations changed the composition of their primary electricity-generating input to achieve desired emissions targets. As a result of the program, many midwestern and eastern installations

[19] Robert Stavins, "What Can We Learn from the Grand Policy Experiment? Lessons from SO_2 Allowance Trading," *Journal of Economic Perspectives*, Summer 1998, Vol. 12, Issue 3.

[20] Dallas Burtraw, "Innovation Under the Tradable Sulfur Dioxide Emission Permits Program in the U.S. Electricity Sector, Resources for the Future Discussion Paper 00-38, Sept. 2000.

[21] Ibid.

[22] Stavins; and Burtraw.

simply switched to low-sulfur coal obtained via rail from Wyoming and Montana– an option that was made cost effective by newly- established scale economies in mining and the reasonable cost of rail transport.[23] Overall, the market for low-sulfur coal grew as a result of the program (Burtraw, 2000).[24]

Each March, the EPA makes available for purchase approximately 2.8 percent of total issued SO_2 allowances at its annual allowance auction, which is administered by the Chicago Board of Trade (CBOT).[25] Affected sources, brokers, environmental groups, and individuals are eligible to purchase allowances at these auctions, provided that they have opened a general allowance account with the EPA.[26] The purpose of the auctions is to ensure that new facilities[27] have a public source from which to purchase allowances not previously allocated to existing units, and to establish allowance pricing data.[28] However, interested parties may also purchase allowances from a variety of other entities over the course of the compliance period.[29] Allowances may be purchased from individuals, affected sources, broker/dealers, or environmental groups, the latter of which may purchase allowances to prevent their use by industry.[30]

Available data suggest that trading activity– as measured in both the number of traded SO_2 allowances and the number of completed SO_2 allowance trades– has increased substantially since inception of the program. According to the EPA, the number of traded SO_2 allowances increased by 79 percent from 9.2 million in 1994 to 16.5 million in 2003, having peaked at 25 million in 2000.[31] Moreover, the number of completed SO_2 allowance trades increased from 215 in 1994 to 4,198 in 2003, having peaked at 5,755 in 2002.[32] Data on the pricing of SO_2 allowances show substantial volatility, yet exhibit an overall upward trend since the program's inception. SO_2 allowance prices increased substantially in 1998, doubling from about $100 per ton to over $200 per ton, but fell to under $130 per ton in 1999. By the summer of 2001, prices again reached over $200 per ton, but subsequently decreased to approximately $130 per ton by the end of 2002, before climbing to over $200 per ton in 2004.[33]

---

[23] Burtraw.

[24] Ibid.

[25] EPA, "Clean Air Markets–Allowance Trading," found at *http://www.epa.gov/airmarkets/trading/buying.html*, retrieved Oct. 2004.

[26] Ibid.

[27] Refers to sources that have not been provided allowances.

[28] EPA, "Acid Rain Program Allowance Auctions Fact Sheet," found at *http://www.epa.gov/airmarkets/auctions/factsheet.html*, retrieved Oct. 2004.

[29] The EPA has identified eight types of allowance transactions that may take place: Inter-utility; intra-utility; reallocation; broker/trader-to-utility; utility-to-broker/trader; fuel company-to-utility; utility-to-fuel company; and other. EPA, "EPA's Classification Methodology for Reported Private Allowance Transfers," found at *http://www.epa.gov/airmarkets/trading/basics/defs.html*, retrieved Oct. 2004

[30] EPA, "Clean Air Markets–Allowance Trading," found at *http://www.epa.gov/airmarkets/trading/buying.html*, retrieved Oct. 2004.

[31] EPA, "Trading Activity Breakdown," found at *http://www.epa.gov/airmarkets/trading/so2market/transtable.html*, retrieved Oct. 2004.

[32] Ibid.

[33] EPA, "Allowance Prices (1995-2004)," found at *http://www.epa.gov/airmarkets/trading/so2market/alprices.html*, retrieved Oct. 2004.

Since early 2003, a detailed analysis of the SO_2 allowance market reveals a substantial increase in price levels and price volatility, combined with erratic volume (figure 5-1). A sharp increase in trading volume– fueled by the approach of the 2003 compliance period deadline, combined with price speculation in anticipation of the EPA's March auction– occurred in February 2003. However, SO_2 allowance prices did not rise significantly until the third quarter of 2003, when speculative buying occurred in response to heavy trading for compliance and short-coverage purposes. Prices continued to increase rapidly through January 2004 due to colder than anticipated winter weather and speculation that the proposed Interstate Air Quality Rule would usher in a period of more stringent SO_2 regulations.[34] Overall, average monthly allowance prices increased from $142 per ton of SO_2 in January 2003 to $245 per ton of SO_2 in January 2004.[35]

During 2004, there was a steep rise in SO_2 allowance price levels and price volatility, combined with an overall decline in trading volume. Average monthly SO_2 allowance prices rose from $245 per ton in January to $643 per ton by November.[36] Factors contributing to this substantial rise include, *inter alia*: (1) expectations of higher future scrubber costs; (2) high oil and natural gas prices, which led to speculative trading activity over concerns of a possible shift toward coal generation which generally requires more allowances (or controls) than other fossil fuels, and is considered less "environmentally friendly," (3) the proposed Clean Air Interstate Rule (CAIR), which would cut the SO_2 emissions cap in 2010 and 2015 and treat banked emissions favorably, thus motivating the early purchase of allowances for future compliance purposes; (4) positive U.S. macroeconomic data, which have indicated a continued U.S. economic recovery; and (5) overall market uncertainty.[37]

The European Union Emissions Trading Scheme (EU-ETS)

Overview

In 1997, the European Union (EU) ratified the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), committing itself to reduce greenhouse gas emissions by 8 percent, relative to 1990 levels, during 2008-2012.[38] As

[34] Evolution Markets, *SO_2 Monthly Market Updates*, Jan. 2003 through Nov. 2004, found at *http://www.evomarkets.com*, retrieved Dec. 3, 2004.

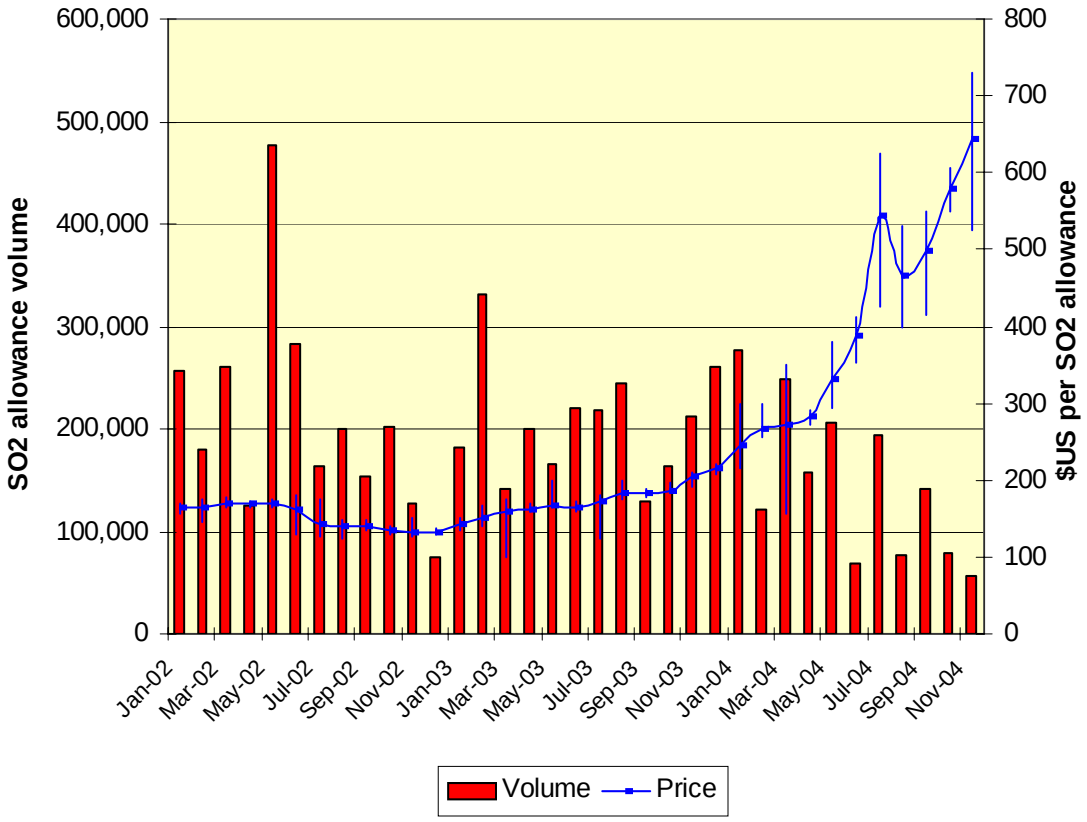
[35] Evolution Markets, "Spot Trades Data for SO_2 From 01/01/02," spreadsheet delivered via e-mail, Nov. 24, 2004.

[36] Ibid.

[37] Evolution Markets, *SO_2 Monthly Market Updates*, Jan. 2003 through Nov. 2004, found at *http://www.evomarkets.com*, retrieved Dec. 3, 2004.

[38] Council Decision 2002/358/EC. The 10 new Accessions States are not covered by the EU target. In most cases, however, Accession States have Kyoto targets in the range of 6-8 percent. European Union, "EU Emissions Trading," Nov. 18, 2004, found at *http://europa.eu.int*, retrieved on Jan. 6, 2005.

Figure 5-1
U.S. SO_2 Program, allowance prices and volumes arranged through brokers, January 2002 - January 2005



Note.—The tick on the high/low bar represents the average SO_2 allowance price for traded contracts during the month. The top of the high/low bar represents the highest price during the month while the bottom of the high/low bar represents the lowest price during the month.

Source: Evolution Markets, "Spot Trade Data for SO_2 From 01/01/02," spreadsheet delivered via e-mail, Nov. 24, 2004.

part of its policy response to these commitments, the EU passed mandatory legislation[39] creating the European Union Emissions Trading Scheme (EU-ETS). This cap-and-trade scheme, which began in January 2005, includes two phases: the Initial Phase (2005-2007) and the Mandatory Phase (2008-2012). The Initial Phase, designed as a trial period, will allow for gradual implementation by all EU-25 Member States prior to full implementation of the scheme during the Mandatory Phase, which is scheduled to coincide with the first Kyoto Commitment Period. Subsequent 5-year phases are expected to follow.

During the Initial Phase, more than 5,000 firms, representing approximately 12,000 installations, will be required to meet CO_2 emissions reduction targets.[40] The affected industrial sectors, which produce nearly 46 percent of the EU's CO_2 emissions, include

[39] EU Directive 2003/87/EC.
[40] Additional greenhouse gases may be added during the Mandatory Phase.

power generation plants, oil refineries, iron and steel plants, and factories producing pulp and paper, cement, glass, lime, bricks, and ceramics.[41] Each EU Member State is required to develop and submit a National Allocation Plan (NAP) to the European Commission (EC). Each country's NAP must list all covered installations as well as the quantity of allowances to be granted to each installation.[42] As of January 2005, the EC had evaluated and approved 21 of 25 NAPs against 11 common criteria established in Annex III of the Emissions Trading Directive.[43] The remaining four NAPs are currently under review.[44] Many analysts believe that current NAP allocation levels do not require significant emissions cuts on the part of affected installations.[45]

Market Characteristics

Although the EU-ETS officially began in January 2005, transactions in EU Allowances (EUAs)[46] occurred through forward contracts[47] as early as February 2003. Such contracts are typically negotiated with the assistance of an over-the-counter broker (box

---

[41] Additional sectors, including aluminum and transport, may be added during the Mandatory Phase.

[42] Starting in 2006, firms with emissions in excess of allowance holdings at the end of an annual April compliance deadline will be subject to fines of €40 per ton of CO_2 during the Initial Phase and €100 per ton of CO_2 during the Mandatory Phase, Vanessa Houlder and Andrew Taylor, "FT Briefing: Cutting Greenhouse Gases," *Financial Times*, Apr. 4, 2004, found at *http://www.ft.com/*, retrieved Sep. 30, 2004.

[43] European Commission, "Questions And Answers On Emissions Trading And National Allocations Plans," updated Jan. 6, 2004, found at *http://europa.eu.int*, retrieved Jan. 10, 2004; and Commission Communication COM(2003)830 of 7 January 2004 on guidance to assist Member States in the implementation of the criteria listed in Annex III to Directive 2003/87/EC.

[44] The UK NAP must also be re-approved following the submission of a revised NAP increasing the number of allowances to be allocated by 19.8 million tons.

[45] "Welcome to Kyoto Land, *The Economist*, found at *http://www.economist.com*, retrieved Nov. 8, 2004; Natsource European Environmental Division, "European GHG Emissions Trading Scheme," found at *http://www.natsource.com/markets/*, retrieved Nov. 19, 2004; Saffina Rana, "EU Regulations: Emissions Trading Risks Collapse, Markets Warn," *Economist Intelligence Unit ViewsWire*, Nov. 2, 2004, found at *http://www.viewswire.com/*, retrieved Nov. 19, 2004; and Point Carbon, "Carbon Politics This Week," *Carbon Market Europe*, Dec. 17, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 17, 2004.

[46] A European Union Allowance (EUA) represents one ton of carbon dioxide equivalent. Carbon dioxide (CO_2) equivalents (CO_2e or CO_2 eq.) provide a universal standard of measurement against which the impacts of releasing (or avoiding the release of) different greenhouse gases can be evaluated. Every greenhouse gas has a Global Warming Potential (GWP), a measurement of the impact that particular gas has on 'radiative forcing'; that is, the additional heat/energy which is retained in the Earth's ecosystem through the addition of this gas to the atmosphere. The GWP of a given gas describes its effect on the climate relative to a similar amount of carbon dioxide. In practice, most transactions involve CO_2 or methane, since these gases are reportedly large contributors to climate change. Carbon dioxide and methane are also relatively easy to monitor. International Emissions Trading Association (IETA), "What are carbon dioxide equivalents (CO2 eq)?" found at www.ieta.org, retrieved on Dec. 8, 2004 and Richard Rosenzweig, Matthew Varilek, Ben Feldman, Radha Kuppalli, and Josef Janssen, The Pew Center on Global Climate Change, "The Emerging International Greenhouse Gas Market," March 2002, pp. iv, v, and 17.

[47] Forward contracts are agreements between two parties, buyer and seller, in which the former agrees to purchase an asset from the latter at a specific future date. The price is agreed in advance, although payment is not made until the transaction date. Forward contracts are used in over-the-counter markets.

5-3), although a significant volume of EUAs are exchanged bi-laterally between companies.[48] During 2003-04, the average forward contract was written for the delivery of 5,000-10,000 allowances in 2005,[49] also known as 2005 vintage.[50] Contract denominations of this size are small relative to corresponding denominations in related energy markets.[51] Since most installations will likely receive millions of allowances as part of the allocation process, market observers believe that contracts of this size are not executed to meet compliance targets. Instead, such transactions are likely undertaken to gain emissions trading experience, test internal systems and processes, and demonstrate the feasibility of emissions trading to senior management.[52]

Unlike established commodities markets, a universally-accepted contract for EUAs has yet to be established. Currently, three types of contracts are used to execute EUA transactions: the International Emissions Trading Association's (IETA) Emissions Trading Master Agreement for the EU scheme; the European Federation of Energy Traders (EFET) Agreement; and the International Swaps and Derivatives Association, Inc. (ISDA) Master Agreement. To date, the majority of trading has taken place through either the IETA contract or the EFET contracts. Some industry sources, however, indicate that adoption of the ISDA contract would promote market development and liquidity by facilitating the entry of financial institutions into the EU scheme as well as providing a framework for the trading of sophisticated financial derivatives such as futures and options contracts.[53]

Market Participants

Upon full implementation, more than 5,000 companies are expected to participate in the trading of emissions allowances on the EU-ETS. Currently, however, large manufacturing emitters are largely absent from the market. Instead, trading activity on the EU-ETS is limited almost exclusively to a small number of large European power generators that have established commodity trading desks and power generation assets

[48] Industry representative, e-mail message to USITC staff, Nov. 29, 2004; and Evolution Markets, *Monthly Market Update: Greenhouse Gas Markets*, Aug. 2004, found at *http://www.evomarkets.com/*, retrieved Nov. 23, 2004.

[49] Evolution Markets, *Monthly Market Update: Greenhouse Gas Markets*, various issues Sept. 2003-Dec. 2004, found at *http://www.evomarkets.com*, retrieved Dec. 15-16, 2004; and Point Carbon, "Market Comment," *Carbon Market Analyst*, various issues Jun. 2004-Dec. 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 15-16, 2004.

[50] Vintage refers to the year in which allowances are delivered. For example, 2006 vintage allowances will be delivered in 2006.

[51] Evolution Markets, *Monthly Market Update: Greenhouse Gas Markets*, June 2004, p. 1, found at *http://www.evomarkets.com/*, retrieved Dec. 17, 2004.

[52] The transaction size under a fully operational EU-ETS likely will be closer to 50,000 EUAs. Benedickt von Butler, "Carbon Market Picture Comes Into Focus," *World Power*, Apr. 2004, found at *http://www.evomarkets.com*, retrieved Nov. 10, 2004.

[53] Evolution Markets, *Monthly Market Update: Greenhouse Gas Markets*, June 2004, p. 1, found at *http://www.evomarkets.com*, retrieved Dec. 17, 2004.

Box 5-3
Anatomy of an EUA brokered trade

Step 1: Buyer Requirement
Customer calls broker to purchase EUAs.

Step 2: Negotiation
Broker contacts likely seller; buyer and seller negotiate price/terms through broker. Terms typically include price, volume, vintage year, and delivery date.

Step 3: Verbal Confirmation
Trade is executed, subject to credit considerations, between buyer/seller counter-parties via legally binding verbal confirmation (typically over recorded phone lines).

Step 4: Written Confirmation
Broker faxes a written confirmation containing contract terms and counter-party contact information.

Step 5: Contract Execution
Legal contract is executed and exchanged between counter-parties.

Step 6: Broker Fee
Broker charges a per ton fee for matching buyers and sellers.

Step 7: Settlement
Due to the forward nature of the EU-ETS market, EUA delivery will take place on a specified future date after January 1, 2005. Delivery will be accomplished, in accordance with the terms of the contract, by a transfer from seller to buyer on an electronic registry. Payment will typically be made concurrent with delivery; companies with a low credit rating may be required to make payment prior to delivery. Spot market transactions will likely start in 2005, subject to allowance allocation and registry establishment.[1]

[1] Evolution Markets, "How To Trade EU Emissions Allowances Using A Broker In Seven Simple Steps," found at *http://www.evomarkets.com,* retrieved Nov. 10, 2004; CO2e, "ETS Basics: Practical Considerations," found at *http://www.co2e.com,* retrieved Nov. 16, 2004, and industry representatives, interviews by USITC staff, London, United Kingdom, Oct. 26-27, 2004.

in several European countries.[54] Important traders in the energy/power sector include RWE (Germany), EDF Energy (U.K.), E-On (Germany), and Electrobel (Belgium). Shell Trading, a division of Royal Dutch Shell (Netherlands/U.K.), is also an active market participant.[55] By contrast, most large financial institutions currently are not active players in the EU market, largely because low trading volumes limit profit-making opportunities.[56] Fortis Bank (Netherlands/Belgium), which offers retail services– including trading services, risk management advisory services, and emissions portfolio management– is the main financial services firm operating in the European market. Barclays Capital (U.K.) is also relatively active in the EU-ETS forward market.[57]

[54] Point Carbon, "Market Comment," *Carbon Market Europe*, Dec. 3, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 10, 2004; Point Carbon, "Market Comment," *Carbon Market Europe*, Dec. 10, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 10, 2004; Evolution Markets, "Monthly Market Update: Greenhouse Gas Markets," Oct. 2004, p. 1, found at *http://www.evomarkets.com*, retrieved Oct. 21, 2004; and Point Carbon, "Industry Chooses Sideline," *Carbon Market Europe*, Dec. 17, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 17, 2004.

[55] Industry representatives, interviews by USITC staff, London, United Kingdom, Oct. 25-26, 2004.

[56] Point Carbon, "EU ETS value growing," *Carbon Market Europe*, Dec. 10, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 10, 2004.

[57] Industry representatives, interviews by USITC staff, London, United Kingdom, Oct. 26-27; and Point Carbon, "EU ETS Value Growing," *Carbon Market Europe*, Point Carbon, Dec. 10, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 10, 2004.

Market Activity

Although the first forward contract was negotiated in February 2003, trading in EUA contracts took place on a relatively infrequent basis during 2003 and most of 2004.[58] Using data for 2005 vintage EUAs,[59] for example, only 1.5 million tons of CO_2 were traded through brokerage firms between September 2003 and August 2004 (figure 5-2);[60] such volumes are considered low as compared to established energy and environmental markets.[61] Low trading levels are attributed to market infancy, a shortage of sellers,[62] a lack of preparation among affected companies,[63] and general uncertainty surrounding Kyoto ratification[64] and the NAP process.[65] During September 2004-February 2005, transaction volumes increased significantly, with the number of weekly transactions regularly exceeding the total number of transactions registered during the first quarter of 2004.[66] This sharp increase is predominantly attributed to market psychology effects stimulated by Russia's decision to ratify the Kyoto Protocol.[67] By the end of 2004, brokered transactions totaling approximately 9.1 million EUAs were recorded in the EU-ETS forward market; 78 percent of this volume was represented by contracts of 2005 vintage, while 2006 vintage and 2007 vintage contracts accounted for 9 percent and 13 percent, respectively.[68]

The Commission obtained daily settlement-price data for EUA 2005 forward contracts for the period July 2003 through January 2005. Using this data, the Commission developed average price estimates for contracts traded during each month (figure 5-2).

---

[58] Point Carbon, *Carbon Market Europe*, various issues Dec. 2003-Dec. 2004, found at *http://www.pointcarbon.com*, retrieved Nov. 22-24, 2004.

[59] EUAs for delivery in 2005 (i.e., 2005 vintage) were the most commonly traded contracts during 2005 and 2004.

[60] Point Carbon, "Weekly Closing prices for EU allowances (EUAs) for delivery in 2005, 2006, and 2007," spreadsheet delivered via e-mail, Nov. 30, 2004.

[61] Industry representatives, interviews by USITC staff, London, United Kingdom, Oct. 26-27, 2004; and Benedickt von Butler, "Carbon Market Picture Comes Into Focus," *World Power*, Apr. 2004, found at *http://www.evomarkets.com*, retrieved Nov. 10, 2004.

[62] According to Evolution Markets, companies that expected to have surplus allowances were unwilling to sell until the announcement of firm-level allocations. Evolution Markets, *Monthly Market Update: Greenhouse Gas Markets*, June 2004, found at *http://www.evomarkets.com*, retrieved Nov. 17, 2004.

[63] Ernst & Young, "The European Union Emissions Trading Scheme: A Challenge For Industry Or Just An Illusion," July 2004.

[64] "Welcome To Kyoto Land," *The Economist*, Oct. 7, 2004, found at *http://www.economist.com*, retrieved Nov. 8, 2004.

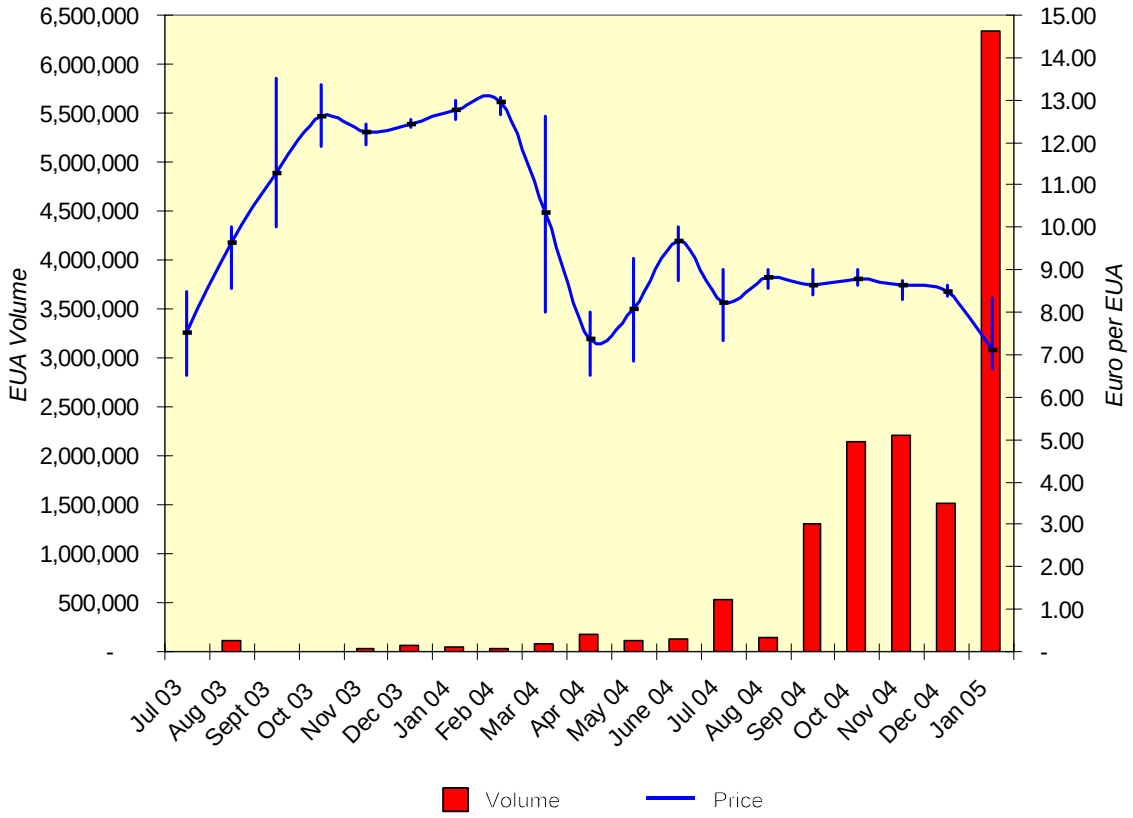
[65] Point Carbon, *Highlights 2003*, December 2003, found at *http://www.pointcarbon.com*, retrieved Nov. 24, 2004.

[66] Point Carbon, "Market Comment," *Carbon Market Europe*, Dec. 3, 2004, found at found at *http://www.pointcarbon.com*, retrieved Dec. 3, 2004; and Point Carbon, "Weekly Closing prices for EU allowances (EUAs) for delivery in 2005, 2006, and 2007," spreadsheet delivered via e-mail, Nov. 30, 2004.

[67] "Welcome To Kyoto Land," *The Economist*, Oct. 7, 2004, found at *http://www.economist.com*, retrieved Nov. 8, 2004; Evolution Markets, "Monthly Market Update," *Carbon Market Europe*, Aug. 2004, found at *http://www.evomarkets.com*, retrieved Nov. 17, 2004, and industry representatives, interviews by USITC staff, London, United Kingdom, Oct. 26-27, 2004.

[68] Point Carbon, "Christmas Limits December EU ETS Trades," *Carbon Market Europe*, Jan. 7, 2005, found at *http://www.pointcarbon.com*, retrieved Jan. 7, 2005.

Figure 5-2
EU Emissions Trading Scheme, EU allowance (EUA) prices and volumes arranged through brokers, July 2003 - January 2005



Note.—The tick on the high/low bar represents the average EUA settle price for contracts traded during the month. The top of the high/low bar represents the highest price during the month while the bottom of the high/low bar presents the lowest price during the month. During periods in which no EUA trades occured, the bid/ask midpoint is used as a proxy for the weekly closing price.

Source: Evolution Markets, "Historical Settle Prices For EUAs From 6/23/03," spreadsheet delivered via e-mail, Jan. 31, 2005; and industry representative, e-mail to USITC staff, Feb. 16, 2005.

During this period, EUA 2005 average prices experienced high levels of volatility, trading between a low of €7.38 in April 2004 and a high of €12.94 in February 2004, before leveling off in the €8-9 range during May 2004 - December 2004.[69] During January 2005, the average monthly price declined to €7.12.[70] Uncertainty regarding anticipated NAP allocations and the EU review process was the dominant factor

[69] Evolution Markets, "Historical Settle Prices For EUAs From 6/23/03," spreadsheets delivered via e-mail, Jan. 31, 2005 and Feb. 16, 2005.

[70] Evolution Markets, "Historical Settle Prices For EUAs From 6/23/03," spreadsheets delivered via e-mail, Jan. 31, 2005 and Feb. 16, 2005. By February 22, 2005, daily prices for EUA 2005 contracts had increased to the €8-9 range. Point Carbon homepage, found at *http://www.pointcarbon.com/*, retrieved on Feb. 22, 2005.

underlying price volatility during much of 2003, 2004, and early 2005.[71] Volatility during much of this period is also attributed to "gaming" in the early stages of price discovery, whereby traders sought to test the price sensitivity of potential buyers and sellers.[72] Some observers expect that the factors influencing future price movements will extend beyond the politics of NAP allocations to include supply/demand fundamentals such as weather trends, economic growth forecasts, oil/coal forward price differentials, greenhouse gas abatement costs, and supply issues associated with the influx of credits from Kyoto-compliant Joint Implementation (JI)[73] and Clean Development Mechanism (CDM)[74] projects.[75]

The United Kingdom Emissions Trading Scheme (UK-ETS)

The United Kingdom's voluntary emissions trading scheme was launched in April 2002. Although 34 companies joined as Direct Participants, the majority of active market participants are Climate Change Agreement Participants.[76] The UK market experienced a relatively high level of trading activity during 2002 and 2003. In 2002, there were 2.48

[71] The expected initial supply of EUAs resulting from the NAP allocation process has historically been an important determinant of EUA pricing. For example, when the European Commission (EC) was perceived as enforcing stringent NAP standards (bullish indicator), the EUA price generally increased. Similarly, during periods when it was perceived that the EC was being more lenient on NAP standards (bearish indicator), the EUA price generally decreased. As a result, bullish and bearish NAP announcements and rumors associated with the NAP allocation process caused prices to fluctuate. Industry representative, interview with USITC staff, London, United Kingdom, Oct. 26-27, 2004, Point Carbon, "Market Comment," *Carbon Market Europe*, Nov. 12, 2004, found at *http://www.pointcarbon.com*, retrieved Nov. 22, 2004; and Point Carbon, "Market Comment," *Carbon Market Europe*, Dec. 17, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 17, 2004.

[72] Point Carbon, "Highlights 2003," Dec. 19, 2003, found at *http://www.pointcarbon.com*, retrieved Nov. 22, 2004.

[73] The Joint Implementation (JI) Mechanism established under Article 6 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) grants 41 industrialized countries and economies in transition (Annex 1 countries) the right to generate and/or purchase emissions reduction units (ERUs) from investments in emissions reduction projects in other Annex 1 countries, subject to certain conditions, IETA, "Kyoto Mechanisms: Joint Implementation," found at *www.ieta.com*, retrieved Sept. 20, 2004.

[74] The Clean Development Mechanism (CDM) established under Article 12 of the UNFCCC grants Annex 1 countries the right to generate and/or purchase certified emissions reductions (CERs) from investments in emissions reduction projects in non-Annex 1 countries, under certain conditions, IETA, "Kyoto Mechanisms: Clean Development Mechanism," found at *http://www.ieta.com*, retrieved Sept. 20, 2004.

[75] Industry representatives, interviews by USITC staff, London, United Kingdom, Oct. 26-27, 2004; and Carbon Market Europe, various issues Jan. 2004-January 2005, found at *http://www.pointcarbon.com*, retrieved on Dec. 17, 2004. Directive 2004/101/EC allows credits from JI and CDM projects to be converted to EUAs and traded on the EU-ETS. European Union, "EU Emissions Trading," Nov. 18, 2004, found at *http://europa.eu.int*, retrieved Jan. 6, 2005.

[76] Companies classified as Direct Participants have committed to emissions reduction targets in exchange for a share of a £215 incentive fund. By contrast, Climate Change Agreement Participant companies, also known as Indirect Participants, are motivated to reduce emissions by a discount on an energy consumption tax.

million UKAs[77] traded in 434 separate trades, most of which occurred during the final quarter. Similarly, 140 contracts, representing approximately 500,000 UKAs, were traded during the first three months of 2003. Heavy trading during this period is reflected in the volatility of spot market prices, which increased from approximately £4 per UKA in April 2002 to a peak of £12 per UKA in September 2002, before declining to £2.50 per UKA by the spring of 2003. This sharp increase in trading is attributed to the efforts of Indirect Participants to meet their first emissions compliance deadline, combined with the small supply of UKAs, as many companies had not yet received their allowances. Speculative activity was also considered to be an important factor.[78]

After the first quarter of 2003, trading volumes decreased significantly, while spot prices stabilized in the £2-4 per UKA range. By the end of 2004, trading volumes had declined to an estimated 4,000-8,000 UKAs per month.[79] Market participants and British Government officials attribute lower market activity to a significant over-supply of allowances.[80] In addition, Indirect Participants appear to trade largely for compliance purposes, remaining absent from the market except during brief periods preceding biennial compliance deadlines.[81]

Chicago Climate Exchange (CCX)

The Chicago Climate Exchange, which started in December 2003, is a voluntary cap-and-trade scheme.[82] Members of the CCX include large U.S. firms such as DuPont, Ford Motor Company, and International Paper, as well as university research institutes, nongovernmental organizations, and numerous brokerage firms. Although the CCX allows trading in six greenhouse gases (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) most trading involves CO_2.[83] Member firms typically trade to gain emissions trading experience as well as to meet emissions compliance targets. However, due to the infancy of the market, monthly transaction volumes are quite low.[84] During January-November 2004, for example, a

[77] One United Kingdom Allowance (UKA) represents 1 ton of carbon dioxide equivalent (CO_2e).

[78] Industry representatives, interviews by USITC staff, London, United Kingdom, Oct. 25-26, 2004; and Point Carbon, "Highlights 2003," *Carbon Market Analyst*, Dec. 19, 2003, found at *http://www.pointcarbon.com*, retrieved Nov. 23, 2004.

[79] Industry representative, e-mail message to USITC staff dated Nov. 22, 2004.

[80] Industry representatives, interviews by USITC staff, London, United Kingdom, Oct. 25-26, 2004. In 2004, the supply of allowances was estimated to exceed demand by approximately 11.5 million tons. As a result, the UK government is examining the options for reducing the over-supply Point Carbon, "What is the UK ETS," *Carbon Market Europe*, September 10, 2004, p. 3, found at *http://www.pointcarbon.com/*, retrieved Dec. 17, 2004.

[81] Industry representatives, interviews by USITC staff, London, United Kingdom, Oct. 25-26, 2004; and Point Carbon, "Highlights 2003," *Carbon Market Analyst*, Dec. 19, 2003, found at *http://www.pointcarbon.com*, retrieved Nov. 23, 2004.

[82] Admission to the CCX is a voluntary decision. However, upon admittance, companies must commit to mandatory emissions targets. Industry representative, interview with USITC staff, Chicago, Dec. 2, 2004.

[83] Industry representative, interview by USITC staff, Chicago, Dec. 2, 2004.

[84] Ibid.

total of approximately 2.2 million metric tons[85] representing 2003, 2004, 2005, and 2006 vintages, were traded on the CCX (figure 5-3); volumes of this size are considered small relative to more established commodity markets.[86]

During much of this period, average monthly prices for all vintage years traded below $1.00 per metric ton (figure 5-4). However, during October and November 2004, transaction volumes increased significantly relative to volumes in previous months. During this period, the average price per metric ton increased to approximately $1.50; the volatility of average prices was also high, ranging between $0.97-$2.06 per metric ton. The increase in prices, volumes, and volatility during October-November 2004 is attributed to market psychology effects stimulated by Russia's decision to ratify the Kyoto Protocol.[87]

Trade and Investment

Although services provided in connection with emissions trading activities are linked to the abatement of air pollution, the primary suppliers of such services are typically brokerage and market research firms. The most visible brokerage firms in the emissions trading market, Evolution Markets LLC and Natsource LLC, are based in the United States.[88] Since these firms are also important providers of brokerage services in European markets, international trade in services likely accounts for a large portion of activity within the sector. While brokerage services are traded across borders (Mode 1), the most common delivery method for such services is sales through a foreign commercial presence (Mode 3). To illustrate, Evolution Markets initially conducted business in Europe through cross-border trade, offering brokerage services to European clients from its offices in White Plains, New York. Starting in January 2004, however, it established an office in London to serve its European customers.[89]

[85] Emissions on the CCX are packaged as Carbon Financial Instruments (CFIs); one CFI is equal to 100 metric tons of carbon dioxide equivalent (CO_2e).

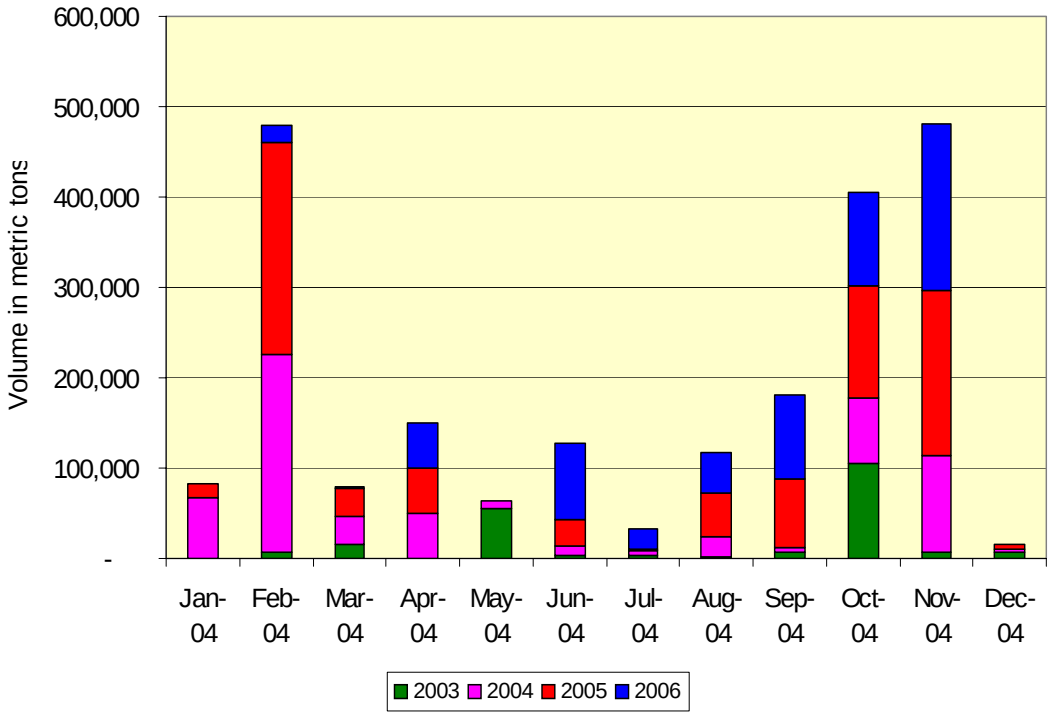
[86] Benedick von Butler, "Carbon Market Picture Comes Into Focus," *World Power*, Apr. 2004, found at *http://www.evomarkets.com*, retrieved Nov. 10, 2004.

[87] Industry representative, interview by USITC staff, Chicago, Dec. 2, 2004.

[88] Other brokers operating in emissions trading markets include CO2e.com, GFI, Greenstream, GT Energy, Spectron, and Traditional Financial Services. Point Carbon. "The Carbon Market Indicator Explained," found at *http://www.pointcarbon.com*, retrieved Nov. 22, 2004.

[89] In general, greenfield investment activity in the emissions trading sector is limited as most brokerage and market research firms offer emissions trading services through established brokerage operations abroad. Emissions trading activities represent a relatively new activity for many brokerage and market research firms.

Figure 5-3
Chicago Climate Exchange, volumes by month and vintage, 2004



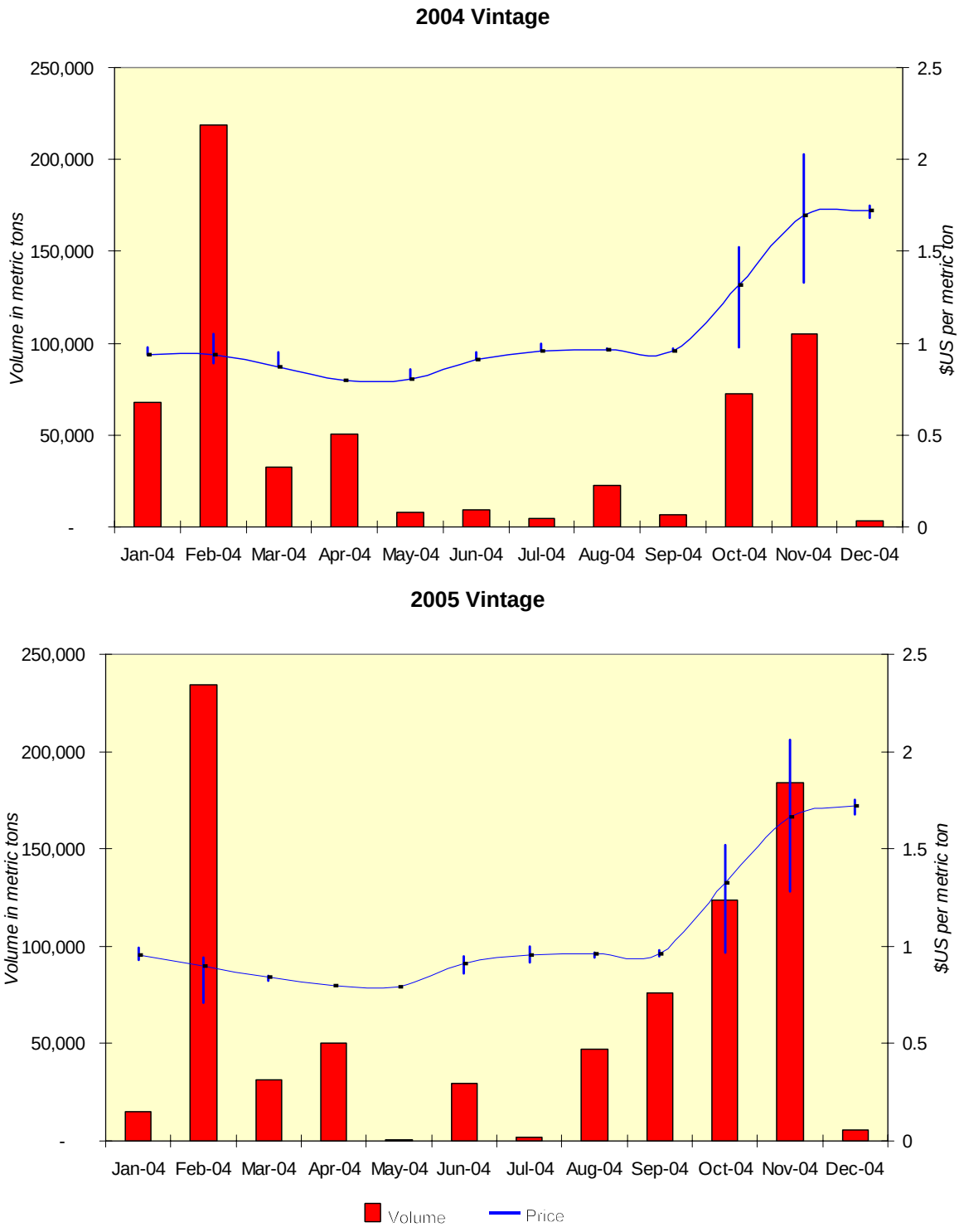
Source: Chicago Climate Exchange, *http://www.chicagoclimatex.com/trading/marketData.html*, retrieved on Dec. 16, 2004.

Market research and data services related to emissions trading are also provided through cross-border trade (Mode 1) and foreign commercial presence (Mode 3). The most visible providers of such services– Point Carbon (Norway), Argus Media (U.K.), and Environmental Finance (U.K.)[90]– deliver their services across borders when subscription-based research reports and/or newsletters are delivered over the Internet to clients outside their home country. Point Carbon and Argus Media, which maintain established offices in a variety of countries, also offer market research and data services through commercial presence. In addition, Point Carbon and Environmental Finance organize industry conferences.[91] When such conferences are held in the home country of the conference organizer, services may be delivered via Mode 2 (Consumption Abroad). However, when a conference is held in another country, services may be delivered via Mode 4 (Natural Persons).

[90] Industry representative, interview by USITC staff, London, United Kingdom, Oct. 27, 2004.

[91] Point Carbon homepage, found at *http://www.pointcarbon.com*, retrieved on Jan. 17, 2005; and Environmental Finance homepage, found at http://www.environmental-finance.com, retrieved on Jan. 17, 2005.

Figure 5-4
Chicago Climate Exchanges prices and volumes traded during January 2004-December 2004



Note.—The tick on the high/low bar represents the average price per metric ton for contracts traded during the month. The top of the high/low bar represents the highest price during the month while the bottom of the high/low bar represents the lowest price during the month.

Source: Chicago Climate Exchange, *http://www.chicagoclimatex.com/trading/marketData.html*, retrieved on Dec. 16, 2004.

Market Outlook

With the exception of the SO_2 program[92] in the United States, emissions trading markets worldwide are in the early stages of development. As a result, the net affects of emissions trading programs in their respective markets for air pollution abatement equipment and services is difficult to determine. Although the newly ratified Kyoto Protocol, which endorses emissions trading as a tool to reduce greenhouse gas emissions, may provide an incentive for more countries to develop emissions trading programs, the EU-ETS will likely be the most active greenhouse gas trading scheme over the next 3-5 years.[93] Some observers expect that an international emissions trading market will develop through the linking of regional schemes. Canada and Japan, for example, are expected to develop emissions trading schemes which will eventually be linked to the EU-ETS.[94] Norway also plans to launch a domestic emissions trading scheme that is expected to link to the EU-ETS.[95] The EU also has discussed linkages with the New South Wales Scheme and the developing Regional Greenhouse Gas Initiative (RGGI) in the United States. The British Government, which assumes the EU presidency in June 2005, also has announced that it intends to pursue links with the RGGI as well as any schemes that develop in Canada or Japan.[96]

Following the establishment of national registries[97] and the final allocation of allowances in 2005, many observers believe that a spot market in EUAs likely will develop in the European Union.[98] How this market will develop, however, remains unclear. Although traders reportedly hope that an active, sophisticated market will emerge in 2005/2006, many observers believe that trading activity will be relatively muted during the Initial Phase. For example, some analysts believe that generous allowance allocations will lead to an over-supply of EUAs, putting downward pressure on pricing and trading activity,

---

[92] For a discussion on the impact of SO_2 emissions trading on the market for air pollution abatement goods and services, see "The U.S. Acid Rain Program (U.S. SO_2 Program)" in this chapter.

[93] Industry representative, e-mail message to USITC staff, Nov. 19, 2004.

[94] Ibid.

[95] Point Carbon, "Norway Sets Up Lackluster ETS," *Carbon Market Europe*, Dec. 17, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 17, 2004.

[96] Point Carbon, "London To Push For ETS Links To State-level Action In US," Dec. 12, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 12, 2004; Point Carbon, "EU-NSW Emissions Trading Link To Be Explored," Dec. 17, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 17, 2004; Point Carbon, "Linking Emissions Trading Schemes," *Carbon Market Europe*, Jun. 11, 2004, found at *http://www.pointcarbon.com;* Point Carbon, "After COP10: What Now For EU Climate Policy?" *Carbon Market Europe*, found at *http://www.pointcarbon.com*, retrieved Jan. 3, 2004, and industry representatives, e-mail messages to USITC staff, Nov. 19, 2004.

[97] European Union Allowances will be recorded in accounts held in electronic registries set up by Member States. European Union, "EU Emissions Trading," Nov. 18, 2004, found at *http://europa.eu.int*, retrieved on Jan. 6, 2005.

[98] Point Carbon, "EC Finalizes Registry Legislation," Dec. 21, 2004, found at *http://www.pointcarbon.com/*, retrieved on Dec. 21, 2004. Denmark established a national registry and allocated allowances to affected institutions in early 2005, facilitating the first EUA spot transaction in Denmark on Feb. 7, 2005 between Shell Trading and Energi E2; price or volume information was not disclosed. Point Carbon, "Shell, Energi E2 Execute First EU ETS Spot Contract," Feb. 7, 2005, found at *http://www.pointcarbon.com*, retrieved on Feb. 7, 2005.

and possibly resulting in a precipitous reduction in EUA prices.[99] Similarly, some participants speculate that the influx of emissions reduction "credits" from CDM and JI projects will increase the supply of EUAs, putting downward pressure on overall pricing.[100] Others, particularly environmental groups, worry that allowance allocations will simply meet existing emissions levels, removing the incentive to abate and/or trade.[101] Low participation rates on the part of many affected firms owing to inexperience and/or lack of preparation also may reduce trading levels.[102]

In anticipation of increasing EUA transactions, several organizations are attempting to establish emissions trading exchanges. For example, the Chicago Climate Exchange and the International Petroleum Exchange (IPE) announced plans to establish the European Climate Exchange (ECX; United Kingdom). Under this plan, the CCX will design and market CO_2 trading products based on the EU-ETS, using the IPE's exchange and electronic trading platform to list spot and futures contracts.[103] Competing initiatives, which are also in the early planning stages, include the Austrian Energy Exchange (EXAA; Austria), and the European Energy Exchange (EEX; Germany). On February 11, 2005, Nord Pool (Norway) launched an electronically-cleared exchange.[104] In France, a group composed of Euronext, Powernext, and Caisse de Dépôts et Consignation plan

[99] Saffina Rana, "EU Regulations: Emissions Trading Risks Collapse, Markets Warn," *Economist Intelligence Unit Views Wire*, Nov. 2, 2004, found at *http://www.viewswire.com*, retrieved Nov. 19, 2004; Point Carbon, "Market Comment," Carbon Market Europe, Dec. 10, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 10, 2004; Point Carbon, "Report Slams ETS Allocation Process, UK Climate Policy," Feb. 5, 2005, found at *http://www.pointcarbon.com/*, retrieved on Feb. 7, 2005; and industry representatives, interviews by USITC staff, Brussels, Belgium, Oct. 27-28, 2004.

[100] Industry representatives, interviews by USITC staff, London, United Kingdom and Brussels, Belgium, Oct. 26-28, 2004.

[101] "Welcome To Kyoto Land," *The Economist*, Nov. 8, 2004, found at *http://www.economist.com*, retrieved Nov. 8, 2004; Point Carbon, "Highlights 2003," Dec. 19, 2003, found at *http://www.pointcarbon.com*, retrieved Nov. 22, 2004; Point Carbon, "Outlook 2004," Dec. 23, 2003, found at *http://www.pointcarbon.com*, retrieved Nov. 22, 2004; Point Carbon, "Over-allocation Undermines EU ETS, says WWF," Dec. 23, 2004, found at *http://www.pointcarbon.com*, retrieved Jan. 3, 2005; David Gow, "CO2 Trading Targets Too Generous, Say Environmentalists," *The Guardian* (United Kingdom), Jan. 5, 2004, found at *http://search.ft.com*, retrieved Jan. 10, 2004; and Point Carbon, "Report Slams ETS Allocation Process, UK Climate Policy," Feb. 5, 2005, found at *http://www.pointcarbon.com/*, retrieved on Feb. 7, 2005.

[102] Industry representative, interview by USITC staff, Oct. 27, 2004; and Point Carbon, "Market Comment," Carbon Market Europe, Dec. 10, 2004, found at *http://www.pointcarbon.com*, retrieved Dec. 10, 2004.

[103] Jeremy Grant, "CCX Takes Chicago By Storm," *Financial Times*, Nov. 15, 2004, found at *http://www.ft.com*, retrieved Nov. 18, 2004; Jeremy Grant, "Exchanges Plan Carbon Emissions Contract," *Financial Times*, Aug. 18, 2004, found at *http://www.ft.com*, retrieved Sep. 14, 2004; and industry representative, interview by USITC staff, Chicago, Dec. 2, 2004.

[104] An initial trade, between EDF Trading and Statoil, was executed for 5,000 EUAs at a price of €7.15. An additional 40,000 EUAs traded during the remainder of the day. Point Carbon, "First Clearing Exchange For European Allowances Launches," Feb. 11, 2005, found at *http://www.pointcarbon.com*, retrieved on Feb. 11, 2005; and Point Carbon, "Nord Pool Sees 45,000 Tonnes Traded During Debut Day," Feb. 11, 2005, found at *http://www.pointcarbon.com*, retrieved Feb. 11, 2005.

to set up a CO_2 emissions exchange.[105] Although some participants express concern that exchanges would compete with brokers, scattering liquidity and leading to a fragmented market, others believe that such exchanges will not be harmful to the nascent CO_2 emissions market. Indeed, some market participants believe that competition among the exchanges will narrow the field and/or result in the emergence of a single dominant exchange.[106]

[105] Laetitia Clavreul and Cecile Ducourtieux, "La Bourse francaise d'exchange de quotas de CO2 devrait etre operationnelle en mars," *Le Monde*, Jan. 6, 2005, found at *http://www.lemonde.fr*, retrieved Jan. 10, 2004.

[106] Industry representatives, interviews by USITC staff, London, United Kingdom, Oct. 26-27, 2004; Point Carbon, "Exchanges, Brokers Set To Compete For Market Share," *Carbon Market Europe*, Sept. 10, 2004, found at *http:///www.pointcarbon.com*, retrieved Nov. 22, 2004; and "A Green Future," *The Economist*, Sep. 9, 2004, found at *http://www.economist.com*, retrieved Sep. 10, 2004.

CHAPTER 6
NOISE POLLUTION ABATEMENT SERVICES AND EQUIPMENT

Introduction

Noise pollution is generally considered to be human-created noise harmful to health or welfare.[1] In addition to hearing loss, noise negatively affects human health by causing stress, high blood pressure, and sleep loss. Noise also affects a person's quality of life.[2] Noise pollution has many sources, most of which are associated with urban development: road, air and rail transport; industry; and recreation.[3] In recent years, the impact of noise on wildlife also has increasingly become a concern.[4] Increased knowledge of the health effects of noise and increased community awareness of environmental noise have created a higher expectation for governments at all levels to reduce noise levels.[5]

Noise pollution produced by a modern society includes the sounds of landing and departing aircraft, the sounds of the millions of cars and trucks traveling along roadways, the sounds of railways and urban subway systems, the constant drone of industrial machinery, the whines and impacts of construction activities, the steady or intermittent sounds of household appliances, and general annoyances such as loud music and barking dogs. In the developed world, most reported noise problems are associated with work environments and traffic, while the developing world commonly identifies traffic noise and other community noise as the most significant source of noise pollution. In response, many countries regulate occupational noise in the workplace to protect workers, and many countries regulate community noise from industrial plants, road and rail traffic, and construction that impact commercial and residential neighborhoods.[6] Noise regulations are generally promulgated, often in conjunction with health departments or

[1] *The Columbia Electronic Encyclopedia,* 6th ed., Columbia University Press, found at *http://www.infoplease.com/ce6/sci/A0835810.html*, retrieved Sept. 22, 2004.

[2] National Pollution Clearinghouse, *Noise Pollution*, found at *http://www.nonoise.org/aboutno.htm*, retrieved Sept. 13, 2004.

[3] Dr. Alice H. Suter, "Noise and Its Effects," Administrative Conference of the United States, Nov. 1991, found at *http://www.nonoise.org/library.htm*, retrieved Oct. 27, 2004

[4] National Pollution Clearinghouse, Noise Effects on Wildlife, found at *http://www.nonoise.org/library/fctsheet/wildlife.htm*, retrieved Sept. 13, 2004.

[5] Aftandilian, Dave, "NoisePollution," *Conscious Choice*, June 1999, found at *http://www.consciouschoice.com/note/note1206.html*, retrieved Sept. 13, 2004.

[6] For example, government officials in Chile stated that the basic conditions for workplace noise regulation were established in 1999. These regulations set noise emission requirements for most fixed sources and delineated measurement and testing methods. Government representative, interview by USITC staff, Santiago, Chile, Dec. 14, 2004.

ministries, by the government entities responsible for the related activity such as traffic, labor and industry, and construction. However, fewer countries regulate neighborhood-generated community noise.[7]

The intensity of the sound, its duration, and the time and place at which it is heard are factors to be considered in assessing noise pollution.[8] Many countries reportedly follow standards such as those prescribed by the World Health Organization and measurement methods prescribed by the International Standards Organization. Many countries' standards are similar to those established in larger, developed economies such as the United States or the European Union, which developed their noise regulations and procedures earlier than most world economies. However, even where regulations and standards are present, noise pollution abatement is often a lower priority and demands a smaller share of attention and national environmental protection expenditures than other more pressing problems such as water supply, wastewater management, solid waste management, and air pollution control.[9] In some countries, monitoring and enforcement of regulations is reportedly not systematic, and noise pollution abatement is stimulated primarily by citizen complaints.[10]

Technologies and Methods

The principal method for reducing noise pollution is the redesign of products and processes. Categories of effective redesign include the substitution of rotary motion for reciprocating action,[11] better dynamic balancing of rotating equipment to reduce vibration and associated noise, and elimination of high-speed gas jets which produce noisy turbulence.[12] Alternatives to product redesign include: confinement within an enclosure or barrier to prevent 'environmental' noise propagation, sound absorption through the use of specialized materials, and personal protective gear such as ear plugs and ear muffs.[13] The methods chosen to abate noise pollution typically depend on the source of a particular noise.

Traffic noise is reportedly the most common source of noise pollution. Traffic noise is affected by factors such as speed, weather, road conditions, terrain and landscaping, as well as the location and design of structures.[14] For example, government officials in Costa Rica and Brazil noted that the lack of insulation in many structures owing to minimal need for heating and limited use of cooling equipment contributes significantly

[7] World Health Organization, Occupational and community noise, Fact sheet No. 258, Feb. 2001, p. 2.

[8] Aftandilian, Dave, "NoisePollution," *Conscious Choice*, June 1999, found at *http://www.consciouschoice.com/note/note1206.html*, retrieved Sept. 13, 2004.

[9] Government representative, interview by USITC staff, Santiago, Chile, Dec. 14, 2004.

[10] Industry representative, interview by USITC staff, Santiago, Chile, Dec. 15, 2004.

[11] For example, rotary air compressors have displaced reciprocating piston compressors at most construction and mining locations.

[12] For example, modern jet engines have air entraining baffles which reduce the velocity of the exiting gas and effectively increase the orifice size, partly for noise reduction purposes.

[13] Other alternatives to noise pollution abatement are to shut down the noise producing activity or to move the activity to another location.

[14] Federico Miyara, Guidelines for an Urban Noise Ordinance, found at *http://www.hfpacoustical.com*, retrieved Oct. 15, 2004.

to noise pollution problems in many urban areas.[15] Approaches used to address roadway and urban traffic noise include limiting the speed and number of vehicles, building smooth and resilient road surfaces which minimize construction breaks, grading and aligning roadways to direct noise away from housing, and constructing noise barriers between highways and adjoining neighborhoods.[16] Some countries regulate one component of traffic noise– vehicle engine noise– as part of annual or semi-annual vehicle safety inspections. For example, Japan requires that cars pass three noise level checks: steady engine speed, acceleration, and exhaust noise.[17] Government officials in several countries noted that traffic noise, while the most significant noise problem reported, is addressed but not well regulated, and that many countries lack monitoring stations, cannot afford expensive sound barriers along roadways, and have few mechanisms to address such noise problems other than technical standards for vehicles.[18] One industry official noted that absence of strict zoning standards exacerbated the problem in many countries as noise producing industrial and commercial activities are often located in or near residential neighborhoods.[19]

New porous asphalt surfaces, which can reportedly reduce traffic noise by 3-5 dBA[20] as compared with dense asphalt surfaces, are used in several countries. The use of such surfaces has become mandatory in Japan, and more than 1,000 km of roads are already surfaced with such materials. A porous elastic road surface (PERS), composed of granulated rubber recovered from discarded auto tires with a urethane binder, could reduce road noise by up to 10 dBA. Through the use of PERS, the share of Japanese urban highways that meet noise limits, 13 percent in 1998, could rise to 90 percent in the near future.[21] In addition, Japan constructed more than 1,800km of acoustical noise barriers through 1998. However, noise barriers are costly; the average cost of barriers constructed in the United States through 1998 was almost $700,000 per kilometer.[22]

---

[15] Government representatives, interview by USITC staff, San Jose, Costa Rica, Dec. 6, 2004, and Sao Paulo, Brazil, Dec. 17, 2004.

[16] Federico Miyara, Guidelines for an Urban Noise Ordinance, found at *http://www.hfpacoustical.com*, retrieved Oct. 15, 2004.

[17] Government representative, interview by USITC staff, Tokyo, Japan, Nov. 8, 2004.

[18] Government representatives, interviews by USITC staff, San Jose, Costa Rica, Dec. 6, 2004, Santiago, Chile, Dec. 15, 2004, and Sao Paulo, Brazil, Dec. 17, 2004.

[19] Industry representative, interview by USITC staff, Santiago, Chile, Dec. 14, 2004.

[20] The term dBA is an expression of the relative loudness of sounds in air as perceived by the human ear. The use of an A filter reduces unfiltered decibel values of low frequency sounds because the human ear is less sensitive to low frequencies than to high frequencies. Decibels are measured in logarithmic terms to give a manageable set of numbers to cover the range of the human ear.

[21] The Sustainable Mobility Project, *Mobility 2030: Meeting the challenges to sustainability*, World Business Council for Sustainable Development, 2004, p. 126.

[22] The Sustainable Mobility Project, *Mobility 2030: Meeting the challenges to sustainability*, World Business Council for Sustainable Development, 2004, p. 126.

Aircraft noise affects both passengers and communities located near airports.[23] Three methods are commonly used to reduce the noise impacts of aircraft: implementing noise management plans, mitigating noise at the receiver by using sound insulation, and reducing noise, such as using quieter aircraft.[24] Approaches for aircraft noise abatement include curfews or time constraints, slot rules, preferential runway usage, specified flight tracks and landing/take-off patterns,[25] restrictions on what type of aircraft can use an airport, construction of noise barriers, and use of personal protective gear particularly by airport workers. In the absence of quieter aircraft or increased restriction of airport operations, the demand for sound insulation to directly protect nearby residents from the noise is likely to increase.[26] For example, following the preparation of a noise profile around an airport, an airport authority may make grants available for home owners to contract for the installation of sound barriers.[27] Such methods may reduce noise complaints and may be less expensive than trying to reduce aircraft noise at the source.[28] Sound barriers for households and businesses may be subsidized or financed by airport operators or local governments.[29]

Although railroad noise, including that of subways, is confined to areas near tracks, it is still an important source of noise pollution, particularly in urban areas.[30] Abatement technologies for noise caused by railways include: tight standards on track alignment and gauge; wide radii on curves; sound-proofing insulation between cars and frames; and sound dampening materials in tunnels and stations.[31]

Industrial activities such as product fabrication, product assembly, power generation, and processing generate noise. Although people living or working near an industrial facility may be affected by industrial noise, the abatement of industrial noise is usually required or undertaken to protect the workers within the plant.[32] Major industrial noise pollution situations also include: basic machinery noise; pipeline pumps and compressors; petrochemical plants, gas plants and refineries; power plants of all kinds (flare and steam venting noise); and, drilling and production at offshore oil and gas platforms.[33]

---

[23] Sources of Noise Pollution, found at *http://www.macalester.edu/~psych/whathap/UBNRP/Audition/site/noisesourcestraffic.html*, retrieved Sept. 15, 2004.

[24] Bugliarello et al. (1976)

[25] For example, government officials in Brazil noted that restrictions on airport operations were in effect at urban airports in both Sao Paulo and Rio de Janeiro, interview by USITC staff, Sao Paulo, Brazil, Dec. 17, 2004.

[26] National Aeronautics and Space Agency, Airport Noise and the Aviation Industry, found at *http://www.aero-space.nasa.gov/library/event_archives/encompat/workshop4/Schiphol.htm*, retrieved Oct. 21, 2004.

[27] Such an approach was reportedly utilized in Sao Paulo, Brazil. Government representative, interview by USITC staff, Sao Paulo, Brazil, Dec. 17, 2004.

[28] Industry representative, telephone interview by USITC staff, Sept. 27, 2004.

[29] HFP Acoustical Consultants, found at *http://www.hfpacoustical.com*, retrieved Oct. 15, 2004.

[30] Sources of Noise Pollution, found at *http://www.macalester.edu/~psych/whathap/UBNRP/Audition/site/noisesourcestraffic.html*, retrieved Sept. 15, 2004.

[31] HFP Acoustical Consultants, found at *http://www.hfpacoustical.com*, retrieved Oct. 15, 2004.

[32] Bugliarello et al. (1976)

[33] HFP Acoustical Consultants, found at *http://www.hfpacoustical.com*, retrieved Oct. 15, 2004.

Following analyses of noise problems at industrial facilities, abatement methods often recommended and implemented include: industrial mufflers and silencers; equipment enclosures; and redesign or engineering of industrial process or ancillary equipment.[34] Redesign is usually performed by the equipment manufacturer's engineering staff rather than the engineering staff of a contract services firm.

Construction, like manufacturing, is a major source of noise pollution, but unlike industrial equipment, which emits noise that primarily affects workers within a facility, construction equipment tends to be used outdoors, and thus affects many other people besides the workers at the site.[35] Most countries address noise pollution from construction projects through the redesign of construction equipment and limits on the operating hours for construction projects or specific types of equipment.[36]

Consumer products represent a wide range of noise-producing items often grouped in the following categories: household (e.g., vacuum cleaners), recreational (e.g., snowmobiles), yard or workshop (e.g., chain saws, lawn mowers, and power saws), and music (e.g., personal and home stereos). Most countries limit noise pollution from consumer products through the use of product standards and building codes.[37]

Market Size and Characteristics

Services related to noise pollution abatement are generally classified as consulting, construction, and engineering services. Examples of specific activities include: sound and vibration testing; noise profiles, assessments, evaluations, and monitoring; modeling of noise from vehicles, aircraft, and stationary sources; planning and design of noise barriers and enclosures; and technical support for litigation, environmental impact assessments, or public policy. These activities may be associated with the abatement of noise from any of the sources noted above.

The global market for services related to noise abatement, as distinguished from the provision of sound absorbing materials and the redesign of products and processes to be less noise producing, is believed to be extremely small economically as it is essentially confined to various testing, measuring, and modeling activities that might be done by outside contractors or consultants. Since the vast majority of the services associated with noise abatement is comprised of inspections, monitoring, engineering, construction, and installation services that are often provided as part of large construction or infrastructure projects, it is difficult to determine how much of those services associated with the construction of new facilities or the renovation of existing facilities can be attributed to noise pollution abatement. No data or estimates were uncovered during the course of the investigation that would provide even an approximate size of the global or country

[34] HFP Acoustical Consultants, found at *http://www.hfpacoustical.com*, retrieved Oct. 15, 2004.

[35] Sources of Noise Pollution, found at *http://www.macalester.edu/~psych/whathap/UBNRP/Audition/site/noisesourcestraffic.html*, retrieved Sept. 15, 2004.

[36] Industry representative, interview by USITC staff, Santiago, Chile, Dec. 15, 2004.

[37] Sources of Noise Pollution, found at *http://www.macalester.edu/~psych/whathap/UBNRP/Audition/site/noisesourcestraffic.html*, retrieved Sept. 15, 2004.

markets for the subject services. Given the lack of information on these services, it is difficult to characterize either the demand or supply for noise pollution abatement services. However, anecdotal evidence suggests that the market for noise monitoring and testing may be significant in larger economies with more mature industries and substantial enforcement of workplace noise regulations.[38]

Key Suppliers and Consumers

The suppliers or providers of noise pollution abatement activities, other than equipment engineering or installation, are almost entirely specialized engineering and consulting firms. Most of these firms are quite small– less than 100 employees, frequently less than 10 employees.[39] However, some larger engineering firms reportedly provide such services, particularly to established clients, with a large percentage of these services reportedly purchased by large multinational companies.[40] One industry representative indicated that his firm seldom accepted noise abatement consulting services assignments except as a favor to existing customers because they required too much time and effort for the compensation received and the sales effort involved.[41] Additionally, public laboratories and public agencies, in addition to providing enforcement of regulations and standards, supply noise monitoring and testing, research on noise abatement methods and technologies, as well as education and training.[42]

Consumers of noise abatement services are private firms or public entities (e.g., public airport authorities) responsible for the operation of those facilities that are sources of environmental noise pollution. In many cases, consumers will go directly to barrier or sound dampening material suppliers rather than engaging a consultant to study the problem and recommend a solution, as such equipment suppliers typically provide advice, at no additional charge, to prospective customers regarding which of their products would be most suitable for a particular application. In other cases, the consumer may pressure equipment suppliers by adopting a particular noise limit specification to encourage redesign.

Related Equipment

Other than certain equipment on the OECD's environmental goods list, such as vehicle mufflers, the equipment associated with noise abatement appears to be primarily measuring and testing equipment, computer hardware and software, and sound dampening panels. This is consistent with the notion that most actual noise abatement involves either the construction of noise barriers or the diminution of noise at its source, and that much of the latter involves incorporating noise limits as part of the product standards for vehicles and other transportation equipment, construction and process equipment, and consumer goods.

---

[38] Government representative, interview by USITC staff, Tokyo, Japan, Nov. 4, 2004.

[39] HFP Acoustical Consultants, found at *http://www.hfpacoustical.com*, retrieved Oct. 15, 2004.

[40] Industry representative, interview by USITC staff, Santiago, Chile, Dec. 15, 2004.

[41] Industry representative, telephone interview by USITC staff, Sept. 27, 2004.

[42] University representative, interview by USITC staff, Santiago, Chile, Dec. 15, 2004.

Trade and Investment

Data specific to trade and investment in noise pollution abatement services were not available. According to industry officials, trade and investment in services directly related to noise abatement is very small and often included in the cost of construction materials, equipment, or in the design, engineering, and construction of facilities. Thus, in the absence of data, it is difficult to estimate or analyze the extent, direction, or character of trade and investment in this sector. In several of the economies studied, local government and industry officials also indicated that domestic engineering and laboratory firms provide much of the monitoring and testing work in this sector, that noise-related testing equipment is often imported, and that other noise-related goods, such as acoustic panels, are often produced locally. One industry representative indicated that cross-border consulting activities are generally unremunerative as the cost of international sales calls to sell such services were prohibitively expensive, and often the contract, if any, usually went to a local firm.[43] For example, the same industry representative reports that Canadian firms typically source sound absorbing materials from domestic suppliers.[44]

In the absence of an internationally established list of environmental goods and equipment, OECD identified three Harmonized System 6-digit level categories as containing noise abatement equipment.[45] OECD then used the applied and bound tariffs for products in these HS 6-digit categories to compare tariff levels across countries in its work on trade liberalization of environmental goods and services. Although OECD did not use these categories to estimate trade in environmental equipment, one may get an indication of the extent of trade in noise pollution abatement equipment from the total goods traded in these HS categories. The three 6-digit categories identified by OECD include certain engine parts, vehicle mufflers, and vehicle exhaust pipes. In 2003, U.S. exports and imports of these goods totaled $4.2 billion and $5.5 billion, respectively. Global exports in these products amounted to more than $42.8 billion in 2003.[46] These figures include products not associated with noise pollution abatement and thus considerably overstate trade in noise abatement equipment. Since HS 870892 includes vehicle mufflers, trade in that category alone may be a better guide. In 2003, U.S. exports and imports of mufflers and exhaust pipes[47] totaled $369 and $489 million, respectively. Global exports of mufflers and exhaust pipes amounted to slightly more than $3.2 billion. These figures still overstate trade in noise abatement equipment, and the trade in these products follows trade in other automobile parts and is thus not necessarily a good indicator of trade in equipment used to abate noise from sources other than vehicle engines. Noise testing equipment, acoustic panels, and noise and vibration

[43] Industry representative, telephone interview by USITC staff, Sept. 27, 2004.

[44] Ibid.

[45] Noise pollution control equipment HS numbers 840991, 840999, and 870892 were noted in "Environmental Goods and Services: An Assessment of the Environmental, Economic and Development Benefits of Further Global Trade Liberalisation," Joint Working Party on Trade and Environment (COM/TD/ENV(2000)86/FINAL), Oct. 5, 2000 and can be found at *http://www.oecd.org/searchResult/0,2665,en_2649_201185_1_1_1_1_1,00.html*.

[46] Import and export data for selected countries as reported by the United Nations for HS 840991, 840999, and 870892. Data was retrieved from the WITS database on Dec. 17, 2004.

[47] Mufflers and exhaust pipes are classified in HS 870892 and those products cannot be differentiated, even in the U.S. Harmonized Tariff Schedule.

dampening materials and equipment are not separately identified in the trade statistics at that level of aggregation, and thus trade statistics are not available for these products.

As expected, the applied and bound tariffs on vehicle mufflers and exhaust pipes in HS 870892 are the lowest (less than 4 percent in 2001) in the those countries with large automobile industries (United States, Japan, Canada, and the European Union). In the other countries examined in this study, the applied rates in 2001 ranged from 5 to 35 percent, the bound rates exceeded 13 percent, or rates were simply unbound.

CHAPTER 7
SUMMARY OF FINDINGS

The analysis presented in this report indicates that demand for air and noise pollution abatement services and equipment is driven largely by government regulation and enforcement efforts, and to a lesser extent, by international treaty obligations, public sentiment, and private-sector financial resources. Regulatory regimes in developing countries are often less stringent than those in high-income countries, due to developing countries' relatively recent experience with such regulations. Similarly, the enforcement of air pollution control regulations tends to be more stringent in developed countries than in developing countries. Available evidence indicates that as incomes grow, regulatory stringency increases, which may increase demand for air pollution abatement goods and services. Participation in regional and multinational environmental agreements such as the Kyoto Protocol to the United Nations Framework Convention on Climate Change may spur future demand for air pollution abatement services. Moreover, disclosure of information on pollution levels has been found to motivate public demand for environmental compliance by polluters.

Air pollution abatement services and equipment are frequently supplied as part of a single transaction, with equipment accounting for the majority of the value of the sale. In addition, a substantial portion of air pollution abatement services are classified outside the air pollution abatement sector, in industries such as engineering and consulting. Global providers of air pollution abatement goods and services include a handful of large firms that provide a wide range of goods and services in numerous markets worldwide, and a large number of small firms that provide a narrow range of goods and services. Principal consumers of air pollution abatement goods and services include power plants, manufacturing facilities, waste incineration facilities, and the mining and agricultural industries.

The United States is estimated to be the world's largest consumer of air pollution abatement goods and services, followed by the European Union, China, and Japan. The United States is also estimated to be the world's top exporter of air pollution abatement services, while the European Union is likely the top exporter of air pollution abatement goods. There are few trade barriers that directly affect trade in air pollution abatement services, although some measures, largely non-tariff barriers, affect trade in related goods and equipment.

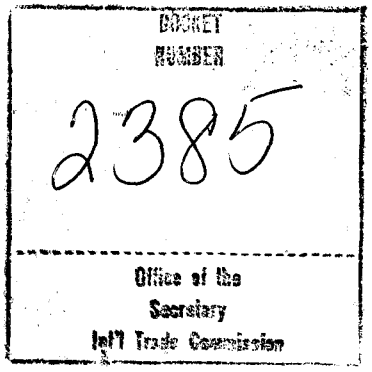
Services provided in connection with emissions trading, a market-based approach to air pollution abatement, are typically provided by brokerage and market research firms. Experience gained with the long-standing and highly successful U.S. Acid Rain Program has made it the model for more recently established emissions trading programs, most of which are in the early stages of development. Due to the relative infancy of many emissions trading programs, the net affect of these schemes in their respective markets for air pollution abatement equipment and services is difficult to determine. The European Union Emissions Trading Scheme (EU-ETS), which was officially launched in January 2005, is the most prominent, active, and ambitious program designed to mitigate greenhouse gas emissions in accordance with the Kyoto Protocol. The development of an international emissions trading market likely will be accomplished

by linking smaller, emerging schemes, such as those planned by Canada, Japan, and Norway, to the EU-ETS.

Little is known regarding the market for noise pollution abatement services. However, this market is likely very small, as such pollution is often addressed through product standards and zoning restrictions. As with the abatement of air pollution, many activities performed to abate noise pollution are classified outside of the noise pollution abatement sector, in industries such as engineering and consulting. Likewise, trade in noise pollution abatement services is likely very small, as the cross-border provision of some of these services is reportedly unremunerative.

APPENDIX A
REQUEST LETTER

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF THE UNITED STATES TRADE REPRESENTATIVE
WASHINGTON, D.C. 20508



JUL 12 2004

The Honorable Stephen Koplan
Chairman
U.S. International Trade Commission
500 E Street, SW
Washington DC, 20436

Steve.

Dear Chairman Koplan:

As you know, members of the World Trade Organization (WTO) have been engaged in negotiations under the General Agreement on Trade in Services (GATS) since January 2000. Negotiations on services are also underway as part of an effort to establish bilateral and regional free trade agreements between the United States and a number of its trading partners. These bilateral, regional, and multilateral negotiations are intended to liberalize services trade by reducing or eliminating measures that limit effective market access.

With these negotiations in mind, two concise reports on discrete segments of the environmental and energy services industries would be of interest to my office. Further information about such services markets will also be useful in carrying out environmental reviews of current and future WTO agreements and bilateral free trade agreements. Certain environmental and energy services– such as, *inter alia*, air and noise pollution abatement services and renewable energy services– are of significant importance to the global economy in terms of both market size and the role of such industries in achieving sustainable development. Government efforts to address environmental degradation and industry efforts to increase efficiency and maintain favorable environmental records have increased demand for environmental and energy services. Trade in such services ensures that all economies have access to reliable environmental technologies, and thus facilitates global environmental protection.

Therefore, I request, pursuant to authority delegated by the President under section 332(g) of the Tariff Act of 1930, that the U.S. International Trade Commission conduct two investigations and prepare reports. The first of these reports should cover air and noise pollution abatement services, and the second should cover renewable energy services. Each of these reports should, to the extent possible, (1) provide an overview of foreign and domestic markets for the subject services; (2) examine trade and investment in the subject services markets, including barriers affecting such trade and investment, if any; and (3) if possible, discuss existing regulatory practices that generate demand for the subject services. With regard to the geographic coverage of these reports, the Commission should endeavor to include examples from both developed- and developing-country markets. In addition, the Commission is encouraged to include examples– as appropriate– from those economies with which the United States has established, or is in the process of negotiating, a free trade arrangement. To the extent possible, these reports should also present information on trade and market conditions for those goods related to the subject environmental and energy services. The Commission is encouraged to include information gathered through public hearings and other consultations with interested parties.

The Commission is requested to deliver a report on the air and noise pollution abatement services industry no later than April 1, 2005. For the purpose of this report, I urge the Commission to define air and noise pollution abatement services to include control services of indoor or outdoor air pollution originating from stationary or mobile sources; services related to the trade of air pollution emission rights; services related to the monitoring, assessment, or control of acid rain; services related to the study of the relationship between

air pollution and climate; noise pollution abatement and control services; testing and monitoring of air or noise pollution; and other services incidental to air and noise pollution abatement.

The Commission is requested to deliver a report on the renewable energy services industry no later than October 1, 2005. For the purpose of this report, I urge the Commission to define the renewable energy industry to include the use of renewable power sources– including wind, solar energy, biomass fuels, tidal energy, and geothermal energy– in heating or electricity generation; the sale of renewable energy; geological analysis, resource assessment, and other services incidental to the evaluation, planning, or siting of a renewable energy project or facility; design, construction, and installation services for renewable energy equipment and facilities; the operation, management, and monitoring of renewable energy projects or facilities; decommissioning services; services incidental to the issuance of renewable energy certificates; research and development services related to renewable energy; and other services incidental to the development and use of renewable power sources.

My office intends to make the Commission's reports available to the general public in *their entirety*. Therefore, the reports should not contain any confidential business or national security classified information.

The Commission's assistance in this matter is greatly appreciated.

Sincerely,

Thanks!

Bob

Robert B. Zoellick

APPENDIX B
FEDERAL REGISTER NOTICE

information collection requests describe the nature of the information collections and their expected burden and cost.

DATES: OMB has up to 60 days to approve or disapprove the information collection but may respond after 30 days. Therefore, public comments should be submitted to OMB by September 10, 2004, in order to be assured of consideration.

FOR FURTHER INFORMATION CONTACT: To request a copy of either information collection request, explanatory information and related form, contact John A. Trelease at (202) 208–2783. You may also contact Mr. Trelease at *jtreleas@osmre.gov*.

SUPPLEMENTARY INFORMATION: OMB regulations at 5 CFR 1320, which implement provisions of the Paperwork Reduction Act of 1995 (Pub. L. 104–13), require that interested members of the public and affected agencies have an opportunity to comment on information collection and recordkeeping activities [see 5 CFR 1320.8(d)]. OSM has submitted two requests to OMB to renew its approval for the collections of information found at 30 CFR Parts 732 and 874. OSM is requesting a 3-year term of approval for these information collection activities.

An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for these collections of information are 1029–0024 for Part 732 and 1029–0113 for Part 874, and may be found in OSM's regulations at 732.10 and 874.10.

As required under 5 CFR 1320.8(d), a **Federal Register** notice soliciting comments on the collections of information for Parts 732 ad 874 was published on March 31, 2004 (69 FR 16954). No comments were received from that notice. This notice provides the public with an additional 30 days in which to comment on the following information collection activities:

Title: Procedures and Criteria for Approval or Disapproval of State Program Submissions, 30 CFR Part 732.

OMB Control Number: 1029–0024.

Summary: Part 732 establishes the procedures and criteria for approval and disapproval of State program submissions. The information submitted is used to evaluate whether State regulatory authorities are meeting the provisions of their approved programs.

Bureau Form Number: None.

Frequency of Collection: Once, quarterly and annually.

Description of Respondents: 24 State regulatory authorities.

Total Annual Responses: 51.

Total Annual Burden Hours: 6,453.

Title: General Reclamation Requirements, 30 CFR Part 874.

OMB Control Number: 1029–0113.

Summary: Part 874 establishes land and water eligibility requirements, reclamation objectives and priorities and reclamation contractor responsibility. 30 CFR 874.17 requires consultation between the AML agency and the appropriate Title V regulatory authority on the likelihood of removing the coal under a Title V permit and concurrences between the AML agency and the appropriate Title V regulatory authority on the AML project boundary and the amount of coal that would be extracted under the AML reclamation project.

Bureau Form Number: None.

Frequency of Collection: Once.

Description of Respondents: 16 State regulatory authorities and Indian tribes.

Total Annual Responses: 16.

Total Annual Burden Hours: 1,168.

Send comments on the need for the collections of information for the performance of the functions of the agency; the accuracy of the agency's burden estimates; ways to enhance the quality, utility and clarity of the information collections; and ways to minimize the information collection burden on respondents, such as use of automated means of collection of the information, to the following address. Please refer to the appropriate OMB control number in all correspondence.

ADDRESSES: Submit comments to the Office of Information and Regulatory Affairs, Office of Management and Budget, Attention: Department of Interior Desk Officer, by telefax at (202) 395–6566 or via e-mail to *OIRA_Docket@omb.eop.gov*. Also, please send a copy of your comments to John A. Trelease, Office of Surface Mining Reclamation and Enforcement, 1951 Constitution Ave, NW, Room 210—SIB, Washington, DC 20240, or electronically to *jtreleas@osmre.gov*.

Dated: June 15, 2004.

Sarah E. Donnelly,

Acting Chief, Division of Regulatory Support.

[FR Doc. 04–18348 Filed 8–10–04; 8:45 am]

BILLING CODE 4310–05–M

INTERNATIONAL TRADE COMMISSION

[Investigation No. 332–461]

Air and Noise Pollution Abatement Services: An Examination of U.S. and Foreign Markets

AGENCY: International Trade Commission.

ACTION: Institution of investigation and scheduling of public hearing.

DATES: Effective August 4, 2004.

SUMMARY: Following receipt of a request on July 12, 2004 from the United States Trade Representative (USTR), the Commission instituted investigation No. 332–461, Air and Noise Pollution Abatement Services: An Examination of U.S. and Foreign Markets, under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)).

FOR FURTHER INFORMATION CONTACT: Information specific to this investigation may be obtained from Jennifer Baumert, Project Leader (202–204–3450; *jennifer.baumert@usitc.gov*), Eric Forden, Deputy Project Leader, (202–205–3235; *eric.forden@usitc.gov*), or Richard Brown, Chief, Services and Investment Division (202–205–3438; *richard.brown@usitc.gov*), Office of Industries, U.S. International Trade Commission, Washington, DC, 20436. For information on the legal aspects of this investigation, contact William Gearhart of the Office of the General Counsel (202–205–3091; *willam.gearhart@usitc.gov*). Hearing impaired individuals are advised that information on this matter can be obtained by contacting the TDD terminal on (202)–205–1810.

Background: As requested by the USTR, the Commission's report will, to the extent possible, (1) provide an overview of foreign and domestic markets for air and noise pollution abatement services; (2) examine trade and investment in air and noise pollution abatement services markets, including barriers affecting such trade and investment, if any; and (3) if possible, discuss existing regulatory practices that generate demand for the subject services. USTR has requested that the Commission's study include examples from both developed- and developing-country markets. In addition, the USTR has asked the Commission to include examples—as appropriate—from those economies with which the United States has established, or is in the process of negotiating, a free trade arrangement. To the extent possible, the Commission is also requested to present information on

trade and market conditions for those goods related to the subject environmental services. For the purpose of this study, air and noise pollution abatement services are defined to include control services of indoor or outdoor air pollution originating from stationary or mobile sources; services related to the trade of air pollution emission rights; services related to the monitoring, assessment, or control of acid rain; services related to the study of the relationship between air pollution and climate; noise pollution abatement and control services; testing and monitoring of air or noise pollution; and other services incidental to air and noise pollution abatement.

The USTR asked that the Commission furnish its report by April 1, 2005, and that the Commission make the report available to the public in its entirety.

The USTR letter also requests an investigation on renewable energy services. In response, the Commission has instituted Investigation No. 332–462, Renewable Energy Services: An Examination of U.S. and Foreign Markets, which is due to the USTR on October 1, 2005.

Public Hearing: A public hearing in connection with the investigation will be held at the U.S. International Trade Commission Building, 500 E Street SW., Washington, DC, beginning at 9:30 a.m. on October 20, 2004. All persons shall have the right to appear, by counsel or in person, to present information and to be heard. Requests to appear at the public hearing should be filed with the Secretary, United States International Trade Commission, 500 E Street SW., Washington, DC 20436, no later than 5:15 p.m., October 5, 2004. Any prehearing briefs (original and 14 copies) should be filed not later than 5:15 p.m., October 7, 2004; the deadline for filing post-hearing briefs or statements is 5:15 p.m., November 4, 2004. In the event that, as of the close of business on October 5, 2004, no witnesses are scheduled to appear at the hearing, the hearing will be canceled. Any persons interested in attending the hearing as an observer or non-participant may call the Secretary of the Commission (202–205–1806) after October 5, 2004, for information concerning whether the hearing will be held.

Written Submissions: In lieu of or in addition to participating in the hearing, interested parties are invited to submit written statements (original and 14 copies) concerning the matters to be addressed by the Commission in its report on this investigation. Commercial or financial information that a submitter desires the Commission to treat as confidential must be submitted on separate sheets of paper, each clearly marked "Confidential Business Information" at the top. All submissions requesting confidential treatment must conform with the requirements of section § 201.6 of the Commission's Rules of Practice and Procedure (19 CFR 201.6). All written submissions, except for confidential business information, will be made available in the Office of the Secretary to the Commission for inspection by interested parties. The Commission will not include any confidential business information in the report it sends to the USTR. To be assured of consideration by the Commission, written statements relating to the Commission's report should be submitted to the Commission at the earliest practical date and should be received no later than the close of business on November 4, 2004. All submissions should be addressed to the Secretary, United States International Trade Commission, 500 E Street SW., Washington, DC 20436. The Commission's rules do not authorize filing submissions with the Secretary by facsimile or electronic means, except to the extent permitted by section 201.8 of the Commission's Rules of Practice and Procedure (19 CFR 201.8) (see Handbook for Electronic Filing Procedures, *ftp://ftp.usitc.gov/pub/reports/electronic_filing_handbook.pdf*). Persons with questions regarding electronic filing should contact the Secretary (202–205–2000 *edis@usitc.gov*).

Persons with mobility impairments who will need special assistance in gaining access to the Commission should contact the Office of the Secretary at 202–205–2000. General information concerning the Commission may also be obtained by accessing its Internet server (*http://www.usitc.gov*).

List of Subjects

WTO, GATS, air and noise pollution abatement services.

Issued: August 5, 2004.

By order of the Commission.

Marilyn R. Abbott,

Secretary to the Commission.

[FR Doc. 04–18315 Filed 8–10–04; 8:45 am]

BILLING CODE 7020–02–P

INTERNATIONAL TRADE COMMISSION

[Investigation No. 332–462]

Renewable Energy Services: An Examination of U.S. and Foreign Markets

AGENCY: International Trade Commission.

ACTION: Institution of investigation and scheduling of public hearing.

DATES: Effective August 3, 2004.

SUMMARY: Following receipt of a request on July 12, 2004 from the United States Trade Representative (USTR), the Commission instituted investigation No. 332–462, Renewable Energy Services: An Examination of U.S. and Foreign Markets, under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)).

FOR FURTHER INFORMATION CONTACT: Information specific to this investigation may be obtained from Lisa Ferens, Project Leader (202–205–3486; *lisa.ferens@usitc.gov*), Jennifer Baumert, Deputy Project Leader, (202–205–3450; *jennifer.baumert@usitc.gov*), or Richard Brown, Chief, Services and Investment Division (202–205–3438; *richard.brown@usitc.gov*), Office of Industries, U.S. International Trade Commission, Washington, DC, 20436. For information on the legal aspects of this investigation, contact William Gearhart of the Office of the General Counsel (202–205–3091; *willam.gearhart@usitc.gov*). Hearing impaired individuals are advised that information on this matter can be obtained by contacting the TDD terminal on (202) 205–1810.

Background: As requested by the USTR, the Commission's report will, to the extent possible, (1) provide an overview of foreign and domestic markets for renewable energy services; (2) examine trade and investment in renewable energy services markets, including barriers affecting such trade and investment, if any; and (3) if possible, discuss existing regulatory practices that generate demand for the subject services. USTR has requested that the Commission's study include examples from both developed- and developing-country markets. In addition, the USTR has asked the Commission to include examples—as appropriate—from those economies with which the United States has established, or is in the process of negotiating, free trade arrangements. To the extent possible, the Commission is also requested to present information on trade and market conditions for those goods related to the subject renewable

APPENDIX C
CLEANING SERVICES OF EXHAUST GASES AND NOISE ABATEMENT SERVICES IN THE GENERAL AGREEMENT ON TRADE IN SERVICES (GATS)

Introduction

The General Agreement on Trade in Services (GATS) was signed in April of 1994 and entered into force in January of 1995. The GATS is the first multilateral, legally enforceable agreement covering trade and investment in the service sector. Modeled after the agreement on goods, the GATS is a "positive-list" agreement[1] which binds signatories to provide foreign firms with market access and nondiscriminatory treatment, subject to defined exemptions. The primary purpose of the agreement is to reduce or eliminate measures that prevent services from being provided across borders or that discriminate against locally established service providers with foreign ownership. The agreement is organized in four parts: the main text containing general principles and obligations; annexes dealing with rules for specific sectors; individual countries' specific commitments; and lists indicating temporary exemptions from the most-favored nation principle of nondiscrimination.

Country-Specific Commitments

Country-specific commitments typically are organized based on the Services Sectoral Classification List,[2] which organizes services industries into twelve broad sectoral categories and provides corresponding numbers from the United Nations Provisional Central Product Classification (CPC). Under this classification scheme, the environmental services sector includes four subsectors: sewage services (CPC 9401); refuse disposal services (CPC 9402); sanitation and similar services (CPC 9403); and other environmental services, which are generally presumed to include cleaning of exhaust gasses (CPC 9404), noise abatement services (CPC 9405), nature and landscape protection services (CPC 9406) and other environmental services (CPC 9409).

Fifty-one WTO members[3] have scheduled specific commitments in the environmental services sector; 39 of these members have scheduled commitments on cleaning services of exhaust gases[4] and 38 members have scheduled commitments on noise abatement services.[5] Twenty members have scheduled commitments granting full market access and national treatment to foreign service suppliers that provide cleaning services of exhaust gases and noise abatement services through

[1] Under a "positive-list" agreement, members are only bound by those commitments that they specifically list within their Schedules, which comprise part of the agreement. By contrast, a "negative-list" agreement binds member countries to all provisions covered by the agreement unless otherwise specified.

[2] World Trade Organization (WTO), "Services Sectoral Classification List," MTN.GNS/W/120, July 10, 1991.

[3] For the purposes of this analysis, the EC-12 is counted as one member as these countries submitted a single schedule.

[4] This number includes members that have full or partial commitments. Also included are members that submitted commitments under a general environmental services heading (e.g., "Environmental Services" or "Other Environmental Services") or that may only include a part of this sector.

[5] Ibid.

cross-border supply (mode 1),[6] consumption abroad (mode 2),[7] and commercial presence (mode 3)[8] (table C-1 and C-2). Limitations listed by the remaining countries include, *inter alia*, licensing restrictions, provisions requiring approval for the establishment of a commercial presence, a provision requiring foreign firms to form a joint venture (listed in China's schedule), and a measure limiting foreign equity participation to 49 percent (listed in Thailand's schedule). Several member countries have not scheduled bindings on cleaning services of exhaust gases or noise abatement services provided through cross-border supply as they consider such transactions technically infeasible. Most measures regarding the supply of services through the presence of natural persons (mode 4)[9] are addressed in each member country's horizontal commitments.

With regard to scope, 26 members have scheduled commitments that cover the full range of services in the cleaning of exhaust gases sector and 25 members have scheduled commitments that cover the full range of services in the noise abatement sector (tables C-1 and C-2). Thirteen countries—Bulgaria, China, Georgia, Korea, Lesotho, Liechtenstein, Norway, Panama, Poland, South Africa, Sweden, Switzerland, and the United States—have limited the range of activities covered under their commitments on cleaning services of exhaust gases and/or noise abatement services. Bulgaria, Liechtenstein, Norway, Sweden, and Switzerland exclude activities provided under government authority, whereas China, Georgia, Korea, Lesotho, Panama, Poland, South Africa, and the United States limit the type activities covered by their commitments. For example, Liechtenstein, Sweden, and Switzerland's commitments do not cover public works functions. Among these countries that limit the activities covered by their commitments, Korea excludes construction services, while China excludes environmental quality monitoring and pollution source inspection. Some countries chose to list a specific set of activities that are covered by their commitments on cleaning services of exhaust gases and noise abatement services. For instance, Georgia, Lesotho, and South Africa indicate that their commitments on these services segments cover only consultancy services.

---

[6] One of four possible modes of delivering services to foreign consumers, whereby the service is transported beyond the home country of the service supplier to the foreign consumer. Cross-border supply may entail transportation by mail, telecommunications, or the physical movement of merchandise embodying a service (e.g., a diskette storing information) from one country to another. The mode is "cross-border" when the service supplier is not present within the territory where the service is delivered.

[7] One of four possible modes of delivering services to foreign consumers, whereby the consumer, or the consumer's property, receives a service outside the territory of his/her home country, either by moving or being situated abroad.

[8] One of four possible modes of delivering services to foreign consumers, whereby a service supplier establishes any type of business or professional establishment in the foreign market. Commercial presence comprises entities such as corporations, trusts, joint ventures, partnerships, sole proprietorships, associations, representative offices, and branches

[9] One of four possible modes of delivering services to foreign consumers, whereby an individual, acting alone or as an employee of a service supplier, provides a service by traveling to a foreign market.

Offers Regarding Cleaning Services of Exhaust Gases and Noise Abatement Services

In keeping with Article XIX of the GATS,[10] a new round of services negotiations began in January 2000. These negotiations are being conducted through a request-offer approach. Under this approach, WTO member economies have submitted initial requests, formally asking other WTO members to make specific changes to their schedules of commitments. Following the receipt of these requests, WTO members submitted initial offers. Paragraph 15 of the Doha Development Agenda established March 31, 2003 as the due date for the submission of initial services offers.[11] These nonbinding offers are presented in redline-strikeout format, illustrating the changes that member economies may be willing to make in their schedules of commitments in response to other members' requests.[12]

As of April 2004, 42 member countries had submitted services offers to the WTO, and 12 of these offers had been derestricted and made available to the public. Tables C-3 and C-4 provide an overview of public offers that specifically address the cleaning services of exhaust gases and noise abatement services segments. The tables indicate the extent to which these offers differ from commitments that are currently in place. The tables also indicate which countries have organized their offers based on the WTO Services Sectoral Classification List (also known as the W/120),[13] and which countries have offered to recast their commitments based on a classification scheme proposed by the European Union in 2000.[14] These classification schemes are compared in table C-5. Offers submitted by WTO members are not binding, but they illustrate how certain member countries proposed to alter their services trade commitments at a certain point in time.

[10] Article XIX of the GATS requires WTO member economies to initiate a new round of services negotiations no later than five years after the entry into force of the WTO agreement.

[11] World Trade Organization (WTO), *Ministerial Declaration: Adopted on 14 November 2001,* WT/MIN(01)/DEC/1, Nov. 20, 2001.

[12] For more information on the current round of WTO services negotiations, see *http://www.wto.org/english/tratop_e/serv_e/s_negs_e.htm.*

[13] WTO, MTN.GNS/W/120, July 10, 1991.

[14] WTO, "Communication from the European Communities and their Member States, GATS 2000: Environmental Services," S/CSS/W/38, Dec. 22, 2000.

Table C-1
Nature of GATS commitments on cleaning services of exhaust gases

Member country	Do commitments apply to all or part of the sector?	Did the member country schedule full or partial commitments?[1]	Nature of limitations listed in GATS schedule
Albania	All	Full	--
Armenia	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Austria	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility. Commercial presence is required for the provision of services through the presence of natural persons (mode 4).
Bulgaria	Part	Full	Commitments do not cover environmental services supplied in the exercise of governmental authority, which includes regulatory, administrative, and control services by government and municipal bodies related to environmental issues. Additionally, commitments do not apply to services related to the collection, transportation, storage, secondary use, recycling, restoration, use in the production of energy and materials, and disposal of dangerous waste, refuse, and substances. The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Canada	All	Full	--
China	Part	Partial	Commitments exclude quality monitoring and pollution source inspection. Additionally, foreign firms are granted market access through a commercial presence (mode 3) only in the form of joint ventures, although foreign majority ownership is permitted. Environmental consultation is the only cross-border (mode 1) service covered by these commitments.
Croatia	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Ecuador	All	Full	--
El Salvador	All	Partial	Commitments only cover market access for provision of services through a commercial presence (mode 3). There are no commitments on national treatment.
Estonia	All	Full	--
EU	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.

See footnotes at end of table.

Table C-1--*Continued*
Nature of GATS commitments on cleaning services of exhaust gases

Member country	Do commitments apply to all or part of the sector?	Did the member country schedule full or partial commitments?[1]	Nature of limitations listed in GATS schedule
Finland	All	Full	--
FYR Macedonia	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Georgia	Part	Full	Commitments on cross-border supply (mode 1) apply only to consulting and advisory services.
Iceland[2]	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility. An environmental operating license is required for market access through commercial presence (mode 3) and presence of natural persons (mode 4).
Japan	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Jordan	All	Full	--
Korea	Part	Full	Commitments cover services other than construction work services under CPC 9404.
Kyrgyz Republic[2]	All	Full	--
Latvia	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Lesotho	Part	Full	Commitments cover consultancy services only.
Liechtenstein	Part	Partial	Commitments do not apply to public works functions, whether owned and operated by municipalities or the Liechtenstein Government or contracted out by them. The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Lithuania	All	Full	--
Moldova	All	Full	--

See footnotes at end of table.

Table C-1--*Continued*
Nature of GATS commitments on cleaning services of exhaust gases

Member country	Do commitments apply to all or part of the sector?	Did the member country schedule full or partial commitments?[1]	Nature of limitations listed in GATS schedule
Morocco[3]	All	Partial	Reserves the right to limit market access through cross-border supply (mode 1) and consumption abroad (mode 2).
Norway	Part	Partial	Commitments do not cover public service functions whether owned and operated or contracted out by the local, regional, or central government. The provision of services through cross-border supply (mode 1) is unbound. Government owned monopoly for contract services of exhaust-gases from cars and trucks. Such services must be offered on a non-profit basis for market access through commercial presence.
Oman	All	Full	--
Panama	Part	Partial	Commitments are limited to implementation and installation of new or existing cleaning systems, remedial, preventive and monitoring services; consulting services in these fields.
Poland	Part	Full	Commitments may not cover all services defined under CPC 9404. The commitments are marked with a double asterisk which typically indicates that only a part of the CPC is covered. However, Poland did not indicated what a double asterisk means.
Qatar[4]	All	Partial	Reserves the right to limit the provision of cleaning services of exhaust gases through cross-border supply (mode 1) and consumption abroad (mode 2).
Romania[2]	All	Full	–
Sierra Leone[4]	All	Partial	Reserves the right to limit the provision of cleaning services of exhaust gases through cross-border supply (mode 1) and consumption abroad (mode 2).
South Africa	Part	Full	Commitments apply to consultancy services only.
Sweden	Part	Partial	Commitments do not cover public works functions whether owned and operated by municipalities, state, or federal governments or contracted out by them.

See footnotes at end of table.

Table C-1--*Continued*
Nature of GATS commitments on cleaning services of exhaust gases

Member country	Do commitments apply to all or part of the sector?	Did the member country schedule full or partial commitments?[1]	Nature of limitations listed in GATS schedule
Switzerland	Part	Partial	Commitments do not cover public works functions whether owned and operated by municipalities, cantons, or the Federal Government, or contracted out by them. The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Taiwan	All	Full	Reserves the right to limit market access through cross-border supply (mode 1).
Thailand	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility. There are no limitations on national treatment for the supply of services through a commercial presence (mode 3), as long as foreign equity participation does not exceed 49 percent and as indicated in the horizontal commitments.
United Arab Emirates[2]	All	Full	--
United States	Part	Full	Commitments are limited to the following activities: implementation and installation of new or existing systems for environmental cleanup, remediation, prevention, and monitoring; implementation of environmental quality control and pollution reduction services; maintenance and repair of environment-related systems and facilities not already covered by the US commitments on maintenance and repair of equipment; on-site environmental investigation, evaluation, and monitoring; sample collection services; training on site or at the facility; and consulting related to these areas.

[1] Most measures regarding the supply of services through the presence of natural persons (mode 4) are addressed in a member country's horizontal commitments. Thus, for the purposes of this table, a full commitment is any commitment that grants full market access or national treatment to foreign individuals or firms that provide cleaning services of exhaust gases through cross-border supply (mode 1), consumption abroad (mode 2), and commercial presence (mode 3).

[2] Commitments include Other Environmental Services but do not specifically identify cleaning services of exhaust gases or CPC 9404.

[3] Does not specifically identify cleaning services of exhaust gases or CPC 9404, but uses the broader CPC 940 category -- which includes cleaning services of exhaust gases – to define the scope of the sector covered by these commitments.

[4] Does not identify specific environmental service categories, but rather treats the entire sector as a whole.

Source: Compiled by the U.S. International Trade Commission.

Table C-2
Nature of GATS commitments on noise abatement services

Member country	Do commitments apply to all or part of the sector?	Did the member country schedule full or partial commitments?[1]	Nature of limitations listed in GATS schedule
Albania	All	Full	--
Armenia	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Austria	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility. Commercial presence is required for the provision of services through the presence of natural persons (mode 4).
Bulgaria	Part	Full	Commitments do not cover environmental services supplied in the exercise of governmental authority, which includes regulatory, administrative, and control services by government and municipal bodies related to environmental issues. Additionally, commitments do not apply to environmental services related to the collection, transportation, storage, secondary use, recycling, restoration, use in the production of energy and materials, and disposal of dangerous waste, refuse, and substances. The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Canada	All	Full	--
China	Part	Partial	Commitments exclude quality monitoring and pollution source inspection. Additionally, foreign firms are granted market access through a commercial presence (mode 3) only in the form of joint ventures, although foreign majority ownership is permitted. Environmental consultation is the only cross-border (mode 1) service covered by these commitments.
Croatia	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Ecuador	All	Full	--
El Salvador	All	Partial	Commitments only cover market access for provision of services through a commercial presence (mode 3). There are no commitments on national treatment.
Estonia	All	Full	--

See footnotes at end of table.

Table C-2--*Continued*
Nature of GATS commitments on noise abatement services

Member country	Do commitments apply to all or part of the sector?	Did the member country schedule full or partial commitments?[1]	Nature of limitations listed in GATS schedule
Finland	All	Full	--
FYR Macedonia	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Georgia	Part	Full	Commitments on cross-border supply (mode 1) apply only to consulting and advisory services.
Iceland[2]	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility. An environmental operating license is required for market access through commercial presence (mode 3) and presence of natural persons (mode 4).
Japan	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Jordan	All	Full	--
Korea	Part	Full	Commitments cover services other than construction work services under CPC 9405.
Kyrgyz Republic[2]	All	Full	--
Latvia	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Lesotho	Part	Full	Commitments cover consultancy services only.
Liechtenstein	Part	Partial	Commitments do not apply to public works functions, whether owned and operated by municipalities or the Liechtenstein Government or contracted out by them. The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Lithuania	All	Full	--
Moldova	All	Full	--

See footnotes at end of table.

Table C-2--*Continued*
Nature of GATS commitments on noise abatement services

Member country	Do commitments apply to all or part of the sector?	Did the member country schedule full or partial commitments?[1]	Nature of limitations listed in GATS schedule
Morocco[3]	All	Partial	Reserves the right to limit market access through cross-border supply (mode 1) and consumption abroad (mode 2).
Norway	Part	Partial	Commitments do not cover public service functions whether owned and operated or contracted out by the local, regional, or central government. The provision of services through cross-border supply (mode 1) is unbound.
Oman	All	Full	--
Panama	Part	Partial	Commitments are limited to implementation and installation of new or existing cleaning systems, remedial, preventive and monitoring services; consulting services in these fields.
Poland	Part	Full	Commitments may not cover all services defined under CPC 9405. The commitments are marked with a double asterisk which typically indicates that only a part of the CPC is covered. However, Poland did not indicated what a double asterisk means.
Qatar[4]	All	Partial	Reserves the right to limit the provision of noise abatement services through cross-border supply (mode 1) and consumption abroad (mode 2).
Romania[2]	All	Full	–
Sierra Leone[4]	All	Partial	Reserves the right to limit the provision of noise abatement services through cross-border supply (mode 1) and consumption abroad (mode 2).
South Africa	Part	Full	Commitments apply to consultancy services only.
Sweden	Part	Partial	Commitments do not cover public works functions whether owned and operated by municipalities, state, or federal governments or contracted out by them. The provision of services through cross-border supply (mode 1) is unbound due to technical feasibility.

See footnotes at end of table.

Table C-2--*Continued*
Nature of GATS commitments on noise abatement services

Member country	Do commitments apply to all or part of the sector?	Did the member country schedule full or partial commitments?[1]	Nature of limitations listed in GATS schedule
Switzerland	Part	Partial	Commitments do not cover public works functions whether owned and operated by municipalities, cantons, or the Federal Government, or contracted out by them. The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility.
Taiwan	All	Full	Reserves the right to limit market access through cross-border supply (mode 1).
Thailand	All	Partial	The provision of services through cross-border supply (mode 1) is unbound due to technical infeasibility. There are no limitations on national treatment for the supply of services through a commercial presence (mode 3), as long as foreign equity participation does not exceed 49 percent and as indicated in the horizontal commitments.
United Arab Emirates[2]	All	Full	--
United States	Part	Full	Commitments are limited to the following activities: implementation and installation of new or existing systems for environmental cleanup, remediation, prevention, and monitoring; implementation of environmental quality control and pollution reduction services; maintenance and repair of environment-related systems and facilities not already covered by the US commitments on maintenance and repair of equipment; on-site environmental investigation, evaluation, and monitoring; sample collection services; training on site or at the facility; and consulting related to these areas.

[1] Most measures regarding the supply of services through the presence of natural persons (mode 4) are addressed in a member country's horizontal commitments. Thus, for the purposes of this table, a full commitment is any commitment that grants full market access or national treatment to foreign individuals or firms that provide noise abatement services through cross-border supply (mode 1), consumption abroad (mode 2), and commercial presence (mode 3).

[2] Commitments include Other Environmental Services but do not specifically identify noise abatement services or CPC 9405.

[3] Does not specifically identify noise abatement services or CPC 9405, but uses the broader CPC 940 category -- which includes noise abatement services – to define the scope of the sector covered by these commitments.

[4] Does not identify specific environmental service categories, but rather treats the entire sector as a whole.

Source: Compiled by the U.S. International Trade Commission.

Table C-3
Publicly available offers submitted by WTO members on cleaning services of exhaust gases

WTO Member	Basis of environmental services classification	Changes to scope of Uruguay Round commitments	Changes to content of Uruguay Round commitments
Australia	EU proposal	Australia previously had no commitments on services to reduce exhaust gases and other emissions (CPC 9404). Uruguay Round commitments cover the entire industry segment.	Australia, which previously had no commitments on services to reduce exhaust gases and other emissions (CPC 9404), is offering to schedule partial commitments on this industry. Commitments would reserve the right to limit market access and national treatment through mode 1 due to lack of technical feasibility.
Canada	W/120	None- Uruguay Round commitments cover the entire industry segment	None- Uruguay Round schedule includes full commitments on this industry segment
Chile	None used	None- There continues to be no commitments scheduled on this industry segment	None- There continues to be no commitments schedule on this industry
European Union[1]	EU proposal	Uruguay Round commitments for most EU member countries cover the entire industry segment. Sweden has a government owned monopoly for control service of exhaust-gas from cars and trucks. Such services must be offered on a non-profit basis.	The EU is offering to make some minor changes, making its mode 4 commitments on this industry segment compatible with its new horizontal commitments on mode 4. Commitments would continue to reserve the right to limit market access and national treatment through mode 1. Finland would continue to maintain no mode 1 and mode 4 restrictions.
Iceland	W/120	None- There continues to be no commitments scheduled on this industry segment.	None- There continues to be no commitments schedule on this industry segment.
Japan	EU proposal	None- Uruguay Round commitments cover the entire industry segment.	None- Commitments would continue to be unbound for mode 1 due to lack of technical feasibility.
Liechtenstein	W/120	None- Uruguay Round commitments cover the entire industry segment.	None- Commitments would continue to be unbound for mode 1 due to lack of technical feasibility.

See footnote at end of table.

Table C-3—*Continued*
Publicly available offers submitted by WTO members on cleaning services of exhaust gases

WTO Member	Basis of environmental services classification	Changes to scope of Uruguay Round commitments	Changes to content of Uruguay Round commitments
New Zealand	EU proposal	New Zealand previously had no commitments on services to reduce exhaust gases and other emissions (CPC 9404). Uruguay Round commitments cover the entire industry segment.	New Zealand, which previously had no commitments on services to reduce exhaust gases and other emissions (CPC 9404), is offering to schedule full commitments on this industry.
Norway	EU proposal	Norway is offering to eliminate the provision requiring that services be on a non-profit basis placed on control services of exhaust-gas from cars and trucks given the government owned monopoly.	Norway is offering to eliminate the right to limit market access and national treatment through mode 1. Uruguay Round schedule would now include full commitments on this industry segment.
Slovenia	W/120	None- There continues to be no commitments scheduled on this industry segment.	None- There continues to be no commitments schedule on this industry segment.
Turkey	W/120	None- There continues to be no commitments scheduled on this industry.	None- There continues to be no commitments schedule on this industry segment.
United States	EU proposal	None- Uruguay Round commitments cover the entire industry segment	None- Uruguay Round schedule includes full commitments on this industry segment

[1] Sweden: The offer does not include public works functions whether owned and operated by municipalities, state or federal governments or contracted out by these governments.

Source: Compiled by the U.S. International Trade Commission

Table C-4
Publicly available offers submitted by WTO members on noise abatement services

WTO Member	Basis of environmental services classification	Changes to scope of Uruguay round commitments	Changes to content of Uruguay Round commitments
Australia	EU proposal	Australia previously had no commitments on services to reduce noise pollution (CPC 9405). Uruguay Round commitments cover the entire industry segment.	Australia, which previously had no commitments on services to reduce noise pollution (CPC 9405), is offering to schedule partial commitments on this industry. Commitments would continue to reserve the right to limit market access and national treatment through mode 1 due to lack of technical feasibility.
Canada	W/120	None- Uruguay Round commitments cover the entire industry segment.	None- Uruguay Round schedule includes full commitments on this industry segment.
Chile	None used	None- There continues to be no commitments scheduled on this industry segment.	None- There continues to be no commitments schedule on this industry.
European Union[1]	EU proposal	The EU previously had no commitments on noise and vibration abatement (CPC 9405). Uruguay Round commitments cover the entire industry segment.	The EU is offering to make some minor changes, making its mode 4 commitments on this industry segment compatible with its new horizontal commitments on mode 4. Commitments will reserve the right to limit market access and national treatment through mode 1. Finland would continue to maintain no mode 1 restrictions. Modes 2 and 3 are full for all countries.
Iceland	W/120	None- There continues to be no commitments scheduled on this industry segment.	None- There continues to be no commitments schedule on this industry segment.
Japan	EU proposal	None- Uruguay Round commitments cover the entire industry segment.	None- Commitments would continue to reserve the right to limit market access and national treatment through mode 1 due to lack of technical feasibility.
Liechtenstein	W/120	None- Uruguay Round commitments cover the entire industry segment.	None- Commitments would continue to reserve the right to limit market access and national treatment through mode 1 due to lack of technical feasibility.

See footnote at end of table.

Table C-4—*Continued*
Publicly available offers submitted by WTO members on noise abatement services

WTO Member	Basis of environmental services classification	Changes to scope of Uruguay round commitments	Changes to content of Uruguay Round commitments
New Zealand	EU proposal	New Zealand previously had no commitments on services to reduce noise pollution (CPC 9405). Uruguay Round commitments cover the entire industry segment.	New Zealand, which previously had no commitments on services to reduce noise pollution (CPC 9405), is offering to schedule full commitments on this industry.
Norway	EU proposal	None- Uruguay Round commitments cover the entire industry segment.	Norway is offering to eliminate the unbound condition for mode 1. Uruguay Round schedule would now include full commitments on this industry segment.
Slovenia	W/120	None- There continues to be no commitments scheduled on this industry segment.	None- There continues to be no commitments schedule on this industry segment.
Turkey	W/120	None- There continues to be no commitments scheduled on this industry.	None- There continues to be no commitments schedule on this industry segment.
United States	EU proposal	None- Uruguay Round commitments cover the entire industry segment	None- Uruguay Round schedule includes full commitments on this industry segment

[1] Sweden: The offer does not include public works functions whether owned and operated by municipalities, state or federal governments or contracted out by these governments.

Source: Compiled by the U.S. International Trade Commission

Table C-5
Environmental services classfications: The W/120 and the European Union proposal

W/120	European Union Proposal
Sewage Disposal Services (CPC 9401)	Waste Water Services (CPC 9401)
Refuse Disposal Services (CPC 9402)	Solid/Hazardous Waste Services (CPC 9402)
Sanitation and Similar Services (CPC 9403)	Sanitation and Similar Services (CPC 9403)
Other Environmental Services: (persumed to include cleaning of exhaust gases (CPC 9404), noise abatement (CPC 9405, nature and landscape protection services (CPC 9406) and other environmental services (CPC 9409))	Protection of Ambient Air and Climate (CPC 9404) *corresponds to Cleaning Services of Exhaust Gases*
	Noise and Vibration Abatement (CPC 9405)
	Remediation and Clean Up of Soil and Waters (part of CPC 9406) *corresponds to parts of Nature and Landscape Protection Services*
	Protection of Biodiversity and Landscape (part of CPC 9406) *corresponds to parts of Nature and Landscape Protection Services*
	Other Environmental and Ancillary Services (CPC9409)

Source: Compiled by the U.S. International Trade Commission based on WTO, MTN.GNS/W/120, July 10, 1991; and WTO, "Communication from the European Communities and their Member States, GATS 2000: Environmental Services," S/CSS/W/38, Dec. 22, 2000.

APPENDIX D
COUNTRY SUMMARIES

This section includes brief overviews of selected country markets for air and noise pollution abatement services. Specifically, overviews are provided for Australia, Brazil, Canada, Chile, Costa Rica, the European Union (which is discussed in a single section), Japan, Korea, Mexico, South Africa, Thailand, and the United States. These economies were chosen for special emphasis based on the USTR request for information on both developed- and developing-country markets, as well as information on countries with which the United States has established, or is in the process of establishing, a free trade arrangement, as appropriate.

Australia

The market for air and noise pollution abatement services in Australia is believed to be evolving, as meaningful laws governing these sectors have been enacted relatively recently.[1] In 2004, Australia's market for air pollution control engineering, consulting, and monitoring services was valued at $28 million, while the market for air pollution control equipment was valued at $515 million.[2] The country's relatively comprehensive system of regulations pertaining to air and noise pollution control combine with public awareness to drive the market. Nonetheless, air pollution control is not presently considered to be among Australia's top environmental management issues. Australia's international obligations in the area of air pollution control and climate change contribute, in part, to its plans for air pollution abatement.

Australia is a net importer of air pollution abatement services with imports estimated at $5 million, and exports estimated at $3 million in 2004.[3] Conversely, Australia is a net exporter of air pollution control equipment with imports estimated at $192 million, and exports estimated at $357 million in 2004.[4] Australia maintains no trade barriers that specifically apply to air or noise pollution abatement services.[5] All foreign firms may face certain obstacles in that prospective foreign investors must obtain investment approval from the Foreign Investment Review Board (FIRB), which may deny specific foreign investments on the basis of national interest.[6] However, in practice, the FIRB rarely denies foreign investments.[7]

Brazil

In 2004, the market for air pollution abatement goods and services in Brazil reached an estimated $1.1 billion, of which service revenues are estimated to represent $56 million, and account for 2 percent of the global market for air pollution abatement services.[8] Potential market drivers for air pollution abatement services in Brazil include stricter government regulation, community

[1] U.S. Commercial Service, "Air Pollution Control Equipment," Dec. 7, 2000.

[2] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.

[3] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 28, 2004, and Jan. 7 and 11, 2005.

[4] Ibid.

[5] World Trade Organization (WTO), General Agreement on Trade in Services (GATS), *Australia: Schedule of Specific Commitments*, GATS/SC/6, Apr. 15, 1994.

[6] U.S. Trade Representative, *2003 National Trade Estimate Report on Foreign Trade Barriers*.

[7] *U.S.-Australia Free Trade Agreement : Potential Economywide and Selected Sectoral Effects*, USITC Publication 3697, May 2004.

[8] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.

pressure, and better environmental management practices.[9] The Conselho Nacional do Meio Ambiente (CONAMA) is the Brazilian regulatory authority responsible for establishing air quality standards and determining fines for violation thereof. Air pollution in Brazil is largely due to vehicle emissions, as 90 percent of the country's electricity is generated by hydroelectric sources.[10] Vehicular air pollution is especially severe in the urban areas of Rio de Janeiro and Sao Paolo and tends to be the focus of CONAMA's regulatory activities. However, enforcement outside of these urban areas is typically weak.[11] Vehicle emissions standards in Brazil have been set by CONAMA at the Euro III[12] level.[13]

Brazil imported approximately $515 million in air pollution abatement goods and services in 2004, with service imports reaching $22 million.[14] In that same year, Brazil exported an estimated $2 million in air pollution abatement services. Brazil maintains few, if any, barriers to trade in air pollution abatement services.

Canada

Canada's abundant energy supplies and reliance on energy intensive industries has led to serious concerns regarding air pollution and climate change.[15] These concerns, coupled with the Canadian Environmental Protection Act (CEPA), drive the demand for air and noise pollution abatement related services and equipment. The CEPA, in force since 2000, is the key federal legislation governing air pollution and empowers the environment minister to target and virtually eliminate toxic substances from the environment.[16] In Canada, the market for services and equipment to address air and noise pollution is mature. As a result, the prospects for growth in the market in the near future depend largely on new regulatory initiatives and standards. Canada's Clean Air Agenda– which is aimed at reducing emissions from the transportation and industrial sectors, as well as transboundary emissions– together with changes in vehicle emission

[9] U.S. Foreign Commercial Service (USFCS), "Brazil: Pollution Control," July 2004, found at *http://www.focusbrazil.org.br/ccg/reports/Pollution.pdf*, retrieved Sept. 2004.

[10] Government representative, interviews by USITC staff, Rio de Janeiro, Dec. 20, 2004.

[11] U.S. Department of Energy, Energy Information Administration (EIA), "Brazil: Environmental Issues," Aug. 2003, Country Analysis Brief, found at *http://www.eia.doe.gov/emeu/cabs/brazenv.html#ENVIRO*, retrieved Jan. 2005; and government representative, interviews by USITC staff, Sao Paolo, Dec. 16, 2004.

[12] In 1998, Directive 98/69/EC of the European Parliament established limits on emissions of carbon monoxide, hydrocarbons, NO_x, and particulate matter by gasoline and diesel cars and trucks within the European Community. These standards are commonly referred to as "Euro III" standards. Europa, official web site of the European Union, found at *http://europa.edint/eur-lex/pri/en/oj/dat/1998/1_350/1_35019981228en00010056.pdf*, retrieved Feb. 2005.

[13] Government representative, interviews by USITC staff, Sao Paolo, Dec. 16, 2004.

[14] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 28, 2004, and Jan. 7 and 11, 2005.

[15] EIA/DOE, Country Analysis Briefs: Canada, Jan. 2004, found at *www.eia.doe.gov/emeu/cabs/canada.html*, retrieved Sept. 14, 2004, p. 14.

[16] Bureau of National Affairs, Country Profile: Canada, found at *http://esweb.bna.com/cgi-bin_isapi.dll//escp.nfo/?advquery*, retrieved Sept. 22, 2004, p. 2.

standards, the addition of PM_{10} to the toxic substances list, and the possible addition of nationwide standards for such pollutants as dioxin for iron and steel operations and mercury from electric power generation[17] may increase demand for air pollution abatement goods and services.[18]

An industry source estimates that the market for air pollution abatement goods and services in Canada has risen from $786 million in 1994 to $1.8 billion in 2004 for an average annual growth rate of 9 percent. Goods accounted for $746 million in 1994 and more than $1.7 billion in 2004. Services, which include engineering, consulting, and monitoring, accounted for $40 million in 1994 and $92 million in 2004.[19] This industry source estimates that Canada imported $849 million and $24 million in goods and services, respectively, in 2004. In that same year, Canada exported $131 million in air pollution abatement goods and posted no exports of air pollution abatement services.[20]

Chile

In 2004, the market for air pollution abatement goods and services in Chile reached an estimated $143 million, of which service revenues, specifically, represented about $8 million.[21] Data on noise pollution abatement services for Chile are not available.

The Servicio de Salud Metropolitano del Ambiente (SESMA), an arm of the cabinet-level Ministry of Health, develops emissions standards, monitors air quality, and implements pollution reduction programs throughout Chile.[22] Air pollution in Chile is largely a product of motor vehicle emissions and copper mining, as over half of Chile's electricity needs is met by hydropower.[23] Vehicular air pollution in Santiago has become severe, with the number of private vehicles in Chile's capital having reached 1 million.[24] Chile is the largest producer of copper in the world, and its copper mining and smelting operations in the Santiago area have contributed to high levels of sulphur dioxide and particulate matter.[25] In 1996, a Supreme Decree signed by the Chilean President identified Santiago and its surrounding areas as an "air pollution saturated zone."[26] Subsequently, the government began providing incentives for private industry to clean

[17] Such standards are currently under development.

[18] Bureau of National Affairs, Country Profile: Canada, found at *http://esweb.bna.com/cgi-bin_isapi.dll//escp.nfo/?advquery*, retrieved Sept. 22, 2004, p. 2.

[19] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.

[20] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 28, 2004, and Jan. 7 and 11, 2005.

[21] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.

[22] BNA, "Chile Overview," found at *http://www.esweb.bna.com/*, retrieved Sept. 2004.

[23] U.S. Department of Energy, EIA, "Chile," Country Analysis Brief, July 2002, found at *http://www.eia.doe.gov/emeu/cabs/chile.html*, retrieved Jan. 2005.

[24] U.S. Department of Energy, EIA, "Chile: Environmental Issues," Country Analysis Brief, July 2002, found at *http://www.eia.doe.gov/emeu/cabs/chilenv.html*, retrieved Jan. 2005.

[25] Ibid.

[26] USFCS, Chile Air pollution Control Equipment Report, found at *http://www.stat-usa.gov/*, retrieved Sept. 2004.

up its activities and created the Atmosphere Prevention and Decontamination Plan for the Metropolitan Region (PPDA), which establishes legally enforceable limits on industry pollution.[27] The recently implemented U.S.-Chile FTA requests that the Chilean government enforce the country's environmental regulations.[28]

Chile imported approximately $68 million in air pollution abatement goods and services in 2004, with service imports estimated at about $1 million.[29] Chile maintains few, if any, barriers to trade in air pollution abatement services.

Costa Rica

The Costa Rican market for air and noise pollution abatement is likely small.[30] There are no country-specific estimates on the size of Costa Rica's market for air pollution abatement goods and services. The primary services market participants are labs that test ambient air quality[31] and Non-Government Organization (NGO) consultants.[32] Significant international presence, in the form of corporate and NGO involvement, ensures a high international market presence. Most of the equipment is sourced from the United States and the European Union (sourced either by local sales subsidiaries of U.S. or EU firms, or directly),[33] whereas many consulting services are provided by EU firms.[34] Costa Rica maintains no trade barriers that specifically apply to air or noise pollution abatement services, and the U.S.-Central American Free Trade Agreement effectively eliminates tariffs on air and noise pollution control equipment. Representatives of regional NGOs report that the bulk of Central American pollution abatement is located in Costa Rica, but that the primary focus of the region is on "green" (biodiversity) development, not "brown or gray" (pollution) issues.[35]

Costa Rica does not have a large manufacturing sector,[36] and little of its electricity is produced through the burning of fossil fuels.[37] As such, the country's primary environmental issues are water,[38] wastewater, and solid waste management. Ambient air quality policy has been under

---

[27] Ibid.

[28] USFCS, "Chile Country Commercial Guide FY 2004," found at *http://www.stat-usa.gov/*, retrieved Sept. 2004.

[29] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 28, 2004, and Jan. 7 and 11, 2005.

[30] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.

[31] Industry representatives, interviews by USITC staff, Costa Rica, Dec. 6 and 9, 2004.

[32] Notably SwissContact, which was been contracted by the government to help develop emissions control strategies, through 2004, and alternative energy sources, ongoing; ENTEBBE; CCAD; the Central American Alliance for Sustainable Development; LINCOS; and ASODIGITEL. Industry representatives, interviews by USITC staff, San Jose, Costa Rica, Dec. 6-10, 2004.

[33] Industry representatives, interviews by USITC staff, Costa Rica, Dec. 6 and 9, 2004.

[34] Industry representative, interview by USITC staff, San Jose, Costa Rica, Dec. 6, 2004.

[35] Industry representative, interview by USITC staff, San Jose, Costa Rica, Dec. 10, 2004.

[36] According to the U.S. Embassy and USAID, over 60 percent of the GDP is services-related and largely associated with tourism, Government representatives, interviews by USITC staff, Costa Rica, Dec. 6-10, 2004.

[37] Capacity is 35 percent, but utilization in 2003 was only 2 percent, according to Centro Nacional de Planificación Eléctrica (ICE), the national electricity monopoly.

[38] Regionally, some municipalities are so over-populated that the availability of fresh water per capita is claimed to be similar to the Saharan desert region. Industry representative, interview by USITC staff, San Jose, Costa Rica, Dec. 10, 2004

development since 1994;[39] laws and decrees to-date have largely focused on vehicular emissions,[40] fuel controls,[41] and developing an air quality monitoring framework.[42] Standards have largely been drawn from U.S. EPA standards.[43] Within metropolitan San Jose, recent policy development is focused on particulates and noise pollution, both of which are primarily attributed to vehicular congestion, though two cement plants are also now regulated as contributory polluters.[44] Present noise control efforts almost exclusively involve the construction of barriers.[45]

European Union

In 2004, consumption of air pollution abatement goods and services in the European Union totaled an estimated minimum[46] of $9.4 billion, of which services accounted for $445 million. In the European Union, demand for air and noise pollution abatement services and equipment is driven largely by EU-level legislation.[47] All EU Member States are required to incorporate and adopt EU Directives into national regulatory regimes.[48] In the EU-15,[49] the harmonization of such legislation is largely complete, and thus, the air and noise pollution abatement market in these countries is largely mature. By contrast, many accession countries,[50] which joined the European Union in 2004, are currently working to bring their national legislation into compliance with EU Directives.[51] As a result, the accession countries are likely to be a large and growing market for air and noise pollution abatement services and equipment in the near future.[52] The EU Emissions Trading Scheme, which provides an incentive for firms with relatively low marginal abatement costs to invest in air pollution abatement services and equipment, will likely stimulate demand for such services and equipment, particularly in the central and eastern European countries. EU firms are highly competitive in the global market for air pollution abatement goods and services, as their experience in addressing the EU's strict air pollution standards has given them a

[39] Ley Organica del Ambiente, which established the structure, fines, sanctioning process, and administration for general air quality.

[40] Industry representative, interview by USITC staff, San Jose, Costa Rica, Dec. 7, 2004.

[41] Decreto 26789 established vehicular and fuel requirements.

[42] Notably, the 2004 Decreto 31849, Reglamento sobre los Procedimientos Evaluacion de Impactor Ambiental, defines a procedure for monitoring ambient air quality.

[43] Government representative, interview by USITC staff, Dec. 6, 2004.

[44] Industry representatives, interviews by USITC staff, San Jose, Costa Rica, Dec. 7, 2004.

[45] Industry representatives, interviews by USITC staff, Costa Rica, Dec. 6-10, 2004.

[46] Industry estimates of consumption are available for 18 Member States of the European Union – Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Poland, Portugal, Slovakia, Spain, Sweden, and the United Kingdom. As these 18 countries accounted for an estimated 84 percent of air pollution abatement services and goods consumed in Europe in 2004, USITC staff observes that the combined estimates for the 18 countries provide a considerable, although slightly underestimated, representation of consumption in the entire European Union.

[47] European Union representatives, interviews by USITC staff, Brussels, Belgium, Oct. 29, 2004; and Polish government representatives, interviews by USITC staff, Warsaw, Poland, Nov. 2, 2004.

[48] Polish Government representative, interview by USITC staff, Warsaw, Poland, Nov. 2, 2004.

[49] The EU-15 includes Germany, France, Belgium, England, Spain, Denmark, Greece, Ireland, Italy, Luxembourg, Portugal, Sweden, Finland, the Netherlands, and the United Kingdom.

[50] The Accession countries include Hungary, Poland, Estonia, Latvia, Lithuania, Slovenia, Slovakia, Malta, Cyprus, and the Czech Republic.

[51] Polish Government representative, interview by USITC staff, Warsaw, Poland, Nov. 2, 2004.

[52] Industry representative, interview by USITC staff, Chicago, U.S., Dec. 3, 2004.

technological advantage in both domestic and foreign markets.[53] Aside from issues related to technical specifications, however, the EU maintains few, if any, barriers to trade in air and noise pollution abatement services.[54]

Japan

Japan is one of the largest markets for air and noise pollution abatement goods and services in Asia. The country maintains some of the most ambitious air quality goals in the world, with regulations and standards oftentimes more rigorous than those found in the United States or Europe. Although environmental legislation is in place and functional, compliance is largely voluntary as penalties offer little deterrence.[55] The system works well, however, as Japanese firms value their public image and would seek to avoid the negative connotations associated with being identified as unconcerned with the environment or with neighbors' sensitivities.[56] This underlying social conscienceness, combined with the strict regulatory regime, has created significant demand for air and noise pollution abatement goods and services. However, like most other developed countries with a history of environmental legislation, market growth is believed to have peaked.[57] Most of the major sources of air pollution, such as electricity generating plants, steel mills, and factories, have already implemented air pollution control measures. New opportunities and market growth may emerge as increasingly stringent standards take effect, new concerns are identified, and technologies improve. Increasing congestion in and around metropolitan areas continues to create demand for noise abatement goods and services, both those that target the source (vehicles, trains, aircraft), and those that reduce noise already in the environment (highway sound barriers, home insulation).[58] Japanese producers of air and noise pollution abatement goods and services are active exporters, particularly in emerging environmental markets in Asia such as China, Thailand, and Vietnam. Industry reports that Asian customers frequently prefer to do business with other Asians, giving Japanese firms an edge over Western competitors.[59] Japan imports a significant amount of air and noise pollution abatement goods and services from the United States and Europe, particularly from Germany. Imports often take the form of technology transfer, where base goods and services are imported, and then modified to meet local needs and requirements.[60]

[53] Industry representative, interview by USITC staff, Chicago, U.S., Dec. 3, 2004.

[54] Industry representatives, interview by USITC staff, Chicago, U.S., Dec. 2-3, 2004; and industry representatives, interview with USITC staff, Warsaw, Poland, Nov. 3, 2004.

[55] Industry representatives, interviews by USITC staff, Tokyo, Nov. 4-8, 2004.

[56] Government official and industry representatives, interviews by USITC staff, Tokyo, Nov. 4-8, 2004.

[57] Industry representatives, interviews by USITC staff, Tokyo, Nov. 4-8, 2004.

[58] Government officials and industry representatives, interviews by USITC staff, Tokyo, Nov. 4-8, 2004.

[59] Industry representatives, interviews by USITC staff, Seoul, Nov. 15-16, 2004.

[60] Industry representatives, interviews by USITC staff, Tokyo, Nov. 4-8, 2004.

Korea

Korea's market for air pollution control services, which was valued at $74 million in 2004,[61] is believed to be active but leveling off as a result of slow economic growth and a lack of big environmental projects.[62] The air quality measurement segment of this market is currently stagnant but is believed to be poised for growth as the Korean Government plans to transfer some environmental control to local governments.[63] Korea's total air pollution control equipment market was valued at $1.4 billion in 2004.[64] Korean imports of air pollution abatement services were valued at $15 million in 2004, while exports totaled $5 million in the same year.[65] Foreign engineering and consulting firms can only participate in the Korean market as license or joint venture partners.[66] Additionally, a lack of intellectual property protections may deter some foreign companies from establishing joint ventures in Korea. Imports of air pollution abatement equipment, predominately from U.S. and Japanese firms, totaled $497 million in 2004, outweighing exports of $341 million.[67] The Korean Government and industry are cooperating to explore opportunities to export environmental goods and services, including air pollution abatement goods and services, to China, Indonesia, Malaysia, Philippines, Thailand, and Vietnam.[68]

The value of Korea's noise pollution abatement services and equipment market is unknown but believed to be small. Market growth is likely in the near future as regulatory agencies are beginning to set noise level targets, with construction site targets having been set for 2009. Although data have not yet been identified, it is believed that trade and investment in noise pollution abatement services is minimal as this is not a high-priority environmental market sector.

Mexico

The market for air pollution abatement services in Mexico is believed to be small and largely comprises testing, monitoring, consulting, and engineering services. The provision of such services typically occurs as part of the specification, sale, and installation of air pollution equipment which may occur as part of a larger project. The Mexican market for air pollution control services in 2004 was reportedly $27 million (US), of which $6 million comprised expenditures by the power generation industry.[69]

The market for noise pollution abatement services in Mexico is believed to be very small, and largely comprises consulting, measurement, and testing. Noise absorbing or barrier materials are sometimes incorporated in products or structures to reduce transmission of noise. No data are

[61] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.
[62] Industry representative, interview by USITC staff, Seoul, Korea, Nov. 15, 2004.
[63] Ibid.
[64] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.
[65] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 28, 2004, and Jan. 7 and 11, 2005.
[66] Industry representative, interview by USITC staff, Seoul, Korea, Nov. 15, 2004.
[67] Ibid.
[68] Industry representative, interview by USITC staff, Seoul, Korea, Nov. 15, 2004.
[69] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.

available on the size of the Mexican market for noise pollution abatement services, but the market is believed to be much smaller than the air pollution abatement services market.

South Africa

The South African market for air pollution abatement services and goods is midsized and growing at a slower rate than most other countries. Estimated consumption of air pollution goods and services rose from $311 million in 1994 to $403 million in 2004, which represents an average annual growth rate of 3 percent.[70] The services component[71] was reported at $22 million in 2004 (5 percent of consumption of goods and services), and grew by less than $5 million (2 percent per year, on average) since 1994. Multiple factors have combined to make the domestic industry, particularly the mining industry– which is the major component of South Africa's economy– struggle to keep up with increased costs of compliance. These issues include Rand devaluation, new mining and land ownership laws,[72] increasing worker safety laws,[73] and varied security exchange reforms.[74] These factors reportedly discourage foreign investment,[75] which is reducing the capital available to further increase the market size or to meet new reform requirements.[76] The Department of Environmental Affairs and Tourism (DEAT), the central policy-formulating and coordinating body,[77] created a Law Reform Program which issued a National Environmental Management Act (NEMA, Act 107) in 1998 for the purpose of developing regulations during 1999-2002. This work is still ongoing. South Africa is a signatory to the 1985 Vienna Convention for the Protection of the Ozone Layer and the 1987 Montreal Protocol.[78] South Africa has also acceded to the Kyoto Protocol, though as a developing country, it is exempt from emissions reduction requirements.

The major domestic providers of air pollution abatement services and goods trade internationally and are well thought of, particularly in the mining sector.[79] Australian and Asian firms account for a significant share of South Africa's imports of air pollution abatement goods and services, while U.S. firms account for a minimal share of such imports. The international market has very good access to the South African market; however, less sophisticated technologies are often chosen to minimize costs. Barriers include a measure requiring domestic engineering/architecture

[70] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004. Tied with Denmark for last among those reported.

[71] Comprised of gaseous and particulate engineering, consulting, and monitoring.

[72] The Mining Law of 2003 reverted all property back to the state; significant company valuation repercussions have occurred as the parties involved attempt to assess fair market values for the land.

[73] Worker noise safety laws are proposed; Health and Safety Act, Chief Inspector of Mines, Department of Mining and Environment; found at *http://www.infomine-africa.com/*, July 13, 2004.

[74] Mineral and Petroleum Royalty Bill of 2004, commonly called "The Money Bill." See "The South African Government Releases Mining Royalty Bill," *Werkmans UK Limited*, Mar. 2003, found at Internet address *http://www.werksmans.co.za/uk/alert_20030326.pdf*, retrieved July 27, 2004.

[75] "Perceived Empowerment Risks Discourage U.S. Investors," Business Day (South Africa), Aug. 18, 2003 retrieved Aug. 19, 2003.

[76] Daniel Thole, "Resources Take a Pounding," *Moneyweb (Johannesburg),* found at *http://allafrica.com/stories/printable/200308180609.html*, retrieved Aug. 28, 2003.

[77] Available at *http://www.environment.gov.za/*.

[78] "South Africa Overview," BNA, Inc., found at *http:/esweb.bna.com/cgi-bin/om_isapi.dll/escp.nfo,* Sept. 22, 2004.

[79] For example, MINTEK is one of the premier mining and metals processing equipment – which includes pollution controls goods and services – providers internationally.

participation for large projects and a borrowing limit for entities with greater than 75 percent foreign ownership.[80]

The Environmental Conservation Act 73 of 1989 defines disturbing noise as that which exceeds the ambient sound level by 7 dBA or more. According to DEAT, noise pollution (defined as noise caused by traffic, construction, mining, or commercial, recreational, and industrial sources) is rising in the absence of stringent regulations or enforcement. Little information is available on South Africa's noise pollution abatement market. However, some work has been done at the Durban airport, which involved flight pattern and timing modifications.[81]

Thailand

Thailand consumed an estimated $285 million in air pollution abatement goods and services, of which services accounted for $13 million, in 2004. Thailand's air and noise pollution abatement services market is small compared to major world markets such as Japan and the United States, but the country's need for such goods and services is significant. As a developing country, Thailand's focus on economic development has historically taken priority over environmental concerns, and recent stagnant economic conditions have slowed environmental initiatives.[82] Consequently, the environmental market in Thailand is comprised of a significant number of legacy and current projects that require attention, many of which center on air and noise pollution.[83] Increasing congestion in metropolitan regions is also derogating air and noise quality, primarily due to increased vehicular traffic and greater demands for electricity.[84] Fairly comprehensive environmental legislation is in place, but enforcement is uneven and corruption is widespread, likely due to a lack of financial resources.[85] Thailand imports most environmental goods and services, amounting to $146 million of air pollution abatement goods and $2 million of such services in 2004, primarily from Japan and the United States.[86]

[80] See WTO GATS SC78.

[81] Noise Response, Durban Metropolitan Area, found at *http://www.ceroi.net/reports/durban/issues/noise/response.htm*, retrieved Sept. 27, 2004.

[82] Government officials and industry representatives, interviews by USITC staff, Bangkok, Nov. 10-12, 2004.

[83] Government officials and industry representatives, interviews by USITC staff, Bangkok, Nov. 10-12, 2004.

[84] Government officials and industry representatives, interviews by USITC staff, Bangkok, Nov. 10-12, 2004.

[85] Industry representatives, interviews by USITC staff, Bangkok, Nov. 12, 2004.

[86] Industry representatives, interviews by USITC staff, Bangkok, Nov. 12, 2004.

United States

In 2004, industry sources estimated that the United States accounted for 28 percent, or $14.5 billion, of total world expenditures on air pollution abatement goods and services.[87] The U.S. market for air pollution abatement services, accounting for $658 million in 2004, is mature and supplied by domestic and foreign firms. Firms from Western Europe and Japan are particularly competitive in the U.S. market, as they are able to leverage the development and implementation of technologies, equipment, and services which they have undertaken in response to stringent legislation and regulation in their home markets. Revenues earned by U.S. air pollution equipment firms have remained virtually the same during 2000-2003, following three decades of substantial annual growth.[88] Nevertheless, U.S. exports of air pollution abatement services grew at a 9-percent yearly rate, on average, during 1994-2004, as compared to export growth averages for suppliers from the European Union (4 percent) and Japan (2 percent). In 2004, estimated U.S. air pollution abatement services exports ($213 million) surpassed imports ($83 million).

The U.S. noise pollution abatement services market is small. With the exception of airport and aircraft noise, much of the responsibility for the enforcement of noise regulations lies with state and local governments. Demand does not appear to be sufficient at either the federal or state government level to enact more stringent laws, which would likely be needed to substantially propel U.S. market growth and U.S. export potential in noise pollution abatement services.[89]

[87] McIlvaine Co., estimates provided to USITC staff via e-mails, Dec. 23 and 28, 2004.

[88] Environmental Business International, Inc., Environmental Business Journal, vol. 17, No. 9/10, p. 2.

[89] Jerry A. Nathanson, "Noise Pollution and Control," ch. 14 in *Basic Environmental Technology*, 4th ed. (Upper Saddle River, New Jersey and Columbus, Ohio: Prentice Hall, 2003); and Bennett M. Brooks and others, "A Global Vision for the Noise Control Marketplace," paper presented to the Technical Committee on Noise of the Acoustical Society of America, 1996, found at Internet address *http://www.nonoise.org/*, retrieved Sept. 20, 2004.

APPENDIX E
POSITION OF INTERESTED PARTY

Purafil, Inc.

Purafil, Inc.[1] is a small, Georgia-based manufacturer of air filtration systems that are used to eliminate harmful gases released within closed environments such as industrial plants and office buildings. As over one-half of its current sales are directed to the export market, trade barriers are a key point of concern for Purafil, specifically in the areas of duties and currency exporting restrictions. In order to maintain competitiveness and overcome the extra cost burdens created by high tariffs, Purafil has been forced to divert valuable manufacturing jobs away from its Atlanta facility to lower-cost foreign markets. For example, due to the high duties imposed on Purafil products in the Indian market (up to 42%), most of the firm's manufacturing for that market must be outsourced to lower-cost equipment fabricators in China. Similarly, in order to offset high duties in Brazil, Purafil has entered into a special licensing agreement where Purafil would manufacture its equipment within Brazil and receive royalty payments in return. However, under current Brazilian law, exporting currency for purposes other than goods trade is problematic and has made it very difficult for Purafil to actually collect these royalties. Thus, Purafil strongly believes that its ability to compete in the Brazilian market and other foreign markets would be strengthened by the lowering of duties and the relaxing of currency exporting requirements. Furthermore, Purafil supports the creation of a standard practice model for the construction of drinking water disinfection facilities abroad. Recognizing that a significant percentage of foreign infrastructure and development projects are funded by U.S. Government aid programs and seeing that most of these projects lack any precautionary safety requirements--specifically in cases of toxic chlorine gas releases--Purafil contends that the establishment of international standards could create a broader global market for products used in the emergency removal of such harmful contaminants.

[1] David Nicholas, Executive Vice President and Chief Operating Officer, Purafil, Inc., Doraville, Georgia, written submission to the Commission, Sept. 30, 2004.

APPENDIX F
GLOSSARY

(The following definitions are based on various sources, including Bloomberg.com's Financial Glossary, Cantor Fitzgerald's Environmental Credit Trading Glossary, CO2e.com's Glossary, the Filter Manufacturers Council, Investorwords.com, the Pew Center for Global Climate Change, the U.S. Environmental Protection Agency's Plain English Guide to the Clean Air Act and Terms of the Environment Glossaries, and Webster's Third New International Dictionary, Unabridged.)

Absorption: A taking up by capillary, osmotic, chemical, or solvent action (i.e., absorption of moisture from the air).

Activated charcoal: A highly adsorbent form of carbon used to remove odors and toxic substances from liquid or gaseous emissions. In waste treatment, it is used to remove dissolved organic matter from waste drinking water. It is also used in motor vehicle evaporative control systems.

Acute: Refers to an injury that happens suddenly.

Adsorption: The removal of a pollutant from air or water by collecting the pollutant on the surface of a solid material; e.g. an advanced method of treating waste in which activated carbon removes organic matter from wastewater.

Air cyclones: A device that uses centrifugal force to remove large particles from polluted air.

Allowance: Allowances grant the holder the right to emit a specific quantity of pollution once (e.g., one ton). The total quantity of allowances issued by regulators dictates the total quantity of emissions possible under the system. At the end of each compliance period each source must surrender sufficient allowances to cover their emissions during that period.

Baseline-and-Credit system: Under a baseline-and-credit system (i.e., credit- or project-based trading), fixed limits are imposed by a regulatory authority on certain sources of a particular pollutant, usually based on historical activity. A source is required to meet its imposed limit, though it may reduce its pollution levels below this limit and sell the corresponding pollution "credits" to other sources seeking to meet voluntary or mandatory limits. Under this approach, there is no guarantee that pollution activities will be reduced, since no overall "cap" is defined for a universe of sources. Although the decision to generate credits is voluntary, certification of these credits requires an administrative process. Canada's Pilot Emission Reduction Trading (PERT) is an example of a credit approach.

Cap-and-Trade system: Involves trading of emission allowances, where the total allowance is strictly limited or 'capped'. A regulatory authority established the cap which is usually considerably lower (50% to 85%) than the historic level of emissions. Allowances are created to account for the total allowed emissions (an allowance is a unit of measurement referred to as AAU). Trading occurs when an entity has excess allowances, either through actions taken or improvements made, and sells them to an entity requiring allowances because of growth in emissions or an inability to make cost-effective reductions. Cap and Trade programs are closed systems, but can be modified to allow the creations of new permits by non-capped sources in the manner of credit-based systems.

Carbon dioxide equivalents (CO2e): A universal standard of measurement against which the impacts of releasing (or avoid the release of) different greenhouse gases can be evaluated. This standard is based on the Global Warming Potential (GWP) of particular greenhouse gases. GWP is a measurement of the impact that a particular gas has on 'radiative forcing', the additional heat/energy which is retained in the Earth's ecosystem through the addition of a particular gas to the atmosphere.

Catalytic conversion: An air pollution abatement process that removes pollutants from motor vehicle exhaust, either by oxidizing them into carbon dioxide and water or reducing them to nitrogen.

Chronic: Refers to a recurring injury or an injury that evolves over time.

Clean Development Mechanism (CDM): Established under Article 12 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), the CDM grants 41 industrialized countries and economies in transition (Annex 1 countries) the right to generate and/or purchase certified emissions reductions (CERs) from investments in emissions reduction projects in non-Annex 1 countries, under certain conditions.

Command-and-Control method: A centralized pollution control strategy whereby governments or other regulators utilize non-market restrictions or methods such as special licenses, zoning permits, and minimum standards requirements on pollution sources.

Commercial presence (mode 3): A service supplier establishes a type of business or professional enterprise in a foreign market.

Consumption abroad (mode 2): A consumer, or the consumer's property, receives a service outside the territory of the consumer's country.

Credit: A government-recognized right to emit under a baseline-and-credit system.

Criteria air pollutants: A group of very common air pollutants regulated by EPA on the basis of criteria (information on health and/or environmental effects of pollution). Criteria air pollutants are widely distributed all over the country.

Cross-border supply (mode 1): A service is transported beyond the country of the service supplier to a foreign consumer (the service supplier is not present within the territory of the consumer).

Emissions trading registry: An internet-based registry that records and tracks the ownership and transfer of emission allowances. All market participants must establish an account with the registry.

Exchange: A formal, institutionalized marketplace where securities or other assets are traded.

Fixed (stationary) sources: A place or object from which pollutants are released and which does not move around. Stationary sources include power plants, gas stations, incinerators, houses etc.

Flash smelters: A modern substitute for open air roasting of sulfide ores for several hours in a horizontal reverberatory furnace by which finely ground ore concentrates are dispersed at the top of a vertical furnace, decomposing into metal and SO_2 in the few seconds it takes to fall to the bottom. The liquid metal is taken off the bottom, while the SO_2 flows upward countercurrent to the falling ore concentrates, going to an acid capture plant.

Forward contract: Agreements between two parties, buyer and seller, in which the buyer agrees to purchase an asset from the seller at a specific future date. The price is agreed in advance, although payment is not made until the transaction date. Forward contracts, which are typically customized, one-off contracts, are traded in over-the-counter markets.

Forward market: A market in which forward contracts are traded between two or more parties. See forward contract.

Futures contract: It is an agreement to buy or sell a specific amount of a commodity or financial instrument at a certain time in the future for a particular price. The price is established between the buyer and seller on a commodity exchange via a standardized contract defined by the exchange. Futures contracts typically have a range of delivery dates and are marked to market daily. Most futures contracts close out their position before maturity, either through an offsetting transaction or by selling the futures contract (i.e., a futures contract is tradable in its own right).

Gravity settling chambers: Settling chambers use the force of gravity to remove solid particles. The gas stream enters a chamber where the velocity of the gas is reduced. Large particles drop out of the gas and are recollected in hoppers. Because settling chambers are effective in removing only larger particles, they are used in conjunction with a more efficient control device.

Greenhouse gases: Gases such as carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulphur hexafluoride, which contribute to potential climate change.

Hazardous air pollutants (HAPs): Chemicals that cause serious health and environmental effects. Health effects include cancer, birth defects, nervous system problems and death due to massive accidental releases such as occurred at the pesticide plant in Bhopal, India. Hazardous air pollutants are released by sources such as chemical plants, dry cleaners, printing plants, and motor vehicles (cars, trucks, buses, etc.)

Joint Implementation (JI) Mechanism: Established under Article 6 of the Kyoto Protocol to the UNFCCC, the JI Mechanism grants Annex 1 countries the right to generate and/or purchase emissions reduction units (ERUs) from investments in emissions reduction projects in other Annex 1 countries, subject to certain conditions.

Kyoto Protocol: In the greenhouse gas program, the Kyoto Protocol is an agreement between 159 nations that attended the 3rd COP to the United Nations Convention on Climate Change which was held in Kyoto, Japan in December of 1997. The Kyoto Protocol specifies the deadlines and specific levels of greenhouse gas reductions that signatory countries are to achieve. Overall, developed countries are to reduce greenhouse gas emissions by 5.2% between 2008 and 2012 as measured against 1990 emission levels.

Liquidity: A high level of trading activity, allowing buying and selling with minimum price disturbance. Also, a market characterized by the ability to buy and sell with relative ease.

Mobile sources: Moving objects that release pollution; mobile sources include cars, trucks, buses, planes, trains, motorcycles and gasoline-powered lawn mowers. Mobile sources are divided into two groups: road vehicles, which includes cars, trucks and buses, and non-road vehicles, which includes trains, planes and lawn mowers.

Mode 1: See Cross-border supply.

Mode 2: See Consumption abroad.

Mode 3: See Commercial presence.

Mode 4: See Presence of natural persons.

National Allocation Plan (NAP): A plan which establishes the overall emissions cap for a country and the amount of emissions allocations to be distributed to each installation within a particular country.

Options contract: A contract that gives the option buyer the right, but not the obligation, to buy (or sell) a financial asset at the exercise price (or to) the option seller within a specified time period, or on a specified date (expiration date).

Over-the-Counter Market: Any asset trading activity outside a formal exchange market.

Ozone: A gas which is a variety of oxygen. The oxygen gas found in the air consists of two oxygen atoms stuck together; this is molecular oxygen. Ozone consists of three oxygen atoms stuck together into an ozone molecule. Ozone occurs in nature; it produces the sharp smell you notice near a lightning strike. High concentrations of ozone gas are found in a layer of the atmosphere -- the stratosphere -- high above the Earth. Stratospheric ozone shields the Earth against harmful rays from the sun, particularly ultraviolet B. Smog's main component is ozone; this ground-level ozone is a product of reactions among chemicals produced by burning coal, gasoline and other fuels, and chemicals found in products including solvents, paints, hair sprays, etc.

Particulate matter (PM): A criteria air pollutant, PM includes dust, soot and other tiny bits of solid materials that are released into and move around in the air. Particulates are produced by many sources, including burning of diesel fuels by trucks and buses, incineration of garbage, mixing and application of fertilizers and pesticides, road construction, industrial processes such as steel making, mining operations, agricultural burning (field and slash burning), and operation of fireplaces and woodstoves. Particulate pollution can cause eye, nose and throat irritation and other health problems. PM-10 is a measure of particles in the atmosphere with a diameter of less than ten or equal to a nominal 10 micrometers. PM-2.5 is a measure of smaller particles in the air. PM-10 has been the pollutant particulate level standard against which the EPA has been measuring Clean Air Act compliance. On the basis of newer scientific findings, the Agency is considering regulations that will make PM-2.5 the new “standard”.

Positive crankcase ventilation (PCV): Is a system that was developed to remove harmful vapors from the engine and to prevent those vapors from being expelled into the atmosphere. The PCV system does this by using manifold vacuum to draw vapors from the crankcase into the intake manifold. Vapor is then carried with the fuel/air mixture into the combustion chambers where it is burned.

Precipitators: An electrostatic precipitator (ESP) uses nonuniform, high-voltage fields to apply large electrical charges to particles moving through the field. The charged particles move toward an oppositely charged collection surface, where they accumulate for removal and disposal.

Presence of natural persons (mode 4): One individual, acting alone or as an employee of a service provider, provides a service while present in a foreign market.

Project-based emissions trading: Activities in which buyers of emissions credits participate in the financing of an emissions reduction project. In return for their investment, buyers expect to receive emissions credits.

Scrubbers: An air pollution device that uses a spray of water or reactant or a dry process to trap pollutants in emissions.

Separators: Pollution control systems that use adsorbant materials, compressed air, gravity, or static electricity to filter contaminants from liquids or gases.

Slurry: A pumpable dispersion of powdered or granular solids in a liquid (usually water).

Spot market: Are markets that involve sales for the immediate delivery of a security, good, or instrument at a currently prevailing price.

Trace elements: Are inorganic chemicals usually occurring in small amounts in nature.

United National Framework Convention on Climate Change (UNFCCC): The UNFCCC was established in June 1992 at the Rio Earth Summit. Its primary objective is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (man-made) interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner." The UNFCCC is the governing body for international negotiations on climate change.

Vintage: Refers to the year in which an allowance will be delivered. For example, 2005 vintage allowances will be delivered during 2005.

Volatile organic compounds (VOC): Organic chemicals all contain the element carbon (C); organic chemicals are the basic chemicals found in living things and in products derived from living things, such as coal, petroleum and refined petroleum products. Many of the organic chemicals we use do not occur in Nature, but were synthesized by chemists in laboratories. Volatile chemicals produce vapors readily; at room temperature and normal atmospheric pressure, vapors escape easily from volatile liquid chemicals. Volatile organic chemicals include gasoline, industrial chemicals such as benzene, solvents such as toluene and xylene, and tetrachloroethylene (perchloroethylene, the principal dry cleaning solvent). Many volatile organic chemicals are also hazardous air pollutants; for example, benzene causes cancer.

Volatility: The relative rate at which the price of an asset moves up and down. Volatility is found by calculating the annualized standard deviation of daily change in price. If the price of a stock moves up and down rapidly over short time periods, it has high volatility. If the price almost never changes, it has low volatility.