Evaluation of Non-Greenhouse Impact as an Environmental Attribute for Inclusion in the FLIS Database System

July 28, 1999

Evaluation of Non-Greenhouse Impact as an Environmental Attribute for Inclusion in the FLIS Database System

July 28, 1999

Requests for this document shall be referred to:

Mr. Jan Reitman
HQ Defense Logistics Agency
8725 John J. Kingman Road
Suite 2533, ATTN: CAAE
Fort Belvoir, VA 22060-6221

Submitted by
Litton/PRC and
Project Performance Corporation

TABLE OF CONTENTS

Chapter 1: Introduction

The federal government must comply with laws, Executive Orders, and various policies designed to reduce waste and minimize the environmental impacts of its activities. Federal agencies can minimize the use of hazardous or toxic substances, promote the use of recycled materials, improve energy efficiency, reduce the volume of waste for disposal, conserve natural resources, improve worker health and safety, reduce operating costs, and save taxpayer dollars via the procurement of environmentally oriented products.

The Federal Logistics Information System (FLIS) is the centerpiece of the federal acquisition process. The FLIS is a large database that catalogues almost 7 million records of products and services available in the federal supply system. All federal agencies use FLIS to requisition items through the General Services Administration (GSA) and Defense Logistics Agency (DLA). In February of 1997, the Joint Logistics Commanders (JLC) tasked the DLA to research the feasibility of adding environmental attributes to the FLIS in order to aid procurement personnel and end-users in identifying products with positive environmental attributes. The JLC asked DLA to identify environmental data currently available and possible constraints for adding environmental attributes to FLIS codes; develop cost estimates for expanding FLIS; and make recommendations on how procurement personnel can identify products that have a lesser impact on human health and the environment. DLA accepted this task and conducted a business case analysis that analyzed the potential costs and benefits of using the FLIS to increase the federal acquisition of environmentally oriented products. Exhibit 1 highlights the benefits of an expanded use of environmentally preferable products that were identified in the business case analysis.

Exhibit 1
Benefits of an Expanded Use of Environmentally Preferable Products

- Reduced operating and disposal costs for facilities
- Reduced exposure to hazardous materials, safety hazards, and environmental violations
- Compliance with regulations and executive orders directing increased federal purchasing of environmentally preferable products
- Achievement of DoD affirmative procurement goals

As a result of the business case analysis, DLA established the Environmental Attribute Initiative and formed the Joint Group on Environmental Attributes (JG-EnvAtt) Coordinating Committee to manage the environmental attribute initiative. The committee is headed by the DLA, with other primary stakeholders being the Army, Navy, Air Force, Marine Corps, and the General Services Administration (GSA). Advisors include the Environmental Protection Agency (EPA), Department of Energy (DOE), and other government agencies. The JG-EnvAtt is responsible for selecting priority attributes for evaluation, approving proposed attributes for inclusion in FLIS, and adding the approved attribute to FLIS. The committee has developed three selection criteria for evaluating the proposed attributes for inclusion in the FLIS:

- A regulatory or policy priority must exist;
- A comprehensive definition must be available; and
- A cost benefit must be evident.

The JG-EnvAtt committee identified and prioritized 35 potential environmental attribute categories. Two of these attributes, "energy efficient" and "EPA Comprehensive Procurement Guidelines" have previously been analyzed and an evaluation of their applicability for inclusion in FLIS has been presented to the committee. In November of 1998, JG-EnvAtt tasked Litton-PRC and Project Performance Corporation to evaluate five additional categories:

- Non-ozone depleting substances
- Water conserving
- Low-VOC content
- Non-greenhouse impact
- Recycled material content

Evaluations of the "Non-ozone depleting substances", "Water Conserving", "Low-VOC and "Recycled Material Content" have been submitted to DLA. Additionally, the FLIS has been modified and prepared to receive environmental attribute data as of September 1998.

The purpose of this report is to evaluate *non-greenhouse impact* as an environmental attribute for inclusion in FLIS. This report highlights the underlying policy priorities, provides standard definitions, and presents associated life-cycle costs associated with this environmental attribute. Litton-PRC and Project Performance Corporation prepared this report, with the assistance and guidance of the JG-EnvAtt Coordinating Committee.

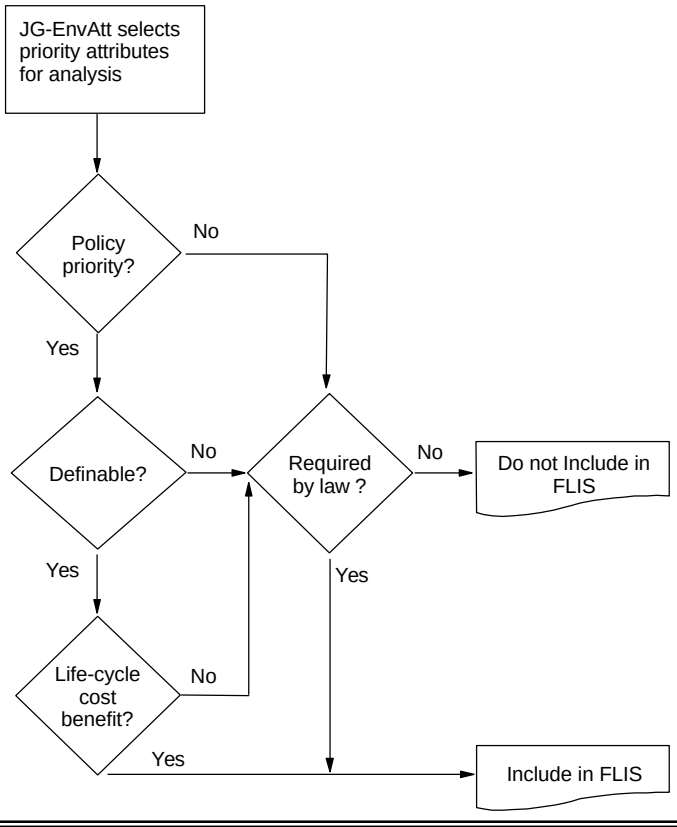
Chapter 2: Evaluation Approach

Federal procurement agencies have initiated activities to encourage the procurement of environmentally preferable products. Various catalogs and guides have been developed for the procurement of environmentally preferable alternatives to conventional products; however, existing catalogs are not linked to the FLIS, which characterizes over 7 million items by over 240 codes, including national stock number, manufacturer, procuring agency, and price. These elements, which define the product's "form, fit, and function," assist the procurement personnel and end-users in choosing items that are appropriate for their need.

The DLA defines environmentally preferable as products or services that have a "*lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose***."** The comparison of environmentally preferable products with other products may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and/or disposal of the product or service.

Incorporating positive environmental attributes in the FLIS will increase the visibility and procurement of environmentally preferable products. The use of environmentally preferable products will minimize the use of hazardous/toxic substances, improve energy efficiency, promote the use of recycled materials, and conserve natural resources.

Exhibit 2
Evaluation Criteria Impact on Attribute Incorporation in FLIS



Evaluation Criteria

The process of selecting and including potential environmental attributes in FLIS involves evaluating each attribute against three selection criteria:

- Be a policy priority;
- Clearly definable; and
- Show a life-cycle cost benefit.

Exhibit 2 illustrates how these criteria impact whether an attribute is incorporated into the FLIS system.

Policy priority?

A potential environmental attribute must have a federal policy priority. On the largest scale, compliance is required under federal environmental laws,

regulations, and executive orders. Additionally, federal procurement personnel must comply with Federal Acquisition Regulations, which provide further direction concerning implementation requirements contained in regulations and Executive Orders. Finally, departmental policies or initiatives may exist that govern affirmative procurement of environmentally oriented products. Environmental stewardship programs and green design projects may also affect procurement decisions. All of these environmental laws, regulations, policies, and initiatives indicate that a particular environmental initiative is a priority both from the policy standpoint and a public consciousness standpoint.

Definable?

If an environmental attribute proves to be a policy priority, it must be clearly defined. The intent of adding environmental attributes to the FLIS is to contribute to the procurement personnel's understanding of the product and why it is preferable to a similar product without the environmental attribute. Procurement personnel must be able to identify products with these attributes from similar products available in the database. The environmental attribute field must contribute information that is understandable, and capable of distinguishing between products of similar form, fit, and function. Therefore, the attribute definitions must be unambiguous and include some quantifiable characteristic.

Show a cost benefit?

Provided the environmental attribute is both a policy priority and definable, it now must be shown to provide a cost benefit when compared to similar products without the environmental attribute. Information concerning cost-effectiveness of an environmental attribute may be found in regulatory impact analyses and in governmental and non-governmental cost studies.

Additionally, a life-cycle cost assessment may be beneficial and/or required as a means of acquisition planning. The cost assessment tracks the costs associated with a particular product from procurement through use, handling and disposal.[1] Often, a higher initial purchase price for environmentally oriented products is off-set by reduced costs associated with:

- Material storage and handling;
- Use of energy, water, and other resources;
- Waste storage, treatment, and disposal;
- Compliance, permitting, and reporting; and
- Liability for work-related injuries and environmental contamination.

In other cases, the results of the cost assessment may be overridden by the requirements of a federal directive or agency policy.

[1] This analysis does not evaluate the cost associated with manufacturing environmentally preferable products relative to other products. Any costs incurred prior to procurement are excluded from this evaluation.

Approach

This report documents the multi-step process used to evaluate *non-greenhouse impact* as an environmental attribute. First Litton-PRC and PPC researched government, industrial, and international regulations, policies, and definitions to determine if a policy priority exists for the proposed attribute. Some of the primary sources used for this analysis are listed in Exhibit 3.

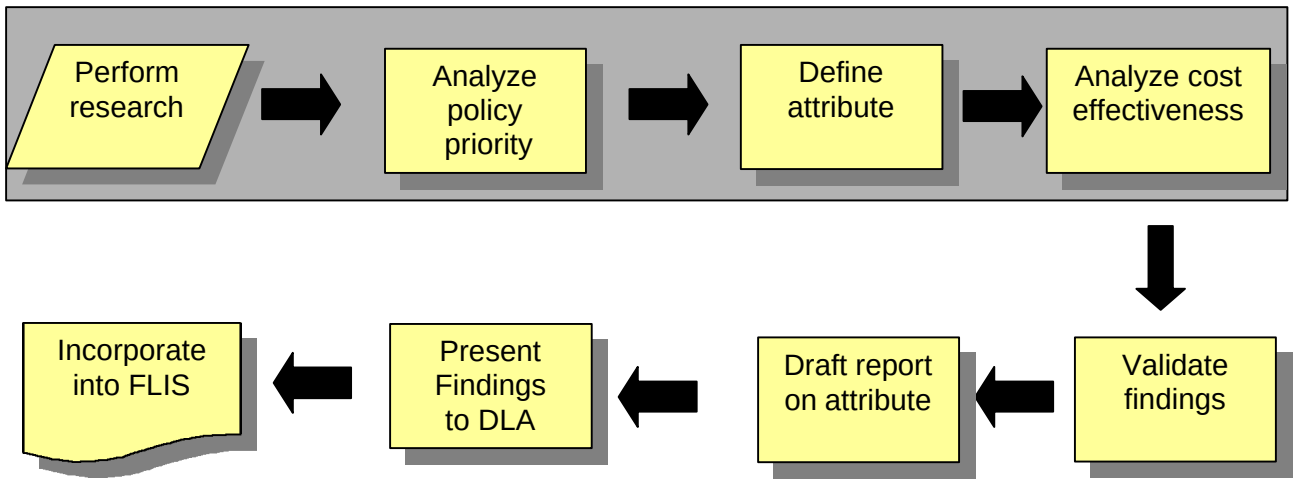
A definition of the attribute was developed based upon this research and validated by subject matter experts at EPA and other federal agencies. For some potential attributes, the existing definitions are vague, originate from numerous sources, and are inconsistent. In order to ensure that any interpretation of the existing definitions remained consistent with the common, accepted definition, the project team asked experts in the subject to validate the definitions established.

Upon validation of the established definition, additional research was conducted on the attribute's life-cycle cost impacts. The overall process used to research the selected environmental attribute is presented in Exhibit 4.

Exhibit 3
Primary Research Sources

- Laws and regulations
- Executive Orders
- DoD affirmative procurement goals
- EPA Partners for the Environment Programs
- Interest group studies
- International standards
- Regulatory impact analyses
- Governmental and NGO cost studies
- DLA inventory control points
- FTC guides for the use of environmental marketing claims (16 CFR Part 260)
- Scientific certification systems - lists of certified products and claims
- ISO 14020 - Guiding Principles for Environmental Labeling Programs (Draft)

Exhibit 4
Research Approach



Chapter 3: Non-Greenhouse Impact

The Earth's climate is the result of a complex system, influenced by many factors. There are a number of uncertainties surrounding how increasing concentrations of "greenhouse gases" released into the atmosphere from human activities may affect the Earth's climate. The natural "greenhouse" effect, however, is well understood. Sunlight radiating to Earth (in the form of shortwave radiation) travels through the atmosphere and heats the Earth's surface. As the Earth absorbs the sunlight, it emits thermal radiation (in the form of longwave radiation) back into the atmosphere. Certain gases – "greenhouse" gases – absorb some of this radiation, heat the atmosphere, and, in turn, further warm the Earth's surface. This "greenhouse" effect is essential to life on earth. In fact, without greenhouse gases the Earth's surface would be approximately 55º F (or 34º C) colder than it is today.[2]

Greenhouse gas levels in the atmosphere are the result of processes that generate greenhouse gases (i.e., sources) and processes that destroy or remove them (i.e., sinks). The primary natural sinks are oceans and forests. Anthropogenic activities[3] have increased greenhouse gases in the atmosphere. Humans have both introduced new sources (e.g., burning fossil fuels such as coal, oil, and natural gas), and have interfered with natural sinks (e.g., deforestation).

Greenhouse gases include both naturally occurring and human-made compounds. Naturally occurring greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3). Human-made compounds that have a greenhouse effect include cholorofluorocarbons (CFCs), partially halogenated fluorocarbons (HCFCs), hydrofluorocarbons (HFCs), and perfluorinated carbons (PFCs). In addition, there are a number of gases that contribute indirectly to the greenhouse effect because they influence the rate at which ozone and other greenhouse gases are created and destroyed in the atmosphere. These gases, known as photochemically important gases, include oxides of nitrogen (NOx) and nonmethane volatile organic compounds (NMVOCs). A description of each of these compounds and the role each one plays in contributing to the greenhouse effect is included in Appendix A.

The concentrations of greenhouse gases in the Earth's atmosphere are increasing, largely due to anthropogenic activities. Changing the concentrations of greenhouse gases in the atmosphere can change the balance of energy transfer between the atmosphere, space, the land, and the oceans. In fact, increased concentrations in the atmosphere are projected to result in increased average temperatures at the surface of the Earth. Warming of the planet could result in a number of undesirable impacts, including a raised level of the oceans and changes in weather that could disrupt current land uses, human settlement, and existing ecosystems.

[2] U.S. Environmental Protection Agency, *States Guidance Document: Policy Planning to Reduce Greenhouse Gas Emissions*, Second Edition, May 1998, page 2-1.
[3] Anthropogenic activities are those of, relating to, or resulting from the influence of human beings on nature.

Is it a Policy Priority?

Research indicates that purchasing products with a *non-greenhouse impact* **is** a policy priority due to the existence of national and state policies. Because greenhouse gases are emitted by virtually all economic sectors, from a wide range of activities, there are a great number of policies that impact greenhouse gas emissions. Below are a number of policies that make *non-greenhouse impact* a policy priority; however, this list is not exhaustive.

- Under the Kyoto Protocol, negotiated in December 1997, the United States would be required to reduce its emissions of six greenhouse gases by the year 2012.
- The Montreal Protocol established the goal of reducing and eventually eliminating the emissions of man-made ozone depleting substances.
- On June 3, 1999, President Clinton made an executive order that the Federal Government significantly improve its energy management to reduce emissions that contribute to global climate change.
- The 1990 Clean Air Act – Sets the stage for the identification and regulation of hazardous air pollutants.
- The Pollution Prevention Act (PPA)– Establishes pollution prevention as the public policy of the United States. The Act states that pollution should be prevented or reduced at the source wherever feasible; when pollution is not preventable, it should be recycled or treated in an environmentally safe manner.
- The Energy Policy Act of 1992 – covers energy efficiency, natural gas, alternative fuels, electricity, and coal.
- Executive Order 12902 – Outlines several energy conservation programs to be designed and implemented at most federal facilities.
- Executive Order 12856 – Requires Federal agencies to comply with the PPA of 1990 by developing management and acquisition programs that promote pollution prevention.
- Executive Order 12845 – Requires the Federal Government to purchase energy-efficient computer equipment.
- Executive Order 12873 – Requires the Federal Government to make more efficient use of natural resources by maximizing recycling, preventing waste, and using and procuring environmentally preferable products and services.
- Executive Order 13031– Requires the Federal Government to exercise leadership in the use of alternative fueled vehicles.
- States requirements – Several states have initiated programs to reduce greenhouse gas emissions.

Each of these initiatives and their impact on or support of *non-greenhouse impact* as an environmental attribute is discussed in further detail in the following sections.

Kyoto Protocol

The Kyoto Protocol refers to an agreement reached in Kyoto, Japan during a Conference of the Parties on Climate Change in December of 1997. More than 160 countries, including the United States, were involved. Under this agreement, the United States would be required to reduce its emissions of six greenhouse gasses – namely, carbon dioxide, methane, nitrous oxide,

hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride – 7 percent below its 1990 emissions level by the year 2012.

Montreal Protocol

The Montreal Protocol established the goal of reducing and eventually eliminating the emissions of man-made ozone depleting substances. The Protocol came into force, on January 1st, 1989. At that point, 29 countries and the EEC, representing approximately 82 percent of world consumption, had ratified it. Since then, several other countries have joined.

June 3, 1999 Executive Order

On June 3, 1999, President Clinton made an executive order that the Federal Government significantly improve its energy management to reduce emissions that contribute to global climate change. One of the goals of this Executive Order is that each agency shall reduce its greenhouse gas emissions attributed to facility energy use by 30 percent by 2010, compared to such emissions levels in 1990.

Clean Air Act

The Clean Air Act (CAA), enacted in 1970, is the comprehensive federal law that regulates air emissions from area, stationary, and mobile sources. The 1990 amendment to the Clean Air Act addresses issues such as acid rain, ground-level ozone, stratospheric ozone depletion, and air toxics. Section 183 of the CAA specifically addresses federal ozone measures, detailing control technique guidelines for VOC sources and prioritizing source categories identified as making the most significant contribution to the formation of ozone air pollution. Because these pollutants are also greenhouse gases, the CAA also requires reduction of anthropogenic greenhouse gas emissions.

Pollution Prevention Act

The policy of the PPA is stated as follows:

> The congress hereby declares it to be the national policy of the United States that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

This focus of the PPA is to reduce the amount of pollution through cost-effective changes in production, operation, and raw materials use. Pollution prevention (P2) also includes other practices that increase efficiency in the use of energy, water, or other natural resources, and protect the resource base through conservation. These goals are achieved through practices such

as recycling, source reduction, and sustainable agriculture. Energy efficiency, conservation of water and other natural resources, and prevention of certain pollutants (i.e., those that are greenhouse gases), all contribute to reducing the contribution of greenhouse gases from anthropogenic activities.

Energy Policy Act of 1992

The Energy Policy Act of 1992 Sets building energy efficiency standards and residential energy efficiency ratings, encourages energy efficiency in utilities, and promotes the use of alternative fuels.

Executive Order 12902

This Executive Order requires Federal agencies to develop and implement a program to reduce energy consumption at their facilities. In addition, this Executive Order requires the Department of Energy (DOE) to develop a program to significantly increase the use of solar and other renewable energy resources. DOE must take the lead in working with other Federal Agencies to implement the program.

Executive Order 12856

Executive Order 12856 was signed August 4, 1993 and tasks federal agencies with complying with the PPA of 1990. Federal agencies focus facility management and acquisition activities so as to reduce overall pollution levels.

Executive Order 12845

Because the United States Government is the largest purchaser of computer equipment in the world, this Executive Order encourages pollution prevention principles through responsible procurement practices. Using energy-efficient equipment directly contributes to reducing emissions of greenhouse gases from energy-producing power plants (e.g., coal-fired utilities).

Executive Order 12873

Executive Order 12873, which details federal acquisition, recycling, and waste prevention, was signed on October 20, 1993. This order specifically requires federal agencies to incorporate waste prevention and recycling into the daily operations, and places emphasis on the acquisition of "environmentally preferable" products and services. Environmentally Preferable is defined as "products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose."[4]

Executive Order 13101

Executive Order 13101 is titled *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*, and was signed on September 16, 1998. This executive order

[4] Executive Order 12873, "Federal Acquisition, Recycling, and Waste Prevention," October 20, 1993, page 2.

specifically requires the Federal Government to work to increase its preference and demand for products that contain recycled content materials. Recycling of materials typically reduces the amount of energy required to manufacture new products and, consequently, contributes to reducing the greenhouse gases emitted from anthropogenic activities. The order calls for a "Government-wide Waste Prevention and Recycling Strategic Plan" that should include "direction and initiatives for acquisition of recycled and recyclable products and environmentally preferable products and services."[5]

State Initiatives to Reduce Greenhouse Gas Emissions

Many individual states and localities have initiated responses to reduce greenhouse gas emissions. At the state level, 20 states have developed or committed to develop a state-level action plan to reduce greenhouse gas emissions.[6] More than 20 states and more than 80 cities and counties have joined a program entitled "Rebuild America."[7] This program, by emphasizing energy efficiency improvements, reduces greenhouse gas emissions.

Attribute Definition

There is no unambiguous definition for *non-greenhouse impact*. EPA has stated that "no single activity is the dominant source of greenhouse gases; therefore, no single measure can stabilize global climate. Many individual components, each having a modest impact on greenhouse emissions, can have a dramatic impact on the rate of climate change when combined."[8] Furthermore, greenhouse gases are emitted by most, if not all, economic sectors. Emissions result from residential and commercial energy use, industrial processes, electricity generation, agriculture, and forestry.

There are numerous methods to decrease greenhouse gas emissions into the environment, which vary based on the targeted source. For example, improving mass transit systems, providing incentives to employees to establish car pools, and developing tele-commuting programs all contribute to reducing greenhouse gases from the transportation sector. Examples of other programs to reduce greenhouse gases include:

- recovering and using methane gas from landfills,
- encouraging construction of energy efficient buildings,
- increasing the aerobic treatment (e.g., composting) of livestock manure,
- improving nitrogen-use efficiency in fertilizer applications,
- promoting the regeneration of forests,
- plowing agricultural wastes and residues back into the soil (e.g., plowing corn husks back into the field rather than open field burning), and
- promoting the use of alternative fuels.

[5] Executive Order 13101, "Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition," September 16, 1998, page 49645.
[6] U.S. Environmental Protection Agency, *States Guidance Document: Policy Planning to Reduce Greenhouse Gas Emissions*, Second Edition, May 1998, page 2-10.
[7] Ibid. page 2-10.
[8] Ibid. page 2-14.

The EPA has a number of volunteer programs designed to reduce pollution and promote partnerships between the public and the private sectors. For example, participants in the Green Lights program upgrade to more energy efficient lighting devices within five years. In return, EPA provides technical support, networking with equipment manufactures, and opportunities for public recognition.

Even though there is not an unambiguous definition for this environmental attribute, DLA is already actively selecting products for purchase that have a *non- or lesser-greenhouse impact* by incorporating other environmental attributes into the FLIS database. The attributes DLA has already evaluated for inclusion in its FLIS database, and the reasons they contribute to a non-greenhouse impact or a lesser-greenhouse impact are described below.

Energy efficient – Carbon dioxide is the primary greenhouse gas contributed to the atmosphere by anthropogenic activities. It is emitted, mainly, through the combustion of fossil fuels. The electric utility sector, for example, produces more than 1.81 billion metric tons of carbon dioxide per year.[9] Energy use in the residential, commercial, and industrial sectors accounts for more than 3.49 billion metric tons of carbon dioxide emissions per year.[10] Therefore, products that are energy efficient directly contribute to reducing carbon dioxide emissions.

EPA Comprehensive Procurement Guidelines – The EPA Comprehensive Procurement Guidelines designates products containing recovered materials for government agencies to purchase. These products are organized into categories, which include: paper and paper products, vehicular products, construction products, transportation products, park and recreation products, landscaping products, non-paper office products, and miscellaneous products. Using products that contain recycled or recovered materials directly contribute to reducing greenhouse gases in the atmosphere. For example, by reducing the need for wood by recycling paper and other wood products may contribute to a decrease in deforestation. Because forests are a natural sink for some greenhouse gases (i.e., plants remove carbon from the atmosphere through photosythesis), reducing deforestation directly contributes to having a *non- or lesser greenhouse impact.*

Non-ozone depleting substances – Ozone depleting substances *are* greenhouse gases. Therefore, incorporating this environmental attribute into the FLIS database also allows DLA to selecting products that have a *lesser-greenhouse impact*.

Low-VOC content – Volatile Organic Compounds (VOCs) *are* greenhouse gases. Therefore, incorporating this environmental attribute into the FLIS database also allows DLA to select products that have a *lesser-greenhouse impact.*

Recycled material content (for glass, aluminum and steel products)-- Using recycled materials rather than the raw, "virgin" materials directly contributes to the reduction in greenhouse gas emissions. Because energy from the combustion of fossil fuels is used to manufacture new products made of glass, aluminum, and steel, energy savings translate into reduced greenhouse gas emissions.

[9] Energy Information Administration, *Mitigating Greenhouse Gas Emissions: Voluntary Reporting. Voluntary Reporting of Greenhouse Gases*, DOE/EIA-0608(96), October 1997, page 9.
[10] Ibid. page 21.

Life-Cycle Cost Assessment

Because there is no unambiguous definition for *non-greenhouse impact,* and consequently this environmental attribute cannot be included in the FLIS database, a life-cycle cost assessment was not conducted.

Chapter 4. Summary and Conclusions

The JG-EnvAtt Coordinating Committee's approach for adding environmental attributes to the FLIS is to identify and evaluate potential environmental attributes based on their policy priority, definability, and life cycle cost savings. This approach was used to evaluate the environmental attribute *non-greenhouse impact*.

This environmental attribute is strongly supported by federal policies, including the Kyoto Protocol, the Montreal Protocol, the Clear Air Act, the Pollution Prevention Act, numerous executive orders, and various states-initiated programs to reduce greenhouse gas emissions. However, there is no unambiguous definition for *non-greenhouse impact*.

Our professional recommendation is that the environmental attribute *non-greenhouse impact* should not be incorporated into the FLIS database. However, by incorporating other environmental attributes that DLA has evaluated into the FLIS database, such as "*energy efficient*," "*EPA comprehensive procurement guidelines*," "*non-ozone depleting substances*," "*water conserving*," and "*low-VOC content*," DLA will select products that contribute to decreasing the concentration of greenhouse gases in the atmosphere.

Appendix A –Greenhouse Gases and Photochemically Important Gases[11]

Greenhouse Gases

Water Vapor is, by far, the most abundant greenhouse gas in the atmosphere. Evaporation from oceans, lakes and soils contributes enormous volumes of water vapor into the atmosphere, which is returned to earth in the form of rain and snow. Human activities are not believed to directly affect the concentration of water vapor in the atmosphere. It is possible that increasing levels of other greenhouse gases in the atmosphere will change the current hydrologic cycle. It is not clear, however, how changing the hydrologic cycle will contribute to climate change. For example, a warmer atmosphere has a greater capacity for holding water than a cooler one. Increased concentrations of water vapor in turn affects the formation of clouds, which both absorb and reflect solar and terrestrial radiation.

Carbon dioxide (CO_2) is one part of the carbon cycle, which is exchanged between various atmospheric, oceanic, land biotic, marine biotic, and mineral reservoirs. The largest fluxes occur between the atmosphere and the terrestrial biota, and between the atmosphere and surface water of the oceans. The combustion of liquid, solid, and gaseous fossil fuels is the primary anthropogenic source of CO_2 into the atmosphere. Some other non-energy production processes (e.g., cement production) also emit notable quantities of CO_2. The atmospheric concentrations of carbon dioxide have been increasing at a rate of approximately 0.5 percent per year.

Methane (CH_4) is produced through anaerobic decomposition of organic matter in biological systems. Agricultural processes, such as wetland rice cultivation, enteric fermentation in animals, and the decomposition of animal wastes, emit methane, as does the decomposition of municipal solid wastes. Methane is also emitted during the production and distribution of natural gas and oil, and is released as a by-product of coal production and incomplete fuel combustion. The atmospheric concentration of methane is increasing, although the rate of increase in the 1990s is lower than the observed rate in the 1970s and 1980s.

Halogenated Fluorocarbons, HFCs, and PFCs are human compounds that include: chlorofluorocarbons (CFCs), halons, methyl chloroform, carbon tetrachloride, methyl bromide, and hydrochlorofluorocarbons (HCFCs). These compounds not only enhance the greenhouse effect, but also contribute to stratospheric ozone depletion. Under the *Montreal Protocol* and the *Copenhagen Amendments*, which controls the production and consumption of these chemicals, the U.S. phased out the production and use of all halons by January 1, 1994 and phased out CFCs, HCFCs, and other ozone-depleting substances (ODSs) by January 1, 1996. Perfluorinated carbons (PFCs) and hydrofluorocarbons (HFCs), a family of CFC and HCFC replacements not covered under the *Montreal Protocol*, are also powerful greenhouse gases.

[11] Taken from the U.S. Environmental Protection Agency, *States Guidance Document: Policy Planning to Reduce Greenhouse Gas Emissions*, Second Edition, May 1998, page 2-3 and U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 1996*, EPA 236-R-98-006, March 1998, pages 1-3 through 1-5.

Nitrous Oxide (N_2O) emissions from anthropogenic sources include soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, adipic and nitric acid production, and biomass burning.

Ozone (O_3). Normal processes in the atmosphere both produce and destroy ozone. Approximately 90 percent of atmospheric ozone resides in the stratosphere, where it regulates the absorption of solar ultraviolet radiation; the remaining 10 percent is found in the troposphere and could play a significant greenhouse role. While ozone is not emitted directly by human activity, anthropogenic emissions of several gases influence its concentration in the stratosphere and troposphere. For example, chlorine and bromine-containing chemicals, such as CFCs, deplete stratospheric ozone. Emissions of carbon monoxide, nonmethane volatile organic compounds, and oxides of nitrogen contribute to the increased production of tropospheric ozone, the primary constituent of smog.

Photochemically Important Gases

Carbon Monoxide (CO) is created when carbon-containing fuels are burned incompletely. CO elevates concentrations of methane and tropospheric ozone through chemical reactions with atmospheric constituents (e.g., the hydroxyl radical) that would otherwise assist in destroying methane and ozone. CO eventually oxidizes to CO_2.

Oxides of Nitrogen (NOx) are created from lightning, biomass burning (both natural and anthropogenic fires), fossil fuel combustion, and in the stratosphere from nitrous oxide. These compounds play an important role in climate change processes because they contribute to the formation of tropospheric ozone.

Nonmethane Volatile Organic Compounds (NMVOCs) include compounds such as propane, butane, and ethane. Volatile organic compounds participate, along with nitrogen oxides, in the formation of ground-level ozone and other photochemical oxidants. VOCs are emitted primarily from transportation, industrial processes, forest wildfires, and non-industrial consumption of organic solvents.

Appendix B – Acronyms and Chemical Compounds

AISI	American Iron and Steel Institute
CFCs	Cholorofluorocarbons
CFR	Code of Federal Regulations
CPG	Comprehensive Procurement Guidelines
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CH_4	Methane
DISC	Defense Industrial Supply Center
DLA	Defense Logistics Agency
DOE	Department of Energy
EPA	Environmental Protection Agency
FLIS	Federal Logistics Information System
GSA	General Services Administration
HCFCs	Partially Halogenated Fluorocarbons
HFCs	Hydrofluorocarbons
ISRI	Institute of Scrap Recycling Industries
JG-EnvAtt	Joint Group on Environmental Attributes
JLC	Joint Logistics Commanders
N_2O	Nitrous Oxide
NMVOCs	Nonmethane Volatile Organic Compounds
NOx	Oxides of Nitrogen
O_3	Ozone
ODSs	Ozone-Depleting Substances
P2	Pollution Prevention
PFCs	Perfluorinated Carbons
PPA	Pollution Prevention Act
VOCs	Volatile Organic Compounds

Appendix C - References

Energy Information Administration, *International Energy Outlook 1998 With Projections Through 2020*, DOE/EIA-0484(98), April 1998.

Energy Information Administration, *Mitigating Greenhouse Gas Emissions: Voluntary Reporting. Voluntary Reporting of Greenhouse Gases*, DOE/EIA-0608(96), October 1997.

Intergovernmental Panel on Climate Change, *Implications of Proposed CO_2 Emissions Limitations*, ISBN: 92-9169-103-8, October 1997.

Intergovernmental Panel on Climate Change, *Stabilization of Atmospheric Greenhouse Gases: Physical, Biological and Socio-economic Implications*, ISBN: 92-9169-102-X, February 1997.

Intergovernmental Panel on Climate Change, *Summary for Policymakers: Aviation and the Global Atmosphere,* April 1999.

Intergovernmental Panel on Climate Change, *Summary for Policymakers: The Economic and Social Dimensions of Climate Change – IPCC Working Group II*, http://www.ipcc.ch/pub/sarsum3.htm.

Intergovernmental Panel on Climate Change, *Summary for Policymakers: The Regional Impacts of Climate Change: An Assessment of Vulnerability*, ISBN: 92-9169-110-0, November 1997

Intergovernmental Panel on Climate Change, *Summary for Policymakers: The Science of Climate Change – IPCC Working Group I*, http://www.ipcc.ch/pub/sarsum1.htm.

Intergovernmental Panel on Climate Change, *Technologies, Policies and Measures for Mitigating Climate Change*, ISBN: 92-9169-100-3, November 1996.

Sperling, Gene, Assistant to the President for Economic Policy, Steinberg, Jim, Deputy Assistant to the President for National Security Affairs, Fuerth, Leon, National Security Advisor to the Vice President, *Press Briefing*, December 11, 1997.

U.S. Environmental Protection Agency, *States Guidance Document: Policy Planning to Reduce Greenhouse Gas Emissions*, Second Edition, May 1998.

U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 1996*, EPA 236-R-98-006, March 1998.

U.S. Environmental Protection Agency, *Partners for the Environment: A Catalogue of the Agency's Partnership Programs*, EPA 100-B-97-003, Spring 1998.

U.S. General Accounting Office, *Climate Change: Information on the U.S. Initiative on Joint Implementation*, Report to the Ranking Minority Member, Committee on Commerce, House of Representatives, GOA/RCED-98-154, June 1998.

Watson, Robert T., *Report to the 10th Session of SBSTA on the Status of the IPCC*, May 31, 1999, http://www.ipcc.ch/press/speech6-99.htm.

White House, Executive Order: *Greening the Government through Efficient Energy Management*, June 3, 1999.

White House, *The Kyoto Protocol and the President's Policies to Address Climate Change: Administration Economic Analysis*, Submitted to congress by the President's Council of Economic Advisors, July 1998.

Executive Order 12873, *Federal Acquisition, Recycling, and Waste Prevention*, October 20, 1993.

Executive Order 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*, September 16, 1998.

Executive Order 13031, *Federal Alternative Fueled Vehicle Leadership*, December 13, 1996.

U.S. Environmental Protection Agency. *Pollution Prevention Act*; 42 USC 13101-12109.

U. S Environmental Protection Agency. *Clean Air A*ct; 42 USC 7401 et seq.

The 1987 Montreal Protocol on Substances that Deplete the Ozone Layer. [Adjusted and amended by the second Meeting of the Parties (London, June 27-29, 1990), the fourth Meeting of the Parties (Copenhagen, November 23-25, 1992), the seventh Meeting of the Parties (Vienna, December 5-7, 1995), and the ninth Meeting of the Parties (Montreal, September 15-17, 1997).] http://www.unep.org/unep/secretar/ozone/mont_t.htm.

English Conference of the Parties, Third Session Kyoto, 1-10 December 1997, *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, http://www.cnn.com/SPECIALS/1997/global.warming/stories/treaty/.