The Washington State
Consumer Environmental Index (CEI)

A Summary of the Development of a Tool to Understand and Support Consumer Choices That Have Preferable Environmental Outcomes

Revised Draft

Prepared by:

Dr. Jeffrey Morris, Sound Resource Management
Dr. H. Scott Matthews, Carnegie Mellon University
Dr. Frank Ackerman, Tufts University
Michelle Morris, Sound Resource Management
Rick Hlavka, Green Solutions

Prepared for
The Washington State Department of Ecology

July 31, 2007

Acknowledgements:

Washington State Department of Ecology, CEI Project Steering Committee:

Dennis Bowhay
Chris Chapman
Cristiana Figueroa-Kaminsky
Ivor Melmore, Project Manager
Gretchen Newman
Cheryl Smith
Ken Zarker

Washington State Department of Ecology staff:

Ellen Caywood
Dan Farrell
David Nightingale
Sally Otterson
Robert Rieck

Table of Contents

1. Introduction 1
2. CEI Objectives 4
3. CEI Model Flow Chart 5
4. Measuring Washington Consumers Annual Expenditures 7
5. The Life Cycle of Products and the CEI's Three Modules 10
   5.a. The upstream phase of a product's life cycle (resource extraction, production & transportation/handling to point of retail sale) 10
      Data sources 11
      How the Carnegie Mellon University EIO-LCA model works 12
   5.b. The use phase of a product's life cycle (consumption) 14
      Data sources 14
      Transportation 15
      Food 15
      Household operations 15
   5.c. The end-of-life phase of a product's life cycle (disposal) 16
      Data sources 16
      Recycling Offsets 17
      Boundary for the Disposal Phase 18
6. Impact Categories Used in Life Cycle Analysis 20
7. Research Results on Methods for Rolling Up Pollutants into Impact Categories 22
   7.a. Aggregation methodologies that won't work for the CEI 22
      7.a.i. Ecological Footprint 22
      7.a.ii. Environmentally Preferable Purchasing 22
      7.a.iii. Union of Concerned Scientists' Analysis of Consumer Choices 23
      7.a.iv. REACH 24
      7.a.v. Monetization 25
      7.a.vi. Health Scores 26
   7.b. Stronger candidates for human health cancers and non-cancers – quantitative rankings of relative toxicity and carcinogenicity 27
      7.b.i. The finalists – RSEI and TRACI 28
         RSEI 28
         TRACI 30
      7.b.ii. In the meantime -- for human toxicity potential and ecotoxicity potential scores use CalTOX 4.5, and for greenhouse gases and criteria air pollutants use the initial TRACI scores 30
8. Calculating an Index for Each Impact Category and for Separate Expenditure Items 32
9. Weighting the Impact Category Indexes to Produce a Single Overall CEI Index 33
10. Examples of CEI and Individual Product Graphs 35
   10.a. Graphs for the Overall CEI and Its Three Components 35
   10.b. Trends for Motor Oil, Paint and Pesticides 39
11. Results of the CEI Peer Review 40
12. CEI Model Limitations, Data Gaps, and Uncertainties 43
   12.a. Imports 43
13. Recommendations for Next Steps 46

14. References 47
Appendix A 50
Appendix B 62

1. Introduction

The Washington State Consumer Environmental Index (CEI) monitors the environmental impact of consumer choices. Just as the Consumer Price Index (CPI) tracks changes in the prices consumers pay for products and services, the CEI tracks changes in environmental emissions and their impacts caused by the production, use and disposal of items purchased each year by Washington's consumers. The CEI declines when consumers decrease the toxic substances, pollution, and wastes associated with consumption of goods and services.

This initial version of the CEI focuses on the potential for consumer choices to cause:

- Climate change,
- Harm to public health, and
- Ecosystems toxicity.

It does not directly cover other environmental impacts caused by consumer behavior. These excluded impacts are, among others[1]:

- Acidification,
- Eutrophication,
- Ozone depletion,
- Ground level smog formation,
- Habitat disruption,
- Biodiversity depletion, or
- Ecosystem services degradation.

The Sound Resource Management Group (SRMG) project team selected climate change, human health and ecosystems toxicity because in our view these are three of the most important environmental impacts. They capture many of the global and local, as well as human and non-human, repercussions of consumer behavior. There also are readily available sources of emissions data on many of the toxic substances and pollutants that cause these particular public health and ecological problems.

The Washington Sate Department of Ecology (Ecology) contracted with SRMG to develop the CEI as one of the tools for measuring progress on Washington State's Beyond Waste vision for solid and hazardous waste management planning. The Beyond Waste plans provide statewide guidance for transitioning "to a society where waste is viewed as inefficient, and where most wastes and toxic substances have been

[1] See Bare et al (2003) and Lippiatt (2007) for a description and discussion of these other environmental impact categories, as well as the climate change, human health and ecosystems toxicity impacts included in the CEI model.

eliminated. This will contribute to economic, social and environmental vitality."[2] The 30 year Beyond Waste vision anticipates a society where consumers demand products and services that have fewer harmful effects on the environment. The objective for this contract was to develop a "basket of goods" type indicator to measure how consumer choices contribute to achieving this vision.[3]

The CEI measures Beyond Waste progress on the part of Washington's consumers by tracking the pollution caused by the goods and services they purchase each year. Pollutants are wastes -- wastes released into our airways and waterways or deposited in or on our lands. Wastes -- i.e., non-product outputs – are often the result of inefficient resource use. Pollutants, thus, can be a constraint on economic vitality.

Furthermore, some pollutants are toxins or carcinogens that have the potential to harm the health of people and ecosystems. This reduces both economic and environmental vitality.

Pollution often tends to be more concentrated near the facilities that manufacture our products and manage our wastes. Thus, the impacts of pollutants may be distributed very unequally. This reduces social vitality.

Perhaps most importantly, certain pollutants contribute to global warming. Climate change may be the greatest threat of all to our economic, environmental and social vitality.

The following report describes the make up of the CEI, what data go into its calculation each year, and how those data are organized to determine whether the potential threats to the environment from Washington consumers' purchases, use and disposal of goods and services are trending up or down.

The Sound Resource Management project team devotes considerable space in this report to the CEI's methodology for aggregating hundreds of pollutants into a handful of indexes that track potential climate change, human toxicity and ecosystem toxicity impacts. Everyone realizes that the weights attached to food or energy or transportation price changes are critical for having a reliable and robust CPI. Similarly, the weights attached to emissions of mercury, benzene, methane, and hundreds of

[2] Washington State's Beyond Waste Project, *Summary of The Washington State Hazardous Waste Management Plan and Solid Waste Management Plan – Final Plan*, Washington State Department of Ecology, Publication Number 04-07-022, November 2004, p.3.
[3] See Attachment C: RFP No. ECY HWTR 0620, Statement of Work for Contract Pertaining to the Implementation of the Beyond Waste Plan Measures Development.

other pollutant emissions are critical for accurately reflecting the potential of these pollutant releases to cause environmental impacts.

Each pollutant has its own stressor weight for each category of impacts, and these stressor weights are the focus of substantial ongoing research. These weights provide the foundation for a robust and reliable CEI. As scientific research progresses there likely will be revisions in some stressor weights. This can be dealt with in the same way that revised weights for energy or food or other consumption basket items in the Consumer Price Index are handled – by re-benchmarking and/or chaining the Consumer Environmental Index.

In addition, in order to calculate a single index number for overall consumer environmental impact, the CEI model aggregates the indexes for each impact category into an overall index. This aggregation is also the subject of considerable methodological research and debate. The difference for this aggregation versus the weighting of pollutants is that values rather than science must provide the guidance for choosing which of the indexes should have greater weight. That is, should climate change be weighted higher than harm to human health and ecosystem toxicity? As the Sound Resource Management project team suggests in the report, the choice of weights in this case is inevitably subjective. It should be carried out in an explicit, transparent manner, not treated as a technical detail.

Lastly, the following report also discusses data limitations, gaps and uncertainties in the CEI model. The Sound Resource Management project team believes the CEI model to be an innovative and important step forward in understanding and tracking consumers' environmental impacts. At the same time the CEI model is a work in progress. The report indicates where data and analytical improvements can strengthen the CEI.

2. CEI Objectives

As we consume products and services, we are responsible for our own "pollution footprint". Some pollution is released during extraction of raw materials from nature's ecosystems. Some occurs during production and transportation of products. More is released when we use those products and when we decide what to do with the discards that remain after products are used.

Of course consumers are not the only societal actors responsible for pollution. Businesses, institutions and governments also generate pollution as a result of providing their services and products to consumers. Furthermore, in setting policies, rules and regulations for the marketplace, governments constrain and influence the substances used to manufacture products and the pollutant emissions from production processes. As a result the Consumer Environmental Index necessarily reflects the decisions and actions of these other societal entities as well.

However, consumers ultimately drive market demand for goods and services. Consumers, thus, can choose to purchase products that are less polluting, use them more wisely (e.g., use them longer), and dispose of products in less harmful ways (e.g., by reusing or recycling them).

In order to track how consumption patterns influence pollution, and to measure progress in reducing the amount of pollution associated with consumer purchases, the Sound Resource Management project team created the CEI. To the extent that it captures the changes in pollution, a down trend in the CEI signals success.

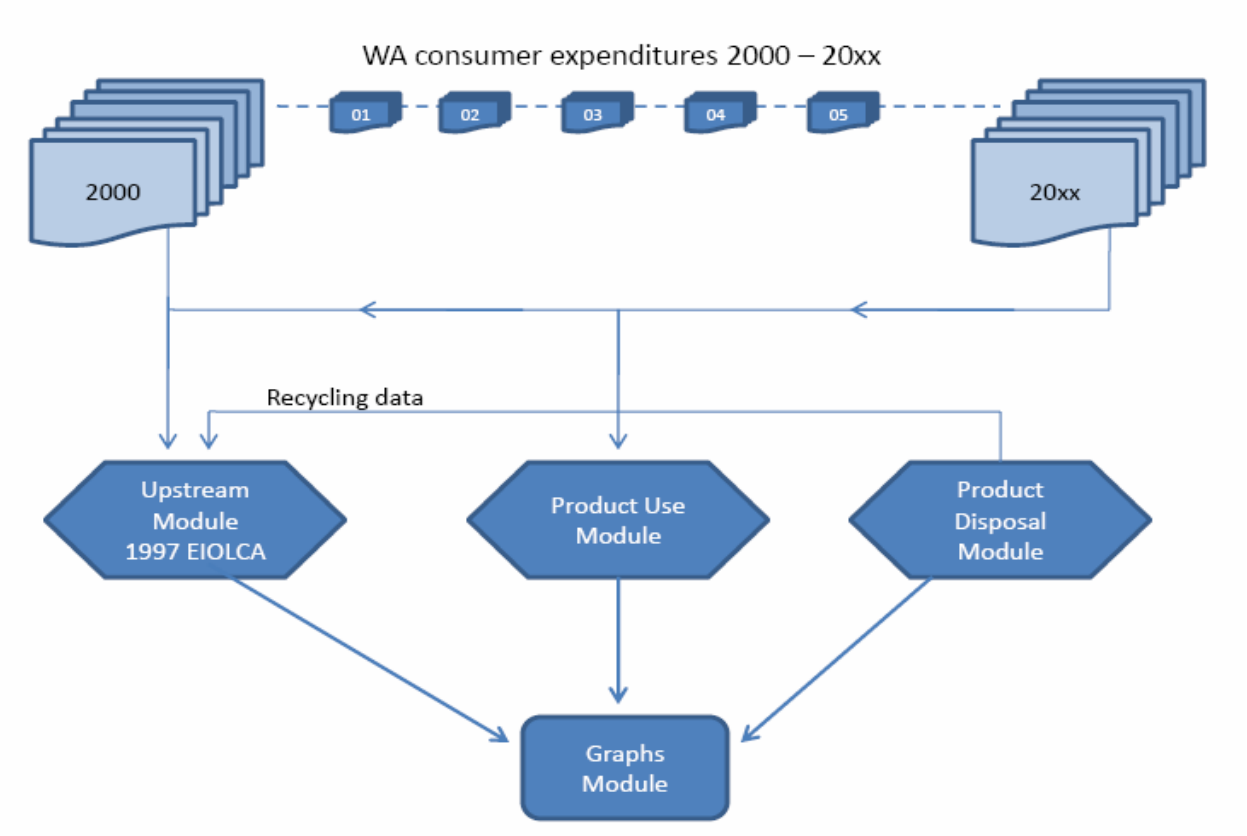
Over time the CEI tracks the environmental impacts from:

- What consumers buy and how their purchasing patterns are changing.
- Growth in average consumer spending.
- Growth in the number of consumers.
- Changes in the efficiency with which manufacturers convert energy and material resources into products and services so as to reduce the pollution output for any given product or service.
- Changes in the efficiency with which consumers use commodities such as electricity and motor vehicles.
- Changes in how consumers manage products at their end of life.

3. CEI Model Flow Chart

Figure 1, The Basic CEI Modules Flow Chart, shows the relationship among the ten modules that encompass the model that computes the CEI. This report is organized to follow the flow of data and calculations through the model for the CEI, beginning with the tracking of Washington consumer spending in the base year 2000.

Figure 1
Basic CEI Modules Flow Chart



The ten CEI model modules tracking consumer impacts for 2000 - 2005 are:

- Six annual expenditure modules to estimate expenditures by Washington's consumers each year from 2000 through 2005.
- An upstream module to estimate annual environmental impacts from pollutants released during resource extraction and refining, manufacturing, and transportation and handling of products through their supply chain to the point of retail sale.
- A product use module to estimate annual environmental impacts during consumers' use of products.

- A product disposal module to estimate annual environmental impacts from consumer choices of management methods for product discards.
- A graphs module to compute and graph the annual indexes.

The CEI model modules are designed to be updatable and expandable:

- Updatable on an annual basis as new expenditures survey data are released by the US Bureau of Labor Statistics. For example, a 2006 expenditures module will be added in 2008.
- Updatable every five years when the US Department of Commerce Bureau of Economic Analysis releases new economic input-output (EIO) matrices based on the economic censuses conducted at five year intervals by the US Census Bureau. The 2002 EIO matrices will be released late in 2007.
- Updatable and expandable to include new data on product life cycle emissions as such data become available.

4. Measuring Washington Consumers Annual Expenditures

Tracking changes over time in the environmental impacts from consumer purchases requires a more dynamic approach than the relatively static basket of goods methodology used for the Consumer Price Index. The Consumer Price Index is aimed at measuring changes in prices for given products.

The Consumer Environmental Index, on the other hand, not only measures environmental impacts for given products. It also tracks environmental impacts from changes in purchasing patterns and total expenditures. Total purchases and the distribution of purchases among products both affect the level of environmental impact from consumer spending. The CEI, thus, encompasses all consumer expenditures. This ensures, for example, that when consumers switch their purchasing patterns, one does not miss the environmental impact of that switch because some products are not among the products being tracked by the CEI.

To measure the total amount and composition of annual expenditures by Washington's consumers, the CEI relies on consumer expenditures estimates from the US Bureau of Labor Statistics Consumer Expenditure Survey. This annual survey consists of a rolling sample of approximately 16,000 households in the United States, 8,000 of which are utilized for a quarterly interview survey on monthly expenditures, with the rest used for a 2 week diary survey of smaller purchases, including food, clothing, household furnishing, entertainment/recreational equipment, and housekeeping supply items.

Expenditures data from these Bureau of Labor Statistics surveys are broken down into four geographical regions of the US, and also disaggregated for many metropolitan statistical areas (MSAs), including Seattle and Portland. The Seattle MSA encompasses Island, Kitsap, King, Pierce, Snohomish, Skagit and Thurston counties, and accounted for 66% of Washington's population in 2005. The Portland MSA includes Clark County, which had 6% of the state's population in 2005. The CEI expenditures modules use the West US region to approximate expenditures by the remaining 28% of Washington consumers.

Table 1, Abridged Summary of Average Household Expenditures -- Western US and Seattle MSA – 1999-2000, provides an example of aggregated expenditure data from the Bureau of Labor Statistics Consumer Expenditure Survey. The table exhibits 1999-2000 Seattle metropolitan statistical area expenditures by the average consumer unit, or household, compared with the average West region household. As indicated in the table, the average Seattle household spends more per year on food, housing, health

care, entertainment, and public transportation, but less on apparel, vehicle purchases, and education.

Table 1
Abridged Summary of Average Household Expenditures
Western US and Seattle MSA
1999-2000

Major Category Expenditure Item	Western US	Seattle
Number of consumer units	24,158,000	1,430,000
Average annual expenditures per household	$41,933	$43,602
Food		
Food at home	3,257	3,839
Food away from home	2,250	2,703
Alcoholic beverages	407	427
Housing		
Shelter	8,746	9,489
Utilities, fuels, and public services	2,202	2,225
Household operations	864	660
Housekeeping supplies	492	636
Household furnishings and equipment	1,781	1,634
Apparel and services	2,021	1,917
Transportation		
Vehicle purchases (net outlay)	3,462	2,766
Gasoline and motor oil	1,291	1,300
Other vehicle expenses	2,605	2,657
Public transportation	515	679
Health care	1,982	2,514
Entertainment	2,181	2,301
Personal care products and services	582	579
Reading	173	209
Education	701	609
Personal insurance and pensions	3,927	4,100

Source: US Bureau of Labor Statistics Consumer Expenditure Survey, 1999-2000

While not shown in Table 1, Bureau of Labor Statistics expenditure data are available at the West region level for almost 700 product categories – e.g., exactly 675 for the year 2000. The Bureau of Labor Statistics reports metropolitan statistical area data in less

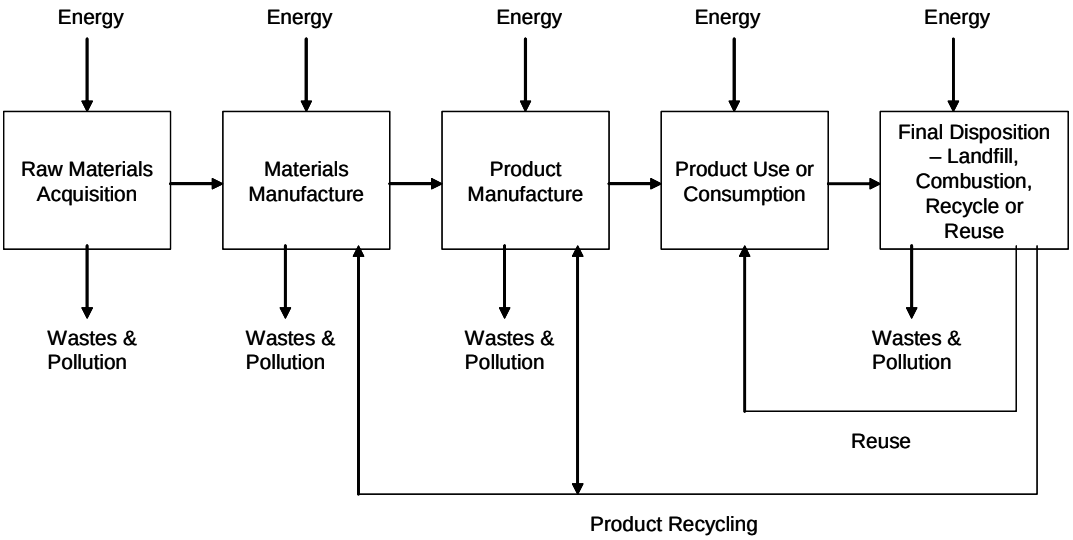
detail. As a result, the CEI expenditures modules disaggregate Seattle and Portland MSA expenditures to the full detail available for the regional data. The CEI modules do this based on spending detail for the West region for each of the more aggregated spending categories reported for metropolitan statistical areas. This provides estimates for Washington consumer expenditures for all of the nearly 700 detailed product categories available in the Consumer Expenditure Survey.[4]

[4] Appendix A lists all the expenditure line items included in the 2005 survey.

5. The Life Cycle of Products and the CEI's Three Modules

Three phases – production (including extraction of raw materials, refining of raw materials, manufacturing, and transportation and handling of finished products through to the point of retail sale), use, and end of life – encompass the life cycle of products and services that we consume. Figure 2, Schematic Detail for a Product's Life Cycle Phases, provides a conceptual diagram for the life cycle of a product or service. It shows the input of energy and output of wastes and pollution that occur over the three phases of a product's life cycle. The schematic indicates how reuse and recycling short circuit the upstream phase, thereby conserving energy and reducing releases of waste and pollutants in the production of goods and services.

Figure 2
Schematic Detail for a Product's Life Cycle Phases



One or limited number of return cycles into product that is then disposed – open-loop recycling. Repeated recycling into same or similar product, keeping material from disposal – closed-loop recycling.

5.a. The upstream phase of a product's life cycle (resource extraction, production & transportation/handling to point of retail sale)

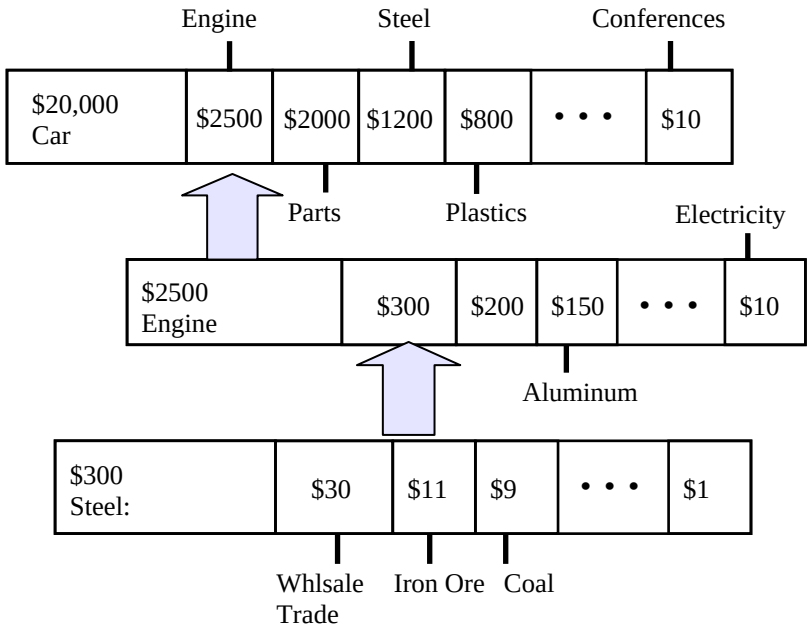
The CEI uses publicly available data for the upstream phase to estimate pollution from resource extraction, manufacturing, and transportation and handling through a product's supply chain to the point of retail sale. These data are from the Economic Input-Output Life Cycle Assessment (EIO-LCA) model (http://www.eiolca.net) maintained by the Green Design Institute at Carnegie Mellon University. This life cycle analysis model

uses economic input-output tables to measure pollutant emissions from the total supply chain used in the production phase (often termed the "upstream" phase) for each product.

Input-output (IO) tables are a long-established view into how the economy works, and were first available for the US economy beginning in the 1940s. They define how much in dollars each economic sector buys from each of the other economic sectors.

For example, as diagrammed in Figure 3, Supply Chain for an Automobile, the tables show the dollar amounts of steel, aluminum, glass, plastics, and other inputs bought by the automobile manufacturing sector to make a car. In turn they show the dollar amounts of steel, aluminum and other inputs purchased by the engine manufacturing sector to make the car's engine. Then they show the dollar amounts of wholesale trade services, iron ore, coal and other inputs used in the steel production sector to make the steel for the car's engine. And so on, so that such tables can be used to summarize spending across the entire supply chain for automobile manufacturing.

Figure 3
Supply Chain for an Automobile



Data sources

The Carnegie Mellon University EIO-LCA model is disaggregated into 491 economic sectors. Each sector encompasses similar economic activities such as automobile

manufacturing, electricity generation, or banking. Besides economic input-output tables, the EIO-LCA model also includes data on energy use and environmental emissions for each of the 491 sectors. The EIO-LCA team developed these data through research funded by the US Environmental Protection Agency (EPA) and the National Science Foundation. These data are publicly available and used by permission of Carnegie Mellon's Green Design Institute through a non-commercial use license.

The current EIO-LCA model version is built upon benchmark input-output tables of the US economy, as provided by the US Department of Commerce's Bureau of Economic Analysis (BEA) (www.bea.gov), for 1997. These 1997 tables are based on data gathered during the 1997 economic census.[5]

As discussed in Cicas *et al* (2006), emissions data in the EIO-LCA model include US EPA's Toxics Release Inventory (TRI) emissions data for 2000 and criteria air pollutant emissions from US EPA's AIRData Report for 1999. The EIO-LCA model also estimates greenhouse gas emissions based on the Intergovernmental Panel on Climate Change's (IPCC) revised 1996 guidelines for national greenhouse gas inventories, the US Department of Energy's transportation data book for 1999, and US EPA's inventory of greenhouse gas emissions and sinks for 1997. These data provide the pollutant emissions information used to measure environmental impacts from the production phase of the life cycle for each product or service purchased by Washington consumers.

How the Carnegie Mellon University EIO-LCA model works

When one runs the 491-sector EIO-LCA model for a particular product, say coffee, he or she inputs a dollar value for 1997 expenditures on that product, say $1 million. The EIO-LCA model then estimates the dollar purchases from each of the 491 economic sectors that are needed to produce $1 million worth of coffee. The model connects purchases from the 491 sectors to the emissions that are generated as a result of that level of economic activity in each sector. The total amount of emissions for a given sector is then found by adding all emissions from each of the 491 sectors whose inputs are required somewhere in the supply chain to produce the $1 million worth of coffee.

Table 2 shows a sample of output data from the EIO-LCA model as a result of spending a million dollars on coffee. The table shows both the top five sectors for purchases and the top five sectors for Toxic Release Inventory pollutant emissions out of all the sectors

[5] The BEA input-output tables based on the 2002 economic census will be available in late 2007, and will be used, along with updated emissions data, to update the EIO-LCA model sometime in 2008 - after the end of this initial project to construct the basic CEI indicator.

involved in the entire supply chain needed to produce $1 million of coffee. Table 2 shows that across the supply chain $352,000 of fruit farming is needed to make $1 million of coffee, $241,000 of insurance purchases, and $163,000 worth of wholesale trade.

Table 2
Top 5 Supply-Chain Economic Sectors and Top 5 Supply-Chain TRI Releases Sectors for $1 Million of Coffee Manufacturing

	Economic Impact ($millions)	TRI Releases(kg)
Total for all sectors	**$2.67**	**339.0**
Top 5 Sectors for Economic Impact		
Coffee and tea manufacturing	1.002	14.8
Fruit farming	0.352	<0.5
Insurance carriers	0.241	<0.5
Wholesale trade	0.163	0.5
Insurance agencies, brokerages, and related	0.086	<0.5
Top 5 Sectors for TRI Releases		
Copper, nickel, lead, zinc mining	<.0005	114.0
Power generation and supply	0.015	30.8
Nitrogenous fertilizer manufacturing	0.003	20.1
Gold, silver, other metal ore mining	<.0005	18.5
Pesticide & other agricultural chemicals	0.029	17.5

Source: Carnegie Mellon EIO-LCA model.

The right hand column of Table 2 shows the amount of toxic pollutants released across the supply chain to the air, water and land as a result of manufacturing $1 million of coffee. In total 339 kilograms (kg) of toxics are released, with copper, nickel, lead and zinc mining accounting for 114 kg, power generation and supply for 30.8 kg, nitrogenous fertilizer manufacturing for 20.1, and pesticide and other agricultural chemicals manufacturing for 17.5 kg. It is results like these for each of the sectors involved in production of the goods and services purchased by Washington consumers that the CEI model uses in calculating the greenhouse gas, criteria air pollutant, and Toxics Release Inventory emissions data for the CEI.[6,7]

[6] We should note that the TRI releases shown in Table 1 are simply the sum of the quantities released for a wide variety of disparate pollutants, from arsenic and benzene to zinc and everything in between. As such the totals do not take into account the different magnitude of environmental impacts caused by the release of similar amounts of different pollutants. For example, to measure the relative impacts on human health one needs to use human toxicity potentials, i.e., toxicity and carcinogenicity scores, to weight the releases of the various pollutants before adding them up. The CEI accounts for the different human health, as well as ecosystem, impacts from different pollutants by using human health and ecosystem toxicity weights, as explained in Sections 6 and 7 of this report.

[7] Further details on the EIO-LCA method, as well as a tutorial, can be found on the EIO-LCA website (http://www.eiolca.net/), and in Cicas *et al*(2006).

5.b. The use phase of a product's life cycle (consumption)

Consumers typically have little control over manufacturing practices for the specific products that they purchase. Consumers influence the level of environmental impacts from the manufacturing phase mainly by choosing what and how much to buy.

However, after they have decided what products and services to purchase, the use phase of a product's life cycle is where consumers can make choices that directly affect pollutant emissions levels. For example, we decide how fast to drive cars, how well to maintain vehicle pollution control systems, how warm or cool to keep homes, how much food to throw away, and how carefully or carelessly to use household cleaning, lawn and gardening products.

Data sources

Consumer spending on energy resources is detailed in the Bureau of Labor Statistics expenditure survey. To the extent that the energy resource used by a consumer is electricity, the EIO-LCA model fully captures its environmental releases via measurement of releases associated with production of electricity.

For other home air and water heating, home air conditioning, and vehicle energy sources, the EIO-LCA model only captures emissions from extraction, refining and distribution of the raw materials such as petroleum used to manufacture fuels. Pollutant emissions from combustion of fuels at home or in the consumer's vehicle need to be added in. For emissions from home and vehicle fuel use the CEI uses data from Ecology's Air Quality Program.

Ecology's Air Quality Program also provided the data the CEI model uses to calculate annual emissions of particulates from tire tread and brake pad wear on passenger vehicles.

For use impacts other than from fuel combustion or from tire tread and brake pad wear, the CEI relies on available literature and studies to estimate pollutant releases on a product by product basis. For this initial version of the CEI, the goal was to concentrate on the three categories of consumer spending which, according to life cycle studies, cause the greatest environmental impacts -- transportation products and services, food, and household operations (including utilities, appliances, and lighting).[8]

[8] See, for example, Brower and Leon (1999).

Transportation

For transportation, motor vehicle fuel consumption accounts for some of the environmental impacts of driving. In addition, the use impacts of motor oil consumption are important. For example, waterborne pollutants from leakage and dumping of used motor oil onto the ground and into waterways, combined with the atmospheric emissions from motor oil being sucked into vehicle combustion chambers, are more than ten times more toxic to ecosystems than atmospheric emissions from combustion of vehicle fuels.

To calculate the impacts of motor oil use, the Sound Resource Management project team obtained data from published studies on the constituents of used motor oil. For estimating environmental releases from motor oil use, the Sound Resource Management project team also used less scientifically rigorous estimates on the rate of engine motor oil leakage and combustion in cylinders, the rate and types of illegal disposal by do-it-yourself oil changers, and the amount of used oil recycling in Washington state.

Food

In the case of food consumption, the production phase emissions data from the EIO-LCA model captures emissions for food consumed away from home at restaurants and fast food establishments. Use phase emissions from food consumption at home mainly have to do with energy used for cooking and dish washing. The CEI measures those as part of overall emissions from energy used for home utilities.

In addition, the extent to which Washington state consumers purchase a greater percentage of their food from local and/or organic growers is an important way in which Washington residents may differ from the US average in food products purchasing. For future updates to the CEI it would be useful to find reliable data on local and organic food consumption in Washington versus the US average, so as to calculate an emissions offset to the production phase US average reflected in the EIO-LCA model's emissions estimates.

Household operations

For household operations, the use phase for household utilities and appliances mainly involves energy consumption. The CEI captures emissions from energy consumption via the EIO-LCA model for electricity and emissions data on fuels from Ecology's Air Quality Program. The CEI includes emissions from wood burning for residential heating based on Ecology Air Program wood stove emissions estimates and US Department of Energy's Energy Information Administration estimates of household wood consumption in Washington.

Of specific interest to the Washington Department of Ecology, as characterized in its Beyond Waste plan, the CEI model also includes estimates of the use phase impacts from household use of pesticides, paints, and motor oil. These estimates are based on various studies on pollutant releases from the use of these products, and local and national data on the types of pesticides and paints used by households.[9]

5.c. The end-of-life phase of a product's life cycle (disposal)

When products reach the end of their useful lives consumers make choices about what to do with product discards – reuse, recycle, or compost them or throw them in the garbage. These decisions directly impact pollutant emissions.

State and local governments also play a role in the end-of-life phase of a product's life cycle. Decisions and services offered by governments regarding programs, regulations, and infrastructure can make it easier for consumers to make better discards management choices. For example, governments can promote choices such as reuse or recycling that reduce pollutant emissions compared with disposal of discarded products.

Data sources

The CEI uses the database from the US Environmental Protection Agency/North Carolina State University/Research Triangle Institute Decision Support Tool (DST) for Municipal Solid Waste Management (MSW) to calculate some of the emissions from landfilling, incineration, recycling and composting of municipal solid wastes in Washington. The CEI model uses US EPA's latest WARM (WAste Reduction Model) software to calculate greenhouse gas (GHG) emissions from waste management activities.[10]

Ecology maintains records as to which landfills used by Washington communities have landfill gas (LFG) collection systems, and which of the landfills collecting landfill gases use it for energy generation versus flaring. In computing climate change impacts from waste management facilities, the WARM model includes greenhouse gas offsets or credits for energy generated by landfills and waste-to-energy incinerators. These offsets are based on the fact that energy from waste reduces the supply required from the electrical energy grid.

The CEI model uses this information from the WARM model in calculating disposal phase greenhouse gas emissions. However, the CEI model adjusts the WARM estimates to account for natural gas being the source for incremental electrical energy

[9] See Appendix B for an example of the detailed data gathered on each of these products.
[10] See EPA (2006b) for a detailed description of the data and methods that support WARM.

in Washington. WARM calculates greenhouse gas offsets based on the US profile of average energy sources used to generate electricity. The US average profile includes a high proportion of coal. As a result greenhouse gas emissions on average from the US profile are higher per kilowatt generated than they are for natural gas.

Recycling Offsets

The Sound Resource Management project team also used the DST database to calculate upstream manufacturing emissions offsets (or increments) when Washington State recycling rates are higher (or lower) than US average recycling rates. Manufacturing recycled-content products dramatically reduces energy use and pollutant emissions versus virgin-content manufacturing. The EIO-LCA model calculates pollutant releases for the upstream phase of a product's life cycle at the US average mix of virgin- and recycled-content.

When MSW recycling rates in Washington are higher (or lower) than US recycling rates, the CEI model gives Washington consumers a credit offset (or debit increment) for the reduced (or increased) emissions released during the production phase. This reflects the emissions differential if the proportion of virgin- and recycled-content manufacturing in the US reflected Washington State recycling rates rather than US average recycling rates. This credit is calculated by making adjustments to the EIO-LCA results, as is done in hybrid life cycle analysis methods.

The recycling credit is implemented across all EIO-LCA sectors for paper (including all types of recyclable paper and cardboard as a group), plastic bottles, plastic film/bags, and glass containers. The credit for aluminum cans is implemented only for sectors likely to use aluminum can packaging – i.e., sectors involved in producing food, beverages, housekeeping supplies, pharmaceuticals, film and photographic supplies, pet food/supplies/services, hair care/oral hygiene/shaving/cosmetic and deoderant products, and tobacco products.

The CEI model does not presently include a recycling credit for steel cans. We are not able to separate out the uses of ferrous metals for cans versus other products such as machinery and cars.

At this time the CEI model also does not attempt to calculate recycling credits for other materials diverted from disposal. There are several main reasons for this:

- The lack of closed loop recycling for a particular material. Emissions offsets for non-closed loop recycling options have not been well documented. Nor are data readily available on the distribution of recycled quantities among the non-closed loop options for any given recycled material.

- The lack of consensus as to what constitutes recycling versus diversion from disposal (sometimes called beneficial use to distinguish it from recycling) for materials such as used motor oil, wood from construction and demolition activities, and used tires.
- The lack of significant recycling levels for materials such as used carpet in Washington, and in the Pacific Northwest.
- The need to develop a mechanism for tracking recycling material credits for individual components of complex products such as computers.

Boundary for the Disposal Phase

The disposal phase in the CEI model does not include environmental impacts from choices made by the waste management sector, other than those impacts associated with waste management facilities themselves – i.e., disposal facilities, composting facilities and recycling material recovery/processing facilities. Once the consumer has decided whether to recycle, compost or throw it away, the fate of a used product passes from consumers to producers. Those used products that do not have their lives ended in disposal facilities are processed at recycling and composting facilities into commodities for sale as inputs to a wide variety of economic sectors. The emissions associated with the various fates for reused and recycled products, thus, belong in the upstream phase along with the emissions from all the other resource inputs for producing goods and services.

This is not to say that the fate of recycled or composted materials is not important. Some end use "markets" for recyclables seem especially problematic. For example, used electronics sent overseas to disassembly operations that are hazardous to public health and ecosystems, unprocessed used motor oil combusted in uncontrolled heaters that emit significant levels of heavy metals and polycyclic hydrocarbons (PAHs), or construction and demolition materials shredded and used as daily cover at landfills are all examples of particularly problematic end uses.

The emissions for these environmentally problematic end uses probably are not included in the TRI and other manufacturing sector emissions data used by the EIO-LCA model to calculate upstream emissions for the CEI. A life cycle analysis of appropriate end uses for recycled materials would likely need to do original research on these environmentally problematic "markets". Once life cycle data become available on problematic recycling practices, the extent of their use, and the economic sectors using them, the upstream product emissions profiles in the CEI model could be expanded to reflect the higher emissions profile for those goods or services produced using

problematic recycled material or energy resource inputs. This could be done by adjustments that are similar to the recycling offsets that are in the current CEI model.

6. Impact Categories Used in Life Cycle Analysis

The first nine modules of the CEI yield a listing of emissions quantities for hundreds of pollutants. In order to calculate a readily understandable measure of the effects of Washington State consumer spending on our environment, it is necessary to aggregate (or "roll up") these emissions data.

The next section of this report, Section 7, discusses available multi-criteria analysis and aggregation options, and the selection of weighting systems used by the CEI model's upstream, use and disposal modules to index pollutant emissions. But first, this section observes that the field of life cycle analysis divides environmental impacts that occur as the result of pollutant releases into a number of environmental impact categories. Each category encompasses a particular type of potential environmental impact. The impact categories typically include, among others[11]:

- Global warming
- Acidification
- Eutrophication
- Human health – criteria air pollutants
- Human health – cancer
- Human health – non-cancer
- Ecosystem toxicity
- Ozone depletion
- Smog formation
- Habitat alteration
- Resource depletion
- Water consumption

By categorizing pollution impacts into a handful of categories life cycle analysis is able to reduce the complexity of following trends for hundreds of pollutants. This simplifies life for policy makers. However, the trade-off is having to sort through the available complex pollutant aggregation and weighting methodologies that are discussed and evaluated in the next section.

At this point in its development the CEI model focuses on global warming, the three human health categories, and ecotoxicity. These categories encompass a broad spectrum of public health and ecological impacts from the pollution caused by

[11] See Bare et al (2003) and Lippiatt (2007) for a detailed description and discussion of these environmental impact categories.

production, use and disposal of goods and services purchased each year by Washington's consumers.

7. Research Results on Methods for Rolling Up Pollutants into Impact Categories

This section compares a number of different multi-criteria analysis and pollutant weighting methods for aggregating (i.e., indexing or "rolling up") pollutants into impact categories. It begins with brief accounts of several widely discussed methods, which for reasons indicated are not adequate for the aggregation tasks required for the CEI.

That discussion is followed by a focus on more appropriate options. These options use detailed methods that can scientifically aggregate the effects of emissions within a category of environmental impacts. The discussion of these options focuses for the most part on the three human health categories: aggregating carcinogens for the human health – cancer, non-carcinogenic toxins for the human health – non-cancer, or criteria air pollutants for the human health – criteria air pollutants impact categories. However, the main conclusions apply to the global warming and ecosystem toxicity impact categories as well.

7.a. Aggregation methodologies that won't work for the CEI

7.a.i. Ecological Footprint

The Ecological Footprint analysis has become one of the best-known methods for aggregating the environmental impacts of economic activity – see Wackernagel et al (2005) and Wiedmann et al (2006). It produces a memorable, quotable statistic: the land area necessary to sustainably produce the resources used by a given economic activity, and to sustainably sequester or dispose of its waste emissions.

In practice, the largest component of a footprint is often the estimated forest area needed to sequester carbon dioxide emissions. The footprint approach is designed to measure impacts of resource use and land-intensive disposal, but has no natural extension to human health impacts. There is no obvious meaning to the land area needed to offset a given number of environmentally caused cancers, for example. Thus this method has little to offer for the human health categories included in the CEI.

7.a.ii. Environmentally Preferable Purchasing

The US Environmental Protection Agency's Environmentally Preferable Purchasing (EPP) program, established in 1998 by Executive Order 13101, put in place a requirement for federal agencies to consider environmental impacts in purchasing: "'Environmentally preferable' is defined in Section 201 of EO 13101 to mean 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. This

comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance or disposal of the product or service.'"(EPA no date)

The methodology for acting in accordance with EPP is a qualitative comparison of a variety of effects including: pollution prevention, environmental preferability based on life cycle impacts, and a set of ecological impacts that include human health. While the high visibility and de facto national endorsement of EPP count in its favor, this method appears to remain mainly qualitative, lacking any specific methodology for quantifying and aggregating these impacts.[12]

7.a.iii. Union of Concerned Scientists' Analysis of Consumer Choices

In *The Consumer's Guide to Effective Environmental Choices* (1999), published by the Union of Concerned Scientists, Michael Brower and Warren Leon rank consumer activities based on their environmental impacts. They conclude that transportation, food, and household activities (residential construction, utilities, and maintenance) are the areas in which changes in consumer practices could have the largest impacts (Brower and Leon 1999).

Brower and Leon succeeded in popular presentation of the need for systematic, proactive comparison of environmental impacts, as an alternative to reactive responses to single-issue concerns. They offered unfamiliar but plausible conclusions, emphasizing the size of houses and cars as leading determinants of household environmental impacts.

Although their methodology represented an innovative improvement over *ad hoc* popular discussion of consumer impacts, it unfortunately does not provide a basis for more precise, quantitative analysis. Brower and Leon combined the ordinal rankings of two qualitative datasets, each of which includes human health and ecological impacts. The rankings for a number of different environmental impacts are subsumed into four final indices: air pollution, global warming, habitat alteration, and water pollution. For each of these categories the results reported are the share of the total environmental impact that can be attributed to the consumption of a given commodity. This method neither aggregates to a final single index nor bases its assessment of human health impacts on what are now widely available quantitative measures of relative toxicity for different pollutants.

[12] It is worth noting that EPP provides links to the US Department of Commerce National Institute for Standards and Technology's BEES model, which uses the US EPA TRACI model's pollutant weights as the primary impact assessment tool. BEES and TRACI are discussed later in this section.

7.a.iv. REACH

The European Union has approved a new chemicals regulation, the Registration, Evaluation, and Authorization of Chemicals (REACH), which goes into effect in 2007. REACH is an important, innovative measure that was widely debated in Europe for several years before its 2006 adoption. That debate gave rise to a number of exaggerations and misconceptions about what the new testing and evaluation procedures will and will not do.

There are three principal reasons why it does not offer a methodology that can be adopted for the CEI:

- REACH is only now launching an 11-year process of evaluating the chemicals in use in Europe, so its judgments on the full range of chemicals it covers will not be available until 2018;
- REACH is evaluating chemicals sold in Europe, not directly evaluating pollutants that result from industrial processes – and many pollutants are not chemical products that are bought and sold;
- The objective of evaluations under REACH is a threshold or "yes-no" decision: is this substance safe enough for use without restrictions? Even when completed, REACH testing procedures will produce lists of chemicals grouped by hazard level: substances approved for unrestricted use, usable only under carefully restricted conditions, or too hazardous for any use. REACH will not create a numerical score for relative hazard levels within those lists.

Although it is not the answer to the questions raised by this project to develop a CEI, REACH will, over time, yield very valuable information on chemical hazards and safer alternatives. Any substance manufactured or imported in the European Union in quantities greater than one metric ton per year will be subject to registration and testing, with progressively stricter requirements for larger-volume substances. An estimated 30,000 substances will be affected. Substances found to be potentially hazardous (presumably a small minority of those tested) will require authorization, allowing only specified, controlled uses of these substances in Europe. In extreme cases, very hazardous substances may be restricted altogether. REACH covers most industrial chemicals and minerals, excluding all fuels, radioactive materials, agricultural chemicals, and pharmaceuticals (categories which are covered by other European Union regulations).

The data required for registration depend on the volume of the substance, and are quite limited for substances with volumes below 10 metric tons per producer per year. The registration requirements for substances that are already on the market will be introduced gradually over a period of eleven years. Substances produced in high

volumes or that are classified as carcinogenic, mutagenic, or toxic to reproduction (CMR) will be registered within three years after the legislation enters into force, followed by other substances in descending order of volumes. Substances above 100 metric tons annually per producer will require particularly extensive testing and evaluation.

All substances suspected to present a risk to human health or to the environment can be further investigated. Authorization will be needed for the use of substances of very high concern -- those classified as CMR; persistent, bioaccumulative, and toxic; or very persistent and very bioaccumulative, and other substances of equivalent concern. More information is available on the official European Commission websites[13] and in many secondary sources, for example see Ackerman *et al* (2006).

REACH was adopted precisely because so little is known about the relative hazards of many common chemicals. It does not currently contain a ranking of hazards, other than the (short and presumably incomplete) lists of substances already known to be CMR, bioaccumulative, or otherwise of great concern. In the final stages of debate before its adoption, some critics called for rewriting REACH to prioritize testing, beginning with the most dangerous chemicals and proceeding in order of relative risks. This proposal was defeated, in part on the grounds that the necessary information about relative risks did not yet exist, but would have to be created by the testing called for under REACH.

At the end of the eleven-year phase-in period, in 2018, REACH will result in a uniquely comprehensive database on health and environmental impacts of industrial chemicals. Even then, however, the list of chemicals tested under REACH will not necessarily coincide with the list of pollutants indexed by the CEI. Also, REACH will not produce a single, aggregate numerical measure of hazard for the substances that are tested. Its extensive test results will be a valuable primary source for research, not a unified ranking.

7.a.v. Monetization

Within environmental economics, the standard theoretical approach to pollution assumes that damages can and should be monetized. That is, each health or environmental impact should be given a price equal to the monetary cost of the damages it causes, often measured by what people are willing to pay to avoid those damages. If this program of monetization could be carried out, it would immediately solve the problems of measurement and aggregation of impacts, since dollar prices for damages could be added and compared with ease.

[13] See http://ec.europa.eu/enterprise/reach/index_en.htm and http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm

However, monetization of damages remains a largely theoretical agenda, which has achieved only very incomplete and inconsistent results to date. For example, the damages that result from human toxicity, in terms of lives lost, shortened, or incapacitated, could in theory be monetized by estimating the health care costs associated with a toxin's release, by attributing some share of each affected person's lifetime income, or by setting a monetary value for all human lives, or for all years of life.

But none of these are easy to calculate. Studies that seek to monetize a category of damages are expensive and time-consuming, and have only been performed for comparatively few cases. A rapidly expanding literature on the methodology for such studies has identified numerous pitfalls to avoid, thereby raising the cost and complexity of best practices for future studies.

And even when performed with best practices, monetization studies frequently raise ethical and philosophical paradoxes, in assigning dollar prices to priceless values. In recent cost-benefit analyses performed for EPA, for example, the value of a human life has been estimated at $6.1 million under the Clinton administration, or $3.7 million under the Bush administration, based on (different) circuitous and hypothetical ways of putting a price tag on life (Ackerman and Heinzerling 2004).

7.a.vi. Health Scores

For human health impacts in particular, another theoretically appealing alternative is the assignment of a health-based score, such as Quality Adjusted Life Years (QALYs) or Disability Adjusted Life Years (DALYs). These health scores reduce a range of health impairments, from small scale discomforts up to total disability and death, to a single numerical scale reflecting the severity and duration of the problem. All human health impacts could in theory be measured and aggregated by such an index.

In practice, however, these approaches have proved extremely problematical. The attempt in Oregon to ration Medicaid spending on the basis of cost per QALY led to years of controversy, which ended with the de facto elimination of all QALY-based calculations from the state's standards. Academic analysis has identified a number of conceptual problems in QALYs and DALYs, which would need to be addressed before trying again (see Ackerman and Heinzerling 2004, Chapter 5). At present, this is not a promising alternative for indexing the releases of pollutants for the CEI model's human health impact categories.

7.b. Stronger candidates for human health cancers and non-cancers – quantitative rankings of relative toxicity and carcinogenicity

The burgeoning field of multi-criteria analysis of environmental impacts has generated a number of quantitative measures of relative toxicity, which aggregate hundreds of disparate impacts on human health into one or a few categories. While less well known, and often less transparent, than the measures described above, these indexing methods are more comprehensive and promising for the creation of an index of human health impacts caused by the expenditures of Washington state consumers. An exhaustive review by Toffel and Marshall (2004) compared thirteen of these methods (some of which include multiple sub-methods) based on their "complexity and realism" in considering various substances' toxicity, persistence, concentration, and actual human intake.

Two dimensions of their analysis are of particular importance for our purposes: the completeness of the coverage of pollutants (i.e., How many pollutants are evaluated by each model?), and the technical area known as "fate and transport" modeling. Laboratory measurement of the toxicity of a pollutant is an indispensable starting point; but it does not, by itself, measure the actual human impact of emissions, which is the goal of the analysis. To determine that, it is also necessary to understand "fate and transport": how rapidly and efficiently is the pollutant transmitted from the point of emission to the point of human contact, how persistent (vs. degradable) is it, and how much of it is absorbed, inhaled, or ingested by people who encounter it?

Toffel and Marshall find that most of the available methods of evaluating human health impacts from the release of pollutants into the environment have serious defects, at least from the perspective of the CEI. For example, some only consider effects on workers, not the general public; some fail to consider the fate and transport of pollutants from the point at which they are released into the environment. Two methods are based only on information about government regulations.

These defects are avoided by five of the analytical methods for measuring human toxicity potentials (HTPs):

- EcoIndicators99, which is based on the European Union System for the Evaluation of Substances;
- Environmental Design of Industrial Products (EDIP), which appears to be a creation of the Danish environmental protection agency;
- U.S. EPA's Tool for the Reduction and Assessment of Chemical Impacts (TRACI) (Bare 2002; Bare et al. 2003);
- The system of human toxicity potential weights reported in Hertwich *et al*. (2001); and,

- EPA's Risk Screening Environmental Indicators (RSEI).

These five methods represented the strongest candidates for providing human toxicity potentials for the CEI. They were evaluated on the complexity with which fate and transport are modeled, the number of pollutants considered, and the range of environmental impacts assessed.

Three of the methods, EcoIndicators99, EDIP, and TRACI incorporate data both on human health and, as well, on climate change, ecotoxicity, and other environmental impacts. Of these, TRACI has the advantage that the number of toxins it includes is much greater than EcoIndicators99 or EDIP (Toffel and Marshall 2004). In addition, TRACI separately indexes the human health impacts of three criteria air pollutants – particulates, sulfur oxides (SOx) and nitrogen oxides (NOx).

TRACI uses a matrix of coefficients measuring relative human health impairments, ecosystem damages, global warming and other environmental impacts from numerous pollutants to aggregate a large set of environmental impacts into twelve indices: ozone depletion, global warming, acidification, eutrophication (too much nitrogen or other nutrients in water), photochemical smog, ecotoxicity, criteria air pollutant human health impacts, cancer human health impacts, non-cancer human health impacts, fossil fuels, land use, and water use.

TRACI's human health impact scores for pollutants that cause cancers and non-cancers were originally based on human toxicity potentials developed by Hertwich and others. Other human toxicity potential sets are now under consideration for the currently-in-process update of the TRACI model, including human toxicity potential scores, as well as ecotoxicity scores, from the latest version (version 4.5) of the CalTOX model developed at the University of California – Berkeley School of Public Health and the Lawrence Berkeley Laboratory.

7.b.i. The finalists – RSEI and TRACI

On the basis of the preceding discussion, RSEI and TRACI appear to be the best options for developing human health impacts into a CEI indicator for Washington. However, RSEI does not provide ecotoxicity scores. A more detailed comparison of these two methods follows. In addition, Bare (2006) provides a comparison of TRACI and RSEI in her paper on the similarities and differences between these two models.

RSEI

The US Environmental Protection Agency's Risk Screening Environmental Indicators (RSEI) applies relative human toxicity weights and fate and transport modeling to the

full range of Toxics Release Inventory (TRI) data, with emissions data for individual TRI facilities nationwide, and a remarkable degree of geographical detail (Bouwes et al. 2001; Ash and Fetter 2002; EPA 2006). There are two types of RSEI results: hazard-based and risk-related. Hazard-based results consider only relative toxicity and the size of the release. Risk-related results consider additional site-specific information on fate, transport, and the scale of the local population, and can be calculated for a wide range of areas and populations.

RSEI has broader coverage of TRI substances than the original version of TRACI, but its fate and transport modeling is less sophisticated than some of the human toxicity potential models being considered for the currently-in-process update of TRACI, such as CalTOX 4.5. Furthermore, CalTOX 4.5 provides a similarly broad coverage of TRI pollutants.

RSEI also differs from the initial and in-process TRACI models in that it requires site-specific data for its calculations. The use of site-specific data seems inconsistent with the purpose for the CEI, which is to measure changes over time in the impacts of Washington consumer spending on the environment. The methodology for the CEI aggregates emissions from numerous locations, losing the geographic specificity needed for RSEI's style of fate and transport modeling.

Another unique feature of RSEI is that it results in a single risk-related human health impact measure for each substance, whereas TRACI results in two impacts, one for carcinogenic and one for non-carcinogenic pollutants. TRACI also evaluates the potential human health impacts from releases of the criteria air pollutants SOx (sulfur oxides), NOx (nitrogen oxides), and particulates. RSEI combines carcinogenic and non-carcinogenic toxicity weights using a scoring system that is based on the EPA's Hazard Ranking System. Using this system, potential carcinogens are assigned factors based on their "weight-of-evidence" categories that approximate equivalence with non-carcinogenic toxins (EPA 2004). These factors maintain the equivalency between cancer and non-cancer scores that was established in the Hazard Ranking System scoring methodology used in EPA's Superfund program. When combining cancer and non-cancer endpoints, it is assumed that exposure at the level of the RfD (reference dose) is equivalent to a 2.5 x 10-4 cancer risk.

At first glance the unified ranking appears to give the advantage to RSEI. However, RSEI is aimed at evaluating site-specific risks at the endpoints of pollutant releases. RSEI does not provide a method for including fate and transport of pollutants on a site generic basis. TRACI, on the other hand, uses a multimedia model followed by human exposure pathways – a site generic approach, and for this reason does encompass

pollutant fate, transport, and exposure. Thus, TRACI is more consistent with the purpose of the CEI, which is to measure changes over time in the environmental impacts caused by the life cycle of the goods and services purchased by Washington consumers each year.

TRACI

The TRACI human health toxicity potentials estimate the potential harm that would result from the release of any of hundreds of chemicals into air, water, or soil. These human health toxicity potentials are also used in BEES (Building for Environmental and Economic Sustainability), an "ecodesign" software program designed for architects and builders (Lippiatt 2007). The first version TRACI/Hertwich weights are also used by Environmental Defense's Scoreboard system, which includes toxicity data from the State of California as well as the U.S. Environmental Protection Agency. For Scoreboard this toxicity data is combined with generic (*not* site specific) U.S. data on fate and transport of chemicals, including detailed modeling of 23 exposure pathways related to inhalation, ingestion, and dermal contact via air, ground and surface water, and two distinct layers of soil using the CalTOX risk assessment model. Both "cancer human toxicity potentials" (expressed in benzene-equivalents) and "non-cancer human toxicity potentials" (toluene-equivalents) are reported for many chemicals (Hertwich et al. 2001).

The human health toxicity potentials used in the early version of TRACI were the human toxicity potential weights detailed in Hertwich *et al.* (2001). In 2003, Hertwich and his associates released a set of updated human toxicity potential weights in a working paper, which has yet to be published in a peer-reviewed journal. The 2003 weights incorporated four improvements: 1) they are based on a more sophisticated modeling of criteria air pollutants that includes airborne oxidation, including NO_2 and SO_2 oxidants; 2) they model additional chemical release mechanisms in soil; 3) they utilize a new model of air dispersal that incorporates atmospheric mixing (or "scale") heights that change the expected concentration of air pollutants; and 4) they are based on more recent toxicity data from the sources used by Scoreboard (Hertwich et al. 2003). In many cases these changes in data and methodology result in large changes in weights from the earlier version.

7.b.ii. In the meantime -- for human toxicity potential and ecotoxicity potential scores use CalTOX 4.5, and for greenhouse gases and criteria air pollutants use the initial TRACI scores

Many of the improvements in Hertwich's last human toxicity potentials were available for inclusion within the most recent version of CalTOX 4.5. Preliminary simulations were conducted by Bare for consideration within the next version of TRACI, but no decision

has as yet been made on what set of human toxicity potentials and ecosystems toxicity potentials will be used in the next TRACI release.

Until the TRACI model is updated later in 2007, our CEI model relies on these preliminary simulations of CalTOX 4.5 for human toxicity potential and ecosystem toxicity potential scores.[14] These weights appear to be the best available at this point in time, based on their incorporation of the Hertwich and other updates to the original TRACI scores.

The comprehensive nature of the CalTOX model is indicated in its description on the CalTOX website. "CalTOX is a risk assessment model that calculates the emissions of a chemical, the concentration of a chemical in the soil, and the risk of an adverse health effect due to a chemical. It consists of two parts:

1. a multimedia environmental fate model, which evaluates the distribution of a chemical among different environmental compartments (air, surface water, etc.), and
2. a multiple pathway exposure model, which calculates how much of a chemical reaches the body using environmental concentration and contact factors (e.g., breathing rate).[15]

Following the initial and in-process versions of TRACI, The CEI uses the Intergovernmental Panel on Climate Change (IPCC) weights for indexing a pollutant's global warming potential. The CEI also uses the initial version of TRACI's weights for indexing human health impacts caused by criteria air pollutants, as detailed in Bare (2002) and Bare *et al* (2003).

[14] See a description of the CalTOX model, references, and downloadable manual and software at http://eetd.lbl.gov/IED/ERA/caltox/index.html .

[15] CalTOX website, *ibid*.

8. Calculating an Index for Each Impact Category and for Separate Expenditure Items

Once one has the rolled-up environmental impact scores for each phase of the life cycle of goods and services purchased by Washington consumers, calculating an index for each impact category is straight forward. The CEI model uses the rolled-up score for 2000 as the base and sets the impact index for 2000 equal to 100. For subsequent years, one calculates the rolled-up impact score, divides it by the score for 2000, and multiplies by 100 to get the index number for each year. This is similar to what is done to calculate the Consumer Price Index.

For many consumer expenditure items the CEI model has emissions data covering all three life cycle phases – e.g., electricity, home heating and cooling fuels, vehicle fuels, motor oil, paint, pesticides, food and beverages (although emissions from pesticide and fertilizer use in agricultural production are not included in the Toxics Release Inventory), personal and financial services, many appliances, and others. It is possible to calculate an index of environmental impact for any one of these consumer goods or services, either individually or in groups. As an example Section 10 includes a graph portraying ecosystems toxicity trends for three of the individual consumer items in Washington's Beyond Waste plan – motor oil, paints and pesticides.

A potential issue in using a group index is that for groups including an item that consumers spend substantially more on, movements in the group index will be dominated by emissions changes for that dominate product if the indexing weights are based on expenditures. This may or may not be desirable depending on the uses for the group index. One of the reasons the Sound Resource Management project team included all consumer purchases in the CEI is so that movements in the index truly reflect changes in environmental impacts from all goods and services consumed.

Factors that should be considered when constructing a group sub-index include:

- Consideration of Ecology's program priorities in the weights given to the index for each product in the group.
- Weighting the individual products so that a trend for one product does not dominate the trend for the whole group.
- Selecting products for the sub-index whose environmental impacts are not too different. For example, including products with only climate change impacts along with products with only ecosystem impacts could make a trend in the group's overall index quite difficult to interpret.

9. Weighting the Impact Category Indexes to Produce a Single Overall CEI Index

As indicated in the discussion on monetization in Section 6, there does not appear to be a credible, "objective" method for combining indexes for the CEI model's five impact categories – climate change, human health-criteria air pollutants, human health-carcinogens, human health-toxics, and ecosystems toxicity. Thus, there is a need to establish subjective, relative weights for the major impact categories in order to calculate a single index number that reflects the overall impacts of Washington consumer spending on the environment.

The BEES model incorporates three sets of weights for aggregating impact category outcomes, and instructs the BEES model user to choose the one that best suits their decision criteria (Lippiatt 2007). Two of these impact category weighting sets are relatively old – one from EPA's Science Advisory Board (SAB) that was developed for the purpose of establishing priorities to protect the environment (EPA 1990), and the other from Harvard University's Kennedy School of Government that was based on international comparisons of environmental hazards (Norberg-Bohm *et al* 1992). The third weighting set was developed in 2006 specifically for the current update of BEES to version 4.0, and establishes a consensus of experts and stakeholders on the appropriate weights for a dozen different health and environmental impact categories.

The three sets of weights are quite different in certain respects. For example among the three categories of climate change, human health and ecosystem/habitat health the weightings for climate change and ecosystems/habitat have reversed. Whereas the SAB weighted climate change at 27% and ecosystems/habitat at 45% in 1990, the 2006 BEES panel rated them at 45% and 21%, respectively. Human health did not change that substantially, getting 28% from the SAB and 34% from the BEES panel.

CEI Weights for Summing Indexes

Overall CEI	
Climate Change	0.45
Human Toxicity	0.34
Ecosystems Toxicity	0.21
	1.00

Human Toxicity	
Criteria Air Pollutants	0.41
Toxics	0.22
Carcinogens	0.37
	1.00

The current CEI model allows the user to select weights for its five impact categories. As a default the CEI uses the 2006 BEES expert consensus weights, mainly because these weights reflect recent opinions of experts and stakeholders.

The CEI does the weighting of impact categories in two steps. First, the three human health categories are rolled into a single index indicating the trend in human health impacts from Washington consumer expenditures. This provides a way to compare the trends in the three aspects of environmental impacts covered by the CEI – climate change, human health and ecosystem toxicity.

As a second step the CEI model rolls the three separate indexes into an overall CEI. As indicated, the model also uses the 2006 BEES expert consensus for this aggregation. If the CEI model user wishes to input their own weights, the Sound Resource Management project team recommends a process of deliberate discussion of alternatives for weighting impact categories into a single CEI index. This is inevitably subjective, and should be carried out in an explicit, transparent manner, not treated as a technical detail.

10. Examples of CEI and Individual Product Graphs

10.a. Graphs for the Overall CEI and Its Three Components

Figures 4 through 7 show the overall CEI, and the indexes for the separate climate change, human toxicity and ecosystems toxicity components of the overall CEI. The weights in the overall CEI for these three components are based on the 2006 BEES panel of experts and stakeholders, with climate change having 45% of the weight, the three human health indexes in total having 34%, and ecosystems toxicity getting 21%.[16]

The human toxicity index itself is an aggregation of three separate human health indexes for criteria air pollutants, toxics, and carcinogens. The BEES panel weighted the relative importance of these human health impacts at 41%, 22% and 37%, respectively. These are the weights used to generate the human toxicity graph shown as Figure 6 below.

Before discussing the four indexes one should note that expenditures for 2005 are in part based on estimates and won't be final until late in 2007. This is due to the end of 2007 release date for the two-year Bureau of Labor Statistics metropolitan statistical area expenditure surveys covering the 2005-2006 biennium. As a result, the graphical results shown below could change somewhat when these expenditure data are released.

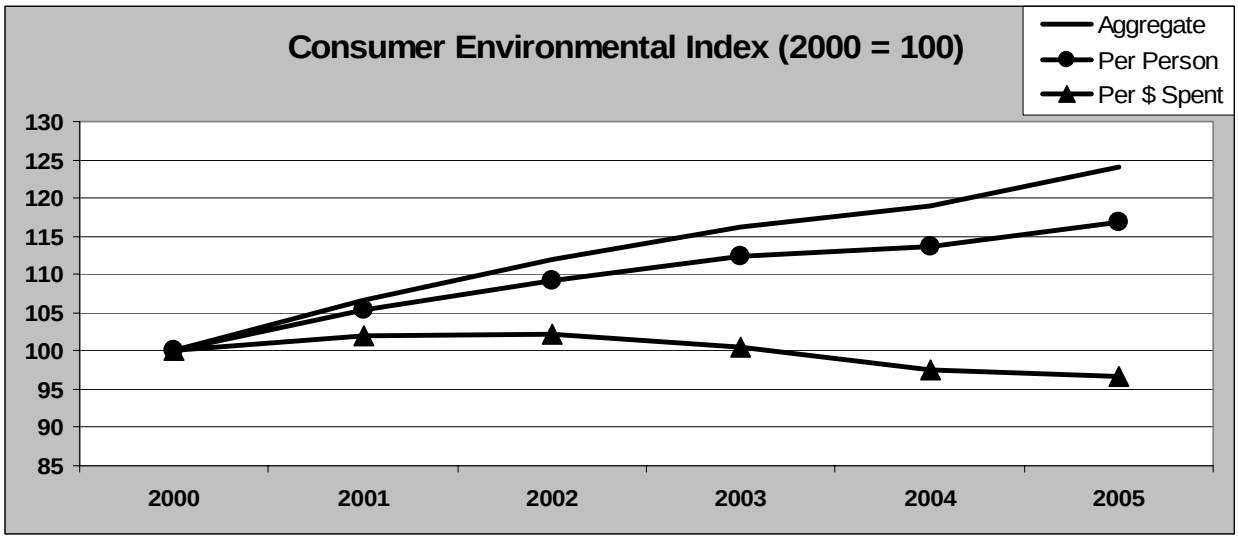
As indicated by the graph in Figure 4 for the overall CEI, Washington consumers have increased their total environmental impacts by 24% since 2000. Even on a per capita basis consumption impacts have gone up 17%, mainly due to the 3.8% annual growth in per capita real income from 2000 to 2005. Income growth explains more of the upsurge because population growth in Washington has only averaged 1.2% annually during 2000 through 2005. It is no surprise that more people, each spending more money, has a deleterious environmental impact unless spending patterns change radically enough to offset the impacts of both income and population growth.

On the brighter side, the CEI would have declined by over 3% over the six year period if both population and per capita spending (in constant dollars) had not increased. That is, Washington consumers apparently are shifting the composition of their purchases in

[16] The BEES panel gave ecosystems toxicity and habitat a combine weight of 21% among the weightings for climate change, the three human health impacts, and the two ecosystem impacts. Even though the CEI model does not as yet contain the habitat impact category, the Sound Resource Management project team gave ecosystems toxicity the combined weight to better balance the relative importance of ecosystems in comparison to human health and climate change.

an environmentally friendly direction. For example, the quantity of gasoline and motor oil consumed in 2005 is below the 2002 peak for both.

Figure 4



Of the three components of the overall CEI, the climate change impacts of Washington consumers show the most progress. As indicated by the Consumer Climate Change Index graph in Figure 5, on a constant real spending basis the greenhouse impacts of consumer expenditures, use and disposal of goods and services declined by 9% between 2000 and 2005. Furthermore, GHG impacts on a constant real spending basis did not trend up in 2001 and 2002 as they did in the overall CEI. On the other hand, the Climate Change Index did grow in total by over 16% and per capita by 10%.

Figure 5

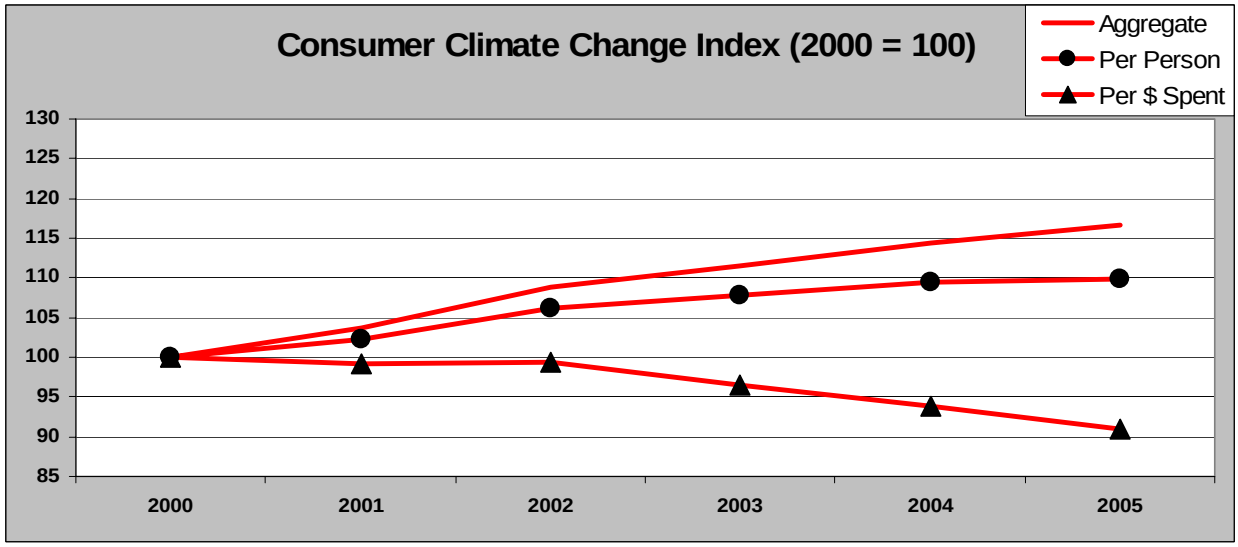
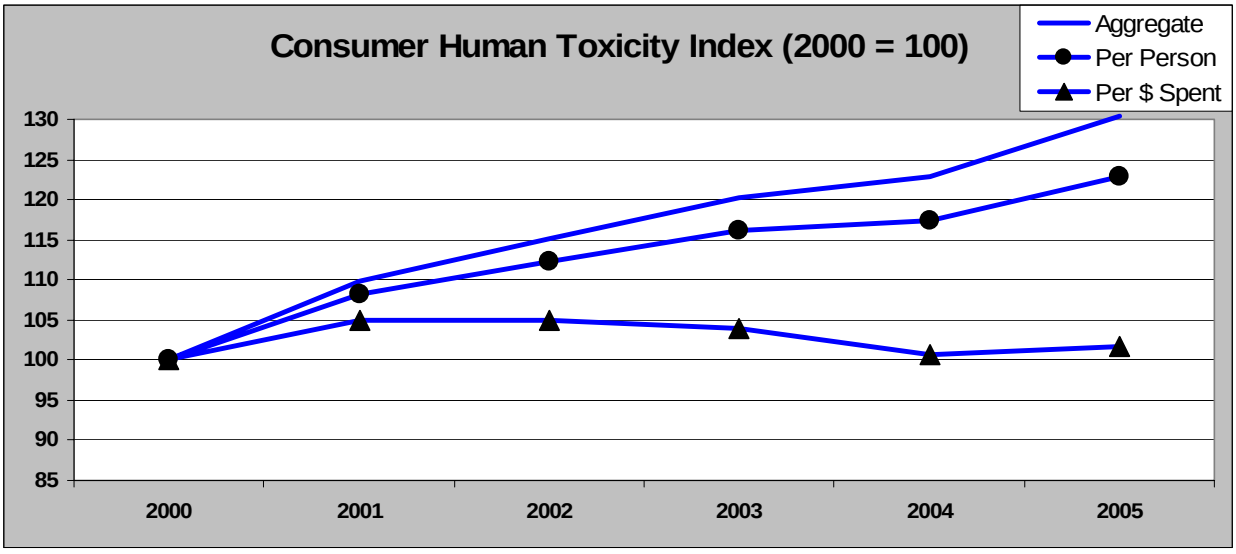


Figure 6 shows the Consumer Human Toxicity Index over the period 2000 through 2005. Even on a per real dollar spent basis, human health impacts of Washington consumers increased between 2000 and 2005. This suggests that the shift away from purchases of GHG generating products such as gasoline and motor oil toward more climate friendly goods and services, has not been accompanied by a shift away from products and services that have the potential to harm public health.

In total, the Consumer Human Toxicity Index went up 30%, and 23% on a per capita basis. These are the largest increases among the three components of the overall CEI, just nosing out the increases in the Consumer Ecosystems Toxicity Index.

In terms of the three components of the human toxicity index – criteria air pollutants, toxics and carcinogens, it is the carcinogens that are amplifying the negative results for human health. The carcinogens component increased by 38% in total, 30% per capita, and 7% on a constant real spending basis. The criteria air pollutant and toxics components, by contrast, declined between 1% and 2% by 2005 on the constant real spending basis.

Figure 6

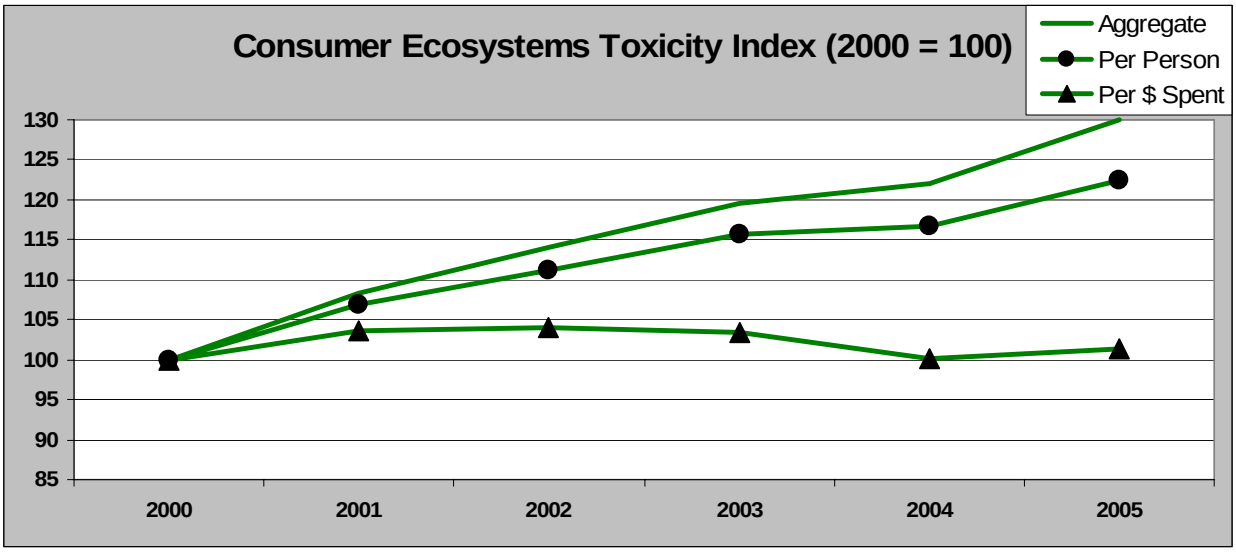


Finally, Figure 7 shows the three trends for ecosystems toxicity from Washington consumption. Here as with human toxicity, the constant spending index at first trended up. On a constant real spending basis the Consumer Ecosystems Toxicity Index then turned down, but rose again in 2005 to end at 101.4.

In total and per capita, the Consumer Ecosystems Toxicity Index went up 30% and 22.5%, respectively. These results and those for human toxicity in comparison with the results for climate change show that the continued public media discussion about global

warming and its potential impacts may be having the effect of concentrating consumers attention on climate change to the detriment of human and ecosystems health.

Figure 7



There also are at least three caveats to keep in mind with respect to consumption driven toxicity impacts on human health and ecosystems:

1) The CEI model assumes that pesticides usage remained at 2002 levels per dollar spent on lawn and garden products and maintenance services for 2003 through 2005, and that the phase out of the insecticide diazinon produced the same steep decline in its usage after 2002 that the phase out of the insecticide chlorpyrifos produced for that active ingredient's usage after 2000. No actual data on the active ingredients of pesticides purchased in Washington are as yet available after 2002.
2) The pesticides profile used by commercial lawn and garden maintenance services may differ from the pesticides profile of consumer purchases. The CEI model uses the consumer pesticide purchases profile to estimate use phase emissions from consumer purchases of lawn and garden maintenance services.
3) The CEI model's use phase module at present contains no emissions data for household cleaning agents or for pharmaceuticals. The upstream module contains no emissions data for agricultural pesticides. Trends in these emissions could run counter to the positive trends for residential pesticides and motor oil that are shown in Figure 8 below.

Furthermore, there is a more general caveat with respect to the ecosystem component of the CEI. That is, this initial version of the CEI lacks any measures for habitat disruption, biodiversity decline, or ecosystems services degradation that may occur as a result of consumption of goods and services.

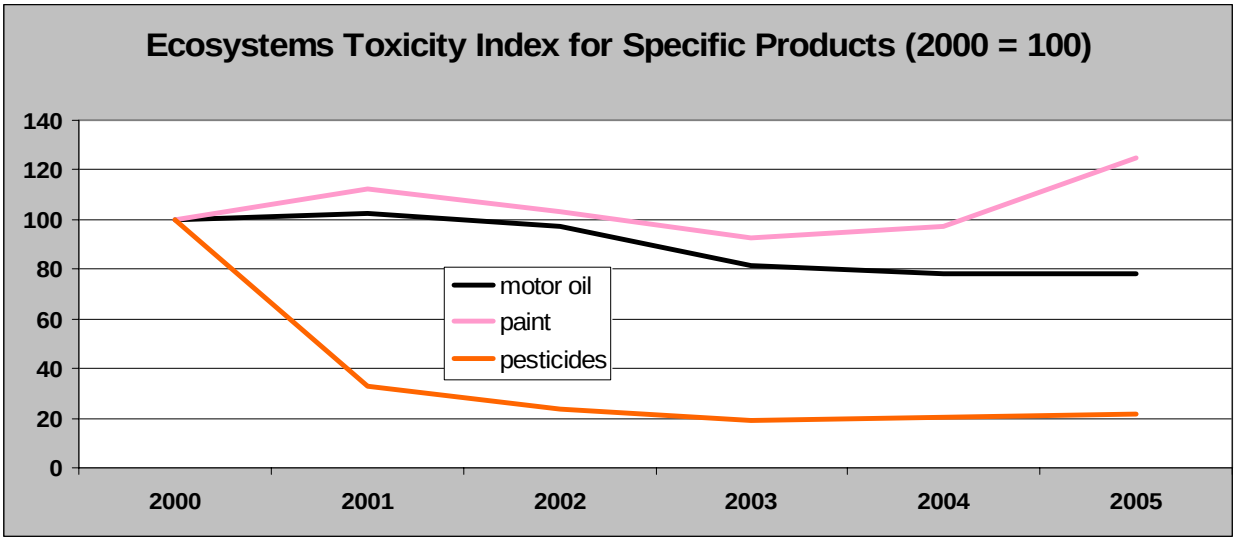
10.b. Trends for Motor Oil, Paint and Pesticides

Figure 8 shows the indexes for motor oil, paint and pesticides – individual consumer products of importance for reducing household hazardous wastes and substances according to Washington's Beyond Waste Plan.

As indicated by the graph, the expenditure and product composition data gathered on these three products indicates a good deal of progress in reducing the impacts on ecosystems from two of these products. The exception is the substantial upturn in paint impacts for 2005. This is due to an estimated 33% increase in spending on painting and paint supplies over the prior year. Also, according to national sales data, the portion of paint that is oil-based has not changed much during the 2000-2005.

The down trend in ecosystems impacts from motor oil production, use and disposal practices is for the most part due to a decrease in quarts sold beginning in 2003. This decline was in part caused by the price increases for motor oil that began in 2003 and accelerated in 2004 and 2005.

Figure 8



The sharp decline in ecosystems impacts from pesticides is partly due to the phase out of chlorpyrifos. By 2002 that insecticide was largely off the market in Washington. Diazinon sales in Washington also dropped sharply in 2002 as the phase out of that insecticide progressed. One of the substitute insecticides for chlorpyrifos and diazinon is carbaryl. Its sales jumped sharply in 2002. However, its ecosystems toxicity rating for releases to either air or water is more than four orders of magnitude lower than for either chlorpyrifos or diazinon.

11. Results of the CEI Peer Review

In order to get feedback on methodology and usefulness of the CEI model, Ecology asked Sound Resource Management to conduct a peer review of the concept and overall methodology. The Sound Resource Management project team contacted ten people knowledgeable in environmental and/or life cycle analysis and modeling who agreed to participate in the review. All ten expressed an interest and intent to participate. In the end personal and work related conflicts kept five from attending the meeting. Those who did participate in person, via telephone or by submitting written comments were:

- David Allaway, Oregon Department of Environmental Quality
- Jane Bare, US EPA Office of Research and Development
- David Batker, Earth Economics
- Philip Dickey, Washington Toxics Coalition
- Heather Trim, People for Puget Sound

The Sound Resource Management project team scheduled a two-hour meeting on June 12, 2007 at Ecology's Northwest Regional Office in Bellevue, Washington to hear comments and answer questions. Two weeks prior to that meeting the Sound Resource Management project team sent out an earlier version of this report to the reviewers.

In the week prior to the meeting Ecology developed the following three questions which the Sound Resource Management project team sent out to reviewers with the request that they be answered as part of their commentary on the CEI:

1. Is the CEI methodology sound? What is the top priority item to consider that will strengthen the CEI methodology?
2. How can the CEI be useful to you? To policy-makers? To the general public?
3. What questions come to mind when observing the 2000-2005 CEI trends?

The reviewers who provided feedback had positive overall comments about the CEI model. Their comments are summarized in outline form in the remainder of this section.

Overall Comments

Level of effort

- "Herculean effort"
- Be flexible and allow change over time as more data becomes available.

- Keep the global versus local and regional scales of the impacts in perspective when explaining the index.
- "This is a very impressive project, and I think you've explained it well."

Direction and Framework

- "Big picture – I don't see anything I would want to comment on negatively."
- Has much potential. Could be used as a web-based tool on Ecology website.
- This is an advancement of economics, and this is why I'm so excited about it." However, it does not currently include all possible environmental impacts.

Practicality

- "Money well spent."
- Improving the CEI when data is lacking is problematic. It is important to explain the shortcomings in terms of data needed for the index. For instance, emissions from runoff are not available in a usable format. Pharmaceutical emissions are not available, and impacts are not fully understood. Chemicals are in use for which little or no impact data is available.
- Currently there is not enough level of detail on many products.
- "Needs to be housed over the long run."
- "As you want to get more and more out of the model, need to ensure the level of detail is there."

Top priority items to strengthen the CEI

Veer away from over-aggregation

- Aggregating climate change, human health and ecosystem toxicity into a single index requires inherently subjective weights. There is true value in studying each impact separately. In fact, the greatest value is looking at the disaggregated data to determine what policy changes are needed.

Adequately communicate its strengths and weaknesses

- Providing access to the different levels of detail in the model will be necessary.
- "It is important to point out the blindness we have [in terms of scientific knowledge of the impact a myriad of individual chemicals]"

Expand the environmental impact categories

- Consider a systems approach that includes land use impacts.
- Include other important environmental impacts of consumption, such as habitat disturbance or ecosystem services disruptions. The name Consumer

Environmental Index implies that all aspects of environmental impact are included.
- Highlight data limitations– for example, emissions from agriculture and other non-point sources are not covered in the CEI.

Expand the line items to track
- Housing construction has big environmental impacts and it would be useful for the CEI to capture those impacts.
- Organic foods.
- Impacts from agriculture.
- Pharmaceutical impacts

Track certain items in a different way
- Environmental impacts of imported goods must be tracked since a substantial portion of product manufacturing is moving out of the US to countries where manufacturing emissions may be higher than in the US.
- Washington consumers use electricity generated by power sources such as hydro that may have lower, or at least different, environmental impacts than the average sources used in the US which may be more reliant on coal. The CMU EIO-LCA model measures environmental impacts of electricity purchases based on the US average mix of power sources.

Uses for the CEI

To inform the public
- The graphs showing the annual trends are great for the public.
- "If Washingtonians want to re-align their impacts, they could use this tool to make choices."
- Be specific about what is not included such as pathogens and radiation.
- Would like to have the "breakdown graphs" by chemical and product.
- Put it on the web site.

To choose policy directions
- Can be used to evaluate policy options. Environmental and business groups will be interested.
- Look at the disaggregated data to determine what policy changes are needed.

12. CEI Model Limitations, Data Gaps, and Uncertainties

Despite legions of bookkeepers, accountants, auditors, and census takers, economists still need many simplifying assumptions to construct their indicators of price change, output, and economic vitality. An environmental index is even more problematic given the scarcity of pollutant emissions and impacts data relative to the amount of data on monetary transactions.

In part methodological limitations are why the CEI model does not have more robust measures for the impacts of pollutants and toxics on ecosystems. As yet there are no particularly compelling measures of habitat vitality, biodiversity or ecosystem services productivity that would portray those impacts.

But even for the human health impact categories there are data gaps that are cause for concern. Toxics Release Inventory (TRI) emissions data are not collected for many producers of goods and services. Agriculture, dry cleaning, auto repair, and smaller businesses in general are among the important exclusions from TRI reporting requirements.

Furthermore the Toxics Release Inventory includes less than 600 chemical substances, even though the number of chemical substances in use in the economy numbers in the tens of thousands or even millions. For example, the American Chemical Society has catalogued over 30 million chemicals.

For these reasons there is much that could be done to improve the CEI model. Coverage of agricultural pollutant releases would be important for tracking those upstream impacts of food production. It is also necessary for understanding and tracking the environmental benefits of organic food consumption.

Another important economic sector currently not included in the CEI model is new home construction. The Bureau of Labor Statistics expenditures survey classifies mortgage principal payments as asset transactions rather than consumption expenditures. This makes economic sense, and also makes some sense for the CEI as well. The mortgage principal payment is a pure financial transfer and has no environmental impacts associated with it. Additionally, many mortgage principal payments are for existing, not newly constructed, home purchases.

At the same time, new housing construction is responsible for a significant portion of consumers' environmental impacts. Thus, the CEI model would benefit from development and use of a methodology for amortizing those new home construction impacts and including them in the annual impacts tracked in the CEI.

12.a. Imports

One other CEI model limitation is worthy of discussion by itself. The Carnegie Mellon University EIO-LCA model calculates emissions for the resource extraction, refining and product manufacturing steps in a product's life cycle under the assumption that products

are produced entirely in the US. It is probable that the pollution intensity of resource extraction, refining, and manufacturing operations in some of the countries exporting goods and services to the US is greater than it is in the US.

Data for testing this conjecture are not readily available for many of our important trading partners. There are counter possibilities. For example, even if a country's environmental standards are on average lower than US standards, It is possible that pollution intensity is lower for the specific companies producing goods for US import, especially if they are the more modern facilities in a trading partner country.

Weber and Matthews (2007) compared the carbon pollution intensity of domestic production versus the carbon pollution intensity of products and services imported into the US from our seven largest trading partners. One of the findings of their study is that the US produced 22% of the world's fossil fuel carbon dioxide emissions in 2004, but that the US consumed products and services responsible for between 25% and 26% of world greenhouse gas emissions in that year. On this basis, the CEI model's estimates of greenhouse gas emissions from resource extraction, refining and production could be underestimated by around 15%, based on comparing the 25-26% share of global carbon emissions from US consumption against the 22% share of those global carbon emissions from US production.

Upstream, use and end-of-life management of the goods and services purchased by Washington consumers generated 98.4 million metric tons of carbon dioxide equivalent (MMTeCO2) greenhouse gases in 2000. Total generation increased steadily to 114.8 MMTeCO2 by 2005.

The resource extraction and refining and product manufacturing steps of the upstream phase accounted for 68% of this total carbon generation in 2000. This share increased steadily thereafter to 30.0% of total by 2005. A fifteen percent undercounting error in the greenhouse gas emissions for these steps would total 10.1 MMTeCO2 in 2000, increasing steadily to 12.1 MMTeCO2 by 2005.

At this point it is important to recall that the CEI model's purpose is to calculate an index of changes over time in the environmental impacts from consumer purchase, use and disposal of goods and services. The climate change index component of the overall CEI reached 116.6 in 2005. Adjusting the greenhouse gas emissions estimates in 2000 and 2005 to include a 15% imports impact would raise the 2005 index to 116.9, a change of only three tenths of one percent.

This does not imply that one should ignore the potential bias in the CEI from ignoring the pollution intensity of imports. The human and/or ecosystems toxicity intensity of foreign production may be substantially worse relative to US intensity than is the carbon emissions intensity of foreign production. There certainly is a great deal of uncertainty about the toxics pollution intensity of foreign producers. But it does show that substantial errors in estimating absolute pollution levels in each year may not be as serious when one is mainly interested in trends and changes over time.

Of course, if there were no carbon intensity differences in 2000 and a 15% difference by 2005, the climate change index component of the CEI would be at 128.9 instead of 116.6, a difference that would be of concern. As the import share of US consumption apparently continues to climb, the differing pollution intensity of imported versus domestic goods and services merits an attempt to incorporate foreign trade into the CEI model.

13. Recommendations for Next Steps

Based on peer reviewer commentary, and the certain limitations of the current CEI model, the Sound Resource Management project team recommends that Ecology consider the following priorities for enhancements and next steps:

1. Finish the 2005 Bureau of Labor Statistics Consumer Expenditure Survey update as soon as the 2005-2006 expenditures surveys for metropolitan statistical areas are available late in 2007.
2. Update the CEI model with the 2002 EIO-LCA data soon after those data become available from Carnegie Mellon University. This would be the five-year update discussed in the User's Guide.
3. Update the CEI model with the latest TRACI model pollutant stressor weights when that update becomes available.
4. Update the CEI model to include the environmental impacts of agriculture's use of pesticides and fertilizers. Also, attempt to assess the differential impacts of organics versus conventional agriculture and find some way to measure the trend toward the purchase of organic and local foods by Washington consumers.
5. Continue to research the use phase impacts of products and include those impacts for goods and services where they currently are not included in the CEI model.
6. Consider adding other environmental impact categories such as ozone depletion, smog formation, habitat disruption, biodiversity impacts, and/or ecosystem services degradation to the list of impact components included in the CEI model.
7. Consider adding environmental impacts from new home construction.
8. Consider updating the CEI model to reflect the environmental impacts of imported goods. The EIO-LCA model now assumes that goods and services are all produced in the US.

14. References

Ackerman, Frank and Lisa Heinzerling (2004), *Priceless: On Knowing the Price of Everything and the Value of Nothing,* The New Press, New York, NY.

Ackerman, Frank, Rachel Massey, Brian Roach, Elizabeth Stanton, Raya Widenoja, Julien Milanesi, William Parienté, Bernard Contamin, Patrick Bond, Euripides Euripidou, Anne-Sofie Andersson and Per Rosander (2006), *Implications of REACH for the Developing Countries,* Policy Department External Policies, European Parliament Directorate-General for External Policies of the Union, Brussels, Belgium.

Ash, Michael and T. Robert Fetter (2002), "Who Lives on the Wrong Side of the Environmental Tracks?" Evidence from the EPA's Risk-Screening Environmental Indicators Model." *PERI Working Paper*. Political Economy Research Institute, Amherst, MA.

Bare, Jane C. (2002), *Developing a Consistent Decision-Making Framework by Using the U.S. EPA's TRACI,* U.S. Environmental Protection Agency, Cincinnati, OH.

Bare, Jane C., Gregory A. Norris, David W. Pennington and Thomas McKone (2003), "TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts." *Journal of Industrial Ecology* 6(3-4): 49-78.

Bare, Jane C. (2006), "Risk Assessment and Life Cycle Impact Assessment (LCIA) for Human Health Cancerous and Noncancerous Emissions: Integrated and Complementary with Consistency within the US EPA," *Human and Ecological Risk Assessment,* Vol. 12, No. 3, 2006.

Bouwes, Nicolaas, Steven M. Hassur and Mark D. Shapiro (2001), "Empowerment Through Risk-Related Information: EPA's Risk Screening Environmental Indicators Project," *PERI Working Paper*, Political Economy Research Institute, Amherst, MA.

Brower, Michael and Warren Leon (1999), *The Consumer's Guide to Effective Environmental Choices: Practical Advice from the Union of Concerned Scientists*, Three Rivers Press, New York, NY.

Cicas, Gyorgyi, H.S. Matthews, and C. Hendrickson (2006), *The 1997 Benchmark Version of the Economic Input-Output Life Cycle Assessment (EIO-LCA) Model*, Green Design Institute, Carnegie Mellon University, Pittsburgh, PA.

EPA (1990), *Reducing risk: Setting priorities and strategies for environmental protection,* SAB-EC-90-021, Environmental Protection Agency, Science Advisory Board, Washington, D.C., 1990.

EPA (2004), *EPA's Risk-Screening Environmental Indicators (RSEI) Chronic Human Health Methodology,* Environmental Protection Agency, Washington, D.C.

EPA. (2006a), "Risk-Screening Environmental Indicators (RSEI): Basic Information," retrieved 11-13-2006, from http://www.epa.gov/opptintr/rsei/pubs/basic_information.html.

EPA (2006b), *Solid Waste Management and Greenhouse Gases – A Life-Cycle Assessment of Emissions and Sinks*, 3rd edition, Environmental Protection Agency, Washington, D.C.

EPA (no date), *Final Guidance on Environmentally Preferable Purchasing*. Washington, D.C., U.S. Environmental Protection Agency.

Hertwich, Edgar G., Sarah F. Mateles, William S. Pease and Thomas McKone (2001). "Human Toxicity Potentials for Life-Cycle Assessment and Toxics Release Inventory Risk Screening." *Environmental Toxicology and Chemistry* 20(4): 928-939.

Hertwich, Edgar G., Sarah F. Mateles, William S. Pease and Thomas E. McKone (2003), *An update of the Human Toxicity Potential with special consideration of conventional air pollutants*. Norwegian University of Science and Technology and Industrial Ecology Programme, Trondheim, Norway.

Lippiatt, Barbara C. (2007), *BEES 4.0 Building for Environmental and Economic Sustainability, Technical Manual and User Guide*, US Department of Commerce Technology Administration, National Institute of Standards and Technology, Publication NISTIR 7423, May 2007.

Norberg-Bohm, V *et al* (1992). *International comparisons of environmental hazards: Development and evaluation of a method for linking environmental data with strategic debate management priorities for risk management*, Center for Science & International Affairs, John F. Kennedy School of Government, Harvard University, October 1992.

Toffel, Michael W., and Julian D. Marshall (2004). "Improving Environmental Performance Assessment: A Comparative Analysis of Weighting Methods Used to Evaluate Chemical Release Inventories." *Journal of Industrial Ecology* 8(1-2): 143-172.

Wackernagel, Mathis, Chad Monfreda, Dan Moran, Paul Wermer, Steve Goldfinger, Diana Deumling and Michael Murray (2005), *National Footprint and Biocapacity Accounts 2005: The underlying calculation method,* Global Footprint Network**:** 1-33, Oakland, CA.

Weber, Christopher L., and H. Scott Matthews (2007). "Embodied environmental emissions in U.S. international trade, *Environmental Science and Technology*, forthcoming.

Wiedmann, Thomas, Jan Minx, John Barrett and Mathis Wackernagel (2006), "Allocating ecological footprints to final consumption categories with input-output analysis," *Ecological Economics* 56: 28-48.

Appendix A

Spending for Year 2005 in 1997 Dollars and Resulting Global Warming, Human Health and Ecosystem Threatening Emissio

Section 3.1 in the Update Guide

4A0000

Food.....	Expenditures	Upstream Phase from Resource Extraction to Point of Retail Sale GHG Emissions (metric tons eCO2)				
Food at home	**1997 $**	**Production**	**Transportation**	**Wholesale**	**Retail**	**Total**
Flour*.....	$12,674,634	27,984.7	827.8	215.3	1,173.2	30,201.0
Prepared flour mixes*.....	$32,059,368	70,784.9	2,093.8	544.6	2,967.6	76,390.8
Ready-to-eat and cooked cereals*.....	$228,010,684	228,664.8	4,753.2	10,476.8	22,304.8	266,199.6
Rice*.....	$41,225,107	94,004.9	1,374.8	379.5	3,974.6	99,733.7
Pasta, cornmeal and other cereal products*.	$59,481,487	28,888.3	574.9	3,735.4	5,923.4	39,121.9
White bread*.....	$68,214,913	43,083.6	400.2	781.1	6,191.7	50,456.5
Bread, other than white*.....	$128,864,486	81,388.9	755.9	1,475.5	11,696.7	95,317.1
Cookies*.....	$119,191,203	57,207.4	7,092.0	2,945.7	11,404.6	78,649.7
Crackers*.....	$74,846,916	35,923.8	4,453.4	1,849.8	7,161.6	49,388.6
Frozen and refrigerated bakery products*	$51,357,268	25,125.1	627.8	2,840.8	5,063.5	33,657.1
Biscuits and rolls*.....	$89,639,222	56,614.8	525.8	1,026.4	8,136.3	66,303.4
Cakes and cupcakes*.....	$72,405,583	45,730.3	424.7	829.1	6,572.1	53,556.2
Bread and cracker products*.....	$9,240,652	5,836.3	54.2	105.8	838.8	6,835.0
Sweetrolls, coffee cakes, doughnuts*	$49,822,234	31,467.0	292.3	570.5	4,522.2	36,852.0
Pies, tarts, turnovers*.....	$31,616,747	19,968.7	185.5	362.0	2,869.8	23,385.9
Ground beef*.....	$148,156,296	274,999.5	3,412.9	1,725.9	14,113.9	294,252.2
Chuck roast*.....	$20,698,795	38,420.0	476.8	241.1	1,971.8	41,109.7
Round roast*.....	$11,855,832	22,006.1	273.1	138.1	1,129.4	23,546.8
Other roast*.....	$35,587,059	66,054.7	819.8	414.6	3,390.1	70,679.2
Round steak*.....	$29,332,972	54,446.2	675.7	341.7	2,794.4	58,258.0
Sirloin steak*.....	$53,826,497	99,909.7	1,240.0	627.0	5,127.7	106,904.4
Other steak*.....	$97,875,337	181,670.7	2,254.7	1,140.2	9,323.9	194,389.5
Other beef*.....	$38,787,380	71,995.0	893.5	451.8	3,695.0	77,035.3
Bacon*.....	$63,964,867	118,728.0	1,473.5	745.1	6,093.5	127,040.2
Pork chops*.....	$82,300,381	152,761.4	1,895.9	958.7	7,840.2	163,456.2
Ham, not canned*.....	$47,034,142	87,302.2	1,083.5	547.9	4,480.6	93,414.2
Canned ham*.....	$2,088,354	3,876.3	48.1	24.3	198.9	4,147.7
Sausage*.....	$57,630,683	106,970.9	1,327.6	671.4	5,490.1	114,459.9
Other pork*.....	$98,245,539	182,357.9	2,263.2	1,144.5	9,359.2	195,124.8
Frankfurters*.....	$46,370,649	86,070.6	1,068.2	540.2	4,417.4	92,096.4
Bologna, liverwurst, salami*.....	$41,511,266	77,050.9	956.3	483.6	3,954.5	82,445.2
Other lunchmeats*.....	$135,131,898	250,824.3	3,112.9	1,574.2	12,873.1	268,384.5
Lamb and organ meats*.....	$19,576,299	36,336.4	451.0	228.0	1,864.9	38,880.4
Mutton, goat and game*.....	$2,242,891	4,163.1	51.7	26.1	213.7	4,454.6
Fresh and frozen whole chicken*.....	$68,568,234	79,861.2	520.3	882.6	6,654.5	87,918.6
Fresh and frozen chicken parts*.....	$204,420,565	238,088.0	1,551.3	2,631.3	19,838.7	262,109.3
Other poultry*.....	$56,151,373	65,399.3	426.1	722.8	5,449.4	71,997.6
Canned fish and seafood*.....	$46,505,541	33,407.2	1,551.2	2,689.9	3,652.7	41,301.0
Fresh fish and shellfish*.....	$165,240,345	118,700.2	5,511.7	9,557.4	12,978.5	146,747.9
Frozen fish and shellfish*.....	$101,108,499	72,631.2	3,372.5	5,848.1	7,941.4	89,793.2
Eggs*.....	$112,218,931	206,364.7	1,668.9	105.3	9,956.1	218,095.0
Fresh milk, all types*.....	$309,911,890	833,426.1	10,538.9	3,204.3	26,356.8	873,526.1
Cream*.....	$43,009,036	115,661.4	1,462.6	444.7	3,657.7	121,226.4
Butter*.....	$36,359,123	71,894.1	2,024.1	1,290.2	2,954.9	78,163.3
Cheese*.....	$293,221,751	739,578.9	5,098.7	5,578.1	28,696.0	778,951.7
Ice cream and related products*.....	$160,142,815	166,303.5	1,123.7	4,410.1	11,082.5	182,919.8
Miscellaneous dairy products*.....	$103,130,359	277,341.9	3,507.1	1,066.3	8,770.8	290,686.0
Apples*.....	$79,609,852	66,649.8	8,627.2	3,012.7	7,765.2	86,055.0
Bananas*.....	$84,809,333	71,002.9	9,190.7	3,209.5	8,272.4	91,675.4
Oranges*.....	$41,324,531	34,597.1	4,478.3	1,563.9	4,030.8	44,670.1
Citrus fruits, excluding oranges*.....	$32,369,734	27,100.1	3,507.9	1,225.0	3,157.4	34,990.4
Other fresh fruits*.....	$268,027,052	224,393.8	29,045.8	10,143.1	26,143.6	289,726.3
Potatoes*.....	$58,802,471	40,708.5	18,066.2	1,896.8	5,570.1	66,241.6

Lettuce*.....	$58,892,683	40,771.0	18,093.9	1,899.7	5,578.6	66,343.2
Tomatoes*.....	$76,923,836	53,253.8	23,633.7	2,481.3	7,286.6	86,655.5
Other fresh vegetables*.....	$220,078,376	152,358.6	67,615.8	7,099.1	20,846.9	247,920.4
Frozen orange juice*.....	$10,222,499	6,735.7	827.0	277.8	990.1	8,830.5
Frozen fruits*.....	$11,674,084	7,692.1	944.4	317.3	1,130.7	10,084.5
Frozen fruit juices*.....	$9,796,562	6,455.0	792.5	266.2	948.8	8,462.6
Canned fruits*.....	$43,051,681	24,655.8	2,415.5	1,684.2	3,961.5	32,717.0
Dried fruit*.....	$20,866,010	11,950.0	1,170.7	816.3	1,920.1	15,857.1
Fresh fruit juice*.....	$45,905,355	26,290.1	2,575.6	1,795.8	4,224.1	34,885.7
Canned and bottled fruit juice*.....	$157,336,903	90,107.2	8,827.8	6,155.0	14,477.9	119,567.9
Frozen vegetables*.....	$62,632,219	41,268.8	5,066.7	1,702.2	6,066.2	54,103.8
Canned beans*.....	$25,417,286	14,556.5	1,426.1	994.3	2,338.9	19,315.8
Canned corn*.....	$12,293,478	7,040.5	689.8	480.9	1,131.2	9,342.4
Canned miscellaneous vegetables*.....	$40,893,691	23,419.9	2,294.5	1,599.8	3,763.0	31,077.1
Dried peas*.....	$957,891	548.6	53.7	37.5	88.1	727.9
Dried beans*.....	$9,099,961	5,211.6	510.6	356.0	837.4	6,915.5
Dried miscellaneous vegetables*.....	$22,031,484	12,617.5	1,236.1	861.9	2,027.3	16,742.8
Dried processed vegetables*.....	$570,369	326.7	32.0	22.3	52.5	433.5
Frozen vegetable juices*.....	$1,077,371	709.9	87.2	29.3	104.3	930.7
Fresh and canned vegetable juices*.....	$33,265,517	19,051.2	1,866.5	1,301.3	3,061.0	25,280.1
Candy and chewing gum*.....	$229,192,795	108,549.1	7,302.6	6,661.1	21,841.9	144,354.7
Sugar*.....	$34,726,293	42,196.4	839.6	938.5	3,166.9	47,141.4
Artificial sweeteners*.....	$10,471,313	6,346.5	2,068.1	423.1	1,022.9	9,860.6
Jams, preserves, other sweets*.....	$65,482,286	40,997.5	1,902.5	647.8	6,066.6	49,614.4
Margarine*.....	$17,329,745	23,107.0	1,881.9	173.5	1,535.5	26,697.9
Fats and oils*.....	$74,426,063	99,237.6	8,082.4	745.0	6,594.4	114,659.5
Salad dressings*.....	$82,030,169	45,946.2	2,585.2	1,171.4	7,813.4	57,516.1
Nondairy cream and imitation milk*.....	$32,195,258	86,580.6	1,094.8	332.9	2,738.1	90,746.4
Peanut butter*.....	$29,225,126	22,579.4	1,090.8	483.6	2,800.2	26,953.9
Frozen meals*.....	$132,062,773	87,017.0	10,683.3	3,589.1	12,790.7	114,080.2
Other frozen prepared foods*.....	$270,331,344	178,123.1	21,868.6	7,346.9	26,182.5	233,521.2
Canned and packaged soups*.....	$130,083,810	74,499.3	7,298.7	5,088.9	11,970.1	98,857.0
Potato chips and other snacks*.....	$235,609,195	148,674.6	3,420.7	11,129.8	23,116.0	186,341.1
Nuts*.....	$82,144,620	63,465.0	3,066.0	1,359.2	7,870.5	75,760.7
Salt, spices, other seasonings*.....	$67,658,611	41,101.9	2,212.7	2,140.1	6,316.0	51,770.7
Olives, pickles, relishes*.....	$39,103,766	22,394.8	2,194.0	1,529.7	3,598.3	29,716.8
Sauces and gravies*.....	$130,944,982	79,547.7	4,282.5	4,141.8	12,223.9	100,195.9
Baking needs and miscellaneous products*..	$64,614,239	39,252.5	2,113.2	2,043.8	6,031.8	49,441.2
Prepared salads*.....	$106,982,491	59,922.3	3,371.6	1,527.7	10,190.1	75,011.7
Prepared desserts*.....	$37,350,959	38,787.8	262.1	1,028.6	2,584.8	42,663.4
Baby food*.....	$67,120,410	38,440.0	3,766.0	2,625.7	6,176.3	51,008.0
Miscellaneous prepared foods*.....	$422,461,379	377,752.4	7,951.8	6,455.9	41,899.7	434,059.8
Vitamin supplements*.....	$3,557,234	984.5	27.2	130.0	336.9	1,478.5
Cola*.....	$201,425,061	111,263.3	2,801.5	5,786.7	20,033.6	139,885.1
Other carbonated drinks*.....	$126,086,099	69,647.5	1,753.6	3,622.3	12,540.5	87,563.9
Roasted coffee*.....	$126,670,776	67,835.6	2,073.2	5,469.1	11,465.0	86,843.0
Instant and freeze dried coffee*.....	$49,491,228	26,503.9	810.0	2,136.8	4,479.5	33,930.2
Noncarbonated fruit flavored drinks including	$58,898,361	33,731.2	3,304.7	2,304.1	5,419.7	44,759.7
Tea*.....	$54,424,660	29,145.9	890.8	2,349.8	4,926.0	37,312.5
Nonalcoholic beer*.....	$2,257,008	356.3	200.4	182.9	184.5	924.2
Other nonalcoholic beverages and ice*.....	$249,527,576	137,834.2	3,470.5	7,168.6	24,817.9	173,291.1
Food prepared by cunsumer unit on out-of-to	$170,933,066	112,628.9	13,827.7	4,645.5	16,555.5	147,657.7
Food away from home						
Lunch at fast food, take-out, delivery, conces	$864,164,599	704,975.4	0.0	0.0	0.0	704,975.4
Lunch at full service restaurants*.....	$692,113,689	564,618.3	0.0	0.0	0.0	564,618.3
Lunch at vending machines and mobile vend	$53,936,423	44,000.7	0.0	0.0	0.0	44,000.7
Lunch at employer and school cafeterias*	$197,400,737	161,037.2	0.0	0.0	0.0	161,037.2
Diner at fast food, take-out, delivery, conces	$780,520,234	636,739.3	0.0	0.0	0.0	636,739.3
Dinner at full service restaurants*.....	$1,680,531,788	1,370,958.2	0.0	0.0	0.0	1,370,958.2
Dinner at vending machines and mobile ven	$8,798,317	7,177.6	0.0	0.0	0.0	7,177.6
Dinner at employer and school cafeterias*....	$12,730,951	10,385.8	0.0	0.0	0.0	10,385.8
Snacks and nonalcoholic beverages at fast f	$293,672,429	239,574.5	0.0	0.0	0.0	239,574.5
Snacks and nonalcoholic beverages at full s	$66,328,905	54,110.3	0.0	0.0	0.0	54,110.3
Snacks and nonalcoholic beverages at vend	$63,208,303	51,564.6	0.0	0.0	0.0	51,564.6
Snacks and nonalcoholic beverages at empl	$14,766,011	12,045.9	0.0	0.0	0.0	12,045.9
Breakfast and brunch at fast food, take-out,	$217,571,649	177,492.4	0.0	0.0	0.0	177,492.4
Breakfats and brunch at full service restaura	$268,285,570	218,864.2	0.0	0.0	0.0	218,864.2
Breakfast and brunch at vending machines a	$9,745,444	7,950.2	0.0	0.0	0.0	7,950.2
Breakfast and brunch at employer and schoo	$16,635,425	13,571.0	0.0	0.0	0.0	13,571.0
Board (including at school).....	$85,348,886	69,626.6	0.0	0.0	0.0	69,626.6
Catered affairs.....	$176,981,913	144,379.8	0.0	0.0	0.0	144,379.8
Food on out-of-town trips.....	$655,666,688	534,885.2	0.0	0.0	0.0	534,885.2
School lunches.....	$177,192,127	144,551.3	0.0	0.0	0.0	144,551.3
Meals as pay.....	$76,670,788	62,547.1	0.0	0.0	0.0	62,547.1

Alcoholic beverages.....						
Alcoholic beverages at home						
Beer and ale*.....	$444,346,621	172,186.5	13,812.0	30,511.3	36,594.6	253,104.4
Whiskey*.....	$33,560,894	5,298.7	2,980.0	2,719.9	2,743.6	13,742.2
Wine*.....	$342,596,197	131,181.9	10,389.0	19,076.6	27,174.9	187,822.5
Other alcoholic beverages*.....	$74,512,513	11,764.4	6,616.2	6,038.8	6,091.4	30,510.8
Alcoholic beverages away from home						
Beer and ale at fast food,take-out, delivery, c	$42,197,056	16,351.6	1,311.6	2,897.5	3,475.2	24,035.9
Beer and ale at full service restaurants*.	$183,651,396	71,165.8	5,708.6	12,610.5	15,124.8	104,609.7
Beer and ale at vending machines and mobi	$3,827,940	1,483.3	119.0	262.8	315.3	2,180.4
Beer at employer*.....	$1,704,629	660.6	53.0	117.0	140.4	971.0
Beer at Board*.....	$0	0.0	0.0	0.0	0.0	0.0
Beer and ale at catered affairs*.....	$0	0.0	0.0	0.0	0.0	0.0
Wine at fast food,take-out, delivery, concess	$3,108,949	1,190.4	94.3	173.1	246.6	1,704.4
Wine at full service restaurants*.....	$100,263,591	38,391.5	3,040.4	5,582.9	7,953.0	54,967.8
Wine at vending machines and mobil vendor	$0	0.0	0.0	0.0	0.0	0.0
Wine at employer*.....	$693,962	265.7	21.0	38.6	55.0	380.5
Winer at Board*.....	$0	0.0	0.0	0.0	0.0	0.0
Wine at catered affairs*.....	$0	0.0	0.0	0.0	0.0	0.0
Other alcoholic beverages at fast food,take-(	$9,378,963	1,480.8	832.8	760.1	766.7	3,840.4
Other alcoholic beverages at full service rest	$145,201,303	22,925.0	12,892.9	11,767.7	11,870.2	59,455.8
Other alcoholic beverages at vending machi	$172,619	27.3	15.3	14.0	14.1	70.7
Other alcohol at employer*...	$489,087	77.2	43.4	39.6	40.0	200.3
Other alcohol at board *.....	$0	0.0	0.0	0.0	0.0	0.0
Other alcoholic beverages at catered affairs*	$0	0.0	0.0	0.0	0.0	0.0
Alcoholic beverages purchased on trips……	$168,844,933	26,658.0	14,992.3	13,683.9	13,803.1	69,137.2
Housing.....						
Shelter - owned dwellings						
Mortgage interest.....	$9,488,958,495	1,089,331.3	0.0	0.0	0.0	1,089,331.3
Interest paid, home equity loan.....	$183,576,487	21,074.6	0.0	0.0	0.0	21,074.6
Interest paid, home equity line of credit……	$439,514,735	50,456.2	0.0	0.0	0.0	50,456.2
Prepayment penalty charges.....	$0	0.0	0.0	0.0	0.0	0.0
Property taxes.....	$3,128,902,727	2,288,469.9	0.0	0.0	0.0	2,288,469.9
Fire and extended coverage (thru Q19991)..	$0	0.0	0.0	0.0	0.0	0.0
Homeowners insurance.....	$655,467,758	55,218.0	0.0	0.0	0.0	55,218.0
Ground rent.....	$137,006,147	31,645.4	0.0	0.0	0.0	31,645.4
Painting and papering.....	$227,580,701	73,621.0	0.0	0.0	0.0	73,621.0
Plumbing and water heating.....	$141,128,611	104,760.0	0.0	0.0	0.0	104,760.0
Heat, a/c, electrical work.....	$151,693,636	112,602.4	0.0	0.0	0.0	112,602.4
Roofing and gutters.....	$186,729,271	138,609.4	0.0	0.0	0.0	138,609.4
Other repair and maintenance services.....	$444,576,254	330,009.6	0.0	0.0	0.0	330,009.6
Repair and replacement of hard surface floo	$170,952,167	126,898.0	0.0	0.0	0.0	126,898.0
Repair of built-in appliances.....	$6,077,405	1,966.0	0.0	0.0	0.0	1,966.0
Paints, wallpaper and supplies.....	$59,846,772	54,444.3	6,152.8	1,444.2	2,166.1	64,207.3
Tools and equipment for painting and wallpa	$6,441,747	2,011.9	854.8	227.0	839.8	3,933.5
Plumbing supplies and equipment.....	$23,307,899	10,603.5	738.1	620.8	2,933.6	14,896.0
Electrical supplies, heating and cooling equip	$13,017,141	7,073.4	297.0	498.4	240.1	8,108.9
Materials for hard surface flooring repair and	$40,548,259	42,335.6	1,012.4	1,762.9	0.0	45,110.9
Materials and equipment for roof and gutters	$11,653,949	12,087.0	2,131.7	105.1	0.0	14,323.8
Materials for plaster, panel, siding, windows,	$37,982,252	29,317.6	6,544.8	209.7	2,823.3	38,895.4
Materials for patio, walk, fence, driveway, ma	$3,093,215	4,368.1	270.8	40.7	0.0	4,679.6
Materials for landscaping maintenance……	$0	0.0	0.0	0.0	0.0	0.0
Materials for insulation, other maintenance a	$74,440,938	98,274.7	0.0	0.0	0.0	98,274.7
Materials to finish basement, remodel rooms	$0	0.0	0.0	0.0	0.0	0.0
Property management.....	$74,587,572	33,310.5	0.0	0.0	0.0	33,310.5
Management and upkeep services for secur	$42,038,738	7,677.9	0.0	0.0	0.0	7,677.9
Parking.....	$21,195,929	10,001.5	0.0	0.0	0.0	10,001.5

Shelter - rented dwellings						
Rent.....	$5,813,700,970	2,743,244.0	0.0	0.0	0.0	2,743,244.0
Rent as pay.....	$81,572,669	38,490.8	0.0	0.0	0.0	38,490.8
Tenant's insurance.....	$18,289,903	1,540.8	0.0	0.0	0.0	1,540.8
Repair or maintenance services.....	$26,032,662	19,324.1	0.0	0.0	0.0	19,324.1
Repair and replacement of hard surface floo	$1,877,018	1,393.3	0.0	0.0	0.0	1,393.3
Repair of built-in appliances.....	$596,436	192.9	0.0	0.0	0.0	192.9
Paint, wallpaper, and supplies.....	$2,493,124	2,268.1	256.3	60.2	90.2	2,674.8
Tools and equipment for painting and wallpa	$279,603	87.3	37.1	9.9	36.4	170.7
Materials for plastering, panels, roofing, gutt	$2,120,320	1,636.6	365.4	11.7	157.6	2,171.3
Materials for patio, walk, fence, driveway, ma	$123,688	174.7	10.8	1.6	0.0	187.1
Plumbing supplies and equipment.....	$675,706	307.4	21.4	18.0	85.0	431.8
Electrical supplies, heating and cooling equip	$978,609	531.8	22.3	37.5	18.1	609.6
Materials for insulation, other maintenance a	$3,005,729	3,968.1	0.0	0.0	0.0	3,968.1
Termite and pest control (capital improveme	$0	0.0	0.0	0.0	0.0	0.0
Materials for additions, finishing basements,	$6,710,464	3,725.6	1,675.4	142.6	0.0	5,543.6
Construction materials for jobs not started…	$2,679,526	1,487.7	669.0	56.9	0.0	2,213.6
Material for hard surface flooring....	$2,143,621	2,238.1	53.5	93.2	0.0	2,384.8
Material for landscape maintenance....	$3,958,012	1,767.6	0.0	0.0	0.0	1,767.6
Shelter - other lodging						
Mortgage interest.....	$184,315,258	21,159.4	0.0	0.0	0.0	21,159.4
Interest paid, home equity loan.....	$0	0.0	0.0	0.0	0.0	0.0
Interest paid, home equity line of credit……	$1,236,822	142.0	0.0	0.0	0.0	142.0
Prepayment penalty charge.....	$0	0.0	0.0	0.0	0.0	0.0
Property taxes.....	$163,691,968	119,723.8	0.0	0.0	0.0	119,723.8
Homeowners insurance.....	$10,684,473	900.1	0.0	0.0	0.0	900.1
Fire and extended coverage (thru Q19991)..	$0	0.0	0.0	0.0	0.0	0.0
Ground rent.....	$3,076,271	710.6	0.0	0.0	0.0	710.6
Repair and remodeling services.....	$52,405,739	38,900.9	0.0	0.0	0.0	38,900.9
Repair and replacement of hard surface floo	$0	0.0	0.0	0.0	0.0	0.0
Paints, wallpaper, supplies.....	$0	0.0	0.0	0.0	0.0	0.0
Tools and equipment for painting and wallpa	$0	0.0	0.0	0.0	0.0	0.0
Materials for plastering, paneling, roofing, gu	$0	0.0	0.0	0.0	0.0	0.0
Material for patio, walk, fence, drive, masonr	$0	0.0	0.0	0.0	0.0	0.0
Plumbing supplies and equipment.....	$0	0.0	0.0	0.0	0.0	0.0
Electrical supplies, heating and cooling equip	$0	0.0	0.0	0.0	0.0	0.0
Miscellaneous supplies and equipment……	$178,389	162.3	18.3	4.3	6.5	191.4
Materials for hard surface flooring.	$0	0.0	0.0	0.0	0.0	0.0
Material for landscaping maintenance....	$0	0.0	0.0	0.0	0.0	0.0
Property management.....	$13,345,807	5,960.2	0.0	0.0	0.0	5,960.2
Management and upkeep services for secur	$5,171,174	944.5	0.0	0.0	0.0	944.5
Parking.....	$1,683,160	794.2	0.0	0.0	0.0	794.2
Housing while attending school.....	$173,636,937	81,932.1	0.0	0.0	0.0	81,932.1
Lodging on out-of-town trips.....	$1,068,850,605	427,504.9	0.0	0.0	0.0	427,504.9
Utilities, fuels, and public services						
Utility--natural gas (renter).....	$98,138,241	216,874.0	0.0	0.0	0.0	216,874.0
Utility--natural gas (owned home).....	$414,992,817	917,085.6	0.0	0.0	0.0	917,085.6
Utility--natural gas (owned vacation).....	$2,393,951	5,290.4	0.0	0.0	0.0	5,290.4
Utility--natural gas (rented vacation)....	$825,500	1,824.3	0.0	0.0	0.0	1,824.3
Electricity (renter).....	$544,890,144	5,728,028.3	0.0	0.0	0.0	5,728,028.3
Electricity (owned home).....	$1,635,806,519	17,196,027.7	0.0	0.0	0.0	17,196,027.7
Electricity (owned vacation).....	$15,973,386	167,916.4	0.0	0.0	0.0	167,916.4
Electricity (rented vacation).....	$4,612,514	48,488.0	0.0	0.0	0.0	48,488.0
Fuel oil (renter).....	$1,933,794	1,912.1	109.8	177.4	142.1	2,341.5
Fuel oil (owned home).....	$14,856,630	14,690.1	843.8	1,363.2	1,091.6	17,988.7
Fuel oil (owned vacation).....	$405,286	400.7	23.0	37.2	29.8	490.7
Fuel oil (rented vacation).....	$208,433	206.1	11.8	19.1	15.3	252.4
Coal, wood, other fuels (renter)…….	$1,016,856	526.0	156.3	7.7	0.0	690.0
Coal, wood, other fuels (owned home)…...	$12,174,023	6,297.9	1,871.0	92.5	0.0	8,261.4
Coal, wood, other fuels (owned vacation)….	$0	0.0	0.0	0.0	0.0	0.0
Coal, wood, other fuels (rented vacation)….	$692,027	358.0	106.4	5.3	0.0	469.6
Coal (renter).....	$0	0.0	0.0	0.0	0.0	0.0
Coal (owned home).....	$0	0.0	0.0	0.0	0.0	0.0
Coal (owned vacation).....	$0	0.0	0.0	0.0	0.0	0.0
Coal (rented vacation).....	$0	0.0	0.0	0.0	0.0	0.0
Gas, btld/tank (renter).....	$8,728,012	8,630.2	495.7	800.9	641.3	10,568.1
Gas, btld/tank (owned home).....	$48,681,971	48,136.3	2,765.0	4,467.0	3,576.8	58,945.1
Gas, btld/tank (owned vacation).....	$7,386,327	7,303.5	419.5	677.8	542.7	8,943.5
Gas, btld/tank (rented vacation).....	$480,182	474.8	27.3	44.1	35.3	581.4
Wood/other fuels (renter).....	$367,198	190.0	56.4	2.8	0.0	249.2
Wood/other fuels (owned home).....	$1,977,220	1,022.9	303.9	15.0	0.0	1,341.8
Wood/other fuels (owned vacation).....	$0	0.0	0.0	0.0	0.0	0.0
Wood/other fuels (rented vacation).....	$0	0.0	0.0	0.0	0.0	0.0

Telephone services in home city, excluding r	$1,054,679,590	188,193.9	0.0	0.0	0.0	188,193.9
Telephone services for mobile car phones…	$1,972,514,899	351,969.7	0.0	0.0	0.0	351,969.7
Pager service.....	$5,569,828	993.9	0.0	0.0	0.0	993.9
Phone cards.....	$97,578,087	17,411.5	0.0	0.0	0.0	17,411.5
Water/sewer maint. (renter).....	$64,289,360	502,800.1	0.0	0.0	0.0	502,800.1
Water/sewer maint. (owned home).....	$526,406,259	4,116,966.3	0.0	0.0	0.0	4,116,966.3
Water/sewer maint. (owned vacation).....	$2,261,146	17,684.2	0.0	0.0	0.0	17,684.2
Water/sewer maint. (rented vacation)....	$4,924,699	38,515.5	0.0	0.0	0.0	38,515.5
Trash/garb. coll. (renter).....	$30,821,644	15,639.9	0.0	0.0	0.0	15,639.9
Trash/garb. coll. (owned home).....	$263,283,686	133,598.5	0.0	0.0	0.0	133,598.5
Trash/garb. coll. (owned vacation).....	$4,126,057	2,093.7	0.0	0.0	0.0	2,093.7
Trash/garb. coll. (rented vacation).....	$1,052,144	533.9	0.0	0.0	0.0	533.9
Septic tank clean. (renter).....	$0	0.0	0.0	0.0	0.0	0.0
Septic tank clean. (owned home).....	$4,564,682	2,316.3	0.0	0.0	0.0	2,316.3
Septic tank clean. (owned vacation).....	$0	0.0	0.0	0.0	0.0	0.0
Septic tank clean. (rented vacation)....	$0	0.0	0.0	0.0	0.0	0.0
Household operations						
Babysitting and child care in your own home	$76,066,352	39,893.6	0.0	0.0	0.0	39,893.6
Babysitting and child care in someone else's	$51,742,901	27,137.0	0.0	0.0	0.0	27,137.0
Care for elderly, invalids, handicapped, etc..	$41,852,135	13,433.5	0.0	0.0	0.0	13,433.5
Adult day care centers.....	$3,552,868	1,863.3	0.0	0.0	0.0	1,863.3
Day-care centers, nursery, and preschools..	$340,560,058	178,609.5	0.0	0.0	0.0	178,609.5
Housekeeping services.....	$217,065,871	96,940.6	0.0	0.0	0.0	96,940.6
Gardening, lawn care service.....	$200,225,013	89,419.6	0.0	0.0	0.0	89,419.6
Water softening service.....	$6,258,140	1,969.6	0.0	0.0	0.0	1,969.6
Household laundry and dry cleaning, sent ou	$2,996,572	2,019.8	0.0	0.0	0.0	2,019.8
Coin-operated household laundry and dry cle	$6,808,667	4,589.2	0.0	0.0	0.0	4,589.2
Services for termite/pest control maintenanc	$34,818,658	15,549.9	0.0	0.0	0.0	15,549.9
Home security system service fee (new UCC	$26,964,959	4,924.8	0.0	0.0	0.0	4,924.8
Other home services.....	$52,086,160	23,261.4	0.0	0.0	0.0	23,261.4
Termite/pest control products.....	$6,252,675	4,480.5	296.5	296.4	419.0	5,492.4
Moving, storage, freight express.....	$122,737,868	259,790.6	0.0	0.0	0.0	259,790.6
Appliance repair, including service center….	$26,140,478	8,456.3	0.0	0.0	0.0	8,456.3
Reupholstering, furniture repair.....	$9,732,156	3,148.3	0.0	0.0	0.0	3,148.3
Repairs/rentals of lawn and garden equipme	$14,400,099	4,658.3	0.0	0.0	0.0	4,658.3
Appliance rental.....	$5,781,216	1,130.5	0.0	0.0	0.0	1,130.5
Rental of office equipment for nonbusiness u	$129,776	19.4	0.0	0.0	0.0	19.4
Repair of miscellaneous household equipme	$4,952,273	1,602.0	0.0	0.0	0.0	1,602.0
Repair of computer systems for nonbusiness	$10,108,278	2,337.4	0.0	0.0	0.0	2,337.4
Computer information services.....	$416,551,136	97,540.1	0.0	0.0	0.0	97,540.1
Rental and installation of dishwashers, range	$0	0.0	0.0	0.0	0.0	0.0
Housekeeping supplies						
Soaps and detergents*.....	$188,511,111	77,344.6	8,779.6	10,587.4	19,860.3	116,572.0
Other laundry cleaning products*.....	$160,960,724	66,040.9	7,496.5	9,040.1	16,957.8	99,535.3
Cleansing and toilet tissue, towels and napk	$228,754,775	125,463.4	8,247.1	2,909.6	28,109.0	164,729.1
Miscellaneous household products*.....	$347,332,369	93,303.7	8,608.1	5,557.9	47,299.7	154,769.3
Lawn and garden supplies*.....	$346,818,462	248,522.1	16,445.6	16,438.8	23,239.6	304,646.0
Stationery, stationery supplies, giftwraps*….	$267,854,495	144,178.5	33,234.9	8,798.3	23,928.8	210,140.5
Postage*.....	$166,817,022	42,799.5	0.0	0.0	0.0	42,799.5
Delivery services*.....	$6,805,106	1,746.0	0.0	0.0	0.0	1,746.0
Household furnishings and equipment						
Bathroom linens*.....	$72,845,505	32,987.3	656.0	1,633.2	10,015.4	45,291.9
Bedroom linens*.....	$205,988,267	93,279.6	1,855.1	4,618.2	28,320.8	128,073.7
Kitchen and dining room linens*.....	$28,561,858	12,933.9	257.2	640.4	3,926.9	17,758.4
Curtains and draperies.....	$66,821,023	30,259.2	601.8	1,498.1	9,187.1	41,546.1
Slipcovers, decorative pillows*.....	$33,194,497	14,649.7	1,284.1	858.9	4,446.9	21,239.4
Sewing materials for slipcovers, curtains, oth	$50,849,592	48,315.4	3,566.8	122.2	7,895.5	59,899.9
Other linens.....	$4,340,819	1,965.7	39.1	97.3	596.8	2,698.9
Mattress and springs.....	$245,769,333	87,650.6	1,151.4	955.3	39,887.4	129,644.7
Other bedroom furniture.....	$309,533,510	114,305.6	11,620.9	2,907.4	51,062.5	179,896.3
Sofas.....	$499,028,261	184,572.5	108.0	8,228.4	83,106.8	276,015.6
Living room chairs.....	$218,058,256	80,651.9	47.2	3,595.5	36,314.8	120,609.3
Living room tables.....	$80,164,294	25,831.7	661.8	875.0	13,371.7	40,740.2
Kitchen, dining room furniture.....	$208,863,218	67,303.0	1,724.2	2,279.7	34,839.2	106,146.1
Infants' furniture.....	$29,817,995	14,849.5	999.1	214.5	5,012.0	21,075.1
Outdoor furniture.....	$89,322,337	44,483.0	2,992.8	642.7	15,013.8	63,132.3
Wall units, cabinets and other occasional fur	$267,506,247	86,199.9	2,208.3	2,919.7	44,621.0	135,948.9
Wall-wall carpet, installed (renter) (thru Q199	$0	0.0	0.0	0.0	0.0	0.0
Wall-to-wall carpet, not installed carpet squa	$0	0.0	0.0	0.0	0.0	0.0
Wall-to-wall carpet (renter) (new UCC Q1999	$0	0.0	0.0	0.0	0.0	0.0
Wall-to-wall carpet (replacement) (renter) (n	$340,903	203.7	19.0	5.5	51.0	279.1
Wall-to-wall carpet, not installed (replacemer	$0	0.0	0.0	0.0	0.0	0.0
Wall-to-wall carpet, installed (replacement) (	$0	0.0	0.0	0.0	0.0	0.0
Wall-to-wall carpet (replacement) (owned ho	$68,364,100	40,841.4	3,805.2	1,093.4	10,234.2	55,974.1

Room size rugs and other floor covering, nor	$0	0.0	0.0	0.0	0.0	0.0
Floor coverings,nonpermanent (new UCC Q	$76,309,754	45,588.2	4,247.4	1,220.4	11,423.7	62,479.7
Dishwashers (built-in), garbage disposals, ra	$407,260	138.3	48.1	17.5	38.1	242.0
Dishwashers (built-in), garbage disposals, ra	$62,498,779	21,220.6	7,377.9	2,689.1	5,843.2	37,130.8
Refrigerators, freezers (renter).....	$25,406,772	14,715.0	1,370.1	572.5	2,284.6	18,942.2
Refrigerators, freezers (owned home).....	$233,861,344	135,446.6	12,611.7	5,269.9	21,028.7	174,356.9
Washing machines (renter).....	$10,363,914	5,490.4	466.2	235.3	958.8	7,150.7
Washing machines (owned home).....	$105,556,169	55,919.2	4,748.2	2,396.7	9,765.8	72,830.0
Clothes dryers (renter).....	$6,679,633	3,538.6	300.5	151.7	618.0	4,608.7
Clothes dryers (owned home).....	$75,452,891	39,971.8	3,394.1	1,713.2	6,980.7	52,059.8
Cooking stoves, ovens (renter).....	$7,424,667	3,402.8	287.4	191.1	692.7	4,574.0
Cooking stoves, ovens (owned home).....	$134,082,593	61,451.6	5,190.3	3,451.6	12,508.7	82,602.2
Microwave ovens (renter).....	$10,150,178	4,651.9	392.9	261.3	946.9	6,253.1
Microwave ovens (owned home).....	$33,708,614	15,449.0	1,304.9	867.7	3,144.7	20,766.3
Portable dishwasher (renter).....	$877,176	297.8	103.5	37.7	82.0	521.1
Portable dishwasher (owned home).....	$939,831	319.1	110.9	40.4	87.9	558.4
Window air conditioners (renter).....	$6,108,903	3,319.5	139.4	233.9	112.7	3,805.5
Window air conditioners (owned home).....	$6,954,751	3,779.1	158.7	266.3	128.3	4,332.4
Electric floor cleaning equipment*.....	$93,251,207	40,278.9	5,253.7	2,525.5	8,990.0	57,048.1
Sewing machines.....	$11,457,738	5,462.4	12.0	437.6	71.2	5,983.1
Miscellaneous household appliances*.....	$10,528,362	4,547.6	593.2	285.1	1,015.0	6,440.9
Plastic dinnerware.....	$5,949,270	2,706.5	188.4	158.5	748.8	3,802.2
China and other dinnerware*.....	$56,623,055	25,942.7	1,730.0	1,033.2	8,875.0	37,580.9
Flatware.....	$15,643,081	2,524.6	416.6	1,028.6	2,128.7	6,098.4
Glassware*.....	$53,928,386	28,935.3	1,449.7	1,023.7	6,553.5	37,962.3
Silver serving pieces*.....	$30,201,296	11,396.7	115.6	806.4	4,864.0	17,182.7
Other serving pieces.....	$6,649,184	3,146.9	60.4	98.9	1,048.5	4,354.7
Nonelectric cookware*.....	$87,713,809	41,512.9	797.1	1,304.9	13,831.0	57,446.0
Tableware, nonelectric kitchenware*.....	$95,959,036	43,965.1	2,931.8	1,750.9	15,040.4	63,688.3
Small electric kitchen appliances.....	$85,806,151	37,063.1	4,834.3	2,323.9	8,272.2	52,493.5
Portable heating and cooling equipment……	$30,419,446	13,139.4	1,713.8	823.8	2,932.6	18,609.7
Window coverings.....	$246,298,698	96,633.4	6,379.1	4,476.7	35,913.0	143,402.1
Infants' equipment*.....	$71,738,254	20,292.9	364.8	1,911.7	496.2	23,065.6
Laundry and cleaning equip.*.....	$64,999,116	34,433.8	2,923.8	1,475.9	6,013.6	44,847.1
Outdoor equipment*.....	$74,401,443	31,153.4	877.3	752.6	11,021.9	43,805.2
Clocks*.....	$15,033,349	3,956.7	154.4	571.6	1,576.8	6,259.5
Lamps and lighting fixtures.....	$87,249,250	29,334.3	5,388.6	2,077.9	11,508.1	48,308.9
Other household decorative items*.....	$1,226,553,789	401,258.7	149,132.3	37,282.8	145,211.5	732,885.3
Telephones and accessories*.....	$168,649,436	47,706.6	857.5	4,494.3	1,166.5	54,224.9
Lawn and garden equipment.....	$79,188,242	25,747.2	1,132.9	1,930.3	13,092.8	41,903.2
Power tools*.....	$257,770,358	66,010.4	784.3	8,830.3	35,873.9	111,498.9
Office furniture for home use.....	$37,308,003	18,512.1	12.8	2,412.3	0.0	20,937.2
Hand tools.....	$23,349,522	8,963.5	213.3	997.4	2,678.1	12,852.4
Indoor plants, fresh flowers.....	$121,907,452	43,574.0	16,420.4	2,551.9	17,951.7	80,498.0
Closet and storage items*.....	$51,182,880	23,284.6	1,620.9	1,363.3	6,441.9	32,710.8
Rental of furniture.....	$8,050,855	1,574.3	0.0	0.0	0.0	1,574.3
Luggage.....	$33,135,692	14,059.5	611.7	345.6	4,752.1	19,768.9
Computers and computer hardware nonbusi	$4,351,833,563	1,311,745.1	75,794.6	207,655.5	158,678.9	1,753,874.1
Computer software and accessories for nonb	$137,008,196	16,687.6	142.8	1,737.1	1,992.9	20,560.3
Personal digital assistants..	$26,605,296	8,019.5	463.4	1,269.5	970.1	10,722.5
Internet services away from home…..	$23,323,718	4,161.8	0.0	0.0	0.0	4,161.8
Telephone answering devices.....	$10,424,671	2,757.7	115.4	221.0	149.1	3,243.2
Calculators.....	$959,326	291.3	22.0	21.2	69.8	404.3
Business equipment for home use.....	$28,843,722	8,758.6	660.9	636.9	2,098.6	12,155.0
Other hardware*.....	$28,395,646	12,928.4	1,081.8	310.1	2,183.0	16,503.2
Smoke alarms (owned home).....	$4,329,515	1,468.8	17.5	97.8	0.0	1,584.0
Smoke alarms (renter).....	$268,729	91.2	1.1	6.1	0.0	98.3
Smoke alarms (owned vacation).....	$0	0.0	0.0	0.0	0.0	0.0
Other household appliances (owned home)..	$53,995,457	23,322.8	3,042.1	1,462.3	5,205.5	33,032.7
Other household appliances (renter).....	$7,595,461	3,280.8	427.9	205.7	732.2	4,646.7
Miscellaneous household equipment and pa	$143,202,437	61,854.9	8,067.9	3,878.3	13,805.6	87,606.7
Apparel and services.....						
Men (16 and over) and boys (2 to 15)						
Men's suits.....	$80,310,939	28,499.5	835.5	1,929.6	12,020.8	43,285.4
Men's sportcoats, tailored jackets.....	$32,146,096	11,407.5	334.4	772.4	4,811.6	17,325.9
Men's coats and jackets*.....	$124,511,820	44,184.9	1,295.4	2,991.6	18,636.6	67,108.5
Men's underwear*.....	$50,079,965	17,771.6	521.0	1,203.2	7,495.9	26,991.7
Men's hosiery*.....	$55,283,698	33,117.1	513.7	286.8	7,570.8	41,488.5
Men's nightwear.....	$3,843,124	1,363.8	40.0	92.3	575.2	2,071.3
Men's accessories*.....	$123,528,989	50,032.2	787.3	3,340.0	17,694.7	71,854.1
Men's sweaters and vests.....	$42,052,982	14,923.1	437.5	1,010.4	6,294.4	22,665.4

Men's active sportswear*	$43,410,503	15,404.9	451.6	1,043.0	6,497.6	23,397.1
Men's shirts*	$340,104,246	120,691.0	3,538.4	8,171.5	50,906.0	183,306.9
Men's pants*	$207,648,313	73,687.1	2,160.3	4,989.0	31,080.3	111,916.8
Men's shorts, shorts sets*	$44,226,938	15,694.6	460.1	1,062.6	6,619.8	23,837.1
Men's uniforms	$9,941,999	3,528.1	103.4	238.9	1,488.1	5,358.5
Men's costumes	$5,959,629	2,114.9	62.0	143.2	892.0	3,212.1
Boys' coats and jackets	$12,595,198	4,469.6	131.0	302.6	1,885.2	6,788.5
Boys' sweaters	$6,682,538	2,371.4	69.5	160.6	1,000.2	3,601.7
Boys' shirts*	$70,921,129	25,167.4	737.9	1,704.0	10,615.3	38,224.6
Boys' underwear*	$14,042,568	4,983.2	146.1	337.4	2,101.9	7,568.6
Boys' nightwear*	$6,097,431	2,163.8	63.4	146.5	912.6	3,286.3
Boys' hosiery*	$12,410,428	7,434.3	115.3	64.4	1,699.5	9,313.6
Boys' accessories*	$16,629,357	6,735.3	106.0	449.6	2,382.0	9,672.9
Boys' suits, sportcoats, vests	$6,528,562	2,316.8	67.9	156.9	977.2	3,518.7
Boys' pants	$74,093,025	26,293.0	770.9	1,780.2	11,090.1	39,934.1
Boys' shorts, shorts sets	$16,167,431	5,737.3	168.2	388.4	2,419.9	8,713.8
Boys' uniforms	$5,789,480	2,054.5	60.2	139.1	866.6	3,120.4
Boys' active sportswear	$9,700,458	3,442.4	100.9	233.1	1,451.9	5,228.3
Boys' costumes	$4,003,364	1,420.7	41.7	96.2	599.2	2,157.7
Women (16 and over) and girls (2 to 15)						
Women's coats and jackets*	$122,539,454	43,484.9	1,274.9	2,944.2	18,341.4	66,045.4
Women's dresses*	$98,124,446	34,820.9	1,020.9	2,357.6	14,687.0	52,886.4
Women's sportcoats, tailored jackets*	$31,976,400	11,347.3	332.7	768.3	4,786.2	17,234.4
Women's vests and sweaters*	$99,886,242	35,446.1	1,039.2	2,399.9	14,950.7	53,836.0
Women's shirts, tops, blouses*	$391,252,635	138,841.8	4,070.5	9,400.4	58,561.8	210,874.5
Women's skirts*	$66,716,910	23,675.5	694.1	1,603.0	9,986.0	35,958.6
Women's pants*	$317,436,324	112,646.9	3,302.6	7,626.9	47,513.2	171,089.5
Women's shorts, shorts sets*	$34,245,880	12,152.7	356.3	822.8	5,125.8	18,457.6
Women's active sportswear*	$78,758,223	27,948.5	819.4	1,892.3	11,788.4	42,448.5
Women's sleepwear*	$106,342,239	37,737.1	1,106.4	2,555.0	15,917.1	57,315.6
Women's undergarments*	$93,775,004	33,277.4	975.6	2,253.1	14,036.0	50,542.2
Women's hosiery*	$42,867,052	25,517.9	239.9	129.8	6,927.4	32,815.0
Women's suits	$42,121,538	14,947.4	438.2	1,012.0	6,304.7	22,702.4
Women's accessories*	$142,260,036	57,618.7	906.7	3,846.5	20,377.7	82,749.6
Women's uniforms	$12,233,403	4,341.2	127.3	293.9	1,831.1	6,593.5
Women's costumes	$2,779,017	986.2	28.9	66.8	416.0	1,497.8
Girls' coats and jackets	$16,969,783	6,022.0	176.6	407.7	2,540.0	9,146.2
Girls' dresses and suits*	$47,923,642	17,006.4	498.6	1,151.4	7,173.1	25,829.5
Girls' shirts, blouses, sweaters*	$116,777,699	41,440.3	1,214.9	2,805.7	17,479.0	62,940.0
Girls' skirts and pants	$81,101,548	28,780.1	843.8	1,948.6	12,139.1	43,711.5
Girls' shorts, shorts sets	$17,030,716	6,043.6	177.2	409.2	2,549.1	9,179.1
Girls' active sportswear*	$36,255,012	12,865.6	377.2	871.1	5,426.6	19,540.5
Girls' underwear and sleepwear	$22,545,134	8,000.5	234.6	541.7	3,374.5	12,151.2
Girls' hosiery*	$12,765,420	7,599.0	71.4	38.6	2,062.9	9,772.0
Girls' accessories*	$30,466,397	12,339.6	194.2	823.8	4,364.1	17,721.6
Girls' uniforms	$7,647,066	2,713.7	79.6	183.7	1,144.6	4,121.6
Girls' costumes	$5,849,548	2,075.8	60.9	140.5	875.5	3,152.7
Children under 2						
Infant coat, jacket, snowsuit	$6,907,169	2,451.1	71.9	166.0	1,033.8	3,722.8
Infant dresses, outerwear	$83,728,364	29,712.2	871.1	2,011.7	12,532.3	45,127.3
Infant underwear*	$139,322,651	49,440.7	1,449.5	3,347.4	20,853.5	75,091.1
Infant nightwear, loungewear	$12,410,442	4,404.0	129.1	298.2	1,857.6	6,688.9
Infant accessories*	$18,643,740	7,551.2	118.8	504.1	2,670.6	10,844.7
Footwear						
Men's footwear*	$322,403,991	132,650.2	3,029.3	9,462.5	52,690.6	197,832.6
Boys' footwear*	$60,959,494	25,081.2	572.8	1,789.2	9,962.6	37,405.8
Women's footwear*	$415,108,693	170,792.7	3,900.3	12,183.4	67,841.4	254,717.8
Girls' footwear*	$73,611,465	30,286.8	691.6	2,160.5	12,030.3	45,169.3
Other apparel products and services						
Material for making clothes*	$27,891,529	21,801.3	977.9	727.2	3,959.5	27,465.9
Sewing patterns and notions*	$16,477,626	9,163.1	70.3	194.4	1,213.9	10,641.7
Watches	$72,383,181	19,050.9	743.5	2,752.2	7,591.9	30,138.5
Jewelry	$444,507,447	167,738.6	1,701.9	11,868.9	71,589.0	252,898.4
Shoe repair and other shoe service	$3,499,387	1,132.0	0.0	0.0	0.0	1,132.0
Coin-operated apparel laundry and dry clean	$106,691,387	71,912.2	0.0	0.0	0.0	71,912.2
Alteration, repair and tailoring of apparel and	$12,670,195	4,098.7	0.0	0.0	0.0	4,098.7
Clothing rental	$5,470,307	1,069.7	0.0	0.0	0.0	1,069.7
Watch and jewelry repair	$12,448,970	4,027.2	0.0	0.0	0.0	4,027.2
Apparel laundry and dry cleaning not coin-op	$137,138,890	92,434.4	0.0	0.0	0.0	92,434.4
Clothing storage	$1,789,916	2,376.6	0.0	0.0	0.0	2,376.6

Transportation						
Vehicle purchases (net outlay)						
New cars	$2,581,055,119	1,363,121.9	84,423.1	31,346.1	94,674.6	1,573,565.7
New trucks	$3,841,965,244	2,029,041.1	125,665.9	46,659.4	140,925.6	2,342,292.0
Used cars	$2,629,346,246	1,388,625.7	86,002.7	31,932.6	96,446.0	1,603,006.9
Used trucks	$2,228,694,578	1,177,031.2	72,897.8	27,066.8	81,749.8	1,358,745.6
New motorcycles	$156,535,340	75,581.8	1,035.7	3,041.5	23,697.7	103,356.6
New aircraft	$0	0.0	0.0	0.0	0.0	0.0
Used motorcycles	$162,641,226	78,529.9	1,076.1	3,160.2	24,622.0	107,388.2
Used aircraft	$0	0.0	0.0	0.0	0.0	0.0
Gasoline and motor oil						
Gasoline	$2,568,879,793	2,540,086.9	145,907.3	235,715.2	188,742.2	3,110,451.6
Diesel fuel	$70,473,842	69,683.9	4,002.8	6,466.5	5,177.9	85,331.2
Gasoline on out-of-town trips	$220,739,616	218,265.5	12,537.6	20,254.6	16,218.3	267,276.0
Gasohol*	$0	0.0	0.0	0.0	0.0	0.0
Motor oil	$19,889,186	45,548.7	3,246.8	759.0	1,375.5	50,930.0
Motor oil on out-of-town trips	$2,956,264	6,770.2	482.6	112.8	204.5	7,570.1
Other vehicle expenses						
Automobile finance charges	$241,261,528	27,696.8	0.0	0.0	0.0	27,696.8
Truck finance charges	$387,793,356	44,518.6	0.0	0.0	0.0	44,518.6
Motorcycle and plane finance charges	$10,319,779	1,184.7	0.0	0.0	0.0	1,184.7
Other vehicle finance charges	$47,330,977	5,433.6	0.0	0.0	0.0	5,433.6
Coolant, additives, brake, transmission fluids	$7,186,172	16,457.2	1,173.1	274.2	497.0	18,401.5
Tires - purchased, replaced, installed	$327,151,950	130,373.1	119,921.8	4,350.7	51,470.1	306,115.7
Parts, equipment, and accessories	$150,158,343	67,946.8	4,691.4	1,787.2	21,166.9	95,592.2
Vehicle audio equipment, excluding labor*	$62,647,353	21,951.2	933.2	1,829.7	6,616.9	31,331.0
Vehicle products*	$8,345,275	3,776.2	260.7	99.3	1,176.4	5,312.7
Vehicle video equipment	$2,028,152	710.6	30.2	59.2	214.2	1,014.3
Misc. auto repair, servicing*	$78,041,964	32,974.4	0.0	0.0	0.0	32,974.4
Body work and painting	$86,046,633	36,356.5	0.0	0.0	0.0	36,356.5
Clutch, transmission repair	$181,869,404	76,843.7	0.0	0.0	0.0	76,843.7
Drive shaft and rear-end repair	$12,990,672	5,488.8	0.0	0.0	0.0	5,488.8
Brake work, including adjustments	$122,316,175	51,681.2	0.0	0.0	0.0	51,681.2
Repair to steering or front-end	$35,675,551	15,073.7	0.0	0.0	0.0	15,073.7
Repair to engine cooling system	$54,218,162	22,908.3	0.0	0.0	0.0	22,908.3
Motor tune-up	$179,287,942	75,752.9	0.0	0.0	0.0	75,752.9
Lube, oil change, and oil filters	$148,979,328	62,946.9	0.0	0.0	0.0	62,946.9
Front-end alignment, wheel balance and rota	$21,791,784	9,207.5	0.0	0.0	0.0	9,207.5
Shock absorber replacement	$13,122,869	5,544.7	0.0	0.0	0.0	5,544.7
Gas tank repair, replacement*	$0	0.0	0.0	0.0	0.0	0.0
Repair tires and other repair work	$101,951,833	43,076.8	0.0	0.0	0.0	43,076.8
Vehicle air conditioning repair	$33,008,017	13,946.6	0.0	0.0	0.0	13,946.6
Exhaust system repair	$17,219,688	7,275.7	0.0	0.0	0.0	7,275.7
Electrical system repair	$70,808,920	29,918.3	0.0	0.0	0.0	29,918.3
Motor repair, replacement	$197,332,424	83,377.1	0.0	0.0	0.0	83,377.1
Auto repair service policy	$40,256,599	17,009.3	0.0	0.0	0.0	17,009.3
Vehicle insurance	$2,081,964,031	175,389.1	0.0	0.0	0.0	175,389.1
Vehicle rental, leases, licenses, and other charges						
Auto rental	$18,953,735	7,659.8	0.0	0.0	0.0	7,659.8
Auto rental, out-of-town trips	$92,708,485	37,466.6	0.0	0.0	0.0	37,466.6
Truck rental	$10,893,247	4,402.3	0.0	0.0	0.0	4,402.3
Truck rental, out-of-town trips	$9,425,363	3,809.1	0.0	0.0	0.0	3,809.1
Motorcycle rental	$0	0.0	0.0	0.0	0.0	0.0
Aircraft rental	$1,069,889	160.0	0.0	0.0	0.0	160.0
Motorcycle rental, out-of-town trips	$15,251,612	2,982.3	0.0	0.0	0.0	2,982.3
Aircraft rental, out-of-town trips	$432,508	64.7	0.0	0.0	0.0	64.7
Car lease payments	$324,220,373	131,028.2	0.0	0.0	0.0	131,028.2
Cash downpayment (car lease)	$9,821,389	3,969.1	0.0	0.0	0.0	3,969.1
Termination fee (car lease)	$0	0.0	0.0	0.0	0.0	0.0
Truck lease payments	$349,360,838	141,188.3	0.0	0.0	0.0	141,188.3
Cash downpayment (truck lease)	$27,746,140	11,213.1	0.0	0.0	0.0	11,213.1
Termination fee (truck lease)	$8,275,165	3,344.3	0.0	0.0	0.0	3,344.3
State and local registration	$0	0.0	0.0	0.0	0.0	0.0
Vehicle registration state (as of Q20012).	$284,927,092	208,394.8	0.0	0.0	0.0	208,394.8
Vehicle registration local (as of Q20012).	$8,519,757	6,231.3	0.0	0.0	0.0	6,231.3
Driver's license	$15,034,234	10,996.0	0.0	0.0	0.0	10,996.0
Vehicle inspection	$21,459,991	15,695.8	0.0	0.0	0.0	15,695.8
Parking fees in home city, excluding residen	$50,622,049	23,886.4	0.0	0.0	0.0	23,886.4
Parking fees, out-of-town trips	$13,583,421	6,409.5	0.0	0.0	0.0	6,409.5
Tolls*	$14,846,543	10,858.7	0.0	0.0	0.0	10,858.7
Tolls on out-of-town trips	$6,587,668	4,818.2	0.0	0.0	0.0	4,818.2
Towing charges	$14,318,835	12,185.7	0.0	0.0	0.0	12,185.7
Global positioning services	$5,216,688	4,439.5	0.0	0.0	0.0	4,439.5
Automobile service clubs	$63,008,943	34,545.8	0.0	0.0	0.0	34,545.8

Public transportation						
Airline fares.....	$1,266,246,323	2,291,178.7	0.0	0.0	0.0	2,291,178.7
Intercity bus fares.....	$56,192,680	33,521.0	0.0	0.0	0.0	33,521.0
Intracity mass transit fares.....	$111,796,442	66,690.7	0.0	0.0	0.0	66,690.7
Local trans. on out-of-town trips.....	$43,232,798	25,790.0	0.0	0.0	0.0	25,790.0
Taxi fares and limousine service on trips.....	$25,386,701	15,144.1	0.0	0.0	0.0	15,144.1
Taxi fares and limousine service*.....	$30,776,837	18,359.5	0.0	0.0	0.0	18,359.5
Intercity train fares.....	$92,313,958	104,033.0	0.0	0.0	0.0	104,033.0
Ship fares.....	$265,510,099	380,904.8	0.0	0.0	0.0	380,904.8
School bus.....	$7,680,245	4,581.5	0.0	0.0	0.0	4,581.5
Health care.....						
Health insurance						
Traditional fee for service health plan (not BC	$100,064,776	8,429.7	0.0	0.0	0.0	8,429.7
Preferred provider health plan (not BCBS)....	$383,174,343	32,279.4	0.0	0.0	0.0	32,279.4
Traditional fee for service health plan (BCBS	$94,522,593	7,962.8	0.0	0.0	0.0	7,962.8
Preferred provider health plan (BCBS).....	$330,589,059	27,849.5	0.0	0.0	0.0	27,849.5
Health maintenance organization (BCBS).....	$228,756,894	19,271.0	0.0	0.0	0.0	19,271.0
Commercial Medicare supplement (BCBS)..	$48,374,097	4,075.1	0.0	0.0	0.0	4,075.1
Other health insurance (BCBS).....	$6,327,690	533.1	0.0	0.0	0.0	533.1
Health maintenance organization (not BCBS	$758,253,607	63,876.9	0.0	0.0	0.0	63,876.9
Medicare payments.....	$488,497,648	41,152.1	0.0	0.0	0.0	41,152.1
Commercial Medicare supplement (not BCB	$169,276,610	14,260.2	0.0	0.0	0.0	14,260.2
Other health insurance (not BCBS).....	$64,236,961	5,411.5	0.0	0.0	0.0	5,411.5
Long term care insurance.....	$85,969,302	7,242.2	0.0	0.0	0.0	7,242.2
Physician's services.....	$414,677,830	70,132.7	0.0	0.0	0.0	70,132.7
Dental services.....	$672,322,735	113,707.1	0.0	0.0	0.0	113,707.1
Eyecare services.....	$104,027,231	17,593.7	0.0	0.0	0.0	17,593.7
Service by professionals other than physicia	$179,691,668	30,390.5	0.0	0.0	0.0	30,390.5
Lab tests, x-rays.....	$116,052,814	19,627.5	0.0	0.0	0.0	19,627.5
Hospital room and services.....	$125,297,704	50,131.2	0.0	0.0	0.0	50,131.2
Hospital room.....	$1,373,522	549.5	0.0	0.0	0.0	549.5
Hospital service other than room.....	$7,662,805	3,065.9	0.0	0.0	0.0	3,065.9
Medical care in retirement community.....	$709,117	314.2	0.0	0.0	0.0	314.2
Care in convalescent or nursing home.....	$71,397,967	31,639.4	0.0	0.0	0.0	31,639.4
Repair of medical equipment*.....	$0	0.0	0.0	0.0	0.0	0.0
Other medical care services.....	$44,202,308	16,722.9	0.0	0.0	0.0	16,722.9
Drugs						
Nonprescription drugs*.....	$196,403,696	54,356.1	1,499.9	7,175.0	18,602.0	81,633.0
Nonprescription vitamins*.....	$143,431,264	39,695.6	1,095.3	5,239.8	13,584.8	59,615.6
Prescription drugs.....	$681,560,099	188,626.5	5,204.8	24,898.6	64,552.7	283,282.7
Medical supplies						
Eyeglasses and contact lenses.....	$141,649,334	19,046.0	464.6	3,944.5	30,088.6	53,543.6
Hearing aids.....	$24,952,254	7,476.1	225.8	854.4	1,023.6	9,579.9
Topicals and dressings*.....	$81,783,400	22,634.1	624.6	2,987.7	7,746.0	33,992.3
Medical equipment for general use.....	$12,189,790	3,373.6	93.1	445.3	1,154.5	5,066.5
Supportive and convalescent medical equipr	$4,772,289	1,366.7	44.5	264.7	7.3	1,683.3
Rental of medical equipment.....	$4,963,181	742.1	0.0	0.0	0.0	742.1
Rental of supportive, convalescent medical e	$1,799,835	304.4	0.0	0.0	0.0	304.4
Entertainment.....						
Fees and admissions						
Recreation expenses, out-of-town trips.....	$75,627,791	42,273.0	0.0	0.0	0.0	42,273.0
Social, recreation, civic club membership.....	$343,668,621	176,994.0	0.0	0.0	0.0	176,994.0
Fees for participant sports.....	$234,866,909	120,959.6	0.0	0.0	0.0	120,959.6
Participant sports, out-of-town trips.....	$77,801,694	40,068.9	0.0	0.0	0.0	40,068.9
Movie, theater, opera, ballet.....	$285,692,835	70,890.5	0.0	0.0	0.0	70,890.5
Movie, other admissions, out-of-town trips...	$119,741,248	29,712.1	0.0	0.0	0.0	29,712.1
Admission to sporting events.....	$146,230,614	28,918.3	0.0	0.0	0.0	28,918.3
Admission to sports events, out-of-town trips	$38,520,762	7,617.8	0.0	0.0	0.0	7,617.8
Fees for recreational lessons.....	$204,377,238	105,257.0	0.0	0.0	0.0	105,257.0
Other entertainment services, out-of-town tri	$75,627,791	24,491.6	0.0	0.0	0.0	24,491.6

Audio and Visual Equipment and Services						
Televisions.....	$939,589,363	329,225.1	13,996.1	27,442.1	99,240.7	469,904.1
Radios*.....	$11,109,577	3,892.7	165.5	324.5	1,173.4	5,556.1
Black and white tv.....	$0	0.0	0.0	0.0	0.0	0.0
Color tv - console.....	$39,681,380	13,904.1	591.1	1,159.0	4,191.2	19,845.3
Color tv - portable, table model.....	$23,631,905	8,280.4	352.0	690.2	2,496.0	11,818.7
Phonographs*.....	$0	0.0	0.0	0.0	0.0	0.0
Community antenna or cable tv.....	$890,223,398	171,273.9	0.0	0.0	0.0	171,273.9
Compact disc, tape, record and video mail o	$958,941	383.4	92.8	0.0	0.0	476.2
Records, CDs, audio tapes, needles.....	$42,761,223	17,094.5	4,139.3	0.0	0.0	21,233.8
Tape recorders and players*.....	$18,782,379	6,581.2	279.8	548.6	1,983.8	9,393.4
Online gaming services…….....	$0	0.0	0.0	0.0	0.0	0.0
VCR's and video disc players.....	$186,631,942	65,394.4	2,780.1	5,450.9	19,712.3	93,337.7
Miscellaneous sound equipment*.....	$19,062,116	6,679.2	283.9	556.7	2,013.4	9,533.3
Sound equipment accessories*.....	$50,512,610	17,699.2	752.4	1,475.3	5,335.2	25,262.2
Video cassettes, tapes, and discs.....	$209,866,066	83,897.2	20,315.1	0.0	0.0	104,212.3
Video game hardware and software.....	$116,067,406	47,562.7	844.3	2,501.8	0.0	50,908.8
Streaming, downloading video…….....	$1,389,038	247.9	0.0	0.0	0.0	247.9
Repair of tv, radio, and sound equipment….	$8,497,477	1,964.9	0.0	0.0	0.0	1,964.9
Rental of televisions.....	$1,611,142	315.0	0.0	0.0	0.0	315.0
Personal digital audio players……..	$75,169,477	26,338.8	1,119.7	2,195.4	7,939.5	37,593.5
Sound components and component systems	$99,946,232	35,020.4	1,488.8	2,919.1	10,556.5	49,984.8
Satellite dishes.....	$1,276,414	361.1	6.5	34.0	8.8	410.4
CDs, records, audio tapes….....	$82,170,085	32,848.7	7,954.1	0.0	0.0	40,802.8
Streaming, downloading audio……..	$5,612,466	1,001.5	0.0	0.0	0.0	1,001.5
Rental of VCR, radio, and sound equipment.	$337,820	66.1	0.0	0.0	0.0	66.1
Musical instruments and accessories.....	$113,142,211	24,417.9	2,167.3	3,792.1	17,655.1	48,032.3
Rental and repair of musical instruments….	$3,426,020	669.9	0.0	0.0	0.0	669.9
Rental of video cassettes, tapes, films, and c	$136,016,653	45,746.8	0.0	0.0	0.0	45,746.8
Pets, toys, and playground equipment						
Pet food*.....	$355,757,575	295,715.5	9,335.2	4,906.5	62,344.8	372,301.9
Pet purchase, supplies, medicine*.....	$208,898,518	173,642.2	5,481.6	2,881.1	36,608.4	218,613.3
Pet services.....	$94,927,727	32,886.4	0.0	0.0	0.0	32,886.4
Vet services.....	$192,196,686	78,472.2	0.0	0.0	0.0	78,472.2
Toys, games, hobbies, and tricycles.....	$362,099,102	109,844.0	3,950.6	12,086.6	55,961.5	181,842.8
Stamp and coin collecting (new UCC Q2004	$43,548,081	7,728.8	1,487.1	1,229.1	5,640.8	16,085.8
Playground equipment.....	$6,462,701	2,386.6	242.6	60.7	1,066.1	3,756.0
Recreational vehicles and boats						
Boat without motor and boat trailers.....	$42,317,475	18,325.2	362.4	159.7	3,591.9	22,439.2
Trailer and other attachable campers (not m	$224,954,806	122,504.9	4,919.0	3,466.3	17,203.5	148,093.6
Purchase of motorized camper.....	$650,064,647	354,009.3	14,214.6	10,016.6	49,713.8	427,954.4
Purchase of other vehicle.....	$91,433,244	38,157.1	4,653.3	1,073.5	8,665.5	52,549.5
Purchase of boat with motor.....	$53,953,507	23,364.0	462.1	203.6	4,579.6	28,609.4
Rental noncamper trailer.....	$509,236	76.1	0.0	0.0	0.0	76.1
Boat and trailer rental out-of-town trips……	$2,648,025	517.8	0.0	0.0	0.0	517.8
Rental of campers on out-of-town trips……	$458,312	68.5	0.0	0.0	0.0	68.5
Rental of other vehicles on out-of-town trips.	$13,520,204	2,021.7	0.0	0.0	0.0	2,021.7
Rental of boat.....	$152,771	22.8	0.0	0.0	0.0	22.8
Rental of motorized camper.....	$0	0.0	0.0	0.0	0.0	0.0
Rental of other RV's.....	$1,324,012	198.0	0.0	0.0	0.0	198.0
Outboard motors.....	$4,659,505	2,017.8	39.9	17.6	395.5	2,470.7
Docking and landing fees.....	$8,587,931	7,308.6	0.0	0.0	0.0	7,308.6
Sports, recreation and exercise equipment						
Athletic gear, game tables, and exercise equ	$256,992,856	92,821.7	2,269.6	9,681.9	34,956.8	139,730.0
Bicycles.....	$61,744,811	29,813.0	408.5	1,199.7	9,347.5	40,768.7
Camping equipment*.....	$28,569,207	10,318.7	252.3	1,076.3	3,886.0	15,533.4
Hunting and fishing equipment*.....	$153,181,653	55,326.7	1,352.8	5,770.9	20,836.1	83,286.6
Winter sports equipment.....	$19,533,667	7,055.2	172.5	735.9	2,657.0	10,620.7
Water sports equipment.....	$28,276,690	10,213.1	249.7	1,065.3	3,846.3	15,374.4
Other sports equipment.....	$37,312,229	13,476.6	329.5	1,405.7	5,075.3	20,287.1
Global positioning system devices*……	$0	0.0	0.0	0.0	0.0	0.0
Rental and repair of miscellaneous sports eq	$5,427,824	1,755.9	0.0	0.0	0.0	1,755.9
Photographic equipment, supplies and services						
Film.....	$40,214,423	16,246.3	637.7	1,747.0	1,831.4	20,462.3
Other photographic supplies*.....	$13,836,227	4,597.9	163.4	660.8	716.2	6,138.3
Film processing.....	$73,564,482	25,485.4	0.0	0.0	0.0	25,485.4
Repair and rental of photographic equipmen	$3,811,885	745.4	0.0	0.0	0.0	745.4
Photographic equipment.....	$230,479,606	76,590.2	2,721.8	11,007.8	11,930.7	102,250.5
Photographer fees.....	$47,958,558	12,141.2	0.0	0.0	0.0	12,141.2
Other entertainment						
Fireworks*.....	$8,754,705	2,835.2	0.0	0.0	0.0	2,835.2
Souvenirs*.....	$6,271,317	2,030.9	0.0	0.0	0.0	2,030.9
Visual goods*.....	$13,130,571	4,252.3	0.0	0.0	0.0	4,252.3
Pinball, electronic video games*.....	$7,251,211	2,348.3	0.0	0.0	0.0	2,348.3

Personal care products and services						
Hair care products*	$155,712,955	41,829.1	3,859.1	2,491.6	21,205.0	69,384.8
Nonelectric articles for the hair*	$17,895,016	5,854.2	2,175.8	543.9	2,118.6	10,692.6
Wigs and hairpieces	$3,447,422	1,127.8	419.2	104.8	408.1	2,059.9
Oral hygiene products, articles*	$76,659,091	20,592.9	1,899.9	1,226.7	10,439.4	34,158.9
Shaving needs*	$36,895,312	9,911.2	914.4	590.4	5,024.4	16,440.3
Cosmetics, perfume, bath preparation*	$389,439,555	104,614.9	9,651.6	6,231.6	53,033.9	173,532.0
Deodorants, feminine hygiene, miscellaneou	$83,027,611	22,303.7	2,057.7	1,328.6	11,306.7	36,996.6
Electric personal care appliances*	$31,921,551	14,355.2	615.6	1,484.5	899.1	17,354.4
Personal care service for females (thru Q19	$0	0.0	0.0	0.0	0.0	0.0
Personal care service for males (thru Q1999	$0	0.0	0.0	0.0	0.0	0.0
Personal care service (as of Q19992)	$656,912,261	210,852.1	0.0	0.0	0.0	210,852.1
Repair of personal care appliances *	$0	0.0	0.0	0.0	0.0	0.0
Reading						
Newspaper, magazine by subscription	$158,227,455	43,847.4	6,553.1	5,276.0	7,763.7	63,440.3
Newspaper, magazine non-subscription	$35,726,003	9,900.3	1,479.6	1,191.3	1,753.0	14,324.1
Newspaper subscriptions	$10,732,149	2,974.1	444.5	357.9	526.6	4,303.0
Newspaper, non-subscriptions	$1,061,737	294.2	44.0	35.4	52.1	425.7
Magazine subscriptions	$5,394,770	1,177.4	460.0	175.3	257.1	2,069.8
Magazines, non-subscriptions	$1,721,735	375.8	146.8	55.9	82.1	660.6
Newsletters*	$0	0.0	0.0	0.0	0.0	0.0
Books thru book clubs	$18,832,203	3,342.3	643.1	531.5	2,439.3	6,956.2
Books not thru book clubs	$241,926,428	42,936.5	8,261.3	6,828.2	31,336.7	89,362.8
Encyclopedia and other sets of reference bo	$6,310,267	1,119.9	215.5	178.1	817.4	2,330.9
Education						
College tuition	$1,089,633,022	311,485.5	0.0	0.0	0.0	311,485.5
Elementary and high school tuition	$312,244,391	125,193.6	0.0	0.0	0.0	125,193.6
Other schools tuition	$95,058,959	25,835.8	0.0	0.0	0.0	25,835.8
Other school expenses including rentals	$110,346,156	29,990.7	0.0	0.0	0.0	29,990.7
School books, supplies, equipment for colleg	$1,634,307,120	290,053.0	55,808.3	46,127.5	211,691.8	603,680.5
School books, supplies, equipment for eleme	$35,894,061	11,518.4	300.1	1,006.9	4,993.3	17,818.8
School books, supplies, equipment for day c	$13,994,796	4,490.9	117.0	392.6	1,946.9	6,947.4
School supplies, etc. - unspecified*	$106,068,834	34,037.5	886.8	2,975.5	14,755.6	52,655.4
Tobacco products and smoking supplies						
Cigarettes	$300,214,342	72,354.4	2,673.8	16,368.5	21,122.3	112,519.0
Other tobacco products	$31,593,343	6,971.8	228.9	2,383.8	2,380.4	11,964.9
Smoking accessories*	$3,297,447	727.7	23.9	248.8	248.4	1,248.8
Marijuana*	$0	0.0	0.0	0.0	0.0	0.0
Miscellaneous						
Miscellaneous fees, pari-mutuel losses*	$0	0.0	0.0	0.0	0.0	0.0
Miscellaneous fees*	$7,881,051	2,552.2	0.0	0.0	0.0	2,552.2
Lotteries and pari-mutuel losses*	$198,161,685	64,173.4	0.0	0.0	0.0	64,173.4
Legal fees	$269,855,157	36,312.2	0.0	0.0	0.0	36,312.2
Funeral expenses	$124,438,672	48,143.6	0.0	0.0	0.0	48,143.6
Safe deposit box rental	$6,542,725	751.1	0.0	0.0	0.0	751.1
Checking accounts, other bank service char	$58,906,403	6,762.4	0.0	0.0	0.0	6,762.4
Cemetery lots, vaults, maintenance fees	$31,332,693	12,122.2	0.0	0.0	0.0	12,122.2
Accounting fees	$159,094,911	23,253.5	0.0	0.0	0.0	23,253.5
Miscellaneous personal services*	$115,789,462	15,580.8	0.0	0.0	0.0	15,580.8
Dating services	$1,495,883	218.6	0.0	0.0	0.0	218.6
Finance charges excluding mortgage and ve	$467,230,568	53,638.0	0.0	0.0	0.0	53,638.0
Occupational expenses (thru Q20011)	$0	0.0	0.0	0.0	0.0	0.0
Occupational expenses (as of Q20012)	$129,102,305	39,202.7	2,957.9	2,850.8	9,393.2	54,404.7
Expenses for other properties	$522,204,846	233,214.3	0.0	0.0	0.0	233,214.3
Interest paid, home equity line of credit (othe	$422,994	48.6	0.0	0.0	0.0	48.6
Credit card memberships	$6,569,758	754.2	0.0	0.0	0.0	754.2
Shopping club membership fees (as of Q200	$28,967,580	3,325.5	0.0	0.0	0.0	3,325.5

Cash contributions.....							
Cash support for college students (Sec. 22)	$0		0.0	0.0	0.0	0.0	0.0
Support for college students (Sec. 19) (as of	$239,175,081		70,403.6	0.0	0.0	0.0	70,403.6
Alimony expenditures (Sec. 19).....	$125,719,560		37,006.8	0.0	0.0	0.0	37,006.8
Child support expenditures (Sec. 19).....	$396,449,540		116,699.0	0.0	0.0	0.0	116,699.0
Gifts of cash, stocks and bonds to non_CU r	$0		0.0	0.0	0.0	0.0	0.0
Gifts to non-CU members of stocks, bonds a	$31,818,076		9,366.0	0.0	0.0	0.0	9,366.0
Contributions to charity.....	$0		0.0	0.0	0.0	0.0	0.0
Contributions to charities and other organiza	$583,594,567		171,787.1	0.0	0.0	0.0	171,787.1
Contributions to church.....	$0		0.0	0.0	0.0	0.0	0.0
Contributions to church, religious organizatio	$1,751,731,136		500,754.7	0.0	0.0	0.0	500,754.7
Contributions to educational organizations....	$0		0.0	0.0	0.0	0.0	0.0
Contributions to educational organizations (tl	$128,509,234		54,991.9	0.0	0.0	0.0	54,991.9
Contributions to educational institutions (as c	$0		0.0	0.0	0.0	0.0	0.0
Contributions to political organizations.....	$24,870,208		10,642.5	0.0	0.0	0.0	10,642.5
Other contributions.....	$0		0.0	0.0	0.0	0.0	0.0
Other cash gifts (as of Q20012).....	$1,000,835,074		294,606.1	0.0	0.0	0.0	294,606.1
Personal insurance and pensions.....							
Life and other personal insurance							
Life, endowment, annuity, other personal ins	$662,874,308		55,842.0	0.0	0.0	0.0	55,842.0
Other nonhealth insurance.....	$35,573,042		2,996.7	0.0	0.0	0.0	2,996.7
Pensions and Social Security							
Deductions for government retirement.....	$217,783,103		13.0	0.0	0.0	0.0	13.0
Deductions for railroad retirement.....	$5,603,259		0.3	0.0	0.0	0.0	0.3
Deductions for private pensions.....	$1,637,314,155		187,963.5	0.0	0.0	0.0	187,963.5
Non-payroll deposit to retirement plans.....	$1,356,337,450		155,707.4	0.0	0.0	0.0	155,707.4
Deductions for Social Security.....	$9,483,202,129		565.9	0.0	0.0	0.0	565.9
					metric tons eCO2		
Total	$128,778,781,906	**Total**	81,001,295	1,893,355	1,534,701	4,629,482	89,058,834
					kilograms eCO2		
Per Capita	$20,584	**Per Capita**	12,946.9	302.6	245.3	740.0	14,234.8
Per Household	$49,150	**Per Household**	30,914.9	722.6	585.7	1,766.9	33,990.1
Population	6,256,400						
Households	2,620,138						

Appendix B

Derivation of Use Phase Emissions for Motor Oil (Section 4.3 in the Update Guide)

Parameters	2000	2001	2002	2003	2004	2005
Motor Oil as % of expenditures for:						
Motor tune-up	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%
Lube, oil, & oil filter	43.0%	43.0%	43.0%	43.0%	43.0%	43.0%
CPI for motor oil, coolant, & other fluids	138	147.2	153.2	157.1	165.3	182.8
Price series based on 2005 price estimate	$2.01	$2.14	$2.23	$2.29	$2.41	$2.66
Loss rate due to vehicle leakage	5.0%	5.0%	4.5%	4.5%	4.0%	4.0%
Loss rate due to combustion in engine	7.0%	7.0%	6.5%	6.5%	6.0%	6.0%
Portion of leakage ending up in water	33.0%	33.0%	33.0%	33.0%	33.0%	33.0%
Portion of leakage ending up on ground	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%
Weight of one gallon of oil (pounds)	7.35	7.35	7.35	7.35	7.35	7.35

Data	2000	2001	2002	2003	2004	2005
Consumer Expenditures for Oil						
Purchased separately	$24,601,893	$27,274,541	$27,776,181	$24,611,086	$26,712,544	$27,606,251
Purchase on out-of-town trips	2,788,687	2,949,258	2,820,428	3,023,718	3,443,513	4,103,304
Purchased w/ motor tune-up	21,191,116	23,650,699	25,368,167	19,009,550	24,045,317	29,477,047
Purchased w/ lube, oil & oil filter service	71,085,320	77,424,335	83,451,378	73,107,851	75,774,233	81,018,464
Total expenditures on motor oil	$119,667,017	$131,298,833	$139,416,154	$119,752,205	$129,975,607	$142,205,065
Quarts purchased	59,592,270	61,298,184	62,538,706	52,384,390	54,036,045	53,460,551
Quarts lost on roadways and parking lots	2,979,614	3,064,909	2,814,242	2,357,298	2,161,442	2,138,422
Quarts combusted	4,171,459	4,290,873	4,065,016	3,404,985	3,242,163	3,207,633

Emissions from leakage (pounds)	CAS #	2000 Calculated (pounds)	2001 Calculated (pounds)	2002 Calculated (pounds)	2003 Calculated (pounds)	2004 Calculated (pounds)	2005 Calculated (pounds)
Barium (Ba)	7440-39-3	73.91	76.03	69.81	58.48	53.62	53.05
Cadmium (Cd)	7440-43-9	18.75	19.29	17.71	14.84	13.60	13.46
Chromium (Cr)	7440-47-3	21.35	21.96	20.17	16.89	15.49	15.32
Copper (Cu)	7440-50-8	251.85	259.06	237.87	199.25	182.70	180.75
Lead (Pb)	7439-92-1	158.78	163.32	149.96	125.61	115.18	113.95
Nickel (Ni)	7440-02-0	10.95	11.26	10.34	8.66	7.94	7.86
Zinc (Zn)	7440-66-6	8042.83	8273.07	7596.45	6363.02	5834.35	5772.22
Chlorides		1475.52	1517.76	1393.63	1167.35	1070.36	1058.96
Phosphate (PO4)	14265-44-2	4188.41	4308.30	3955.94	3313.62	3038.31	3005.95
Sulfur (SO2)	7446-09-5	14618.36	15036.83	13807.02	11565.20	10604.30	10491.37
Acenaphthene	83-32-9	87.60	90.11	82.74	69.30	63.55	62.87
Acenaphthylene	208-96-8	18.07	18.58	17.06	14.29	13.11	12.97
Anthracene	120-12-7	440.74	453.36	416.28	348.69	319.72	316.31
Benzo(a)anthracene	56-55-3	406.52	418.16	383.96	321.62	294.89	291.75
Benzo(a)pyrene	50-32-8	708.20	728.47	668.89	560.28	513.73	508.26
Benzo(b)fluoranthene	205-99-2	269.37	277.08	254.42	213.11	195.41	193.32
Benzo(g,h,i)perylene	191-24-2	548.33	564.02	517.89	433.80	397.76	393.52
Benzo(k)fluoranthene	207-08-9	119.63	123.05	112.99	94.64	86.78	85.86
Chrysene	218-01-9	175.20	180.22	165.48	138.61	127.09	125.74
Dibenzo(a,h)anthracene	53-70-3	44.35	45.62	41.89	35.09	32.17	31.83
Fluoranthene	206-44-0	484.54	498.41	457.65	383.34	351.49	347.75
Fluorene	86-73-7	373.67	384.37	352.93	295.63	271.07	268.18
Indeno(1,2,3-cd)pyrene	193-39-5	513.56	528.26	485.06	406.30	372.54	368.57
Naphthalene	91-20-3	392.01	403.23	370.26	310.14	284.37	281.34
Phenanthrene	85-01-8	1739.15	1788.93	1642.62	1375.91	1261.59	1248.16
Pyrene	129-00-0	606.36	623.72	572.71	479.72	439.86	435.18

Emissions from combustion (pounds)

Barium (Ba)	7440-39-3	103.48	106.44	100.84	84.46	80.43	79.57
Cadmium (Cd)	7440-43-9	26.25	27.00	25.58	21.43	20.40	20.19
Chromium (Cr)	7440-47-3	29.89	30.75	29.13	24.40	23.23	22.99
Copper (Cu)	7440-50-8	352.59	362.69	343.60	287.81	274.04	271.13
Lead (Pb)	7439-92-1	222.29	228.65	216.61	181.44	172.77	170.93
Nickel (Ni)	7440-02-0	15.33	15.77	14.94	12.51	11.91	11.79
Zinc (Zn)	7440-66-6	11259.97	11582.30	10972.65	9191.03	8751.53	8658.32
Chlorides		2065.73	2124.87	2013.02	1686.17	1605.54	1588.44
Phosphate (PO4)	14265-44-2	5863.77	6031.63	5714.14	4786.35	4557.47	4508.93
Sulfur (SO2)	7446-09-5	44426.04	45697.80	43292.42	36263.09	34529.03	34161.29
Acenaphthene	83-32-9	122.64	126.15	119.51	100.11	95.32	94.30
Acenaphthylene	208-96-8	25.29	26.02	24.65	20.65	19.66	19.45
Acetaldehyde	75-07-0	5.13	5.28	5.00	4.19	3.99	3.95
Anthracene	120-12-7	617.04	634.70	601.29	503.66	479.58	474.47
Benzene	71-43-2	0.22	0.23	0.21	0.18	0.17	0.17
Benzo(a)anthracene	56-55-3	569.13	585.42	554.61	464.56	442.34	437.63
Benzo(b+k)fluoranthene	205-99-2	544.60	560.19	530.71	444.54	423.28	418.77
Benzo(g,h,i)perylene	191-24-2	767.66	789.63	748.07	626.60	596.64	590.29
Carbon Dioxide	124-38-9	23343484.19	24011724.68	22747828.75	19054297.92	18143142.53	17949914.57
Carbon Monoxide	630-08-0	5214.32	5363.59	5081.27	4256.23	4052.70	4009.54
Chrysene	218-01-9	245.28	252.30	239.02	200.21	190.64	188.61
Dibenzo(a,h)anthracene	53-70-3	62.09	63.86	60.50	50.68	48.26	47.74
Fluoranthene	206-44-0	678.36	697.78	661.05	553.71	527.24	521.62
Fluorene	86-73-7	523.14	538.12	509.79	427.02	406.60	402.27
Formaldehyde	50-00-0	355.51	365.69	346.44	290.19	276.31	273.37
Indeno(1,2,3-cd)pyrene	193-39-5	718.98	739.56	700.64	586.87	558.81	552.86
Isobutane	75-28-5	29.93	30.79	29.17	24.43	23.26	23.01
Isomers_of_heptane	142-82-5	18.98	19.52	18.50	15.49	14.75	14.59
Isomers_of_hexane	110-54-3	37.96	39.05	36.99	30.99	29.50	29.19
Isomers_of_octane	111-65-9	34.31	35.29	33.43	28.01	26.67	26.38
Isomers_of_pentane	109-66-0	40.15	41.30	39.13	32.77	31.21	30.87
Naphthalene	91-20-3	548.82	564.53	534.81	447.98	426.56	422.01
N-butane	106-97-8	89.06	91.61	86.79	72.70	69.22	68.48
N-heptane	142-82-5	2.19	2.25	2.13	1.79	1.70	1.68
N-hexane	110-54-3	78.84	81.10	76.83	64.35	61.28	60.62
Nitrogen Oxides	NOX	91820.64	94449.14	89477.65	74949.30	71365.31	70605.25
N-pentane	109-66-0	34.31	35.29	33.43	28.01	26.67	26.38
Phenanthrene	85-01-8	2434.80	2504.50	2372.68	1987.43	1892.39	1872.24
PM10	PM10	10211.25	10503.57	9950.69	8335.02	7936.44	7851.92
PM2_5	PM2.5	9415.03	9684.55	9174.79	7685.09	7317.60	7239.66
Propane	74-98-6	8.76	9.01	8.54	7.15	6.81	6.74
Pyrene	129-00-0	848.90	873.21	827.24	692.93	659.79	652.76

Sources for emissions profiles (column K): Leakage profile based on Boughton and Horvath article in Environmental Science and Technology 38(2); and Wong and Wang article in Environmental Pollution 112(2001).
Combustion profile based on same sources, except that combustion profile also assumes VOC emissions per gallon are same as for distillate oil (home heating oil) as given in Fuels spreadsheet.