

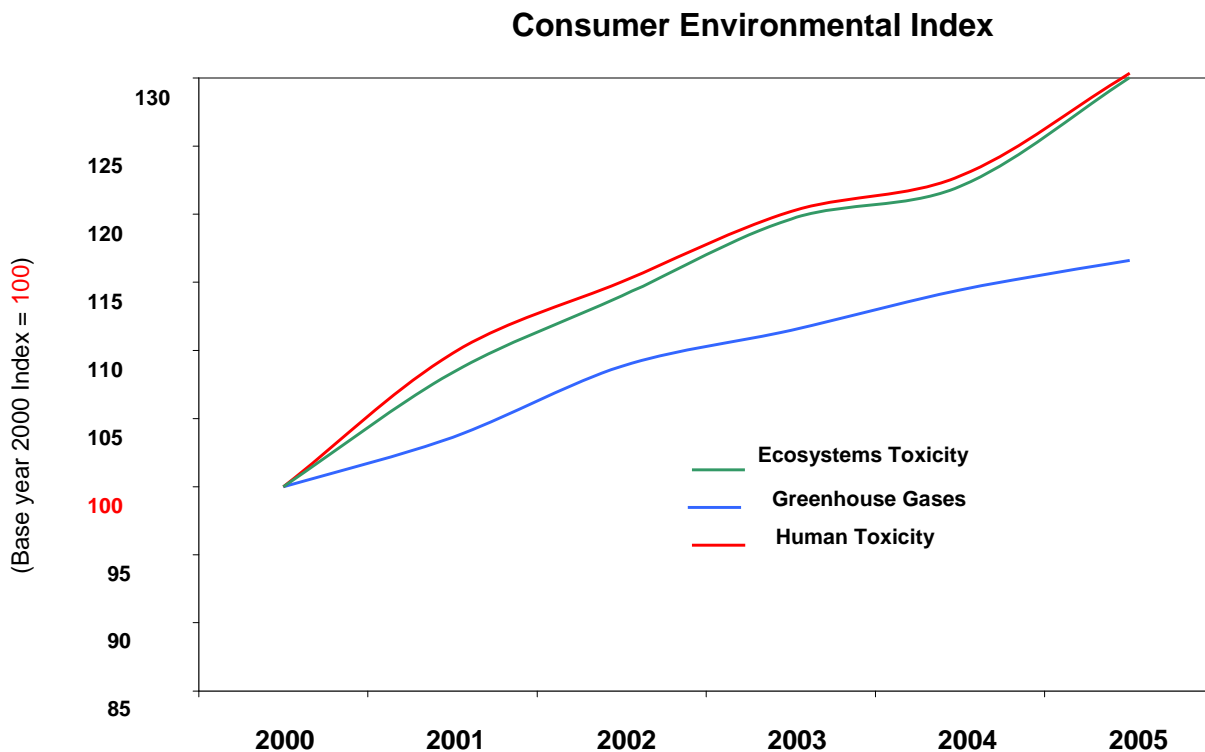
Consumer Environmental Index (CEI) Background Information

As we consume products or services during our life, we are ultimately responsible for our own contribution to society's "pollution footprint". However, we often don't know the environmental impacts on our purchasing habits. To get a better idea of this, Ecology contracted for the development of the Consumer Environmental Index (CEI).

What is a Consumer Environmental Index?

In order to track how consumption patterns are influencing the pollution releases we observe, and to measure the extent to which we are successful in reducing the amount of pollution associated with our purchases, the Washington Department of Ecology is currently evaluating the use of the Consumer Environmental Index (CEI) as a tool. The CEI uses actual expenditure patterns and calculates the cumulative environmental impacts from consumer choices. The CEI focuses on the potential to cause:

- Climate change,
- Harm to human health, and
- Ecosystems toxicity, as impacts to the environment and wildlife.



Pollution can be released during the extraction of raw materials. More pollution may occur during production and transportation of those products to the consumer. Yet more pollution may be released when we use those products and more when we decide how we are going to discard that which remains after products are used up. That is why each stage of a product's life cycle must be evaluated to show the total impact we are having on; climate, our own health and the environment. CEI looks at the manufacturing, use and end of life phase. Each phase is discussed below.

Products “Upstream” or Manufacturing Impacts

The Department of Commerce's Bureau of Economic Analysis (BEA) www.bea.gov develops economic input-output (EIO) tables to calculate gross domestic product (GDP) among other things. These are a long-established view into how the economy works, and were first available for the U.S. economy beginning in the 1940s. They define how much in dollars each economic sector buys from all the other economic sectors.

The CEI uses these economic input-output tables and emissions from those industries to calculate the cumulative impacts from manufacturing. This gives us the pollutant emissions from the total supply chain used in the upstream phase.

An Economic Input-Output Life Cycle Assessment (EIO-LCA) model (<http://www.eiolca.net>) was available as a software tool providing a wealth of data, summarizing the current U.S. economy in 500

sectors with information on energy and materials use, pollution and greenhouse gas discharges, and other attributes like associated occupational deaths and injuries. This model is maintained by the Green Design Institute of Carnegie Mellon University, which were partners in the development of Washington's Consumer Environmental Index (2007).

The screenshot shows the EIO-LCA model interface. At the top, it displays the sector name "Sector #336110: Automobile and light truck manufacturing" and the economic activity "\$1 Million Dollars". Below this, there are navigation options like "Display Toxic Releases" and "Show how many sectors?". A table of pollutant emissions is shown, with columns for Sector, Non-Point Air (kg), Point Air (kg), Total Air (kg), Water Releases (kg), Land Releases (kg), U'ground Releases (kg), Total Releases (kg), POTW Transfers (kg), Offsite Transfers (kg), and Total Rel/Trans (kg). The table lists various manufacturing sectors and their corresponding emissions values.

| Sector | Non-Point Air (kg) | Point Air (kg) | Total Air (kg) | Water Releases (kg) | Land Releases (kg) | U'ground Releases (kg) | Total Releases (kg) | POTW Transfers (kg) | Offsite Transfers (kg) | Total Rel/Trans (kg) |
|--|--------------------|----------------|----------------|---------------------|--------------------|------------------------|---------------------|---------------------|------------------------|----------------------|
| Total for all sectors | 36.2 | 165. | 201. | 41.8 | 926. | 35.0 | 1200. | 48.8 | 172. | 1420. |
| 36300 Motor vehicle parts manufacturing | 3.53 | 17.2 | 20.7 | 0.269 | 1.16 | 0 | 22.1 | 5.21 | 12.8 | 40.1 |
| 36110 Automobile and light truck manufacturing | 3.44 | 29.1 | 32.6 | 0.003 | 0.009 | 0 | 32.6 | 4.09 | 1.40 | 38.1 |
| 31111 Iron and steel mills | 1.89 | 1.77 | 3.66 | 23.8 | 15.9 | 0.259 | 43.6 | 0.626 | 80.5 | 125. |
| 31112 Ferroalloy and related product manufacturing | 1.75 | 0.377 | 2.13 | 0.418 | 6.39 | 0 | 8.93 | 0.003 | 0.704 | 9.64 |
| 25212 Synthetic rubber manufacturing | 1.66 | 1.90 | 3.57 | 0.133 | 0.008 | 0.347 | 4.05 | 0.033 | 0.061 | 4.15 |
| 25211 Plastics material and resin manufacturing | 1.64 | 3.56 | 5.20 | 0.388 | 0.021 | 1.90 | 7.51 | 3.09 | 0.456 | 11.1 |
| 25190 Other basic organic chemical manufacturing | 1.51 | 2.57 | 4.08 | 1.53 | 0.088 | 4.36 | 10.1 | 3.48 | 1.29 | 14.8 |
| 31312 Primary aluminum production | 1.26 | 3.94 | 5.20 | 0.023 | 0.455 | 0 | 5.68 | 0.000 | 1.14 | 6.82 |
| 31510 Ferrous metal foundries | 1.17 | 1.57 | 2.74 | 0.023 | 4.93 | 0 | 7.69 | 0.538 | 10.8 | 19.0 |
| 26140 Foam product manufacturing | 1.05 | 1.89 | 2.93 | 0.000 | 0.013 | 0 | 2.95 | 0.000 | 0.012 | 2.96 |

Products Consumption or “Use” Phase Impacts

Consumers typically have little control over manufacturing practices for the specific products that we purchase, but can and do influence the level of environmental impacts from the manufacturing phase mainly by choosing how to use the products we buy. We 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.

The development of the Washington State Consumer Environmental Index (CEI) starts with examining our actual consumption patterns derived from the annual Consumer Expenditure Survey (CES) from the U.S. Bureau of Labor and Statistics (<http://www.bls.gov/cex/csxreprt.htm>). The emissions during the use phase are then calculated using the average unit price to convert to quantities. The emissions profiles of products are taken from known literature and other sophisticated models, like BEES and WARM. The emissions during the use phase are shown to be mainly from energy and fossil fuels use.

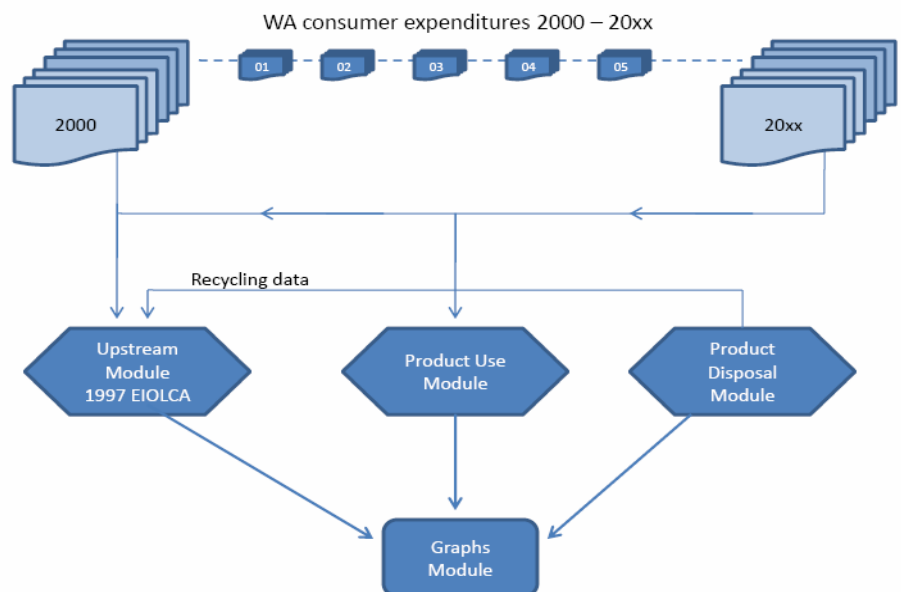
Products Disposal or “End-of-life” Impacts and Credits

We have all bought products and used them up. Many products are thrown in to landfills and others end up down the drain. When a product reaches the end of its useful life, consumers make choices about what to do with the product: reuse, recycle, or compost it or throw it in the garbage. These decisions directly affect pollutant emissions. State and local governments and businesses play a key role in providing opportunities and access to infrastructure and take-back opportunities, which can make it easier for consumers to make end-of-life choices. Those choices can reduce pollutant emissions compared with disposal of discarded products. Government also is crucial in the management of end-of-life wastes, such as wastewaters and solid and hazardous wastes.

Most of the emissions that are part of the CEI end-of-life calculated impacts are derived from waste management strategies. Recycling and reuse or composting quantities are used to reduce raw material extraction impacts in the ‘upstream’ module of the CEI and thus are considered credits. Emissions are calculated using the EPA’s Greenhouse Gas Emissions with the Waste Reduction Model (<http://yosemite.epa.gov/oar/globalwarming.nsf/warm?openform>), and Solid Waste Management Decision Support Tool (DST).

Putting it all together

Using actual consumer expenditure data for each year compiled by the US Bureau of Labor and Statistics each year, the impacts from the manufacturing of those goods and products is calculated using the EIO-LCA model from our partners at Carnegie Mellon University. The use phase emissions are calculated by converting expenditure into quantities and then using weighted emission impacts. The end-of-life module calculates emissions from the disposal of the products. If goods and products are recycled, they are credited to the upstream effects.



The CEI examines expenditure patterns in changes over time for human health, climate change and ecological harm, just as the Consumer Price Index (CPI) tracks changes in the prices consumers pay for

those purchases. The individual life cycle impacts are calculated and summed. The index can be developed in many different ways. It can be used as a single CEI as a rolled-up index or as several indexes. Additionally, key products such as pesticides can be pulled out and measured separately for such attributes as purchases and/or toxicity.

What does this index tell us?

Over time, the CEI tracks the environmental impacts from:

- What consumers buy and how their purchasing patterns are changing.
- Growth in the number of consumers and their adoption of new technologies.
- Changes in the efficiency with which manufacturers reduce the pollution footprint.
- Changes in the pollution footprint of various commodities.
- Changes in how consumers manage products at the end of the product's life.

How can we use the Consumer Environmental Index?

Just as the Consumer Price Index (CPI) is used as a single index of how inflation and costs are increasing over time, the Consumer Environmental Index (CEI) has the potential to show how our behavior is affecting our own health, the environment and climate change. The relative impacts of consumer spending gives a great deal of information of what projects and regulations may be working and where the best “bang for the buck” is in reducing pollution and making the world more sustainable.

As the CEI is derived using economics and spending patterns then methodology can be applied to any scale by changing the amount spent on products as services. Therefore, we see a use for the CEI in indexing the pollution footprints of agencies, businesses and even individuals based only on their spending. Additionally, as mentioned earlier, certain products can be pulled out and tracked separately. The CEI is specifically designed for Washington State and based on consumer spending patterns. Therefore, by definition it does not yet include impacts from government spending, or new housing costs. The Bureau of Economic Analysis manufacturing relational tables are based on manufacturing in the U.S. and there is work being undertaken now to define impacts from overseas manufacturing.

The fact that the index has dramatically increased over the past five years is because people are buying more and disposing more. Until that trend changes, it will be difficult to reach the goal of beyond waste.

More information

- The European Union has consulted a research study called Environmental Impact of Products (EIPRO). The environmental impact categories used in EIPRO were: global warming, acidification, photochemical ozone formation, and eutrophication:
http://ec.europa.eu/environment/ipp/pdf/eipro_report.pdf.
- Ecology staff that are most familiar with CEI are Dennis Bowhay and Cristiana Figueroa-Kaminsky from the Hazardous Waste and Toxics Reduction program and Gretchen Newman from the Solid Waste and Financial Assistance Program. They can be contacted by phone or e-mail for more information.
- Jeff Morris of Sound Resource Management is the consultant who developed CEI. His website includes some additional information about CEI:
<http://www.zerowaste.com/default.htm>.