Canning Green Beans
Ecoprofile of Truitt Brothers Process

Network for Business Innovation and Sustainability

Institute for Environmental Research and Education

Rita Schenck
August 6, 2007

Table of Contents

Executive Summary

This study is an assessment of the environmental impacts of canning green beans at the Truitt Brothers Cannery in Salem, Oregon. It is compared to a hypothetical freezing process at the same location. Data for the Truitt Brothers canning operations were analyzed, and a freezing scenario was estimated using published data and assuming that the freezing was done in the same location and with the same energy and water sources. The assumptions for the freezing analysis were based on conservative resource use. Life Cycle Assessment (LCA) was the tool used for the comparison and represent a reasonable best case for freezing.

Using this technique, the calculated environmental impacts of freezing were somewhat higher than those for canning.

Impact category	Percent Improvement of Canning over Freezing
Global Warming	38.7
Acidification	99.8
Human Health Cancer	150.4
Human Health Noncancer	9.1
Eutrophication	1.2
Ozone Depletion	1.3
Ecotoxicity	28.2
Smog	31.5
Criteria Air - average	59.2
Total Water Use	0.3
Fossil Fuel Depletion	75.1

The differences between the environmental impacts of the two preservation techniques are small relative to the confidence one can apply to the figures, but it is clear that the environmental performance of canning is at least as good as and possibly better than freezing. It is likely that the global warming and fossil fuel depletion due to canning is significantly less than that due to freezing green beans.

The majority of the impacts derive from the use of fossil fuel. In the case of canning, it is the energy use to manufacture the steel can that dominates the ecoprofile. In the case of freezing, it is the energy used in storage that dominates the ecoprofile. One could improve the ecoprofile by buying green tags or modifying the production process to reduce energy use.

Introduction

Truitt Brothers has retained the Network for Business Innovation and Sustainability (NBIS) and their subcontractor the Institute for Environmental Research and Education (IERE) to perform a life cycle assessment study, in conformance with the ISO 14044 standard[i]. The goal of this study is to provide a comprehensive assessment of the environmental impact of canning green beans by Truitt Brothers for use in marketing and customer support, while providing context for the major alternative preservation technique, freezing. The overwhelming majority of Truitt Brother's product is produced for commercial, rather than home-based use. The scope of the study is a comparison of the preservation of green beans, from the time it is delivered to the plant until it arrives at the wholesale customer. A hypothetical conservative assessment of freezing is used for comparison with the known canning process.

The study is a gate-to-customer study, ignoring the upstream production of the beans themselves, because it was assumed that the production of the beans was the same whether canned or frozen. While this is certainly true of beans delivered from the fields, frozen beans have more waste associated with them due to losses during storage. Agricultural production processes tend to dominate the life cycle impacts of food, so the one to three percent extra wastage in the frozen system may be significant in the context of canned versus frozen food. The environmental impacts of food preparation and consumption are ignored in this study, because it is assumed that they will be the same for the two preservation methods.

The reference flow for the study is a year's production of the Truitt Brothers Cannery, while the functional unit is preserving a single 4 ounce serving, for one year. Two years is the minimum amount of time that canned foods are considered to retain acceptable quality. The Truitt Brothers "sell-by" date is three years. In contrast frozen green beans are known to lose quality fairly quickly, with a maximum freezer time of 296 days[ii]. This study does not provide a comparative assertion of the overall superiority of canning versus freezing beans as defined in ISO 14044, for three reasons.

1) As noted below, the Truitt Brothers represent a small fraction of the total amount of processed green beans in the country,
2) The data on the freezer impacts are hypothetical in nature, and
3) The study does not represent a full cradle to grave assessment.

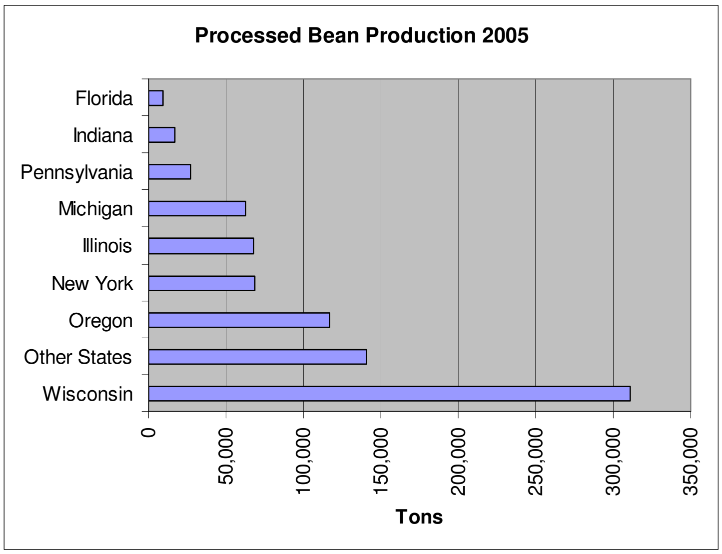
The audience is primarily Truitt Brothers' commercial customers, although the results will be shared with others, such as the Food Alliance[iii] and other non-governmental organizations (NGO's) as well as other interested parties.

The environmental impacts are calculated using the US EPA's TRACI[iv] methodology.

Background on USA Bean Production

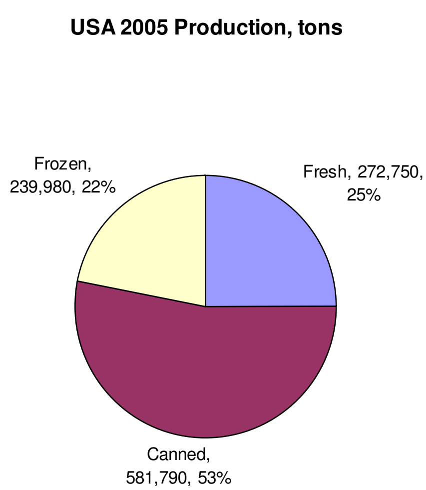
Oregon State is the second largest producer of green beans in the United States after Wisconsin. The Truitt Brother's production represents 9.5% of the total production of the state of Oregon.

Figure 1 Green Bean Production by State



More than half the US green bean crop is canned, and a quarter is frozen, according to the USDA most recent figures[v]. Green beans are one of the vegetables that both can and freeze well, thus permitting a comparison of the two preservation methods.

Figure 2 Green Bean Production in the USA



The Truitt Brothers production represents approximately 1.9 percent of the total US canned green bean crop.

System Description

Figure 3 shows the system for green bean preservation via canning. No energy is required for storage of the canned product, but a substantial amount of energy is required for processing and transport. Since nearly half of the content of a can of beans is water, about twice as much energy is required for canned bean transport as for the frozen product transport.

Truitt Brothers disposes of its bean waste (vines, leaves, etc.) to a dairy farm, which picks the material up on site and uses it as cattle feed. Thus this material is considered to have no disposal impact because it leaves the system boundary of the bean production system and enters that of the dairy system. It is not considered a co-product because without the dairy, the material would be composted.

Figure 3 Green Beans Canning System

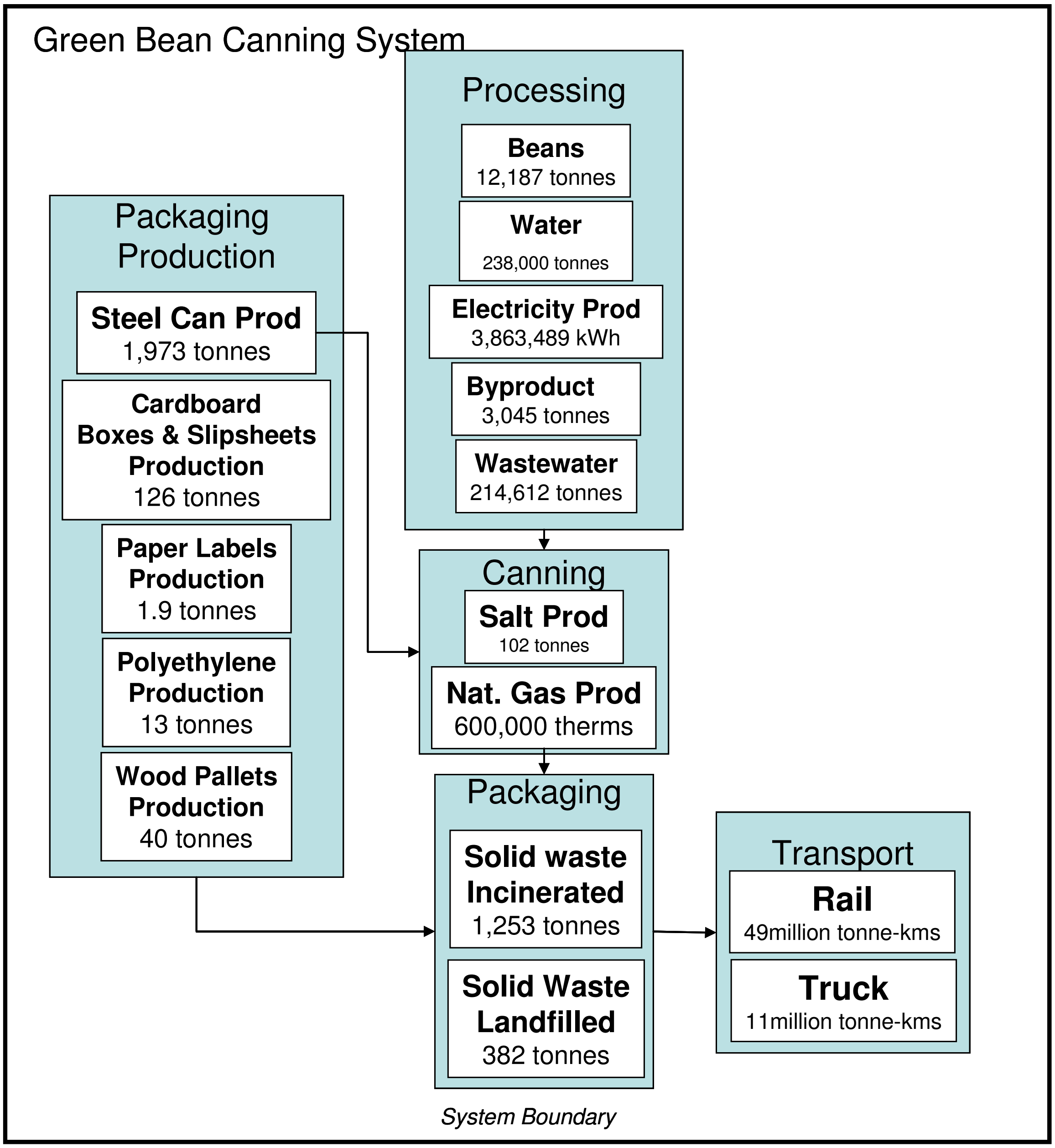
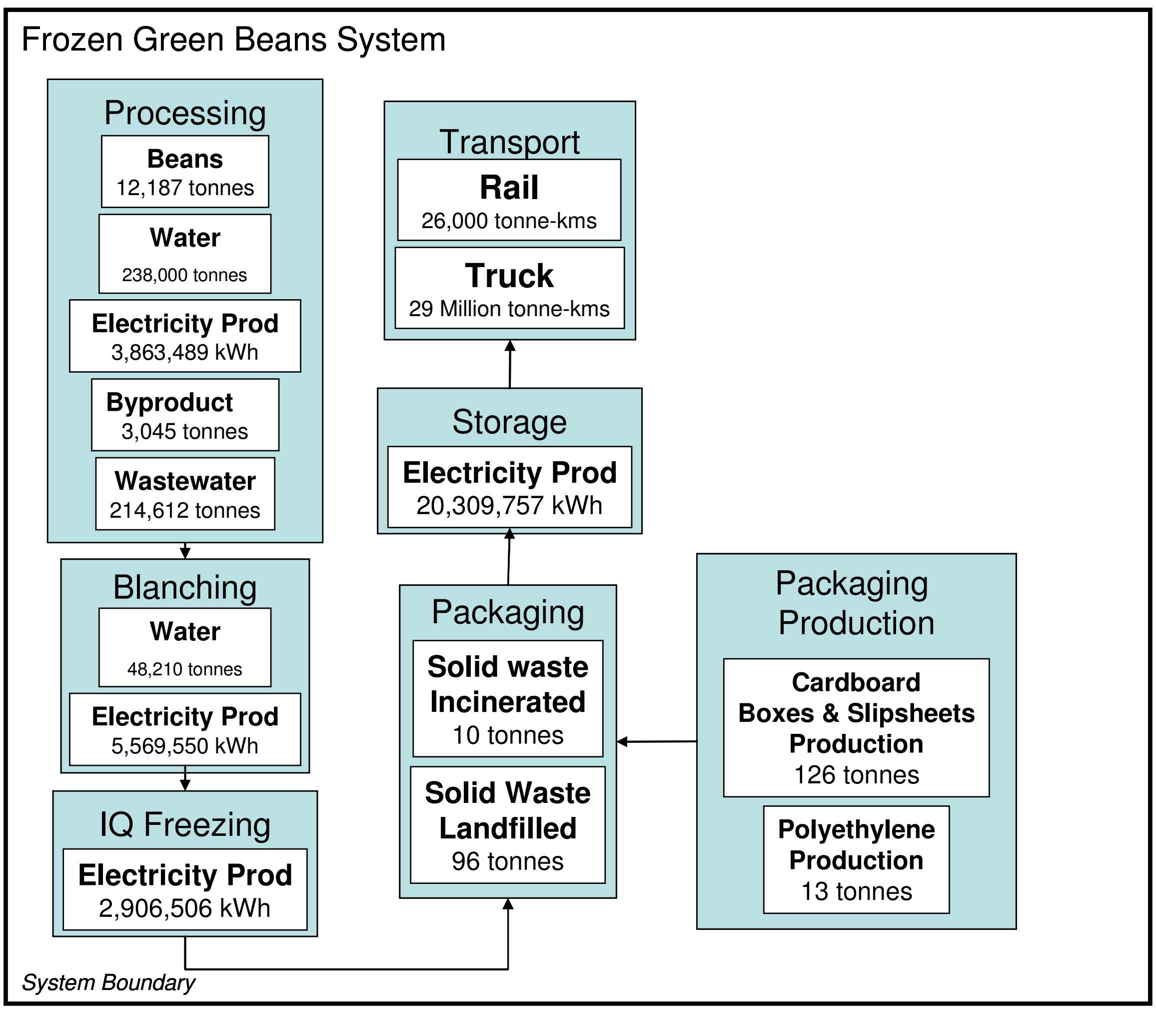


Figure 4 shows the system for the freezing of green beans. Since primary information was not available for much of the freezing life cycle, several assumptions were made:

1. Processing beans was identical for the canning and freezing processes. Processing includes removal of vines and leaves, washing, cutting to size and sorting of the beans.
2. The freezing and frozen storage operation is assumed to be at the same location as the canning process, using the same water and electricity sources. In essence, this assumes that the Truitt Brothers have converted their process to freezing rather than canning.
3. One and one-half percent of the frozen beans are lost in storage. This was based on the estimate provided by Truitt Brothers' clients that one to three percent is lost in storage.
4. Blanching was performed according to suggested guidelines of the cooperative extension service, and blanching water was re-used eight times.
5. The frozen beans were used uniformly through the year, i.e. the average bean was frozen for six months.

Figure 4 Frozen Beans Production System



Specific Unit Process Information

Processing

Beans are delivered from the fields in 12 to 14-ton trucks. The beans are fed at a rate of 16 tons per hour into an electrically-driven conveyor system that washes, removes vines and leaves, removes ends and cuts the beans and sorts them by diameter. About ten percent of the water used in this process is lost to spray and splashes. One-quarter of the mass of the beans is removed in this process and sent to a dairy as feed, as noted above. No chemicals are used in this process unless the residual chlorine of the water falls below regulatory requirements. Water packed in the canned beans is not chlorinated.

The water used is sourced from the river, through the local public water system. The wastewater is treated by elementary neutralization using sodium hydroxide and is sent to the municipal wastewater treatment plant.

Electricity (for both canned and frozen beans)

Processing beans requires electricity to operate belts, blowers, and pumps. The table below shows the electric grid provided to the Truitt Brothers plant. This grid has a relatively high hydropower and relatively low coal usage compared to the US average electric grid, making it a cleaner source of energy than the national average.

Figure 5 Electric Grid

Electrical Grid, Portland General Electric	
2005 Actuals	**Percent**
Hydropower	31
Coal	25
Natural Gas	41
Other	3
Total	100

Canning

The canning process uses natural gas to create live steam that is then blown into the cans prior to sealing. Then the retort is heated with natural gas as well.

The only additive to the beans is sea salt from the Great Salt Lake. Truitt Brothers makes two different can sizes: a nominal “15 oz” # 300 size and a nominal “gallon” #10 can size. The 15 oz. can size is sold to consumers and the “gallon” size is sold primarily to institutional customers.

As can be seen in the table below, the Truitt Brothers production is dominated by the "gallon" size. The last column shows the results adjusted for losses or shrinkage during the processing and canning of the beans.

Figure 6 Annual Mass of Truitt Green Bean Materials

Truitt Green Beans Annual Use				
	15 oz	**1 gal**	**Total in product**	**Shrinkage adjusted**
# cases	**473,100**	**691,500**		
Cans, kg	708,162	1,235,033	1,943,195	1,972,787
water, L	2,381,999	5,292,998	7,674,997	7,732,995
Beans, Kg	**2,253,243**	**6,880,897**	**9,134,140**	12,178,853
Salt, kg	35,408	67,045	102,453	103,227
PE, kg	536	0	536	541
Paper, kg	1,674	196	1,870	1,884
Cardboard, kg	126,074	296,016	422,090	422,090
Wood Pallets, kg		40,091	40,091	40,091
Cardboard slipsheets,kg	24,055	0	24,055	24,055
Total Weight, kgs	5,531,152	13,812,275	**19,343,427**	22,476,522
Weight/case, kg	**11.7**	**20.0**		

Can Production

Truitt Brothers procures its cans from Portland, Oregon (the steel plate for the cans comes from Pittsburg, California). They are tinned steel cans with a polyethylene interior lining. Life Cycle Inventory data on the cans was kindly provided by the Steel Recycling Institute, and represent the world average steel can material. Approximately 30% of the mass of the cans comes from recycled steel, while an estimated 62% of steel cans are recycled. Details in the allocation method can be found in the IISI document.[xii]

Packaging Production (applicable to both canning and freezing)

With the exception of cans, all the packaging and shipping materials are procured locally (weighted average distance was 52 miles, with the most distant source 95 miles away). The amounts of packaging can be seen in Figure 7.

Where available, US LCI database data was used for other unit processes other than steel. This was supplemented by inventory data in the Ecoinvent database.

Figure 7 Transport of packaging materials

Transportation			
Inputs	**miles**	**type**	**Notes**
Cans	580	Rail	Pittsburg, CA
Water	2	Pipeline	Local
Beans	10	Truck	Local
Salt	518	Rail	Saltlake City
PE	47.4		Portland
Corrugated Box & Slipsheets	51.72	Rail	Longview, WA
Wood Pallets	9.5	Rail	Turner, OR

Transport of Canned Beans

The transport distances and transport types for the different products can be seen in Figure 8.

The transport distance of the final product is significantly larger than the transport distance of all the product components. On average the product travels over 1800 miles.

Figure 8 Transport of Canned Beans

Product	miles	type	Location
473,100 15 oz cases	922	Truck	Los Angeles
276,600 gallon cases	2655	Rail	Atlanta, GA
304,260 gallon cases	2175	Rail	Dallas, TX
27,660 gallon cases	2323	Rail	Indianapolis
82, 980 gallon cases	922	Truck	Los Angeles
All product	1.5	Truck	local warehouse

It was assumed that all frozen product was distributed using 20 ton trucks for the same distances as the canned goods. The UN's listing of all types of transport does not include a refrigerated rail car[vi], so we assumed that refrigerated rail transport was not an option.

Frozen Packaging

We assumed that the frozen beans were delivered in 4-pound bags. This size is comparable to the "gallon" can that represents about two-thirds of the Truitt Brothers production. An investigation of the packaging at the local Costco store showed that these packages are packed without additional liner, eight to a corrugated carton. The plastic bags weigh 12 grams each and the corrugated cartons 24 ounces each. This is a minimal packaging level and represents a realistic conservative estimate of the packaging for frozen green beans. We did not assume that there were pallets or slipsheets used in the frozen bean transport.

Blanching

Blanching means rapidly heating fruits or vegetables to denature the enzymes that contribute to loss of color. It is performed using boiling water or steam, either in rotating drums or in drench baskets.

We have assumed that the blanching was performed using boiling water (heated by electricity) at a ratio of 1200 gallons per ton of beans.[vii] The environmental impact comes primarily from the use of energy to heat the water and vegetables from room temperature to boiling. We assumed that electricity from the local grid was the source of energy for blanching. Electricity from the local grid provides substantially less environmental impact than assuming natural gas was the energy source, so this is a conservative assumption that minimizes the environmental impact of blanching. If the process were to occur in the Midwest, where the grid is largely coal based, natural gas would be the cleaner energy source.

Freezing

We assumed that the green beans were all individually quick frozen. IQF technology is the industry standard. We used a study by the American Council for an Energy-Efficient Economy as our data source.[viii] The study showed 0.313 kWh per kg of food frozen. We performed a sensitivity analysis of this result assuming that the energy use was either half or twice this amount. The difference in the various indicators was small, on the order of a percent of the overall outcome.

No attempt was made to account for stratospheric ozone depleters. Modern refrigeration equipment uses refrigeration fluids that have little if any ozone depletion potential.

Frozen Storage

We assumed that the beans were used an equal amount over the year, so that the average green bean was stored for six months. The electricity required for storage was taken as the arithmetic mean of EPA’s listing of commercial closed door freezers, current as of September, 2006.[ix] This too is a conservative estimate of the amount of electricity used, since older equipment is less energy efficient.

As for the freezing process above, no ozone depleters were estimated.

Impact Assessment

As noted above, the environmental impact of the two food systems was calculated using the USEPA TRACI program, normalized to a single, 4-ounce serving of green beans. This methodology is applicable to the USA using factors developed for this country. The TRACI program covers a wide range of environmental impacts, and has a strong emphasis on human health impacts. Three of the 11 impact categories (Human health cancer, human health non-cancer and Criteria Air) relate directly to human health.

Global Warming

This impact indicator measures global warming potential in terms of carbon dioxide units at a hundred year horizon, following the guidance of the Intergovernmental Panel on Climate Change. Greenhouse gases derive primarily from the burning of fossil fuels.

Acidification

Acidification is measured as hydrogen ion equivalents. Emissions of oxides of sulfur and nitrogen as well as other acid gases can be converted to hydrogen ion equivalents. These gases come mostly from burning fossil fuels.

Human Health Cancer

This indicator is based on emissions of carcinogenetic compounds from industrial and other resources. It is measured in benzene equivalents. The indicator takes into account the partitioning of the substances into the different parts of the ecosphere. The most common source of benzene is gasoline, with up to 5% benzene by volume, and other carcinogenetic materials are formed during combustion processes. The primary source of the carcinogenicity of the canned and frozen beans life cycles is the combustion of natural gas.

Human Health Non-cancer

This indicator is the parallel to the cancer, only for substances that do not cause cancer. It is measured in units of toluene equivalents.

Eutrophication

Eutrophication is the overgrowth of algae due to the addition of nutrients into water bodies. Primarily, eutrophication comes from human and animal waste and runoff of agricultural fertilizers. In this study, most of the eutrophication comes from the production of oxides of nitrogen during fossil fuel burning. Agricultural use of fertilizers of a major source of eutrophication, but production of the beans is ignored in this study. Eutrophication is measured in units of nitrogen equivalents.

Ozone Depletion

Certain substances, notably refrigerants such as chlorofluorocarbons, are ozone depleters, causing the holes in the stratospheric ozone layer. Ozone depletion is measured in units of CFC-11 equivalents. The worst ozone depleters have been phased out as a consequence of the international Montreal Protocol, and the ozone hole appears to be shrinking in size.

Ecotoxicity

This indicator measure the effect of toxic emissions on the ecosystem. It measures them in terms of 2,4-Dioxin equivalents. Once again, fossil fuel burning is an important source of these impacts. We should note here that the toxicity does not refer to the toxicity of the product, but rather to the toxicity of emissions of materials during manufacturing and transport of the beans.

Smog

This indicator measures the potential to produce ozone near ground level. Ozone is produced in the presence of sunlight when both oxides of nitrogen and volatile organic substances are in the air. Ozone is damaging to people and plants. Once again oxides of nitrogen and the combustion events they come from are implicated in the production of smog, and this indicator is measured in units of oxides of nitrogen, or NOx.

Criteria Air Pollutants

This indicator is a measure of the production of particulate matter in the air. Particulate matter causes asthma and other human respiratory illnesses, and shortens the life of those who live in polluted areas. It is expressed in $PM_{2.5}$ units, that is, in units of particulate matter with the equivalent diameter of less than 2.5 microns.

Total Water Usage

This indicator speaks for itself. It is expressed in liters of water used.

Fossil Fuel Depletion

This indicator combines the effect of losses of the different fossil fuels based on their abundance and energy density. It is expressed in units of energy, in this case in megajoules (MJ).

Canned Green Beans

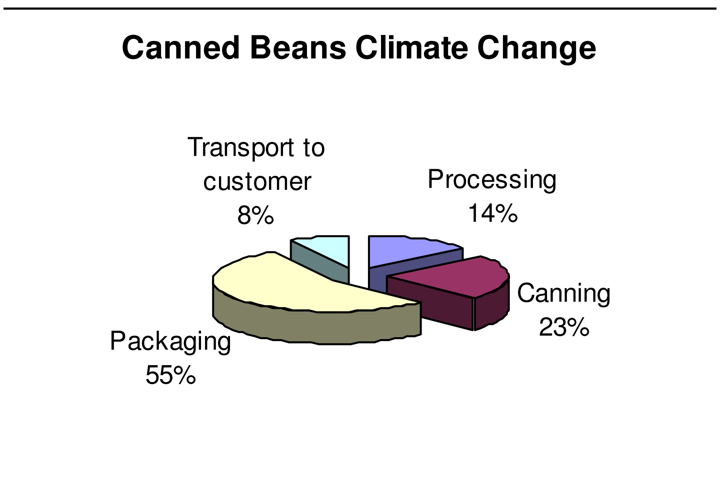
The table below shows the ecoprofile of the canned beans from the Truitt Brothers Cannery. The ecoprofile is the collection of the impact indicator results for a given product.

Figure 9 Canned Green Beans Ecoprofile

Impact category	Unit	Total Canned Green Beans	Processing	Canning	Packaging	Transport to customer
Global Warming, kg	CO_2 eq.	**0.212**	0.030	0.049	0.116	0.017
Acidification, kg	H+ moles eq.	**75.1**	13.4	21.6	28	12.1
Human Health Cancer, milligrams	benzene eq.	**62.7**	15.9	15.2	26.4	5.27
Human Health Noncancer, kg	toluene eq.	**0.869**	0.089	0.263	0.405	0.112
Eutrophication, milligrams	N eq.	**814**	781	3.49	17	12.6
Ozone Depletion, milligrams	CFC-11 eq.	**0.00149**	4.7E-07	5.67E-07	0.00148	5.83E-07
Ecotoxicity, grams	2,4-D eq.	**13.1**	1.31	3.88	4.85	3.1
Smog, milligrams	NOx eq.	**515**	56.8	47.1	137	275
Criteria Air - average, milligrams	PM2.5 eq.	**512**	80.4	113	203	116
Total Water Use, L	liter	**3.5**	2.87	0.096	0.529	0
Fossil Fuel Depletion	Surplus MJ	**0.233**	0.041	0.125	0.038	0.029

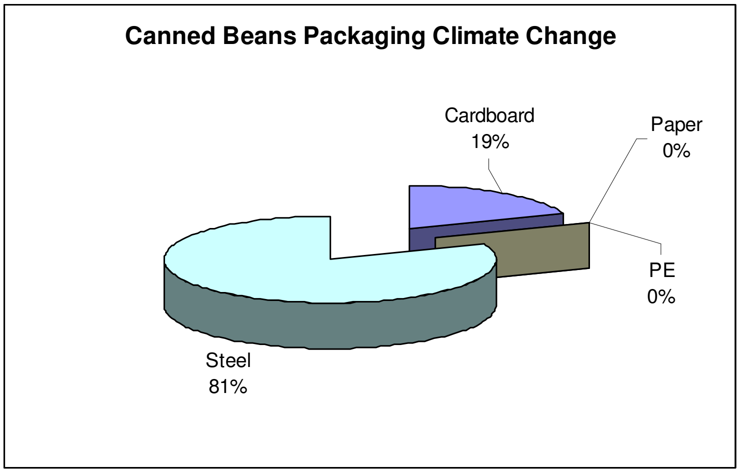
The majority of the greenhouse gases can be attributed to the production of packaging material, as shown below in Figure 10.

Figure 10 Source of Canned Green Beans Climate Change



Of the packaging materials, the cans themselves were the primary source of the greenhouse gases, as shown in Figure 11. These figures include the transport of materials to the facility, but the majority of the greenhouse gases derive from the production of steel.

Figure 11 Sources of Packaging Climate Change



Frozen green beans

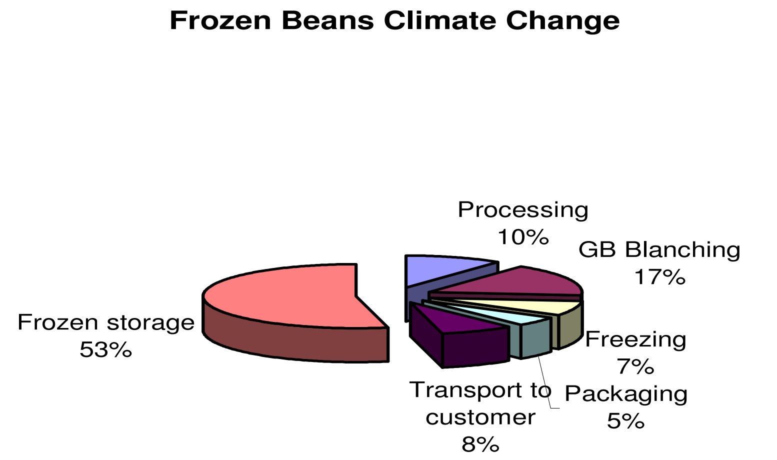
The frozen green beans ecoprofile is shown in Figure 12.

Figure 12 Frozen Green Bean Ecoprofile

Impact category	Unit	Total Frozen Green Beans	Processing	GB Blanching	Freezing	Packaging	Transport to customer	Frozen storage
Global Warming, kg	CO2 eq.	**0.294**	0.03	0.0487	0.0219	0.014	0.0228	0.157
Acidification, kg	H+ moles eq.	**0.128**	0.0134	0.0218	0.0098	0.00547	0.00758	0.0702
Human Health Cancer, milligrams	benzene eq.	**157**	15.9	25.9	11.6	13.1	7.13	83.4
Human Health Noncancer, kg	toluene eq.	**0.948**	0.0889	0.145	0.0652	0.0297	0.152	0.467
Eutrophication, milligrams	N eq.	**824**	783	4.79	2.16	11.4	7.24	15.4
Ozone Depletion, milligrams	CFC-11 eq.	**0.00151**	4.71E-07	2.29E-07	1.03E-07	0.0015	7.88E-07	7.37E-07
Ecotoxicity, grams	2,4-D eq.	**16.8**	1.31	2.13	0.959	1.34	4.2	6.87
Smog, milligrams	NOx eq.	**677**	57	91.8	41.3	39.5	151	296
Criteria Air - average, milligrams	PM2.5 eq.	**815**	80.6	131	58.8	56.1	68.2	421
Total Water Use, L	liter	**3.51**	2.88	0.594	0	0.0378	0	0
Fossil Fuel Depletion	Surplus MJ	**0.408**	0.041	0.067	0.030	0.013	0.040	0.217

The dominant source of the climate change impacts of the frozen foods lies in the storage process, as shown below. As noted above, this is based on a conservative (low) estimate of the energy use to operate the freezers.

Figure 13 Source of Frozen Green Beans Climate Change



Canned versus Frozen Green Beans

Figure 14 Ecoprofiles of Canned and Frozen Beans

Impact category	Unit	Total Canned Green Beans	Total Frozen Green Beans
Global Warming, kg	CO_2 eq.	0.212	0.294
Acidification, kg	H^+ moles eq.	75.1	0.128
Human Health Cancer, milligrams	benzene eq.	62.7	157
Human Health Noncancer, kg	toluene eq.	0.869	0.948
Eutrophication, milligrams	N eq.	814	824
Ozone Depletion, milligrams	CFC-11 eq.	0.00149	0.00151
Ecotoxicity, grams	2,4-Dioxin eq.	13.1	16.8
Smog, milligrams	NOx eq.	515	677
Criteria Air - average, milligrams	$PM_{2.5}$ eq.	512	815
Total Water Use, L	liter	3.5	3.5
Fossil Fuel Depletion	Surplus MJ	0.233	0.408

The summary of the results for the two product systems is shown in Figure 14. In each case, lower figures indicate better environmental performance.

Significance of the Results

Figure 15 Canned versus Frozen Summary

Impact category	Percent Improvement of Canning over Freezing
Global Warming	39
Acidification	100
Human Health Cancer	150
Human Health Noncancer	9.1
Eutrophication	1.2
Ozone Depletion	1.3
Ecotoxicity	28
Smog	32
Criteria Air - average	59
Total Water Use	0.3
Fossil Fuel Depletion	75

When we compare canned versus frozen green beans, we can see that in every case, the canned green beans have equal or lower environmental impacts than the frozen beans for the delivery of a four-ounce serving. As noted above, we have estimated a hypothetical freezing process providing low estimates of emissions wherever possible, but these results must be taken as hypothetical, not actual analyses.

Acidification was almost 100 percent greater for frozen than for canned beans, and criteria air pollutants were 59 percent higher for frozen than for canned beans and human health non-cancer was 9 percent higher for frozen than for canned green beans. The expected variability for these indicators is large relative to these differences, and so these differences may not be statistically significant.

Note that the indicator for the human health-cancer impacts is expressed in units of milligrams, as compared with the human health non-cancer impacts, which is expressed in kilograms. This indicates that the human health cancer impacts are extremely small. Frozen beans have 2.5 times as much cancer impact as do canned beans, but this difference is between two very small numbers and is probably not significant.

The greenhouses gases from the lifecycle of frozen green beans were 39 percent greater than for canned beans. The model for climate change and the inventory information for climate change are quite robust and have relatively low variability and so this difference is probably statistically significant.

The use of water in processing the beans was substantial— almost three liters per four-ounce serving. Overall, nearly a gallon of water was used to process and package four ounces of the product, regardless of whether the product was canned or frozen. More water appears in the canned product, but blanching uses an equivalent amount for the frozen product.

Source of Impacts

The majority of the environmental impacts of the two systems come from the use of energy. This is a typical outcome for an industrial system, because as noted above, most of the known and measurable environmental impacts derive at least in part from burning fossil fuels. If the entire bean agricultural production unit processes had been included in the study, other issues such as the impact of land use on biodiversity would have become apparent.

Comparison with Other Studies

These figures compare well with a study on canned food commissioned by the Steel Recycling Institute[x] and performed by Scientific Certification Systems. That study showed that canning food uses less energy than freezing food, in roughly the same proportions as were found in this present study.

These results compare well with those found in studies in Europe as well[xi].

Improvement Opportunities

Truitt Brothers can take some steps to further reduce their environmental impacts. For example, they could choose to only use recycled steel in their cans. This would likely decrease the green house gas emissions by about a quarter. It may be difficult to find a can manufacturer willing or able to use only recycled steel in its cans, but it is worth asking. The Steel Recycling Institute[xii] reports that over 60 percent of steel cans are recycled and over 90 percent of the steel in buildings is recycled, but the recycled content of steel is only 30%. That implies a temporal disequilibrium is the use/reuse cycle of steel. That is to say, most of the steel manufactured goes into long term service in buildings and machinery, and these materials are not yet being recycled.

Lightweighting packaging could make a difference as well. Other choices are limited by the nature of the processing step. Is it possible to re-design the bean processing to reduce the water and energy consumption? This would be a major, long-term project, but it might provide cost savings as well as environmental benefits. The canning process itself might be changed, as some researchers in Europe are suggesting.[xiii]

A first step towards redesigning the processing step to be more energy efficient would be to install electric meters on the different pieces of equipment in the processing line, and begin to measure the electricity consumption at each step.

In the meantime, since the majority of the environmental impacts of canning derive from energy use, the Truitt Brothers could choose to offset their environmental impacts by purchasing green tags. The Bonneville Environmental Foundation[xiv] in Portland sells green tags, which assures energy production from wind and solar resources. Purchasing green tags could essentially "zero out" the carbon emissions of the entire canning process and the transport impacts could be offset as well.

Because the electric grid in the Portland General Electric service area is relatively clean, the overall environmental impacts of either canning or freezing beans is lower than it would be in another part of the country. As noted in the introduction, Truitt Brothers represents only 1.9 percent of the canned green bean production in the USA. Care must be taken extrapolating these results and suggestions to other green bean processors.

Acknowledgements

We wish to thank the Steel Recycling Institute for their generous donation of data on steel production, and Franklin Associates, a division of ERG, whose critical review identified opportunities for greater language clarity for improved transparency.

Appendix A Life Cycle Inventory Tables

Note in these tables that the compartment name "raw" indicates raw materials inputs, "air" indicates air emissions, "water" indicates water emissions, "waste indicates solid waste emissions and "non material" indicates land or energy use.

Overall system for canned green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (canned)	GB Canning (canned)	GB Packaging (canned)	GB Transport to customer (canned)
Bauxite (Al2O3, ore)	Raw	kg	1.56E-10	x	x	1.56E-10	x
Clay (in ground)	Raw	kg	4.49E-10	x	x	4.49E-10	x
Coal (in ground)	Raw	kg	0.02270475	0.006194494	0.000399692	0.015898212	0.000212353
Dolomite (CaCO3.MgCO3, in ground)	Raw	kg	0.000937831	x	x	0.000937831	x
Green bean	Raw	kg	0.15144306	0.15144306	x	x	x
Iron (Fe, ore)	Raw	kg	0.020016271	-8.74E-26	-1.83E-23	0.020016271	-3.90E-25
Lignite (in ground)	Raw	kg	5.03E-06	-7.33E-23	-1.53E-20	5.03E-06	-3.27E-22
Limestone (CaCO3, in ground)	Raw	kg	0.002745624	-3.12E-21	-6.52E-19	0.002745624	-1.39E-20
Na2SO4	Raw	kg	2.67E-05	-3.79E-38	-6.77E-38	2.67E-05	-1.39E-38
Natural Gas (in ground)	Raw	kg	0.022854905	0.004946312	0.015853965	0.001814031	0.000240597
Oil (in ground)	Raw	kg	0.006984343	0.000160649	0.000185749	0.002181386	0.00445656
oxygen	Raw	kg	4.05E-08	2.23E-22	-1.13E-22	4.05E-08	-3.50E-22
Potassium Chloride (KCl, as K2O, in ground)	Raw	kg	3.89E-07	5.25E-23	5.46E-23	3.89E-07	-8.21E-23
Sand (in ground)	Raw	kg	3.35E-09	-3.80E-26	-7.95E-24	3.35E-09	-1.70E-25
Sodium Chloride (NaCl, in ground or in sea)	Raw	kg	9.32E-05	7.95E-05	-2.35E-20	1.37E-05	-5.02E-22
Sulfur (S, in ground)	Raw	kg	1.31E-06	-1.86E-39	-3.32E-39	1.31E-06	-6.79E-40
Sulfur dioxide, secondary	Raw	kg	1.09E-08	-1.59E-25	-3.32E-23	1.09E-08	-7.10E-25
Uranium (U, ore)	Raw	kg	6.90E-06	9.71E-07	1.54E-06	3.55E-06	8.48E-07
Water Used (total)	Raw	m3	0.003510937	0.002870147	9.60E-05	0.000544787	-1.24E-21
Water, river	Raw	m3	0.00296615	0.002870147	9.60E-05	x	x
Water: River	Raw	m3	2.54E-07	2.06E-23	-1.04E-23	2.54E-07	-3.24E-23

Overall system for canned green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (canned)	GB Canning (canned)	GB Packaging (canned)	GB Transport to customer (canned)
Water: Unspecified Origin	Raw	m3	3.65E-11	-3.94E-27	-1.29E-26	3.65E-11	-1.68E-27
Water: Well	Raw	m3	1.47E-06	1.19E-22	-6.04E-23	1.47E-06	-1.88E-22
wood	Raw	kg	0.005917636	5.33E-19	-2.70E-19	0.005917636	-8.38E-19
Wood scrap	Raw	kg	0.001266738	-1.80E-36	-3.21E-36	0.001266738	-6.57E-37
2,4 - D (C8H6Cl2O3)	Air	kg	8.00E-11	6.50E-27	-3.29E-27	8.00E-11	-1.02E-26
Acenaphthene (C12H10)	Air	kg	2.30E-12	1.61E-12	1.04E-13	5.26E-13	5.51E-14
Acenaphthylene (C12H8)	Air	kg	1.14E-12	8.05E-13	5.17E-14	2.60E-13	2.75E-14
Acetaldehyde (CH3CHO)	Air	kg	3.79E-08	1.37E-10	3.33E-10	3.74E-08	3.99E-11
Acetochlor (C14H20ClNO2)	Air	kg	1.11E-09	9.01E-26	-4.56E-26	1.11E-09	-1.42E-25
Acetophenone (C8H8O)	Air	kg	9.00E-12	1.11E-13	1.34E-13	8.75E-12	1.21E-14
Acrolein (CH2CHCHO)	Air	kg	1.77E-07	9.44E-10	9.89E-11	1.76E-07	3.64E-11
Alachlor (C14H20ClNO2)	Air	kg	1.09E-10	8.87E-27	-4.49E-27	1.09E-10	-1.39E-26
Aldehyde (unspecified)	Air	kg	2.58E-07	9.49E-09	7.73E-09	6.00E-08	1.81E-07
Ammonia (NH3)	Air	kg	5.01E-07	3.29E-09	3.81E-09	4.03E-07	9.05E-08
Ammonium chloride	Air	kg	6.38E-10	8.97E-11	1.42E-10	3.28E-10	7.83E-11
Anthracene (C14H10)	Air	kg	9.67E-13	6.81E-13	4.37E-14	2.19E-13	2.33E-14
Antimony (Sb)	Air	kg	4.27E-10	5.58E-11	3.60E-12	3.66E-10	1.91E-12
Aromatic Hydrocarbons (unspecified)	Air	kg	1.43E-08	-2.06E-25	-4.32E-23	1.43E-08	-9.22E-25
Arsenic (As)	Air	kg	2.90E-09	1.33E-09	1.58E-10	1.35E-09	6.26E-11
Atrazine (C8H14ClN5)	Air	kg	2.17E-09	1.76E-25	-8.90E-26	2.17E-09	-2.76E-25
Bentazon	Air	kg	8.82E-12	7.16E-28	-3.62E-28	8.82E-12	-1.13E-27
Benzene (C6H6)	Air	kg	2.05E-06	4.30E-07	1.36E-06	2.32E-07	2.09E-08
Benzo(a)anthracene	Air	kg	3.54E-13	2.48E-13	1.60E-14	8.19E-14	8.49E-15
Benzo(a)pyrene (C20H12)	Air	kg	1.68E-13	1.18E-13	7.59E-15	3.89E-14	4.03E-15
Benzo(bjk)fluoranthene	Air	kg	4.87E-13	3.41E-13	2.20E-14	1.13E-13	1.17E-14
Benzo(g,h,i)perylene (C22H12)	Air	kg	1.23E-13	8.67E-14	5.57E-15	2.81E-14	2.96E-15
Benzyl Chloride (C7H7Cl)	Air	kg	4.20E-10	5.19E-12	6.27E-12	4.08E-10	5.65E-13

Overall system for canned green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (canned)	GB Canning (canned)	GB Packaging (canned)	GB Transport to customer (canned)
Beryllium (Be)	Air	kg	1.54E-10	7.25E-11	9.86E-12	6.82E-11	3.14E-12
Biphenyl (1,1-C12H10)	Air	kg	7.53E-12	5.27E-12	3.40E-13	1.74E-12	1.81E-13
Bromoform (CHBr3)	Air	kg	2.34E-11	2.89E-13	3.50E-13	2.27E-11	3.15E-14
Bromoxynil (C7H3Br2NO)	Air	kg	1.94E-11	1.57E-27	-7.95E-28	1.94E-11	-2.47E-27
Butadiene (1,3-CH2CHCHCH2)	Air	kg	5.10E-11	6.63E-12	1.59E-11	2.64E-11	2.01E-12
Cadmium (Cd)	Air	kg	3.04E-09	2.83E-10	3.92E-10	2.35E-09	1.53E-11
Carbofuran (C12H15NO3)	Air	kg	1.66E-11	1.34E-27	-6.80E-28	1.66E-11	-2.11E-27
Carbon Dioxide (CO2, biomass)	Air	kg	0.008490437	1.93E-19	2.11E-19	0.008490437	-1.83E-19
Carbon Dioxide (CO2, fossil)	Air	kg	0.14608354	0.027685805	0.043539427	0.058652587	0.016205716
Carbon Disulfide (CS2)	Air	kg	7.80E-11	9.65E-13	1.17E-12	7.58E-11	1.05E-13
Carbon Monoxide (CO)	Air	kg	0.000492025	1.46E-05	3.40E-05	0.000352854	9.06E-05
Carbon Tetrachloride (CCl4)	Air	kg	1.98E-09	1.81E-15	2.09E-15	1.98E-09	5.02E-14
CFC 12 (CCl2F2)	Air	kg	6.28E-13	1.79E-14	2.07E-14	9.23E-14	4.97E-13
Chlorine (Cl2)	Air	kg	3.51E-08	3.86E-11	-1.52E-25	3.51E-08	-3.87E-24
Chloroacetophenone (2-C8H7ClO)	Air	kg	4.20E-12	5.19E-14	6.27E-14	4.08E-12	5.65E-15
Chlorobenzene (C6H5Cl)	Air	kg	1.32E-11	1.63E-13	1.97E-13	1.28E-11	1.78E-14
Chloroform (CHCl3, HC-20)	Air	kg	3.54E-11	4.38E-13	5.29E-13	3.44E-11	4.77E-14
Chlorpyrifos (C9H11Cl3NO3PS)	Air	kg	1.27E-10	1.03E-26	-5.23E-27	1.27E-10	-1.62E-26
Chromium (Cr III, Cr VI)	Air	kg	4.19E-08	9.60E-10	5.37E-10	4.03E-08	4.43E-11
Chromium (Cr VI)	Air	kg	3.54E-10	2.48E-10	1.60E-11	8.13E-11	8.48E-12
Chrysene (C18H12)	Air	kg	4.43E-13	3.10E-13	2.00E-14	1.02E-13	1.06E-14
Cobalt (Co)	Air	kg	9.25E-10	3.33E-10	6.97E-11	4.35E-10	8.76E-11
Copper (Cu)	Air	kg	1.16E-11	6.15E-12	2.59E-12	2.06E-12	8.13E-13
Cumene (C9H12)	Air	kg	3.18E-12	3.93E-14	4.75E-14	3.09E-12	4.28E-15
Cyanazine (C9H13ClN6)	Air	kg	1.90E-11	1.55E-27	-7.82E-28	1.90E-11	-2.43E-27
Cyanide (CN-)	Air	kg	1.50E-09	1.86E-11	2.24E-11	1.46E-09	2.02E-12
Di(2-ethylhexyl)phthalate (DEHP, C24H38O4)	Air	kg	4.38E-11	5.42E-13	6.54E-13	4.26E-11	5.90E-14

Overall system for canned green beans - per 4 oz green beans							
Substance	**Compartment**	**Unit**	**Total**	**GB processing (canned)**	**GB Canning (canned)**	**GB Packaging (canned)**	**GB Transport to customer (canned)**
Dicamba (C8H6Cl2O3)	Air	kg	1.12E-10	9.12E-27	-4.61E-27	1.12E-10	-1.43E-26
Dimethenamid (C12H18ClNO2S)	Air	kg	2.65E-10	2.15E-26	-1.09E-26	2.65E-10	-3.38E-26
Dimethyl Sulfate (C2H6O4S)	Air	kg	2.88E-11	3.56E-13	4.30E-13	2.80E-11	3.88E-14
Dinitrogen monoxide	Air	kg	1.94E-07	-2.85E-24	-5.95E-22	1.94E-07	-1.27E-23
Dinitrotoluene (2,4-C7H6N2O4)	Air	kg	1.68E-13	2.08E-15	2.51E-15	1.63E-13	2.26E-16
Dioxins (unspecified)	Air	kg	7.33E-11	2.54E-15	2.32E-16	7.33E-11	2.81E-16
Dioxins, measured as 2,3,7,8-tetrachlorodibenzo-p-dioxin	Air	kg	1.80E-13	-2.64E-30	-5.52E-28	1.80E-13	-1.18E-29
EPTC (C9H19NOS)	Air	kg	1.81E-10	1.47E-26	-7.44E-27	1.81E-10	-2.31E-26
Ethyl Benzene (C6H5C2H5)	Air	kg	1.79E-06	4.25E-07	1.36E-06	-1.71E-08	2.07E-08
Ethyl Chloride (C2H5Cl)	Air	kg	2.52E-11	3.12E-13	3.76E-13	2.45E-11	3.39E-14
Ethylene Dibromide (C2H4Br2)	Air	kg	7.20E-13	8.91E-15	1.08E-14	7.00E-13	9.69E-16
Ethylene Dichloride (C2H4Cl2)	Air	kg	2.40E-11	2.97E-13	3.59E-13	2.33E-11	3.23E-14
Fluoranthene	Air	kg	3.18E-12	2.23E-12	1.44E-13	7.31E-13	7.63E-14
Fluorene (C13H10)	Air	kg	4.07E-12	2.85E-12	1.84E-13	9.36E-13	9.76E-14
Fluorides (F-)	Air	kg	2.68E-08	3.31E-10	4.00E-10	2.60E-08	3.60E-11
Formaldehyde (CH2O)	Air	kg	2.35E-07	9.18E-09	2.69E-08	1.98E-07	8.05E-10
Furan (C4H4O)	Air	kg	1.88E-14	1.54E-14	8.74E-16	2.02E-15	4.82E-16
Glyphosate (C3H8NO5P)	Air	kg	2.38E-10	1.94E-26	-9.79E-27	2.38E-10	-3.04E-26
Halogenated Hydrocarbons (unspecified)	Air	kg	2.58E-11	-3.78E-28	-7.90E-26	2.58E-11	-1.69E-27
Hexane (C6H14)	Air	kg	4.02E-11	4.97E-13	6.01E-13	3.91E-11	5.41E-14
Hydrocarbons (except methane)	Air	kg	3.95E-05	7.41E-07	4.27E-07	2.86E-05	9.73E-06
Hydrocarbons (unspecified)	Air	kg	3.12E-05	5.00E-06	1.43E-05	1.31E-06	1.06E-05
Hydrogen Chloride (HCl)	Air	kg	9.99E-06	3.72E-06	2.39E-07	5.89E-06	1.37E-07
Hydrogen Fluoride (HF)	Air	kg	6.37E-07	4.64E-07	2.96E-08	1.28E-07	1.59E-08
Hydrogen Sulfide (H2S)	Air	kg	1.22E-06	x	x	1.22E-06	x
Indeno (1,2,3,c,d) Pyrene	Air	kg	2.74E-13	1.92E-13	1.24E-14	6.29E-14	6.57E-15

Overall system for canned green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (canned)	GB Canning (canned)	GB Packaging (canned)	GB Transport to customer (canned)
Isophorone	Air	kg	3.48E-10	4.30E-12	5.20E-12	3.38E-10	4.68E-13
Kerosene	Air	kg	1.15E-09	1.61E-10	2.55E-10	5.89E-10	1.41E-10
Lead (Pb)	Air	kg	9.01E-08	1.39E-09	2.93E-10	8.84E-08	6.94E-11
Magnesium (Mg)	Air	kg	4.87E-08	3.41E-08	2.20E-09	1.13E-08	1.17E-09
Manganese (Mn)	Air	kg	7.27E-08	1.60E-09	2.42E-10	7.07E-08	9.35E-11
MCPA	Air	kg	1.49E-12	1.21E-28	-6.13E-29	1.49E-12	-1.90E-28
Mercaptans, unspecified	Air	kg	1.30E-07	1.60E-09	1.94E-09	1.26E-07	1.74E-10
Mercury (Hg)	Air	kg	3.93E-09	3.64E-10	1.19E-10	3.44E-09	1.27E-11
Metals (unspecified)	Air	kg	1.90E-06	1.93E-11	-2.98E-23	1.90E-06	-4.39E-23
Methane (CH4)	Air	kg	0.000398935	9.59E-05	0.00022762	5.46E-05	2.08E-05
Methane, bromotrifluoro-, Halon 1301	Air	kg	1.28E-11	-1.88E-28	-3.93E-26	1.28E-11	-8.39E-28
Methyl Bromide (CH3Br)	Air	kg	9.60E-11	1.19E-12	1.43E-12	9.33E-11	1.29E-13
Methyl Chloride (CH3Cl)	Air	kg	3.18E-10	3.93E-12	4.75E-12	3.09E-10	4.28E-13
Methyl Chrysene (5-C19H15)	Air	kg	9.74E-14	6.81E-14	4.40E-15	2.25E-14	2.34E-15
Methyl Ethyl Ketone (MEK, C4H8O)	Air	kg	2.34E-10	2.89E-12	3.50E-12	2.27E-10	3.15E-13
Methyl Hydrazine (CH6N2)	Air	kg	1.02E-10	1.26E-12	1.52E-12	9.91E-11	1.37E-13
Methyl Methacrylate (CH2C(CH3)COOCH3)	Air	kg	1.20E-11	1.48E-13	1.79E-13	1.17E-11	1.62E-14
Methyl Parathion (C8H10NO5PS)	Air	kg	1.34E-11	1.09E-27	-5.50E-28	1.34E-11	-1.71E-27
Methyl tert Butyl Ether (MTBE, C5H12O)	Air	kg	2.10E-11	2.60E-13	3.14E-13	2.04E-11	2.83E-14
Methylene Chloride (CH2Cl2, HC-130)	Air	kg	1.43E-08	9.74E-10	9.04E-11	1.31E-08	9.75E-11
Metolachlor (C15H22ClNO2)	Air	kg	8.76E-10	7.11E-26	-3.60E-26	8.76E-10	-1.12E-25
Metribuzin (C8H14N4OS)	Air	kg	4.07E-12	3.30E-28	-1.67E-28	4.07E-12	-5.19E-28
Naphthalene (C10H8)	Air	kg	4.63E-09	1.09E-10	2.17E-10	4.28E-09	1.78E-11
Nickel (Ni)	Air	kg	6.06E-09	1.30E-09	1.07E-09	2.56E-09	1.12E-09
Nitrogen	Air	kg	1.07E-10	1.96E-24	-1.13E-22	1.07E-10	-5.22E-24
Nitrogen Oxides (NOx as NO2)	Air	kg	0.000499899	5.51E-05	4.18E-05	0.000129814	0.000273166
Nitrous Oxide (N2O)	Air	kg	1.88E-05	1.93E-08	7.80E-07	1.76E-05	3.66E-07

Overall system for canned green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (canned)	GB Canning (canned)	GB Packaging (canned)	GB Transport to customer (canned)
odorous sulfur	Air	kg	4.76E-10	2.62E-24	-1.33E-24	4.76E-10	-4.12E-24
Organic Matter (unspecified)	Air	kg	6.39E-09	4.25E-11	4.41E-12	6.34E-09	2.38E-12
Paraquat (C12H14N2)	Air	kg	1.78E-11	1.45E-27	-7.31E-28	1.78E-11	-2.27E-27
Particulates (PM 10)	Air	kg	3.57E-05	1.54E-06	2.77E-06	2.50E-05	6.36E-06
particulates (unspecified)	Air	kg	6.41E-05	1.03E-05	6.99E-07	5.17E-05	1.39E-06
Pendimethalin (C13H19N3O4)	Air	kg	9.12E-11	7.40E-27	-3.74E-27	9.12E-11	-1.16E-26
Permethrin (C21H20Cl2O3)	Air	kg	8.20E-12	6.66E-28	-3.37E-28	8.20E-12	-1.05E-27
Phenanthrene (C14H10)	Air	kg	1.23E-11	8.67E-12	5.57E-13	2.81E-12	2.96E-13
Phenol (C6H5OH)	Air	kg	2.47E-09	8.37E-11	2.64E-11	2.31E-09	5.11E-11
Phorate (C7H17O2PS3)	Air	kg	4.20E-12	3.41E-28	-1.72E-28	4.20E-12	-5.35E-28
Phosphate	Air	kg	4.95E-12	1.02E-22	-3.18E-23	4.95E-12	-9.83E-25
Polycyclic Aromatic Hydrocarbons (PAH, unspecif.)	Air	kg	2.32E-10	2.85E-11	6.86E-11	1.26E-10	8.64E-12
Propionaldehyde (CH3CH2CHO)	Air	kg	2.28E-10	2.82E-12	3.41E-12	2.22E-10	3.07E-13
Propylene (CH2CHCH3)	Air	kg	3.35E-09	4.36E-10	1.04E-09	1.75E-09	1.33E-10
propyleneoxide	Air	kg	1.74E-11	2.31E-12	1.49E-11	1.19E-13	-4.14E-28
Pyrene (C16H10)	Air	kg	1.50E-12	1.05E-12	6.77E-14	3.42E-13	3.60E-14
Radioactive Substance (unspecified)	Air	Bq	22237.654	3270.7707	4905.82	11353.038	2708.0253
Selenium (Se)	Air	kg	5.94E-09	4.05E-09	2.77E-10	1.46E-09	1.49E-10
Simazine (C7H12ClN5)	Air	kg	5.76E-11	4.67E-27	-2.36E-27	5.76E-11	-7.34E-27
Styrene (C6H5CHCH2)	Air	kg	1.50E-11	1.86E-13	2.24E-13	1.46E-11	2.02E-14
Sulfur Oxides (SOx as SO2)	Air	kg	0.0007936	0.000215813	0.00039255	0.000162265	2.30E-05
Terbufos (C9H21O2PS3)	Air	kg	1.43E-10	1.16E-26	-5.89E-27	1.43E-10	-1.83E-26
Tetrachloroethylene (C2Cl4)	Air	kg	1.97E-10	1.37E-10	9.26E-12	4.52E-11	5.64E-12
Toluene (C6H5CH3)	Air	kg	1.79E-06	4.25E-07	1.36E-06	-1.68E-08	2.07E-08
total reduced sulfur	Air	kg	1.20E-07	-1.71E-40	-3.06E-40	1.20E-07	-6.25E-41
Trichloroethane (1,1,1-CH3CCl3)	Air	kg	1.25E-11	1.64E-13	1.97E-13	1.17E-11	4.35E-13
Vinyl Acetate (C4H6O2)	Air	kg	4.56E-12	5.64E-14	6.81E-14	4.43E-12	6.14E-15

Overall system for canned green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (canned)	GB Canning (canned)	GB Packaging (canned)	GB Transport to customer (canned)
Xylene (C6H4(CH3)2)	Air	kg	1.79E-06	4.25E-07	1.36E-06	-1.70E-08	2.07E-08
Zinc (Zn)	Air	kg	3.20E-07	4.07E-12	1.71E-12	3.20E-07	5.38E-13
1-Methylfluorene	Water	kg	1.28E-11	2.55E-12	8.05E-12	2.34E-13	1.92E-12
2-Hexanone	Water	kg	7.32E-10	1.46E-10	4.62E-10	1.34E-11	1.10E-10
2-Methylnaphthalene	Water	kg	1.78E-09	3.55E-10	1.12E-09	3.26E-11	2.68E-10
2,4-Dimethylphenol	Water	kg	3.14E-09	6.28E-10	1.98E-09	5.76E-11	4.74E-10
2,4 - D (C8H6Cl2O3)	Water	kg	3.44E-12	2.79E-28	-1.41E-28	3.44E-12	-4.38E-28
4-Methyl-2-Pentanone	Water	kg	4.71E-10	9.43E-11	2.97E-10	8.65E-12	7.10E-11
Acetochlor (C14H20ClNO2)	Water	kg	4.75E-11	3.86E-27	-1.95E-27	4.75E-11	-6.06E-27
Acetone	Water	kg	1.12E-09	2.24E-10	7.07E-10	2.06E-11	1.69E-10
Acids (H+)	Water	kg	6.29E-08	3.93E-25	-1.99E-25	6.29E-08	-6.17E-25
Alachlor (C14H20ClNO2)	Water	kg	4.67E-12	3.79E-28	-1.92E-28	4.67E-12	-5.96E-28
Alkylated benzenes	Water	kg	1.89E-09	2.43E-10	7.21E-10	1.36E-10	7.89E-10
Alkylated fluorenes	Water	kg	1.09E-10	1.41E-11	4.18E-11	7.88E-12	4.57E-11
Alkylated naphthalenes	Water	kg	3.10E-11	3.98E-12	1.18E-11	2.23E-12	1.29E-11
Alkylated phenanthrenes	Water	kg	1.28E-11	1.65E-12	4.90E-12	9.23E-13	5.36E-12
Aluminum (Al3+)	Water	kg	4.00E-06	4.55E-07	1.35E-06	7.54E-07	1.44E-06
Ammonia (NH4+, NH3, as N)	Water	kg	2.25E-06	2.80E-07	8.77E-07	7.79E-07	3.16E-07
Ammonium, ion	Water	kg	2.21E-07	-3.23E-24	-6.76E-22	2.21E-07	-1.44E-23
Antimony (Sb++)	Water	kg	2.16E-09	2.78E-10	8.25E-10	1.55E-10	9.00E-10
AOX (Adsorbable Organic Halogens)	Water	kg	1.05E-11	-1.54E-28	-3.22E-26	1.05E-11	-6.87E-28
Aromatic Hydrocarbons (unspecified)	Water	kg	2.37E-09	-3.46E-26	-7.23E-24	2.37E-09	-1.55E-25
Arsenic (As3+, As5+)	Water	kg	2.60E-08	4.99E-09	1.57E-08	6.70E-10	4.62E-09
Atrazine (C8H14ClN5)	Water	kg	9.27E-11	7.53E-27	-3.81E-27	9.27E-11	-1.18E-26
Barium (Ba++)	Water	kg	5.08E-05	6.92E-06	2.08E-05	3.37E-06	1.98E-05
Bentazon	Water	kg	3.78E-13	3.07E-29	-1.55E-29	3.78E-13	-4.82E-29
Benzene (C6H6)	Water	kg	1.88E-07	3.76E-08	1.19E-07	3.45E-09	2.84E-08

Overall system for canned green beans - per 4 oz green beans							
Substance	**Compartment**	**Unit**	**Total**	**GB processing (canned)**	**GB Canning (canned)**	**GB Packaging (canned)**	**GB Transport to customer (canned)**
Benzoic acid	Water	kg	1.14E-07	2.28E-08	7.18E-08	2.09E-09	1.71E-08
Beryllium (Be)	Water	kg	1.23E-09	2.28E-10	7.12E-10	3.68E-11	2.56E-10
Biphenyl (1,1-C12H10)	Water	kg	1.22E-10	1.57E-11	4.67E-11	8.80E-12	5.11E-11
BOD5 (Biochemical Oxygen Demand)	Water	kg	0.015683403	0.015568578	1.23E-05	9.94E-05	3.09E-06
Boron (B III)	Water	kg	3.52E-07	7.04E-08	2.22E-07	6.46E-09	5.31E-08
Bromide	Water	kg	2.40E-05	4.81E-06	1.52E-05	4.41E-07	3.62E-06
Bromoxynil (C7H3Br2NO)	Water	kg	5.00E-13	4.06E-29	-2.05E-29	5.00E-13	-6.38E-29
Cadmium (Cd++)	Water	kg	5.22E-09	7.28E-10	2.28E-09	1.52E-09	6.82E-10
Calcium (Ca++)	Water	kg	0.000360386	7.21E-05	0.000227361	6.61E-06	5.43E-05
Carbofuran (C12H15NO3)	Water	kg	7.09E-13	5.75E-29	-2.91E-29	7.09E-13	-9.04E-29
Chlorides (Cl-)	Water	kg	0.004110808	0.000810421	0.002555311	0.000134523	0.000610552
Chlorpyrifos (C9H11Cl3NO3PS)	Water	kg	5.45E-12	4.42E-28	-2.24E-28	5.45E-12	-6.95E-28
Chromium (Cr III, Cr VI)	Water	kg	1.01E-07	1.25E-08	3.72E-08	1.09E-08	4.09E-08
Chromium (Cr VI)	Water	kg	1.99E-10	5.69E-12	6.57E-12	2.93E-11	1.58E-10
Cobalt (Co I, Co II, Co III)	Water	kg	2.48E-09	4.97E-10	1.57E-09	4.56E-11	3.75E-10
COD (Chemical Oxygen Demand)	Water	kg	8.54E-05	6.49E-06	2.04E-05	5.26E-05	5.87E-06
Copper (Cu+, Cu++)	Water	kg	1.98E-08	3.27E-09	1.01E-08	1.68E-09	4.73E-09
Cresol (C6H4OHCH3)	Water	kg	6.71E-09	1.34E-09	4.23E-09	1.23E-10	1.01E-09
Cyanazine (C9H13ClN6)	Water	kg	8.17E-13	6.63E-29	-3.36E-29	8.17E-13	-1.04E-28
Cyanide (CN-)	Water	kg	1.94E-11	1.62E-12	5.11E-12	1.14E-11	1.22E-12
Dibenzofuran	Water	kg	2.13E-11	4.27E-12	1.34E-11	3.91E-13	3.21E-12
Dibenzothiophene	Water	kg	1.73E-11	3.46E-12	1.09E-11	3.17E-13	2.60E-12
Dicamba (C8H6Cl2O3)	Water	kg	4.81E-12	3.91E-28	-1.98E-28	4.81E-12	-6.14E-28
Dimethenamid (C12H18ClNO2S)	Water	kg	1.14E-11	9.24E-28	-4.67E-28	1.14E-11	-1.45E-27
Dissolved Matter (unspecified)	Water	kg	0.005016605	0.00100028	0.003152333	0.000110948	0.000753045
Dissolved Organic Carbon (DOC)	Water	kg	6.80E-10	-9.95E-27	-2.08E-24	6.80E-10	-4.44E-26
Disulfoton (C8H19O2PS3)	Water	kg	2.80E-13	2.27E-29	-1.15E-29	2.80E-13	-3.57E-29

Overall system for canned green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (canned)	GB Canning (canned)	GB Packaging (canned)	GB Transport to customer (canned)
Diuron (C9H10Cl2N2O)	Water	kg	7.88E-14	6.40E-30	-3.24E-30	7.88E-14	-1.00E-29
EPTC (C9H19NOS)	Water	kg	4.71E-12	3.82E-28	-1.93E-28	4.71E-12	-6.00E-28
Ethyl Benzene (C6H5C2H5)	Water	kg	1.06E-08	2.12E-09	6.68E-09	1.94E-10	1.60E-09
Fluorides (F-)	Water	kg	2.92E-08	2.35E-10	3.83E-10	2.84E-08	2.20E-10
Glyphosate (C3H8NO5P)	Water	kg	1.02E-11	8.31E-28	-4.20E-28	1.02E-11	-1.30E-27
Hexanoic acid	Water	kg	2.36E-08	4.71E-09	1.49E-08	4.32E-10	3.55E-09
Hydrocarbons (unspecified)	Water	kg	5.44E-11	x	x	5.44E-11	x
Hydrocarbons, chlorinated	Water	kg	3.05E-12	-4.46E-29	-9.33E-27	3.05E-12	-1.99E-28
Iron (Fe++, Fe3+)	Water	kg	1.21E-05	1.43E-06	4.19E-06	3.62E-06	2.88E-06
Kjeldahl-N	Water	kg	9.77E-10	-1.43E-26	-2.99E-24	9.77E-10	-6.38E-26
Lead (Pb++, Pb4+)	Water	kg	5.34E-08	7.28E-09	2.27E-08	1.38E-08	9.66E-09
Lead 210	Water	kg	1.17E-17	2.33E-18	7.35E-18	2.14E-19	1.76E-18
Lithium	Water	kg	9.89E-05	2.35E-05	7.52E-05	-9.46E-07	1.16E-06
m-xylene (sea)	Water	kg	3.40E-09	6.80E-10	2.14E-09	6.23E-11	5.12E-10
Magnesium (Mg++)	Water	kg	7.05E-05	1.41E-05	4.44E-05	1.29E-06	1.06E-05
Manganese (Mn II, Mn IV, Mn VII)	Water	kg	1.66E-07	5.87E-08	7.45E-08	1.46E-08	1.83E-08
MCPA	Water	kg	6.41E-14	5.20E-30	-2.63E-30	6.41E-14	-8.17E-30
Mercury (Hg+, Hg++)	Water	kg	5.44E-11	5.06E-12	1.45E-11	1.91E-11	1.58E-11
Metallic ions, unspecified	Water	kg	1.91E-08	-2.80E-25	-5.85E-23	1.91E-08	-1.25E-24
Metals (unspecified)	Water	kg	1.03E-10	-4.91E-44	-8.77E-44	1.03E-10	-1.79E-44
Methychloride	Water	kg	4.51E-12	9.03E-13	2.85E-12	8.28E-14	6.80E-13
Methyl Ethyl Ketone (MEK, C4H8O)	Water	kg	9.03E-12	1.81E-12	5.69E-12	1.66E-13	1.36E-12
Methyl Parathion (C8H10NO5PS)	Water	kg	5.74E-13	4.66E-29	-2.36E-29	5.74E-13	-7.32E-29
Metolachlor (C15H22ClNO2)	Water	kg	3.76E-11	3.05E-27	-1.54E-27	3.76E-11	-4.80E-27
Metribuzin (C8H14N4OS)	Water	kg	1.75E-13	1.42E-29	-7.18E-30	1.75E-13	-2.23E-29
Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	Water	kg	2.58E-09	5.16E-10	1.63E-09	4.73E-11	3.89E-10
n-Decane	Water	kg	3.27E-09	6.54E-10	2.06E-09	6.00E-11	4.93E-10

Overall system for canned green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (canned)	GB Canning (canned)	GB Packaging (canned)	GB Transport to customer (canned)
n-Docosane	Water	kg	1.20E-10	2.40E-11	7.57E-11	2.20E-12	1.81E-11
n-Dodecane	Water	kg	6.20E-09	1.24E-09	3.91E-09	1.14E-10	9.35E-10
n-Eicosane	Water	kg	1.71E-09	3.42E-10	1.08E-09	3.13E-11	2.57E-10
n-Hexacosane	Water	kg	7.49E-11	1.50E-11	4.72E-11	1.37E-12	1.13E-11
n-Hexadecane	Water	kg	6.77E-09	1.35E-09	4.27E-09	1.24E-10	1.02E-09
n-Octadecane	Water	kg	1.67E-09	3.35E-10	1.05E-09	3.07E-11	2.52E-10
n-Tetradecane	Water	kg	2.72E-09	5.44E-10	1.71E-09	4.99E-11	4.10E-10
Naphthalene (C10H8)	Water	kg	2.04E-09	4.07E-10	1.28E-09	3.76E-11	3.08E-10
Nickel (Ni++, Ni3+)	Water	kg	2.71E-08	3.98E-09	1.24E-08	6.16E-09	4.54E-09
Nitrate (NO3-)	Water	kg	1.50E-07	1.26E-09	1.99E-09	1.45E-07	1.10E-09
Nitrogenous Matter (unspecified, as N)	Water	kg	1.15E-06	2.68E-11	4.24E-11	1.15E-06	2.34E-11
Oils (unspecified)	Water	kg	2.84E-06	4.46E-07	1.36E-06	6.46E-07	3.88E-07
Organic Dissolved Matter (unspecified)	Water	kg	6.80E-11	x	x	6.80E-11	x
p-Cymene	Water	kg	1.12E-11	2.24E-12	7.07E-12	2.06E-13	1.69E-12
Paraquat (C12H14N2)	Water	kg	7.60E-13	6.17E-29	-3.12E-29	7.60E-13	-9.69E-29
Pendimethalin (C13H19N3O4)	Water	kg	3.92E-12	3.18E-28	-1.61E-28	3.92E-12	-4.99E-28
Pentamethylbenzene	Water	kg	8.40E-12	1.68E-12	5.30E-12	1.54E-13	1.27E-12
Permethrin (C21H20Cl2O3)	Water	kg	3.51E-13	2.85E-29	-1.44E-29	3.51E-13	-4.48E-29
Phenanthrene (C14H10)	Water	kg	1.75E-11	2.96E-12	9.17E-12	7.26E-13	4.66E-12
Phenol (C6H5OH)	Water	kg	5.80E-08	1.01E-08	3.17E-08	7.76E-09	8.51E-09
Phorate (C7H17O2PS3)	Water	kg	1.09E-13	8.82E-30	-4.46E-30	1.09E-13	-1.39E-29
Phosphates (PO4 3-, HPO4--, H2PO4-, H3PO4, as P)	Water	kg	5.48E-07	4.26E-19	-1.33E-19	5.48E-07	-4.13E-21
Phosphorus (P)	Water	kg	1.40E-07	1.33E-23	-6.71E-24	1.40E-07	-2.08E-23
Polycyclic Aromatic Hydrocarbons (PAH, unspecif.)	Water	kg	3.50E-11	-5.12E-28	-1.07E-25	3.50E-11	-2.29E-27
Radioactive Substance (unspecified)	Water	Bq	143.08027	20.106987	31.791258	73.632962	17.54906
Radium 226	Water	kg	4.05E-15	8.11E-16	2.56E-15	7.44E-17	6.11E-16
Radium 228	Water	kg	2.07E-17	4.15E-18	1.31E-17	3.80E-19	3.13E-18

Overall system for canned green beans - per 4 oz green beans							
Substance	**Compartment**	**Unit**	**Total**	**GB processing (canned)**	**GB Canning (canned)**	**GB Packaging (canned)**	**GB Transport to customer (canned)**
Salts (unspecified)	Water	kg	7.38E-07	7.38E-07	x	x	x
Selenium (Se II, Se IV, Se VI)	Water	kg	6.01E-10	8.00E-11	2.03E-10	1.22E-10	1.96E-10
Silver (Ag+)	Water	kg	2.35E-07	4.70E-08	1.48E-07	4.33E-09	3.55E-08
Simazine (C7H12ClN5)	Water	kg	2.46E-12	2.00E-28	-1.01E-28	2.46E-12	-3.14E-28
Sodium (Na+)	Water	kg	0.001142343	0.000228561	0.000720669	2.10E-05	0.000172159
Sodium dichromate	Water	kg	8.10E-14	4.45E-28	-2.25E-28	8.10E-14	-7.00E-28
Strontium (Sr II)	Water	kg	6.11E-06	1.22E-06	3.86E-06	1.12E-07	9.22E-07
Sulfate (SO4--)	Water	kg	1.15E-05	1.77E-06	5.39E-06	3.02E-06	1.33E-06
Sulfide (S--)	Water	kg	5.19E-07	4.69E-11	3.35E-11	5.18E-07	8.03E-10
Sulfurated Matter (unspecified, as S)	Water	kg	2.97E-07	5.94E-08	1.87E-07	5.45E-09	4.48E-08
Surfactants	Water	kg	1.08E-07	2.23E-08	7.04E-08	1.57E-09	1.43E-08
Suspended Matter (unspecified)	Water	kg	0.000394356	0.00023194	4.63E-05	7.18E-05	4.43E-05
Terbufos (C9H21O2PS3)	Water	kg	3.72E-12	3.02E-28	-1.53E-28	3.72E-12	-4.74E-28
Thallium	Water	kg	4.55E-10	5.87E-11	1.74E-10	3.26E-11	1.90E-10
Tin (Sn++, Sn4+)	Water	kg	1.46E-08	2.54E-09	7.86E-09	5.64E-10	3.68E-09
Titanium (Ti3+, Ti4+)	Water	kg	3.31E-08	4.27E-09	1.27E-08	2.38E-09	1.38E-08
TOC (Total Organic Carbon)	Water	kg	1.14E-06	-1.66E-23	-3.47E-21	1.14E-06	-7.42E-23
Toluene (C6H5CH3)	Water	kg	1.78E-07	3.56E-08	1.12E-07	3.59E-09	2.68E-08
Vanadium (V3+, V5+)	Water	kg	3.04E-09	6.09E-10	1.92E-09	5.59E-11	4.59E-10
waste water (vol)	Water	m3	0.0028397	0.0028397	x	x	x
Waste water/m3	Water	m3	1.63E-11	-2.39E-28	-5.00E-26	1.63E-11	-1.07E-27
Xylene (C6H4(CH3)2)	Water	kg	8.97E-08	1.80E-08	5.66E-08	1.65E-09	1.35E-08
Xylene (o-C6H4(CH3)2)	Water	kg	2.47E-09	4.95E-10	1.56E-09	4.54E-11	3.73E-10
Yttrium	Water	kg	7.56E-10	1.51E-10	4.77E-10	1.39E-11	1.14E-10
Zinc (Zn++)	Water	kg	1.07E-07	1.20E-08	3.60E-08	2.56E-08	3.33E-08
Overburden from mining	Waste	kg	0.000131203	1.85E-05	2.92E-05	6.74E-05	1.61E-05
Recovered material	Waste	kg	0.000339306	0.000198856	1.35E-05	0.000120106	6.81E-06

Overall system for canned green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (canned)	GB Canning (canned)	GB Packaging (canned)	GB Transport to customer (canned)
Waste (hazardous)	Waste	kg	2.39E-08	1.47E-24	-8.45E-23	2.39E-08	-3.91E-24
Waste (mfg)	Waste	kg	0.031793786	0.002162227	0.000559929	0.028855364	0.000216267
Waste (total)	Waste	kg	0.03229887	0.002163148	0.000561042	0.029358314	0.000216367
Waste (unspecified, to incineration)	Waste	kg	7.48E-09	x	x	7.48E-09	x
Waste: Mineral (inert)	Waste	kg	1.03E-08	1.47E-24	-8.45E-23	1.03E-08	-3.91E-24
Waste: Slags and Ash (unspecified)	Waste	kg	0.00050504	9.21E-07	1.11E-06	0.000502906	1.00E-07
E Feedstock Energy	Non mat.	MJ	0.066773309	-0.002365563	-0.00759416	0.076812755	-7.97E-05
E Fuel Energy	Non mat.	MJ	2.4647097	0.48048365	0.84756603	0.9200391	0.21662093
E Non Renewable Energy	Non mat.	MJ	2.1658575	0.418939	0.83931556	0.69142405	0.21617892
E Renewable Energy	Non mat.	MJ	0.35632876	0.061473664	0.000655729	0.2938374	0.000361968
E Total Primary Energy	Non mat.	MJ	2.5337744	0.48041266	0.83997129	0.99684952	0.21654089
Land Use: Cropland (Conservation Tillage)	Non mat.	m2	2.26E-05	1.83E-21	-9.28E-22	2.26E-05	-2.88E-21
Land Use: Cropland (Conventional Tillage)	Non mat.	m2	2.48E-05	2.01E-21	-1.02E-21	2.48E-05	-3.16E-21
Land Use: Cropland (Reduced Tillage)	Non mat.	m2	1.52E-05	1.23E-21	-6.24E-22	1.52E-05	-1.94E-21

Overall system for frozen green beans - per 4 oz green beans									
Substance	**Compartment**	**Unit**	**Total**	**GB processing (frozen)**	**GB Blanching w/ electricity (frozen)**	**GB Freezing (frozen)**	**GB Packaging (frozen)**	**GB transport to user (frozen)**	**GB Frozen storage (frozen)**
Bauxite (Al2O3, ore)	Raw	kg	1.73E-08	x	x	x	1.73E-08	x	x
Clay (in ground)	Raw	kg	4.96E-08	x	x	x	4.96E-08	x	x
Coal (in ground)	Raw	kg	0.0558399	0.006206086	0.010099994	0.00454355	0.002166415	0.0002873	0.0325366
Green bean	Raw	kg	0.1517265	0.15172649	x	x	x	x	x
Iron (Fe, ore)	Raw	kg	1.95E-07	x	x	x	1.95E-07	x	x
Lignite (in ground)	Raw	kg	1.70E-06	x	x	x	1.70E-06	x	x
Limestone (CaCO3, in ground)	Raw	kg	2.40E-05	x	x	x	2.40E-05	x	x
Na2SO4	Raw	kg	2.72E-05	x	x	x	2.72E-05	x	x
Natural Gas (in ground)	Raw	kg	0.0439176	0.004955569	0.008093671	0.003640992	0.000828581	0.0003255	0.0260733
Oil (in ground)	Raw	kg	0.0083646	0.000160949	0.000255765	0.000115058	0.000980131	0.0060288	0.0008239
Potassium Chloride (KCl, as K2O, in ground)	Raw	kg	3.90E-07	x	x	x	3.90E-07	x	x
Sand (in ground)	Raw	kg	8.26E-08	x	x	x	8.26E-08	x	x
Sodium Chloride (NaCl, in ground or in sea)	Raw	kg	8.61E-05	7.97E-05	x	x	6.44E-06	x	x
Sulfur (S, in ground)	Raw	kg	1.45E-06	x	x	x	1.45E-06	x	x
Uranium (U, ore)	Raw	kg	1.13E-05	9.73E-07	1.20E-06	5.42E-07	3.56E-06	1.15E-06	3.88E-06
Water Used (total)	Raw	m3	0.0035069	0.002875519	0.000593614	x	3.78E-05	x	x
Water, river	Raw	m3	0.0028755	0.002875519	x	x	x	x	x
Water: River	Raw	m3	2.55E-07	x	x	x	2.55E-07	x	x
Water: Unspecified Origin	Raw	m3	0.0005936	x	0.000593614	x	3.67E-11	x	x
Water: Well	Raw	m3	1.48E-06	x	x	x	1.48E-06	x	x
wood	Raw	kg	0.005933	x	x	x	0.005933041	x	x
Wood scrap	Raw	kg	0.0012912	x	x	x	0.001291183	x	x
2,4 - D (C8H6Cl2O3)	Air	kg	8.04E-11	x	x	x	8.04E-11	x	x
Acenaphthene (C12H10)	Air	kg	1.45E-11	1.61E-12	2.63E-12	1.18E-12	5.32E-13	7.46E-14	8.46E-12
Acenaphthylene (C12H8)	Air	kg	7.24E-12	8.07E-13	1.31E-12	5.91E-13	2.63E-13	3.72E-14	4.23E-12
Acetaldehyde (CH3CHO)	Air	kg	3.89E-08	1.37E-10	1.71E-10	7.71E-11	3.79E-08	5.40E-11	5.52E-10

Overall system for frozen green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (frozen)	GB Blanching w/ electricity (frozen)	GB Freezing (frozen)	GB Packaging (frozen)	GB transport to user (frozen)	GB Frozen storage (frozen)
Acetochlor (C14H20ClNO2)	Air	kg	1.11E-09	x	x	x	1.11E-09	x	x
Acetophenone (C8H8O)	Air	kg	9.22E-12	1.12E-13	4.89E-14	2.20E-14	8.87E-12	1.64E-14	1.58E-13
Acrolein (CH2CHCHO)	Air	kg	1.87E-07	9.46E-10	1.53E-09	6.90E-10	1.79E-07	4.93E-11	4.94E-09
Alachlor (C14H20ClNO2)	Air	kg	1.10E-10	x	x	x	1.10E-10	x	x
Aldehyde (unspecified)	Air	kg	3.68E-07	9.51E-09	1.52E-08	6.86E-09	4.22E-08	2.45E-07	4.91E-08
Ammonia (NH3)	Air	kg	4.09E-07	3.30E-09	5.23E-09	2.35E-09	2.59E-07	1.22E-07	1.68E-08
Ammonium chloride	Air	kg	1.05E-09	8.99E-11	1.11E-10	5.01E-11	3.29E-10	1.06E-10	3.59E-10
Anthracene (C14H10)	Air	kg	6.12E-12	6.82E-13	1.11E-12	5.00E-13	2.21E-13	3.15E-14	3.58E-12
Antimony (Sb)	Air	kg	8.55E-10	5.59E-11	9.09E-11	4.09E-11	3.71E-10	2.59E-12	2.93E-10
Aromatic Hydrocarbons (unspecified)	Air	kg	2.48E-08	x	x	x	2.48E-08	x	x
Arsenic (As)	Air	kg	1.29E-08	1.33E-09	2.17E-09	9.75E-10	1.37E-09	8.47E-11	6.98E-09
Atrazine (C8H14ClN5)	Air	kg	2.18E-09	x	x	x	2.18E-09	x	x
Bentazon	Air	kg	8.86E-12	x	x	x	8.86E-12	x	x
Benzene (C6H6)	Air	kg	4.03E-06	4.31E-07	7.03E-07	3.16E-07	2.85E-07	2.83E-08	2.26E-06
Benzo(a)anthracene	Air	kg	2.23E-12	2.48E-13	4.04E-13	1.82E-13	8.27E-14	1.15E-14	1.30E-12
Benzo(a)pyrene (C20H12)	Air	kg	1.06E-12	1.18E-13	1.92E-13	8.63E-14	3.93E-14	5.46E-15	6.18E-13
Benzo(bjk)fluoranthene	Air	kg	3.07E-12	3.41E-13	5.55E-13	2.50E-13	1.14E-13	1.58E-14	1.79E-12
Benzo(g,h,i)perylene (C22H12)	Air	kg	7.80E-13	8.69E-14	1.41E-13	6.36E-14	2.83E-14	4.01E-15	4.55E-13
Benzyl Chloride (C7H7Cl)	Air	kg	4.30E-10	5.20E-12	2.28E-12	1.03E-12	4.14E-10	7.65E-13	7.35E-12
Beryllium (Be)	Air	kg	6.99E-10	7.27E-11	1.18E-10	5.32E-11	6.93E-11	4.24E-12	3.81E-10
Biphenyl (1,1-C12H10)	Air	kg	4.74E-11	5.28E-12	8.58E-12	3.86E-12	1.76E-12	2.44E-13	2.77E-11
Bromoform (CHBr3)	Air	kg	2.40E-11	2.90E-13	1.27E-13	5.72E-14	2.31E-11	4.26E-14	4.10E-13
Bromoxynil (C7H3Br2NO)	Air	kg	1.94E-11	x	x	x	1.94E-11	x	x
Butadiene (1,3-CH2CHCHCH2)	Air	kg	7.65E-11	6.64E-12	8.64E-12	3.89E-12	2.68E-11	2.72E-12	2.78E-11
Cadmium (Cd)	Air	kg	2.74E-09	2.84E-10	4.63E-10	2.08E-10	2.73E-10	2.07E-11	1.49E-09
Carbofuran (C12H15NO3)	Air	kg	1.66E-11	x	x	x	1.66E-11	x	x
Carbon Dioxide (CO2, biomass)	Air	kg	0.0086225	x	x	x	0.008622543	x	x

Overall system for frozen green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (frozen)	GB Blanching w/ electricity (frozen)	GB Freezing (frozen)	GB Packaging (frozen)	GB transport to user (frozen)	GB Frozen storage (frozen)
Carbon Dioxide (CO2, fossil)	Air	kg	0.2690581	0.027737618	0.045068572	0.020274401	0.008822901	0.0219687	0.1451859
Carbon Disulfide (CS2)	Air	kg	7.99E-11	9.67E-13	4.24E-13	1.91E-13	7.69E-11	1.42E-13	1.37E-12
Carbon Monoxide (CO)	Air	kg	0.0002941	1.46E-05	2.36E-05	1.06E-05	5.79E-05	0.0001114	7.60E-05
Carbon Tetrachloride (CCl4)	Air	kg	2.01E-09	1.81E-15	2.88E-15	1.30E-15	2.01E-09	6.80E-14	9.29E-15
CFC 12 (CCl2F2)	Air	kg	8.65E-13	1.79E-14	2.85E-14	1.28E-14	4.23E-14	6.72E-13	9.18E-14
Chlorine (Cl2)	Air	kg	3.53E-08	3.87E-11	x	x	3.53E-08	x	x
Chloroacetophenone (2-C8H7ClO)	Air	kg	4.30E-12	5.20E-14	2.28E-14	1.03E-14	4.14E-12	7.65E-15	7.35E-14
Chlorobenzene (C6H5Cl)	Air	kg	1.35E-11	1.64E-13	7.17E-14	3.23E-14	1.30E-11	2.40E-14	2.31E-13
Chloroform (CHCl3, HC-20)	Air	kg	3.63E-11	4.39E-13	1.92E-13	8.65E-14	3.49E-11	6.45E-14	6.20E-13
Chlorpyrifos (C9H11Cl3NO3PS)	Air	kg	1.28E-10	x	x	x	1.28E-10	x	x
Chromium (Cr III, Cr VI)	Air	kg	9.53E-09	9.62E-10	1.57E-09	7.05E-10	1.19E-09	5.99E-11	5.05E-09
Chromium (Cr VI)	Air	kg	2.23E-09	2.48E-10	4.04E-10	1.82E-10	8.21E-11	1.15E-11	1.30E-09
Chrysene (C18H12)	Air	kg	2.79E-12	3.10E-13	5.05E-13	2.27E-13	1.03E-13	1.44E-14	1.63E-12
Cobalt (Co)	Air	kg	3.41E-09	3.34E-10	5.41E-10	2.43E-10	4.32E-10	1.19E-10	1.74E-09
Copper (Cu)	Air	kg	5.62E-11	6.16E-12	1.00E-11	4.51E-12	2.11E-12	1.10E-12	3.23E-11
Cumene (C9H12)	Air	kg	3.26E-12	3.94E-14	1.73E-14	7.77E-15	3.13E-12	5.79E-15	5.57E-14
Cyanazine (C9H13ClN6)	Air	kg	1.91E-11	x	x	x	1.91E-11	x	x
Cyanide (CN-)	Air	kg	1.54E-09	1.86E-11	8.15E-12	3.67E-12	1.48E-09	2.73E-12	2.63E-11
Di(2-ethylhexyl)phthalate (DEHP, C24H38O4)	Air	kg	4.49E-11	5.43E-13	2.38E-13	1.07E-13	4.32E-11	7.98E-14	7.67E-13
Dicamba (C8H6Cl2O3)	Air	kg	1.13E-10	x	x	x	1.13E-10	x	x
Dimethenamid (C12H18ClNO2S)	Air	kg	2.66E-10	x	x	x	2.66E-10	x	x
Dimethyl Sulfate (C2H6O4S)	Air	kg	2.95E-11	3.57E-13	1.56E-13	7.04E-14	2.84E-11	5.24E-14	5.04E-13
Dinitrotoluene (2,4-C7H6N2O4)	Air	kg	1.72E-13	2.08E-15	9.13E-16	4.11E-16	1.66E-13	3.06E-16	2.94E-15
Dioxins (unspecified)	Air	kg	7.45E-11	2.55E-15	4.15E-15	1.87E-15	7.44E-11	3.80E-16	1.34E-14
EPTC (C9H19NOS)	Air	kg	1.82E-10	x	x	x	1.82E-10	x	x
Ethyl Benzene (C6H5C2H5)	Air	kg	3.74E-06	4.26E-07	6.95E-07	3.13E-07	3.96E-08	2.80E-08	2.24E-06
Ethyl Chloride (C2H5Cl)	Air	kg	2.58E-11	3.12E-13	1.37E-13	6.16E-14	2.48E-11	4.59E-14	4.41E-13

Overall system for frozen green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (frozen)	GB Blanching w/ electricity (frozen)	GB Freezing (frozen)	GB Packaging (frozen)	GB transport to user (frozen)	GB Frozen storage (frozen)
Ethylene Dibromide (C2H4Br2)	Air	kg	7.38E-13	8.92E-15	3.91E-15	1.76E-15	7.09E-13	1.31E-15	1.26E-14
Ethylene Dichloride (C2H4Cl2)	Air	kg	2.46E-11	2.97E-13	1.30E-13	5.87E-14	2.36E-11	4.37E-14	4.20E-13
Fluoranthene	Air	kg	2.01E-11	2.23E-12	3.64E-12	1.64E-12	7.38E-13	1.03E-13	1.17E-11
Fluorene (C13H10)	Air	kg	2.56E-11	2.85E-12	4.65E-12	2.09E-12	9.45E-13	1.32E-13	1.50E-11
Fluorides (F-)	Air	kg	2.74E-08	3.32E-10	1.45E-10	6.54E-11	2.64E-08	4.87E-11	4.68E-10
Formaldehyde (CH2O)	Air	kg	2.82E-07	9.20E-09	1.48E-08	6.66E-09	2.02E-07	1.09E-09	4.77E-08
Furan (C4H4O)	Air	kg	1.36E-13	1.54E-14	2.52E-14	1.13E-14	2.03E-15	6.52E-16	8.11E-14
Glyphosate (C3H8NO5P)	Air	kg	2.39E-10	x	x	x	2.39E-10	x	x
Hexane (C6H14)	Air	kg	4.12E-11	4.98E-13	2.18E-13	9.83E-14	3.96E-11	7.32E-14	7.04E-13
Hydrocarbons (except methane)	Air	kg	2.01E-05	7.42E-07	1.13E-06	5.07E-07	9.72E-07	1.32E-05	3.63E-06
Hydrocarbons (unspecified)	Air	kg	5.19E-05	5.01E-06	7.79E-06	3.51E-06	3.34E-06	7.15E-06	2.51E-05
Hydrogen Chloride (HCl)	Air	kg	3.41E-05	3.73E-06	6.07E-06	2.73E-06	1.80E-06	1.85E-07	1.96E-05
Hydrogen Fluoride (HF)	Air	kg	4.16E-06	4.65E-07	7.57E-07	3.41E-07	1.31E-07	2.15E-08	2.44E-06
Indeno (1,2,3,c,d) Pyrene	Air	kg	1.73E-12	1.92E-13	3.13E-13	1.41E-13	6.35E-14	8.89E-15	1.01E-12
Isophorone	Air	kg	3.57E-10	4.31E-12	1.89E-12	8.51E-13	3.43E-10	6.34E-13	6.09E-12
Kerosene	Air	kg	1.88E-09	1.62E-10	2.00E-10	9.01E-11	5.92E-10	1.91E-10	6.45E-10
Lead (Pb)	Air	kg	1.64E-08	1.39E-09	2.24E-09	1.01E-09	4.46E-09	9.39E-11	7.21E-09
Magnesium (Mg)	Air	kg	3.07E-07	3.41E-08	5.55E-08	2.50E-08	1.14E-08	1.58E-09	1.79E-07
Manganese (Mn)	Air	kg	8.58E-08	1.60E-09	2.61E-09	1.18E-09	7.18E-08	1.27E-10	8.41E-09
MCPA	Air	kg	1.50E-12	x	x	x	1.50E-12	x	x
Mercaptans, unspecified	Air	kg	1.33E-07	1.61E-09	7.04E-10	3.17E-10	1.28E-07	2.36E-10	2.27E-09
Mercury (Hg)	Air	kg	3.81E-09	3.65E-10	4.79E-10	2.16E-10	1.18E-09	1.72E-11	1.54E-09
Metals (unspecified)	Air	kg	1.90E-06	1.93E-11	x	x	1.90E-06	x	x
Methane (CH4)	Air	kg	0.0008787	9.61E-05	0.000156455	7.04E-05	2.40E-05	2.78E-05	0.000504
Methyl Bromide (CH3Br)	Air	kg	9.84E-11	1.19E-12	5.22E-13	2.35E-13	9.46E-11	1.75E-13	1.68E-12
Methyl Chloride (CH3Cl)	Air	kg	3.26E-10	3.94E-12	1.73E-12	7.77E-13	3.13E-10	5.79E-13	5.57E-12
Methyl Chrysene (5-C19H15)	Air	kg	6.13E-13	6.83E-14	1.11E-13	5.00E-14	2.28E-14	3.16E-15	3.58E-13

Overall system for frozen green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (frozen)	GB Blanching w/ electricity (frozen)	GB Freezing (frozen)	GB Packaging (frozen)	GB transport to user (frozen)	GB Frozen storage (frozen)
Methyl Ethyl Ketone (MEK, C4H8O)	Air	kg	2.40E-10	2.90E-12	1.27E-12	5.72E-13	2.31E-10	4.26E-13	4.10E-12
Methyl Hydrazine (CH6N2)	Air	kg	1.05E-10	1.26E-12	5.54E-13	2.49E-13	1.01E-10	1.86E-13	1.79E-12
Methyl Methacrylate (CH2C(CH3)COOCH3)	Air	kg	1.23E-11	1.49E-13	6.52E-14	2.93E-14	1.18E-11	2.19E-14	2.10E-13
Methyl Parathion (C8H10NO5PS)	Air	kg	1.35E-11	x	x	x	1.35E-11	x	x
Methyl tert Butyl Ether (MTBE, C5H12O)	Air	kg	2.15E-11	2.60E-13	1.14E-13	5.13E-14	2.07E-11	3.82E-14	3.68E-13
Methylene Chloride (CH2Cl2, HC-130)	Air	kg	2.18E-08	9.76E-10	1.59E-09	7.14E-10	1.33E-08	1.32E-10	5.11E-09
Metolachlor (C15H22ClNO2)	Air	kg	8.80E-10	x	x	x	8.80E-10	x	x
Metribuzin (C8H14N4OS)	Air	kg	4.09E-12	x	x	x	4.09E-12	x	x
Naphthalene (C10H8)	Air	kg	5.32E-09	1.09E-10	1.77E-10	7.96E-11	4.36E-09	2.41E-11	5.70E-10
Nickel (Ni)	Air	kg	1.50E-08	1.31E-09	2.09E-09	9.42E-10	2.36E-09	1.52E-09	6.74E-09
Nitrogen	Air	kg	1.08E-10	1.66E-22	3.83E-23	6.13E-23	1.08E-10	-1.23E-23	3.19E-22
Nitrogen Oxides (NOx as NO2)	Air	kg	0.0006578	5.52E-05	8.89E-05	4.00E-05	3.77E-05	0.0001494	0.0002865
Nitrous Oxide (N2O)	Air	kg	1.61E-05	1.93E-08	2.98E-08	1.34E-08	1.55E-05	4.95E-07	9.59E-08
Organic Matter (unspecified)	Air	kg	4.51E-07	4.26E-11	6.88E-11	3.10E-11	4.51E-07	3.22E-12	2.22E-10
Paraquat (C12H14N2)	Air	kg	1.79E-11	x	x	x	1.79E-11	x	x
Particulates (PM 10)	Air	kg	4.08E-05	1.54E-06	2.47E-06	1.11E-06	2.51E-05	2.61E-06	7.97E-06
particulates (unspecified)	Air	kg	0.0001031	1.03E-05	1.65E-05	7.44E-06	1.36E-05	1.87E-06	5.33E-05
Pendimethalin (C13H19N3O4)	Air	kg	9.16E-11	x	x	x	9.16E-11	x	x
Permethrin (C21H20Cl2O3)	Air	kg	8.24E-12	x	x	x	8.24E-12	x	x
Phenanthrene (C14H10)	Air	kg	7.80E-11	8.69E-12	1.41E-11	6.36E-12	2.83E-12	4.01E-13	4.55E-11
Phenol (C6H5OH)	Air	kg	3.12E-09	8.39E-11	1.35E-10	6.06E-11	2.34E-09	6.91E-11	4.34E-10
Phorate (C7H17O2PS3)	Air	kg	4.21E-12	x	x	x	4.21E-12	x	x
Phosphate	Air	kg	4.97E-12	1.68E-22	-2.38E-23	-7.36E-24	4.97E-12	-8.94E-24	-5.76E-22
Polycyclic Aromatic Hydrocarbons (PAH, unspecif.)	Air	kg	3.29E-10	2.86E-11	3.71E-11	1.67E-11	1.15E-10	1.17E-11	1.20E-10
Propionaldehyde (CH3CH2CHO)	Air	kg	2.34E-10	2.83E-12	1.24E-12	5.57E-13	2.25E-10	4.15E-13	3.99E-12
Propylene (CH2CHCH3)	Air	kg	5.05E-09	4.37E-10	5.71E-10	2.57E-10	1.77E-09	1.80E-10	1.84E-09
propyleneoxide	Air	kg	2.39E-12	2.32E-12	x	x	7.62E-14	x	x

Overall system for frozen green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (frozen)	GB Blanching w/ electricity (frozen)	GB Freezing (frozen)	GB Packaging (frozen)	GB transport to user (frozen)	GB Frozen storage (frozen)
Pyrene (C16H10)	Air	kg	9.47E-12	1.05E-12	1.72E-12	7.72E-13	3.45E-13	4.87E-14	5.53E-12
Radioactive Substance (unspecified)	Air	Bq	37605.712	3276.8919	4126.5716	1856.366	11388.99	3663.3733	13293.519
Selenium (Se)	Air	kg	3.66E-08	4.05E-09	6.60E-09	2.97E-09	1.48E-09	2.01E-10	2.13E-08
Simazine (C7H12ClN5)	Air	kg	5.78E-11	x	x	x	5.78E-11	x	x
Styrene (C6H5CHCH2)	Air	kg	1.54E-11	1.86E-13	8.15E-14	3.67E-14	1.48E-11	2.73E-14	2.63E-13
Sulfur Oxides (SOx as SO2)	Air	kg	0.0019688	0.000216216	0.00035233	0.000158498	7.57E-05	3.11E-05	0.001135
Terbufos (C9H21O2PS3)	Air	kg	1.44E-10	x	x	x	1.44E-10	x	x
Tetrachloroethylene (C2Cl4)	Air	kg	1.23E-09	1.37E-10	2.23E-10	1.00E-10	4.55E-11	7.63E-12	7.20E-10
Toluene (C6H5CH3)	Air	kg	3.74E-06	4.26E-07	6.96E-07	3.13E-07	4.00E-08	2.80E-08	2.24E-06
total reduced sulfur	Air	kg	1.23E-07	x	x	x	1.23E-07	x	x
Trichloroethane (1,1,1-CH3CCl3)	Air	kg	1.30E-11	1.64E-13	8.92E-14	4.01E-14	1.19E-11	5.88E-13	2.87E-13
Vinyl Acetate (C4H6O2)	Air	kg	4.67E-12	5.65E-14	2.48E-14	1.11E-14	4.49E-12	8.30E-15	7.98E-14
Xylene (C6H4(CH3)2)	Air	kg	3.74E-06	4.26E-07	6.96E-07	3.13E-07	3.98E-08	2.80E-08	2.24E-06
Zinc (Zn)	Air	kg	4.08E-11	4.08E-12	6.64E-12	2.99E-12	4.95E-12	7.28E-13	2.14E-11
1-Methylfluorene	Water	kg	2.50E-11	2.56E-12	4.17E-12	1.88E-12	3.85E-13	2.60E-12	1.34E-11
2-Hexanone	Water	kg	1.44E-09	1.47E-10	2.40E-10	1.08E-10	2.21E-11	1.49E-10	7.72E-10
2-Methylnaphthalene	Water	kg	3.49E-09	3.56E-10	5.81E-10	2.61E-10	5.36E-11	3.62E-10	1.87E-09
2,4-Dimethylphenol	Water	kg	6.16E-09	6.30E-10	1.03E-09	4.62E-10	9.48E-11	6.41E-10	3.31E-09
2,4 - D (C8H6Cl2O3)	Water	kg	3.45E-12	x	x	x	3.45E-12	x	x
4-Methyl-2-Pentanone	Water	kg	9.25E-10	9.45E-11	1.54E-10	6.94E-11	1.42E-11	9.61E-11	4.97E-10
Acetochlor (C14H20ClNO2)	Water	kg	4.77E-11	x	x	x	4.77E-11	x	x
Acetone	Water	kg	2.20E-09	2.25E-10	3.67E-10	1.65E-10	3.38E-11	2.29E-10	1.18E-09
Acids (H+)	Water	kg	6.78E-08	x	x	x	6.78E-08	x	x
Alachlor (C14H20ClNO2)	Water	kg	4.69E-12	x	x	x	4.69E-12	x	x
Alkylated benzenes	Water	kg	3.25E-09	2.43E-10	3.96E-10	1.78E-10	8.62E-11	1.07E-09	1.28E-09
Alkylated fluorenes	Water	kg	1.88E-10	1.41E-11	2.30E-11	1.03E-11	5.00E-12	6.19E-11	7.40E-11
Alkylated naphthalenes	Water	kg	5.32E-11	3.99E-12	6.50E-12	2.92E-12	1.41E-12	1.75E-11	2.09E-11

Overall system for frozen green beans - per 4 oz green beans									
Substance	**Compartment**	**Unit**	**Total**	**GB processing (frozen)**	**GB Blanching w/ electricity (frozen)**	**GB Freezing (frozen)**	**GB Packaging (frozen)**	**GB transport to user (frozen)**	**GB Frozen storage (frozen)**
Alkylated phenanthrenes	Water	kg	2.21E-11	1.65E-12	2.69E-12	1.21E-12	5.86E-13	7.25E-12	8.68E-12
Aluminum (Al3+)	Water	kg	6.53E-06	4.55E-07	7.41E-07	3.33E-07	6.58E-07	1.95E-06	2.39E-06
Ammonia (NH4+, NH3, as N)	Water	kg	3.01E-06	2.81E-07	4.58E-07	2.06E-07	1.60E-07	4.28E-07	1.48E-06
Antimony (Sb++)	Water	kg	3.71E-09	2.78E-10	4.53E-10	2.04E-10	9.84E-11	1.22E-09	1.46E-09
Arsenic (As3+, As5+)	Water	kg	5.02E-08	5.00E-09	8.16E-09	3.67E-09	8.39E-10	6.25E-09	2.63E-08
Atrazine (C8H14ClN5)	Water	kg	9.31E-11	x	x	x	9.31E-11	x	x
Barium (Ba++)	Water	kg	8.87E-05	6.94E-06	1.13E-05	5.08E-06	2.23E-06	2.67E-05	3.64E-05
Bentazon	Water	kg	3.79E-13	x	x	x	3.79E-13	x	x
Benzene (C6H6)	Water	kg	3.69E-07	3.77E-08	6.15E-08	2.77E-08	5.67E-09	3.84E-08	1.98E-07
Benzoic acid	Water	kg	2.23E-07	2.28E-08	3.72E-08	1.67E-08	3.43E-09	2.32E-08	1.20E-07
Beryllium (Be)	Water	kg	2.36E-09	2.28E-10	3.72E-10	1.68E-10	4.13E-11	3.47E-10	1.20E-09
Biphenyl (1,1-C12H10)	Water	kg	2.10E-10	1.58E-11	2.57E-11	1.15E-11	5.58E-12	6.91E-11	8.27E-11
BOD5 (Biochemical Oxygen Demand)	Water	kg	0.0157329	0.015597714	6.40E-06	2.88E-06	0.000101164	4.18E-06	2.06E-05
Boron (B III)	Water	kg	6.91E-07	7.05E-08	1.15E-07	5.18E-08	1.06E-08	7.18E-08	3.71E-07
Bromide	Water	kg	4.72E-05	4.82E-06	7.86E-06	3.54E-06	7.25E-07	4.90E-06	2.53E-05
Bromoxynil (C7H3Br2NO)	Water	kg	5.02E-13	x	x	x	5.02E-13	x	x
Cadmium (Cd++)	Water	kg	7.34E-09	7.30E-10	1.19E-09	5.35E-10	1.28E-10	9.23E-10	3.83E-09
Calcium (Ca++)	Water	kg	0.0007074	7.22E-05	0.000117909	5.30E-05	1.09E-05	7.35E-05	0.0003798
Carbofuran (C12H15NO3)	Water	kg	7.12E-13	x	x	x	7.12E-13	x	x
Chlorides (Cl-)	Water	kg	0.0079505	0.000811938	0.001325184	0.000596143	0.000122288	0.0008259	0.004269
Chlorpyrifos (C9H11Cl3NO3PS)	Water	kg	5.47E-12	x	x	x	5.47E-12	x	x
Chromium (Cr III, Cr VI)	Water	kg	1.68E-07	1.25E-08	2.04E-08	9.19E-09	4.48E-09	5.53E-08	6.58E-08
Chromium (Cr VI)	Water	kg	2.75E-10	5.70E-12	9.05E-12	4.07E-12	1.34E-11	2.13E-10	2.92E-11
Cobalt (Co I, Co II, Co III)	Water	kg	4.88E-09	4.98E-10	8.13E-10	3.66E-10	7.49E-11	5.07E-10	2.62E-09
COD (Chemical Oxygen Demand)	Water	kg	0.0001098	6.50E-06	1.06E-05	4.77E-06	4.58E-05	7.94E-06	3.42E-05
Copper (Cu+, Cu++)	Water	kg	3.54E-08	3.28E-09	5.34E-09	2.40E-09	7.49E-10	6.40E-09	1.72E-08
Cresol (C6H4OHCH3)	Water	kg	1.32E-08	1.34E-09	2.19E-09	9.87E-10	2.02E-10	1.37E-09	7.07E-09

Overall system for frozen green beans - per 4 oz green beans									
Substance	**Compartment**	**Unit**	**Total**	**GB processing (frozen)**	**GB Blanching w/ electricity (frozen)**	**GB Freezing (frozen)**	**GB Packaging (frozen)**	**GB transport to user (frozen)**	**GB Frozen storage (frozen)**
Cyanazine (C9H13ClN6)	Water	kg	8.21E-13	x	x	x	8.21E-13	x	x
Cyanide (CN-)	Water	kg	1.64E-11	1.62E-12	2.65E-12	1.19E-12	7.46E-13	1.65E-12	8.53E-12
Dibenzofuran	Water	kg	4.18E-11	4.27E-12	6.98E-12	3.14E-12	6.43E-13	4.35E-12	2.25E-11
Dibenzothiophene	Water	kg	3.39E-11	3.46E-12	5.65E-12	2.54E-12	5.21E-13	3.52E-12	1.82E-11
Dicamba (C8H6Cl2O3)	Water	kg	4.83E-12	x	x	x	4.83E-12	x	x
Dimethenamid (C12H18ClNO2S)	Water	kg	1.14E-11	x	x	x	1.14E-11	x	x
Dissolved Matter (unspecified)	Water	kg	0.0098092	0.001002152	0.001634793	0.000735423	0.000151704	0.0010187	0.0052664
Disulfoton (C8H19O2PS3)	Water	kg	2.81E-13	x	x	x	2.81E-13	x	x
Diuron (C9H10Cl2N2O)	Water	kg	7.91E-14	x	x	x	7.91E-14	x	x
EPTC (C9H19NOS)	Water	kg	4.73E-12	x	x	x	4.73E-12	x	x
Ethyl Benzene (C6H5C2H5)	Water	kg	2.08E-08	2.12E-09	3.46E-09	1.56E-09	3.19E-10	2.16E-09	1.12E-08
Fluorides (F-)	Water	kg	3.04E-08	2.35E-10	2.94E-10	1.32E-10	2.85E-08	2.97E-10	9.48E-10
Glyphosate (C3H8NO5P)	Water	kg	1.03E-11	x	x	x	1.03E-11	x	x
Hexanoic acid	Water	kg	4.62E-08	4.72E-09	7.71E-09	3.47E-09	7.11E-10	4.80E-09	2.48E-08
Hydrocarbons (unspecified)	Water	kg	6.01E-09	x	x	x	6.01E-09	x	x
Iron (Fe++, Fe3+)	Water	kg	1.71E-05	1.43E-06	2.33E-06	1.05E-06	9.15E-07	3.90E-06	7.49E-06
Lead (Pb++, Pb4+)	Water	kg	7.74E-08	7.30E-09	1.19E-08	5.35E-09	1.45E-09	1.31E-08	3.83E-08
Lead 210	Water	kg	2.29E-17	2.34E-18	3.81E-18	1.71E-18	3.51E-19	2.38E-18	1.23E-17
Lithium	Water	kg	0.0002067	2.35E-05	3.84E-05	1.73E-05	2.19E-06	1.57E-06	0.0001237
m-xylene (sea)	Water	kg	6.67E-09	6.81E-10	1.11E-09	5.00E-10	1.02E-10	6.93E-10	3.58E-09
Magnesium (Mg++)	Water	kg	0.0001383	1.41E-05	2.31E-05	1.04E-05	2.13E-06	1.44E-05	7.43E-05
Manganese (Mn II, Mn IV, Mn VII)	Water	kg	5.47E-07	5.88E-08	9.57E-08	4.30E-08	1.61E-08	2.48E-08	3.08E-07
MCPA	Water	kg	6.44E-14	x	x	x	6.44E-14	x	x
Mercury (Hg+, Hg++)	Water	kg	6.55E-11	5.07E-12	7.95E-12	3.58E-12	1.96E-12	2.14E-11	2.56E-11
Metals (unspecified)	Water	kg	7.55E-09	x	x	x	7.55E-09	x	x
Methychloride	Water	kg	8.86E-12	9.05E-13	1.48E-12	6.64E-13	1.36E-13	9.20E-13	4.76E-12
Methyl Ethyl Ketone (MEK, C4H8O)	Water	kg	1.77E-11	1.81E-12	2.95E-12	1.33E-12	2.72E-13	1.84E-12	9.51E-12

Overall system for frozen green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (frozen)	GB Blanching w/ electricity (frozen)	GB Freezing (frozen)	GB Packaging (frozen)	GB transport to user (frozen)	GB Frozen storage (frozen)
Methyl Parathion (C8H10NO5PS)	Water	kg	5.77E-13	x	x	x	5.77E-13	x	x
Metolachlor (C15H22ClNO2)	Water	kg	3.78E-11	x	x	x	3.78E-11	x	x
Metribuzin (C8H14N4OS)	Water	kg	1.76E-13	x	x	x	1.76E-13	x	x
Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	Water	kg	5.06E-09	5.17E-10	8.43E-10	3.79E-10	7.78E-11	5.26E-10	2.72E-09
n-Decane	Water	kg	6.42E-09	6.55E-10	1.07E-09	4.81E-10	9.86E-11	6.67E-10	3.44E-09
n-Docosane	Water	kg	2.36E-10	2.41E-11	3.93E-11	1.77E-11	3.62E-12	2.45E-11	1.26E-10
n-Dodecane	Water	kg	1.22E-08	1.24E-09	2.03E-09	9.13E-10	1.87E-10	1.26E-09	6.54E-09
n-Eicosane	Water	kg	3.35E-09	3.42E-10	5.59E-10	2.51E-10	5.15E-11	3.48E-10	1.80E-09
n-Hexacosane	Water	kg	1.47E-10	1.50E-11	2.45E-11	1.10E-11	2.26E-12	1.53E-11	7.89E-11
n-Hexadecane	Water	kg	1.33E-08	1.36E-09	2.21E-09	9.96E-10	2.04E-10	1.38E-09	7.13E-09
n-Octadecane	Water	kg	3.28E-09	3.35E-10	5.47E-10	2.46E-10	5.04E-11	3.41E-10	1.76E-09
n-Tetradecane	Water	kg	5.33E-09	5.45E-10	8.89E-10	4.00E-10	8.20E-11	5.54E-10	2.86E-09
Naphthalene (C10H8)	Water	kg	4.00E-09	4.08E-10	6.66E-10	3.00E-10	6.15E-11	4.17E-10	2.15E-09
Nickel (Ni++, Ni3+)	Water	kg	4.13E-08	3.99E-09	6.51E-09	2.93E-09	7.31E-10	6.14E-09	2.10E-08
Nitrate (NO3-)	Water	kg	2.20E-08	1.26E-09	1.56E-09	7.02E-10	1.19E-08	1.49E-09	5.03E-09
Nitrogenous Matter (unspecified, as N)	Water	kg	2.83E-07	2.69E-11	3.33E-11	1.50E-11	2.83E-07	3.16E-11	1.07E-10
Oils (unspecified)	Water	kg	4.98E-06	4.46E-07	7.28E-07	3.28E-07	6.10E-07	5.24E-07	2.35E-06
Organic Dissolved Matter (unspecified)	Water	kg	7.51E-09	x	x	x	7.51E-09	x	x
p-Cymene	Water	kg	2.20E-11	2.25E-12	3.67E-12	1.65E-12	3.38E-13	2.29E-12	1.18E-11
Paraquat (C12H14N2)	Water	kg	7.63E-13	x	x	x	7.63E-13	x	x
Pendimethalin (C13H19N3O4)	Water	kg	3.93E-12	x	x	x	3.93E-12	x	x
Pentamethylbenzene	Water	kg	1.65E-11	1.68E-12	2.75E-12	1.24E-12	2.54E-13	1.71E-12	8.86E-12
Permethrin (C21H20Cl2O3)	Water	kg	3.53E-13	x	x	x	3.53E-13	x	x
Phenanthrene (C14H10)	Water	kg	3.25E-11	2.97E-12	4.84E-12	2.18E-12	6.45E-13	6.30E-12	1.56E-11
Phenol (C6H5OH)	Water	kg	1.08E-07	1.01E-08	1.65E-08	7.41E-09	9.50E-09	1.15E-08	5.30E-08
Phorate (C7H17O2PS3)	Water	kg	1.09E-13	x	x	x	1.09E-13	x	x
Phosphates (PO4 3-, HPO4--, H2PO4-, H3PO4, as P)	Water	kg	4.22E-07	7.02E-19	-9.98E-20	-3.08E-20	4.22E-07	-3.74E-20	-2.41E-18

Overall system for frozen green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (frozen)	GB Blanching w/ electricity (frozen)	GB Freezing (frozen)	GB Packaging (frozen)	GB transport to user (frozen)	GB Frozen storage (frozen)
Phosphorus (P)	Water	kg	1.41E-07	x	x	x	1.41E-07	x	x
Radioactive Substance (unspecified)	Water	Bq	234.21968	20.144617	24.945859	11.222062	73.805373	23.740088	80.361685
Radium 226	Water	kg	7.96E-15	8.12E-16	1.33E-15	5.97E-16	1.22E-16	8.27E-16	4.27E-15
Radium 228	Water	kg	4.07E-17	4.16E-18	6.78E-18	3.05E-18	6.25E-19	4.23E-18	2.19E-17
Salts (unspecified)	Water	kg	7.40E-07	7.40E-07	x	x	x	x	x
Selenium (Se II, Se IV, Se VI)	Water	kg	1.02E-09	8.01E-11	1.21E-10	5.43E-11	1.12E-10	2.66E-10	3.89E-10
Silver (Ag+)	Water	kg	4.61E-07	4.71E-08	7.69E-08	3.46E-08	7.10E-09	4.80E-08	2.48E-07
Simazine (C7H12ClN5)	Water	kg	2.47E-12	x	x	x	2.47E-12	x	x
Sodium (Na+)	Water	kg	0.0022426	0.000228988	0.000373738	0.000168128	3.48E-05	0.0002329	0.001204
Strontium (Sr II)	Water	kg	1.20E-05	1.23E-06	2.00E-06	9.00E-07	1.84E-07	1.25E-06	6.44E-06
Sulfate (SO4--)	Water	kg	1.79E-05	1.77E-06	2.84E-06	1.28E-06	1.01E-06	1.80E-06	9.16E-06
Sulfide (S--)	Water	kg	5.30E-07	4.70E-11	4.61E-11	2.07E-11	5.28E-07	1.09E-09	1.48E-10
Sulfurated Matter (unspecified, as S)	Water	kg	5.83E-07	5.95E-08	9.72E-08	4.37E-08	8.96E-09	6.06E-08	3.13E-07
Surfactants	Water	kg	2.15E-07	2.23E-08	3.64E-08	1.64E-08	3.15E-09	1.93E-08	1.17E-07
Suspended Matter (unspecified)	Water	kg	0.0004805	0.000232374	2.62E-05	1.18E-05	6.55E-05	6.00E-05	8.45E-05
Terbufos (C9H21O2PS3)	Water	kg	3.73E-12	x	x	x	3.73E-12	x	x
Thallium	Water	kg	7.83E-10	5.88E-11	9.57E-11	4.31E-11	2.07E-11	2.56E-10	3.08E-10
Tin (Sn++, Sn4+)	Water	kg	2.74E-08	2.54E-09	4.14E-09	1.86E-09	5.27E-10	4.98E-09	1.33E-08
Titanium (Ti3+, Ti4+)	Water	kg	5.70E-08	4.28E-09	6.97E-09	3.13E-09	1.51E-09	1.87E-08	2.24E-08
TOC (Total Organic Carbon)	Water	kg	1.05E-08	x	x	x	1.05E-08	x	x
Toluene (C6H5CH3)	Water	kg	3.49E-07	3.56E-08	5.81E-08	2.62E-08	5.36E-09	3.62E-08	1.87E-07
Vanadium (V3+, V5+)	Water	kg	5.98E-09	6.10E-10	9.96E-10	4.48E-10	9.19E-11	6.21E-10	3.21E-09
waste water (vol)	Water	m3	0.0033793	0.002845014	0.000534253	x	x	x	x
Xylene (C6H4(CH3)2)	Water	kg	1.76E-07	1.80E-08	2.94E-08	1.32E-08	2.71E-09	1.83E-08	9.46E-08
Xylene (o-C6H4(CH3)2)	Water	kg	4.85E-09	4.96E-10	8.09E-10	3.64E-10	7.46E-11	5.04E-10	2.61E-09
Yttrium	Water	kg	1.48E-09	1.51E-10	2.47E-10	1.11E-10	2.28E-11	1.54E-10	7.96E-10
Zinc (Zn++)	Water	kg	1.60E-07	1.20E-08	1.96E-08	8.81E-09	1.14E-08	4.50E-08	6.31E-08

Overall system for frozen green beans - per 4 oz green beans

Substance	Compartment	Unit	Total	GB processing (frozen)	GB Blanching w/ electricity (frozen)	GB Freezing (frozen)	GB Packaging (frozen)	GB transport to user (frozen)	GB Frozen storage (frozen)
Beans wasted	Waste	kg	0.001701	-2.45E-20	-6.59E-20	-3.34E-20	x	x	0.001701
Overburden from mining	Waste	kg	0.0002151	1.85E-05	2.29E-05	1.03E-05	6.78E-05	2.18E-05	7.38E-05
Recovered material	Waste	kg	0.0018408	0.000199228	0.000323425	0.000145495	0.000121533	9.22E-06	0.0010419
Waste (hazardous)	Waste	kg	2.63E-06	1.24E-22	2.87E-23	4.59E-23	2.63E-06	-9.24E-24	2.39E-22
Waste (mfg)	Waste	kg	0.0199006	0.002166273	0.003527113	0.001586696	0.000965583	0.0002926	0.0113624
Waste (total)	Waste	kg	0.0221289	0.002167196	0.003527518	0.001586878	0.001489951	0.0002927	0.0130647
Waste (unspecified, to incineration)	Waste	kg	8.26E-07	x	x	x	8.26E-07	x	x
Waste: Mineral (inert)	Waste	kg	1.13E-06	1.24E-22	2.87E-23	4.59E-23	1.13E-06	-9.24E-24	2.39E-22
Waste: Slags and Ash (unspecified)	Waste	kg	0.0005225	9.23E-07	4.05E-07	1.82E-07	0.000519501	1.36E-07	1.30E-06
E Feedstock Energy	Non mat.	MJ	0.1235539	-0.00236999	-0.003873326	-0.001742442	0.14412518	-0.0001078	-0.0124777
E Fuel Energy	Non mat.	MJ	4.7141265	0.48138287	0.78549887	0.35336195	0.27040093	0.2930413	2.5304406
E Non Renewable Energy	Non mat.	MJ	4.0412537	0.41972304	0.68100521	0.30635478	0.14790714	0.2924434	2.1938201
E Renewable Energy	Non mat.	MJ	0.7987217	0.061588711	0.10061987	0.045264527	0.26661763	0.0004897	0.3241413
E Total Primary Energy	Non mat.	MJ	4.8399754	0.48131175	0.78162509	0.35161931	0.41452477	0.2929331	2.5179614
Land Use: Cropland (Conservation Tillage)	Non mat.	m2	2.27E-05	x	x	x	2.27E-05	x	x
Land Use: Cropland (Conventional Tillage)	Non mat.	m2	2.49E-05	x	x	x	2.49E-05	x	x
Land Use: Cropland (Reduced Tillage)	Non mat.	m2	1.53E-05	x	x	x	1.53E-05	x	x

[i] ISO 14044 Environmental management — Life cycle assessment — Requirements and guidelines

[ii] Shelf Life Testing: Procedures and Prediction Methods for Frozen Foods. Bin Fu Kellogg's Battle Creek MI, Theodore P. Labuza Dept. of Food Science & Nutrition, University of Minnesota 1334 Eckles Ave., St. Paul, MN 55108

iii http://www.foodalliance.org/

[iv] http://epa.gov/ORD/NRMRL/std/sab/traci/index.html
v http://www.nass.usda.gov/index.asp

[vi] http://www.unece.org/trade/untdid/d00a/tred/tred8179.htm
vii Integrated Blanching and Cooling to Reduce Plant Effluent. John L. Bomben, George E. Brown, William C. Dietrich, Joyce S. Hudson and Daniel F. Farkas USPA, Western Regional Research Laboratory, Berkeley, California.
http://www.p2pays.org/ref/19/18654.pdf

viii Steven Nadel. Commercial Packaged Refrigeration:An Untapped Lode for Energy Efficiency American Council for an Energy-Efficient Economy.

[ix] http://www.energystar.gov/ia/products/prod_lists/commer_refrig_prod_list.xls

[x] From farm to table: An energy consumption assessment of refrigerated, frozen and canned food delivery. Scientific Certification Systems Kirsten Ritchie, B.S., M.S., P.E. Civil Engineering

[xi] Hekkert, MP. Dolf J. Gielen, Ernst Worrell, and C. Turkenburg 2001. Wrapping up Greenhouse Gas Emissions An Assessment of GHG Emission Reduction Related to Efficient Packaging Use. J. Industrial ecology 5(1)55-75

[xii] IISI recycling methodology. Application of the IISI LCI Data to Recycling Scenarios.

xiii http://www.foodproductiondaily.com/news/ng.asp?id=28494-researchers-improve-canning
[xiv] www.b-e-f.org