Goods Miles Methodology and Calculations[1]

Table of Contents

The Goods Miles project's purpose is to increase public awareness about the greenhouse gas (GHG) emissions caused by the travel of goods that we buy and to encourage people to purchase locally-produced goods (to reduce greenhouse gas emission created by the transportation of goods), when there is a viable, good quality, competitively priced alternative to an imported product. Local here refers to goods produced in Nova Scotia. To adequately assess the best method for assessing the GHG emissions caused by the travel of goods one must have an understanding of the concept of a Life Cycle Assessment (LCA), and the role of the transportation phase. Thus, these were the focus of my initial research.

1) Background: Life Cycle Assessment (LCA)

A) History

University of British Columbia professor of urban planning William Rees introduced the concept of the ecological footprint. It is meant to measure how much of the earth's resources humans' consume. An ecological footprint calculation is a resource management tool that measures both the amount land and water area human populations require to produce the resources it consumes and to absorb its wastes (using prevalent technologies).[2] Rees encouraged people to think about how much of the earth's resources we consume on a yearly basis, and estimates "if everyone in the world lived like we do in North America, we would need the resources of four or five more planets."[3] Attending to the ecological footprint is necessary not only an environmental perspective, but from an economic perspective. As Rees recognized, "the human economy is a fully dependent sub-system of the ecosphere and a basic understanding of our ecological constraints is a prerequisite for effective and liveable sustainability strategies."[4] Such thinking paved the way for development of methodologies to assess the environmental impacts of various human actions.

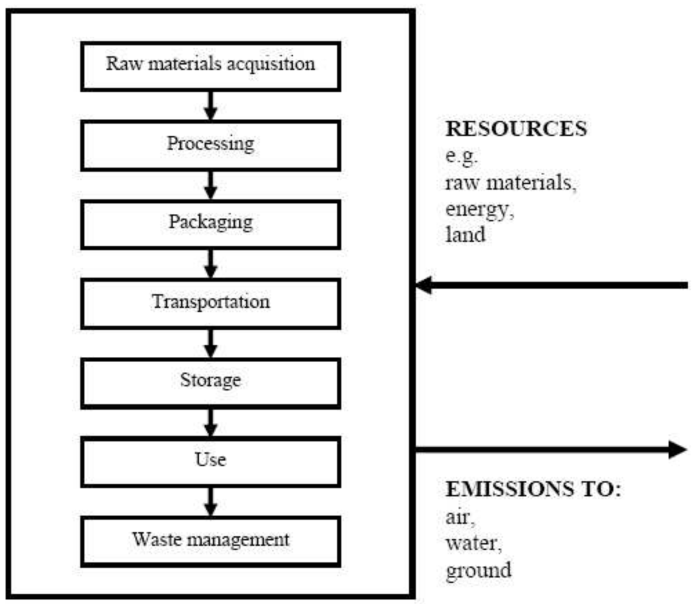
Life Cycle Assessments (LCAs) of products seek to quantify the environmental impact of the creation and distribution of various products. The first commissioned study from a "life cycle perspective" was conducted for Coca Cola in the late 1960s.[5] Thus, the economic benefits of a life cycle assessment were recognized from the outset. Early life cycle commissions and those who performed them sought to discover the material, energy, and environmental consequences related to the production and disposal of packaging options.[6] In Europe specifically "the need for a tool to compare products and processes from an environmental point of view became obvious in 1985, when a draft European Community directive on beverage packaging was published and the development of eco-labelling began."[7] Moreover, developments in environmental science made it possible to access the environmental effects of many activities and emissions.[8]

B) Concept

The clearest statement of a lifecycle assessment was put forward by the Society of Environmental Toxicology and Chemistry, which was the first organization that devoted itself to the development of LCAs.[9] Their definition is as follows:

> a process to evaluate the environmental burdens associated with a product, process, or activity by identifying and quantifying energy and materials used and wastes released to the environment; to assess the impact of those energy and material uses and releases to the environment; and to identify and evaluate opportunities to affect [sic] environmental improvements. The assessment includes the entire life-cycle of the product, process, or activity, encompassing extracting and processing raw materials; manufacturing; transportation and distribution; use, re-use, maintenance; recycling, and final disposal.[10]

An environmental LCA involves "performing material and energy balances over inputs and outputs for the system under study. Examples of inputs are raw materials, energy and land. Outputs are products and by-products, but also emissions to air, water and land."[11] How the relation between inputs and outputs is understood depends on the aim of the study. "The inputs and outputs of different systems can either be compared directly or converted into their various environmental effects. There are also methods that convert all inputs and outputs of a system into a single 'environmental impact' index"[12] A visualization is helpful here:



The life cycle model. The model illustrates 1) LCA's focus on all stages of a product's life cycle, from raw material extraction, through to post-consumer disposal activities and 2) LCA's quantification of the material, energy and waste flows through a production system. Arrows illustrate the flow of energy and matter.[13]

It is important to note that transportation is one element of a fuller LCA.

Businesses can be hired to perform life cycle assessments of various goods, activities and processes. Businesses of this sort proliferate in Europe, while in Nova Scotia outside of academic performances of LCAs (e.g. the work of Dr. Peter Tydemer's and his graduate students) there is, to my knowledge, only one US company that has one individual in Nova

Scotia whose full time work is performing LCAs (namely, Nathan Ayer, LCA Consultant, Earthshift). Part of the work of companies performing LCAs is to identify ‘hot spots’ of wasteful activity/areas of the lifecycle where the greatest improvements can be made. Whether transportation is a ‘hot spot’ depends on the distance raw materials are transported to site of manufacture and by what method, the distance finished products are transported to site of retail and by what method, the distance an individual travels to site of retail for purchasing goods and by what method, as well the environmental impacts of other aspects of a product’s life cycle. In terms of environmental harms, GHG emissions are one of the environmental impacts that may be focused on. Others include, but are not limited to: toxicity, resource consumption, ozone depletion, land use, etc.[14] Moreover, what it is identified as ‘hot spot’ is relative to the other ecological impacts associated with raw material acquisition, processing, packaging, transportation, storage, use, and waste management.[15]

In so far as these hot spots are addressed, there are both environmental and economic advantages to be had. By minimizing waste the demands put on the environment are lessened. The increases in efficiency achieved by attending to the hot spots are economically valuable. The terminology of LCAs is often coupled with notions of “cradle to cradle” or “cradle to grave” meant to take into account the entire life of a good. “LCA is a method for analyzing and assessing the environmental loadings and effects caused by a product, process or service throughout its life cycle or lifetime, ‘from cradle to grave’. The method is rapidly developing into an important tool for industries, authorizes and consumers.[16] The purposes of LCAs can vary, and include:

- comparing alternative products, processes or services
- comparing alternative life cycles for a certain product or service

- identifying parts of the life cycle where the greatest improvements can be made [17]

LCA assessments are complex and labour intensive, and for best results raw data must be derived from the specific company being assessed.[18] I believe the demand for such assessments will continue to grow given the continuing importance of corporate environmental responsibility and stewardship coupled with the economic benefits to be had via increased efficiency. Moreover, consumer demand for environmentally responsible products continues to grow despite an economic recession.[19]

To be kept in mind, however, is that current industrial systems may need significant overhaul to achieve long term sustainable practices. As noted by those well versed in LCAs, current industrial process may already be entirely suboptimal such that revision to said processes will still remain inadequate. Though efficiency with regard to current processes is important, just distribution may require revision to those processes themselves. "The use of resources must be efficient and just with respect to meeting human needs. In practical terms, this means increased technical and organizational efficiency as well as a more just distribution of resources, including more resource-efficient lifestyles for the rich part of humankind."[20] Sub-optimization can be the "consequence of using the present production system as a starting point," rather than having a methodology which looks at the bigger picture wherein ethical, social, political, ecological, and economic concerns are brought to bear on business as usual.[21]

2) Transportation Phase

The Goods Miles project focuses on the GHG emissions generated by the transportation of goods.[22] Due to time constraints and challenges with businesses sharing data, the focus thus far has been on the distribution phase (transport of product to retail). See recommendations in Section 11. Given that the transportation phase is the focus on the Goods Miles project, it is worthwhile to spend some time considering the relevance of the transportation phase.

The following table is useful for broadly illustrating the correlation between the transportation methods used, the percentage of transportation used solely for commercial goods, and the associated GHGs emissions. It is also helpful for charting trends in the transportation sector in Canada.

Canada's main sources of GHG emissions.[1, , ,234]

Source	% of national emissions (1990)	Emissions (Mt CO_2e[5], 2006)	% of national emissions (2006)	% change in emissions (1990–2006)
Industrial facilities	52.8	379	52.5	21
Electricity generation	*15.6*	*111*	*15.3*	*19*
Oil and gas production, transmission and distribution	*16.8*	*144*	*20.0*	*44*
Other industrial facilities	*20.4*	*124*	*17.2*	*3*
Transportation	24.2	180	25.0	26
Passenger cars and trucks	*11.3*	*74*	*10.3*	*11*
Freight trucks	*5.2*	*60*	*8.3*	*92*
Railways	*1.2*	*6*	*0.8*	*−14*
Aviation (domestic)	*1.1*	*8*	*1.2*	*31*
Other transportation (off-road, marine, buses etc.)	*5.3*	*32*	*4.5*	*2*
Buildings	11.8	73	10.2	5
Residential buildings	*7.4*	*40*	*5.5*	*−9*
Commercial buildings	*4.3*	*33*	*4.6*	*30*
Agriculture (apart from energy use)	8.3	62	8.6	27
Landfills	2.9	20	2.8	18
Other	0.9	4	0.6	
Federal government operations[a]	0.7	3	0.4	−24[b]
Total		721		22

[a] These emissions have already been counted once in the preceding sources.
[b] Change 1990–2002.
http://pubs.pembina.org/reports/canadas-ghg-mainsources-1.pdf

Transportation emissions in 1990 accounted for 24.2% of Canada's main sources of GHG emissions, and in 2006 that number had increased to 25%. The bulk of these emissions are accounted for by the use of: freight trucks, railways, domestic aviation and 'other' transportation (12.8% in 1990 and 14.8% in 2006). The use of freight trucks (used solely for transportations of commercial goods) generated 5.2% of Canada's main sources of GHG emissions in 1990. In 2006 that number rose to 8.3%. The remainder of emissions generated by the transportation sector in 1990 and 2006 were caused by passenger cars and trucks. Only one source was responsible for more GHG emissions than transportation sector: industrial facilities. Industrial facilities were responsible for over 50% of Canada's main sources of GHG emissions in both 1990 and 2006. Thus, the transportation sector is an important site for reducing GHG emissions, as it is second highest contributor to main sources of GHG emissions in 1990 and 2006. Furthermore, the use of transportation for freight is an important site for reducing GHG emissions. Freight trucks *alone* accounted for 5.2% in 1990 and 8.3% in 2006. These figures do not include the GHGs generated by the use of rail, ship and aviation - which would require a further breakdown of their use regarding the percentage used for human passenger transport and the percentage used for transport of commercial goods.

Within Nova Scotia "freight transport was responsible for 81% of the increase in total road vehicle energy use between 1990 and 2002."[23] Road transport contributed the most GHG emissions (69%) in 2004 within Nova Scotia's transportation sector.[24] The air sector contributed about 8%, and the marine sector about 12%, of transportation-related GHG emissions.[25] In Nova Scotia rail was responsible for only 2% of total transportation-related emissions.[26] Heavy-duty diesel trucks produced about 54% more emissions in 2004 than in 1990.[27]

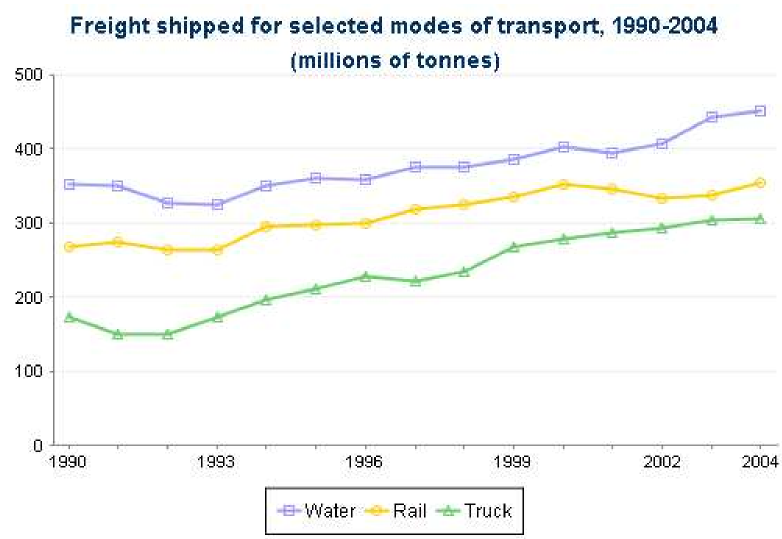
On the basis of available emissions information, one of the primary anthropogenic sources of CO_2 is fossil fuel combustion, of both mobile and stationary sources.[28] According to the World Resources Institute's Greenhouse Gas Protocol the GHGs generated by the transportation of goods are highest for domestic air, followed by short-haul air, long-haul air, ship, truck, and rail. Rail has, by far, the smallest GHG emissions associated with it (See Section 6). There is still disagreement in the literature about whether ships or trucks contribute more

GHGs (of course size and age of the technology in question are also contributing factors). According to the World Resources Institute's Greenhouse Gas Protocol ships and trucks are quite close in terms of GHG emissions. In any case, a marked increase in the transport of goods and the associated increase in GHG emissions remain of central importance.

In 2006, transportation-related demand accounted for 12.2% of Canada's gross domestic product (GDP).[29] The transportation sector continues to be a major air pollutant emitter,

> producing nearly three quarters of carbon monoxide emissions, more than half of nitrogen oxide emissions, and more than one-quarter of the volatile organic compounds affecting air quality in 2004[2]. Meanwhile, increases in the number of vehicles on the road and the size of these vehicles have contributed to rising levels of GHG emissions. In 2005, transportation accounted for 26% of Canada's estimated GHG emissions, an increase of 33% from levels reported for 1990[3].[30]

In Canada there has been an increase in shipping freight generally, with a significant rise in transportation by truck.



http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=67#foottext_2

Since the early 1990s the importance of the trucking industry has increased significantly: "Between 1990 and 2004, the for-hire trucking industry, excluding smaller carriers and private trucking fleets owned or leased by companies, grew nearly three times faster than all other modes combined. Factors such as the ability to deliver goods to companies on a 'just-in-time' basis and the impact of trade agreements helped to fuel this growth [8]."[31] Moreover, the distances travelled have increased for all types of truck between 1990-2004,

> …with distances increasing by 72% for freight light trucks, 19% for medium trucks and 29% for heavy trucks. Freight light trucks travelled the greatest total distance in 2004, at 34.8 billion kilometres. The average distance travelled by trucks on Canadian roads has also risen since 1990. Between 1990 and 2004, the annual distance travelled by trucks increased by 43%. This led to a 71% increase in fuel consumption and a 73% increase in GHG emissions [9].[32]

Another key factor is a rise in trade:

Table 2 Summary of emission changes in the transportation sector (1990 and 2006)

	1990	2006	1990 to 2006		
	Emissions ($Mt\ CO_2eq$)		Absolute change	% change	% of total
* "Other" includes recreational vehicles and residential equipment such as lawnmowers.					
Passenger Transport	77.3	97.3	19.9	26	53
Freight Transport	39.5	56.6	17.1	43	46
Other*	4.60	4.89	0.3	6	1
Total	**121**	**159**	**37.3**	**31**	**100**

A rise in domestic and international trade was the most important factor underlying the 17 Mt (43%) increase in emissions from freight transport. Alongside increases in the requirements for freight travel, another important factor influencing most of Canada's commercial deliveries have been the types of modes used. Since 1990, due to processes such as the emergence of just-in-time delivery and the need for flexible freight transportation systems, most freight movement has been undertaken using heavy-duty trucks, the most energy- and emission-intensive mode of freight transport.[33]

In addition to the fact that domestic and international trade has increased, fuel for international transport is not taxed.[34] The combination of the above factors highlights the importance of the transport phase of products with regard to their GHG emissions.

3) Selection of Goods

The following considerations were used to aid in the selection of the five case study items.

Research Potential:	
Data available re: travel distances of raw material to point of manufacture and retail	
Data available re: mode of transportation (ship, truck, rail, air)	
Accessibility:	
Products that common consumers can purchase	
Price:	
Price for local good is within a similar price range of imported good	
Impact:	
Goods that have a significant impact due to the quantity of them imported	
Local Products:	
Raw materials derived from Nova Scotia ideally; or the Maritimes	
Manufactured in Nova Scotia ideally; or the Maritimes	
Ecological Transparency: manifests environmental awareness and commitment	
Capacity to meet consumer demand of local goods	
Imported Products:	
Travels a great distance for effective contrast case	

Multiple items were researched, both locally and in terms of imports, prior to settling on the following five: Wine, Lumber, Knives, Shrimp/Prawn, and Wool Clothing. All are produced locally, and all have imported versions that are shipped a considerable distance. Each of the case studies identifies a product where the imported version has a significantly higher carbon footprint via the distribution transportation phase in comparison with the local good. Although this does not show that the distribution phase is necessarily a hot spot (a full LCA would be required to infer this), it does indicate an instance where GHG emissions can be decreased by consumer's purchasing decisions.

4) Strategis Database

In order to identify goods that were imported great distances to Nova Scotia Industry Canada's Strategis Database was used:

http://www.ic.gc.ca/sc_mrkti/tdst/tdo/tdo.php?lang=30&productType=HS6

This database is maintained by Industry Canada, using data from Statistics Canada and the US Census Bureau.

Through researching and comparing locally available goods and imported versions of those goods, as well as the distances they travel, the following five goods were selected for case study: Wine, Wool Clothing, Shrimp/Prawn, Lumber and Knives. Businesses were identified within Nova Scotia where both raw goods and manufacturing occurred within the province for wine, wool, lumber and shrimp. Knives are manufactured locally.

Relevant data derived from the Strategis Database is found below. All amounts refer to the 2008 data and all amounts are in Canadian dollars. [35] Percent (%) calculations are of the percentage of the total amount of imports of the item(s) in question for 2008. Further breakdown of the specific states from within the United States is available at the bottom of the list. To put the quantities below into context consider that for 2008 all products exported from Nova Scotia amounted to $5,835,000,000 and all products imported to Nova Scotia amounted to $8,416,000,000. A limitation to the data available from the Strategis database is that it only provides data on international trade; as such, it fails to capture interprovincial trade. Moreover, the database does not provide the product's starting destination. In other words, a product's origin and the various possible stops along the product's life cycle prior to arrival in Nova Scotia are not captured.

A) Wine

220421 - GRAPE WINES - OTHER THAN SPARKLING (INCLUDING FORTIFIED) - 2 LITRES OR LESS

TOTAL NOVA SCOTIA EXPORTS: $ 7,032
TOTAL NOVA SCOTIA IMPORTS: $ 25,533,997

Nova Scotia Imports	Amount In Canadian Dollars	Percentage of Wine Imports
Australia	$ 6,692,488	26.21%
Italy (includes Vatican City State)	$ 4,766,808	18.67%
United States (U.S.)	$ 3,490,600	13.67%
France (incl. Monaco, French Antilles)	$ 2,485,055	9.73%
US Breakdown		
California	$ 3,219,607	12.61%

Note: Despite Nova Scotia's burgeoning wine industry which is set to more than double, it is rarely exported.

B) Lumber

HS 4407 - LUMBER (THICKNESS >6MM)

TOTAL NOVA SCOTIA EXPORTS: $ 69,919,797
TOTAL NOVA SCOTIA IMPORTS: $ 1,128,813

Nova Scotia Imports	Amount In Canadian Dollars	Percentage of Lumber Imports
Italy (includes Vatican City State)	$ 380,245	33.69%
China	$ 209,541	18.56%
United States (U.S.)	$ 198,385	17.57%
Chile	$ 176,059	15.60%
US Breakdown		
Washington	$ 108,043	9.57%
California	$ 88,150	7.81%
New Hampshire	$2,192	0.19%

C) Knives

KNIVES (HS 8211) AND BLADES OTHER THAN FOR MACHINES OR MECHANICAL APPLIANCES

TOTAL NOVA SCOTIA EXPORTS: $ 36,171
TOTAL NOVA SCOTIA IMPORTS: $ 514,347

Nova Scotia Imports	Amount In Canadian Dollars	Percentage of Knives Imports
Portugal	$215,779	41.95%
Brazil	$102,982	20.02%
China	$101,925	19.82%

D) Shrimp/Prawn

HS 030613 - SHRIMPS AND PRAWNS – FROZEN

TOTAL NOVA SCOTIA EXPORTS: $ 56,509,328
TOTAL NOVA SCOTIA IMPORTS: $ 2,747,239

Nova Scotia Imports	Amount In Canadian Dollars	Percentage of Shrimp/P Imports
China	$2,050,947	74.65%
Thailand	$696,292	25.35%

HS 160520 - SHRIMPS AND PRAWNS - PREPARED OR PRESERVED

TOTAL NOVA SCOTIA EXPORTS: $1,156,243
TOTAL NOVA SCOTIA IMPORTS: $4,970,864

Nova Scotia Imports	Amount In Canadian Dollars	Percentage of Shrimp/P Imports
China	$ 2,336,632	47.01%
Thailand	$ 2,301,512	46.30%

E) Wool Clothing

610110 - MENS/BOYS OVERCOATS, SKI AND WIND JACKETS - KNITTED - WOOL/HAIR
610210 - WOMENS/GIRLS OVERCOATS, SKI AND WIND JACKETS - KNITTED - WOOL/HAIR
610311 - MEN'S/BOYS SUITS - KNITTED -WOOL/HAIR
610321 - MEN'S/BOYS ENSEMBLES – KNITTED - WOOL/HAIR
610331 - MEN'S/BOYS JACKETS AND BLAZERS - KNITTED - WOOL/HAIR
610341 - MEN'S/BOYS TROUSERS, OVERALLS AND SHORTS - KNITTED - WOOL/HAIR
610411 - WOMENS/GIRLS SUITS – KNITTED - WOOL/HAIR

610421 - WOMENS/GIRLS ENSEMBLES - KNITTED - WOOL/HAIR
610431 - WOMENS/GIRLS JACKETS AND BLAZERS - KNITTED - WOOL/HAIR
610441 - WOMENS/GIRLS DRESSES - KNITTED - WOOL/HAIR
610451 - WOMENS/GIRLS SKIRTS AND DIVIDED SKIRTS - KNITTED - WOOL/HAIR
610461 - WOMENS/GIRLS TROUSERS, OVERALLS AND SHORTS - KNITTED - WOOL/HAIR
610590 - MEN'S/BOYS SHIRTS - KNITTED - TEXTILE NES
610690 - WOMENS/GIRLS BLOUSES, SHIRTS AND SHIRT-BLOUSES - KNITTED – TEXTILE NES
610719 - MEN'S/BOYS UNDERWEAR - KNITTED - TEXTILE NES
610729 - MEN'S/BOYS PYJAMAS AND NIGHTSHIRTS - KNITTED - TEXTILE NES
610799 - MEN'S/BOYS' BATHROBES,DRESSING GOWNS,ETC OF O TEXTILE MATERIALS,KNITTED/CROCHETED
610819 - WOMENS/GIRLS SLIPS AND PETTICOATS - KNITTED - TEXTILE NES
610829 - WOMENS/GIRLS BRIEFS AND PANTIES - KNITTED - TEXTILE NES
610899 - WOMENS/GIRLS BATHROBES AND DRESSING GOWNS - KNITTED - TEXTILE NES
611010 - SWEATERS, SWEATSHIRTS AND WAIST-COATS - KNITTED - WOOL/HAIR
611011 - SWEATERS, SWEATSHIRTS AND WAIST-COATS - KNITTED - WOOL
611110 - BABIES GARMENTS AND CLOTHING ACCESSORIES - KNITTED - WOOL/HAIR
611410 - OTHER GARMENTS NES - KNITTED - WOOL/HAIR
611591 - SOCKS AND STOCKINGS - KNITTED - WOOL/HAIR
611594 - HOSIERY, OF WOOL OR FINE ANIMAL HAIR, KNITTED OR CROCHETED, NES
611691 - GLOVES, MITTENS AND MITTS - KNITTED - WOOL/HAIR
620111 - MENS/BOYS OVERCOATS, RAINCOATS, CAPES, CLOAKS AND SIMILAR ARTICLES - WOVEN - WOOL/HAIR
620191 - MENS/BOYS ANORAKS, SKI AND WIND JACKETS AND SIMILAR ARTICLES – WOVEN - WOOL/HAIR
620211 - WOMENS/GIRLS OVERCOATS, RAINCOATS, CAPES, CLOAKS AND SIMILAR ARTICLES - WOVEN - WOOL/HAIR
620291 - WOMENS/GIRLS ANORAKS, SKI AND WIND JACKETS AND SIMILAR ARTICLES - WOVEN - WOOL/HAIR
620311 - MENS/BOYS SUITS - WOVEN - WOOL/HAIR
620312 - MENS/BOYS SUITS - WOVEN - SYNTHETIC FIBRES
620321 - MENS/BOYS ENSEMBLES – WOVEN - WOOL/HAIR
620323 - MENS/BOYS ENSEMBLES - WOVEN - SYNTHETIC FIBRES
620331 - MENS/BOYS JACKETS AND BLAZERS - WOVEN - WOOL/HAIR
620333 - MENS/BOYS JACKETS AND BLAZERS - WOVEN - SYNTHETIC FIBRES
620341 - MENS/BOYS TROUSERS, OVERALLS AND SHORTS - WOVEN - WOOL/HAIR
620343 - MENS/BOYS TROUSERS, OVERALLS AND SHORTS - WOVEN - SYNTHETIC FIBRES
620411 - WOMENS/GIRLS SUITS - WOVEN - WOOL/HAIR
620413 - WOMENS/GIRLS SUITS - WOVEN - SYNTHETIC FIBRES
620421 - WOMENS/GIRLS ENSEMBLES - WOVEN - WOOL/HAIR
620431 - WOMENS/GIRLS JACKETS AND BLAZERS - WOVEN - WOOL/HAIR
620433 - WOMENS/GIRLS JACKETS AND BLAZERS - WOVEN - SYNTHETIC FIBRES
620441 - WOMENS/GIRLS DRESSES - WOVEN - WOOL/HAIR
620451 - WOMENS/GIRLS SKIRTS AND DIVIDED SKIRTS - WOVEN - WOOL/HAIR

620453 - WOMENS/GIRLS SKIRTS AND DIVIDED SKIRTS - WOVEN - SYNTHETIC FIBRES
620461 - WOMENS/GIRLS TROUSERS, OVERALLS AND SHORTS - WOVEN - WOOL/HAIR
620463 - WOMENS/GIRLS TROUSERS, OVERALLS AND SHORTS - WOVEN - SYNTHETIC FIBRES
620510 - MENS/BOYS SHIRTS - WOVEN - WOOL/HAIR
620620 - WOMENS/GIRLS BLOUSES, SHIRTS AND SHIRT-BLOUSES - WOVEN - WOOL/HAIR
620910 - BABIES GARMENTS (INCL COATS AND SNOWSUITS) AND CLOTHING ACCESSORIES - WOVEN - WOOL/HAIR
621131 - MENS/BOYS COVERALLS, SMOCKS AND GARMENTS NES - WOVEN - WOOL/HAIR
621141 - WOMENS/GIRLS COVERALLS, SMOCKS AND GARMENTS NES - WOVEN - WOOL/HAIR
621420 - SHAWLS, SCARVES, VEILS, MUFFLERS, MANTILLAS AND THE LIKE - WOVEN - WOOL/HAIR[36]

TOTAL NOVA SCOTIA EXPORTS: $52,114
TOTAL NOVA SCOTIA IMPORTS: $1,685,217

Nova Scotia Imports	**Amount In Canadian Dollars**	**Percentage of Wool Clothing Imports**
Bangladesh	$1,003,417	59.54%
India	$220,753	13.10%
China	$ 211,936	12.58%

Note: Although Nova Scotia both a) has sheep farms and b) manufactures wool clothing we still import more than 32X the amount we export.

5) World Resources Institute's Greenhouse Gas Protocol

The calculation tools for estimating GHG emissions generated via transportation was selected through the recommendation of Marla MacLeod. Her experience working for the last two years on the Foods Miles project at the Ecology Action Centre makes her a specialist in her field. The Foods Miles Project, like the Goods Miles Project, focuses on the GHG emissions generated by the transportation of imported and local products. The calculation tool utilized comes from the Greenhouse Gas Protocol (GHG Protocol) and "is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions."[37] The GHG Protocol itself is a decade-long relationship between the World Resources Institute and the World Business Council for Sustainable Development, which is working with "businesses, governments, and environmental groups around the world to build a new generation of credible and effective programs for tackling climate change."[38] Notably, the World Resources Institute's Greenhouse Gas Protocol

> …provides the accounting framework for nearly every GHG standard and program in the world - from the International Standards Organization to The Climate Registry - as well as hundreds of GHG inventories prepared by individual companies. The GHG Protocol also offers developing countries an internationally accepted management tool to help their businesses to compete in the global marketplace and their governments to make informed decisions about climate change.[39]

The emissions table below reflects the GHG calculator's recommendations for calculating GHG emissions by mode of transportation.

Emission factors for different modes of transportation based on 1000 kg of product

Mode	**Kg CO_2 equivalent per tonne-kilometre shipped**
Truck	0.204
Rail	0.017
Domestic-Air	2.071
Short Haul-Air	1.439
Long Haul-Air	0.665
Ship	0.222

6) Transportation and GHG Calculations

Estimates below are for GHG emissions for transporting one metric tonne of product. The limitation of the straight multiplication used below is that the fine grained raw data that would give the most precise comparison is not included. Such data, however, cannot have been collected in the six month time frame allotted for the Goods Miles project. Though attempts were made to glean raw data from local industry, significant blocks arose through lack of response to phone calls/emails. As noted above, there was also lack of carry through with representatives that had said the data would be forthcoming. I take this in part to be the result of the significant time investment required to provide weights of individual products, yearly estimates for forms of transport and weights of shipments, disclosure of information about distribution, and so on. Another problem encountered was a lack of consistency in any fiscal year regarding methods of transport, distances travelled, and the like. The timeframe for the project would have to be extended to facilitate such research. Time must be afforded for both designing relevant survey material, securing participant interest in the survey, and for having the survey materials returned.

The benefit of the straight multiplication that is used below is that it provides a simple, streamlined method, which can be performed by any interested party to discover for themselves the transportation generated GHGs for the product in question. Moreover, individuals can assess whether the imported good has a significantly higher transportation generated GHG emissions than its local version. In other words, the methodology for the calculations performed below can be applied to other products with relative ease, using the publically accessible Strategis Database. As such, everyday people can be encouraged to exercise their capacity to make informed decisions about what they will purchase and why, and are given the tools to do so.

Distances were calculated using provincial or state capital cities. Distances were determined using Google Maps (http://www.google.com/maps), except with regard to the estimates in Section II below. Estimates about the travel distances of local goods were estimated using Mapquest.ca. To estimate travel distances for items imported from all other countries, it was assumed that the products were traveling by ship. That ship is the common form of transporting these goods was confirmed by the Shipping Federation of Canada's director of environmental affairs.[40] Maritime Chain (http://www.maritimechain.com), an online port distance calculator, was used to determine distances from the port of the originating country to the port of Halifax. In all cases the imported versions have substantially higher GHG emissions associated with their distribution transportation phase than the local versions.

I) Imports

A) Wine

Industry Canada HS220421 - Grape Wines - other than sparkling (including fortified) - 2 litres or less

Melbourne, Australia (26.21 % of all wine imports to NS)
Distance travelled 19,014 km
GHG emissions by ship 4.221 T

Naples, Italy (18.67% of all wine imports to NS)
Distance travelled 6,641 km
GHG emissions by ship 1.474 T

Sacramento, California, United States (12.61% of all wine imports to NS)
Distance travelled 5,876 km
GHG emissions by truck 1.199 T
GHG emissions by rail 0.100 T

Marseille, France (9.73% of all wine imports to NS)
Distance travelled 6,123 km
GHG emissions by ship 1.359 T

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
Australia (26.21%)	4.2	
Italy (18.67%)	1.5	
California (12.61%)		1.2
France (9.73%)	1.4	

B) Lumber

HS 4407 - Lumber (Thickness > 6mm)

Naples, Italy (33.69% of all lumber imports of NS)
Distance travelled 6,641 km
GHG emissions by ship 1.474 T

Hong Kong, China (18.56% of all lumber imports to NS)
Distance travelled 20,516 km
GHG emissions by ship 4.555 T

Valparaiso, Chile (15.60% of all lumber imports to NS)
Distance travelled 9,173 km
GHG emissions by ship 2.036 T

Olympia, Washington, United States (9.57% of all lumber imports to NS)
Distance travelled 5,058 km
GHG emissions by truck 1.032 T
GHG emissions by rail 0.086 T

Sacramento, California, United States (7.81% of all lumber imports to NS)
Distance travelled 5,876 km
GHG emissions by truck 1.199 T
GHG emissions by rail 0.100 T

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
Italy (33.69%)	1.5	
China (18.56%)	4.6	
Chile (15.6%)	2	
Washington (9.57%)		1
California (7.81%)		1.2

C) Knives

Knives (HS 8211) and blades other than for machines and electrical appliances

Lisbon, Portugal (41.95% of all knives and blades imported to NS)
Distance travelled 4,415 km
GHG emissions by ship 0.980 T

Santos, Brazil (20.02% of all knives and blades imported to NS)
Distance travelled 8,956 km
GHG emissions by ship 1.988 T

Hong Kong, China (19.82% of all knives and blades imported to NS)
Distance travelled 20,516 km
GHG emissions by ship 4.555 T

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
Portugal (41.95%)	1	
Brazil (20.02%)	2	
China (19.82%)	4.6	

D) Shrimp/Prawn

HS 030613 - Shrimps and Prawns - Frozen

Hong Kong, China (74.65% of all frozen shrimp and prawn imports to NS)
Distance travelled 20,516 km
GHG emissions by ship 4.555 T

Bangkok, Thailand (25.35% of all frozen shrimp and prawn imports to NS)
Distance travelled 19,735 km
GHG emissions by ship 4.381 T

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
China (74.65%)	4.6	
Thailand (25.35%)	4.4	

HS 160520 - Shrimp and prawns - prepared or preserved

Hong Kong, China (47.01% of all prepared shrimp and prawn imports to NS)
Distance travelled 20,516 km
GHG emissions by ship 4.555 T

Bangkok, Thailand (46.30% of all prepared shrimp and prawn imports to NS)
Distance travelled 20,516 km
GHG emissions by ship 4.555 T

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
China (40.01%)	4.6	
Thailand (46.3%)	4.4	

E) Wool Clothing

Wool clothing (55 different codes, See Section 5. E)

Chittagong, Bangladesh (59.54% of all wool clothing imports to NS)
Distance travelled 17,472 km
GHG emissions by ship 3.879 T

Chennai, India (13.10% of all wool clothing imports to NS)
Distance travelled 16,022 km
GHG emissions by ship 3.557 T

Hong Kong, China (12.58% of all wool clothing imports to NS)
Distance travelled 20,516 km
GHG emissions by ship 4.555 T

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
Bangladesh (59.54%)	3.9	
India (13.1%)	3.6	
China (12.58%)	4.6	

II) Local Goods

For each of the following calculations a destination point was selected where the goods in question are produced locally, and estimates are given for transport to Halifax.

Wine (Wolfville-Halifax)
Distance travelled 97 km
GHG emissions by truck 0.02 T

Lumber (Lunenburg-Halifax)
Distance travelled 100 km
GHG emissions by truck 0.02 T

Knives (Pictou-Halifax)
Distance travelled 166 km
GHG emissions by truck 0.034 T

Shrimp (Canso-Halifax)
Distance travelled 323 km
GHG emissions by truck 0.066 T

Wool Articles (Lismore-Halifax)
Distance travelled 193 km
GHG emissions by truck 0.039 T

7) Case Studies

A) Wine

In 2008 Grape Wine ranked 22nd of all products imported to Atlantic Canada ($54,222,000 or 0.23%) and 23rd of all products imported to Nova Scotia ($25,534,000 or 0.30%).[41] A comprehensive study of wine was performed by Emma Point, who studied under Peter Tydemers – a well respected figure in life cycle analysis work.[42] I will highlight key findings as pertains to the Goods Miles project.

Regarding the transportation phase a study by Aranda et al found the export of wine to other EU countries (via truck) and to North and Central American countries (via freighter ship) to be a hot spot.[43] Transport of wine to retail was also cited as the life cycle stage causing the most greenhouse gas emissions in a study that modeled the transport of wine over varying distances by road, and by sea (Coleman & Päster, 2007).[44] As Point rightly notes, though "In both of these analyses, distances to markets modeled were far greater than that which Nova Scotia wine undergoes at present. However when Nova Scotia wine was modeled as being exported to Vancouver, BC (6000km), contributions to impact categories increased between 2% and 20%..."[45]

In studies done by Smith et al. and Schlich & Feisner they maintain that while the distance a product travels may offer vital information about wine's environmental impact, ideally it is reported alongside information about wine's mode of transport.[46] Distance is only part of the GHG equation. Other considerations with regard to energy expenditures and environmental impacts when it comes to wineries might include inputs to the soil to make it fertile, pesticides and herbicides, production methods, storage facilities and the creation and shipping of packaging materials. The manufacture of packaging is typically a very important life cycle phase for products packaged in glass, including wine.[47]

Point's thesis also directs our attention to the relevance of GHGs generated by the transportation from point of retail to site of consumption.

> For the impact categories of abiotic resource depletion, global warming potential, and cumulative energy demand, the result of driving 5 km to purchase a bottle of wine is larger than all the impacts arising from grape growing and wine making combined. With respect to ozone depletion potential, a 5 kilometer trip is more harmful than all impacts arising from grape growing, wine making, bottle production and wine's transport to retail. A scenario modeling a 25 km drive to purchase wine indicated increases from the base case between 28% and 250% to impact categories. The relative importance of consumer transport is supported by work undertaken in the UK which suggests that the environmental impacts of car-based shopping and other consumer activities are of greater import than transport. Consumer education programs that provide information on the relative importance of consumer transport may influence consumer behaviour (Owen *et al*., 2007).[48]

As such, thinking about the contribution of customer transport to point of purchase is encouraged in Goods Miles educational material.

The local grape content in Nova Scotian wines is conveniently labeled. Under the Nova Scotia Wine Standards, wineries can receive this provincial designation if no less than 85% of a wine's content is derived from grapes grown in Nova Scotia.[49] Point notes that:

> In 2005, the establishment of Nova Scotia Wine Standards laid essential ground work for the province to become a nationally recognized, authentic and prosperous wine producing region (Wood, 2006; Lewis *et al*., 2006; Naugler & Wright, 2006). Most recently, the provincial liquor commission, mandated to promote the economic objectives of the province's alcohol industries (Nova Scotia Liquor Commission, 2006), reduced the retail "mark up price" for Nova Scotia wines by 70% (Brooks-Arenburg, 2007). According to a recent economic impact study, the market share of Nova Scotia wine is increasing, accounting for 8.7% of all wine sales in the province in 2006 (Josza Management &Economics, 2006).[50]

In 2006 in Nova Scotia 130 hectares produced approximately 740 tonnes of grapes.[51] In production terms this amounts to approximately 900,000 bottles of wine containing at least

85% Nova Scotia grapes by weight.[52] The wine industry in NS is a burgeoning one. Wine industry

> seeks to triple the area of wine grape production in the province by 2020, raising the number of bottles produced (containing 85% Nova Scotia grapes by weight) to approximately 2.5 million (Josza Management & Economics, 2006). An recent economic impact study deemed this target feasible (Josza Management & Economics, 2006).[53]

If the above estimates are correct there will be a growing supply of local wine.

Key Findings:

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
Australia (26.21%)	4.2	
Italy (18.67%)	1.5	
California (12.61%)		1.2
France (9.73%)	1.4	
Nova Scotia		0.02

The distribution phase of the transportation generated GHG emissions for wine travelling from Australia are 210X higher than the local version, 75X higher when travelling from Italy, 60X higher when travelling from California, and 70X higher when travelling from France.

B) Lumber

The forestry industry of Nova Scotia contributes $700 million to Nova Scotia's gross domestic product, and accounts for more than 1 billion in exports – or 17 % of Nova Scotia's export trade and employs 11,000 people.[54] Also worth noting is that local lumber businesses contribute to communities through supporting local schools, supporting sports and scouting programs, and offering scholarships to youth in their communities.[55][56]

Consumers can identify ecologically preferable types of lumber in two ways. One is through the use of Forest Stewardship Council (FSC) certification. Regional forest management standards, chain of custody standards, controlled wood standards and standards and policy documents guide the certification of FSC wood products.[57] Consumers can also identify Nagaya Forest Restoration Ltd. (NAGAYA) certified wood, which has more rigorous standards than the FSC standards alone.[58] The NAGAYA group is dedicated to the sustainable restoration of the Acadian Forest and includes members such as: forestland owners, forest workers, forest technicians, woodworkers, marketing companies, retailers and customers.[59] Their goal is to achieve low impact management of forest land, to preserve and restore the Acadian Forest, to properly recognize the contribution of forest workers, to create high quality products and to guarantee customers that their purchase puts the value back into the forest.[60] There are local sources of lumber that harvest and manufacture wood within a small radius and then ship it by truck to point of sale.[61]

Key Findings:

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
Italy (33.69%)	1.5	
China (18.56%)	4.6	
Chile (15.6%)	2	
Washington (9.57%)		1
California (7.81%)		1.2
Nova Scotia		0.02

The distribution phase of the transportation generated GHG emissions for lumber travelling from Italy is 75X higher than the local version, 230X higher when travelling from China, 100X higher when travelling from Chile, 50X higher when travelling from Washington, and 60X higher when travelling from California.

C) Knives

There is a local producer of knives in Pictou Nova Scotia, namely Grohmann Knives. It is a small business with approximately 25 employees, and now sells kitchen knives in addition to other unique custom and machine made knives.[62] This item was selected in part because kitchen knives are a common good; given their centrality to daily life they can serve as a visual cue for consumers familiar with the Goods Miles project - prompting consideration of environmental impacts associated with this good.

Key Findings:

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
Portugal (41.95%)	1	
Brazil (20.02%)	2	
China (19.82%)	4.6	
Nova Scotia		0.034

The distribution phase of the transportation generated GHG emissions for knives travelling from Portugal is 29X higher than the local version, 59X higher when travelling from Brazil, and 135X higher when travelling from China.

D) Shrimp/Prawn

In 2004 in Nova Scotia the landed value of invertebrate fisheries was $ 596 million, or 80% of the overall landed value from all species.[63] Lobster, snow crab, shrimp and scallops account for $582 million of the invertebrate fisheries.[64]

> The Scotian Shelf shrimp fishery takes place in waters off eastern Cape Breton, primarily in the Louisbourg, Canso and Misaine holes. It is managed by quotas and the TAC is shared between Scotia-Fundy (Nova Scotia) based vessels (75%) and Gulf (New Brunswick) vessels (25%). There are 23 Scotia-Fundy and 6 Gulf licence holders. The season is open year round, however, most fishing occurs from mid-March to July. The TAC is expected to be 5000 tonnes in 2006 and may increase to 6-7000 tonnes in 2007/08. The estimated value of the fishery is $4-6 million.
>
> In addition to the mobile fisheries, there is also an inshore trap fishery that uses baited wire mesh traps similar to a lobster fishery. This fishery was developed by inshore fishermen in Guysborough and Richmond Counties. Most of the 13 licences are concentrated in Chedabucto Bay. Management is by effort controls such as limited number of licences and trap limits, however, a harvesting cap is also in place. Most activity occurs in the fall and winter when catch rates are the highest. The estimated value of this fishery is $400,000 - $500,000.[65]

The environmental impacts of the fishery in Canso are significantly less than fisheries that use trawling.[66] Trawling dangerously disrupts local ecosystems because they are dragged along the bottom of the ocean; while in Canso the shrimp are caught using mesh baited traps under the sustainability standards of Seachoice.[67] Seachoice provides sustainable options for consumers when selecting seafood.[68] Select Nova Scotia also provides information for conscientious consumers about buying local and in season.[69] Prawn is fished in Atlantic waters from southern Nova Scotia to Baffin island, usually by otter trawl.[70]

There are sizeable concerns about imported shrimp. These are founded on worries about Asian fisheries. Asia produces nearly four-fifths of the world's farmed shrimp output.[71] Concerns include but are not limited to the following: disease control, pollution generated by shrimp farms, inefficiency (e.g. one hectare of a semi-intensive shrimp culture system in Columbia producing approximately 4000 kg annually requires the productive and assimilative capacity of 38-189 hectares of natural ecosystem per year, whereas higher intensity farming uses approximately 296 Joules of ecological work to produce 1 Joule of edible shrimp protein), and destruction of pristine tropical wetlands for fish farms – the destruction of mangrove forests for shrimp pond construction is of particular concern.[72]

Key Findings:

Shrimps and Prawns - Frozen

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
China (74.65%)	4.6	
Thailand (25.35%)	4.4	
Nova Scotia		0.066

Shrimp and prawns - prepared or preserved

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
China (40.01%)	4.6	
Thailand (46.3%)	4.4	
Nova Scotia		0.066

The distribution phase of the transportation generated GHG emissions for shrimp/prawn travelling from China is 70X higher than the local version, and 67X higher when travelling from Thailand.

E) Wool Clothing

Pictou County is the largest sheep producing county in the province.[73] The sheep industry in the Nova Scotian farm economy is valued at approximately $2 million. [74] It is worth noting that sheep are raised Nova Scotia primarily for meat production, with wool considered to be a minor source of income.[75] There are currently no locally available materials for clothing production in Nova Scotia except for wool. [76] There has been interest, however, in exploring the possibilities textile creation with hemp, flax and nettle.[77] When determining the ecological impact of items of clothing Chen et al. recommend the following four considerations:

1. nonpolluting to obtain, processing, and fabricate
2. Made from renewable resources
3. Reusable/recyclable
4. Fully biodegradable[78]

One can also consider energy expenditures in production. Another site for concern with wool is the dying process which can involve toxic pollutants. [79] A potential source of textiles, not currently utilized to full capacity, involves recycling textiles.

Key Findings:

Per 1 Tonne of Product	Ship (Tonnes of GHGs)	Truck (Tonnes of GHGs)
Bangladesh (59.54%)	3.9	
India (13.1%)	3.6	
China (12.58%)	4.6	
Nova Scotia		0.039

The distribution phase of the transportation generated GHG emissions for wool articles travelling from Bangladesh is 100X higher than the local version, 92X higher when travelling from India, and 118X higher when travelling from China.

9) Endnotes

---

[1] I wish to express my thanks to Marla MacLeod whose contributions to the methodology, provision of data, and expertise with Foods Miles have been essential to the project. I also wish to thank Nathan Ayer for his willingness to read a draft version, and for sharing of his Life Cycle Assessment expertise with me. I also appreciate Sachi Gibson's comments on an earlier draft.

[2] http://www.footprintnetwork.org/gfn_sub.php?content=footprint_overview

[3] http://www.davidsuzuki.org/about_us/Dr_David_Suzuki/Article_Archives/weekly11010201.asp

[4] Andersson 2000, 239. Andersson, Karin. LCA of food products and production systems *The International Journal of Life Cycle Assessment*, Vol. 5, No. 4. (1 July 2000), pp. 239-248.

[5] Hunt and Franklin, 1996; Baumann and Tillman, 2004. Hunt, R.G. & W.E. Franklin. 1996. LCA – How it Came About: personal reflections on the origin and the development of LCA in the USA, *International Journal of LifeCycle Assessment*, 1(1): 4–7. Baumann, H. & A. Tillman. 2004. *The Hitch Hiker's Guide to LCA: An orientation in life cycle assessment methodology and application*. Lund, Sweden: Studentlitteratur.

[6] Baumann & Tillman, 2004.

[7] Andersson et. al. 1994, 34. Karin Andersson, Thomas Olssona and Pär Olssona, Life cycle assessment (LCA) of food products and production systems. Trends in Food Science & Technology Volume 5, Issue 5, May 1994, Pages 134-138.

[8] Andersson et. al. 1994, 134.

[9] Arsenault et al, 21. Arsenault et al., Comparing the environmental impacts of pasture-based and confinement-based dairy systems in Nova Scotia (Canada) using life cycle assessment. International Journal of Agricultural Sustainability, 2009, 19–41.

---

[10] Arsenault Et. Al, 21; Consoli et al., 1993. Consoli, F., Scott Paper Company, Allen, D., UCLA, Boustead, I., The Open University, Fava, J., Roy F. Weston Inc., Franklin, W., Franklin Associates, Jensen, A. A., dk-TEKNIK, de Oude, N., SETAC-Europe, Parrish, R., SETAC Foundation, Perriman, R., ZENECA, Postlethwaite, D., Unilever, Quay, B., The Coca-Cola Company, Seguin, J., Environment Canada, Vigon, B. W., & Battelle (Eds.). (1993). Guidelines for Life Cycle Assessment: A "Code of Practice". Pensacola, FL: SETAC.

[11] Andersson et. al, 1994, 134.

[12] Andersson et. al, 1994, 134.

[13] Baumann & Tillman, 2004.

[14] Nathan Ayer, personal communication, March 2010.

[15] Nathan Ayer, personal communication, March 2010.

[16] Andersson et. al, 1994, 34.

[17] Andersson et. al, 1994, 34.

[18] Nathan Ayer, personal communication, March 2010.

[19] http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE5AJ2HL20091120

[20] Andersson, 2000 244.

[21] Andersson, 2000 246.

[22] "Interest in the miles products travel initiated following a 1993 study where it was discovered that a typical Swedish breakfast of coffee, cream, sugar, orange juice, bread, butter and cheese travelled the circumference of the earth before reaching the table."

http://www.worldwatch.org/node/6064

[23] http://www.gpiatlantic.org/publications/summaries/transportationsumm.pdf

[24] http://www.gpiatlantic.org/publications/summaries/transportationsumm.pdf

[25] http://www.gpiatlantic.org/publications/summaries/transportationsumm.pdf

[26] http://www.gpiatlantic.org/publications/summaries/transportationsumm.pdf

[27] http://www.gpiatlantic.org/publications/summaries/transportationsumm.pdf

[28] http://www.ec.gc.ca/pdb/ghg/about/gases_e.cfm

[29] http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=67#foottext_2

[30] http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=67#foottext_2

[31] http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=67#foottext_2

[32] http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=67#foottext_2

[33] http://www.ec.gc.ca/pdb/ghg/inventory_report/2008_trends/trends_eng.cfm#toc_3

[34] Fuel for International Transport not Taxed (Rosenthal 2008)

[35] The most recent available data when this research project was started.

[36] Although some of the above are not stated as wool, they are identified by the database when the search term "wool" is used.

[37] http://www.ghgprotocol.org/

[38] http://www.ghgprotocol.org/

[39] http://www.ghgprotocol.org/

[40] Personal Communication, March 2010.

[41] http://www.ic.gc.ca/sc_mrkti/tdst/tdo/tdo.php?lang=30&productType=HS6

[42] Emma Point, "Life Cycle Environmental Impacts of Wine Production and Consumption in Nova Scotia" School for Resource and Environmental Studies, Dalhousie University, Halifax, Nova Scotia, 2008.

[43] Aranda *et al*., 2005. Aranda, A., Zabalza, I. & S. Scarpellini. 2005. Economic and Environmental Analysis of the Wine Bottle Production in Spain by Means of Life Cycle Assessment. *International Journal of Agricultural Resources, Governance and Ecology*, 4(2): 178-191. Point, 6.

[44] Point, 6.

[45] Point, 6.

[46] Smith et al., 2005; Schlich & Fleissner, 2005. Smith, A., Watkiss, P. Tweddle, G., McKinnon, A., Browne, M. & A. Hunt., et al. 2005. The Validity of Food Miles as an Indicator of Sustainable Development: Final Report. DEFRA. Schlich, E. H., & U. Fleissner. 2005. The Ecology of Scale: assessment of regional energy turnover and comparison with global food. International Journal of Life Cycle Assessment, 10(3): 219-223. Point, 7.

[47] Notarnicola *et al*., 2003; Ardente *et al*., 2006; Pizzigallo *et al*., 2006. Notarnicola, B., Tassielli, G. & G. M. Nicoletti. 2003. Life Cycle Assessment (LCA) of Wine Production. In: Mattson, B. & U. Sonesson (eds.), *Environmentally-friendly food processing*, pp. 306-326. Cambridge, England: Woodhead Publishing Limited. Ardente, F., Beccali, G., Cellura, M. & A. Marvuglia. 2006. POEMS: A case study of an Italian wine-producing firm. *Environmental Management*, 38(3): 350-364. Pizzigallo, A.C.I., Granai, C. & S. Borsa. 2006. The Joint Use of LCA and Emergy Evaluation for the Analysis of Two Italian Wine Farms. *Journal of Environmental Management*, 86(2): 396-406. Point 12 -13.

[48] Point, 69.

[49] Winery Association of Nova Scotia, 2005. Point, 19.

[50] Point, 19.

[51] Personal Communication, J. Ruddick, March 17, 2007. Point, 19.

[52] Point, 19.

[53] Point, 19.

[54] http://www.gov.ns.ca/news/details.asp?id=20100301001

[55] http://www.nslocal.ca/results.php?hide_id=1308&hide_stylesheet=3&butt_details.x=

40&butt_details.y=18

[56] http://www.atholforestry.com/

[57] http://www.fsccanada.org/standardsm.htm

[58] http://acadianforest.com/Nagaya.html

[59] http://acadianforest.com/Nagaya.html

[60] http://acadianforest.com/index.html

[61] Personal communication.

[62] grohmann@grohmannknives.com

[63] http://www.gov.ns.ca/fish/marine/sectors/invert.shtml

[64] http://www.gov.ns.ca/fish/marine/sectors/invert.shtml

[65] http://www.gov.ns.ca/fish/marine/sectors/invert.shtml

[66] http://www.seachoice.org/page/cansotrapshrimp

[67] http://www.seachoice.org/page/cansotrapshrimp

[68] http://www.seachoice.org/

[69] http://www.selectnovascotia.ca/

[70] http://www.msc.org/track-a-fishery/certified/north-west-atlantic/Canada-northern-prawn

[71] http://archive.greenpeace.org/oceans/shrimpaquaculture/shrimpreport.html#8

[72] http://archive.greenpeace.org/oceans/shrimpaquaculture/shrimpreport.html#8

[73] http://www.gov.ns.ca/AGRI/agaware/teacher/68-71sheep.pdf

[74] http://www.gov.ns.ca/AGRI/agaware/teacher/68-71sheep.pdf

[75] http://www.gov.ns.ca/AGRI/agaware/teacher/68-71sheep.pdf

[76] Personal communication, EAC Clothing and Textile Action Group.

[77] Personal communication, EAC Clothing and Textile Action Group.

[78] Chen et al, 2006. Environmental Analysis of Textile Products. Clothing and Textiles Research Journal, Vol. 24, No. 3, 248-261 (2006).

[79] Personal communication, EAC Clothing and Textile Action Group.