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TABLE RONDE NATIONALE SUR L'ENVIRONNEMENT ET L'ÉCONOMIE

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Packaging and the Canadian Agri-Food System

A Preliminary Discussion Paper

Colin F. W. Isaacs
Contemporary Information Analysis Ltd.
31 March 1996

Summary of findings

The agri-food industry in Canada consumes more than 60% of the total usage of containers in the manufacturing sector. This adds $2.3 billion to the price of food and leads to the creation of waste which costs consumers another $200 million in annual disposal costs.

However, Canada has one of the lowest rates of food spoilage and wastage in the world, in significant part due to use of enhanced food packaging systems. Packaging adds only an estimated 4% to the price of food. It helps make Canadian food more competitive: an increase of $1 billion in value-added (packaged) food exports will provide 15,000 jobs for Canadians.

The agri-food packaging industry is a complex weave of food safety, economics, environmental factors, regulations and marketing. Advances towards sustainability are likely to take place through a multitude of small steps.

Introduction

This paper has been prepared for the National Round Table on Environment on Economy as background for a discussion of key issues associated with packaging and the agri-food system. This report summarizes some of the key environmental and economic factors surrounding use of packaging and packaging materials in the agri-food sector in Canada. It is based on an extensive but by no means comprehensive review of the literature and focuses particularly on the quantities, environmental impacts and economic costs of packaging materials employed in the agri-food industry.

The terms of reference provided by the NRTEE Secretariat requested that this report encompasses non-vehicular packaging materials (cartons, cases, bags, boxes, bins, pallets, portable bulk bins, etc.) which are used to enclose domestic and imported food products at each stage of the food production chain from farm to household, including wholesale (bulk), retail and store (take home) packaging.

Background

The Canadian agri-food industry includes agriculture and fisheries, food and beverage processing, wholesale trade, retail trade, and food service such as institutions and restaurants. Sectors of the food industry include: meat-processing, dairy, confectionery, sugar, fruits and vegetables, soft-drinks, distilling, brewing and

Year	Gross profit margin
1978	2.63%
1980	2.25%
1986	4.6%

Source: Canadian Encyclopedia

Figure 1 After tax profit in the Canadian agri-food industry per dollar of sales

wine. The Canadian food and beverage industry has lower profit margins than is average for other Canadian industry sectors.

Current Canadian food exports amount to about 3% (US$12 billion) of world agri-food trade; annual world exports total approximately US$400 billion. An increase of $1 billion in value-added food exports provides 15,000 new jobs for Canadians. The federal Department of Foreign Affairs and International Trade (DFAIT) aims to increase Canadian exports of food to 3.5% of world trade by the year 2000 through promoting "convenient, attractively packaged and competitively priced food." DFAIT sees packaging as an intrinsic component of value-added food, making it able to attract high profit margins compared to bulk commodity food. The U.S. is Canada's most important market for processed food and beverages.

Employment distribution in the industry has changed over time with food service employment increasing (for example, it doubled between 1971 and 1986) and agriculture declining. Employment in agribusiness also varies significantly by province.

	% of GDP	Number of employees	% of total employment
Agriculture	2.1	449,000	3.7
Food & Beverage Processing	2.1	230,000	1.9
Distribution, Retail & Food Service	3.8	1,143,000	9.4
Total	8.0	1,822,000	15.0

Source: Statistics Canada cited in Canada's export strategy: Agriculture and Food Products.

Figure 2 The Agri-Food Industry Contribution to Canada's Economy

World trends in agri-food business

Corporate concentration in the food industry began in the early 1970s and continues. This is reflected in a steady increase in the sales and number of subsidiaries of the top 100 agri-food companies. In 1981 the top 100 agri-food companies world-wide had 4,190 subsidiaries, by 1985 this had increased to 5,741.

In the agri-food industry, in contrast to many other industries, labour is a relatively low portion of total costs. In the U.S., food processing is very capital intensive and labour is only 12% of the turnover value compared to twice that for manufacturing as a whole. Other OECD countries are similar.

The result of this economic situation is that a few companies dominate the world agri-food market, making it difficult to implement a domestic policy that also covers international practices. Corporate control will affect packaging used. For example, more products may be shipped over longer distances requiring more protective packaging that retains freshness and prevents damage.

Packaging

Benefits

Food wastage (loss) in developed countries is 2% of total food production compared to 30% in developing countries. In part this is a result of preservatives, packaging, date labelling and other treatment and handling methods that are now standard in the developed world. Packaging helps to prevent contamination by preventing access to food poisoning bacteria, spoilage, deterioration and tampering or intentional sabotage of food and drug products. Other benefits are improved freshness and longer shelf life, reduced food waste from freezer burn and other damage, odour containment, improving the ease of transporting food around the world and to the home. By allowing for stacking packaging can also permit better use of shelf space and transport vehicles in some cases.

Packaging is an essential marketing tool to gain the attention of the consumer and differentiate the product from others through branding and unique design. Packaging is also the carrier for information such as nutritional content, ingredient lists, cooking methods and ideas for using the product effectively and imaginatively. Some of this information is required by law. By containing a specified amount of product, packaging can also help ensure compliance with government weight regulations.

Packaging often makes the product more convenient to use and aids in more efficient use of it through such things as measuring devices, reclosure devices and pour spouts. Convenience is also increased by adapting the size and volume to consumer usage. Packaging can help prevent wastage in the home.

In some cases, the package is essentially a component of the product, for example, aerosol containers for fat sprays or for whipped cream deliver a form of product that would not be the same in any other container. In food service areas and institutions, the package serves as portion/pricing control - a certain number of single servings of jam, say, are free with the toast and extra ones are $0.25 each. In many settings, for example institutions such as hospitals, packaged food reduces labour costs associated with dishing out servings.

Environmental Disadvantages of Packaging

Packaging contributes to litter, solid waste problems and other environmental problems. About one third of the municipal waste stream is packaging. Packaging systems (aerosols, foam trays) used to be a major contributor of ozone depleting substances, but almost all such uses of chlorofluorocarbons (CFCs) have now been banned. Packaging takes energy to produce, transport, recycle and dispose: this energy use contributes to global warming and air pollution. Resources, some of them unrenewable, including petroleum and wood from unsustainable forests, are used in the manufacturing of packaging. Water and toxic chemical pollution sometimes result from packaging manufacture and disposal.

In agriculture, some packaging, such as that used for pesticides, may be contaminated and

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In agriculture, some packaging, such as that used for pesticides, may be contaminated and

improper disposal can cause environmental harm.

As society moves toward "user pay" and, in Europe, "polluter pays", packaging manufacturers and users will find cost savings in designing packaging for more energy-efficient transportation, reduced use of toxic materials, and reduced use of raw materials.

Life-cycle analysis (LCA)

Although a comprehensive life cycle analysis (LCA) can be an overwhelming, expensive task, an overview of the environmental impacts of various types of packaging can begin to identify the most important environmental impacts. Because of its complexity, LCA results are invariably disputed although the results are often very useful in providing some previously lacking information. Also adjustments to the LCA may need to be made for different regions which suffer from different environmental problems. For example, in some cases, light-weight plastic will be a better environmental choice than transporting heavy refillable glass bottles across the country. LCA data will become increasingly important in developing relationships with consumers and regulators.

Tellus Institute packaging study. The Tellus Institute completed a packaging study in May 1992 for the EPA and The Council of State Governments assessing the impacts of production and disposal of packaging. The "lifecycle" analyses done focus on package material types rather than individual package types and so do not include package forming, filling and transportation. The Tellus study attempt to put a "full cost" on environmental effects of packaging such as air emissions based on the current control measures required. Examples of the full cost of various types of materials are shown in figure 3.

Material	$/ton of material
HDPE	537
PET	1,108
PVC	5,288
Bleached Kraft Paperboard	443
Virgin glass	157
Recycled Glass	127
Virgin Aluminum	1,963
Recycled Aluminum	342
Virgin Steel	366
Recycled Steal	358

Source: Tellus Institute, 1992

Figure 3 "Full" environmental cost of packaging materials

Toxicity and safety related to packaging

A study of the safety of food packaging materials concluded that because of the high plastic content (70-80% of food is packaged in various plastic or plastic-like materials), the potential exists for low-level migration of chemicals to food. The EPA is quoted as saying that most materials used in packaging (ie. paper, plastics, steel, and glass) are sources of toxic substances, particularly metals. Sources of lead in packaging include solder in steel cans, paint pigments, ceramic glazes and inks, and plastics. Recent concerns about the impact of estrogen-

mimicking substances on male fertility have pointed fingers at certain chemicals used to improve the properties of plastics, though this suggestion is as yet far from proven.

Vacuum Packaging. Large grocery stores package many items in the store, for example, at deli, cheese and seafood counters, bulk foods and salad bars. A Connecticut Department of Consumer Protection survey surveyed how stores met standards of sanitation and on-premise vacuum packaging. Results indicated that fewer stores than expected, only 12 of 56 stores surveyed used vacuum packaging. Of these 3 were found in violation, one of them with a serious violation. Food Division Director, John F. McGuire, was reported to have said that because the oxygen-free environment in vacuum-packaged foods prevents the growth of many oxygen-requiring molds that inhibit anaerobic organisms, this type of packaging can easily allow dangerous anaerobic organisms such as *Clostridium botulinum* and *Listera monocytogenes* to grow fast and undetected. Forty of the 56 stores failed to maintain adequately low temperatures to ensure the safety of packaged fresh foods.

Occupational health and safety. The soft drink industry ranked 15th in the amount of time lost to injury and illness in 1991 (U.S. Department of Labour). Drivers of delivery vans and trucks suffer 30% of the injuries. A growing diversity in soft drink packaging which means that simple stacking is not possible while the products are being trucked and handled is one of the significant occupational health problems cited by the National Institute of Occupational Health and Safety (NIOSH).

Public Perception

Public perception influences not only what marketers offer but also what forms of packaging will be specifically targeted for more attention by regulators. Soft drinks feature large in anti-litter, packaging and recycling campaigns especially due to their tendency to be single-serving packages. Other consumer perceptions, not always based on fact, that affect packaging are:

- plastic is there forever; it is not natural
- other materials that are biodegradable such as paper are always better
- the packaging industry are among the media moguls; packaging is advertising
- recyclability is best.

Some consumer perceptions are without substantiation, resulting in regulations that ignore more serious impacts on the environment. The attention focussed by environmental groups on specific types of packaging may result in less success for that packaging type. For example, the plastic can was attacked and at least temporarily set back by the Environmental Task Force in Washington, DC.

Public education will becoming increasingly important in the handling of garbage with the aim being voluntary reduction of garbage including packaging. In Bonn, Germany, citizens are given an annual 40-page guide that advises on what to do with all kinds of disposals. Citizens are also advised on how to avoid garbage, for example, by refraining from buying film-wrapped vegetables.

Packaging and Solid Waste

Canadians produce about 30 million tonnes of waste each year with about half coming from residential and half from commercial sources. In 1990 packaging totalled 13.5 million tonnes produced by the Industrial, Commercial and Light Industrial sector. Each person produces about 1.7 kg. of waste per day. About one third of municipal solid waste is packaging. Public spending in Canada for solid waste disposal is about $600 million a year in Canada, so it can be assumed that disposal of packaging waste costs taxpayers about $200 million, or close to $20 per household, per year.

A study prepared for the Environment Canada Environmental Protection Series indicated that by 2000, 65% of methane (a greenhouse gas) releases in Canada would be from landfills. Source reduction, reuse and recycling were found to be significant in reducing the net greenhouse gas emissions related to the production and disposal of products and their waste. The 3Rs reduce greenhouse gases by reducing the quantity of new materials which need to be extracted and processed. Energy from waste projects reduce the amount of new fossil fuels which need to be used. It should be noted that alternatives may also emit greenhouse gases through increased transportation, variations in production processes and biodegradation as well as through combustion.

Municipal waste can be measured by volume or weight and the percentages will

Material	% of residential waste	Total weight '000 tonnes
Total	100	10,276
Paper	26.9	2,766
waxed-plastic	1.7	175
boxboard	3.6	372
kraft	1.1	113
old corrugated cardboard	2.4	244
other paper	0.4	38
Glass	5.8	600
beverage containers	0.7	71
food containers	2.9	296
Ferrous	3.8	391
beverage containers	0.5	49
food containers	2.1	215
Non-ferrous	0.7	71
beverage containers	0.2	24
other packaging	0.1	10
Plastics	6.5	666
rigid containers HDPE	0.8	82
other rigid	0.2	21
PET containers	0.2	19
polystyrene	0.5	51
bags LDPE	0.7	72
other film	0.2	22
other packaging	2.6	271
Organics	38.4	3,949
Food waste	21.8	2,237

Source: Environment Canada

Figure 4 Residential Waste Generation and Composition in Canada 1992 with breakout of selected items

	percentage of total by weight based on a total of 6.4 billion pounds	percentage of total by number of containers based on a total market of 71.6 billion containers
Glass	52.9%	10%
Aluminum	29.7%	77%
PET	14.6%	10%
Steel	2.8%	3%

Source: Plastics News cited in Market Share Reporter.

Figure 5 Soft drink containers by material weight and number of containers, 1994

be different for various materials. For example, glass is relatively heavy so ranks high by weight but is relatively low volume (and fairly inert). Figure 5 indicates how different the two measures vary.

Volume is important because the capacity of landfill is based on volume. One estimate of 1988 waste generation in Canada is that 35.3 million cubic metres was produced. As landfills become less available, a greater percentage of that market will be allocated to recycling.

Regulations and Guidelines

Packaging is the focus of increasing attention of regulators worldwide. Until recently most of the regulations related to beverage containers with regulations focussing on refillable containers, deposit systems and alleviating litter. Consideration is now shifting to encompass all packaging because of a worldwide concern about solid waste disposal and, slowly but increasingly, other environmental issues. In the EC estimates are that one-way beverage containers contribute about 5% to solid waste by weight in the domestic waste stream while all packaging contributes 25%-35%.

Pressures to reduce amount of material going to landfill has resulted in regulations at various levels to consider or implement:

- bans on specific types of material or container such as clamshell plastic foam boxes and for a while, aseptic containers (in Maine).
- requiring product designs to take into account environmental issues
- mandatory disclosure of environmental impacts.
- deposit/refund or deposit/partial refund systems.
- mandatory separation of recyclable materials in the home.
- tax credits to encourage the use of recycled materials in new products.
- grants, subsidies, or low-interest loans to support package reduction.
- legislation such as the German Duales System where manufacturers are responsible for collecting and recycling all packaging waste or taking back packaging at the stores.
- variable garbage collection fees.

Legislation on packaging is made difficult because of the diversity of materials (eg. glass, plastics, multi-layered) and forms (eg. trays, films, bags). Also individual products in their primary packaging are often packaged again in secondary packaging. A tertiary packaging occurs in the shipping or transportation packaging. Insufficient analysis has been done in terms of lifecycle analysis or other data collection systems to make adequate comparisons between various types of packaging.

One example: in 1989 Suffolk County, New York State, banned non-biodegradable plastic in film and plastic grocery bags and required retail food outlets to find environmentally improved substitutes for polyethylene grocery bags, polystyrene or polyvinyl chloride wrapping. However, enforcing such a law is almost impossible because there is no simple way of telling whether the packaging used by the stores uses the "banned" materials.

Trends in regulations are likely to take as their model initiatives undertaken in other countries as well as the following premises:

- while energy from waste appears to be attractive, incineration is a less efficient use of resources than recovering and recycling. For example, a pound of paper burned in an incinerator produces 500 BTUs of steam while recycling a pound of paper saves 2000 BTUs in energy required to produce paper from virgin materials.

- one-way packages must have recovery systems based on the same principle as are now in place for reusable packaging, that is, the producer or agent must take back the packaging; recycling goals will be established for various types of material.

- closing the loop is a priority; markets must be established for use of recycled material

- reusable packaging will become more important.

The National Packaging Protocol (NAPP)

In order to address concerns about packaging waste, the Canadian Council of Ministers of the Environment (CCME) set up the National Task Force on Packaging. In 1990 this body published the National Packaging Protocol. Six packaging policies were recommended:

Policy one: All packaging shall have minimal effects on the environment.

Policy two: Priority will be given to the management of packaging through source reduction. This policy sets out the following for preferred packaging in hierarchy:

1. no packaging
2. minimal packaging
3. consumable, returnable or refillable/reusable packaging and
4. recyclable packaging/recycled material in packaging

Policy three: A continuing campaign of information and education will be undertaken to make all Canadians aware of the function and environmental impacts of packaging.

Policy four: These policies will apply to all packaging used in Canada, including imports.

Policy five: Regulations will be implemented as necessary to achieve compliance with these policies.

Policy six: All government policies and practices affecting packaging will be consistent with these national policies.

In Canada, the National Packaging Protocol set targets of reductions from 1988 levels by 20%

by 1992, by 35% by 1996 and by 50% by 2000. Half of the reduction is to come from source reduction and reuse activities and the other half from recycling. So far the guidelines are voluntary. In Canada, the results from National Packaging Protocol packaging survey may draw increased attention to particular industries and packaging materials. As of March 1995, the National Packaging group was merged with the CCME Solid Waste Management Task Group. Furthermore, budget cuts at CCME may seriously hamper this initiative. To companies which have taken a lead in this initiative in the hopes of getting ahead of their competitors when regulations are implemented, this lack of aggressive progress by government is a disincentive to further voluntary action.

Producer responsibility

Regulators in many countries are partly or entirely putting the responsibility for finding solutions on the business selling the products and the packaging. Some examples of initiatives are:

- the Duales System in Germany
- a voluntary agreement in 1990 in Belgium where industries agreed to develop and finance an action programm to reduce, collect and recycle packaging and eliminate toxic heavy metals in packaging. The initiative covers consumer, commercial and industrial packaging waste
- in the Netherlands, a Packaging Covenant covering a wide scope of packaging issues such as banning harmful materials and forbidding the landfilling of packaging waste by 2000. Another target is to reduce by the year 2000 the annual 2 million tonnes of packaging waste produced in 1986 by 10%. This will require drastic action as the unchecked waste output in 2000 is estimated to be 2.8 tonnes.
- in France, a decree adopted in 1992 requires producers to establish a deposit system for their packaging or join a state recognized organization that will deal with the waste or form an independent collection network for their packaging waste
- The Nordic Council in 1990 prepared an Action Program for Packaging in which objectives are 15% reduction by volume by 2000; increase in recyclability of beverage containers to 75% and of detergent packaging to 25%. A general target is 80% recovery of packaging material.

Market Instruments

Surcharges on difficult to dispose of items have various purposes. One purpose is to force companies to design at the initial stage for the disposal of the item. For example, aluminum caps on plastic bottles increase the cost of recycling. Another purpose is to transfer the cost of disposal from the municipality to the manufacturer. In B.C., a multi-stakeholder discussion focussed on the pigments in plastics. Recycling companies pay considerably less per tonne for coloured plastics. Municipalities want to maximize the amount of revenue returned resulting in pressure on the manufacturers to either design out the pigments or cover the revenues lost due to the pigments.

The method of disposal will also enter into the weighing of levies against various types of packaging. Plastics and polystyrene may release toxic gases in incinerators. Glass, aluminum and iron do not burn resulting in a lower temperature in incinerators; the reduced efficiency increases the amount of toxic material in the ash. Some packaging also releases heavy metals or other hazardous substances in emissions or ash during incineration or leachate if landfilled. Paperboard materials used with food cannot easily be separated for recycling.

Environmental groups are also focussing on environmental accounting which presently makes it appear cheaper to use virgin materials rather than recycled materials. Indirect subsidies such as government building roads and low royalties for use of crown land means logging companies do not pay the true cost of wood to produce new materials.

Effect of Regulations and Guidelines

PLM of Sweden blames the Duales System recycling program for impacting negatively on its business of supplying glass containers and cans. Various PLM plants in Germany, France and Sweden have already suspended productions of a number of lines because of the marked drop in demand of one-way packaging from supermarkets.

Source Reduction Initiatives

Food suppliers

In supplying large-scale fast-food restaurants, food suppliers have a variety of options to reduce packaging. They can deliver bulk items in recyclable or reusable containers rather than disposable cardboard; for example, use of reusable plastic containers by Cara Operations Ltd. for their Swiss Chalet and Harvey chains for chicken would save 2 million pounds of waste per year.

For consumers, food suppliers can supply dry foods in bulk, switch the types of packaging, for example, PET rather than glass reducing weight by 80%; film packaging to replace higher volume paperboard.

Some products are designed for reuse, for example, spaghetti sauce in mason jars and McDonald's products in bags designed to be reused as garbage bags. Refillables or asking the consumer to bring-your-own containers are also options. Such options can be applied on a local basis and as one part of a retail store operations. Such options while potentially reducing waste also have downsides: there is a limit to how many Mason jars a household likely to reuse; the switch to lighter lower weight materials such as plastic may reduce the amount of material recycled.

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Shipping container suppliers

Reusable shipping containers and pallets are becoming more common. Schoeller International in Germany has developed and implemented on a wide scale a plastic carton system to replace cardboard boxes in retail grocery stores.

Use of Recycled and Recyclable Material

Guidelines and regulations are promoting the use of reusable packages, recyclable packages, or packages with recycled content and discouraging use of non-recyclable, difficult to recycle and virgin content packages.

Recycled content in food packaging

The push towards recycling is resulting in federal and state proposals to mandate recycled materials in food packaging as well. Both Agri-Food and Agriculture Canada and the U.S. FDA is concerned about the public health issues. While for glass, aluminum and other metals, the recycling process produces an end product free of harmful substances, that is not always the case for post-consumer plastics and paperboard. Both in Canada and the U.S. manufacturers must demonstrate that the material meets safety guidelines on a case-by-case basis.

Trends In Packaging

Market share by material

A study by Freedonia in 1995 predicted that plastic packaging would gain market share from paper and paperboard and be increasingly used in bags, sacks, shippingsaks and food containers. Plastic film, which is chiefly used in food packaging will gain at the expense of kraft paper, glassine and grease-proof papers. Use of plastic will increase at twice the rate of paperboard material in food containers. These trends are already apparent in the marketplace.

Packaging design

The product stewardship model means that the ultimate disposal of the package should be part of the package design. Some companies have already taken steps in that direction even if the reasons for doing so are not always overtly environmental.

Lightweighting. There has been a trend towards lightweighting of packaging sometimes done by decreasing the thickness of the material or by switching to different, lighter weight materials. This lighter weight often allows for larger packs, for example a 2 litre PET bottle is much lighter than a 1 litre glass bottle.

No or little packaging. A survey of German stores following the introduction of the packaging law indicated elimination or reduced use of certain types of packaging such as blister packs, cardboard backs, and plastic bottles without a cardboard box.

Secondary and tertiary packaging. Various initiatives have also taken place to reduce these types of packaging. Design features adopted include:

- redesign of cardboard shipping containers to eliminate the top part which is normally cut off and to reduce the amount of material in the display box
- redesign of the package to eliminate the need for liners and separators
- minimization of strapping materials and design so that they do not interfere with recyclability

Secondary and tertiary packaging is not a negligible quantity. For example, empty packages such as PET bottles destined for the food or beverage processor are also shrink-wrapped, boxed, labelled, strapped, and palleted.

Ancillary packaging features: Inks, labels, adhesives, closures and other related packaging features can affect the environmental impact and recyclability of the package. Non-toxic inks are becoming more common.

Packaging innovations

Food packagers want a great deal from their packaging materials: barrier qualities, temperature resistance, no migration of container materials into the food and no effect on the food taste or quality, appealing appearance, enhanced shelf life, consumer convenience, safety and environmental qualities.

The use of PET is increasing globally by 10-12% a year with two growth areas in Canada and the U.S. - single servings and containers for sports and fruit drinks. PET is recyclable and its growth has impacted on the glass market. PEN (a compound of dimethyl-2,6-naphthylene dicarboxylate or NDC and ethylene glycol) is a new polymer and a competitor to PET for hot fill products such as jam, jellies and fruit juices where high temperature processing is used but it is expensive. Flexible packaging such as OPP (oriented polypropylene) has the potential to supply the benefits of packaging with a lot less materials. One problem may be that OPP will be use in multi-layer packaging such as metal coated film that may be more difficult to recycle.

When industry opinion leaders were asked about the leading paperboard packaging innovations and forecasts for the future in a survey by the U.S. Paperboard Packaging Council in 1994, they listed drink boxes, oven-proof paper packages, cartons that when used in the microwave brown the food, multipack drink carriers, reclosable containers and source-reduced packaging. Future innovations included cartons with indicators to show the food is spoiled or cooked, hidden computer chips to stop shoplifting, holographic designs and cartons that have chips with sound so the instructions can be given by voice.

No or little packaging. A survey of German stores following the introduction of the packaging law indicated elimination or reduced use of certain types of packaging such as blister packs, cardboard backs, and plastic bottles without a cardboard box.

Secondary and tertiary packaging. Various initiatives have also taken place to reduce these types of packaging. Design features adopted include:

- redesign of cardboard shipping containers to eliminate the top part which is normally cut off and to reduce the amount of material in the display box
- redesign of the package to eliminate the need for liners and separators
- minimization of strapping materials and design so that they do not interfere with recyclability

Secondary and tertiary packaging is not a negligible quantity. For example, empty packages such as PET bottles destined for the food or beverage processor are also shrink-wrapped, boxed, labelled, strapped, and palleted.

Ancillary packaging features: Inks, labels, adhesives, closures and other related packaging features can affect the environmental impact and recyclability of the package. Non-toxic inks are becoming more common.

Packaging innovations

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The requirements to label packaging in both French and English has caused packagers in Canada to look to places like France and bring back to Canada innovative ideas to deal with the stringent labelling requirements. Milk in flexible pouch bags is a Canadian packaging innovation. Research within the fruit and vegetable sector is looking for improvements in packaging for produce such as broccoli and lettuce that is environmentally-friendly and allows air to circulate to retain moisture while extending shelf-life.

Materials - recycling and recycled content

Effect of price: High prices for certain material types and availability affect food packaging decisions. Beverage producers made a switch to aluminum cans but when aluminum prices almost doubled in 1994, Coca Cola used steel cans in some European and Asian markets and PepsiCo switched from aluminum cans to PET bottles. According to an Anheuser-Busch packaging expert, the cost of steel is too high in the U.S. for beverage containers and there is insufficient PET resin available for a large scale conversion to plastic. Doug Symington, Director of Public Relations at Consumers Glass, suggests that the competition of those who use recycled materials is not other recyclables but the low cost and easy availability of virgin materials. He provides an estimated price (Summer, 1995) for one tonne of virgin glass based on its inputs:

Material	% of glass	Value/tonne
Sand	60 %	$ 33
Soda ash	20	180
Limestone	15	25
Other	5	100
Total	100%	$ 65

Unless some other element enters into competition, recycled glass must be priced below $65 per tonne, requiring more efficiencies in the recycling systems such as better collection and sorting methods, more household participants, better recycling infrastructure and a greater expectation for recycled content in products.

Importance of education: The importance of communication and education is indicated by the MORE project, a one year program operated in cooperation with the City of Barrie, Ontario, OMMRI, the industry-sponsored recycling support organization, the Ministry of Environment and Energy and Laidlaw Waste System. Clear communication to both residents and the ICI sector in the period 1991-1992 resulted in an average of 12%-13% increase in collection of recyclable materials. Glass collection increased by 50% from residences and by 142% from the ICI sector. Household recycling systems become very much more efficient when recycling rates increase.

Glass: Despite the recycling awareness campaigns, about 1 billion glass bottles remain outside the recovery system each year. Consumers Glass in the fall of 1995 asked for "More Glass Please!" saying that it could use another 150,000 tonnes annually for the manufacture of new glass containers for seven glass recycling plants across Canada. Moosehead Breweries and Consumers Glass in New Brunswick received the Envirowise Award from the Packaging

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Association of Canada for a beer bottle containing 77% recycled content.

Trends in Agribusiness Strategies and Product Development

Food consumption trends

Food consumption trends in the OECD countries include:

1) polarization of income has polarized the demand between high income and low income families;
2) demographic changes which have resulted in a higher female participation rate in the labour market has increased the demand for convenience food such as "frozen foods, sauces, dehydrated potatoes, pet foods, flour mixes and other convenience foods";
3) rapid changes in technology and equipment are supporting consumption of precooked and convenience foods;
4) the internationalization of foods has spread: baguettes, sushi, and pizza are eaten all over the world; and
5) light snacks and meals on the run are a trend away from the traditional three meals a day. Different products affects packaging.

Product development trends

Concentrated foods both to reduce packaging and the energy needed to transport large quantities of water may become more common. One example is the sparkling beverage machines using drink concentrates and gas cylinders for the home market. These are currently available only for hotels and restaurants; with enough consumers, cylinders would be returned for refill and there would be a reduction of empty cans and bottles as well as trips to the store. Other product development trends include frozen juices and dried foods such as soups. Single serving products increase packaging use.

Value-added strategies

New and emerging strategies in the food and beverage industry change the nature of both products and their packaging. Examples include opportunities to turn basic commodities (usually sold in bulk) into high value-added products (usually processed and packaged). New technologies create new types of packaging innovations some of which have more or less impact on the economy and the environment. For example, processing methods such as food irradiation requires special packaging to prevent recontamination. Biotechnology may affect farm pesticide use as plants are bred to repel predators.

The Economics of Packaging

The Nature of the Packaging Industry

The packaging industry includes producers of the basic packaging material such as paper, glass, metal, wood and the producers of the finished packaging product with some intermediaries along the way. Companies that turn basic materials into packaging are often described as converters. Most of the packaging industry in Canada serves only the domestic market as the competition in the U.S. in the packaging industry is very strong. The Canadian industry is worried about the effect on its competitiveness if environmental standards are applied to Canadian packaging that are not equally applied to imported packaging. According to a 1992 Report on Business article, the highest revenue earning packaging companies in Canada were Lawson Mardon Group, CCL Industries, Paperboard Industries, Consumers Packaging, International Innopac, Bonar Inc and Canadian Overseas Packaging.

A number of Canadian firms have been leaders in various environmental initiatives. Atlantic Packaging Products Ltd., which employs 2000 people and has 20 centres for manufacturing corrugated containers, linerboard and polyethylene films and bags, built one of the early paper de-inking plant in Whitby, Ontario; Resource Plastics Corp. was leading the U.S. competition in plastics recycling as recently as five years ago. The only Canadian manufacturer of glass containers and major buyer of recycled glass is Consumers Glass with 2850 employees in 7 plants in Canada.

The package fillers are the prime driver of packaging requirements. The packaged product at the retail level is designed to attract the consumer enough to buy it. Sometimes the pressures on the retailers are contradictory - for example, best use of shelf space would lead to smaller, compact, easily handled packages but the consumer may be more likely to buy larger more prominently displayed products.

Specifications for industrial packaging tend to focus on protection of the product and ease of transport. A number of buyers are specifying at least some recycled content and in some cases, reusable packaging. Industrial packaging makes up half of all packaging used and it will probably be cheaper and more efficient to focus efforts in this area than the consumer area.

In 1991, sales for the Canadian packaging industry were about $13.3 billion producing 5.7 million tons of packaging. The top five products by weight are corrugated cases (21%), wood packaging mostly pallets and skids (15%), folding cartons/setup boxes (14%) and glass (14%). Other items in descending order by weight are flexible film packaging, rigid plastic containers, paper bags and wraps, steel cans, kegs and aerosols, labels, aluminum drink cans and various closures both metal and plastic. The highest value packaging product was flexible packaging valued at $3 billion (23% of all packaging sales) with steel cans and rigid plastic containers tied at second place representing $2.3 billion or 18% each of total sales.

For the purpose of a national packaging policy, the structure of the industry has an impact

because it is difficult to regulate many small firms while if there are only one or two major players it is easier to develop policy and regulation in relation to them.

Import and Packaging in Use

One of the difficulties in determining how much packaging is in use in Canada is that imports and exports change the effects on the environment and the economy. For example, about 80% of pesticides used in Canada are imported. Some imports will be in bulk and other in units suitable for immediate distribution.

Industry Expenditure on Packaging

Packaging expenditure by companies manufacturing in Canada

Statistics Canada keeps figures on all packaging purchased by Canadian industry in terms of dollar value. The data does not include the weight of the packaging which CCME considers most important for developing a national packaging strategy. The data is missing a significant aspect of packaging use in Canada because it does not include "packaging in use" which is imported into Canada when a finished product is purchased. Canada is a net importer of finished goods so that this amount of packaging is likely to be an important component of the total used. Also rules for confidentiality on Statistics Canada mean some data figures are not available for certain categories of industry. Annual growth rate in expenditure on packaging was almost 9% a year and based on this, the total of all industry expenditure on packaging will be $18 billion by the year 2000.

Type	1988 $ million	1993 $million
Plastic containers and packaging	1,067	1,144
Corrugated boxes	1,214	1,087
Metal cans	1,097	852
Folding and setup boxes	638	640
Glass	472	400
Other	1,690	1,700
Total	6,177	5,823

Source: Statistics Canada

Figure 6 Canadian consumption of containers by type - 1988 and 1993 in millions of dollars

On average the total cost of packaging as a per cent of total materials and supplies is about 3,5%.

The biggest category of container used is corrugated boxes and cartons ($1.7 billion in 1993). The trend since 1981 is an increase in plastic

Industry	1988 $million	1993 $million
Food industries	$2,264	$2,271
Beverage industries	1,272	1,145
All manufacturing	6,177	5,823

Source: Statistics Canada

Figure 7 Consumption of containers - 1988 and 1993 in millions of dollars

containers and plastic packaging with consumption more than doubling. Use of plastic rose by 94% compared to 21% for paperboard boxes and 12% for metal cans. CCME estimates that by the year 2000 25% of total packaging expenditure will be for plastics while paper and paperboard will be maintaining a 45% market share. These figures may not adequately reflect recent price increases for fibre products and relative price stability (at least in the immediate future) for hydrocarbon based materials.

	Total tonnage tonnes	% of all manufacturing	Rank of all manufacturing
Food Industries	1,855,271	32.5%	1
Beverage Industries	1,004,985	17.6%	2
All Industries	5,704,543	100%	

Source CCME. The Technical basis for the national packaging protocol. 1992.

Figure 8 Tonnage of Packaging Used in Canada - Food and Beverage Industries 1988

Packaging expenditure by food and beverage companies manufacturing in Canada

Of all the manufacturing industries in Canada, the food industry is the biggest user of packaging, consuming 40% of the total ($5.8 billion) or $2.3 billion worth of containers and packaging supplies in 1993. The food and beverage industry together consume sixty percent of the total usage of containers in the manufacturing sector.

	Tonnes of packaging per $1000 of spending	Rank of all manufacturing
Food Industries	0.78	17
Beverage Industries	0.75	16
All Industries	0.89	

Source CCME. The Technical basis for the national packaging protocol. 1992.

Figure 9 Tonnes of packaging per $1000 of Expenditure on packaging - Food and Beverage Industries 1988

The beverage industry's expenditure on containers, $1.1 billion in 1993, was 50% of their total cost of raw materials and supplies. For the confectionary industry in Canada, packaging materials also represent a high input cost, representing 26% of the cost of raw materials.

The beverage industry uses more than 50% of the glass containers with the other major users being the food industry and the chemical industry.

Packaging Material	% of total used by food industry	% of total used by beverage industry
Folding and set-up boxes	19.5	3.9
Corrugated cardboard boxes and cartons	24.4	17.5
Cans, metal	9.1	16.0
Barrels & drums	<0.1	0
Glass bottles and carboys	16.3	48.7
Wrapping paper products	8.2	N/A
Wood	0.6	1
Plastics	8.7	12.1
Transparent film	12.6	<0.1
Foils, labels, tags, wrappers	0.1	0.6

Source CCME. The Technical basis for the national packaging protocol. 1992. Note: N/A means statistics not available

Figure 10 Percentage of total packaging used by the Food and Beverage Industries 1988

One indicator used by CCME is

number of tonnes of packaging purchased per thousand dollars of packaging expenditure. The range was as low as 0.44 tonnes of packaging per $1000 of expenditure for the refined petroleum and coal products industry which ranked lowest to as high as 3.02 for the printing, publishing and allied industries which is ranked at 1. A high rank could mean that the industry uses a heavy but cheap packaging material, such as wood. The use of wood by this industry is shown as very low but the wood packaging producers say that food and beverage industries consumes 40% of their supply. However, the figure is so low because the industry tends to reuse wooden pallets, hence reducing their annual expenditure. Corrugated cardboard boxes and cartons make up about one quarter of the tonnage consumed in a year. Plastics represent the second most used packaging.

Impact of food packaging on the total cost of food

An article in Food Review in 1994 indicated that for the U.S. only 22 per cent of what consumers paid for food was the farm value of food, the amount farmers receive for the raw commodity. The rest of the price paid by the consumer was for such items as labour, packaging, transportation and energy. Cost of packaging is cited by food companies as a reason for increasing prices, for example, when General Mills raised cereal prices by 2.9% in 1995. In Ontario in 1995, turkey processors won a price roll-back on turkey meat from the supply management board based on documented major price increases on packaging and minor percentage increases in labour costs.

Agriculture Canada estimates (1990) that the marketing value of food is about two-thirds the retail price of food with the remaining being farm value. Packaging represented 6% of the value of production in food but 22% in beverages.

Sector	Materials excl.packaging	Labour	Packaging	Energy	Other
All food	61.4%	13.7%	6.0%	1.7%	17.3%
All beverages	33.5	20.5	21.5	2.1	34.9
All food & beverages	56.1	14.5	8.0	1.7	19.6

Source: Agriculture Canada

Figure 11 Packaging and other key inputs as a per cent of total inputs in food processing, 1986.

Larry Dworkin, Government Relations, Packaging Association of Canada, cautioned that it is difficult to assess how much of the value of the consumer food cost is due to packaging due to

- collection of different statistics and different definitions of food. For example, numbers may be available from grocery stores or a "typical shopping basket" but non-food items such as detergents and hardware may be included or items such as bottled water may be classified as soft drinks.
- different products vary in the types of packaging involved. For example, bread wrapped in lightweight plastic film may have been delivered on reusable plastic shippers while a tomato sauce delivered in a glass bottle may require protection with cardboard shippers.
- the distance travelled and mode of transport. Products that are subject to long

range haulage may require extra packaging to protect them during shipping and handling. Products shipped by rail, truck and marine may all have different transport packaging.

- time of year/season. Refrigeration requirements or protection from weather conditions such as hauling through mountains in winter may affect the type of packaging.
- changing practices. Environmental and cost concerns have changed some food packaging methods very recently. For example, PEI potatoes are now shipped in one bulk container that holds the same amount as formerly required 20 individual shippers.

He suggests that the price of packaging could be as little as 0.1% to as much as 10% of the consumer price of food or as a rough estimate, the average cost of packaging is 4% of the total consumer price of food.

Recycling and Source Reduction of Agri-Food Packaging

Dr. Lencki of the University of Guelph recommended that the food industry do more to explore its options concerning waste overall. Options include reducing waste, the best option, he suggests, turn wastes into marketable products e.g. animal feed and other products and improving processing and waste treatment technologies. He suggests that there is no universal solution. Instead the industry needs to deal with each situation on a case by case basis. The economics of each option is variable and dynamic. In some cases, several options may have equal economic viability so that the politically correct decisions is more likely to be the best one. The agri-food industry reduced the amount of packaging waste by 20% by 1992 compared to 1988 which met the target set by the National Packaging Protocol.

Sector	Consumed	Reused	Recycled	Disposed
Agriculture	100%	31%	22%	46%
Meat & poultry	100	51	26	22
Fruit & veg	100	22	28	50
Dairy	100	26	13	61
Flour & cereal	100	30	15	55
Bakery	100	30	35	36
Sugar	100	19	33	49
Other food	100	33	20	47
Soft drink	100	19	41	40
Brewery	100	62	13	5
Distillery	100	35	27	39
All industries	100	36	23	41

Source: CCME

Figure 12 Per cent of reuse, recycled and disposed package compared to total used by agriculture and food sectors including imports

For most industries, 80% of the packaging is represented in 5 types out of a total of 32 packaging types. This suggests that industries should focus on the materials they most use in terms of their recycling effort.

Packaging type	Industry sector
Multi-material - mostly plastic	Dairy products
Multi-material - mostly paper	Dairy products
Multi-material - predominantly metal	Bakery products
Plastic boxes, crates, drums, pails	Agricultural industries
Plastic carboys, bottles, flasks	Food, beverage and drug industries
Plastic other	Soft drink industry
Corrugated cartons, boxes, cartons	Food, beverage and drug wholesale
Paper sacks, base width < 40 cm	Flour and prepared cereal products
Paper labels and tags	Other food products
Textile sacks, bags and wrappings	Agricultural industries
Clear glass containers	Soft drink industries
Coloured glass containers	Brewery industries
Ferrous food and beverage containers (exc for aluminum)	Fruit and vegetable industries
Metal foils, foil containers, collapsable tubes	Meat, poultry and fish industry
Aluminum food and beverage containers	Soft drink industries
Stoppers, lids, caps and other closures	Other food industries

Source: CCME

Note: "largest user" designation is for all industries; only agri-food largest user selected for this table

Figure 13 Largest user of packaging types by sector, 1992

Grocery stores

One of the problems the industry has is disposing of substandard or outdated packaged food. Packaging separation technology is improving rapidly and a growing number of companies are getting into the organic waste processing business. Some of these companies have the ability to separate packaging so that the resulting material can be processed for feed or compost.

Food services

A pilot project in Kingston under the auspices of the Canadian Restaurant and Foodservices Association is demonstrating the feasibility of sorting, composting and recycling wastes. Recyclable wastes are funnelled through the community recycling system and food and paper wastes are composted for spreading on farm land. Recycling of some packaging used for food is difficult because the food particles interfere with recycling or the food such as meat may be a potential contaminant. Use of waste from urban areas is controversial because of the risk of pollutants and because the volume may be too high for the capacity of the agricultural land. The chance of future liability puts a damper on experimentation.

Major components of waste stream

cardboard	46%
food	43
glass	4
plastic	4
other	3

Source: Mary Davies, of the Canadian Federation of Independent Grocers, citing a 1991 U.S. survey

Figure 14 Typical distribution of waste in a grocery store

Agricultural packaging

Animal feed products worth more than $1 billion dollars are sold in bags containing heavy liners that are not easily recyclable. Pesticide containers have been a double trouble because of their

contamination. A project of the Crop Protection Institute, the Container Management Program has two main objectives: the first is to recycle pesticide containers with waste metal made into reinforcing rod and waste plastic into fence posts; the second is to reduce pesticide containers by 50% through bulk and water soluble packaging.

Paul Cook of the Crop Protection Institute said that the recycling program has collected 17.1 million rigid containers, metal and plastic, since its inception in 1989 with 3.5 million containers collected in 1995, an increase of 20.5% over 1994. About half of the pesticides are imports with one half packed in Canada. A revamping of the Institute program in 1995 is intended to achieve recycling rates of 70% by 1997 and 90% by 2000. One of the primary features of the program is communication to farmers that the recycling produces a useful product. Canada is one of the only country in the world with a country-wide recycling program of pesticide containers operating in 763 locations in every province except Newfoundland, where few pesticides are used. The Institute is working towards having the used containers identified as industrial input to manufacturing rather than as a waste as the paperwork and other aspects associated with hazardous waste are a barrier to recyclers accepting the containers for transport and reprocessing.

Recycled content in food packaging

Use of recycled material in packaging which is to contain food is technically allowed but the package producer must be able to prove no hazards exist such as the leaching out of toxic chemicals. Collection of curbside material with its diverse mix of materials from unknown sources makes this difficult unless recycled material is layered with virgin material. If the material is sourced from a large factory or other identifiable source, this task is made much easier which is another reason why some recycling analysts suggest targeting the ICI sector, which generates at least half the total waste in the municipal waste for recycling.

Conclusions

As this short paper shows, agri-food packaging is a complex area involving many players, issues, economic factors, and trade and employment implications. In most agri-food sectors packaging constitutes only a small percentage of total product price, though when added to waste management, handling and other environmental costs the total cost to society may be much higher than that paid by the consumer.

It is suggested that implementation of increased sustainability in the agri-food sector is eminently suited to a stepwise approach, working with individual sectors or producers where packaging is a particular burden, or focussing on instruments, such as economic instruments, that can reduce the unnecessary environmental burden of packaging. In all situations care must be taken to observe the economic and employment implications of proposed changes, to ensure that the competitiveness of Canadian industry is enhanced rather than jeopardized, and to ensure that reductions in the packaging burden are not offset by increased food spoilage, wastage, or other negative environmental impacts.

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